User needs reliable and actionable information for decision-making.

Goal of S2S project

Many decisions in agriculture, water, disaster risk reduction and health fall into the sub-seasonal to seasonal (S2S) range.
The goal of a new WWRP/THORPEX-WCRP joint research project is to improve forecasts and understanding on the S2S scale, and promote uptake by operational centers and use by the applications community.

The WWRP/WCRP S2S project (2013)

The APCC's Subseasonal Forecasting Activity

(July 24, 2018)

Hae-Jeong Kim*,
Yoo-Rim Jung, A-Young Lim,
Chang-Mook Lim and Yoo-bin Yhang
APEC Climate Center

Mission of the APEC Climate Center

To enhance the socio-economic well-being of member economies by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques.

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

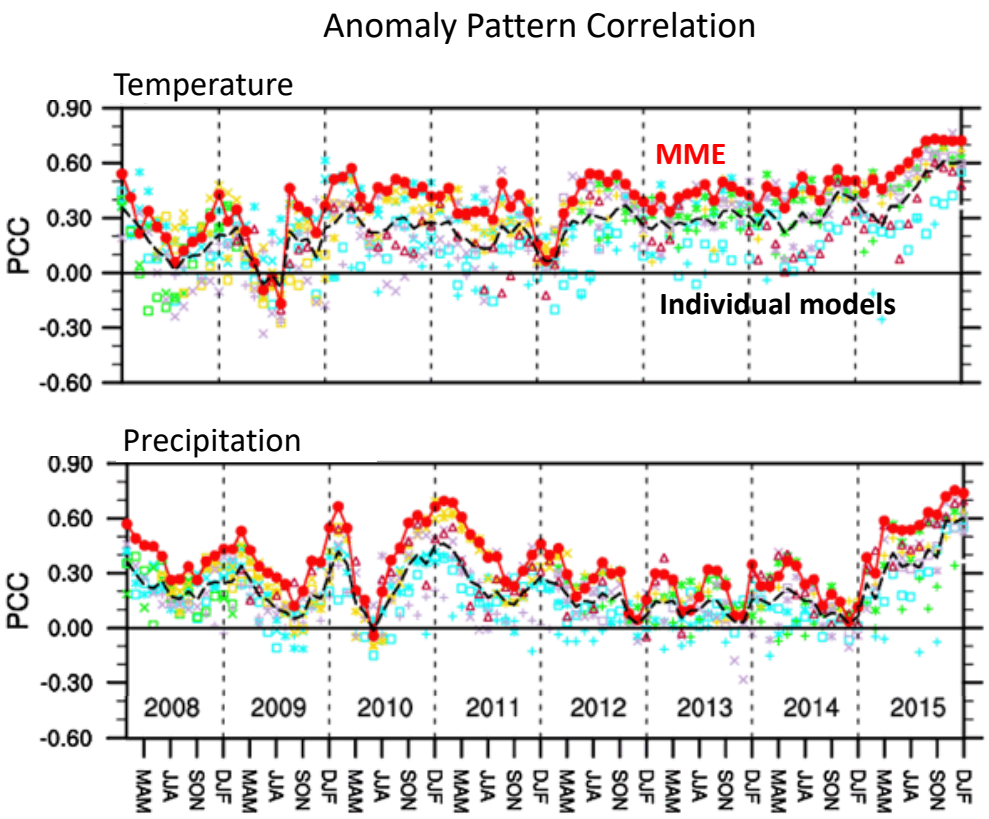
APCC guides developing countries from the APEC region toward building their own capacity to produce reliable climate prediction information.

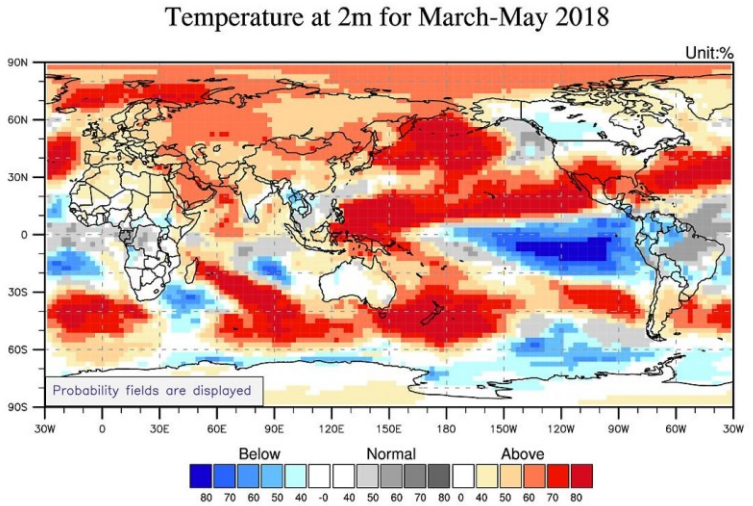
Climate Prediction & Information Service

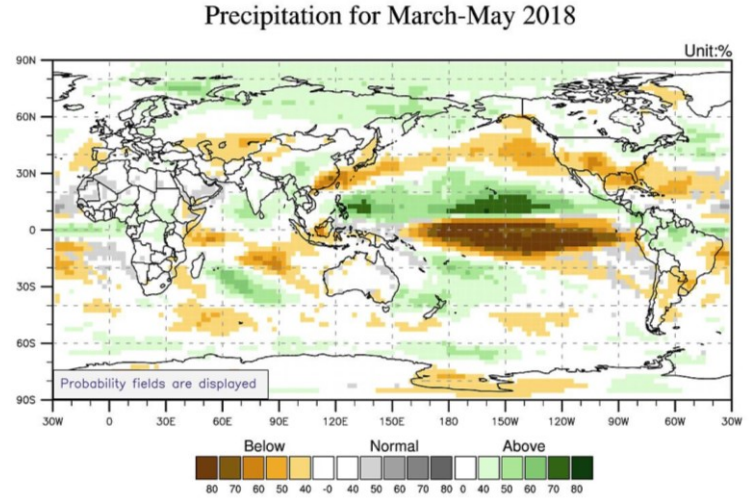
✓ ***http://www.apcc21.org***

Seasonal Forecast

- **Producing skillful real-time climate predictions and developing reliable climate prediction system based on a Multi-Model Ensemble (MME) technique.**
- **MME seasonal prediction is one of the most reliable seasonal forecast information at present.**







Min et al. (2017), Climate Dynamics

APCC MME Prediction System

- **The world's largest MME system based on international cooperation to generate monthly rolling 3-month and 6-month MME climate outlooks.**

Multi-institutional Cooperation

Economy	Organization/Institute
Australia	Bureau of Meteorology (BoM)
Canada	Meteorological Service of Canada (MSC)
China	Beijing Climate Center (BCC) Institute of Atmospheric Physics of China (IAP)
Chinese Taipei	Central Weather Bureau of Chinese Taipei (CWB)
Italy	Euro-Mediterranean Center on Climate Change (CMCC)
Japan	Japan Meteorological Agency (JMA)
Korea	Korea Meteorological Administration (KMA) Pusan National University (PNU)
Peru	Servicio Nacional de Meteorología e Hidrología (SENAMHI)
Russia	Hydrometeorological Centre of Russia (HMC) Main Geophysical Observatory of Russia (MGO)
UK	Met Office
USA	Center for Ocean-Land-Atmosphere Studies (COLA) International Research Institute for Climate and Society (IRI) National Aeronautics and Space Administration (NASA) National Center for Environmental Prediction (NCEP) / National Ocean and Atmospheric Administration (NOAA)

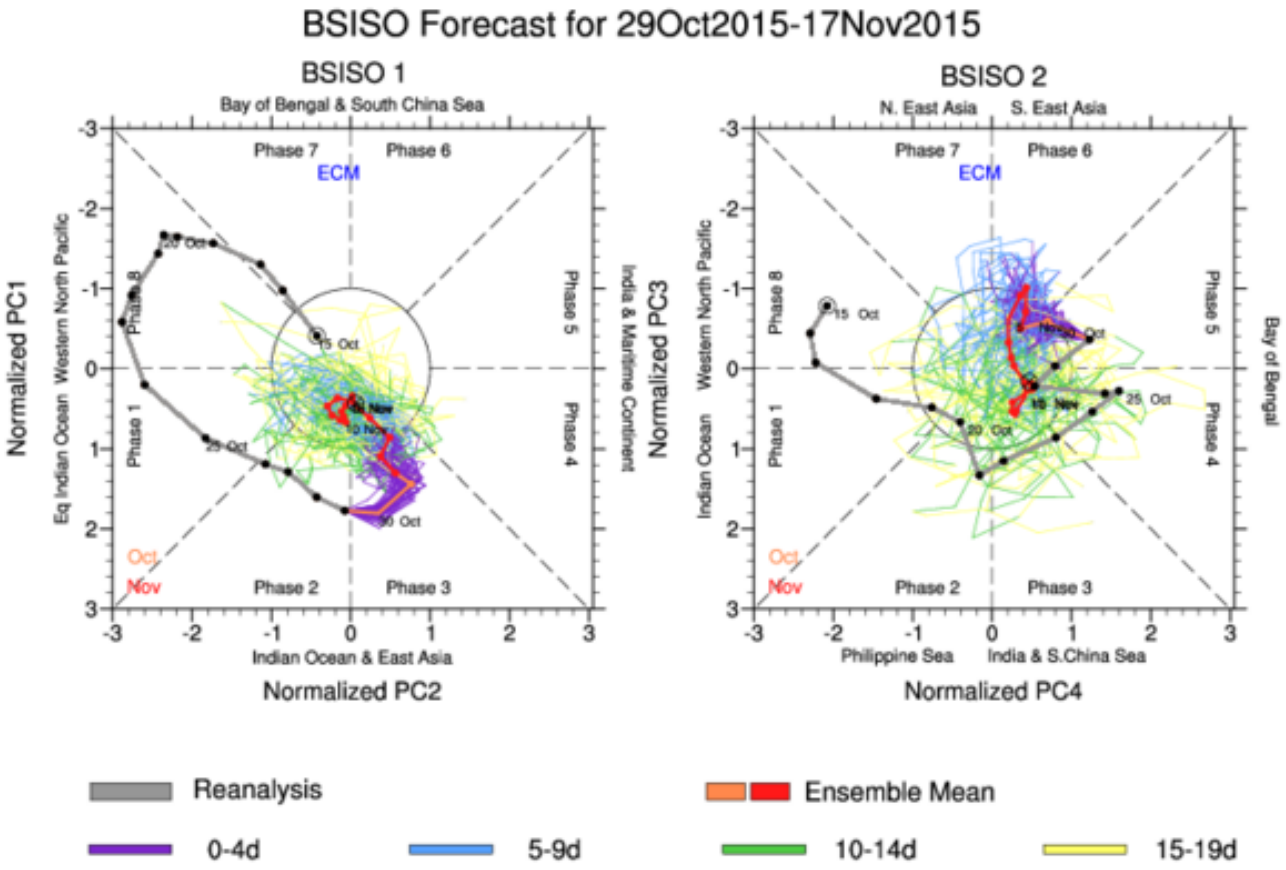
Climate Prediction & Information Service

