

문서번호 APCC-출장-16-1328(2016-11-29)

## TRAVEL REPORT FORM

### 출장보고서

|        |              |              |              |              |
|--------|--------------|--------------|--------------|--------------|
| 결<br>재 | 연구원          | 팀장           | 부서장          | 원장           |
|        | 11/28<br>김미아 | 11/28<br>이우섭 | 11/29<br>유진호 | 11/29<br>정홍상 |
| 협<br>조 | 팀장           |              |              |              |
|        | 11/29<br>김선태 |              |              |              |

#### I. Reporter 보고자

| Department<br>소속 | Position<br>직위(직급) | Name<br>성명 | Travel Date<br>날짜 | Note<br>비고 |
|------------------|--------------------|------------|-------------------|------------|
| 기후예측본부<br>기후예측팀  | 선임연구원              | 김유진        | 2016/11/16-18     |            |
|                  | 연구원                | 김미아        | 2016/11/13-18     |            |
| 기후예측본부<br>기후연구팀  | 선임연구원              | 오지현        | 2016/11/13-18     |            |

#### II. Major Activities 주요업무 수행내용

##### 1. Main Contents and Activities 주요내용 및 활동

###### 가. 개요

- 참가 회의명: Seventh Session of ASEAN Climate Outlook Forum(ASEANCOF-7)
  - Manila(Philippines)에서 개최된 ASEANCOF-7은 회원국과 여러 기후 전문가들이 참여하였으며, subseasonal to seasonal(S2S)의 소개와 이에 대한 영향, S2S Prediction의 예측성과 불확실성, 그리고 winter monsoon 기간의 기후 전망에 대한 의견을 공유하는 것을 목적으로 함.
- 일시: 2016년 11월 14일 - 2016년 11월 18일 (5일 간)
- 장소: The B Hotel Quezon city, Manila, Philippines

###### 나. 주요 업무 수행 사항

- S2S prediction system(MJO, BSISO)의 전반적인 이해 및 영향에 관한 강의 진행(붙임1-1, 붙임1-2, 붙임1-3) 참조 (오지현)
- APEC Climate Center(APCC) 소개 및 APCC MME를 활용한 ASEAN 지역(Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam)의 winter monsoon seasonal outlook 발표(붙임 2) 참조 (김유진)
- WMO 장기예보 선도센터(WMO LC-LRF)소개 및 ASEAN 지역의 DJF(2016/17) seasonal outlook 발표(붙임 3) 참조 (김미아)

##### 2. Relevance to APEC Climate Center's Activities 결론 및 소감

- Winter monsoon(Dec-Jan-Feb) 기간 동안 기온은 ASEAN 지역 전반적으로 평년에 비해 높을 것으로 예측함. 특히 Myanmar(북부), Vietnam, Laos의 경우, 높은 확률로 Above normal을 나타낼 것으로 보이며, Thailand와 Philippines는 평년과 비슷할 것으로 전망됨.

- 
- 강수의 경우, Southeast Asia 지역은 평년보다 낮을 것으로 예측함. Central/western Southeast Asia(Thailand, Cambodia, southern Myanmar, Philippines(서부))는 평년과 비슷할 것으로 보임. Philippines의 일부(남부), eastern Maritime Continent에서는 강수가 약간 많을 것으로 예측됨.
  - 관측(Jul-Aug-Sep) 기간 동안 tropical Pacific의 SST는 약한 La Nina-like condition을 보이고 western tropical Pacific에서는 La Nina-like atmospheric response를 나타내었음. 많은 모델들은 DJF2016/17 기간에 대해 약한 La Nina를 모의함.

### III. References 참고사항

(with attachment of any information or report in case of attendance of conferences, workshops and meetings) 학술대회, 워크숍, 회의 등 참석 시 관련 정보 및 문서 첨부

#### 1. Presented and Collected Materials 주요 수집자료

- 붙임 4: ASEANCOF7\_Statement
- 붙임 5: ASEANCOF7\_Agenda

#### 2. Suggestions and Remarks 건의사항





## **Seventh Session of the ASEAN Climate Outlook Forum (ASEANCOF-7)**

### **Consensus Bulletin for December-January-February 2016-2017 Season**

---

#### **Introduction**

The Seventh ASEAN Climate Outlook Forum (ASEANCOF-7) was organised by the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) in cooperation with ASEAN Specialized Meteorological Center, with funding support from the United States Agency for International Development (USAID) through the World Meteorological Organization (WMO). As with previous ASEANCOF meetings, representatives from National Meteorological and Hydrological Services (NMHSs) of all 8 ASEAN Member countries: Brunei, Indonesia, Lao, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam convened to create a consensus forecast of winter monsoon 2016-17 (DJF) in the ASEAN region. In addition, experts from the WMO Global Producing Centres (GPCs): Japan Meteorological Agency (JMA), Climate Prediction Center (CPC, NOAA), Bureau of Meteorology (BOM), APEC Climate Center (APCC), European Centre for Medium-range Weather Forecast (ECMWF), China Meteorological Administration (CMA), and WMO Lead Center for Long Range Forecast Multi-Model Ensemble (WMO LC-LRFMME) also shared their respective outlooks and guided the forum through building a consensus statement in the region.

The ASEANCOF is an avenue to collaboratively develop a consensus-based seasonal climate outlooks and related information on a regional scale. The forum outlook and its activities contribute significantly to one of the key roles of the ASEAN Specialised Meteorological Centre (ASMC), which is to conduct climate and seasonal prediction for ASEAN region through pooling the expertise of ASEAN National Meteorological Services. The consensus outlook for the December-January-February 2016-2017 season for the ASEAN region benefits from the guidance of the WMO GPC model outputs, as well as other global

providers. In particular, use is made of the multi-model ensemble forecasts from WMO LC-LRFMME as well as country-level forecasts developed by the participating national experts. The forum reviewed the present climate conditions in the Southeast Asia region, and discussed the various global and regional climatic factors that will influence the DJF season in the area. In particular, the forum took into account the significant influence of the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) on the climate over Southeast Asia.

### **Conditions and Outlook for DJF 2016-2017**

Observed sea surface temperatures (SST) in the tropical Pacific remain cooler than average since July-August-September 2016 season indicating La Niña-like conditions. However, recent analyses of atmospheric conditions remain within the neutral range.

A number of climate models slightly favor weak and short-lived La Niña to persist in DJF 2016-17. La Niña is characterized by persistent cooler tropical Pacific SST anomalies, SSTA ( $-0.5^{\circ}\text{C}$  or below) and stronger easterly winds over the tropical Pacific Ocean. While varying in local impacts, La Niña events are generally associated with wetter-than-average rainfall conditions over the ASEAN region, especially in the southern and eastern half of the region.

Negative IOD is weakening. The IOD is predicted to be in a weakly negative to neutral state in DJF 2016-17. Negative IOD is generally associated with warmer than usual SSTA in tropical eastern Indian Ocean in contrast with cooler than normal SSTA in tropical western Indian Ocean. While negative IOD can potentially reinforce the impacts of La Niña, climate models generally do not predict persistence in negative IOD values.

It is also predicted that the frequency of tropical cyclones in the Western North Pacific Region will be above average in DJF 2016-17. Meanwhile, tropical cyclone frequency in the Bay of Bengal will likely remain near average.

Finally, a number of climate models show that the northeast Monsoon is likely stronger than average. It is, however, noteworthy that the effects of this predicted strength in the monsoon could potentially be confined to the northern portions of the region.

Taking into consideration the national-level forecasts, the present status of the climate conditions affecting Southeast Asia, and the forecasts available from the GPCs and other global centres, the forum agreed on the following consensus-based outlook for the DJF 2016-17 season for the Southeast Asia region:

## RAINFALL

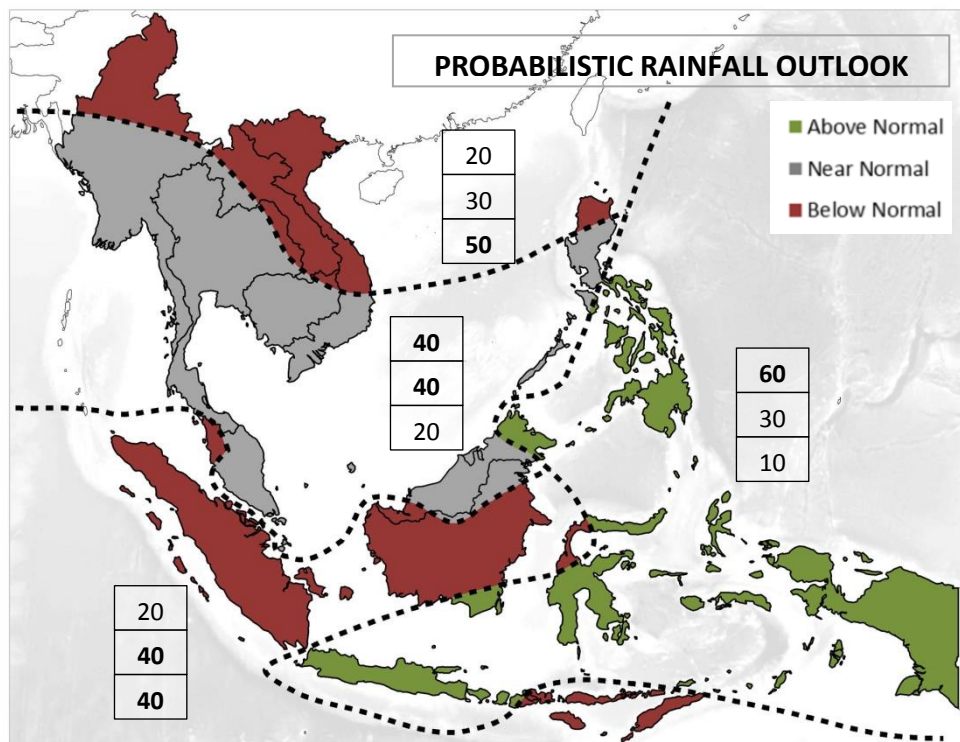
*For the upcoming Northern Hemisphere winter monsoon season (Dec-Jan-Feb 2016-17), there is a slightly enhanced probability of below normal rainfall over northern mainland Southeast Asia, near normal to above normal rainfall over central and western Southeast Asia, which includes most parts of Thailand, Cambodia, southern Myanmar, and western portion of the Philippines. Slightly enhanced probabilities of above normal rainfall are predicted over the rest of the Philippines and eastern Maritime Continent.*

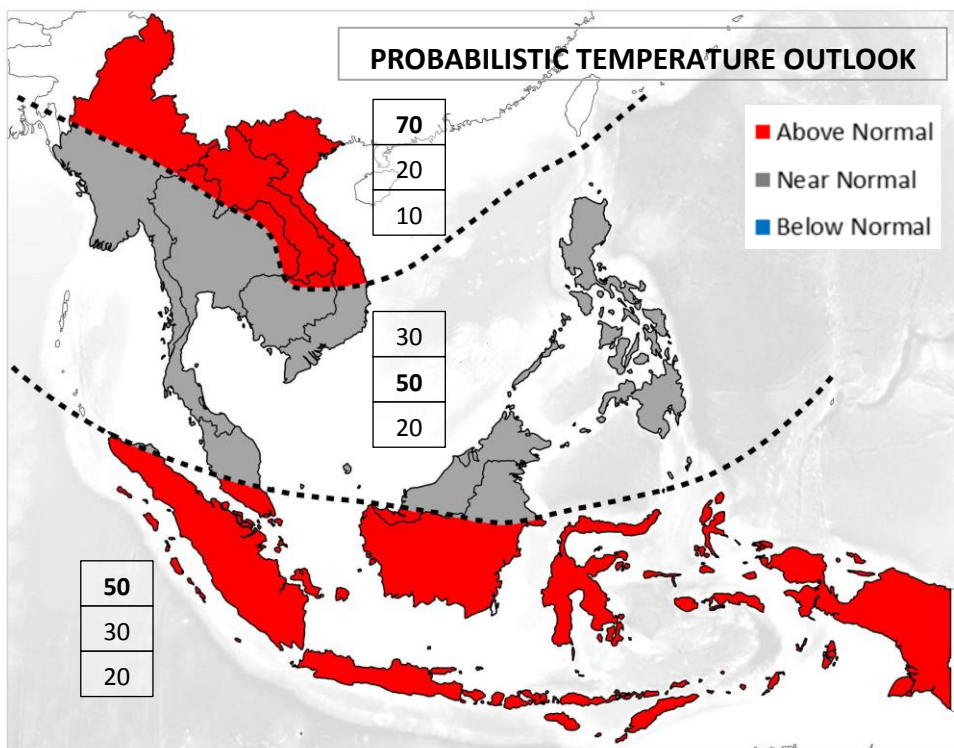
## TEMPERATURE

*Slightly above to above normal air temperatures are very likely to occur over much of Southeast Asia region for the upcoming Northern Hemisphere winter monsoon season (Dec-Jan-Feb), with the highest probabilities over the northern portions of Myanmar, Vietnam, and Lao. Near average air temperatures are predicted over Thailand and Philippines.*

Refer to Annex A for reference on what is meant by “above, near, or below normal” in the outlook. For more information on the Northern Hemisphere winter monsoon outlook and further updates on the national scale, the relevant NMSs should be consulted (see Annex B). The review for the JJA 2016 consensus outlook from ASEANCOF-6 is included in Annex C for reference.

## Consensus Maps for DJF 2016-2017





## Acknowledgements

The forum would like to thank the National Meteorological Services of the ASEAN Member countries for conveying their national-level forecasts, the Global Producing Centres, and other participating international climate modelling centres for their products and expertise made available for this climate outlook forum. The forum would also like to thank the WMO Secretariat for providing support and guidance for this bulletin.

## Annex A: Rainfall and Temperature Tercile Climatologies

The following figures are rainfall and temperature mean and tercile boundary climatologies to reference against the consensus outlook. Only a single source of data for each variable is provided ([CRU](#), [UEA](#)). For more representative climatologies, reference should be made also against observational datasets known to better characterize local patterns (e.g. quality-controlled station data from the respective National Meteorological Services).

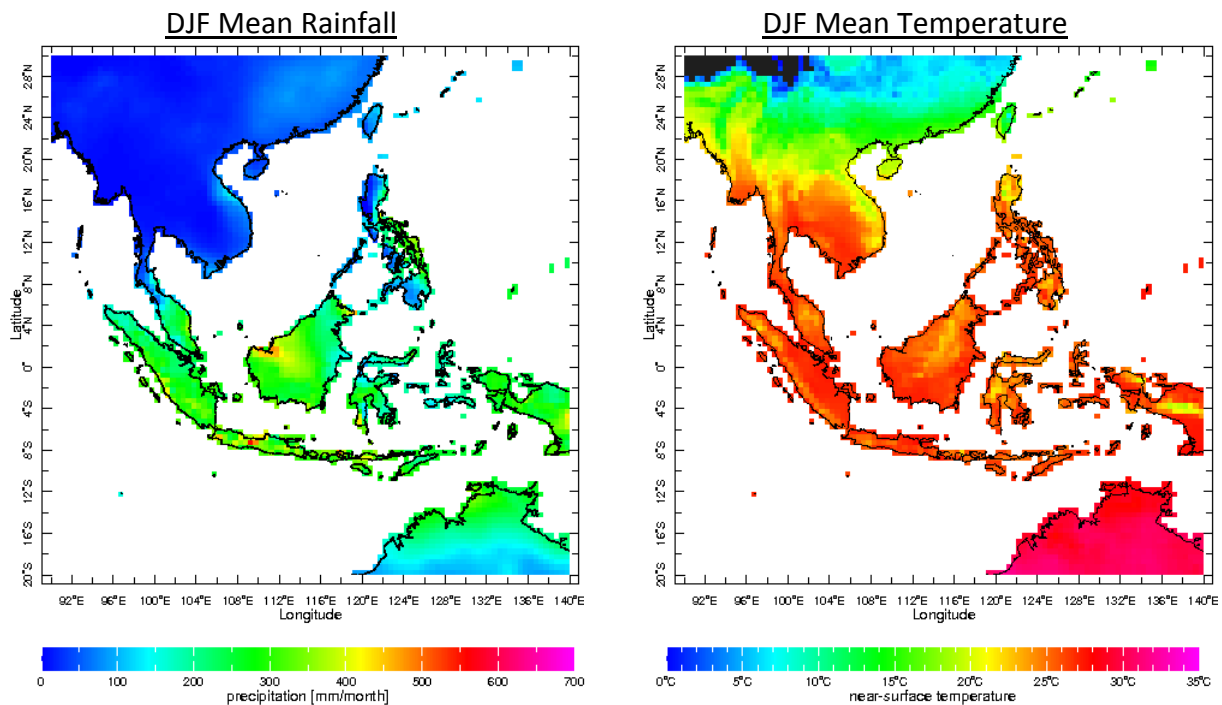


Figure A1: Rainfall mean climatology in mm/month (left) and the temperature mean climatology in degrees Celsius (right) for DJF from 1981-2010 from TS3p22 (CRU, UEA).

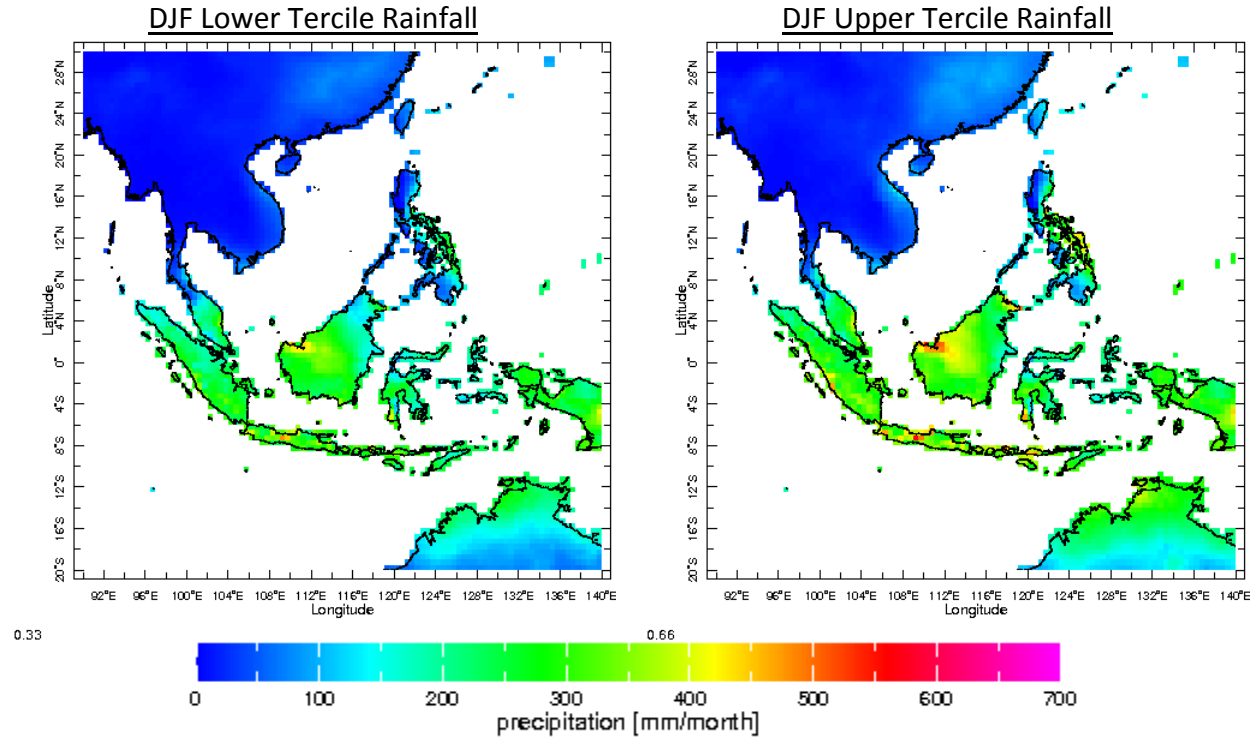


Figure A2: Rainfall climatologies of the lower tercile boundary (left) and the upper tercile boundary (right) for DJF from 1981-2010 from TS3p22 (CRU, UEA) in mm/month.

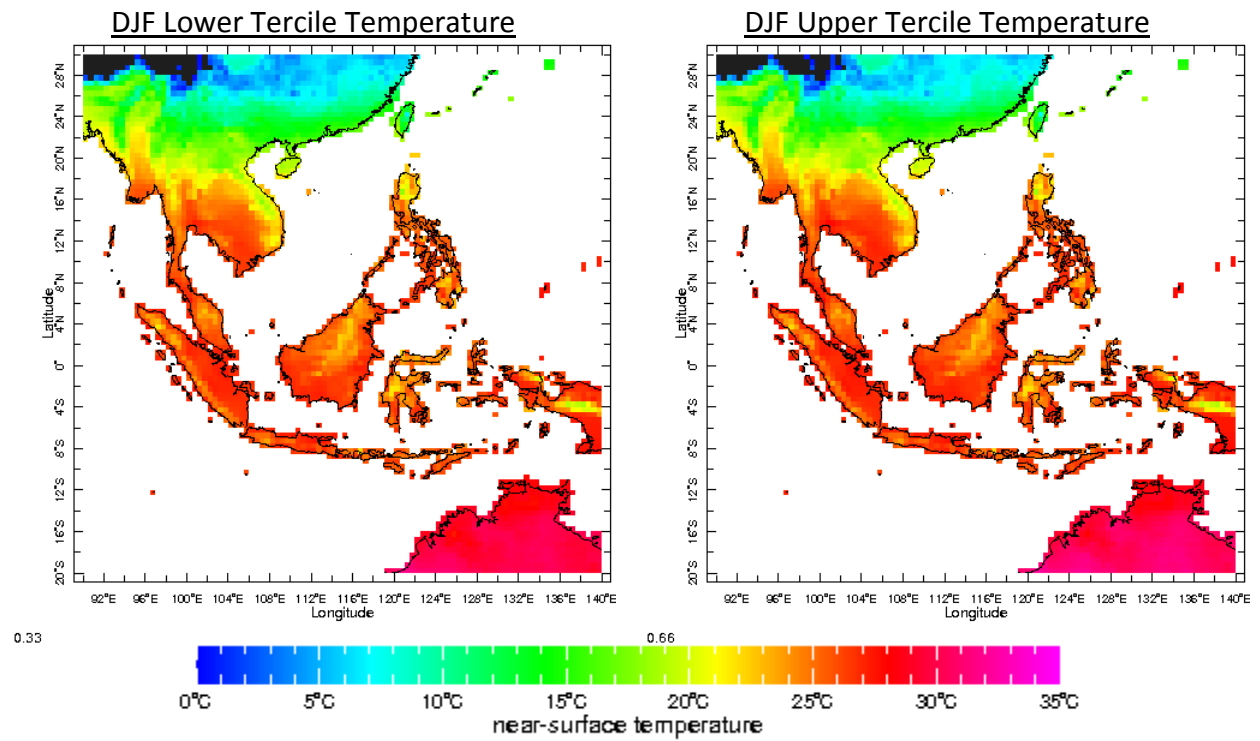


Figure A3: Temperature climatologies of the lower tercile boundary (left) and the upper tercile boundary (right) for DJF from 1981-2010 from TS3p22 (CRU, UEA).

## **Annex B: National Meteorological Services' Contact Information**

**- Brunei Darussalam Meteorological Department (BDMD)**

<http://www.met.gov.bn/weather>

**- Department of Meteorology, Cambodia**

<http://www.cambodiameteo.com/map?menu=3&lang=en>

**- Badan Meteorologi, Klimatologi dan Geofisika, Indonesia (BMKG)**

<http://www.bmkg.go.id>

**- Department of Meteorology and Hydrology (DMH), Lao**

<http://dmhlao.etllao.com/>

**- Malaysian Meteorological Department (MMD)**

<http://www.met.gov.my/>

**- Department of Meteorology and Hydrology (DMH), Myanmar**

<http://www.dmh.gov.mm/>

**- Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)**

<http://www.pagasa.dost.gov.ph/>

**- Meteorological Service Singapore Government (MSS)**

<http://www.weather.gov.sg/home/>

**- Thai Meteorological Department (TMD)**

<http://www.tmd.go.th/en/>

**- National Center for Hydro-Meteorological Forecasting (NCHMF), Vietnam**

<http://www.nchmf.gov.vn/Web/en-US/43/Default.aspx>



## Annex C: Review of Consensus Outlook JJA 2016

The following was the consensus outlook for JJA 2016:

### **RAINFALL**

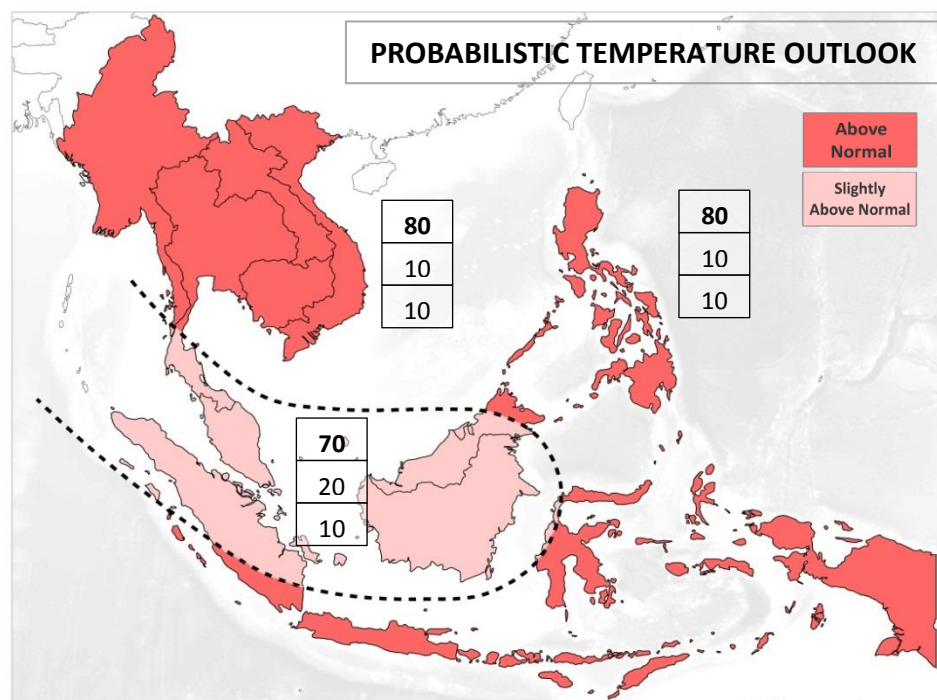
*For the upcoming Northern Hemisphere summer monsoon season (June-July-Aug), there is a slightly enhanced probability of above normal rainfall over the Maritime Continent, which includes most parts of Borneo, Singapore, and southern Sumatra. Slightly enhanced probabilities of below normal rainfall are predicted over northern Philippines. Elsewhere over the region, there are slightly enhanced probabilities for near normal rainfall.*

### **TEMPERATURE**

*Above normal temperatures are very likely over much of the Southeast Asia region for the upcoming Northern Hemisphere summer monsoon season (June-July-Aug), with the highest probabilities over the Philippines and mainland Southeast Asia.*

## Consensus Maps for JJA 2016

In review, temperature outlook for JJA 2016 was largely consistent with observations in the region, which experienced above normal conditions in general (Figure 1).





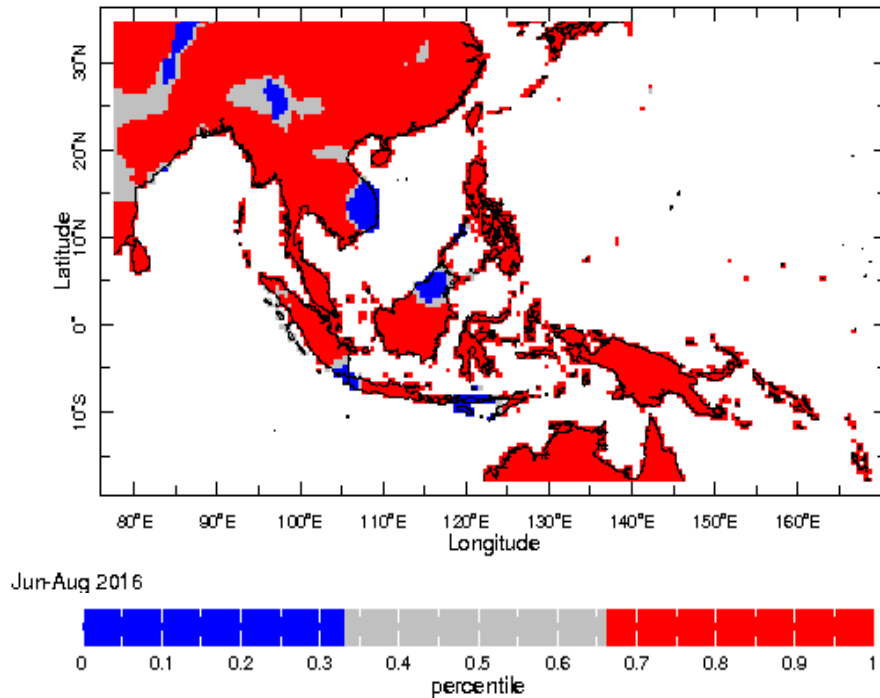
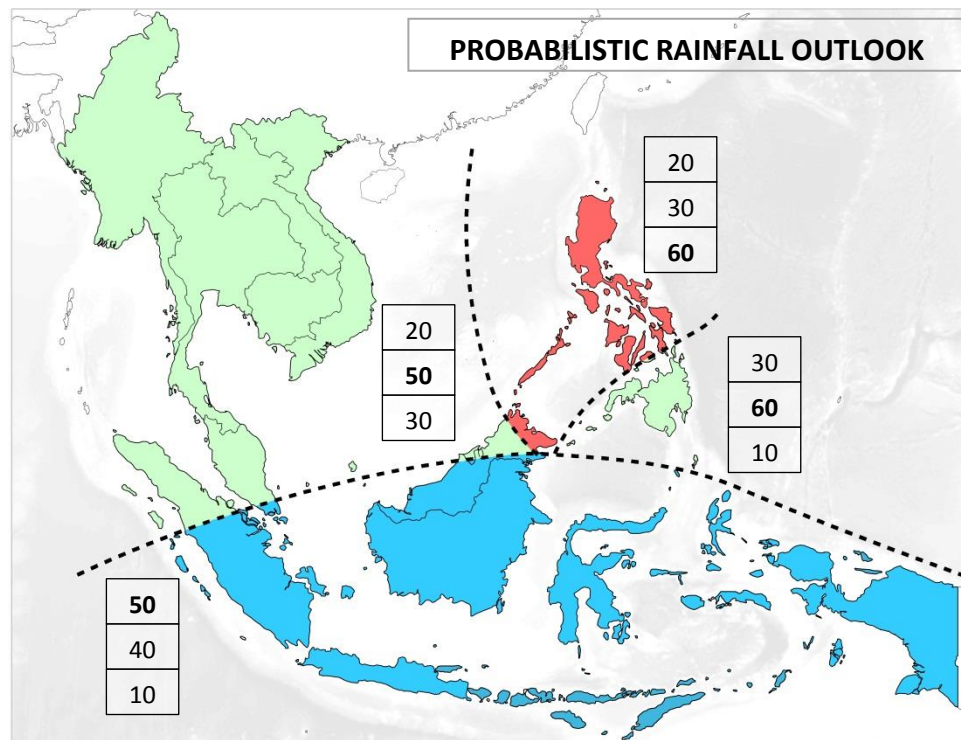
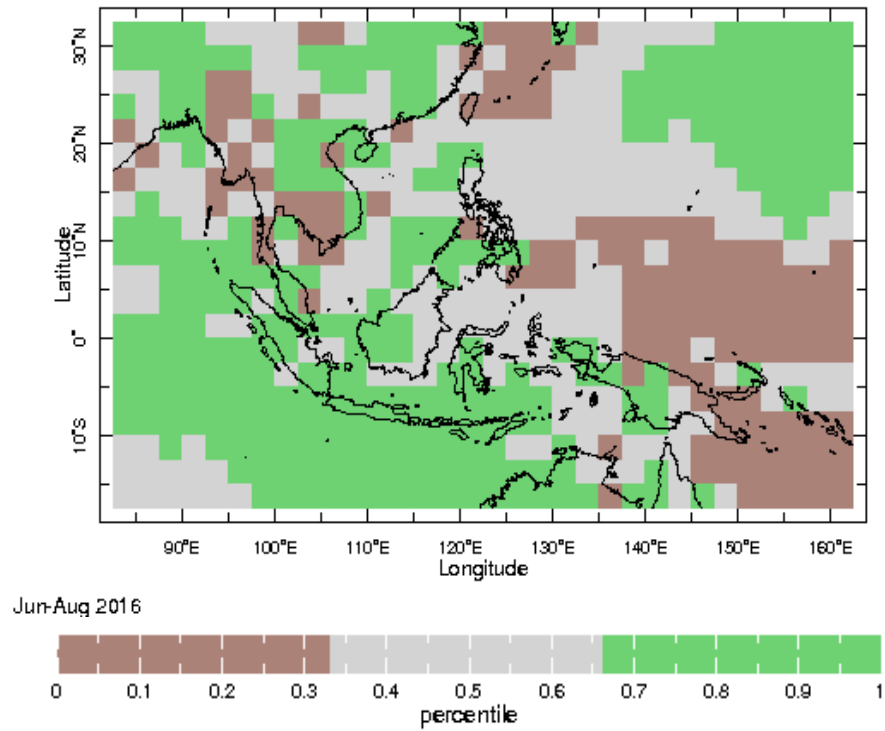


Figure 1: Temperature tercile categories with blue shaded areas showing below normal, grey showing near normal and red showing above normal conditions for JJA 2016. Image credit: GHCN-CAMS.

For rainfall, the outlook was consistent with above normal conditions experienced in the Maritime Continent (most parts of Indonesia). Elsewhere in the region, rainfall observations show mixed categories (less spatially coherent) and reflects the difficulty in making seasonal predictions on finer spatial scale in that region for the season concerned.





**Figure 2: Rainfall tercile categories with brown shaded areas showing below normal, grey showing near normal and green showing above normal conditions for JJA 2016. Image credit: CAMS-OPI.**

**7<sup>th</sup> Session of the Association of Southeast Asian Nations (ASEAN)**  
**Climate Outlook Forum (ASEANCOF-7)**  
 Manila, Philippines  
 November 14-18, 2016

| <b>Day 1</b><br><b>Pre-COF</b><br>November 14, 2016<br>Pre-COF Training on subseasonal to seasonal (S2S) prediction system                                                                                                                                                                                                                                                                 |                                                                                                    |                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| TIME                                                                                                                                                                                                                                                                                                                                                                                       | ACTIVITY                                                                                           | PRESENTER                                                    |
| 8:30 – 9:00                                                                                                                                                                                                                                                                                                                                                                                | Registration                                                                                       |                                                              |
| 9:00 – 10:00                                                                                                                                                                                                                                                                                                                                                                               | Opening Ceremony                                                                                   |                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                            | Welcome Remarks                                                                                    | <b>Dr. Vicente B. Malano</b><br><i>Administrator, PAGASA</i> |
|                                                                                                                                                                                                                                                                                                                                                                                            | Keynote Message                                                                                    | <b>Prof. Fortunato De La Peña</b><br><i>Secretary, DOST</i>  |
|                                                                                                                                                                                                                                                                                                                                                                                            | Message                                                                                            | <b>Mr. Joseph Curry, USAID-</b><br>Philippines               |
|                                                                                                                                                                                                                                                                                                                                                                                            | Message                                                                                            | <b>Dr. Rupa Kumar Kolli, WMO</b>                             |
| 10:00-10:30                                                                                                                                                                                                                                                                                                                                                                                | Photo Session & Break                                                                              |                                                              |
| <b>SESSION 1: Understanding subseasonal to seasonal (S2S) prediction system</b><br>Objectives: <ul style="list-style-type: none"> <li>To provide an overview of the S2S scale, its predictability, uncertainties</li> <li>To demonstrate the application and significance of S2S scale in climate prediction</li> <li>To provide the dominant mode of intraseasonal variability</li> </ul> |                                                                                                    |                                                              |
| 10:30-12:00                                                                                                                                                                                                                                                                                                                                                                                | Introduction to subseasonal to seasonal (S2S) scale and its predictability                         | <b>Dr. Mong-ming Lu, CWB</b>                                 |
| 12:00-1:00                                                                                                                                                                                                                                                                                                                                                                                 | Lunch                                                                                              |                                                              |
| 1:00-2:00                                                                                                                                                                                                                                                                                                                                                                                  | S2S prediction research initiatives and opportunities                                              | <b>Dr. Mong-ming Lu, CWB</b>                                 |
| 2:00 – 3:30                                                                                                                                                                                                                                                                                                                                                                                | Dynamics of Madden-Julian Oscillation (MJO), its predictability, and uncertainties                 | <b>Dr. Ji-Hyun Oh, APCC</b>                                  |
| 3:30-3:45                                                                                                                                                                                                                                                                                                                                                                                  | Break                                                                                              |                                                              |
| 3:45-5:00                                                                                                                                                                                                                                                                                                                                                                                  | Dynamics of Boreal Summer Intraseasonal Oscillation (BSISO), its predictability, and uncertainties | <b>Dr. Ji-Hyun Oh, APCC</b>                                  |
| 6:00-8:00                                                                                                                                                                                                                                                                                                                                                                                  | Welcome Dinner                                                                                     | <b>Secretariat</b>                                           |
| <b>End of DAY 1</b>                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                    |                                                              |
| <b>Day 2</b><br>November 15, 2016<br><b>SESSION 2: Tropical Cyclone Prediction (and a workshop on climate modes)</b><br>Objective: <ul style="list-style-type: none"> <li>To demonstrate the application of S2S scale in tropical cyclones</li> </ul>                                                                                                                                      |                                                                                                    |                                                              |
| Recap of Day 1                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                    |                                                              |
| 9:00 – 12:00                                                                                                                                                                                                                                                                                                                                                                               | Workshop (BSISO)                                                                                   | <b>Dr. Ji-Hyun Oh, APCC</b>                                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------|
| 12:00 – 1:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lunch                                               |                                                              |
| 1:00 – 2:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Subseasonal to seasonal tropical cyclone prediction | <b>Prof. Yuriy Kuleshov, BOM</b>                             |
| 2:30-2:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Break                                               |                                                              |
| 2:45 -5:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Workshop (Tropical Cyclones)                        | <b>Prof. Yuriy Kuleshov, BOM</b>                             |
| <b>End of DAY 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                     |                                                              |
| <b>Day 3</b><br>November 16, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                     |                                                              |
| <b>SESSION 3: Impacts of climate modes to extreme events</b><br><br><b>Objective:</b><br>To demonstrate the application of S2S scale in tropical cyclones                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                     |                                                              |
| Recap of Day 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                     |                                                              |
| 9:00 – 10:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | S2S and extremes                                    | <b>Dr. Michelle L’Heureux, CPC</b>                           |
| 10:00 – 10:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Break                                               |                                                              |
| 10:15-12:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Accessing and interpreting S2S data and products    | <b>Dr. Michelle L’Heureux, CPC</b>                           |
| 12:00 – 1:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lunch                                               |                                                              |
| 1:00-5:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Manila Tour (Intramuros and Luneta)                 |                                                              |
| <b>End of DAY 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                     |                                                              |
| <b>DAY 4</b><br><b>COF PROPER</b><br>November 17, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                     |                                                              |
| Seventh Session of the ASEAN Climate Outlook Forum (ASEANCOF-7)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |                                                              |
| 8:30 – 9:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Registration                                        |                                                              |
| 9:00 – 10:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Opening Ceremony                                    |                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Welcome Remarks                                     | <b>Dr. Vicente B. Malano</b><br><i>Administrator, PAGASA</i> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Message                                             | <b>Mr. Joseph Curry, USAID-</b><br>Philippines               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Message                                             | <b>Ms. Lee Sing Cheong, ASEAN</b>                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Message                                             | <b>Dr. Rupa Kumar Kolli, WMO</b>                             |
| 10:00 – 10:20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Break                                               |                                                              |
| <b>SESSION 4: Presentation of outlook for winter monsoon (DJF) 2016-17 of WMO Global Producing Centers (GPC) for Long-range Forecasting and other international climate prediction centers</b><br><br><ul style="list-style-type: none"> <li>Brief description of the current status of WMO Global Producing Centres’ (GPCs) of Long Range Forecasts and activities of other centres producing global long range forecasts.</li> <li>Models’ skill for Southeast Asia region based on verification of historical forecasts (hindcast)</li> <li>Regional seasonal forecasts for temperature and rainfall DJF 2016-2017, including the seasonal evolution of large-scale circulation features of importance to Southeast Asian climate, such as ENSO and IOD</li> </ul><br>Chair: <b>Dr. Flaviana D. Hilario, PAGASA</b><br>Rapporteurs: <b>Remedios L. Ciervo</b> |                                                     |                                                              |
| 10:20-10:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | APEC Climate Center                                 | <b>Dr. Yoojin Kim, APCC</b>                                  |
| 10:45-11:10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Japan Meteorological Administration                 | <b>Mr. Chihiro Matsukawa, JMA</b>                            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                           |                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------|
| 11:10-11:35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Climate Prediction Center                                                 | <b>Dr. Michelle L'Heureux, CPC</b>                         |
| 11:35 – 12:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Regional Integrated Multi-Hazard Early Warning System for Africa and Asia | <b>Mr. Itesh Dash, RIMES</b>                               |
| 12:00 – 1:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Lunch                                                                     |                                                            |
| 1:00-1:25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bureau of Meteorology                                                     | <b>Prof. Yuriy Kuleshov, BOM</b>                           |
| 1:25-1:50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | China Meteorological Administration                                       | <b>Dr. Fang Wang, CMA</b>                                  |
| 1:50 – 2:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | European Centre for Medium-Range Weather Forecasts                        | <b>Session Chair</b>                                       |
| 2:15 - 2:40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | WMO-Lead Centre for Long Range Forecast                                   | <b>Ms. Miah Kim, KMA</b>                                   |
| 2:40-3:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Break                                                                     |                                                            |
| <b>SESSION 5:</b> Presentation of outlook for winter monsoon (DJF) 2016-17 of National Hydro-Meteorological Services <ul style="list-style-type: none"> <li>Brief description of the operational long range forecast activities of ASEAN National Meteorological Services' (NMSs)</li> <li>Working relationships/experience between the national seasonal forecast producers with the water/disaster risk management sectors on official/experimental forecasts (e.g. requirements, what's proven useful)</li> <li>Country-level seasonal forecasts for temperature and rainfall for DJF 2016-2017</li> </ul> Chair: <b>Ms. Edna L. Juanillo, PAGASA</b><br>Rapporteurs: <b>Joseph Q. Basconillo &amp; Rusy G. Abastillas</b> |                                                                           |                                                            |
| 3:00 – 3:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Brunei Darussalam                                                         | BDMD                                                       |
| 3:15 -3:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Cambodia                                                                  |                                                            |
| 3:30 – 3:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Indonesia                                                                 | BMKG                                                       |
| 3:45 – 4:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Laos                                                                      | DMH                                                        |
| 4:00 - 4:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Malaysia                                                                  | MMS                                                        |
| 4:15 – 4:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Myanmar                                                                   | DMH                                                        |
| 4:30- 4:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Philippines                                                               | PAGASA                                                     |
| 4:45 – 5:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Singapore                                                                 | MSS-CCRS                                                   |
| 5:00 – 5:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Thailand                                                                  | TMD                                                        |
| 5:15-5:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Vietnam                                                                   | VHMS                                                       |
| 5:30-6:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Consensus-building                                                        | <b>Session Chair and ASMC</b>                              |
| 7:30-9:30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Fellowship Night (PAGASA Main Office)                                     | <b>Secretariat</b>                                         |
| End of Day 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                           |                                                            |
| <b>Day 5</b><br>November 18, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                           |                                                            |
| <b>SESSION 6:</b> Climate services and products and presentation of ASEANCOF-7 Consensus Forecast for Winter Monsoon (DJF) 2016-17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                           |                                                            |
| Chair: <b>Dr. Cynthia P. Celebre, PAGASA</b><br>Rapporteurs: <b>Cherry L. Cada</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                           |                                                            |
| 8:30 – 9:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ASEAN Specialized Meteorological Center Products and Services             | <b>Mr. Raizan Rahmat, MSS-CCRS</b>                         |
| 9:00 – 10:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Survey on Climate Services                                                | <b>Mr. Raizan Rahmat, MSS-CCRS</b>                         |
| 10:00-10:15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Break                                                                     |                                                            |
| 10:15 – 10:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Use of PAGASA Products & Services in Climate-resiliency Field School      | <b>Ms. Hazel Tanchuling, Rice Watch and Action Network</b> |

|               |                                                 |                                                           |
|---------------|-------------------------------------------------|-----------------------------------------------------------|
| 10:45-11:15   | Water security under Be Secure Project          | <b>Ms. Lisa K. Pagkalinawan</b> , Be Secure Project-USAID |
| 11:15-11:45   | Food Security and Climate Products and Services | <b>Mr. Praveen Agrawal</b> , World Food Programme         |
| 11:45 – 12:00 | Open Forum                                      |                                                           |
| 12:00-1:00    | Lunch                                           |                                                           |
| 1:00 – 1:45   | Presentation of draft consensus statement       | <b>Dr. Flaviana D. Hilario</b> , PAGASA                   |
| 1:45-2:00     | Break                                           |                                                           |
| 2:00 -3:00    | Closing Ceremony                                |                                                           |
|               | Message                                         | WMO                                                       |
|               | Message                                         | <b>Dr. Landrico U. Dalida, Jr.</b> , PAGASA               |

# Introduction to Madden-Julian Oscillation

Ji-Hyun Oh  
APEC Climate Center





# Personal Introduction

Ji-Hyun Oh ([jihyunoh@apcc21.org](mailto:jihyunoh@apcc21.org))

Research fellow

Climate Research Team

Climate Prediction Department

APEC Climate Center

Busan, South Korea

## Research Interest

### Intraseasonal Oscillation

- Madden-Julian Oscillation
- Boreal Summer Intraseasonal Oscillation

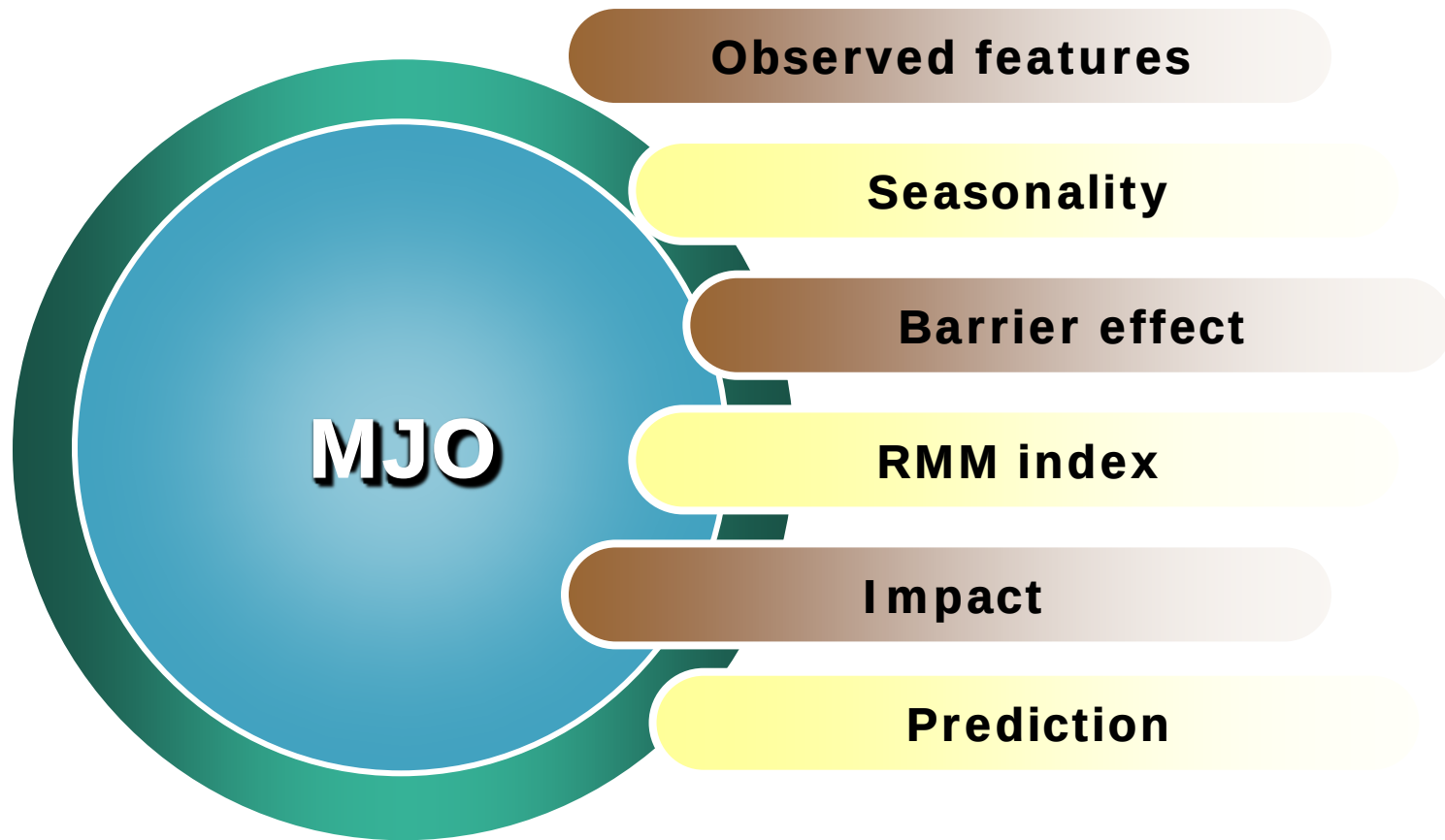
Understanding its impact, mechanism,  
and application







# Today

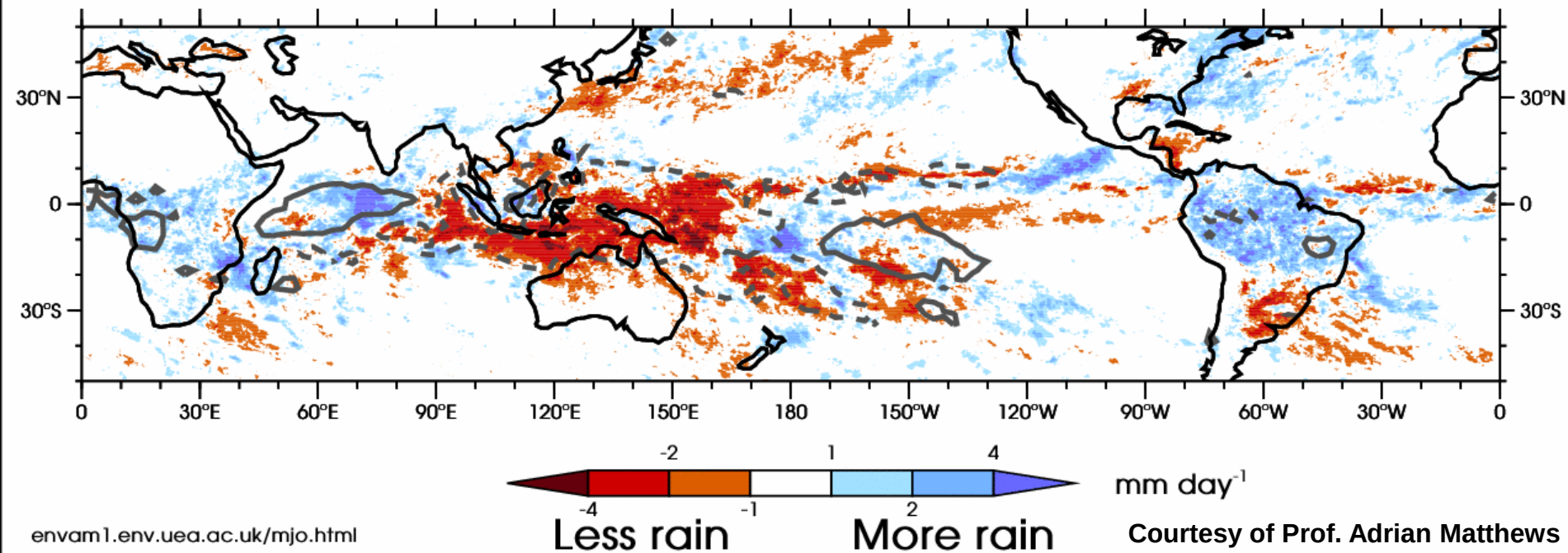
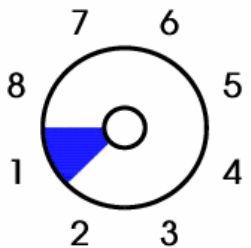


# What is MJO?

Madden-Julian Oscillation: Eastward propagation of rainfall

MJO CYCLE  
Precipitation rate (TRMM)

RMM Phase 1 of 8  
Day 0 of 48



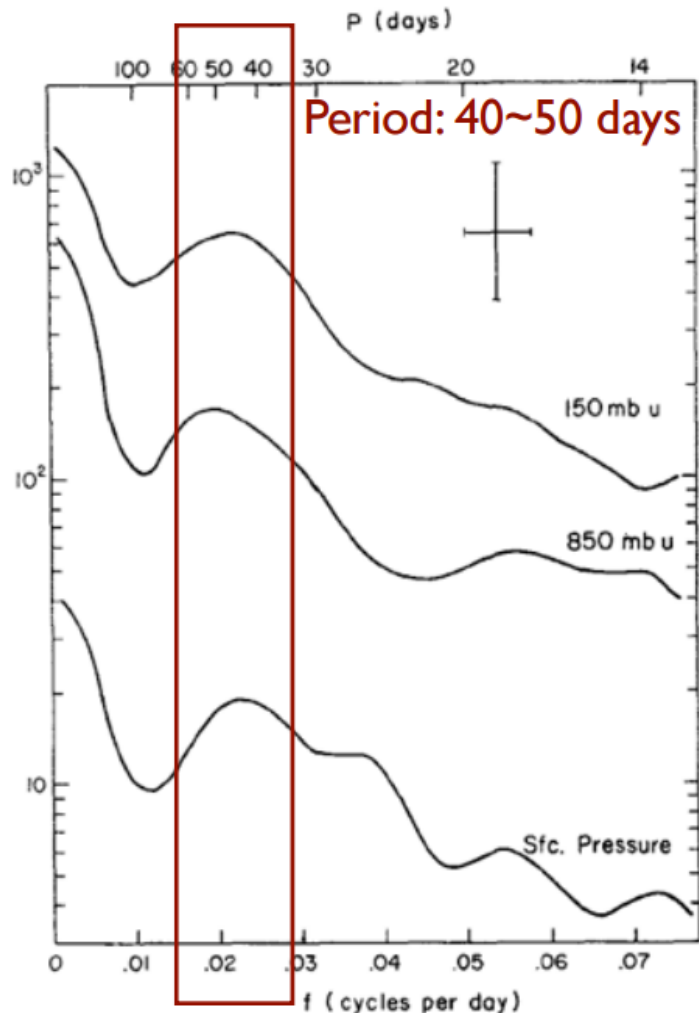
# Why do we call it Madden-Julian Oscillation?

- ❑ Discovered by Roland Madden and Paul Julian in early 1970's
  - AMS Symposium on Prediction of the Madden-Julian Oscillation, **10 January 2013**, Austin, TX



# Back in 1971...

Power spectrum of zonal wind and surface pressure



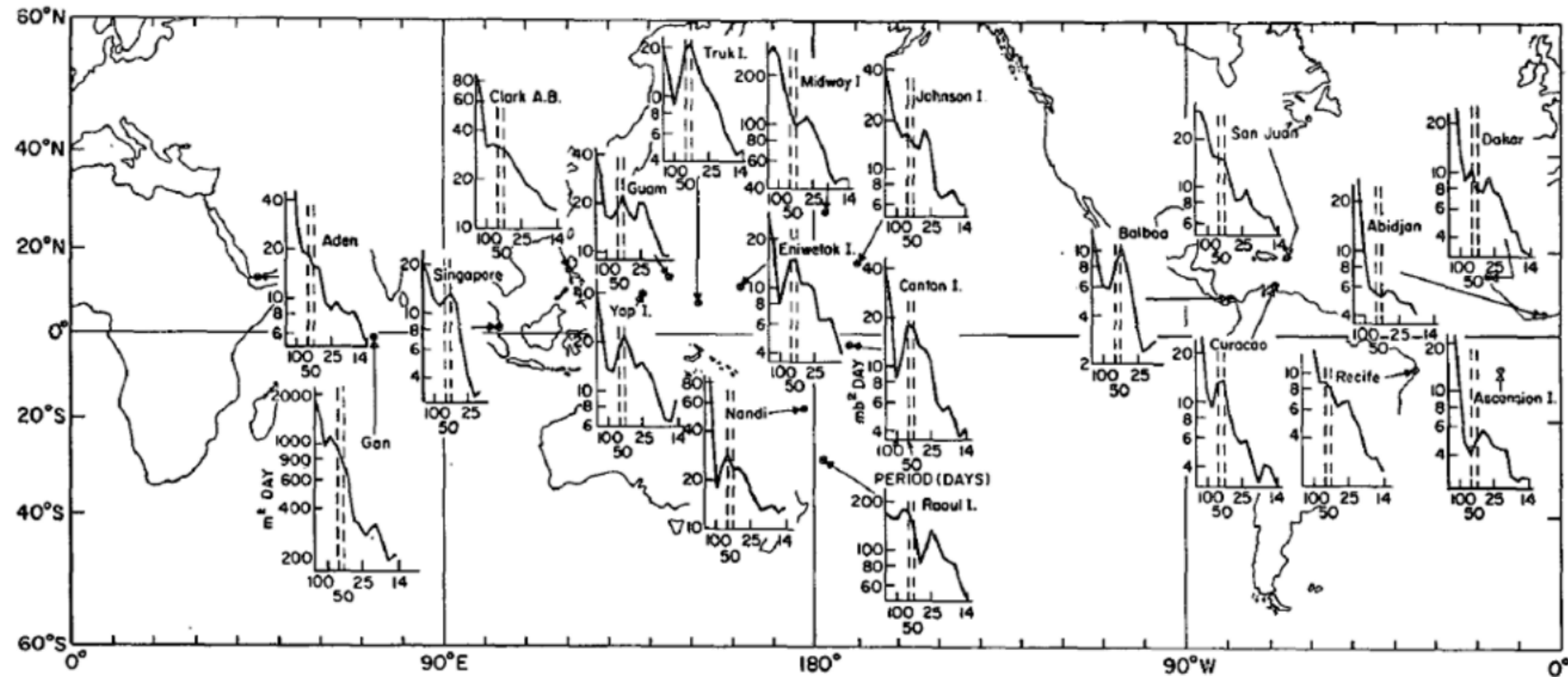
Madden and Julian were looking at zonal wind and surface pressure data at Canton Island (3°S, 172°W)

~ 10 years daily rawinsonde data

Madden and Julian 1971

# More evidences of MJO

Power spectrum of surface pressure of 20 stations



Madden and Julian 1972

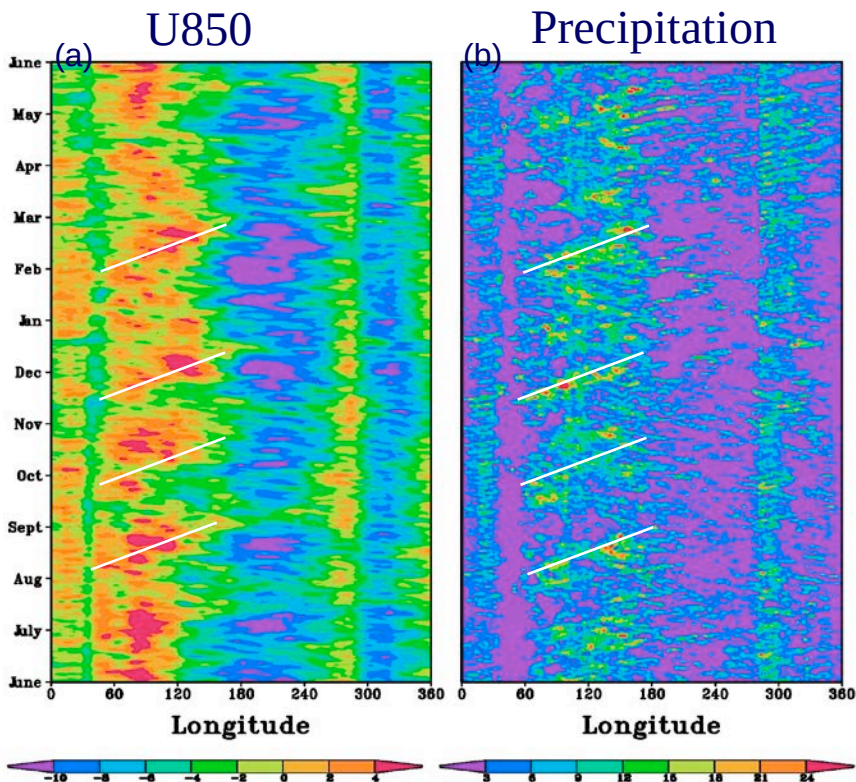


# Why do we call it Madden-Julian Oscillation?

## \*\* Oscillation

The act of regularly moving from one position to another and back to the original position

A frequent change from one state, position, or amount to another

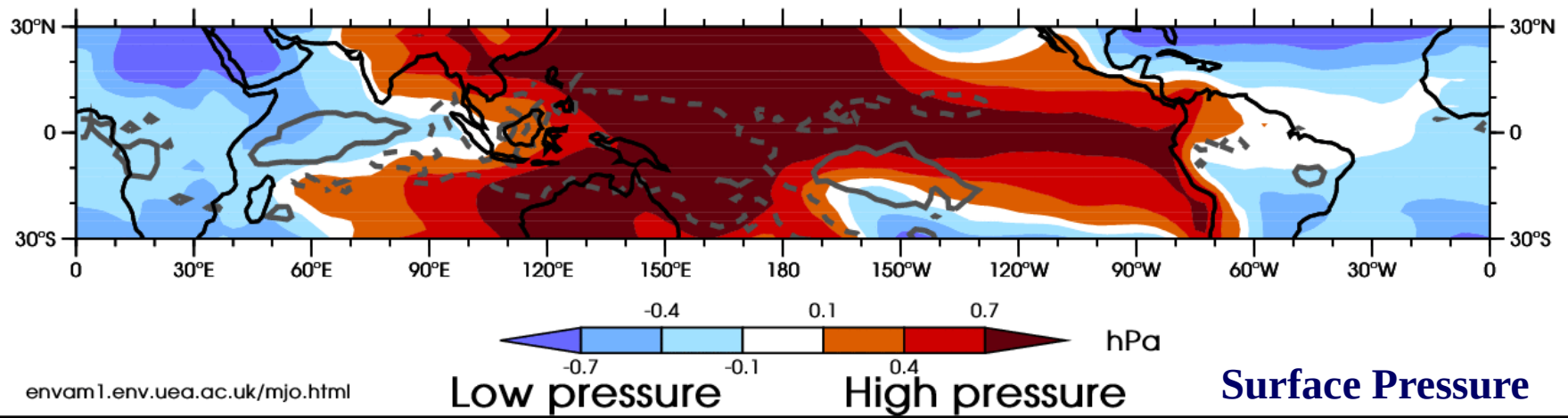
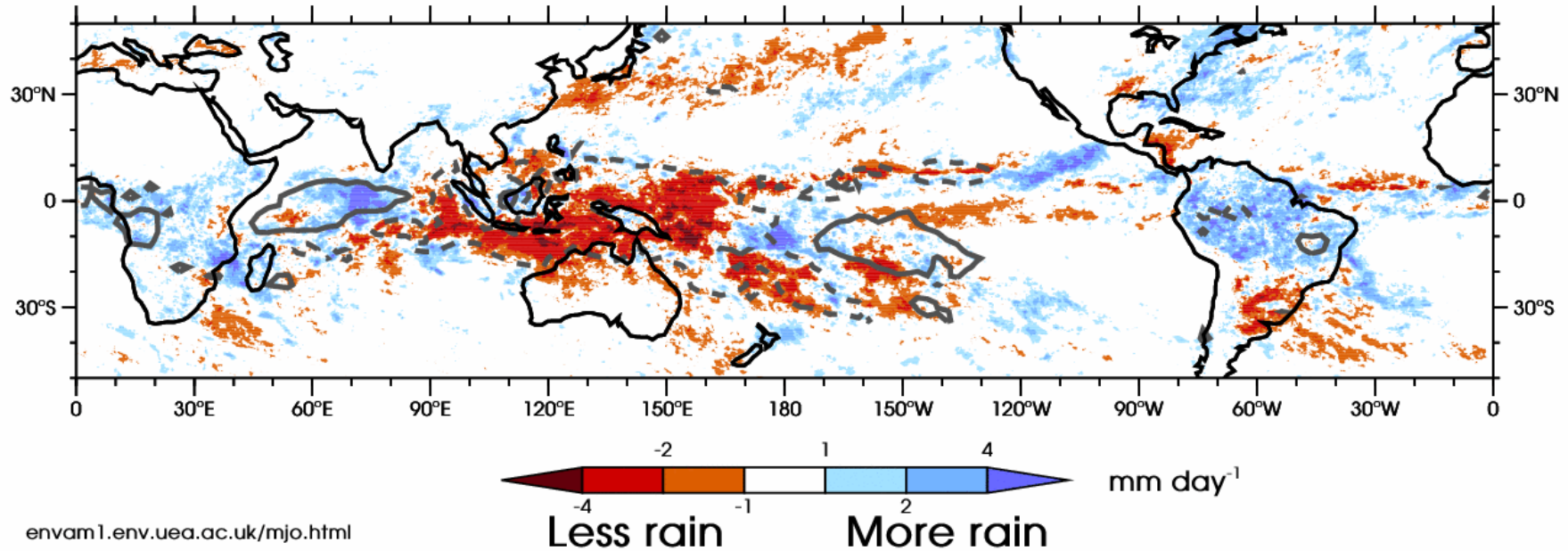
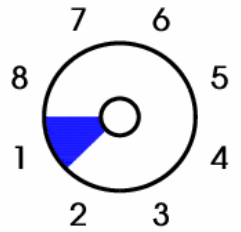


An eastward moving 'pulse' of clouds, rainfall, winds and pressure near the equator. It's a traversing phenomenon and is most prominent over the Indian and Pacific Oceans

It typically recurs every 30 to 60 days  
.-> "Intraseasonal"

MJO CYCLE  
Precipitation rate (TRMM)

RMM Phase 1 of 8  
Day 0 of 48

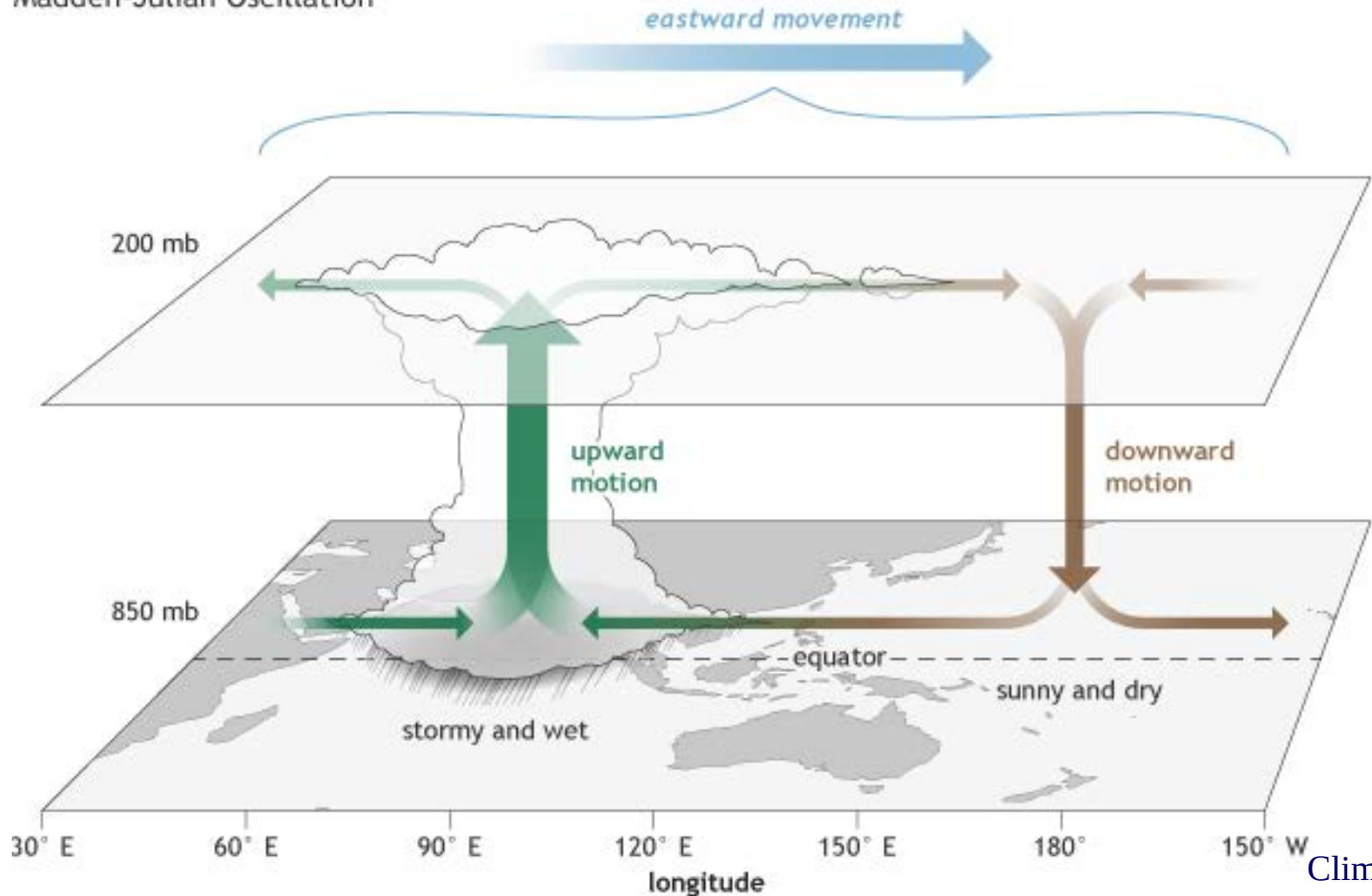






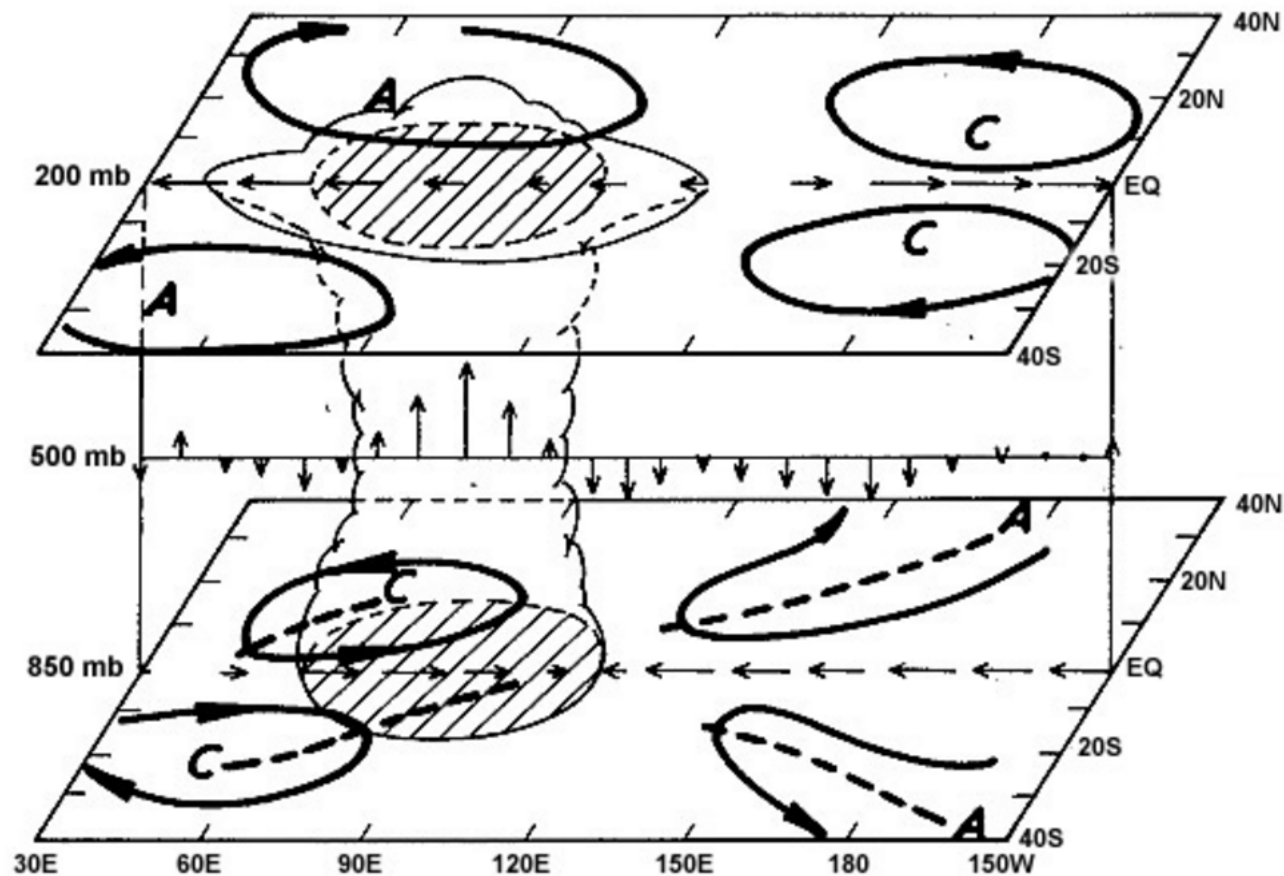
# Basic features      Structure

Madden-Julian Oscillation

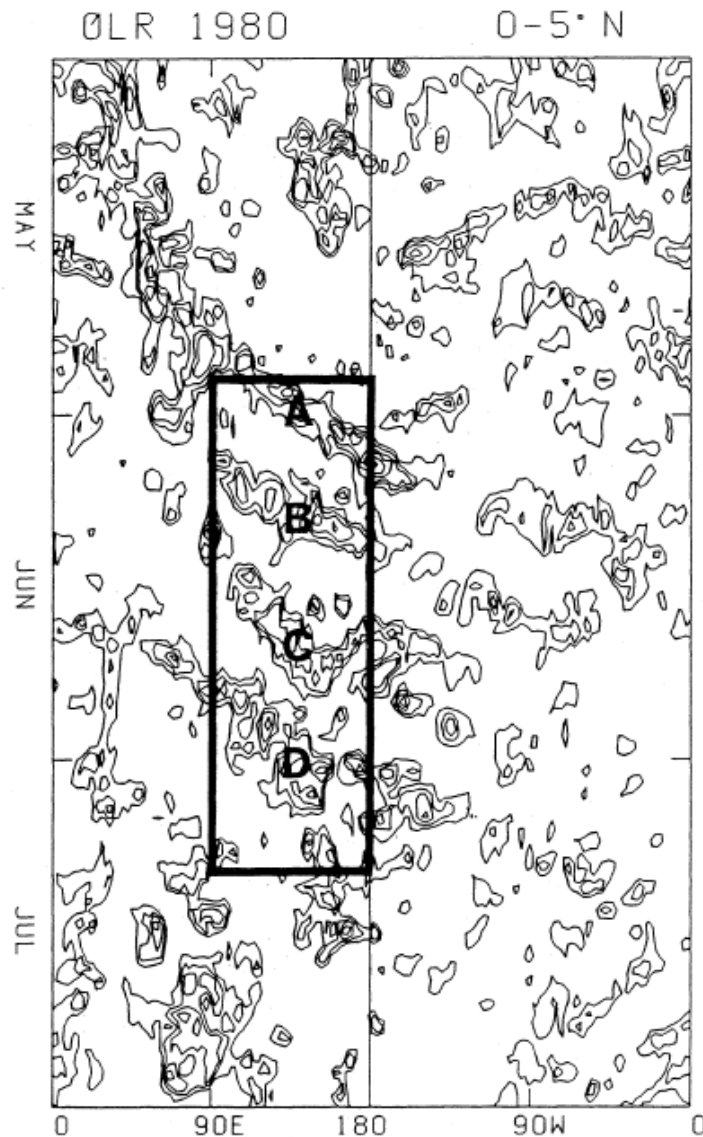


# Basic features

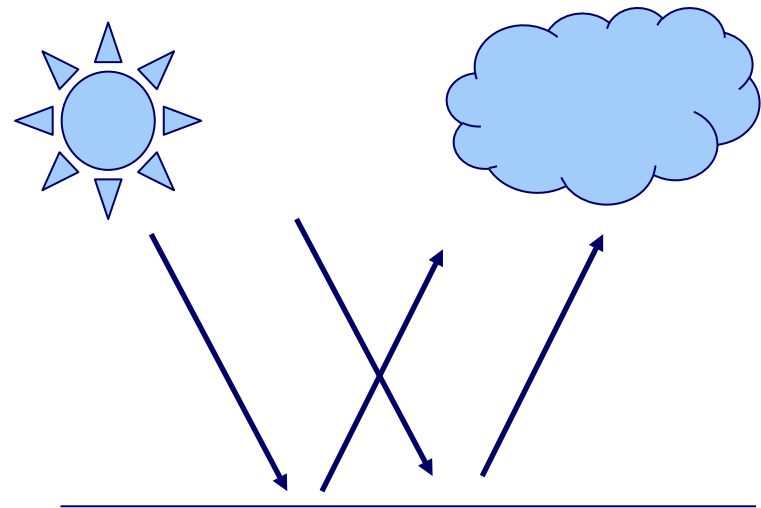
Schematic Depiction of the Large-scale Wind Structure of the MJO



# Multiscale Structure of the MJO

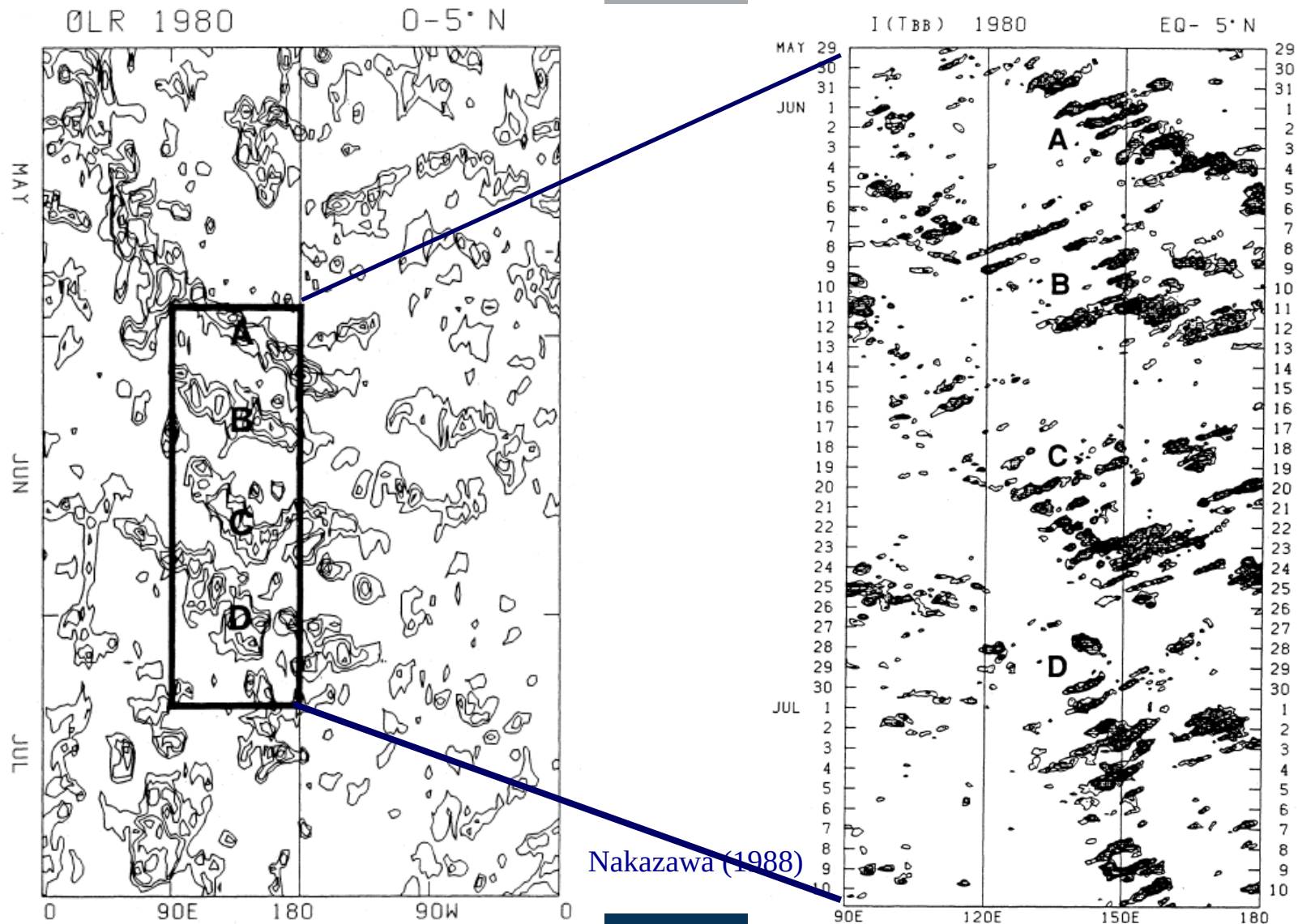


OLR: Outgoing Longwave radiation



Nakazawa (1988)

# Multiscale Structure of the MJO

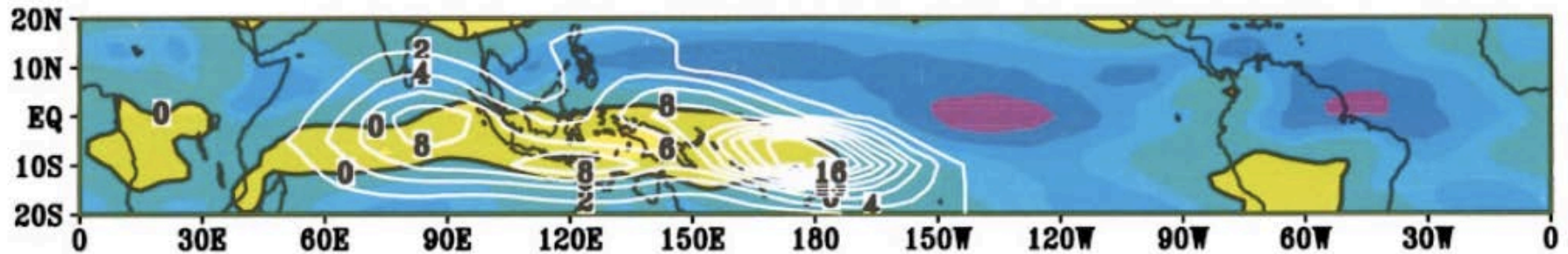






# Seasonality of MJO

Dec-Mar



Jun-Sep

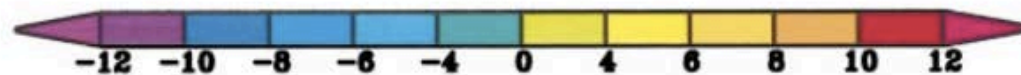
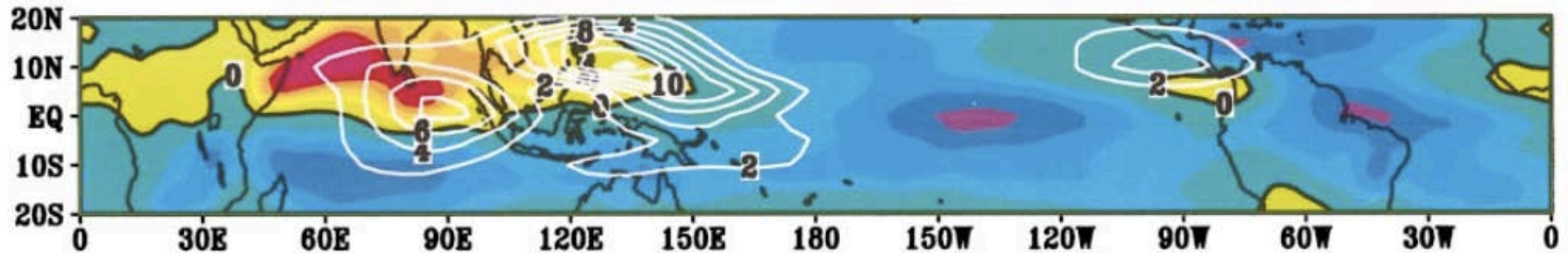
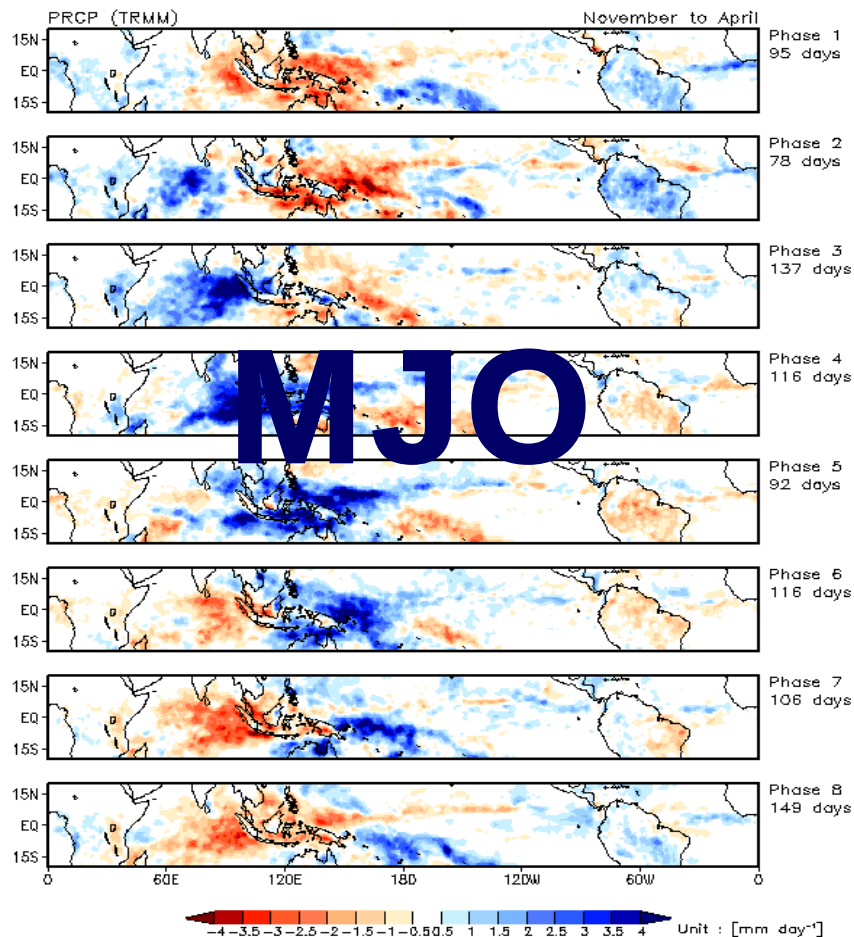


FIG. 7. Variance of  $P^*$  ( $\text{mm}^2 \text{ day}^{-2}$ , contour) and mean  $U_{850}$  ( $\text{m s}^{-1}$ , color) averaged over (a) Dec-Mar and (b) Jun-Sep.

