

Climate Change & Extreme Weather Events Monitoring

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SCOPE

- Weather & Climate**
- Climate Change**
- Monitoring of Extreme Weather Events**
- Concluding Remarks**



Weather & Climate

Weather

Weather is atmospheric condition over a particular location

- ▶ Precipitation
- ▶ Temperature
- ▶ Wind
- ▶ Sky condition

Climate

Climate is averaged weather over a period of time

▶ Tropical maritime climate with:

- **uniform temperature**
- **high humidity**
- **rainfall throughout the year**

▶ The seasons:

- **Northeast Monsoon (*Nov – Mar*)**
- **Southwest Monsoon (*June – August*)**
- **Two Inter-Monsoon (*Apr-May & Sept-Oct*)**



Climate Change

Climate Change

Climate change refers to change in the statistics of weather

- Change in mean state
- Change in variability
- Change in Extremes

Climate Change - Causes

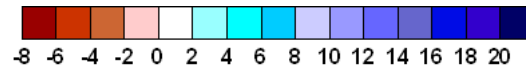
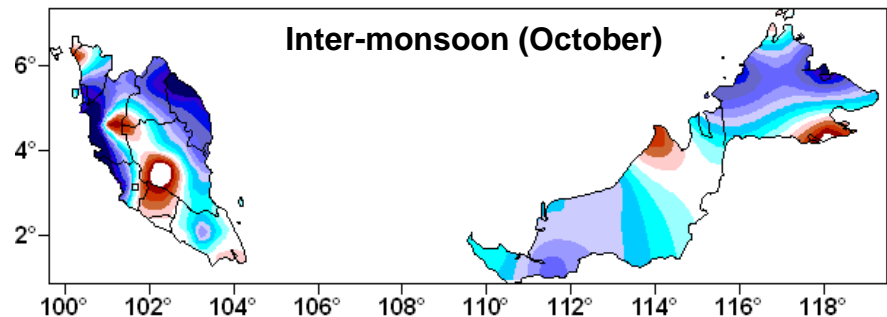
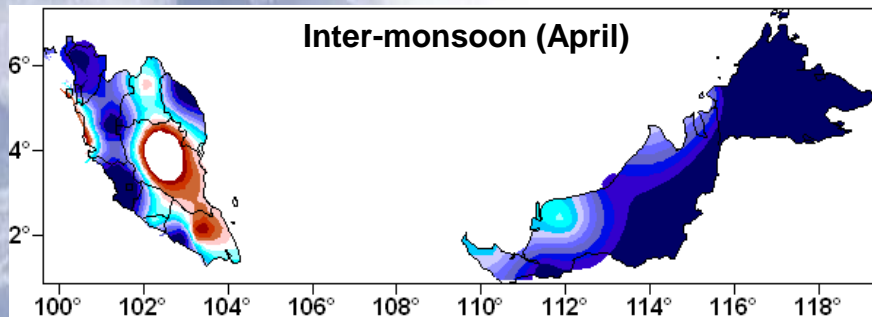
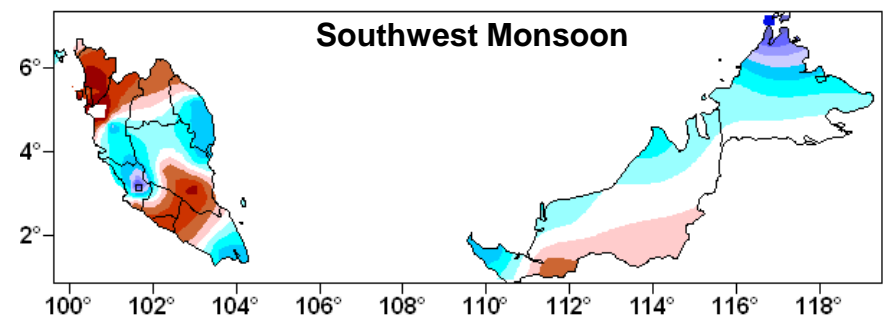
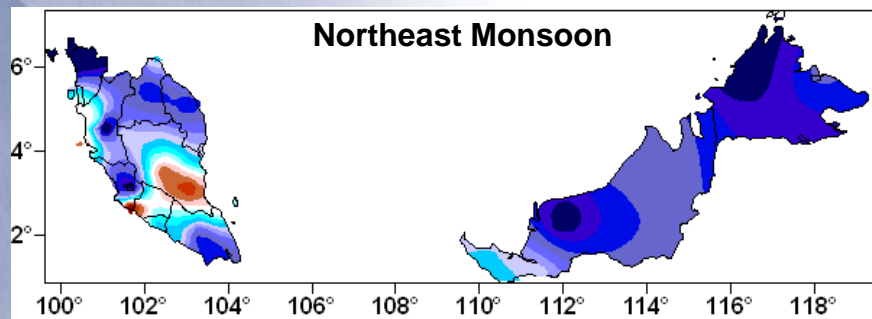
Natural