✓ ***http://www.apcc21.org***

Expansion into subseasonal forecast
by providing BSISO real-time forecasts

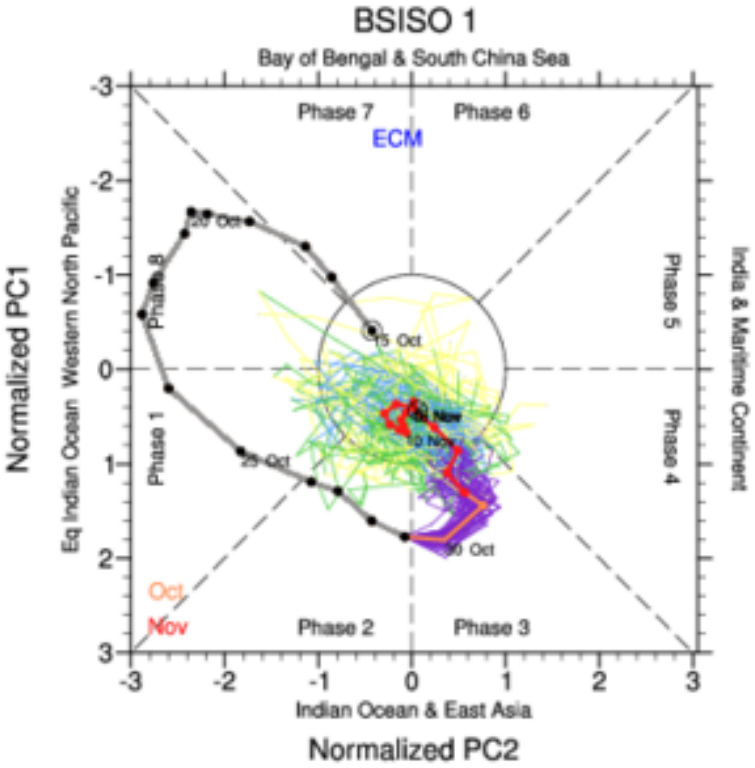
BSISO(Boreal Summer Intraseasonal Oscillation) Prediction

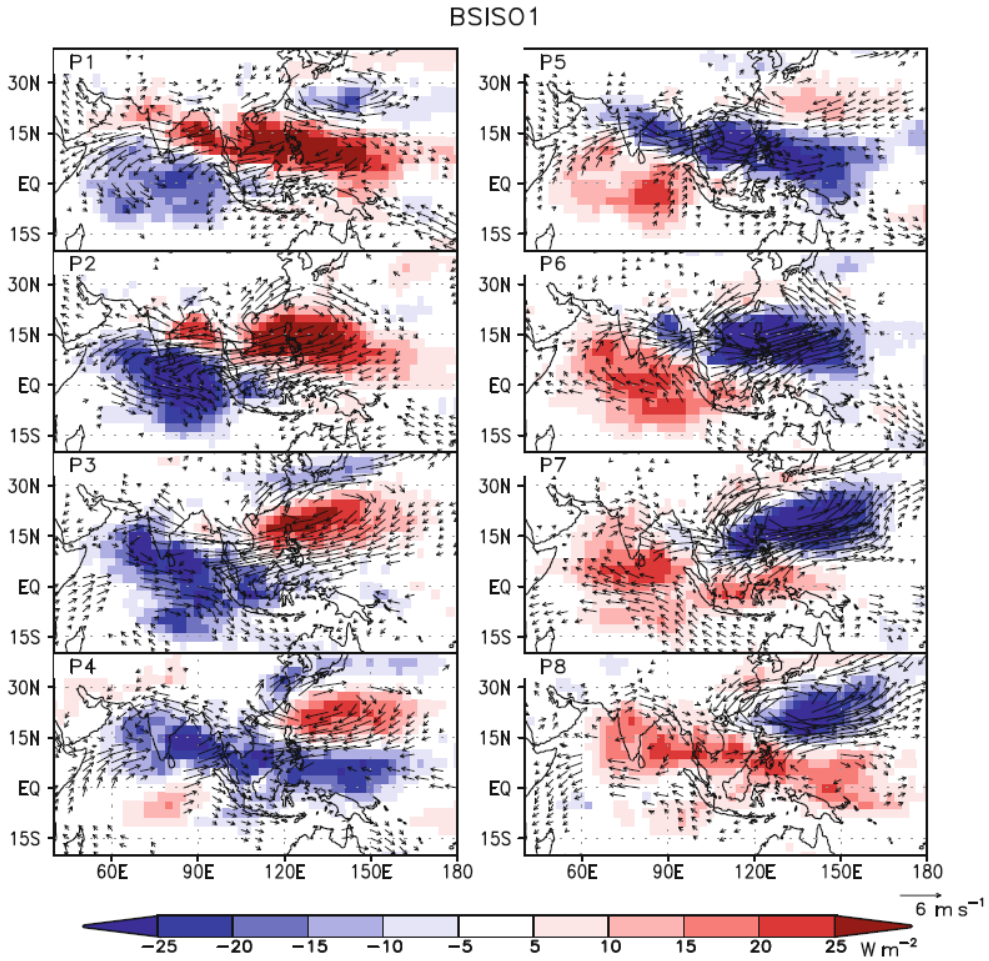
- Since 2013, APCC has **expanded climate service** from seasonal to subseasonal timescale **by providing BSISO real-time forecasts** for upcoming 20 days. It is available from **May to October** at APCC webpage and updates everyday.
- For the **real-time forecast**, the Lee et al. (2013) BSISO index is applied.



BSISO(Boreal Summer Intraseasonal Oscillation) Prediction

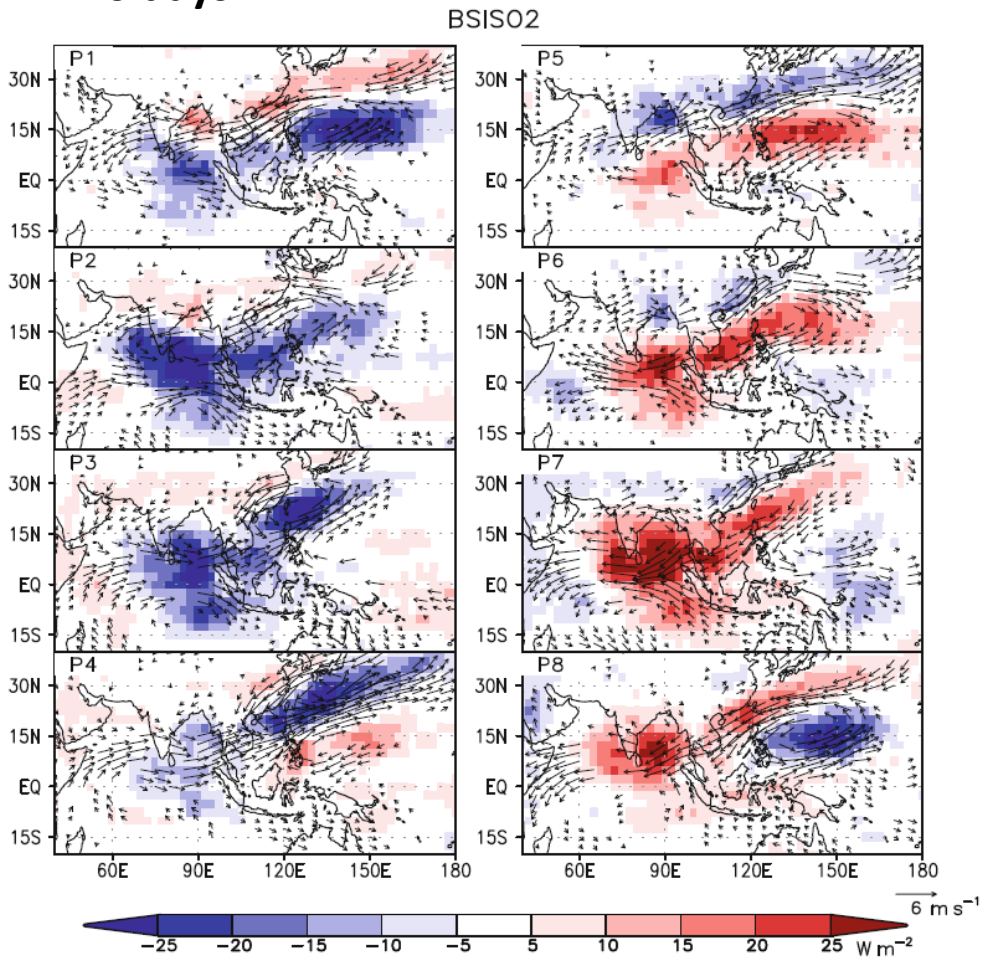
- The wet and dry spells of the BSISO strongly *influence extreme hydro-meteorological events*, major driving forces of natural disasters.
- **BSISO1 : canonical northward propagating BSISO over ASM region with 30-60 days quasi-oscillating period**