# Seasonality of MJO

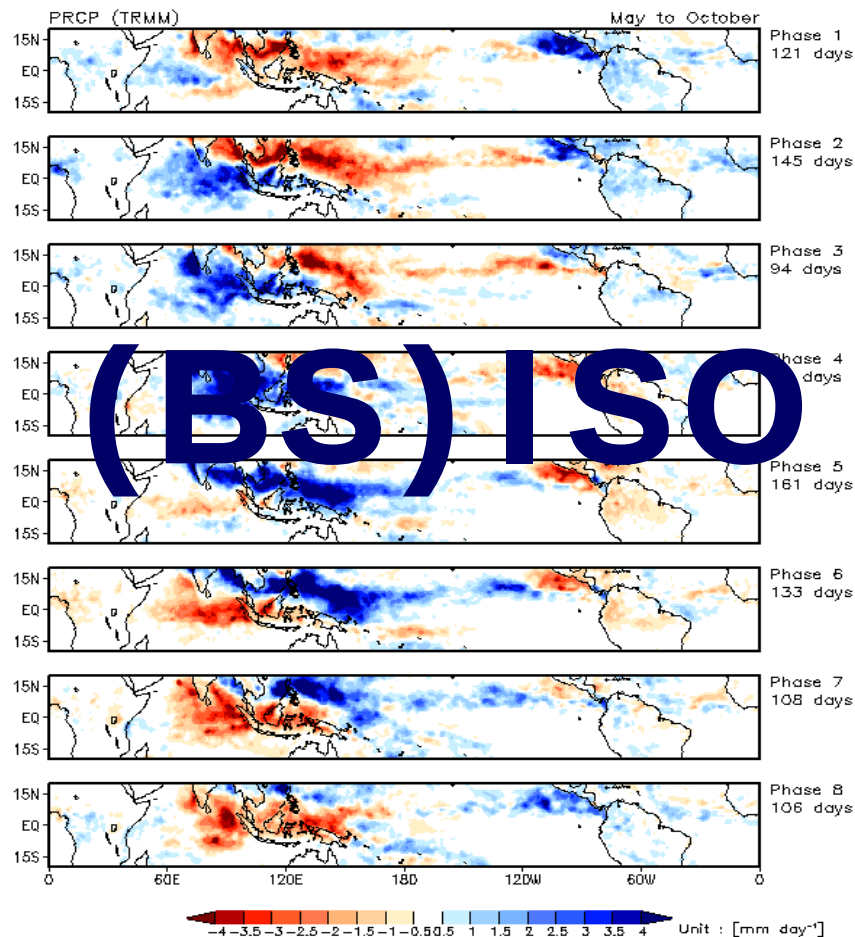
## Dec-Feb Composite

MJO Life cycle composite



## May-June Composite

MJO Life cycle composite







# Barrier Effect of the Maritime Continent

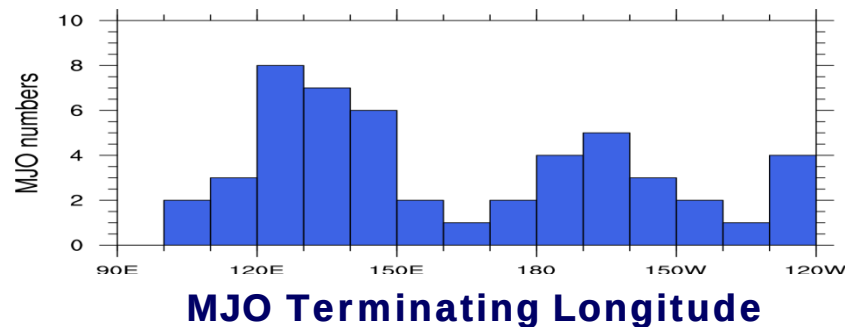
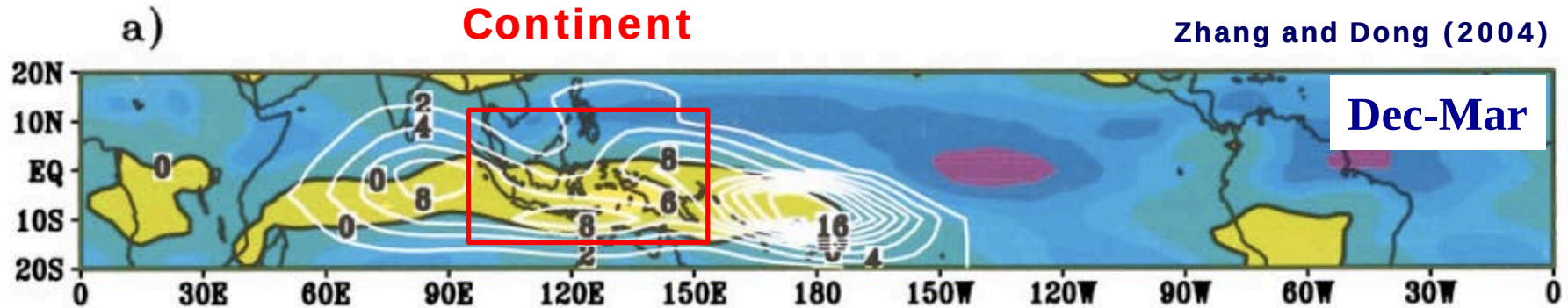


**Maritime  
Continent**

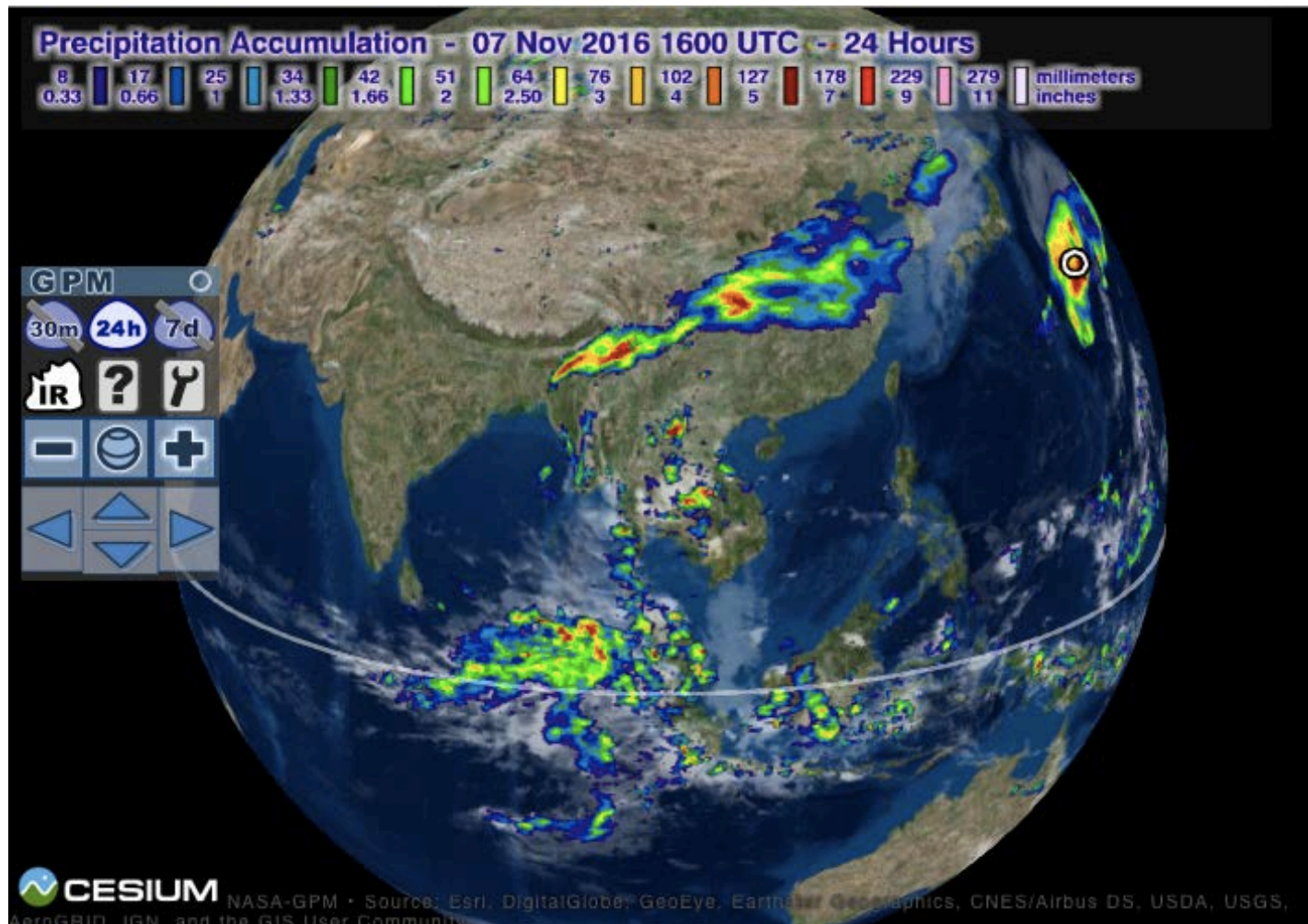
**MJO does not propagate smoothly eastward  
over the Maritime Continent**

Complex topography and land-sea contrast

Zhang and Dong (2004)



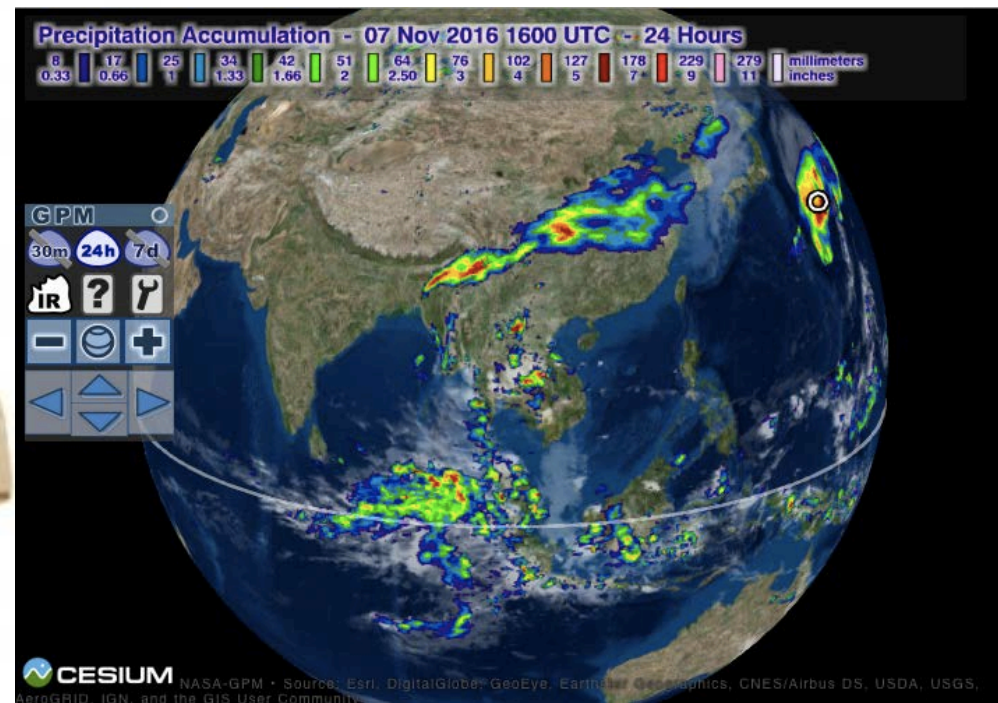
# How to detect the MJO?



# How to detect the MJO?



<http://www.advertolog.com/jenga-game-6110805/print-outdoor/jenga-spartan-17483255/>

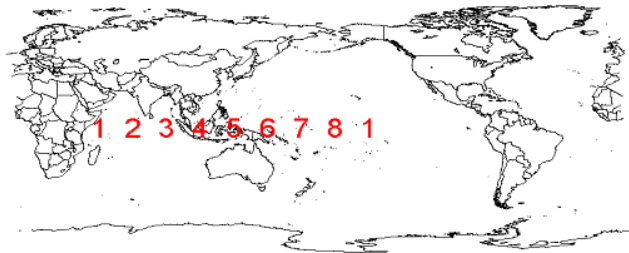




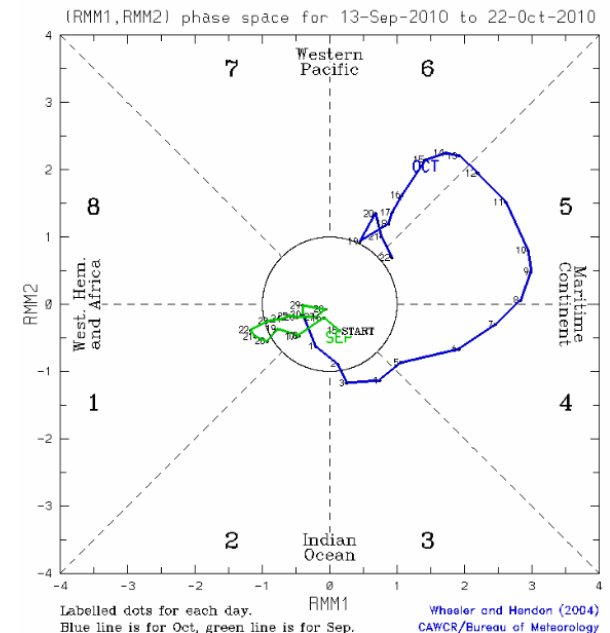
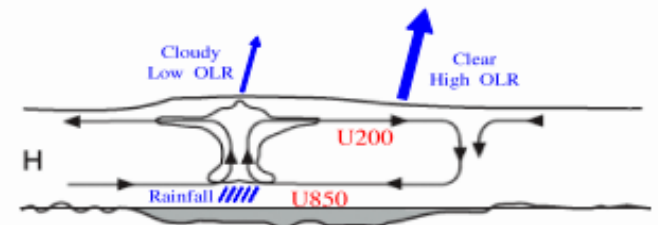
# How to detect the MJO?

MJO index : RMM index (Real-time Multivariate MJO index)

- Designed by Wheeler and Hendon (2004) considering observed features of the MJO (use of OLR, zonal wind at 850hPa & 200hPa)
- Phase (where is MJO?) & amplitude (how strong is it?)



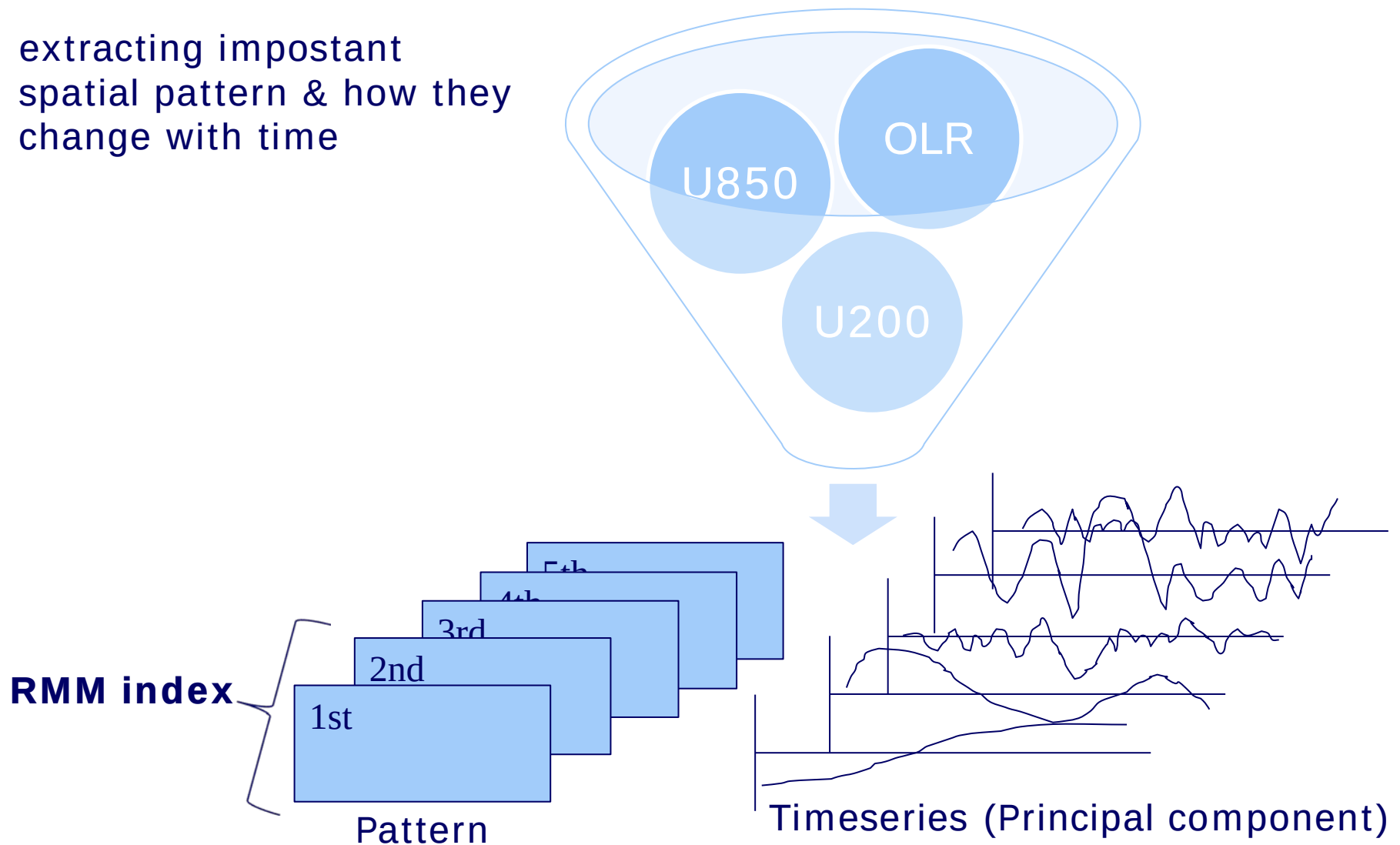
## Typical Variables Used for MJO Analysis





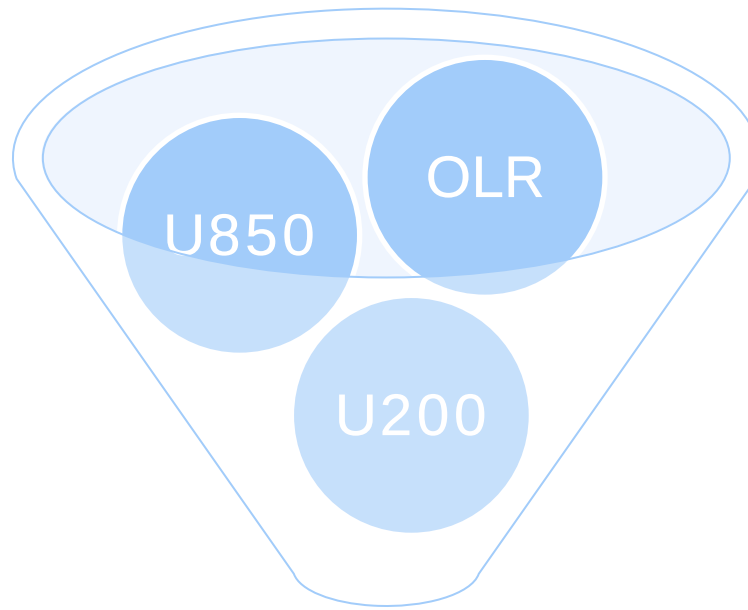
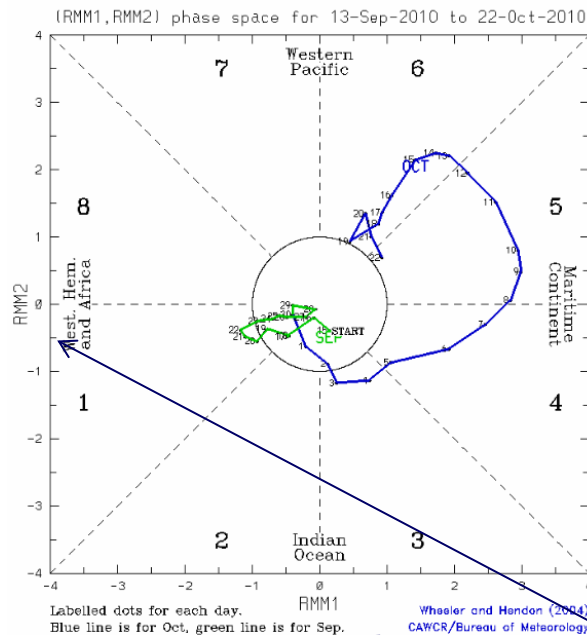
# Multivariate EOF

extracting important  
spatial pattern & how they  
change with time





# Multivariate EOF



**RMM index**

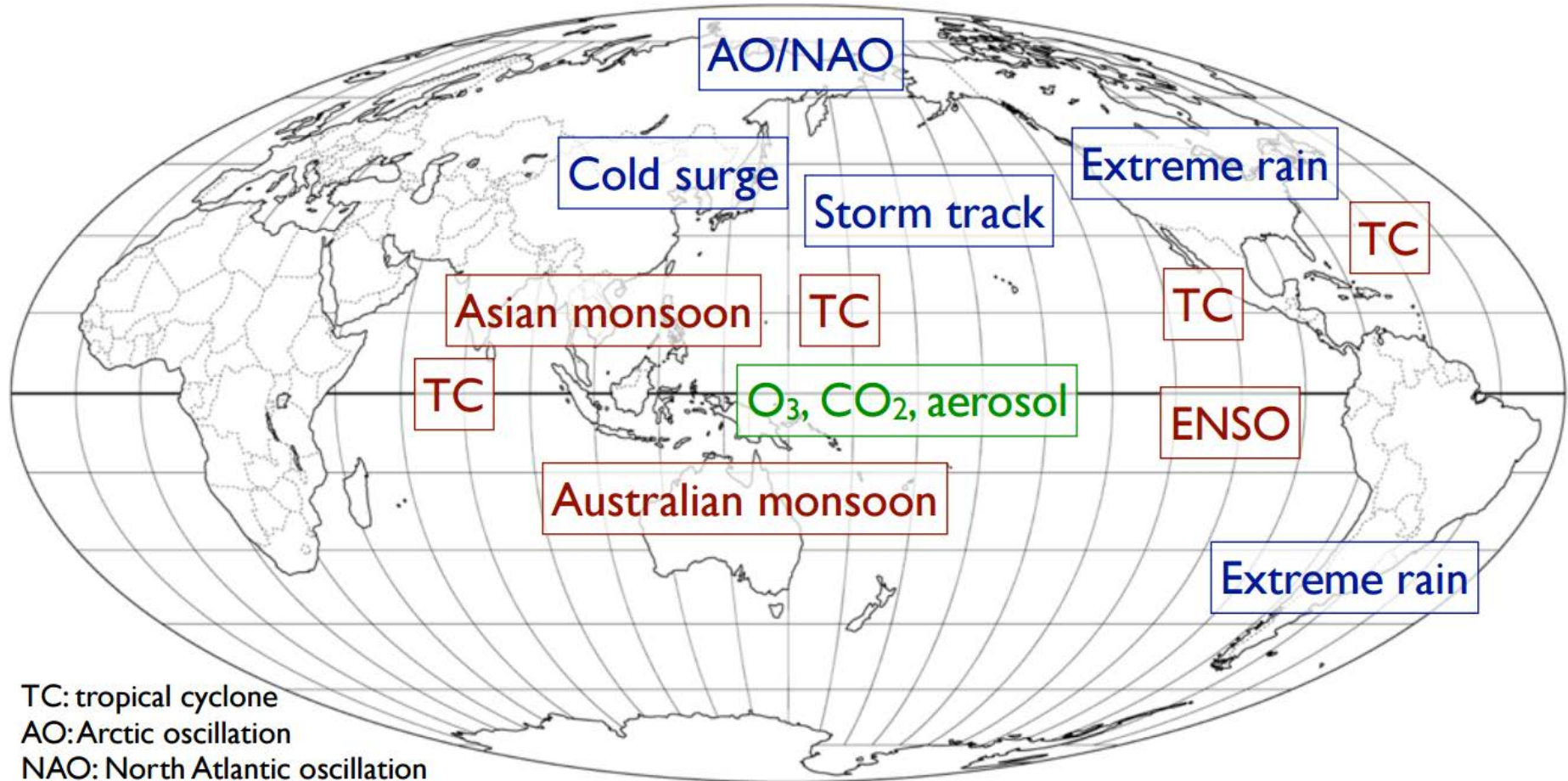
**Pattern**

**Timeseries**





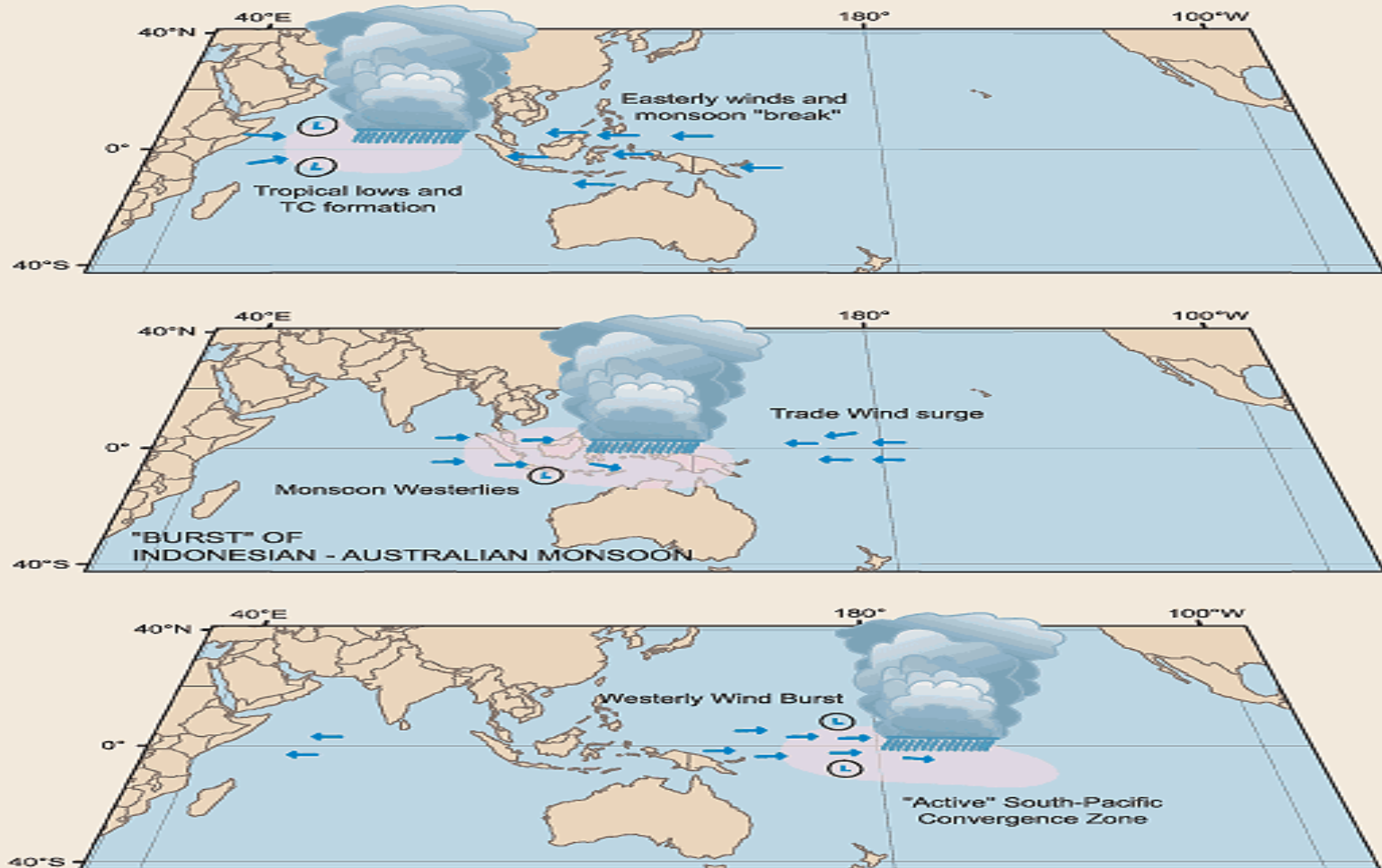
# Impact of the MJO



# Impact of the MJO

Approximate 1 Month Sequence

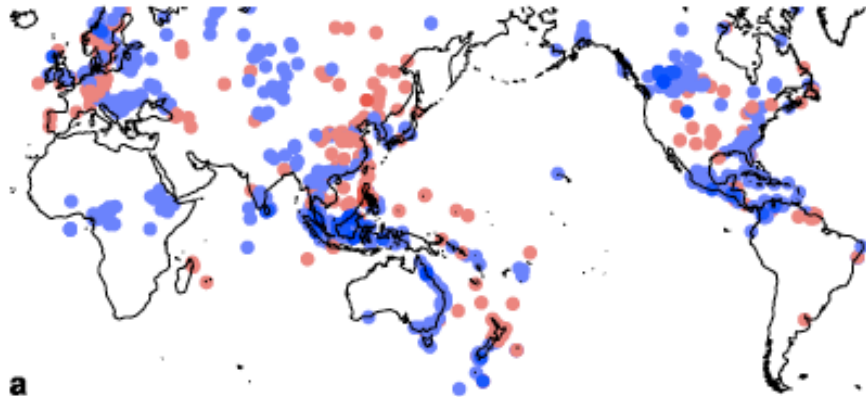
## Madden - Julian Oscillation



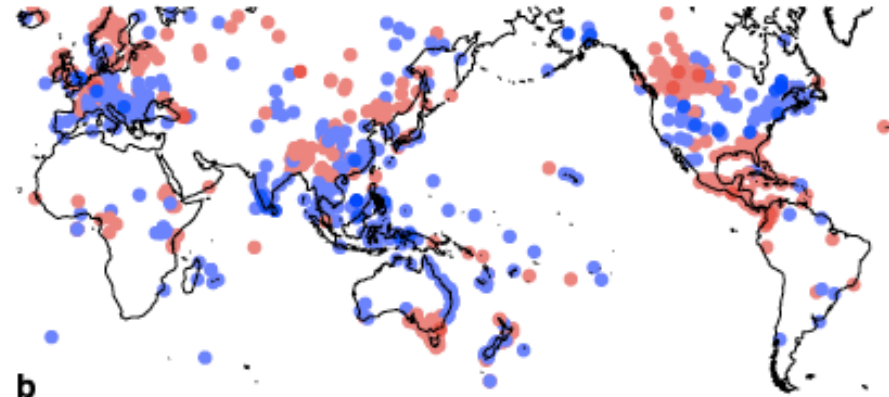
From International Science Roundtable for the Media. "Madden-Julian Oscillation." 17 April 2007. <[http://www.igbp.net/prepcom4/wheeler\\_image.gif](http://www.igbp.net/prepcom4/wheeler_image.gif)>

# Impact of the MJO on global precipitation

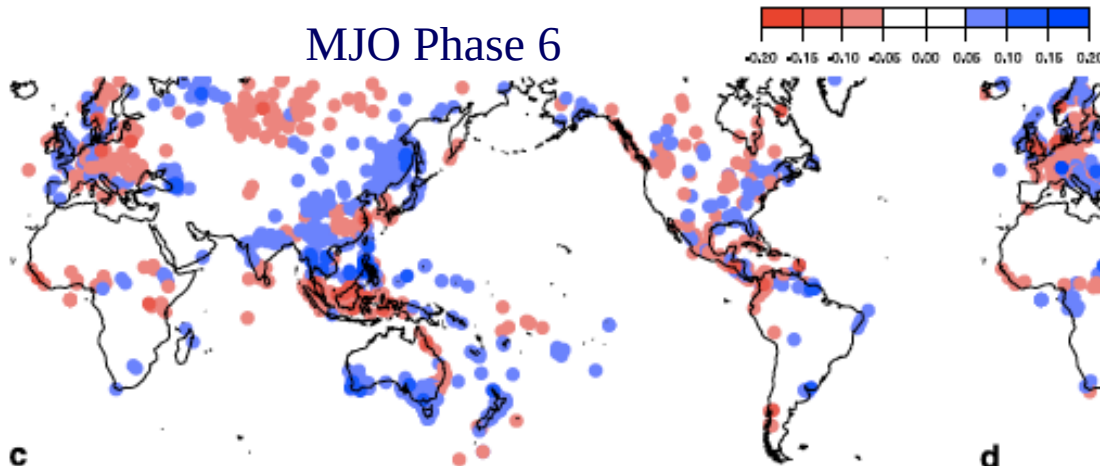
MJO Phase 2



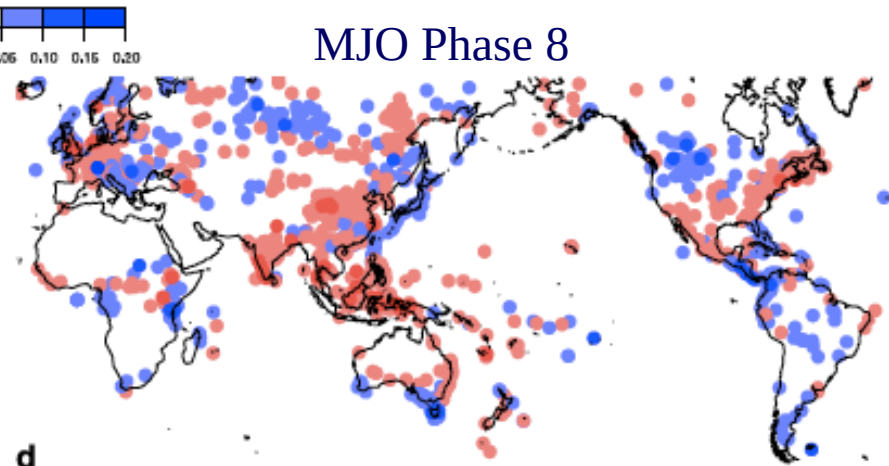
MJO Phase 4



MJO Phase 6



MJO Phase 8

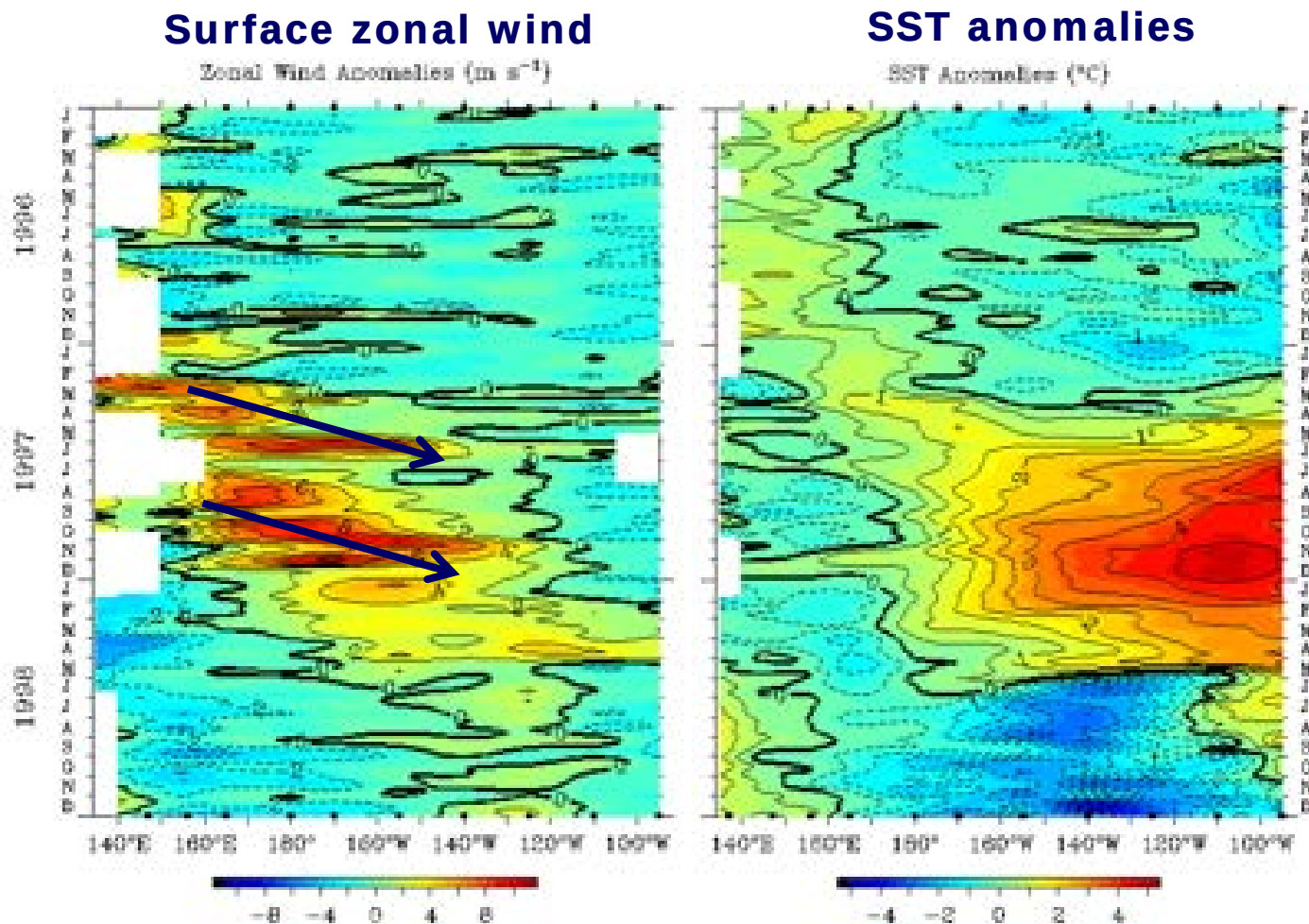


Rainfall anomalies (in boreal summer)

Donald et al. (2006)

# Impact of the MJO on ENSO

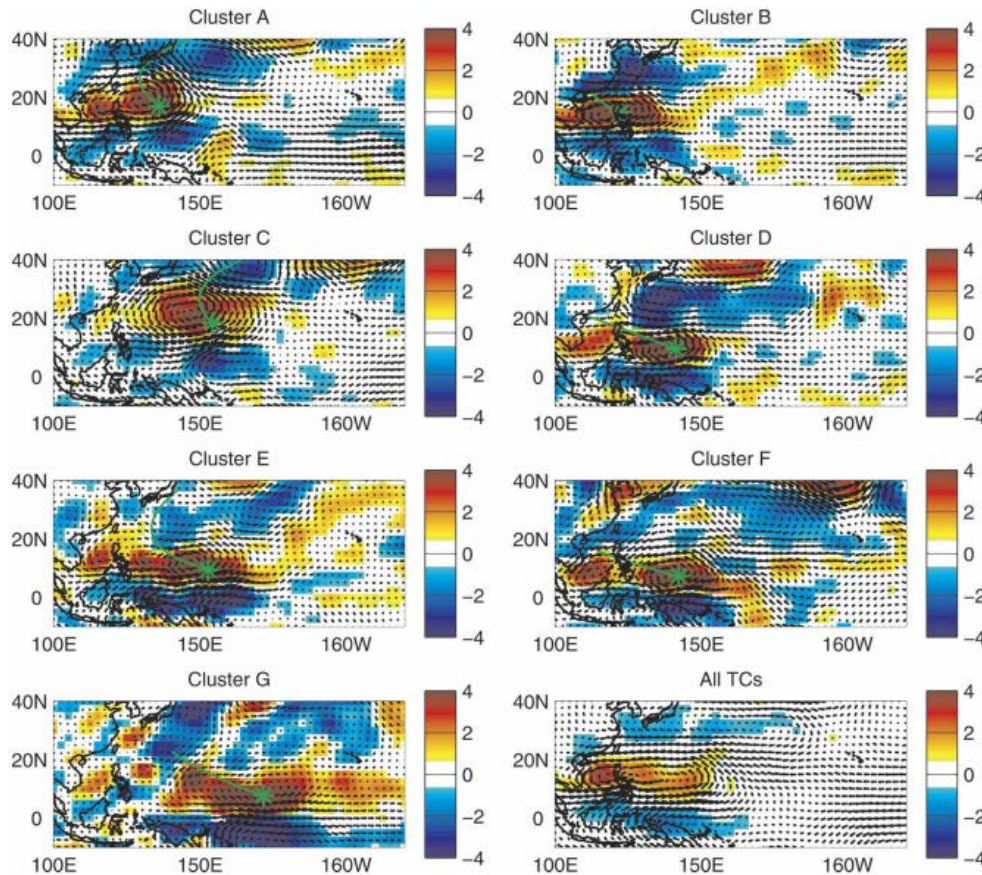
**Stochastic forcing to ENSO:** westerly wind burst associated with the MJO





# Impact of the MJO on TC

## Tropical cyclone (TC) propagation in the western North Pacific (WNP)



TC record: 1950–2002

vectors at 850hPa

shading vorticity

green line: TC trajectory

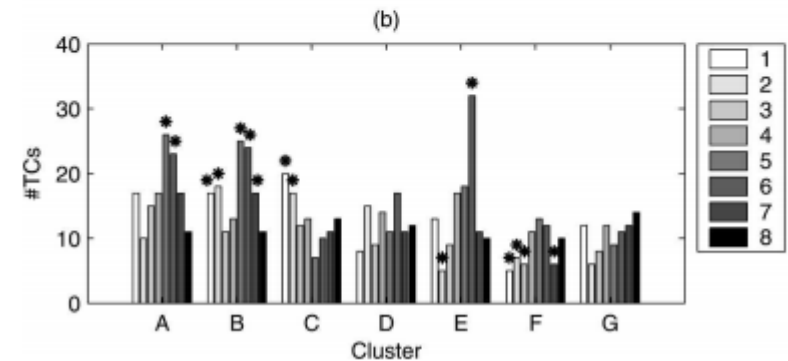
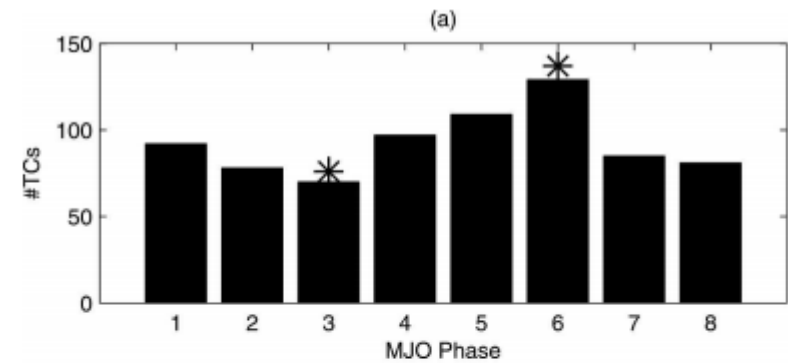
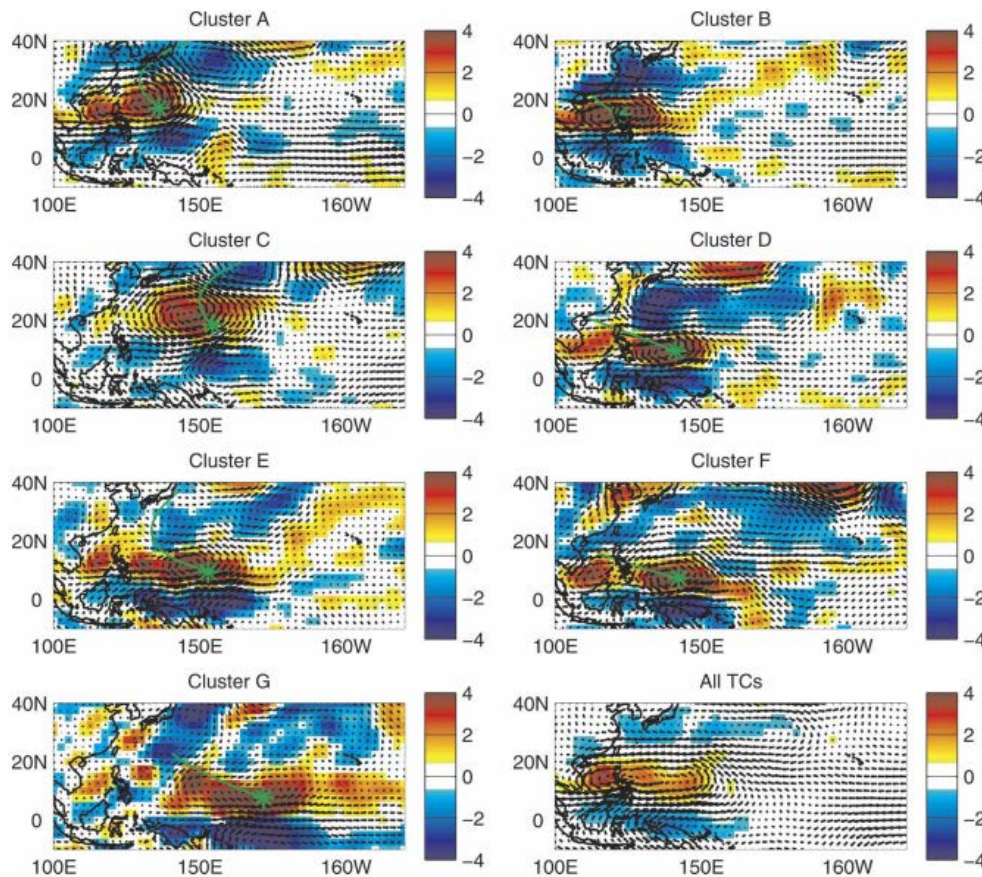
asterisk: genesis location

(Carmago et al., 2007)



# Impact of the MJO on TC

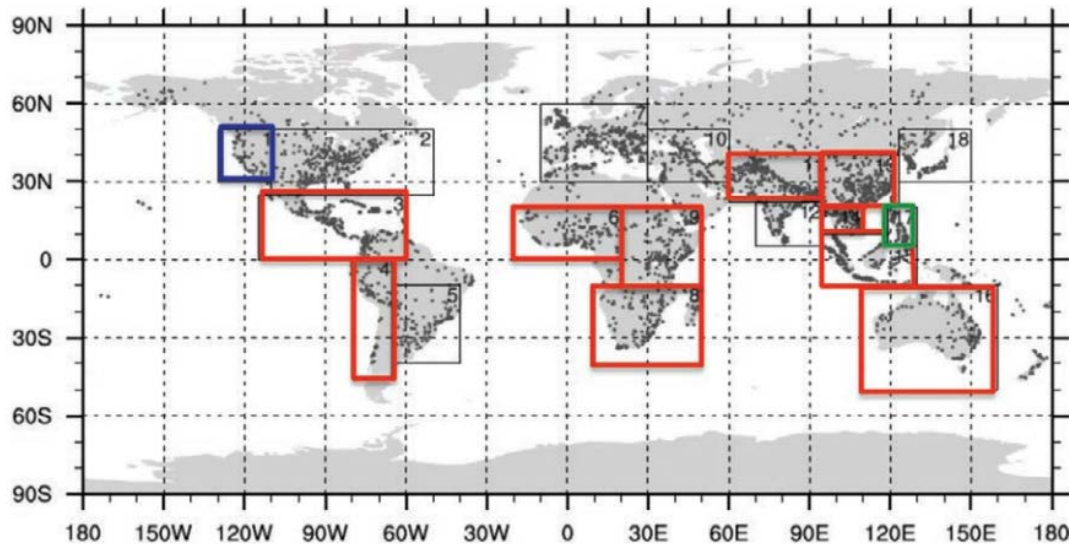
## Tropical cyclone (TC) propagation in the western North Pacific (WNP)



(Carmago et al., 2007)

# Impact of the MJO on flood

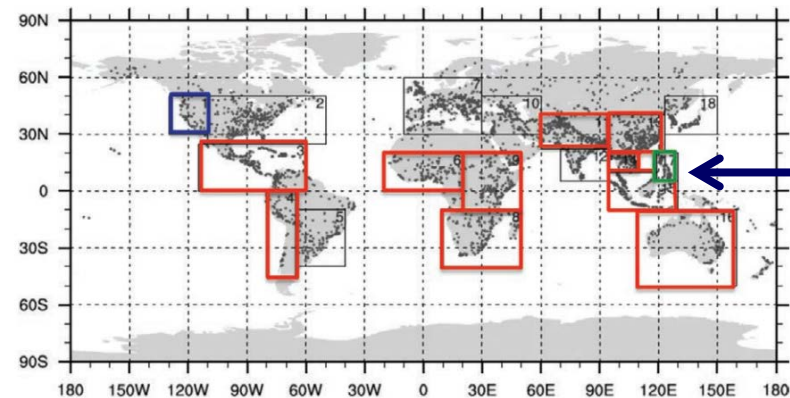
Location of large floods during 1985-2010



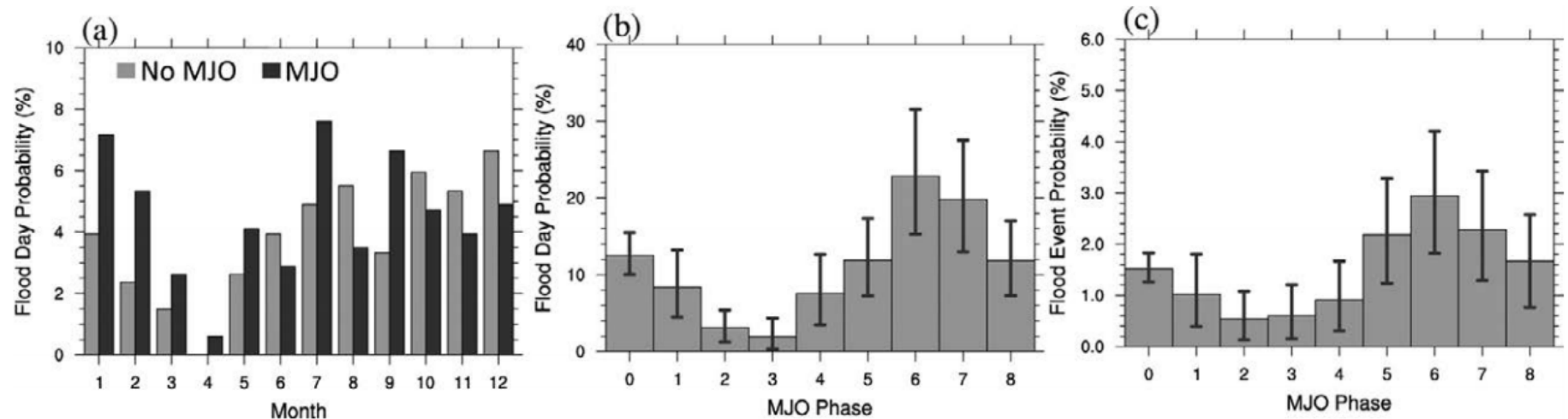
Boxes mark regions where probability of total flood days and/or events are significantly affected by the MJO.

<http://floodobservatory.colorado.edu/Archives/index.html>

# Impact of the MJO on flood



MJO influences large floods of the Philippines

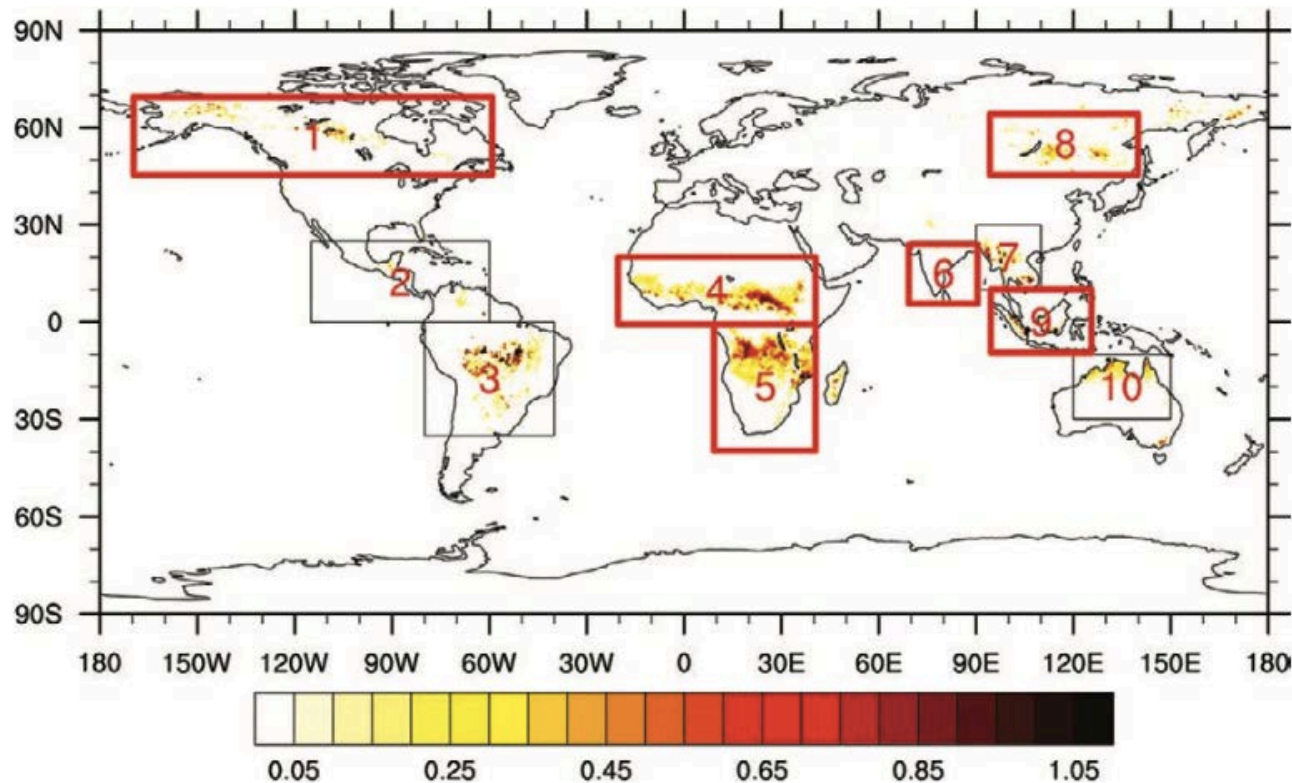


FDP: total number of flood days in each phase divided by the total number of days in that phase

# Impact of the MJO on wild fire

Mu et al. (2011)

Total fire carbon emission ( $\text{g C m}^{-2} \text{ day}^{-1}$ )

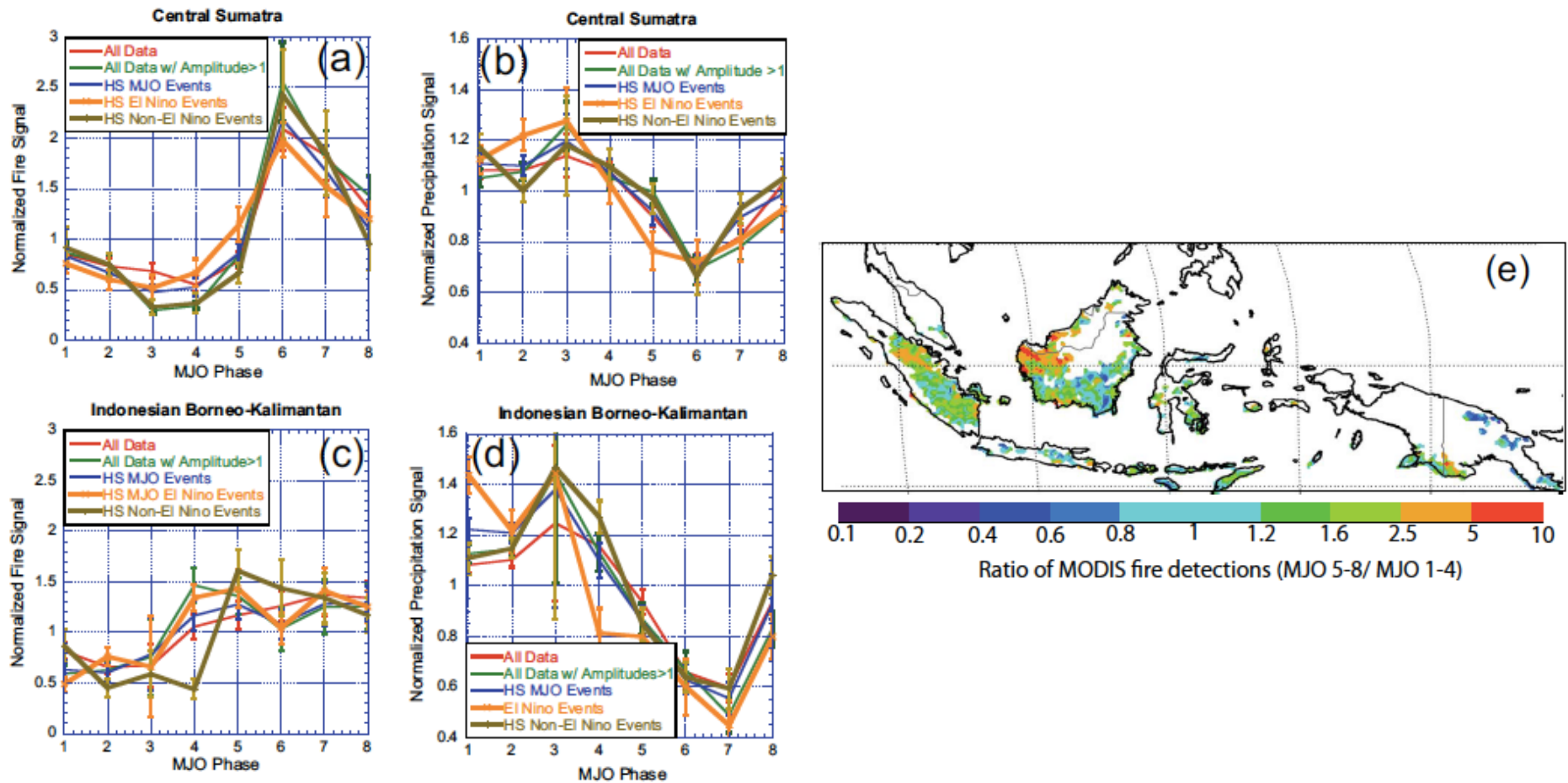


Red boxes indicate regions where fire emission fluctuates substantially with MJO phases.



June–November  
(2003–10)

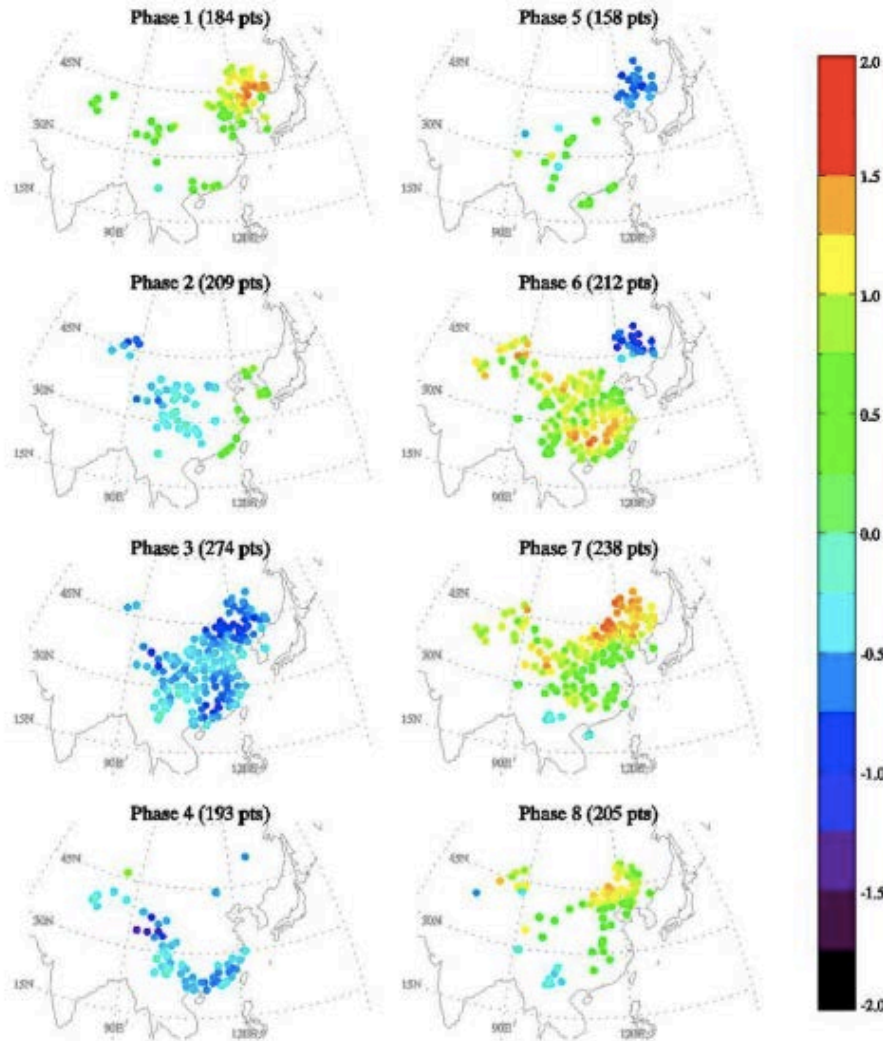
# Impact of the MJO on wild fire







# MJO and cold surges



Composite of SAT  
(1974/75-2000/01, Nov-March)

- Cold surge: steep drop of SAT  
A decreasing SAT value exceeds 1.5std within 2 days

**Table 1.** Criteria for the Determination of Cold Surges<sup>a</sup>

|                          | Temperature Decrease<br>Within 2 Days, °C | Northerly Wind, m/s |
|--------------------------|-------------------------------------------|---------------------|
|                          | <i>Cold Surges</i>                        |                     |
| Mid-China <sup>b</sup>   | 4.37 <sup>c</sup>                         | —                   |
| South China <sup>d</sup> | 5.17 <sup>c</sup>                         | —                   |
|                          | <i>Extreme Cold Surges</i>                |                     |
| Mid-China <sup>b</sup>   | 5.82 <sup>e</sup>                         | 4.01 <sup>c</sup>   |
| South China <sup>d</sup> | 6.90 <sup>e</sup>                         | —                   |

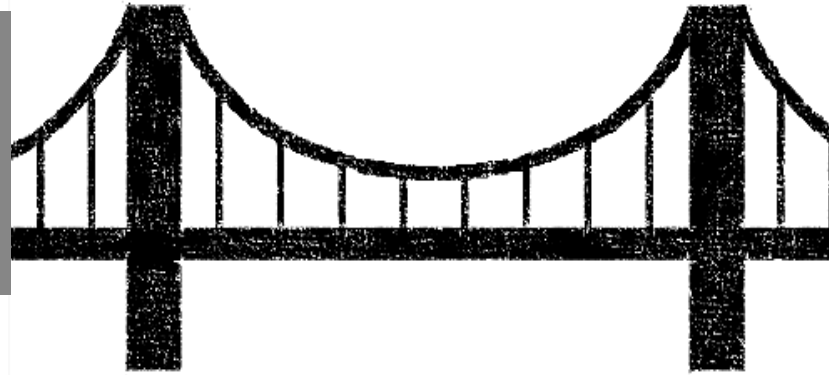


# Importance of the MJO

~ 2 weeks

**NWP**

2 weeks ~ 1 month



**Subseasonal prediction**

1 ~ 12 months

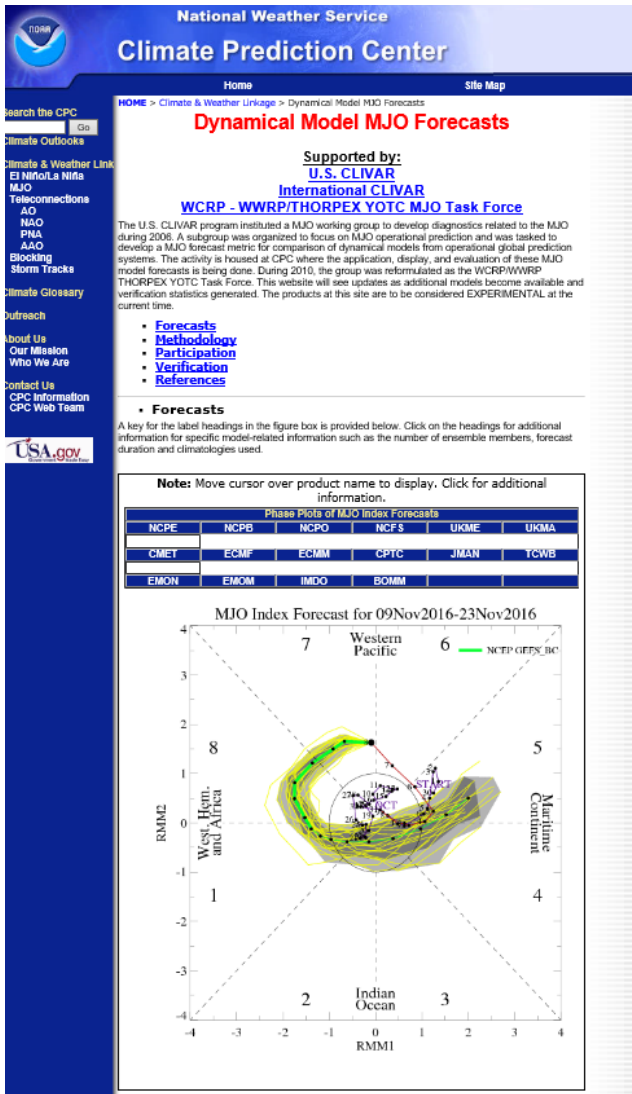
**Seasonal  
prediction**

Source of predictability:  
**atmospheric initial  
condition**

Source of predictability:  
**MJO**

Source of predictability:  
**ENSO**

# Where do we get MJO forecast?



## MJO operational prediction:

[http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar\\_wh.shtml](http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar_wh.shtml)

**NCPO:** National Centers for Environmental Prediction - Operational Global Forecast System  
**NCPE:** National Centers for Environmental Prediction - Ensemble Global Forecast System  
**NCPB:** National Centers for Environmental Prediction - Bias-Corrected Ensemble Global Forecast System  
**NCFS:** National Centers for Environmental Prediction - Climate Forecast System

**UKMA:** UK Met Office - MOGREPS-G Operational Control Run  
**UKME:** UK Met Office - MOGREPS-G Ensemble System

**CMET:** Canadian Meteorology Centre - Ensemble System

**ECMF:** European Centre for Medium Range Weather Forecasts - Ensemble System  
**ECMM:** European Centre for Medium Range Weather Forecasts - Ensemble System (anomalies based on lead dependent model climatology)

**BOMM:** Australian Bureau of Meteorology - POAMA Coupled System

**CPTC:** Brazil Center for Weather and Climate Studies - Ensemble System

**JMAN:** Japan Meteorology Agency - Global Spectral Model Ensemble System

**TCWB:** Taiwan Central Weather Bureau - Operational Prediction System

**IMDO:** India Meteorology Department - Operational Global Forecast System

**EMOM:** European Centre for Medium Range Weather Forecasts - Seasonal Prediction Ensemble Forecast System

**EMOM:** European Centre for Medium Range Weather Forecasts - Seasonal Prediction Ensemble Forecast System (anomalies based on lead dependent model climatology, weekly - Thursday only)

# Participation in MJO forecast

## Center Participation



US – NCEP



ECMWF



United Kingdom



Brazil



US – NRL



India



Taiwan



Australia



Japan



Canada – CMC

| Center | Model                         | Data Stream ID | Ensemble Members | Forecasts Start | Length (Days) | Realtime Data FTP | Version 1 Plots | Model Climatology |
|--------|-------------------------------|----------------|------------------|-----------------|---------------|-------------------|-----------------|-------------------|
| NCEP   | GFS EPS T126 <sup>1</sup>     | NCPE           | 21               | Nov 2007        | 15            | -----             | Yes             | No                |
| NCEP   | GFS T382 <sup>1</sup>         | NCPO           | 1                | Jan 2008        | 15            | -----             | Yes             | No                |
| NCEP   | CFS T62 <sup>1</sup>          | NCFS           | 4                | Jan 2007        | 40            | -----             | Yes             | Yes               |
| CMC    | GEMDM 400x200 <sup>2</sup>    | CANM           | 20               | Jun 2008        | 16            | Yes               | Yes             | No                |
| UKMO   | MOGREPS <sup>3</sup>          | UKMA           | 1                | Oct 2007        | 15            | Yes               | Yes             | No                |
| UKMO   | MOGREPS <sup>3</sup>          | UKME           | 23               | Oct 2007        | 15            | Yes               | Yes             | No                |
| ABOM   | GASP T239 <sup>4</sup>        | BOMA           | 1                | Jan 2008        | 10            | Yes               | Yes             | No                |
| ABOM   | GASP EPS T119 <sup>4</sup>    | BOME           | 32               | Aug 2008        | 10            | Yes               | Yes             | No                |
| ABOM   | POAMA1 5bT47 <sup>5</sup>     | BOMC           | 1                | Jan 2008        | 40            | Yes               | Yes             | No                |
| ABOM   | POAMA1 5T47 <sup>5</sup>      | BOMH           | 1                | -----           | 40            | No                | No              | Yes               |
| ECMWF  | VAREPS T299/T255 <sup>6</sup> | ECMF           | 51               | Jun 2008        | 15            | Yes               | Yes             | No                |
| ECMWF  | VAREPS T299/T255 <sup>6</sup> | ECMM           | 51               | Jun 2008        | 15            | Yes               | Yes             | Yes               |
| ECMWF  | SFSv3 T159 <sup>7</sup>       | EMON           | 51 (W)           | Jun 2008        | 32            | Yes               | Yes             | No                |
| ECMWF  | SFSv3 T159 <sup>7</sup>       | EMOM           | 51 (W)           | Jun 2008        | 32            | Yes               | Yes             | Yes               |
| JMA    | GSM WEPS T319 <sup>8</sup>    | JMAN           | 51               | Nov 2008        | 9             | Yes               | Yes             | No                |
| CPTec  | GWEFS T126                    | CPTC           | 15               | Feb 2009        | 15            | Yes               | No              | No                |
| IMD    | NCMRWF T254 <sup>9</sup>      | IMDO           | 1                | Jun 2009        | 7             | Yes               | Yes             | No                |
| IMD    | NCMRWF EPS T30 <sup>9</sup>   | IMDE           | 8                | -----           | 7             | No                | No              | No                |
| FNMOG  | NOGAPS T119 <sup>9</sup>      | NGAP           | 10               | -----           | 10            | No                | No              | No                |
| TCWB   | CWB EPS T119 <sup>9</sup>     | TCWB           | 1                | Oct 2009        | 40            | Yes               | Yes             | No                |



**NCPE:** National Centers for Environmental Prediction - Ensemble Global Forecast System





# Current status of MJO prediction

## Prediction vs. Predictability

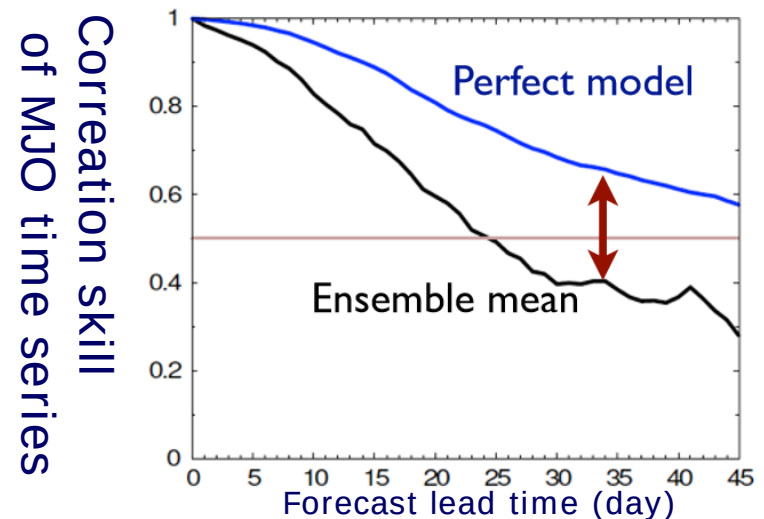
Prediction: Action of forecast

Prediction skill: Model (or human) capability of making forecast

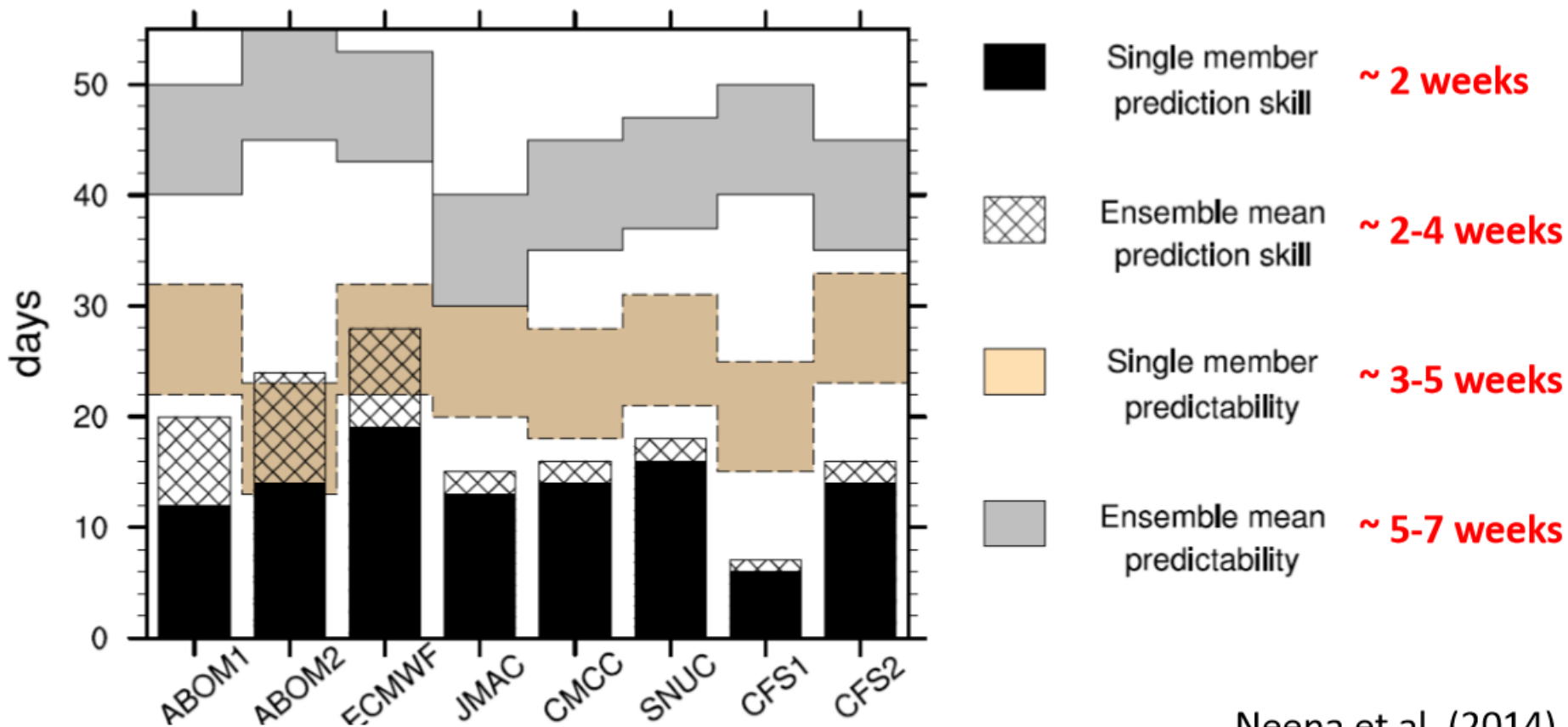
Predictability: Characteristics of Nature – How fast two states of the system would departure from each other in time

- MJO forecast

Useful prediction up to ~ 25 days,  
potential predictability > 45days  
(ECMWF, Vitart 2010)



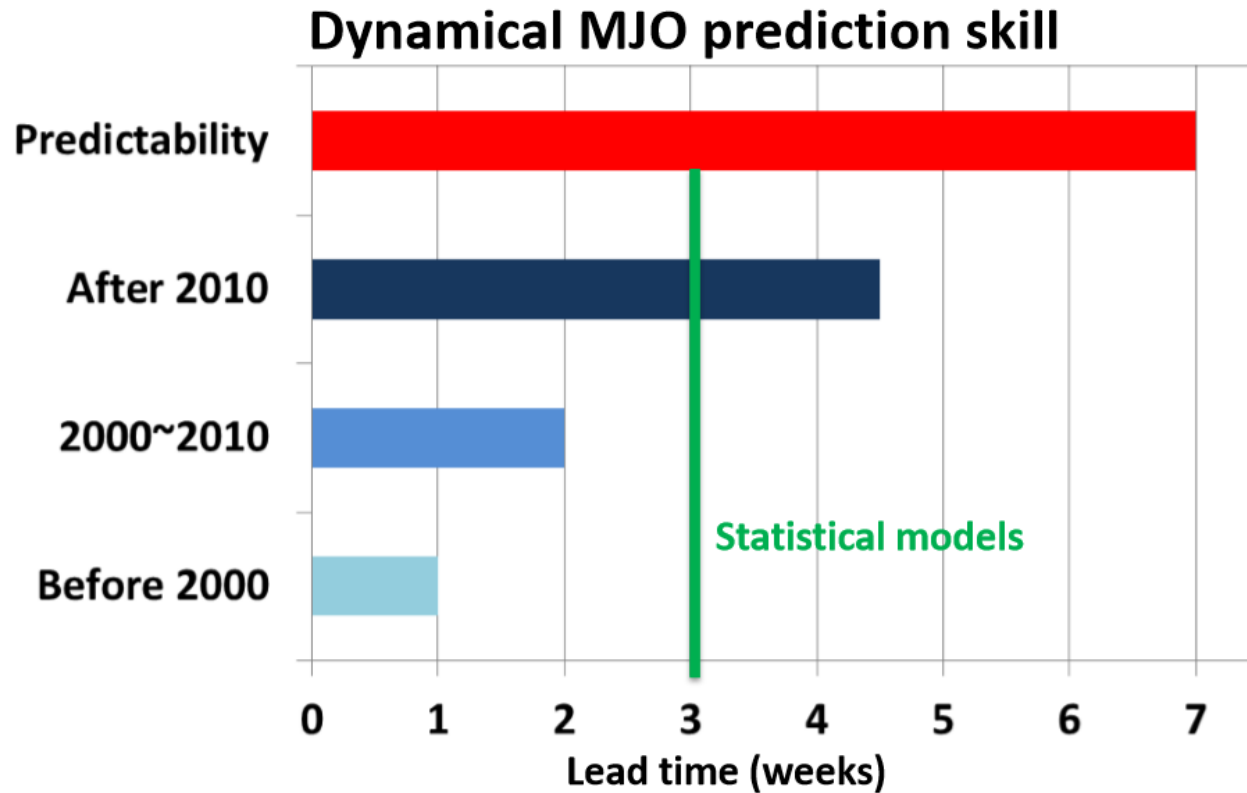
# Capability of MJO forecast



Neena et al. (2014)

\* ISVHE (Intraseasonal Variability Hindcast Experiment)

# We are progressing



(Chen and Alpert 1990, Jones et al. 2000, Hendon et al. 2000, Waliser et al. 2003, Seo et al. 2005, 2009, Pegion and Kirtman 2008, Lin et al. 2008, Vitart and Molteni 2010, Weaver et al. 2011, Arribas et al. 2011, Fu et al. 2011, 2013, Rashid et al., 2011, Kang et al. 2013, Ham et al. 2013, Kim et al. 2014, Neena et al. 2014, Vitart 2014, Wang et al. 2014)

*Courtesy of Hyemi Kim (SUNY/stony brook)*



# Mechanisms?

## MJO Theories

Frictional coupled moist K-R waves

Evaporation-wind feedback

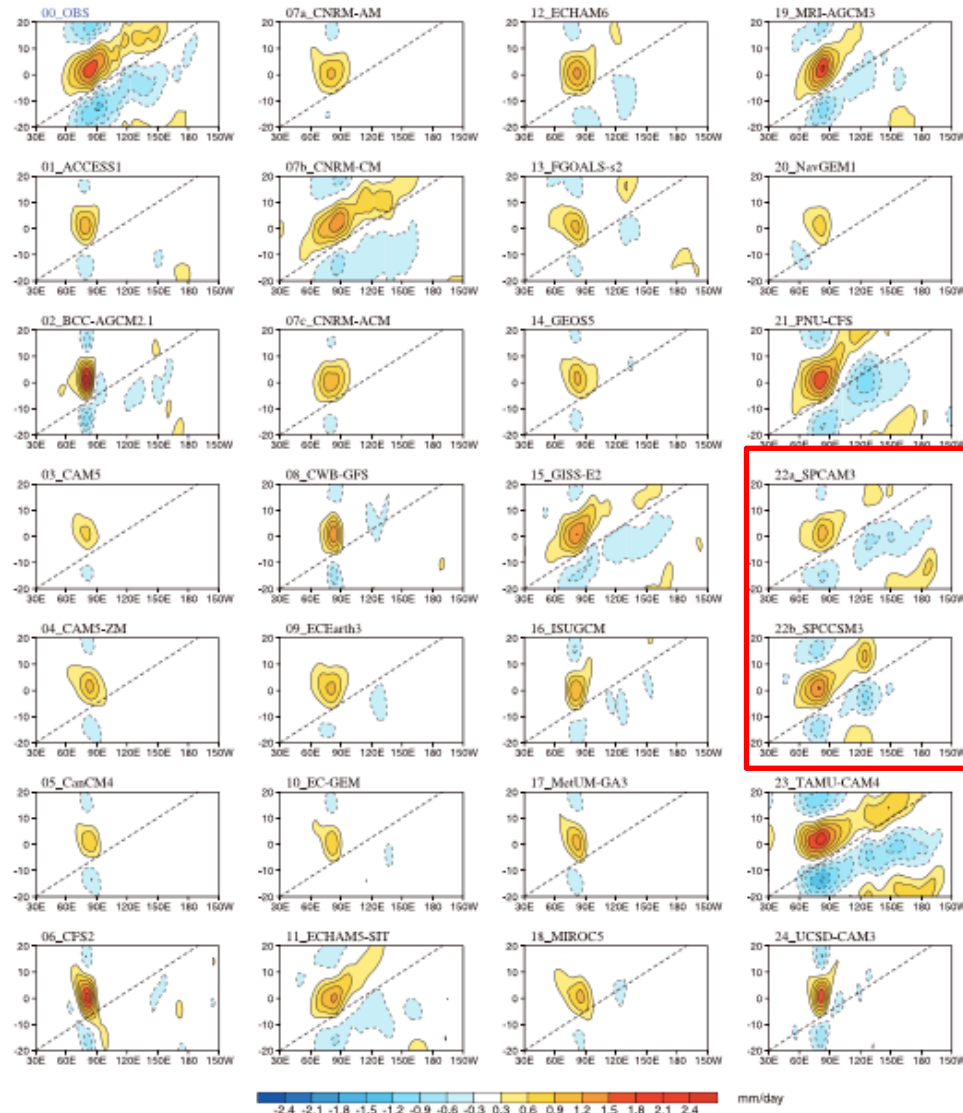
Multi-scale interaction

Moisture mode theory

Atmosphere-ocean interaction



# Air-sea interaction



Improvement of MJO  
simulation  
: SST effect

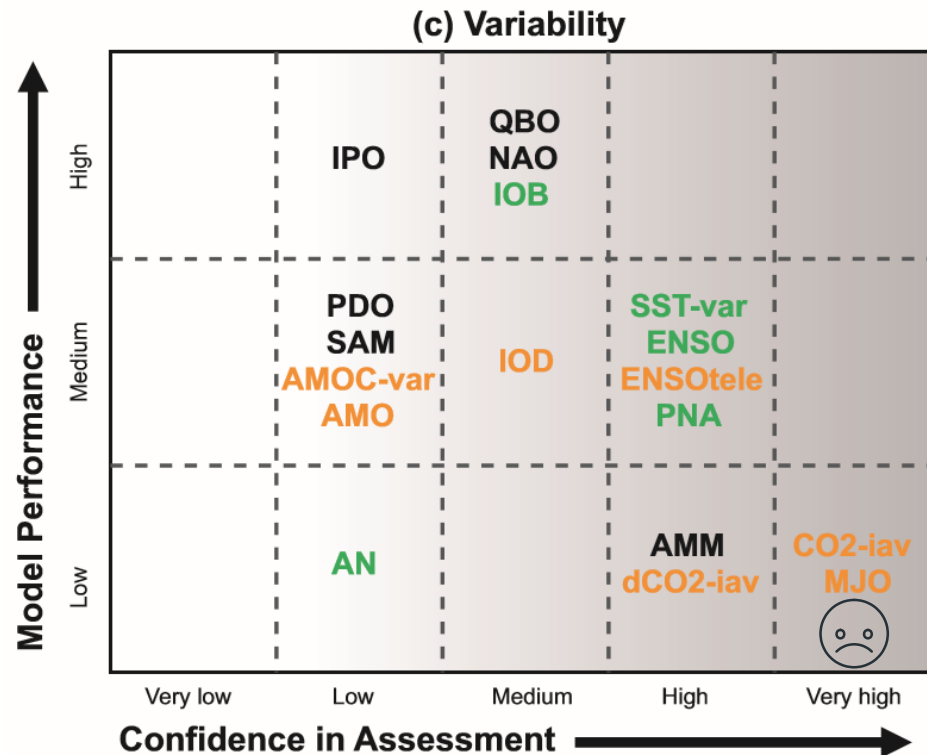


ISO initiation : Indian Ocean

Jiang et al (2015)



