Flood Producing Extreme Rainfall Events Study in Malaysia

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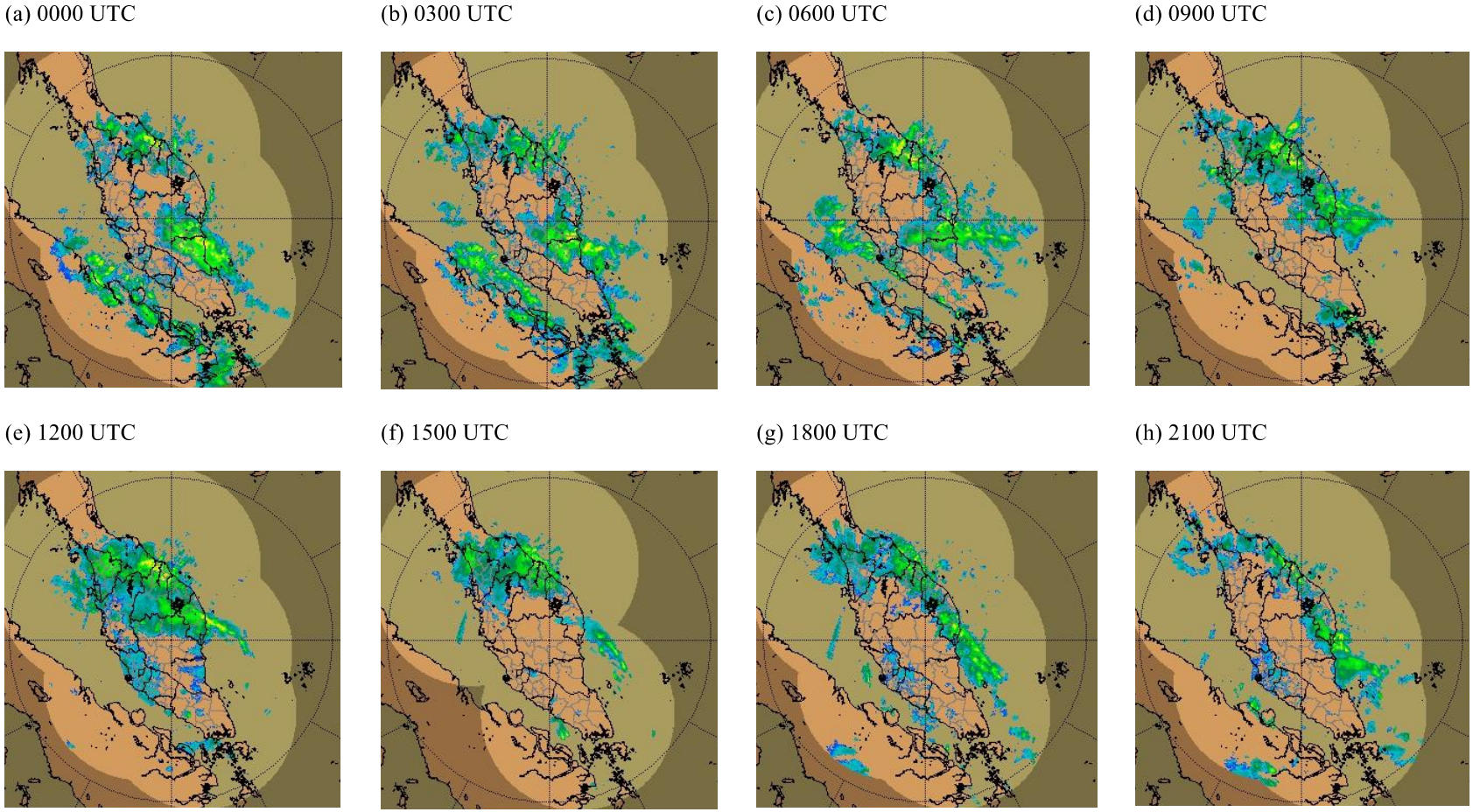
Introduction

