

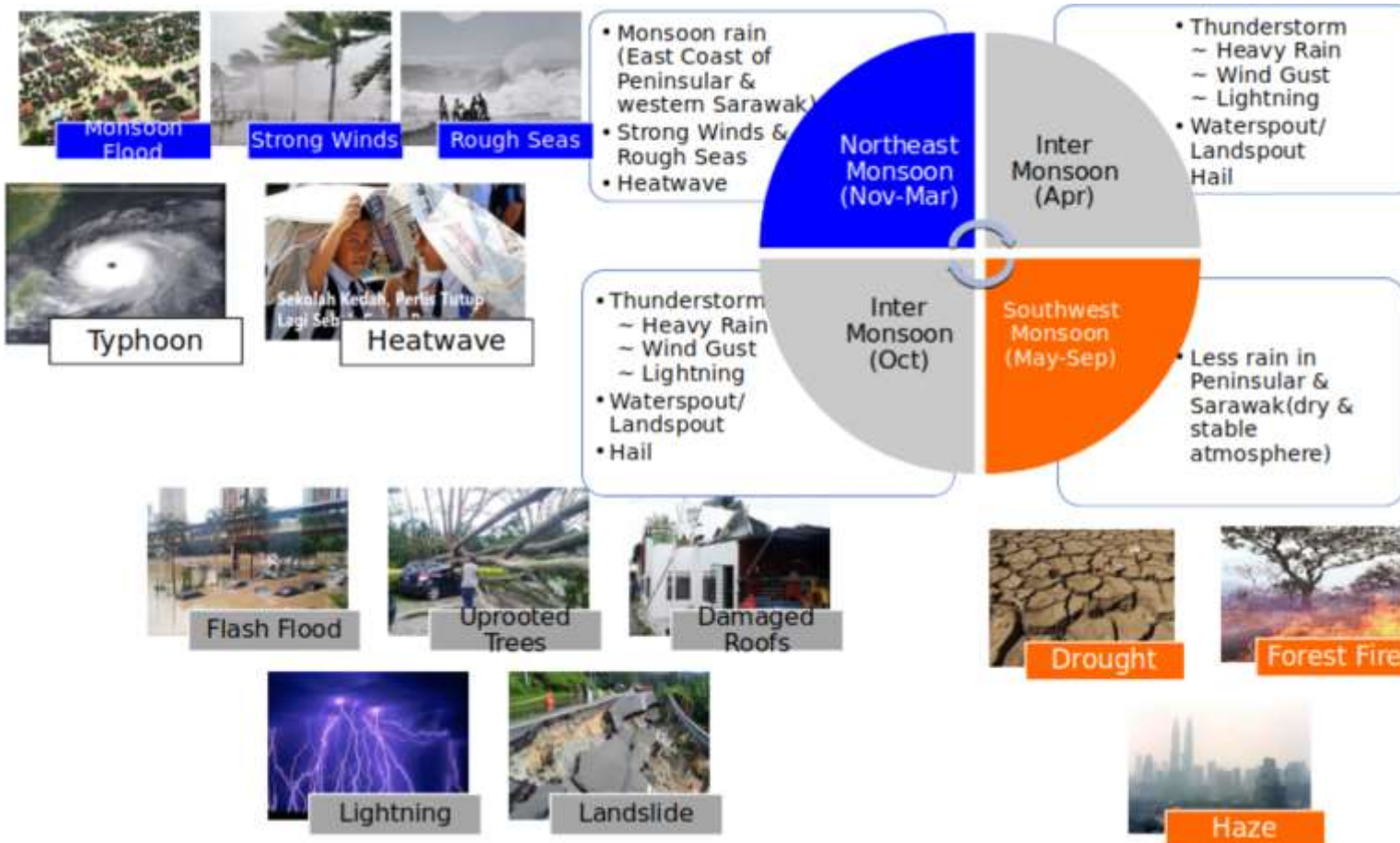
Effort and challenges in implementing climate information services in disaster risk reduction in Malaysia

Outline

- Introduction
- Weather Monitoring, Warning and Forecasting System
- End-to-end Early Warning System
- Challenge: Reliable Forecast
- Integrating Extreme Weather Warnings into Disaster Risk Reduction
- MMD's needs on climate information services from APCC

