The role of inner-core processes in the rapid intensification of Typhoon Nepartak (2016)

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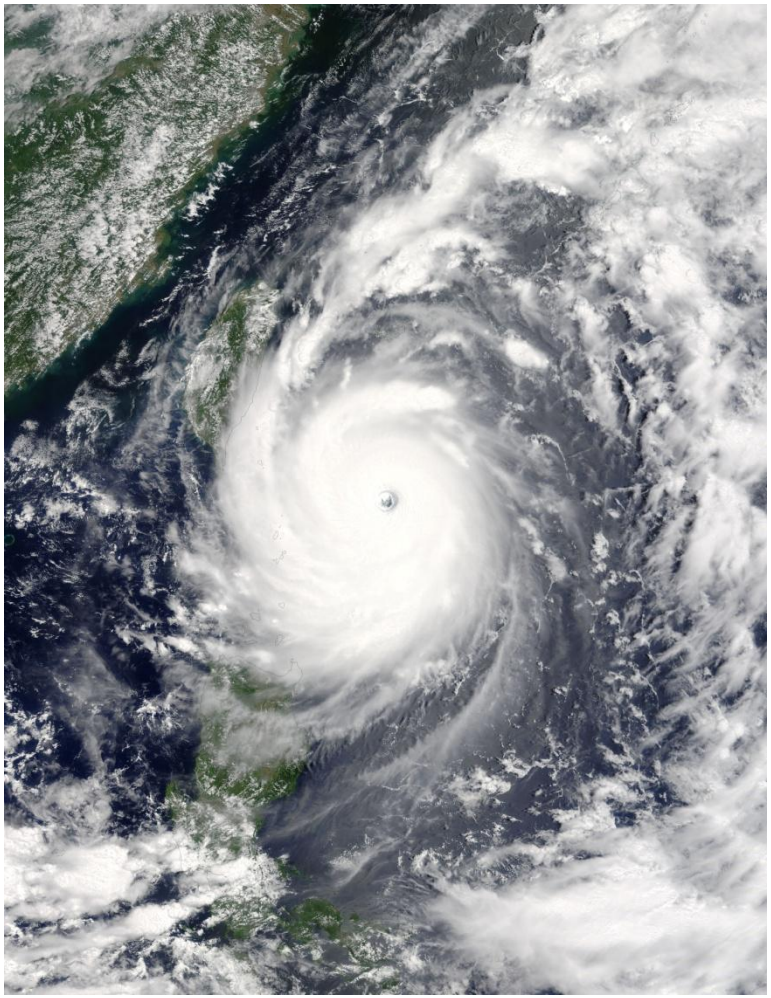
Our research



Typhoon Nepartak (2016). Source: NASA via https://earthobservatory.nasa.gov/NaturalHazards/view.php?id=88331.

- Use numerical modelling to understand what drives tropical cyclone rapid intensification.
- Aim to improve tropical cyclone intensity forecasts.
- Collaboration with the Met Office and with the national meteorological service in the Philippines (PAGASA).
- Developing a training course for forecasters and scientists in SE Asia (Philippines, Malaysia and Indonesia) and at the Met Office.

What motivates our research?

- Accurately forecasting the rapid intensification of tropical cyclones is one of the most difficult challenges in meteorology today.
- Rapid intensification can be particularly devastating if it occurs just before landfall.
- We want to better understand what controls intensity change, so we can improve future intensity forecasts, and save lives.

Damage caused by Typhoon Haiyan (2013). Source: ABC News.