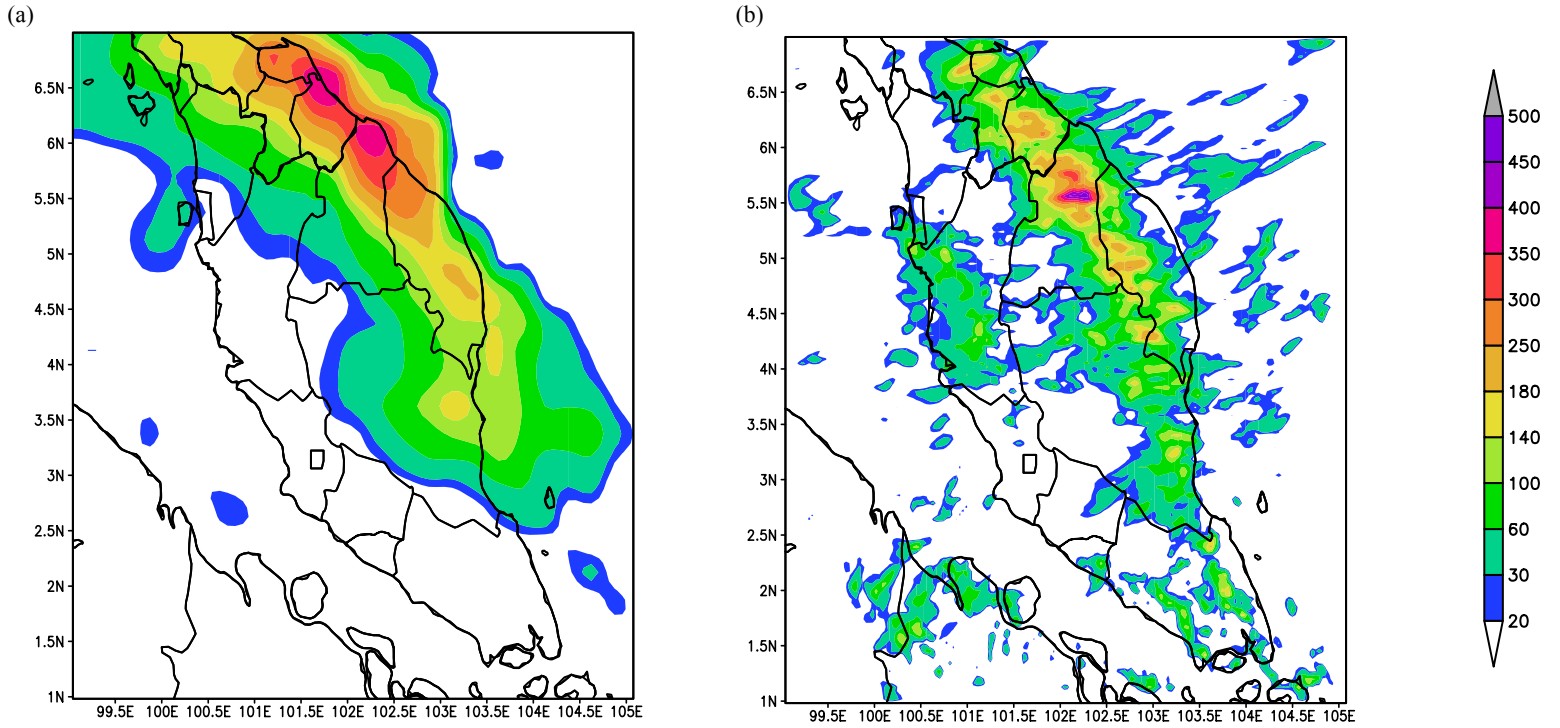
- Most high-profile flood producing extreme rainfall events in Malaysia can be associated to synoptic circulation modulated by large scale climatic signals (e.g ENSO, IOD, MJO).
- It is crucial to understand the underlying processes:
  - What are the roles of large scale and local forcings?
  - How does the warmer climate alter the probabilities of these events?
  - Has local changes augmented the severity of the extremes
  - etc.
- Need more test cases.
- In previous meeting, we have reported a case study of the extreme rainfall event on 17 December 2014 based on WRF simulation.

17 December 2014 Extreme Rainfall Events



Maximum intensification of rainfall could be seen between 0900UTC and 1200UTC

FIGURE. Rain rate (mm/hr) on 17 December 2014 from radar observation. (source: Malaysian Meteorological Department).



