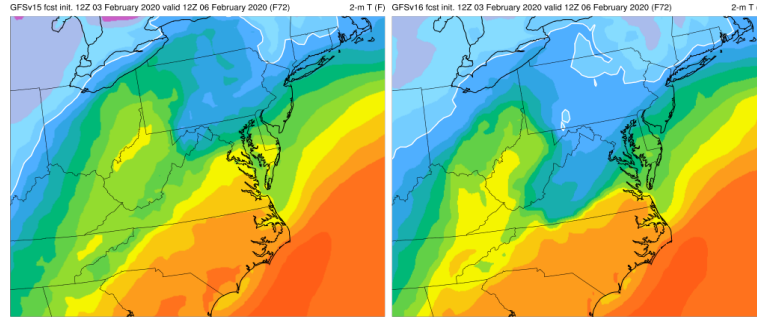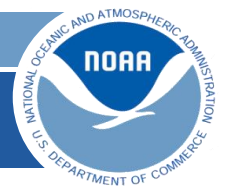# The Model Evaluation Group (MEG) at The Environmental Modeling Center

Geoffrey S. Manikin, Alicia M. Bentley, Logan C. Dawson, Shannon R. Shields, Christopher MacIntosh, and Jason J. Levit
*NOAA/NWS/NCEP/EMC*

Brief History of the MEG

- Formed in 2012 to formally organize model evaluation activities at EMC and expand model evaluation beyond simply examining a few key verification metrics;   goal was to complement objective verification with a subjective component
- Initially consisted of 2 people who presented weekly updates to the modeling teams
- Began inviting external colleagues to join the weekly meetings ~2014, per request from the field (customers and stakeholders)
- Now resides within the Verification, Post-Processing, and Product Generation Branch of EMC (since the Center reorganization in 2017)

Key Functions of the MEG

- Serves as the "customer service" function of EMC, communicating with the field and filling the role of liaison between modelers and forecasters
- Conducts and leads formal field evaluations of mature parallel systems
- Identifies and documents critical verification metrics
- Assesses performance of models on high-impact weather events, often assisting with formal NWS reviews
- Leads weekly-ish webinars to share info with modelers and customers
- Identifies systematic model biases
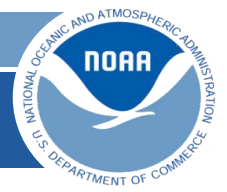
MEG's Role in Formal Evaluations

- Assists with writing of test plans for evaluations; identifies important and relevant verification metrics
- Compiles a list of key events from retrospective periods and generates forecast maps from retrospective and real-time model runs
- Generates centralized evaluation web site with all relevant links
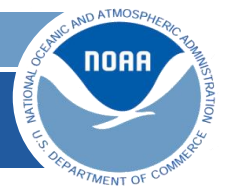
MEG's Role in Formal Evaluations

- Organizes stats and perform full statistical assessment
- Examines how the stats translate into real impacts on forecast maps
- Looks for systematic changes in model performance that might not necessarily be reflected in statistics
- Conducts multiple webinars to assess strengths and concerns for major model upgrades to assist field with their formal recommendations and with their understanding of how to use the new version
- Helps modeling teams determine priorities for next upgrade
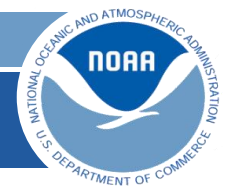
Example of Evaluation Web Pages

http://www.emc.ncep.noaa.gov/users/meg/gfsv16

TIMELINE

Evaluation Period (Start - End)	Recommendations from Field Due	NCEP Director Briefing	Code Handoff to NCO	IT Test Period (Start - End)	Implementation Date
8/3/20 - 9/25/20	9/28/20	10/5/20	10/9/20	~12/21/20 - 1/20/21	~2/3/21

SUMMARY

GFSv16 NWS SOO Team Evaluation Overview - Presented by NWS SOO Team (9/17/20 MEG Meeting)
GFSv16 MEG Evaluation Overview - Presented by Alicia Bentley/Geoff Manikin (9/24/20 MEG Meeting)
NCEP/EMC Change Configuration Board Presentation - Presented by Fanglin Yang/Geoff Manikin (9/30/20 CCB Meeting)
GFS Wave vs. Multi-1 Evaluation Summary - Presented by Deanna Spindler (10/1/20 MEG Meeting)
GFSv16 Field Evaluations (Waves/Days 1-10 Weather) - Presented by Shannon Shields/Philippe Papin (10/1/20 MEG Meeting)
NCEP OD Science and Decisional Briefing: Summary - Presented by Vijay Tallapragada/Geoff Manikin (10/5/20 OD Briefing)
NCEP OD Science and Decisional Briefing: Field Evaluations - Presented by WPC/NHC/SPC/AK Region/OPC (10/5/20 OD Briefing)
NCEP OD Decision: APPROVED

