



**NATIONAL  
WEATHER  
SERVICE**

# An Overview of Subseasonal Verification at the Environmental Modeling Center (EMC)

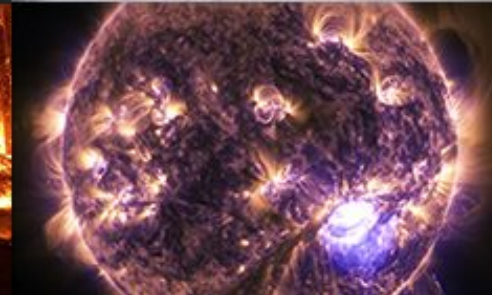
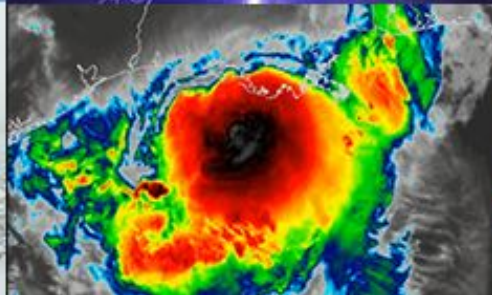
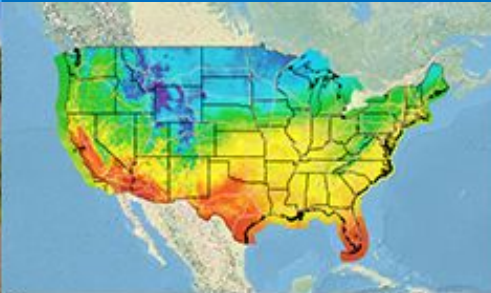
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7 June 2024

Session: Diagnostic, Validation, and Verification

2024 S2S Community Workshop | Boulder, CO





# Introduction and Motivation






- Subseasonal forecasts are important for decision support across numerous economic sectors
- Subseasonal forecasts provide guidance to forecasters, stakeholders, and emergency managers for keeping the public informed and prepared for various weather phenomena
- Two of the National Centers for Environmental Prediction (NCEP)'s global models cover the subseasonal forecast period: the Global Ensemble Forecast System (GEFS) and the Climate Forecast System (CFS)
- The current operational version of the GEFS is version 12.3 as of 2022 October 19 and the current operational version of the CFS is version 2.3 as of 2022 March 9



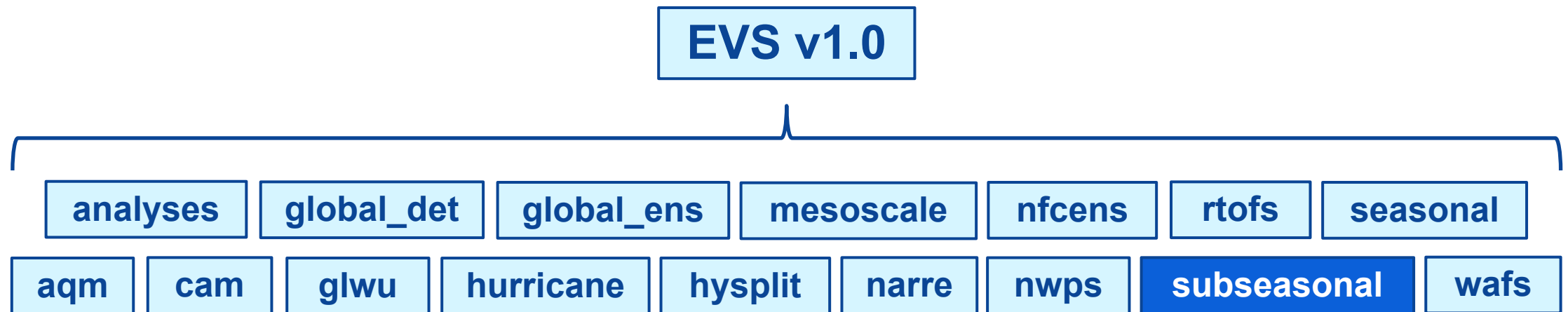


# Outline

- EMC Verification System (EVS) v1.0 Subseasonal Component
  - EVS v1.0 Subseasonal Website
  - Future EVS Development
  - Summary
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# EMC Verification System (EVS) v1.0

- EVS was implemented into operations on March 26, 2024
- EVS is a new software system used to assess operational NCEP model performance
  - Utilizes the Model Evaluation Tools (METplus) software package from DTC
- EVS routinely creates verification 1) statistics and 2) graphics in NCEP operations, allowing EMC to monitor operational NCEP model performance in near real time



