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

Sam Hardy\(^1\), Juliane Schwendike\(^1\), Roger Smith\(^2\), Chris Short\(^3\), Stuart Webster\(^3\) and Cathryn Birch\(^1\)

\(^1\) University of Leeds, UK
\(^2\) University of Munich, Germany
\(^3\) Met Office, UK

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Our research

• 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.

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.

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

900 hPa horizontal windspeed (m s⁻¹)
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

- Symmetric
- Asymmetric
Forecasting 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.

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.