Structure and Evolution of Tropical Cyclone Cempaka (27 - 29 Nov 2017)

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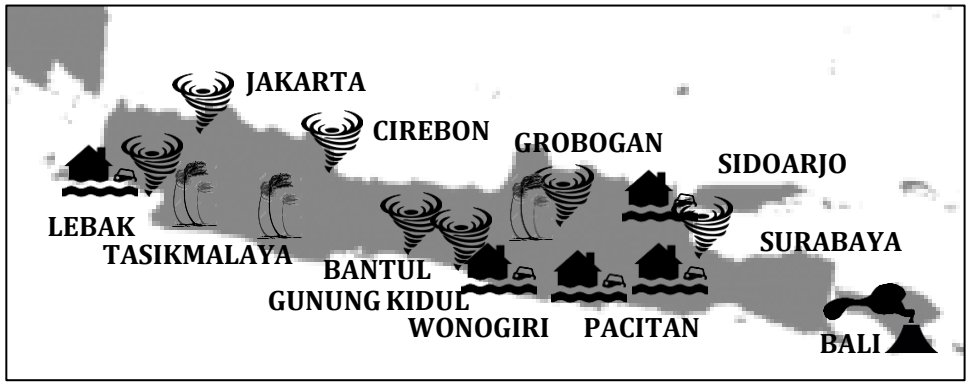
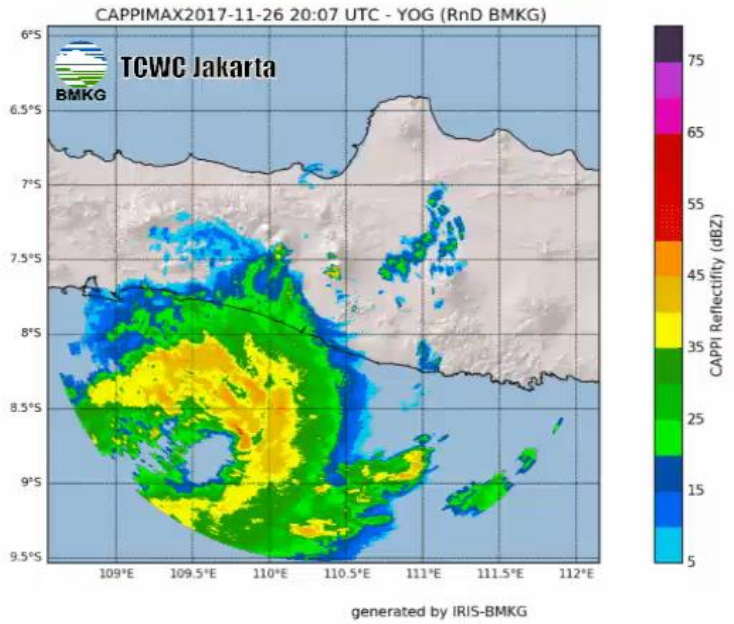
Hanoi, Vietnam, 26 – 27 February 2018

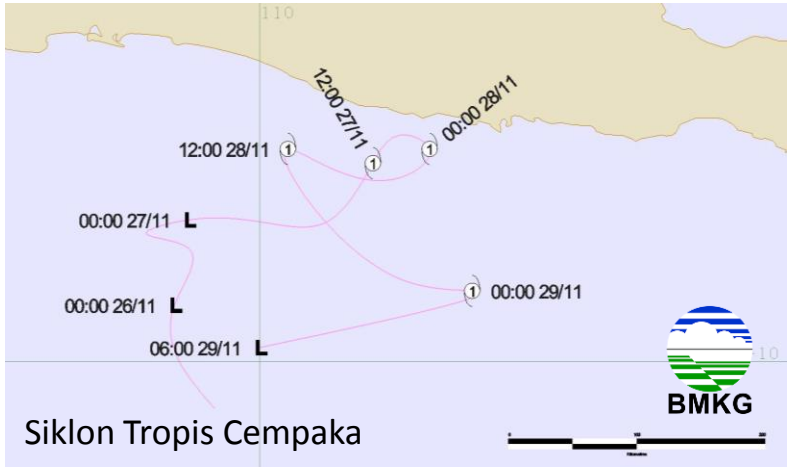
Hazards and Disaster at the Event of Cyclone Cempaka
27-29 November 2017



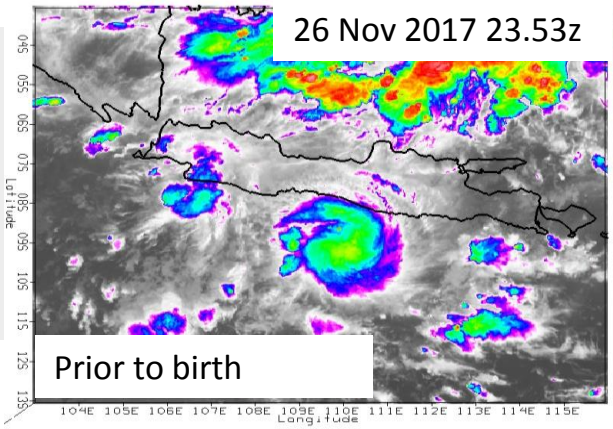
Strong wind Tornado Flood

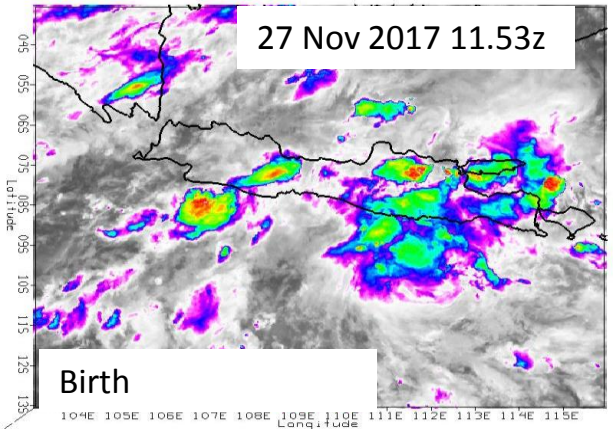


Time	Latitude	Longitude	Pressure	MeanWind	WindGust
2017-11-26 00Z	-9.6	109.4	1003	25	45
2017-11-26 06Z	-9.2	109.5	1003	25	45
2017-11-26 12Z	-9.5	109.0	1005	20	40
2017-11-26 18Z	-9.1	109.2	1004	20	40
2017-11-27 00Z	-9.0	109.5	1005	20	40
2017-11-27 06Z	-8,6	110,5	1004	20	40
2017-11-27 12Z	-8,6	110,9	999	35	55
2017-11-27 18Z	-8,4	111,3	998	35	55
2017-11-28 00Z	-8.5	111.2	999	35	55
2017-11-28 06Z	-8.7	111.0	998	35	55
2017-11-28 12Z	-8.5	110.2	998	35	55
2017-11-28 18Z	-9.4	111.0	999	35	55
2017-11-29 00Z	-9.5	111.5	1000	35	55
2017-11-29 06Z	-9.9	110.0	1003	25	45