# Model performance

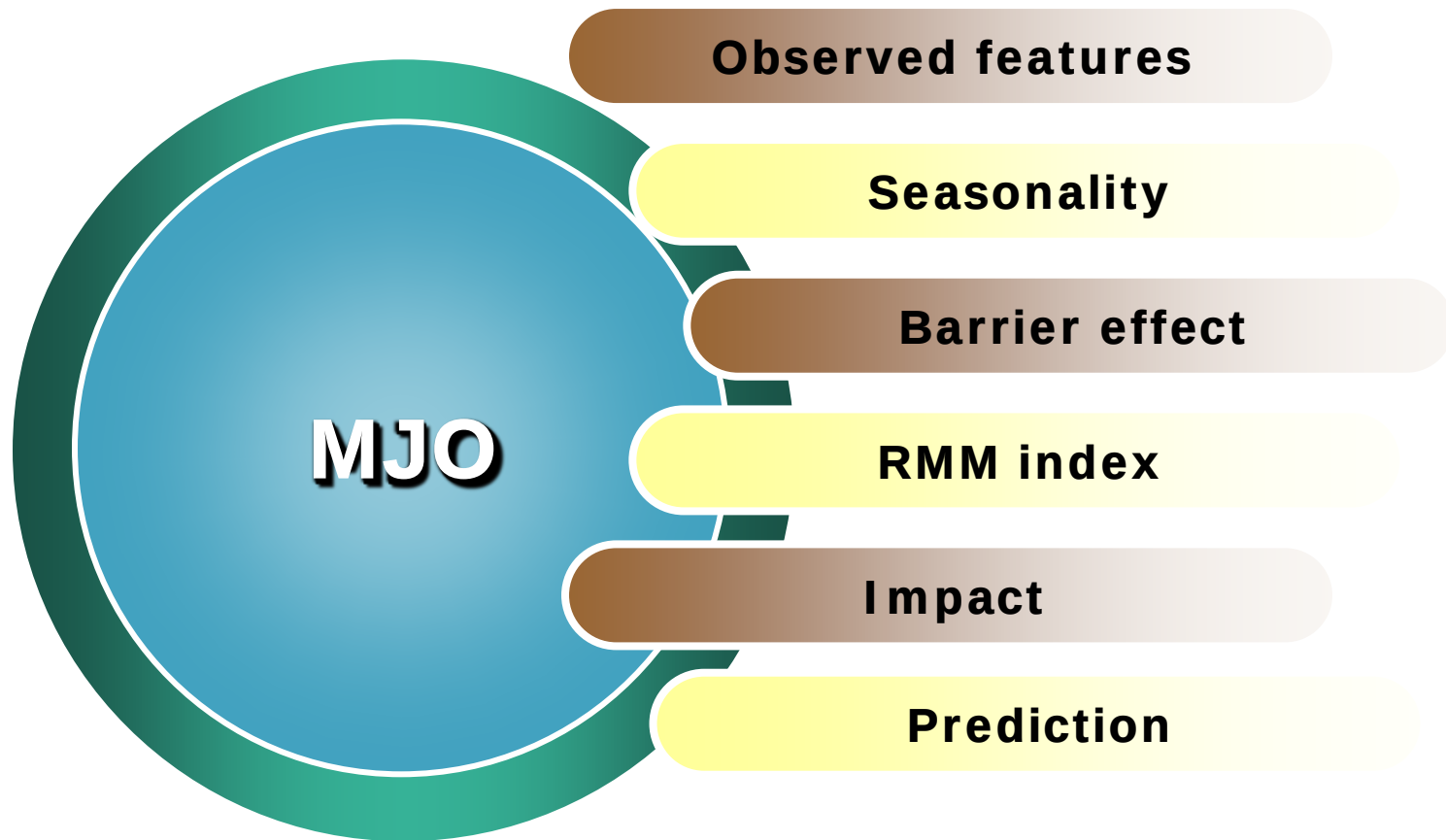


Degradation since CMIP3  
No changes since CMIP3  
Improvements since CMIP3  
No relative assessment CMIP3 vs. CMIP5