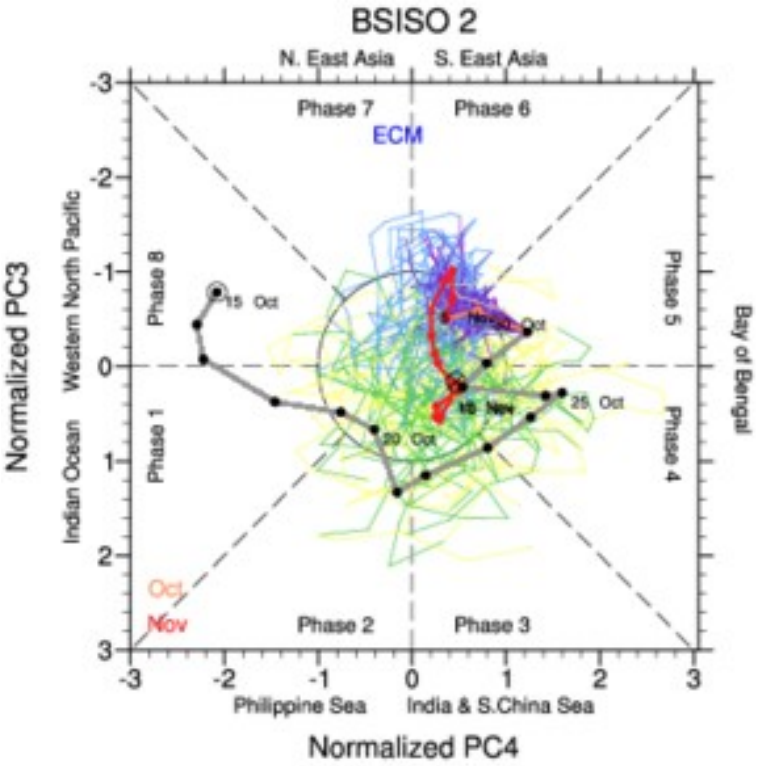




BSISO(Boreal Summer Intraseasonal Oscillation) Prediction

- The wet and dry spells of the BSISO strongly *influence extreme hydro-meteorological events*, major driving forces of natural disasters.
- **BSISO2 : pre-monsoon and onset mode with periods of both around 30 days and 10-20 days**





APCC BSISO Prediction System

- **Multi-Institutional Cooperation**

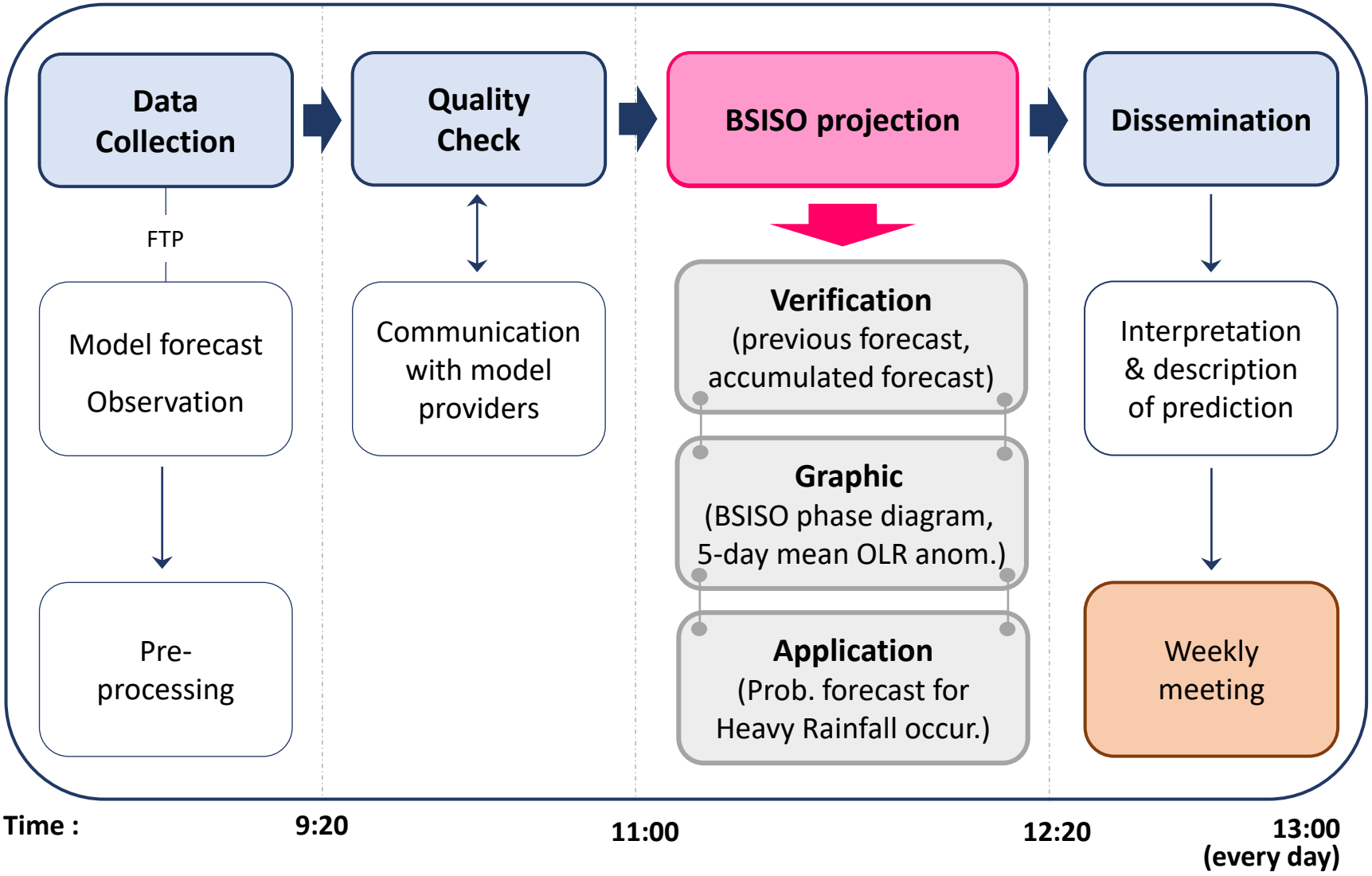
Institute	Model	Ensemble Size	Forecast Period	Update frequency	Resolution
NCEP	Climate Forecast System	4	40 days	Once a day	T126 L64
	Global Forecast System	1	16 days	Once a day	T574, T190 L64
Australia	POAMA 2.4 multi-week model	33	40 days	Twice per week	T47 L17
ECMWF	ECMWF Ensemble Prediction System	51	32 days	Twice per week	T639, T319 L62
Taiwan CWB	CWB EPS T119	6	40 days	Every 5 days	T119 L30

Required data

Specifications for the type and format of data needed from the operational centers in order to participate in the activity

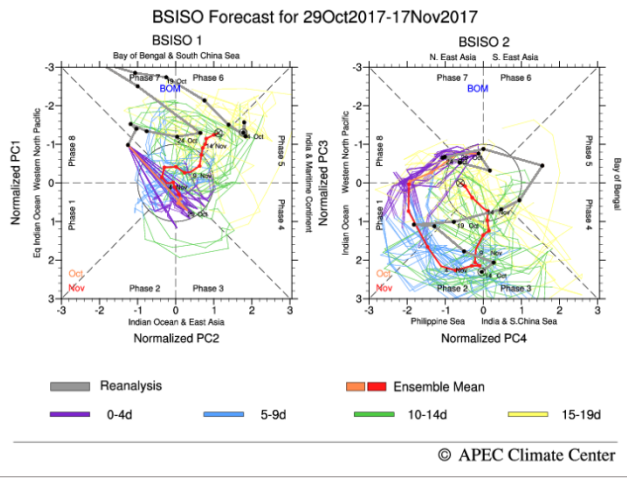
Fields	**OLR, and u850 totals (anomaly fields optional)**
Resolution	2.5° in latitude (10°S, 7.5°S, 5°S, …, 40°N) and longitude (40°E, 42.5°E, 45.0°E, … , 160°E) Daily averaged (00-24Z)
Update frequency	Daily, or less for those systems run at a reduced frequency
Additional data	At beginning of transfer, send analysis data for past 120 days
Format	ASCII

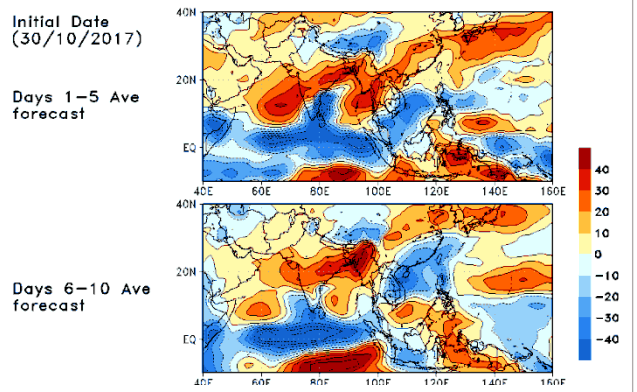
Operation Schedule

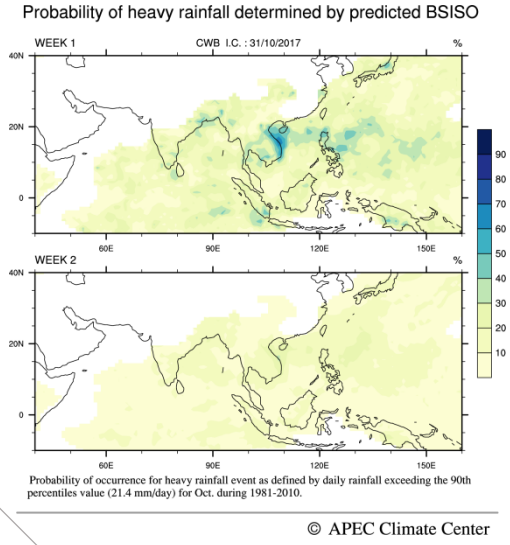


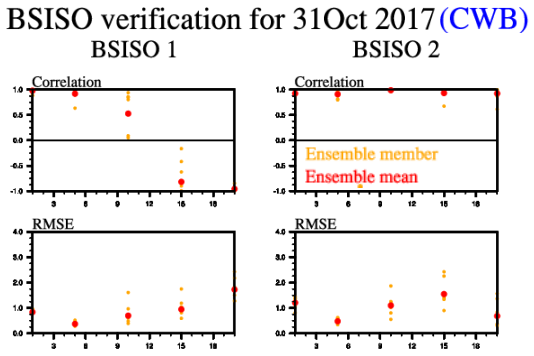
BSISO Forecast Products

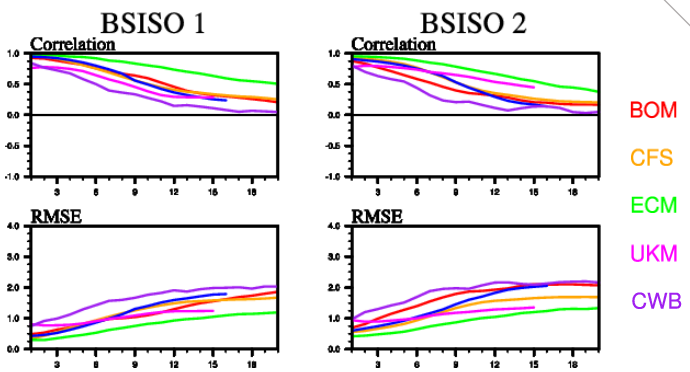
- Daily forecast of BSISO index
- 5-day mean OLR anomaly
- Probability of heavy rainfall for week1&2 predicted by BSISO index
- Verification results (hindcast, realtime forecast)