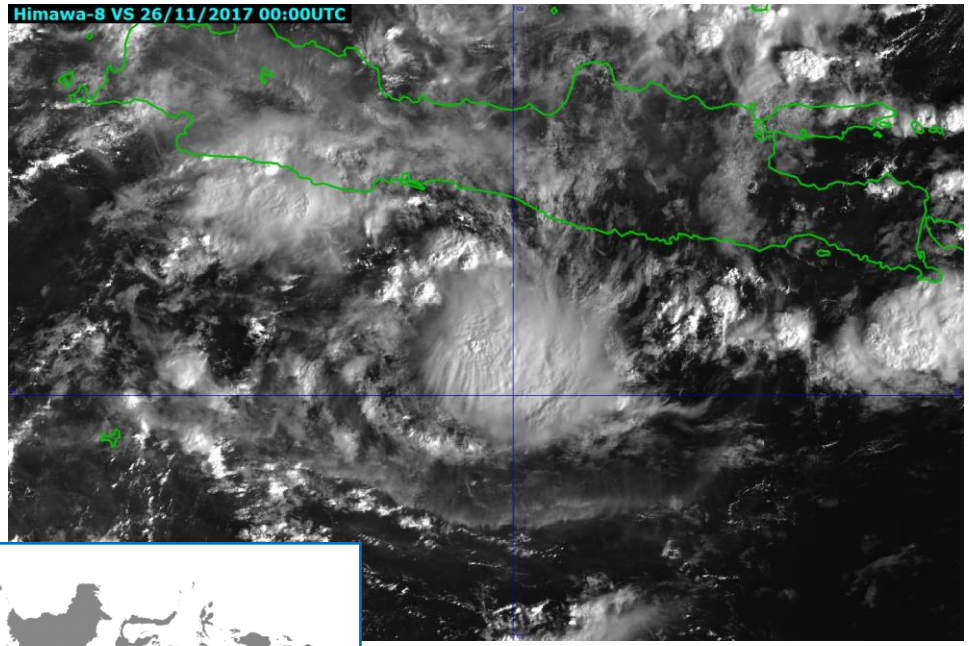


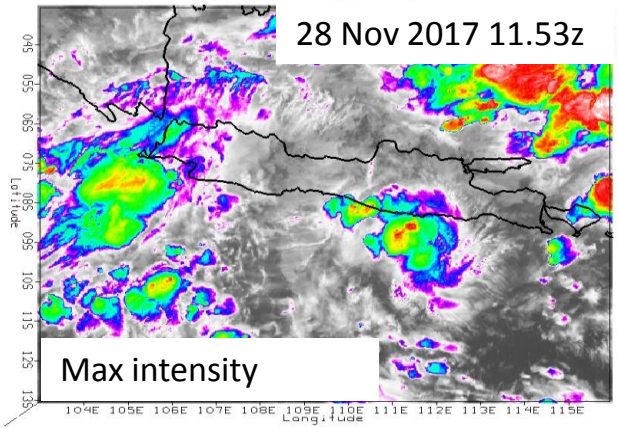
Stages of Cyclone Cempaka 26 - 29 Nov 2017

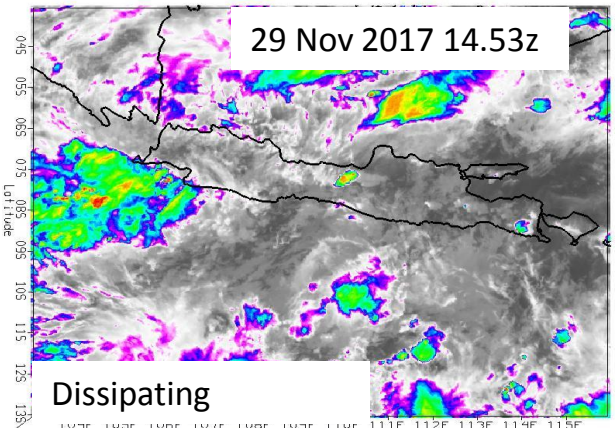




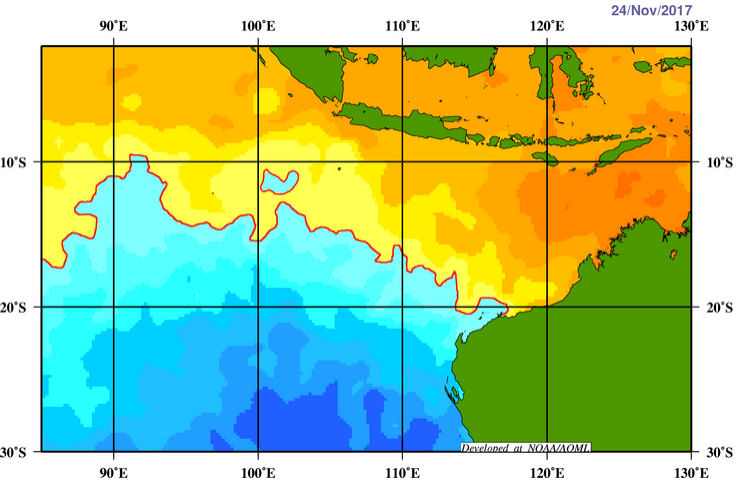
Tropical depression on 26 Nov 2017 00.00z

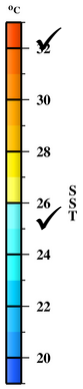






Synoptic condition prior to formation of Cyclone Cempaka

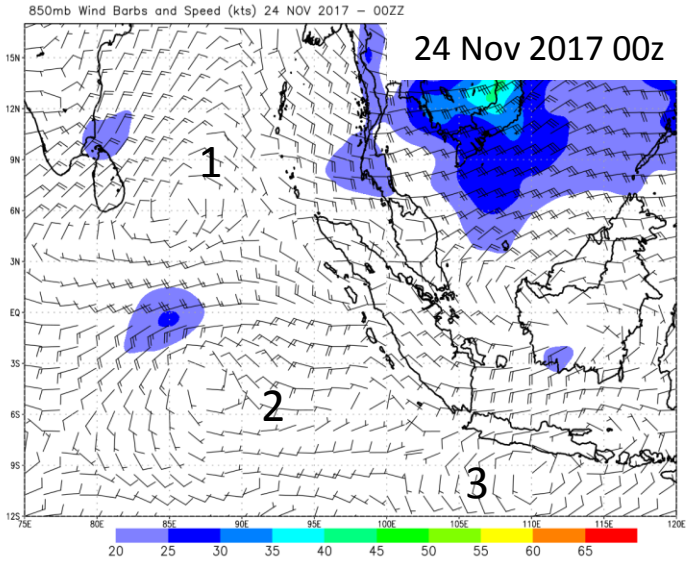




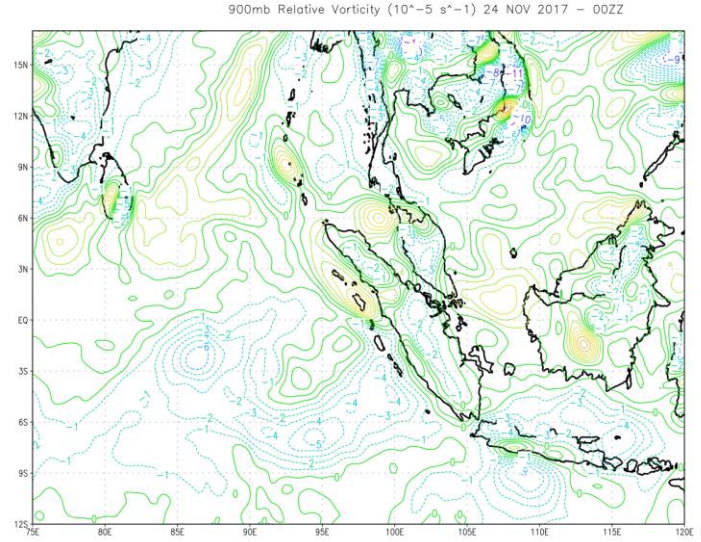
✓ Pre-existing disturbance at lower level

