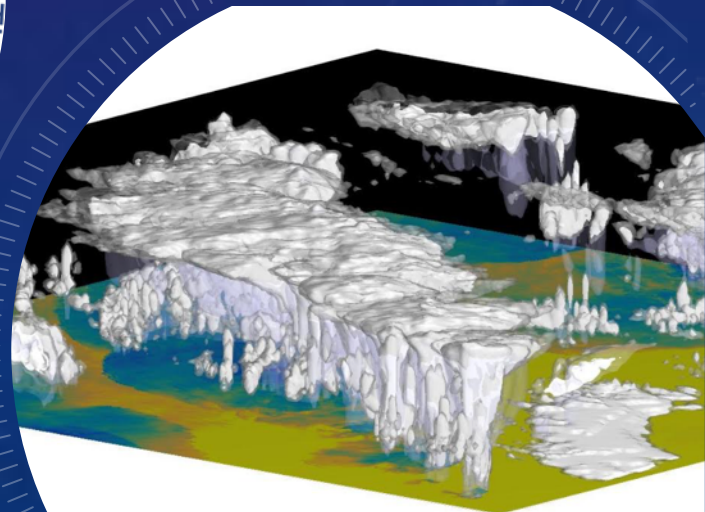
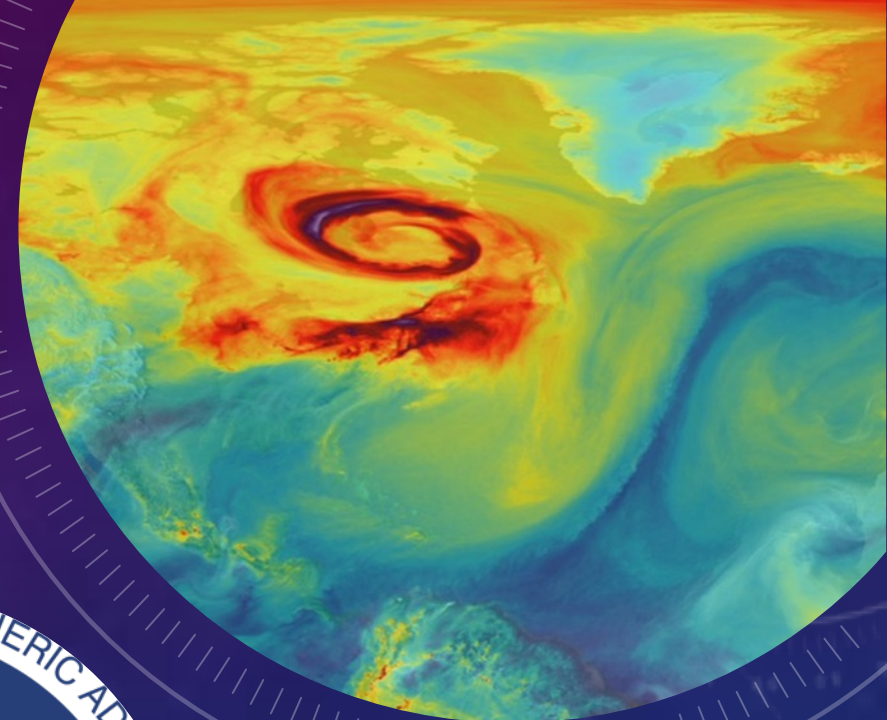
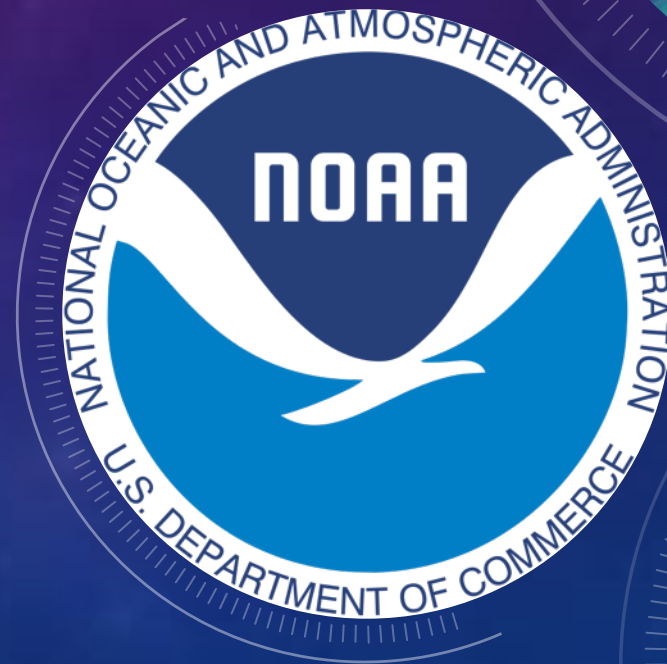