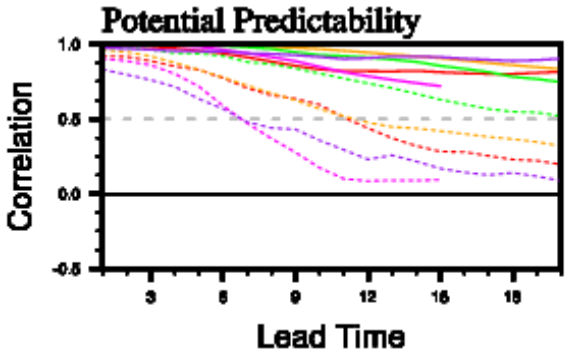




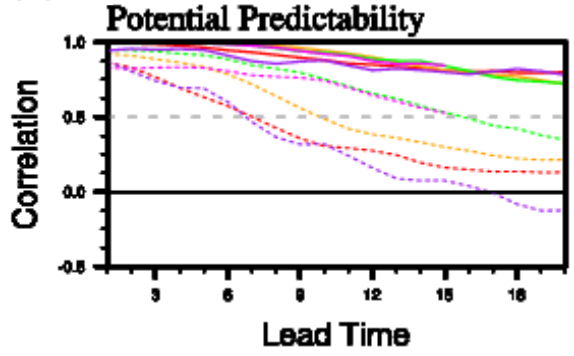


Performance of APCC BSISO

BSISO 1

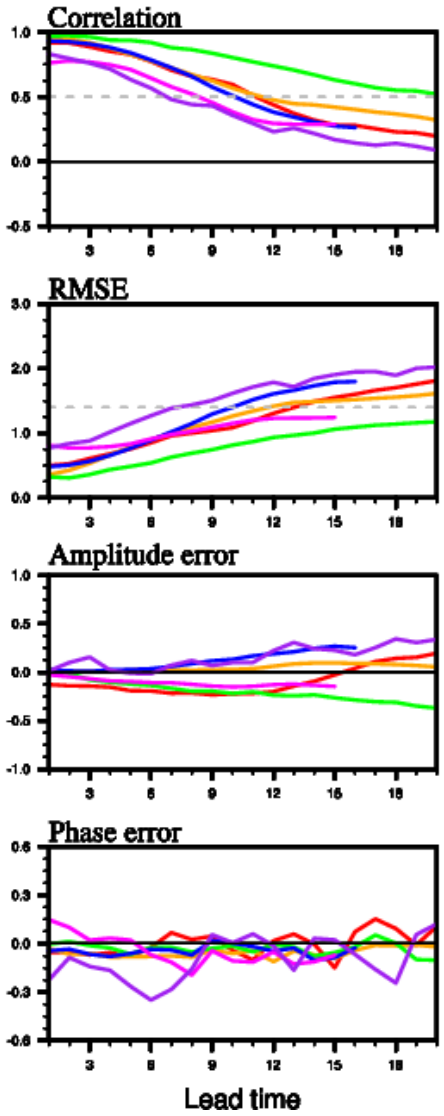


BSISO 2

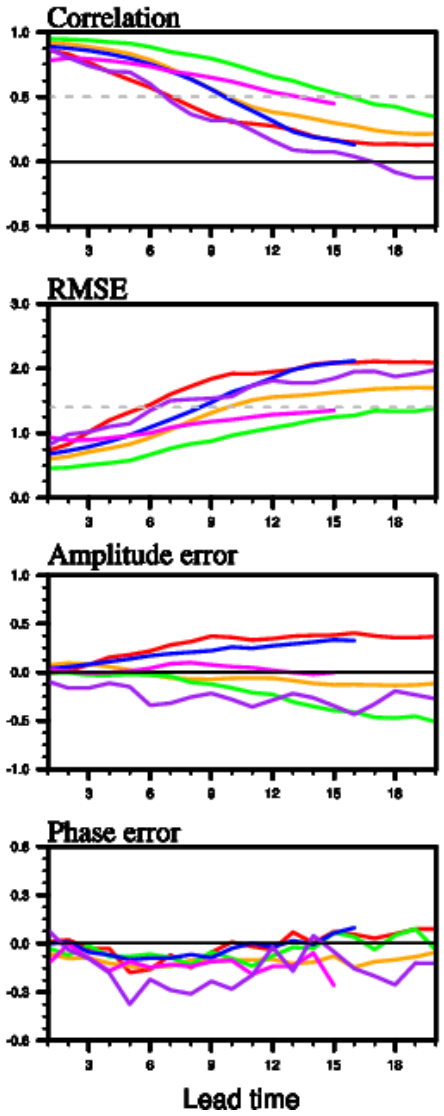


BOM CFS ECM UKM CWB

BSISO 1



BSISO 2



Better forecast? *practical use*

Reliable forecast

Reasonable interpretation

Recognition of the value

Actionable information

BSISO
Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

BSISO Forecast

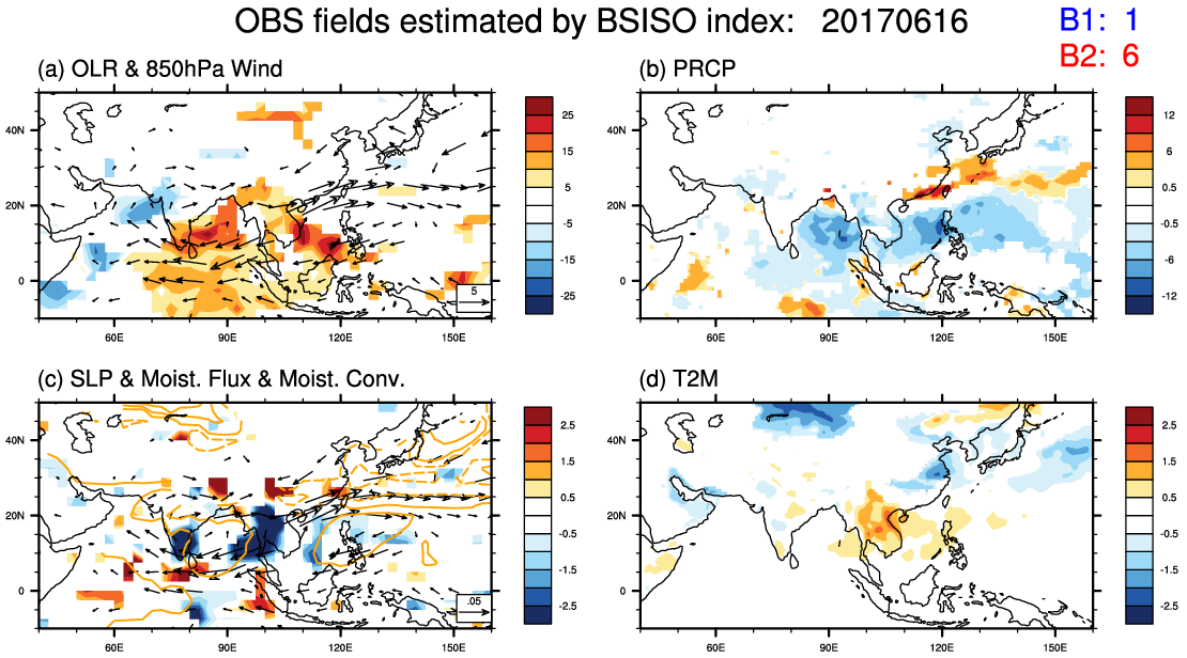
Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

Before meeting

: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

Verification → Monitoring → Forecast



T2M, SH, RH, MSLP, OLR, Z, OMEGA, U, V, SST, PRCP

from ERA interim, NCEP/DOE, NOAA, GPCP, APHRODITE

BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

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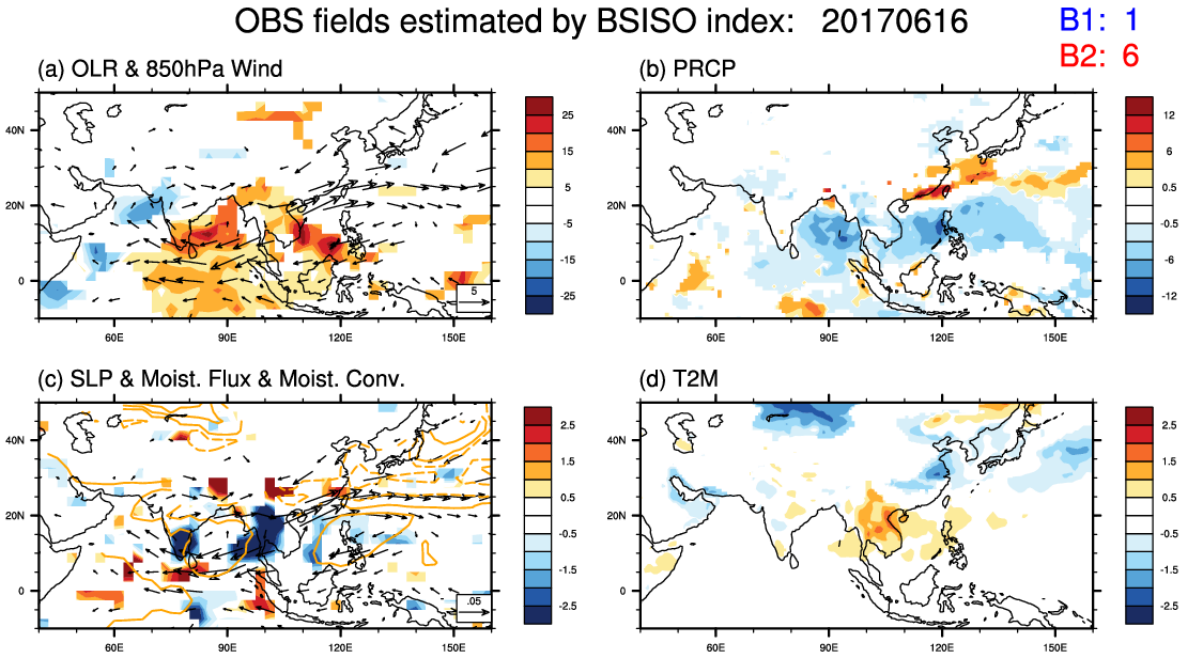
Verification | Monitoring | Forecast