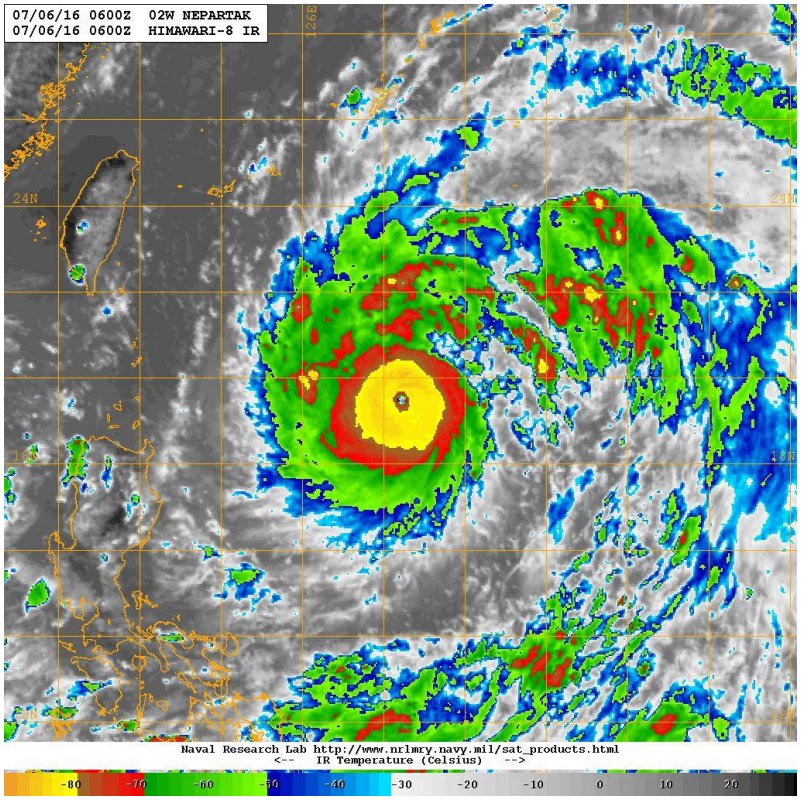
Why do cyclones intensify?

Large-scale factors:

- Warm sea surface temperatures.
- Little change in wind speed and direction with height.
- Moist atmosphere.

Smaller-scale processes:

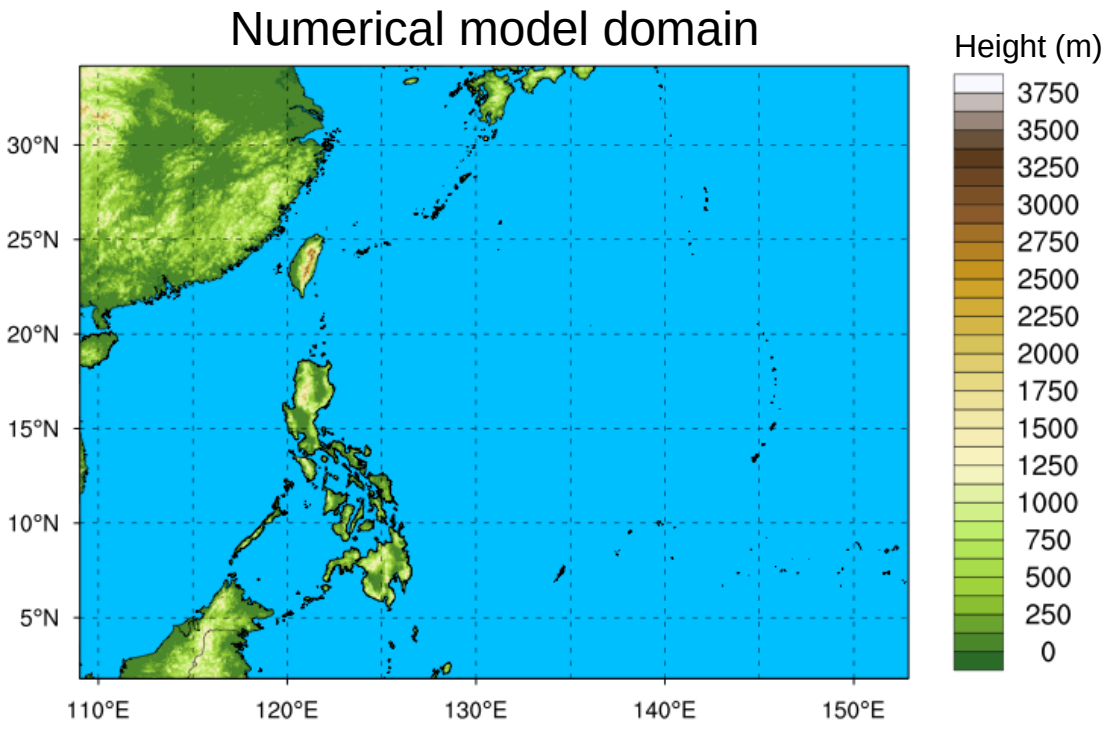
- Cloud formation (latent heat release).
- Inner-core structure.
- Merger of small vortices into single, larger vortex.