- ▶ Low frequency variability of the earth system
- ▶ Solar activity

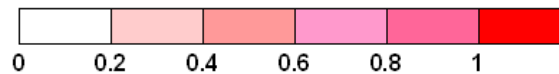
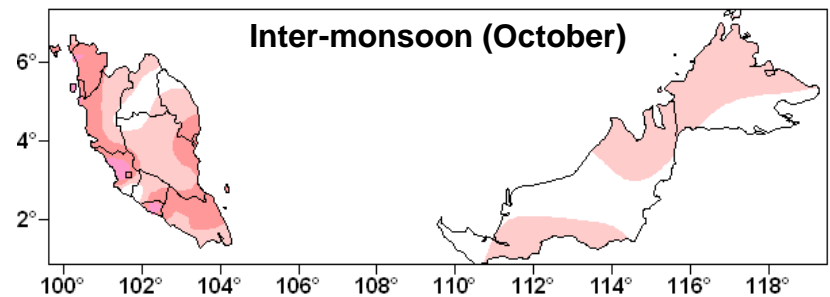
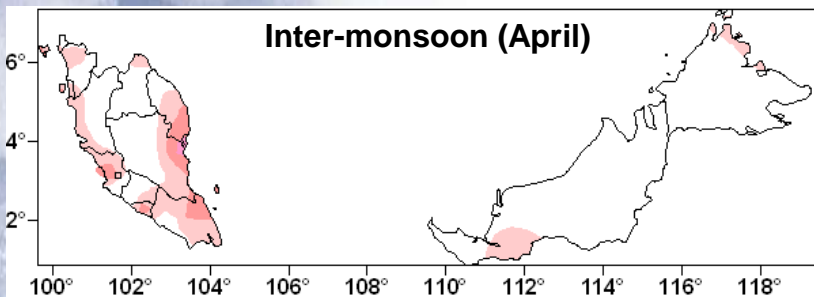
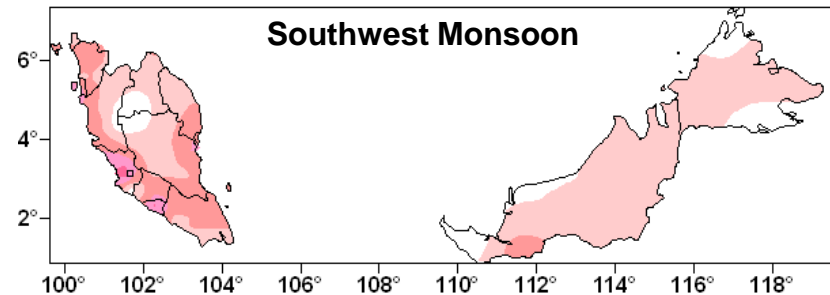
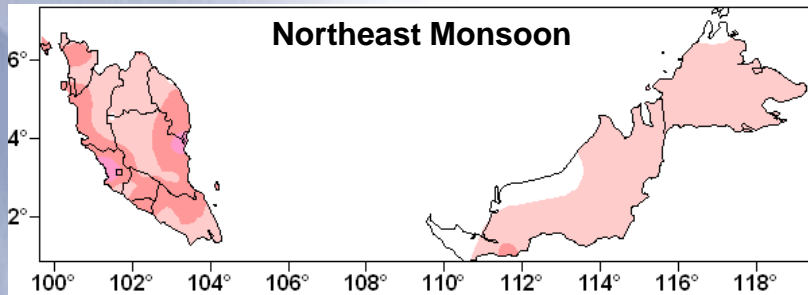
Human Caused