T2M, SH, RH, MSLP, OLR, Z, OMEGA, U, V, SST, PRCP

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BSISO Forecast

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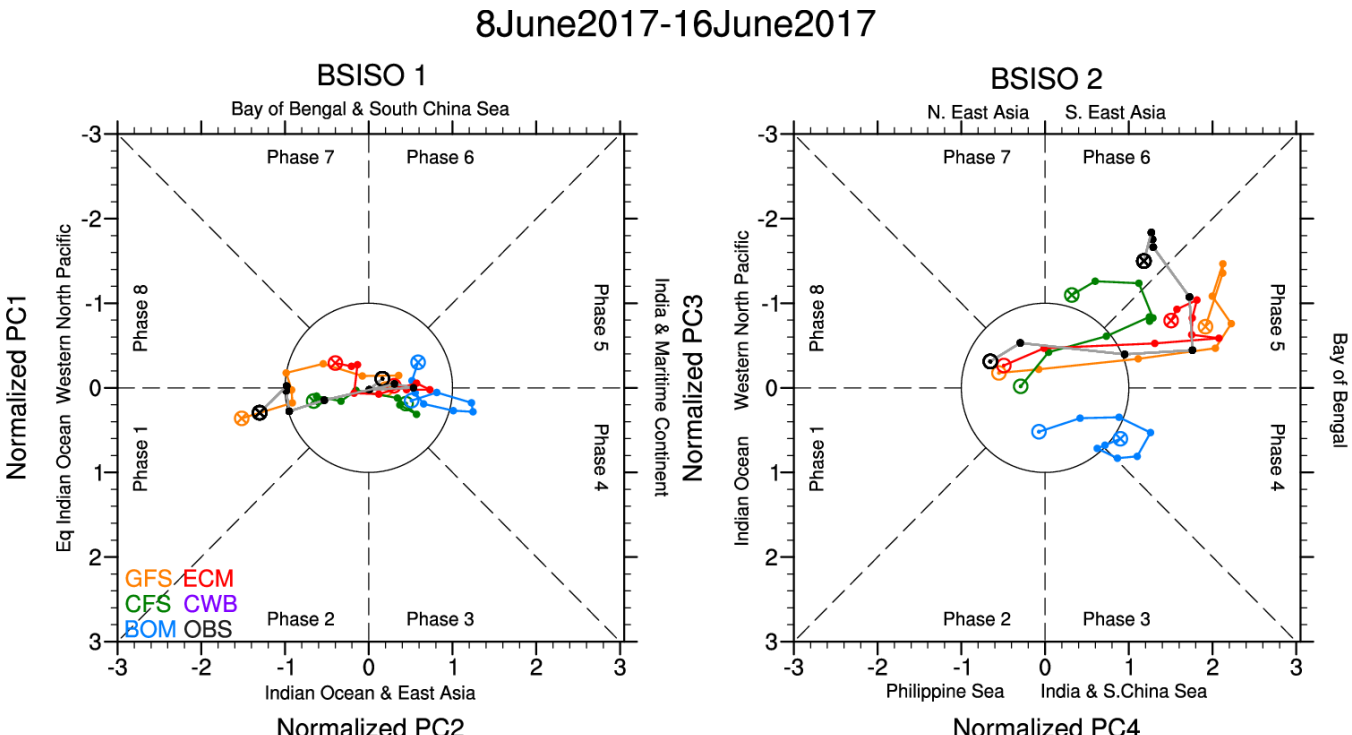
BSISO activity

Verification



BSISO Forecast

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Weekly meeting based on BSISO index forecast

Before meeting

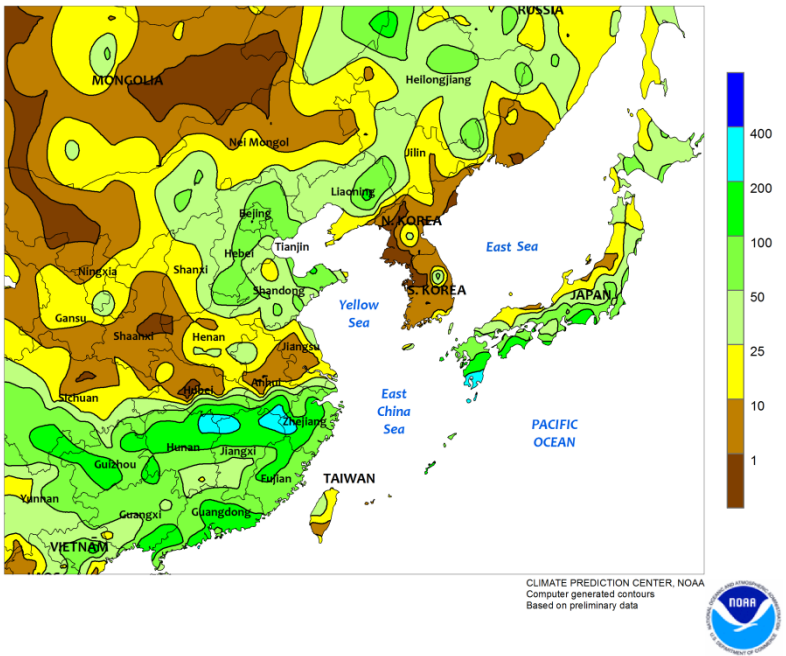
: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

Verification

- BSISO activity
- BSISO effect

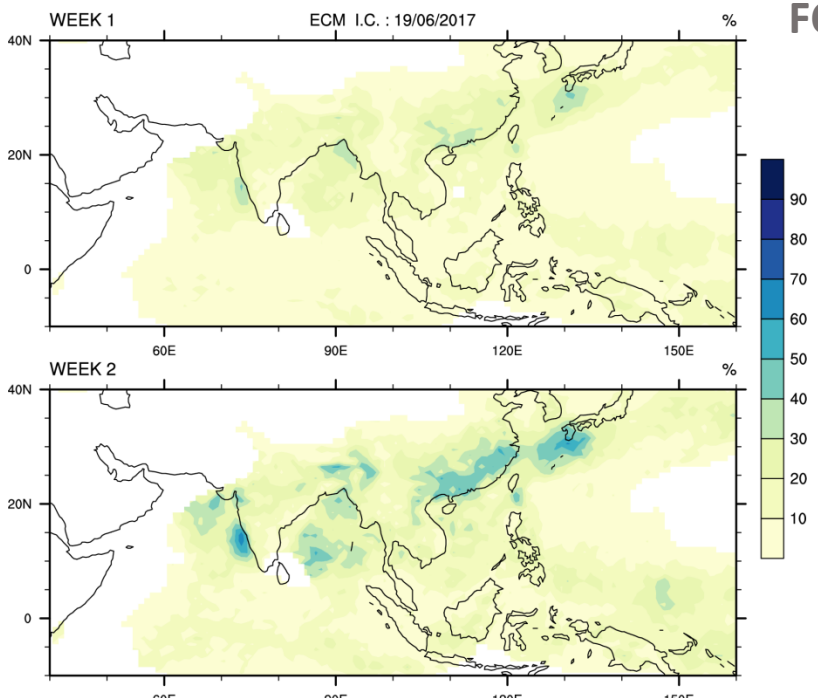
EASTERN ASIA
Total Precipitation (mm)
JUN 18 - 24, 2017

OBS



Probability of heavy rainfall determined by predicted BSISO

FCST



BSISO Forecast

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Weekly meeting based on BSISO index forecast

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Verification | Monitoring | Forecast

BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

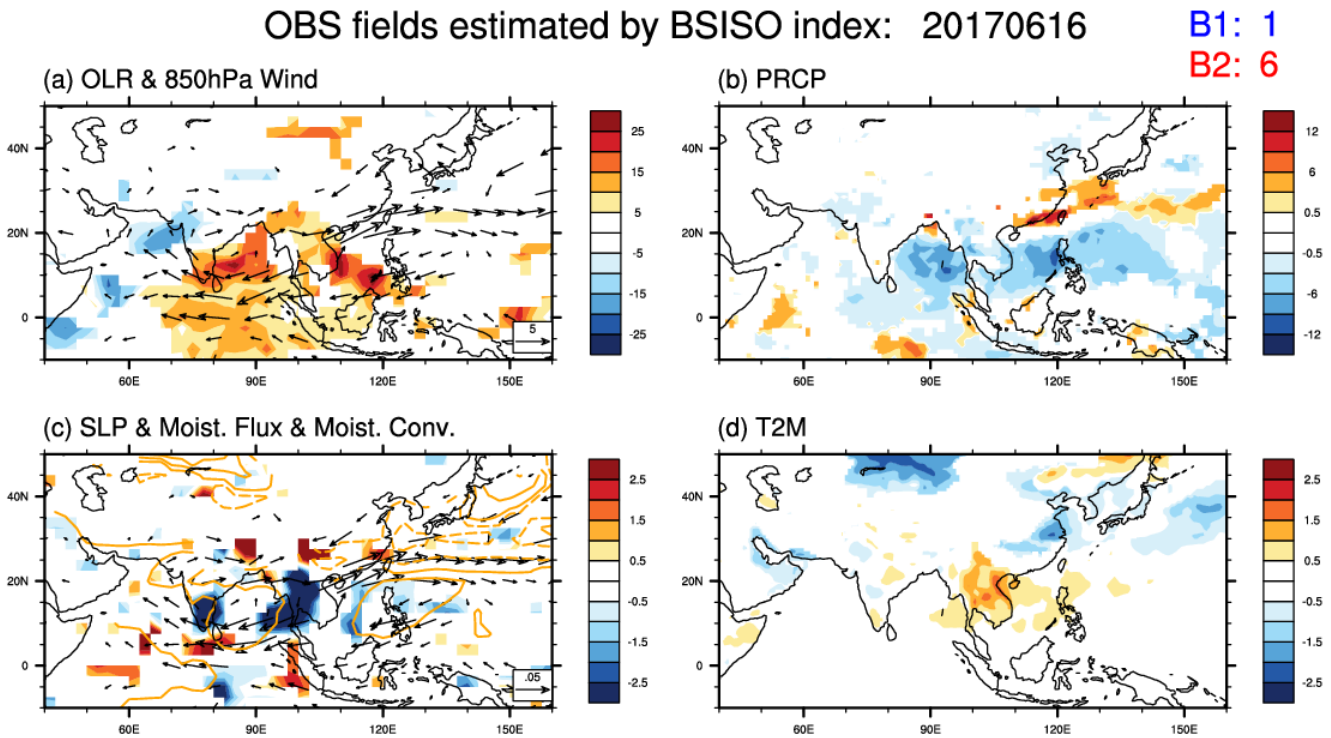
Before meeting

: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

Asia monsoon region

Atmospheric circulation pattern

Monitoring



BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

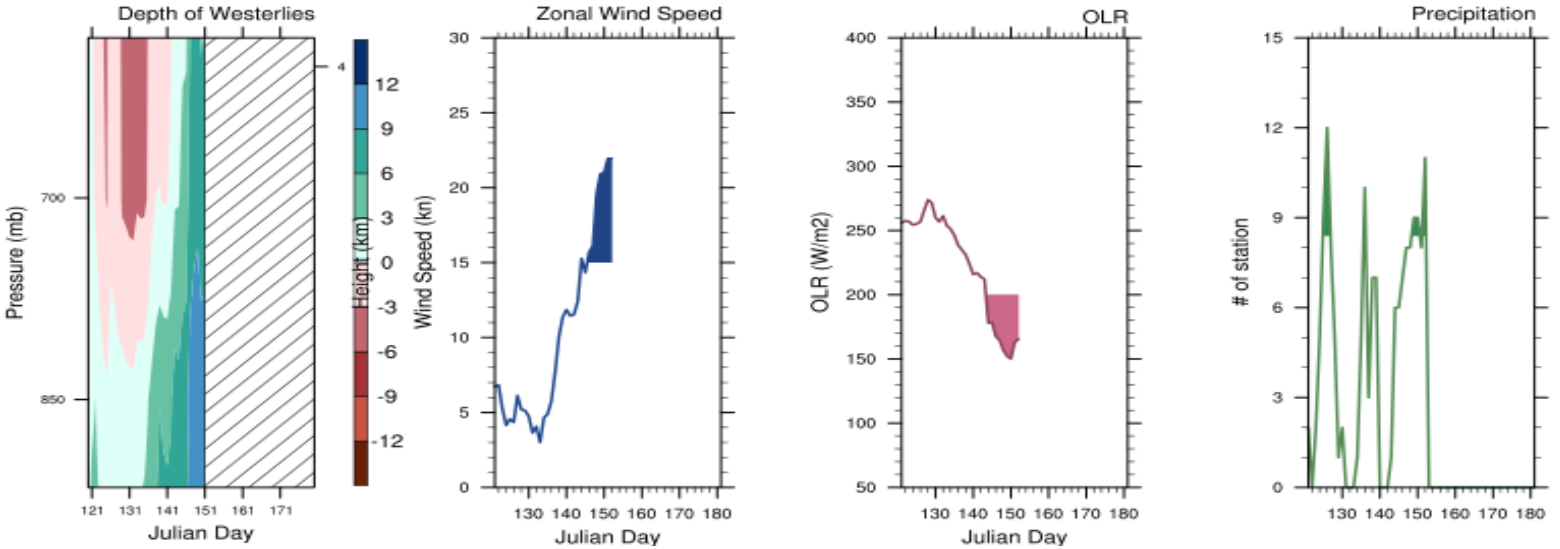
Before meeting

: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

❖ **Southwest Monsoon Onset Monitoring (20180604)**

Monitoring

- Asia monsoon region — *Atmospheric circulation pattern*
- India — *Monsoon onset, heat wave*



Possible Onset Date :

149 150 152

BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

Before meeting

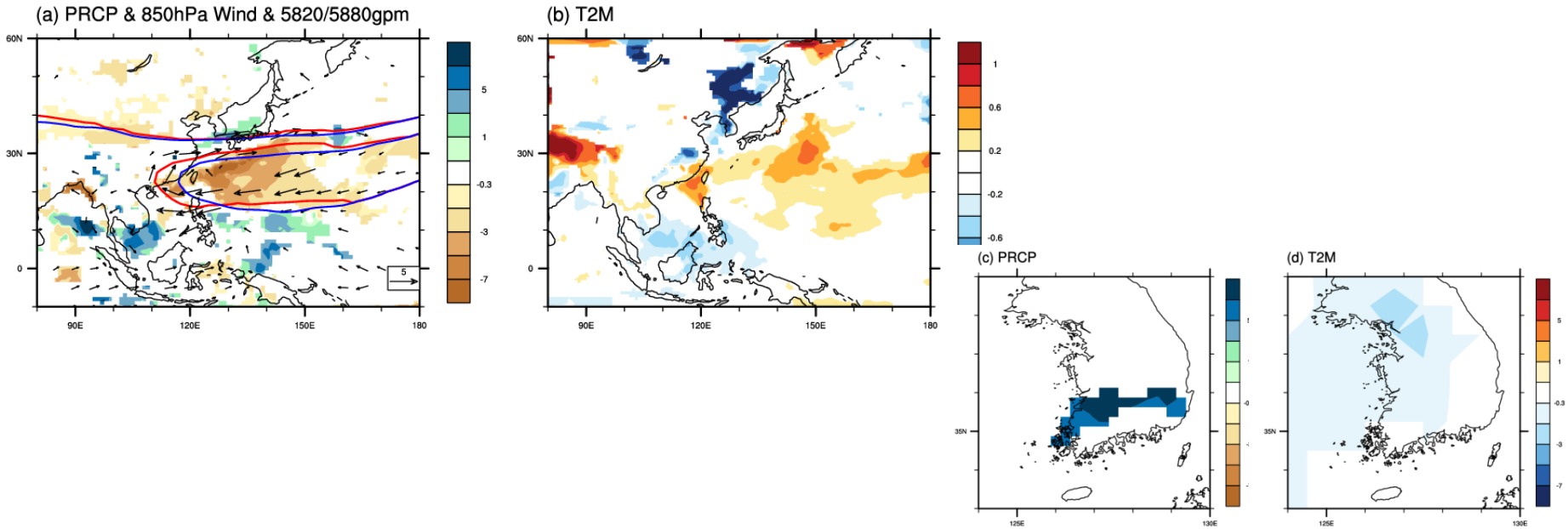
: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

Monitoring

Asia monsoon region	*Atmospheric circulation pattern*
India	*Monsoon onset, heat wave*
S. Korea	*Changma, heat wave*

B1: 4
B2: 8

OBS fields estimated by BSISO index: 20160630



BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

Before meeting

: Construction of analysis system for BSISO related atmospheric status
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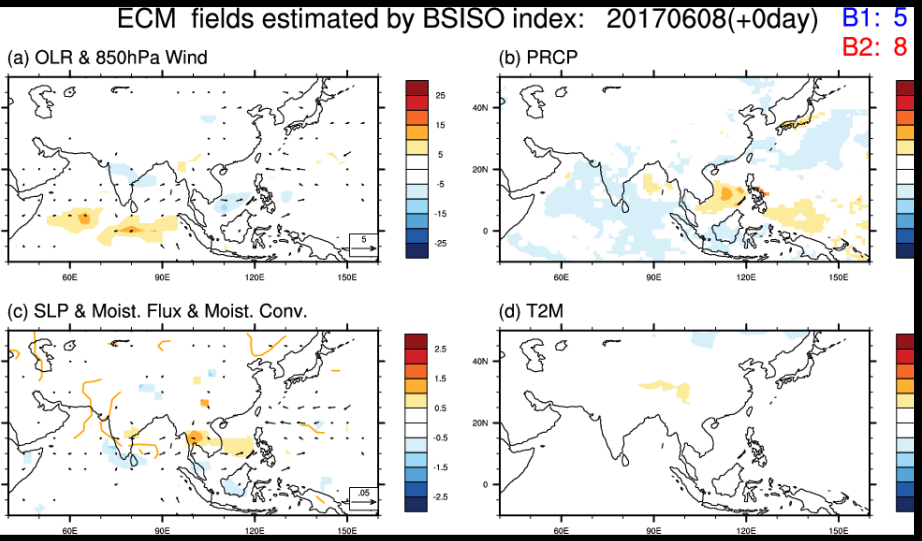
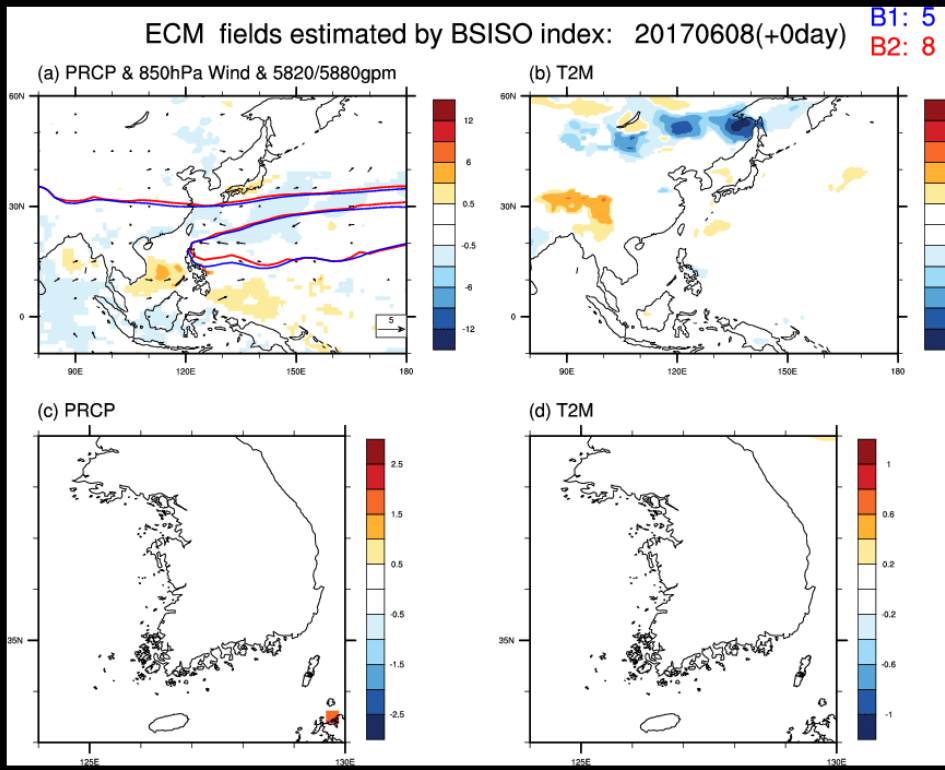
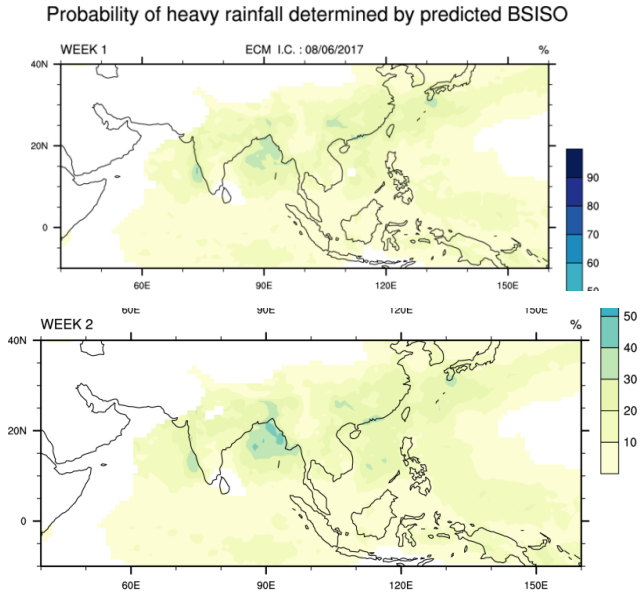
Verification | Monitoring | Forecast