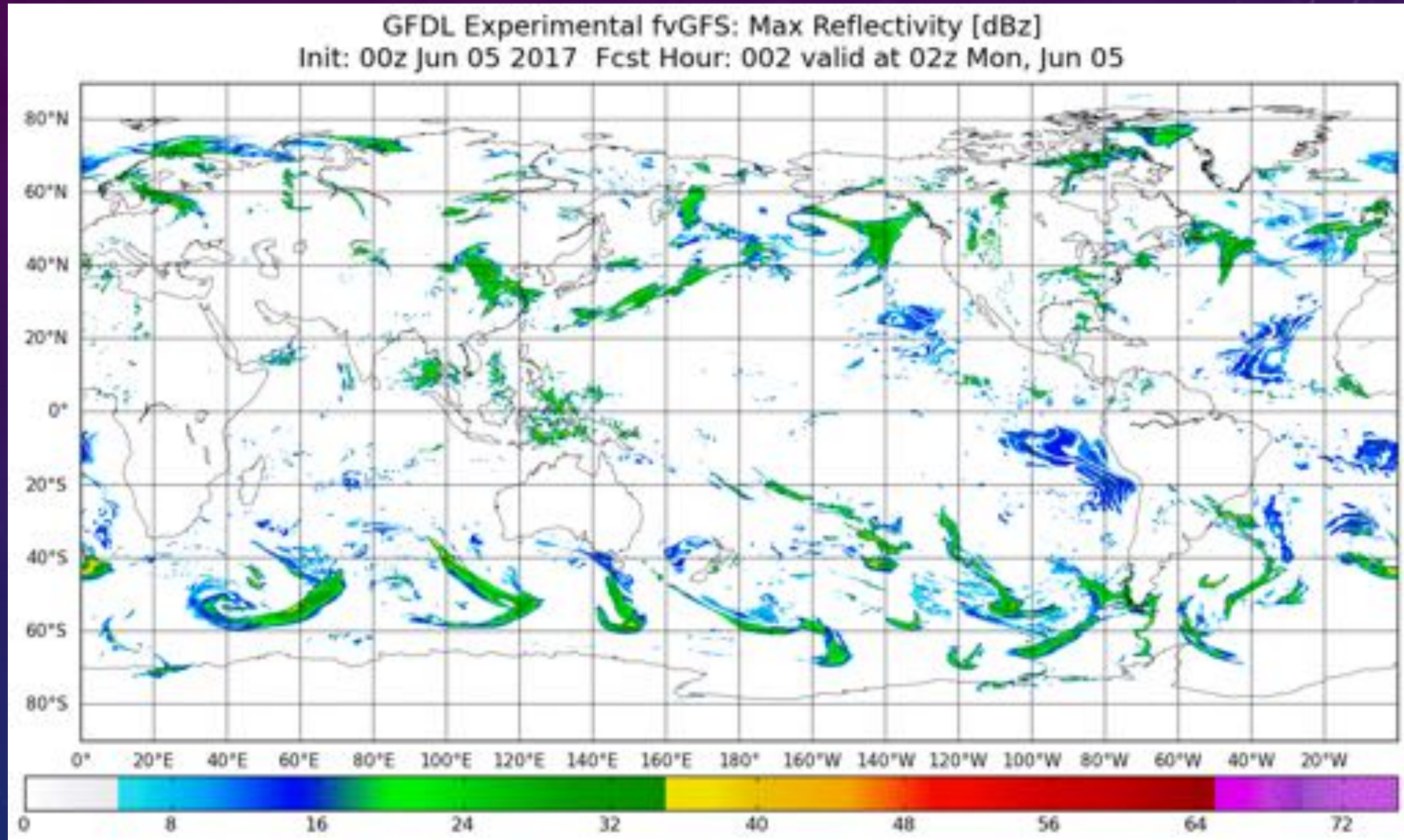


# THE PRESENT AND FUTURE OF WEATHER AND CLIMATE MODELS

LUCAS HARRIS  
AND THE FV<sup>3</sup> TEAM  
GEOPHYSICAL FLUID DYNAMICS LABORATORY  
PRINCETON, NJ



# FV<sup>3</sup>—THE CHOICE OF THE NEXT GENERATION



Experimental FV<sup>3</sup>-based forecast—a prototype for the next NOAA global forecast model



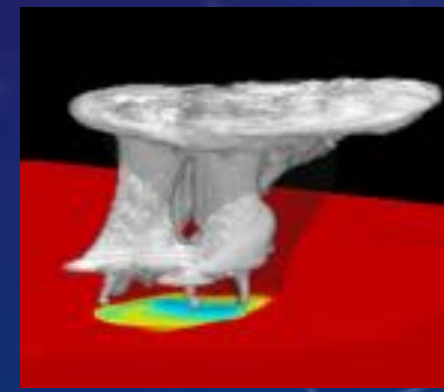
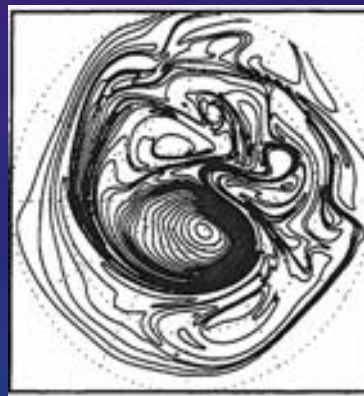
WHY FV<sup>3</sup>?



Fast!



World-class wind transport



Superior rotation dynamics

# WHAT IS FV<sup>3</sup>?



- The GFDL Finite-Volume Cubed-Sphere dynamical core

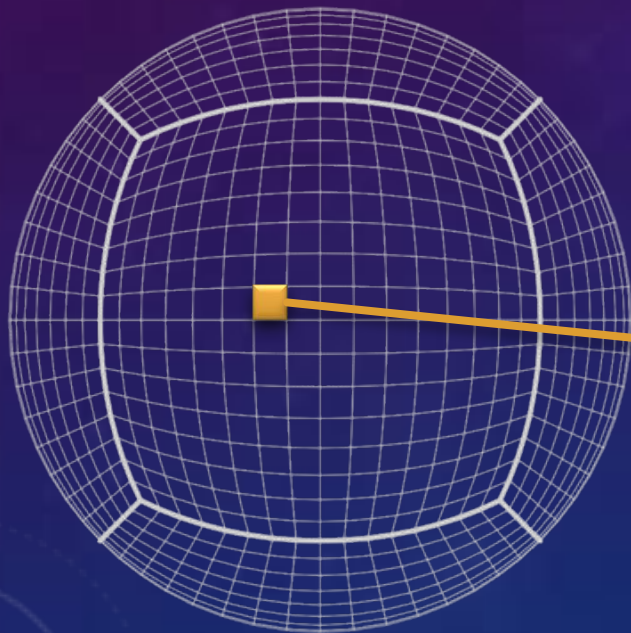


“Engine” or “heart” of a  
weather or climate model

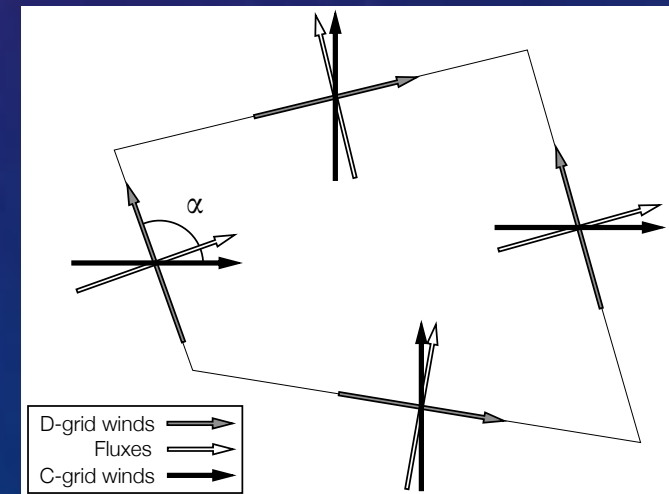
# WHAT IS FV<sup>3</sup>?