- ▶ Population growth
- ▶ Land use change
- ▶ GHG emissions

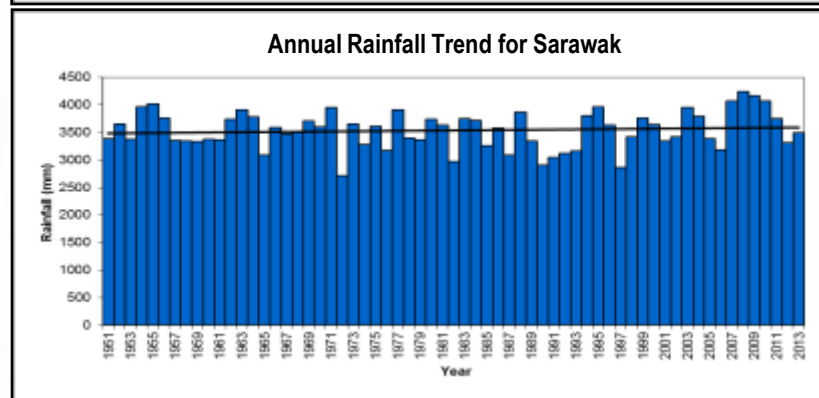
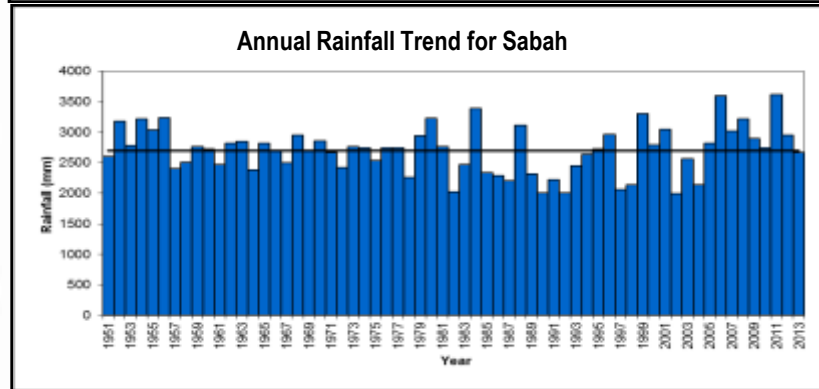
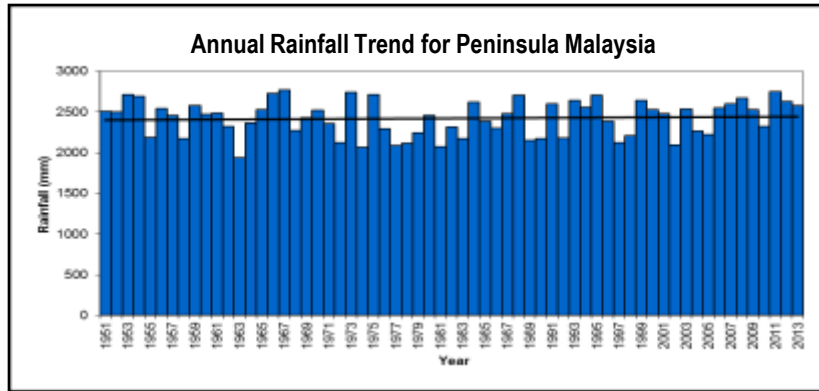
Percentage Change in Seasonal Rainfall between the Periods 2000-2011 and 1970-1999 (baseline)



Change in Seasonal Temperature between the Periods 2000-2011 and 1970-1999 (baseline)

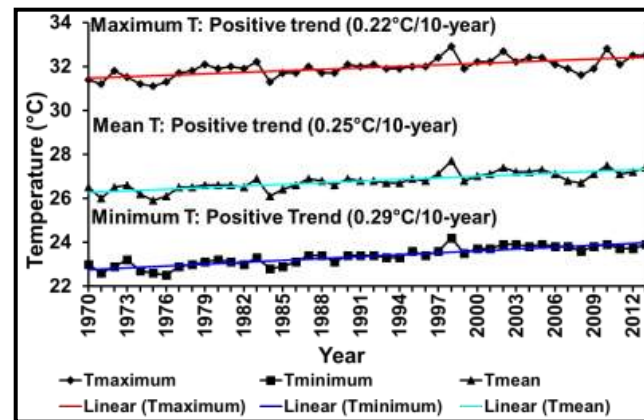


Annual Rainfall Trend

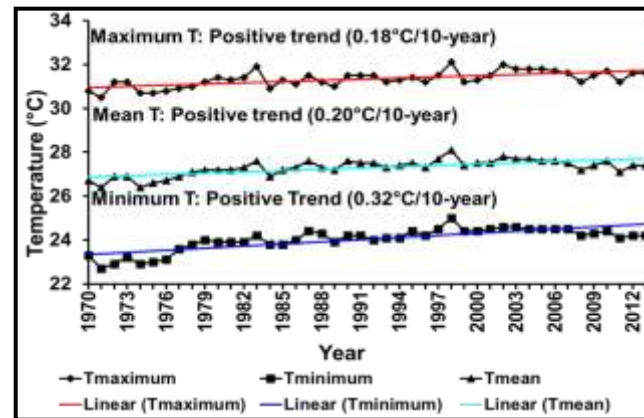


No significant trend

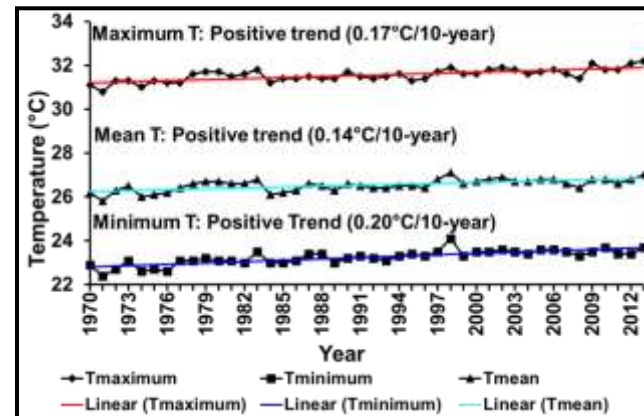
Peninsular




Sabah



Sarawak



Annual Temperature Trend



Monitoring of Extreme Weather Events

Climate Change Consequences

Extreme weather events are becoming more common

- ▶ Floods
- ▶ Droughts
- ▶ Extreme temperature

Sea-level rise

- ▶ thermal expansion of the oceans
- ▶ loss of land-based ice due to increased melting