Introduction

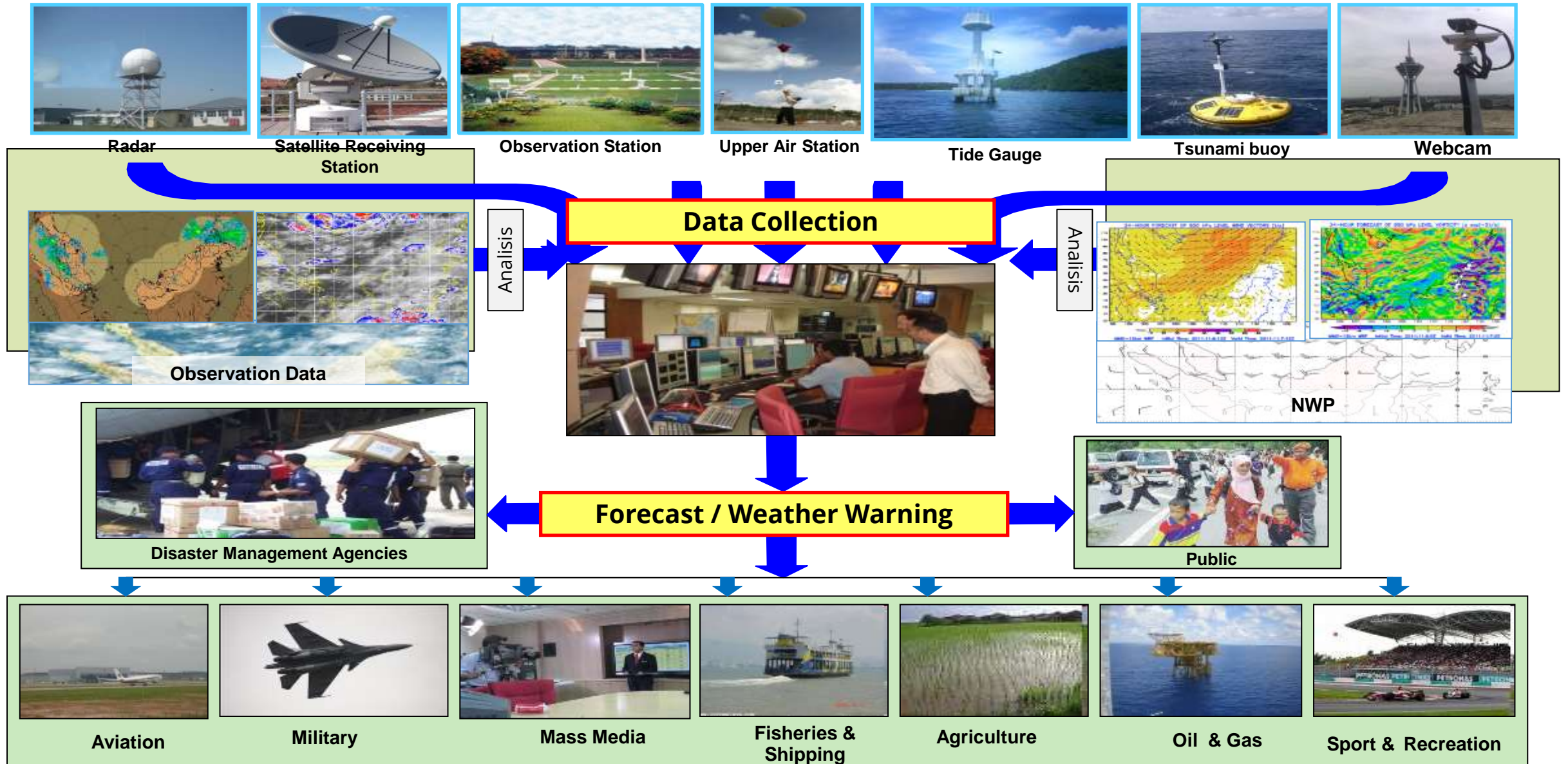
Extreme Weather Phenomena in Malaysia



Climate change based on past observed data and future climate scenarios, creates a picture of a warming climate along with changes in variability and extreme. The concern facing the impacts and adaptation science community is the determination of the frequency and magnitude of extreme events in the future

Over the recent years, the occurrence of extreme weather events in Malaysia has increased

Weather Monitoring, Warning and Forecasting System



End-to-end Early Warning System

Four Components of end-to-end Early Warning System

DISASTER RISK KNOWLEDGE

* Forecaster has the knowledge of the hazards and the vulnerabilities



MONITORING AND WARNING SYSTEM

* Forecaster monitor hazard precursor, to forecast the hazard evolution, and issue warnings



DISSEMINATION & COMMUNICATION

* Disaster Management agencies understand the warnings, and get the preparation ready prior the expected events



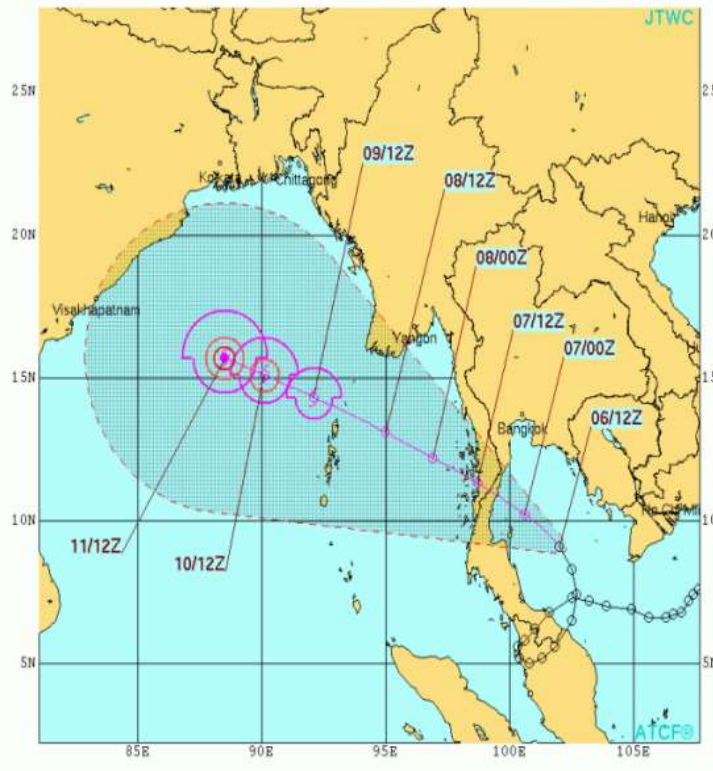
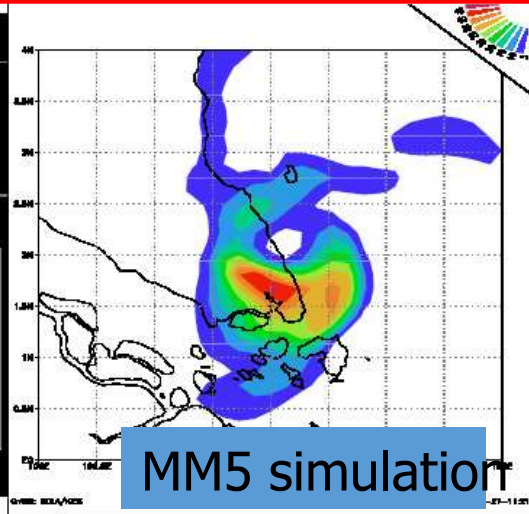
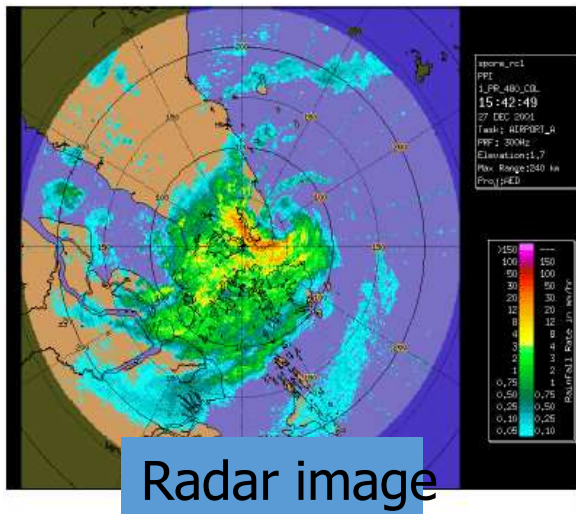
RESPONSE CAPACITY

