

S2S Verification Topics at the NOAA Environmental Modeling Center

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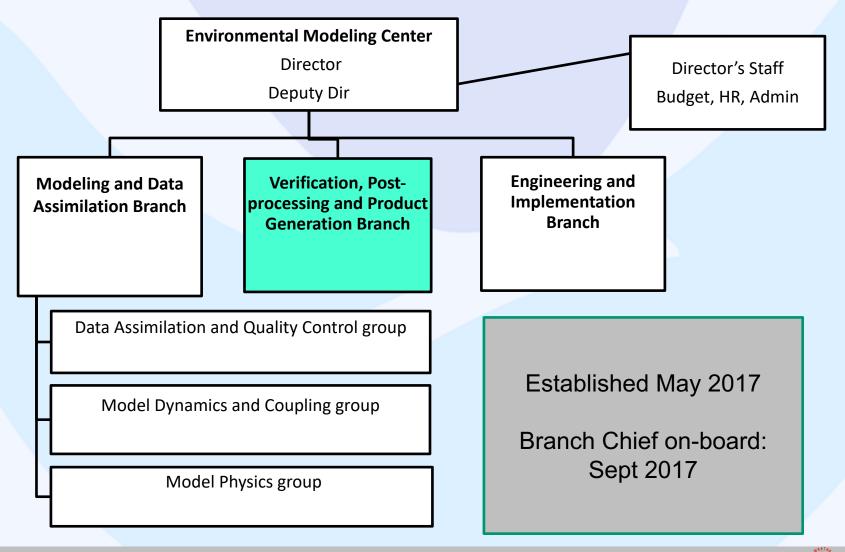
Chief, Verification/Post-Processing/Production Generation Branch NOAA/NWS/NCEP/Environmental Modeling Center

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New EMC Branch - VPPPG

Verification, Post-Processing, Product Generation





VPPPG Branch Purpose

- Consolidates verification and evaluation functions to more efficiently and consistently support all modeling groups.
- Also removes evaluation functions from model science chain of command, ensuring *independent* evaluations

Functions (from new functional statement) include:

- Conduct diagnostic verification studies of model performance on weather and climate time and space scales;
- Processing and quality control of observations;
- Evaluation of new observing systems for the atmosphere, ocean, land surface and cryosphere;
- Data impact studies to evaluate potential improvements in forecast skill with new or improved observing systems;
- **Ensemble products** using models from EMC and external partners;
- Post-processing of model output and generation of products for use by internal and external users and partners.

Employee alignment: 9 federal positions, ~35 contractors supporting projects





S2S Verification Software Systems at EMC

- As part of the Next Generation Global Prediction System (NGGPS), the community is moving towards a <u>unified verification system</u>
- The Model Evaluation Tools (MET+) software system (NCAR) will eventually be the <u>exclusive</u> verification software package used at EMC
- Current EMC S2S verification software at EMC developed in-house
- Essentially the same as CPC's verification software
- If funded, EMC S2S verification software will move to MET+
- EMC is testing the development of ensemble forecasts to 35 days, with varying strategies (Zhu talk at this workshop)
- EMC Verification web page organization coming soon





Model Evaluation Tools



Comprehensive and unified verification tool - Make R2O more efficient - Provide a consistent set of metrics

Allows Researchers and Operational Scientists to speak a "common verification" language



User Support of unified package provides greater opportunity to train all on verification best practices

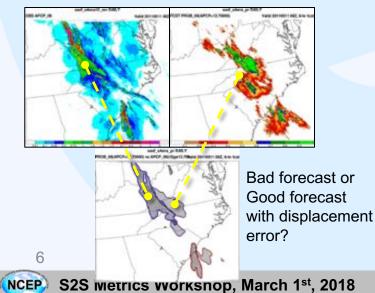


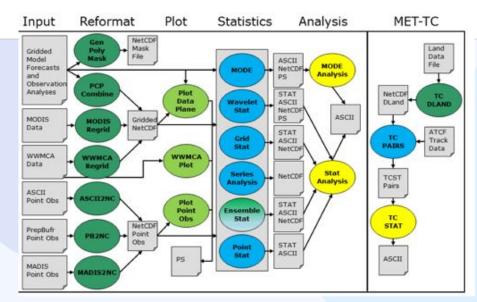


A verification toolkit designed for flexible yet systematic evaluation (supported to the community via the DTC)

