Development of Moving Nest in FV3GFS: Rationale and Accomplishments

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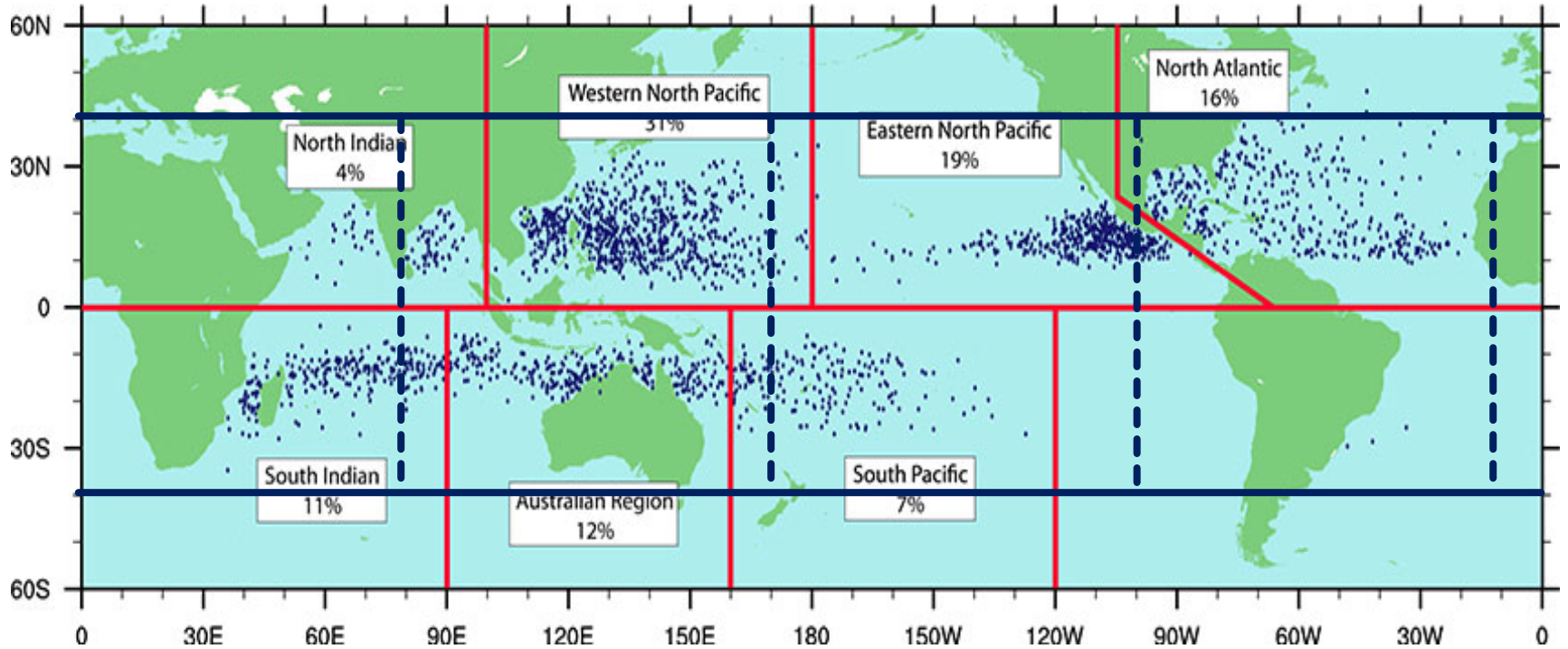
Accomplished and Ongoing Tasks

- Accomplished
  - Completed end-to-end nested FV3GFS installation on Theia and Jet
  - Successfully tested 3-km nest forecast (7-day run) in the Atlantic basin with tropics global configuration
  - Transferred hurricane analysis and forecast products & graphics (GPLOT) for HWRF-B to FV3GFS (See HWRF-B TC & forecast products in Dr. G. Alaka's talk tomorrow)
  - Native grid visualization and analysis system
- Ongoing
  - Developing moving nest capacity
  - Evaluating physics parameterization schemes in FV3GFS with hurricane field observations and satellite data (PBL, surface layer, microphysics, etc.)
  - Configuring static high-resolution nests for Eastern/Central/Western Pacific basins
  - Developing ensemble capacity
  - Transitioning forecast products for HWRF-B to FV3GFS (See FV3GFS TC & forecast products in Dr. A. Hazelton's talk tomorrow)

Moving Nest Approach and Global Configuration

Purpose-driven development

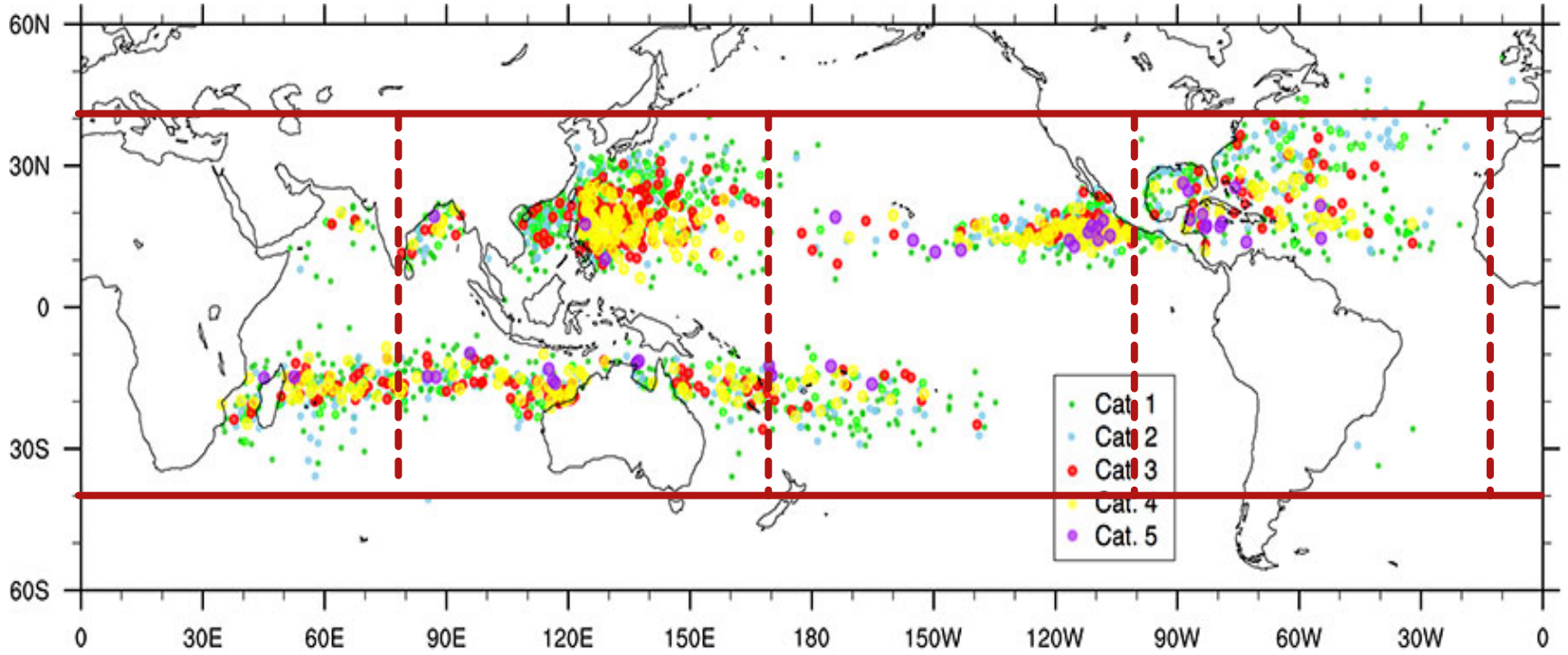
Global Distribution of TC Genesis



The global distribution of tropical cyclone formation points for the period of most reliable global best track data, 1985–2014. The percentage of tropical cyclones occurring in each basin (relative to the global total) is also shown based on data from 1990 to 2014

Ramsay, Hamish. 2017 "The Global Climatology of Tropical Cyclones." Oxford Research Encyclopedia of Natural Hazard Science. 15 Aug. 2018. http://naturalhazardscience.oxfordre.com/view/10.1093/acrefore/9780199389407.001.0001/acrefore-9780199389407-e-79.

