



# Linking weather and climate: predictions and projections of extremes in global models

Lucas Harris, Deputy Division Leader,  
Weather and Climate Dynamics Division  
Geophysical Fluid Dynamics Laboratory

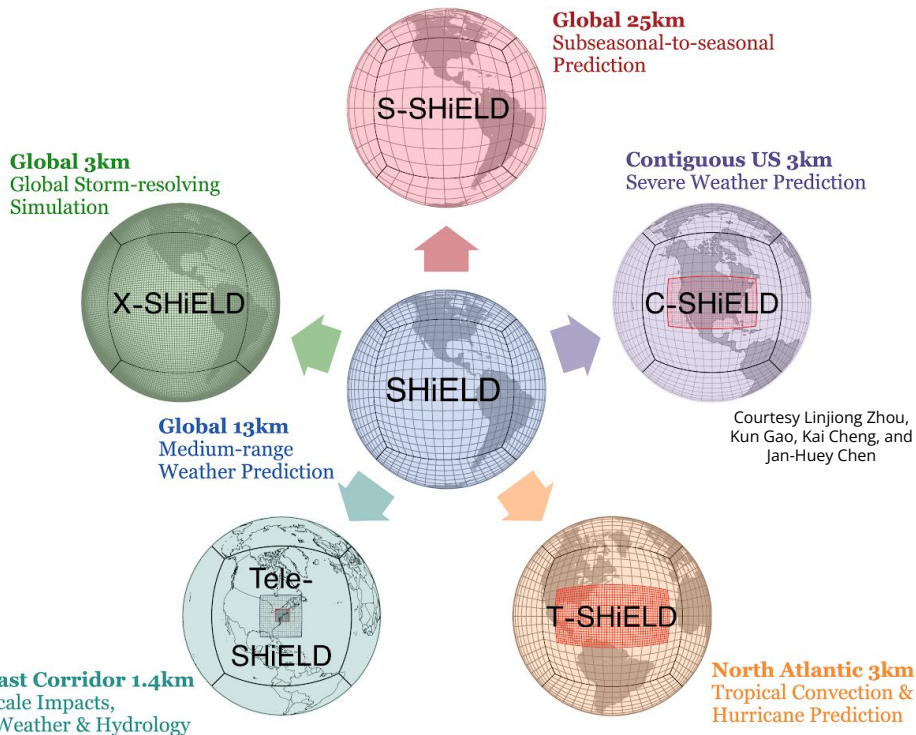
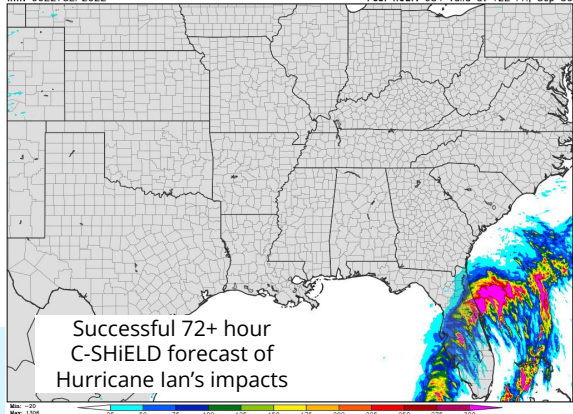
# SHiELD System for High-resolution prediction on Earth-to-Local Domains



SHiELD is an experimental FV3-based prediction system prototyping future operational capabilities, unified with GFDL's suite of climate models

See more about SHiELD at [www.gfdl.noaa.gov/shield](http://www.gfdl.noaa.gov/shield)

Run-to-hour Maximum 2-5 km Updraft Helicity ( $m^2 s^{-2}$ ) GFDL C-SHIELD  
 Init: 00Z7SEP2022 Fast hour: 084 valid at 12Z Fri, Sep 30





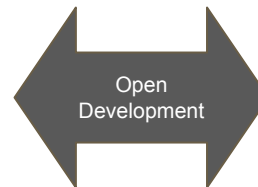
# FV3 The GFDL Finite-Volume Cubed-Sphere Dynamical Core