Weather Monitoring

- ▶ Surface Observations
- ▶ Upper-Air Observations
- ▶ Radar Observations
- ▶ Satellite Observations
- ▶ Marine Observations

Meteorological Stations



Satellite & Radar Stations

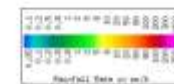
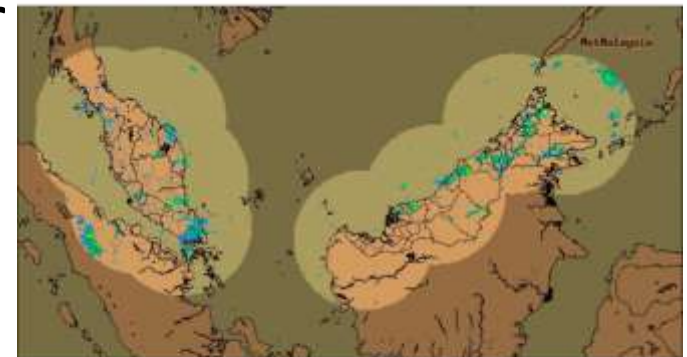
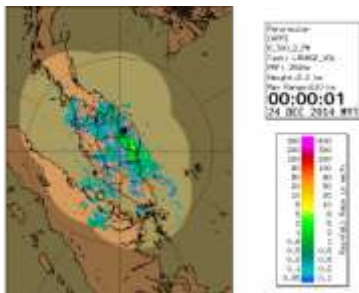


Radar Stations

One Doppler radar at KLIA

▶ 11 other are conventional radars with Doppler capability

Plan to add more radars in future to provide better early warning for severe weather

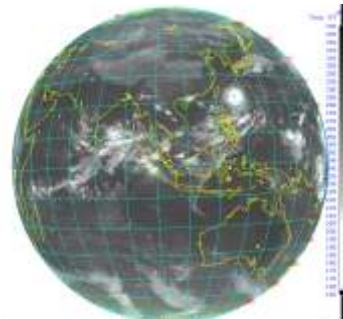
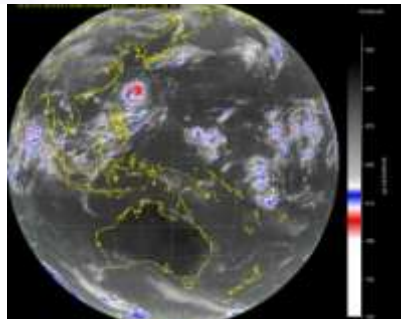
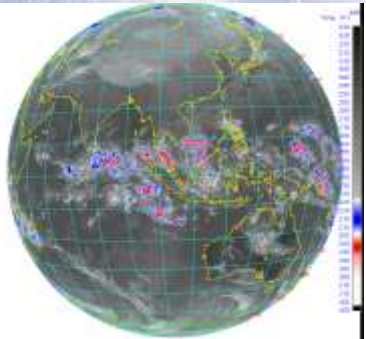


Weather Satellite Receiving Station

Receives **Geostationary Meteorological Satellite** images from

- ▶ the Japan Meteorological Agency (JMA)
 - MTSAT-2 (Himawari 7)
- ▶ the China Meteorological Administration (CMA)
 - FY-2G