✓ near equatorial trough

High sea surface temperatures



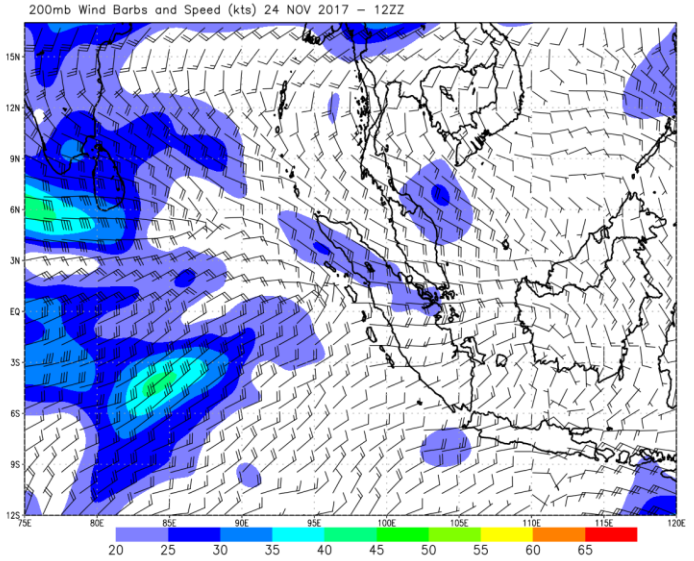
24 Nov 2017 00z



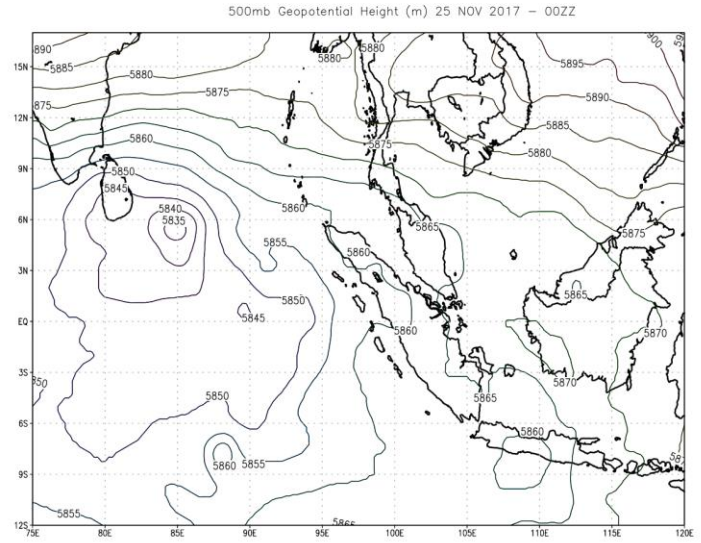
✓ High relative vorticity at lower level

✓ Upper level divergence

✓ Low vertical wind shear

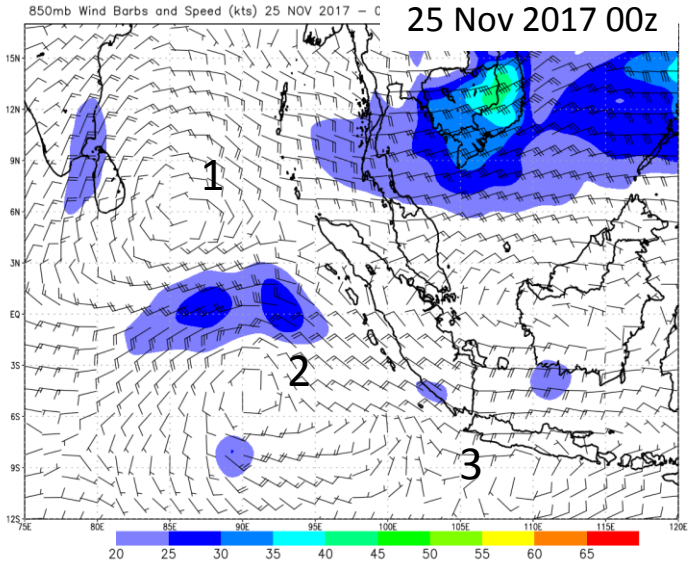


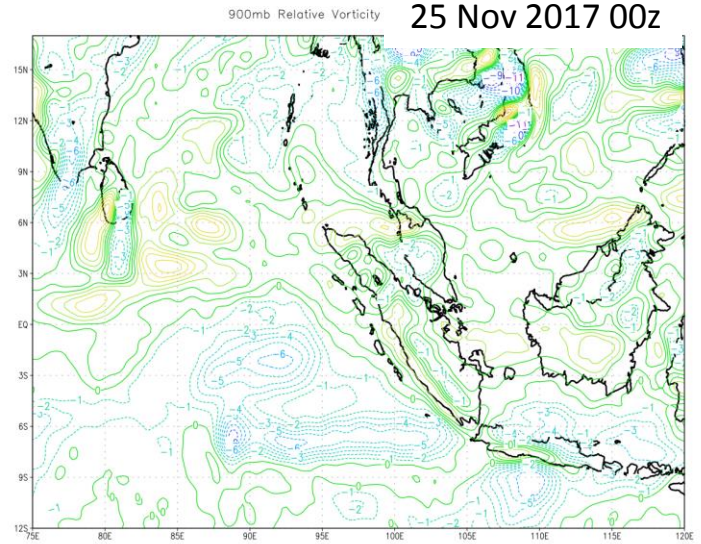
Synoptic condition - tropical depression



- ✓ Highs in Siberia
- ✓ lows developed in north & south Indian ocean and weak low develop in south of Java

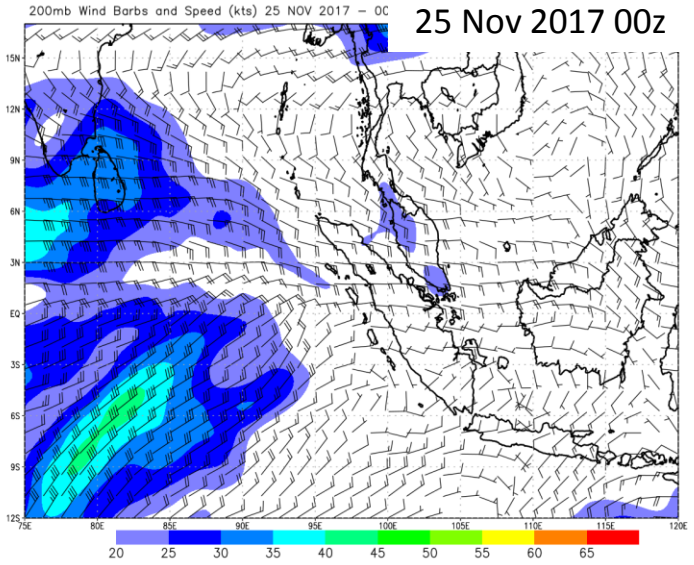
- ✓ Strong westerly winds develop twin disturbace west of Sumatra and another one on south of Java