- The GFDL **Finite-Volume** Cubed-Sphere dynamical core



$$Q^{n+1} = Q^n - \frac{1}{\Delta A} \int_t^{t+\Delta t} \oint Q \vec{U} \cdot \vec{n} dl$$

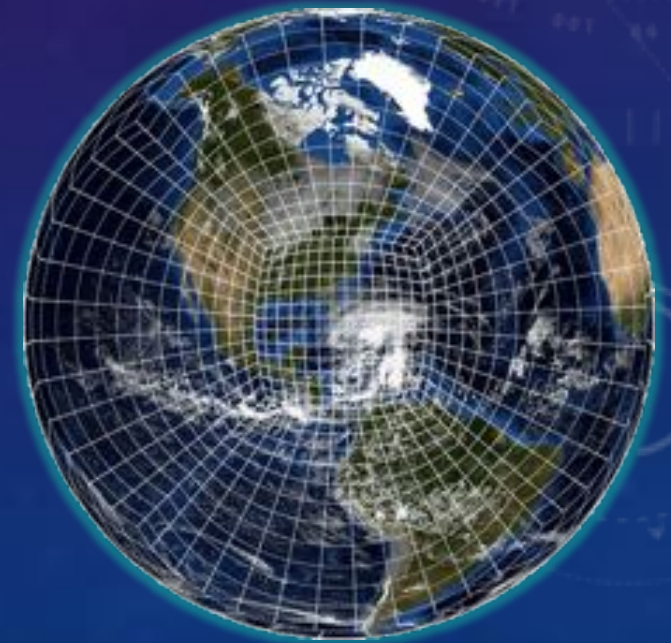
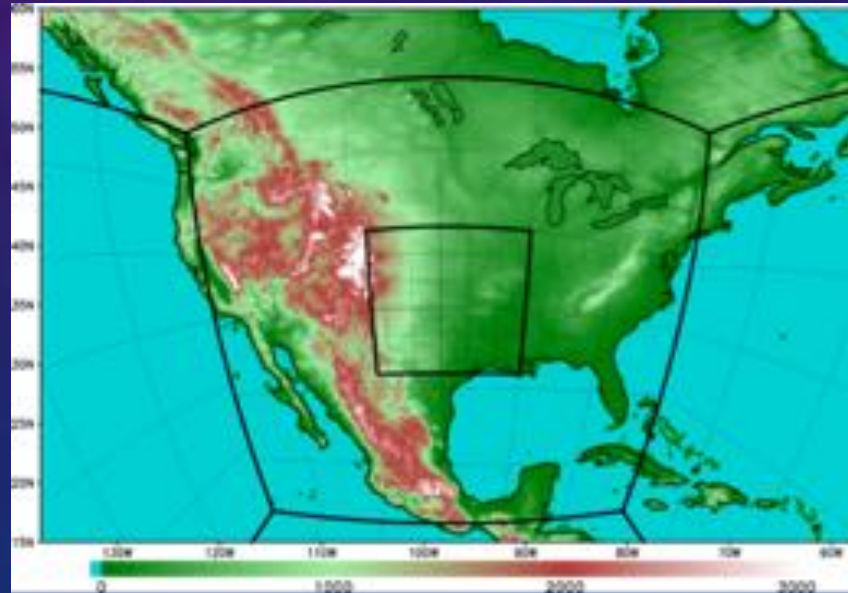
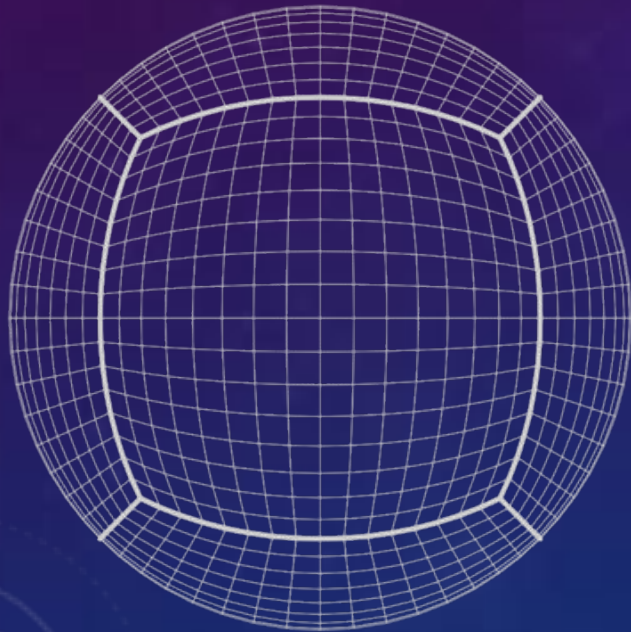