IPCC AR5 chapter 9

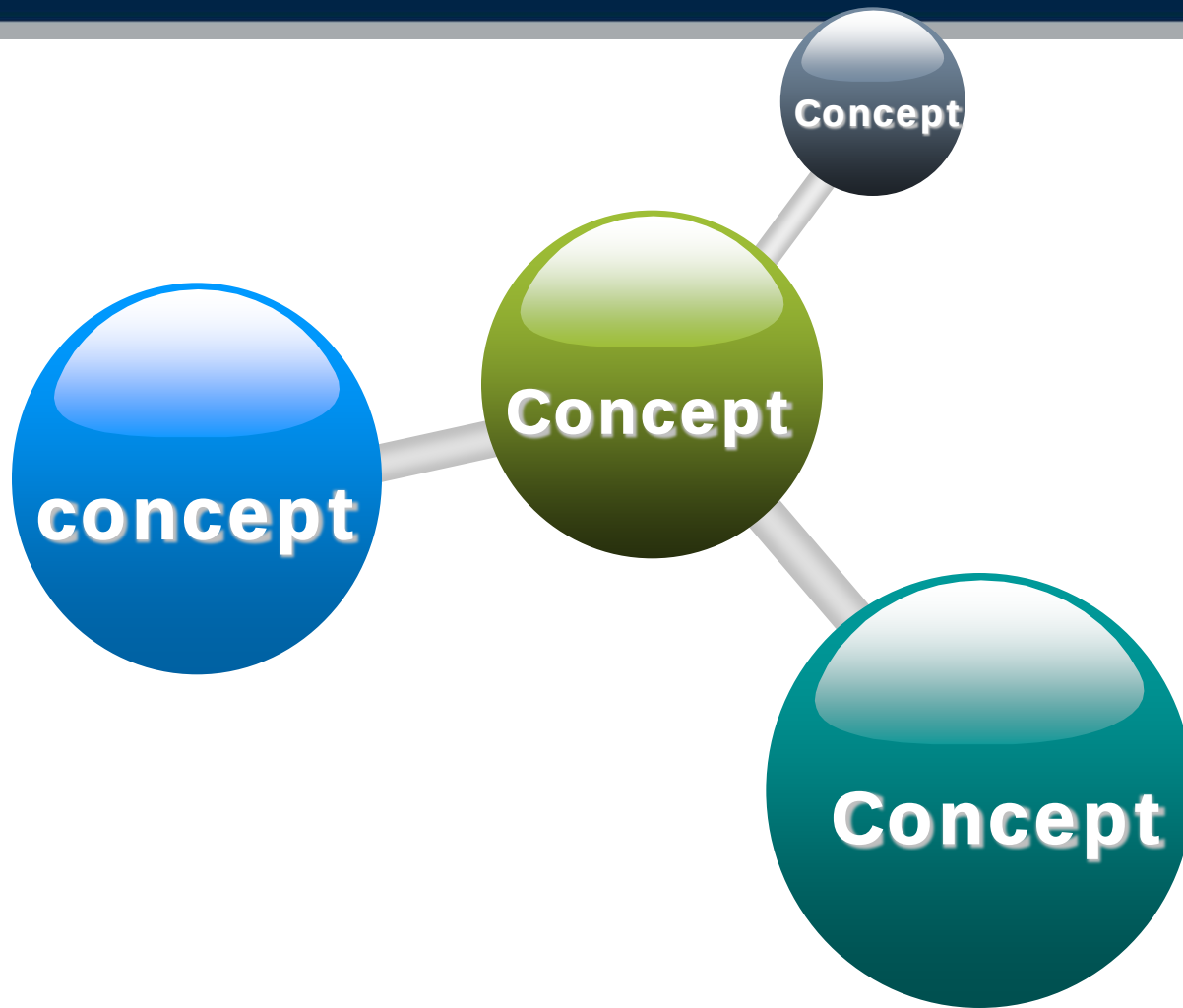


# Summary





**Thank you 😊**

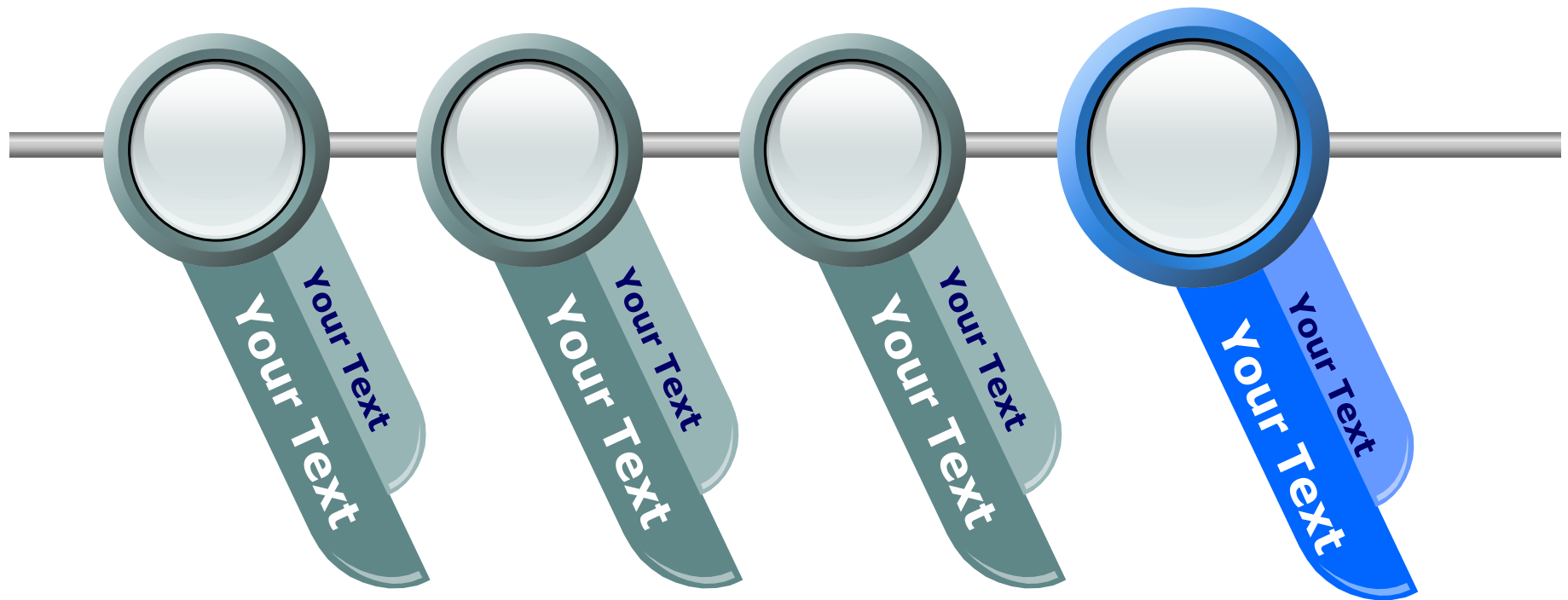






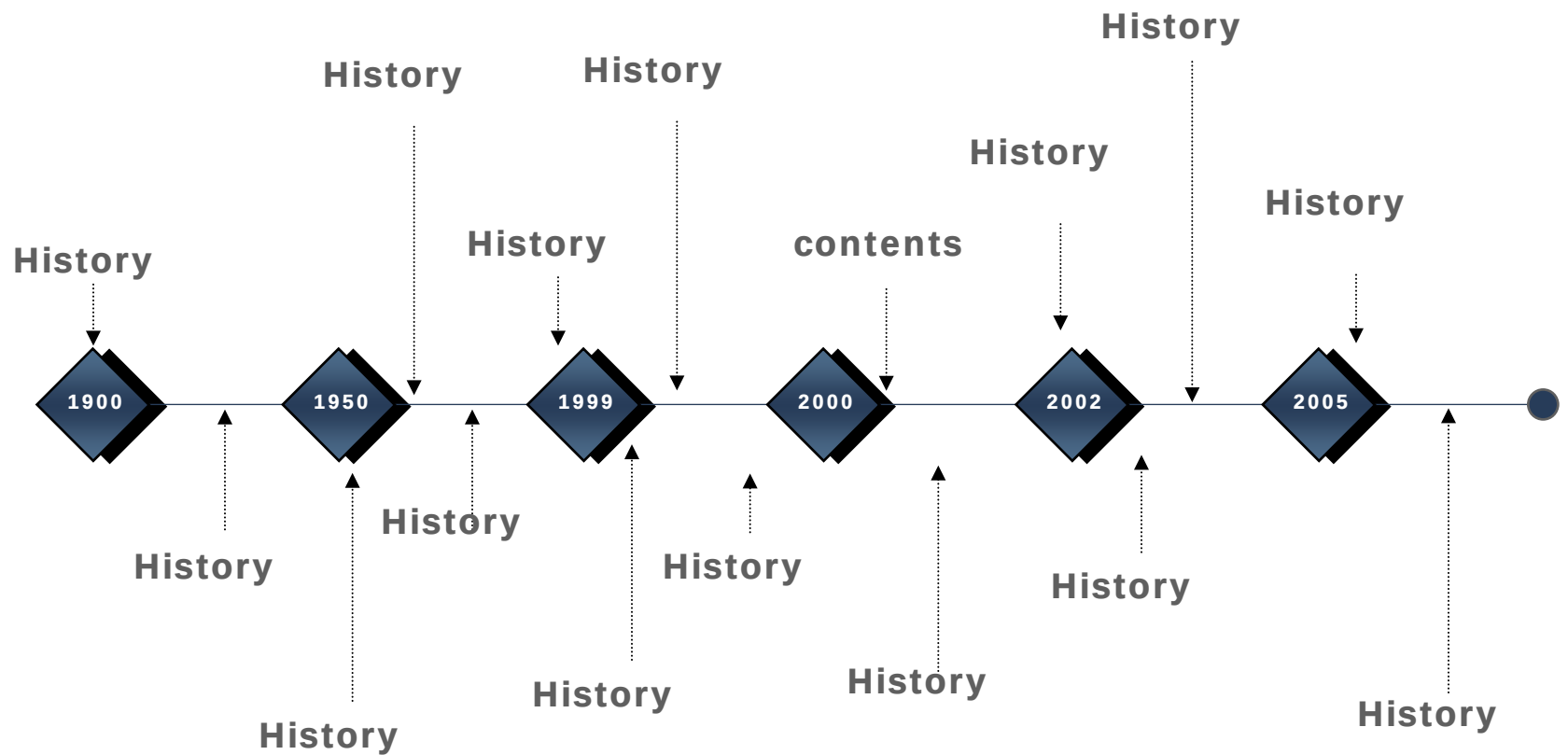


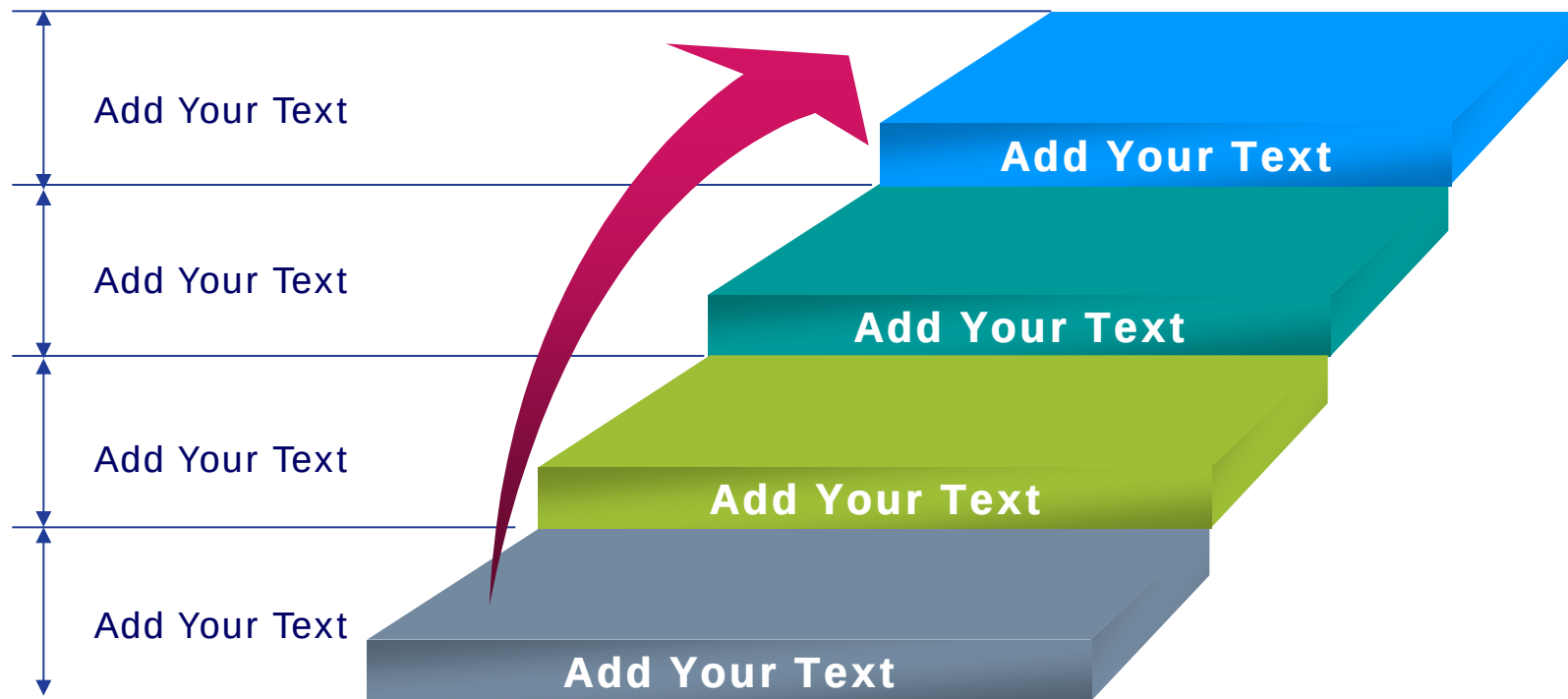
2001 → 2002 → 2003 → **2004**

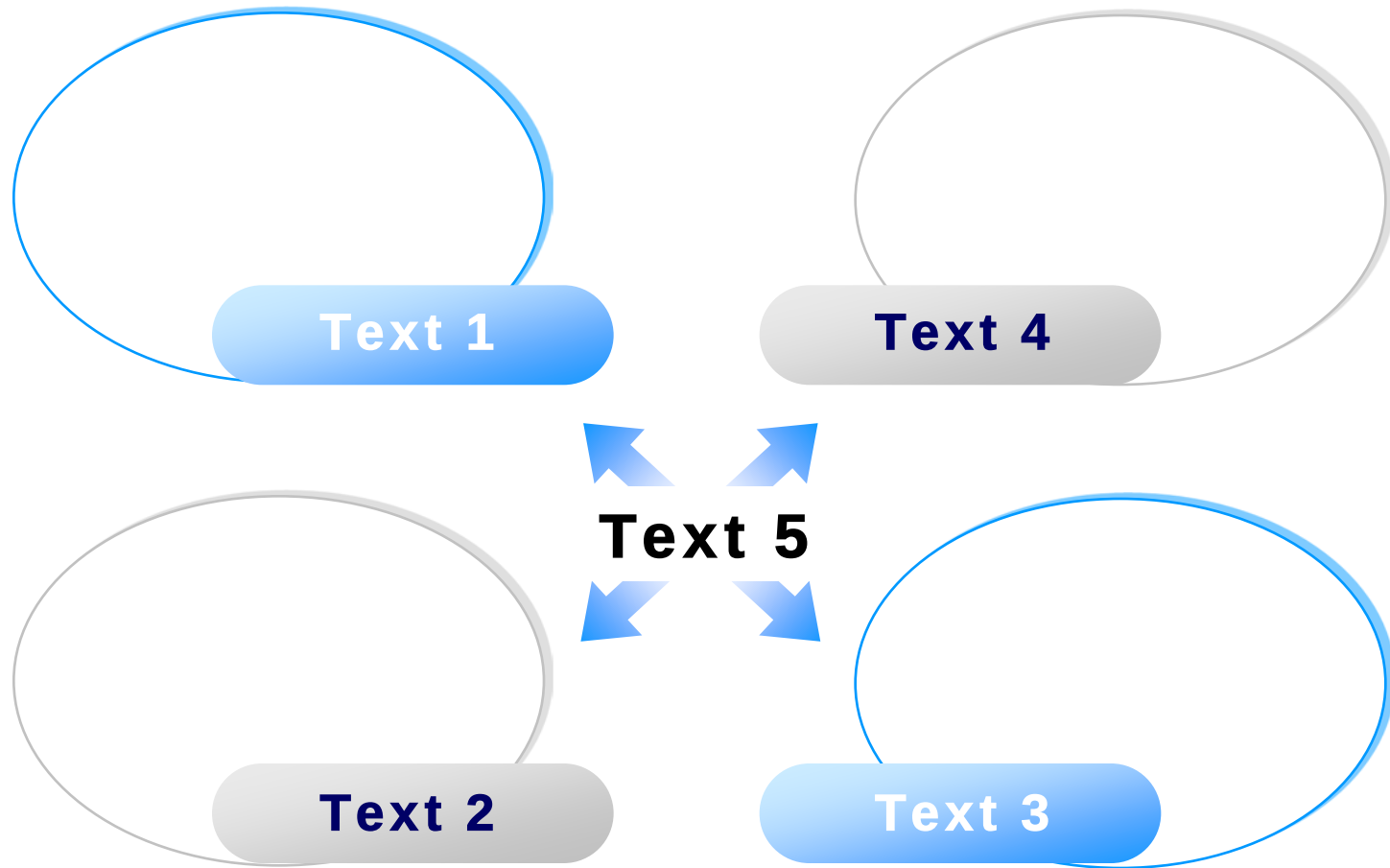




## ◆ History



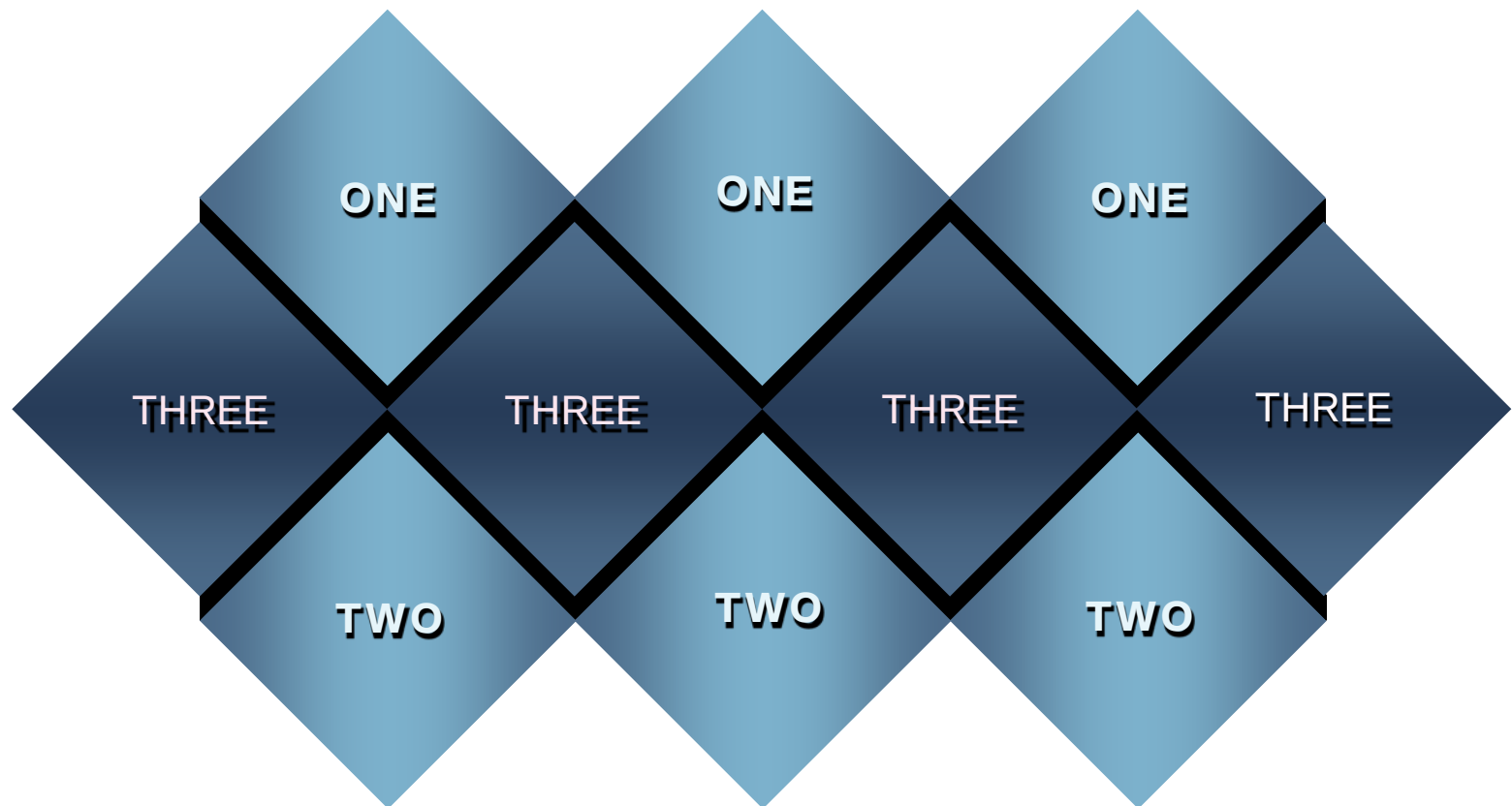


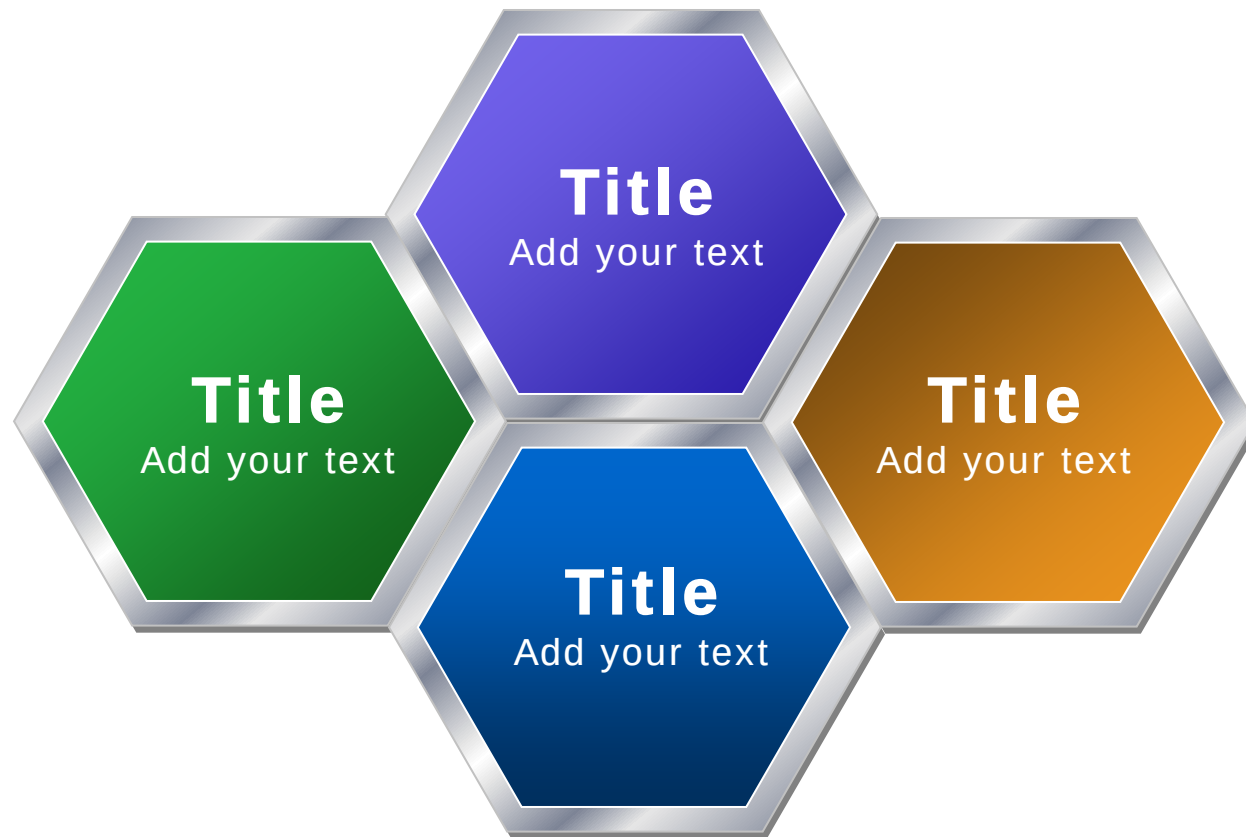


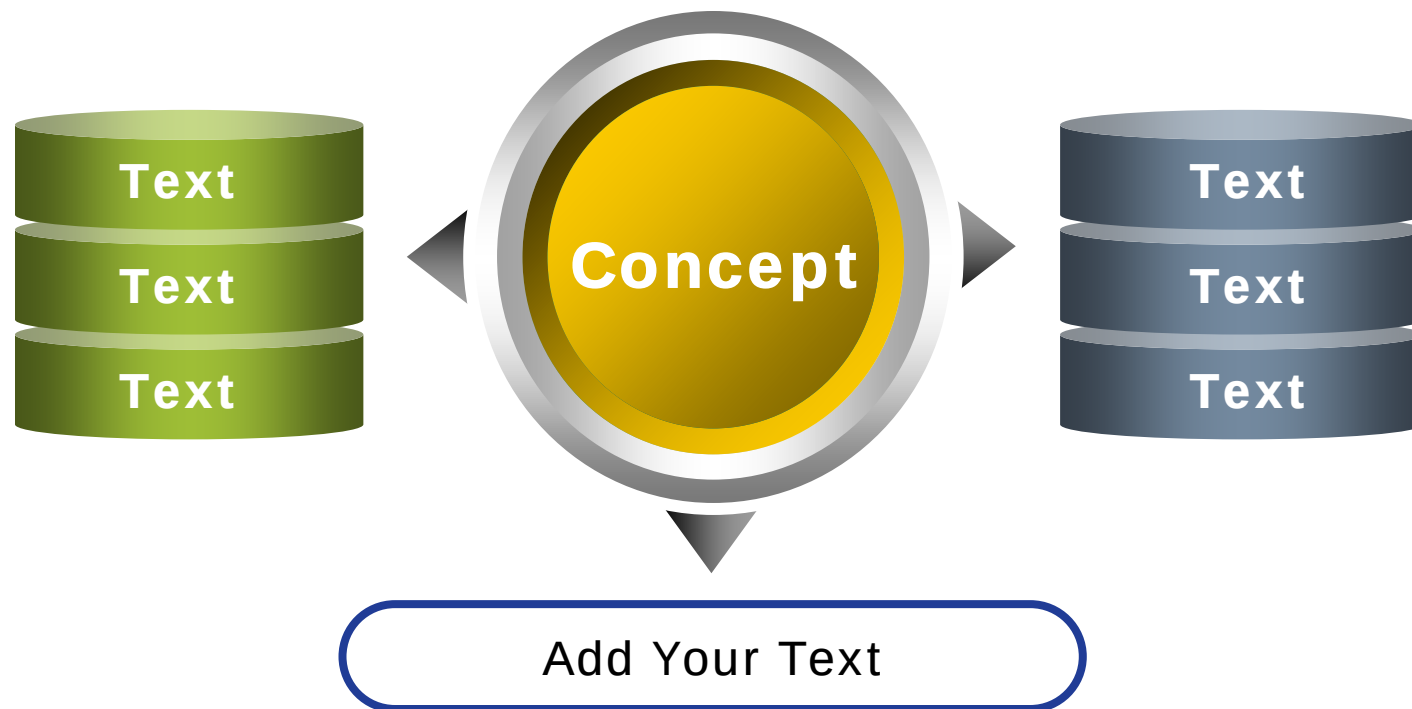




## ◆ Sub title









Add Your Text

Add Your Text

Add Your Text

**Add Your  
Title**



Subtitle



text1



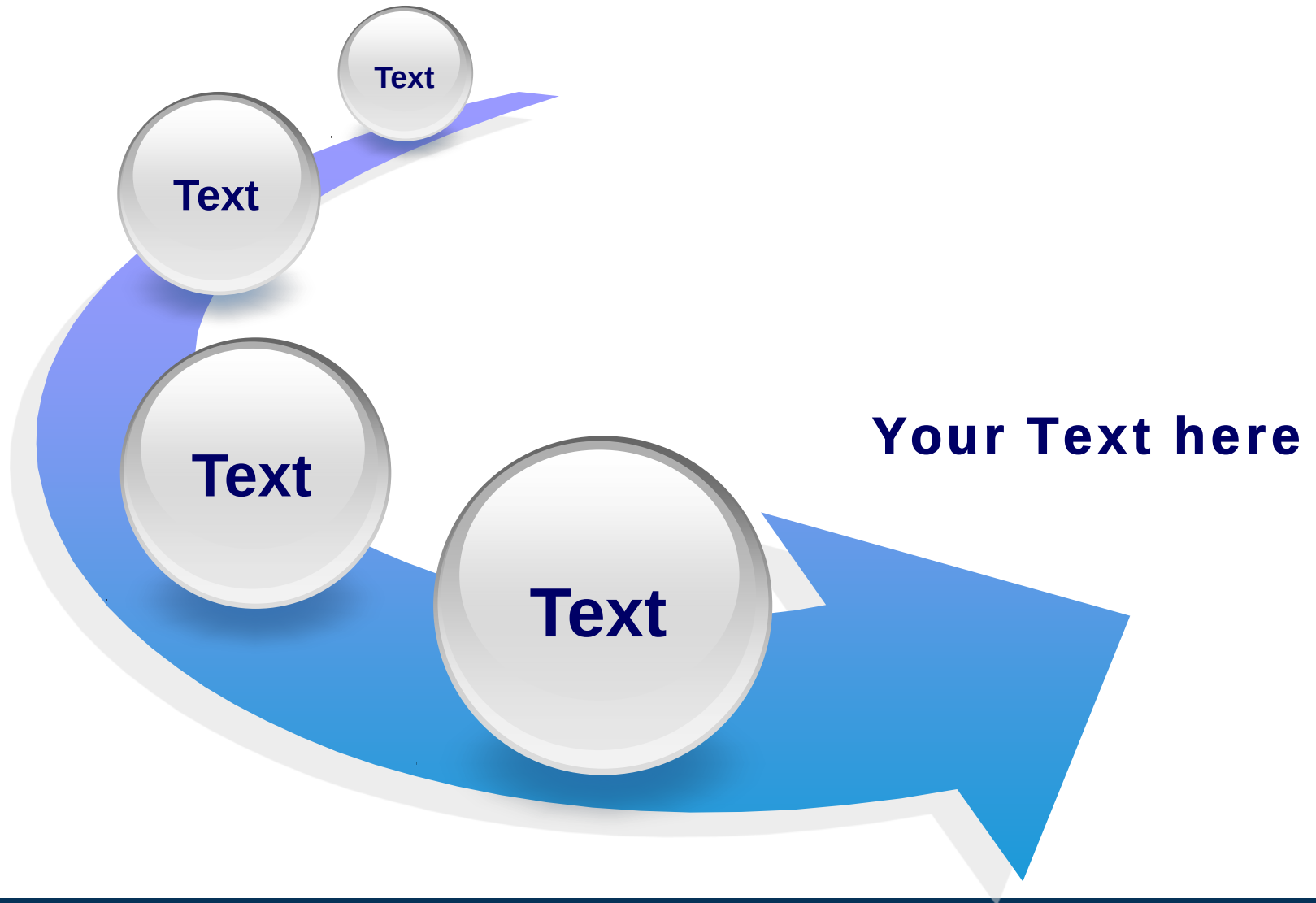
text2

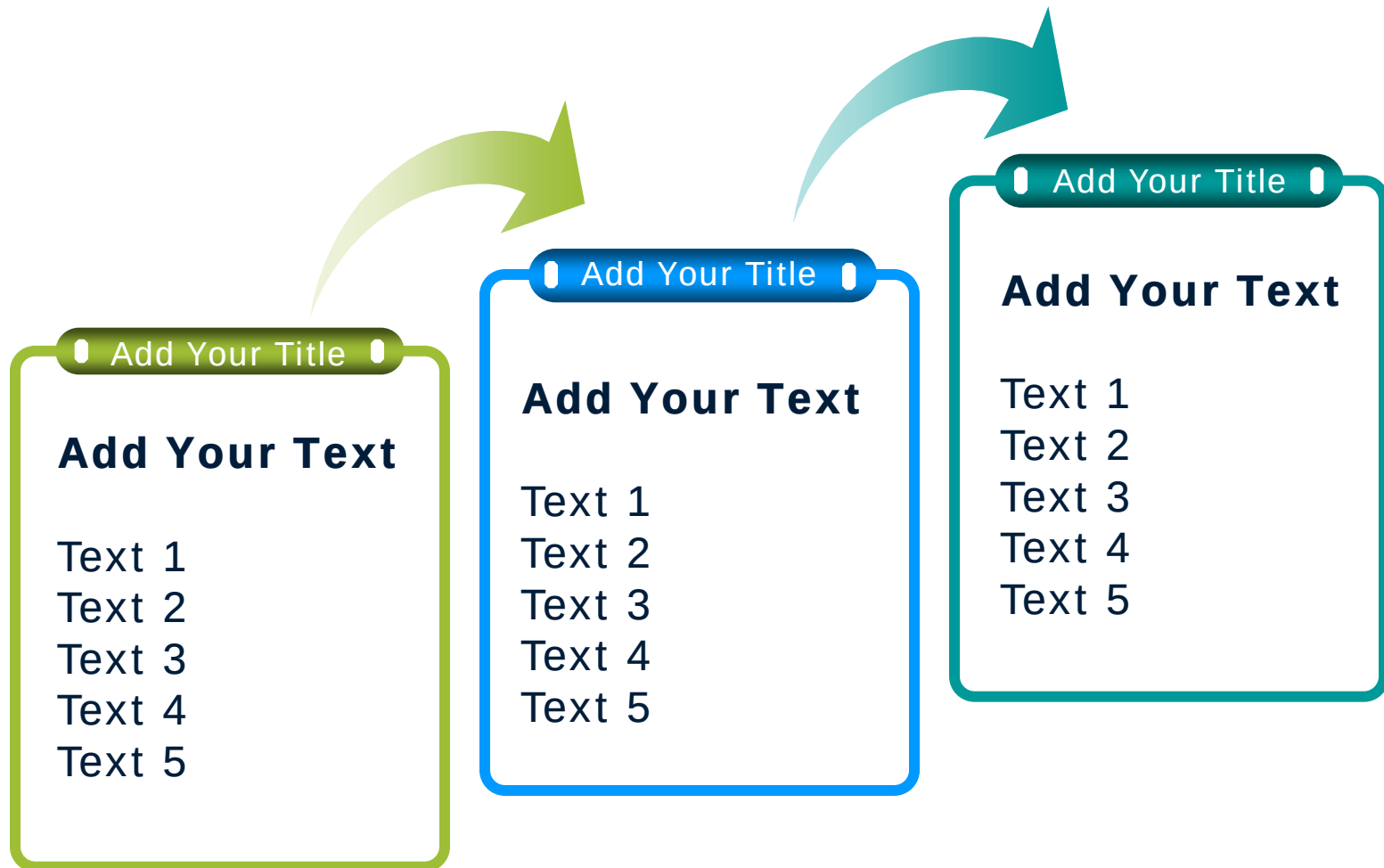


text3











**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5

**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5

**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5



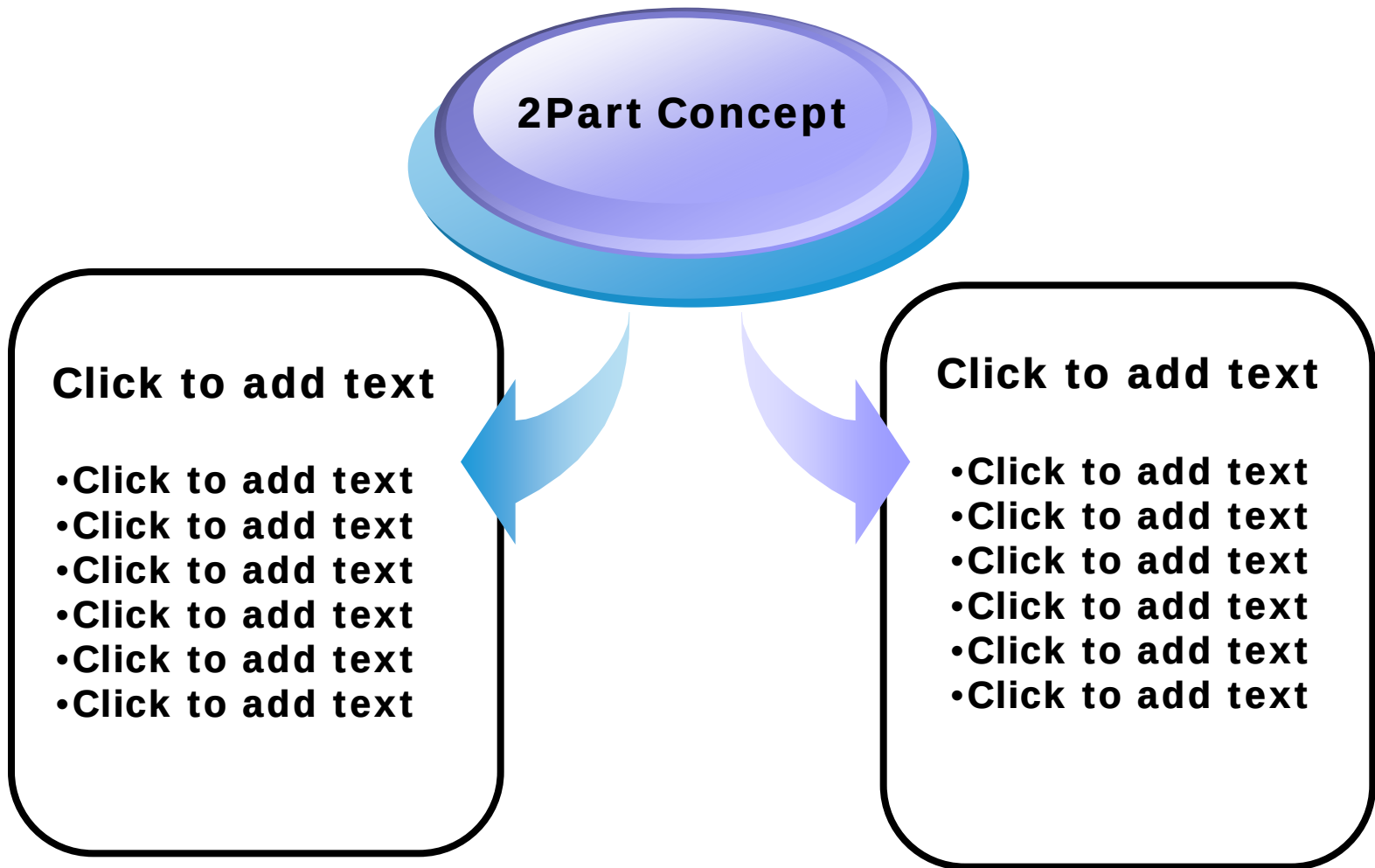
**Add Your Text**



**Add Your Text**

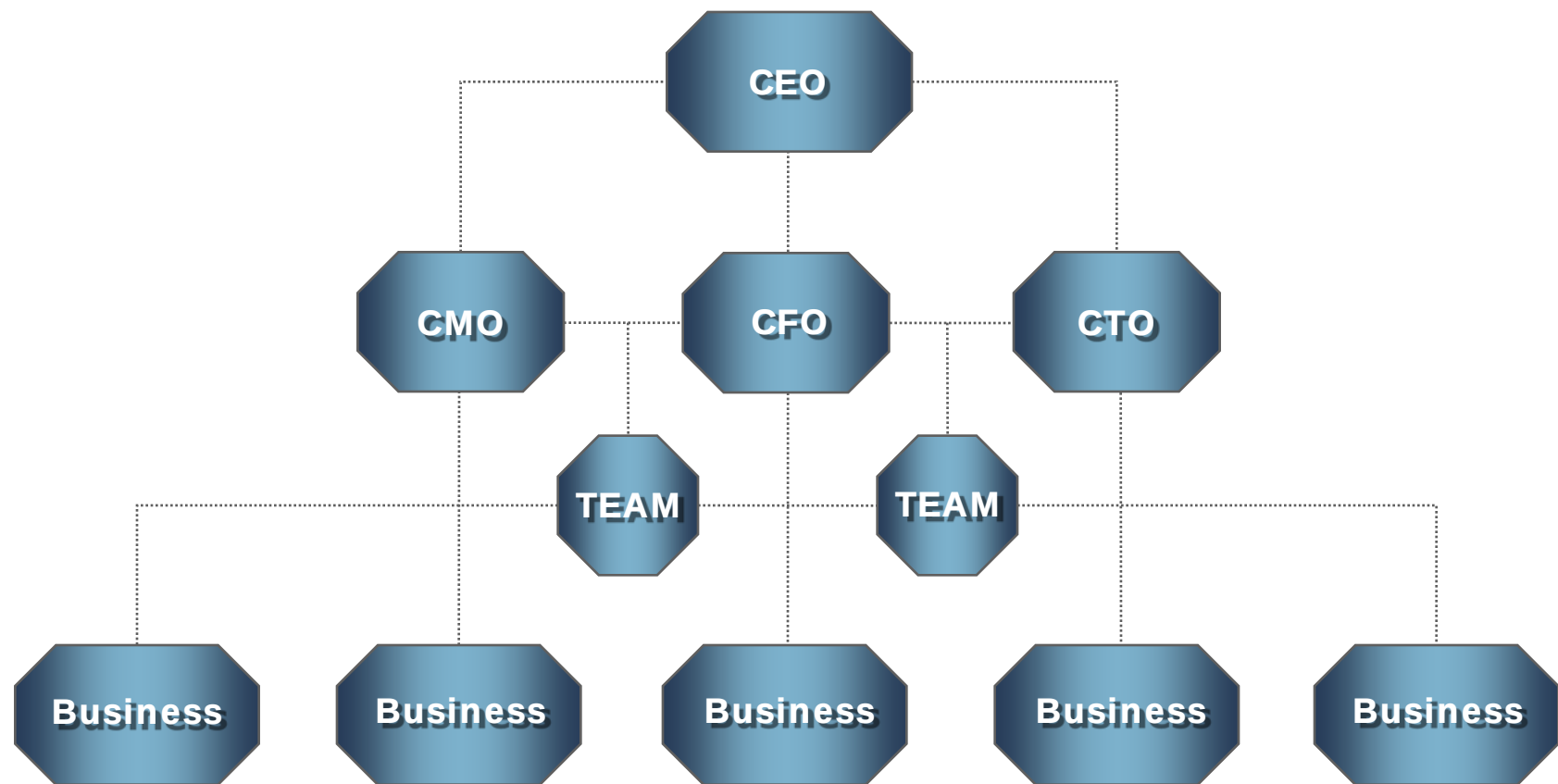


**Add Your Text**

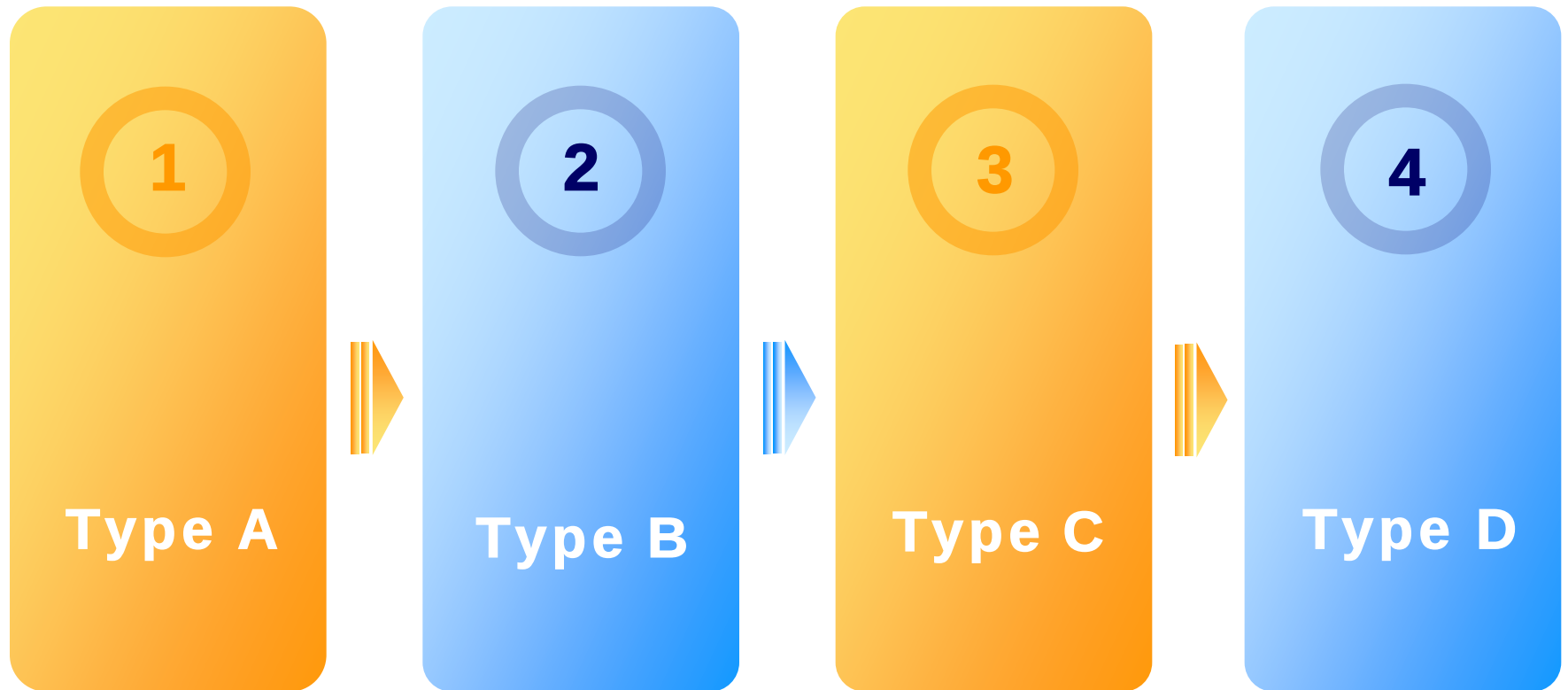




## ◆ Sub title

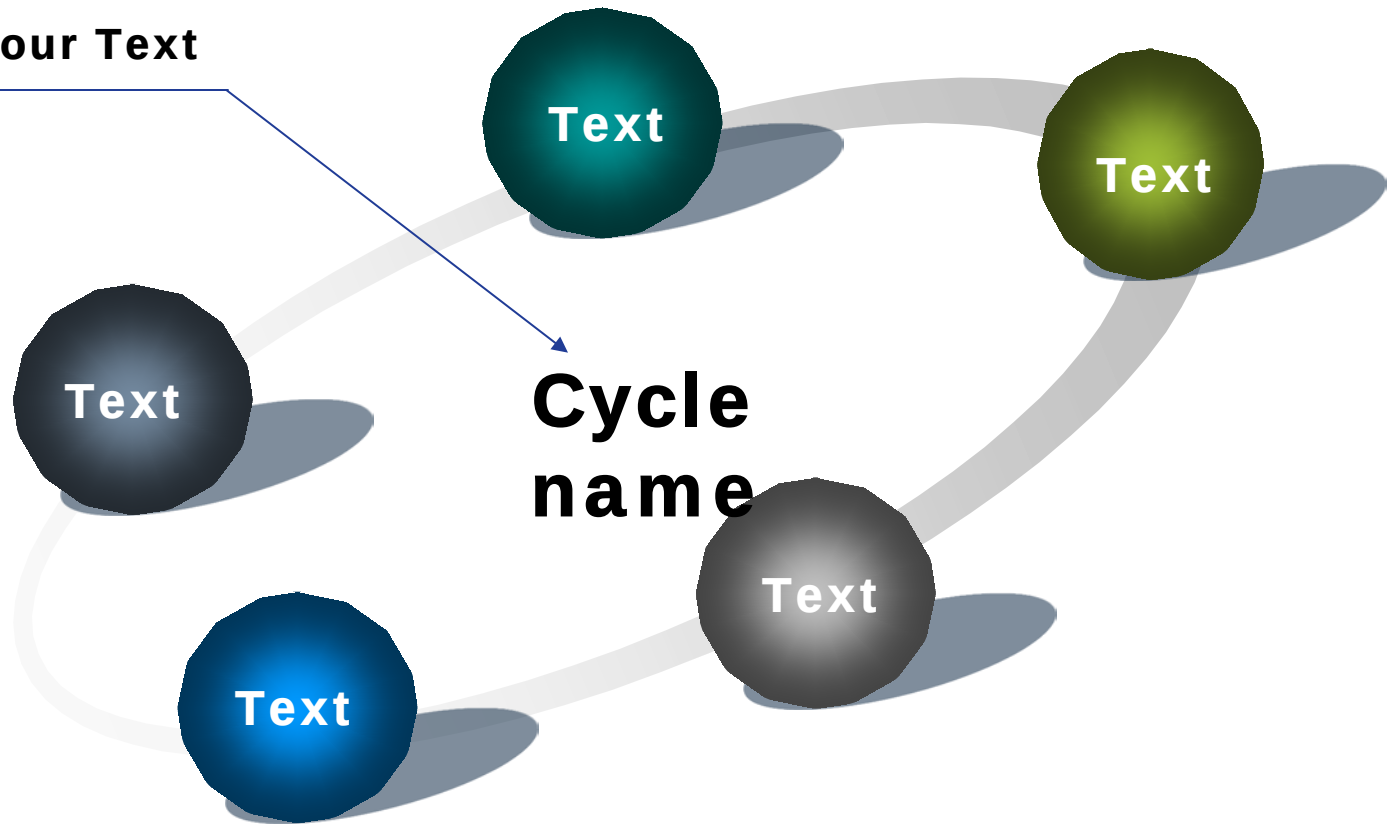








Add Your Text



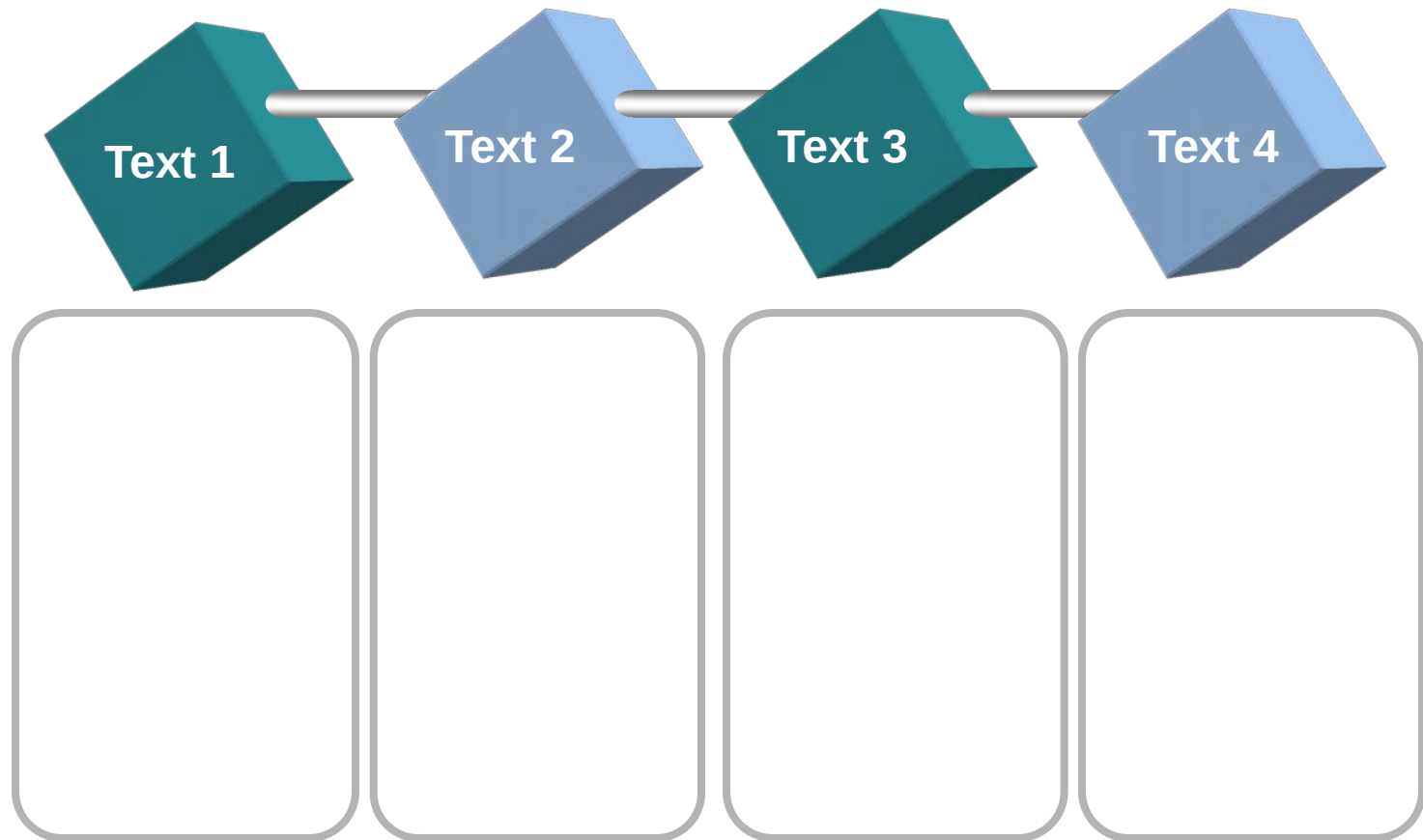


**Phase 1**

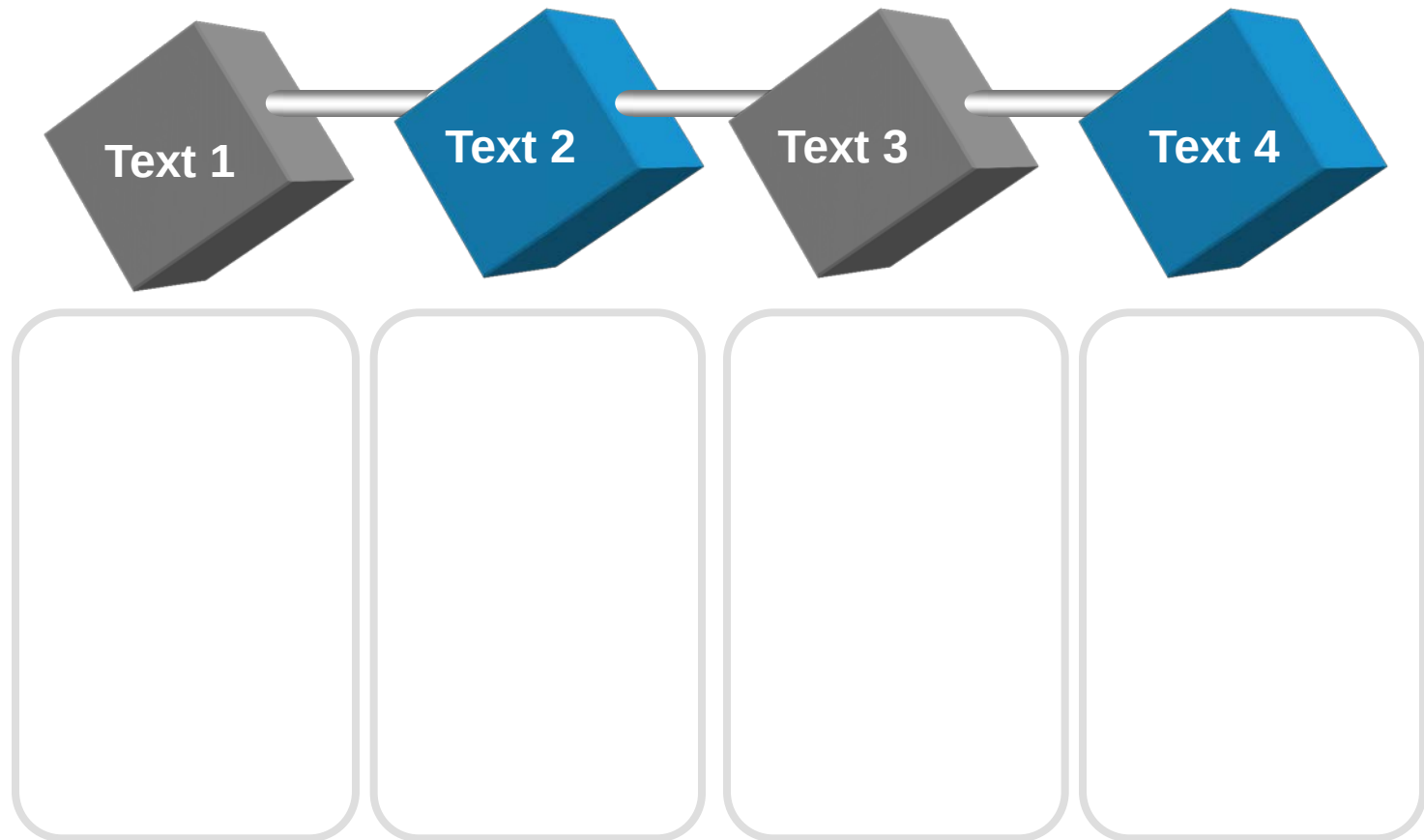
**Phase 2**

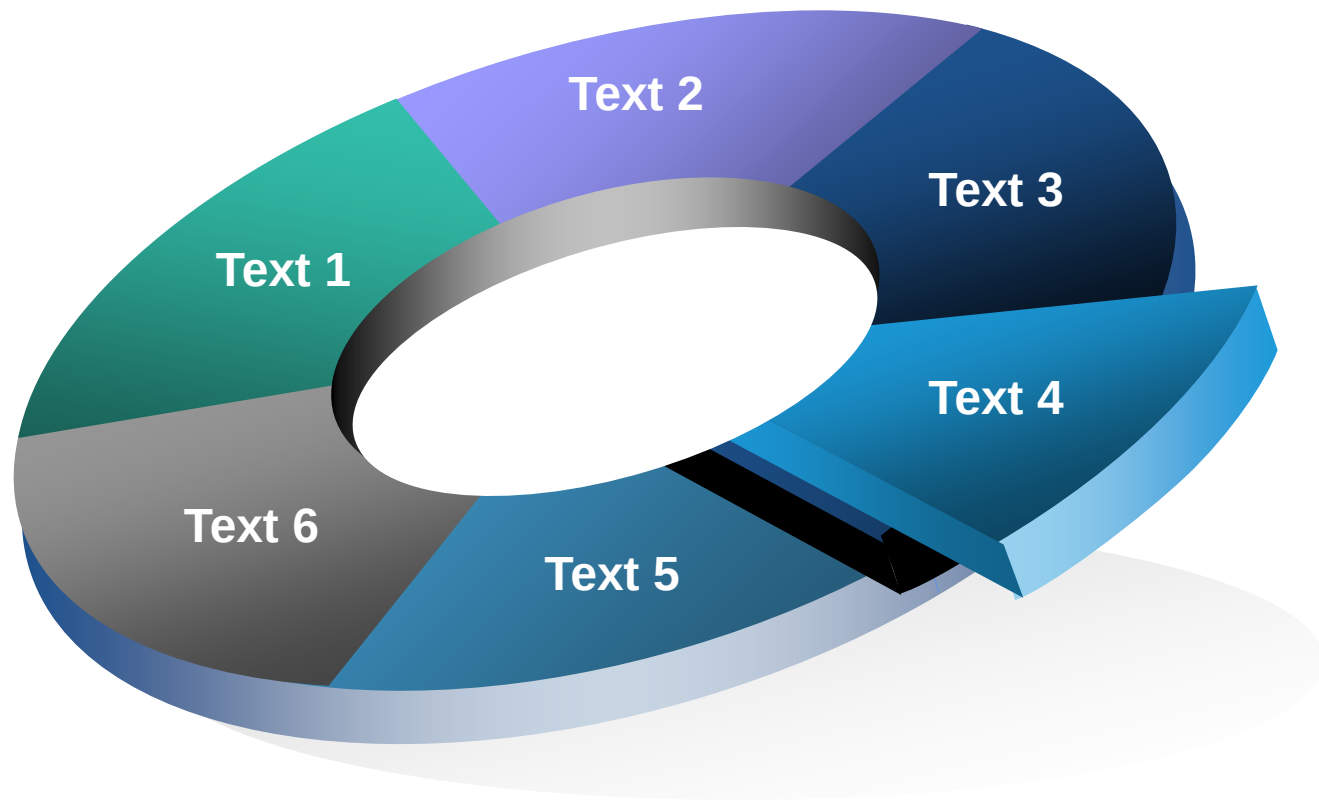
**Phase 3**

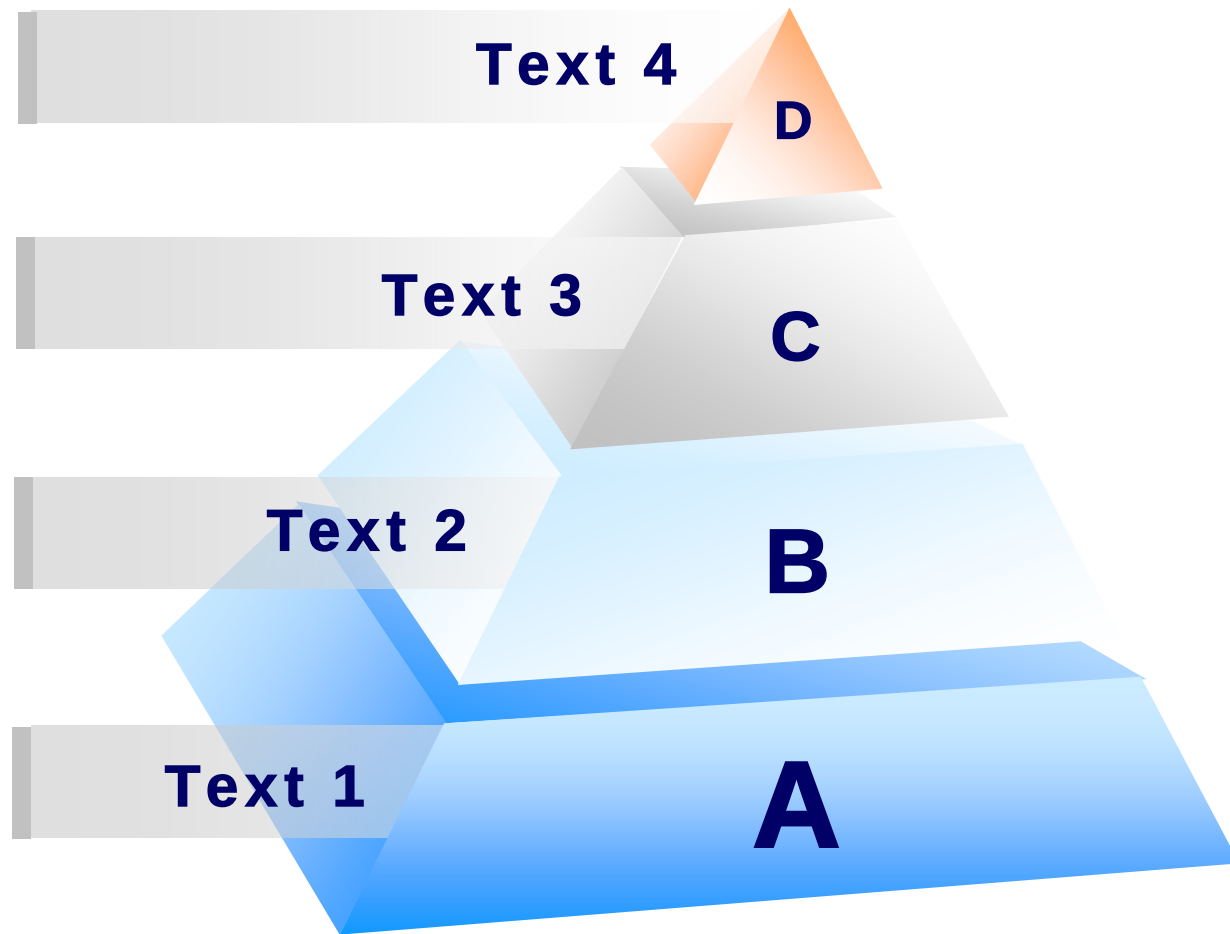


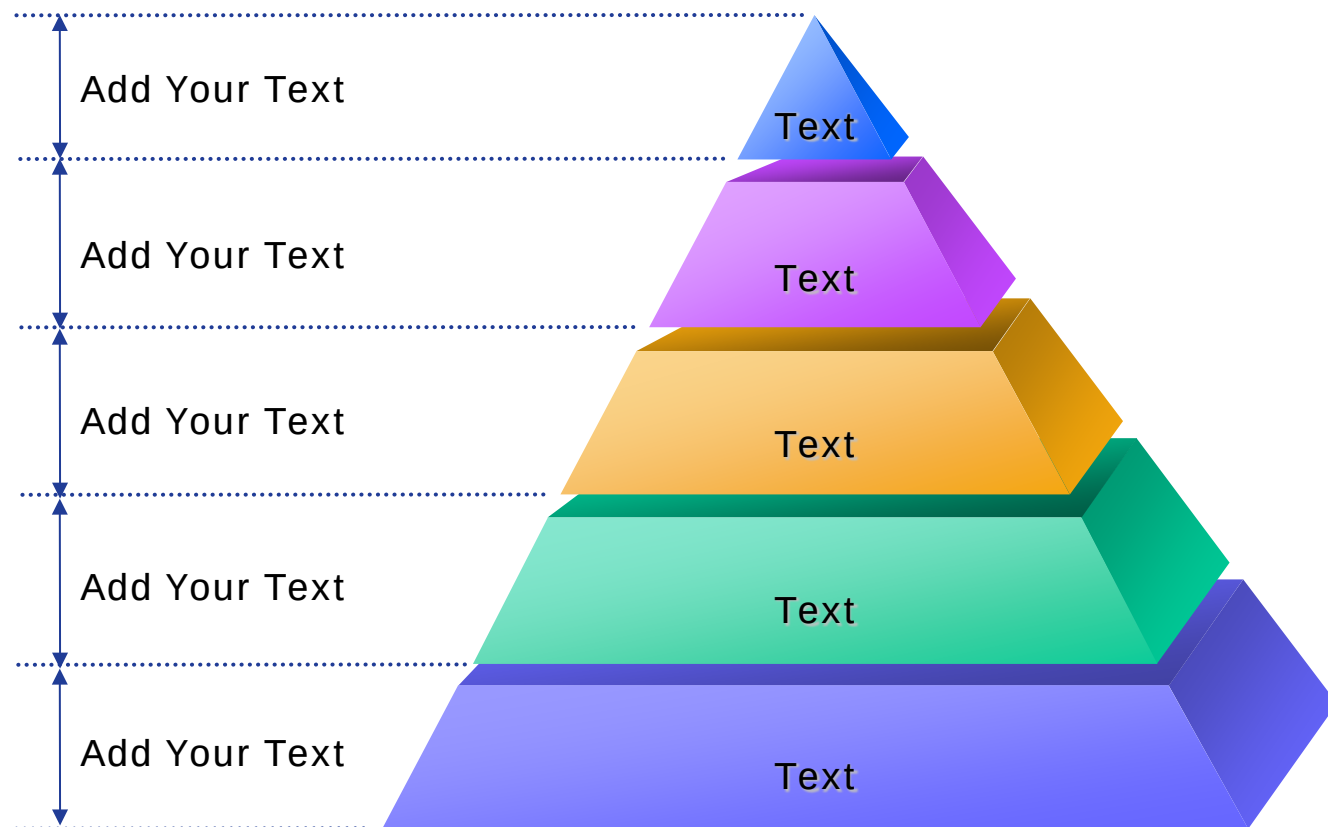






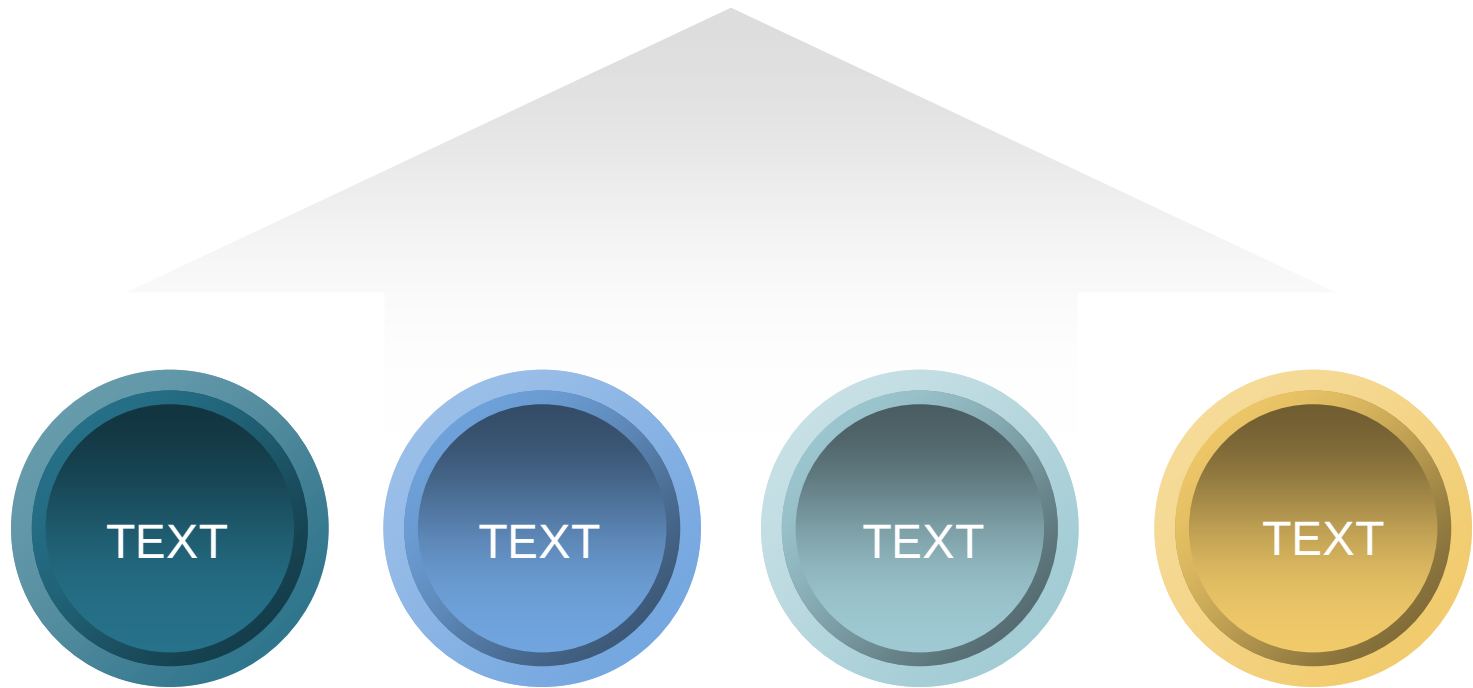


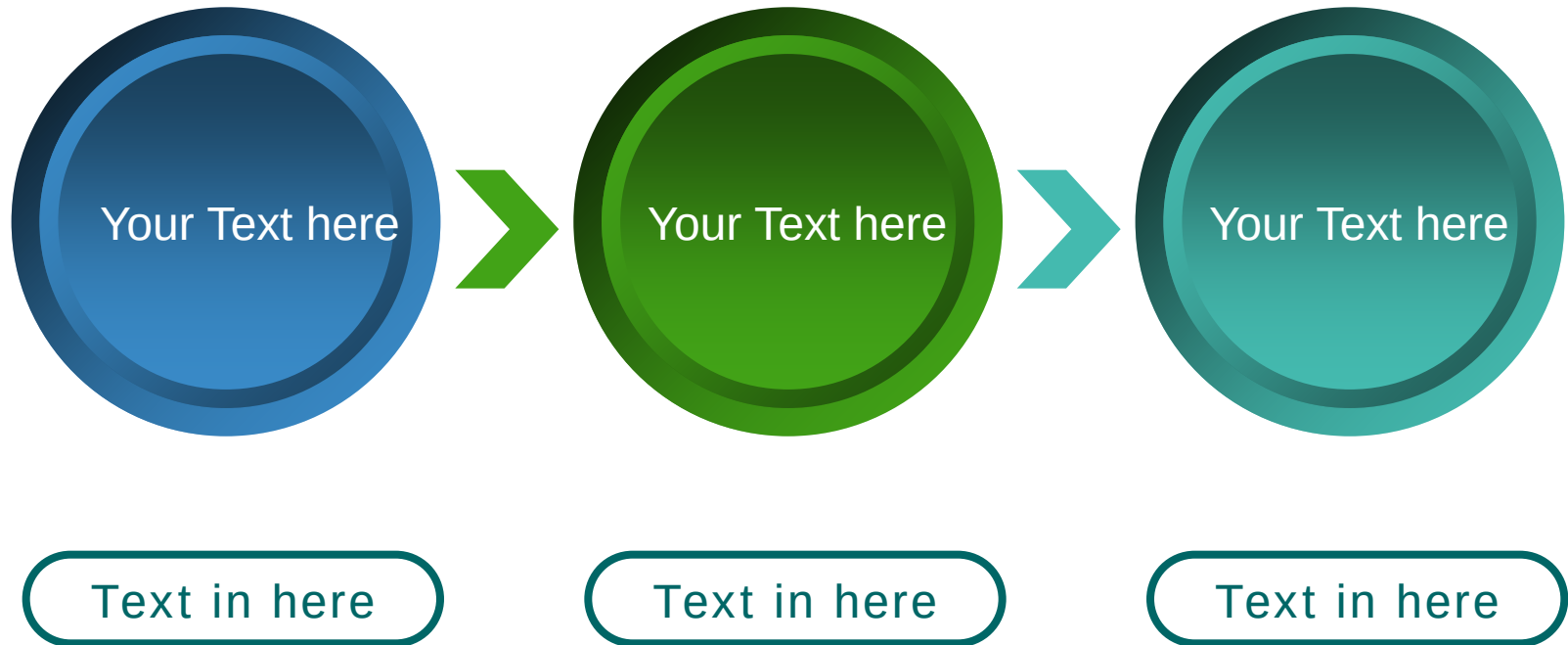




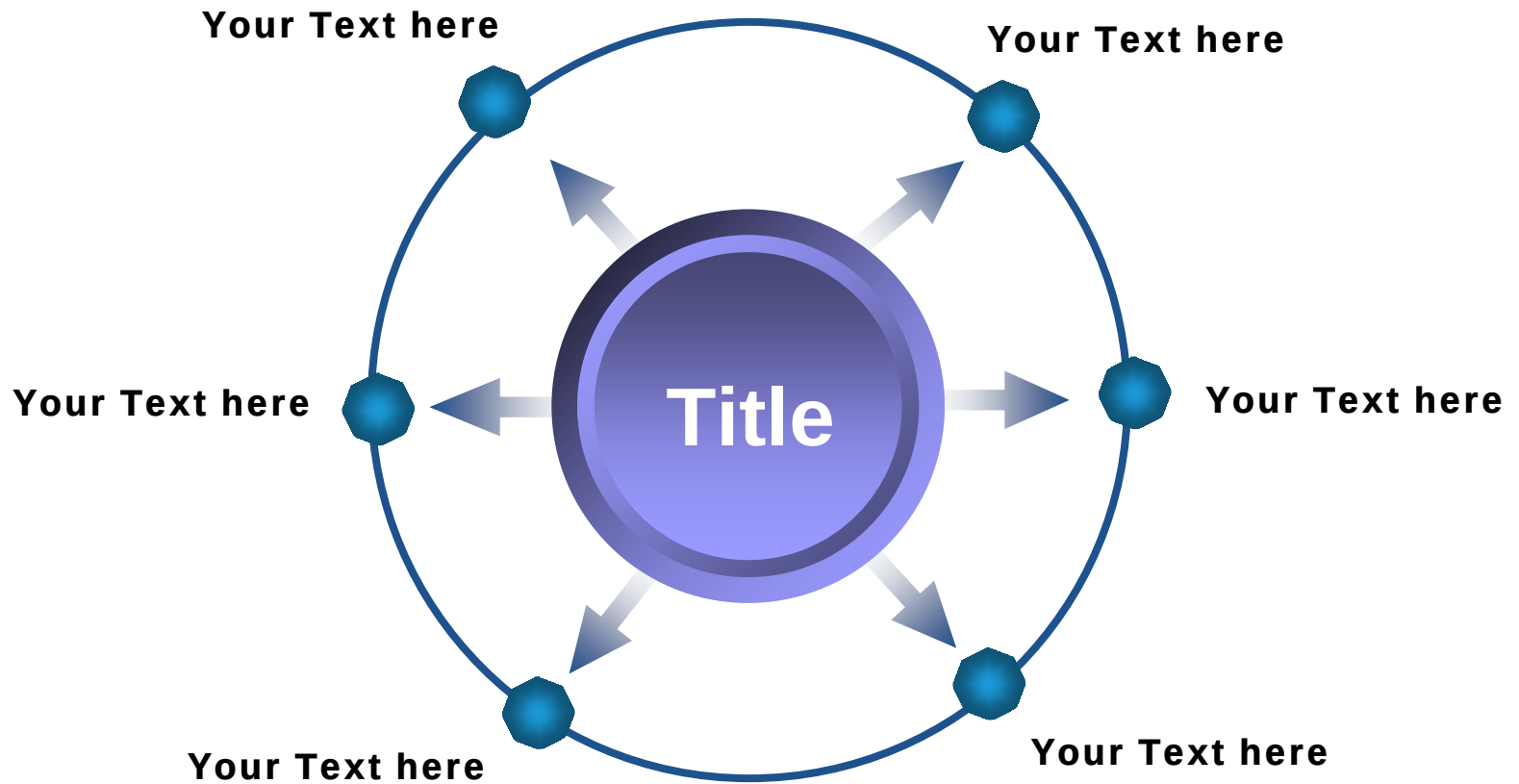


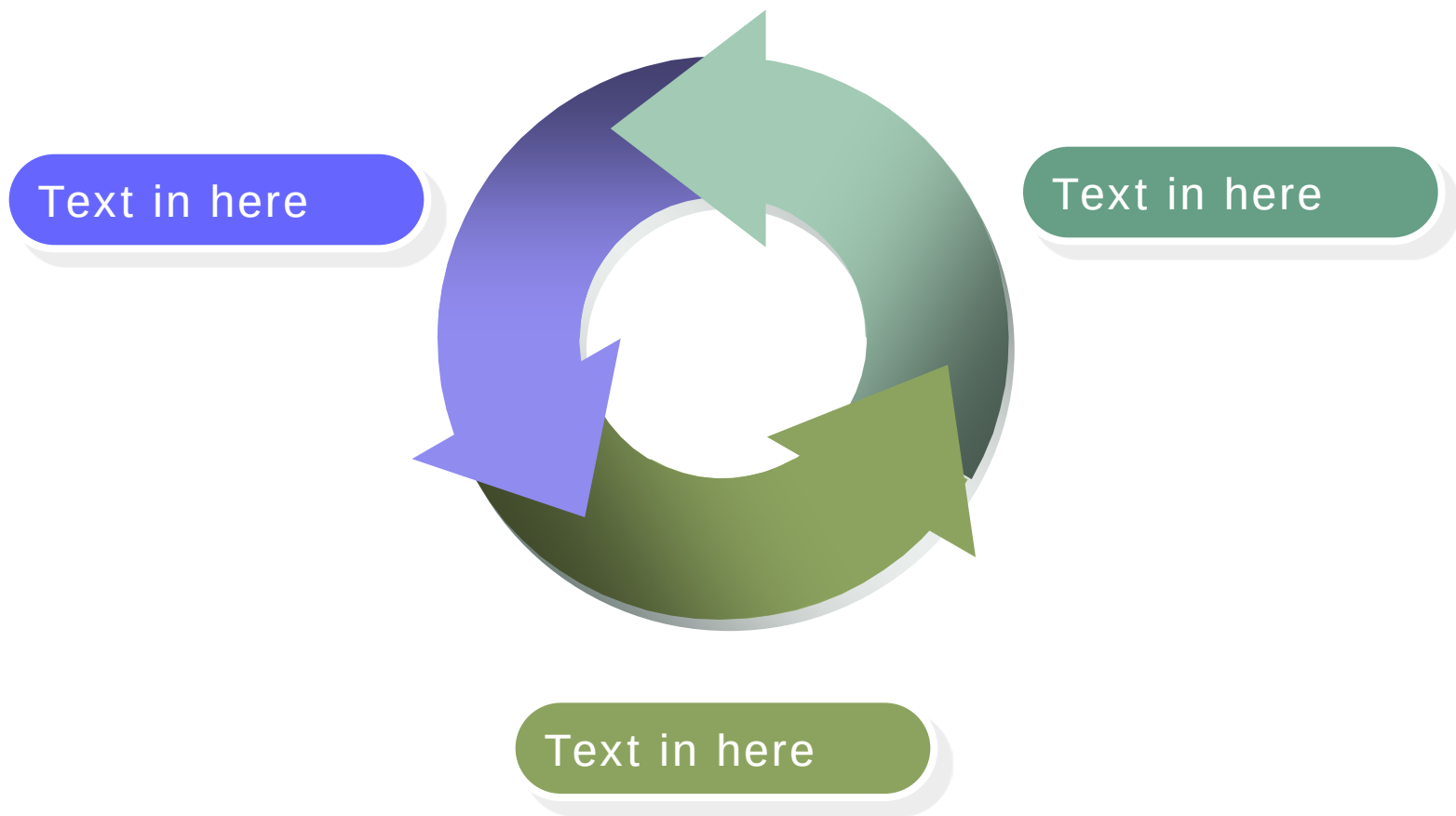
# Title





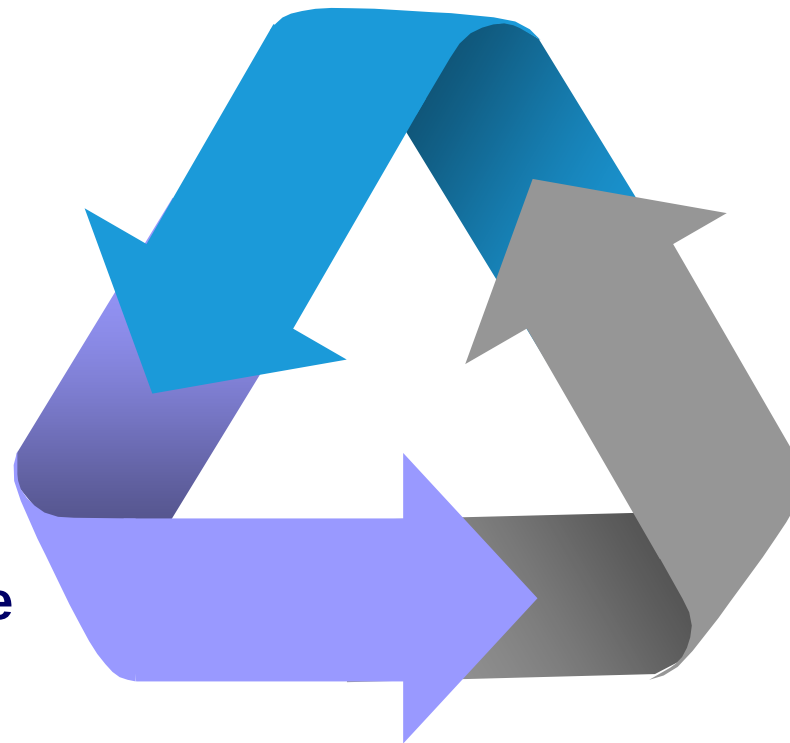






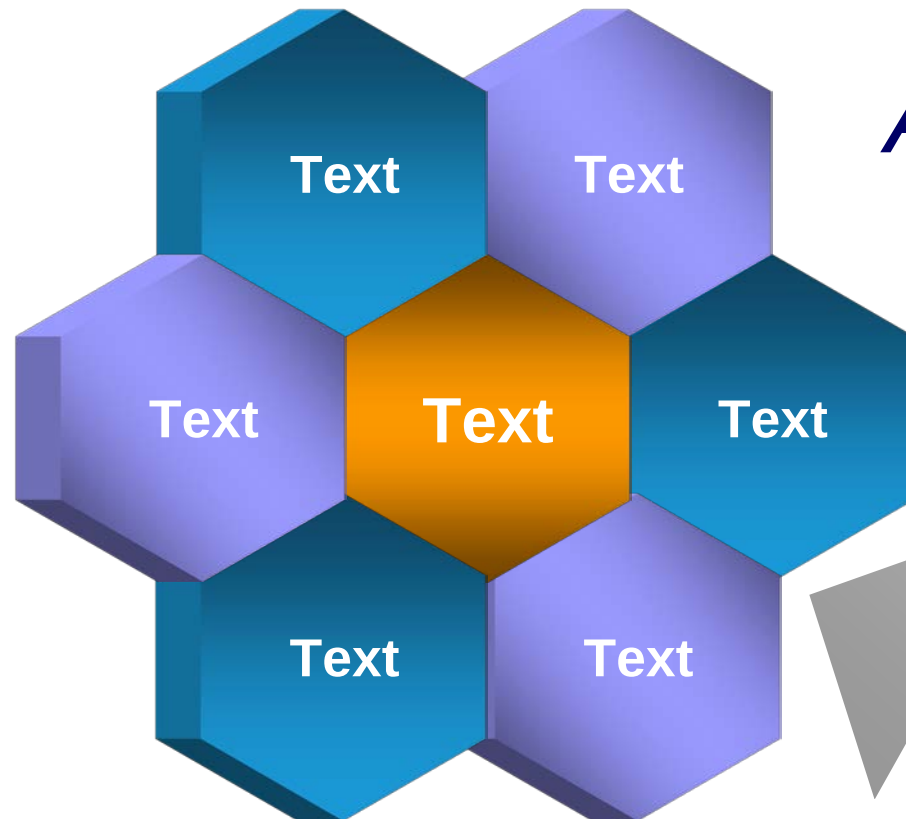


**Your Text here**



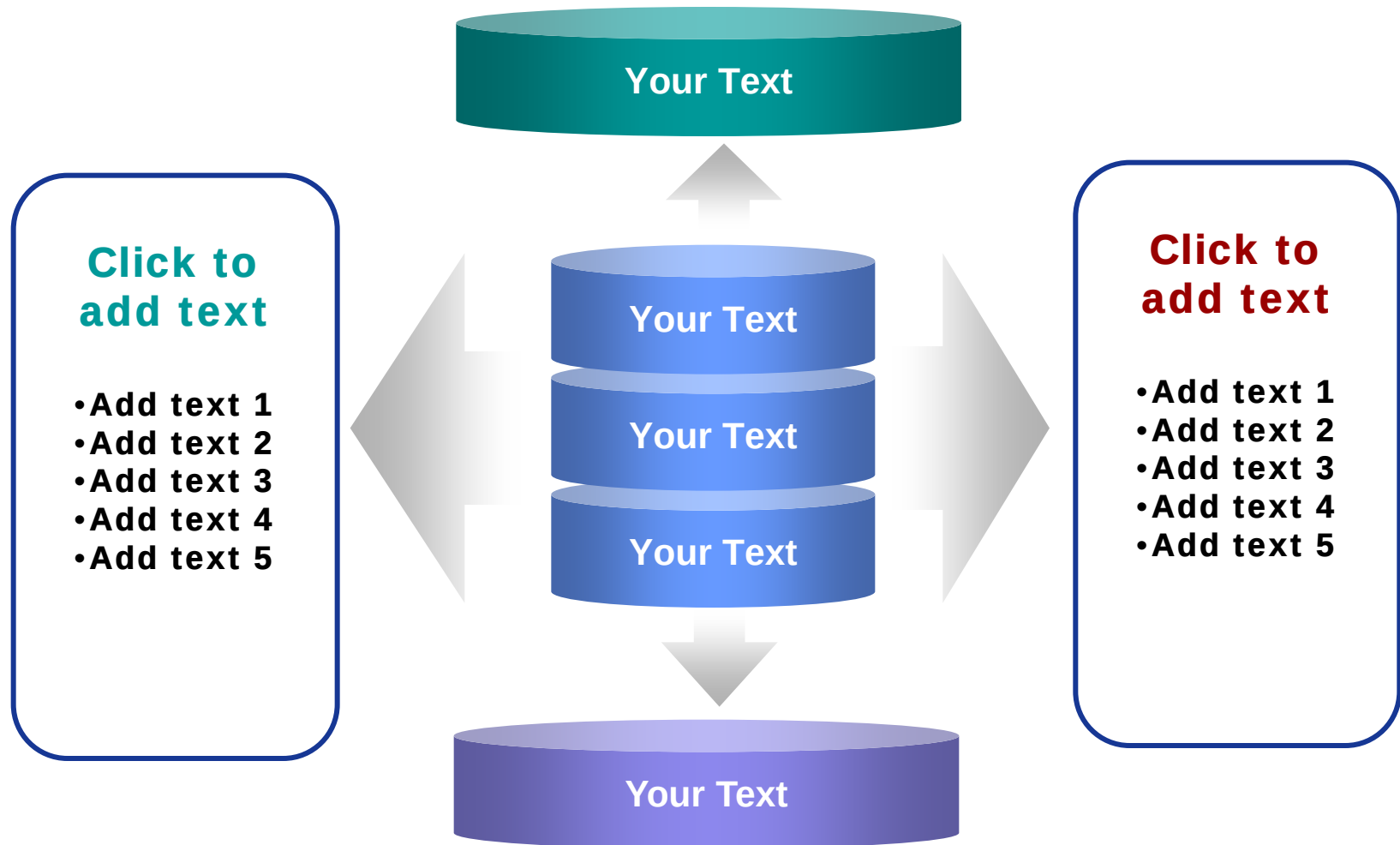
**Your Text here**

**Your Text here**



*Add title text*



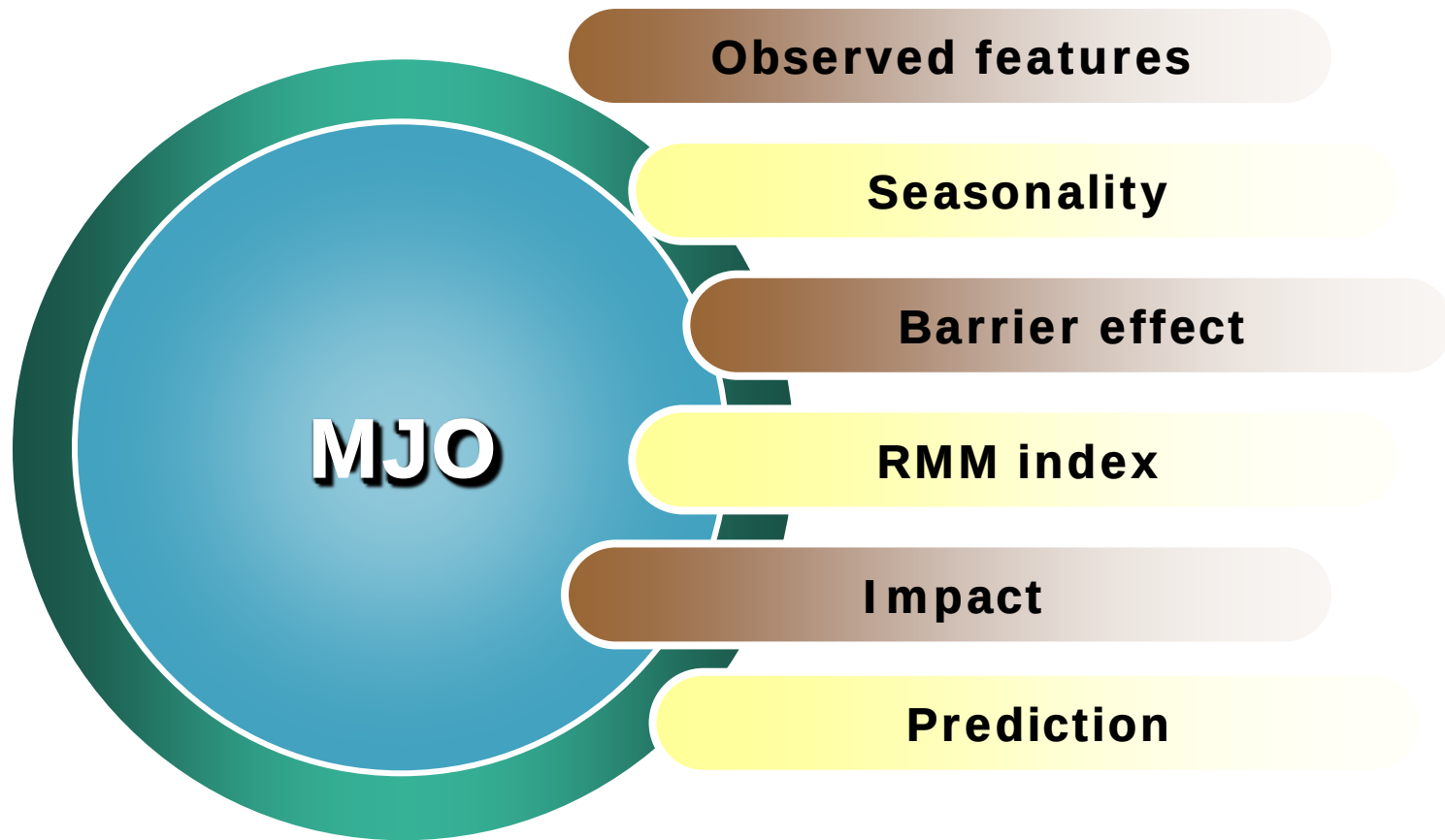


# Introduction to Boreal Summer Intraseasonal Oscillation

Ji-Hyun Oh  
APEC Climate Center



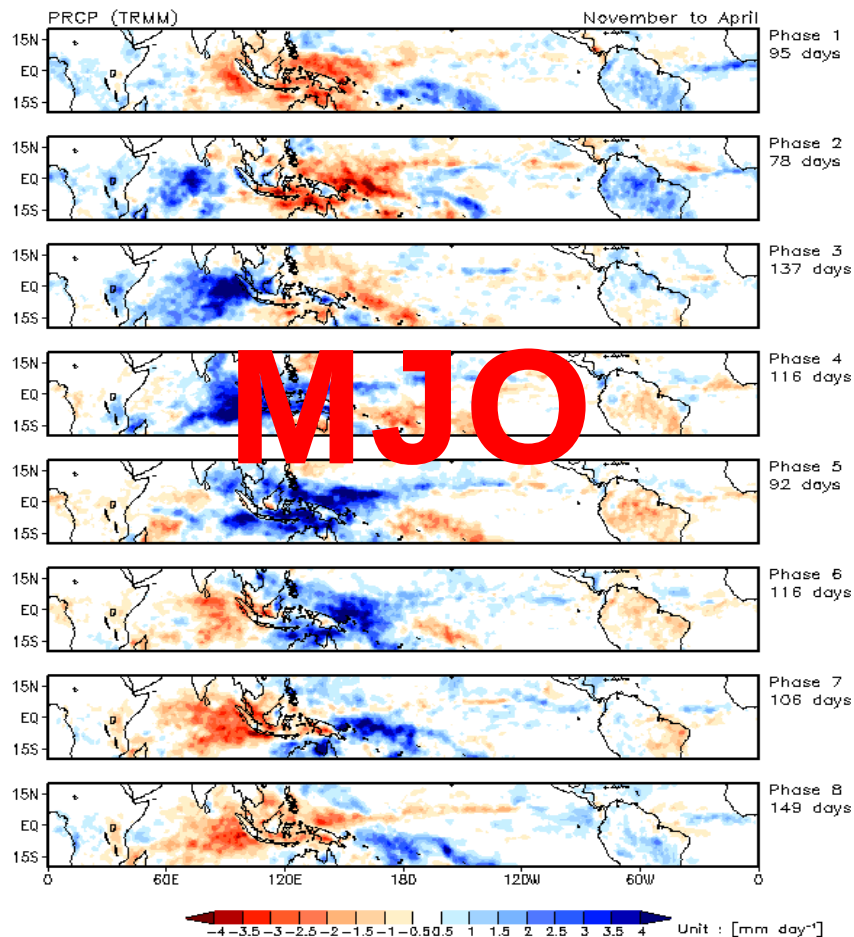
# In the previous session



# Seasonality of MJO

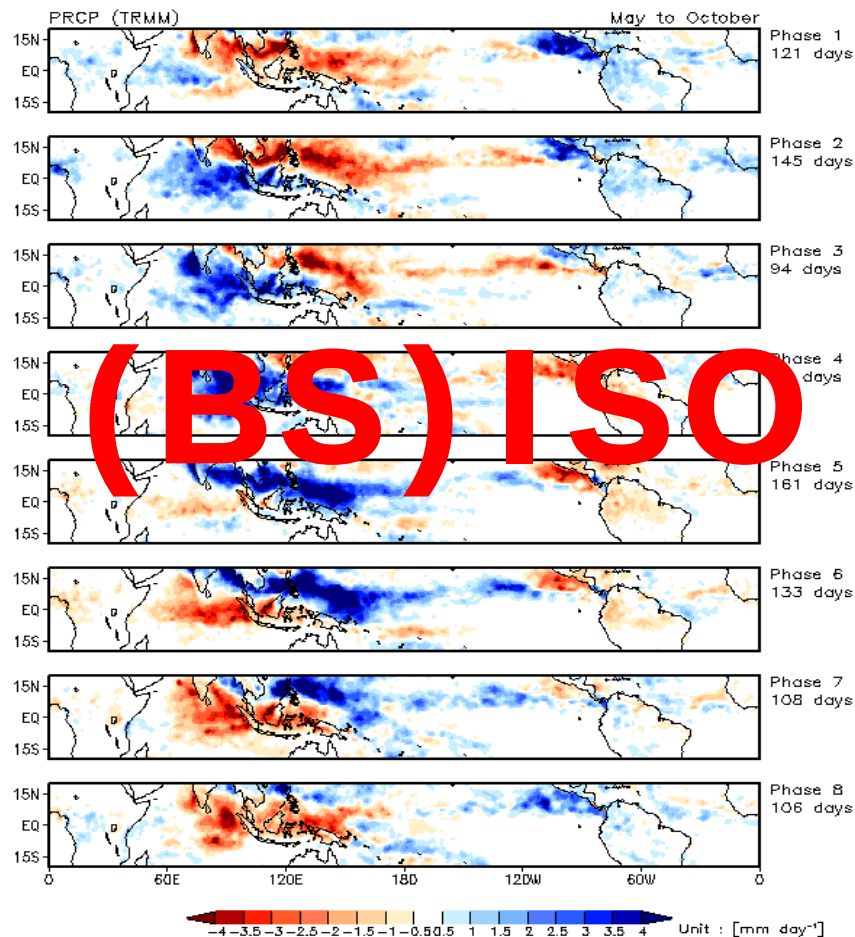
## Dec-Feb Composite

MJO Life cycle composite



## May-June Composite

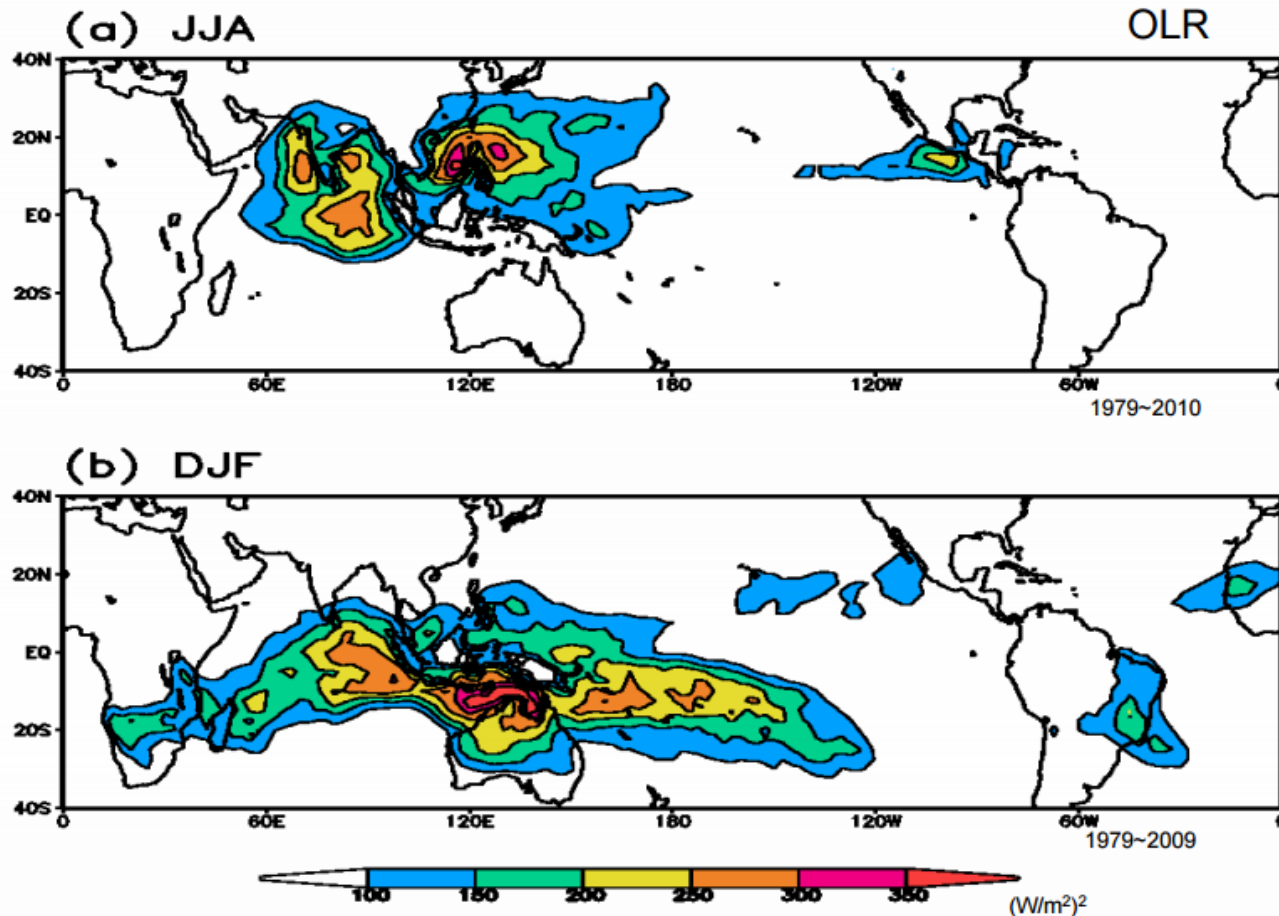
MJO Life cycle composite



# Intraseasonal variance

## Intraseasonal Variance

Intraseasonal : 20-90

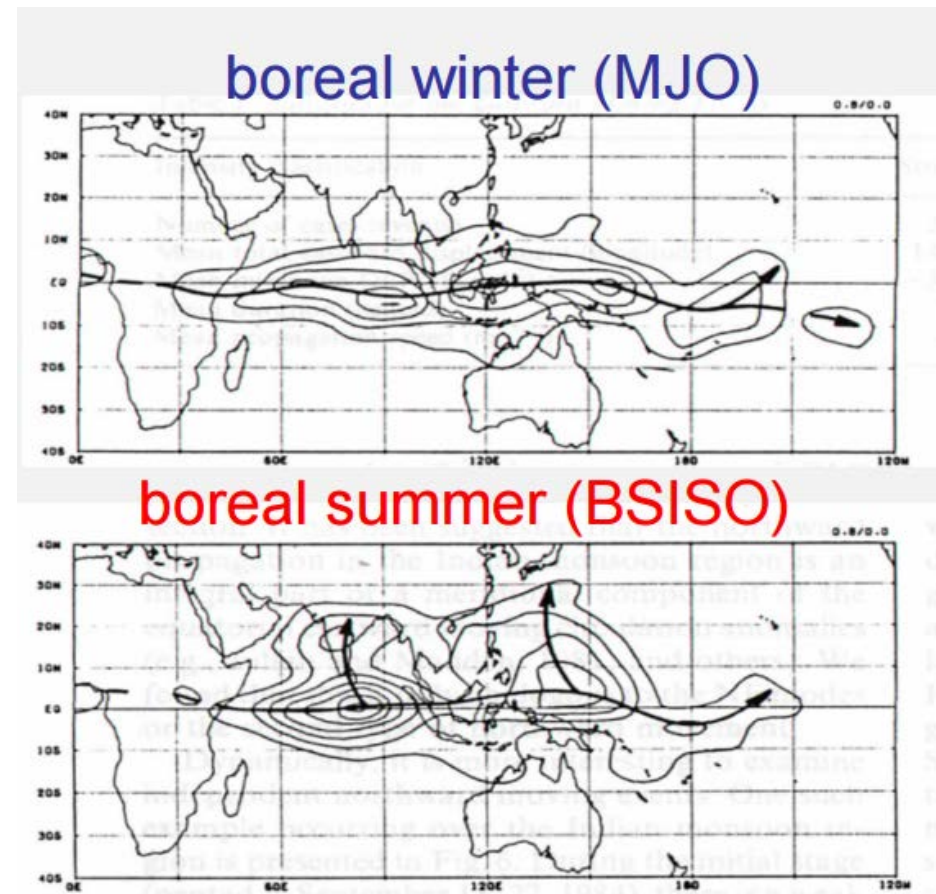


1979-20010

# Boreal summer ISO

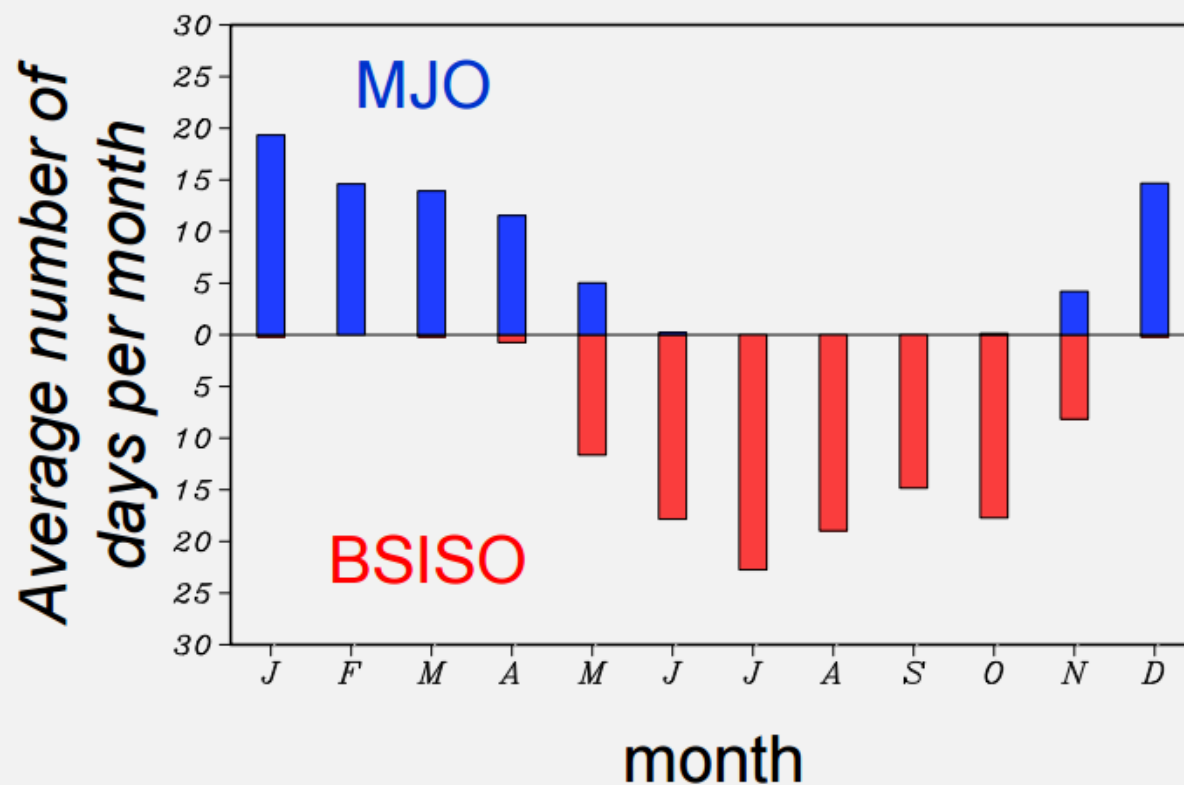
- In northern summer, signal maximizes in the **northern Indian Ocean and South China Sea**.
- Propagation is both **northward** and **eastward**.
- Northward propagation is related to the onset/break of Indian and East Asia Monsoon

**Northward & Eastward propagation**



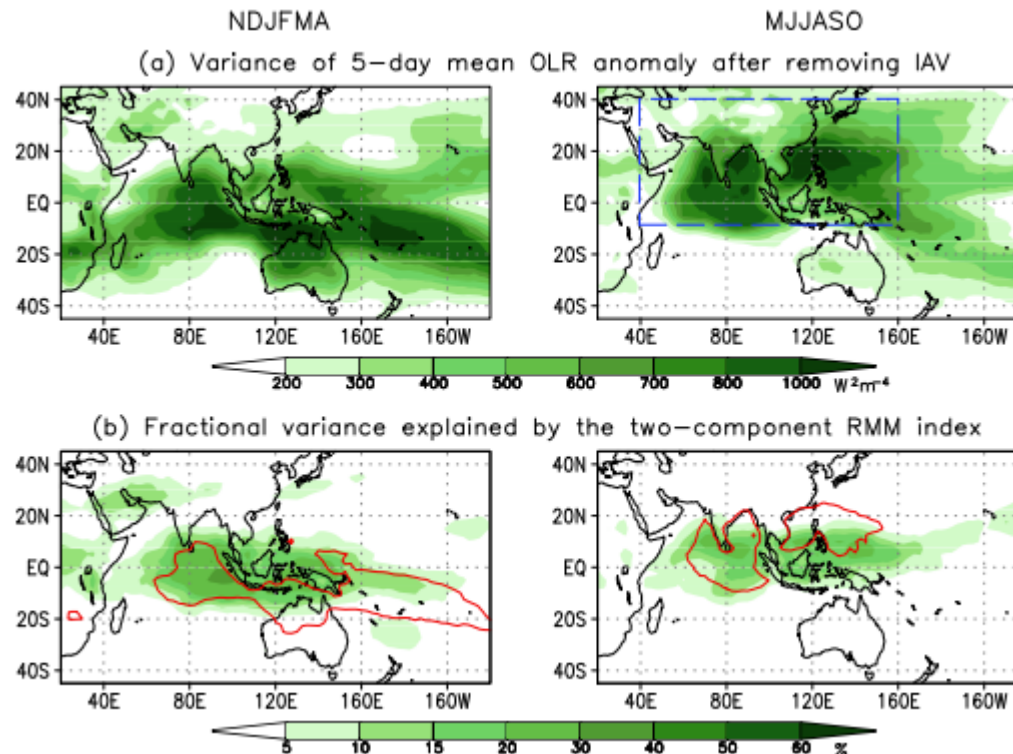


# Seasonal variation of the two ISO modes



# Limitation of RMM index

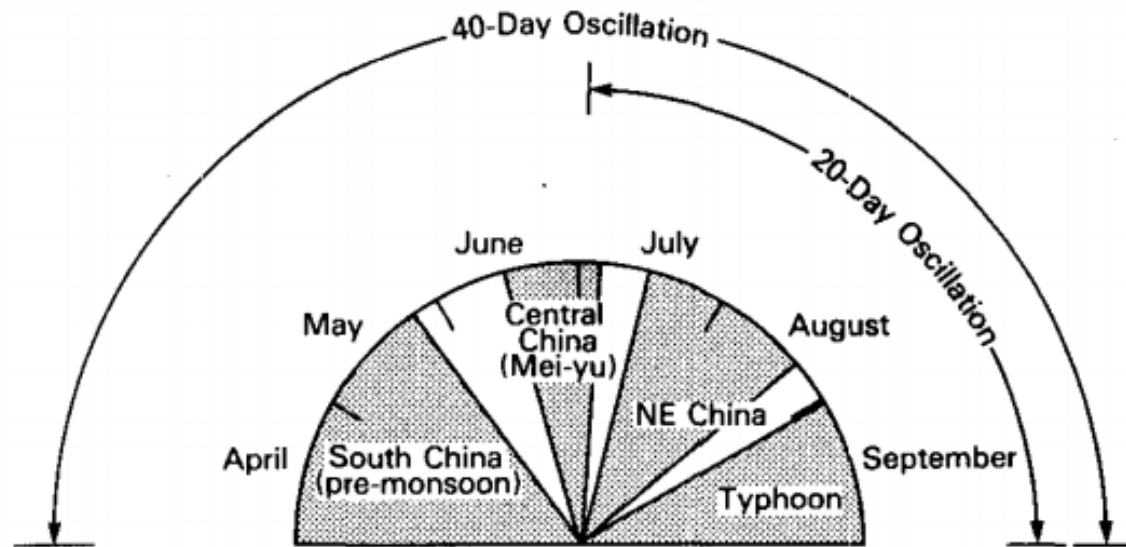
- The RMM index uses the first leading multivariate EOF modes of the equatorial mean (between 15S and 15 N) OLR, and zonal winds at 850 & 200 hPa, it has **limitation to explain ISO over off-equatorial monsoon domain during boreal summer**



Courtesy of J. Lee



# Two modes of ISO



Lau et al (1988) found that the 40-day & 20-day Oscillations are related to rainfall fluctuations over East Asia.





# BSISO indices

Feasible for real-time ISO monitoring

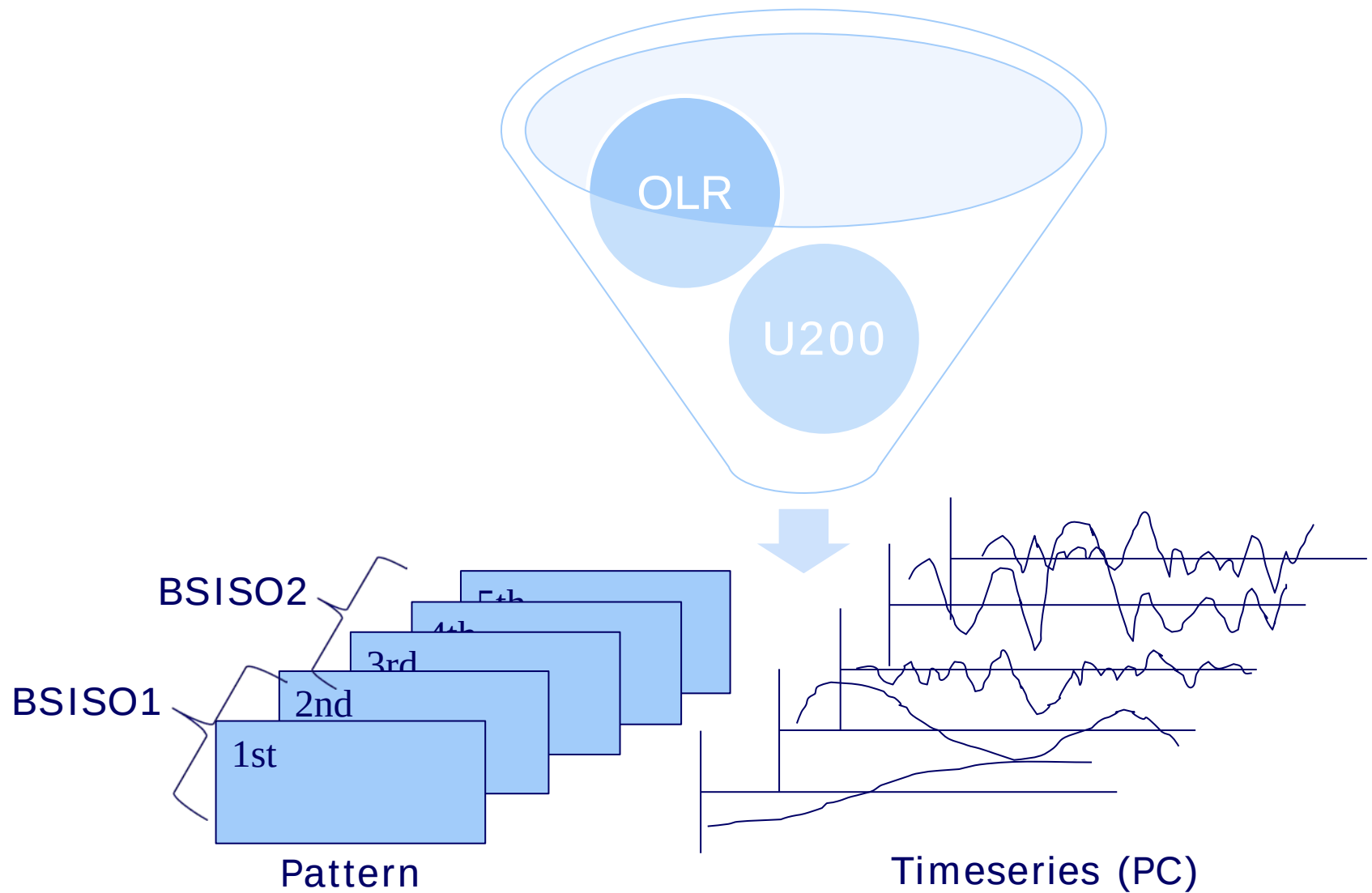
Consist of BSISO1 & BSISO2: daily (phase, amplitude)

Overcome the limitation of the RMM index for representing BSISO

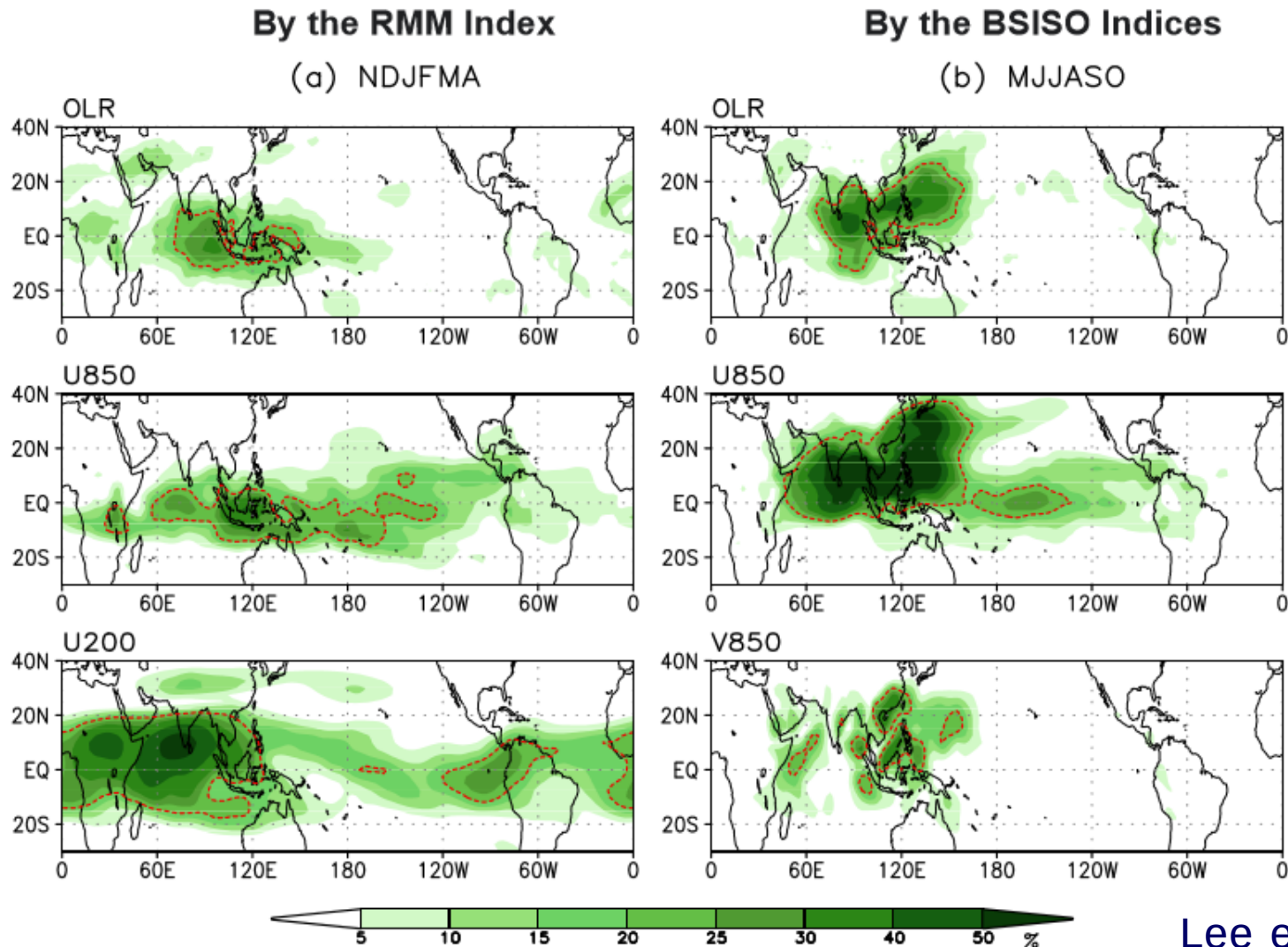
| RMM index                                | BSISO index                                   |
|------------------------------------------|-----------------------------------------------|
| Wheeler and Hendon (2004)                | Lee et al (2013)                              |
| OLR, and zonal winds at 850 and 200 hPa  | daily OLR and U850                            |
| Equatorial average between 15S and 15N   | 10S-40N, 40E-150E                             |
| All year round                           | MJJASO                                        |
| first two leading multivariate EOF modes | The first four leading multivariate EOF modes |
|                                          | BSISO1, BSISO2                                |



# Multivariate EOF



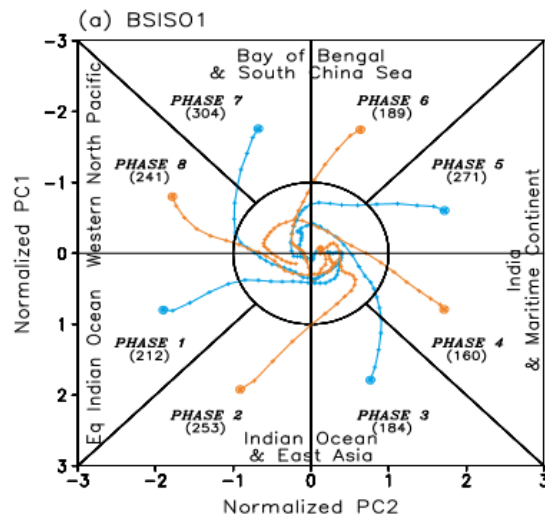
# Fractional variance explained by the MJO and BSISO indices



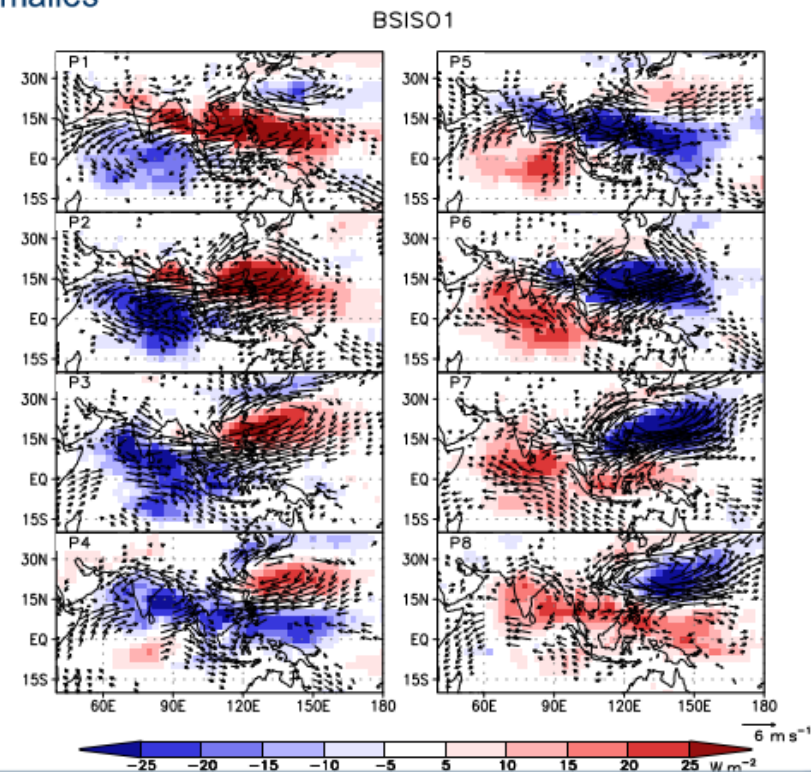
Lee et al (2013)

# BSISO1

- Consists of EOF1 and EOF2
- Represent canonical northward and northeastward propagating ISO
- Periods of 30-60 days

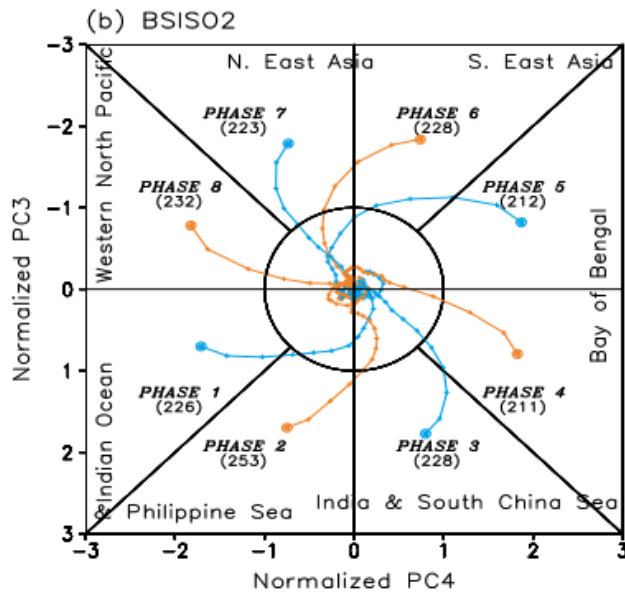


Life cycle composite of OLR (shading) and 850-hPa wind anomalies

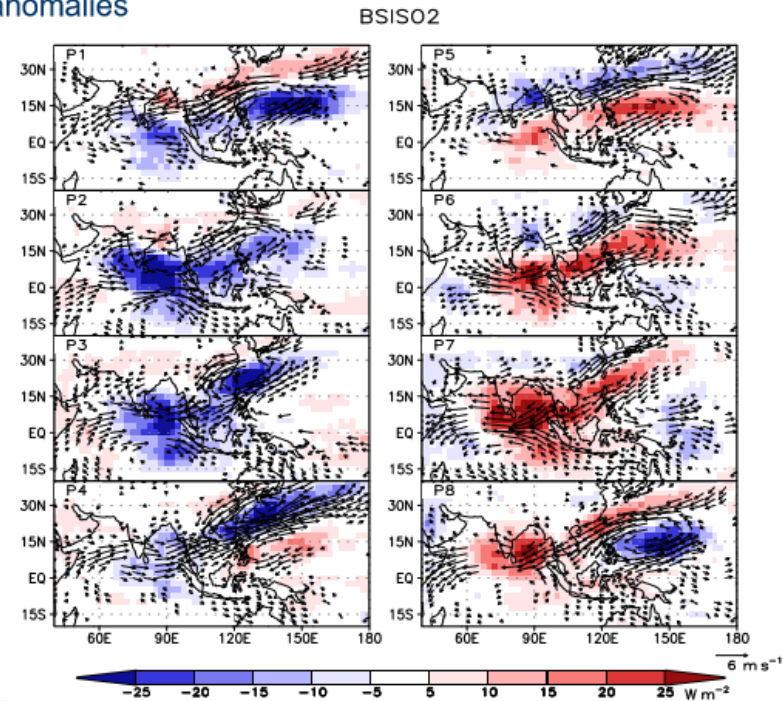


# BSISO2

- Consists of EOF3 and EOF4
- Represent northward/northwestward propagating variability
- Periods of 10-30 days

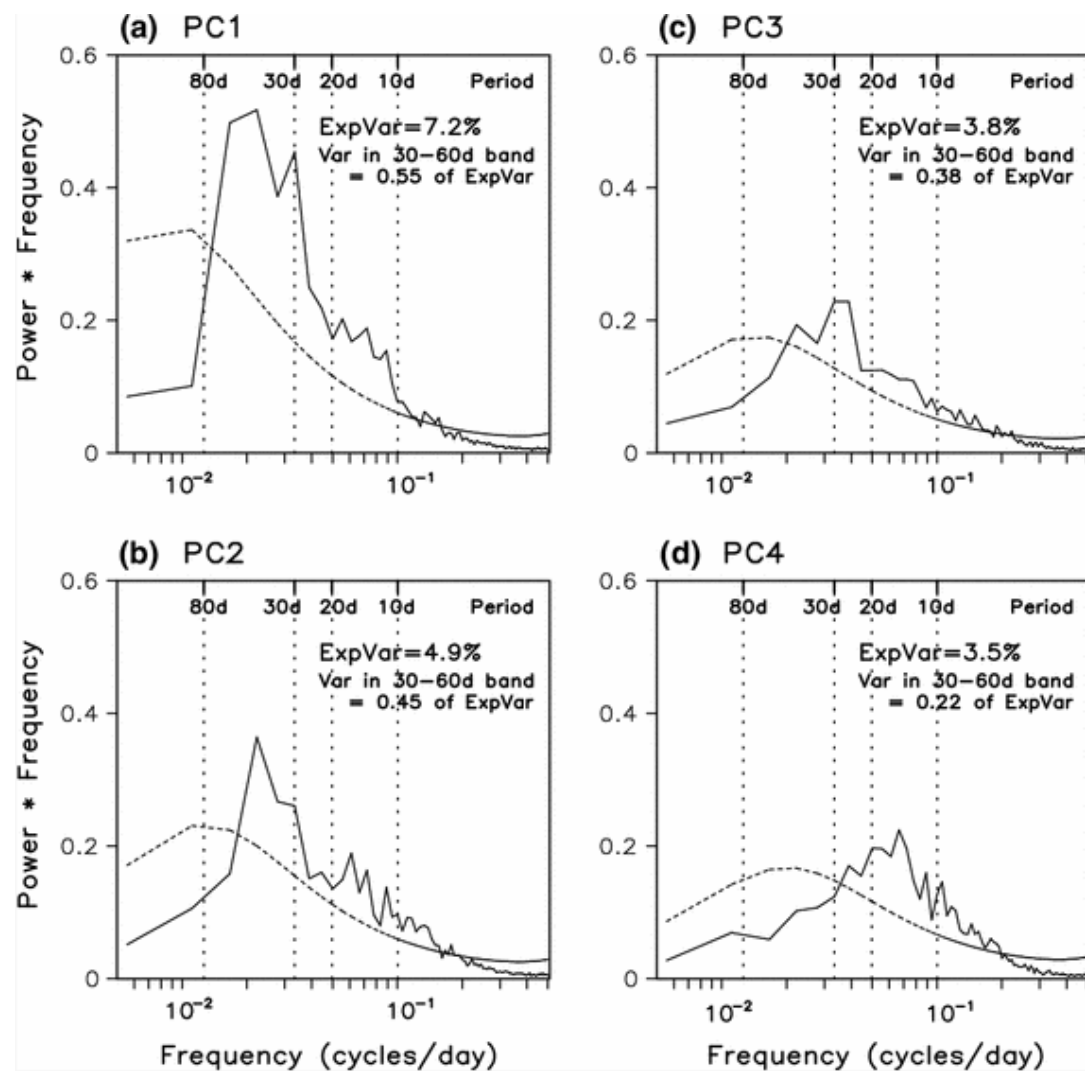


Life cycle composite of OLR (shading) and 850-hPa wind anomalies





# Periods of BSISO1 & 2

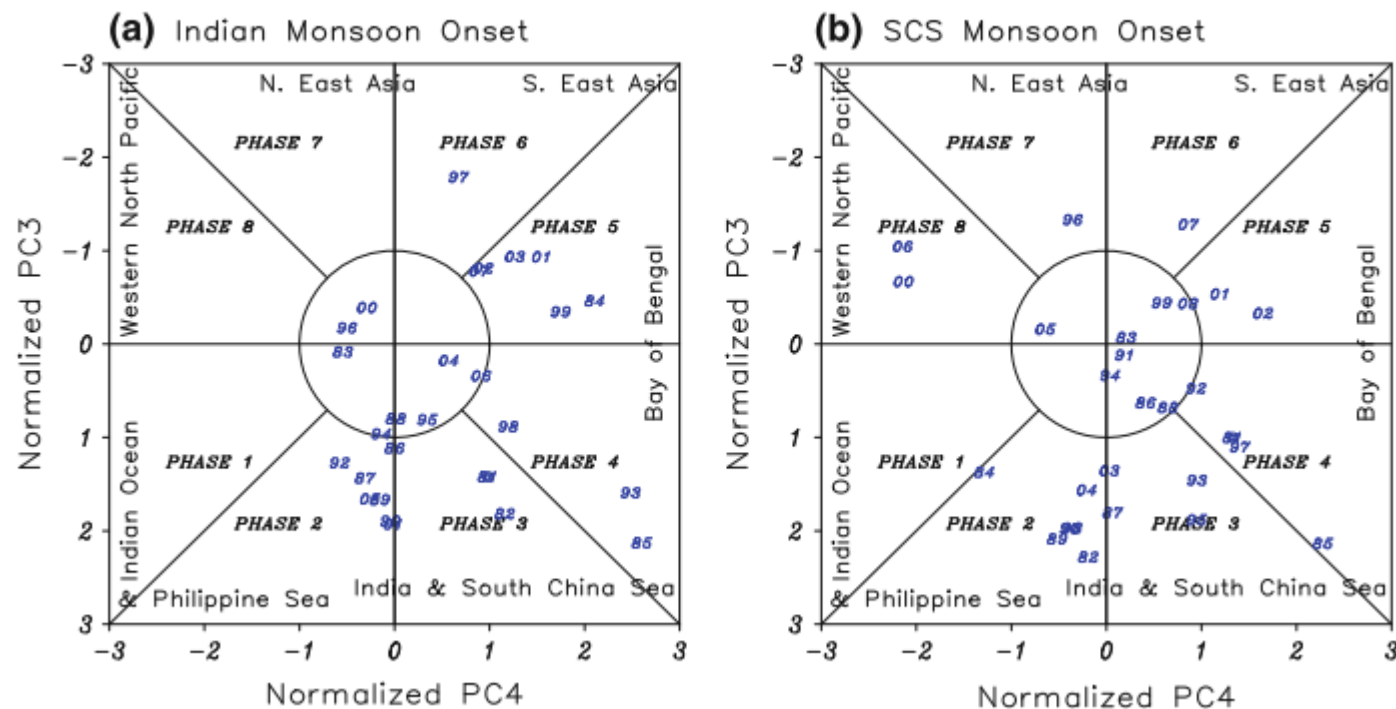




# BSISO impact

## Monsoon Onset over the ASM region

Lee et al (2013)



18 out of 28 cases of Indian monsoon onset occur in phases 2-4

19 out of 29 cases of South China Sea monsoon onset occur in phases 2-4



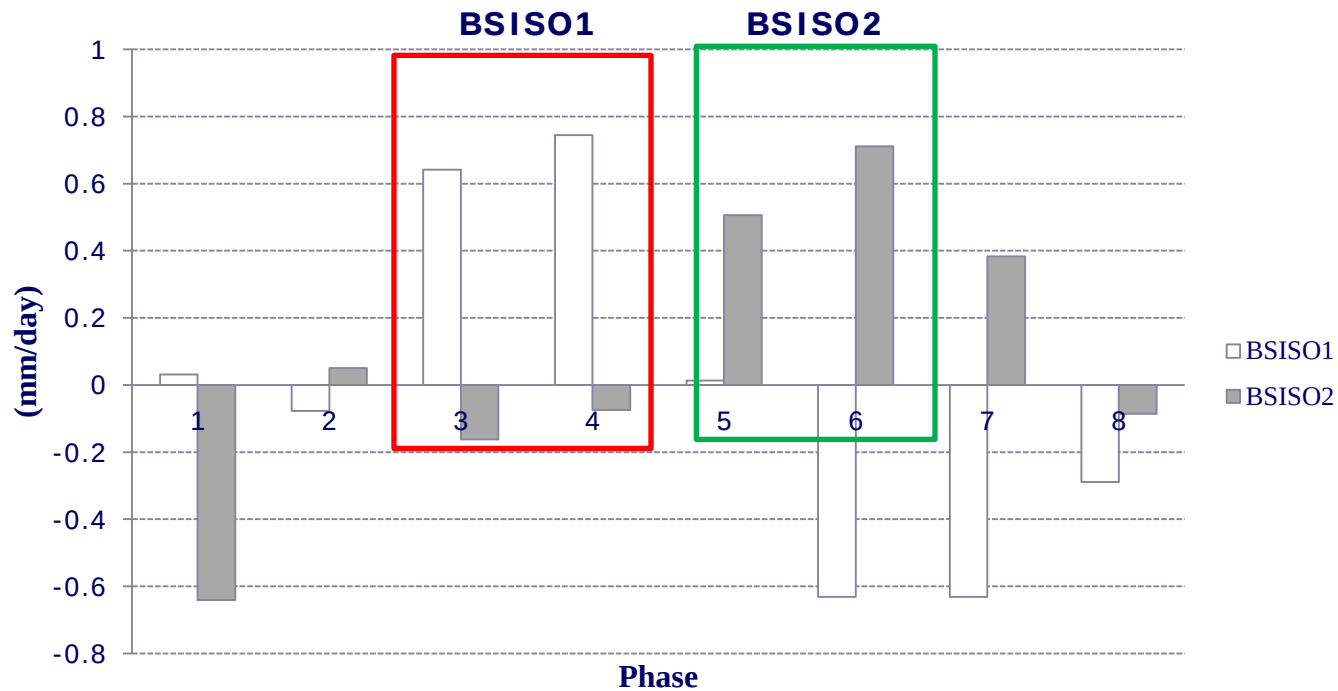


# BSISO impact

## Changma onset in Korea

Changma: long rainy period of over Korea within EASM

The rainfall during Changma accounts for 30% of annual precipitation in Korea

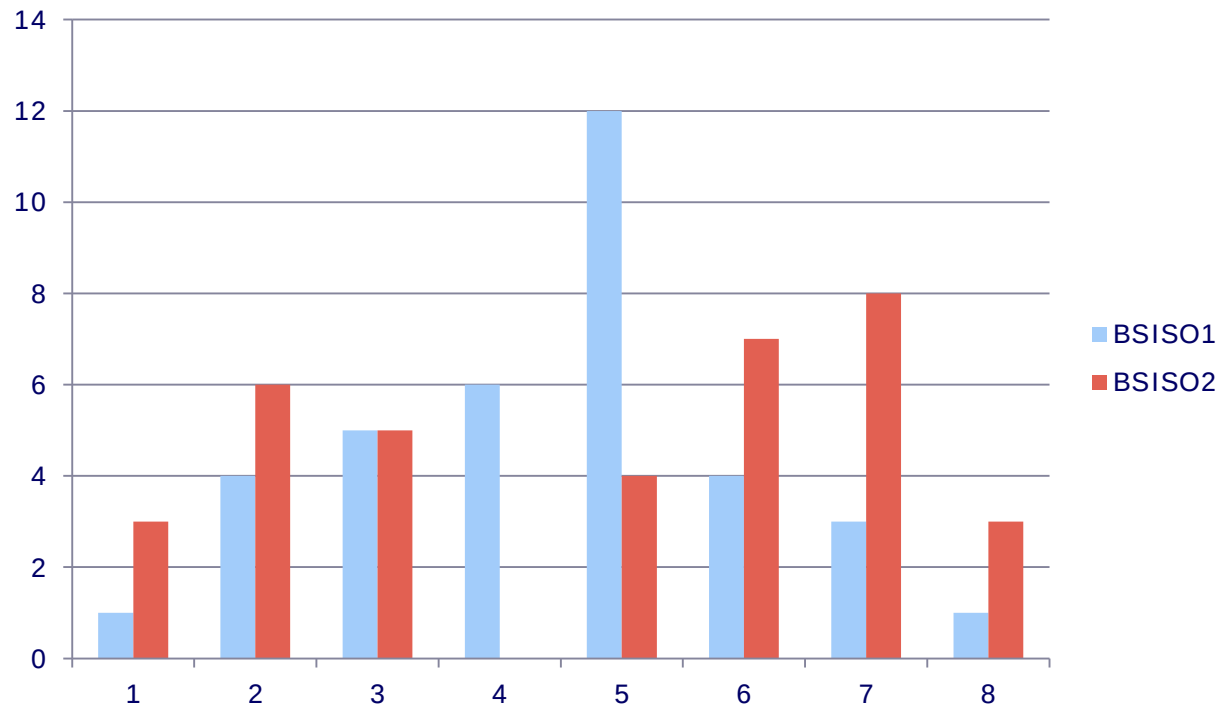




# BSISO impact

## Changma onset in Korea

Occurrence frequency of BSISO1, 2 phase  
on Changma Onset day (1981-2016)



# BSISO impact

## Changma onset in Korea

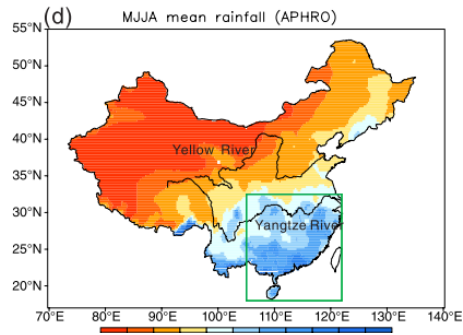
| 장마                |        |        |    | BSISO1 |    | BSISO2 |    |
|-------------------|--------|--------|----|--------|----|--------|----|
| 연도                | 시작일    | 종료일    | 기간 | 강도     | 위상 | 강도     | 위상 |
| 1981              | 6월 19일 | 7월 14일 | 26 | 1.417  | 5  | 2.368  | 3  |
| 1982              | 7월 7일  | 7월 29일 | 23 | 0.473  | 2  | 0.842  | 7  |
| Post El Nino 1983 | 6월 19일 | 7월 25일 | 37 | 1.332  | 4  | 0.265  | 2  |
| 1984              | 6월 15일 | 7월 13일 | 29 | 1.652  | 7  | 0.826  | 7  |
| 1985              | 6월 21일 | 7월 18일 | 28 | 2.346  | 5  | 1.386  | 2  |
| 1986              | 6월 23일 | 7월 26일 | 34 | 2.171  | 5  | 0.671  | 5  |
| 1987              | 7월 1일  | 8월 8일  | 39 | 1.22   | 5  | 1.312  | 3  |
| 1988              | 6월 23일 | 7월 27일 | 35 | 1.806  | 8  | 1.649  | 6  |
| 1989              | 6월 23일 | 7월 29일 | 37 | 1.131  | 7  | 0.291  | 3  |
| 1990              | 6월 19일 | 7월 19일 | 31 | 2.151  | 5  | 2.013  | 8  |
| 1991              | 6월 26일 | 8월 2일  | 38 | 0.733  | 3  | 0.41   | 7  |
| 1992              | 7월 9일  | 7월 23일 | 15 | 1.416  | 3  | 0.545  | 6  |
| 1993              | 6월 22일 | 7월 30일 | 39 | 0.701  | 5  | 0.775  | 7  |
| 1994              | 6월 22일 | 7월 6일  | 15 | 1.44   | 5  | 1.37   | 7  |
| 1995              | 6월 30일 | 7월 27일 | 28 | 0.648  | 3  | 0.489  | 3  |
| 1996              | 6월 24일 | 7월 22일 | 29 | 0.203  | 5  | 1.547  | 6  |
| 1997              | 6월 25일 | 7월 22일 | 28 | 1.233  | 6  | 0.596  | 2  |
| Post El Nino 1998 | 6월 24일 | 7월 28일 | 35 | 1.305  | 4  | 1.553  | 3  |
| 1999              | 6월 23일 | 7월 10일 | 18 | 0.305  | 1  | 3.328  | 6  |
| 2000              | 6월 21일 | 7월 16일 | 26 | 0.636  | 2  | 0.664  | 6  |
| 2001              | 6월 22일 | 7월 21일 | 30 | 2.169  | 5  | 0.676  | 8  |
| 2002              | 6월 23일 | 7월 24일 | 32 | 1.164  | 4  | 1.79   | 5  |
| 2003              | 6월 23일 | 7월 25일 | 33 | 1.536  | 3  | 1.712  | 5  |
| 2004              | 6월 24일 | 7월 17일 | 24 | 2.064  | 7  | 2.644  | 7  |
| 2005              | 6월 26일 | 7월 18일 | 23 | 1.286  | 5  | 1.083  | 6  |
| 2006              | 6월 21일 | 7월 29일 | 39 | 1.557  | 3  | 2.166  | 2  |
| Post El Nino 2007 | 6월 21일 | 7월 24일 | 34 | 2.035  | 4  | 1.286  | 2  |
| 2008              | 6월 17일 | 7월 26일 | 40 | 1.044  | 6  | 2.224  | 6  |
| 2009              | 6월 28일 | 7월 21일 | 24 | 1.642  | 2  | 1.086  | 7  |
| 2010              | 6월 18일 | 7월 28일 | 41 | 0.987  | 4  | 1.714  | 7  |
| 2011              | 6월 10일 | 7월 10일 | 31 | 1.106  | 5  | 2.149  | 6  |
| 2012              | 6월 18일 | 7월 17일 | 30 | 1.025  | 6  | 0.787  | 5  |
| 2013              | 6월 18일 | 8월 2일  | 46 | 1.648  | 5  | 0.728  | 1  |
| 2014              | 7월 2일  | 7월 29일 | 28 | 0.448  | 5  | 1.558  | 8  |
| 2015              | 6월 25일 | 7월 29일 | 35 | 1.1816 | 6  | 2.716  | 6  |
| Post El Nino 2016 | 6월 24일 | 7월 30일 | 32 | 2.304  | 4  | 0.806  | 2  |



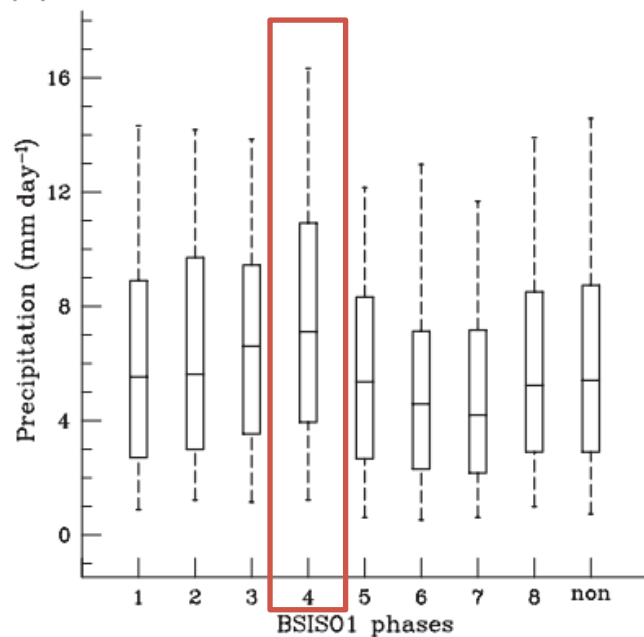
# BSISO impact

## Modulation of BSISO on rainfall extremes

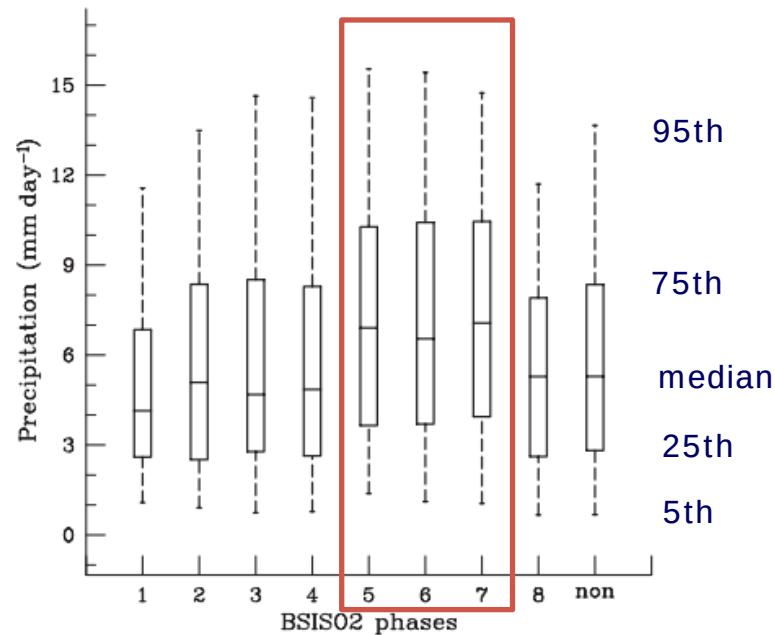
Hsu et al (2015)



(a) Box Plot for ENS rain (SE China)



(b) Box Plot for ENS rain (SE China)



# BSISO impact

## Modulation of BSISO on rainfall extremes

Hsu et al (2015)

- Relationship with historical floods
- 1998 Yangtze River flood, 2000 Fujian flood: most devastating flooding events occurred in southeastern China over the past half century

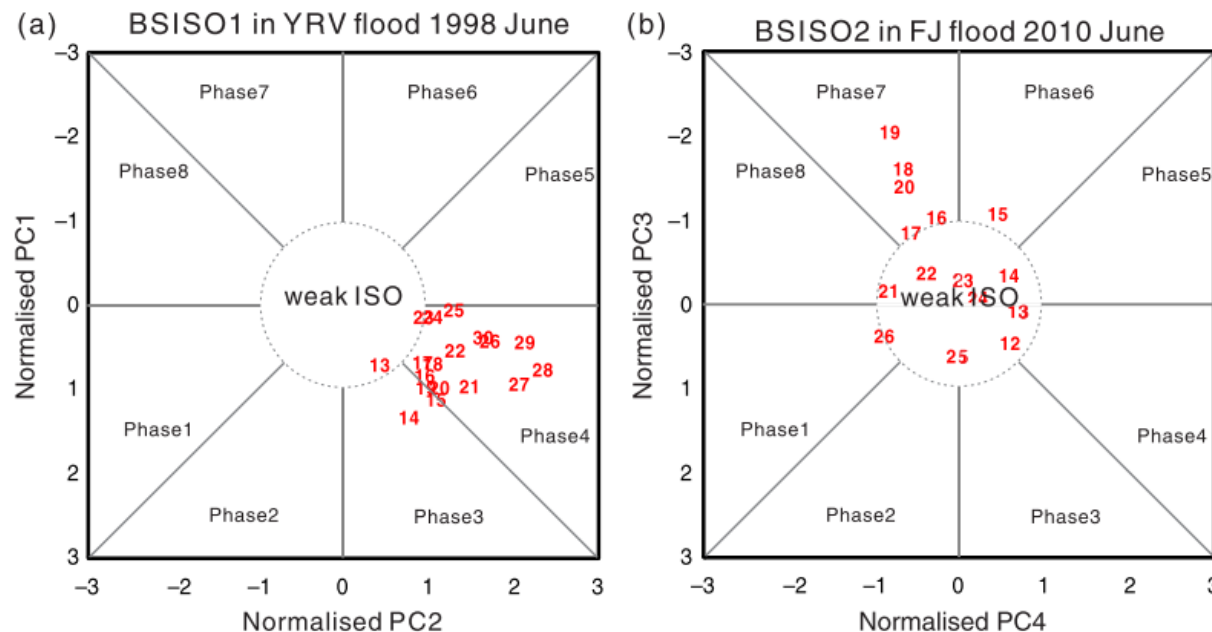
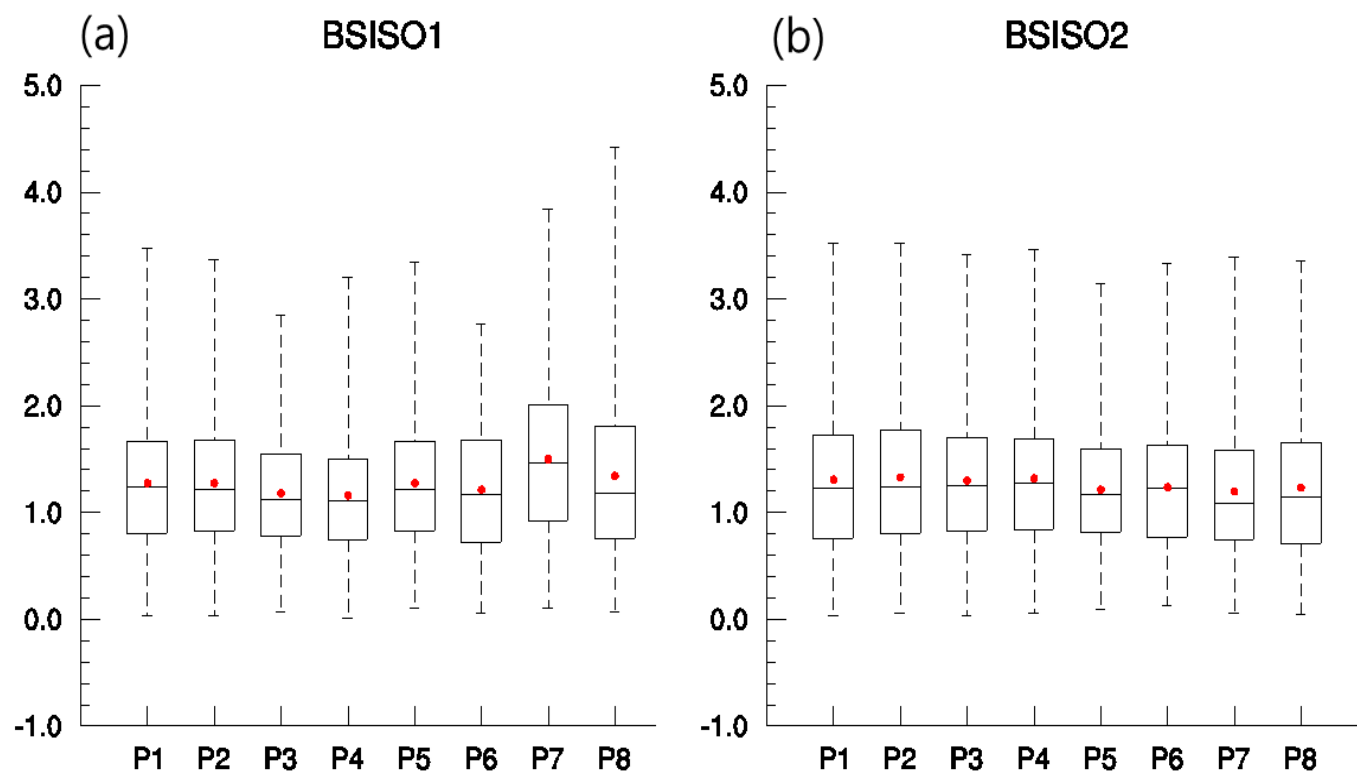


Figure 5. (a) BSISO1 phase indices during the maximum rainfall period (13–30 June) of Yangtze River flood in 1998. The numbers shown in the phase diagram indicate the date. (b) Same as (a), except for the BSISO2 phase points during the period (12–26 June) of Fujian flood in 2000.



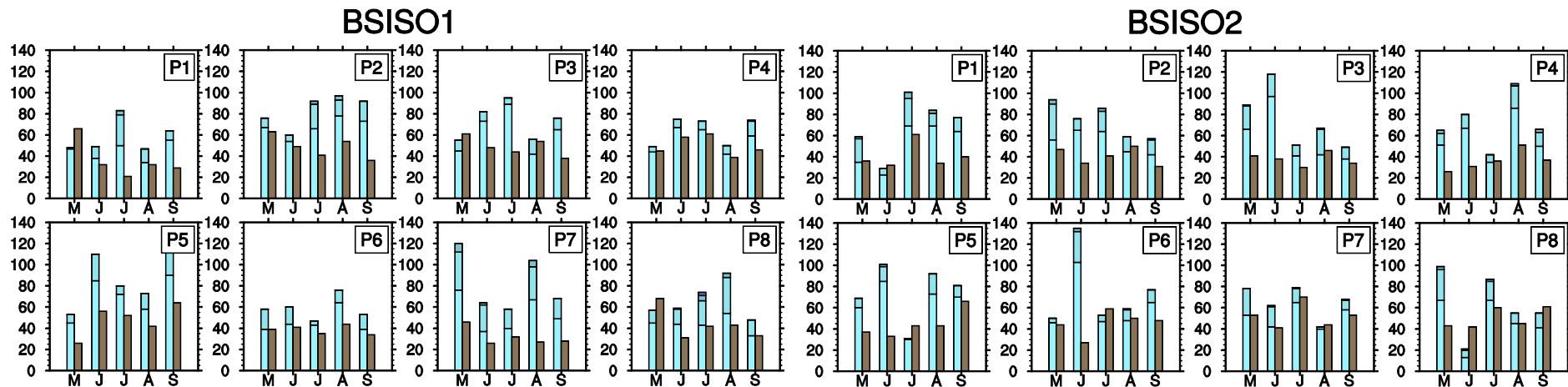
# Climatological aspects

## BSISO indices statistics



# Climatological aspects

## Active vs Inactive BSISO frequencies

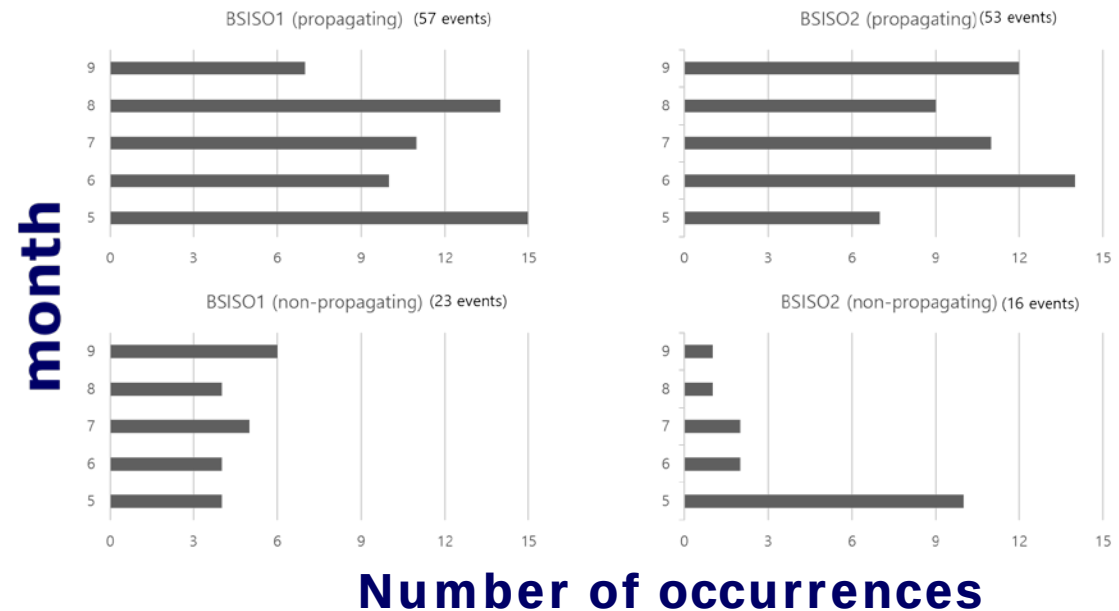




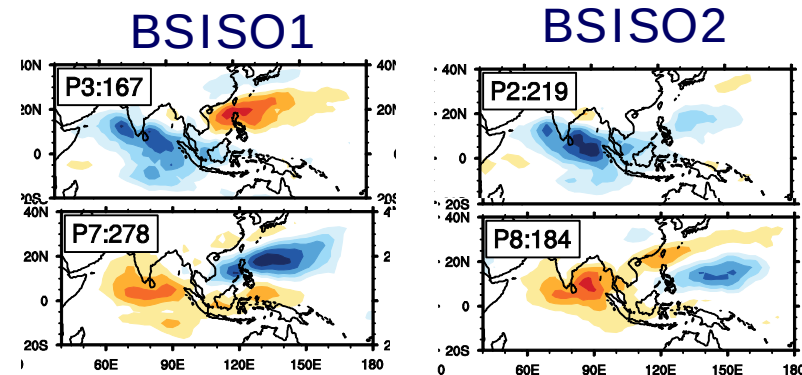
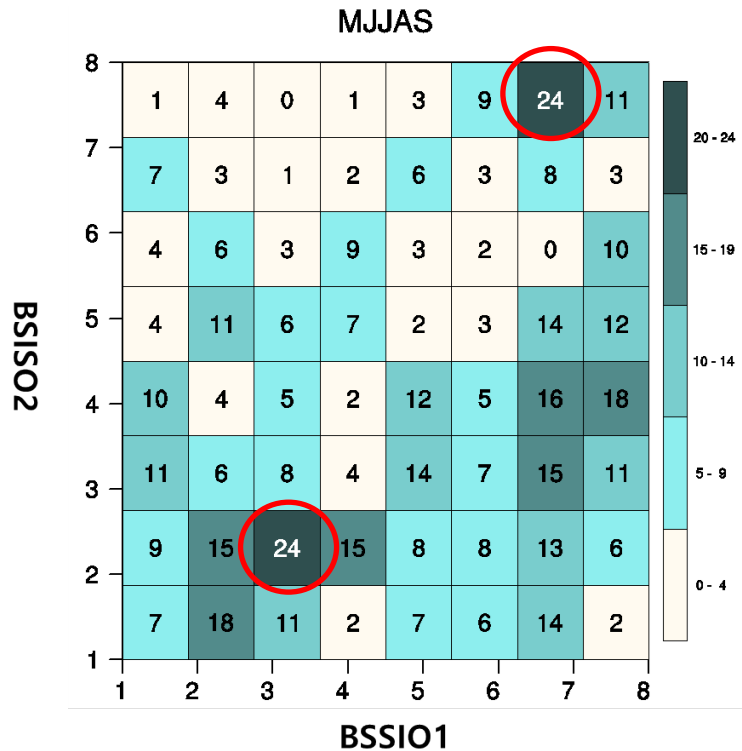


# BSISO event feature

|                  | BSISO1              |                         | BSISO2              |                         |
|------------------|---------------------|-------------------------|---------------------|-------------------------|
|                  | Propagating<br>(57) | Non-Propagating<br>(23) | Propagating<br>(53) | Non-Propagating<br>(16) |
| Duration (days ) | 11.40351            | 8.043478                | 10.36538            | 8                       |
| Number of phases | 2.631579            | 1                       | 3.134615            | 1                       |



# Co-occurrence of BSISO1 & BSISO2



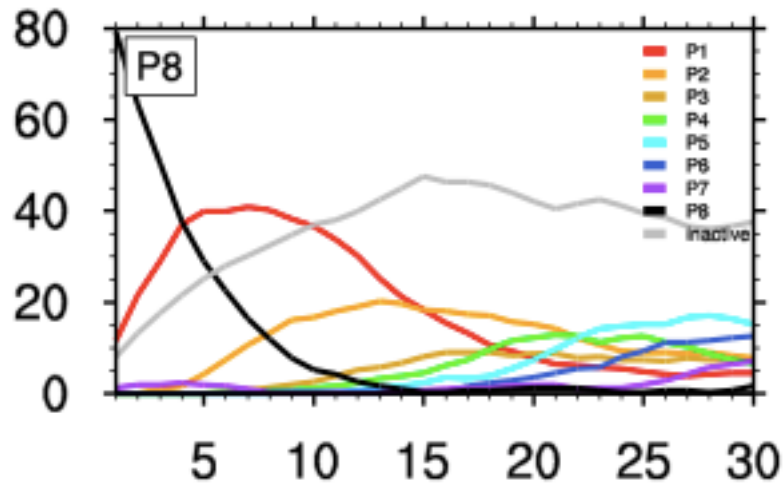
Number of days when both BSISO1 and BSISO2 are greater than 1.5 (1981-2010)

| M  | J   | J  | A   | S  |
|----|-----|----|-----|----|
| 97 | 111 | 99 | 104 | 84 |

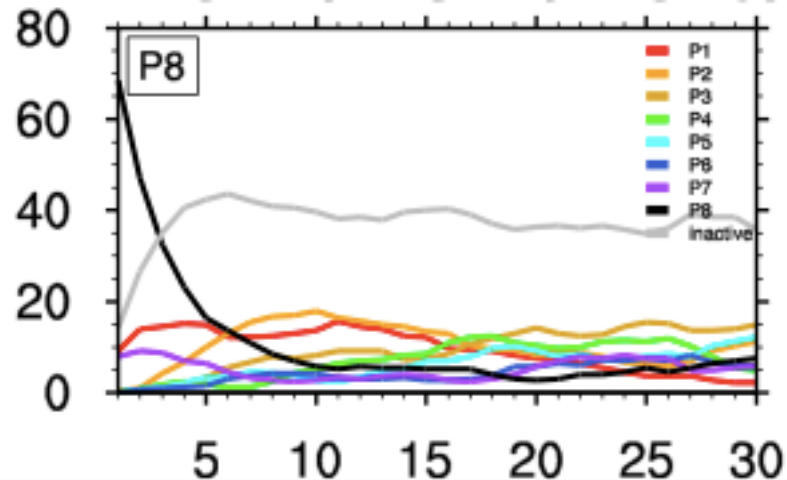


# Phase transition probability

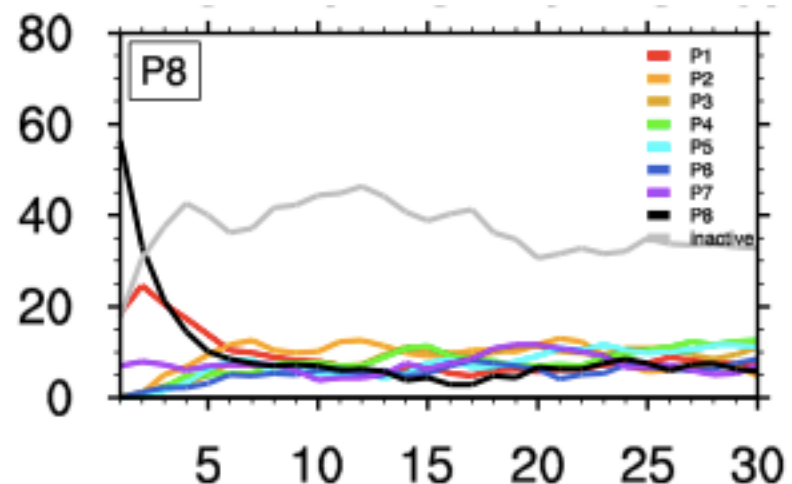
MJO



BSISO1



BSISO2

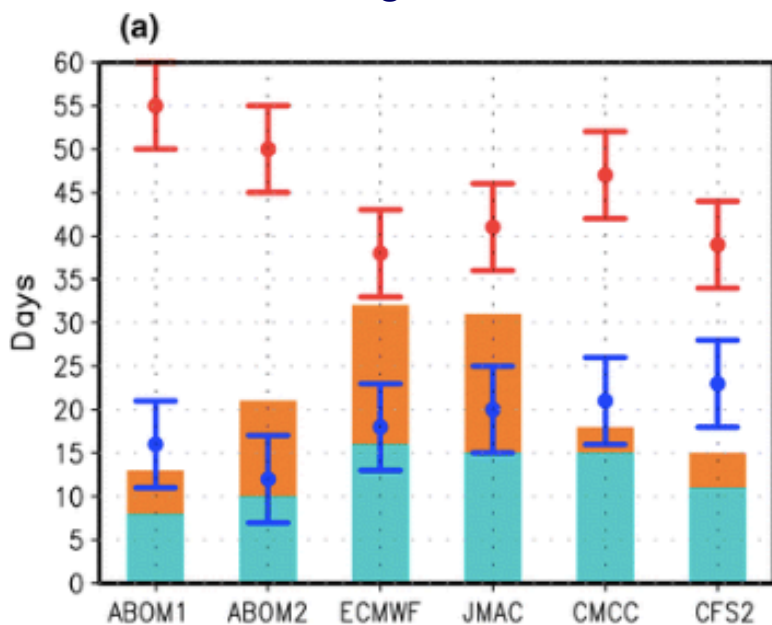


days

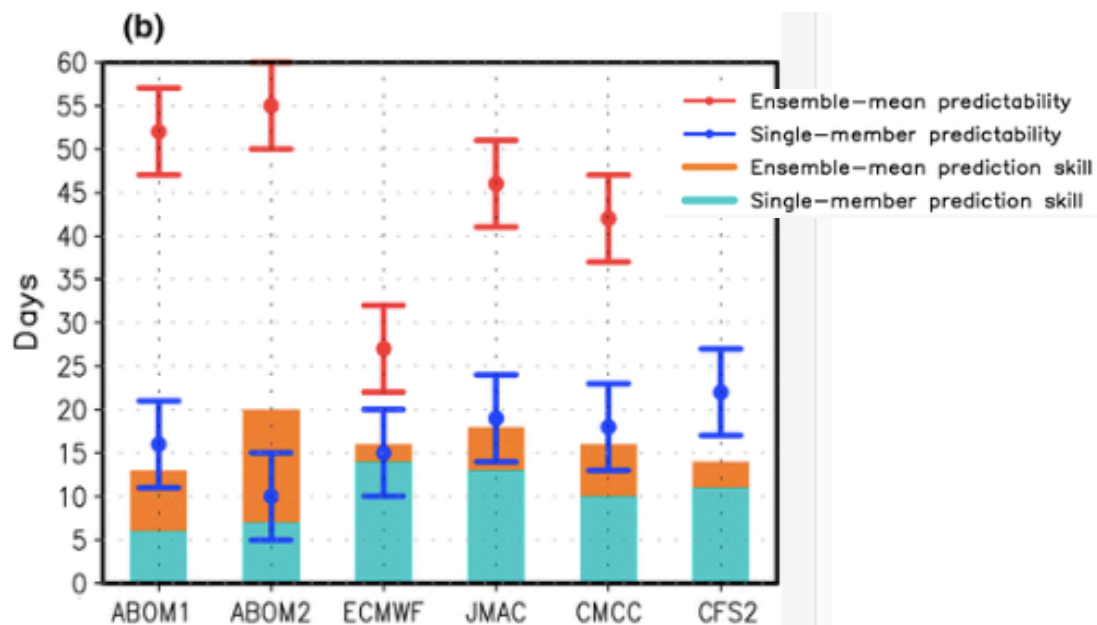
# Prediction skill of BSISO

## Intraseasonal Variability Hindcast Experiment (ISVHE)

Strong BSISO IC



weak BSISO IC



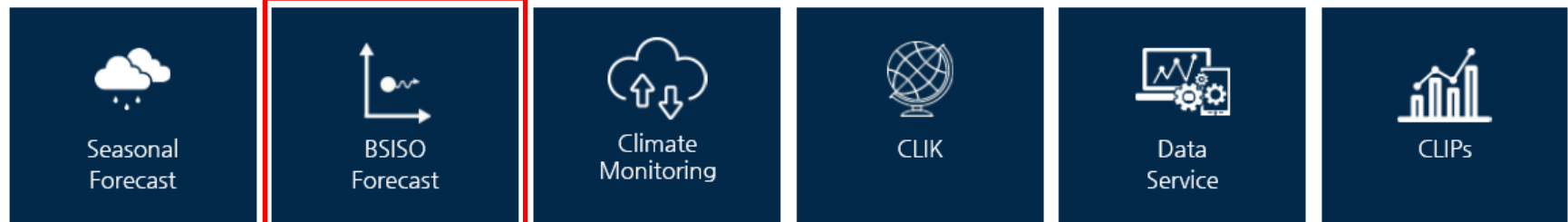
the prediction skill gap between single-member method and ensemble-mean method is larger in the strong BSISO initial conditions.