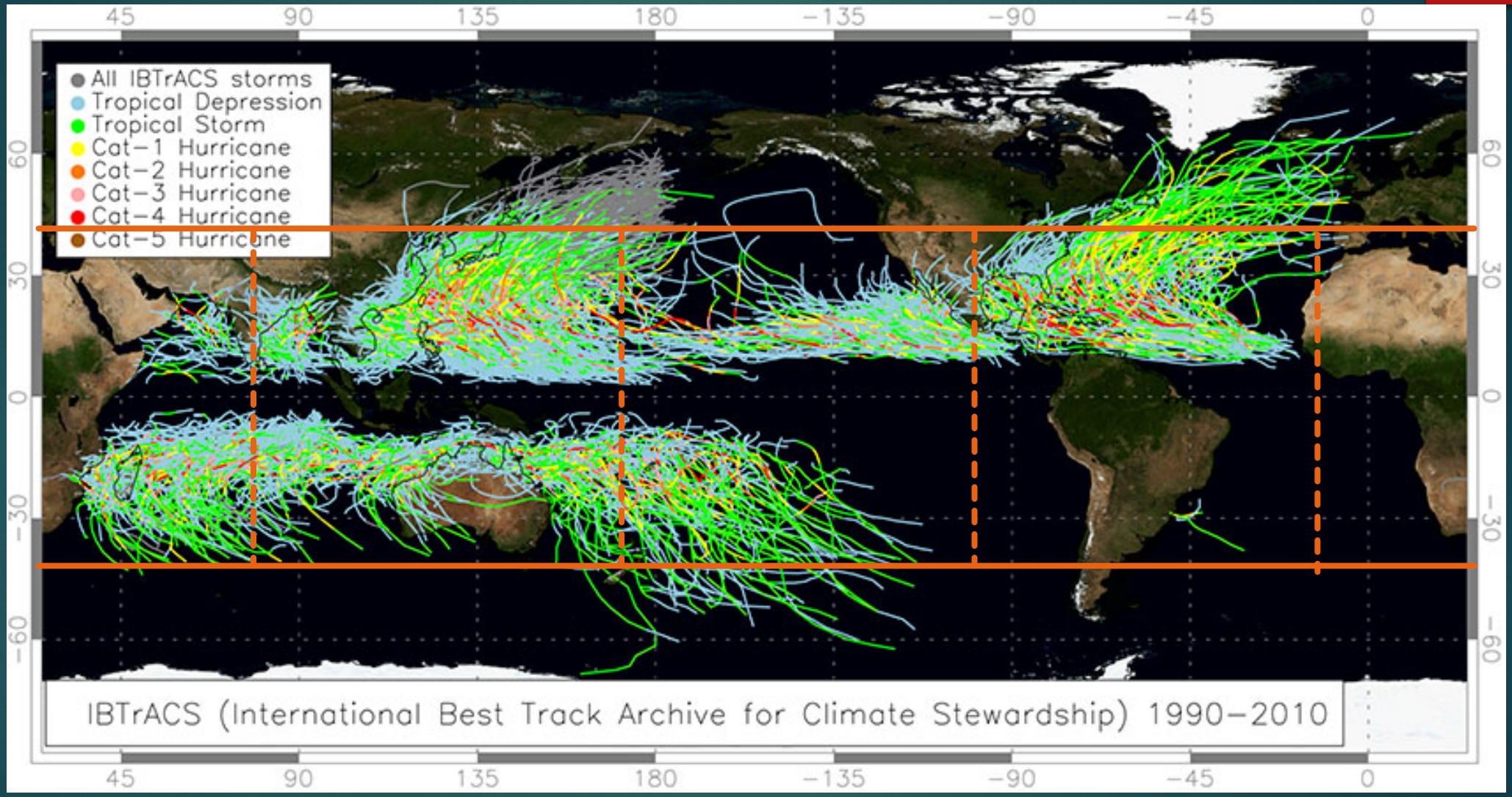
Locations of TC Lifetime Maximum Intensity



The locations of lifetime maximum intensities (LMI) of tropical cyclones for the period 1985–2014. LMI is color-coded according to category on the Saffir-Simpson Hurricane Wind Scale.

Ramsay, Hamish. 2017 "The Global Climatology of Tropical Cyclones." Oxford Research Encyclopedia of Natural Hazard Science. 15 Aug. 2018. http://naturalhazardscience.oxfordre.com/view/10.1093/acrefore/9780199389407.001.0001/acrefore-9780199389407-e-79.

Distribution of Global TC Tracks



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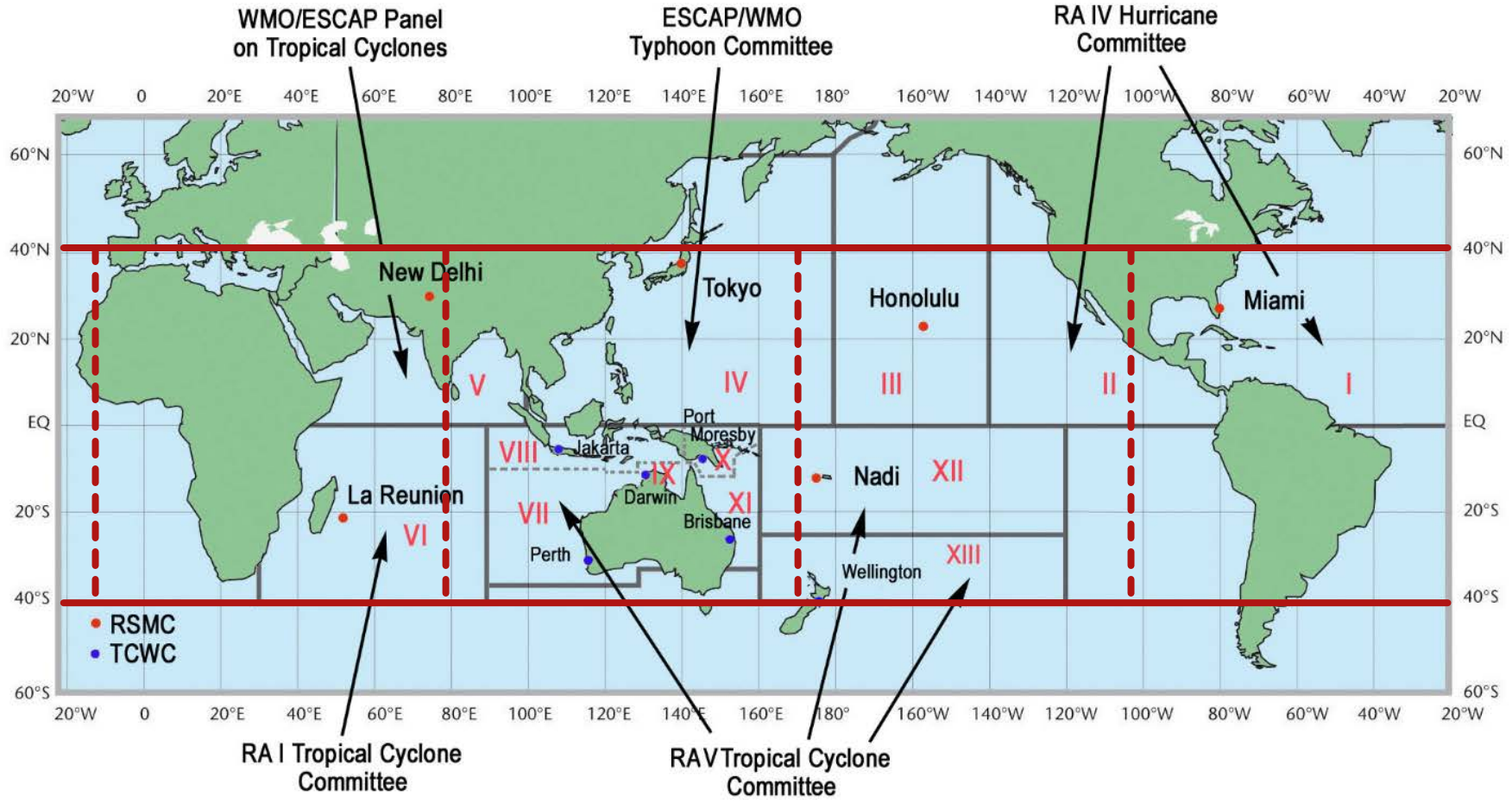
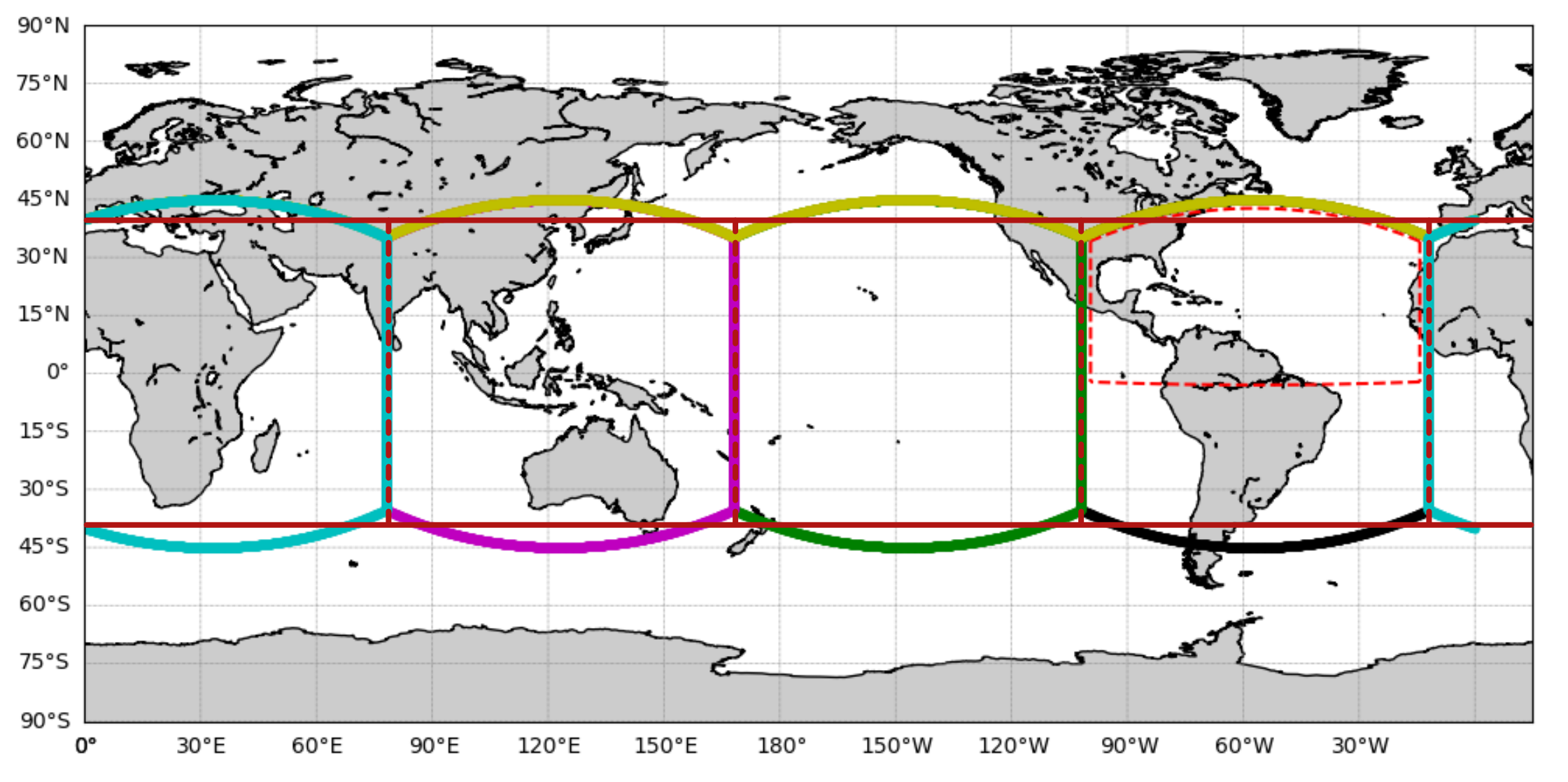
WMO Regional Specialized Meteorological Centers and TC Warning Centers

