

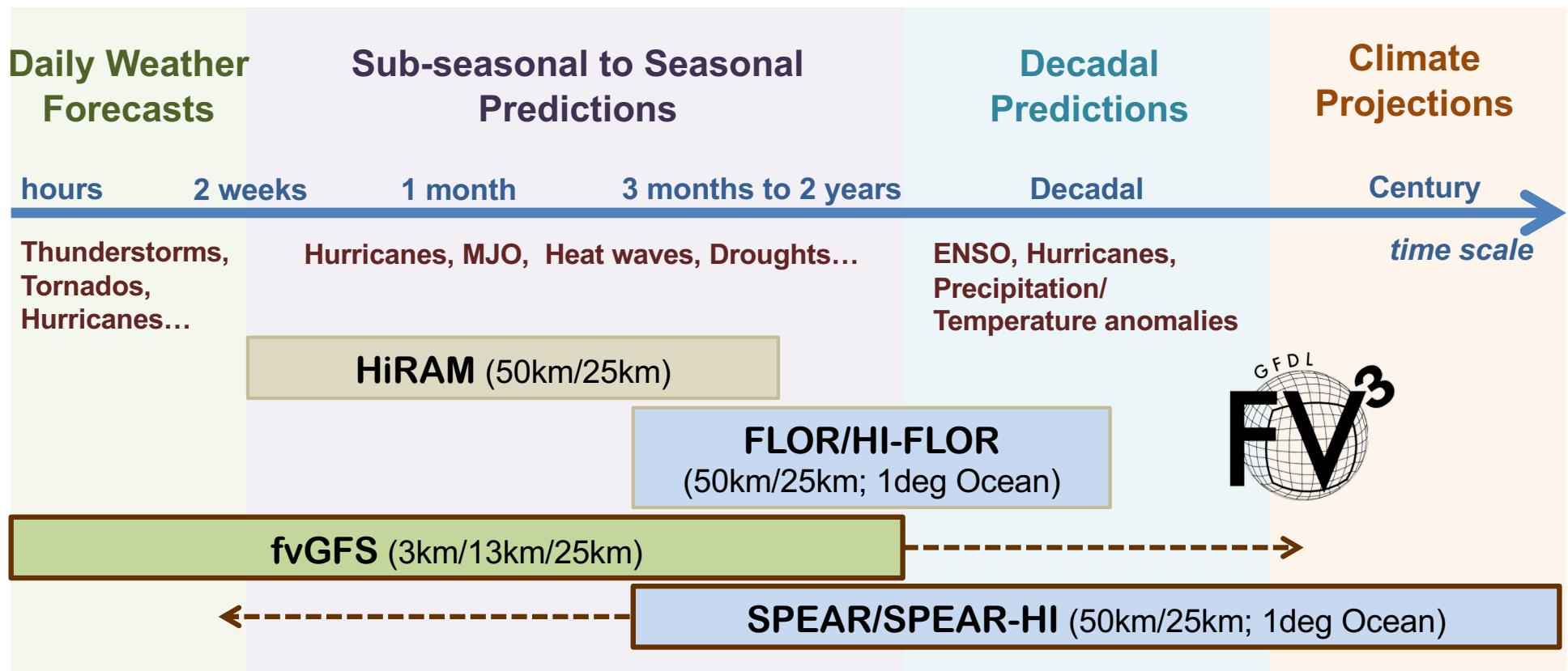


UNIFIED MODELING AT GFDL

Lucas Harris
with contributions by Jan-Huey Chen,
Morris Bender, and Andy Hazelton

for S-J Lin and the GFDL FV3 Team

GFDL Prediction Modeling System



From Weather Forecasts to S2S Prediction

GFDL fvGFS

The finite-volume Global Forecast System
A prototype for the Unified Forecast System

Nonhydrostatic FV3 dynamical core coupled to a heavily-modified GFS Physics suite and NOAH land model