* Public has knowledge, plans and take the appropriate action especially for those at high risk



Challenge: Reliable Forecast

The Development/movement of Mesoscale Convective System (MCS) Difficult to Forecast
Case: Tropical Storm Vamei Dec 2001 / TD Nov. 2017



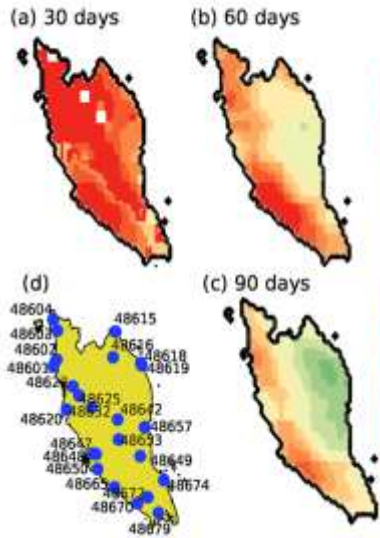
- Developed on 27 Dec 2001 over South China Sea
- Abnormal TS as it formed near the equator (1.5°U)
- Five swept away by mudslide over Gunung Pulai, Johor



- Movement of TD hard to forecast over South China Sea / Gulf of Thailand
- Heavy rain for 17 hours with strong winds on 4 Nov. 2017
- More than 8000 people were evacuated and 7 people died

Challenge: Reliable Forecast

Short Dry Period / Drought
Case: Drought Feb – Mac 2014

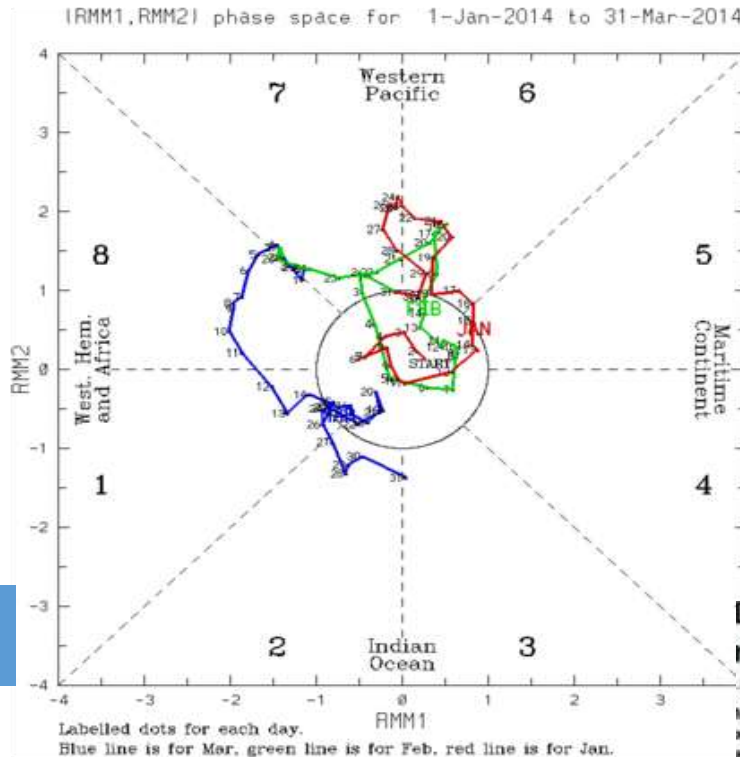


Satellite SPI for Feb 2014

(e)

Sta No	Lat	Lon	SPI		
			1month	2month	3month
48601	5.30	100.27	-1.43	-0.98	-1.38
48602	5.45	100.38	-1.77	0.02	-0.83
48603	6.20	100.40	-1.71	-1.67	-0.83
48604	6.48	100.27	-3.30	-1.67	-1.53
48615	6.17	102.30	1.83	-1.02	1.08
48636	5.53	102.20	-1.58	0.01	0.32
48638	5.38	103.50	-2.50	-1.10	-0.59
48620	4.22	100.70	-1.49	-0.33	0.00
48623	4.80	100.90	-3.00	-1.73	-
48625	4.57	101.50	-3.19	-0.22	-0.85
48632	4.47	101.37	-3.25	-1.08	-0.48
48642	3.97	102.35	-1.70	-0.90	-0.25
48647	3.13	101.55	-3.00	-0.80	-0.73
48648	3.10	101.65	-1.08	-1.01	0.45
48649	3.05	103.08	-1.05	-3.62	0.19
48650	2.73	101.70	-3.58	-1.70	-1.44
48653	3.47	102.38	-3.67	-2.38	-0.32
48657	3.77	103.22	-1.11	-0.42	0.69
48665	2.27	102.25	-3.58	-1.95	-1.54
48670	1.87	102.98	-0.35	-1.21	-0.38
48672	2.02	103.32	-3.10	-1.64	-0.65
48674	2.45	103.83	-1.88	-0.88	-0.57
48639	5.33	103.11	-1.47	-0.76	-0.57
48679	1.63	103.67	-1.29	-1.27	-0.34

MET stations SPI for Feb 2014



Water rationing in Selangor

Drought forces Malaysia to expand water rationing around Kuala Lumpur

Updated 1 Mar 2014, 2:42am

Malaysia says it will expand water rationing in and around its capital Kuala Lumpur, in a move affecting millions as drought continues to scorch a tropical country usually synonymous with torrential rain.

The National water commission said over 300,000 households in Kuala Lumpur and nearby Selangor, will experience cuts for the whole of March, after a two-month dry spell depleted reservoirs.

Some 60,000 households in Selangor - the nation's economic hub - have already been hit by rationing since Tuesday.

According to the commission, another 50,000 premises in the southern state of Johor have also undergone rationing last week, as much of Malaysia suffers under bone-dry conditions and high temperatures.