for weather monitoring & forecasting operations



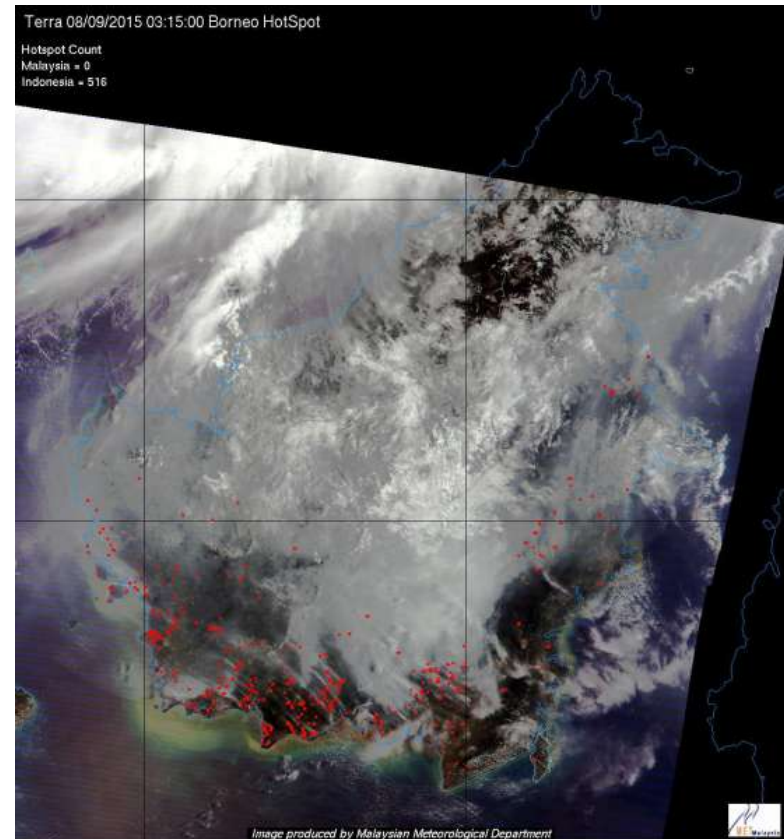
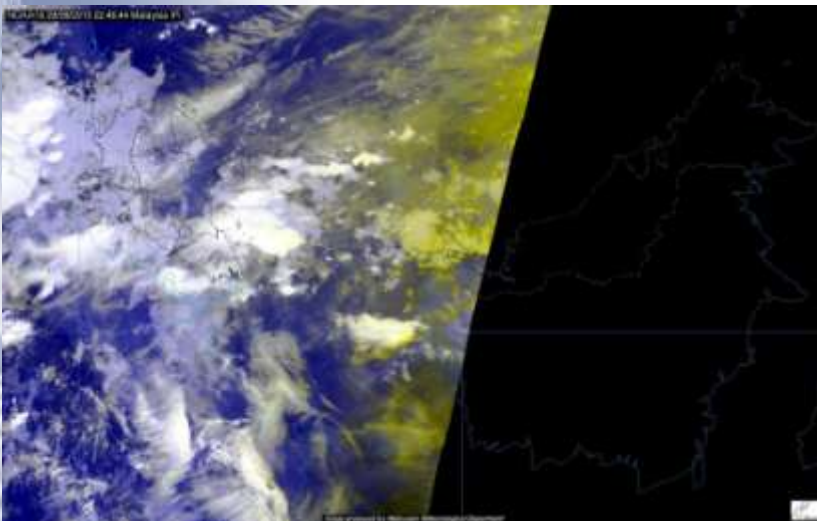
Weather Satellite Receiving Station

Receives **polar-orbiting satellite** images from

▶ the USA

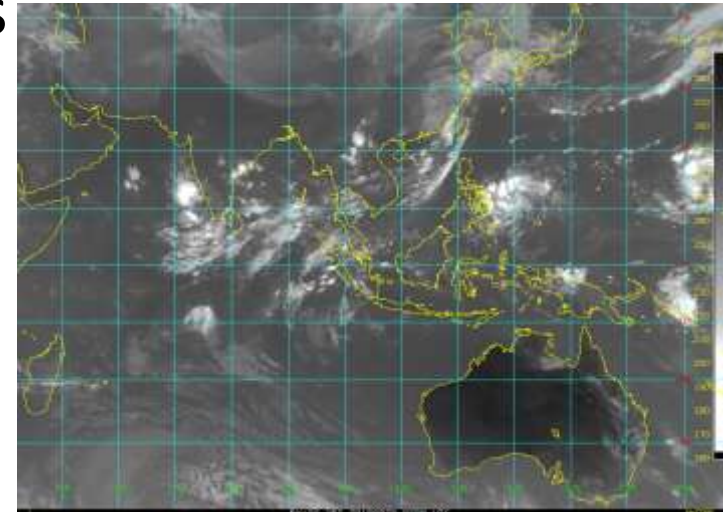
- NOAA-18, NOAA-19
- MODIS (Terra and Aqua)