- GFS EDMF PBL → **YSU PBL**

Courtesy Hailey Shin, UCAR/GFDL

- **Fully-Inlined GFDL six-category MP**

L. Zhou et al. (2019, BAMS)

- Specified SST → **Mixed-layer ocean**

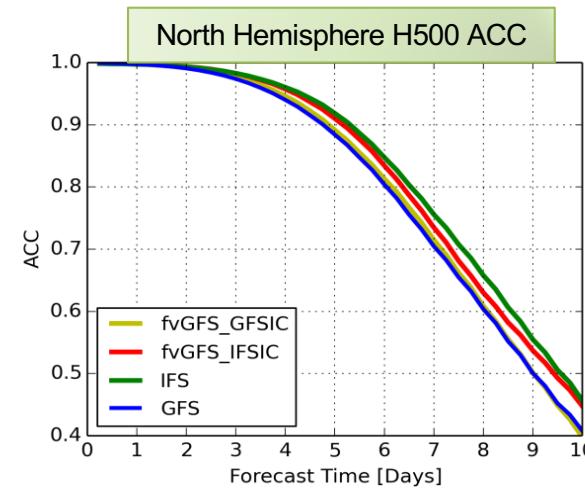
Courtesy Baoqiang Xiang, UCAR/GFDL

- **Scale-Aware SAS shallow/deep convection**

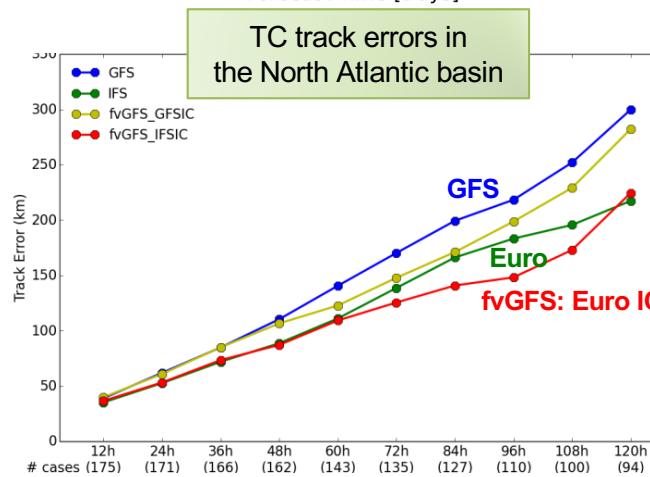
J-I Han et al, (2017, MWR)

- **Initialization from GFS or ECMWF analyses**

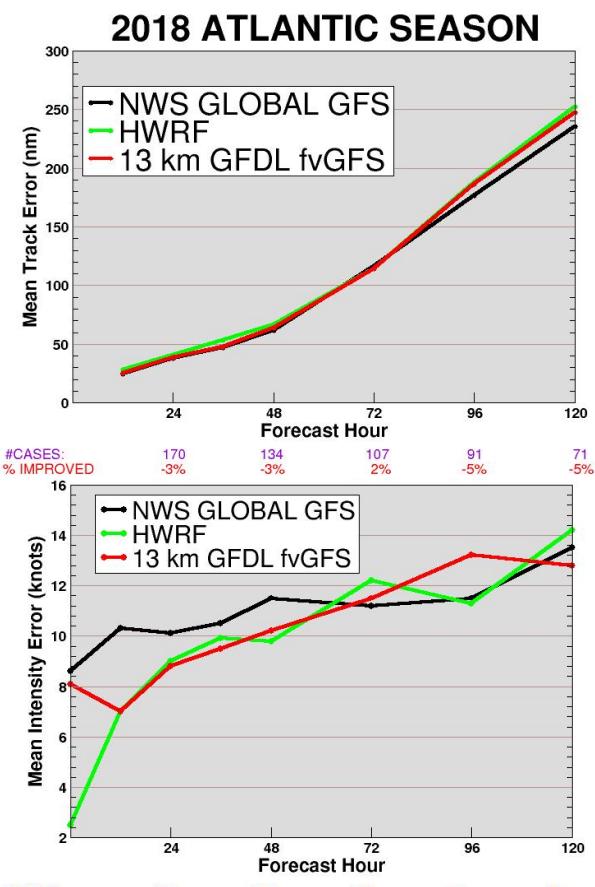
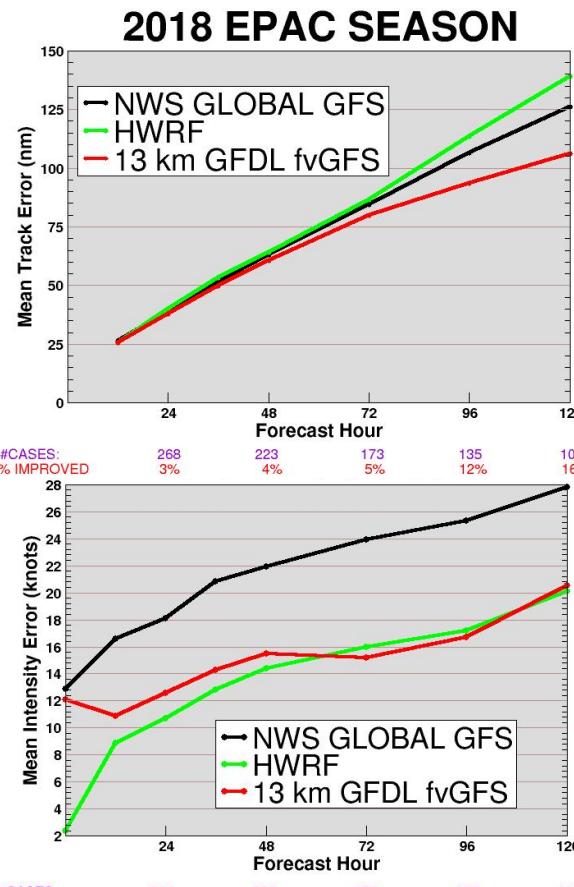
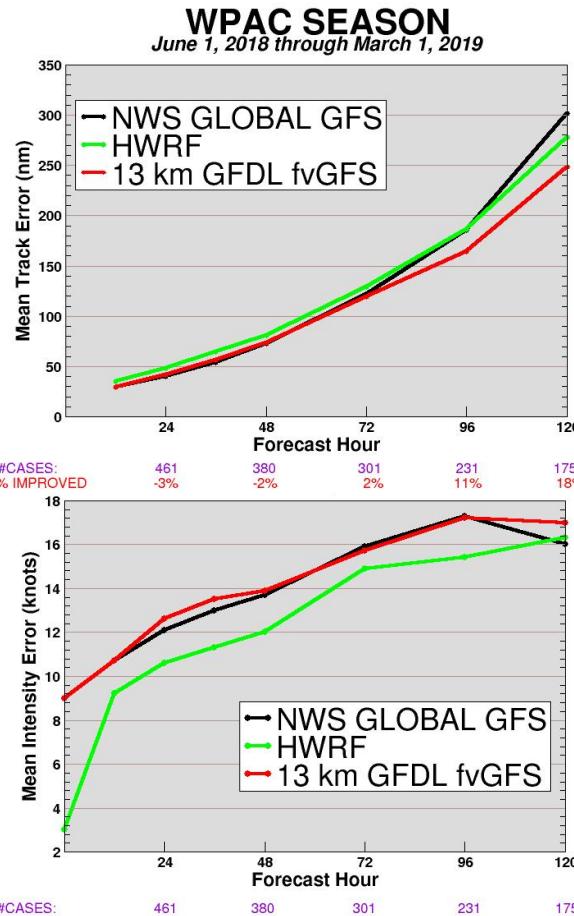
J-H Chen et al, 2018; Proc. 33rd Tropical Conf.