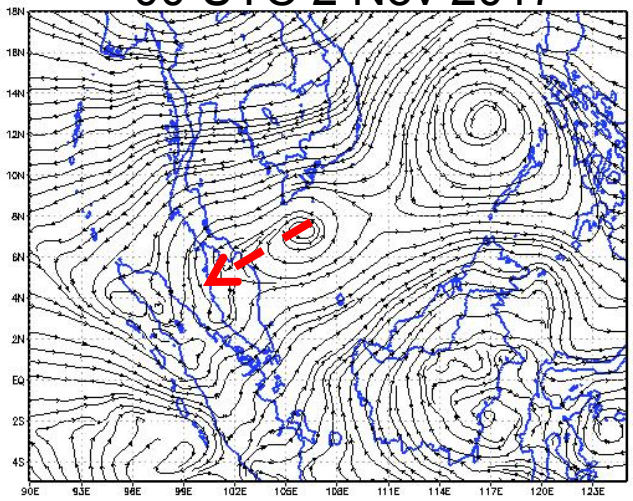
(a) The TRMM accumulated 24-hour rainfall (mm), (b) WRF simulation for EXP5 on 17 December 2014.

- The event simulation (intensity and location) is very sensitive to deep convection parameterizations.
- Kain-Fritch scheme for outer domains and no cumulus scheme used at the inner most domain produces the best result.

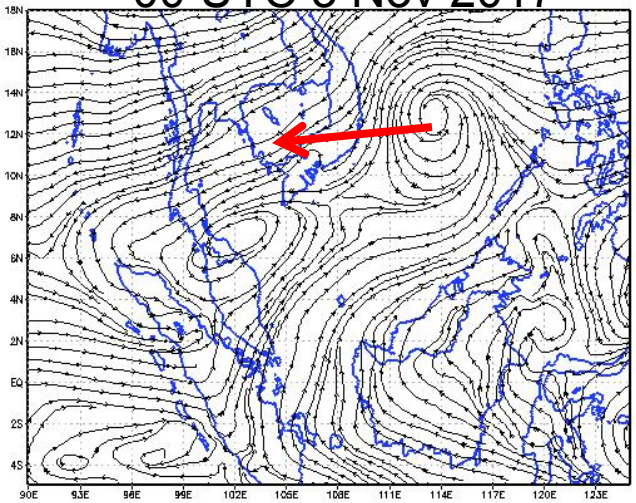
- More test cases are needed for us to understand various extreme rainfall producing mechanism at different part of Malaysia.
- For the DMCC case study, we plan to add another recent extreme rainfall case occurred along the northern west coast of Peninsular Malaysia on 4-5th November 2017.
- Following slides provide an overview of the event.

Synoptic winds overview (850 hPa)