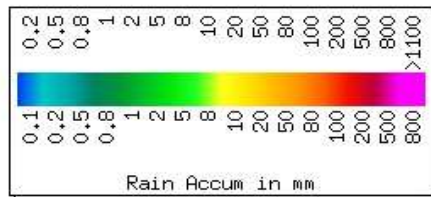
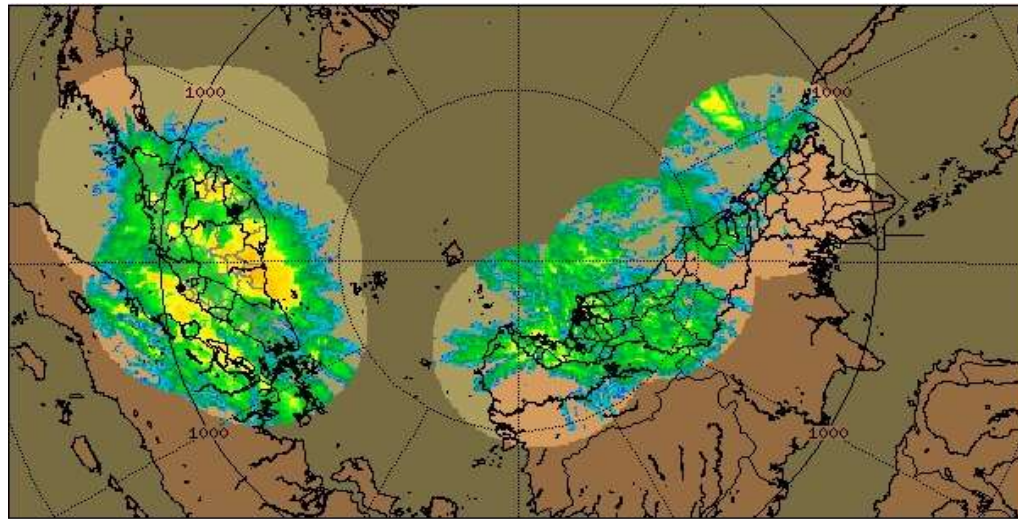
PHOTO: People queue to collect water from a tap in Balakong, outside Kuala Lumpur. Authorities are rationing water to thousands of households as a dry spell depleted reservoirs across the country (AFP)

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

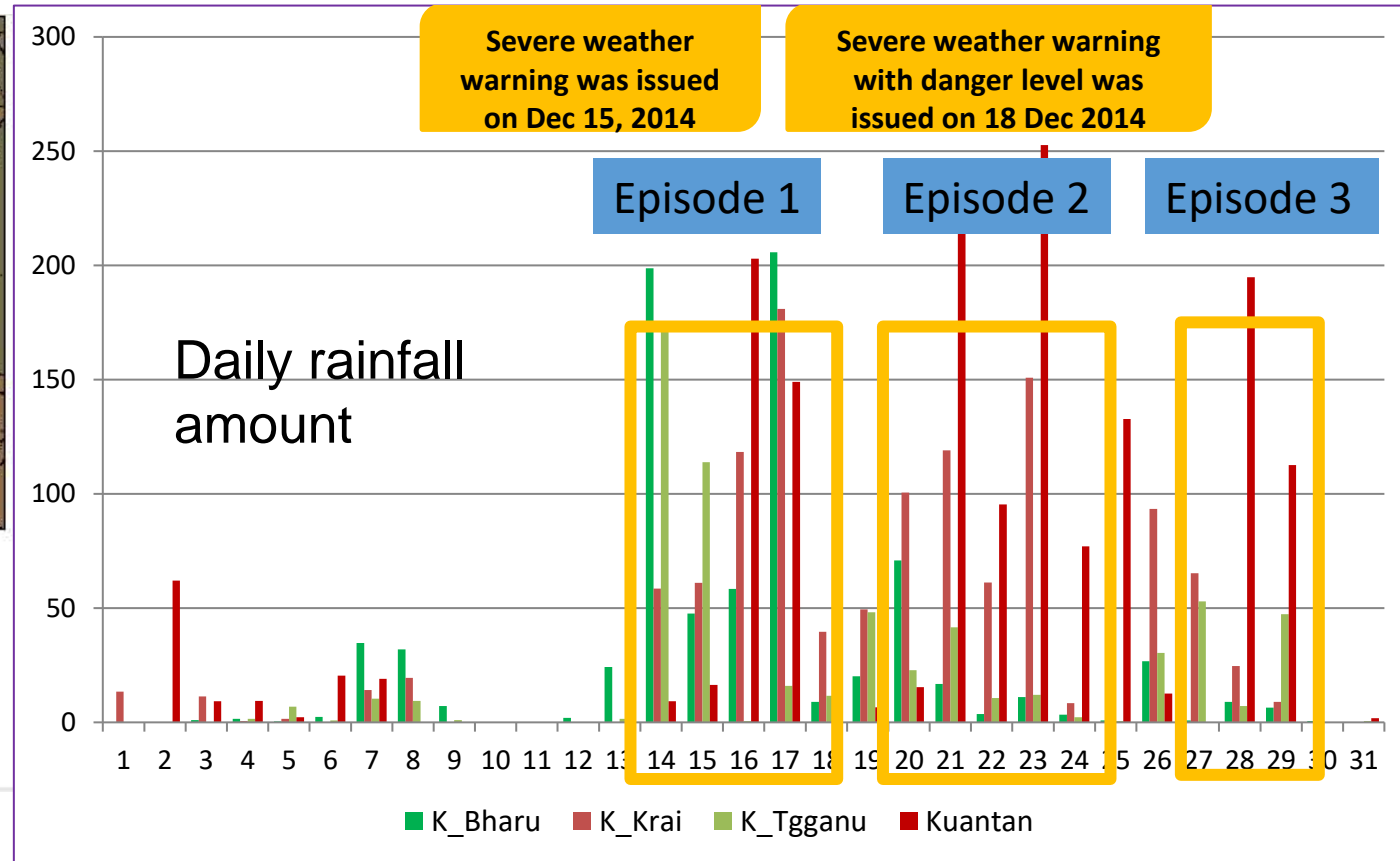
- Short time drought modulate by sub-seasonal climate phenomena, while longer time drought modulate by El-Nino / +ve dipole IOD
- Associated with strong suppressed phase of MJO (phase 6-8)
- Not seamless prediction for sub-seasonal forecast where forecast is rapidly changes
- TV & radio broadcasts on dry and hot weather & the latest weather information

Challenge: Reliable Forecast

Rainfall Amount during Extreme Weather Events Hard to Predict
Case: Flood in Kelantan Dec 2014