# WHAT IS FV<sup>3</sup>?



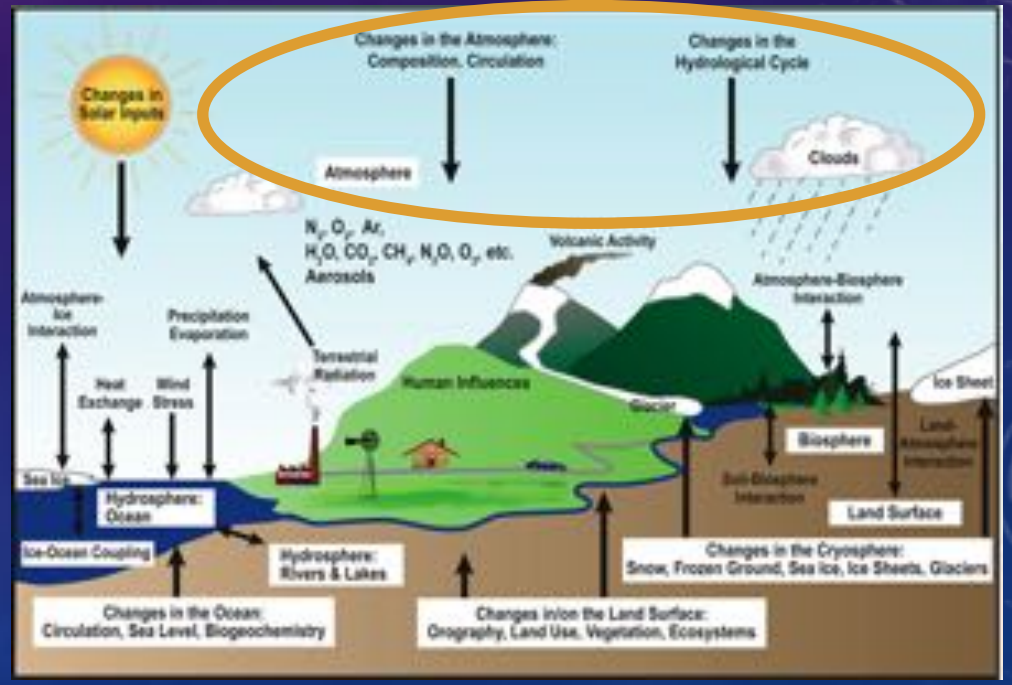
- The GFDL Finite-Volume **Cubed-Sphere** dynamical core



# WHAT IS FV<sup>3</sup>?



- The GFDL Finite-Volume Cubed-Sphere **dynamical core**



What is FV<sup>3</sup> *not*? It is not a complete model.



# WHO USES FV<sup>3</sup>?



**NOAA's Next Generation  
Global Weather Model!**



GFDL Climate and  
Prediction Model Family



NASA Goddard  
Forecast, Chemistry, Climate,  
and MERRA Reanalysis model  
Also used for Ames Mars model



NCAR-led Community Earth  
System Model (FV)



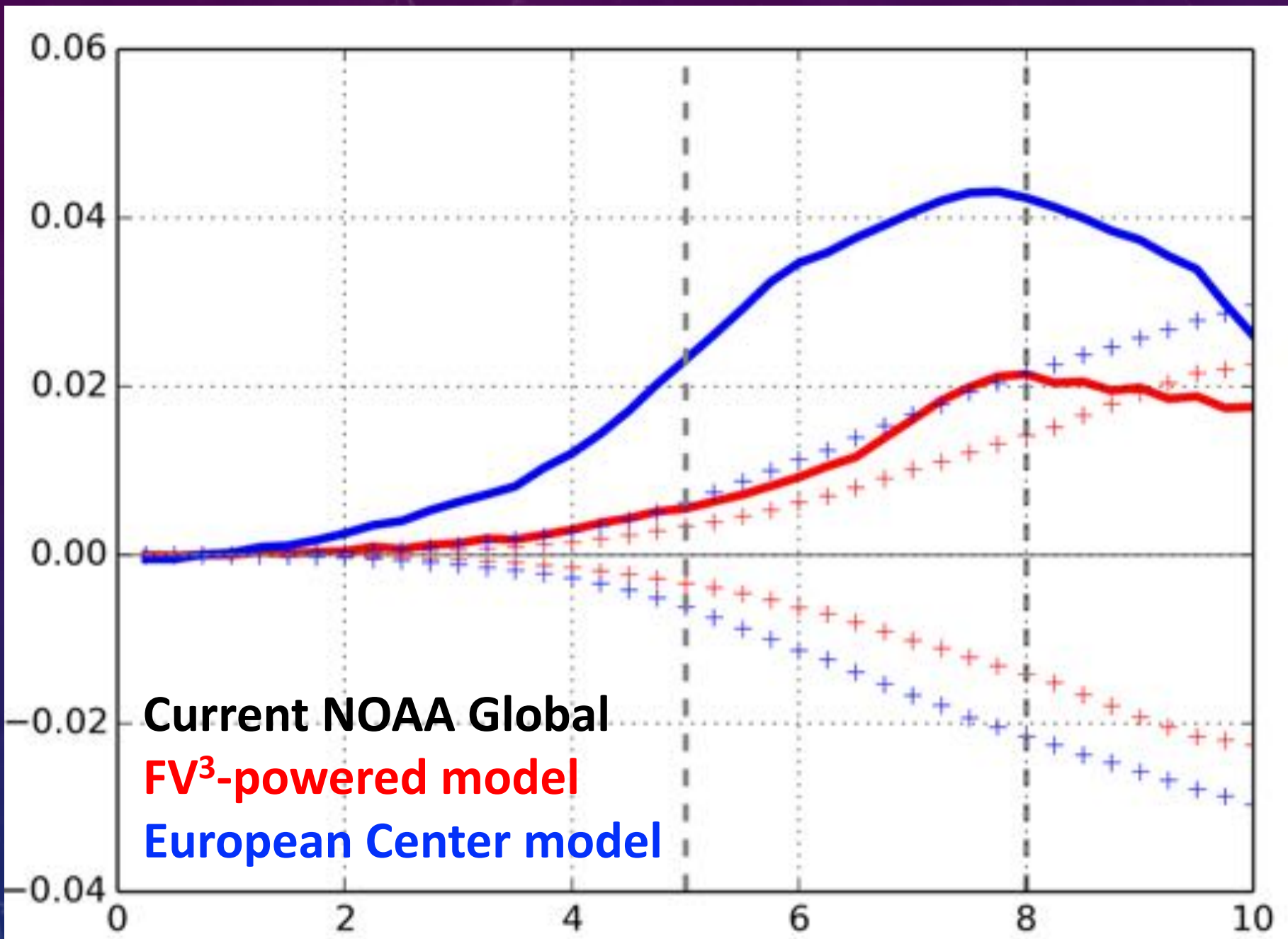
Harvard-led  
Community Chemistry  
Model