Weekly meeting
based on BSISO index forecast

Forecast







BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

Before meeting

: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

At meeting

: Discussion on verification for previous week, current status,
and prospect BSISO activity and atmospheric condition for next two weeks

Verification | Monitoring | Forecast

BSISO Forecast

Better forecast from better understanding on BSISO

Weekly meeting based on BSISO index forecast

Before meeting

: Construction of analysis system for BSISO related atmospheric status
Searching climate issues and analyze them for previous week

At meeting

: Discussion on verification for previous week, current status,
and prospect BSISO activity and atmospheric condition for next two weeks

After meeting

: Writing BSISO weekly bulletin

Verification | Monitoring | Forecast

BSISO Forecast

Better forecast from better understanding on BSISO

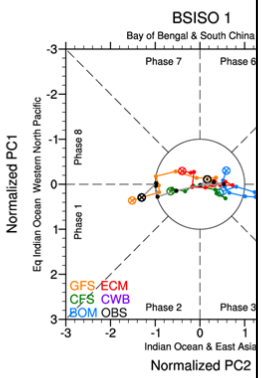
Extended forecast over Asia-monsoon region estimated by BSISO forecasts

Forming into the BSISO Weekly Bulletin (at the pilot stage for regular operation)

❖ **Updated every Monday from May to Oct.**

BSI

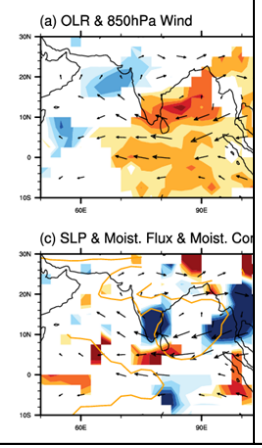
Verification



- Period : 08 June ~ 16 June
- BSISO 1 : nonactive 한 상태로 지
  모델들이 nonactive 한
- BSISO 2 : 약하게 유지되다가 P5-
  모델들이 관측의 경향을

Monitoring

2. Indian monsoon area
   -현재 +IOD
   -BSISO와 관련된 대기 순환장도
   -BSISO 로 인해 Anomalous 동풍
   Indo monsoon 이 약화되거나 북

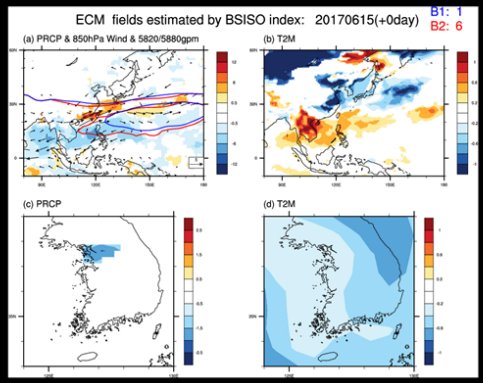


Forecast

1. ECMWF (I.C. 15Jun)
   : BSISO1 : P18→nonactive→P34
   : BSISO2 : P4→nonactive

[S.Korea]

- L15~20 : 장마 전선 남부(심지어 중부) 상륙 (30일)
- 장마비는 평년 or 평년 보다 적을 것으로
- 북태평양 고기압 (5880gpm) 서쪽으로 확장
- L0~5 : 동해안 cool
- L6~14 : 남한(한반도) cool
- L15~20 : 북서부(북한) cool
- 기온 ano 의 중국-한국 동서 대비



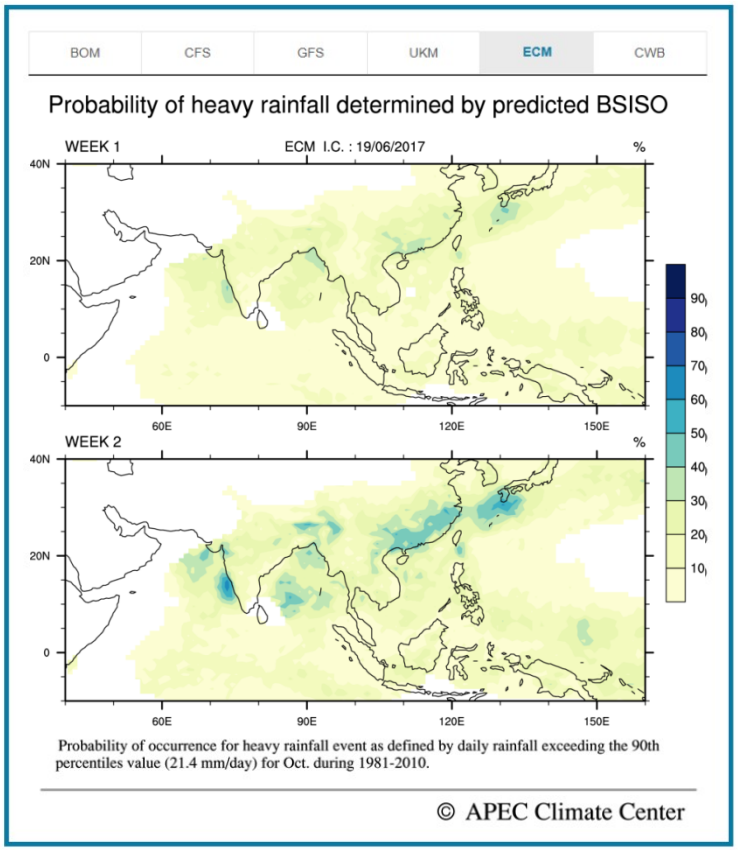
BSISO Forecast

Better forecast from better recognition of the value

Development of a guideline to increase practical use of BSISO forecast

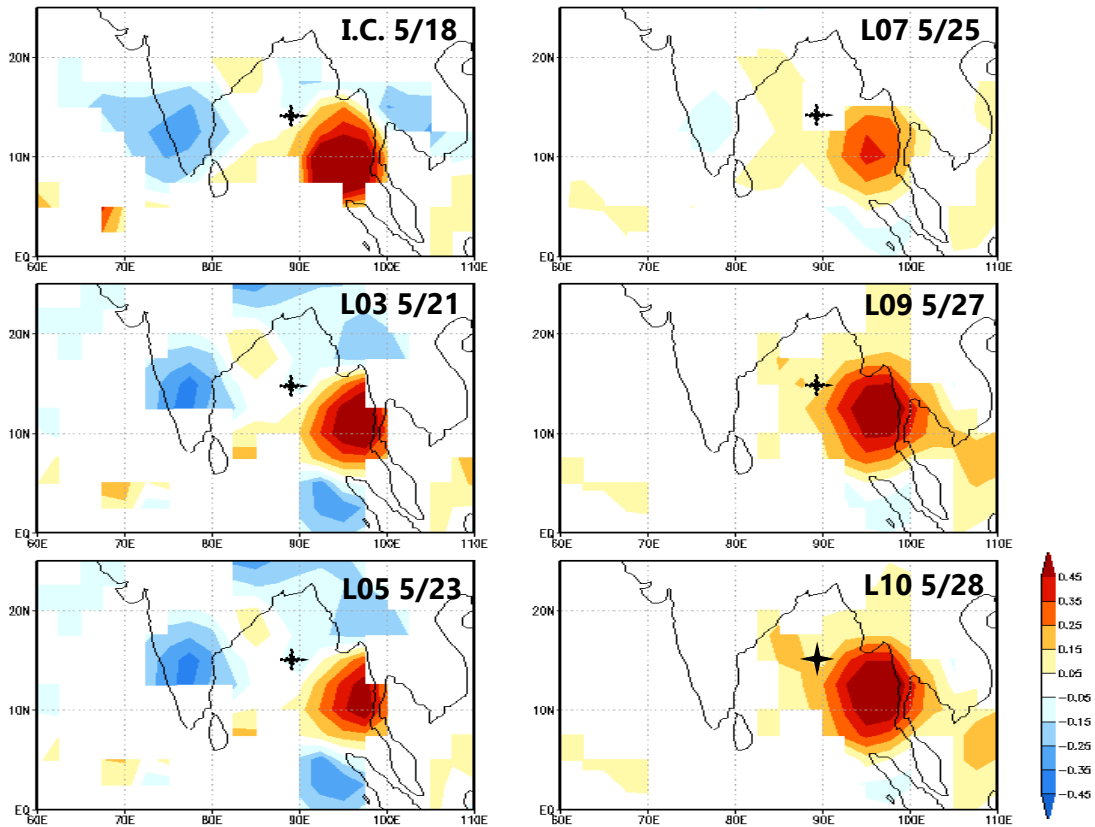
Heavy rainfall forecast based on BSISO index forecast [ECMWF]