24HRS
N Hours Rainfall
RAIN24_300_M
Task: LRANGE_VOL
PRF: 250Hz
Hours:24/24
Max Range:1422 km
00:00:00
23 DEC 2014 MYT



Flood in Kelantan 24 Dec 2014

- ❑ Extreme rainfall (> 150 mm/day) over interior Kelantan
- ❑ Two episodes consecutive of monsoon surges and coincidence with coastal flood due to high tides
- ❑ Evacuation of 151,072 residents on 29 December 2014, 10 deaths (e-banjir, 2014) estimated losses is about RM 2.8 billion

Challenge: Reliable Forecast

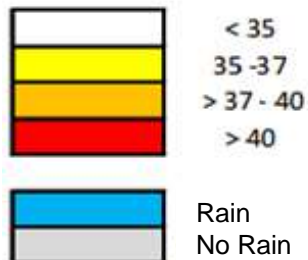
Heatwave Forecast depends on Dry Spell and Weather Conditions
Case: Heatwave April 2016 / Heatwave January 2020

Dry Spell, daily maximum temperature and forecast of weather and maximum temperature for 3 days

Bil	Negeri	Daerah	Stesen/Kawasan	27/1/2020		Weather and temp forecast			
				Bil Hari Tanpa Hujan	Suhu Maks	28/1/2020	29/1/2020	30/1/2020	Julat Suhu Maks untuk 3 Hari
1	PERLIS	Chuping	Stesen Meteorologi Pertanian Chuping	15	34.9				
2		Padang Besar	Taman Negeri Perlis	8	32.2				
3	KEDAH	Sik	Pertanian Batu Seketul	40	36.1				
4		Pulau Langkawi	Stesen Meteorologi Pulau Langkawi	40	31.9				
5		Kota Setar	Stesen Meteorologi L. T. Alor Star	40	33.8				
6		Kulim	Hosp. Kulim	7	34.7				
7	PULAU PINANG	Bayan Lepas	Stesen Meteorologi Bayan Lepas	8	34.1				
8		George Town	Kebun Bunga	9	34.3				
9		Seberang Perai	Stesen Meteorologi TUDM Butterworth	8	35.8				
10			Stesen Meteorologi Pencemaran Udara Prai	22	35.8				
11	PERAK	Kinta	Hosp. Bahagia	9	35.2				
12			Stesen Meteorologi L.T. Ipoh	8	34.9				
13		Kuala Kangsar	FELDA Lasah	8	37.1				
14		Hulu Perak	FELDA nenering 2	10	35.1				
15	SELANGOR	Kuala Selangor	Tennamaran Estate	8	32.5				
16	NEGERI SEMBILAN	Port Dickson	Salak Estate-Sillau	14	30.4				
17	PAHANG	Maran	FELDA Jengka 14	15	32.4				
18		Raub	Pertanian Gali Raub	8	32.7				
19		Pekan	FELDA Chini 2	7	31.5				
20	SABAH	Kota Kinabalu	Stesen Meteorologi L.T.A. Kota Kinabalu	9	32.7				
21		Nabawan	Salong	9	33.4				
22		Tuaran	Tuaran-Mensilau	9	31.5				
23		Kudat	Stesen Meteorologi L.T. Kudat	7	30.6				
24			Pulau Bagan		10	31.0			

Heatwaves status in January 2020

HEATS Model



- ❑ Model HEATS Forecast limited to 3 days
- ❑ Model simulate less temperature than observation
- ❑ Longer dry spell, no moisture to develop cloud and rain
- ❑ Slight rain can terminate the heatwave episode
- ❑ Short and repetitive heatwaves, complicated the disaster management, e.g. school closures

APRIL 11, 2016

Heatwave shuts more than 250 Malaysian schools: reports



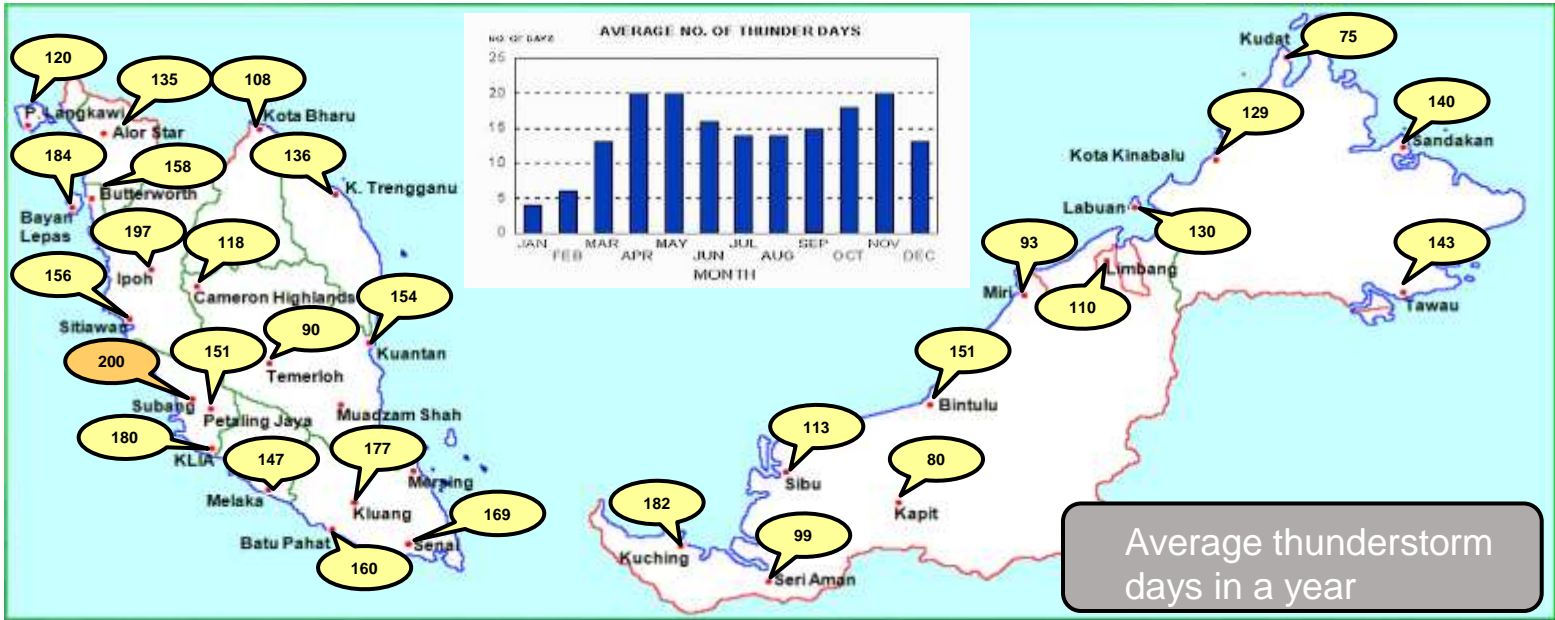
Heatwaves status in April 2016

Malaysia's Meteorological Department says the current heatwave is expected t...