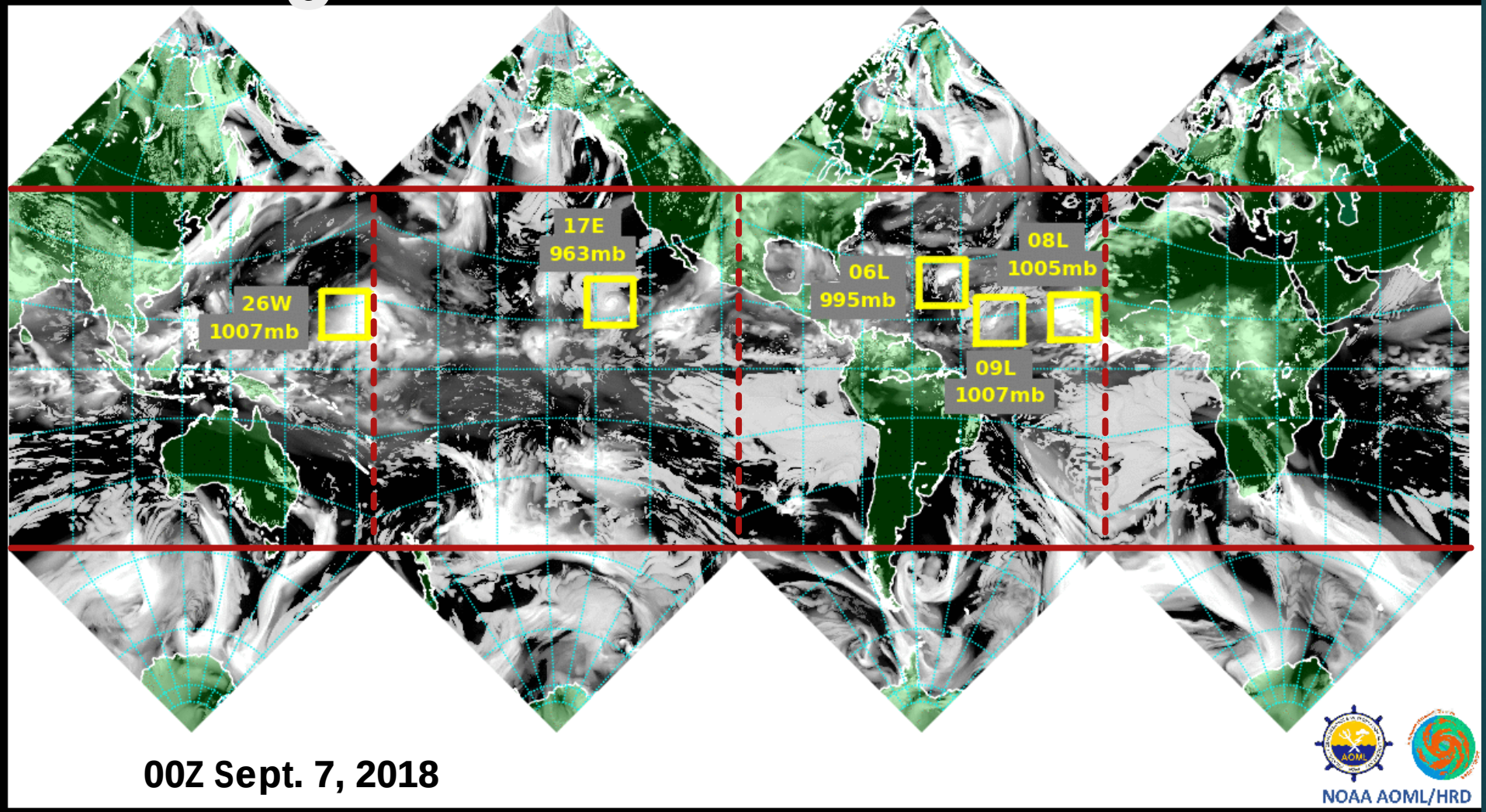


https://www.nhc.noaa.gov/aboutrsmc.shtml

Tropical Channel Configuration

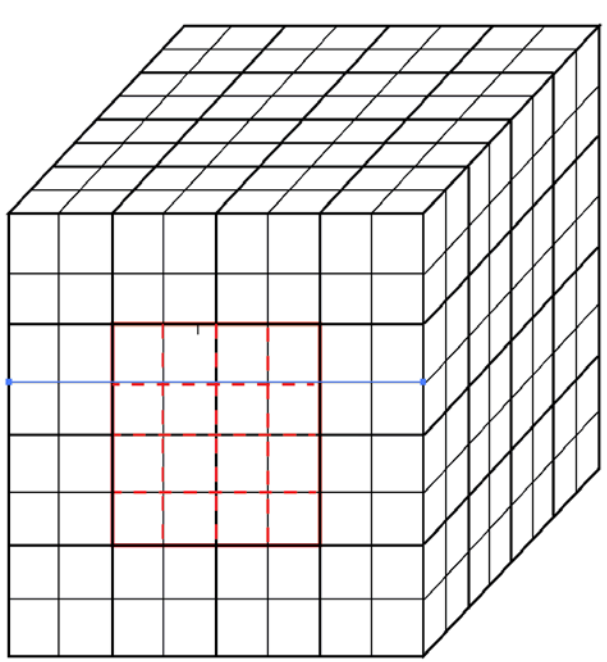


What do multiple moving nests look like in global model?