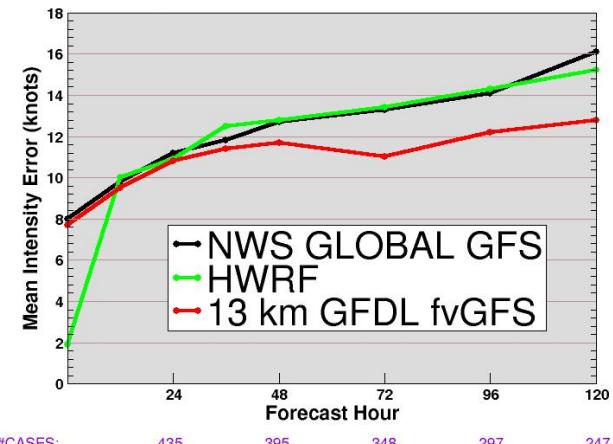
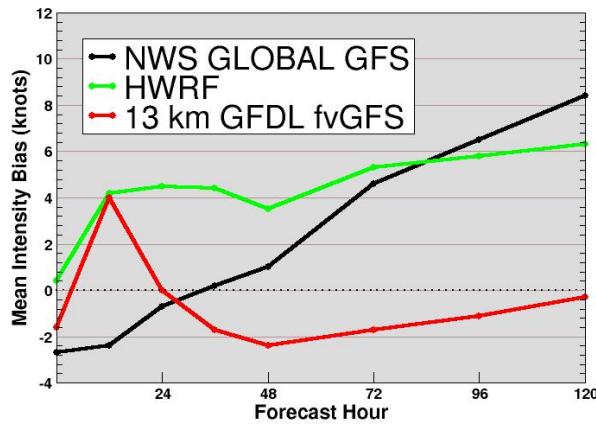
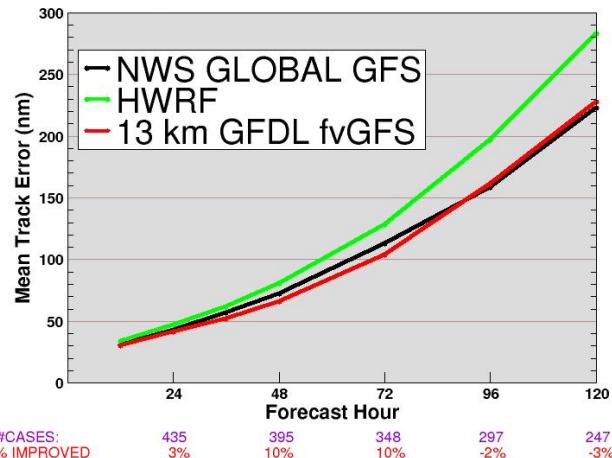
13-km fvGFS (v2018)
Chen et al. 2019 GRL