More than 250 Malaysian schools were closed on Monday due to a heatwave brought on by the El Nino weather phenomenon

Challenge: Reliable Forecast

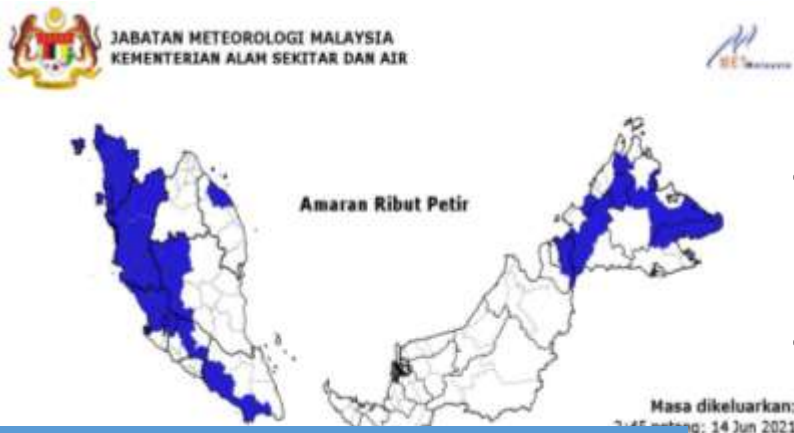
Thunderstorm Development less than an hour
Case: Thunderstorms can be accompanied by violent showers (>50mm/hr) and strong winds (>100km/hr)



Three people were killed over Cameron Highlands; 14 Oct. 2018



Lightning strikes cause a large fire at Petronas oil storage depot, in Pasir Gudang (April 28, 2006)



Thunderstorm warning on 14 Jun 2021

- Thunderstorms can be accompanied by violent showers (>50mm/hr) and strong winds (>100km/hr)
- Rapid formation of thunderstorms and uncertain location make it difficult to forecast thunderstorm
- Weather model unable to simulate strong wind that associated to thunderstorm

Challenge: Reliable Forecast

Types of Warnings / Alerts

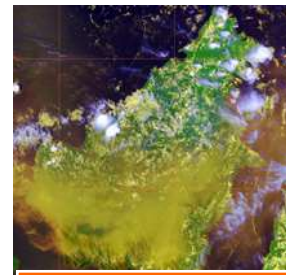
Haze / Forest Fire

Strong winds / Rough Seas

Monitoring

API index

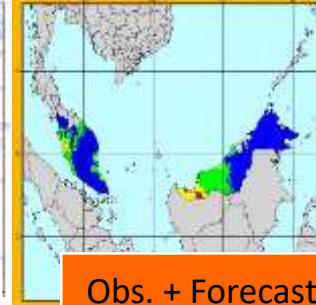
Obs. DOE



Hot spot & Low visibility



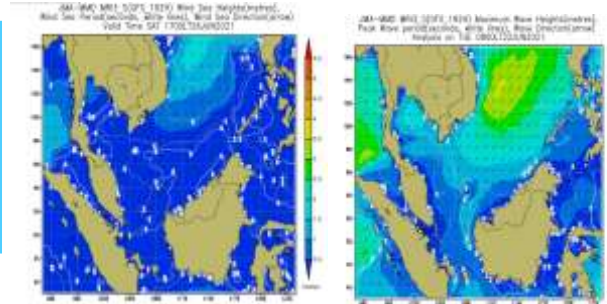
Forecast Hysplit & sub-seasonal



Obs. + Forecast FDRS



Tide Gauge



Marine Model

Challenges

- FDRS and trajectory forecast limited to 3 days
- Cloud seeding when API > 200
- Prohibition of open burning
- Difficult to extinguish peat forest fire
- Not seamless sub-seasonal forecast

- Observational data from other agencies.
- Depend on NWP model for forecasting
- Limited source data, especially remote sensing data.

Challenge: Reliable Forecast

Types of Warnings / Alerts

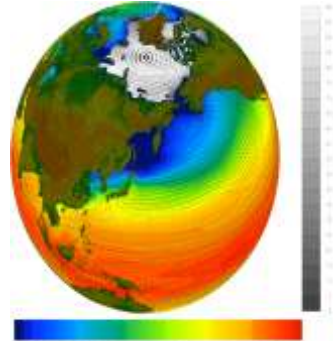
Monitoring

Challenges

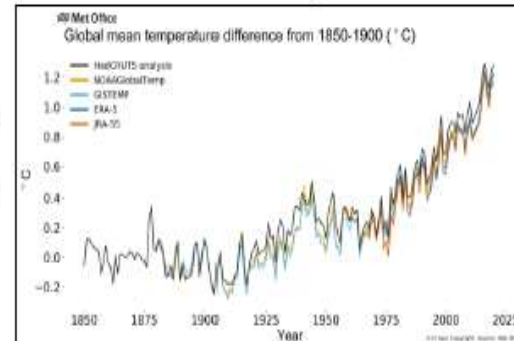
Climate Change



GHG monitoring



Climate Model



Climate Trend

- Covid-19 lockdown: almost no impact on GHG concentrations and temperature
- High level uncertainty to climate projections
- Understanding the impact of GHG on local temperatures + rainfall

Integrating Extreme Weather Warnings into Disaster Risk Reduction

Disaster Risk Reduction emphasizes protection through mitigation, preparedness and **monitoring, prediction and early warning**. There is no doubt that the role of relief assistance during the crisis will remain important and need to be enhanced at all levels. However, much greater intention will need to be given to **preventive strategies that can be contribute to saving lives and protection assets before they are lost.**

Conclusion

Extreme events such as heatwaves, haze/forest fire, flash flood, severe storms and strong winds have become more prevalent over the recent years in Malaysia. The socio-economics impacts of these extreme events have been a cause for concern for the country. The ability to deliver early notification of extreme weather events through an effective weather monitoring, warning and forecasting system are needed.