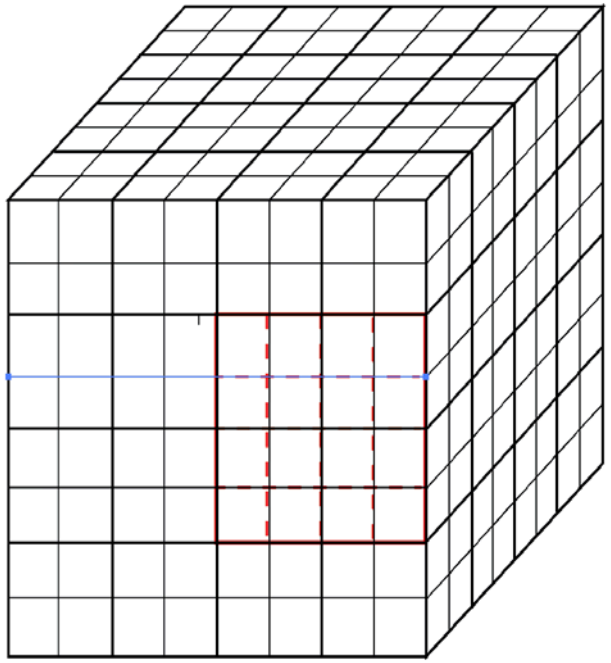


06L: Florence
08L: Helene
09L: Isaac
17E: Olivia
26W: Mangkhut

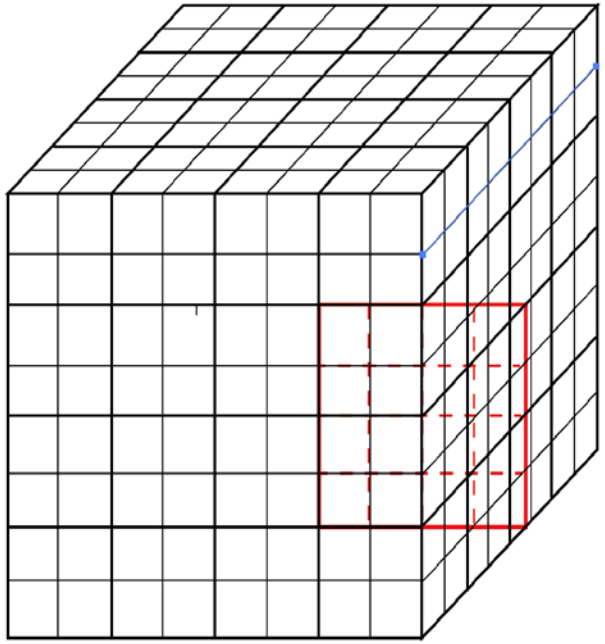
Moving grid structure



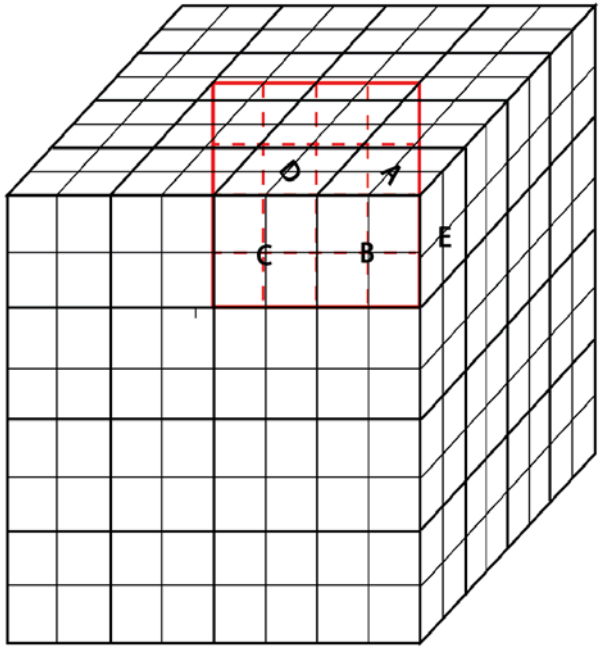
Refinement



Movement



Over edge

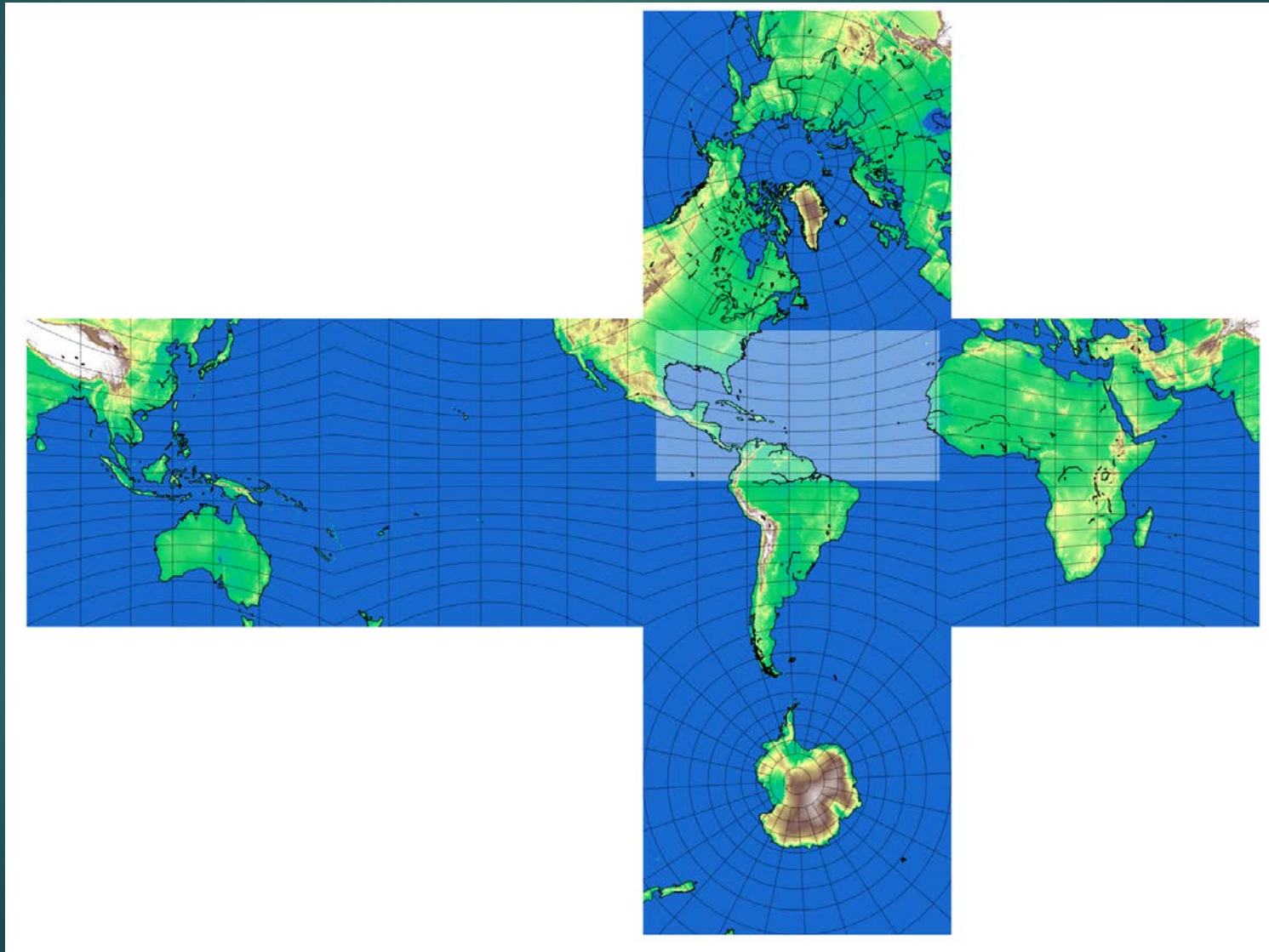


Over tri-vertex

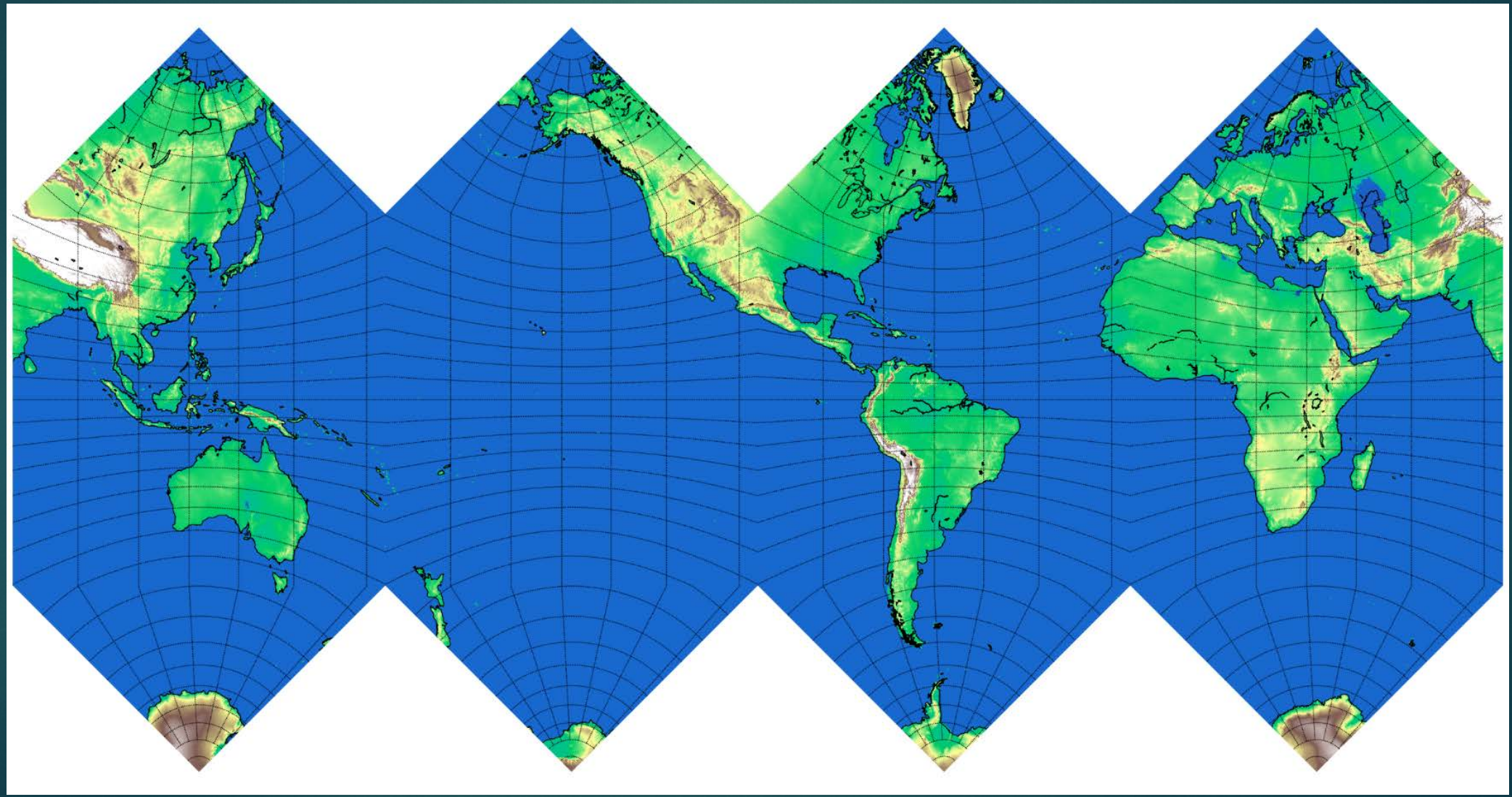
Native Grid Visualization and Representation