FV3 is the *powerful, flexible fluid solver* ("engine") for a community of atmosphere models

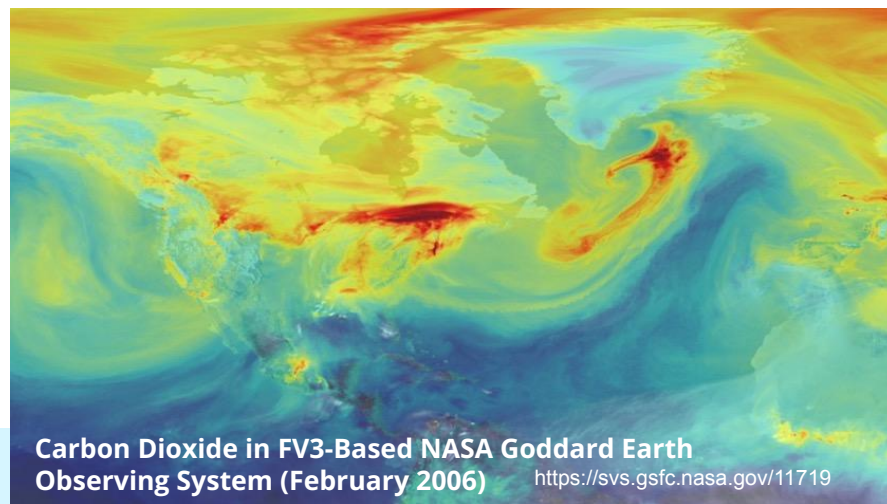
FV3's *accuracy and efficiency* allows timely forecasts and ultra high-resolution models



FV3 can be configured for many different weather, climate, air quality, data assimilation, and scientific applications



**Worldwide  
FV3 Community**  
GFDL Seamless Modeling  
Unified Forecast System  
NASA  
and others



Carbon Dioxide in FV3-Based NASA Goddard Earth Observing System (February 2006) <https://svs.gsfc.nasa.gov/11719>



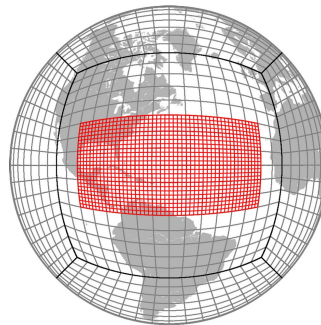
# Extending Storm Forecasts

## With FV3's Global Nesting

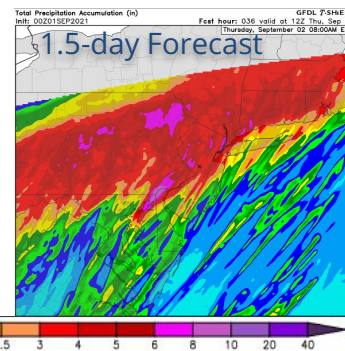
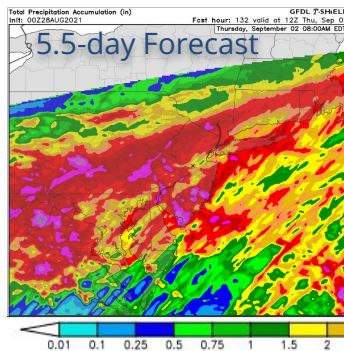
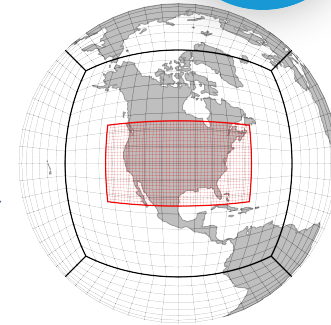
Current "limited-area" storm-scale models have limited forecast times (48 hrs)

FV3's Global Nesting allows us to zoom in on intense storms while continuing forecasts to 5-10 days, and onto subseasonal and climate timescales

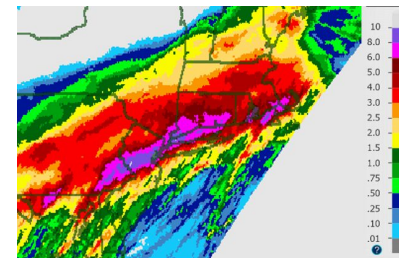
Advances in these configurations inform developments of new NWS storm-scale models



3-km Nested  
← T-SHIELD  
and C-SHIELD →



Hurricane Ida (2021) Rainfall Forecasts (in.)