# Where do we get BSISO forecast?



<http://www.apcc21.org>

## CLIMATE INFORMATION SERVICES



Forecast

Monitoring

Methodology

- The BSISO forecast activity has been initiated in 2013 with the goal of improving our ability to understand and forecast the BSISO based on numerical models
- The forecast is updated everyday with the latest information and is available from May to October

# Participating models

| Institute                                                                                                   | Model                            | Ensemble Size | Forecast Period | Update frequency | Resolution        |
|-------------------------------------------------------------------------------------------------------------|----------------------------------|---------------|-----------------|------------------|-------------------|
| <br><b>NCEP</b>            | Climate Forecast System          | 4             | 40 days         | Once a day       | T126<br>L64       |
|                                                                                                             | Global Forecast System           | 1             | 16 days         | Once a day       | T574, T190<br>L64 |
| <br><b>Australia</b>       | POAMA 2.4 multi-week model       | 33            | 40 days         | Twice per week   | T47<br>L17        |
| <br><b>ECMWF</b>          | ECMWF Ensemble Prediction System | 51            | 32 days         | Twice per week   | T639, T319<br>L62 |
| <br><b>UK Met Office</b> | MOGREPS-15                       | 24            | 15 days         | Once a day       | 60km<br>L70       |
| <b>Taiwan CWB</b>                                                                                           | CWB EPS T119                     | 1             | 40 days         | Every 5 days     | T119 L30          |

In Cooperation with MJO task Force

# BSISO forecast

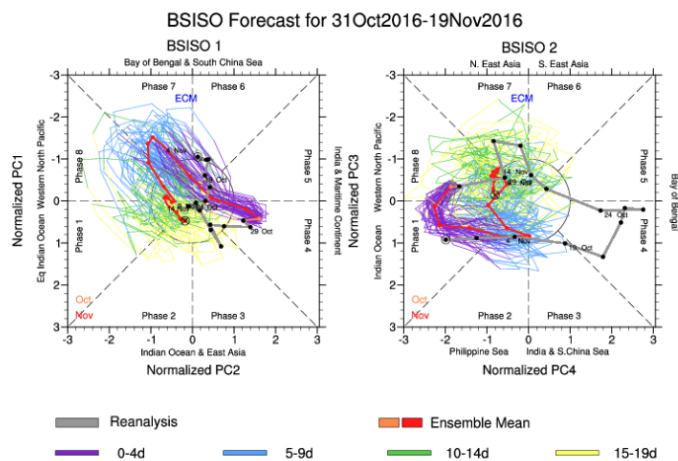
## Phase diagram

A key for the label headings in the figure box is provided below.

Note: Move cursor over product name to display. Click for additional information

Phase Plots of BSISO Index Forecasts

| BOM | CFS | GFS | UKM | ECM | CWB |
|-----|-----|-----|-----|-----|-----|
|-----|-----|-----|-----|-----|-----|



© APEC Climate Center

## OLR anomalies

| BOM | CFS | GFS | UKM | ECM | CWB |
|-----|-----|-----|-----|-----|-----|
|-----|-----|-----|-----|-----|-----|

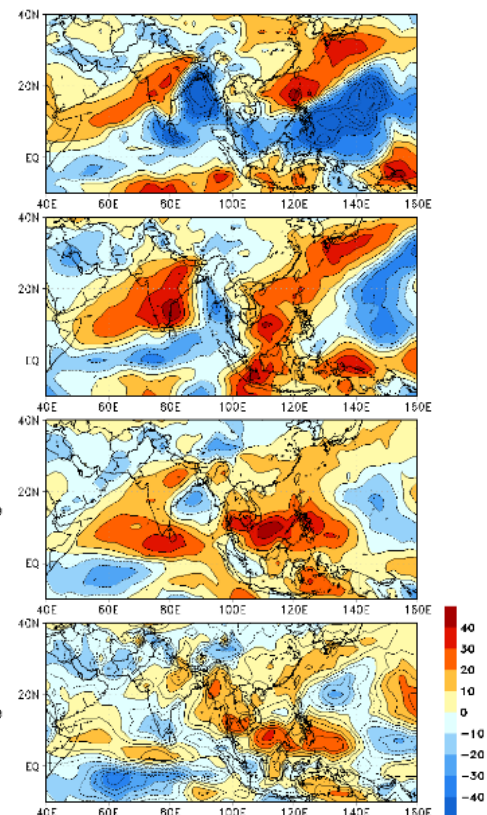
Initial Date  
(31/10/2016)

Days 1-5 Ave  
forecast

Days 6-10 Ave  
forecast

Days 11-15 Ave  
forecast

Days 16-20 Ave  
forecast





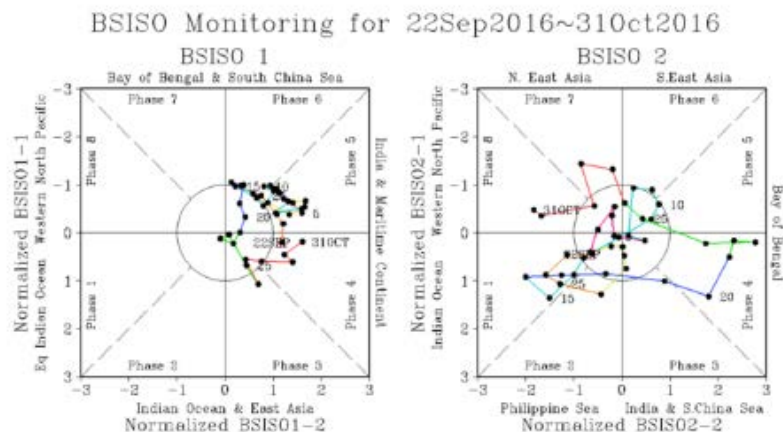
# BSISO monitoring

Home > Climate Information Service > BSISO Forecast > **Monitoring**

## Monitoring

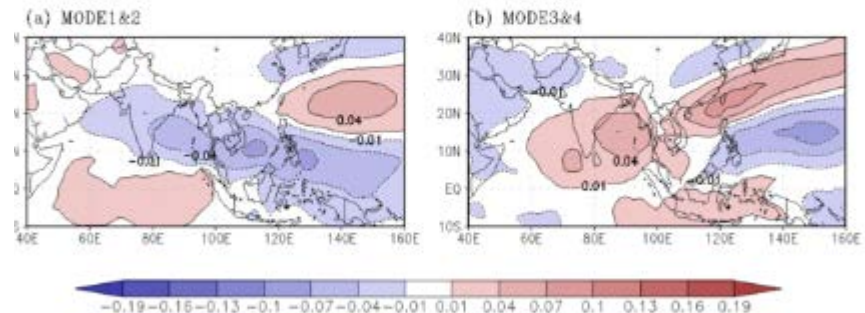
Welcome to the Boreal Summer Intraseasonal Oscillation (BSISO) monitoring website. The BSISO, one of the dominant phenomena over the Asian summer monsoon region, is characterized by northward/northeastward propagation over the Indian summer monsoon region and northward/northwestward propagation over the Western North Pacific-East Asian region, including equatorial eastward propagation. **This monitoring information is available from May to October.**

[Text file of Normalized Time Series for the BSISO1 and BSISO2 index](#)



© APEC Climate Center

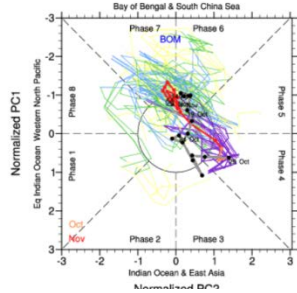
Reconstructed OLR anomaly  
based on the BSISO indices (31Oct2016)



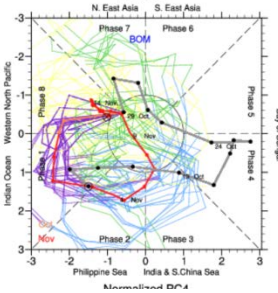
# BSISO verification system

BSISO Forecast for 30Oct2016-18Nov2016

BSISO 1

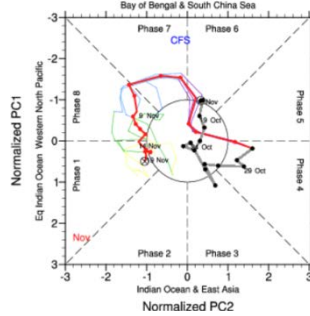


BSISO 2

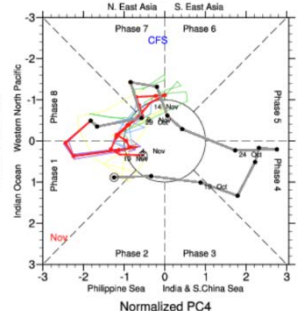


BSISO Forecast for 1Nov2016-20Nov2016

BSISO 1

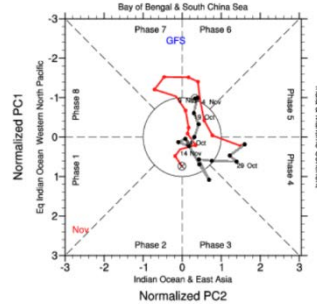


BSISO 2

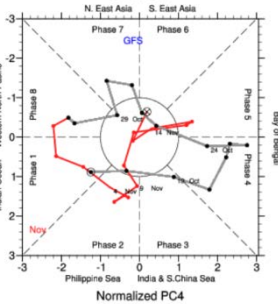


BSISO Forecast for 1Nov2016-16Nov2016

BSISO 1

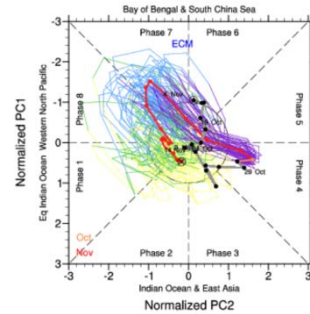


BSISO 2

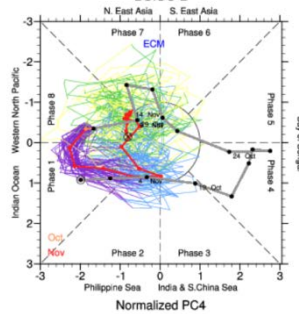


BSISO Forecast for 31Oct2016-19Nov2016

BSISO 1

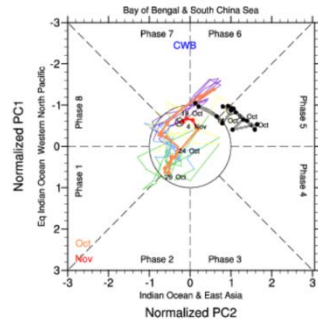


BSISO 2

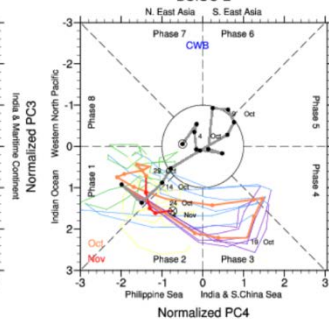


BSISO Forecast for 17Oct2016-5Nov2016

BSISO 1

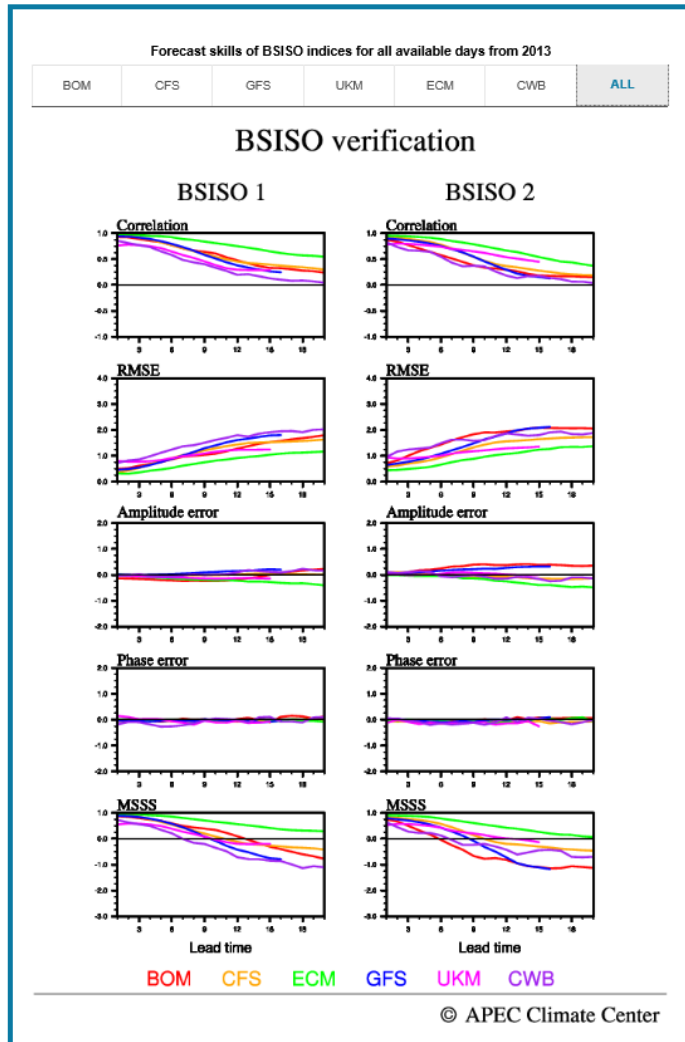


BSISO 2



Verification  
(Real-time & total  
skill score based  
on all available  
forecast)

# BSISO verification system



- **Correlation coefficient**

Perfect score: 1

Skill in forecasting the phase of the BSISO

- **Root Mean Square Error (RMSE)**

Perfect score: 0

Errors in both phase & amplitude

- **Phase amplitude**

Perfect score: 0

Relative amplitude difference btw observation and forecast

Positive: forecast amplitude is larger than the observed

- **Phase error**

Perfect score: 0

Positive: phase speed of the forecast is faster than that of the observation

- **Mean square skill score (MSSS)**

Perfect score: 1

Relative level of skill of forecast compared to a climatological forecast that predict no BSISO signal



# APCC mission

The mission of APCC is to enhance the socio-economic well-being of member economies by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques through



## Climate Prediction

APCC produces value-added, reliable, and real-time climate prediction information and provides the APEC region with it.



## Interdisciplinary Research

APCC leads in the development of interdisciplinary research and application techniques at the climate-environment-society nexus.



## Climate Information Services

APCC strives to be a key climate database center to distribute climate data, information products, and related tools.

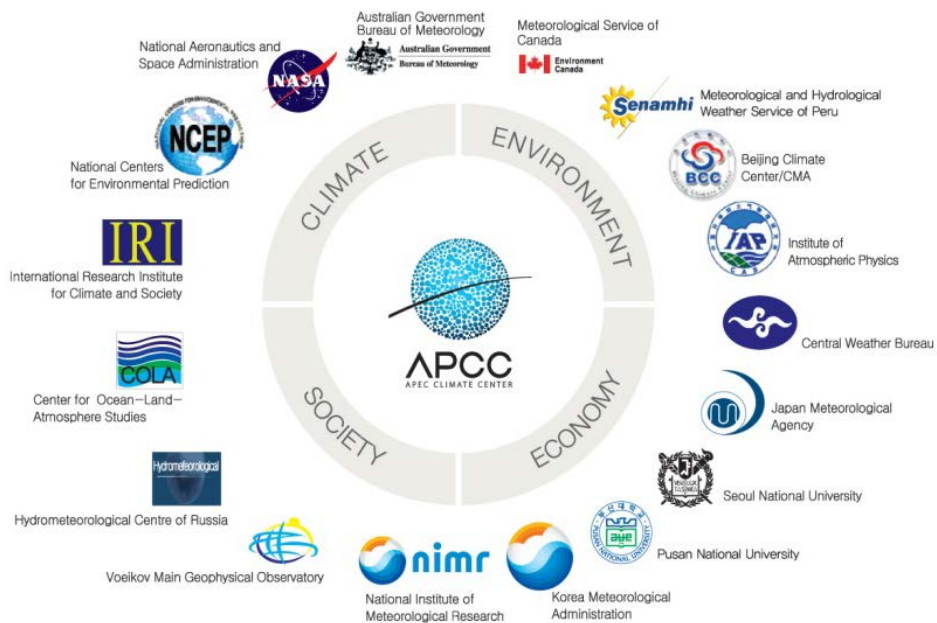


## International Cooperation

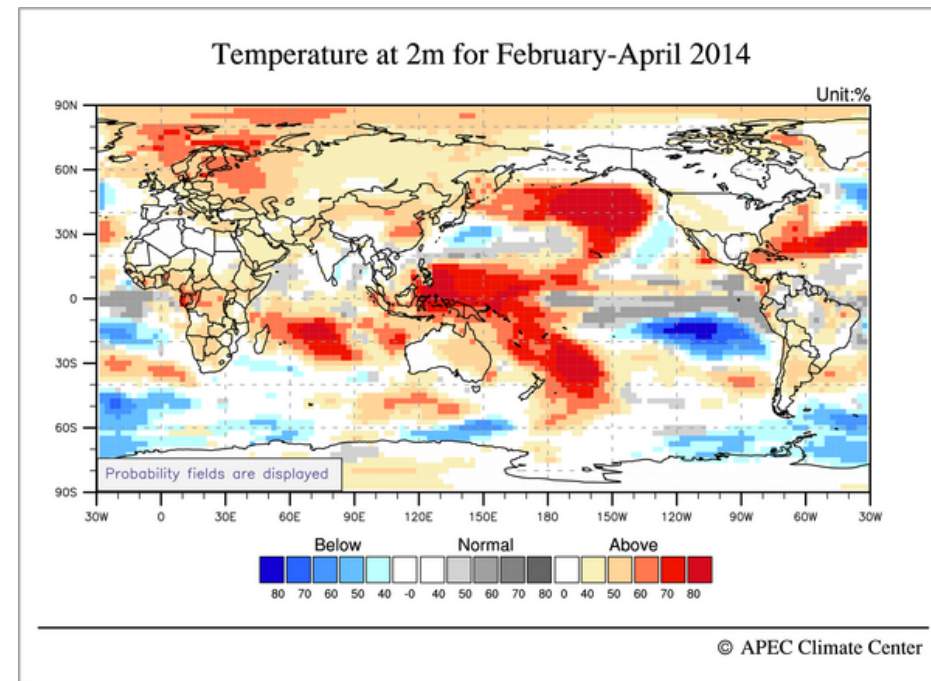
APCC guides developing countries from the APEC region toward building their own capacity to produce reliable climate prediction information.

# Operational Seasonal Forecast

## Multi-Institutional Cooperation



## Seasonal Forecasts





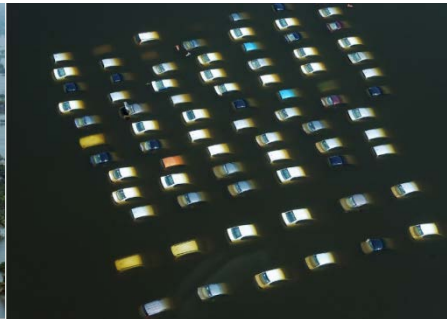
# A research proposed for 2017 in APCC

## ***“Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand”***

### **Worst flood in half a century: 2011**



4. This aerial picture shows an under-construction temple surrounded by floodwater outside the ancient Thai capital of Ayutthaya, north of Bangkok, on October 10, 2011. [AP Photo/Cheney Lundberg](#)



5. Cars sit submerged in floodwater at a Honda car factory outside the ancient Thai capital of Ayutthaya, north of Bangkok, on October 10, 2011. [AP Photo/Cheney Lundberg](#)



6. Family members watch TV lifted onto a cabinet to avoid floodwater at their home in Bangkok, Thailand, on October 5, 2011. [AP Photo/Cheney Lundberg](#)



7. Children play in a flooded street in Samut Prakan province, about 80 km (50 miles) north of Bangkok, on September 12, 2011. Monsoon rains, storms, floods and mudslides have killed at least 280 people since July, authorities said. [AP Photo/Cheney Lundberg](#)



8. A Buddhist monk walks through floodwater on a street at a temple in Ayutthaya province, on October 7, 2011. [AP Photo/Cheney Lundberg](#)



9. Flooded houses outside Ayutthaya, north of Bangkok, on October 10, 2011. [AP Photo/Cheney Lundberg](#)



10. Rattaporn, 13, floats along the swollen Yom river near her home on August 23, 2011 in Phra Pradaeng, Thailand. [AP Photo/Cheney Lundberg](#)

<http://www.theatlantic.com/photo/2011/10/worst-flooding-in-decades-swamps-thailand/100168/>



# Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand

**Table 2: Impact of Floods in Thailand**

|                                                                           |                                                                             |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Impacted Households <sup>1</sup>                                          | 1,886,000 (as of Nov 22, 2011)                                              |
| Destroyed homes <sup>2</sup>                                              | 19,000 homes                                                                |
| Displaced people <sup>1</sup><br>(Affected people)                        | 2.5 million people                                                          |
| Casualty                                                                  | 813 people                                                                  |
| Impacted farm land <sup>1</sup>                                           | 17,578 square kilometers                                                    |
| Economic Damage and Losses <sup>2</sup><br>(Only in Manufacturing Sector) | THB 1.43 trillion USD 46.5 billion<br>(THB 1,007 billion (US\$ 32 billion)) |

Source:

1: The Government of Thailand (2011)

2: The World Bank (2011)

(Haraguchi & Lall, 2012)

Thailand accounts for about 30% of global trade in rice and 25% of the main crop was not expected to survive the floods.<sup>[71]</sup> On the other side of the world rice farmers in Arkansas, usually accounting for 42% of US output, also were flooded early that year, and then faced drought, reducing their crop by 32% according to the USDA.<sup>[72]</sup> Combined, these two events will have a global impact on rice prices.

- [71] Apornrath Phoonphongphiphat (28 October 2011). ["Floods may damage quarter of Thai rice crop, exports hit"](#). Reuters.
- [72] Javier, Luzi Ann; Suwannakij, Supunnabul. ["Floods Ruining 14% of Thai Rice May Erase Global Export Glut: Commodities"](#). Bloomberg.



# Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand

## Worst drought (2014-2015) in decades

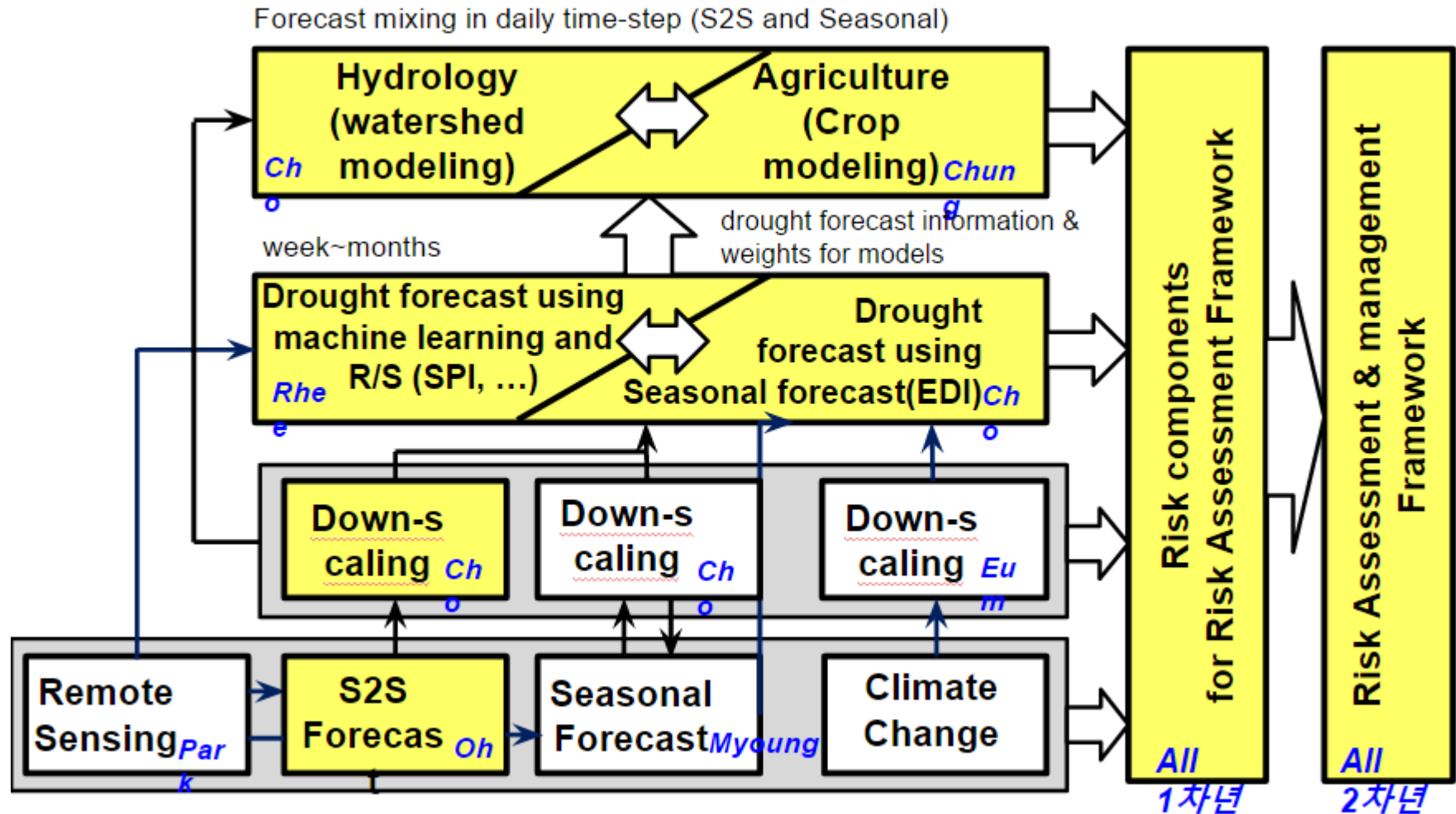


- Rice farmers usually plant their paddy in June or July but because of critical water shortages, the Agriculture Ministry has asked farmers to delay planting their crop until August.
- According to the Office of Agricultural Economics, the delay could cost farmers in Thailand's central plains 60 billion baht (\$1.8 billion) in losses and straddle them with significant debt.
- Thailand is one of the world's top producers of rice, exporting more than 10 million tons annually. As a result of the drought, the Thai government has lowered its [forecast](#) rice exports for this year by 2 million tons.

**Drought could mean a rise in rice prices**

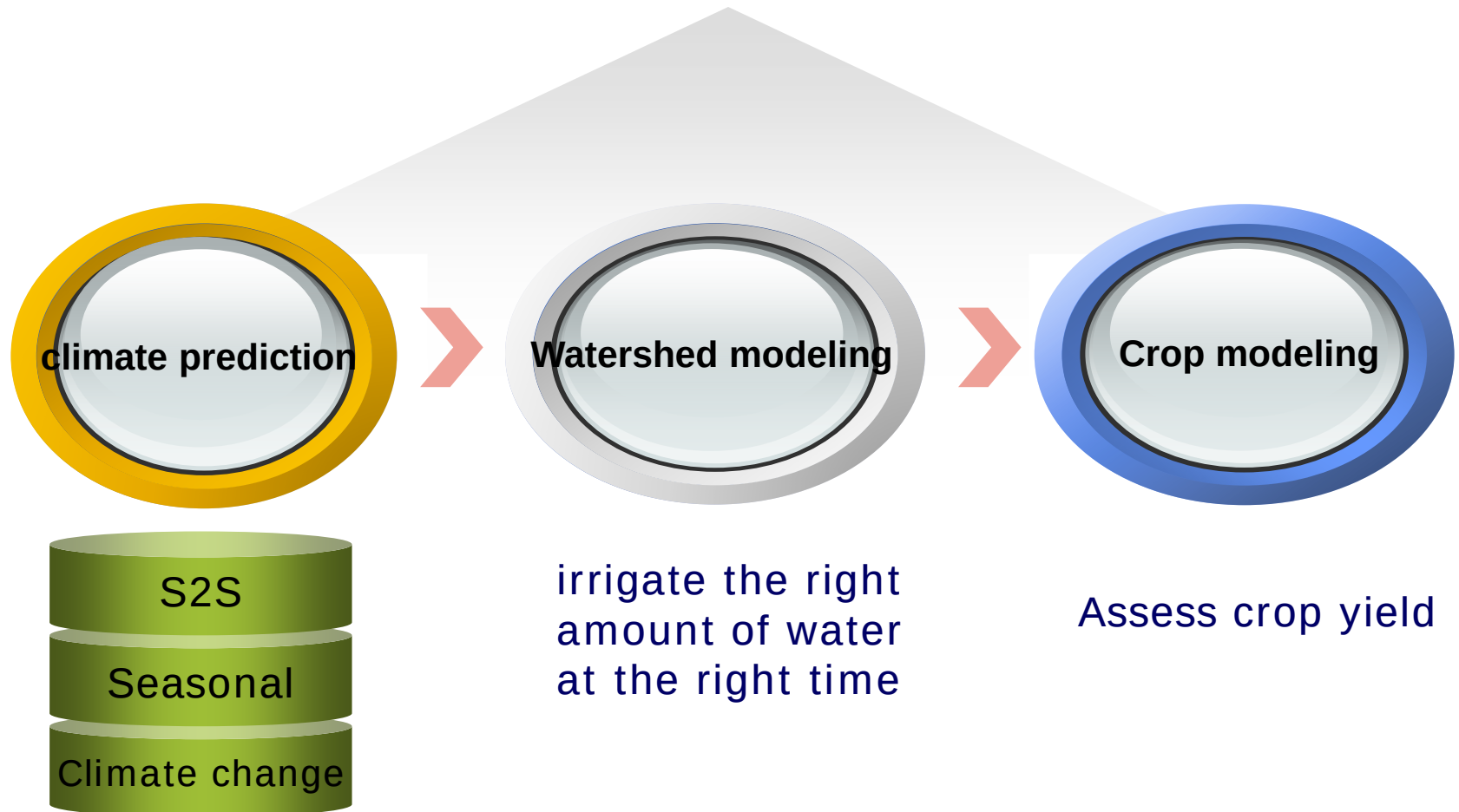
**(Time, Jul 16, 2015)**

# Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand



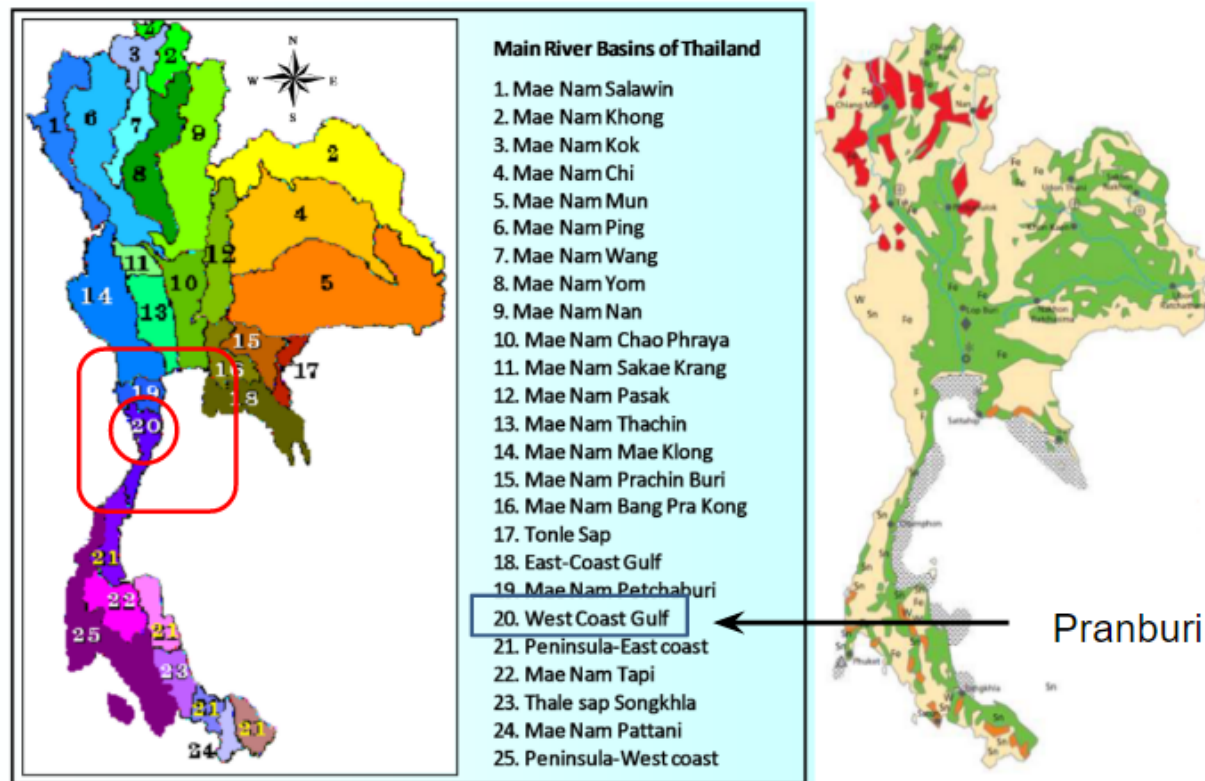
# Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand

## Risk assessment & management



# Utilization of multi-range climate information for risk assessment on agriculture-water resources in Thailand

Irrigated, isolated river basin including a Dam  
Impact of the BSISO, reliable prediction skill of MME of APCC  
Availability of data (Royal Irrigation Department of Thailand(RID) and the Korea Rural Community Corporation of the Republic of Korea(KRC )



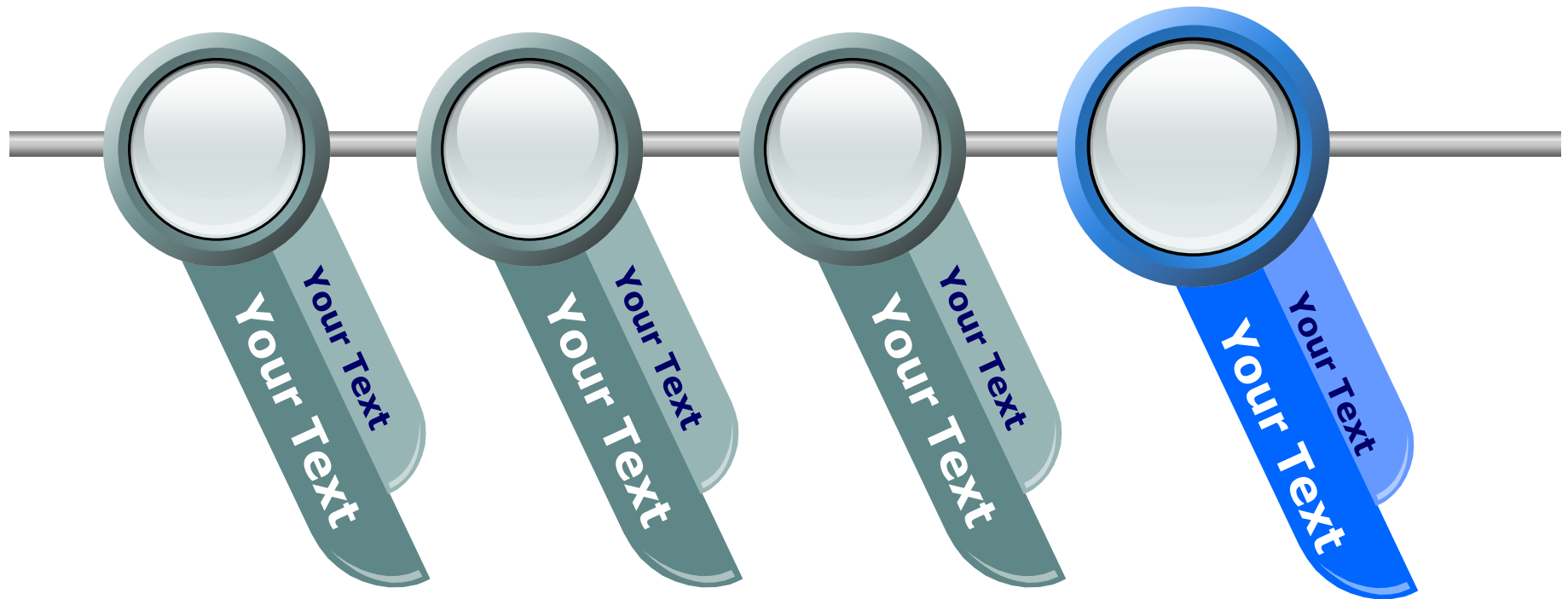


# Tomorrow morning session

- Details in composite analysis
- Investigate impact of the BSISO on your area of interest
- Please bring your laptop
- Email me at [jihyunoh@apcc21.org](mailto:jihyunoh@apcc21.org) so that I can share the link to the data & programs