Accurate and intuitive visualization

Cubed Sphere Grid Representation



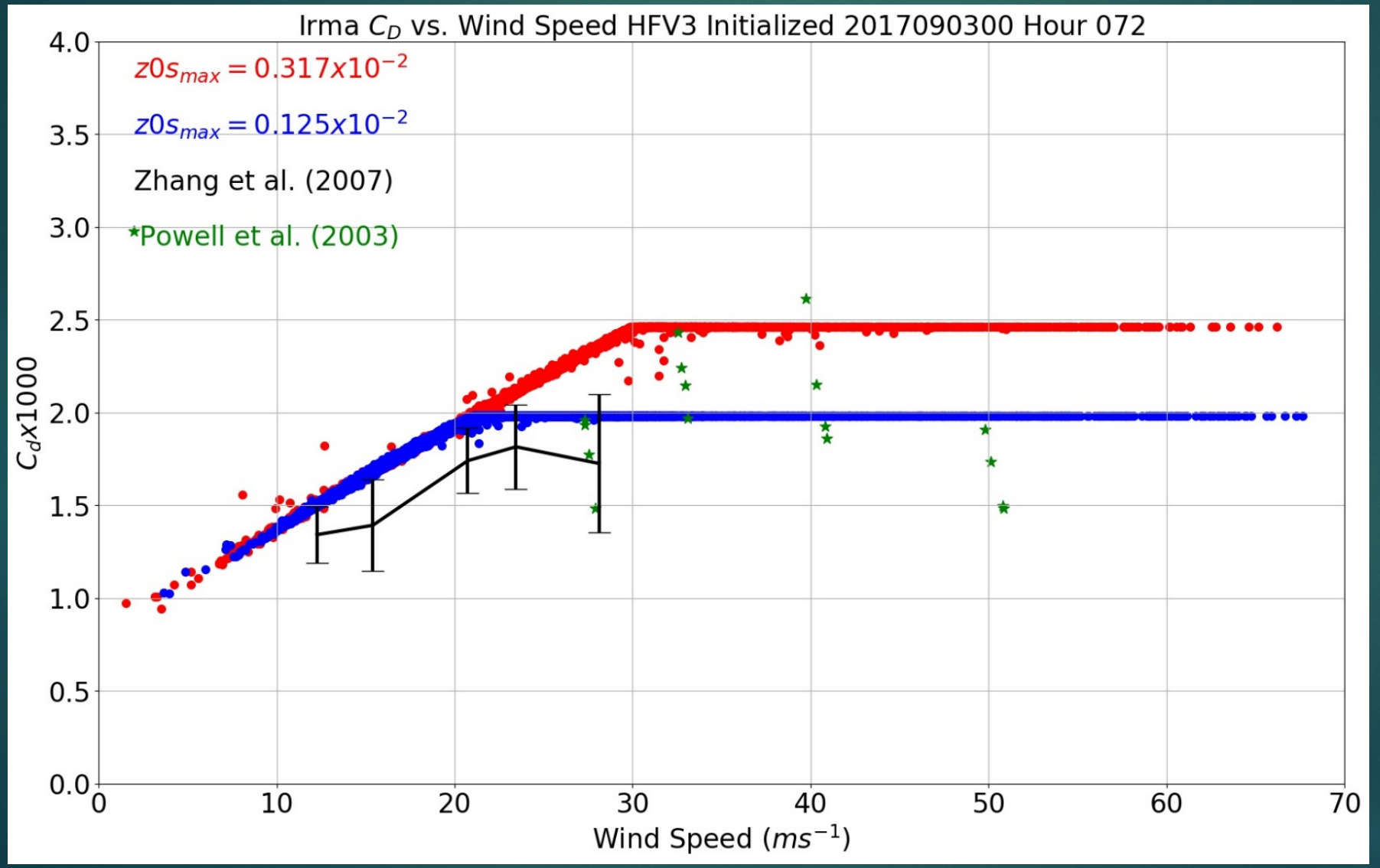
Global Native Grid Representation



Physics Parameterizations for Tropical Cyclones

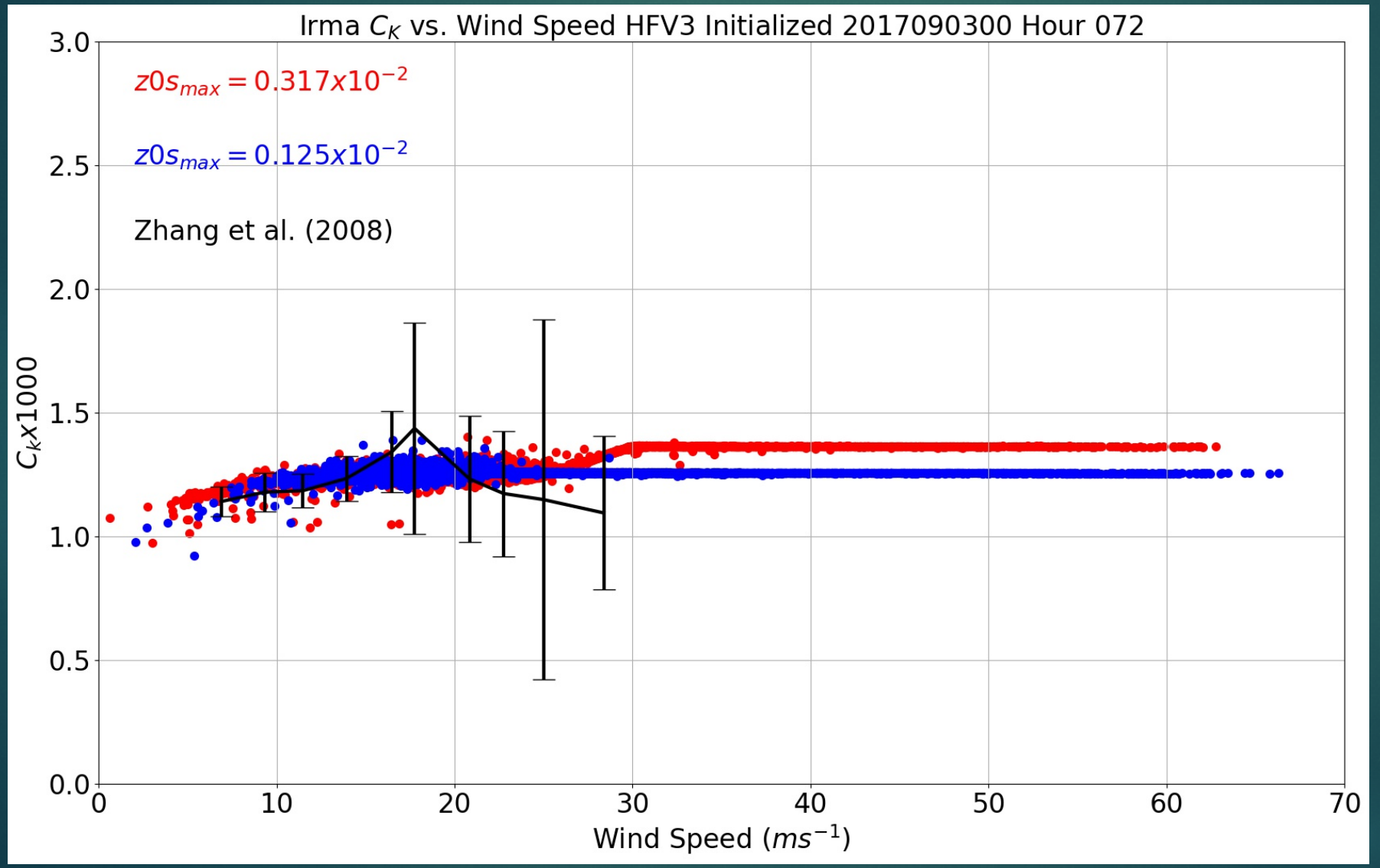
Customizing physics based on observations