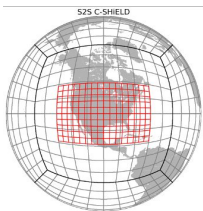


Observed 24-hr Precip  
1-2 Sep 2021

Courtesy Kun Gao  
and Matt Morin



# Subseasonal Severe Outbreak Prediction



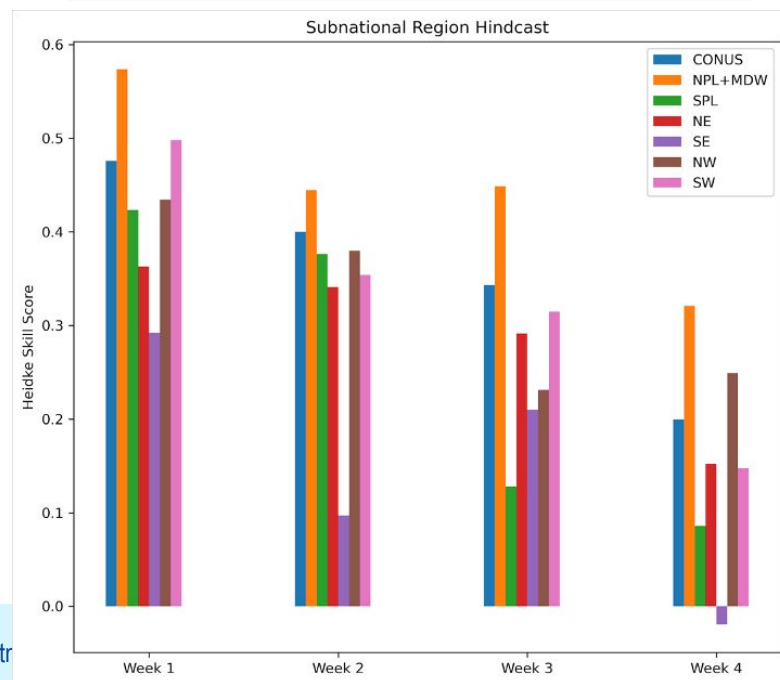
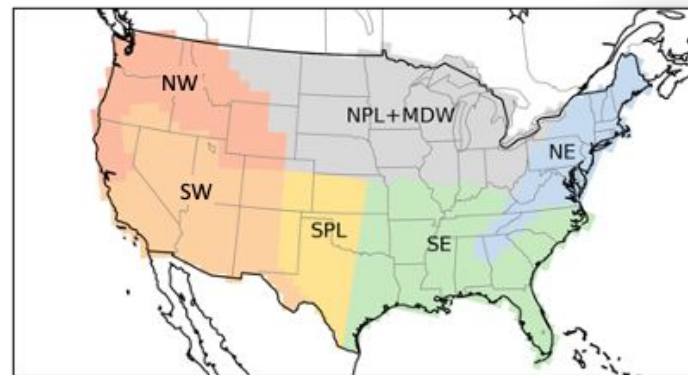
Global 16-km grid  
5-km CONUS nest

*Explicit* prediction of severe weather events on a 5-km nested grid: 5 years of springtime 30-day hindcasts

Can predict *outbreaks* of storms over CONUS regions by predicting anomalous storm activity vs. storm reports in regions