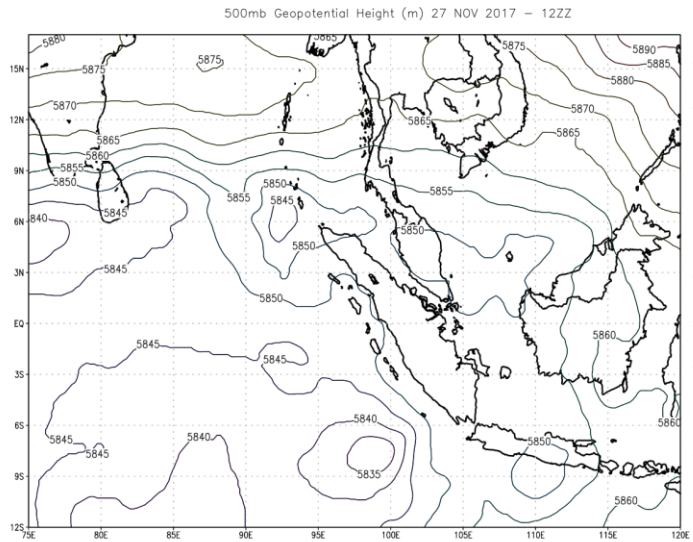


- ✓ High relative vorticity at lower level

- ✓ Upper level divergence
- ✓ Low vertical wind shear

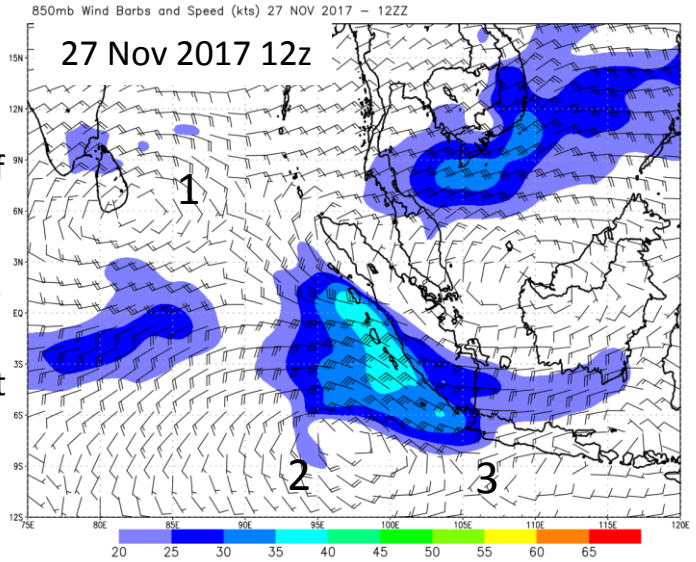


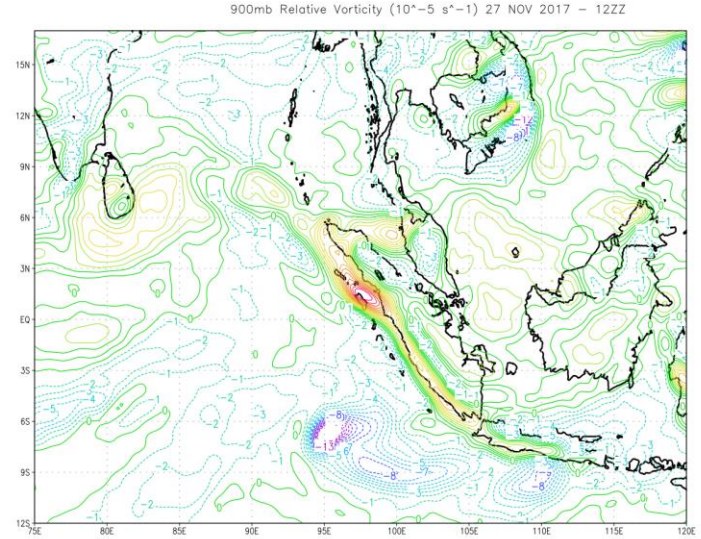
Synoptic condition - birth stage



- ✓ SIberian high gets stronger
- ✓ Moist air flows to disturbance 2 and support development of cyclone Cempaka

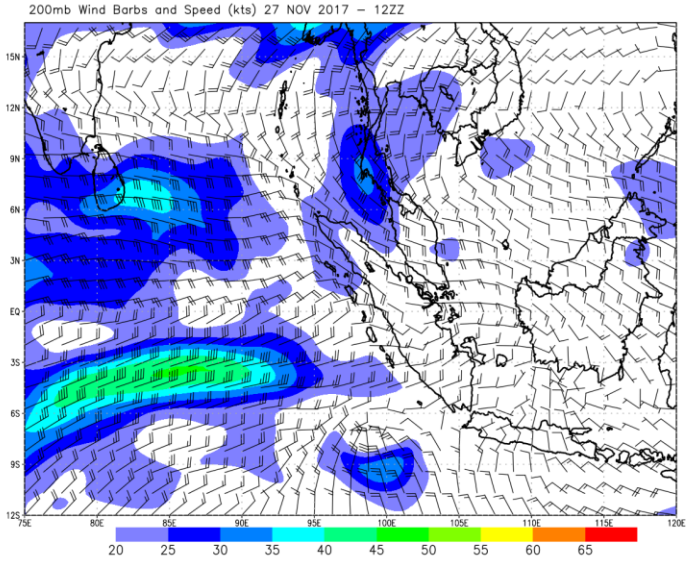
- ✓ Strong surges spin the cyclone
- ✓ High low to mid level RH
- ✓ Global model missed to detect cyclone Cempaka
- ✓ AMSU swath missed also



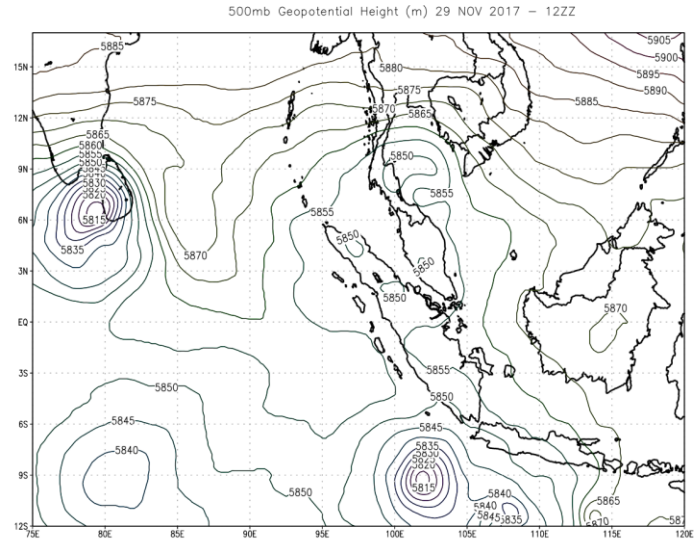


- ✓ The second disturbance can not make it due to strong vertical shear

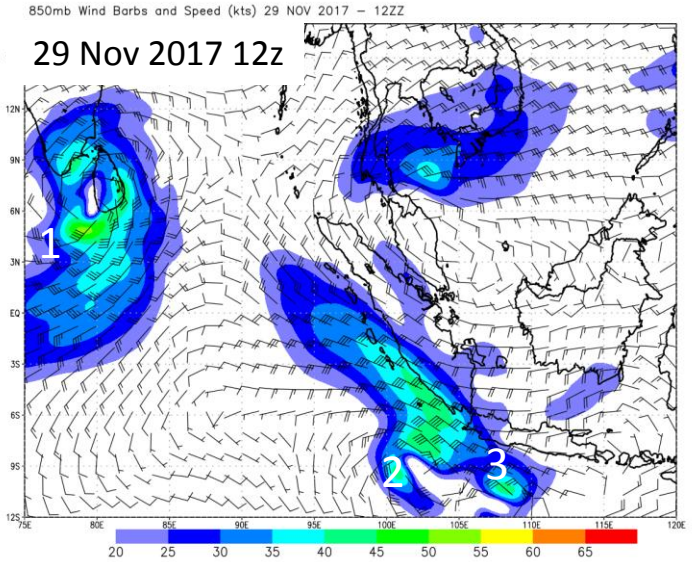
- ✓ stronger relative vorticity at lower level