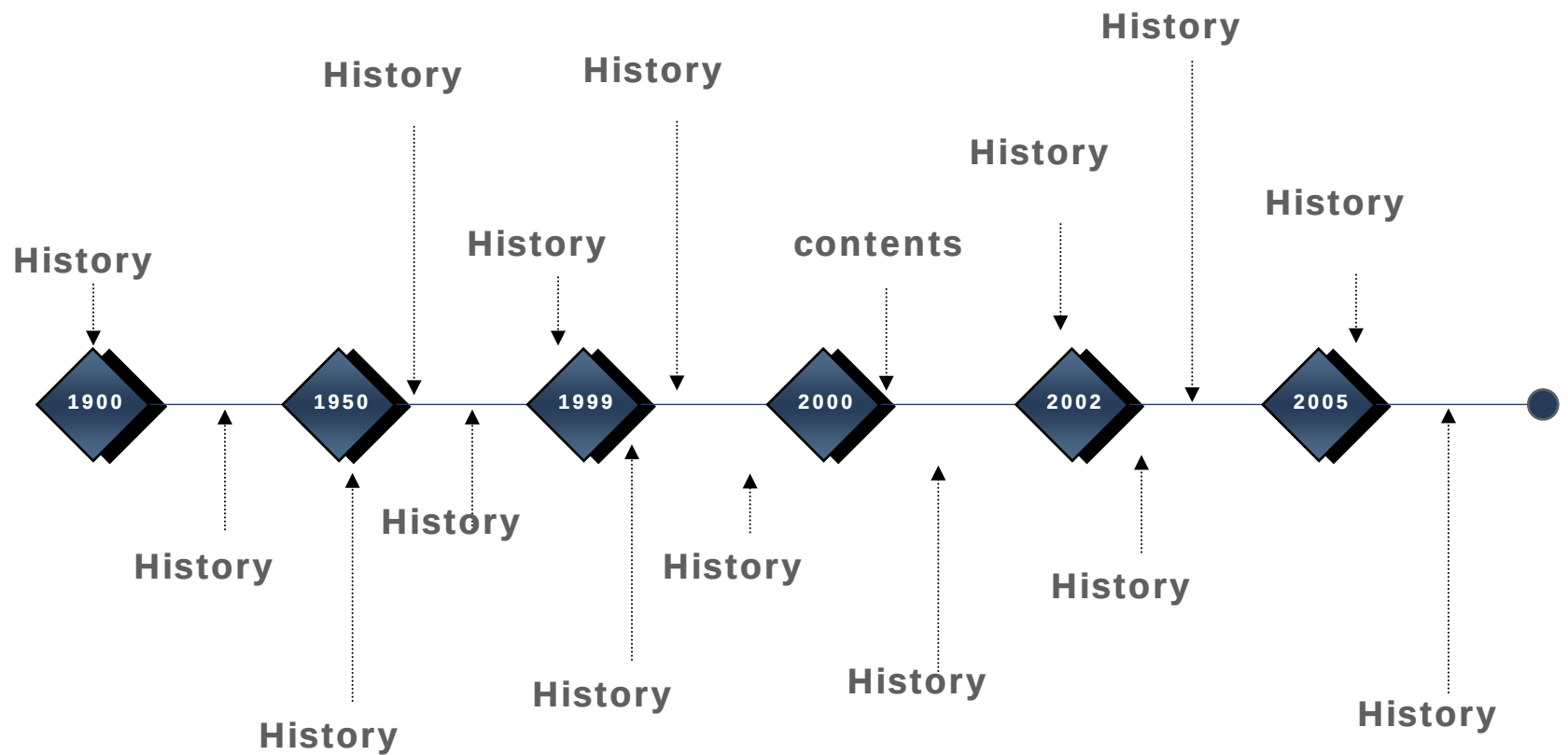


2001 → 2002 → 2003 → **2004**

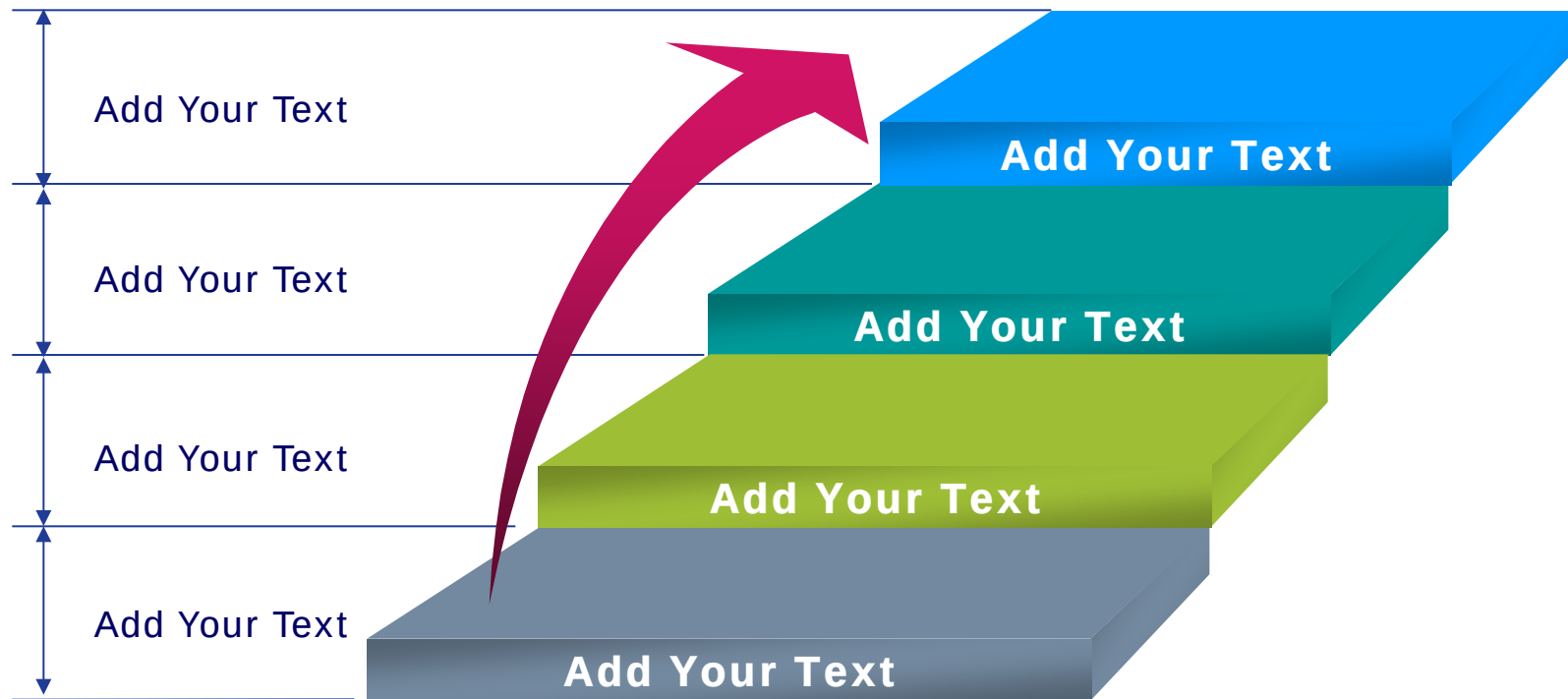


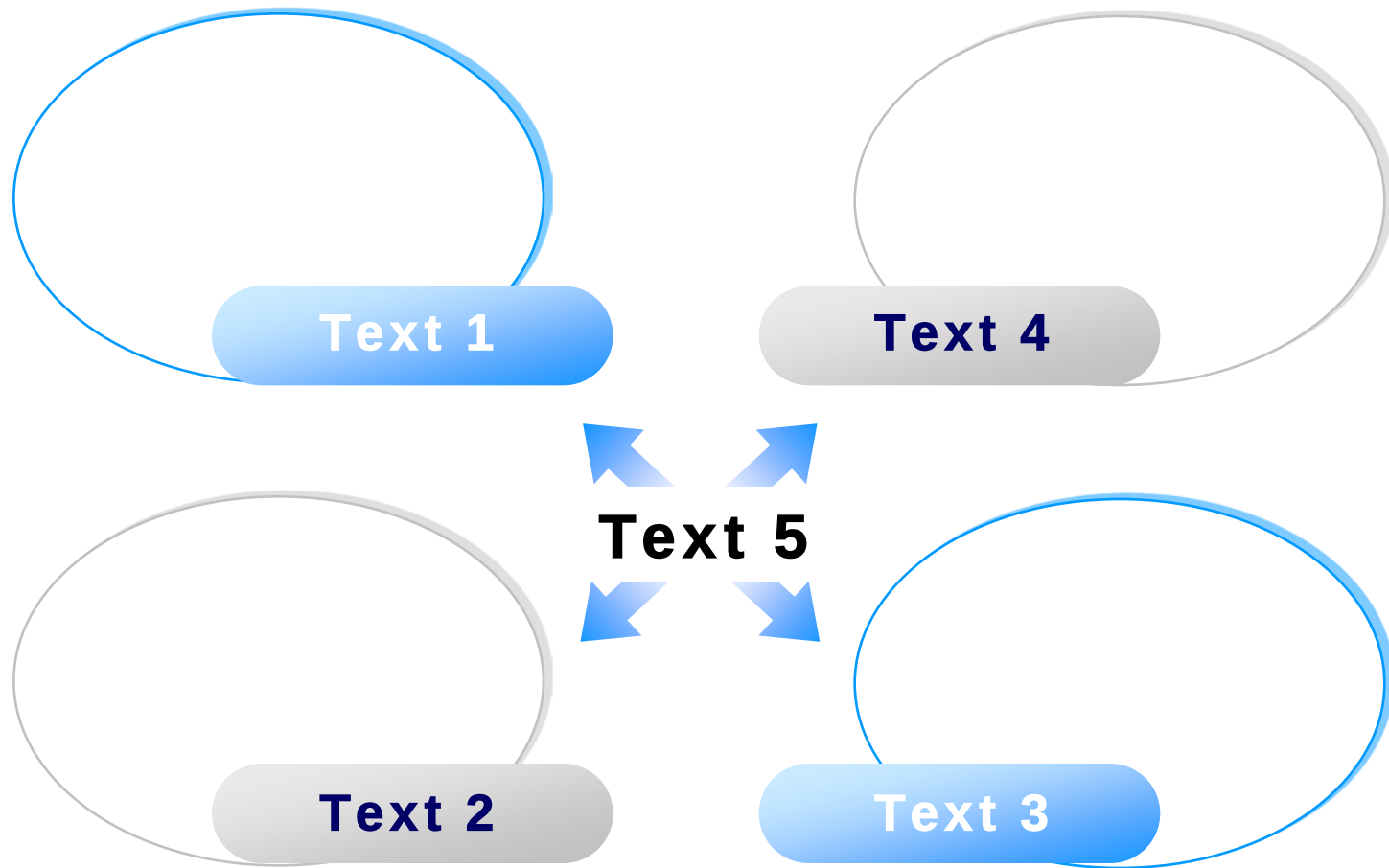


## ◆ History



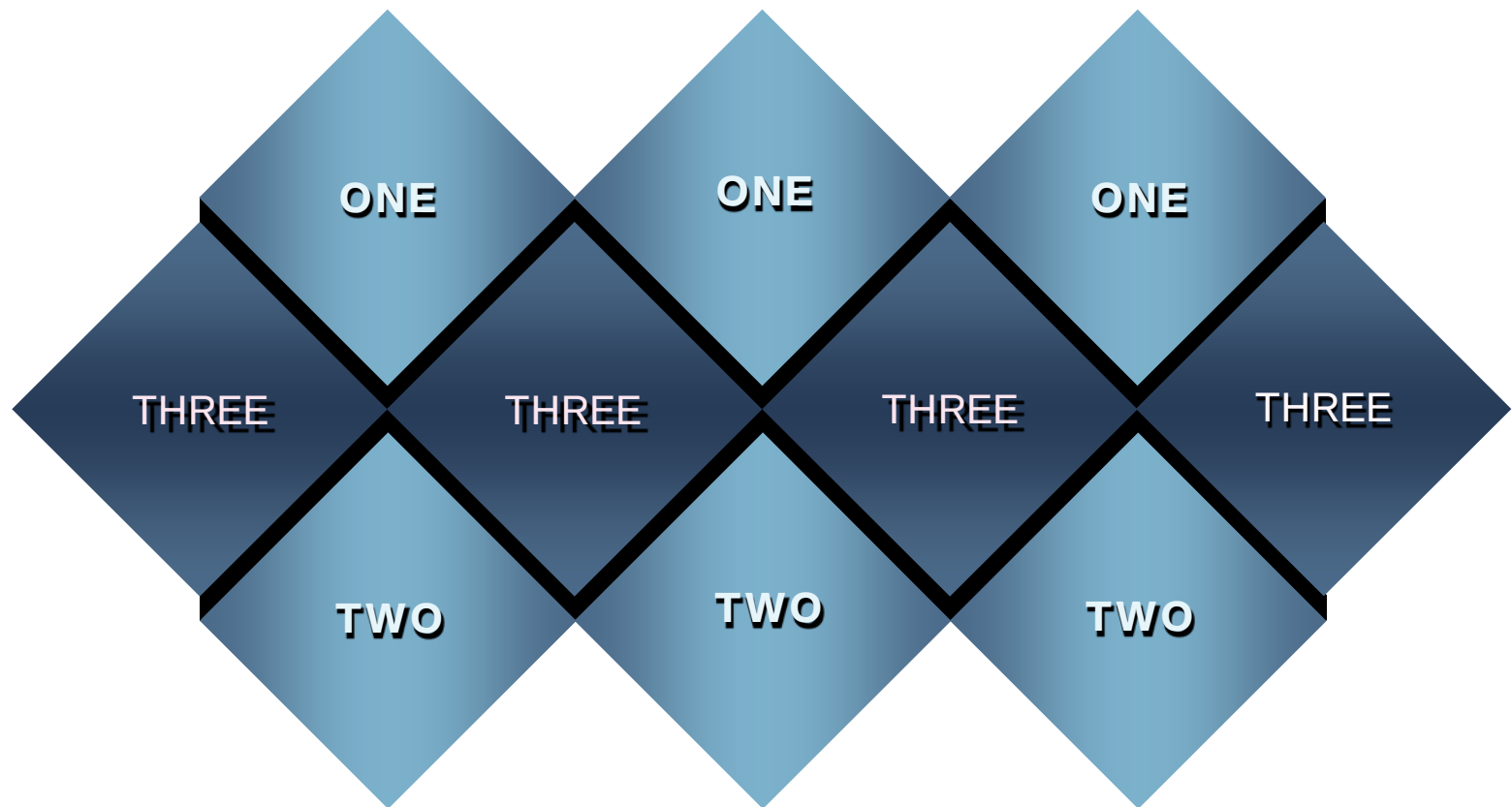


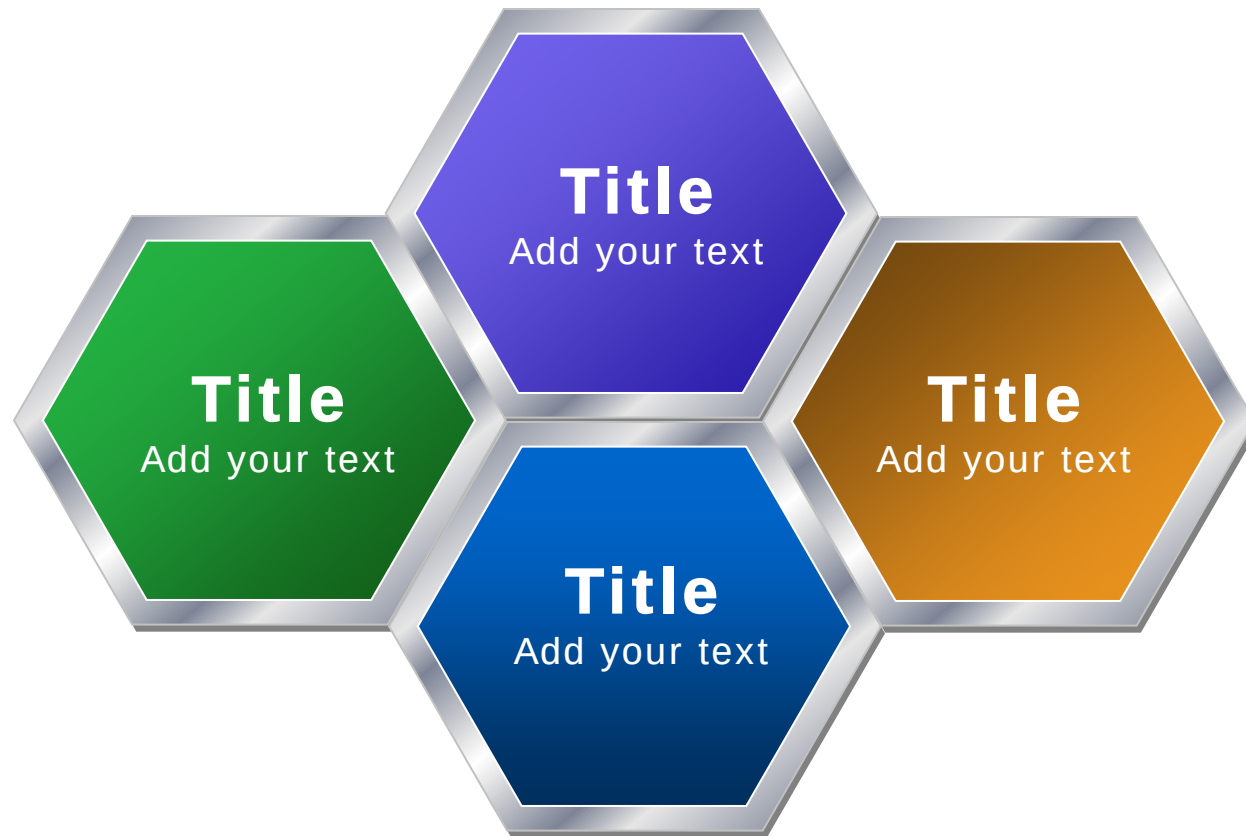


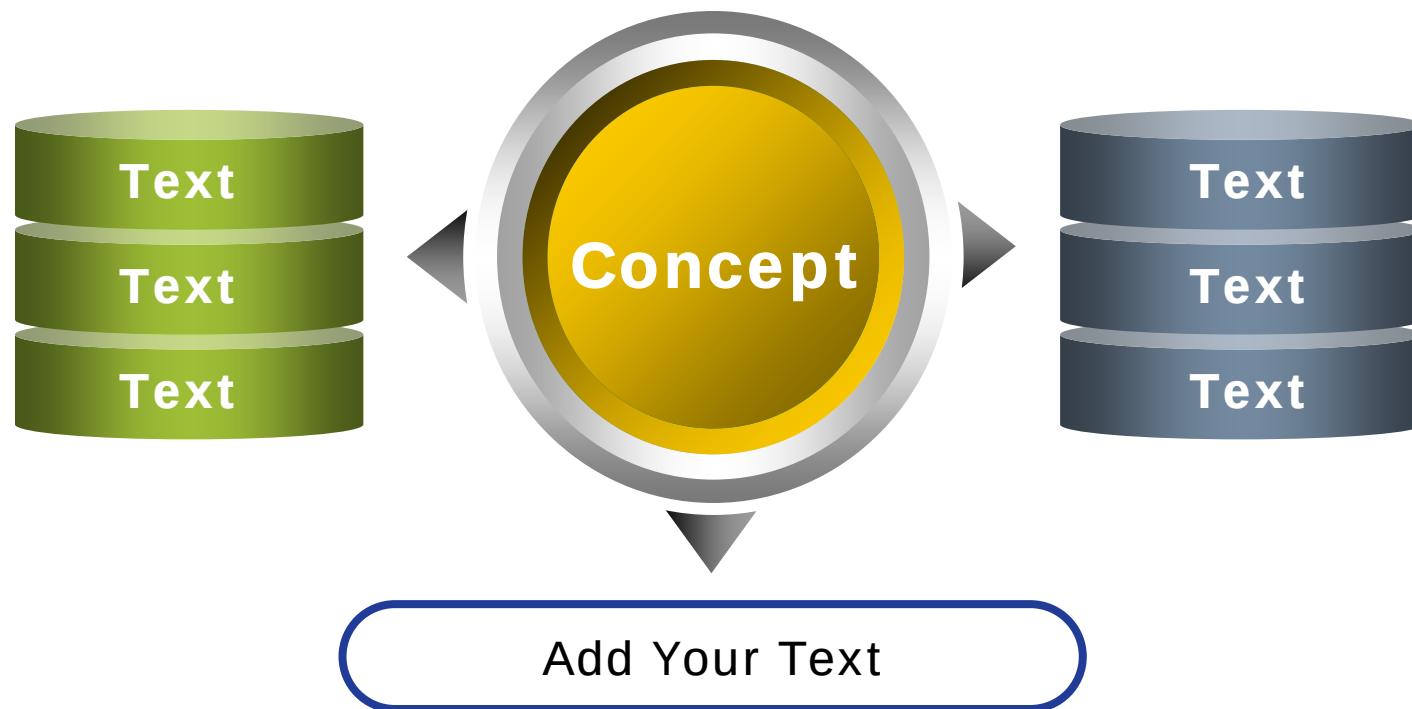




## ◆ Sub title









Add Your Text

Add Your Text

Add Your Text

**Add Your  
Title**



Subtitle



text1



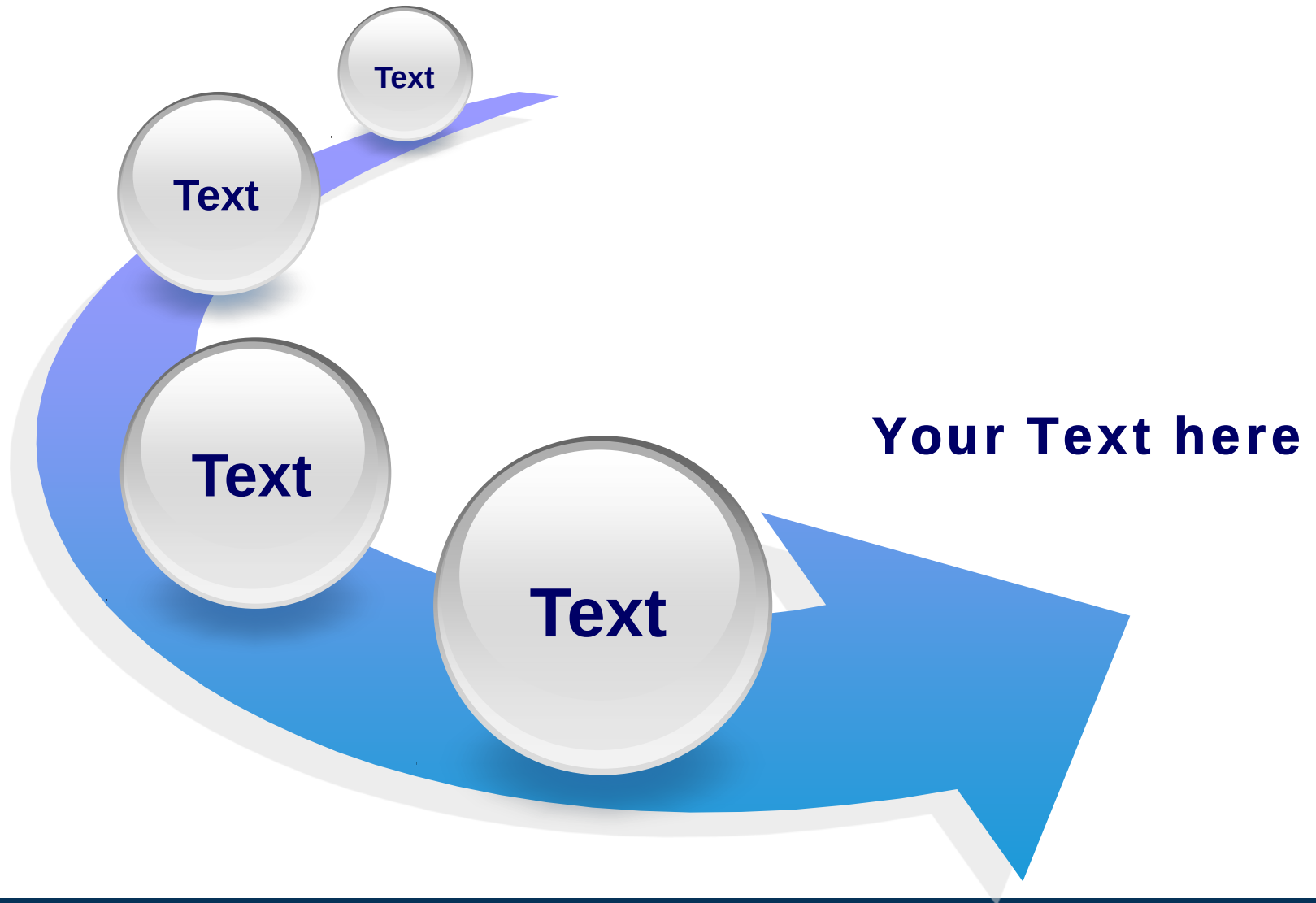
text2

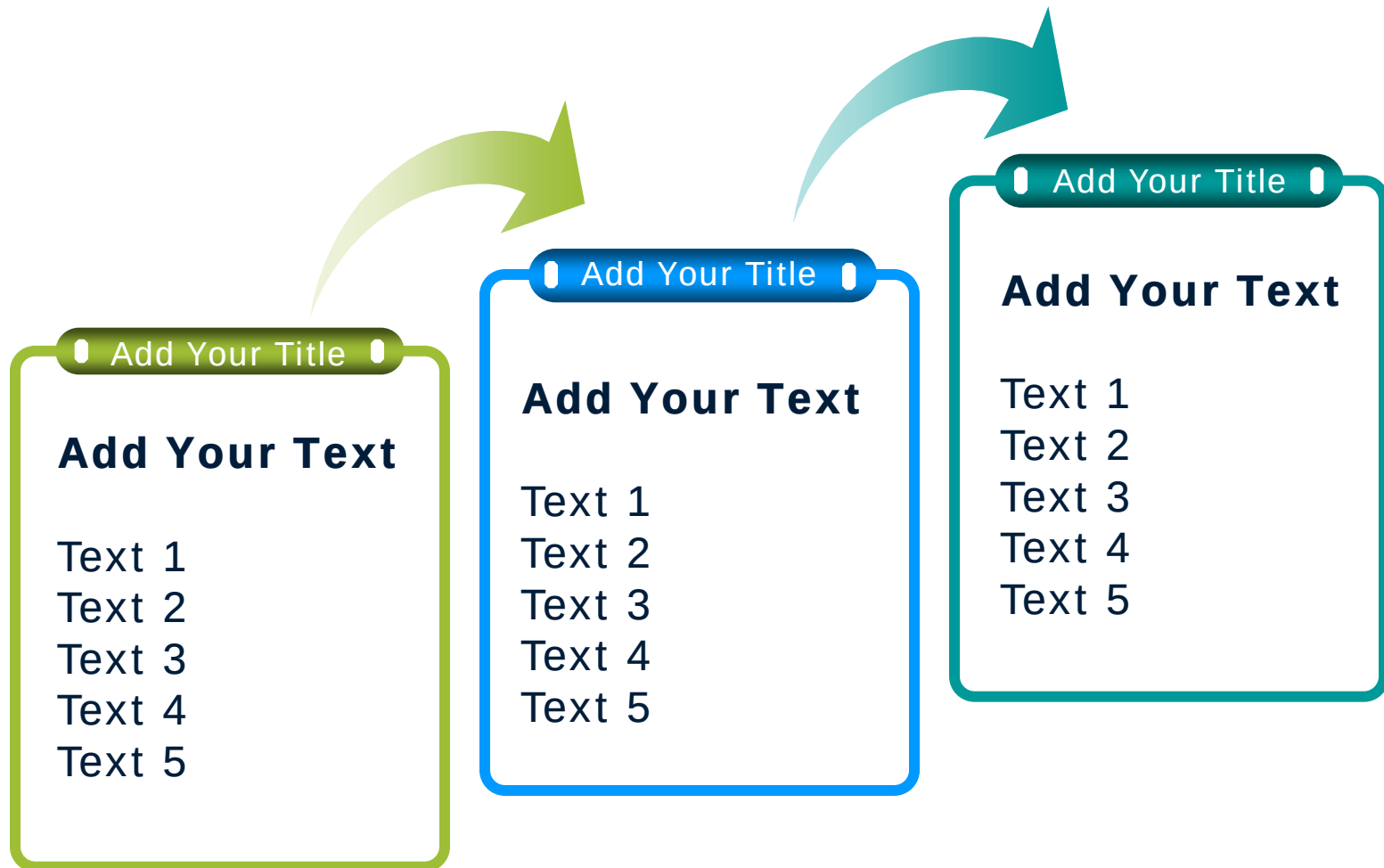


text3











**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5

**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5

**Add Your Text**

Text 1  
Text 2  
Text 3  
Text 4  
Text 5



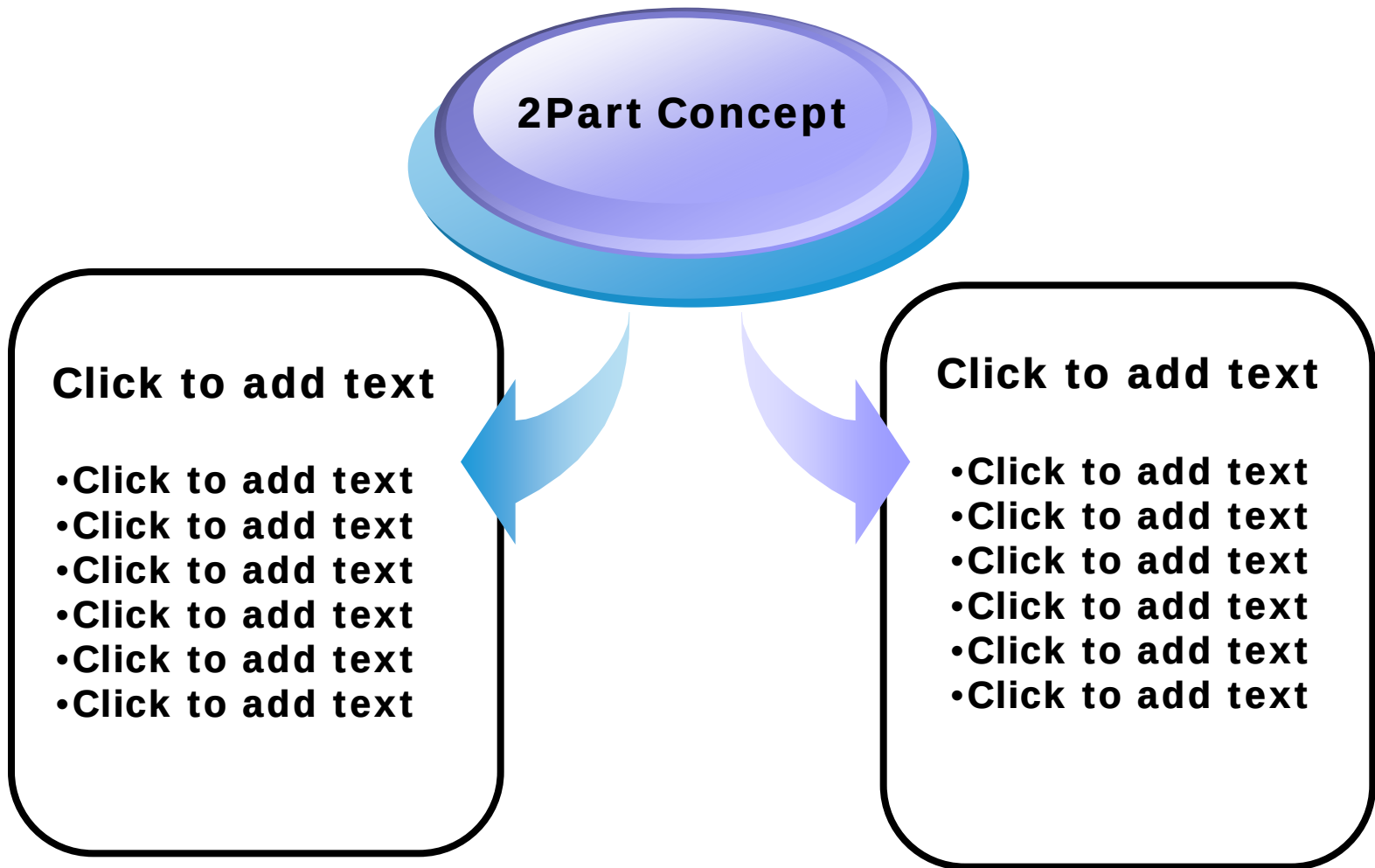
**Add Your Text**



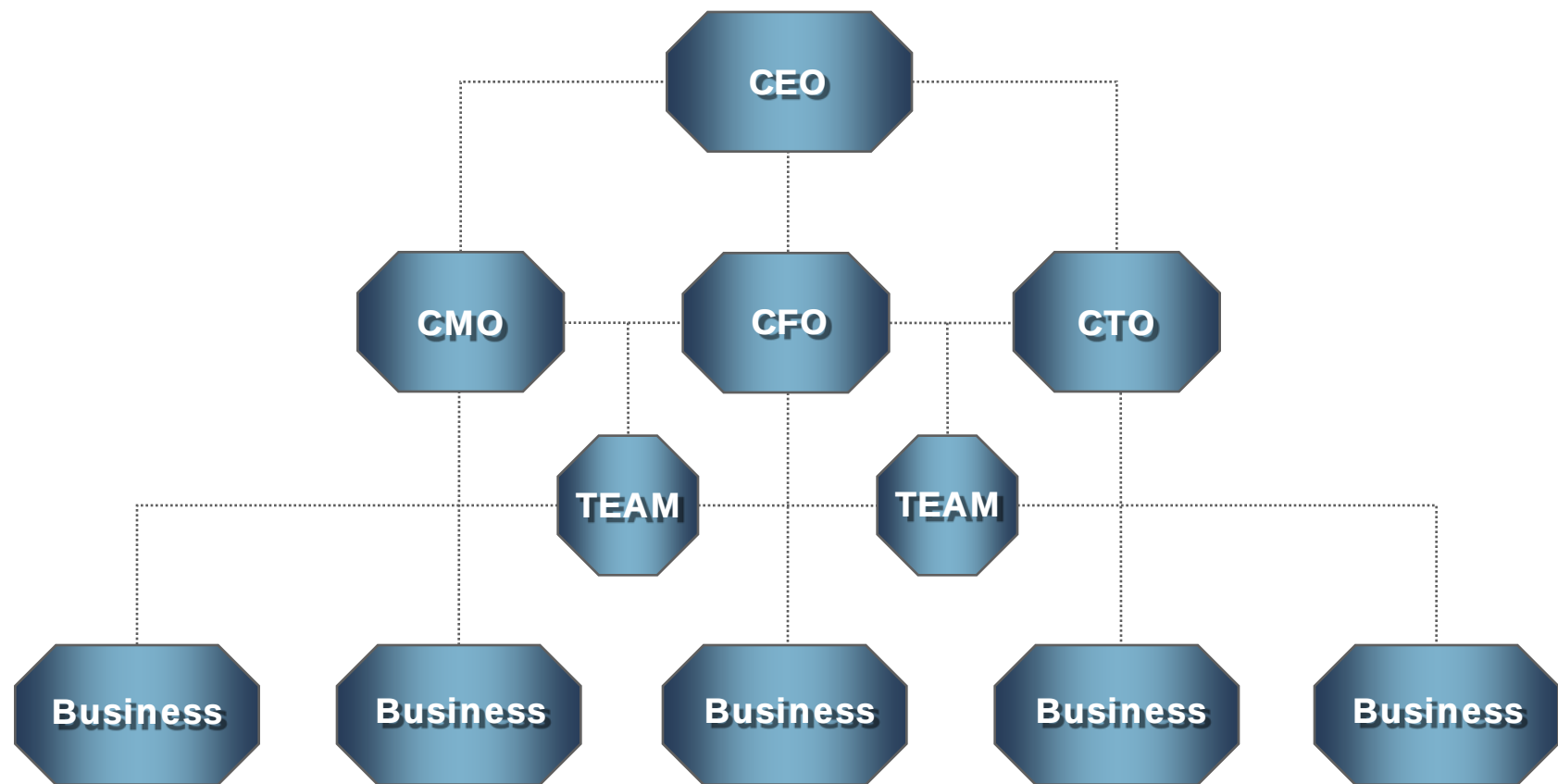
**Add Your Text**



**Add Your Text**

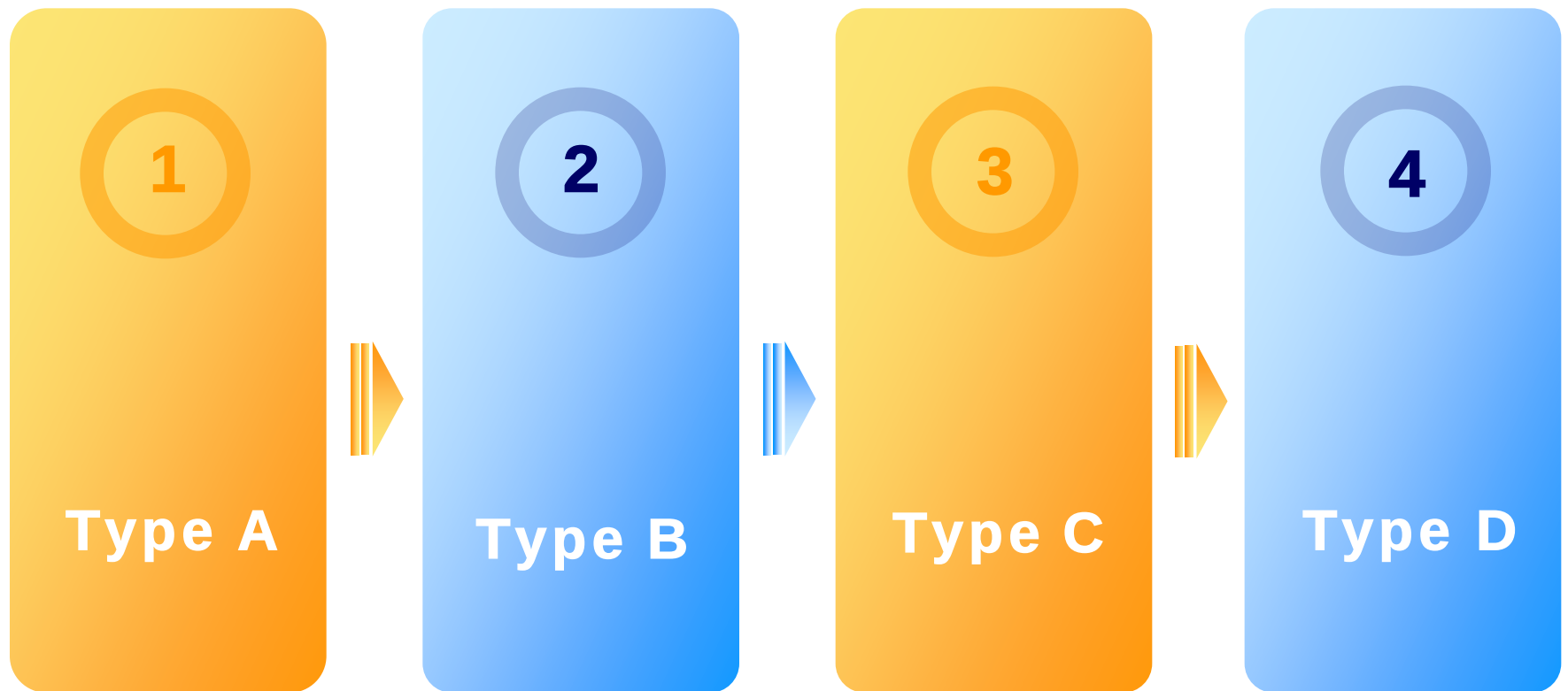


## ◆ Sub title



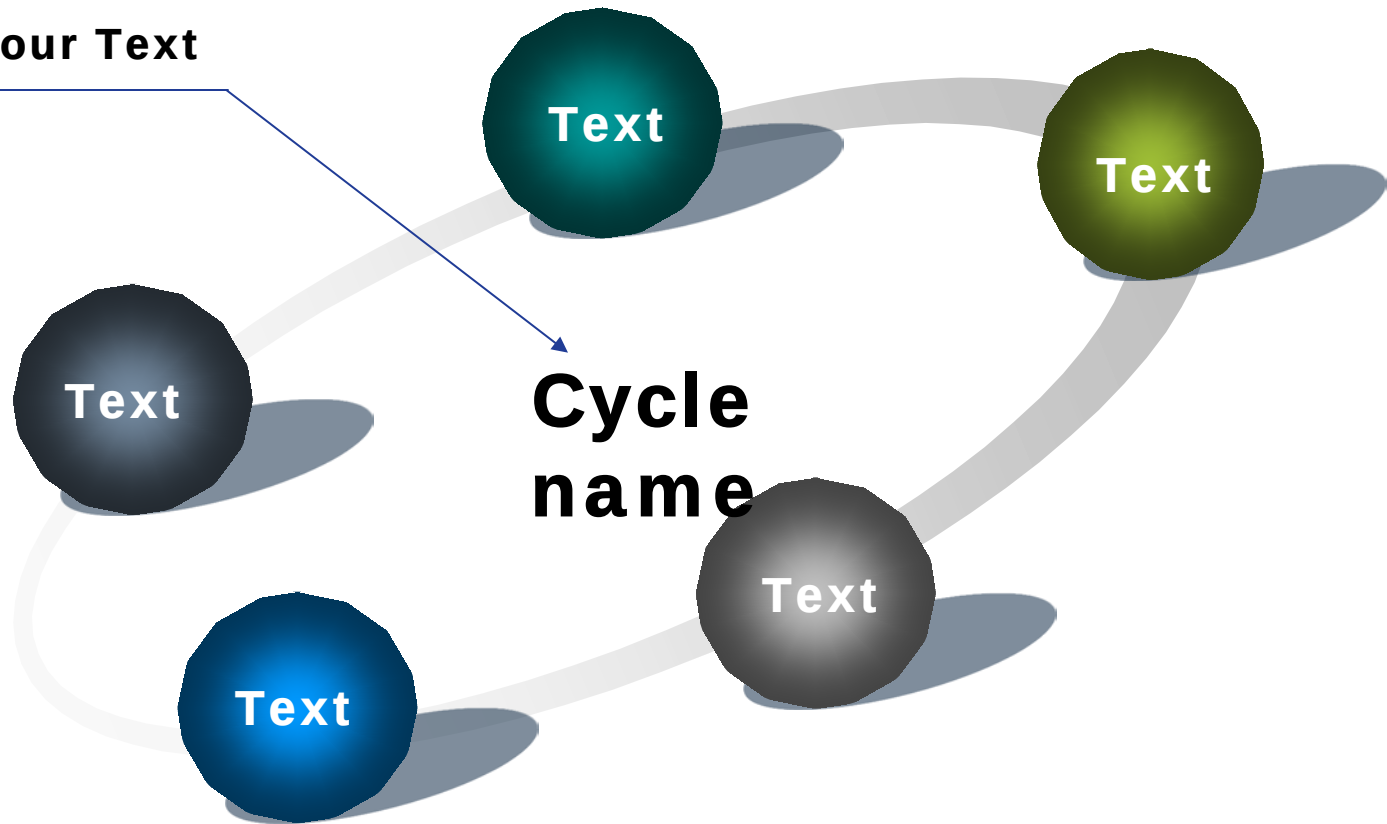








Add Your Text



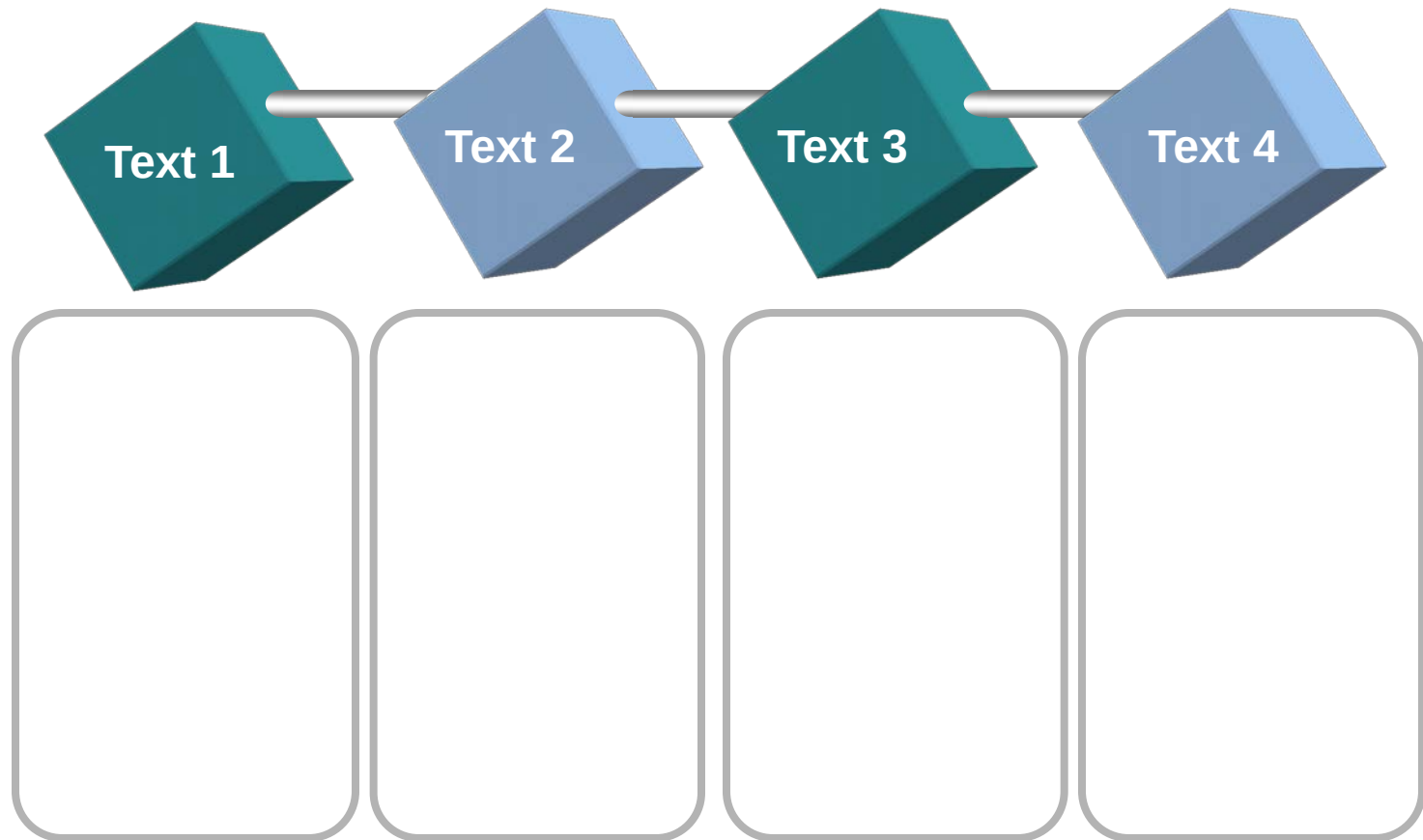


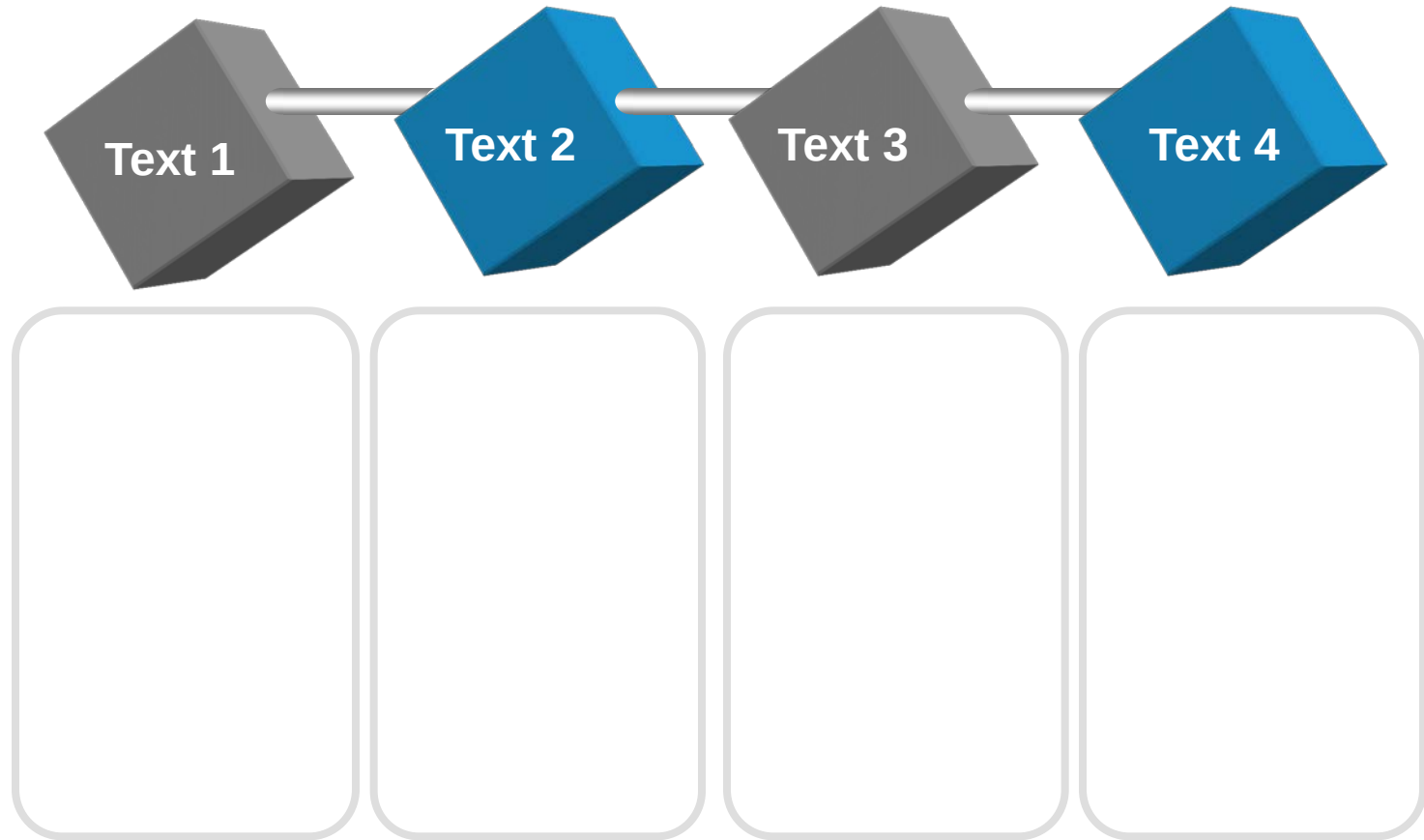
**Phase 1**

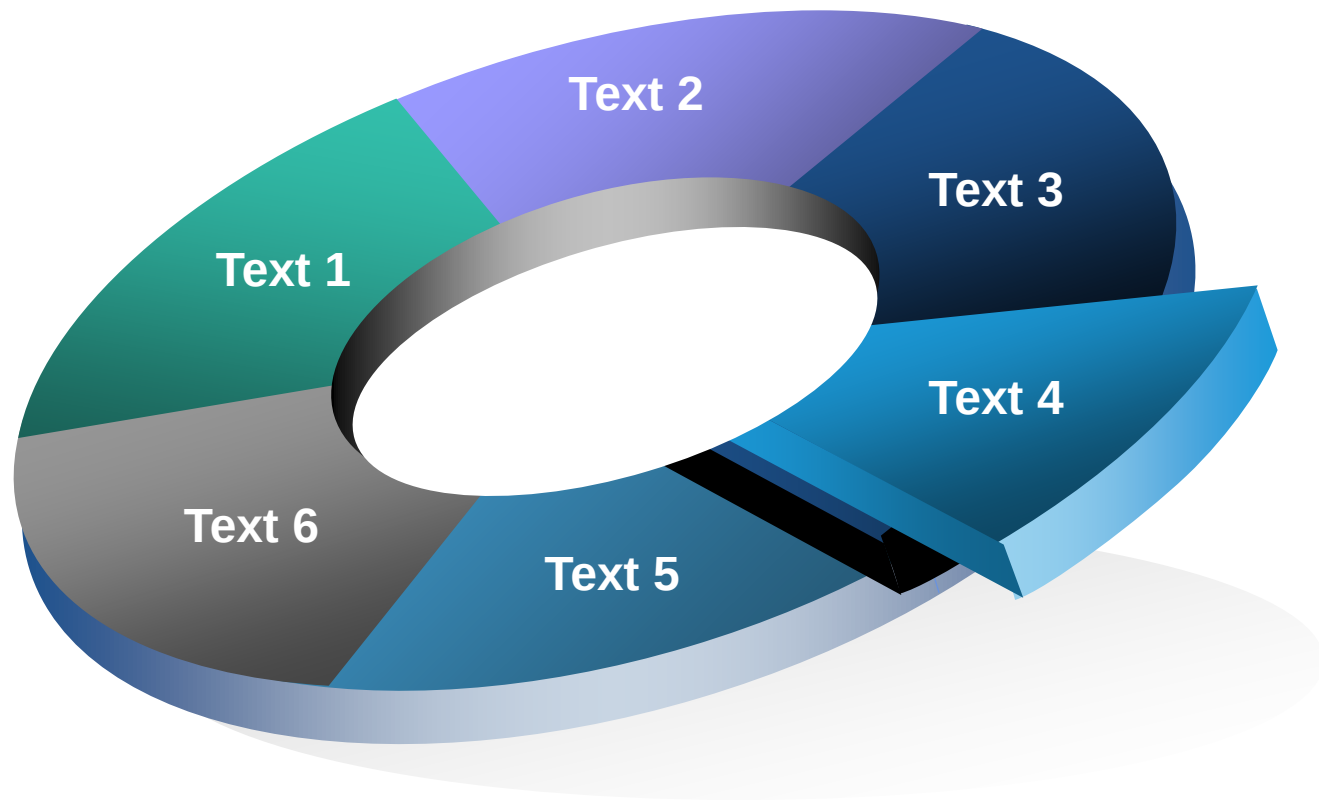
**Phase 2**

**Phase 3**

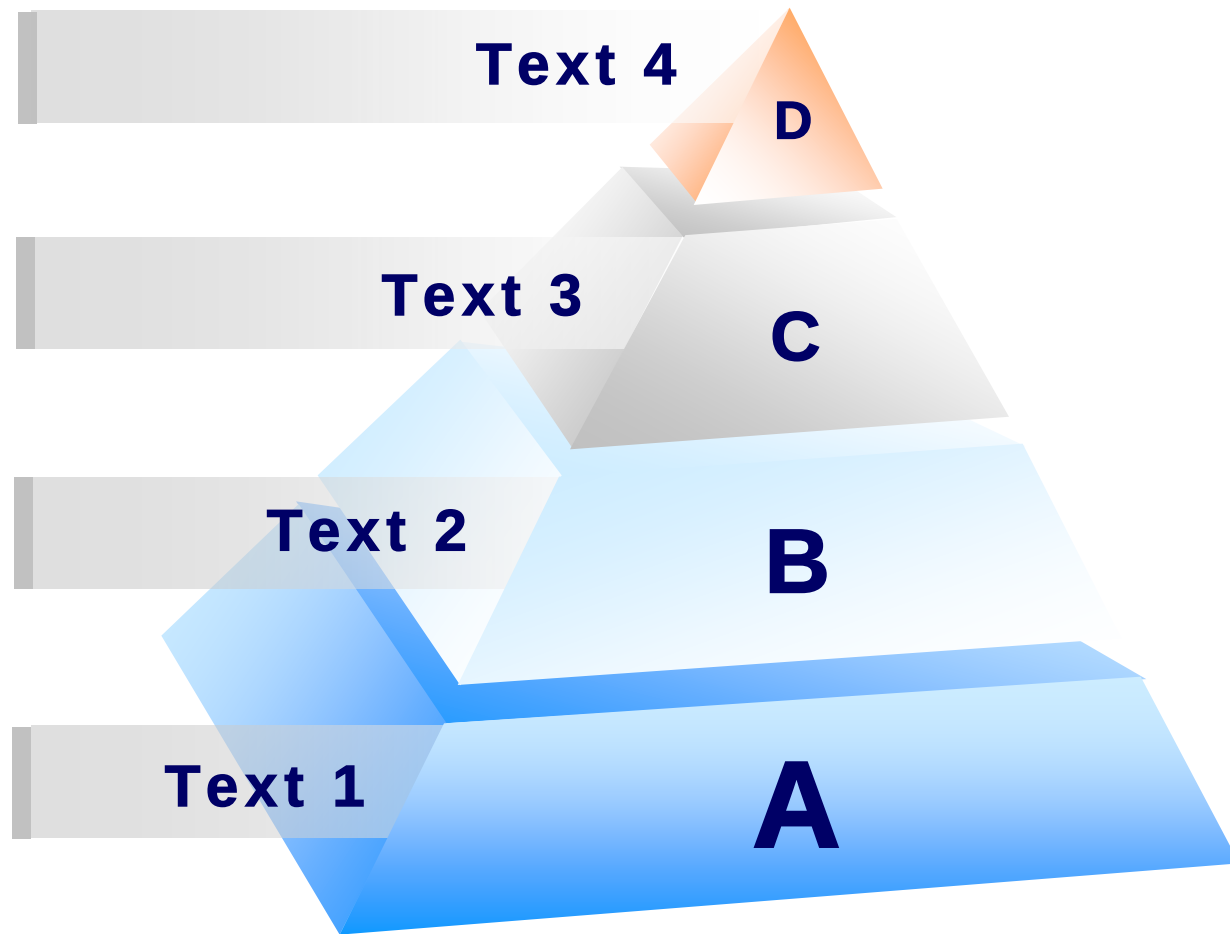


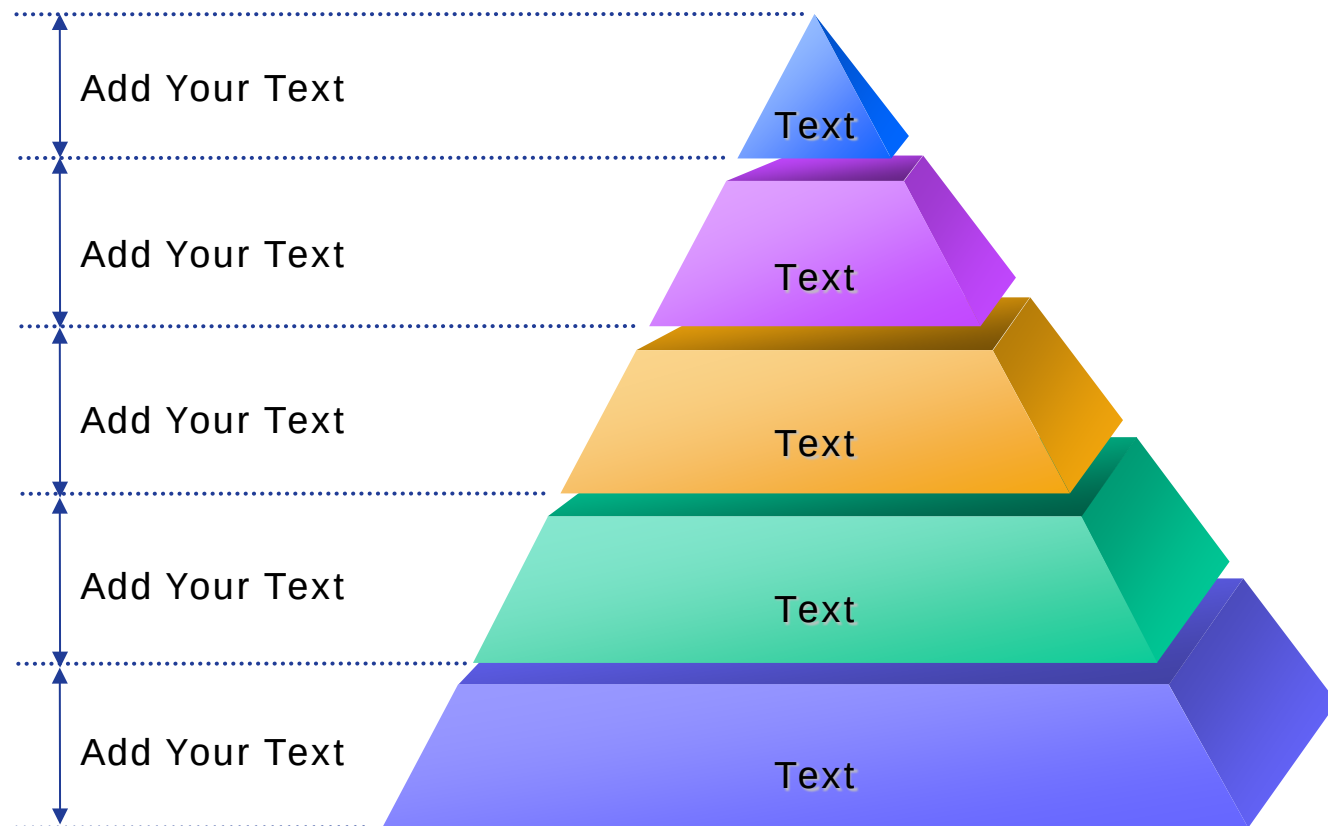






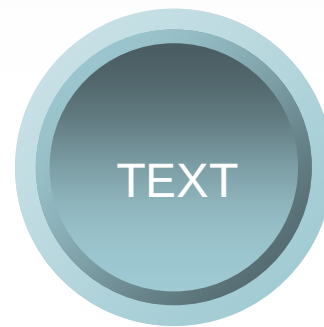
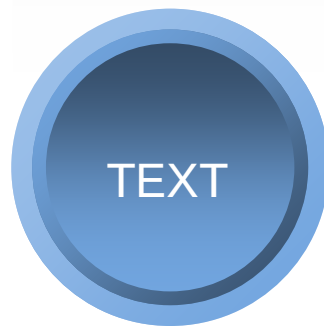


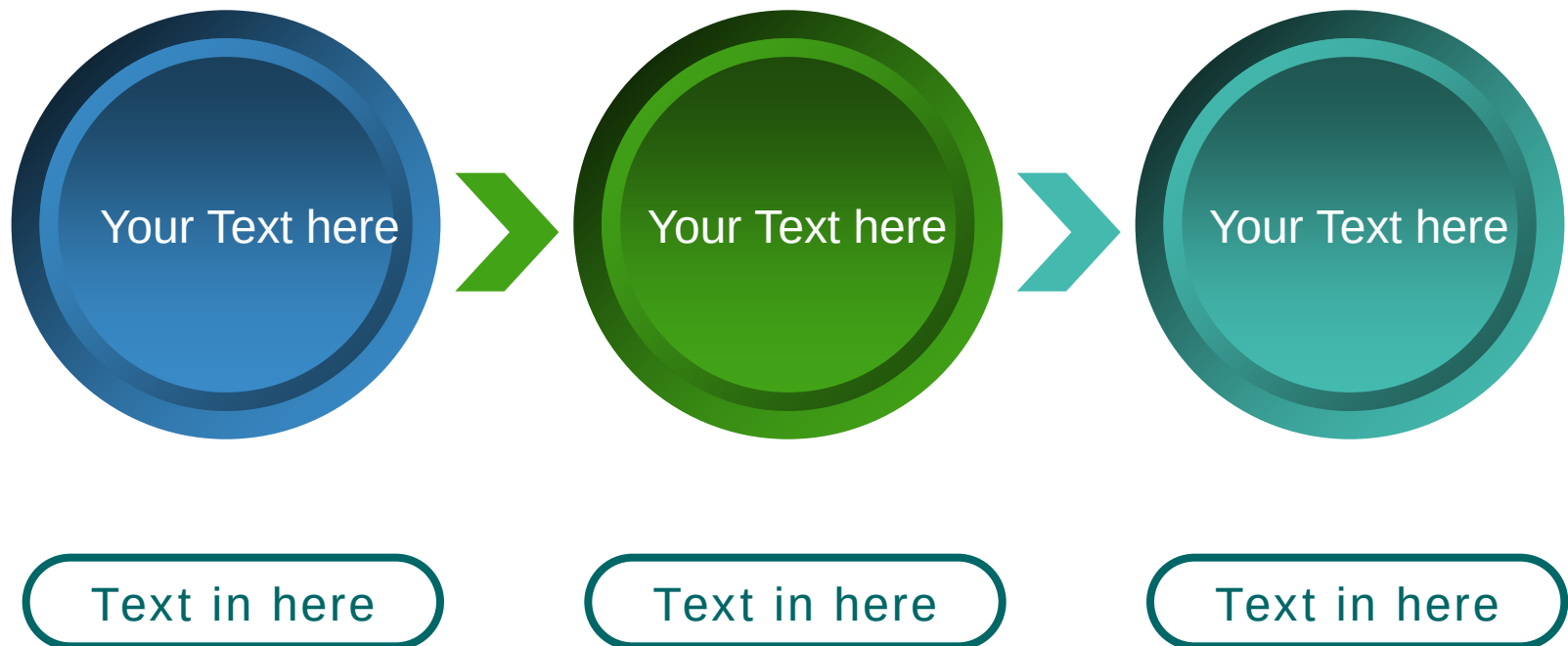


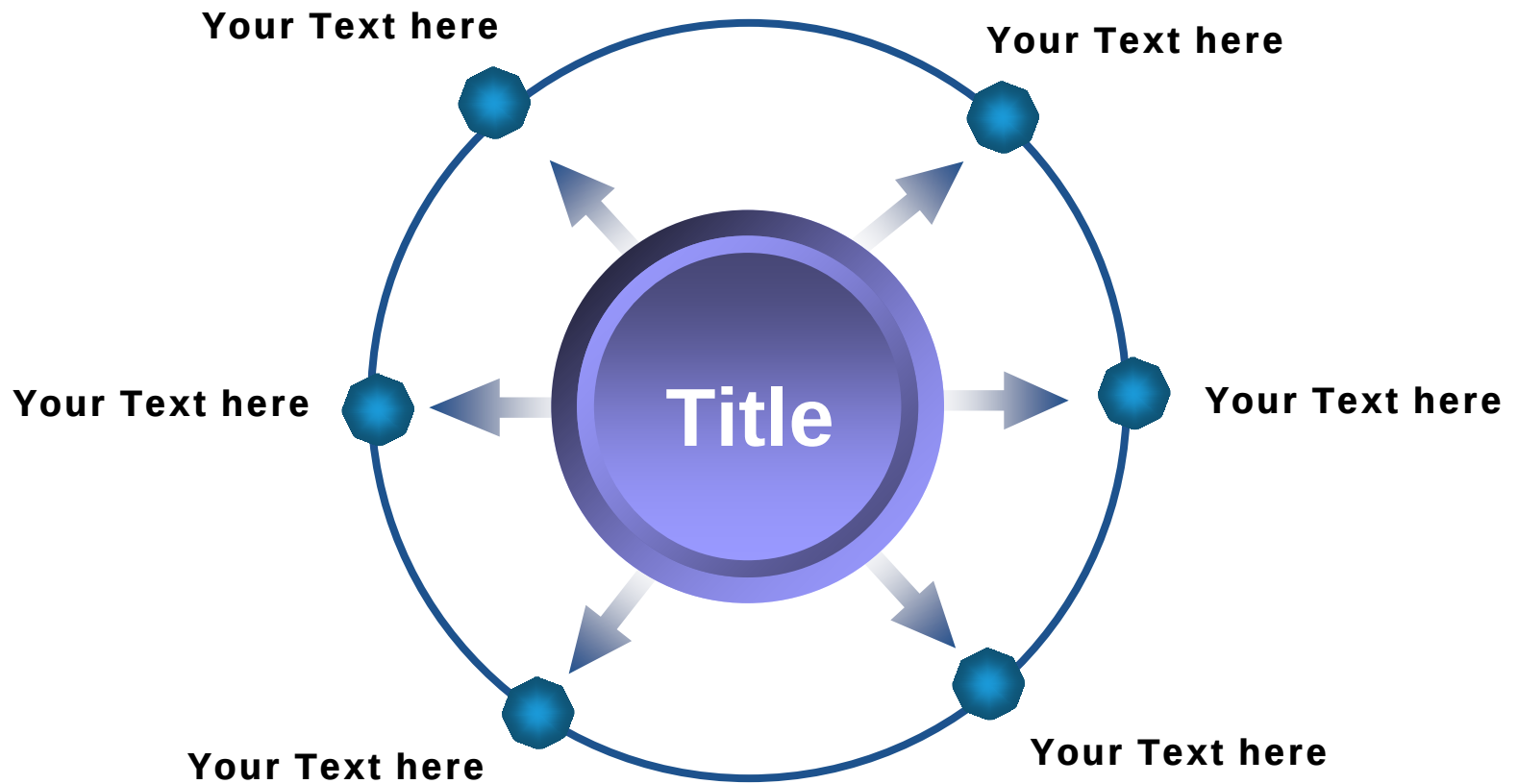


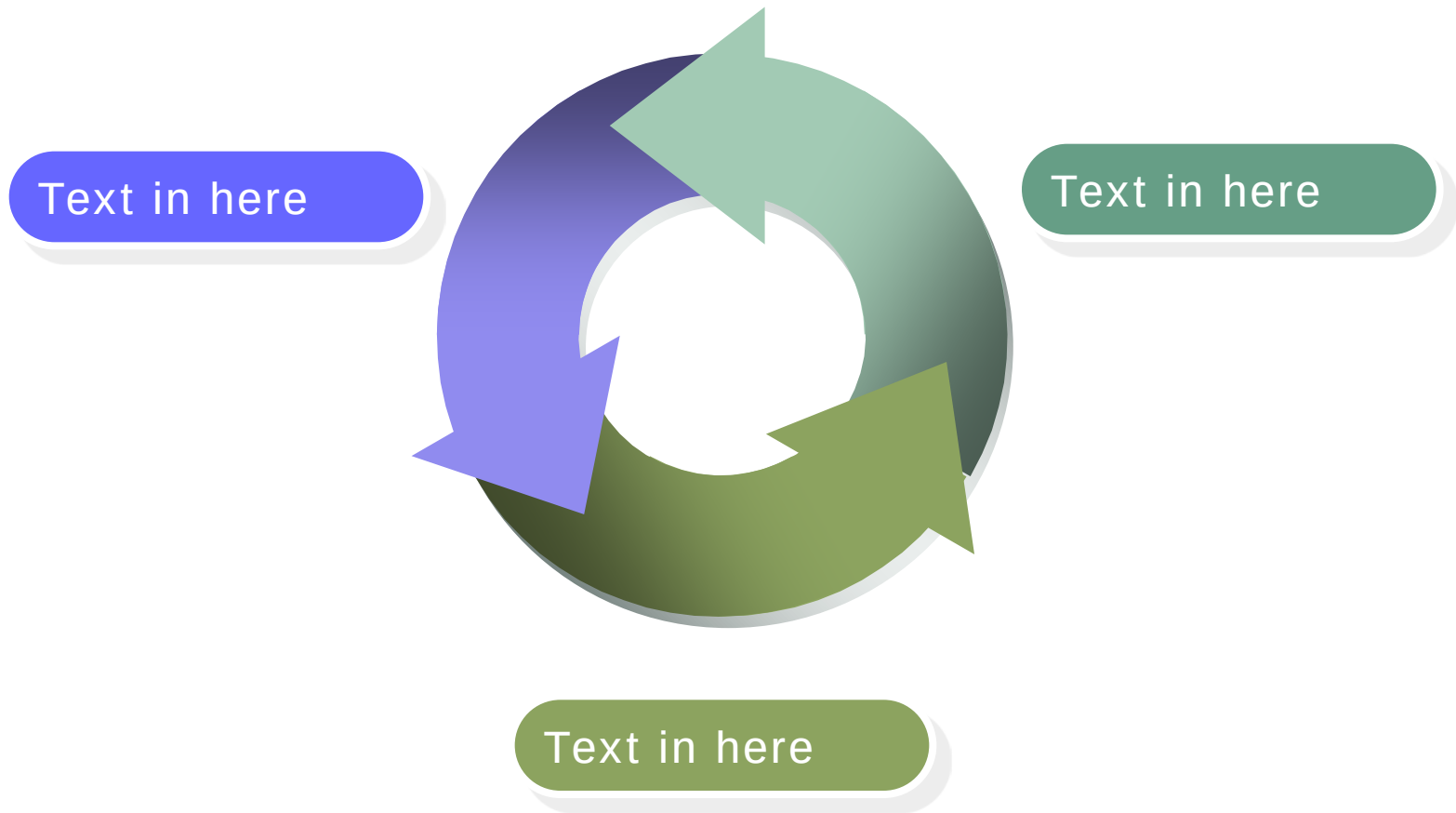


# Title



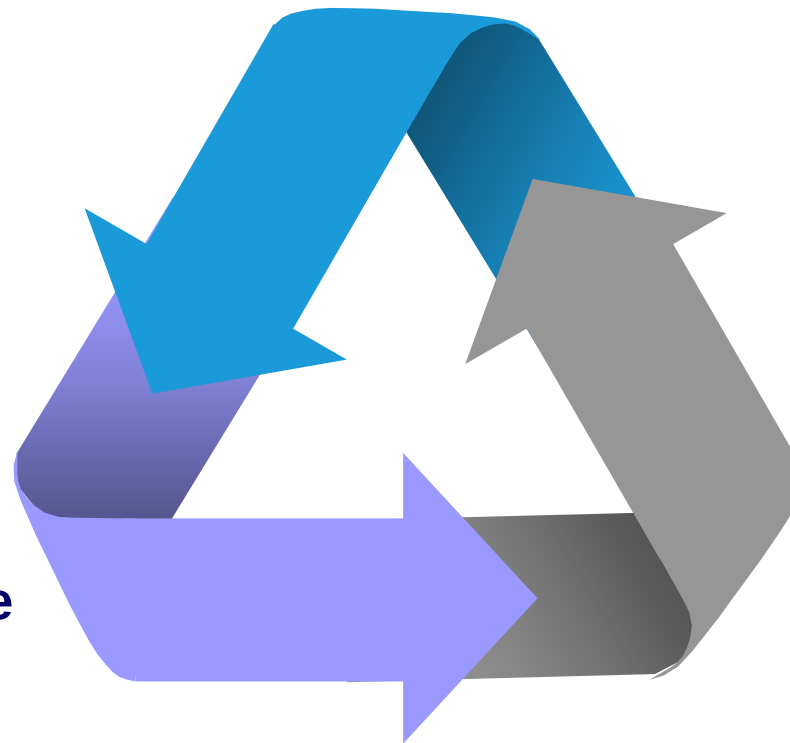








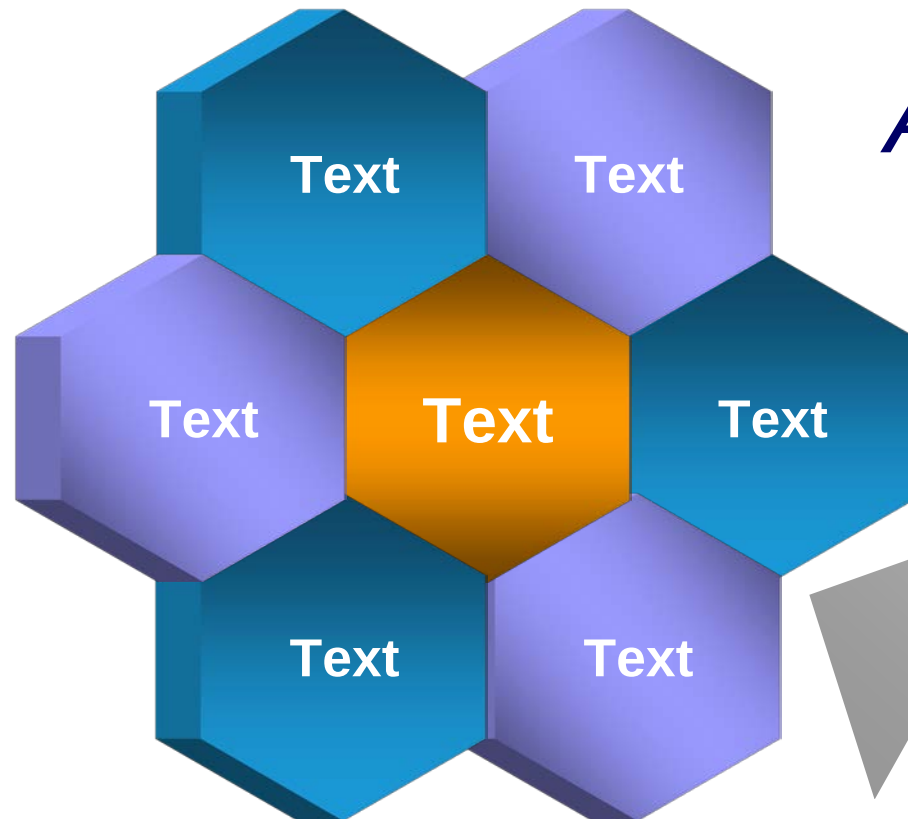
**Your Text here**



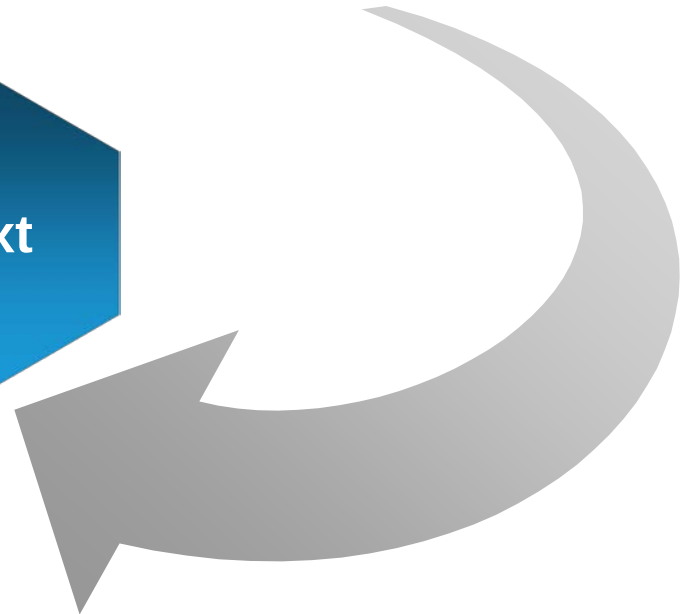
**Your Text here**

**Your Text here**

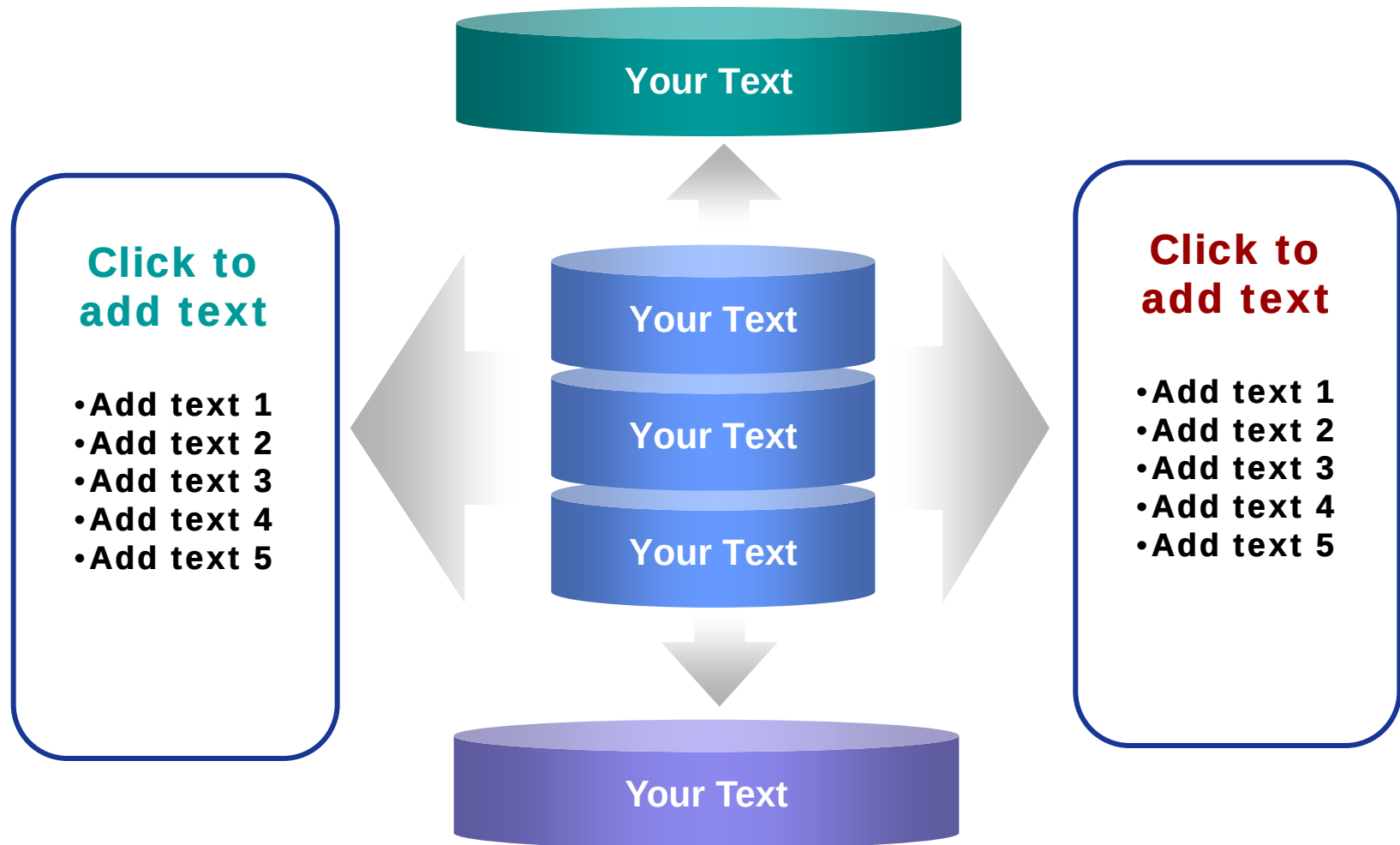




*Add title text*

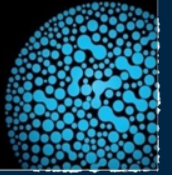






# BSISO analysis

# Before we begin...



<http://iprc.soest.hawaii.edu/users/jylee/>



CIDAR  
ISVHE



BSISO

YOTC  
MJOTF

S2SProject

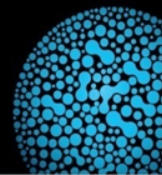
Welcome to

**June-Yi Lee's Homepage**

[HOME](#) [VITAE](#) [RESEARCH INTEREST](#) [PUBLICATIONS](#) [PROJECTS](#)

Recent study: Lee, June-Yi and Bin Wang, 2014: Future change of global monsoon precipitation in the CMIP5. Clim Dyn, 42, 101-119, Doi:[10.1007/s00382-012-1564-0](https://doi.org/10.1007/s00382-012-1564-0)

# Before we begin...



**BSISO**

Boreal Summer Intraseasonal Oscillation

CIPAS  
ISVHE

iorc  
INTERNATIONAL ORGANIZATION  
OF RAIN FOREST CLIMATE

APCC  
AFRICAN POLYCENTRIC CLIMATE CENTER

YOTC  
MJO TF



[Home](#) [Introduction](#) [Definition](#) [Realtime Monitoring](#) [Data and Program](#)

## Data and Program

### Data Process

- 1) Removal of the first three harmonics in climatological annual cycle

[Fortran code](#) [Parameter](#)

- 2) Removal of the effect of ENSO signal through subtracting last 120-day mean

[Fortran code](#)

- 3) Normalization by area averaged temporal standard deviation over the Asian region

[Fortran code](#)

[Data, CTL file](#)

- 4) Multi-variate EOF analysis using daily OLR and U850 anomalies

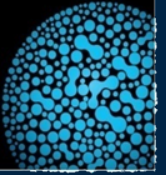
[Fortran code for EOF analysis](#)

[Fortran code for projection of model output \(or observed data\) onto the BSISO EOFs](#)

[BSISO EOF Structure Data](#)

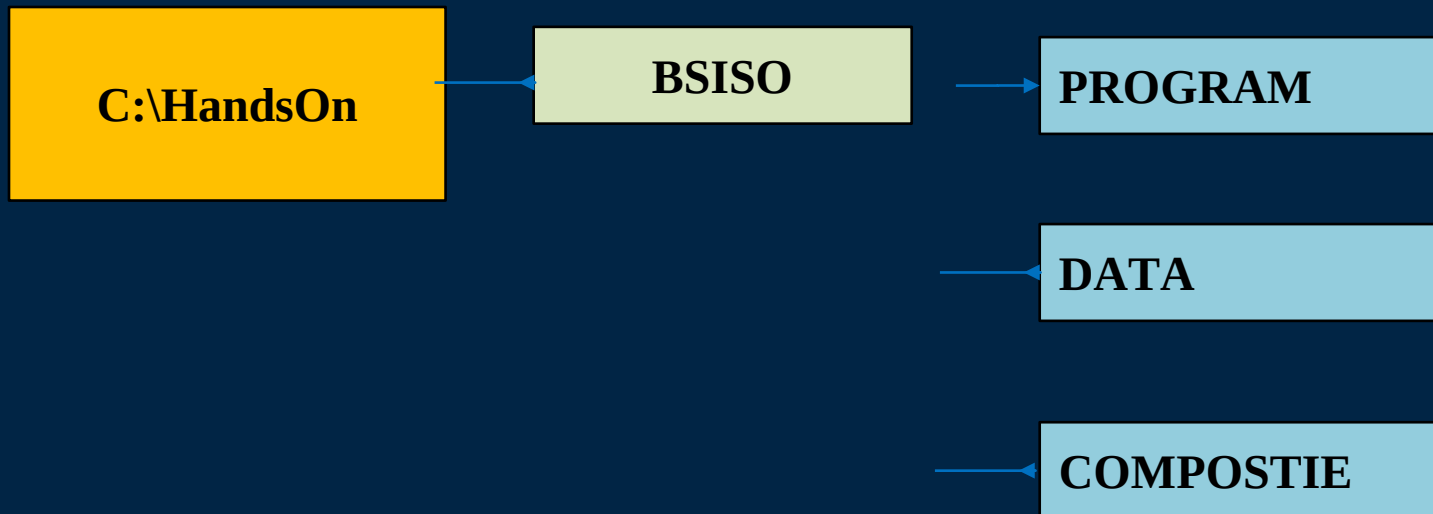
[Text file of Normalized Time Series for the BSISO1 and BSISO2 index](#)

# Set up



*1. Create a folder C:\HandsOn*

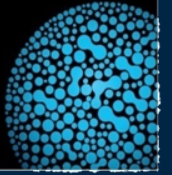
*2. Copy BSISO folder from Dropbox to your folder C:\HandsOn*



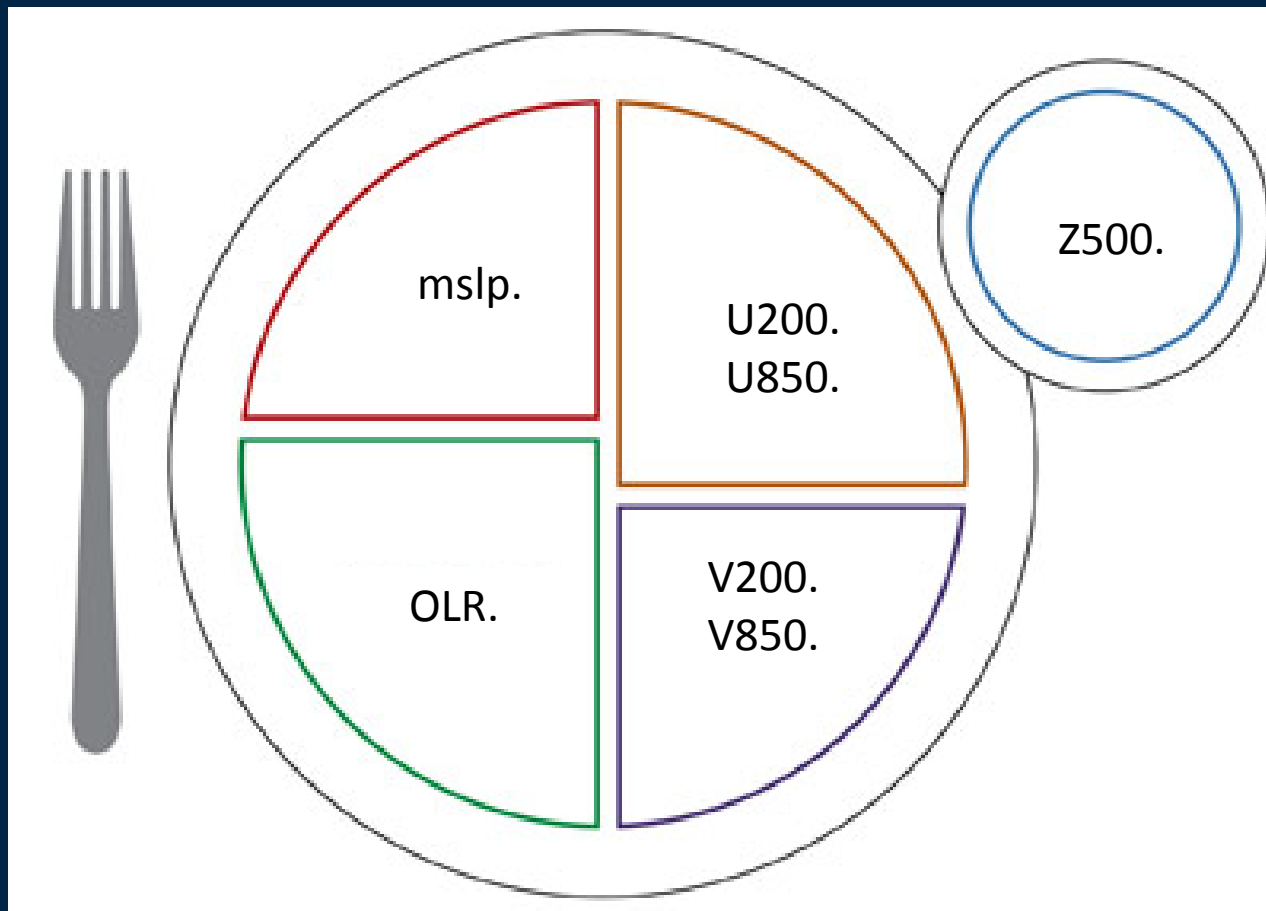
Target period: 1981-2010, MJJASO



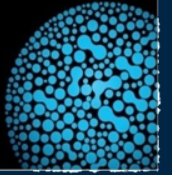
# You have many composite maps



C:\HandsOn\BSISO\COMPOSITE

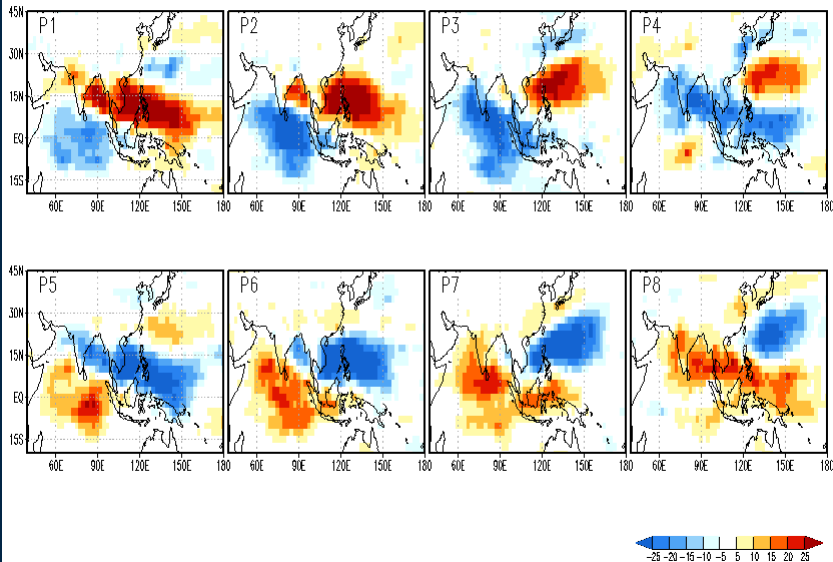


# Example

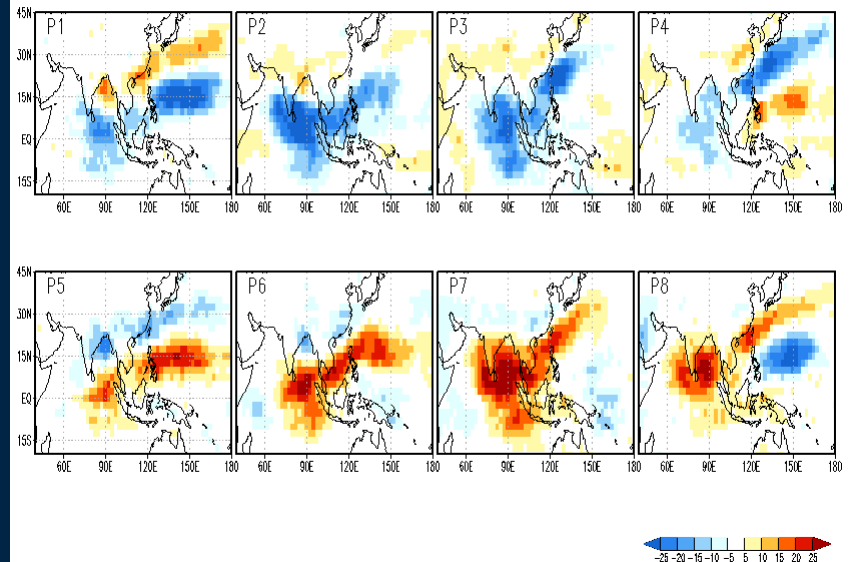


## OLR (Outgoing Longwave Radiation)

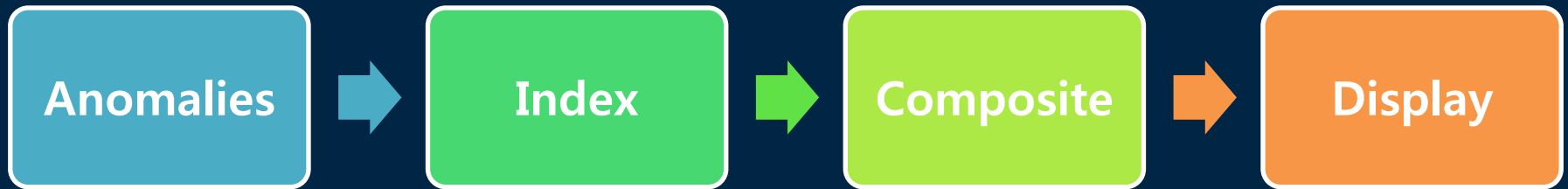
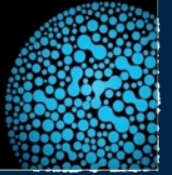
BSIS01



BSIS02



# Procedure



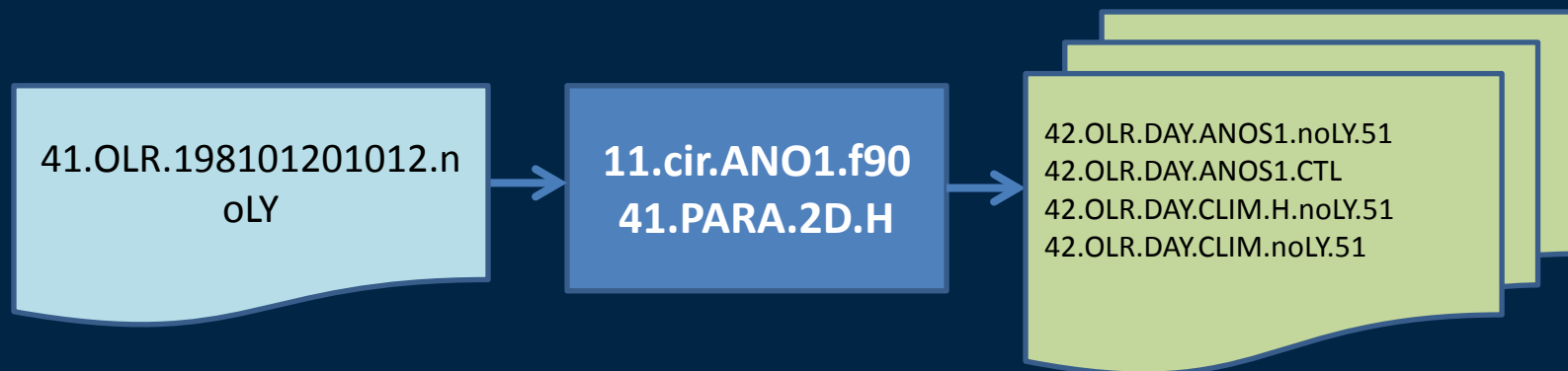
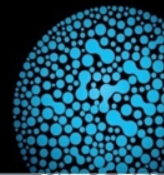
## DATA

41.OLR.198101201012.noLY

## PROGRAM

11.cir.ANO1.f90  
12.cir.ANO2.f90  
03.BSISO.PHS.amp1.5.MJJASO.f90  
14.cir.BSISO1.COMP.f90  
14.cir.BSISO2.COMP.f90  
16.cir.COMP.gs

# 11.cir.ANO1.f90

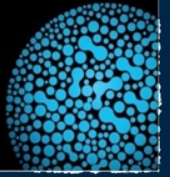


***Compute anomalies by removing first three harmonics in climatological annual cycle***

***#1. Extracting climatology***

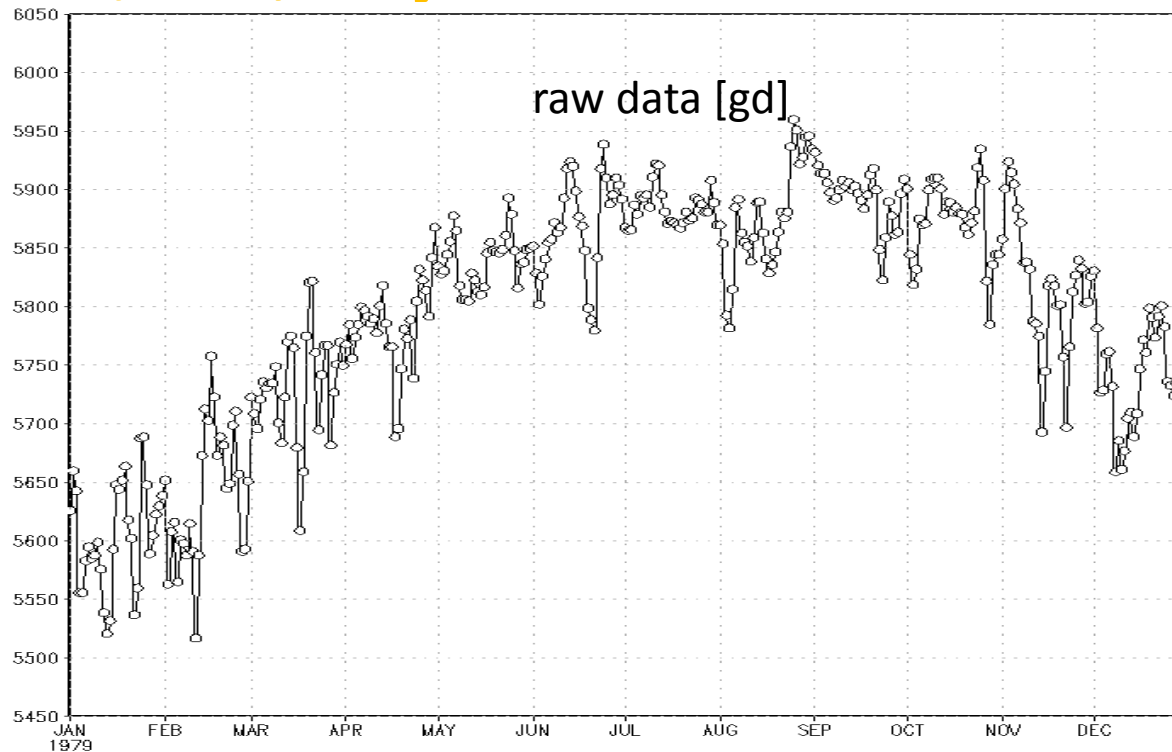
***#2. Extracting first three harmonics in climatological annual cycle***

# 01.ad.ANO1.f90

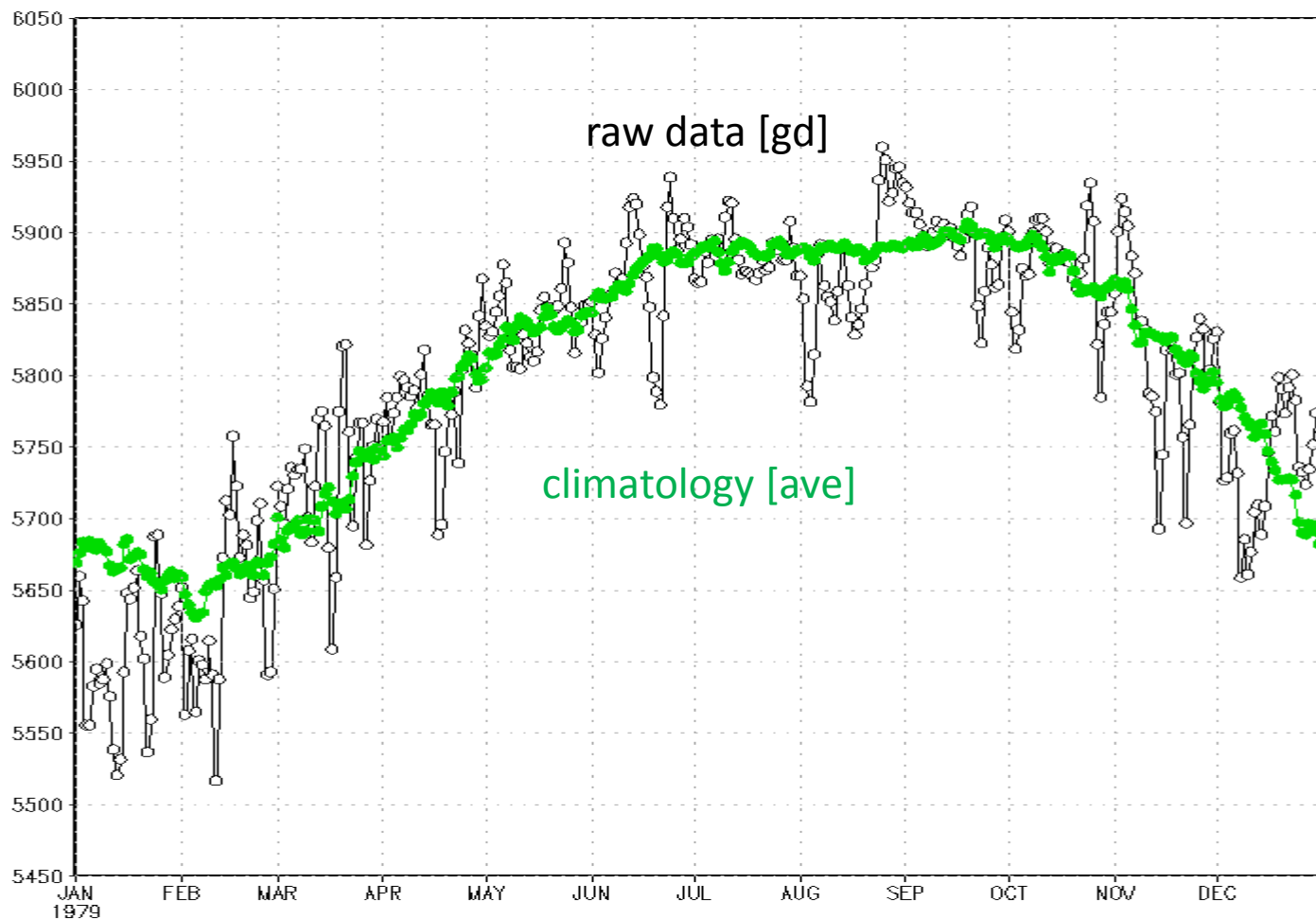
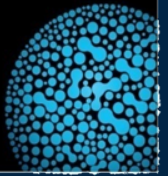


Regarding BSISO analysis, we are more interested in day-to-day variation!

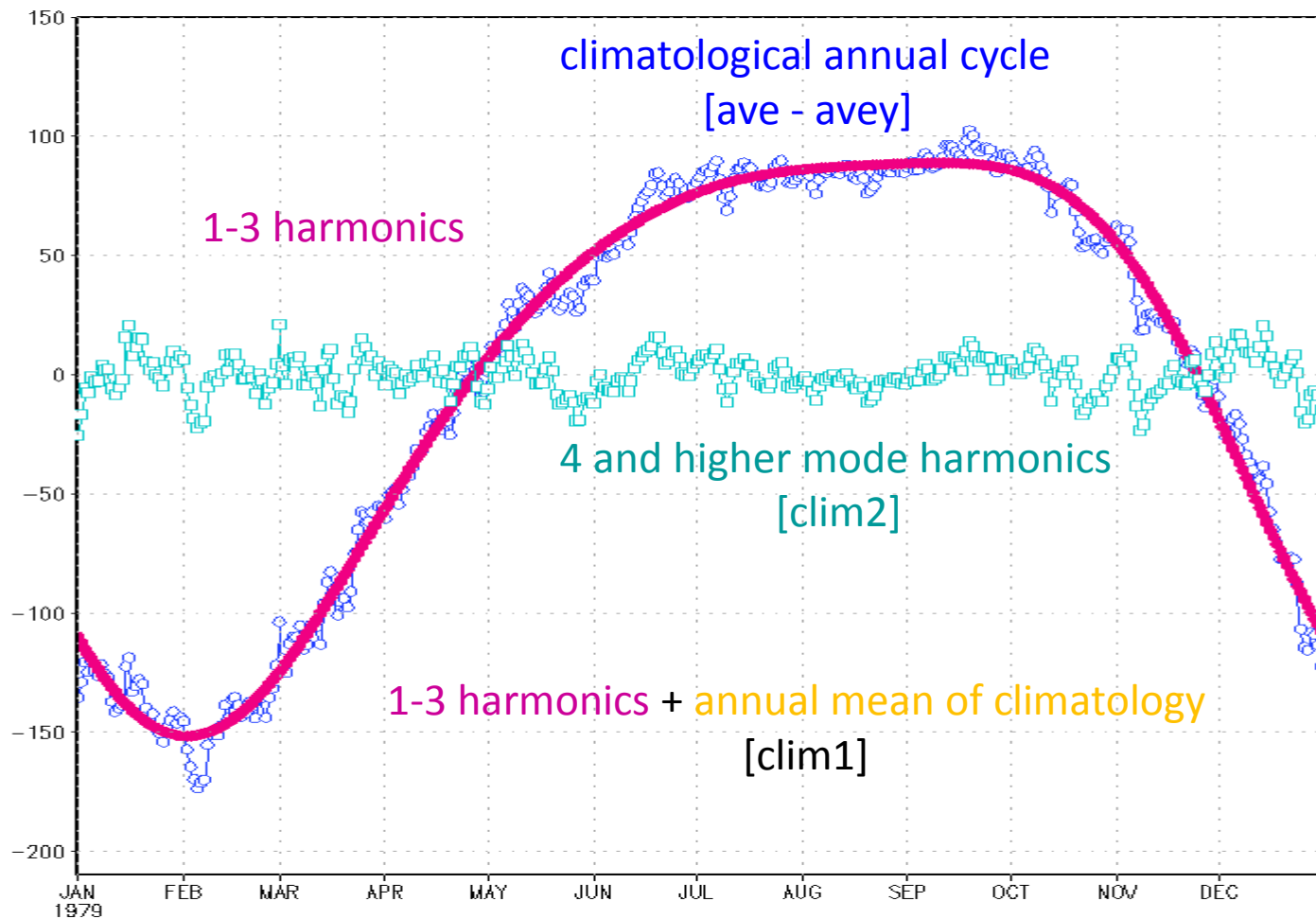
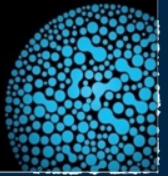
**[Z500; 150E, 30N]**



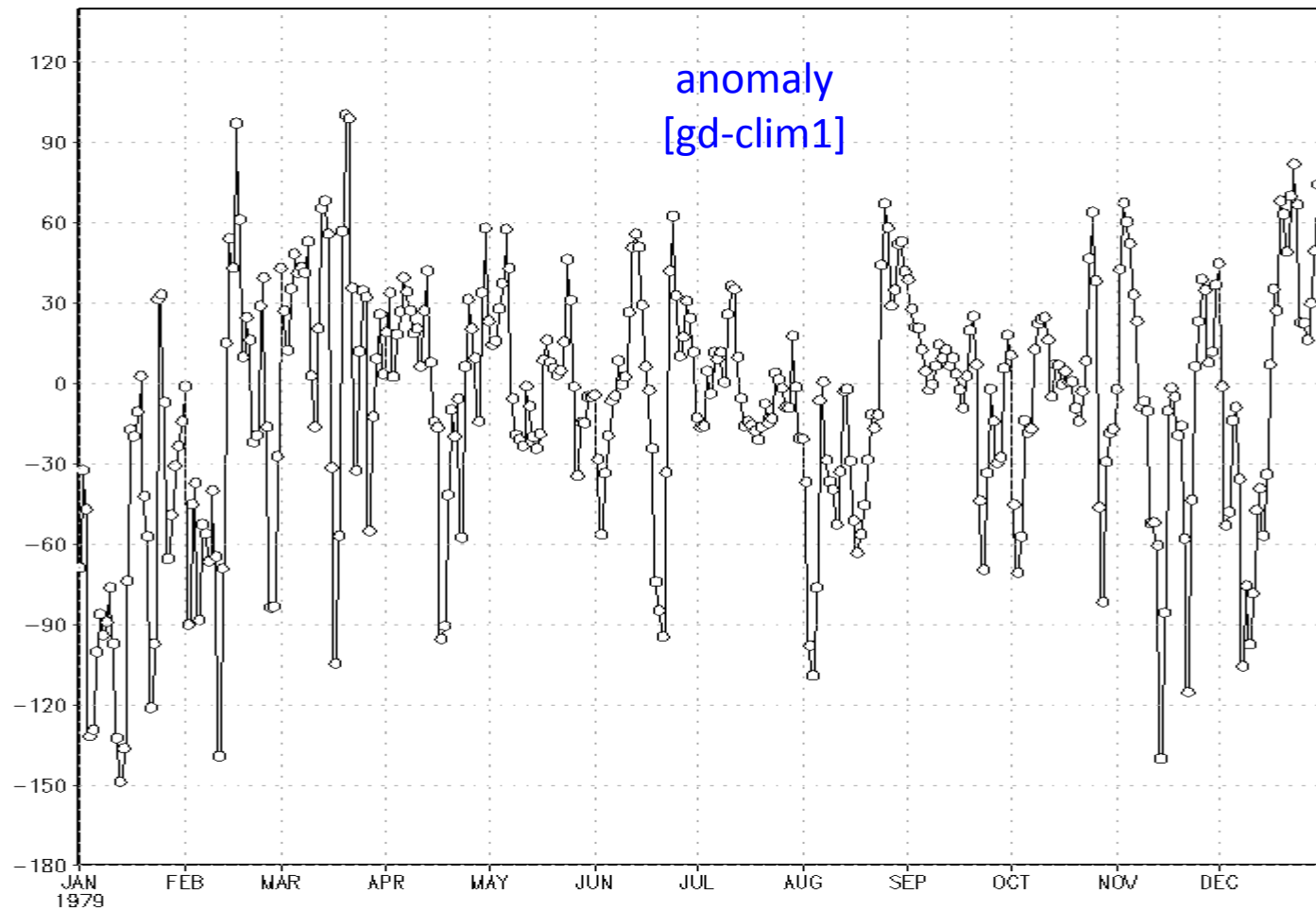
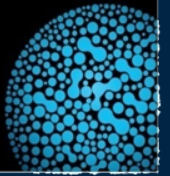
# 01.ad.ANO1.f90



# 01.ad.ANO1.f90

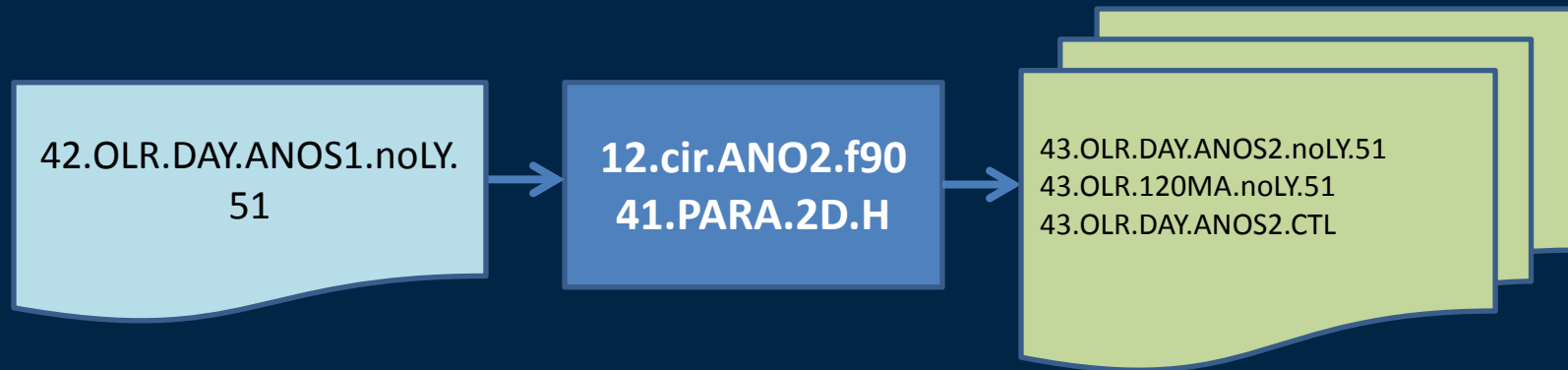


# 01.ad.ANO1.f90





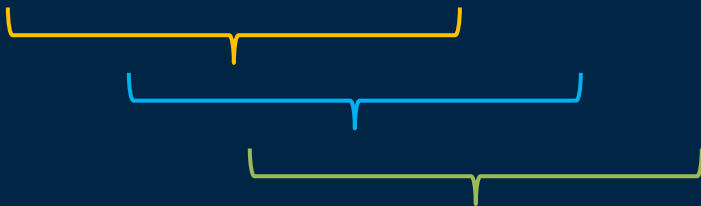
# 12.cir.ANO1.f90



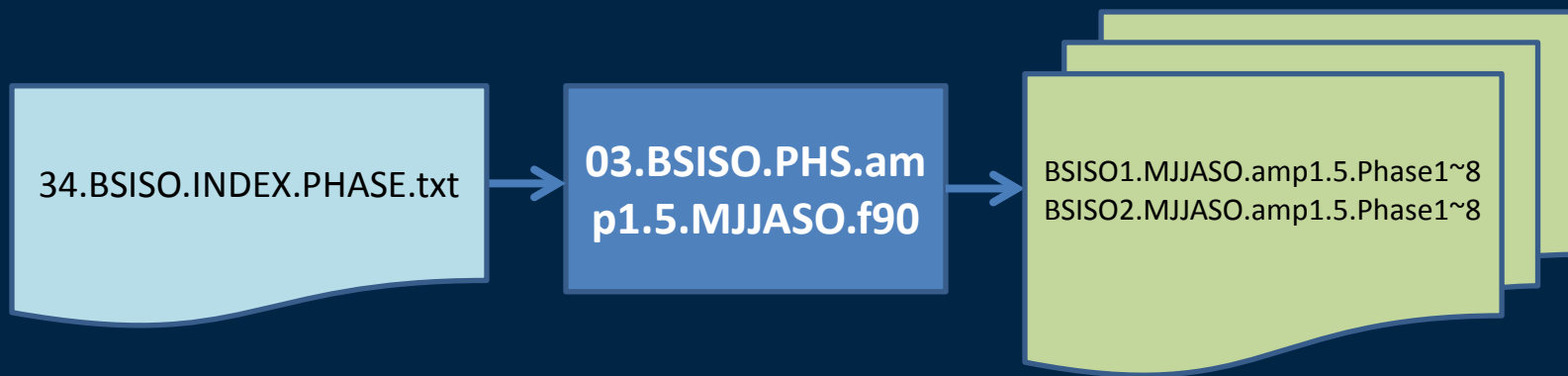
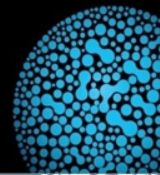
***Remove the effect of interannual variability through subtracting last 120-day mean***

Julian day

|   |   |     |     |     |     |     |     |     |     |     |     |     |     |     |
|---|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | 2 | ... | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | ... |
|---|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

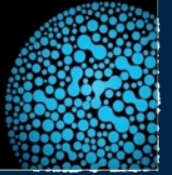


## 03.BSISO.PHS.amp1.5.MJJASO.f90



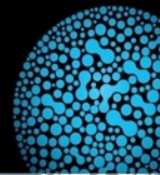
*Separate BSISO indices*

# 14.cir.BSISO1.COMP.f90



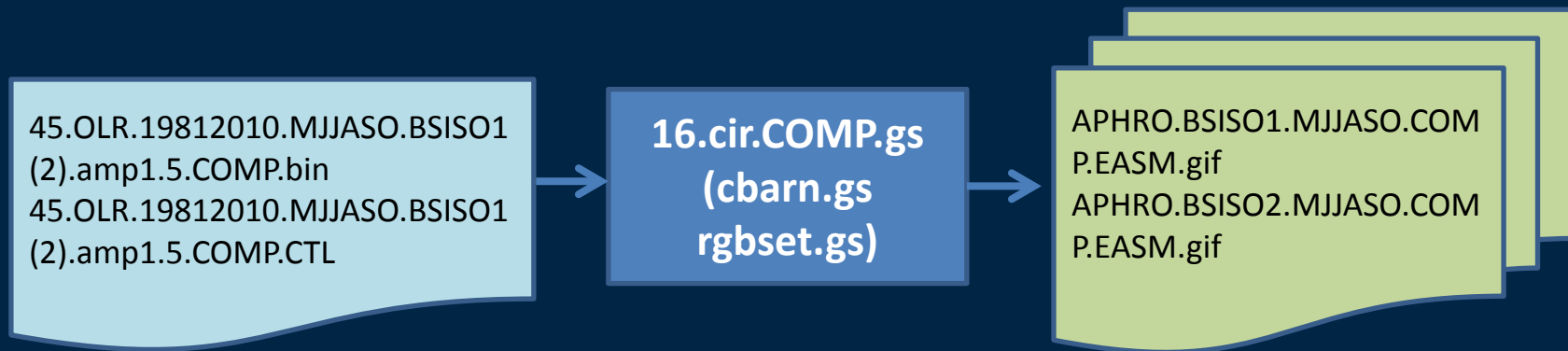
***Composite OLR for BSISO1***

# 14.cir.BSISO2.COMP.f90



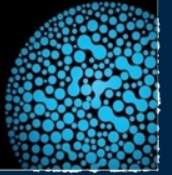
***Composite OLR for BSISO2***

# Display using GrADS



**Make sure your .CTL & .gs files are set up correctly.  
Modify your .gs file to effectively display your result (e.g.,  
color level, domain of interest, etc)**

# How to interpret your ingredient



C:\HandsOn\BSISO\composite

| Variables    | Positive               | Negative               |
|--------------|------------------------|------------------------|
| Mslp<br>Z500 | High pressure          | Low pressure           |
| OLR          | Clear                  | Cloudy                 |
| U            | Blowing from the west  | Blowing from the east  |
| V            | Blowing from the south | Blowing from the north |

C:\HandsOn\BSISO\COMPOSITE\sheet.pptx

BSISO1

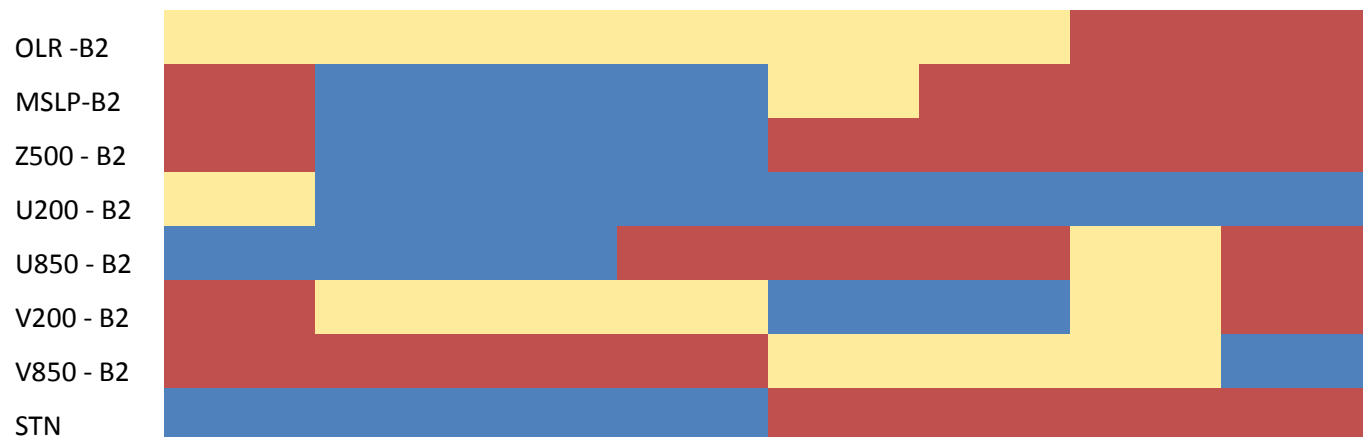
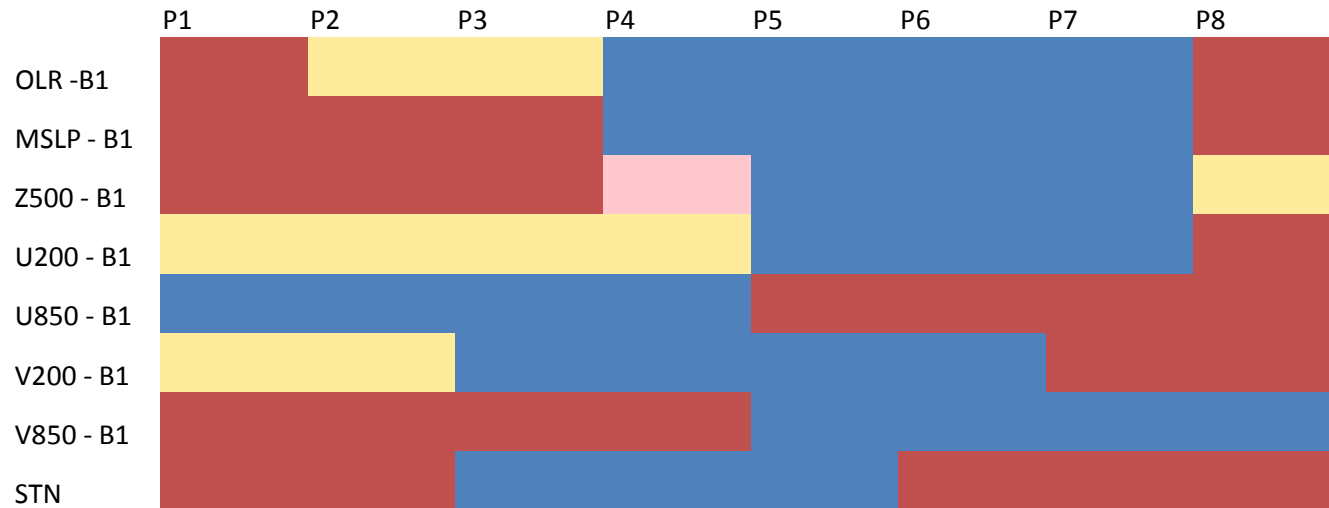
|      | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|------|----|----|----|----|----|----|----|----|
| Rain |    |    |    |    |    |    |    |    |
| OLR  |    |    |    |    |    |    |    |    |
| MSLP |    |    |    |    |    |    |    |    |
| Z500 |    |    |    |    |    |    |    |    |
| U200 |    |    |    |    |    |    |    |    |
| U850 |    |    |    |    |    |    |    |    |
| V200 |    |    |    |    |    |    |    |    |
| V850 |    |    |    |    |    |    |    |    |

Target Area:

BSISO2

|      | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|------|----|----|----|----|----|----|----|----|
| Rain |    |    |    |    |    |    |    |    |
| OLR  |    |    |    |    |    |    |    |    |
| MSLP |    |    |    |    |    |    |    |    |
| Z500 |    |    |    |    |    |    |    |    |
| U200 |    |    |    |    |    |    |    |    |
| U850 |    |    |    |    |    |    |    |    |
| V200 |    |    |    |    |    |    |    |    |
| V850 |    |    |    |    |    |    |    |    |

# Effect of all Parameters in Thailand and Myanmar during BSISO

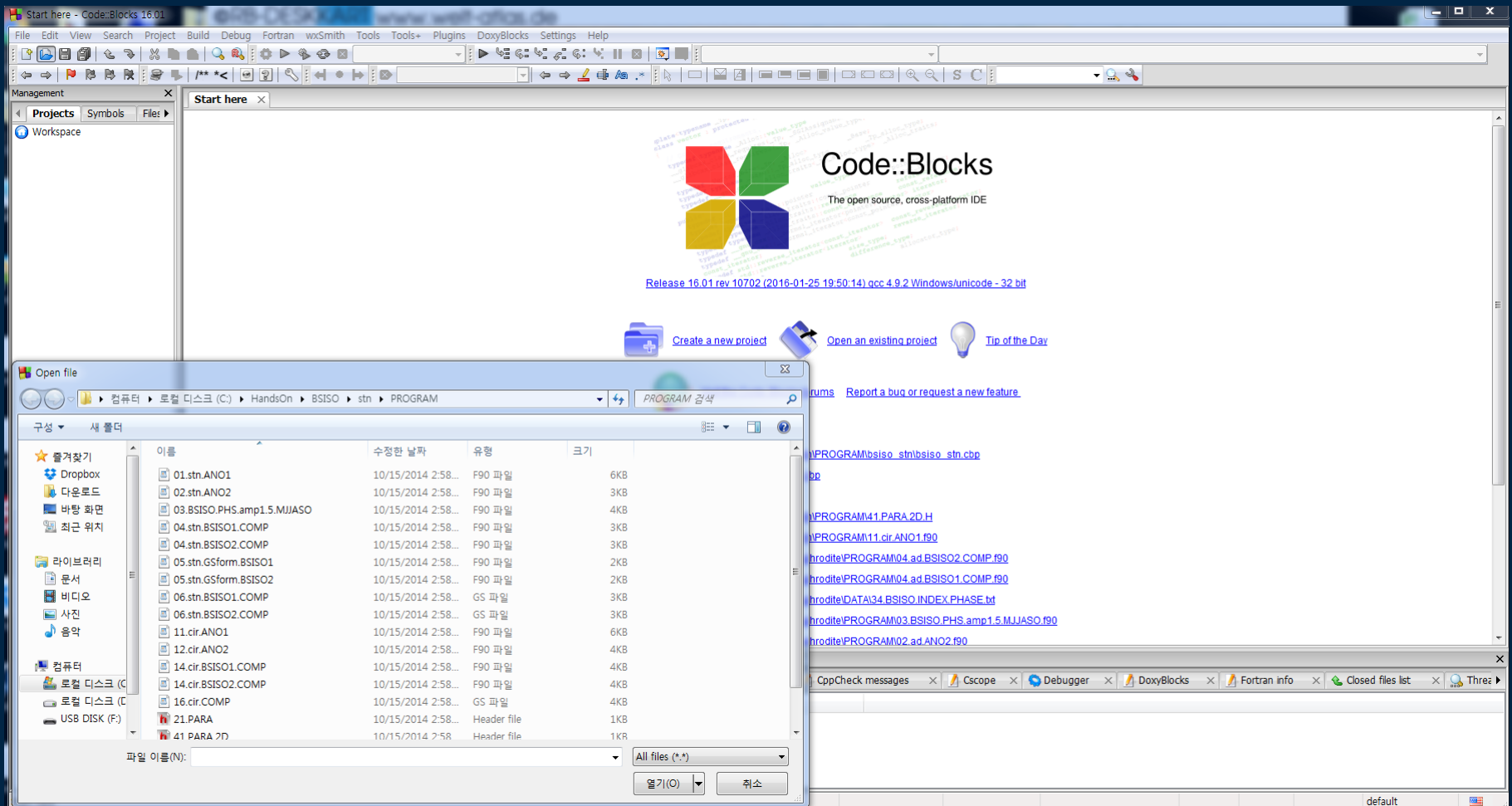


Group presentation done by **Kannika/San/Winai/Aung/Itesh**



# Run Codeblocks

*File -> Open*



# 11.cir.ANO1.f90



## Compute anomalies (1)

```
1 include "C:\HandsOn\BSISO\src\PROGRAM\41.PARA.2D.H"
2 real :: gd(nx,ny), ave(nx,ny), num(nx,ny)
3 real :: xx(nx,ny,nday), yy(nday), xano(nday)
4 real :: clim1(nx,ny,nday), clim2(nx,ny,nday)
5
6 open (1,file='C:\HandsOn\BSISO\src\DATA\42.'//VNAME//'.DAY.ANOS1.noLY.51',form='unformatted', &
7 access='direct',recl=nx*ny*4,status='unknown')
8 open (2,file='C:\HandsOn\BSISO\src\DATA\42.'//VNAME//'.DAY.ANOS1.CTL',status='unknown')
9
10 open (11,file='C:\HandsOn\BSISO\src\DATA\41.'//VNAME//'.198101201012.noLY',form='unformatted', &
11 access='direct',recl=nx*ny*4,status='old')
12
13 open (12,file='C:\HandsOn\BSISO\src\DATA\42.'//VNAME//'.DAY.CLIM.H.noLY.51',form='unformatted', &
14 access='direct',recl=nx*ny*4,status='unknown')
15 open (13,file='C:\HandsOn\BSISO\src\DATA\42.'//VNAME//'.DAY.CLIM.noLY.51',form='unformatted', &
16 access='direct',recl=nx*ny*4,status='unknown')
17
18 !-----Climatology (1981-2010)
19 do 100 iday = 1, nday
20   ave = 0.; num = 0.
21   do iyr = nyri, nyrf
22     read(11,rec=(iyr-nyri)*nday+iday) gd
23     call JAVE1(ave,num,gd,nx,ny,dmiss)
24   enddo
25   call JAVE2(ave,num,nx,ny,dmiss)
26   do jj = 1, ny: do ii = 1, nx
27     xx(ii,jj,iday) = ave(ii,jj)
28   enddo;enddo
29   write(13,rec=iday) ave
30 100 continue
31 !-----The first three harmonics in climatological annual cycle
32 do 200 jj = 1, ny: do 200 ii = 1, nx
33
34   avey = 0.
35   do iday = 1, nday
36     IF(xx(ii,jj,iday).ne.dmiss) THEN
37       yy(iday) = xx(ii,jj,iday)
38       avey = avey + yy(iday)/float(nday)
39     ENDIF
```