Find skillful predictions in Northern plains  
Midwest out to three weeks

Explicit S2S severe storm prediction is practicable and potentially skillful



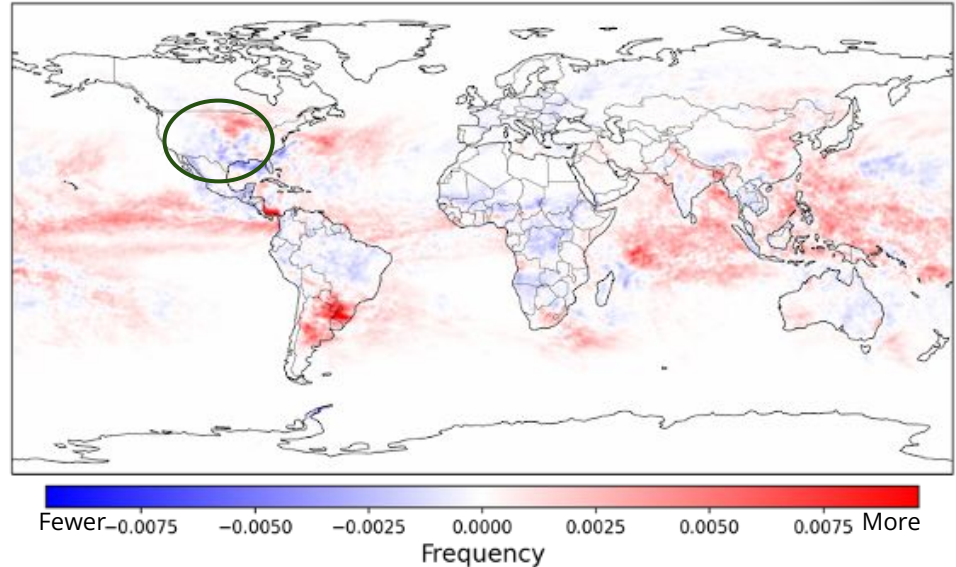


# The Future: Global Storm Models

Global 3-km X-SHiELD represents thunderstorms and extreme events worldwide!

Supercomputing at Princeton's Cooperative Institute allows unique years-long runs in warmer climates. **Storm-scale climate modeling is here** (but very expensive)

Exploring prospects for local hydroclimate information



Change in thunderstorm frequency with warmer oceans  
Cheng et al. 2022

**Warning** only one year of simulation!!

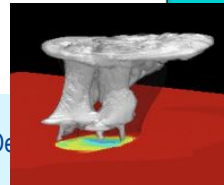
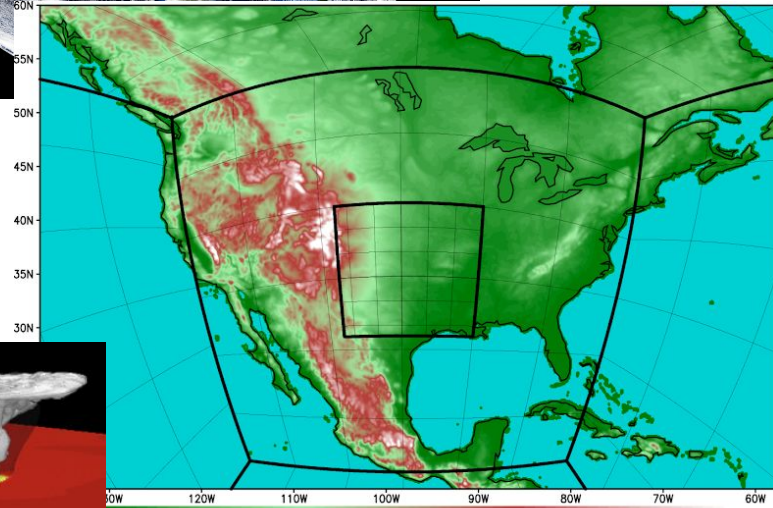
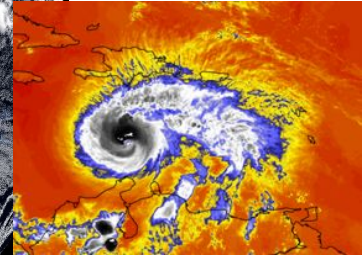
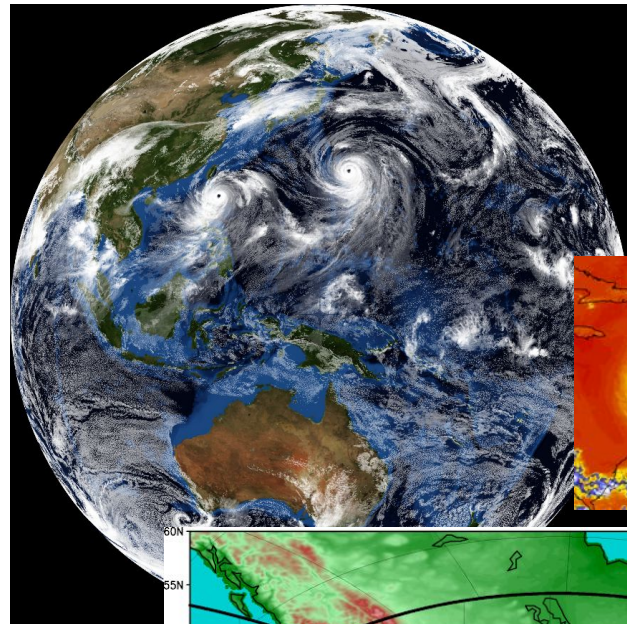
# NOAA Research Global-Nest Initiative