Better than current

Worse than current



**Current NOAA Global**  
**FV<sup>3</sup>-powered model**  
**European Center model**

Days from forecast start

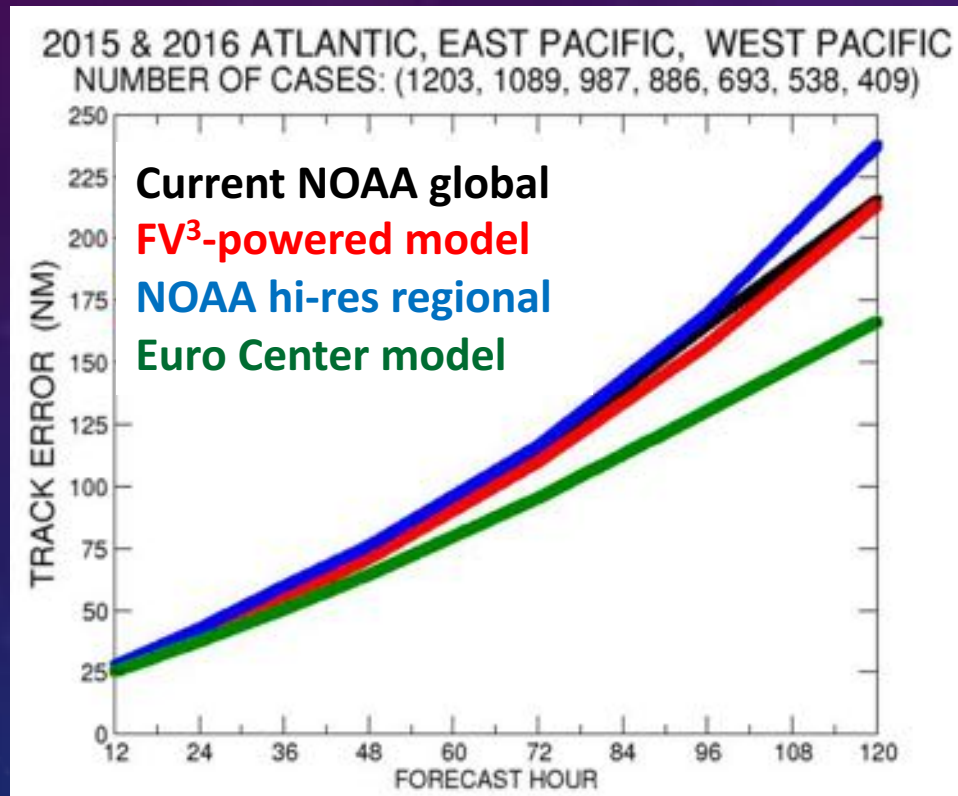
GLOBAL FORECASTS WITH FV<sup>3</sup>

Real-time global runs at GFS resolution

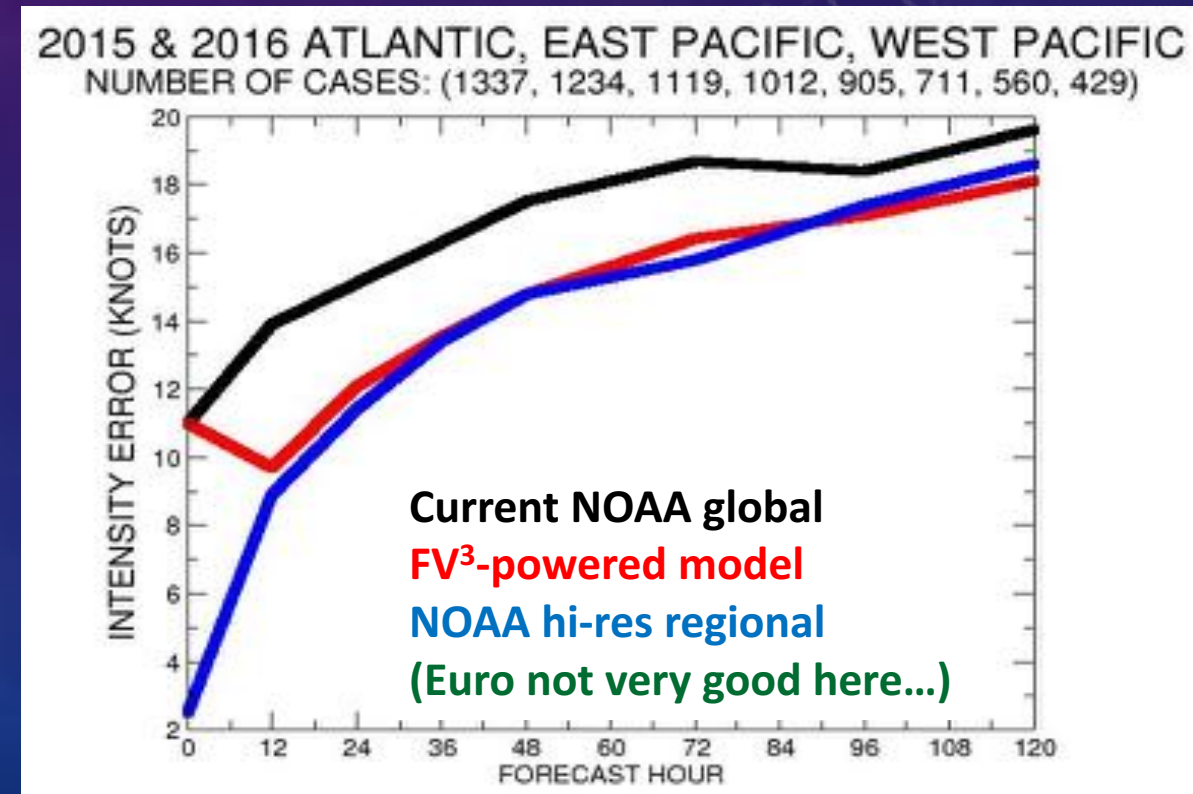
# HURRICANE FORECASTING

## Real-time FV<sup>3</sup>-powered Global Runs vs. Operational Models

Error in hurricane center location (mi)