Typhoon Nepartak: 0600 UTC 6 July 2016. Himawari-8 IR image. Source http://nrlmry.navy.mil/sat_products.html

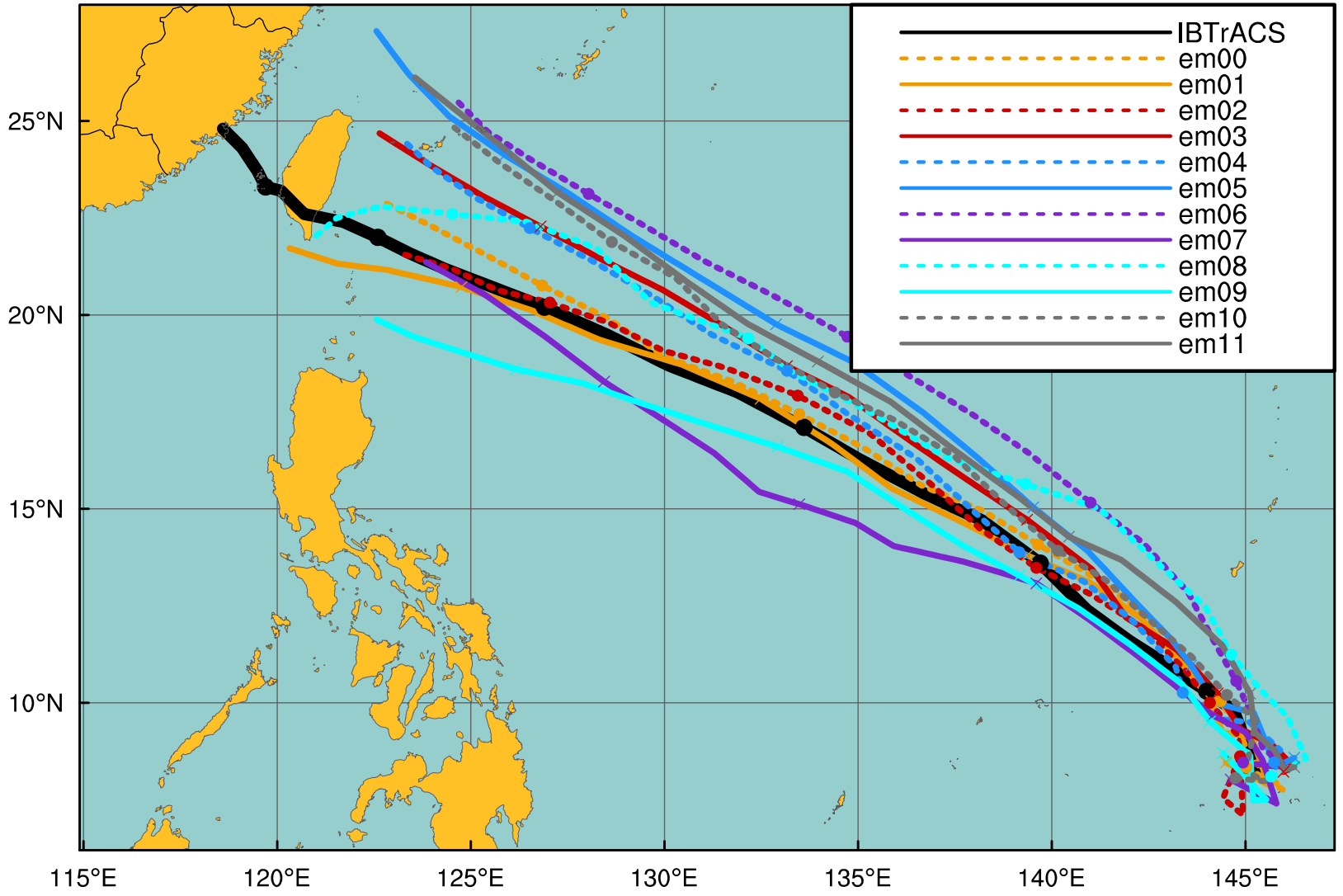
Ensemble forecasting

- We predict storm intensity using the Met Office Unified Model.
- Model solves atmospheric equations of motion and outputs solution on a latitude-longitude grid.
- We run the model multiple times with very small differences introduced at the start of the forecast.