fvGFS: Track + Intensity Errors



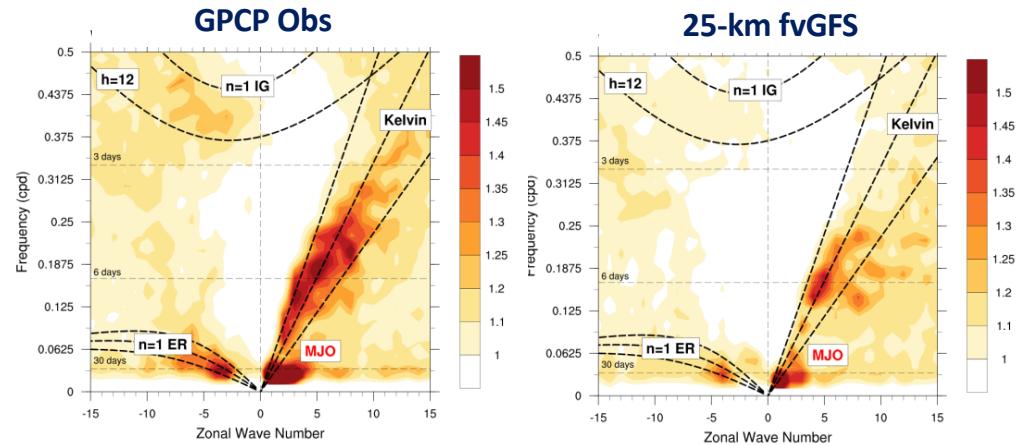
fvGFS: Southern Hemisphere TCs



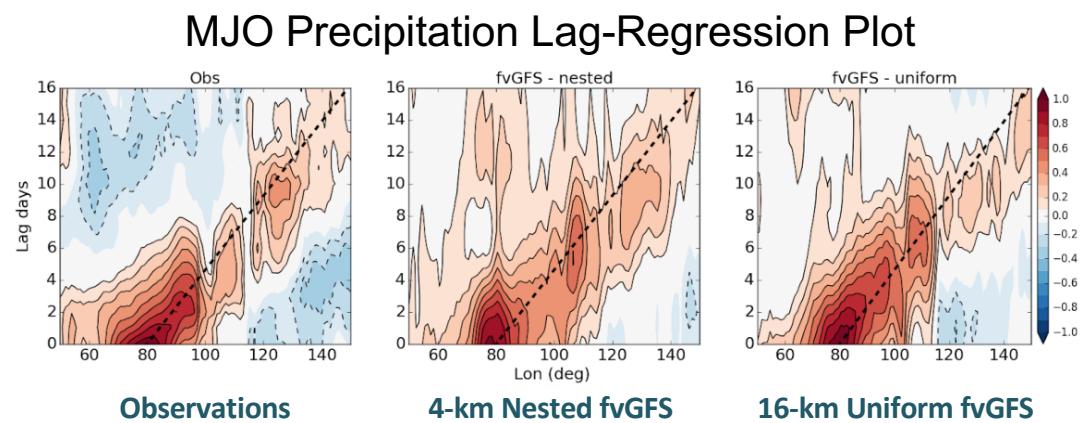
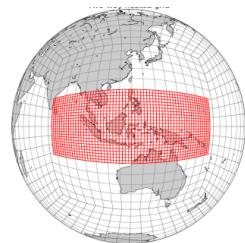
1 Sep 2018–20 Mar 2019 Southern Hemisphere

GFDL fvGFS for S2S & MJO Prediction

- 25-km S2S prediction model
 - Courtesy Jan-Huey Chen & Yongqiang Sun
- Preliminary 10-year climatology run:
Good MJO and CCEW variability
 - Further improvement through better air-sea interactions