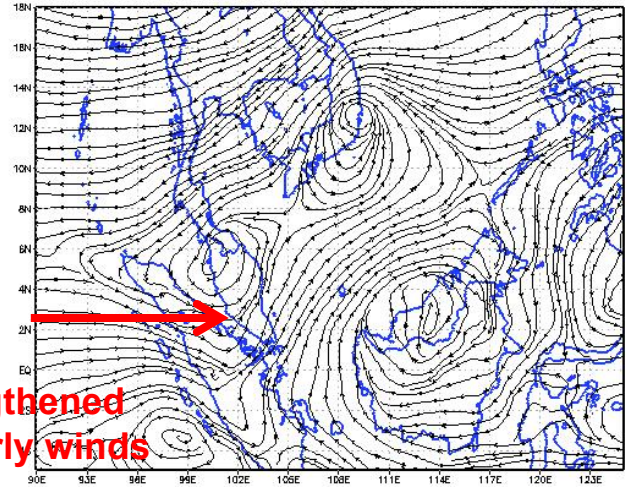
00 UTC 2 Nov 2017



00 UTC 3 Nov 2017

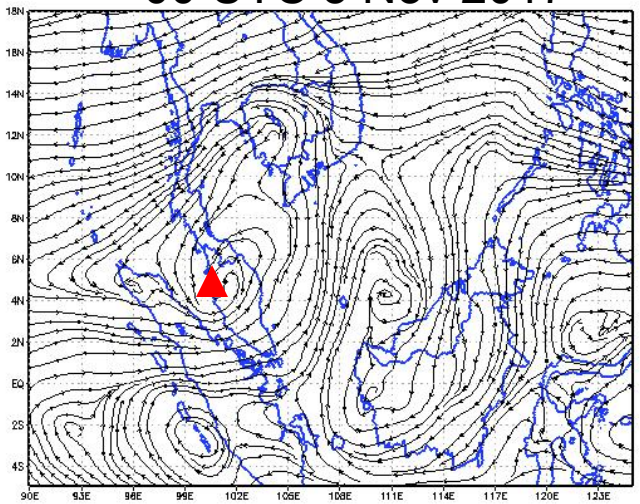


00 UTC 4 Nov 2017

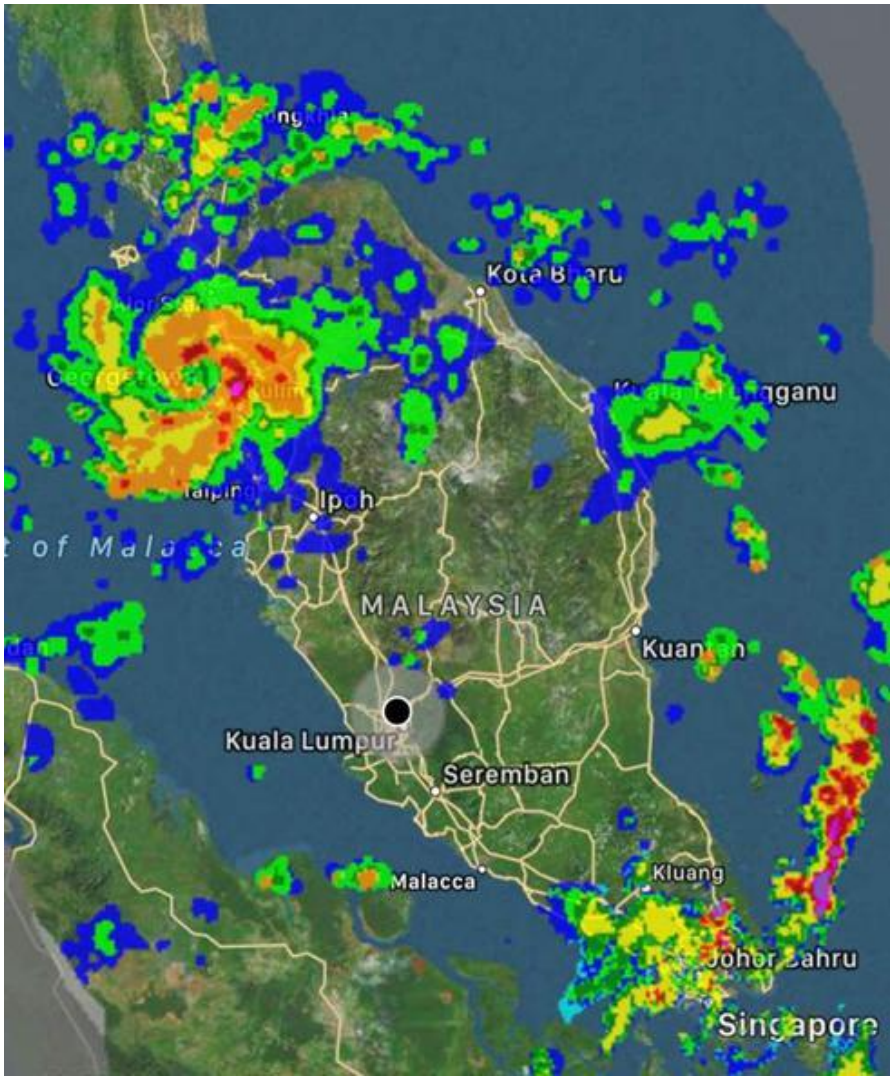


Strengthened westerly winds

00 UTC 5 Nov 2017



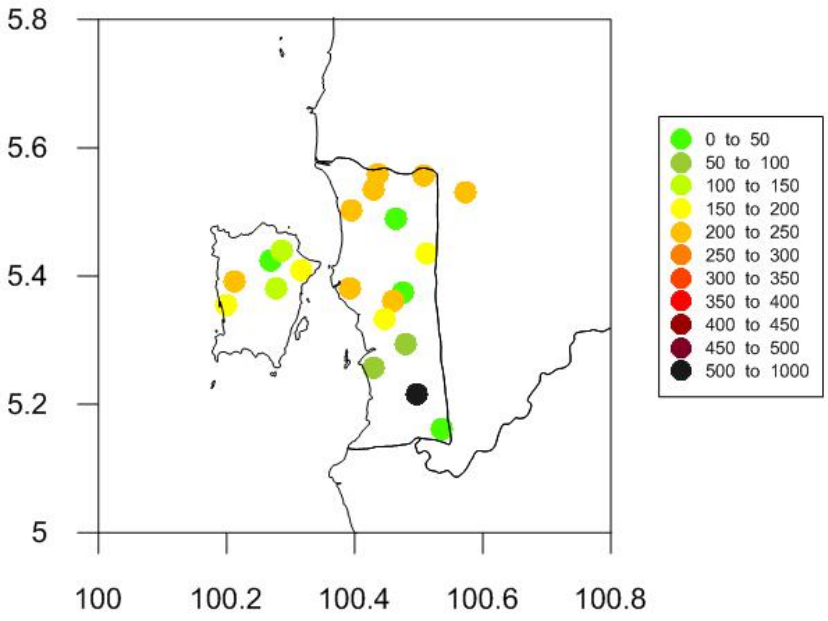