INFORMATION

GFSv16 Official Evaluation Kickoff Meeting - Presented by Geoff Manikin/Alicia Bentley (7/16/20 MEG Meeting)
Overview of GFSv16 Wave (e.g., science/product changes) - Presented by Deanna Spindler (8/6/20 MEG Meeting)
Overview of GFSv16 Verification Statistics - Presented by Chris MacIntosh/Alicia Bentley (8/6/20 MEG Meeting)
GFSv16 Case Studies: Tropical Cyclones - Presented by Shannon Shields (8/20/20 MEG Meeting)
GFSv16 Tropical Cyclones: Strengths and Concerns - Presented by Alicia Bentley (8/20/20 MEG Meeting)
GFSv16 Case Studies: QPF/Precipitation - Presented by Philippe Papin (8/27/20 MEG Meeting)
GFSv16 Case Studies: Winter Weather - Presented by Alicia Bentley (8/27/20 MEG Meeting)
GFSv16 Case Studies: Severe Weather - Presented by Chris MacIntosh (9/3/20 MEG Meeting)
GFSv16 Severe Weather: Strengths and Concerns - Presented by Logan Dawson (9/3/20 MEG Meeting)
GFSv16 Case Studies: Extreme Temperatures - Presented by Shannon Shields (9/10/20 MEG Meeting)
GFSv16 Case Studies: Temp. Profiles/Inversions - Presented by Geoff Manikin (9/10/20 MEG Meeting)
Assessing HMON/HWRF performance initialized with GFSv16 - Presented by Zhan Zhang (10/1/20 MEG Meeting)

DATA

GFSv16 Data - Available on Para NOMADS

RETROSPECTIVES

GFSv16 Retrospective Case Studies - Maintained by NCEP/EMC MEG
GFSv16 Retrospective Soundings - Maintained by NCEP/EMC MEG

REAL-TIME

GFSv16 Real-time Forecast Graphics - Maintained by Shannon Shields (EMC)
GFSv16 Real-time Soundings - Maintained by Keqin Wu (EMC)

VERIFICATION

GFSv16 Real-time Parallel Verification - Maintained by Mallory Row (EMC)

GFSv16 Retrospective Verification (All Streams) - Maintained by Mallory Row (EMC)
GFSv16 Retrospective Stream 0 Verification - Maintained by Mallory Row (EMC)
GFSv16 Retrospective Stream 1 Verification - Maintained by Mallory Row (EMC)
GFSv16 Retrospective Stream 2 Verification - Maintained by Mallory Row (EMC)
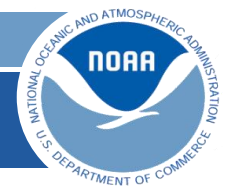GFSv16 Retrospective Stream 3 Verification - Maintained by Mallory Row (EMC)
GFSv16 Retrospective Stream 4 was combined with Stream 3
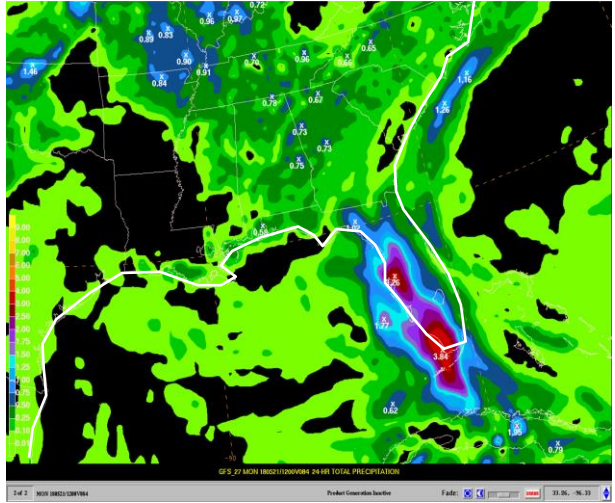GFSv16 Retrospective Stream 5 Verification - Maintained by Mallory Row (EMC)

GFSv16 Wave Verification (Buoys) - Maintained by Deanna Spindler (EMC)
GFSv16 Wave Verification (Satellite) - Maintained by Todd Spindler (EMC)
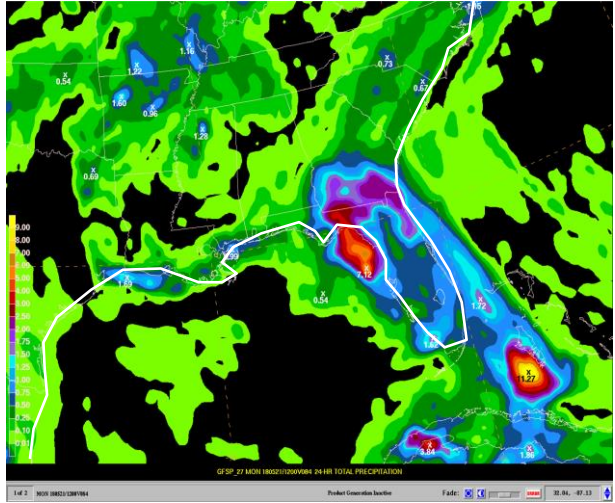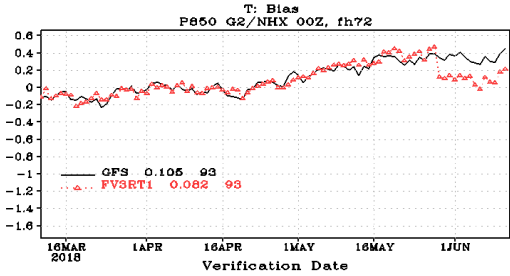
Working With the Field To Identify Issues