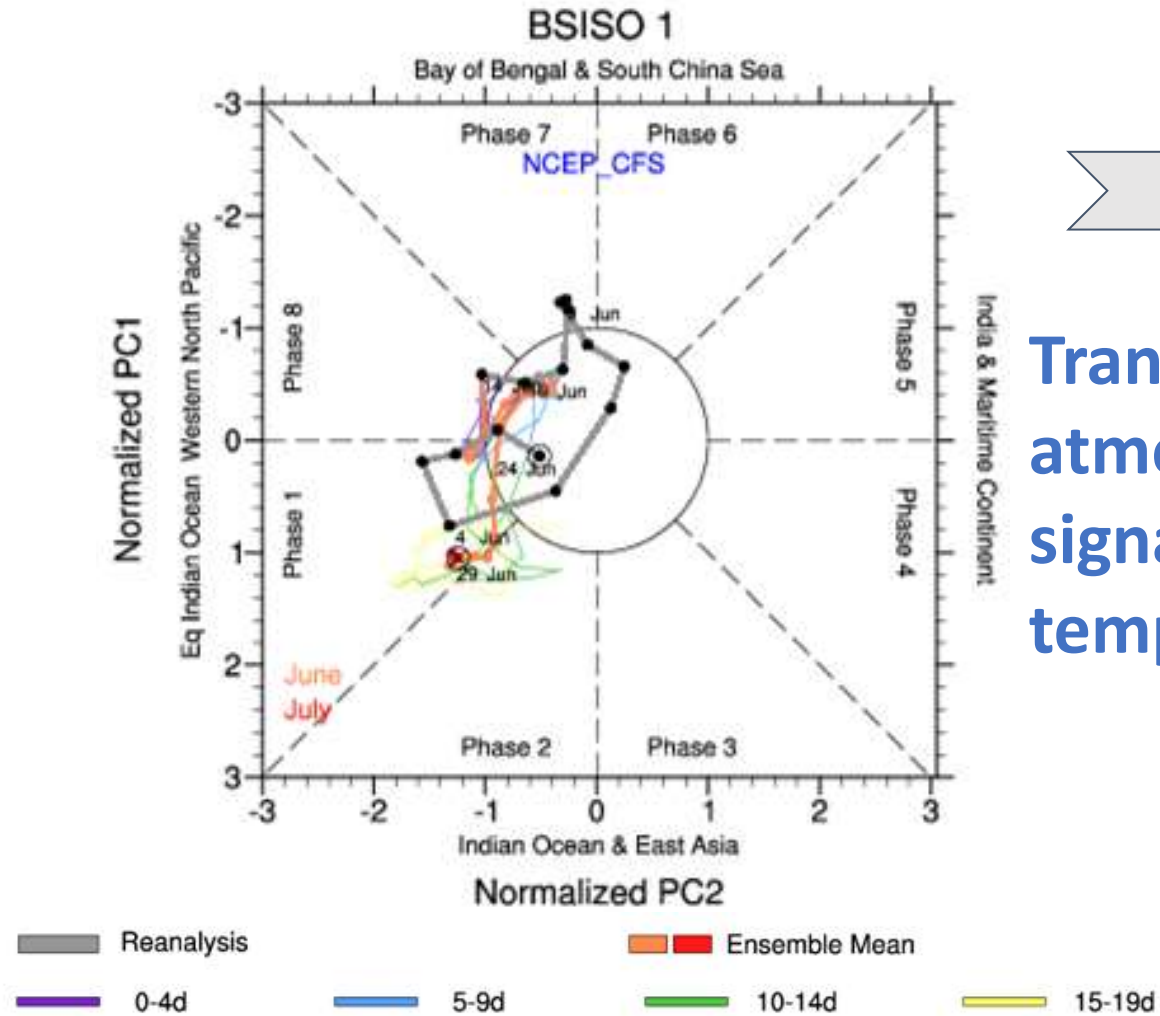
The accuracy and effectiveness of severe weather warnings has led to reduction in loss of lives and properties during weather related disasters. The accuracy and effectiveness of early warning system can be enhanced by:

- improved scientific understanding
- improved technology and modelling
- increased community awareness

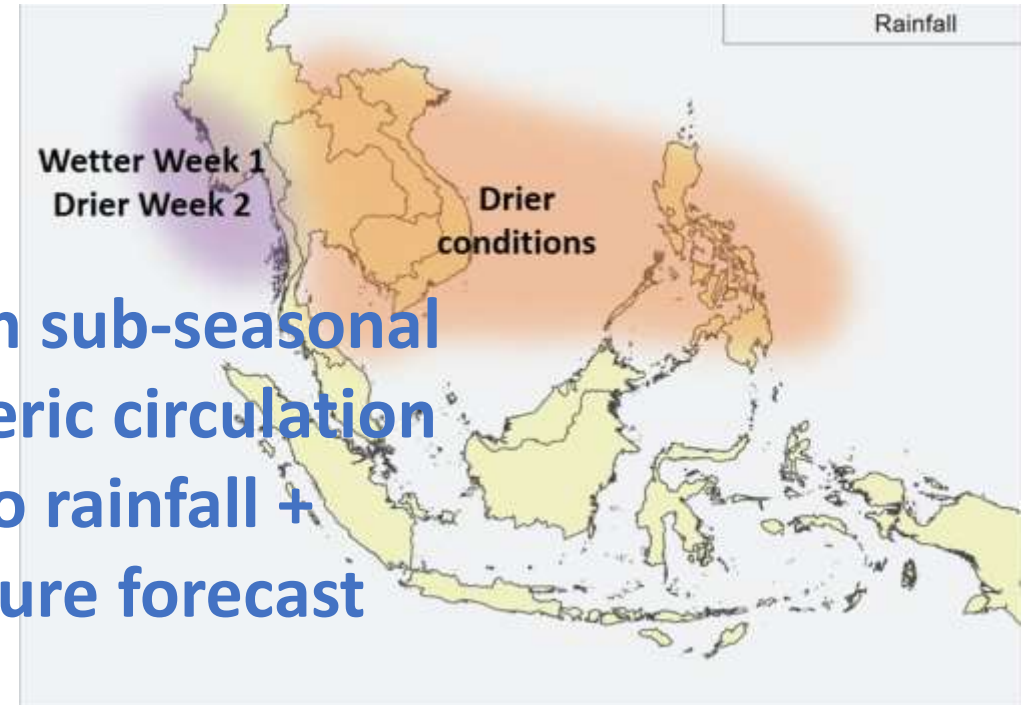
MMD's needs on climate information services from APCC