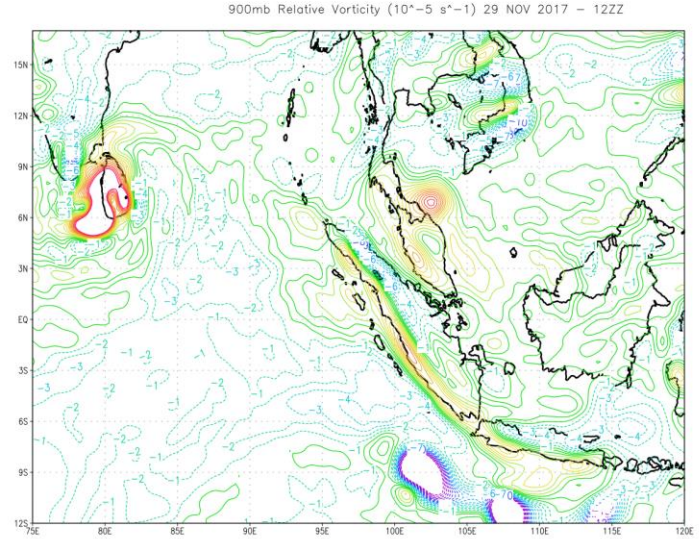


Synoptic condition dissipating stage

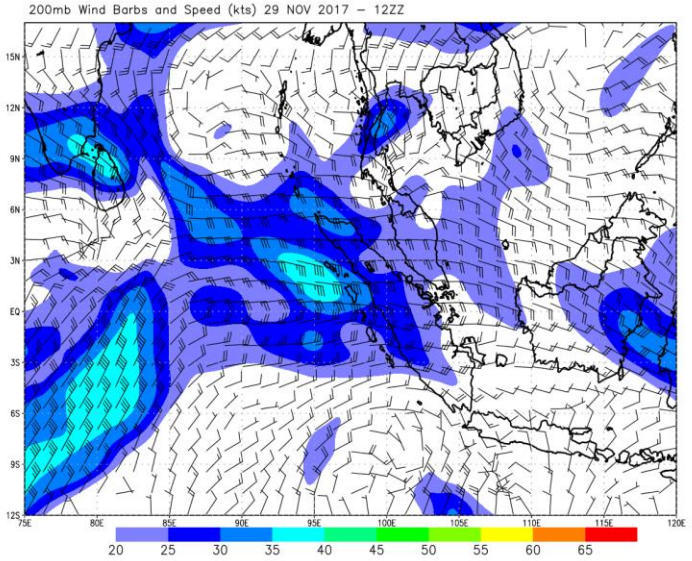


- ✓ Cyclone Ockhi developed on Srilanka
- ✓ The second disturbance moves southward, surges spin this disturbance



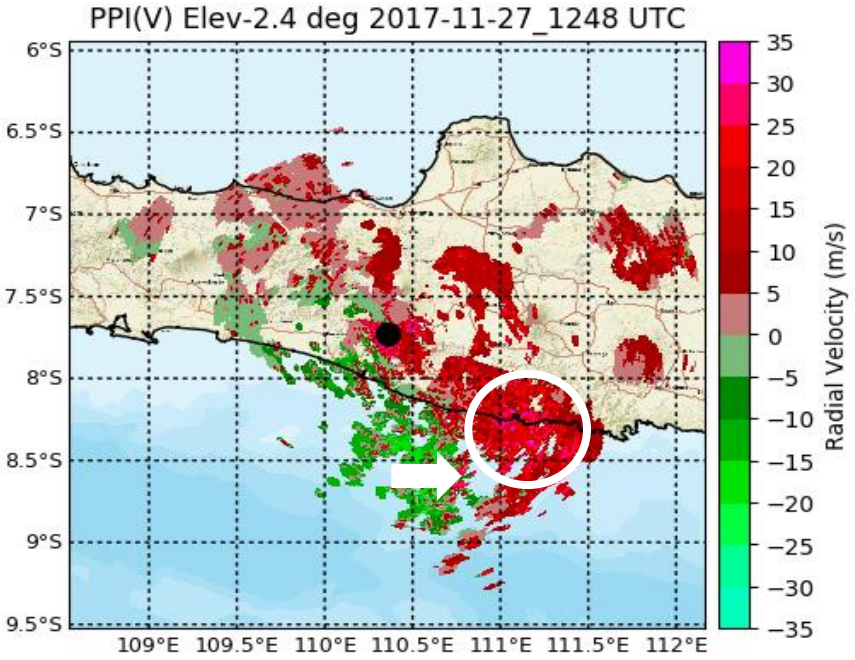


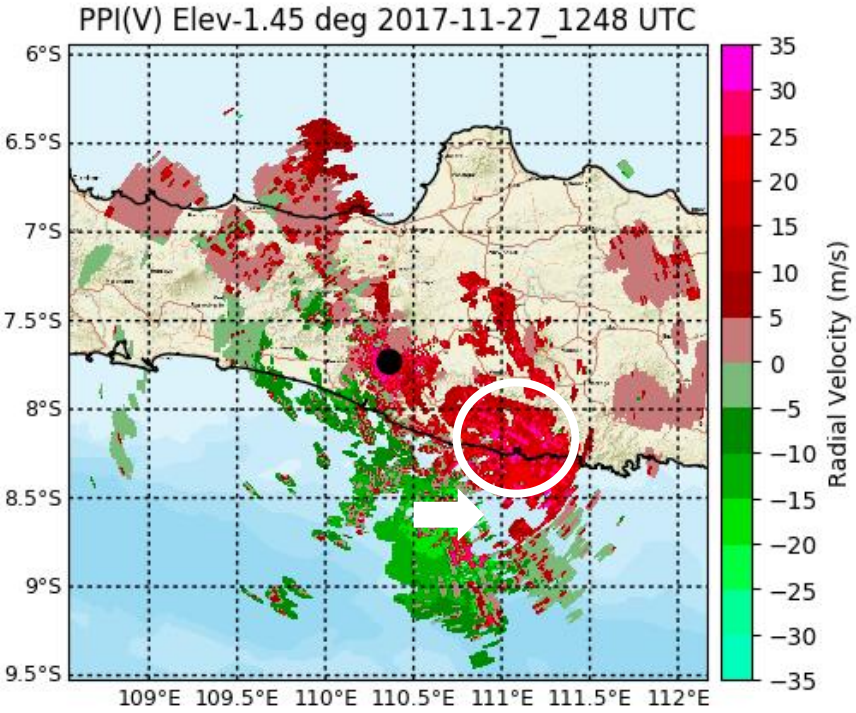
- ✓ Relative vorticity keeps developing stronger
- ✓ Fujiwara effect takes place