for environmental monitoring



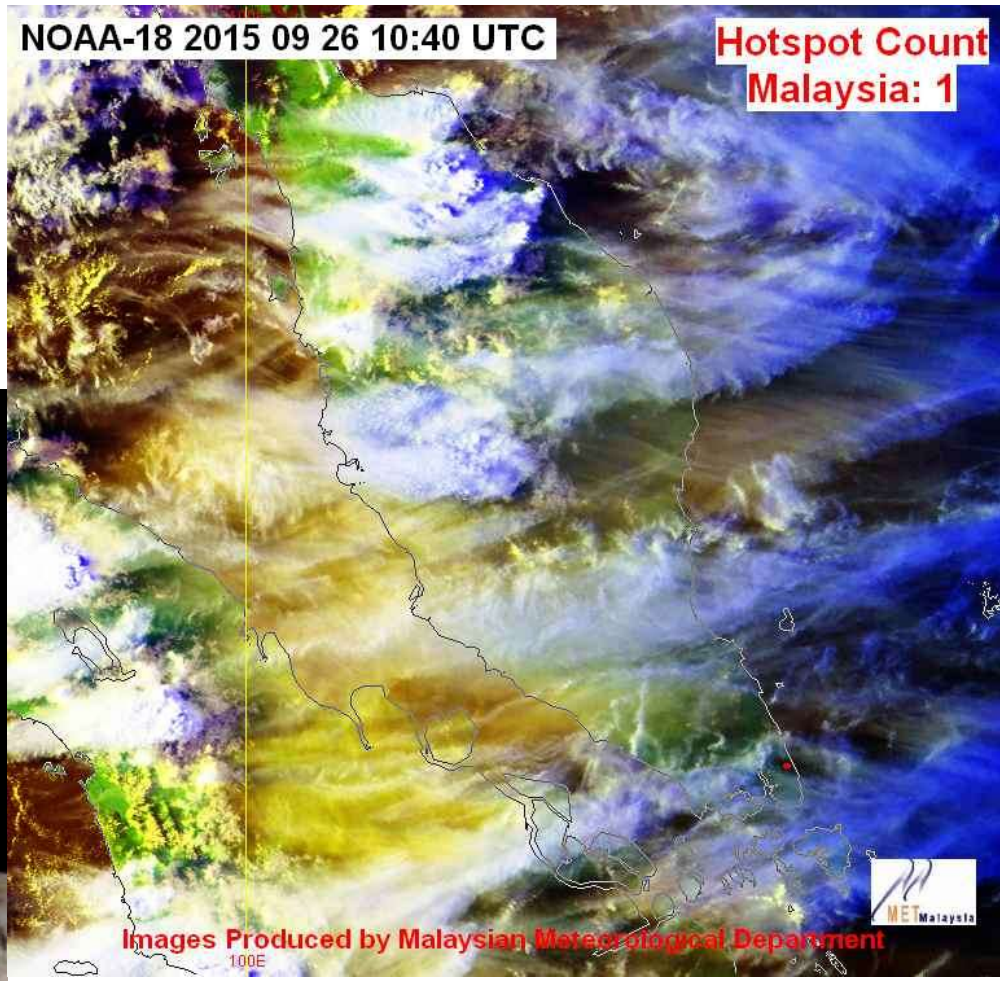
Satellite Images also for

- ▶ hotspot monitoring
- ▶ sea surface temperature
- ▶ cloud top height
- ▶ Normalized Difference Vegetation Index (NDVI)
- ▶ rainfall estimation
- ▶ satellite sea level observations