- The propagation of the low pressure vortex from Southern China Sea and the associated convergence fuel the moisture into the system.



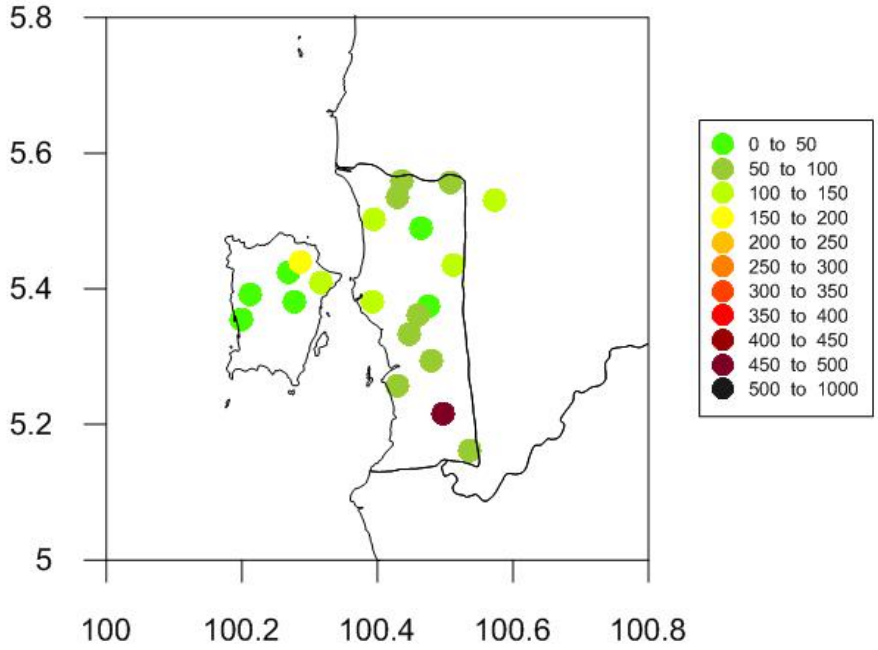
- Radar image taken during the peak of the event showing a a mesoscale vortex with intense rain band.
- Effected states: Penang and Kedah.

The daily rainfall.