Drag Coefficient



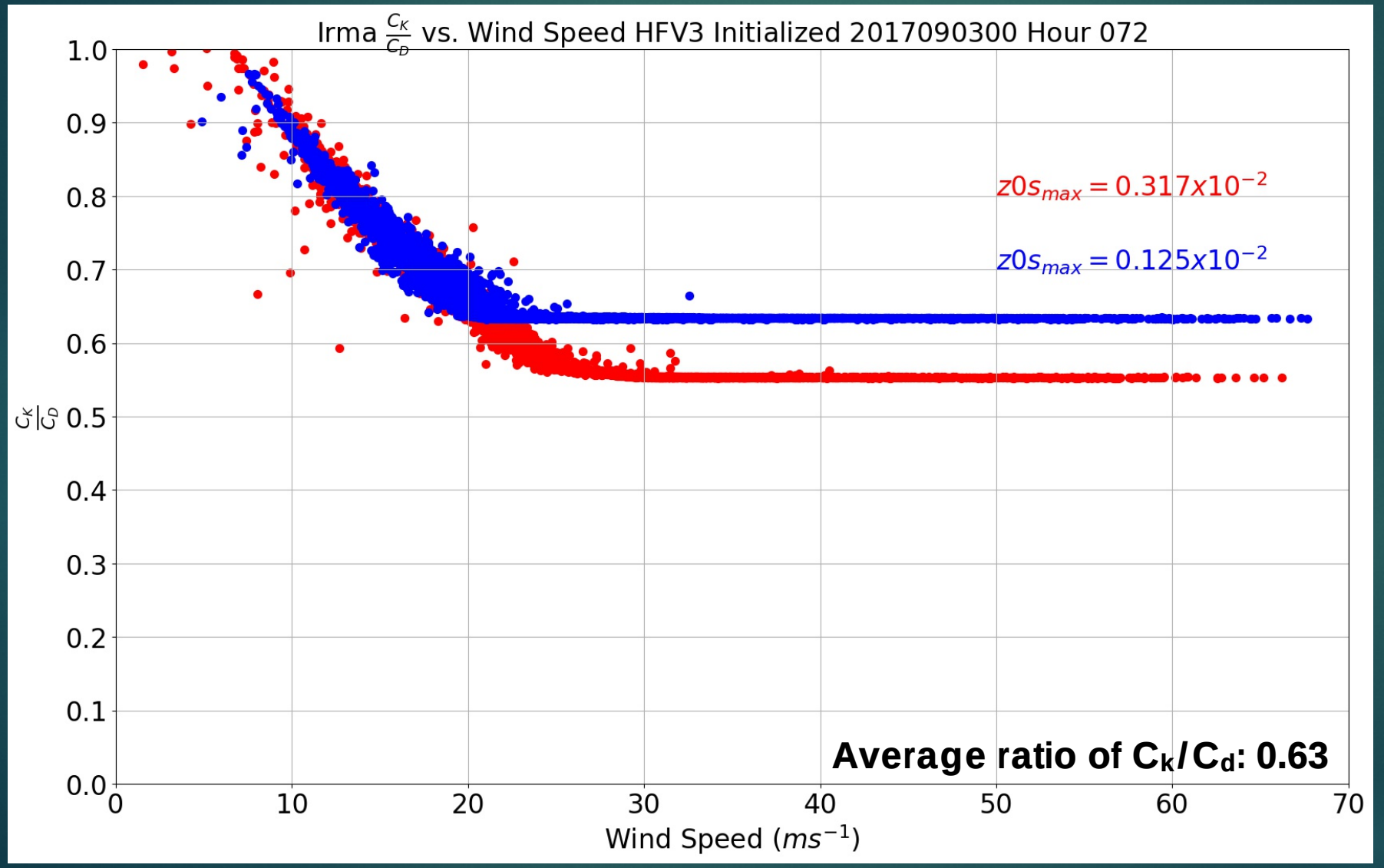
J. A. Zhang et al. (2007)
Powell et al. (2003)

Thermal Exchange Coefficient



J. A. Zhang et al. (2008)

Thermal Exchange Coefficient

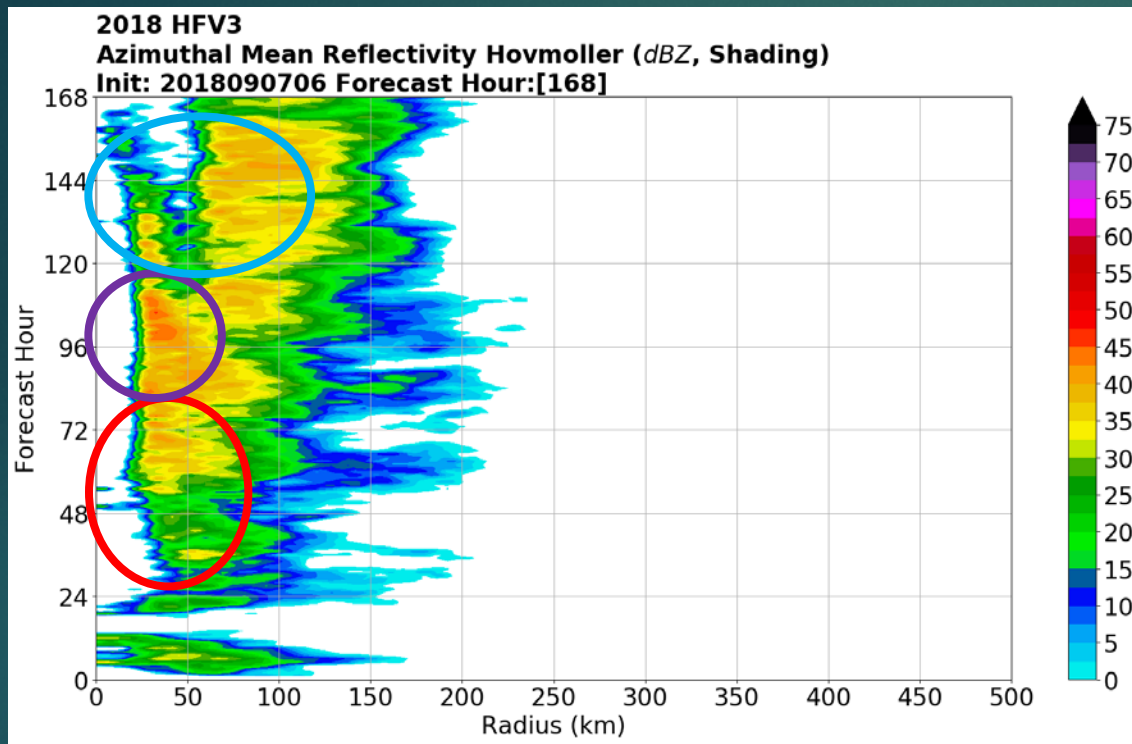


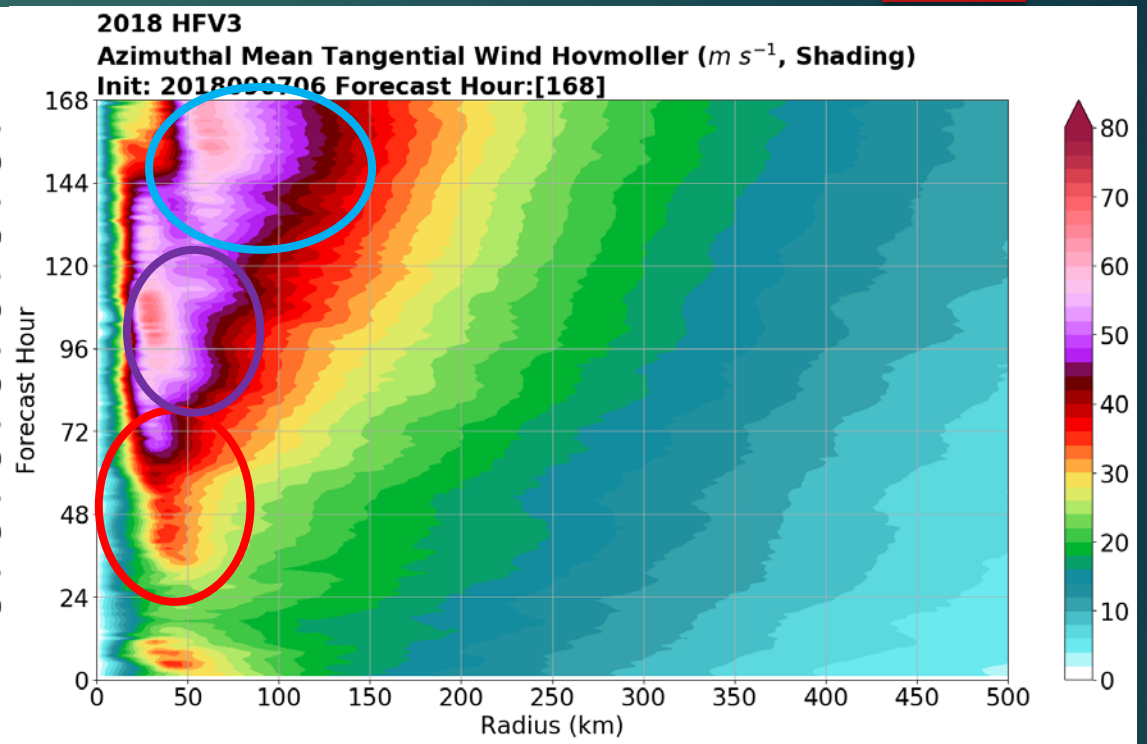
J. A. Zhang et al. (2008)