Error in maximum wind speed (kt)

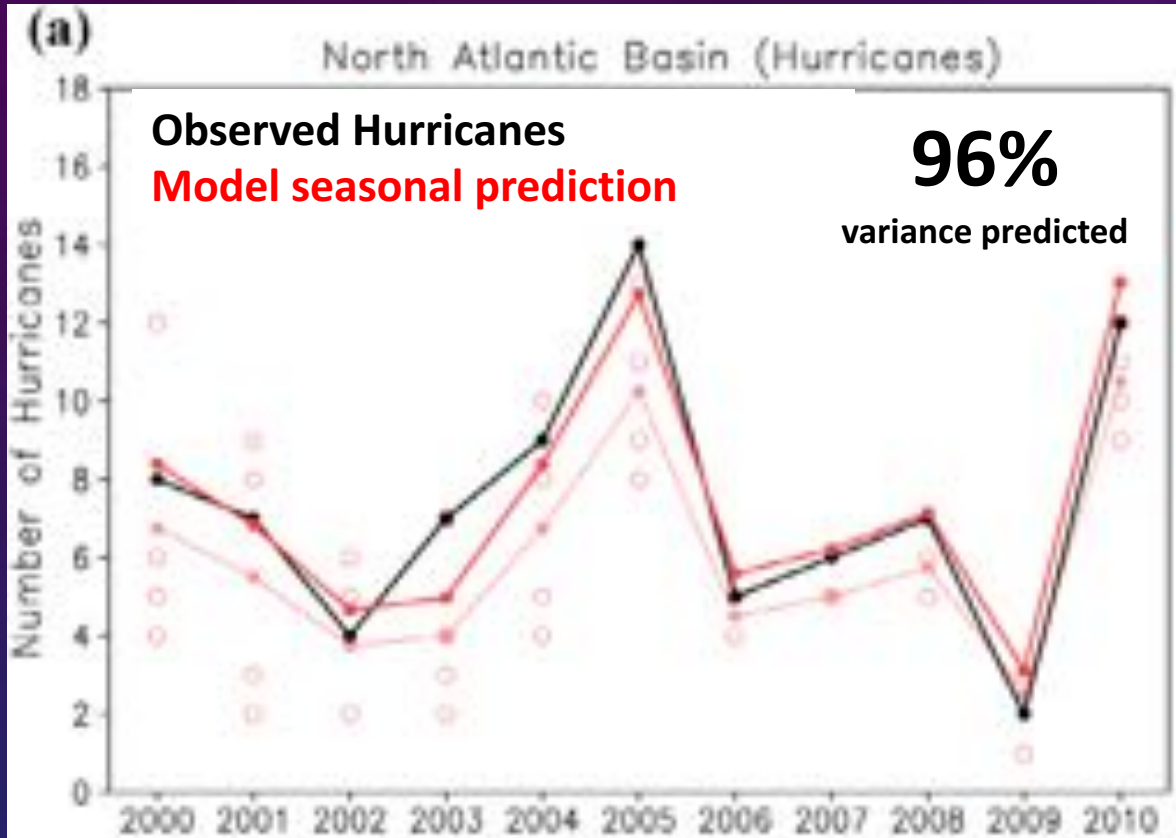


Lower errors are better

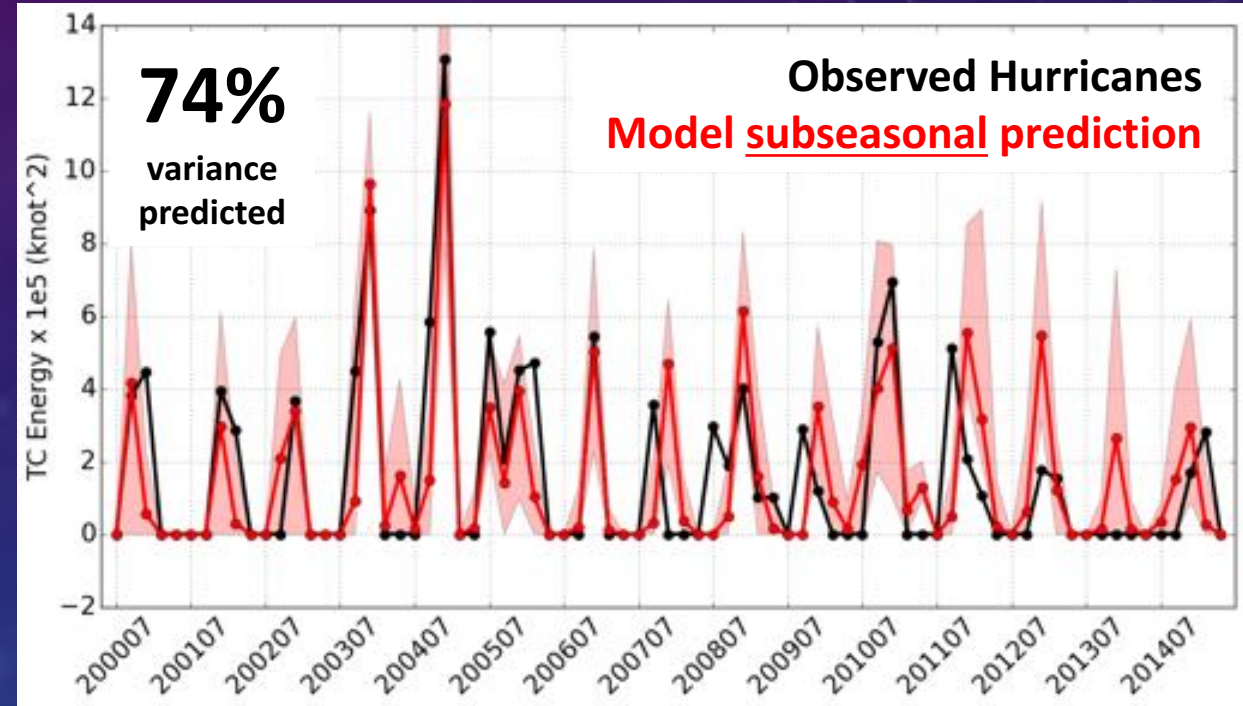




# SEASONAL-TO-SUBSEASONAL PREDICTION

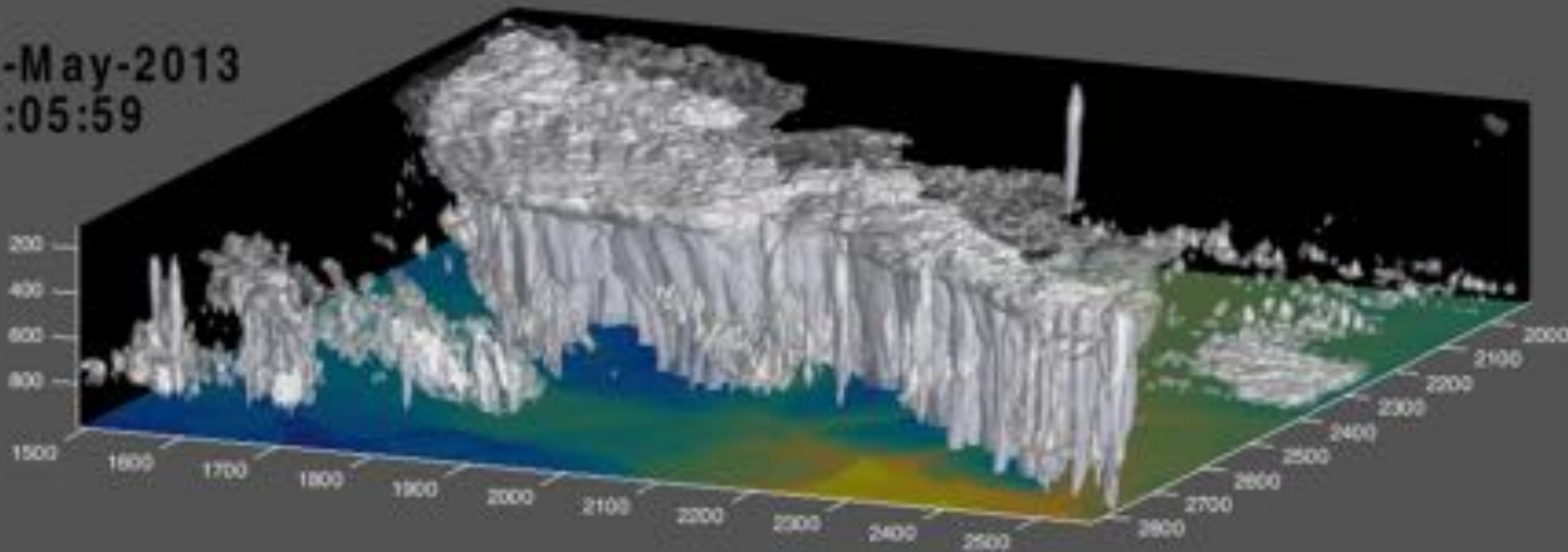


Seasonal Atlantic  