NOAA-18 2015 09 26 10:40 UTC

Hotspot Count
Malaysia: 1



Images Produced by Malaysian Meteorological Department

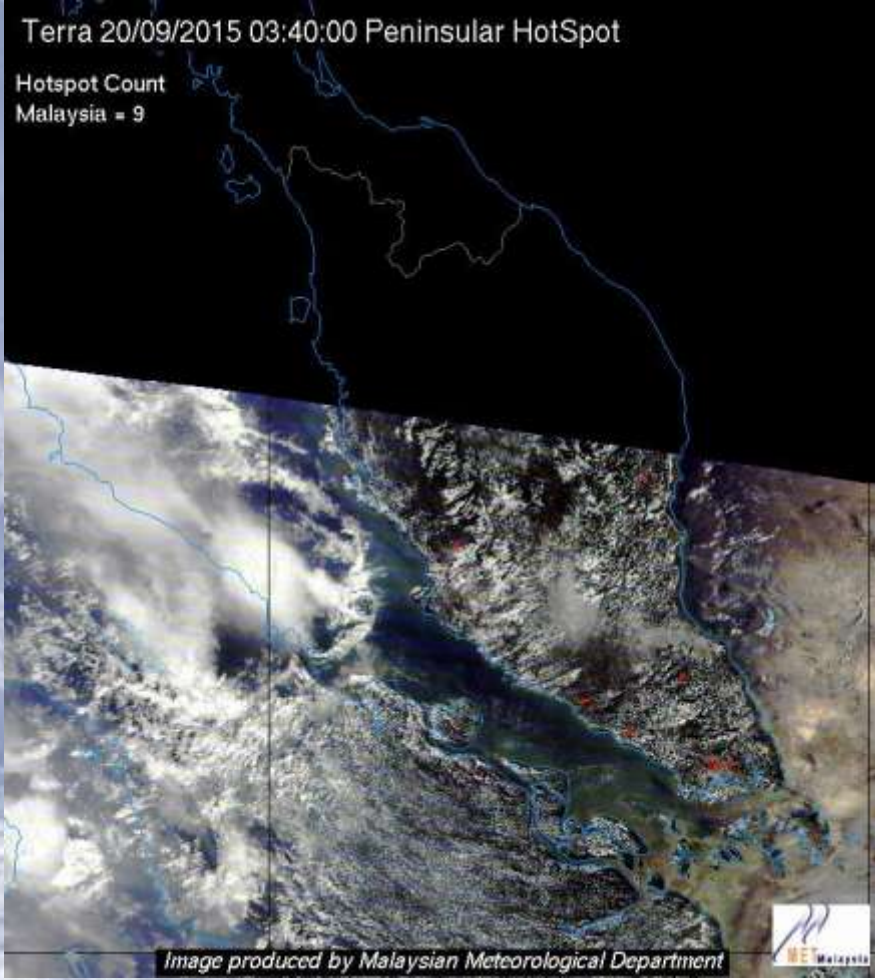
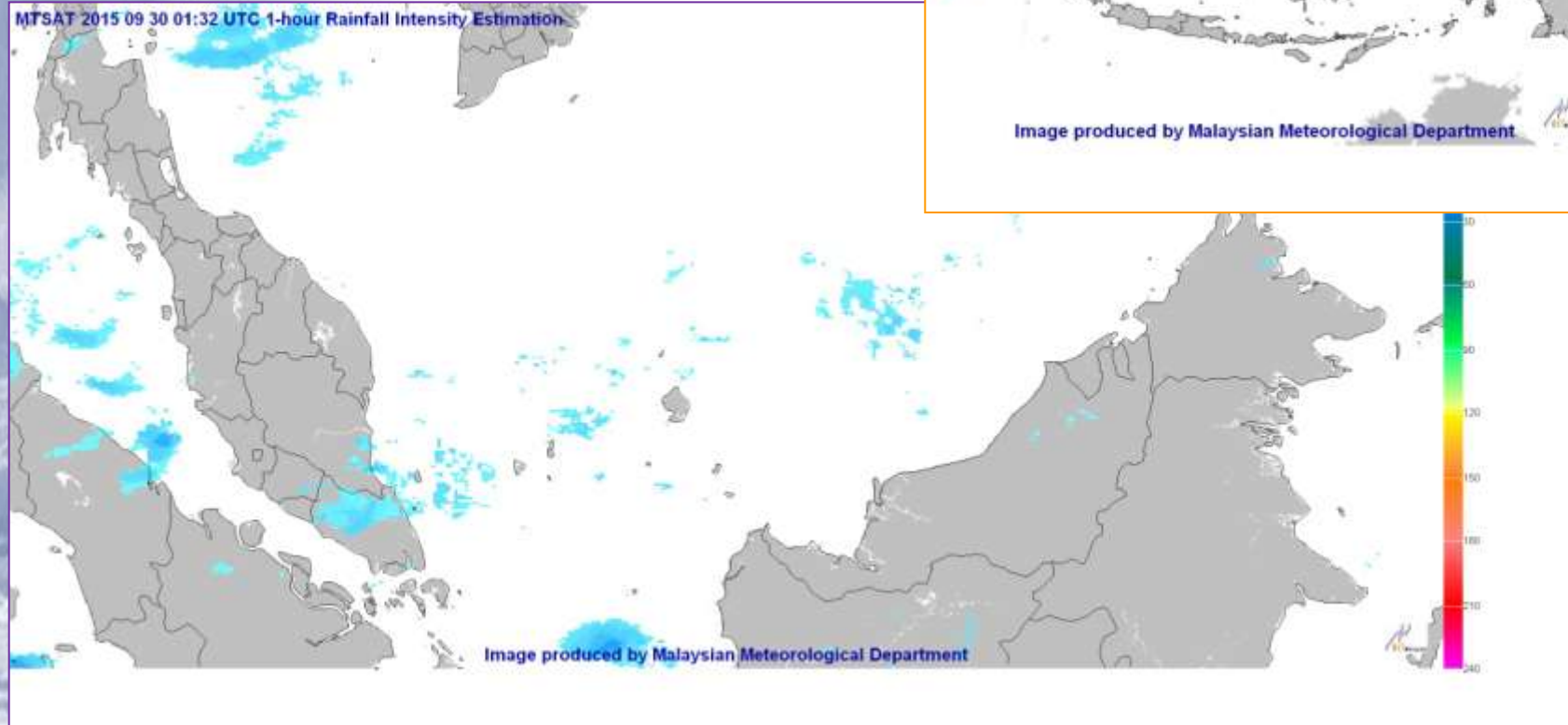
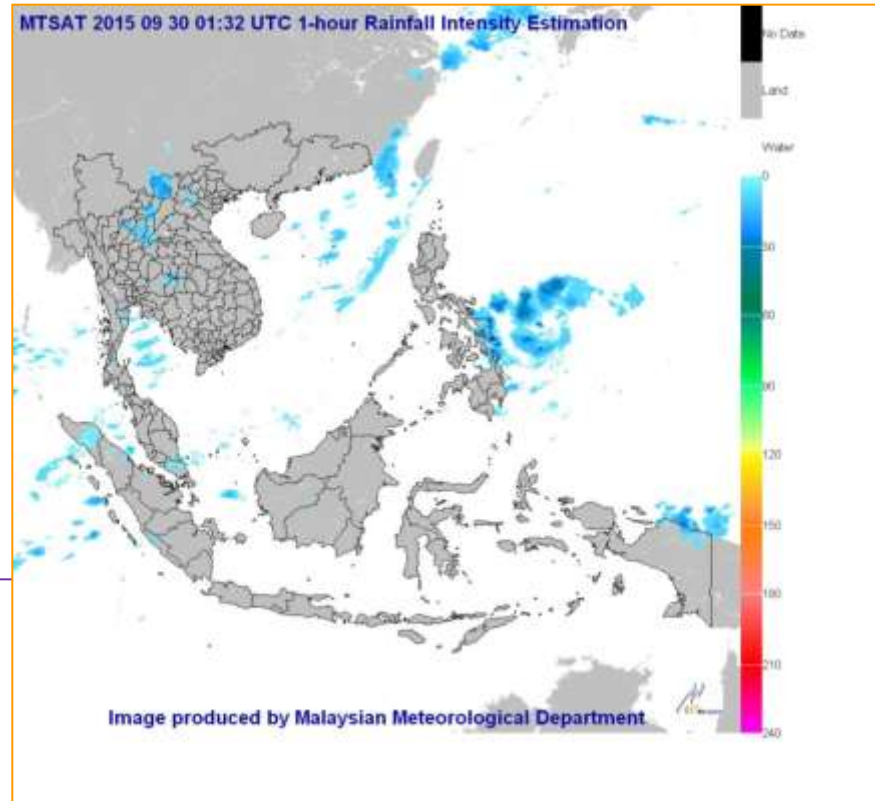