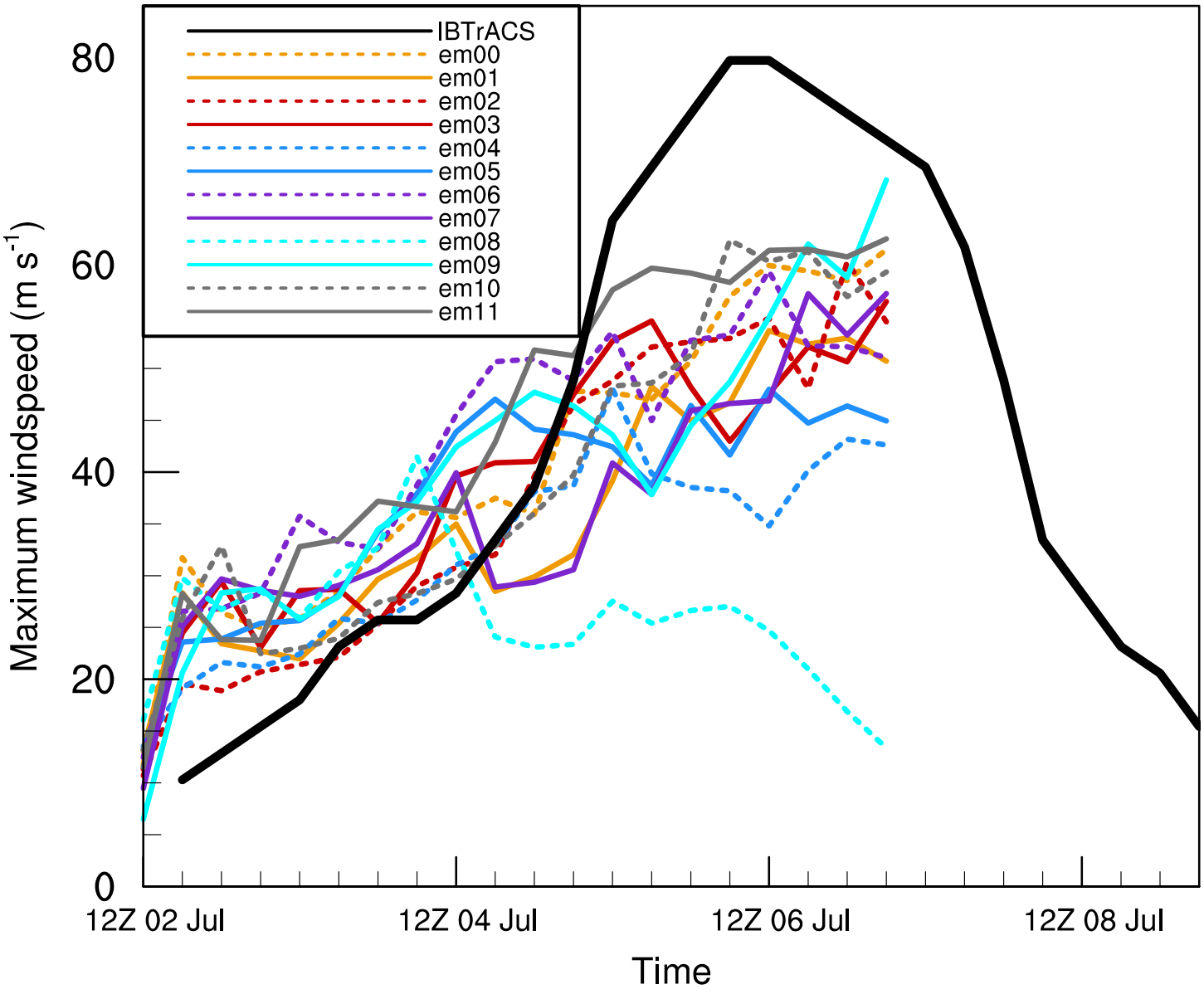


- This method is called **ensemble forecasting:** it tells you how predictable the atmosphere is at any given time, and is widely used today.