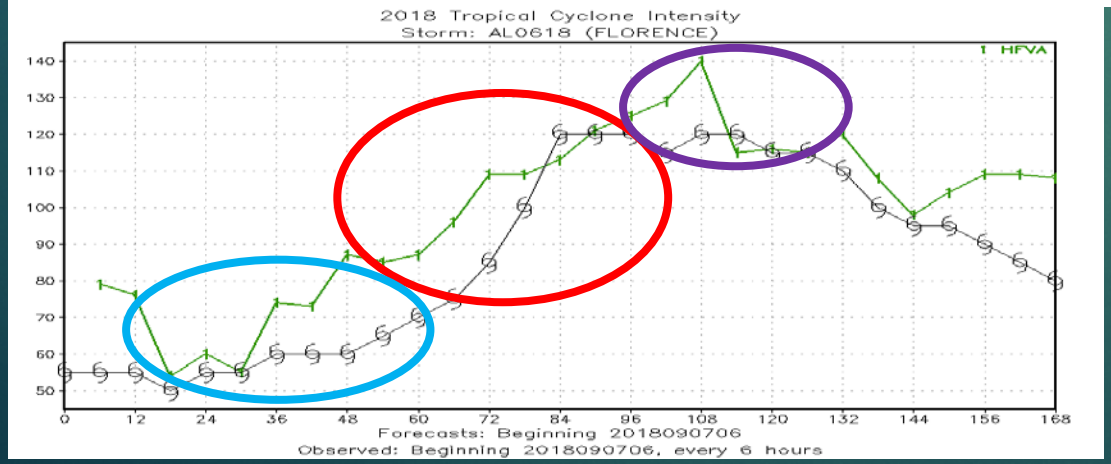
Products for Forecasts and Research

Developing customer-oriented products

Secondary Eyewall in Hurricane Florence



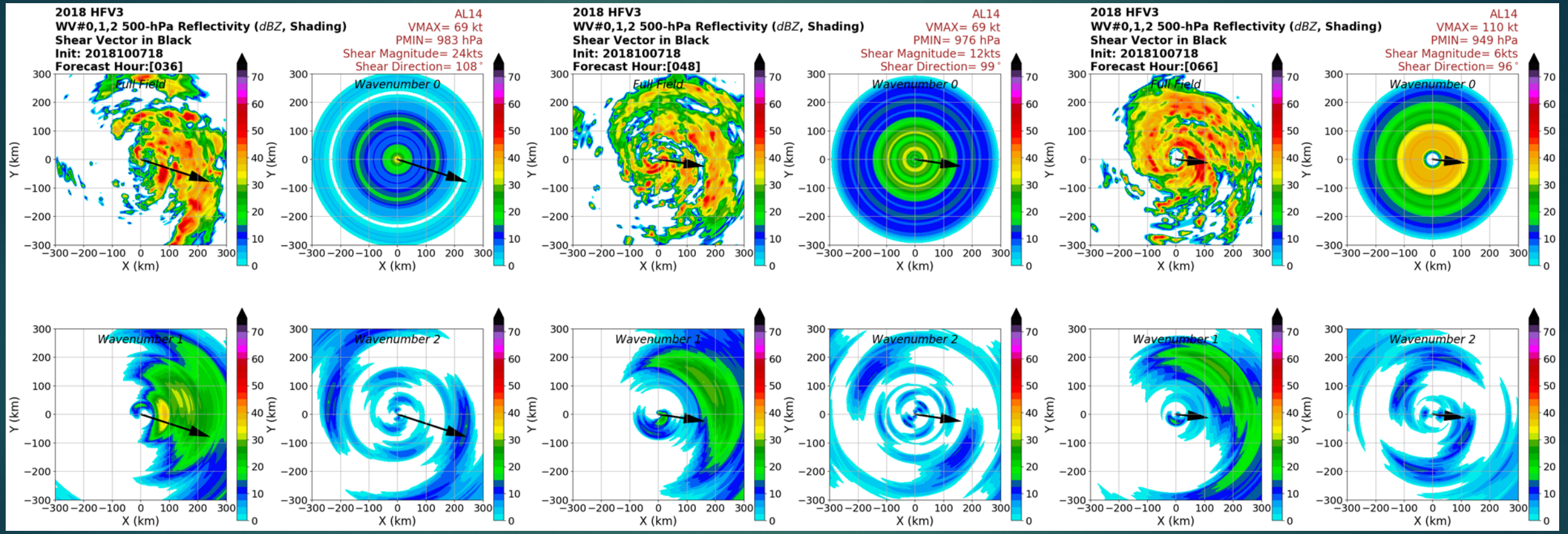




- Initial eye contraction and RI
- Asymmetric intensification despite eye staying same size
- ERC and expansion of wind field
- Diurnal cycle in convection

Michael Cylindrical Analysis

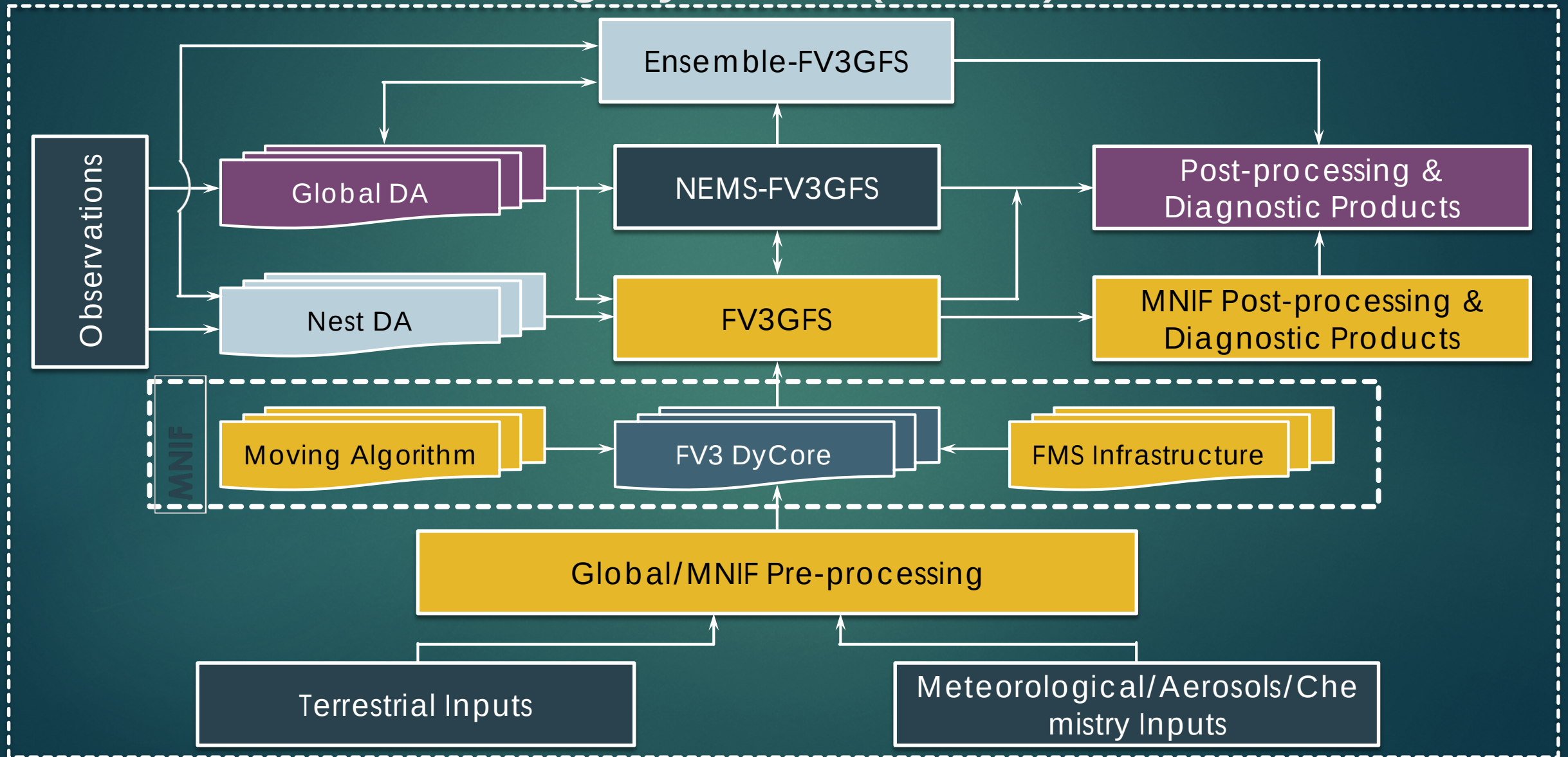
036h 048h 066h



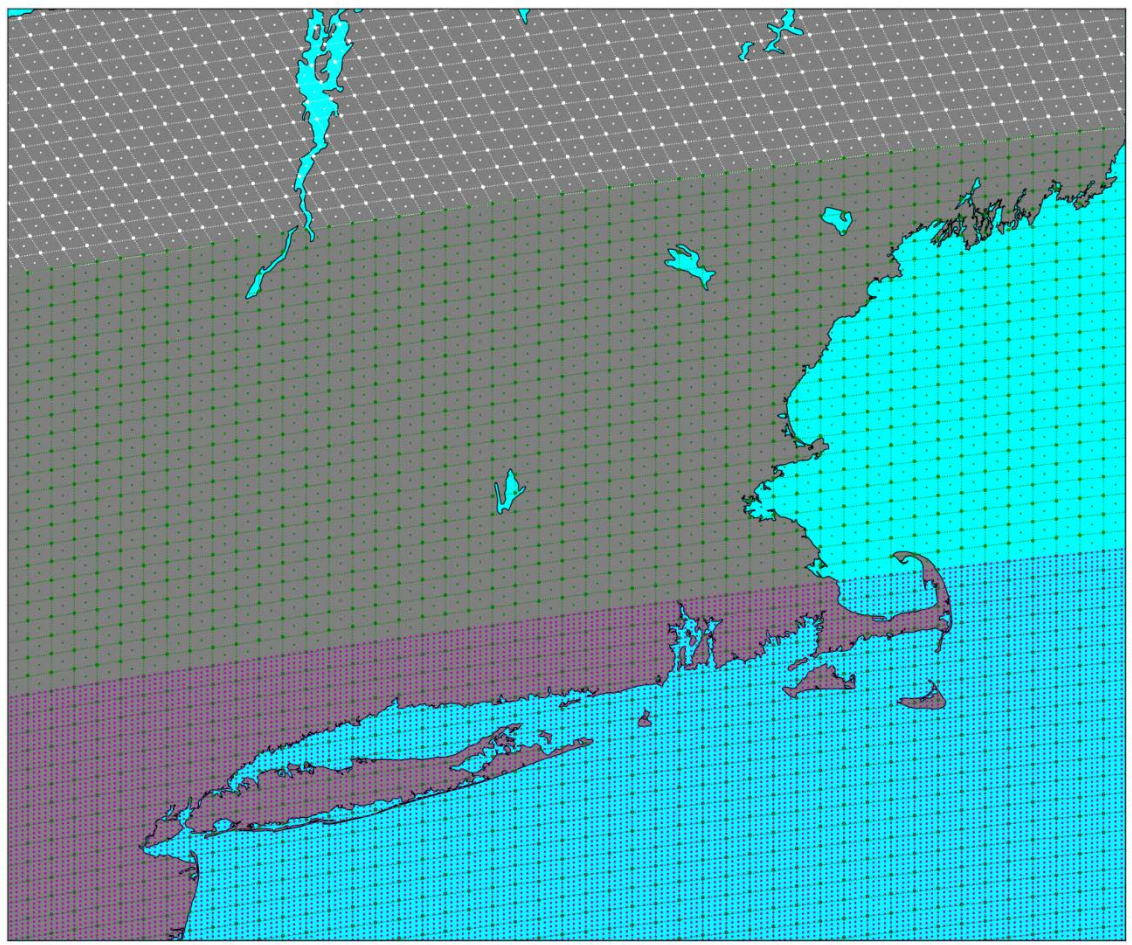
- **Wavenumber analysis shows how Michael became more symmetric as the shear decreased**