Hurricane Predictions

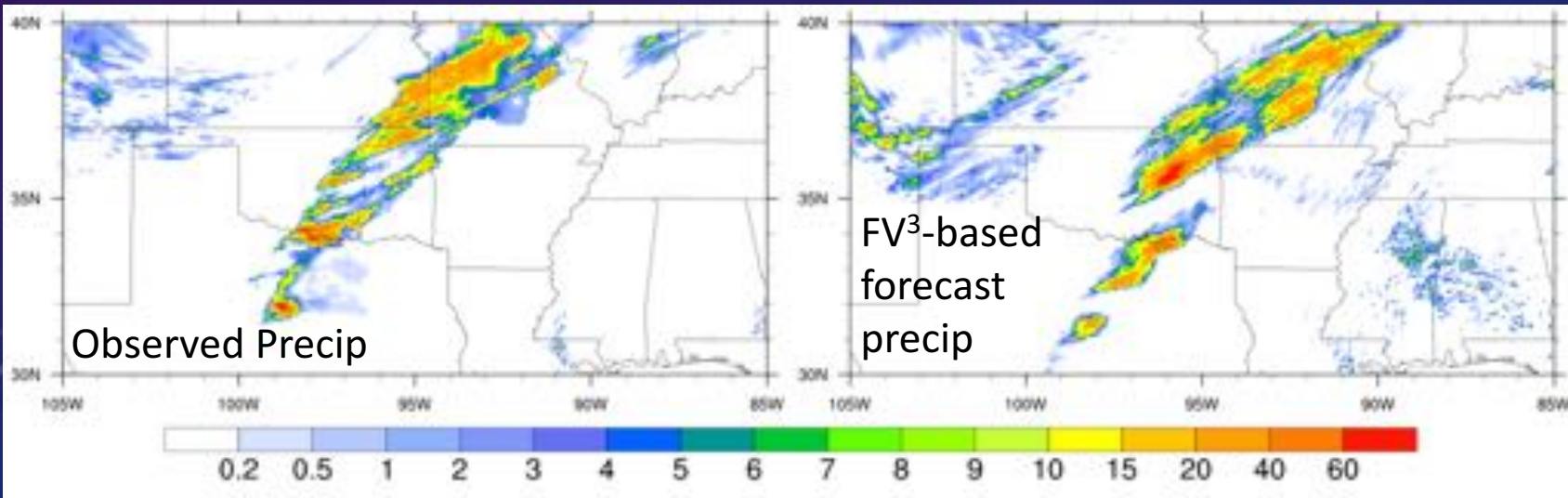


Subseasonal (harder!) Atlantic  
Major hurricane Predictions

21-May-2013  
00:05:59



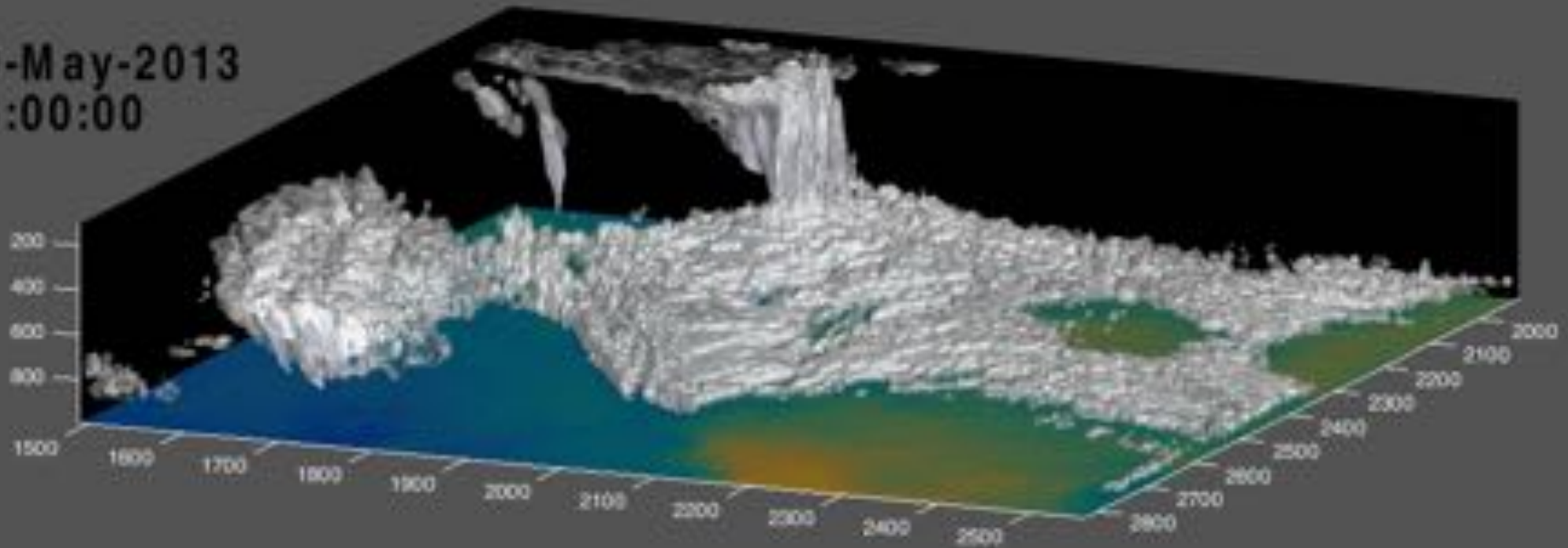
72-hour forecast of the 2013 Moore, OK tornado outbreak