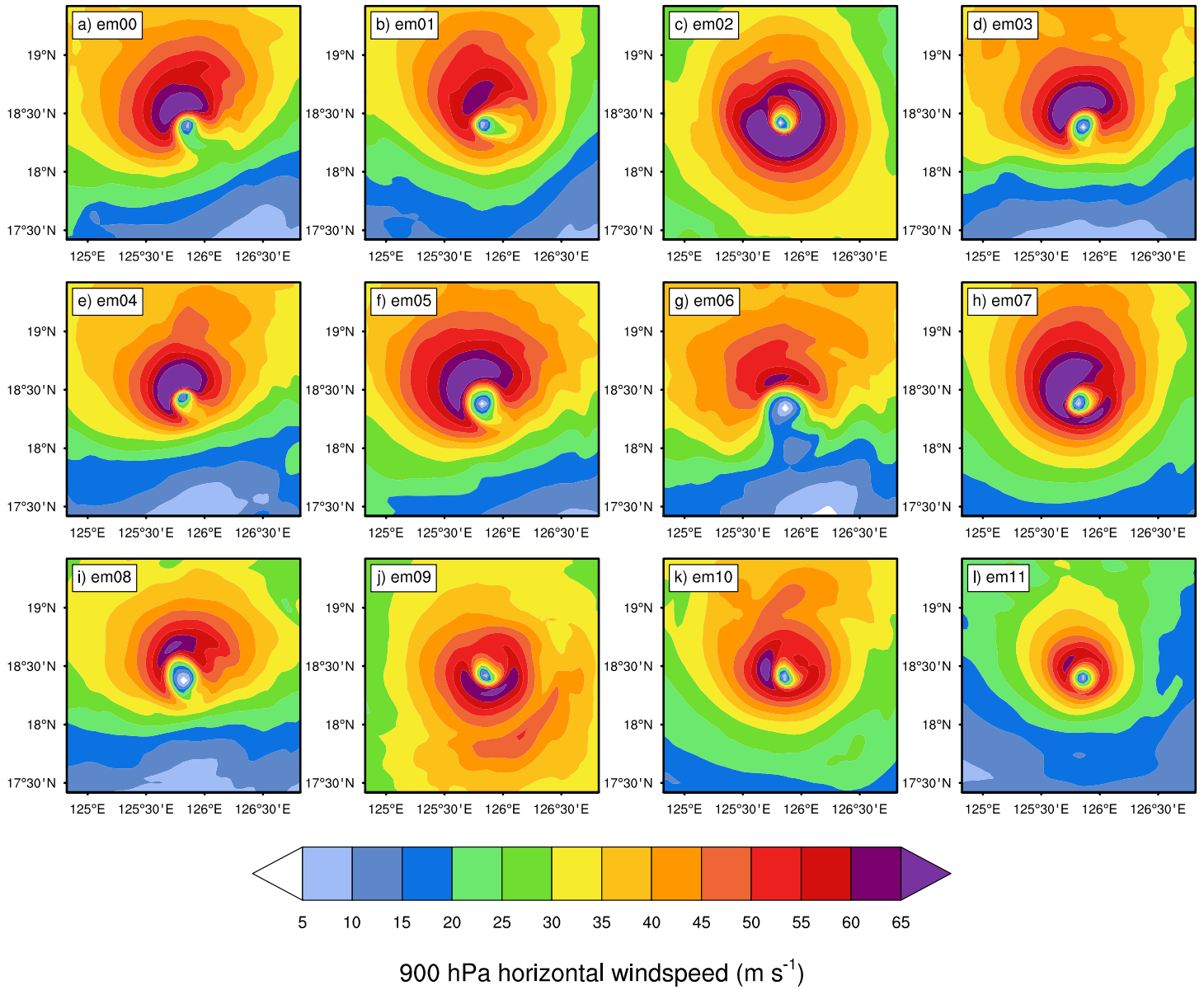
Ensemble forecast products: track



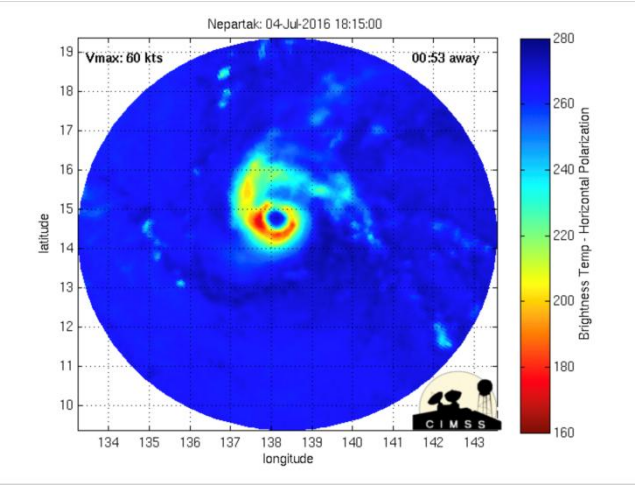
Ensemble forecast products: intensity



Ensemble forecast products: stamp plots

