

Theme 1

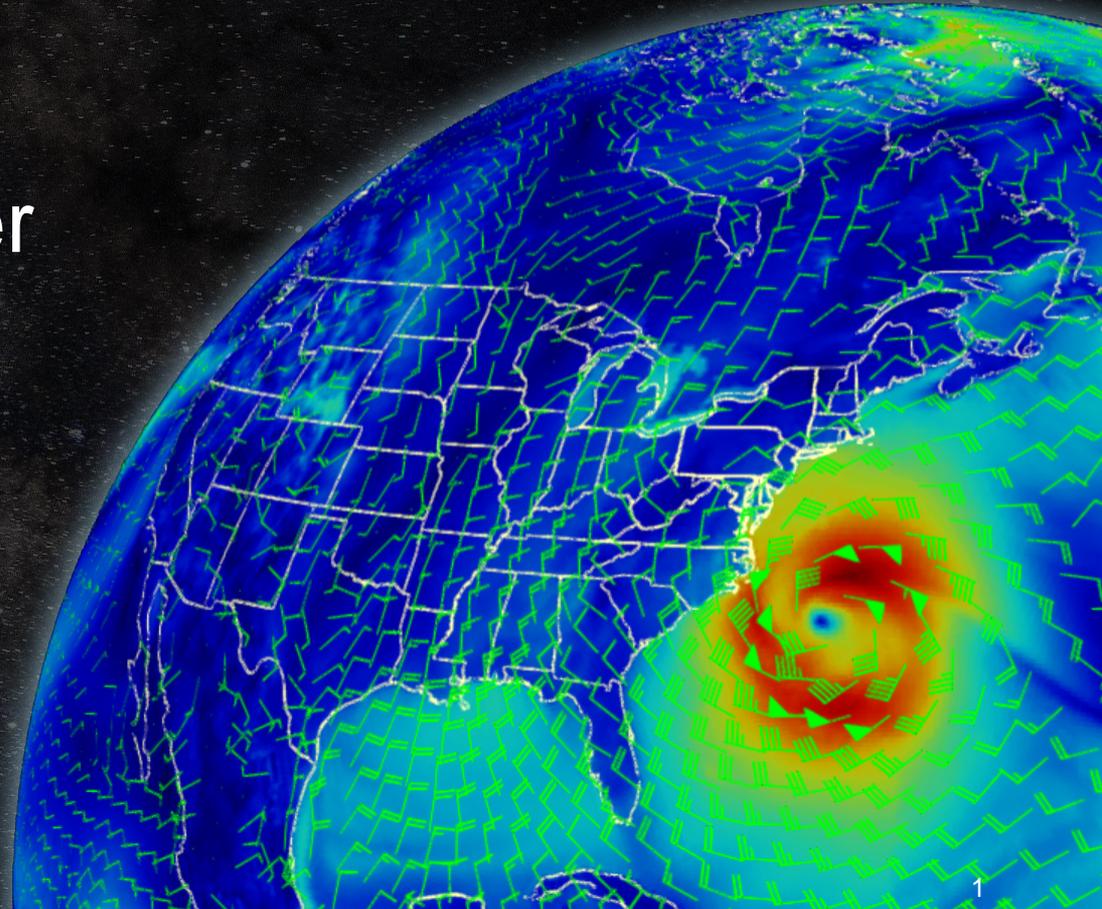
Numerical Weather Prediction

Stan Benjamin

NOAA/ESRL/GSD



GSD Science Review
3-5 Nov 2015

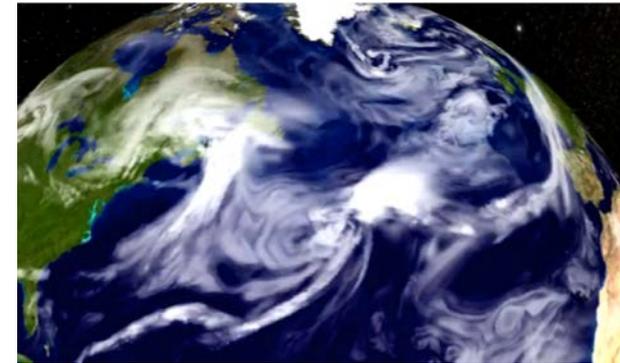


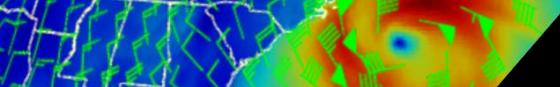
Key mission – for **GSD Earth Modeling Branch**

- **Develop** research **modeling** and **assimilation** suitable for operations – **applied** research and development.
- Accomplish transfer from research to operations **primarily within NOAA.**
- Collaborate with **community modeling/assimilation efforts.** Work with other laboratories, universities toward these efforts.
- Address both global and regional modeling efforts with same scientific expertise/techniques/code where possible.
- Broaden atmospheric modeling **into Earth system.**

Our Story

- Mesoscale modeling – 1980s → weather, automated aircraft data → Memo of Agreement on RUC between OAR and NWS (National Meteorological Center)
- Success in integration of one user group needs into applied research toward operational NWP – aviation – 1994 onward
- Extension to other NOAA user groups using same situational awareness NWP niche – severe weather, energy, hydrology
- Increased global NWP need from OAR –
 1. Science – new numerical methods, physics, coupling, assimilation (PSD)
 2. Advanced computing (optimization, HPC)