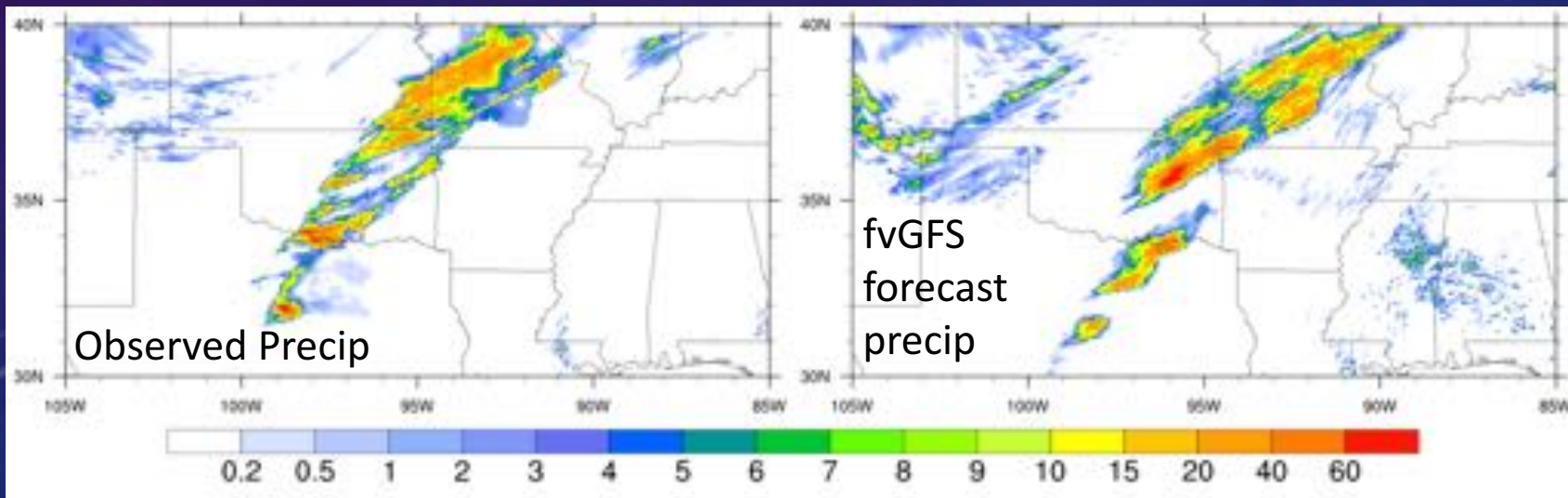
FV<sup>3</sup>-POWERED  
SEVERE STORMS  
FORECASTING



20-May-2013  
16:00:00



72-hour forecast of the 2013 Moore, OK tornado outbreak



FV<sup>3</sup>-POWERED  
SEVERE STORMS  
FORECASTING