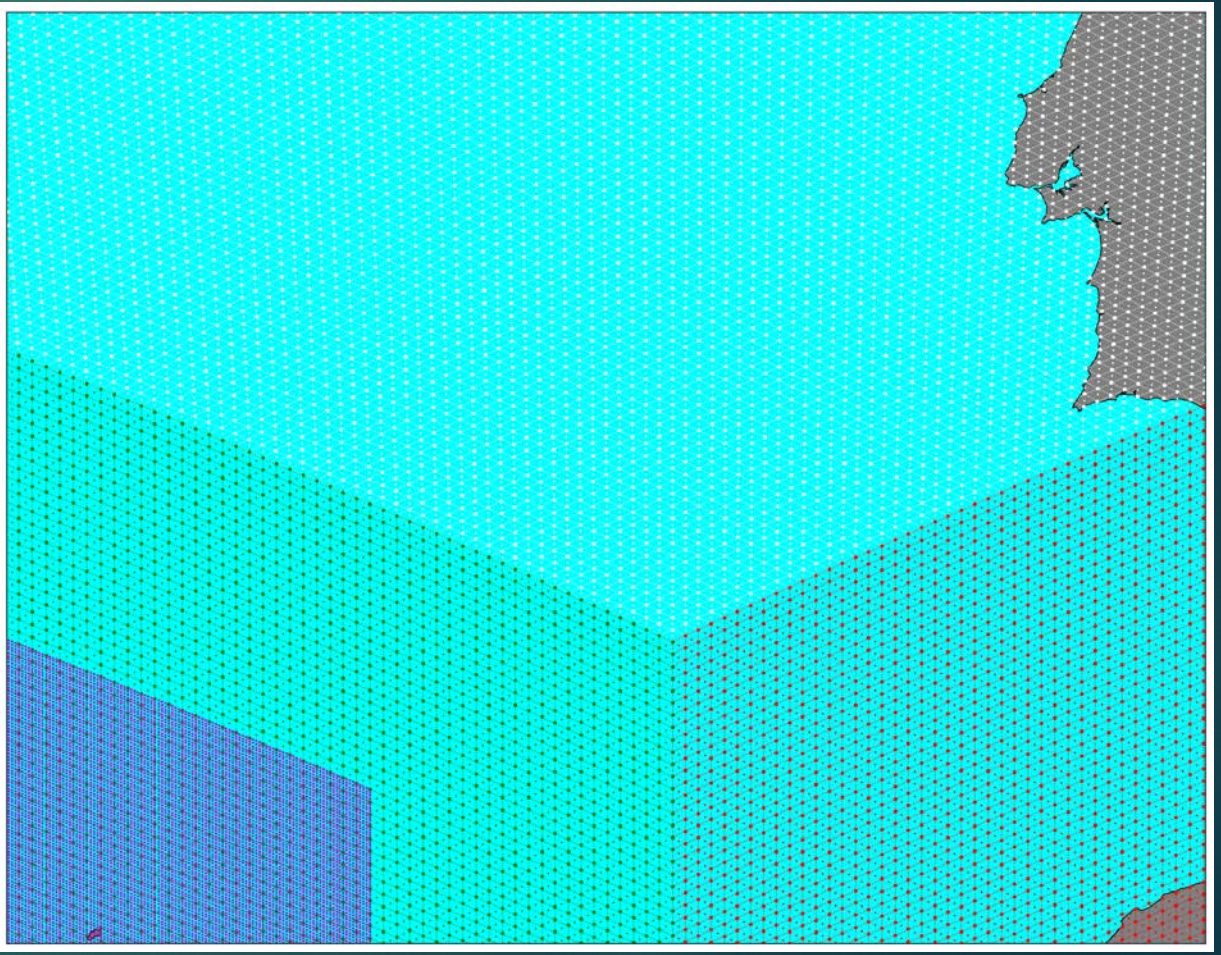
Extra Slides

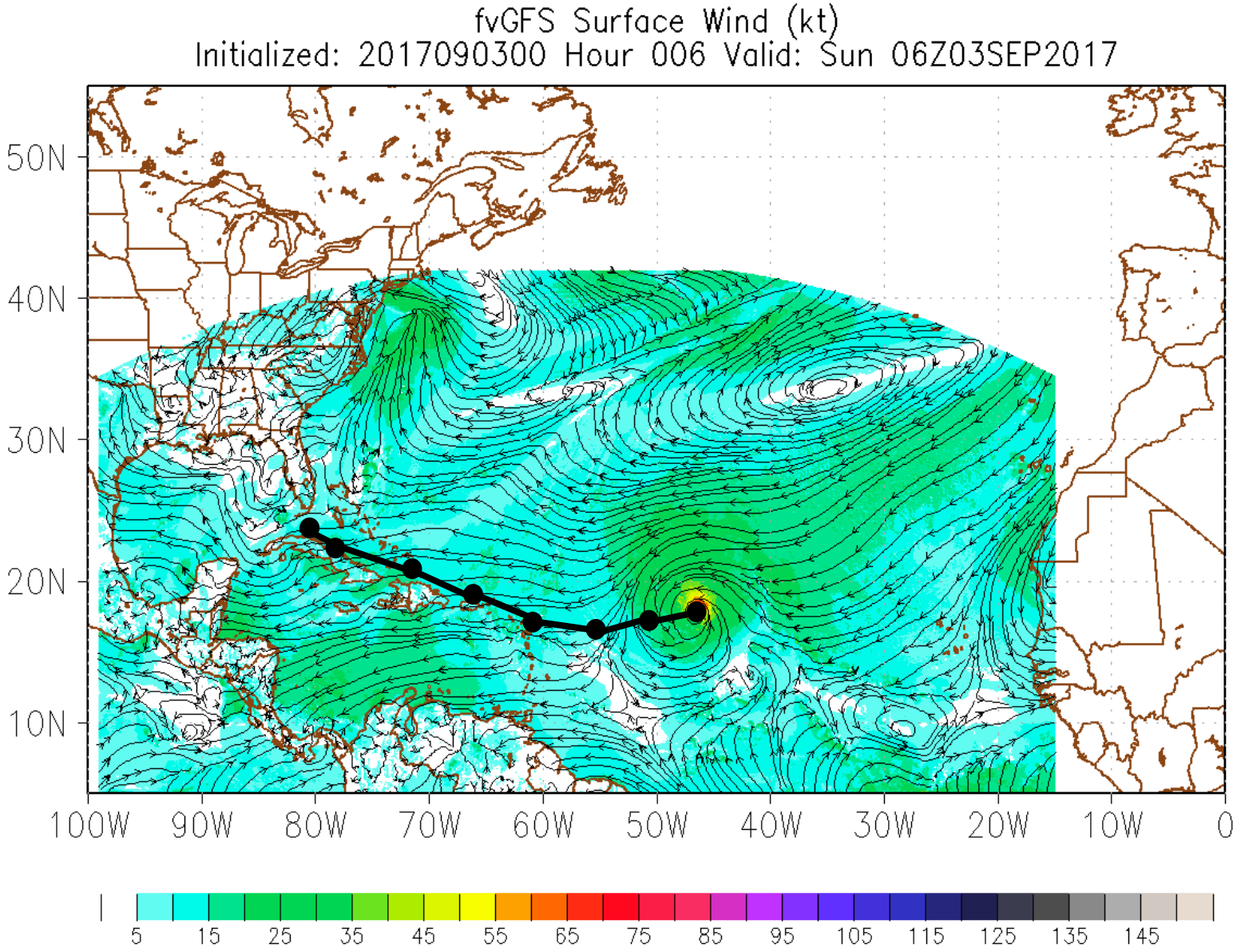
Roadmap to Hurricane Analysis & Forecasting System (HAFS)



Nest Grid Representation







- Track is generally consistent with obs (slightly NE by Day 7)
- Storm is very intense (down to 890 hPa in the model)
- Ocean coupling needed
- Evaluation and re-calibration of global physics parameterizations in tropics needed