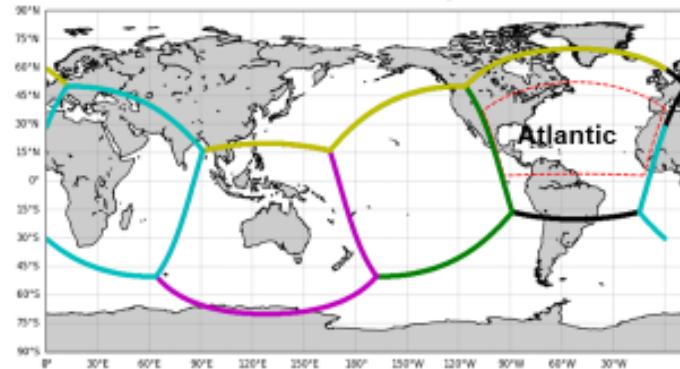
- Variable-resolution fvGFS
 - Courtesy Lucas Harris & Kun Gao
- Efficient two-way 4-km nest improves propagation of MJO across maritime continent



hfvGFS 2019: Triple Alliance

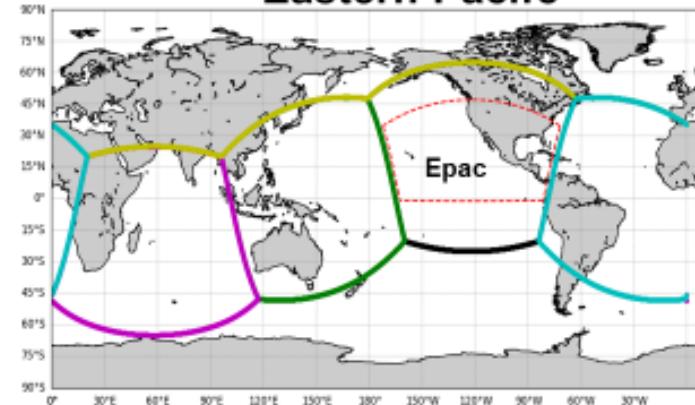
- EMC is running 3-km Atlantic nest
- **New for 2019:** GFDL and AOML will run nests in the Pacific basins, each twice-daily or on a priority basis

Atlantic Grid Configuration

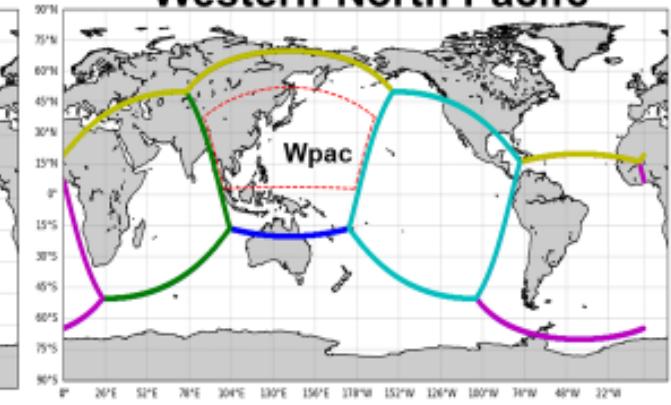


Courtesy
Andy Hazelton
(HRD)