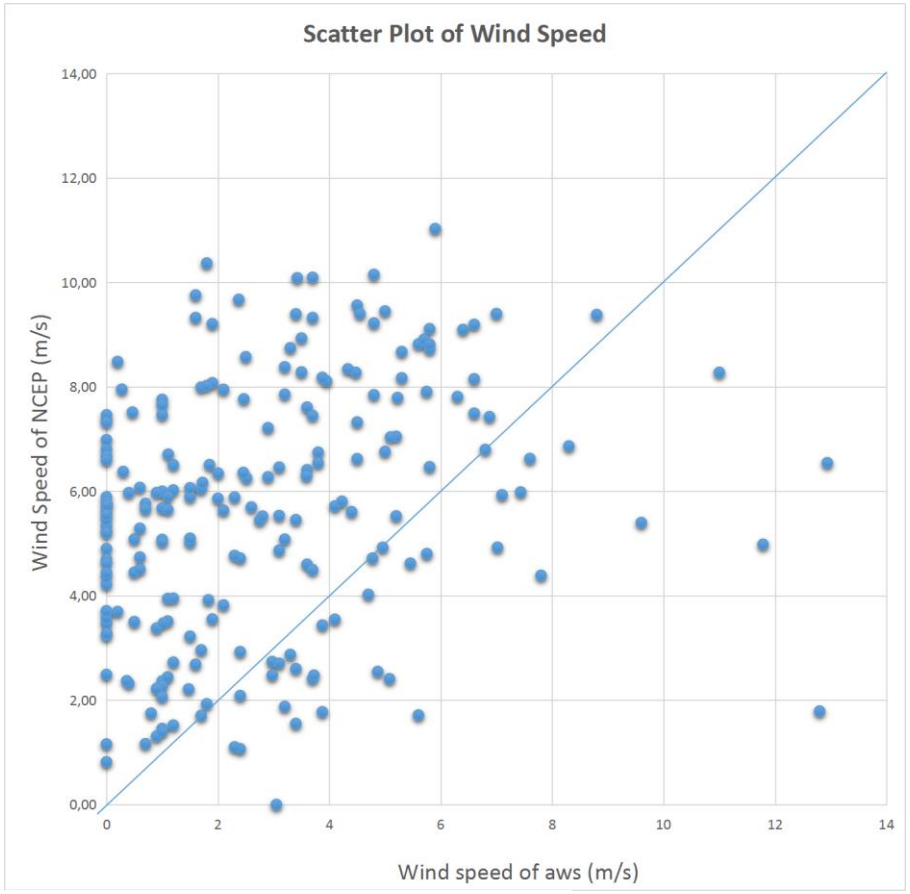
Radial velocity (m/s)

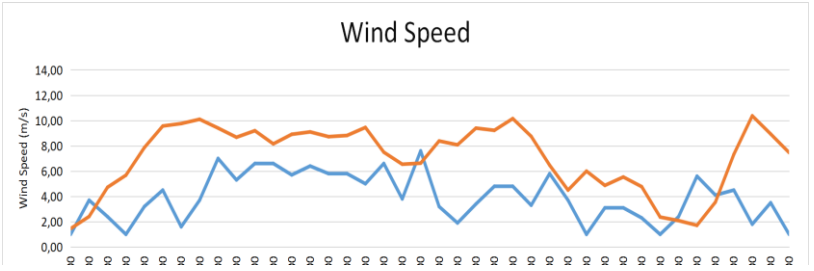
- ✓ Radial wind >60 knots identified N to NE of LLCC at about 950, 800 to 700hPa
- ✓ Radius of relatively calm wind in the center approx. 12 km

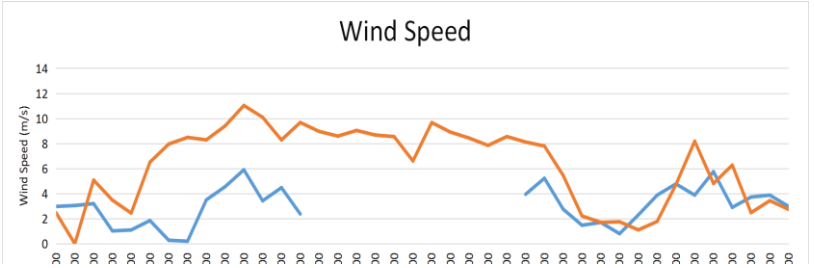


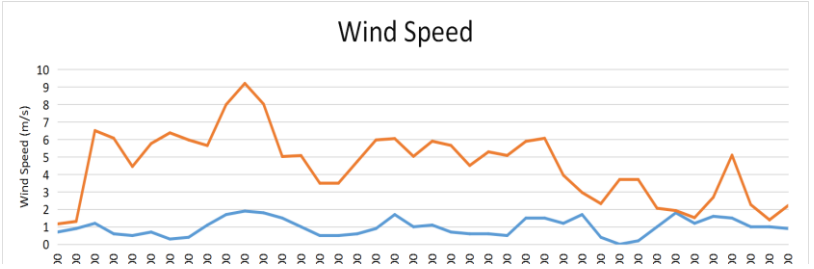


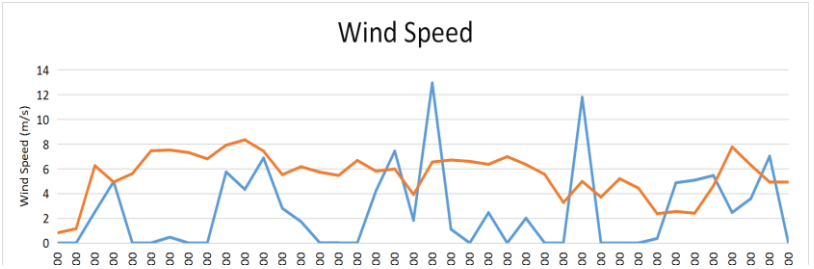
Comparison of simulated and observed wind speed in Java Island