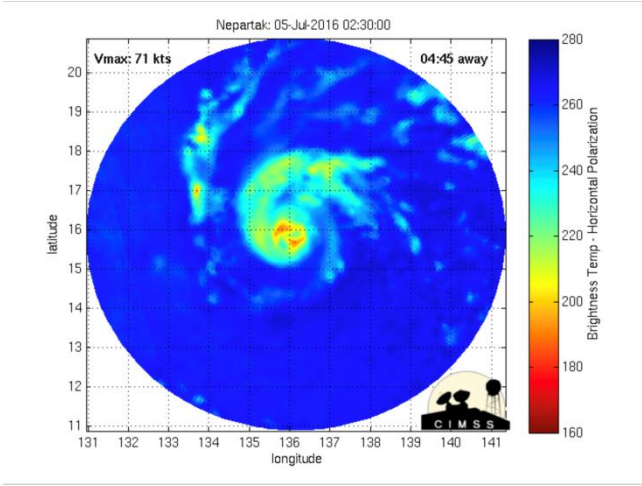


Results: inner-core fluctuations



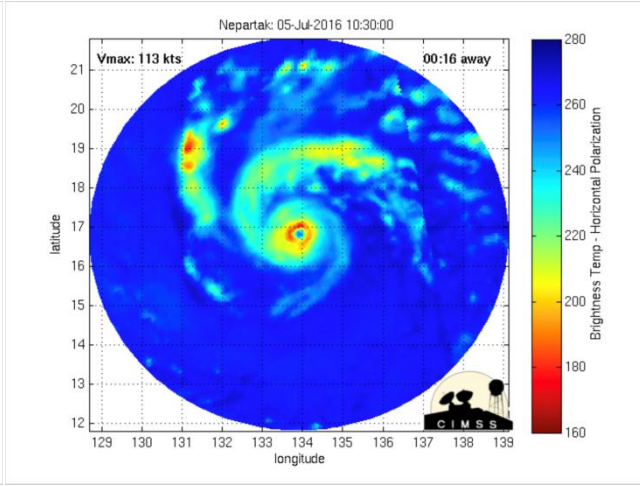
Symmetric

1815 UTC 4 July



Asymmetric

0230 UTC 5 July

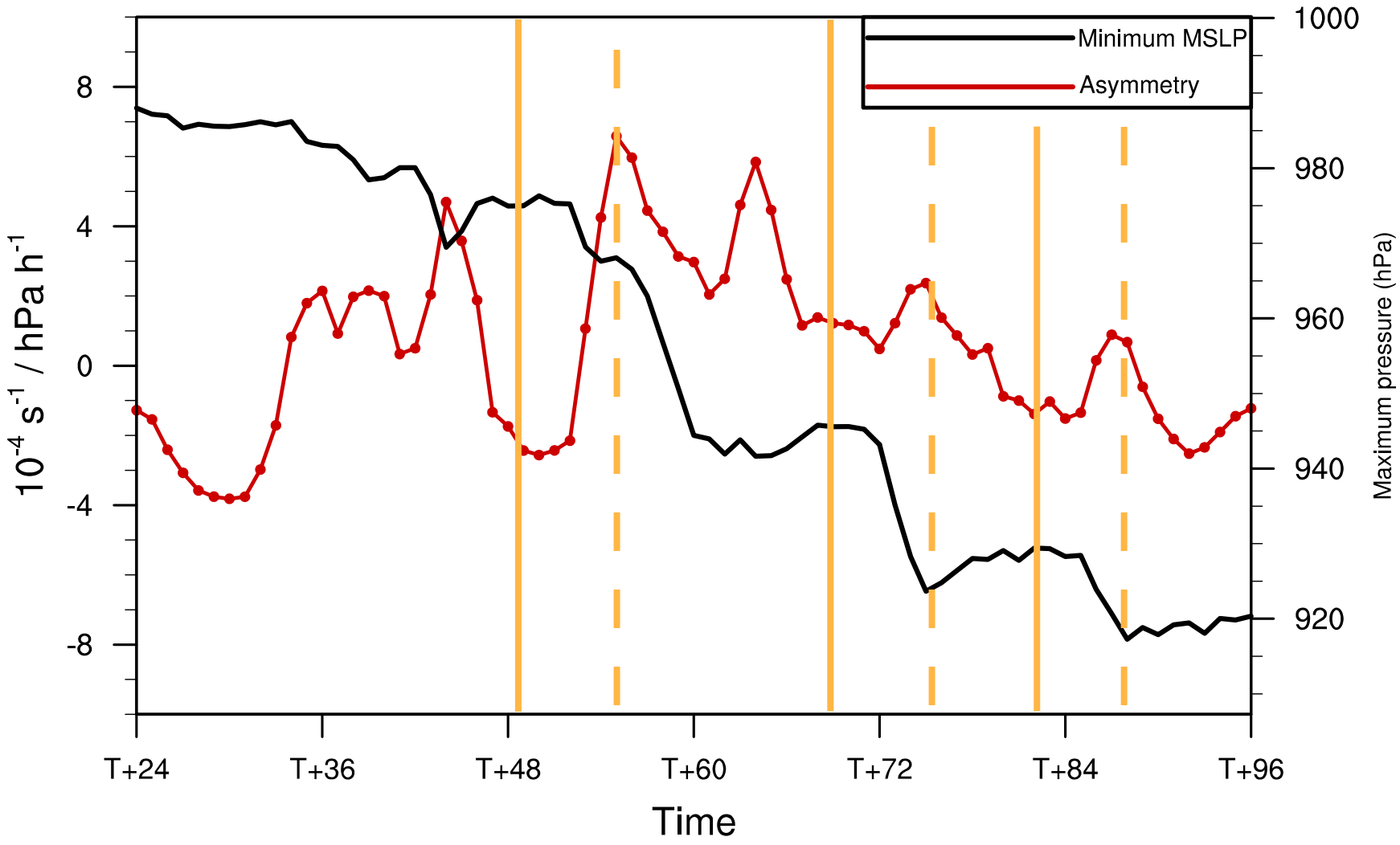


Symmetric

1030 UTC 5 July

Plots of Brightness Temperature from the Morphed Integrated Microwave Imagery at CIMSS (MIMIC) product. Source: http://tropic.ssec.wisc.edu/real-time/mimic-tc/2016_02W/webManager/mainpage.html