GFSv14

GFSv15

Forecaster noticed spurious convection in experimental GFS in coastal waters near beginning of GFSv15 evaluation and contacted the MEG
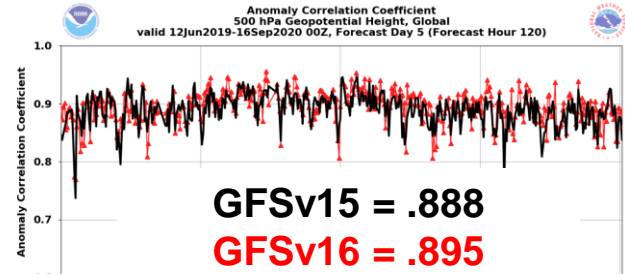
GFS SST
v14-v15

180520/0000V000 SKIN TEMP (F) GFS - FV3

MEG investigated, found problems with new GFS SST field, and alerted modeling team

T: Bias
P850 G2/NHX 00Z, fh72

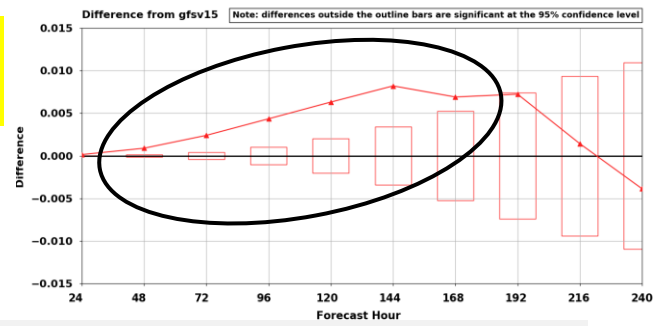GFS   0.105   93
FV3ET1 0.082   93

SST was fixed soon after, resulting in the end of an increasing warm bias

Relating Stats to Impacts on Forecasts

Anomaly Correlation Coefficient
500 hPa Geopotential Height, Global
valid 12Jun2019-16Sep2020 00Z, Forecast Day 5 (Forecast Hour 120)

GFSv15 = .888
GFSv16 = .895

Valid: 6/12/19–9/16/20
500 hPa ACC (Day 5)

Global

Difference from gfsv15   Note: differences outside the outline bars are significant at the 95% confidence level
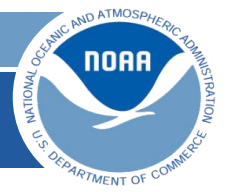
Stats show improvement in Day 5 GFSv16 forecasts.   It's statistically significant.
What does it mean for forecasters?

GFSv15

GFSv16

ANL
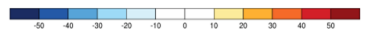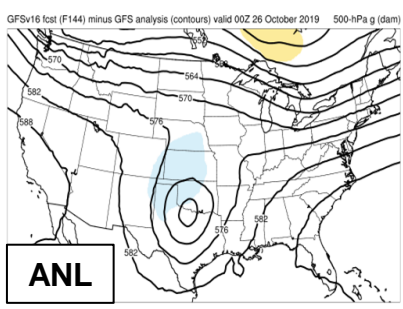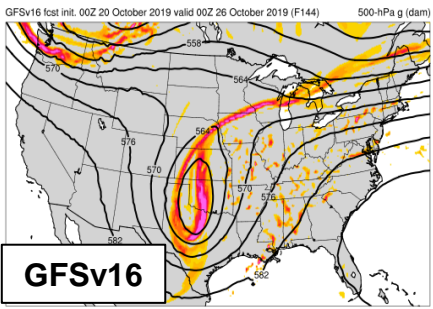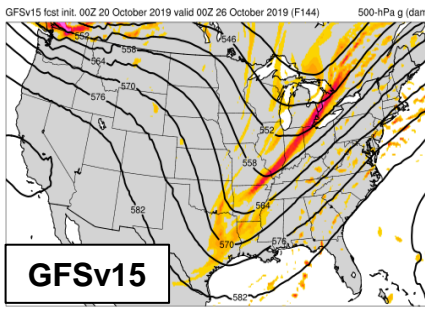
Case inspection revealed multiple events in which there was clear improvement in medium range pattern predictability, especially with regard to the known GFSv15 progressive bias, which is hard to measure statistically.

Final Thoughts

- The MEG will be playing a critical role going forward in the transition of the NCEP Production Suite to the Unified Forecast System

- MEG web page: https://www.emc.ncep.noaa.gov/users/meg/home

- Webinars held most Thursdays at 11:30 AM U.S. Eastern Time; open to all

- Recording and slides available in MEG google drive folder