MMD's needs on climate information services from APCC

Seasonal Forecast - Capacity Building



Transform sub-seasonal atmospheric circulation signal into rainfall + temperature forecast

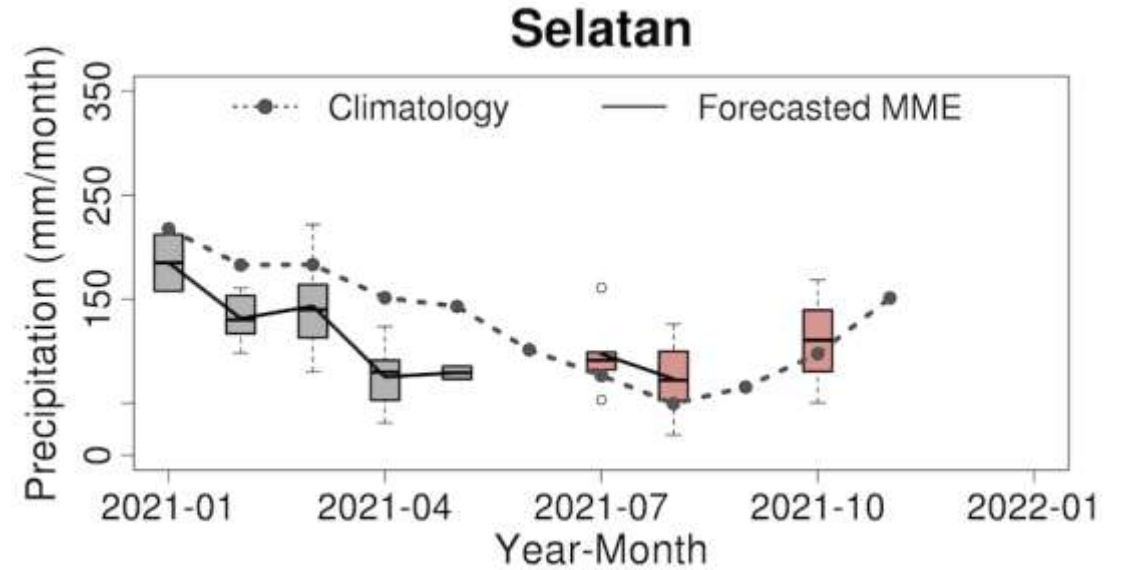
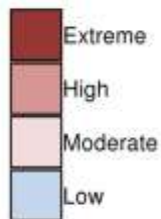


- No MJO during boreal winter
- Impact of BSISO / MJO on rainfall
- Understanding of BSISO

MMD's needs on climate information services from APCC

FDRS - Integration/complement with Southeast Asia FDRS

Probabilistic Forest Fire Forecast (issued : 2021-05) for 2021 : AUG-OCT



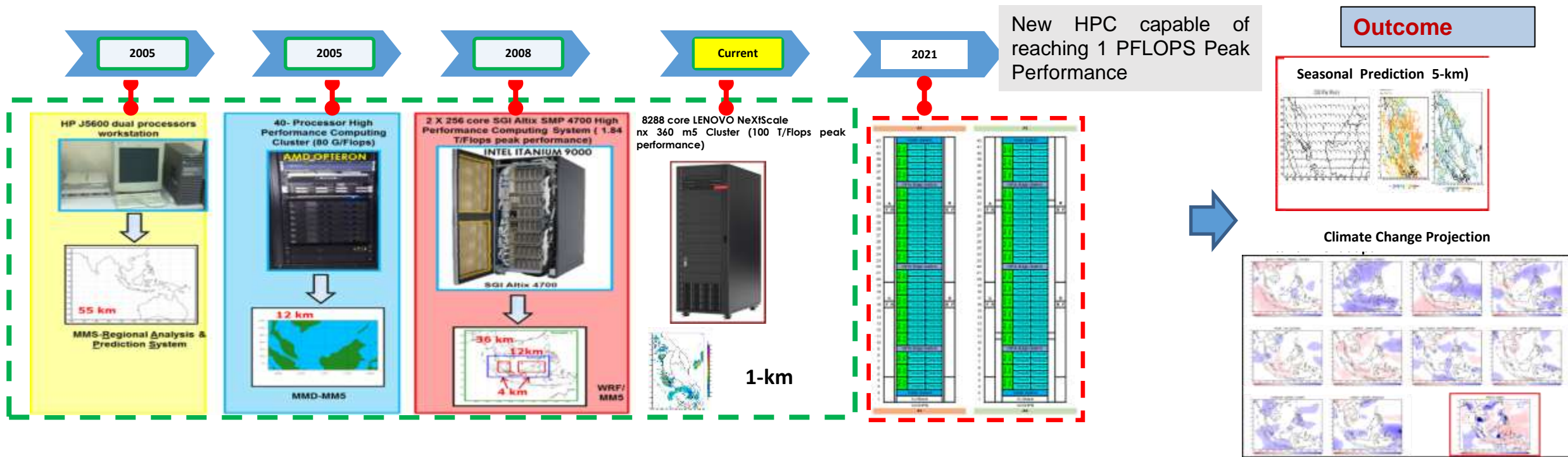
- Probabilistic forecast not available over other region
- Integration with Southeast Asia FDRS to include seasonal probabilistic forecast
- Understanding of APCC Fire and Haze EWS
- More info on map for location of High and extreme
- Include hot spot, MJO and ENSO information
- Weakly forecast
- Update information on monthly basis
- Explanation on which indicator of FDRS (FWI/FFMC/DC)

MMD's needs on climate information services from APCC

Climate Modelling - Capacity Building / Collaboration

Boundary condition use to downscale to 5-km or higher resolution for seasonal forecast

CMIP6 with SSP scenarios downscale to 5-km or higher resolution for climate projection



Thank You

End-to-end Early Warning System