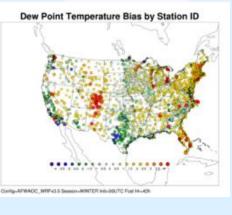
• Over 85 traditional statistics using both point and gridded datasets

- Multiple interpolation methods
- Computation of confidence intervals
- Able to read in GRIB1, GRIB2 and CF-compliant NetCDF 4, HDF5
- Applied to many spatial and temporal scales (multi-decadal climate to 15min storm-scale)
- Regridding within the tools and ability to apply complex masking
- 3400+ users, both US & Int'l
 Object Based and Spatial Methods

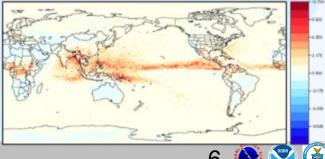




Geographical Representation of Errors



90th Percentile of difference between two models



S2S Verification Needs at EMC

- Current software and strategy verifies standard metrics, such as these values (for the CFSv2):
 - > 2m temperature
 - Surface precipitation
 - ► MJO
 - ► SSTs
 - Various Anomaly Correlation (500mb, etc.)
- EMC uses verification tools for two main purposes:
 - Internal model verification during testing and refinement
 - Operational verification of real-time models
 - EMC is an implementation Center of R&D from the community
 - Operational verification at EMC needs to be community-vetted and peerreviewed



Scores Card: GEFSv11 21m .vs 41m (August 1 – October 1 2013)

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S2S Verification Examples at EMC

- Prototype Unified Forecast System: Coupled Subseasonal System
 - GSM: Spectral T574L64 semi-Lagrangian grid
 - MOM5.1: GFDL Ocean Model. Z-coordinates, Tripolar CFSv2 grid 0.25° in the tropics and 0.5° global.
 - CICE5: Los Alamos Sealce Model. Same grid as MOM5.1 ocean model.
 - April 2011 to March 2017
 - 144 forecasts, two weeks apart
- Calibration Climatologies
 - Fit six year time series to a sine wave of period 365.24 days
 - Plus three harmonics
 - Done for each grid point and variable separately
 - Need systematic error correction (SEC) to produce a smooth climo



CONUS 2-meter temperature AC (CPC daily*)

	UFSbench	UFSbench	CFSv2ops	CFSv2ops				
	Raw	Sec	Raw	Sec				
week1	78.0	87.5	79.3	85.9				
week2	40.1	46.7	41.7	46.4				
week3	19.4	23.3	17.6	19.9				
week4	11.0	12.6	0.3	1.8				
week3&4	20.8	26.1	11.6	14.7				

UFSbench equal or better than the CFSv2ops for all lead times.

*CPC Global 0.5 degree Daily 2-m TMIN/TMAX from: ftp://ftp.cpc.ncep.noaa.gov/precip/wd52ws/global_temp/ e.g., CPC_GLOBAL_T_V0.x_0.5deg.Inx.YYYY





S2S Verification Needs at EMC

- WWRP/WGNE Joint Working Group on Forecast Verification Research (JWGFVR)
 - Wiki page: S2S sub-project on verification and products
 - http://s2sprediction.net/xwiki/bin/view/Main/Verification
- WMO Standardized Verification System (SVS) for Long Range Forecasts (LRF)
- WMO's Commission for Climatology (CCI) probabilistic forecasts
- Deterministic vs Probabilistic
- Limited sample sizes and low levels of predictability





Questions and Research

Asking the right verification questions for a S2S system:
 What is S2S forecast "skill"? Needs to be defined for S2S
 Difficult due to poor predictability
 Complicated to design a verification system that works well

Research needs for verification
 What's beyond the standard skill scores?
 Designing the right kind of hindcasts
 Object-oriented verification
 Revisiting the WMO standards

Probabilistic verification