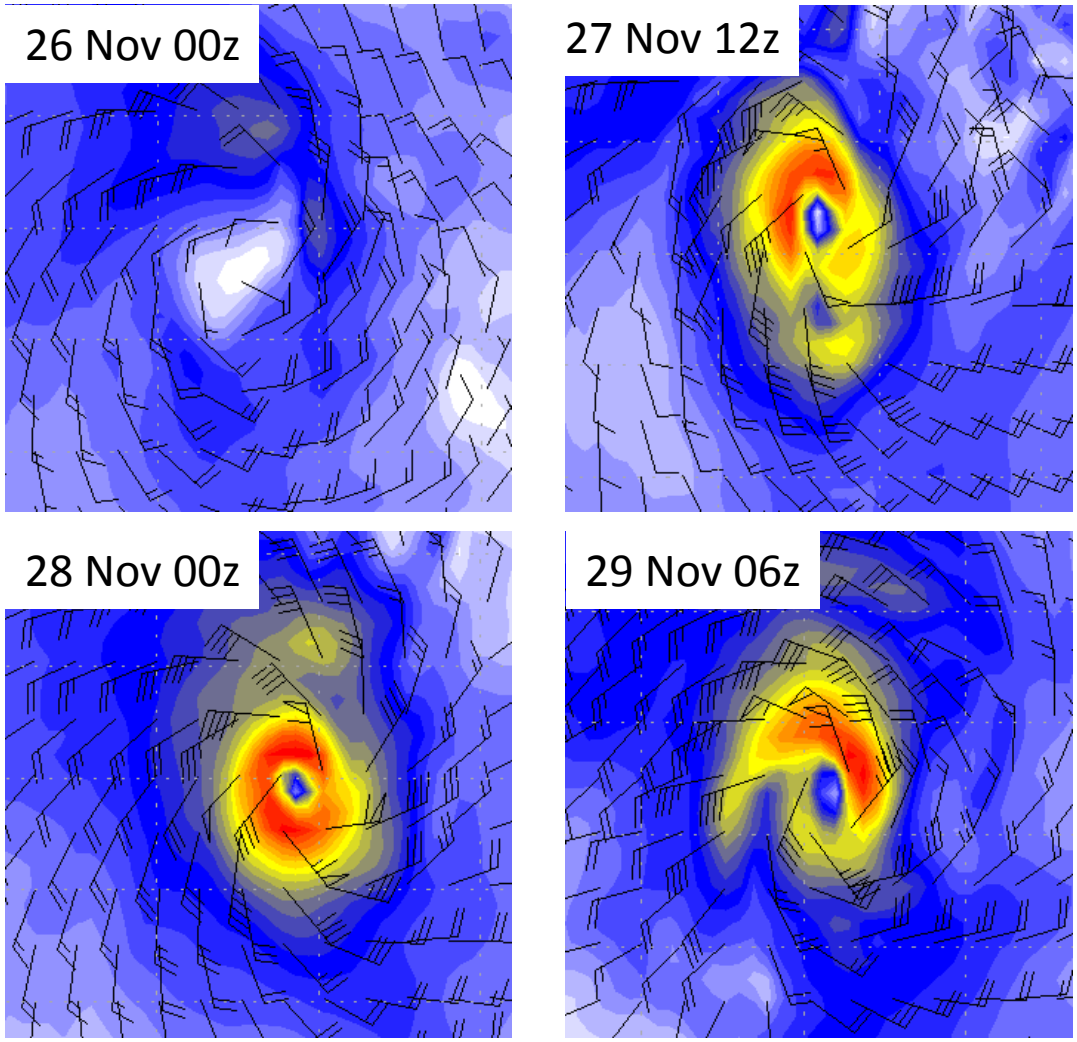




average error = 3,1513999
median = 3,3885
max = 9,666
min = -11,011

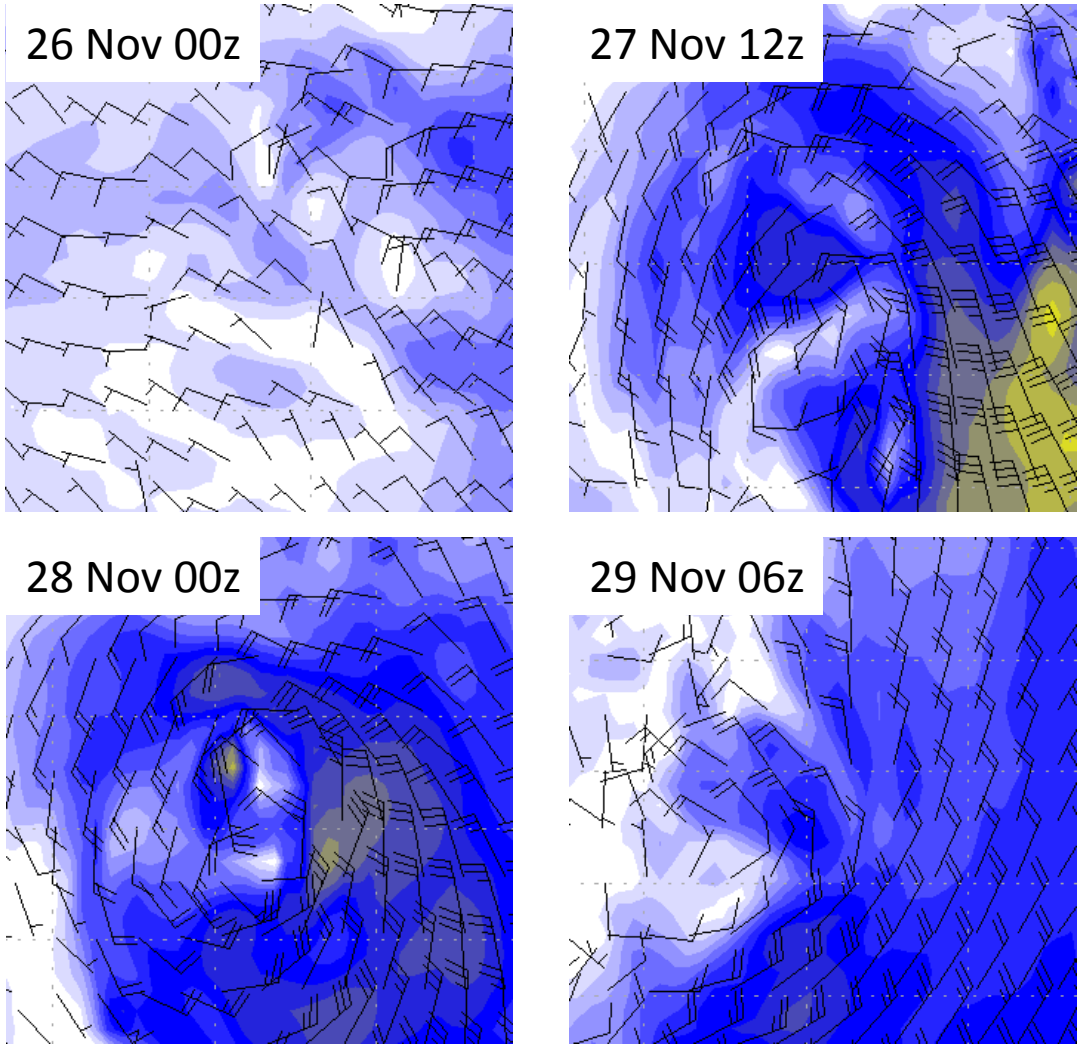
Surface Wind Simulation of downscalled NCEP NRL

- ✓ Max wind > 34 knots on 26 Nov 12z
- ✓ Max intensity on 28 Nov 00z with max wind speed > 59 knots
- ✓ Cyclone Cempaka dissipated on 30 Nov 00z

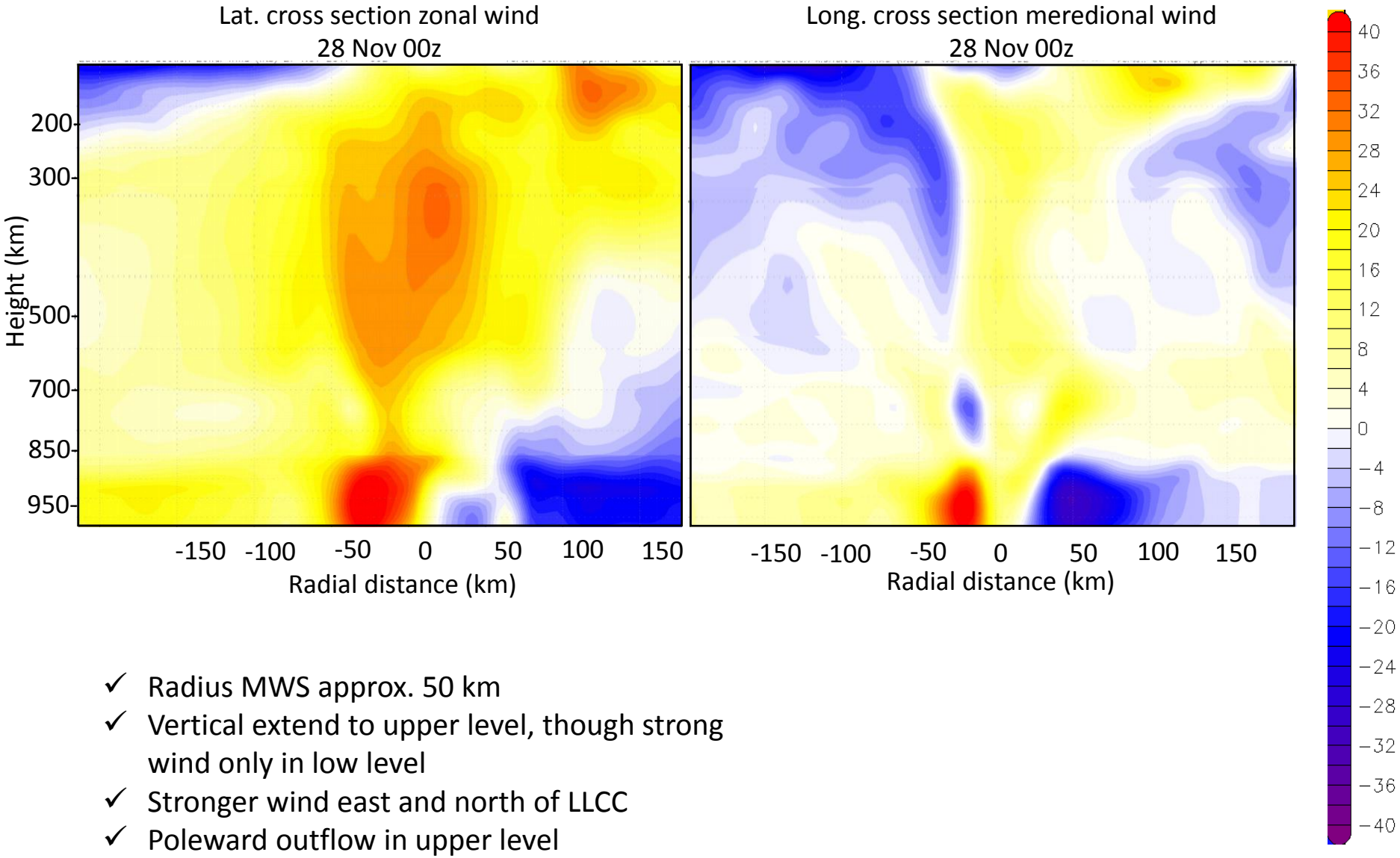


uppermost region (300 hPa)