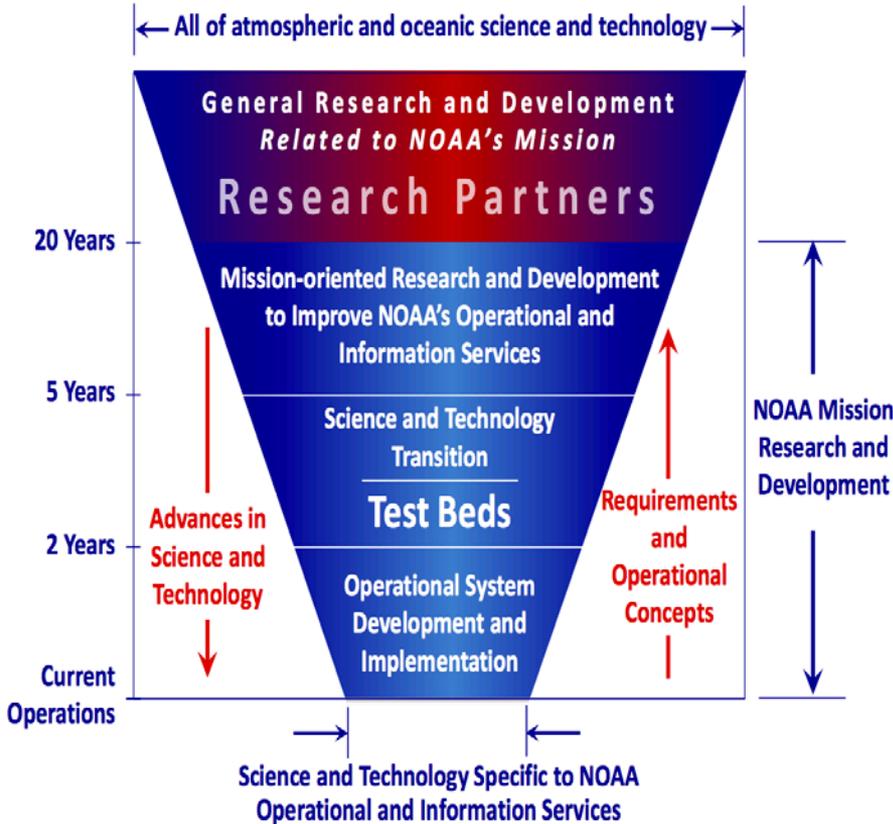




GSD Grand Challenges

1. Storm-scale ensemble assimilation and prediction
 - **This morning – Session 1**
2. Earth-system modeling with atmosphere, ocean, chemistry even for short-range
 - **PM today - Session 2**
3. Probabilistic information for decision making
 - **Session 1** (HRRR ens), **Session 2** (multi-model GEFS)
4. Determine best heterogeneous observing system
 - **Session 3** (GOSA/OSSE), **Session 1** (obs impact -RAP)
5. Instant access to data (**Tomorrow** – Themes 2 and 3)

NOAA Research and Development Funnel



Session 2: Global NWP
toward earth system
2-10 years ahead

Session 1: Regional NWP
(HRRR/RAP +
applications)
0.5 to 4 years ahead

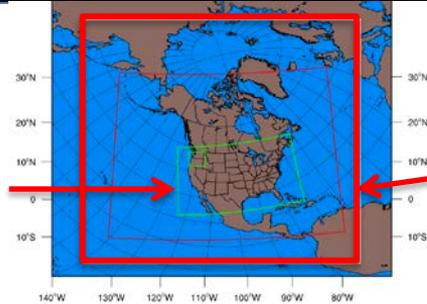
GSD's 5-year NWP Trajectory

2010

RUC-CONUS domain
Internal development

HRRR

- RUC init conds, CONUS just started
- no pathway to NWS



2015+

RAP – N. American domain
Development with community
WRF/GSI

HRRRv2 @NCEP. Centerpiece for NOAA. Physics dev, energy apps

GSI - hybrid ens/var DA with radar/cloud assimilation

FIM skill sufficient to consider multi-model GEFS at NCEP, extensive global experience toward NGGPS

Aerosol-aware microphysics (HRRR/RAP), RAP/HRRR-chem/smoke, FIM-chem/CO₂ / CH₄

*GSI-community 3-d RUA
HRRR-based RTMA*

Assimilation - RUC 3dvar

Global - FIM could run (starting late 2009) but no evaluation, poor skill (as it turned out). NCEP/ESRL MOA

Chem – WRF, not connected to RUC or early FIM

Nowcasting - LAPS, RTMA

- Hourly-to-subhourly global storm-scale ($\leq 3\text{km}$) ensemble data assimilation and ensemble forecasting for global situational awareness
- Start with: Storm-scale CONUS-wide 3km data assimilation and ensemble forecast modeling
 - More accurate **severe weather** forecasts
 - Safer **aviation**
 - More effective use of **renewable energy**
 - Improved **hydrological, flood, water/snow** resource guidance

- **Session 2 - A fully coupled earth system modeling prediction capability – Challenge #2**
- Atmosphere, ocean, chemistry, ice, and land-surface components for research and potential operational applications
 - Improved **air quality / health** forecasts
 - More useful **seasonal** outlooks
 - **Full environmental** prediction
 - Improved **global NWP** forecasts from Day 1 – Week 4 (including ensembles/ reforecasting)
- **Session 3 – Cross-cutting activities including optimized observing system (Challenge #3)**