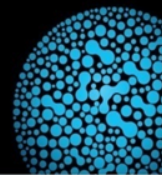
Code:Blocks Search results Cccc Build log Build messages CppCheck CppCheck messages Cscope Debugger DoxyBlocks Fortran info Closed files list Thres

File Line Message

APEC CLIMATE CENTER

C:\HandsOn\BSISO\src\PROGRAM\41.cir.ANO1.f90 Windows (CR+LF) WINDOWS-949 Line 1, Column 1 Insert Read/Write default

# 11.cir.ANO1.f90



## Modify Header file (41.PARA.2D.H)

```
1 integer,parameter :: nx=144, ny=73
2 integer,parameter :: nyri=1981, nyri2=1981, nyrf=2010, nyr=nyrf-nyri
3 integer,parameter :: nday=365, ndayf=365
4 integer,parameter :: ntot=nyr*nday+ndayf
5 character*3       :: VNAME
6 character*26      :: DIR
7
8 data              VNAME/"OLR"/
9 data              DIR/"C:\HandsOn\BSISO\stn\DATA\"/
10 data              dmiss/32766/
11
```

|            |
|------------|
| mslp       |
| <b>OLR</b> |
| U200       |
| U850       |
| V200       |
| V850       |
| Z500       |

# 12.cir.ANO1.f90



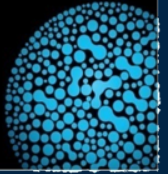
## Compute anomalies (2)

```
1  include "C:\HandsOn\BSISO\src\PROGRAM\41.PARA.2D.H"
2  real :: gd(nx,ny), gd2(nx,ny), ave(nx,ny), num(nx,ny)
3
4  open (1,file='C:\HandsOn\BSISO\src\DATA\43.'//VNAME//'.DAY.ANOS2.noLY.51',form='unformatted', &
5        access='direct',recl=nx*ny*4,status='unknown')
6  open (2,file='C:\HandsOn\BSISO\src\DATA\43.'//VNAME//'.DAY.ANOS2.CTL',status='unknown')
7  open (3,file='C:\HandsOn\BSISO\src\DATA\43.'//VNAME//'.120MA.noLY.51',form='unformatted', &
8        access='direct',recl=nx*ny*4,status='unknown')
9
10 open (11,file='C:\HandsOn\BSISO\src\DATA\42.'//VNAME//'.DAY.ANOS1.noLY.51',form='unformatted', &
11       access='direct',recl=nx*ny*4,status='old')
12
13 write (2,211) DIR, VNAME, ntot, VNAME
14
15 do 2008 iyr = nyri , nyrf
16   print *, iyr
17   do 100 iday = 1 , nday
18     if (iyr.eq.nyri .and. iday.le.120) then
19       read(11,rec=(iyr-nyri)*nday+iday) gd
20       write(1,rec=(iyr-nyri)*nday+iday) gd
21     elseif (iyr.eq.nyrf .and. iday.gt.ndayf) then
22       goto 100
23     else
24       read(11,rec=(iyr-nyri)*nday+iday) gd
25       ave = 0.; num = 0.
26       do imov = 0 , 119 !last 120-day mean
27         read(11,rec=(iyr-nyri)*nday+iday-imov) gd2
28         call JAVE1(ave,num,gd2,nx,ny,dmiss)
29       enddo
30       call JAVE2(ave,num,nx,ny,dmiss)
31       write(3,rec=(iyr-nyri)*nday+iday) ave
32       do jj = 1 , ny; do ii = 1 , nx
33         if (gd(ii,jj).ne.dmiss .and. ave(ii,jj).ne.dmiss) then
34           gd(ii,jj) = gd(ii,jj) - ave(ii,jj)
35         else
36           gd(ii,jj) = dmiss
37         endif
38       enddo;enddo
39       write(1,rec=(iyr-nyri)*nday+iday) gd
```

Build messages:

```
==== Build file: "no target" in "no project" (compiler: unknown) ====
Warning: Nonexistent include directory "C:\HandsOn\BSISO\src\PROGRAM\41.cir.ANO1.os_ou...
==== Build finished: 0 error(s), 1 warning(s) (0 minute(s), 0 second(s)) ====
```

# 03.BSISO.PHS.amp1.5.MJJASO.f90

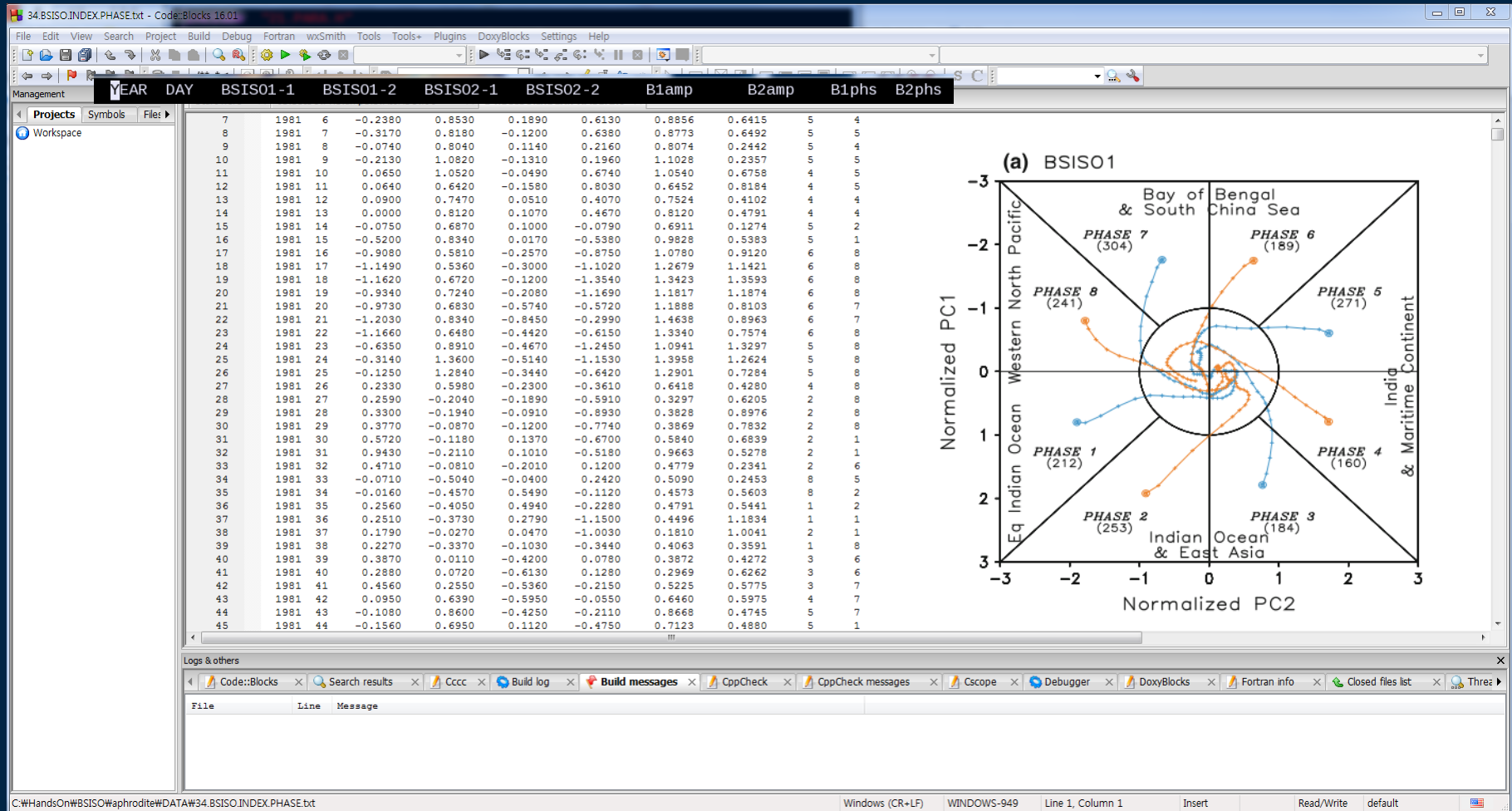


## Separate BSISO indices into 8 phases

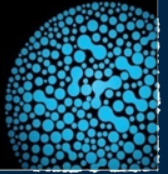
```
03.BSISO.PHS.amp1.5.MJJASO.f90 - Code::Blocks 16.01
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
Start here x 03.BSISO.PHS.amp1.5.MJJASO.f90 x
Management
Projects Symbols Files
Workspace
1 !-----
2 ! Program for projecting model output or observed data onto the BSISO
3 ! EOFs
4 ! NVAR1 = OLR, NVAR2 = U850
5 ! NMODE1 = BSISO1, NMODE2 = BSISO2
6 ! NDAYF = The number of days in the latest year
7 !-----
8 integer, parameter :: nyr=27, nmode=4
9 integer, parameter :: ndayt=365, ndayf=365 !!! modify
10 integer, parameter :: ntot=(nyr-1)*ndayt+ndayf
11 integer :: iyr, idy, irec, ip, inum, jnum
12 integer :: ico(8), jco(8)
13 integer :: iyear(ntot), iday(ntot), pp1(ntot), pp2(ntot)
14 real :: pc(nmode,ntot), amp(ntot), amp2(ntot)
15
16 open (1,file='C:\HandsOn\BSISO\aphrodite\DATA\34.BSISO.INDEX.PHASE.txt',status='old')
17
18 open(31,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase1',status='unknown')
19 open(32,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase2',status='unknown')
20 open(33,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase3',status='unknown')
21 open(34,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase4',status='unknown')
22 open(35,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase5',status='unknown')
23 open(36,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase6',status='unknown')
24 open(37,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase7',status='unknown')
25 open(38,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO1.MJJASO.amp1.5.Phase8',status='unknown')
26 open(41,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase1',status='unknown')
27 open(42,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase2',status='unknown')
28 open(43,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase3',status='unknown')
29 open(44,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase4',status='unknown')
30 open(45,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase5',status='unknown')
31 open(46,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase6',status='unknown')
32 open(47,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase7',status='unknown')
33 open(48,file='C:\HandsOn\BSISO\aphrodite\DATA\BSISO2.MJJASO.amp1.5.Phase8',status='unknown')
34
35
36 read(1,*)
37
38 irec=0
39 DO iyr = 1, nyr
```

# 03.BSISO.PHS.amp1.5.MJJASO.f90

## Input: BSISO indices



# 14.cir.BSISO1.COMP.f90



## Input: BSISO1 index + anomalies

Separated  
BSISO1 index  
files

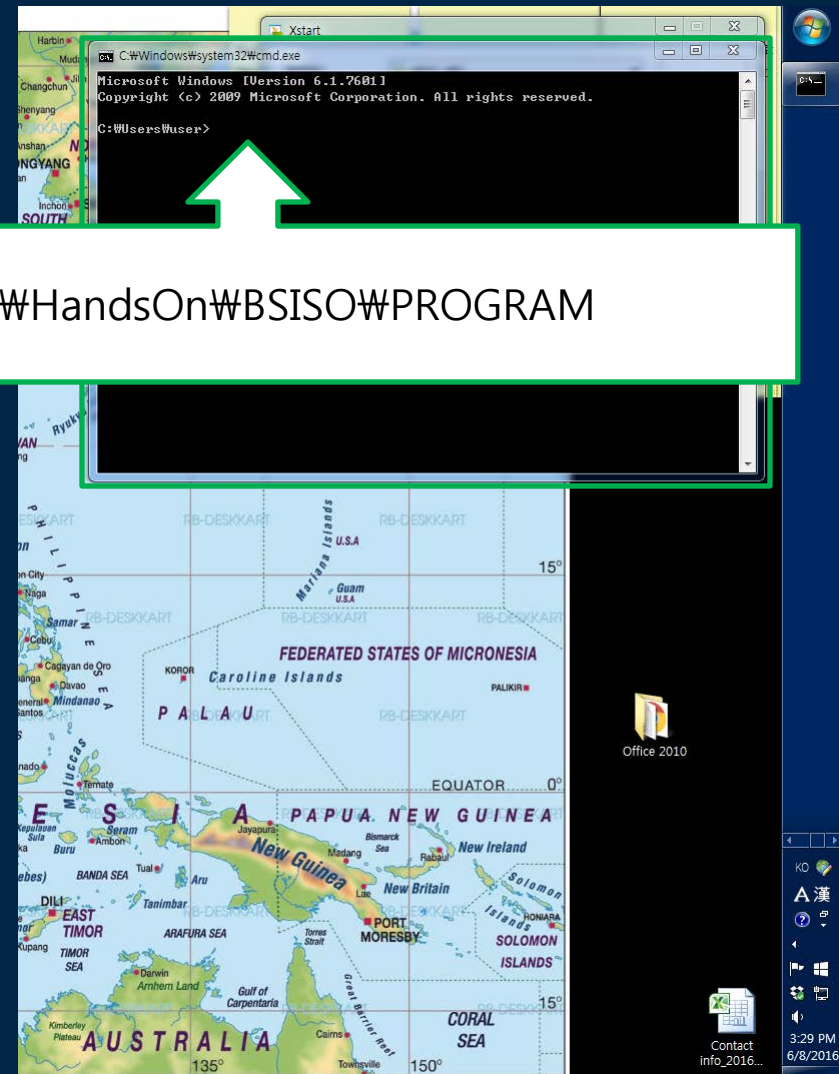
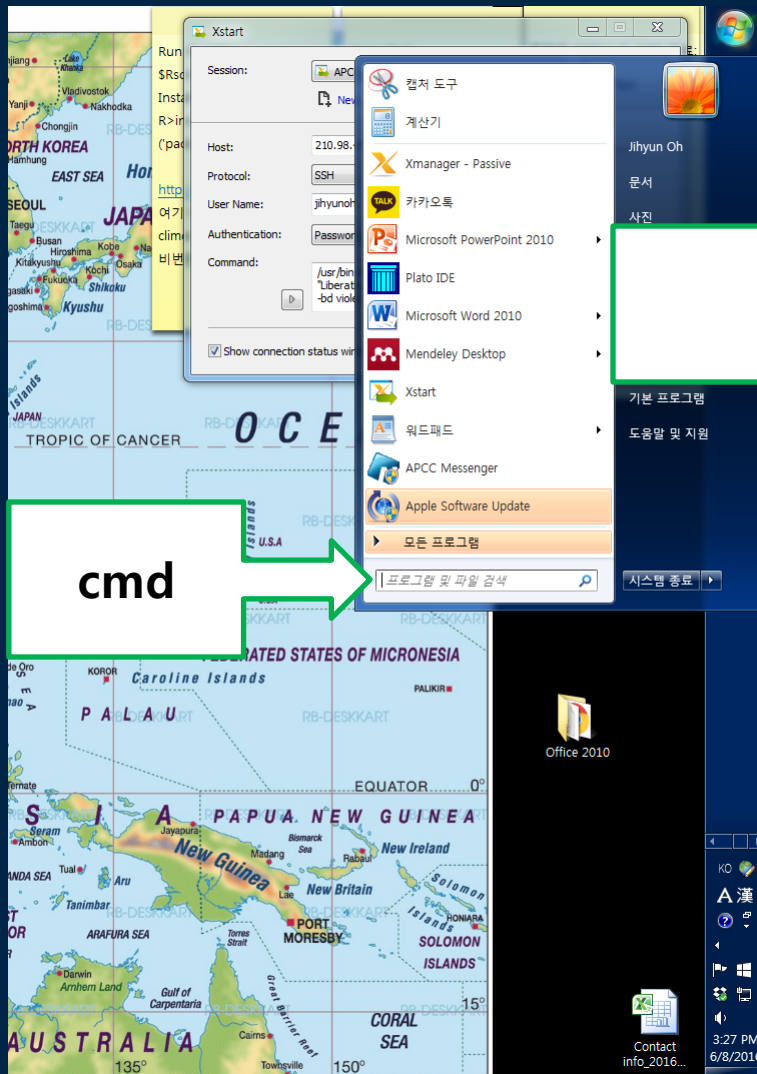
```
14.cir.BSISO1.COMP.f90 - Code::Blocks 16.01
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
Management
Projects Symbols Files
Workspace
Start here 14.cir.BSISO1.COMP.f90 41.PARA.2D.H
1 !-----
2 ! Program for projecting model output or observed data onto the BSISO
3 ! EOFs
4 ! NVAR1 = OLR, NVAR2 = VVV
5 ! NMODE1 = BSISO1, NMODE2 = BSISO2
6 ! NDAYF = The number of days in the latest year
7 !-----
8 include "C:\HandsOn\BSISO\src\PROGRAM\41.PARA.2D.H"
9 real :: pavg(8,nx,ny),VAR(nx,ny),ave(nx,ny),num(nx,ny)
10 integer :: imun, irec
11 integer :: pdate(8)
12 integer,dimension(8,309) :: year, jday
13
14 data pdate / 197, 215, 173, 151, 236, 165, 283, 216 /
15
16 open (11,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase1',status='old')
17 open (12,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase2',status='old')
18 open (13,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase3',status='old')
19 open (14,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase4',status='old')
20 open (15,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase5',status='old')
21 open (16,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase6',status='old')
22 open (17,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase7',status='old')
23 open (18,file='C:\HandsOn\BSISO\src\DATA\BSISO1.MJJASO.amp1.5.Phase8',status='old')
24 open (1,file='C:\HandsOn\BSISO\src\DATA\43.'//VNAME//'.DAY.ANOS2.noLY.51',access='direct',status='old', &
25 & form='unformatted', recl=nx*ny*4)
26
27
28 open (33,file='C:\HandsOn\BSISO\src\DATA\45.'//VNAME//'.19812010.MJJASO.BSISO1.amp1.5.COMP.bin',access='direct',status='unknown', &
29 & form='unformatted', recl=nx*ny*4)
30 open (22,file='C:\HandsOn\BSISO\src\DATA\45.'//VNAME//'.19812010.MJJASO.BSISO1.amp1.5.COMP.CTL',status='unknown')
31
32
33 !----- READ BSISO indices
34 do ip=1,8
35 do ik=1,pdate(ip)
36 imun = 10+ip
37 read(imun,100) year(ip,ik),jday(ip,ik)
38 enddo
39 close (imun)
```

eparated  
SISO2 index  
les

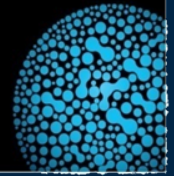
 APEC CLIMATE CENTER



# Display using GrADS



# Display using GrADS



```
C:\Windows\system32\cmd.exe
06/09/2016 11:30 AM 38,496 14.cir.BSIS02.COMP.exe
10/15/2014 02:58 PM 4,075 14.cir.BSIS02.COMP.f90
06/09/2016 11:30 AM 8,217 14.cir.BSIS02.COMP.o
10/15/2014 02:58 PM 3,430 16.cir.COMP.gs
10/15/2014 02:58 PM 223 21.PARA.H
10/15/2014 02:58 PM 372 41.PARA.2D.H
10/15/2014 02:58 PM 4,882 cbarn.gs
10/15/2014 02:58 PM 1,762 rghset2.gs
26개 파일 241,747 바이트
2개 디렉터리 399,053,885,440 바이트 남음

C:\HandsOn\BSISO\stn\PROGRAM>DIR
C 드라이브의 볼륨에는 이름이 없습니다.
볼륨 일련 번호: E612-0F07

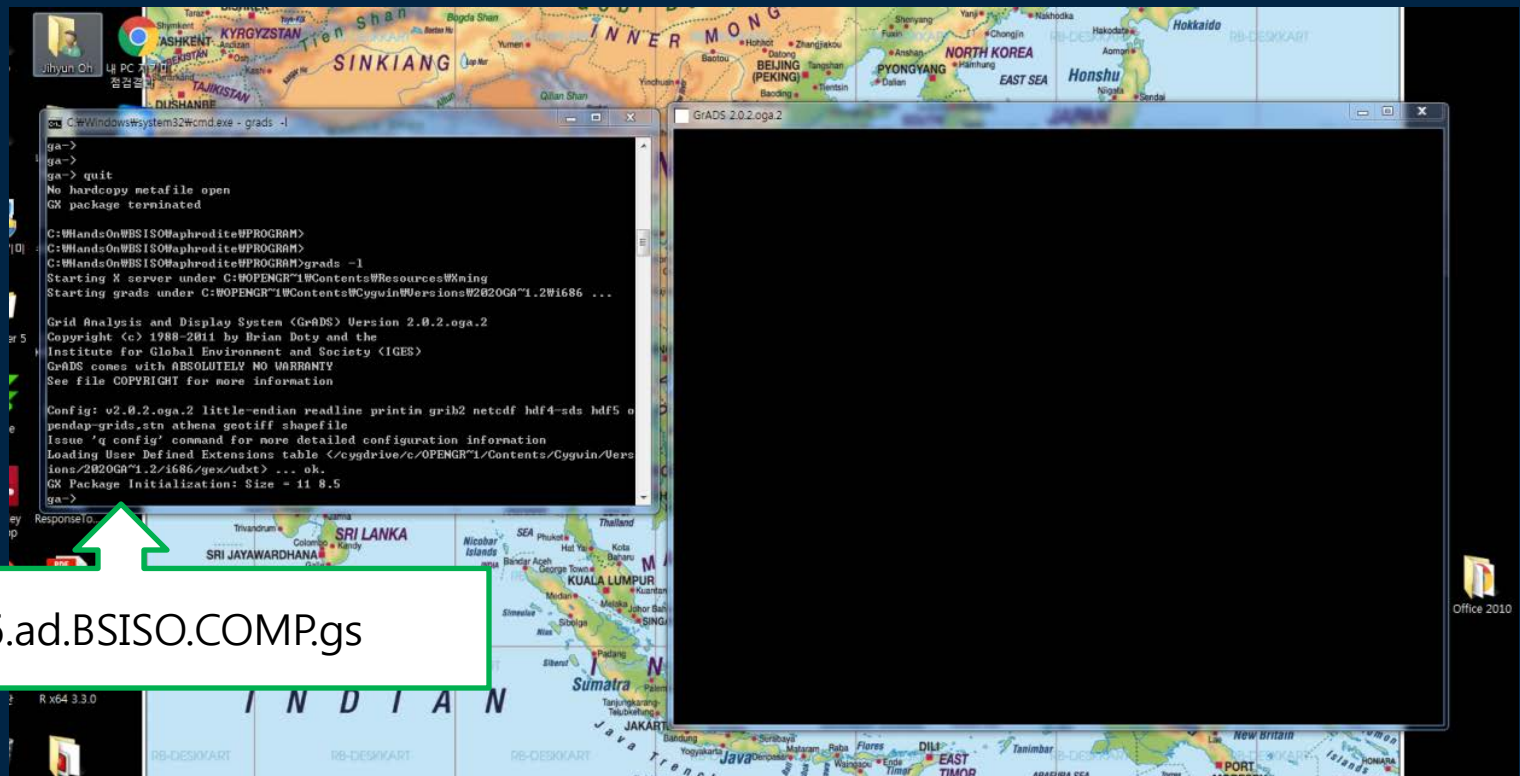
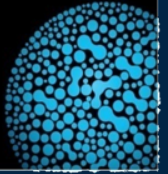
C:\HandsOn\BSISO\stn\PROGRAM 디렉터리

06/09/2016 11:30 AM <DIR> .
06/09/2016 11:30 AM <DIR> ..
10/15/2014 02:58 PM 5,778 01.stn.AN01.f90
10/15/2014 02:58 PM 2,633 02.stn.AN02.f90
10/15/2014 02:58 PM 3,097 03.BSISO.PHS.amp1.5.MJAS0.f90
10/15/2014 02:58 PM 2,054 04.stn.BSIS01.COMP.f90
10/15/2014 02:58 PM 2,052 04.stn.BSIS02.COMP.f90
10/15/2014 02:58 PM 1,860 05.stn.GSform.BSIS01.f90
10/15/2014 02:58 PM 1,857 05.stn.GSform.BSIS02.f90
10/15/2014 02:58 PM 2,731 06.stn.BSIS01.COMP.gs
10/15/2014 02:58 PM 2,731 06.stn.BSIS02.COMP.gs
06/09/2016 11:02 AM 41,792 11.cir.AN01.exe
10/15/2014 02:58 PM 5,503 11.cir.AN01.f90
06/09/2016 11:02 AM 10,110 11.cir.AN01.o
06/09/2016 11:07 AM 36,637 12.cir.AN02.exe
10/15/2014 02:58 PM 3,111 12.cir.AN02.f90
06/09/2016 11:07 AM 7,555 12.cir.AN02.o
06/09/2016 11:30 AM 38,496 14.cir.BSIS01.COMP.exe
10/15/2014 02:58 PM 4,076 14.cir.BSIS01.COMP.f90
06/09/2016 11:30 AM 8,217 14.cir.BSIS01.COMP.o
06/09/2016 11:30 AM 38,496 14.cir.BSIS02.COMP.exe
10/15/2014 02:58 PM 4,075 14.cir.BSIS02.COMP.f90
06/09/2016 11:30 AM 8,217 14.cir.BSIS02.COMP.o
10/15/2014 02:58 PM 3,430 16.cir.COMP.gs
10/15/2014 02:58 PM 223 21.PARA.H
10/15/2014 02:58 PM 372 41.PARA.2D.H
10/15/2014 02:58 PM 4,882 cbarn.gs
10/15/2014 02:58 PM 1,762 rghset2.gs
26개 파일 241,747 바이트
2개 디렉터리 399,053,885,440 바이트 남음

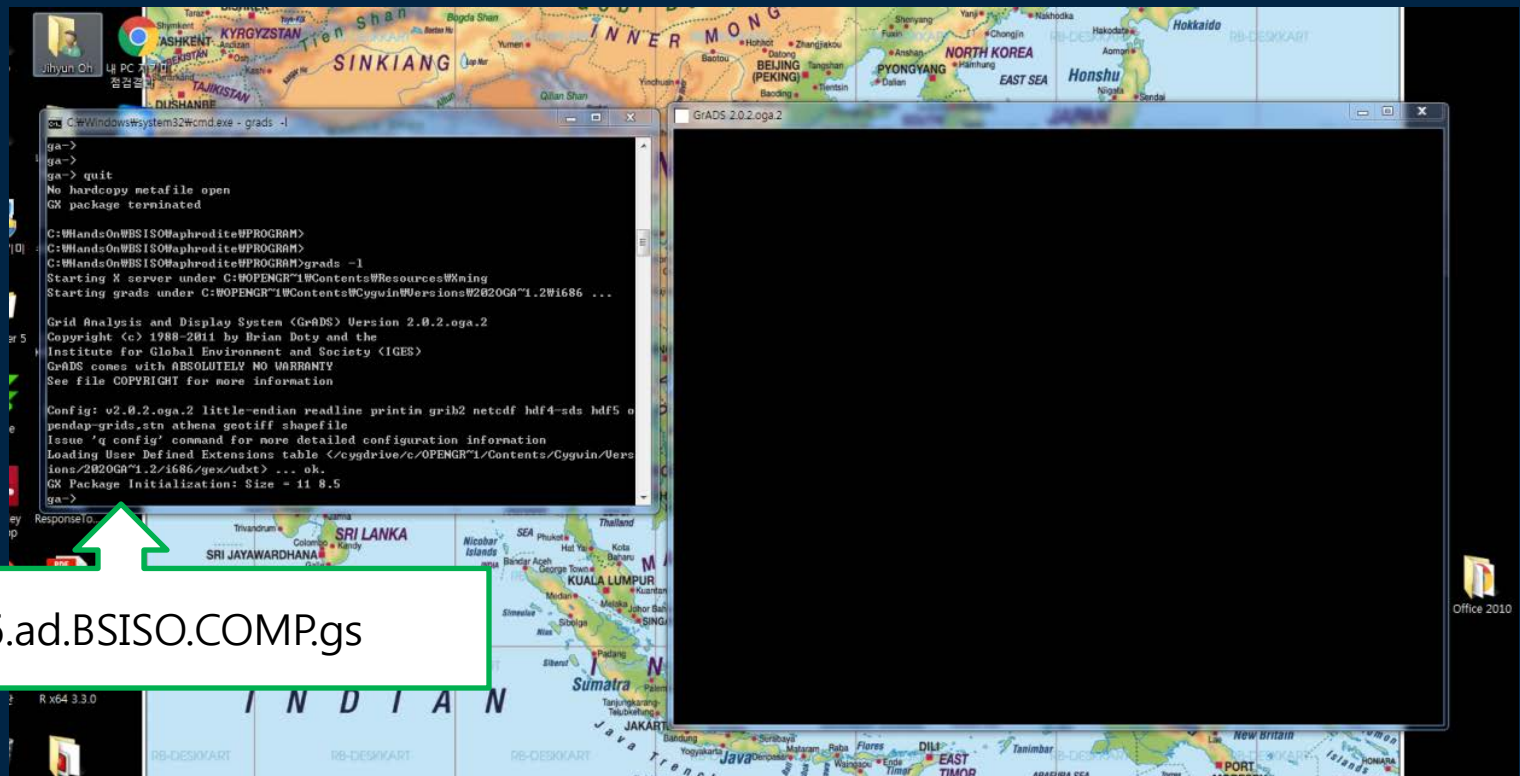
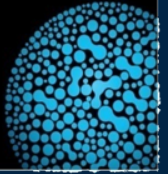
C:\HandsOn\BSISO\stn\PROGRAM>
```

Grads -I

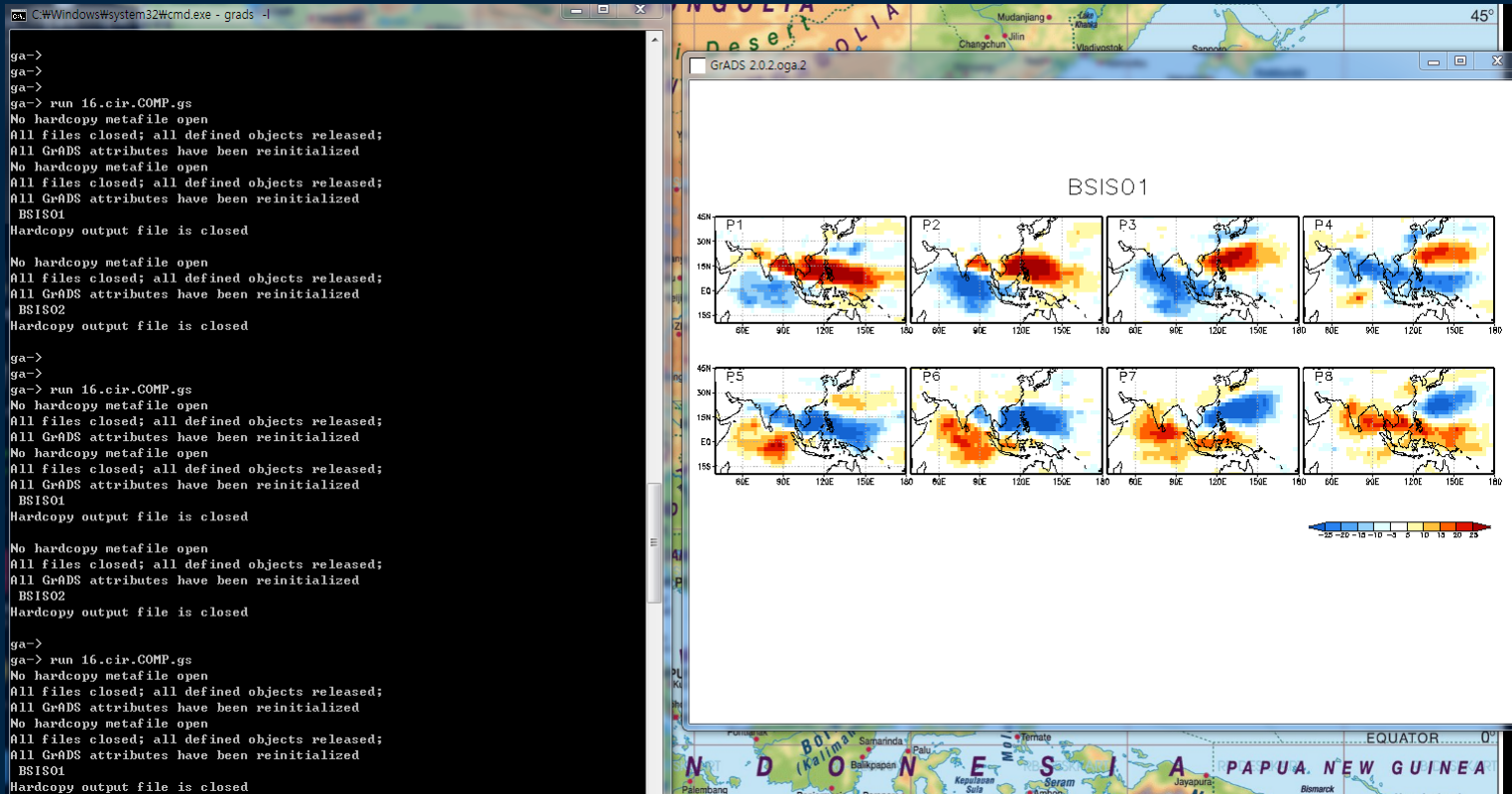
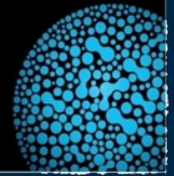
# Display using GrADS



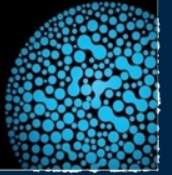
# Display using GrADS



# Display using GrADS



# Practice

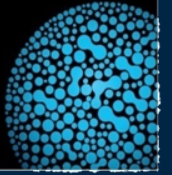


Fill out the table in sheet.pptx using composite plots in C:\WBSISOW\COMPOSITE

Send the file to [jihyunoh@apcc21.org](mailto:jihyunoh@apcc21.org)



# Complete your sheet



Investigate impact of the BSISO on your area of interest

**C:\HandsOn\BSISO\composite**

open 35.APHRO.19812007.MJJASO.BSISO1.amp1.5.COMP.CTL

q file

set x 1

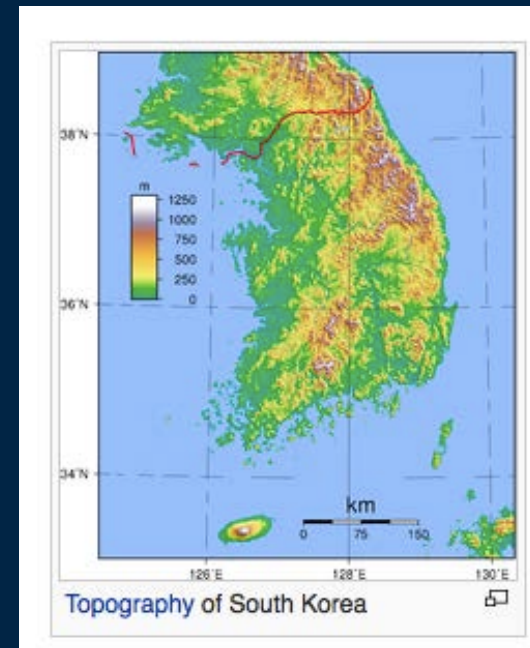
set y 1

d aave(p1,lon=124,lon=130,lat=33,lat=38)

d aave(p2,lon=124,lon=130,lat=33,lat=38)

d aave(p3,lon=124,lon=130,lat=33,lat=38)

d aave(p4,lon=124,lon=130,lat=33,lat=38)



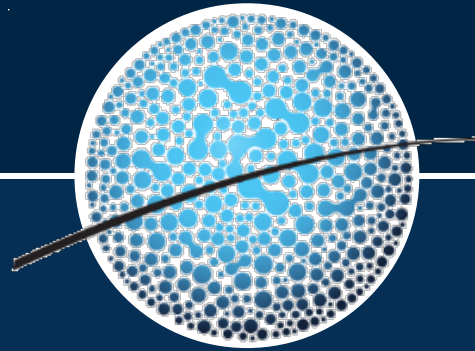
# Seasonal Outlook for Winter 2016 by APCC-MME

Yoojin Kim

Climate Prediction Team

APEC Climate Center (APCC), Busan, Republic of Korea





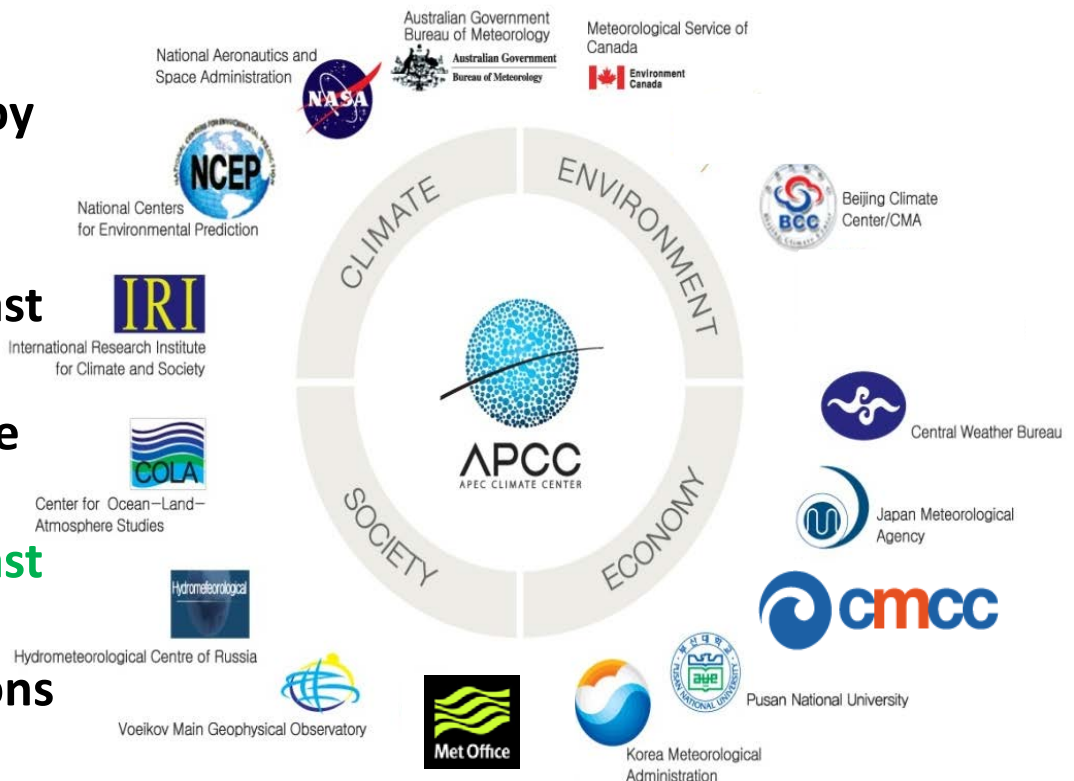
# Contents

1. Introduction to the APCC
2. Seasonal Outlook of ASEAN by APCC-MME

# Introduction to the APCC MME

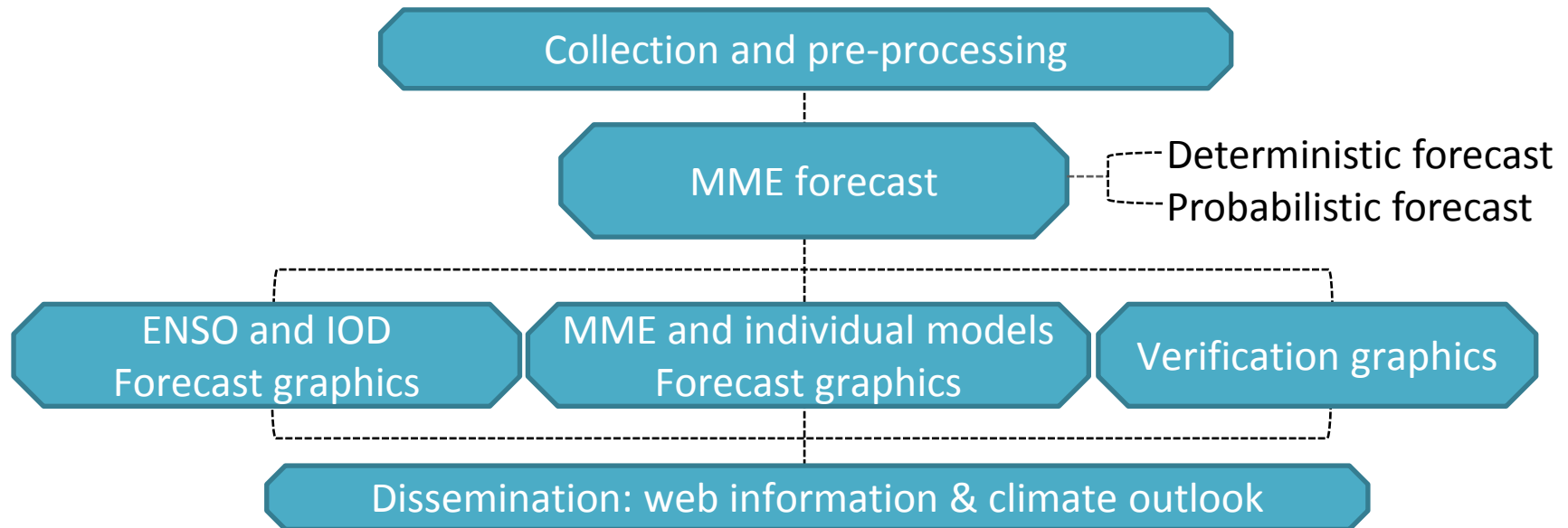
## APCC-MME model providers

- APCC had produced 3M lead seasonal-rolling forecast data by **multi-model-ensemble (MME)** skill since 2005.
- 3M lead monthly-rolling forecast since 2008.
- **At present**, 16 organizations are participating.
- **6M lead monthly-rolling forecast** has been established since **September, 2013**: 7 organizations in 5 countries



# Introduction to the APCC Seasonal Forecast

## APCC-MME 6-month climate forecast system



- **Deterministic MME: SCM, SPM, MRG, SSEM**
- **Probabilistic MME: Tercile-category probability forecast**
- **2-m/850-hPa temperature, precipitation, GPH 500-hPa, SST**



# Introduction to the APCC Seasonal Prediction

## ● MME Schemes

### ■ Deterministic Forecast:

- ➔ ● Simple Composite Method (SCM): Simple composite of individual forecast with equal weighting
- Stepwise Pattern Projection Method (SPM; Kug et al. 2008): Calibrated MME which is obtained from the adjusted (or corrected) single-model predictions based on a stepwise pattern projection method
- Multiple Regression Method (MRG; Krishnamurti et al. 2000): Empirically weighted MME with coefficient computed by multiple linear regression
- Synthetic Multi-Model Super Ensemble Method (SSE; Yun et al. 2003): Empirically weighted MME with EOF-filtered data

### ■ Probabilistic Forecast:

- ➔ ● Probabilistic Multi-Model Ensemble (PMME; Min et al. 2009) : Probabilistic MME based on position of the forecast PDF in respect to historical PDF using Gaussian fitting method

# Introduction to the APCC Seasonal Prediction

- APCC webpage : <http://apcc21.org>

The screenshot displays the APCC (APEC Climate Center) website. The header includes the APCC logo, navigation links (Research, Climate Information Services, International Cooperation, Media, Notices, About us), and a search bar. The main content area is titled 'Climate Information Service' and features a sidebar with a 'Seasonal Forecast' menu. The 'Outlook' option is selected, leading to a page titled 'Climate Outlook for November 2016 - April 2017'. The page includes a search bar with '2016' and 'NDJFMA' selected, and a table with four columns: Outlook, Deterministic MME Forecast, Probabilistic MME Forecast, and Deterministic Forecast. The 'Outlook' column is highlighted, and the text below states: 'BUSAN, 25 October 2016 – Synthesis of the latest model forecasts for November 2016 to April 2017 (NDJFMA) at the APEC Climate Center (APCC), located in Busan, Korea, indicates the ENSO state to be neutral. The positive temperature anomalies are most likely to prevail over the globe. Highly probable above normal rainfalls over the maritime continent are predicted for NDJ.' The 'Temperature and Precipitation Outlook' section is also visible, with a sub-section for 'Forecast for November 2016 - January 2017'.

- ✓ CLIK: Climate Information Tool Kit
- ✓ ADSS: APEC Climate Center Data Service System



# APCC Activities

## Interdisciplinary Research

### **A. APCC-NCDR Project “Pilot Study of Early Warning and Risk Assessment on Drought Disaster”**

- National Science and Technology Center for Disaster Reduction, Chinese Taipei
- Developed prediction tools for drought using APCC seasonal forecast results, to establish an early warning system for drought



# APCC Activities Interdisciplinary Research

## B. APN Project “Toward a Fire and Haze Early Warning System for Southeast Asia”

- Multi-National Projects with Indonesia, Malaysia, Korea, Singapore, Japan, USA
- Fire and haze early warning system for the region in Indonesia, Malaysia and Singapore by using seasonal forecasts to predict the drought conditions that trigger forest fires







# APCC Activities

## Interdisciplinary Research

### **C. APCC-CRIEPI Project “Application of Seasonal Forecasts to Predict Electricity Demand in Japan”**

- Central Research Institute of Electric Power Industry, Japan
- Used APCC’s climate forecasts to establish a system to predict electricity demand in Japan



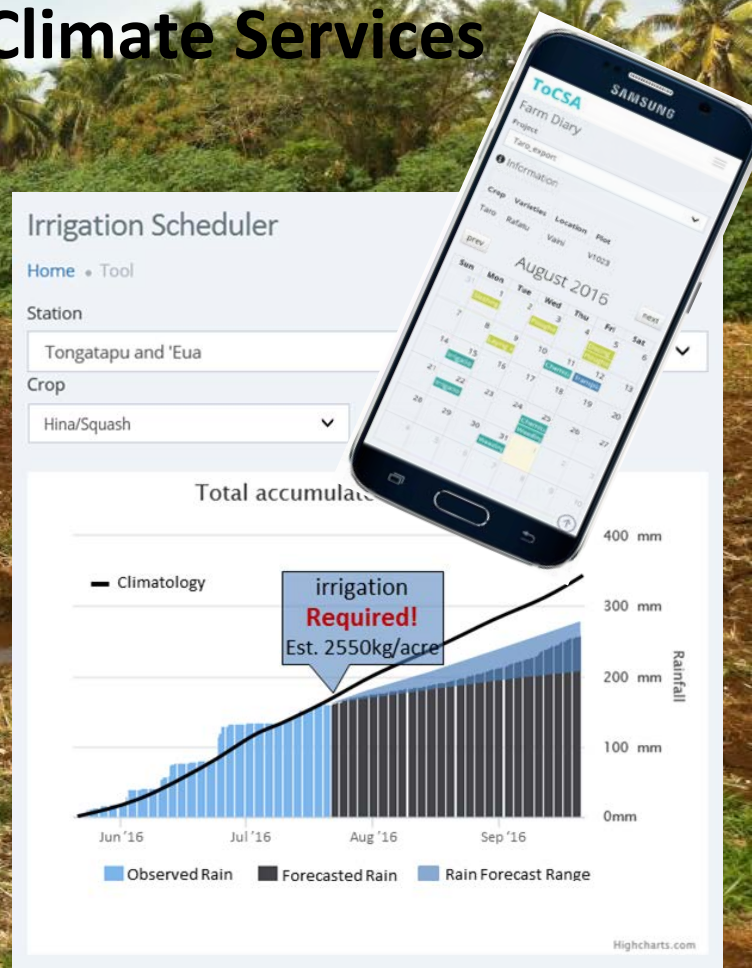




# APCC Activities Interdisciplinary Research

## D. Improving Agricultural Productivity through Ensuring Data Availability and Enhancing Climate Services

- Tonga Meteorological Agency
- Tonga Ministry of Agriculture
- Improving agro-met data network
- Climate Smart Agriculture (Smart Irrigation)

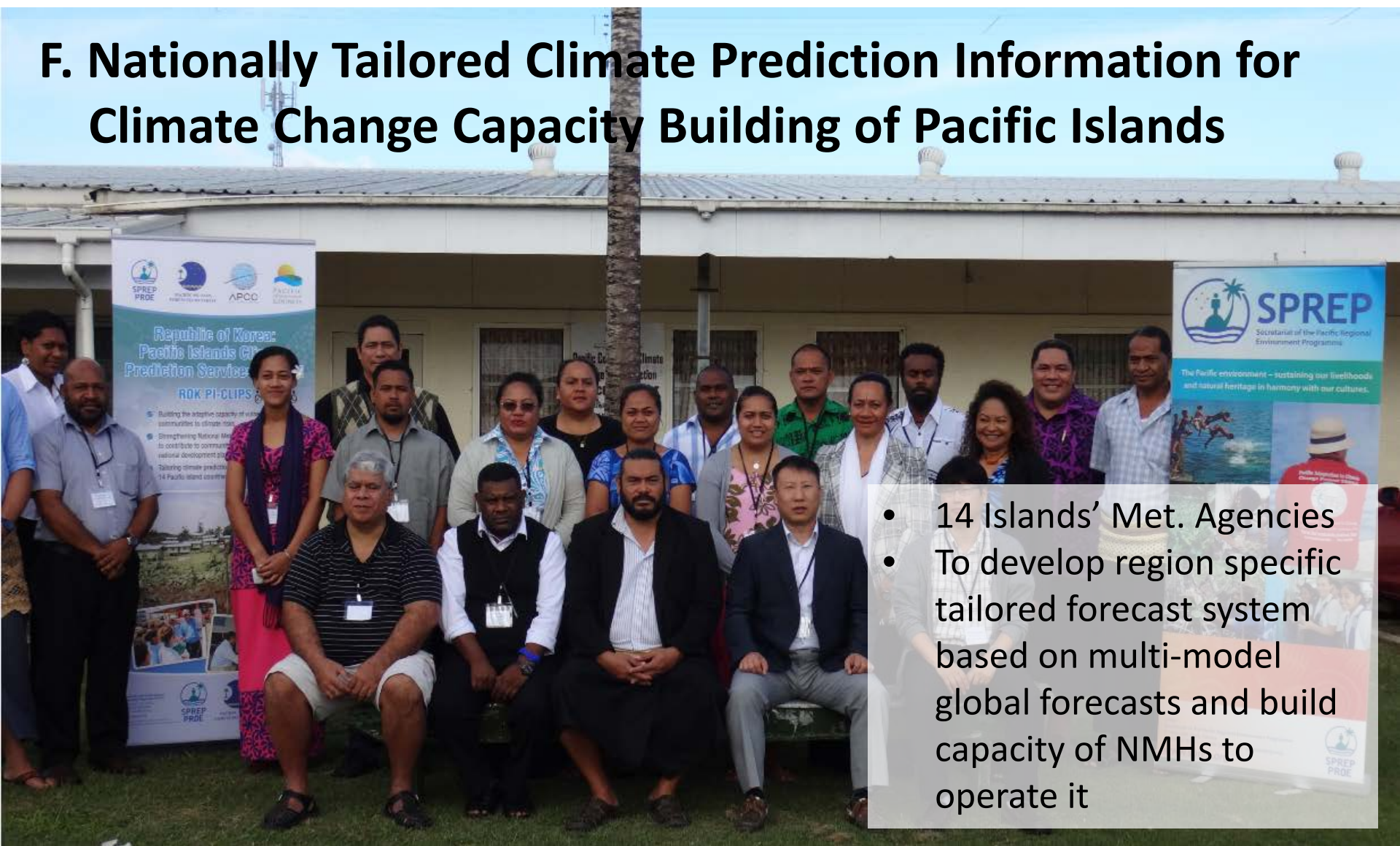






# APCC Activities Interdisciplinary Research

## F. Nationally Tailored Climate Prediction Information for Climate Change Capacity Building of Pacific Islands



- 14 Islands' Met. Agencies
- To develop region specific tailored forecast system based on multi-model global forecasts and build capacity of NMHs to operate it

# APCC Activities

## Interdisciplinary Research

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
|  <b>ASEAN Cooperation Project Proposal</b><br><b>FULL PROPOSAL FORMAT - FOR PROJECTS OF USD 100,000 AND ABOVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                 |
| Project Classification Code: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                 |
| Project Title: ASEAN Science-Based Disaster Management Platform <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                 |
| Project Description: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                 |
| <p>The project supports the full implementation of Concept Note 19: Promoting Science-Based Disaster Risk Management of APCC Work Programme Phase II (2013-2015). The project is aimed to enhance the capacity of ASEAN member states in disaster management and risk reduction in the ASEAN region through the following main activities:</p> <ol style="list-style-type: none"> <li>1) Development of a web platform for facilitating exchange of knowledge, methodologies, and other information that contributes to the effective application of science in risk mitigation and disaster prevention.</li> <li>2) Organization of cross-sectoral workshops and symposium between the science and policy sectors to assess information needs, enhance collaboration and communication among scientists and practitioners, and develop short and long-term policy-oriented multidisciplinary research priorities and programs.</li> <li>3) Co-development of the platform and training with AHA Centre for its sustainable operation and maintenance.</li> </ol> |                                                                                 |
| Sponsoring ASEAN Body: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                 |
| Sectoral Committee/Main Body: ASEAN Committee on Disaster Management (ACDM) <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                 |
| Meeting Number/Date: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                 |
| Working Group/Sub-Committee: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                 |
| Meeting Number/Date: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                 |
| Proponent's name and address: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                 |
| Dr. Chin-Seung Chung (Director) <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                 |
| APEC Climate Center <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                 |
| 12 Centum 7-ro, Haeundae-gu, Busan, 612-020 Republic of Korea <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                 |
| Date of Preparation: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                 |
| April 15 2015 <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                 |
| Proposed Funding Source: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                 |
| ASEAN-ROK Special Cooperation Fund <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                 |
| Proposed Project Budget (total): <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                 |
| USD 540,314 (tentative) <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                 |
| Information below to be completed by the SPCD <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                 |
| Recommendation of Secretary-General/Project Appraisal Committee <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                 |
| Meeting No./Date: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Action: <input type="checkbox"/> Endorsed <input type="checkbox"/> Not Endorsed |
| Approval of Committee Of Permanent Representatives to ASEAN (CPR) <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                 |
| Meeting No./Date: <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Action: <input type="checkbox"/> Endorsed <input type="checkbox"/> Not Endorsed |

## G. ASEAN Science-Based Disaster Management Platform

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Brief Project Description– 300 words max</b> <input type="text"/> <p>Science and technology play a big role in supporting disaster risk management. Areas such as meteorology, seismology, engineering, land use management, remote sensing, and others contribute to effective disaster risk management (DRM) (ASEAN 2013a). However, the use of scientific tools and models in DRM is still limited due to the lack of interactions between scientists and practitioners, few mechanisms to facilitate research uptake, and a small number of initiatives to build scientific and technical capacity (UNISDR 2009, ASEAN 2013b). <input type="text"/></p> <p>To help bridge gaps between researchers and policymakers, the APEC Climate Center (APCC) will develop the ASEAN Science-Based Disaster Management Platform (ASDMP). The ASDMP will make available decision-relevant tools <input type="text"/></p> <p>Knowledge products on DRM. The structure of database will then be developed based on an analysis of practitioner needs and outputs of the previous step. Finally, the investigated content will be integrated into the ASDMP. The AHA Centre will jointly develop the ASDMP and be trained to ensure sustainable operation and maintenance. ASDMP will contribute to promoting the use of knowledge and research products for evidence-based DRM and policy in ASEAN member states. <input type="text"/></p> <p>Regional cross-sectoral meetings (a symposium and workshops) will be held to identify gaps in current scientific knowledge and barriers and enablers to effectively applying existing knowledge in disaster risk reduction. Based on the identified priorities and needs from the meetings, APCC will develop a short-term to long-term multidisciplinary research roadmap. The meetings will determine emerging challenges in research uptake in disaster risk reduction and promote multidisciplinary dialogues to help create an environment for shared understanding of science and decision-making processes in DRM. <input type="text"/></p> | <b>2. Background and Justification – 600 words max</b> <input type="text"/> <p><b>(a) Problem Analysis</b> – Describe the underlying cause of the problem and the present situation. Include any related and relevant ASEAN activities, policies and plans of action. <input type="text"/></p> <p>ASEAN member states have suffered losses and damages from natural hazards such as typhoons, floods, earthquakes, and tsunamis. There is room to scale up disaster risk reduction and management to avoid these impacts. Many scientific and technical studies regarding disaster risk reduction have been conducted by universities and research institutions in the ASEAN region. However, there are gaps in the between the decision-relevant information needs of disaster management practitioners on one hand and the accessibility of scientific information on the other. There are insufficient mechanisms in the form of knowledge platforms and events<sup>2</sup> to broker relationships among knowledge producers and users and create a collaborative learning environment. Projects also <input type="text"/></p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

<sup>1</sup> Decision-relevant tools and information include the scientific information, guidelines, protocols that support decision making processes.

<sup>2</sup> In knowledge management literature, knowledge platforms include online and offline information and other venues for facilitating the capture, storage, and sharing of knowledge. Knowledge platforms include programs, conferences, and other similar activities that enable knowledge capture, storage, and sharing.

Create a knowledge platform

Build the capacity of AHA Centre in knowledge management



# APCC Activities

## Interdisciplinary Research

### ✓ Training Program (1-week)

- During last 5 years, APCC has trained about 260 participants from over 50 countries

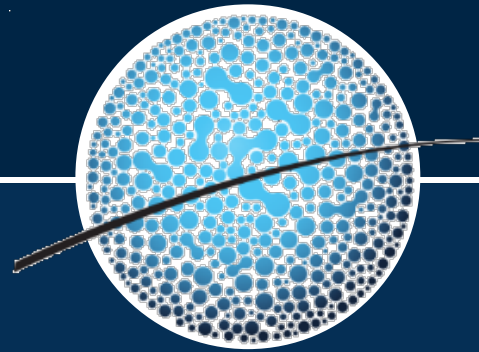
### ✓ CLIK Training Workshop (3 days)

- Since 2015, APCC has trained Climate Researchers in National Met Services for Philippine, Indonesia, Vietnam, Thailand, Brunei.

### ✓ Young Scientist Support Program (3-months)

- Since 2011, APCC has invited 65 young scientists from 26 countries





# Oceanic outlook

# Introduction to the APCC Seasonal Forecast

## Participating models (2016 DJF)

Initial Condition (Mon)

11

12

1

2

3

4

5

6

7

Nov

DJFMAM

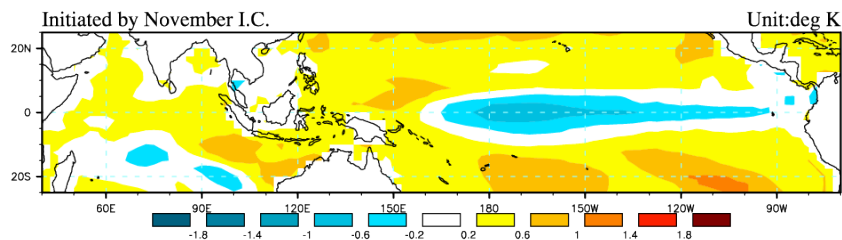
| Model                | Initialization                                                                           | Ens. | SST Specification                                    | Sea Ice Specification                                               | Snow Specification                 |
|----------------------|------------------------------------------------------------------------------------------|------|------------------------------------------------------|---------------------------------------------------------------------|------------------------------------|
| CWB (Chinese Taipei) | Last 10 days(12Z) of previous month from NCEP Reanalysis version2                        | 10   | OPGSST 1.1 from CWB                                  | NCEP climatology                                                    | -                                  |
| HMC (Russia)         | From 00hr 26 Mar. to 12hr 30Mar with 12-hour step                                        | 10   | Persisted anomalies                                  | Initial actual sea ice with relaxation to climate                   | NCEP/NCAR reanalysis-2 initial.    |
| IRI_CA (USA)         | Restart files from long running ECHAM4.5                                                 | 24   | Ensemble forecasts based on Constructed Analogue SST | -                                                                   | -                                  |
| JMA (Japan)          | BGM method(9 members) and 5-day LAF                                                      | 51   | Predicted (one-tier method)                          | Climatology                                                         | Forecasted from climatology        |
| APCC (Korea)         | GODAS ocean initialization                                                               | 10   | GODAS reanalysis                                     | Predicted (APCC/CCSM3 SST Nudging)                                  | Predicted (APCC/CCSM3 SST Nudging) |
| CMCC (Italy)         | Operational analysis ECMWF/ CIGODAS-CMCC analysis                                        | 9    | Opreational analysis ECMWF                           | Climatological                                                      | -                                  |
| MSC (Canada)         | The CMC Global 4D-var analysis                                                           | 20   | Predicted (OGCM4)                                    | Continuous nudging                                                  | -                                  |
| NCEP (USA)           | CFS data assimilation system each day at 00Z, 06Z, 12Z and 18Z                           | 20   | Predicted (GFDL MOM4 global ocean model)             | Predicted (a two-layer sea ice model)                               | Predicted                          |
| PNU (Korea)          | NCEP/NCAR Reanalysis 2 in AGCM, OISST data in OGCM                                       | 5    | Predicted                                            | Predicted                                                           | Predicted                          |
| POAMA (Australia)    | Nudging to the analyses from the Australian Community Climate and Earth System Simulator | 33   | Predicted (ACOM2 Ocean model based on GFDL Mon2)     | Created indirectly in response to the nudged atmospheric conditions | NCEP sea-ice data                  |
| GloSea5 (Korea)      | KMA Global Analysis (N512L70)                                                            | 38   | Predicted (Met Office NEMOVAR)                       | LosAlamos model                                                     | -                                  |

11 models 230 ensemble members

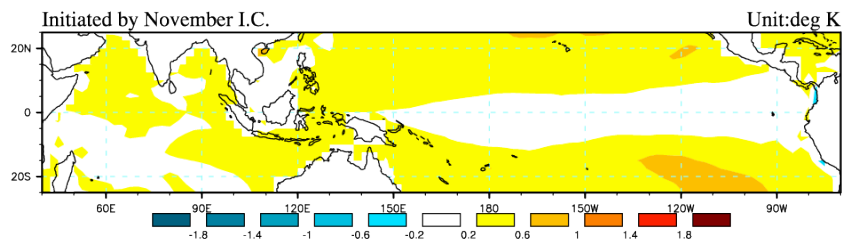
# ENSO & IOD Forecast

## Sea Surface Temperature

SST Anomaly for DJF 2016



SST Anomaly for MAM 2017

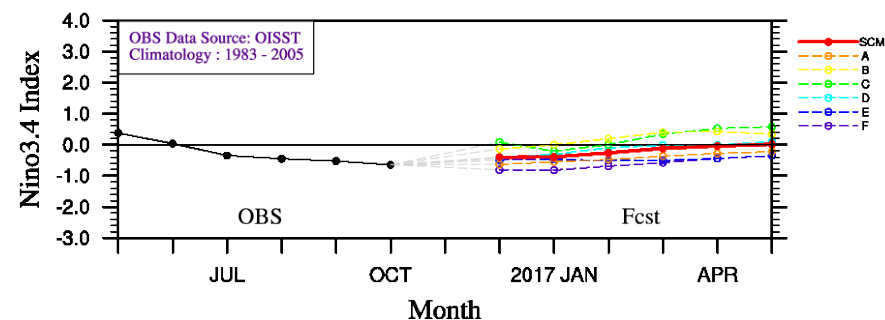


ENSO: Negative side neutral states (DJFMAM) are predicted.

IOD: Neutral states (6-month) are predicted.

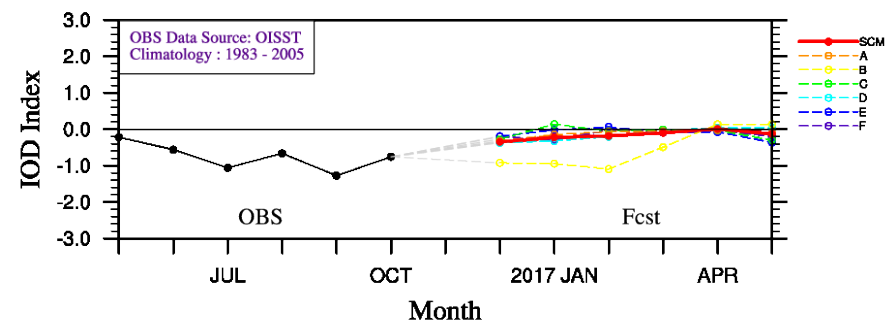
## Forecast for ENSO (6-month)

Nino3.4 Index for 2016 DJFMAM



## Forecast for IOD (6-month)

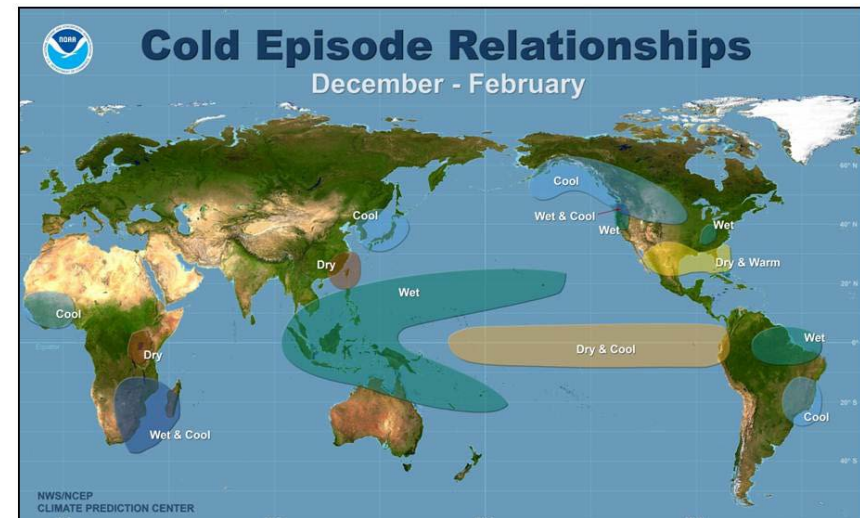
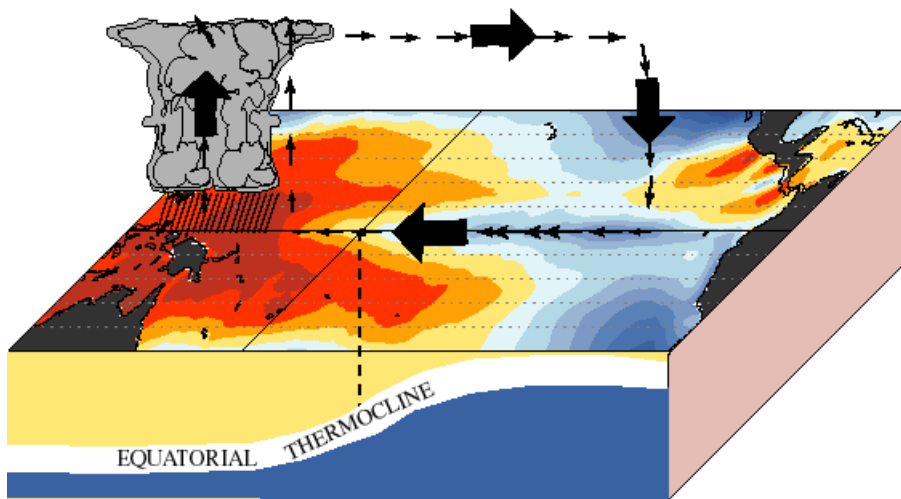
IOD Index for 2016 DJFMAM



# La Niña & Southeast Asian Winter Monsoon

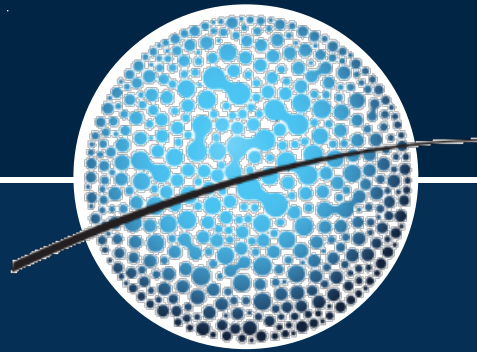
- Sea Surface Temperature & precipitation

December - February La Niña Conditions



- Western tropical Pacific SST warming, eastern tropical Pacific SST cooling
- Convection activity in the western Pacific is strong.





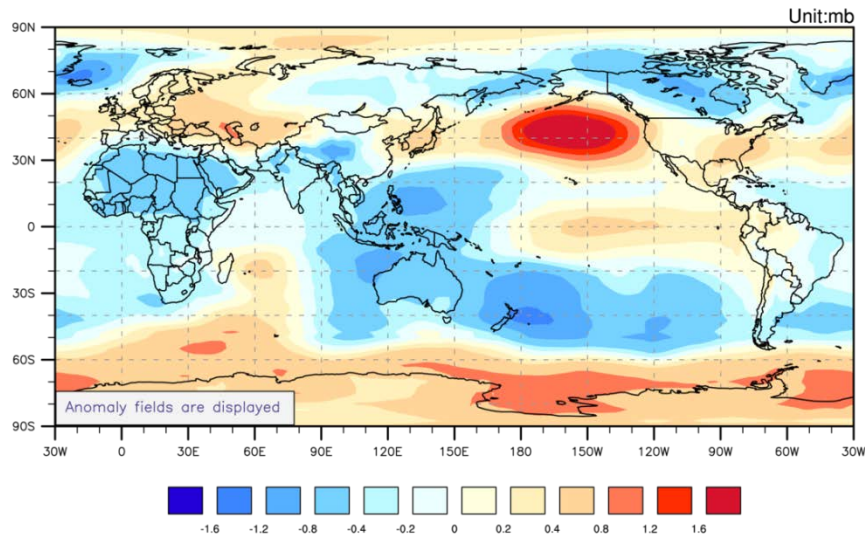
## Seasonal outlook for winter in the Southeast Asia

# Winter (DJF) 2016

## ● Sea Level Pressure & GPH 500

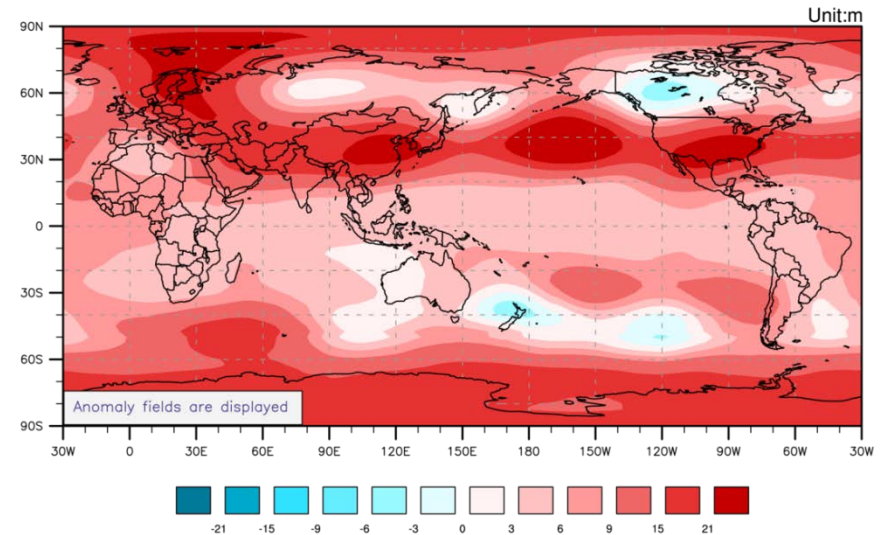
Anomaly fields [SLP]

Sea Level Pressure for December 2016-February 2017



Anomaly fields [GPH500]

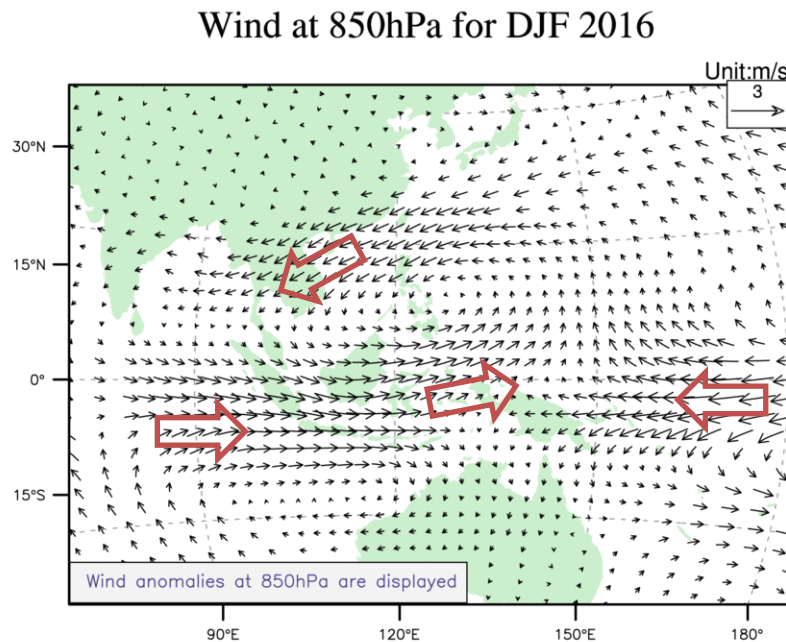
Geopotential height at 500 mb for December 2016-February 2017



- Low SLP in the western Pacific & Southeast Asia
- High GPH at 500-hPa in the western Pacific & Southeast Asia

# Winter (DJF) 2016

- **Horizontal wind 850-hPa**



## Anomaly fields

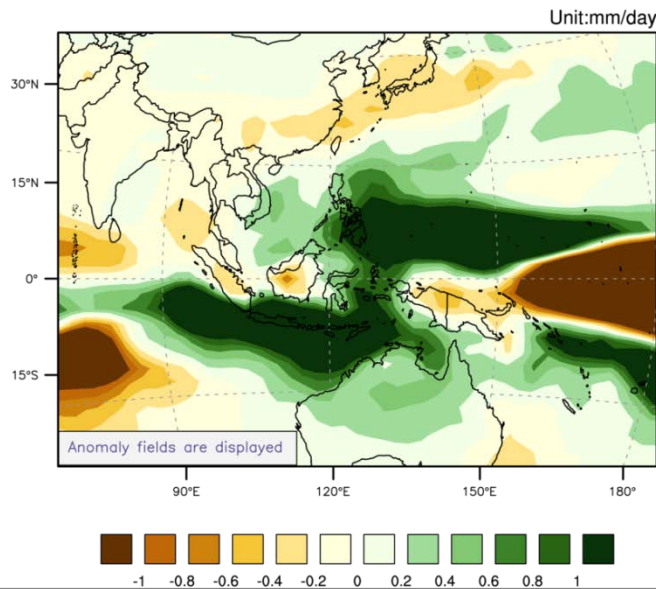
- **Cyclonic flow in the western Pacific**
- **Westerly wind in the equatorial Southeast Asia**
- **Northeasterly wind in the subtropical Southeast Asia**
- **Convergence in the western Pacific**

# Winter (DJF) 2016

## ● Precipitation

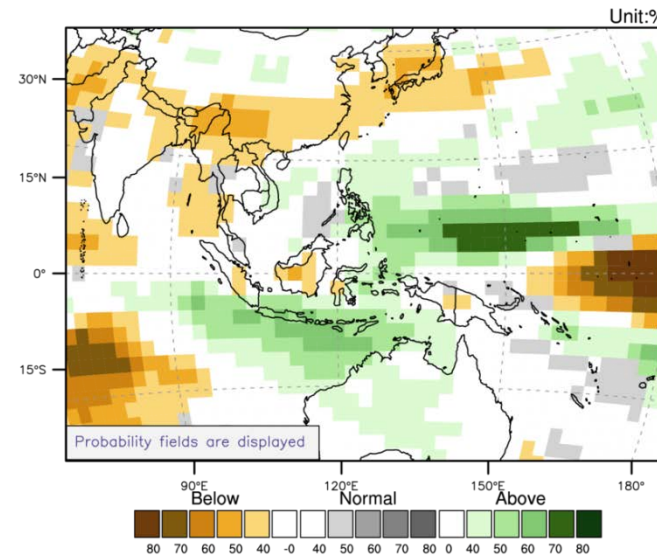
SCM

Precipitation for December 2016-February 2017



Probability fields

Precipitation for December 2016-February 2017



© APEC Climate Center

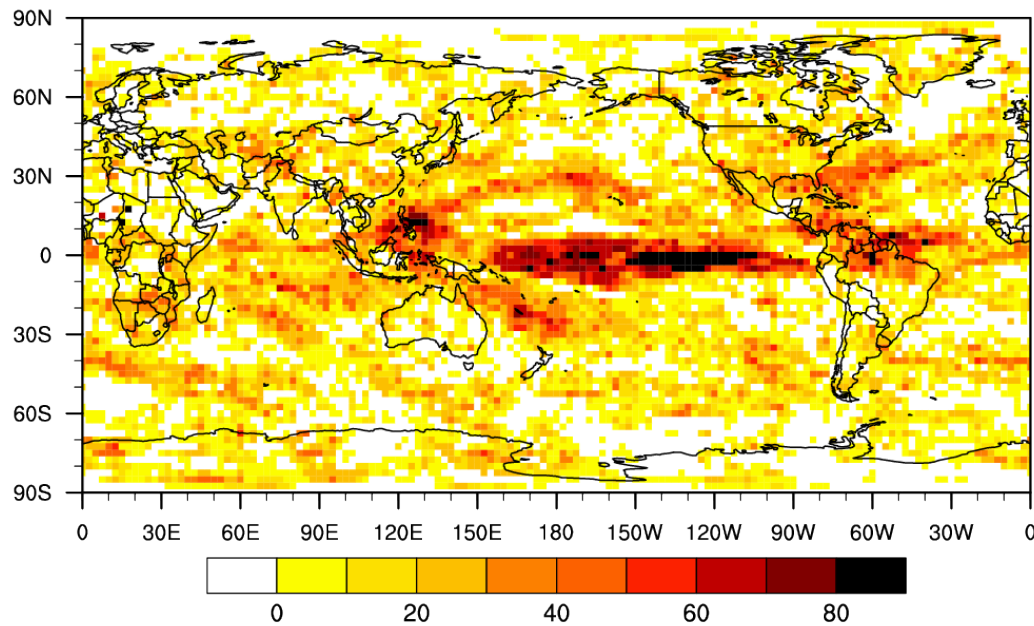
© APEC Climate Center

- Dry condition in Myanmar, north of Laos, Vietnam, South of Thailand, Sumatra, Kalimantan, Sulawesi; Wet condition in south of Vietnam, Philippines, Java; Normal condition in some part of Thailand, Malaysia

# Winter (DJF) 2016

## ● Precipitation verification

Heidke Skill Score : PREC, DJF (1983-2005)



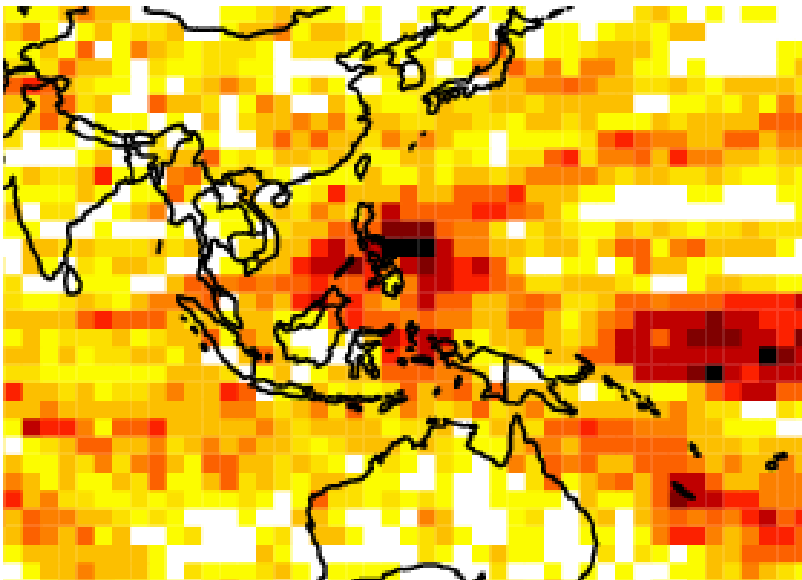
$HSS = \frac{(\text{score} - \text{score by chance})}{(\text{perfect score} - \text{score by chance})}$

© APEC Climate Center

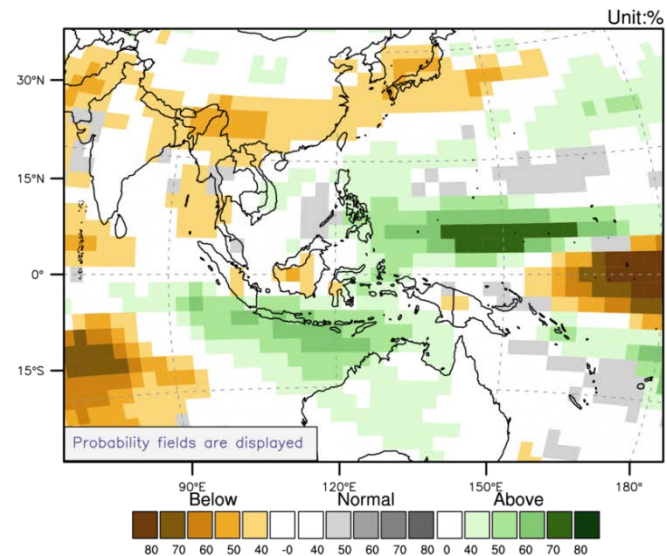
# Winter (DJF) 2016

- Precipitation verification

HSS



Precipitation for December 2016-February 2017



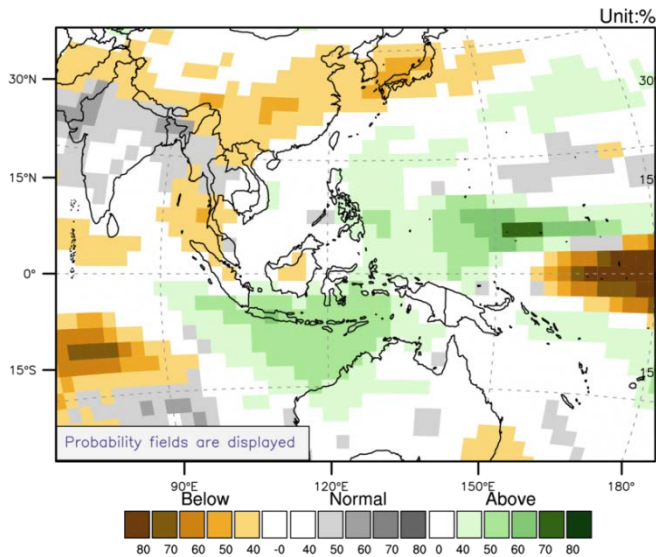
© APEC Climate Center



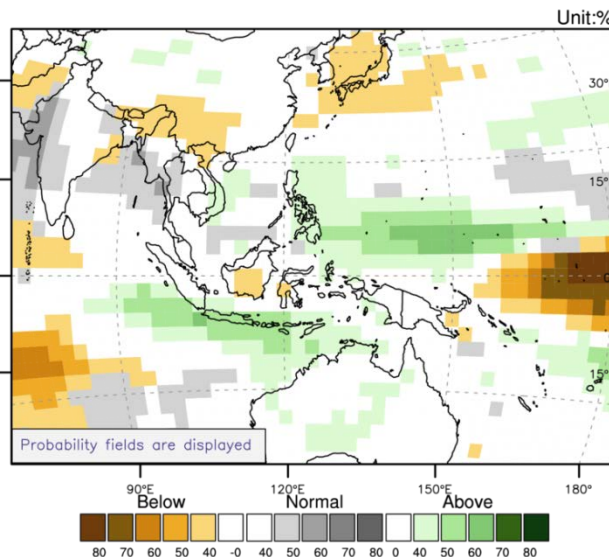
# Winter (DJF) 2016

- Monthly Precipitation

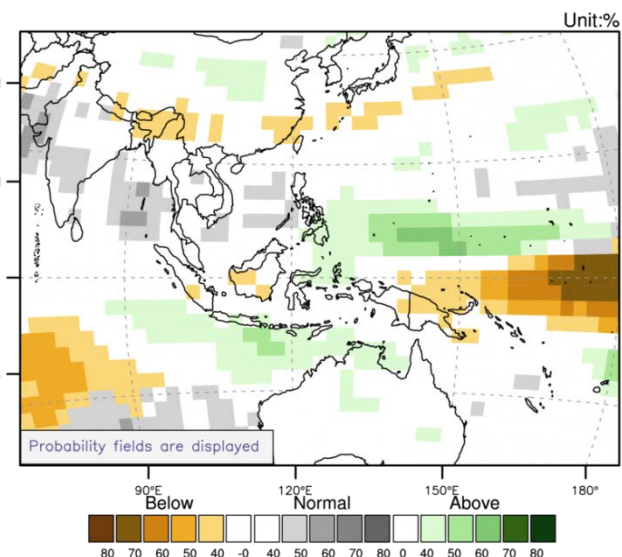
Precipitation for DEC 2016



Precipitation for JAN 2017



Precipitation for FEB 2017



- ENSO signal is going to be reduced.