Eastern Pacific



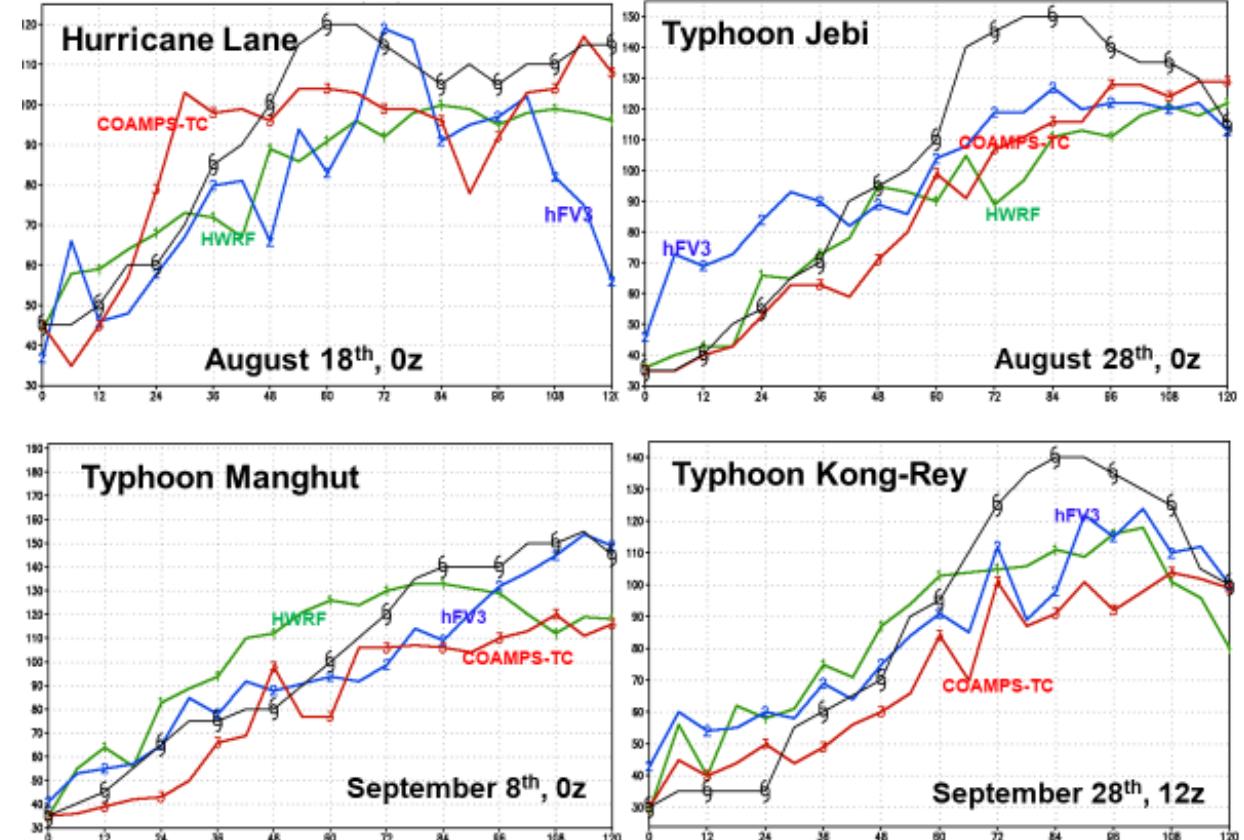
Western North Pacific



hfvGFS: Pacific Basin RI events

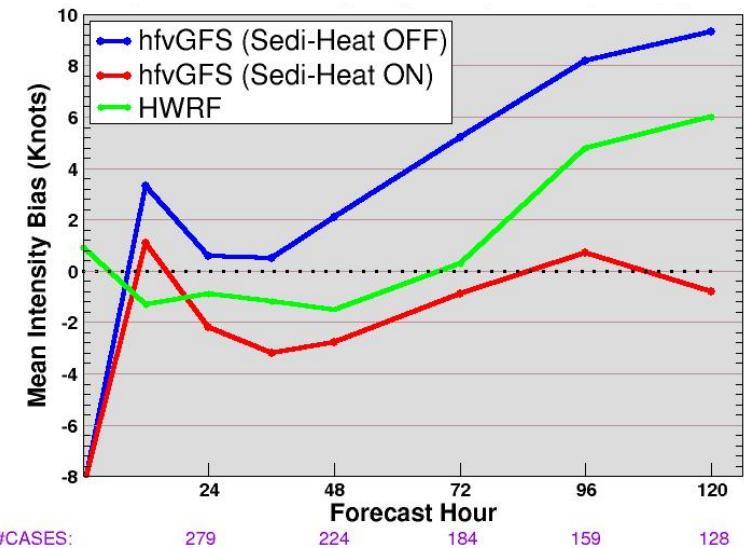
hfvGFS intensity forecasts comparable to HWRF and COAMPS-TC