❖ Ex> Japan flood, 398mm/4hr, July 6, 2017



ISGPI forecast estimated by BSISO index forecast [ECMWF]

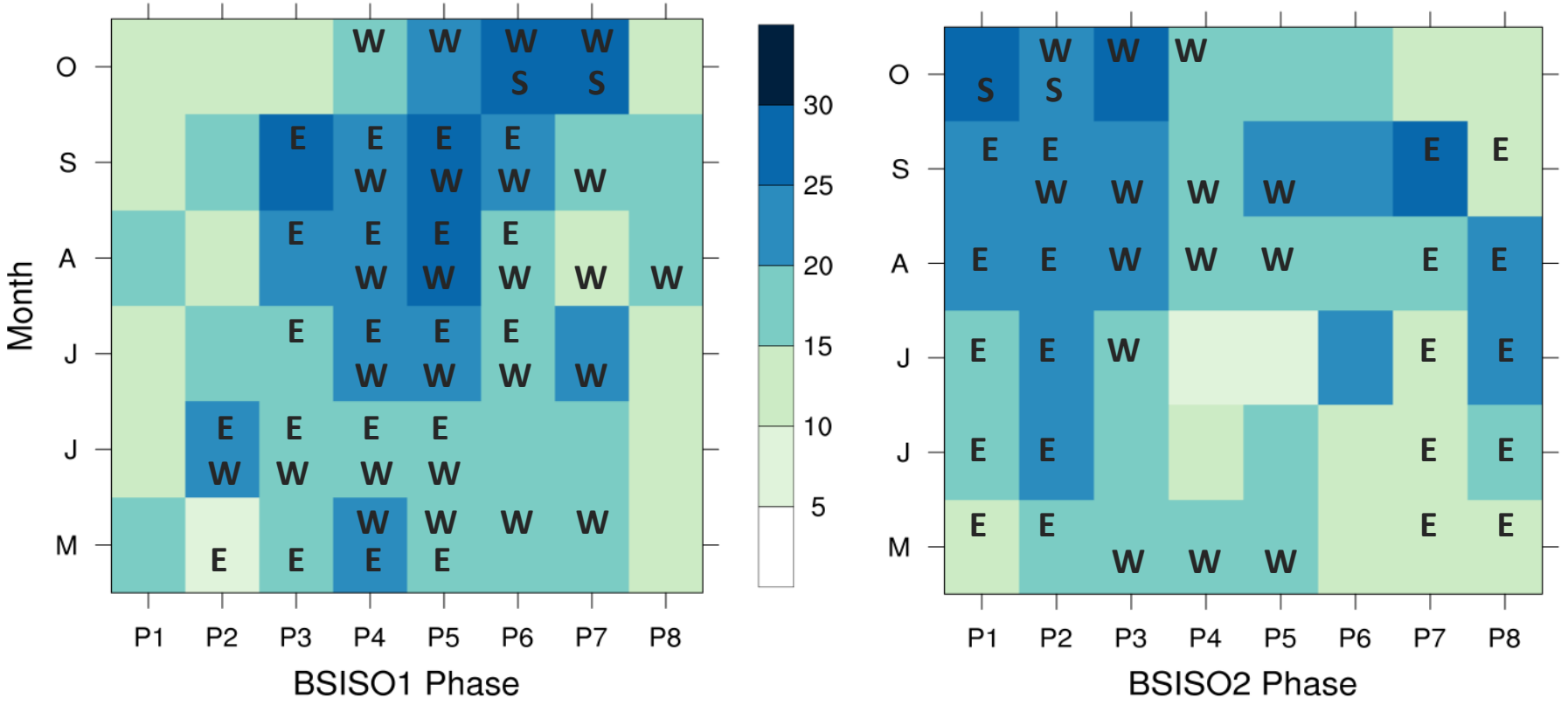
❖ Ex> Tropical Cyclone Mora-17, May 28, 2017



BSISO Forecast

Better forecast from better recognition of the value

Development of a guideline for heavy rainfall probability forecast over Mekong river basin

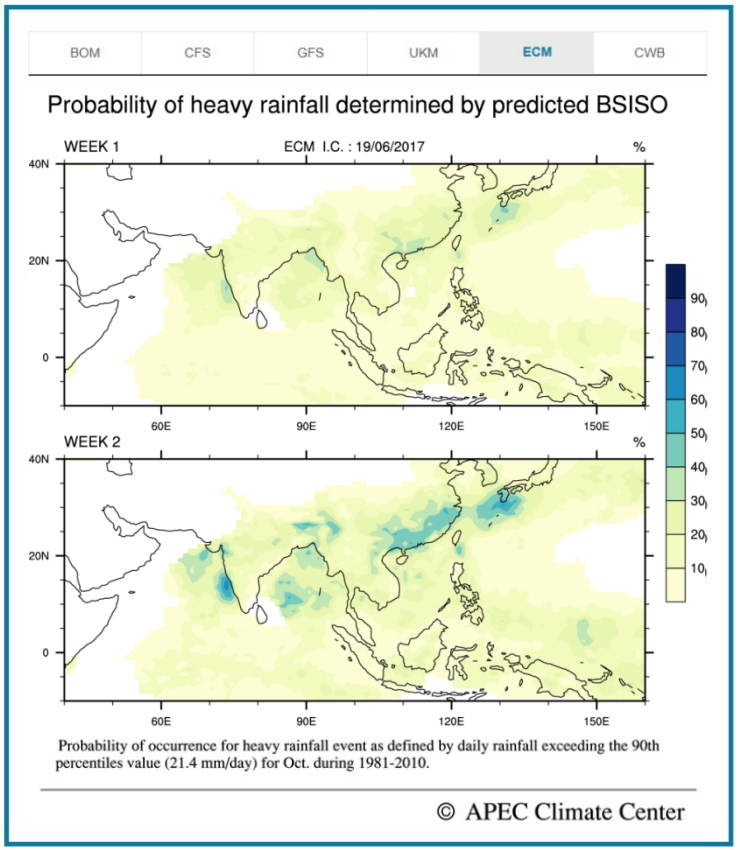


Probability table marked with favorable wind condition which can contribute strong Indo-China monsoon and bring heavy rainfall.

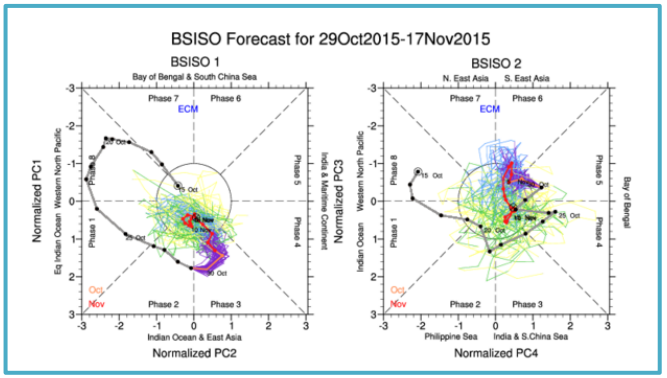
BSISO Forecast

Better forecast by actionable information

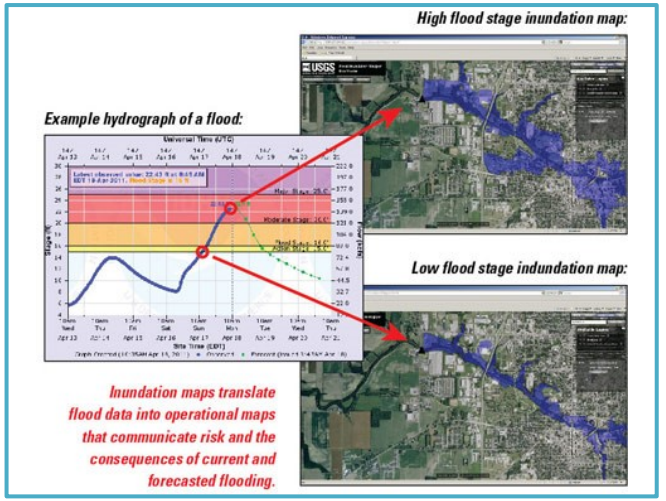
Heavy rainfall forecast



BSISO forecasts



Flood Inundation Mapping



Interdisciplinary Research

International Cooperation

BSISO Forecast

✓ **APCC's S2S Training Program (1-week)**

- Every 2 years, APCC has trained about 20 participants from developing countries
- 2014 : S2S to cope with high impact weather
- 2016 : S2S to cope with extreme hydrological events
- 2018 : APCC in the forefront of S2S Forecast

Summary

- APEC Climate Center (APCC) is a leading operational center providing seasonal forecast based on the **Multi-Model Ensemble** (MME) prediction system.

- APCC has produced **real-time BSISO forecast** using multi-models based on the international cooperation.

- The goal of APCC's BSISO forecasting activity is to produce better forecast by promoting **practical use** of real-time BSISO information.

Summary

- Along with pursuing **more reliable forecast**, we've made an effort to **improve our understanding** on BSISO forecast and created **user friendly information**.

- In order **to arouse the people to the worth of BSISO** forecast, the possibility of BSISO application is estimated and which would be the cornerstone for making **actionable information**.

- APCC's BSISO forecasting activity has become the origin of **APCC's S2S Training program** that takes places every two years.

(http://www.apcc21.org)