4th Nov 2017

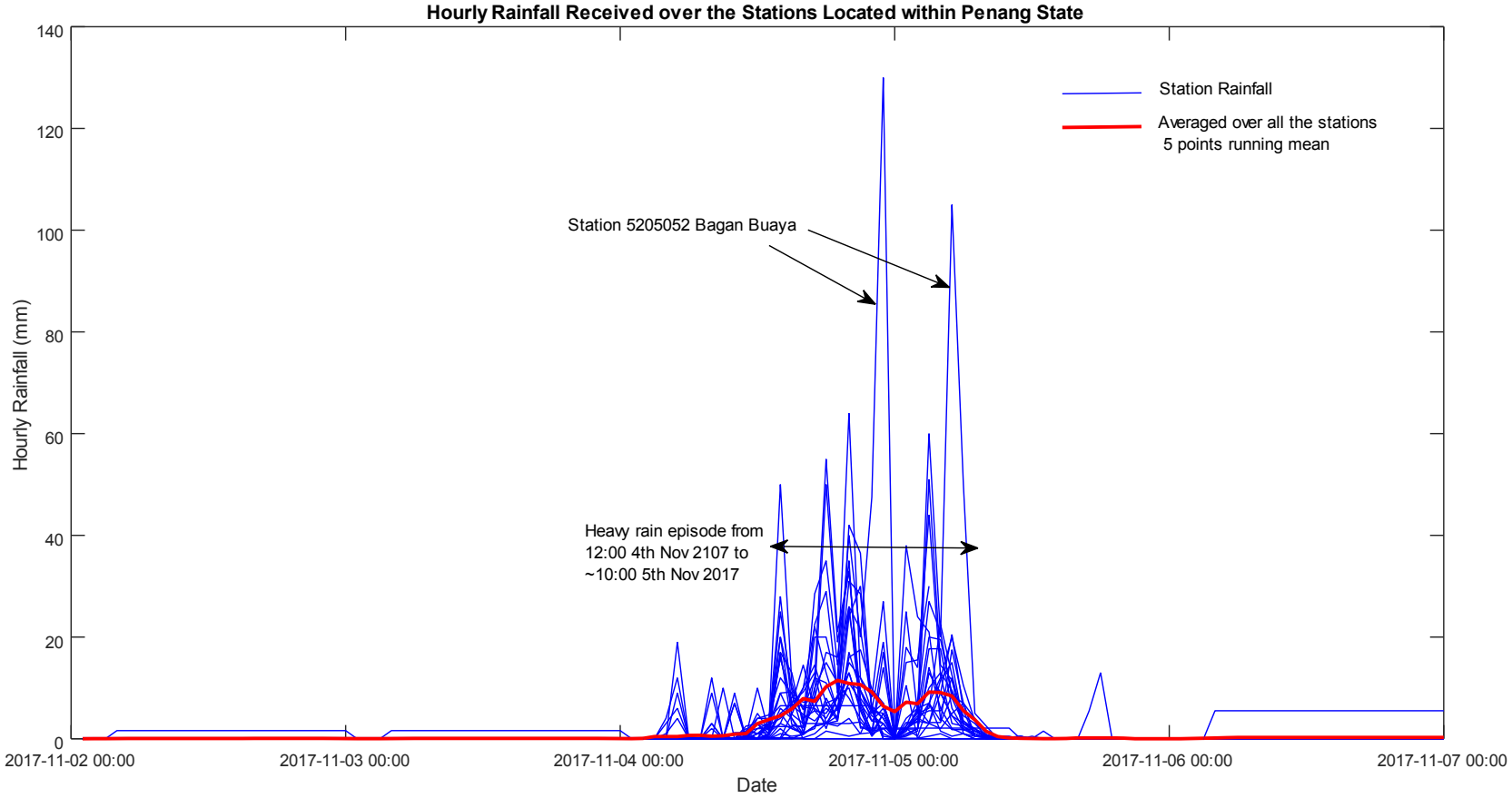


5th Nov 2017



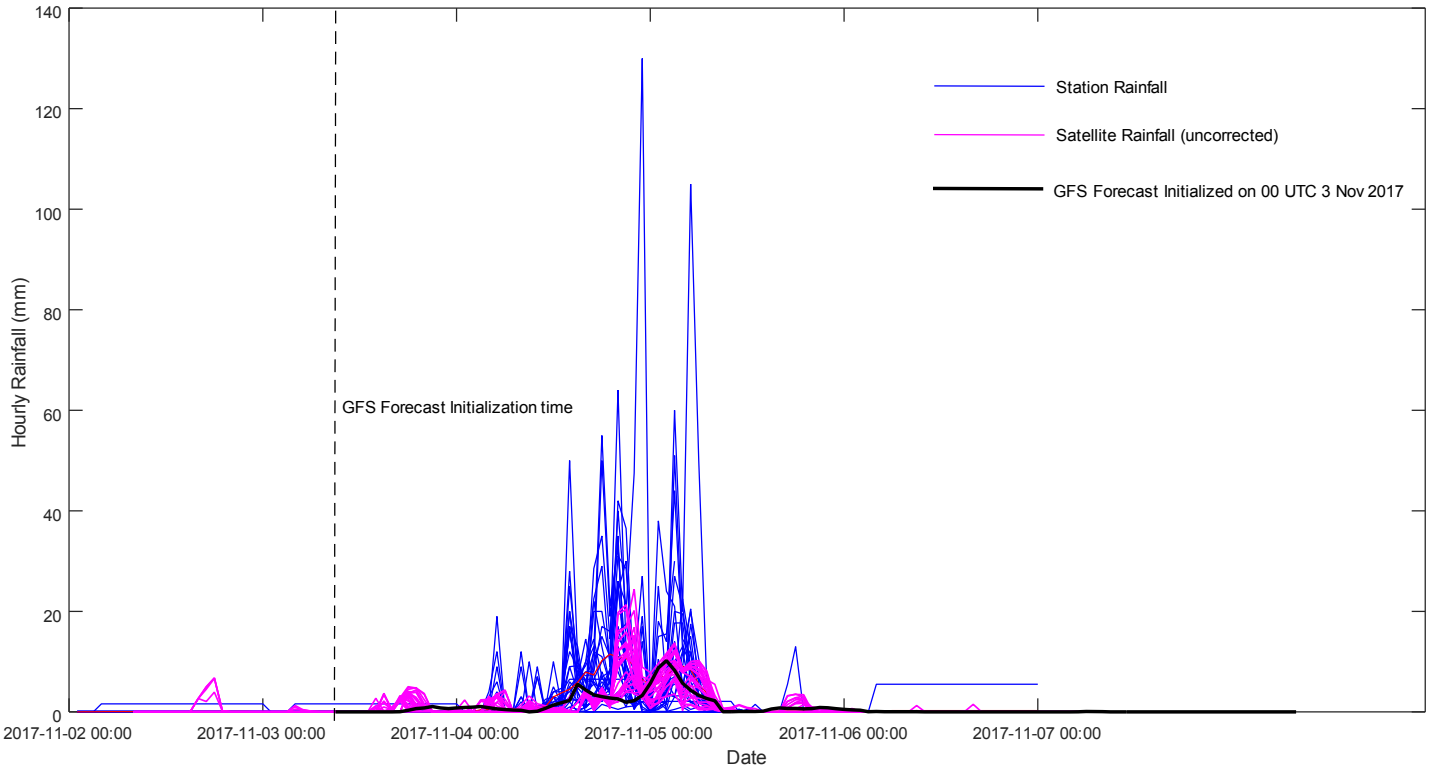
- 4th – Consistently larger rainfall over the northern part (200-250mm perday).
- Station Bangan Buaya (south) recorded largest rainfall (>450mm).
- This large value at Bangan Buaya extended to 5thNov 2017

The stations recorded rainfall



- The rainfall episode lasted about a day from the noon of 4th to morning 5th November 2017.
- The episode has 2 distinctive rainfall peaks, one at the night o 4th and the other during the morning of 5th.
- The largest recorded hourly rainfall > 100mm at Bagan Buaya.
- During the episode, most of the stations has recorded hourly rain rate of atleast 20-30 mm/hr.

Has the global model forecasted the event?



- Figure above shows comparison between station rainfall, satellite products (GsMAP) as well as the GFS (initial on 00 UTC 3 November 2017) forecast over the Penang areas.
- Generally both satellite and GFS forecast underestimate the station records, despite they consistently picked up the double peaks characteristics of the heavy rainfall episode.

What's next?

- Currently, the team is still working on numerical experiment (WRF) setup and configuration.
- There are a few questions that need to be answered:

  - How does the environmental flow fueled the event?

  - Does the anomalies over the Indian Ocean play a role in this?

  - Can the local factors such as orography and land-use affected the intensity of the event?

  - Given that the global forecast picked up the event but not its intensity, can a high resolution limited are model such as WRF improves the forecast?

  - And more importantly, how much lead-time do we have?

- We are hoping to answer these questions through a series of numerical experiment.
- Looking forward to work with expertise interested in this case.

The END

Thank you for your time …

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