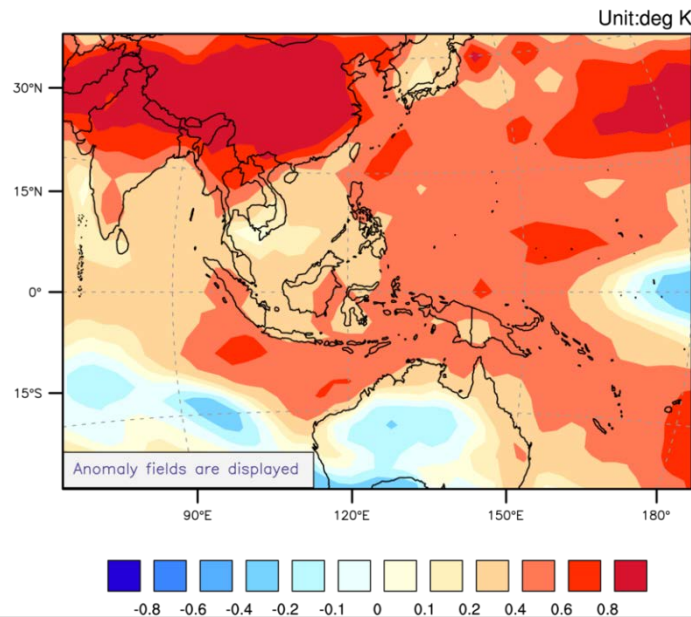


# Winter (DJF) 2016

## ● Temperature at 2-m

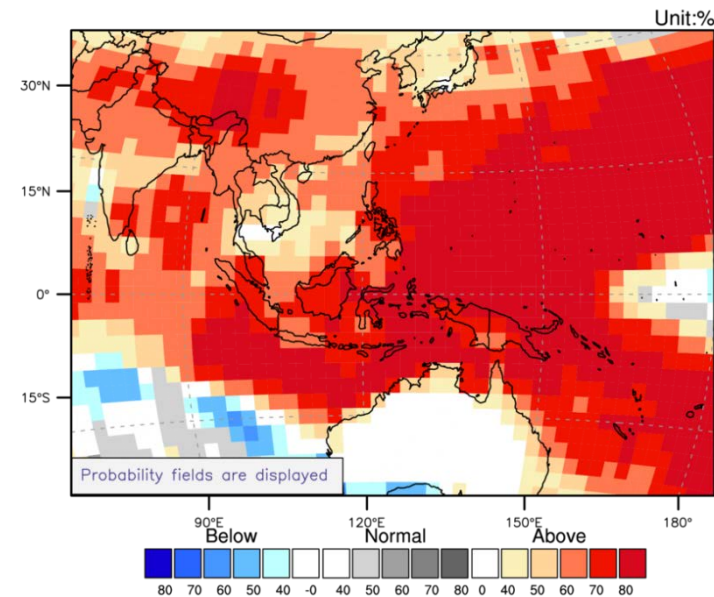
SCM

Temperature at 2m for December 2016-February 2017



Probability fields

Temperature at 2m for December 2016-February 2017

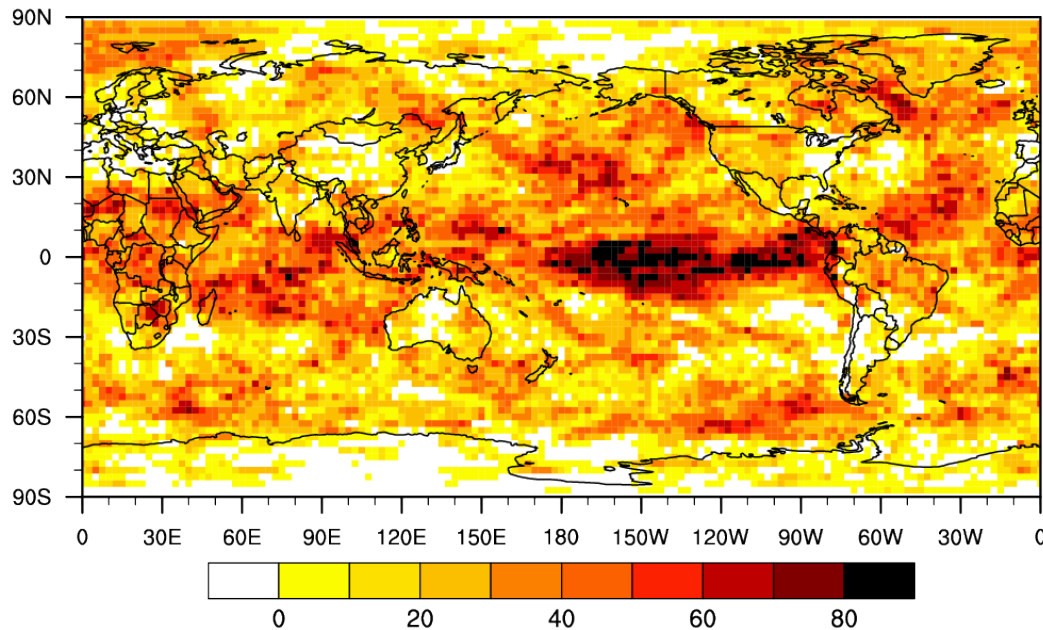


## ● Above normal condition

# Winter (DJF) 2016

## ● Temperature 2-m verification

Heidke Skill Score : T2M, DJF (1983-2005)



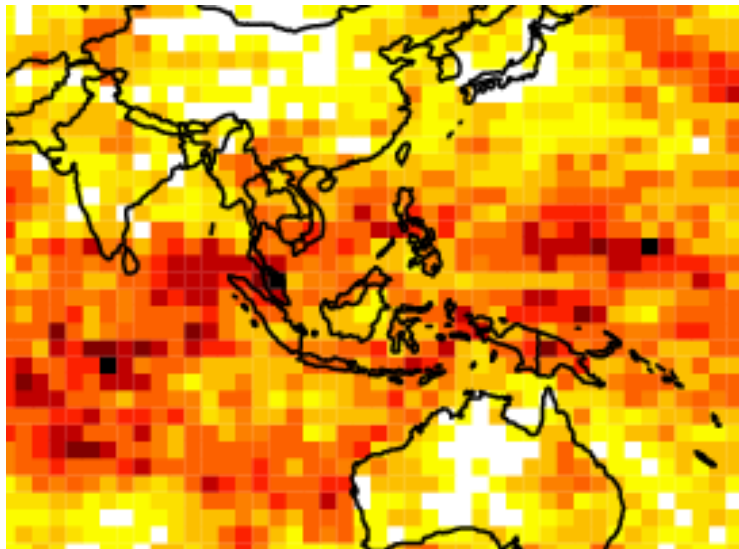
$$HSS = \frac{(\text{score} - \text{score by chance})}{(\text{perfect score} - \text{score by chance})}$$

© APEC Climate Center

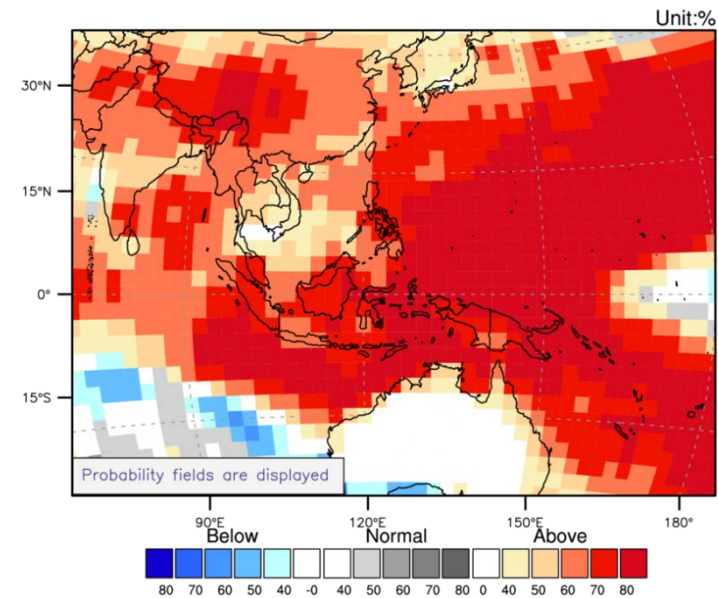
# Winter (DJF) 2016

- T-2m verification

HSS



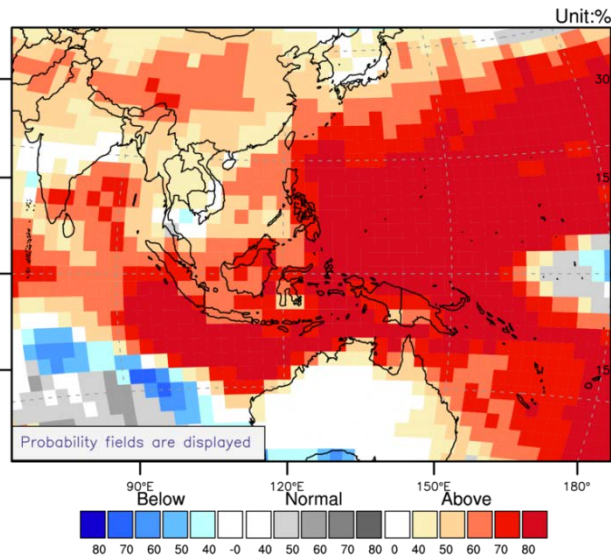
Temperature at 2m for December 2016-February 2017



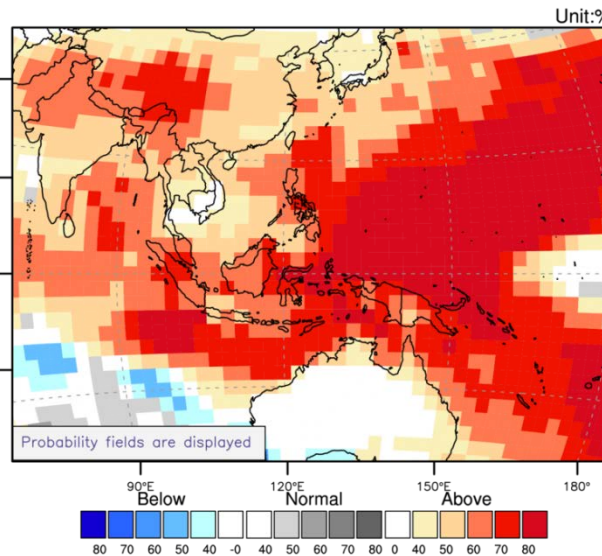
# Winter (DJF) 2016

- **Monthly Temperature at 2-m**

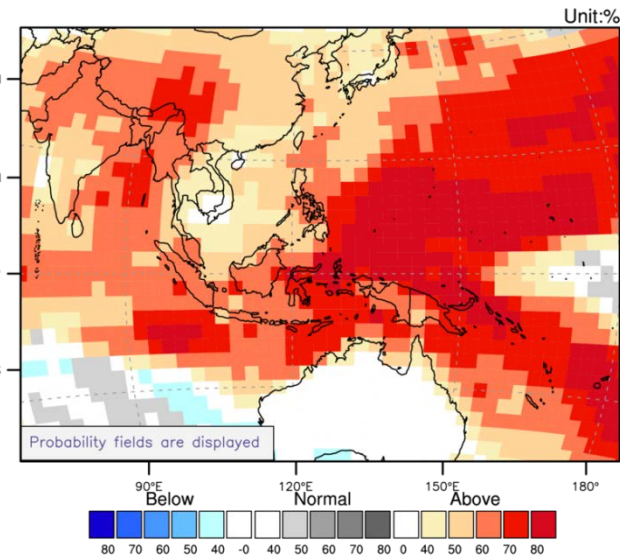
Temperature at 2m for DEC 2016



Temperature at 2m for JAN 2017



Temperature at 2m for FEB 2017



- **Above normal condition!!**



# Climate Outlook for Winter 2016 in the ASEAN

## APCC-MME seasonal forecast

- ENSO (DJFMAM)
  - Neutral state with weak negative signal
  - The strength of negative signal will be reduced.
- Precipitation (DJF)

| North         | West       | East       | South         | Central    |
|---------------|------------|------------|---------------|------------|
| -<br>(40~50%) | -<br>(40%) | +<br>(40%) | +<br>(40~50%) | -<br>(40%) |

- Temperature 2-m (DJF)
  - Above-normal condition over the Southeast Asia (40~80%)



# Thank You



**Yoojin Kim**  
**Climate Prediction Team**  
**APEC Climate Center**  
**E-mail: [yoojin.kim@apcc21.org](mailto:yoojin.kim@apcc21.org)**

# Probabilistic forecast (Categorical)

- HSS (Heidke Skill Score)**

| <b>F</b> \ <b>O</b> | <b>Yes</b> | <b>No</b>             |
|---------------------|------------|-----------------------|
| <b>Yes</b>          | Hit (H)    | False Alarm (F)       |
| <b>No</b>           | Miss (M)   | Correct Rejection (C) |

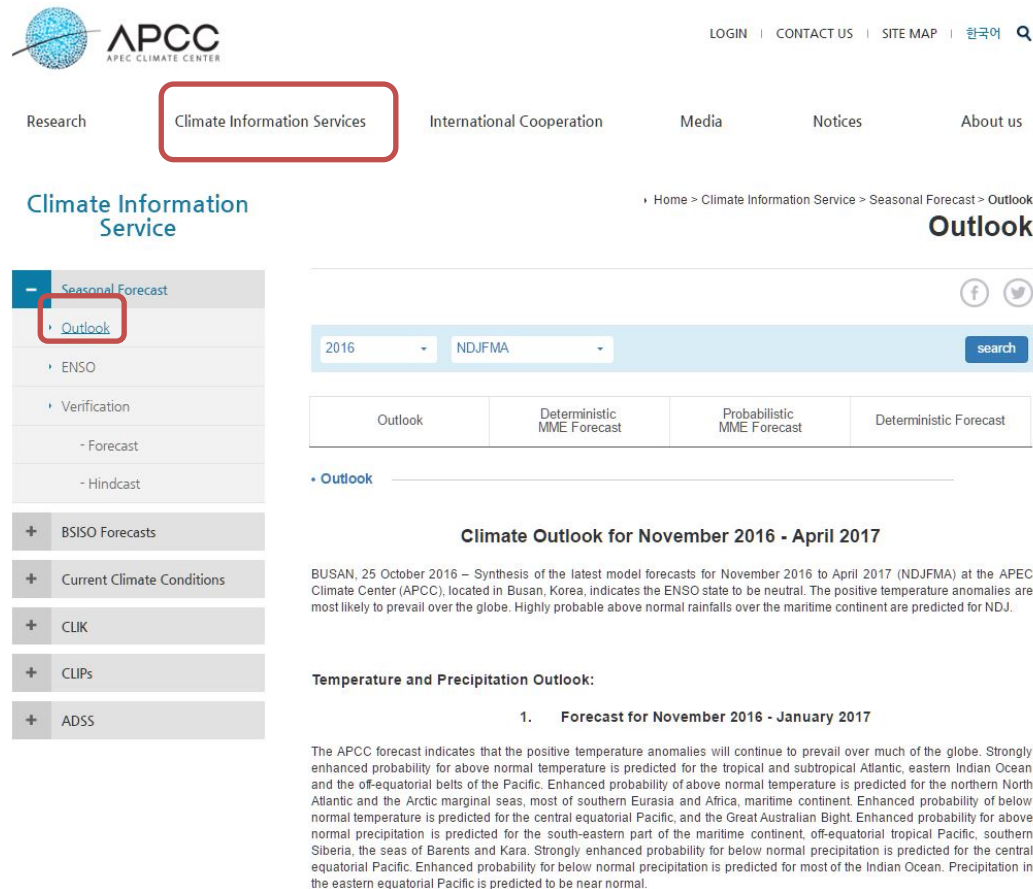
- $$HSS = \frac{(score - score\ by\ chance)}{(perfect\ score - score\ by\ chance)}$$

$$\frac{\{(h+c)/n - [(h+f)(h+m) + (f+c)(m+c)]/n^2\}}{\{1 - [(h+f)(h+m) + (f+c)(m+c)]/n^2\}}$$



# Introduction to the APCC Seasonal Forecast

- APCC web site



The screenshot shows the APCC website interface. At the top, the APCC logo and navigation links (LOGIN, CONTACT US, SITE MAP, 한국어) are visible. The main navigation bar includes Research, Climate Information Services (highlighted with a red box), International Cooperation, Media, Notices, and About us. Below this, the 'Climate Information Service' section is displayed, featuring a sidebar with a 'Seasonal Forecast' menu (also highlighted with a red box) containing links to Outlook, ENSO, Verification, Forecast, and Hindcast. The main content area shows the 'Outlook' page for November 2016 to April 2017 (NDJFMA). It includes a search bar with the year '2016' and the period 'NDJFMA'. Below the search bar, there are four tabs: Outlook, Deterministic MME Forecast, Probabilistic MME Forecast, and Deterministic Forecast. The 'Outlook' tab is selected, displaying the title 'Climate Outlook for November 2016 - April 2017'. The text below states: 'BUSAN, 25 October 2016 – Synthesis of the latest model forecasts for November 2016 to April 2017 (NDJFMA) at the APEC Climate Center (APCC), located in Busan, Korea, indicates the ENSO state to be neutral. The positive temperature anomalies are most likely to prevail over the globe. Highly probable above normal rainfalls over the maritime continent are predicted for NDJ.' Under the heading 'Temperature and Precipitation Outlook:', there is a sub-heading '1. Forecast for November 2016 - January 2017'. The detailed forecast text follows, indicating that positive temperature anomalies will continue to prevail over much of the globe, with enhanced probability for above normal temperature in the tropical and subtropical Atlantic, eastern Indian Ocean, and off-equatorial belts of the Pacific. Enhanced probability of above normal temperature is also predicted for the northern North Atlantic and the Arctic marginal seas, most of southern Eurasia and Africa, maritime continent. Enhanced probability of below normal temperature is predicted for the central equatorial Pacific, and the Great Australian Bight. Enhanced probability for above normal precipitation is predicted for the south-eastern part of the maritime continent, off-equatorial tropical Pacific, southern Siberia, the seas of Barents and Kara. Strongly enhanced probability for below normal precipitation is predicted for the central equatorial Pacific. Enhanced probability for below normal precipitation is predicted for most of the Indian Ocean. Precipitation in the eastern equatorial Pacific is predicted to be near normal.

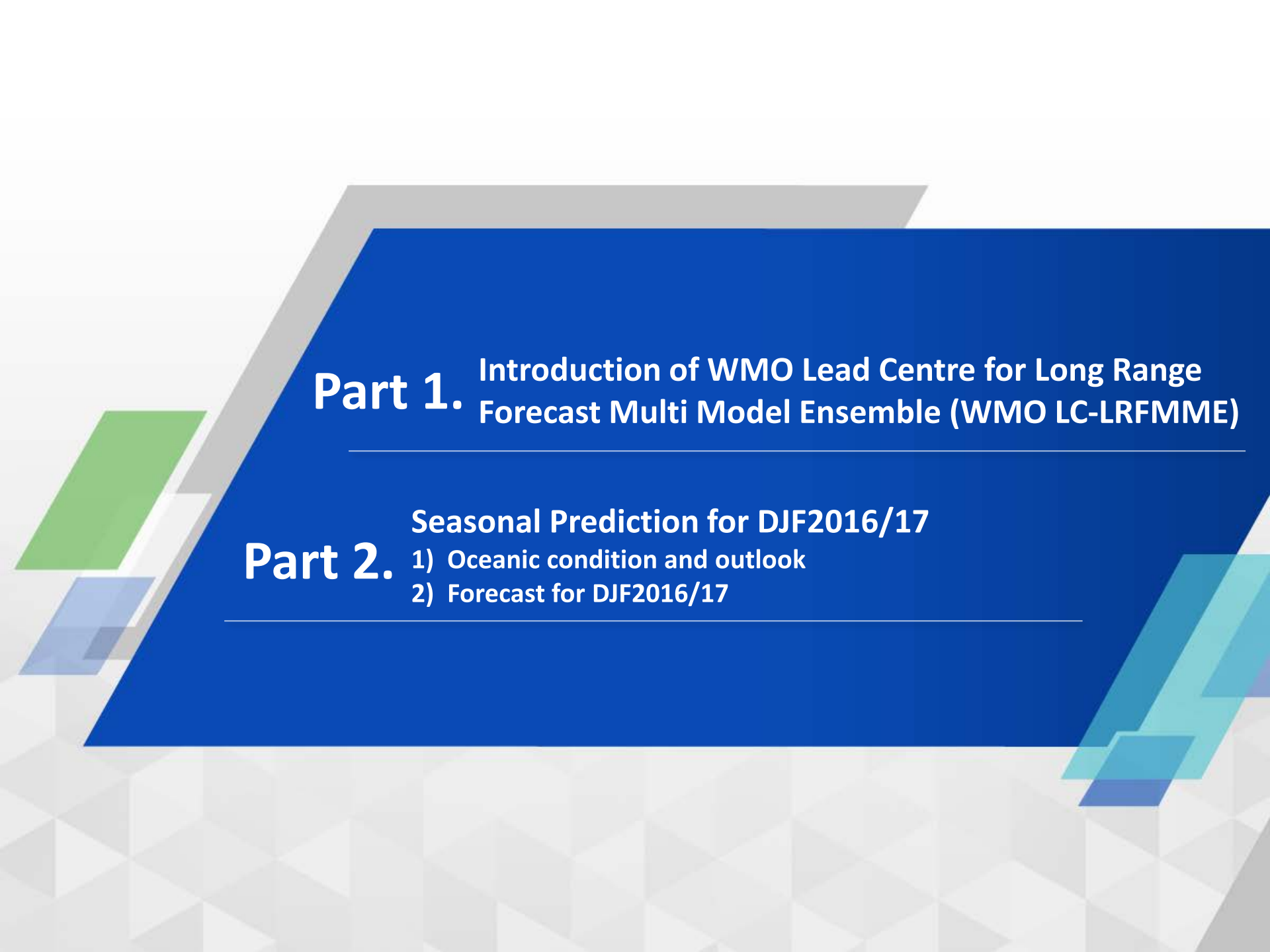
Source > <http://www.apcc21.org>

# Seasonal Climate Outlook for DJF2016/17 over ASEAN region from WMO LC-LRFMME

Miah Kim and WMO LC-LRFMME team

Seventh Session of the ASEAN Climate Outlook Forum (ASEANCOF7)  
17-18 November 2016  
Manila, Philippines





## **Part 1.** Introduction of WMO Lead Centre for Long Range Forecast Multi Model Ensemble (WMO LC-LRFMME)

---

## **Part 2.** Seasonal Prediction for DJF2016/17

---

- 1) Oceanic condition and outlook
- 2) Forecast for DJF2016/17



# **1. WMO Lead Center for Long-Range Forecast Multi-Model Ensemble (WMO LC-LRFMME)**

# Goal

**Provide** a conduit for sharing  
global prediction models

**Develop** a well-calibrated  
MME system and user-friendly services



**Maximize**  
the benefit from  
favorable climate conditions





# Background

## 12 WMO-designated Global Producing Centres (GPCs) for long-range forecasts

- adhering to agreed procedures/ standards in delivery of global long-range forecasts (e.g. products, timeliness, verification/ validation info, system documentation)

Linkage is needed among GPCs and other organizations including NMHSs, RCCs and RCOFs to ensure wider and more effective use of LRF



# Objectives

- The LC-LRFMME aims to support collecting and sharing GPCs forecast information to increase the reliability of LRFs.
- Improved LRFs can help reduce socioeconomic losses associated with seasonal variability and protect life and property
- From the end-user perspective, the sub-seasonal to seasonal time range is a very important one, as many management decisions in agriculture and food security, water, disaster risk reduction and health fall into this range



# 12 WMO GPCs for LRF

## WMO Global Producing Centres

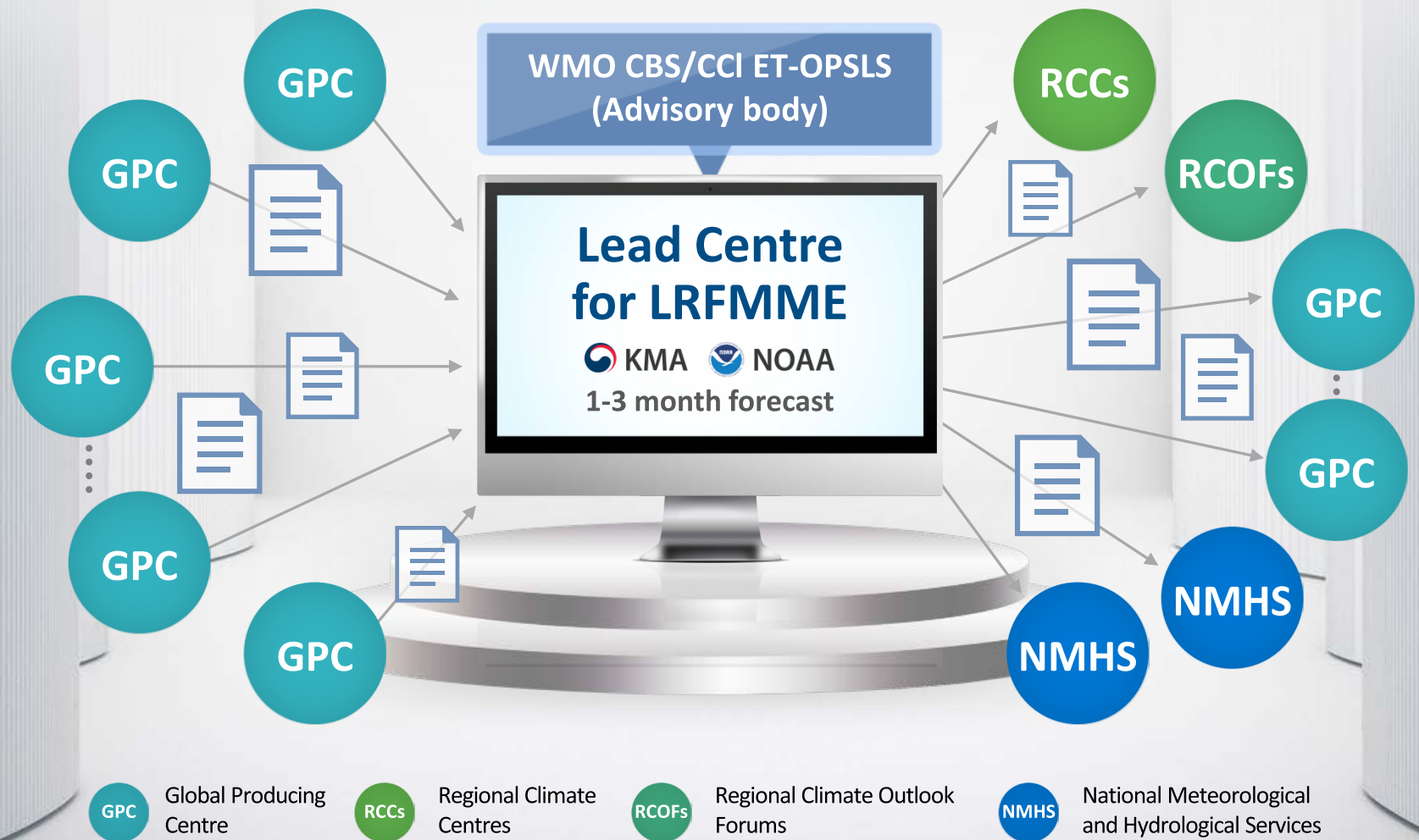


- **Beijing**: China Meteorological Administration (CMA) / Beijing Climate Center (BCC)
- **CPTEC**: Center for Weather Forecasting and Climate Research / National Institute for Space Research (INPE), Brazil
- **ECMWF**: European Centre for Medium-Range Weather Forecasts
- **Exeter**: Met Office, United Kingdom
- **Melbourne**: Bureau of Meteorology (BOM), Australia
- **Montreal**: Meteorological Service of Canada (MSC)
- **Moscow**: Hydrometeorological Centre of Russia
- **Pretoria**: South African Weather Services (SAWS)
- **Seoul**: Korea Meteorological Administration (KMA)
- **Tokyo**: Japan Meteorological Agency (JMA) / Tokyo Climate Center (TCC)
- **Toulouse**: Météo-France
- **Washington**: Climate Prediction Center (CPC) / National Oceanic and Atmospheric Administration (NOAA), United States of America



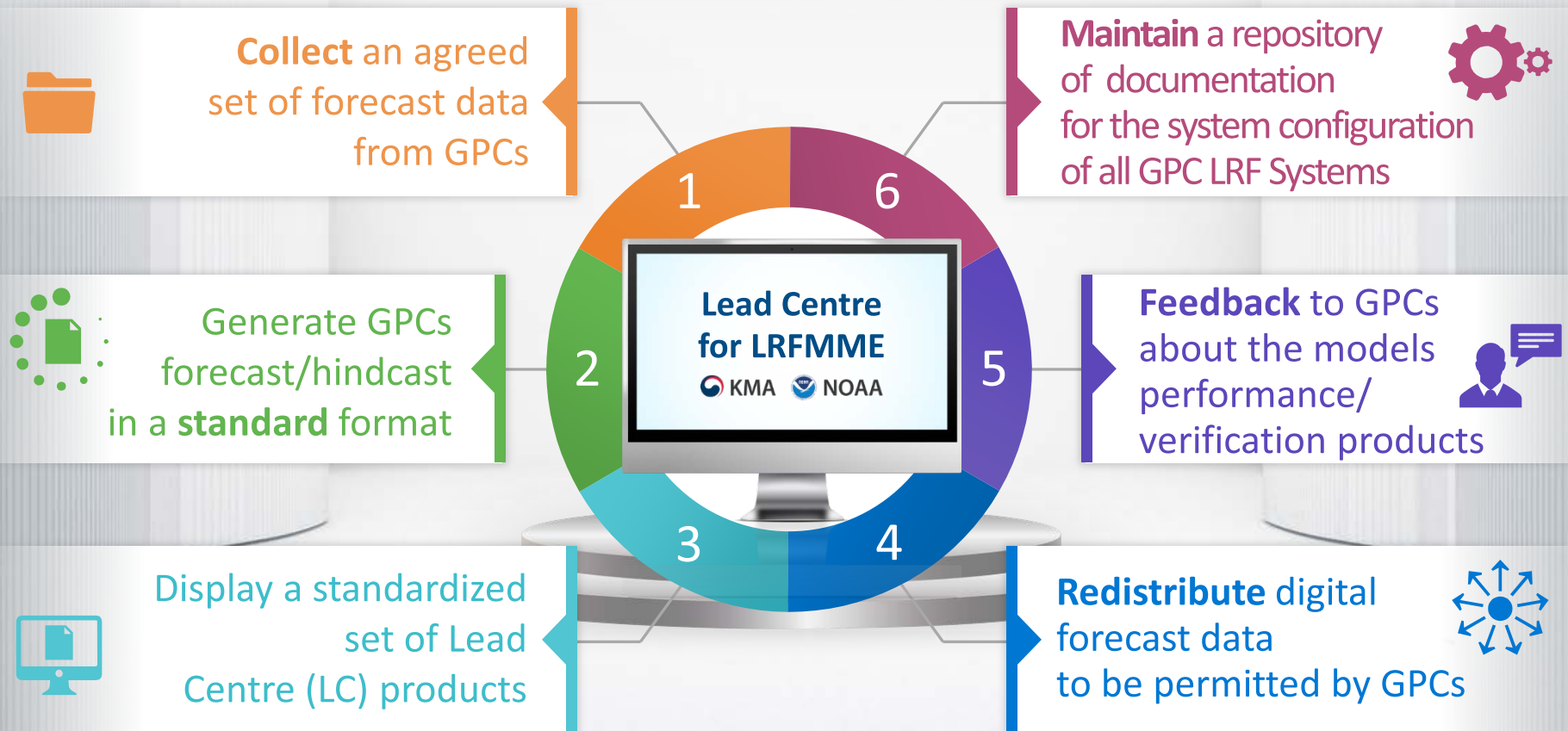
# Functions

**LC-LRFMME provides a conduit between GPC and NMHS, RCC, RCOF, etc.**



# Functions

LC-LRFMME provides a conduit between GPC and NMHS, RCC, RCOF, etc.



# Summary of data provided by the GPCs

## Information on the data configuration supplied by the 12GPCs

| GPC             | Beijing          | CPTEC     | ECMWF            | Exeter           | Melbourne        | Montreal         | Moscow    | Pretoria         | Seoul            | Tokyo            | Toulouse         | Washington       |
|-----------------|------------------|-----------|------------------|------------------|------------------|------------------|-----------|------------------|------------------|------------------|------------------|------------------|
| Forecast system | 1-tier (coupled) | 2-tier    | 1-tier (coupled) | 1-tier (coupled) | 1-tier (coupled) | 1-tier (coupled) | 2-tier    | 1-tier (coupled) | 1-tier (coupled) | 1-tier (coupled) | 1-tier (coupled) | 1-tier (coupled) |
| Forecast        |                  |           |                  |                  |                  |                  |           |                  |                  |                  |                  |                  |
| Ensemble size   | 24               | 15        | 41               | 42               | 33               | 20               | 10        | 40               | 42               | 51               | 41               | 40               |
| Hindcast        |                  |           |                  |                  |                  |                  |           |                  |                  |                  |                  |                  |
| Period          | 1991-2010        | 1979-2010 | 1981-2010        | 1993-2015        | 1981-2011        | 1981-2010        | 1981-2010 | 1982-2009        | 1991-2010        | 1979-2014        | 1991-2014        | 1983-2010        |
| Ensemble size   | 24               | 15        | 41               | 42               | 33               | 20               | 10        | 40               | 42               | 51               | 41               | 40               |
| Digital data    | ⊙                | ⊙         | ✗                | ✗                | ⊙                | ⊙                | ⊙         | ⊙                | ⊙                | ✗                | ✗                | ⊙                |

An “✗” indicates that data is not currently available in LC-LRFMME, because of GPC’s data Policy



# Products

## Digital products

**Both forecast and hindcast of monthly mean anomalies of the GPCs' ensemble mean for lead time of 1~3 month, following the month of submission.**

- 2m surface temperature
- Precipitation
- Mean sea level pressure
- 850hPa temperature
- 500hPa geopotential height
- Sea surface temperature



## Graphical products

### Individual forecast

- Plots for each GPCs' forecast anomalies in common graphical format (Rectangular, Time series, Stereographic type, etc.)
- Consistency map
- SST Plume (Nino3.4 SST anomalies)

### Deterministic MME

- Simple composite mean(SCM)
- Regular Multiple Regression
- Singular Value Decomposition(SVD)
- Genetic Algorithm(AG)

### Probabilistic MME

- Tercile-based categorical probabilities

### Verification

- Hindcast for both MME and Individual GPCs
- Forecast for MME



# Further plan

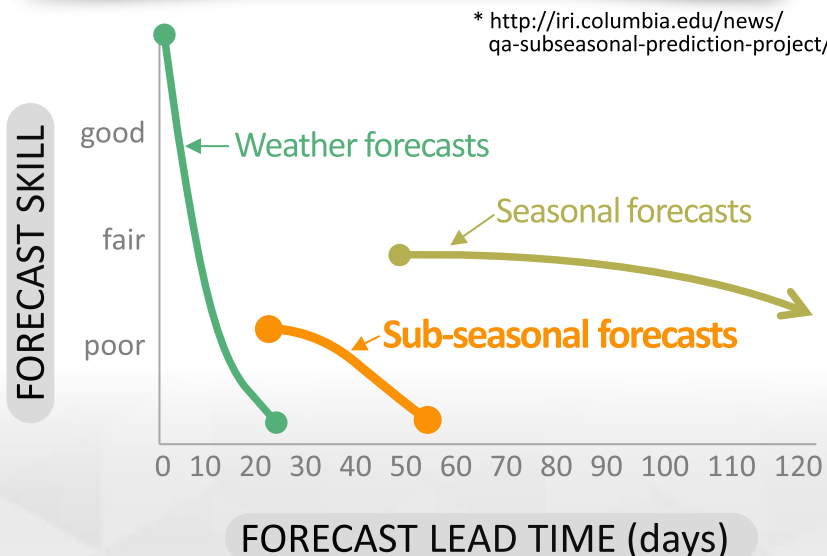
## About the Sub-Seasonal Multi-Model Ensemble

### Sub-Seasonal time scale

**2 weeks ~2 months**

Sub-seasonal to Seasonal Prediction Research  
Implementation Plan (Dec2013, WMO)

Considered as  
A “predictability desert”



Larger ensemble  
can give higher skill

Technical challenge in Sub-seasonal MME





# Further plan

## Pilot real-time MME service for sub-seasonal forecasts

- WMO Cg-XVI(2011) requested LC-LRFMME to expand its role to include exchange of extended-range predictions.
- In the meeting of the S2S steering group (2014), it was agreed to make use of the S2S research archive of sub-seasonal forecasts to develop a real-time multi-model display at the LC-LRFMME.

\* S2S : Sub-seasonal to Seasonal Prediction Project





# Further plan

## Pilot real-time MME service for sub-seasonal forecasts

- The LC-LRFMME is planning to provide MME forecasts and its verification results through website after ET-OPSLS and GPCs agree (2017~)

※ **ET-OPSLS** : Expert Team on Operational Predictions from Sub-seasonal to Longer-time Scales.

| Products/variables                                                                                   | Covering periods       | Charts                                                                                           | Verification scores              |
|------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------|----------------------------------|
| <ul style="list-style-type: none"><li>• Accumulated prec</li><li>• Average 2m temp</li></ul>         | Weeks 1,2,3,4, 3-4,1-4 | Probabilistic maps<br>• terciles                                                                 | Reliability diagrams<br>/ ROC    |
| <b>MJO Need:</b> <ul style="list-style-type: none"><li>• OLR</li><li>• U850</li><li>• U200</li></ul> | 32 days                | <ul style="list-style-type: none"><li>• Hendon and Wheeler Diagram</li><li>• Hovmoller</li></ul> | Temporal correlation<br>and RMSE |
| <b>Velocity Potential</b>                                                                            | Weeks 1,2,3,4, 3-4,1-4 | Velocity potential anomaly (Ensemble mean for each period)                                       | correlation                      |





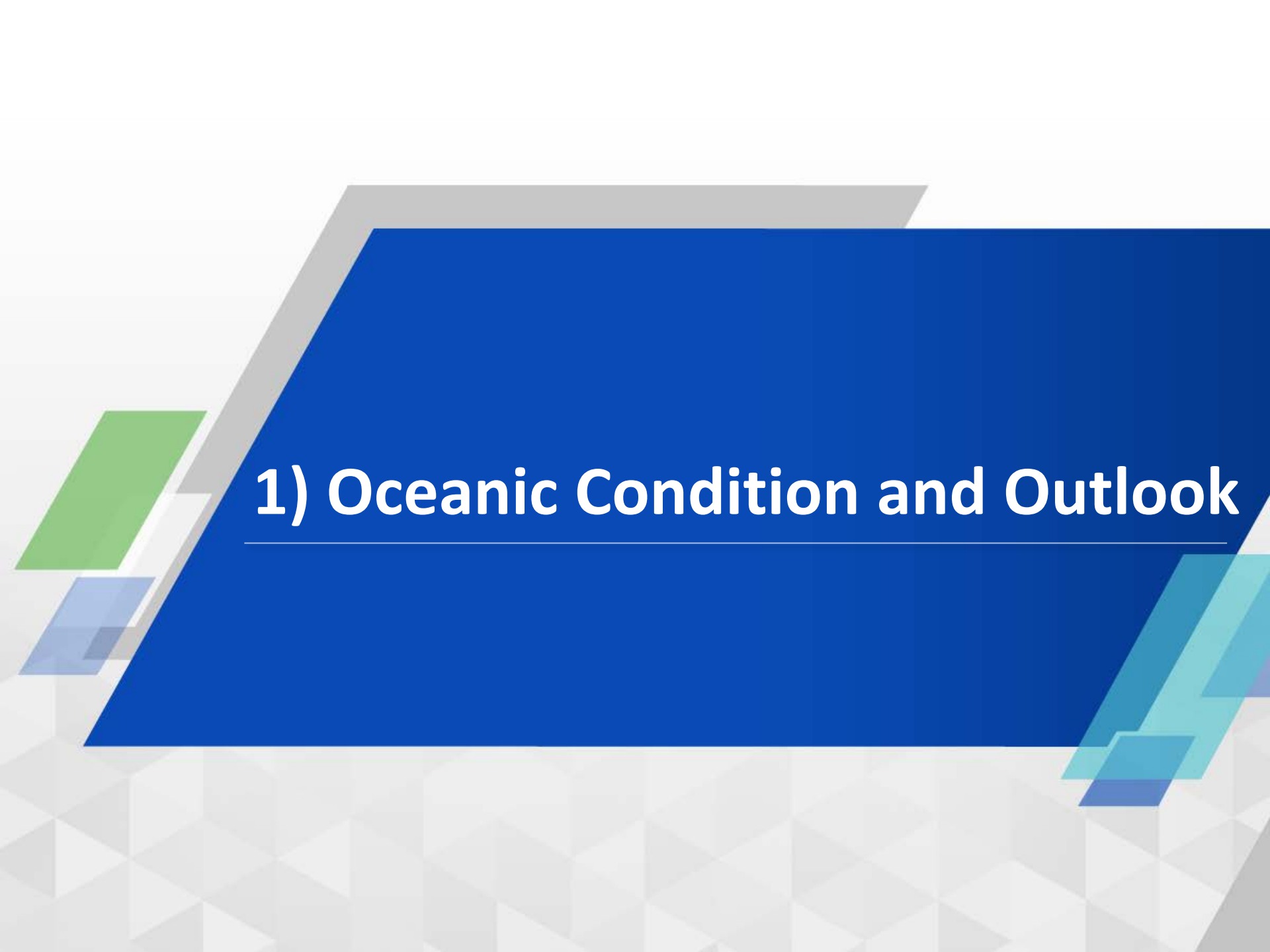
## **2. Seasonal prediction DJF2016/17**

---

# Participating Models for DJF2016/17

| GPC             | Beijing   | CPTEC     | ECMWF     | Exeter    | Melbourne | Montreal  | Moscow    | Pretoria  | Seoul     | Tokyo     | Toulouse*    | Washington |
|-----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|------------|
| Institute       | BCC       | CPTEC     | ECMWF     | UKMO      | BoM       | MSC       | HMC       | SAWS      | KMA       | TCC       | Meteo-France | NCEP       |
| Hindcast period | 1991-2010 | 1979-2010 | 1981-2010 | 1993-2015 | 1980-2011 | 1981-2010 | 1981-2010 | 1982-2009 | 1991-2009 | 1979-2010 | 1979-2007    | 1981-2010  |

| Initial Month | 11 | 12  | 1 | 2 | 3 | 4 | 5 |
|---------------|----|-----|---|---|---|---|---|
| Nov           |    | DJF |   |   |   |   |   |



# 1) Oceanic Condition and Outlook

---

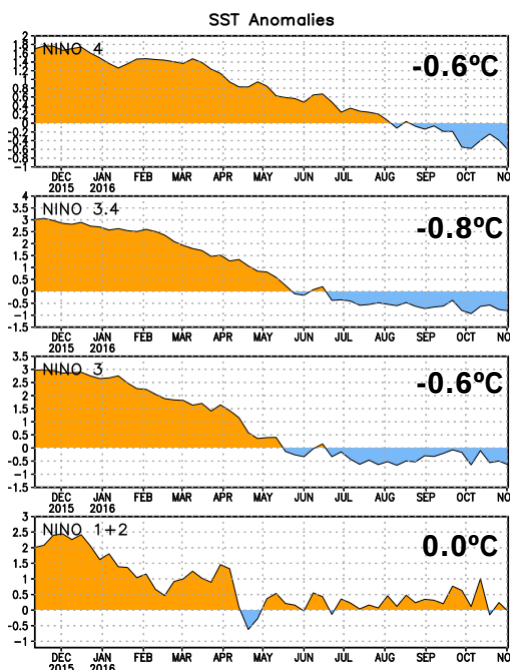
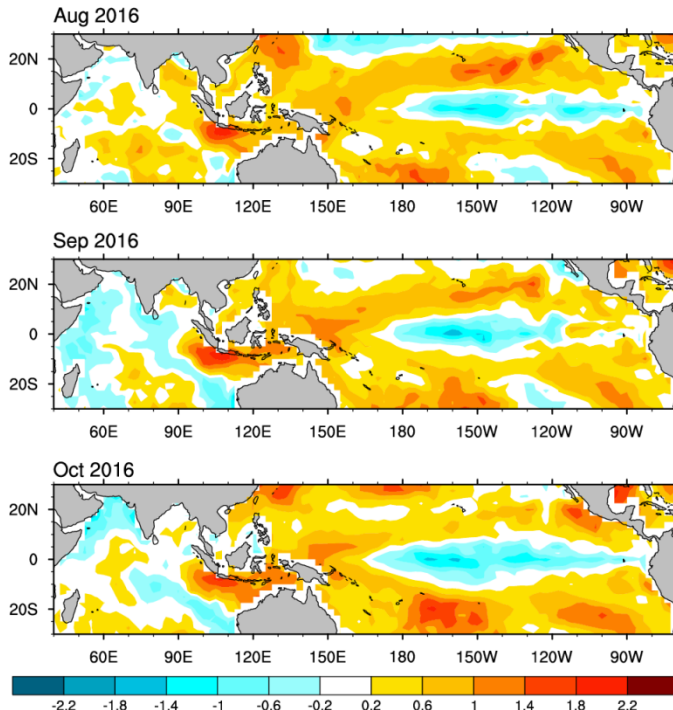
# Large scale SST indices

| Month          | Niño 1+2 | Niño 3 | Niño 4 | Niño3.4 | IOD   |
|----------------|----------|--------|--------|---------|-------|
| August 2016    | 0.33     | -0.40  | -0.01  | -0.49   | -0.68 |
| September 2016 | 0.45     | -0.17  | -0.22  | -0.58   | -1.29 |
| October 2016   | 0.28     | -0.42  | -0.38  | -0.72   | -0.79 |

■ **Weak La Nina** has presented for last months(ASO).

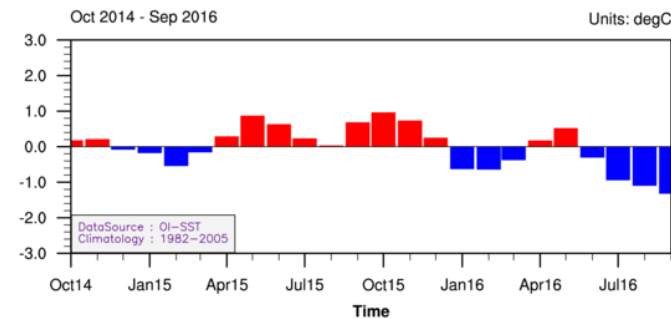
■ The Indian Ocean Dipole (IOD) kept on **negative phase** during last 3 months.

Observed SST anomalies



courtesy of NCEP/CPC

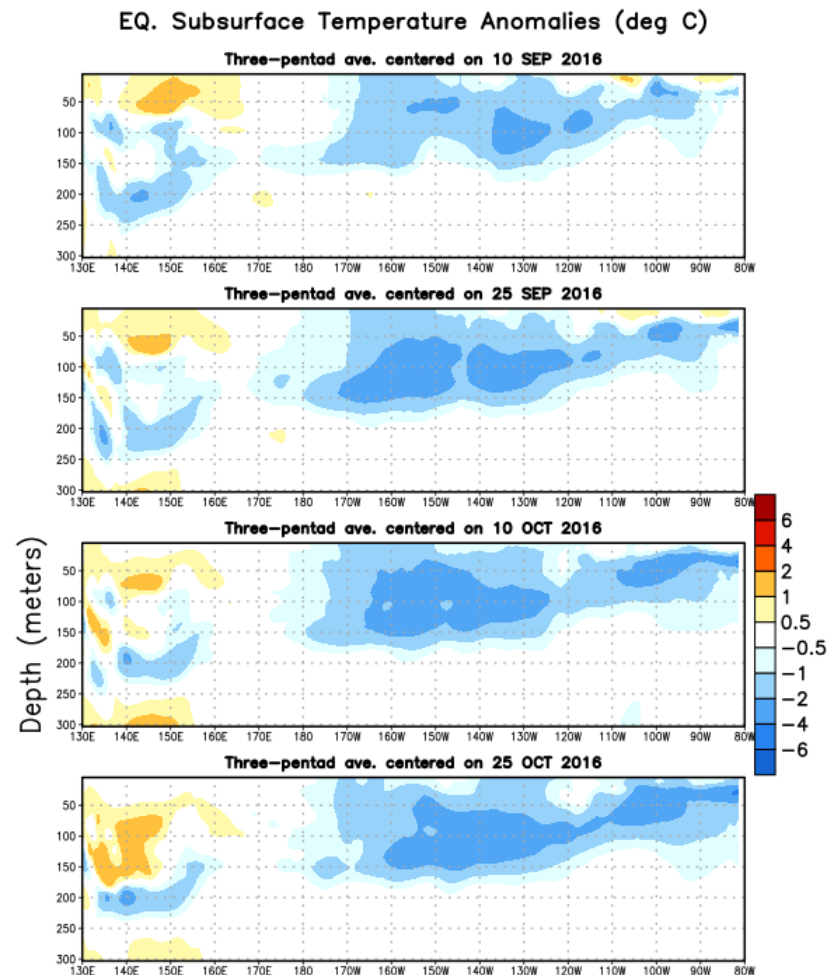
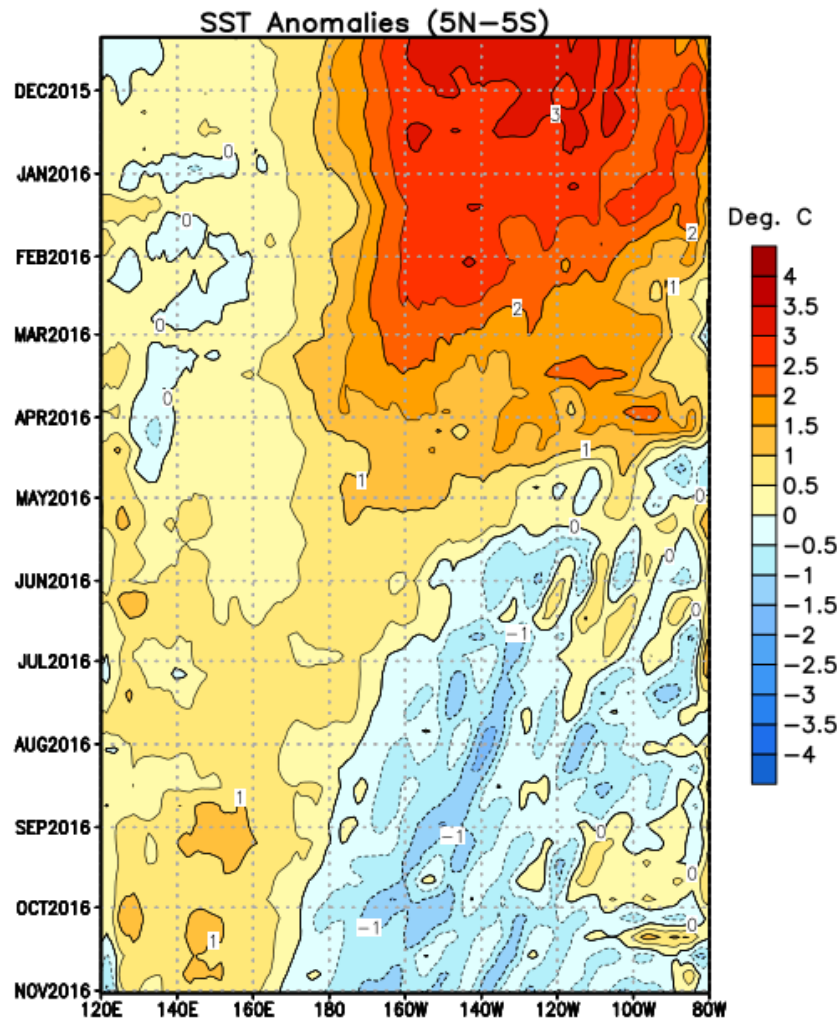
Dipole Mode Index (DMI)



courtesy of APEC Climate Center

# Recent condition in the Pacific Ocean

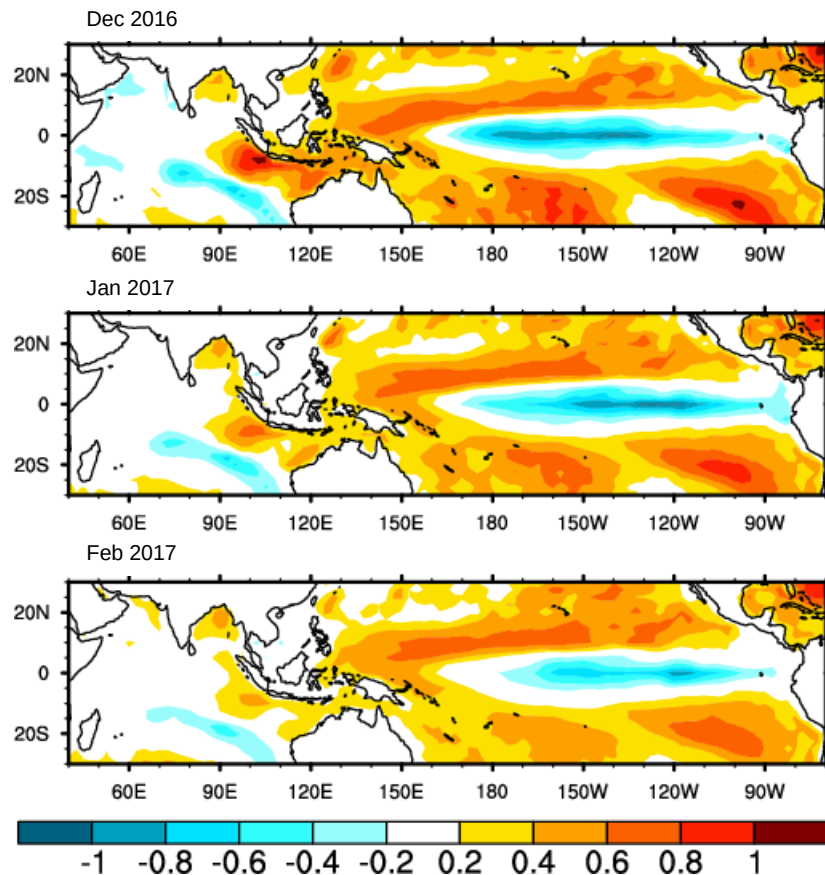
- Since mid-April 2016, near-to-below average SSTs have expanded westward toward the Date Line.
- Over the last month, negative SST anomalies have persisted in the central and east-central Pacific, while SST anomalies in the eastern Pacific have been more variable.



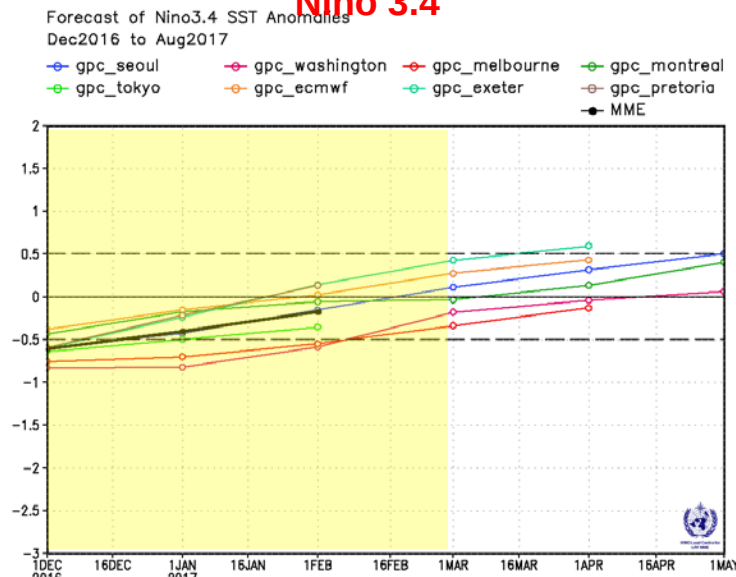


# ENSO and DMI Prediction

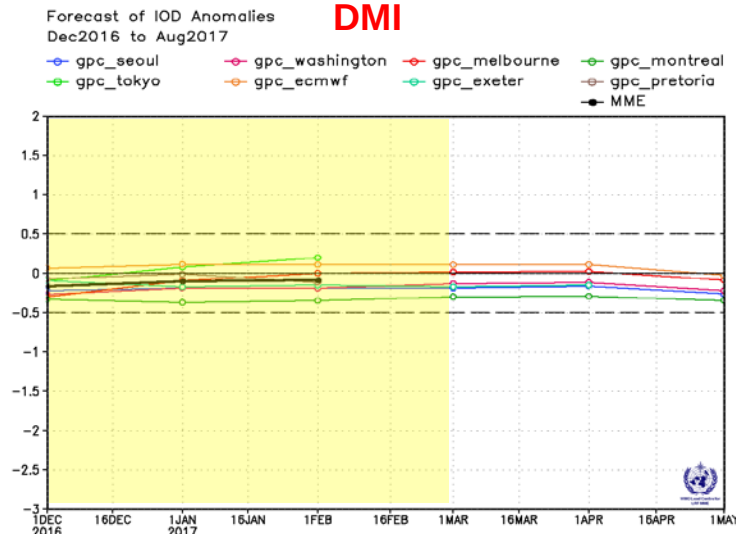
## Predicted SST anomalies



## Nino 3.4



## DMI



- Most models show **neutral condition** on DJF2016/17, and they predict Nino3.4 will increase slightly.
- Neutral IOD** will be continued during boreal winter.





## 2) Prediction for DJF2016/17

---

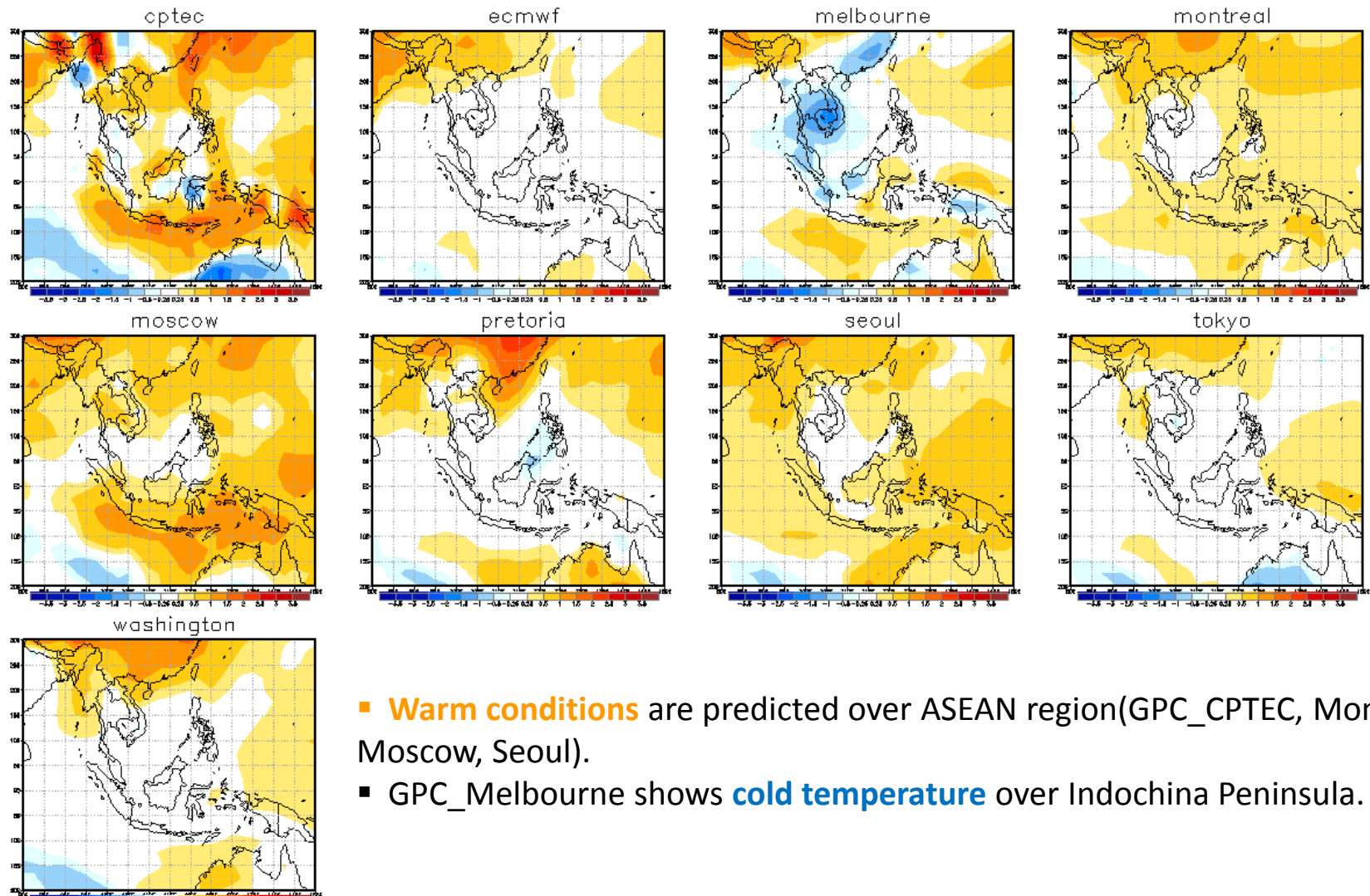
# Individual Forecasts: 2m temperature

lat=-20 30  
lon=80 150

2m Temperature : DJF 2016/17

(issued on Nov2016)

[Unit: K]



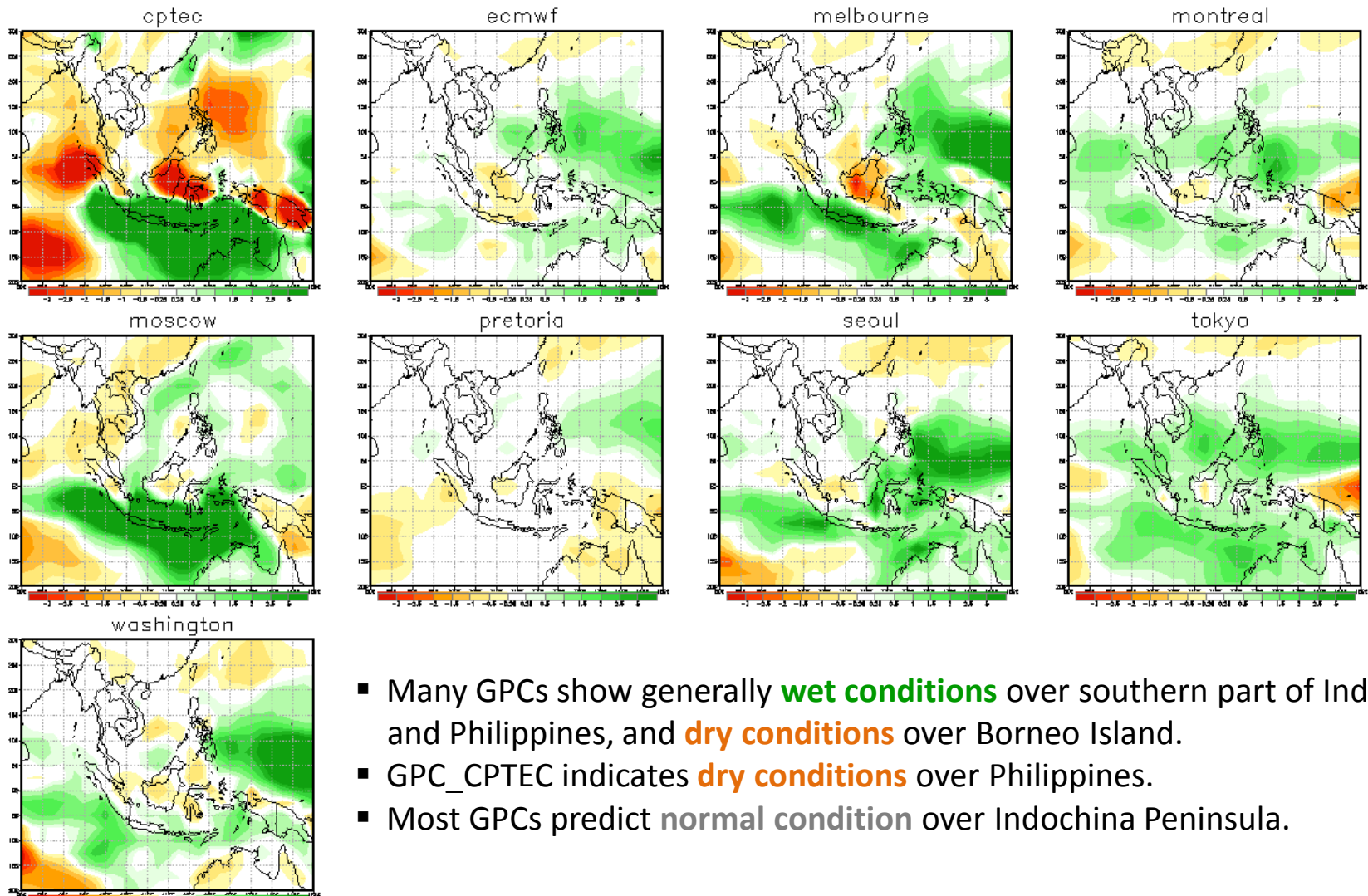
- **Warm conditions** are predicted over ASEAN region(GPC\_CPTEC, Montreal, Moscow, Seoul).
- GPC\_Melbourne shows **cold temperature** over Indochina Peninsula.

# Individual Forecasts: Precipitation

lat=-20 30  
lon=80 150

Precipitation : DJF 2016/17

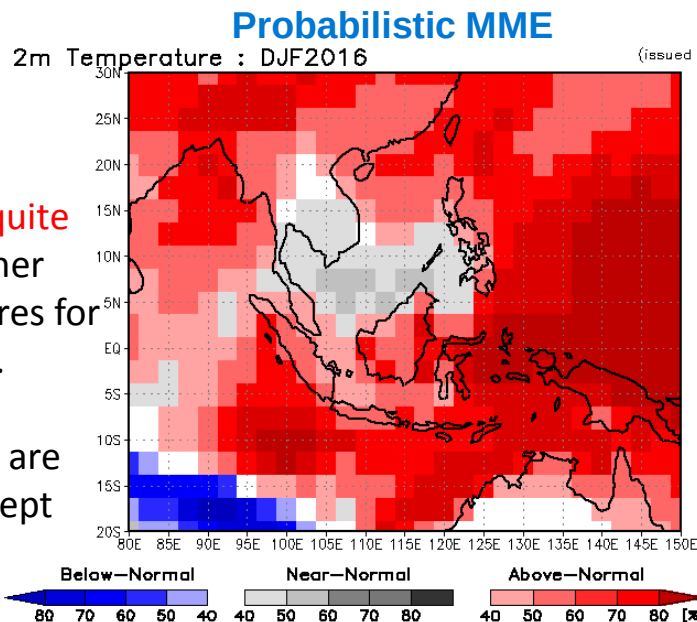
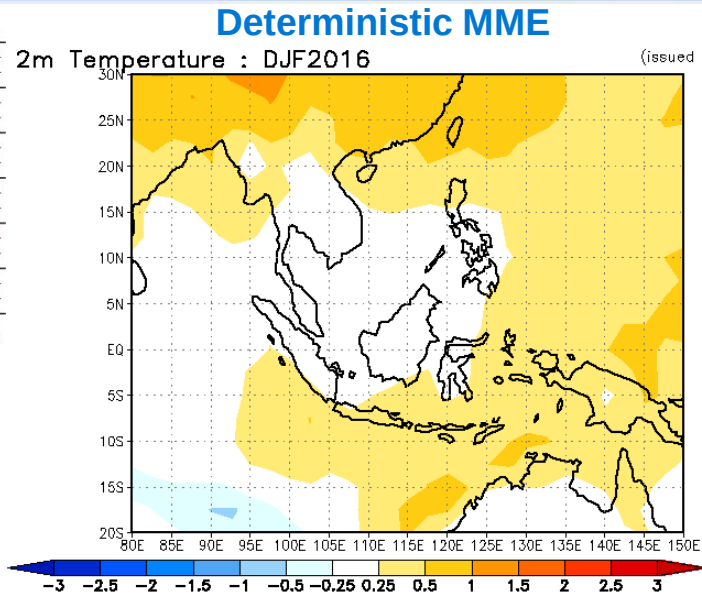
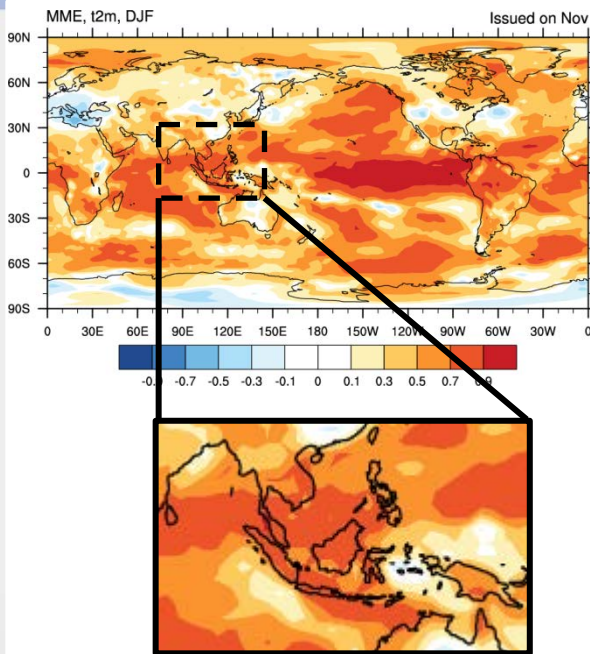
(issued on Nov2016) [Unit: mm/day]



- Many GPCs show generally **wet conditions** over southern part of Indonesia and Philippines, and **dry conditions** over Borneo Island.
- GPC\_CPTEC indicates **dry conditions** over Philippines.
- Most GPCs predict **normal condition** over Indochina Peninsula.

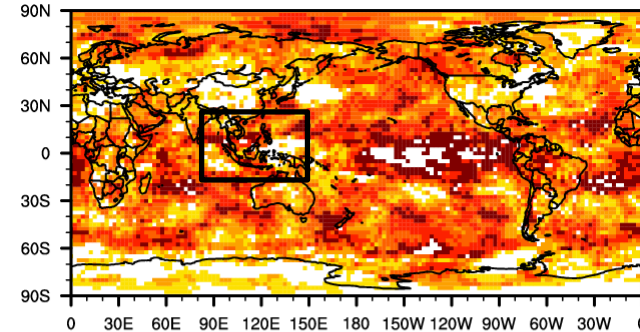


# MME Forecast: 2m Temperature for DJF 2016/17

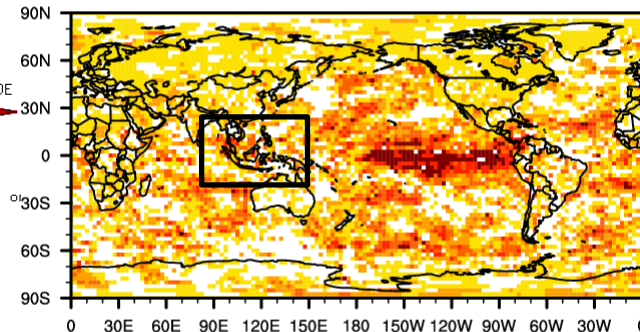


pmme, TMP2m, DJF (issued on Nov)

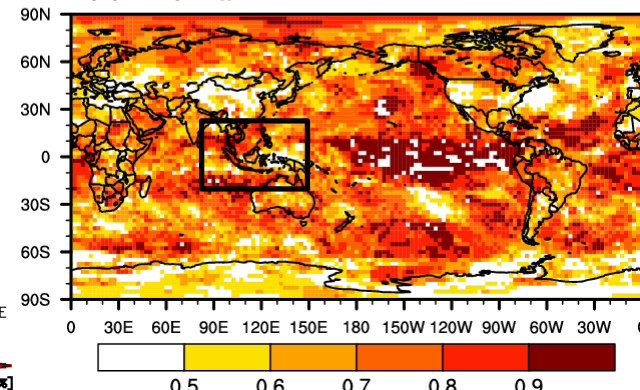
Above-Normal



Near-Normal

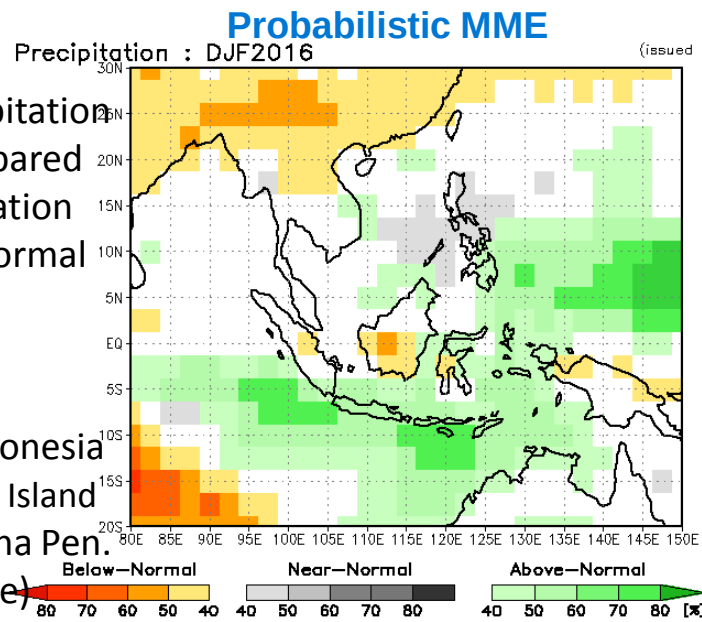
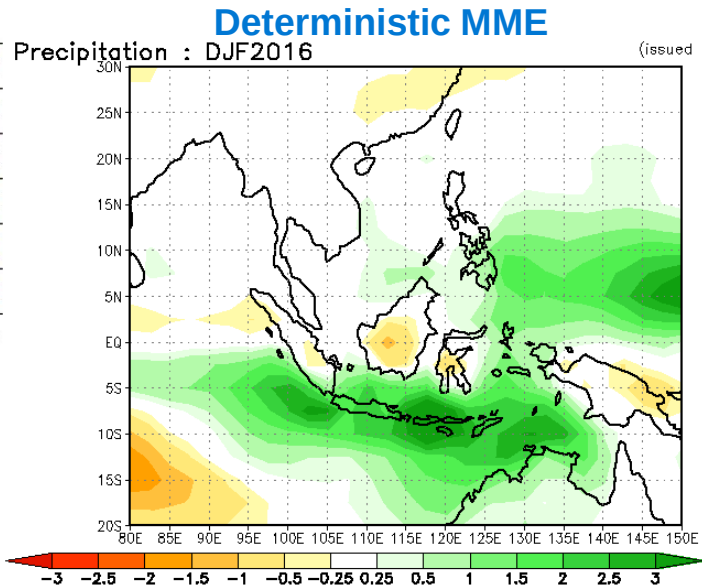
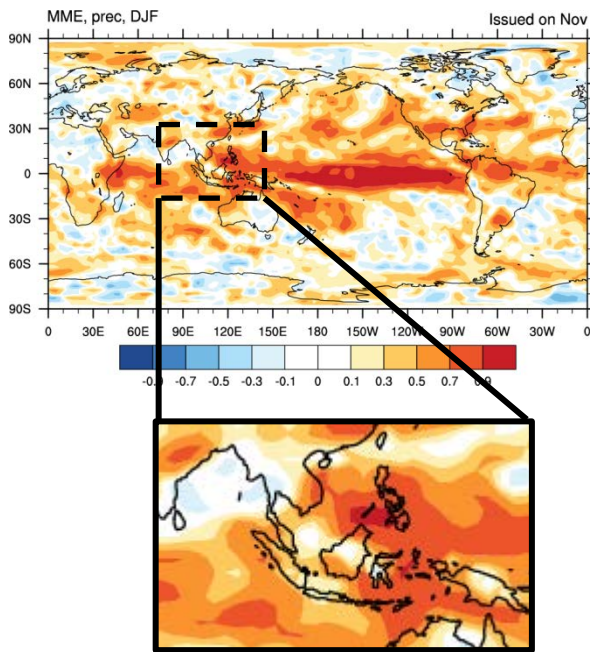


Below-Normal

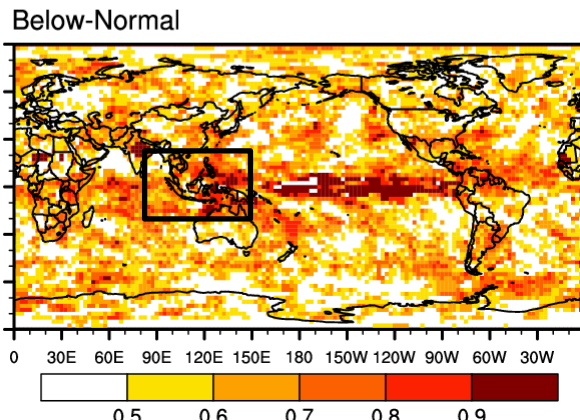
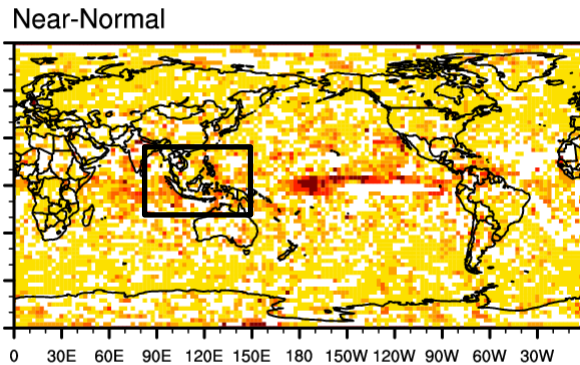
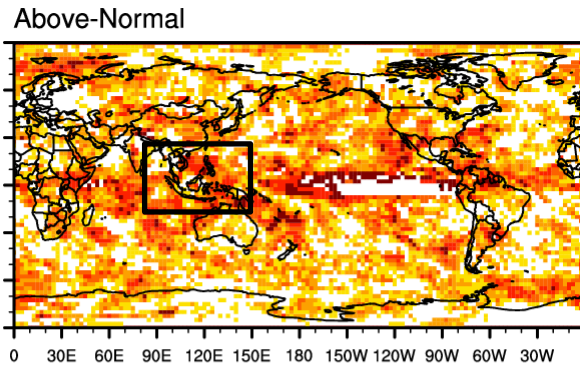


- The MME prediction skills of 2m temperature for DJF season are quite good compared with those of other regions (correlation and ROC scores for above/below normal categories).
- Warmer-than-Normal conditions are dominant over ASEAN region except Indochina Pen..

# MME Forecast: Precipitation for DJF 2016/17



pmme, APCP0m, DJF (issued on Nov)



The MME prediction skills of precipitation for DJF season are quite good compared with those of other regions (correlation and ROC scores for above/below normal categories).

Above-than-Normal conditions are expected over southern part of Indonesia and Philippines, and part of Borneo Island is expected below normal. (Indochina Pen. and Malay Pen. shows equal-chance)

# Summary for DJF2016/17

## ■ Ocean

### • ENSO prediction

**Weak negative SST anomalies** in the eastern Pacific with Nino3.4 being negative.

### • IOD prediction

**Neutral** phase through DJF season

## ■ Atmosphere

### • 2m Temperature

- **Warmer-than-normal** conditions are dominant over ASEAN region(**Near normal** over Indochina Pen.).

### • Precipitation

- **Above-than-normal** conditions are expected over southern part of Indonesia and parts of Philippines , and part of Borneo Island is expected **below normal**.





# Survey for Satisfaction Measurement on the Website

WMO LRF MME ... x Gayoung

← → ↻ https://www.wmolc.org

2016 Survey for satisfaction measurement (during Sept.-Nov. 2016)

Thank you for using our WMO LC-LRFMME website. The LC-LRFMME is jointly organized and operated by the Korea Meteorological Administration (KMA) and NOAA/NCEP. It provides high-quality climate prediction products and develops advanced climate prediction technology, which is contributing to the reduction of the adverse impacts of abnormal climate. As a part of our ongoing efforts to provide better services, we are conducting a simple survey on our website. In this regard, we would appreciate it if you can take a few moments to fill in the survey form below.

\* is a required input.

1. Which organisation do you belong to/which organisation are you involved in? (select all that match) \*

The maximum number of choices is 4.

☐ WMO Global Producing Centres (GPCs) for Long Range Forecasts (LRF)

☐ National Hydrological and Meteorological Services (NHMS)

☐ WMO Regional Climate Centre (RCC)

☐ Regional Climate Outlook Forum (RCOF)

☐ Other :

2. How often do you visit the WMO LC-LRFMME homepage? \*

☐ more than 12 times a year (at least once a month)

☐ 4~12 times (at least once a season)

☐ 1~3 times (at least once a year)

☐ once in a while

3. What is your major purpose of using the forecast information from WMO LC-LRFMME? \*

Administration

© Copyright KMA all rights reserved. Privacy Handling Policy

today : 91 total : 172726

- **Why?**

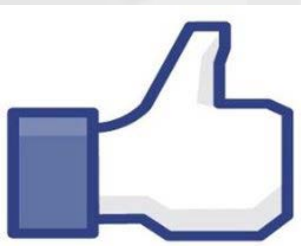
To diagnose the current status of WMO LC-LRFMME and provide better services to the website users

- **When?**

1<sup>st</sup> September – 30<sup>th</sup> November 2016

- **To whom?**

All website registered members



# LIKE

We **hope** that you give your cooperation!





<http://www.wmolc.org> ▼



**For more Information,  
Please contact !**



**Climate Prediction Division  
Korea Meteorological  
Administration**

- 61, Yeouidaebang-ro 16-gil, Dongjak-gu, Seoul, 07062, Republic of KOREA
- Tel : +82-2-2181-0475
- Fax : +82-2-2181-0489
- E-mail : lc\_lrfmme@korea.kr

# Thank you



Climate Prediction Division  
Korea Meteorological  
Administration



# Products of WMO LC-LRFMME

WMO LRF MME

https://www.wmolc.org/

WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble

LoginSign UpSitemapContact Us

HomeAbout usNewsData & PlotRelated SitesWMO Lead Centre for SVSLRF

## Membership Levels & Accessibility

Latest Forecast data

- **Level A** (GPCs)
  - Upload & download digital data (limited)
  - Download image plots
- **Level B** (NMHSs, RCCs)
  - Download digital data (limited) & image plots

Latest PMME plot

View all

- **Level C** (Others)
  - Image plots

|                                        |            |
|----------------------------------------|------------|
| All GPCs(12) for FM 2016 are uploaded  | 2016.01.25 |
| All GPCs(12) for JFM 2016 are uploaded | 2015.12.22 |
| All GPCs(12) for DJF 2015 are uploaded | 2015.12.01 |
| All GPCs(12) for NDJ 2015 are uploaded | 2015.10.22 |
| All GPCs(12) for OND 2015 are uploaded | 2015.09.30 |

Latest Individual Forecast plot

View all

WMO Global Producing Centres

|        |          |      |           |       |                 |            |
|--------|----------|------|-----------|-------|-----------------|------------|
| Canada | Montreal | BCC  | Beijing   | ECHWF | TEXES OF MOSCOW | Moscow     |
|        | Seoul    |      | Tokyo     |       | Toulouse        | Washington |
|        | Exeter   | PCMA | Melbourne |       | Pretoria        | CPTEC      |

61 16-GIL YEOUIDAEBANG-RO DONGJAK-GU SEOUL 156-720 Republic of Korea  
Email. lc\_lrfmme@korea.kr Tel. 82-2-2181-0474 Fax. 82-2-2181-0489  
© Copyright KMA all rights reserved.  
Privacy Handling Policy

KMA Korea Meteorological Administration

today : 82 total : 148407



[→](#) [↺](#) [🏠](#) [www.s2sprediction.net/static/documents#reports](#)



[About S2S](#) [News](#) [Documents](#) [Sub-projects](#)



## Reports

- [Applications of S2S Forecasts: From Disaster Early Warning to Early Action](#)
- [Report on subseasonal MME in LC-LRFMME](#)
- [Subseasonal to Seasonal Prediction Research Implementation Plan](#)

<http://www.wmo.int/pages/prog/www/CBS-Reports/DPFS-index.html>

FINAL REPORTS  
CBS-DPFS related Meetings

[WWW home](#)  
[Reports index](#)

| Reference | CBS OPAG ON DPFS<br>Global Data-Processing and Forecasting System                                                                                                         |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ET-OPSLs  | <a href="#">Meeting of the Joint CBS-CCL Expert Team on Operational Predictions from Sub-seasonal to Longer-time Scales (ET-OPSLs)</a> , Beijing, China, 11-15 April 2016 |