hfvGFS better predicts maximum intensity than existing models

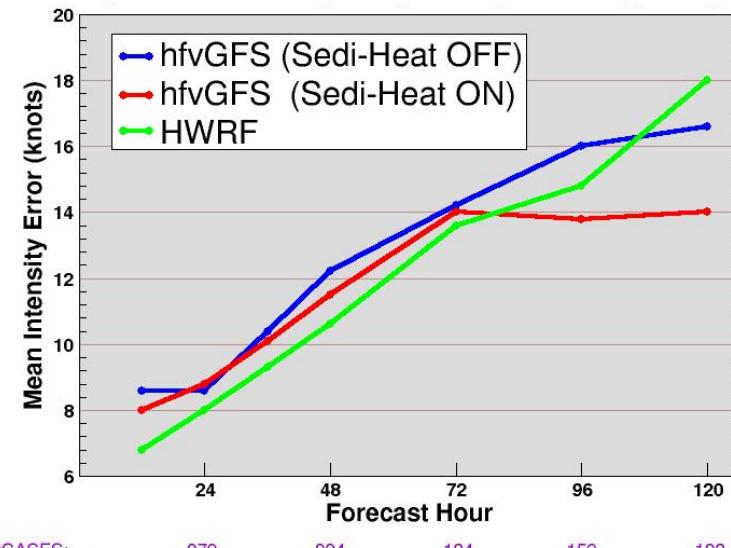


hfvGFS: Sensitivity to Microphysics

Intensity Bias



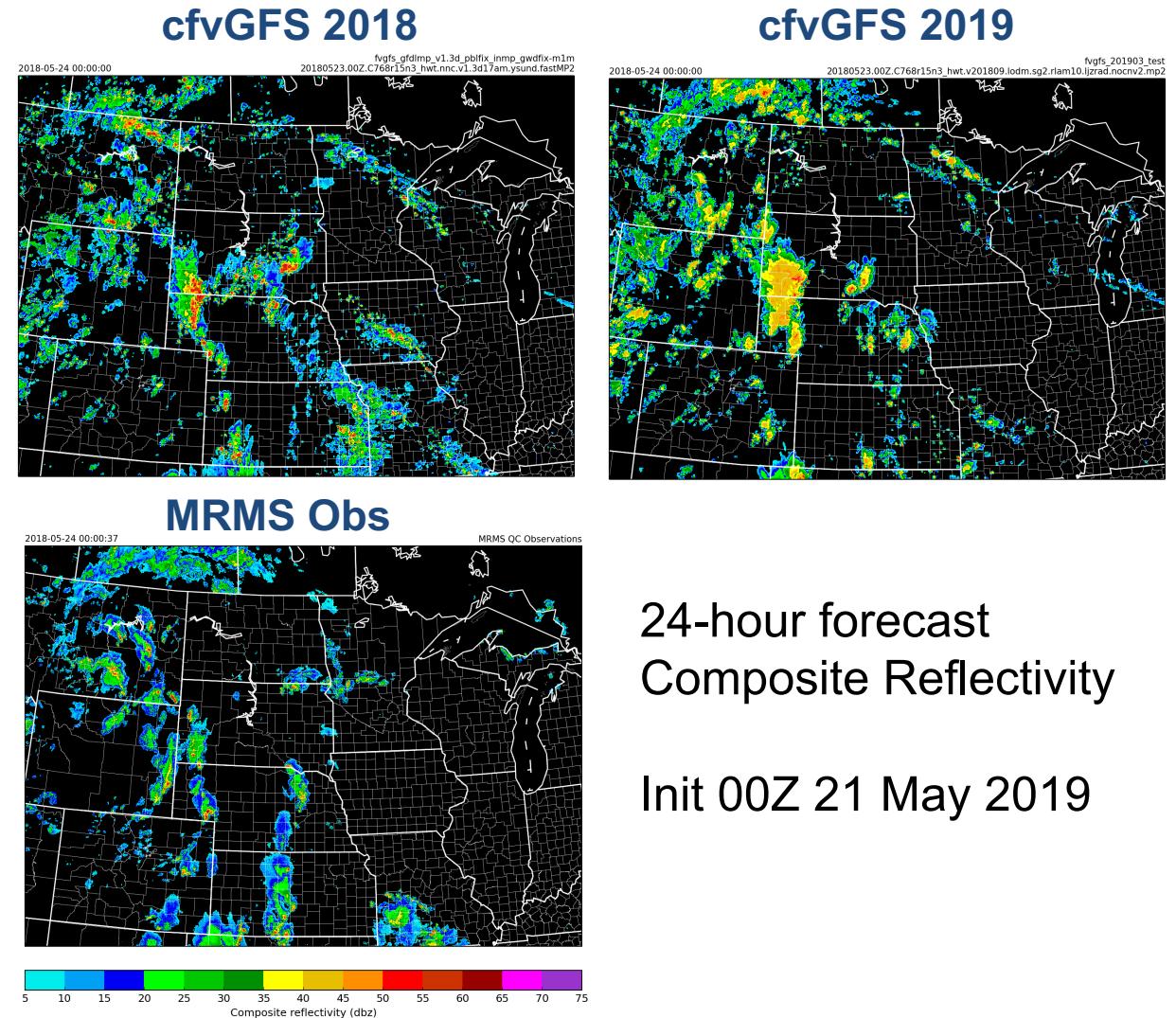
Intensity Error



2018 Atlantic Hurricane Season

cfvGFS 2019: HWT Spring Experiment

- Re-tuned GFDL MP for better reflectivity and reduced intense precipitation
 - Still working on moderate → intense coverage
- Scale-aware shallow SAS (no deep) reduces over-active convection
- Re-configured YSU PBL to address undermixing, surface wet bias, and instabilities
- FV3 is virtually inviscid in the vertical