Image produced by Malaysian Meteorological Department

Hotspot Monitoring

Rainfall Estimation



Weather Monitoring & Early Warning Systems



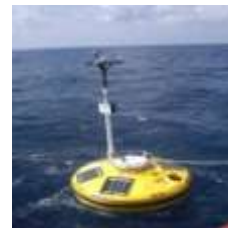
Radar Station



Surface Observation Station



Tide Gauge Station



Tsunami Buoy



Weather Camera

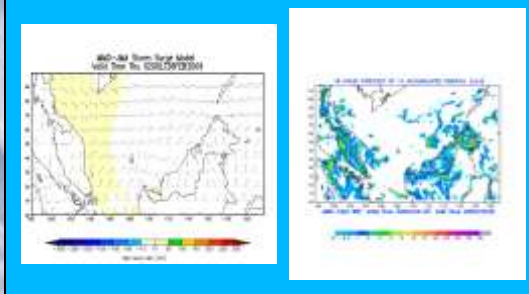
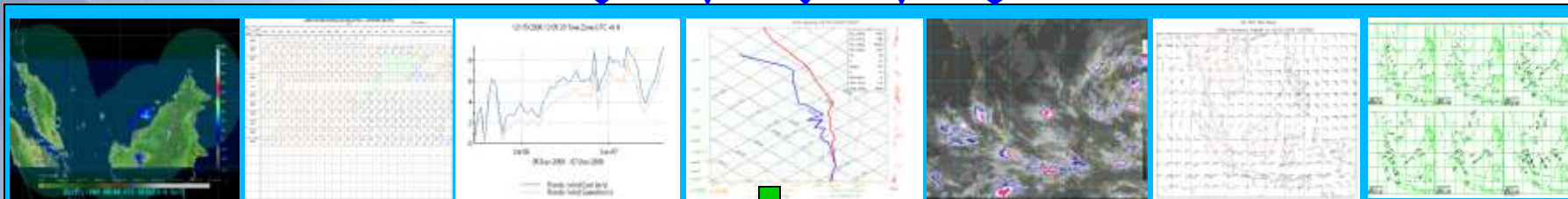


Upper-Air Observation

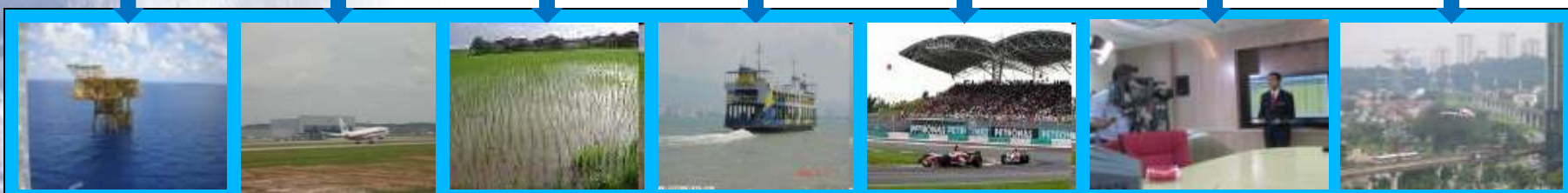
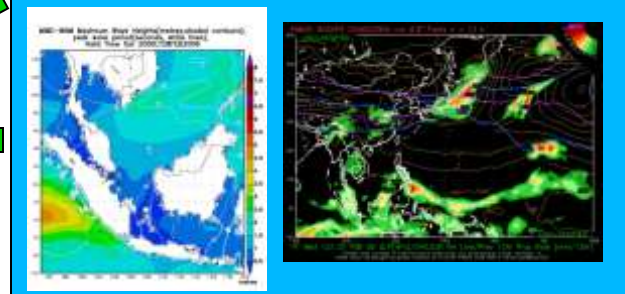


Satellite Earth Station

Computerised Processing & Numerical Weather Prediction



Disaster Early Warning Centre



Industry

Aviation

Agriculture

Ferry

Sports & Recreation

Mass Media

Transports



Concluding Remarks

Concluding Remarks

- ❑ Malaysia is experiencing climate change
- ❑ Climate change results in increasing in the frequency and/or severity of extreme weather
- ❑ Monitoring of extreme weather events can be improved by improving observing systems
- ❑ Satellite and radar are useful tools in multi-hazard early warning systems



Thank You