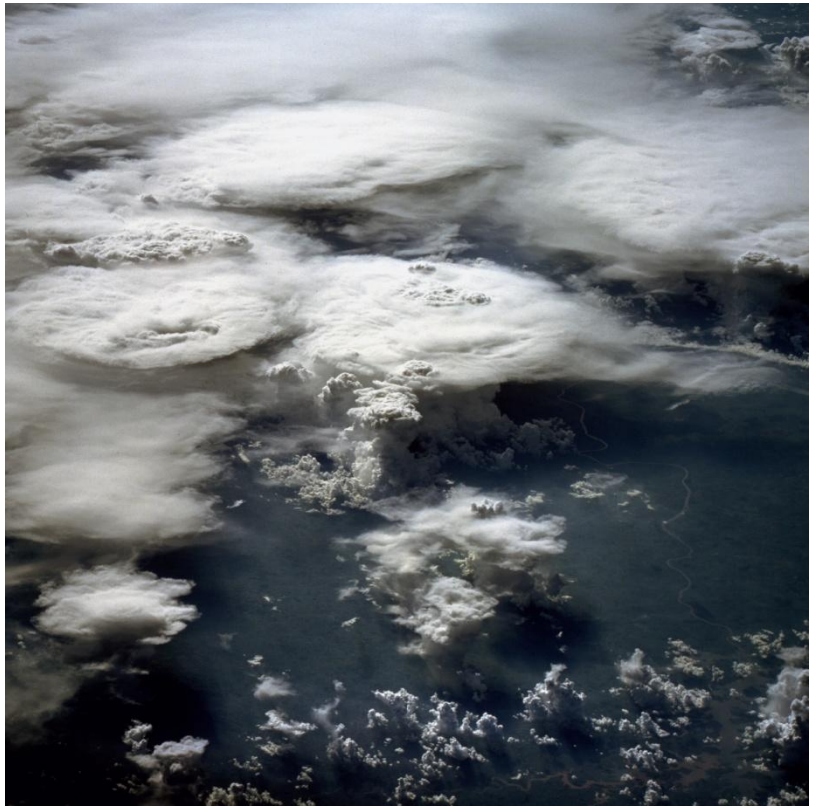
Results: inner-core fluctuations



Forecaster Training in Southeast Asia (FORTIS)

Planning and developing a 5-day training workshop on tropical meteorology for forecasters and scientists in Southeast Asia.

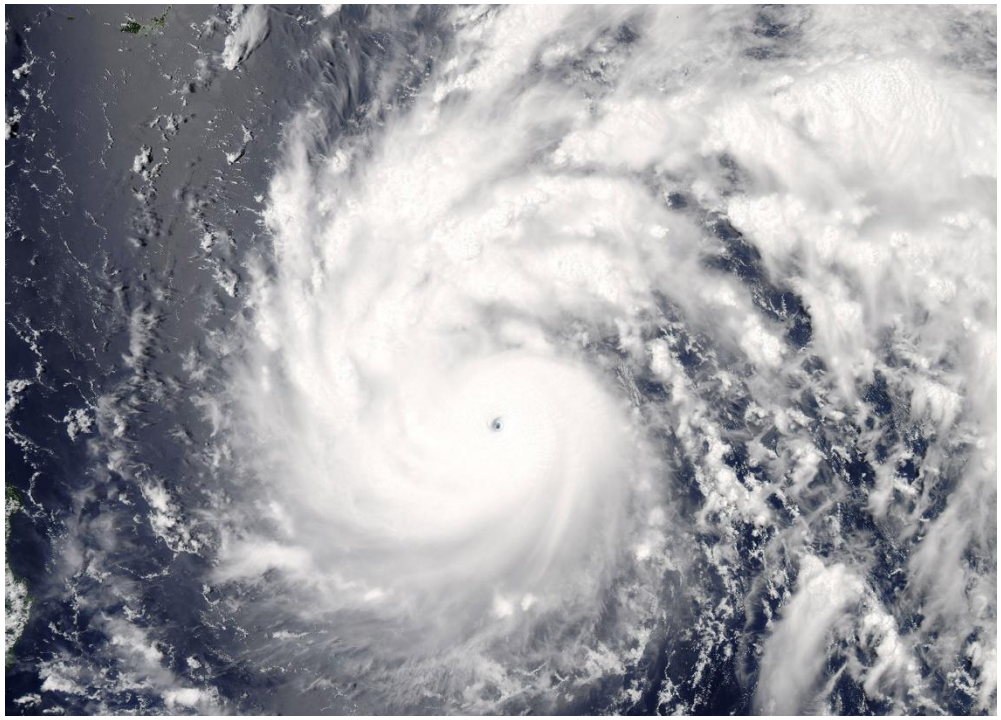
- Lecture material on topics including deep convection, tropical cyclones and large-scale tropical processes.
- Practical exercises based on operational tools provided by the Met Office.
- Delivery of training courses to partner countries in Southeast Asia (Indonesia, Philippines, Malaysia) and the Met Office in 2019.



Mature thunderstorms. Source: NASA via https://earthobservatory.nasa.gov/images/2443/thunderstorms-over-brazil

Summary

- We research processes that drive the rapid intensification of tropical cyclones.
- We also study how these processes are represented by the Met Office Unified Model.
- Our long-term goal is to improve tropical cyclone intensity forecasts.
- These outcomes feed into FORTIS, a collaborative effort between UK universities (Leeds, Reading, UEA) and the Met Office.



Typhoon Nepartak (2016). Source: National Geographic via https://news.nationalgeographic.com/2016/07/super-typhoon-nepartak-hurricanes-cyclones-storms/