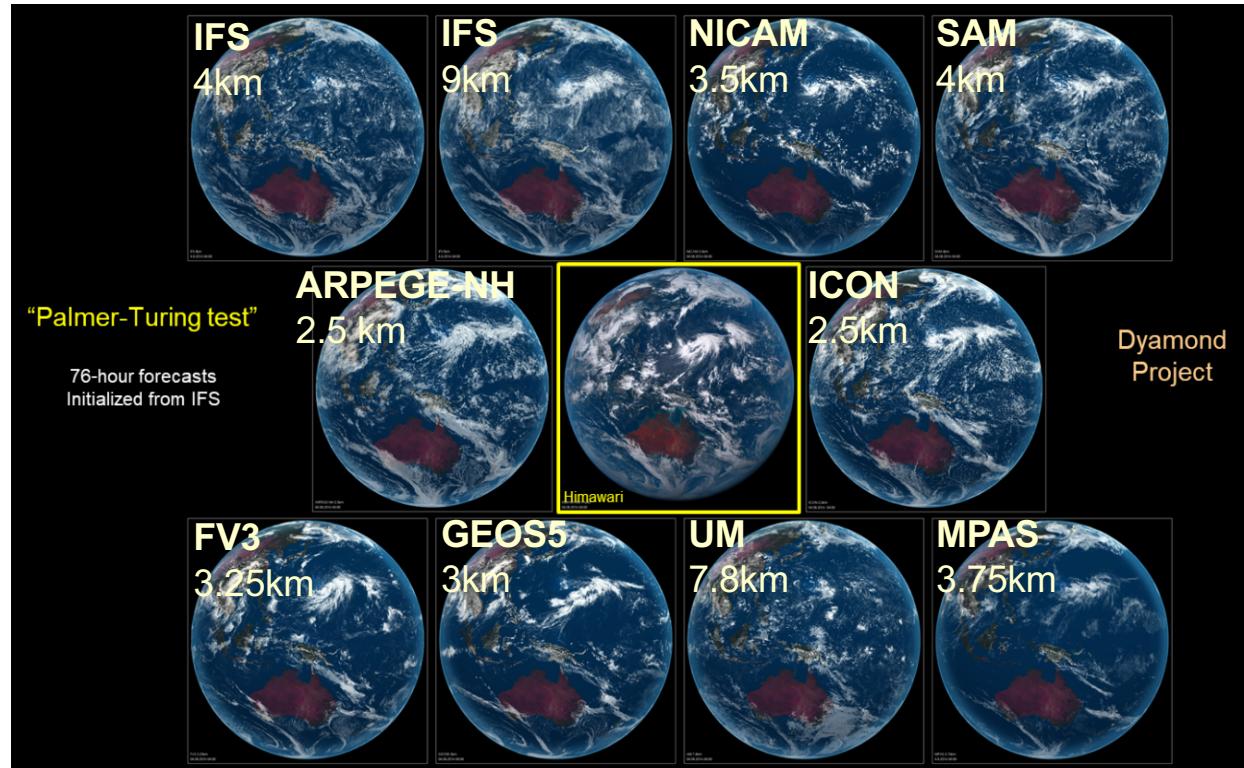
24-hour forecast
Composite Reflectivity

Init 00Z 21 May 2019

DYAMOND 40-Day Simulations

- First International inter-comparison of global cloud-resolving models

The screenshot shows the esiwace website interface. At the top, there is a navigation bar with tabs: OVERVIEW, RESULTS, EVENTS, SERVICES, and CONTEXT. The SERVICES tab is selected, showing a dropdown menu with options: Cyc, OpenIFS, NEMO, OASIS3-MCT, XIOS, and DYAMOND. The DYAMOND option is highlighted with a blue square. Below the navigation, the page title is "DYAMOND". A brief description states: "DYAMOND stands for DYNAMICS of the Atmospheric general circulation Modeled On Non-hydrostatic Domains." To the right is a search bar with "Search Site" and "OK" buttons. Below the search is a section titled "UPCOMING EVENTS" with a link to "5th ENES HPC Workshop May 17, 2018 - May 18, 2018 Lecce (Italy)". There are also links for "Previous events...", "Upcoming events...", and "More...". A "COMMUNITY INFORMATION" section shows a date "Jan 24, 2018" and a link to "French minister of science visits university of Hamburg Sep 22, 2017". Another link points to "ENES HPC Task Force Newsletter (Sep 2017) available Sep 22, 2017". At the bottom, it says "More..." and shows a "2.5km global atmospheric simulation using the ICON model" with a map of the world.



- Participants:

- FV3 (GFDL)
- NICAM
- ICON
- UKMO-UM
- MPAS
- GEOS
- ARPEGE-NH
- ECMWF-IFS
- SAM

S-J Lin, Linjiong Zhou & Xi Chen