- ✓ Poleward outflow identified from 27 Nov 12z
- ✓ Anticyclonic in the upper level more develop in 28 Nov

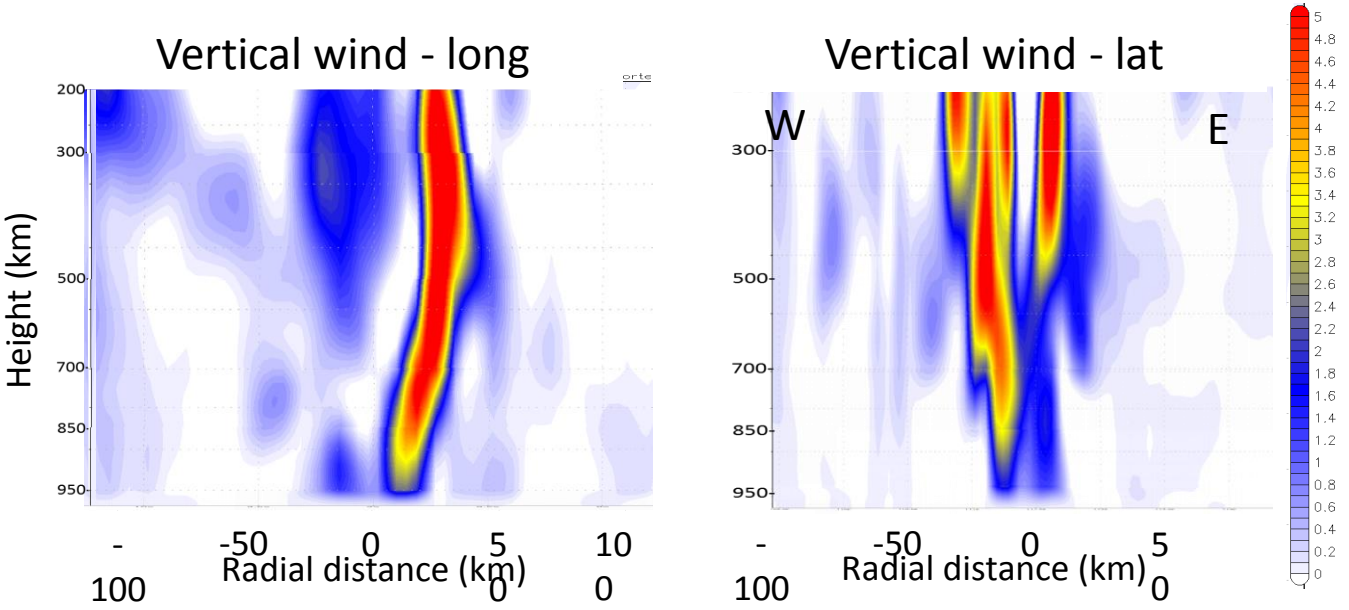


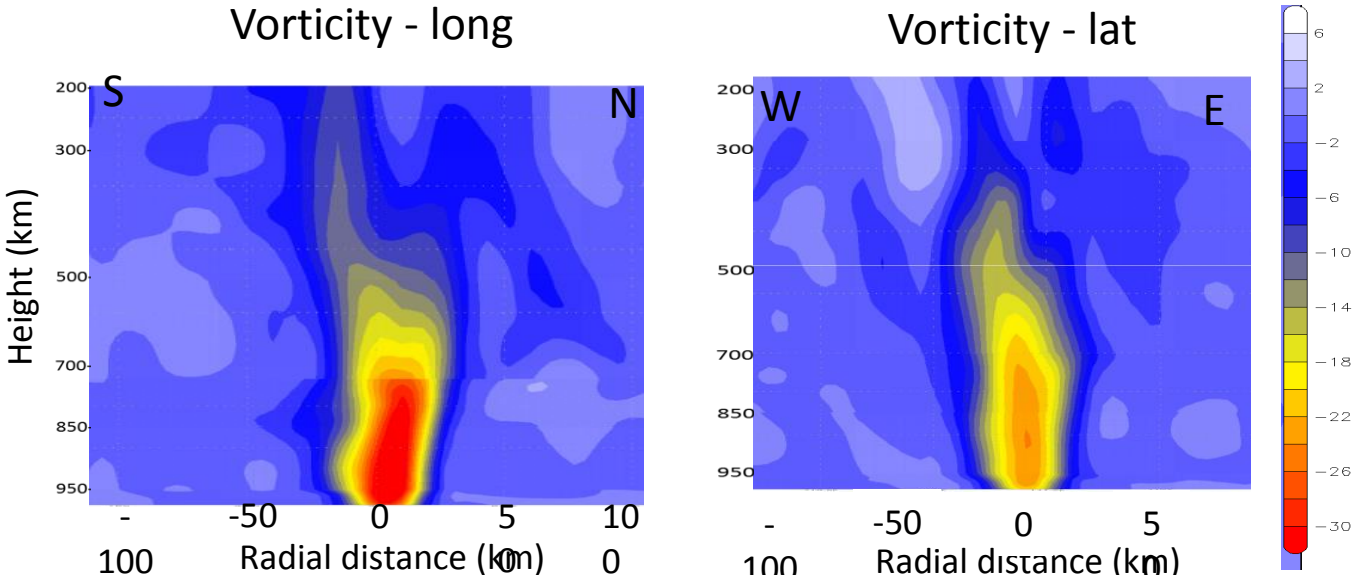
Meredional & zonal wind cross section



- ✓ Radius MWS approx. 50 km
- ✓ Vertical extend to upper level, though strong wind only in low level
- ✓ Stronger wind east and north of LLCC
- ✓ Poleward outflow in upper level

Latitude & longitude cross section of vertical wind (kts) and relative vorticity (10^-4/s) 28 Nov 2017 00z





- ✓ Maximum updraft at mid level
- ✓ Updraft a lot stronger north of LLCC than south of LLCC,
- ✓ Maximum vorticity at low to mid level

Conclusion

1. Prior to its formation, a westerly wind event persisted days over Indian ocean provided a source for background cyclonic disturbance in both hemisphere

2. Three cyclonic disturbance develop in north east Indian Ocean, south east Indian Ocean and SOuth of Java.

3. The channeling and strengthening of the westerly winds helps to spin and provide fuel to the disturbances - while disturbance 2 experience strong wind shear, disturbance 3 develop

4. Small sized cyclone developed, with radius max winds approximately 50 km. Global model and AMSU swath miss the cyclone

5. The cyclone life for 72 hours, model simulation shows max wind speed > 60 knots on 28th Nov with shallow vertical depth.

6. Spatial Distribution of max wind is assymetric, due to most likely due to assymetry of boundary layer condition

7. The cyclone dissipate due to fujiwara effect

Thank you