Storm-scale holistic, integrated  
global analysis & modeling for  
weather and climate applications

- 6-km global, 2-km USA nest (10 days)
- 5-km USA nested ensemble (30 days)
- 3-km Global Storm model (experimental)

Focus on extreme events worldwide and  
in the US: prediction + warmed climates

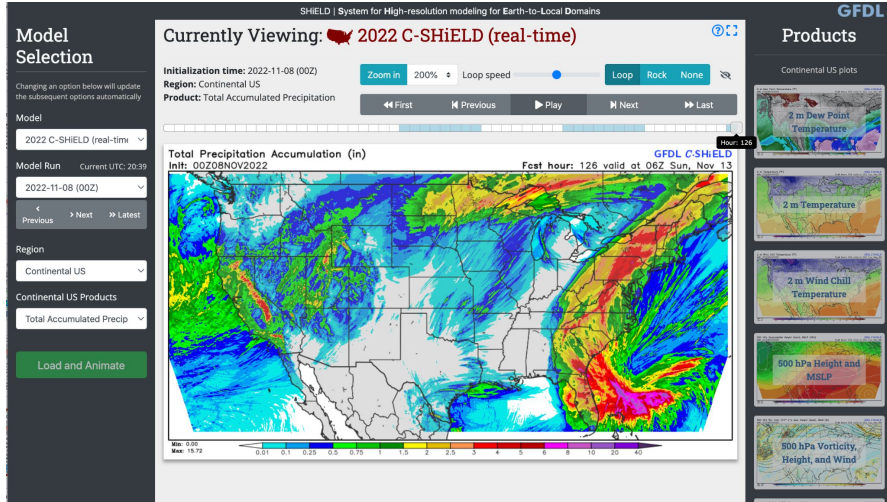
Collaboration between NOAA Research  
Labs, National Weather Service, and AI2.







# Data availability for SHiELD simulations



Real-time storm-scale SHiELD forecasts out to 5.5 days  
[shield.gfdl.noaa.gov](http://shield.gfdl.noaa.gov)

An official website of the United States government. [Here's how you know we're official.](#)

Find your local weather

News | Tools | About

NOAA National Oceanic and Atmospheric Administration  
 U.S. Department of Commerce

Search NOAA sites

Home / Offices / Office of the Chief Information Officer

## NOAA Open Data Dissemination (NODD)

Office of the Chief Information Officer home | NOAA Open Data Dissemination home | About NODD | Data Community Resources | NODD in the news | NODD Program Datasets

NOAA GOES-18 Products are now available via NODD!  
 for more information please see our latest news story: [NODD Supports Access to NOAA GOES-18 Data](#)

RECENT NEWS //  
 Cloud Access to Provisional GOES-18 Data now available through NOAA Open Data Dissemination (NODD) Program >

NOAA Open Data Dissemination

X-SHiELD GSRM output available soon through NOAA NODD  
[www.noaa.gov/information-technology/open-data-dissemination](http://www.noaa.gov/information-technology/open-data-dissemination)