# EMC Verification System (EVS) v1.0: subseasonal

- The subseasonal component of EVS v1.0 verifies GEF5 and CFS forecasts at Days 1–35 (for 0000 UTC cycles only)
- The following variables and verification periods are included in EVS v1.0:
  - 500-hPa geopotential height anomaly: Days 6–10, Weekly, and Weeks 3–4
  - 2-m temperature anomaly: Days 6–10, Weekly, and Weeks 3–4
  - Sea surface temperature (SST): Daily, Weekly, and Monthly
  - Sea ice concentration: Weekly and Monthly
- Verification sources include:
  - GFS Analysis (500-hPa geopotential height anomaly)
  - ECMWF Analysis (Grid-to-grid 2-m temperature anomaly)
  - NAM prebufr/METARS (Grid-to-obs 2-m temperature anomaly)
  - GHRSSST OSPO (SST)
  - OSI-SAF (Sea ice concentration)



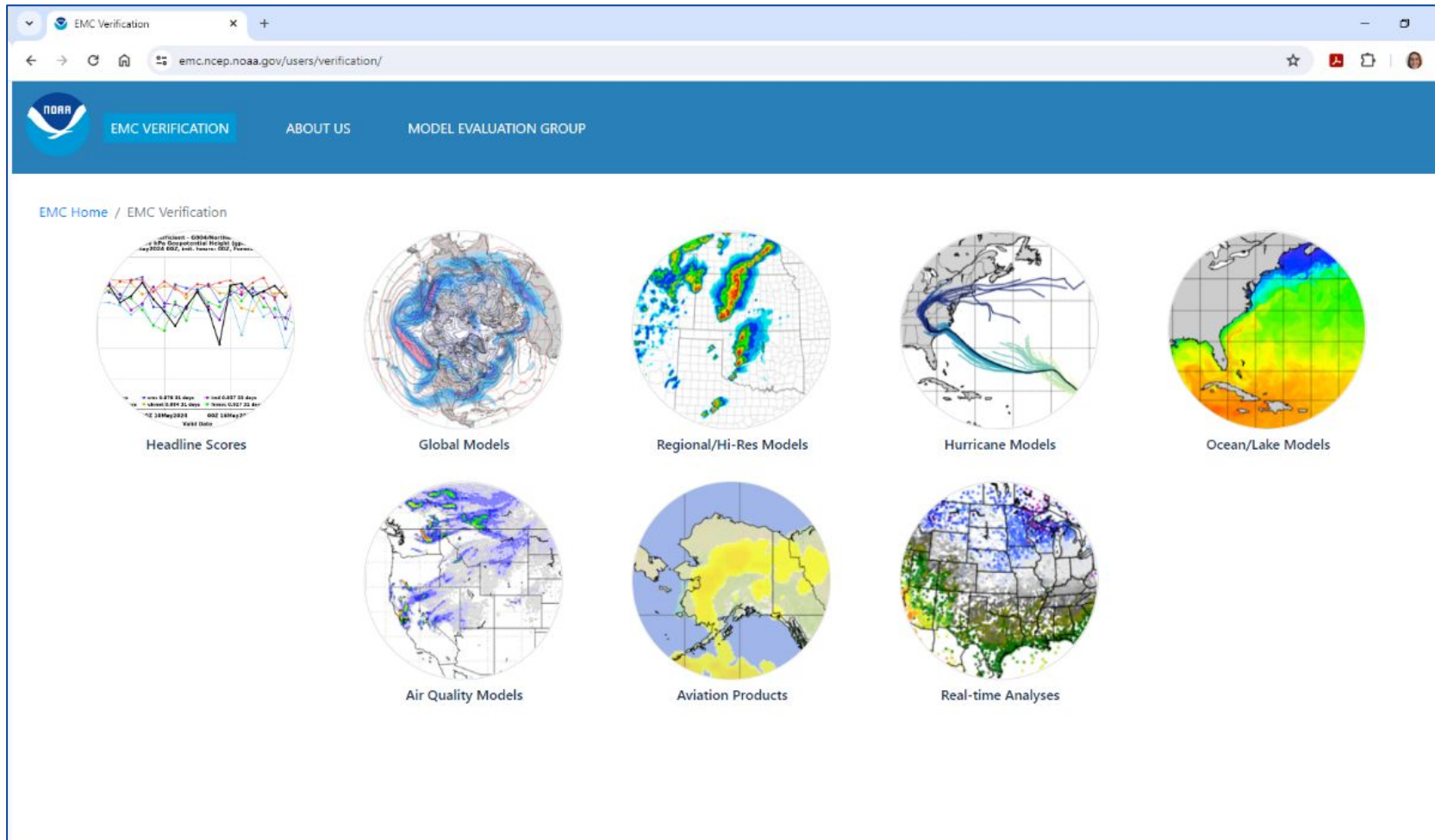


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# EMC Verification Website

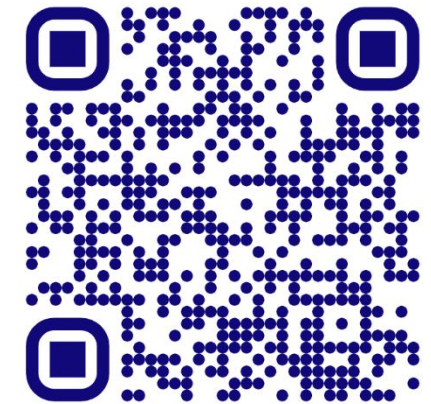
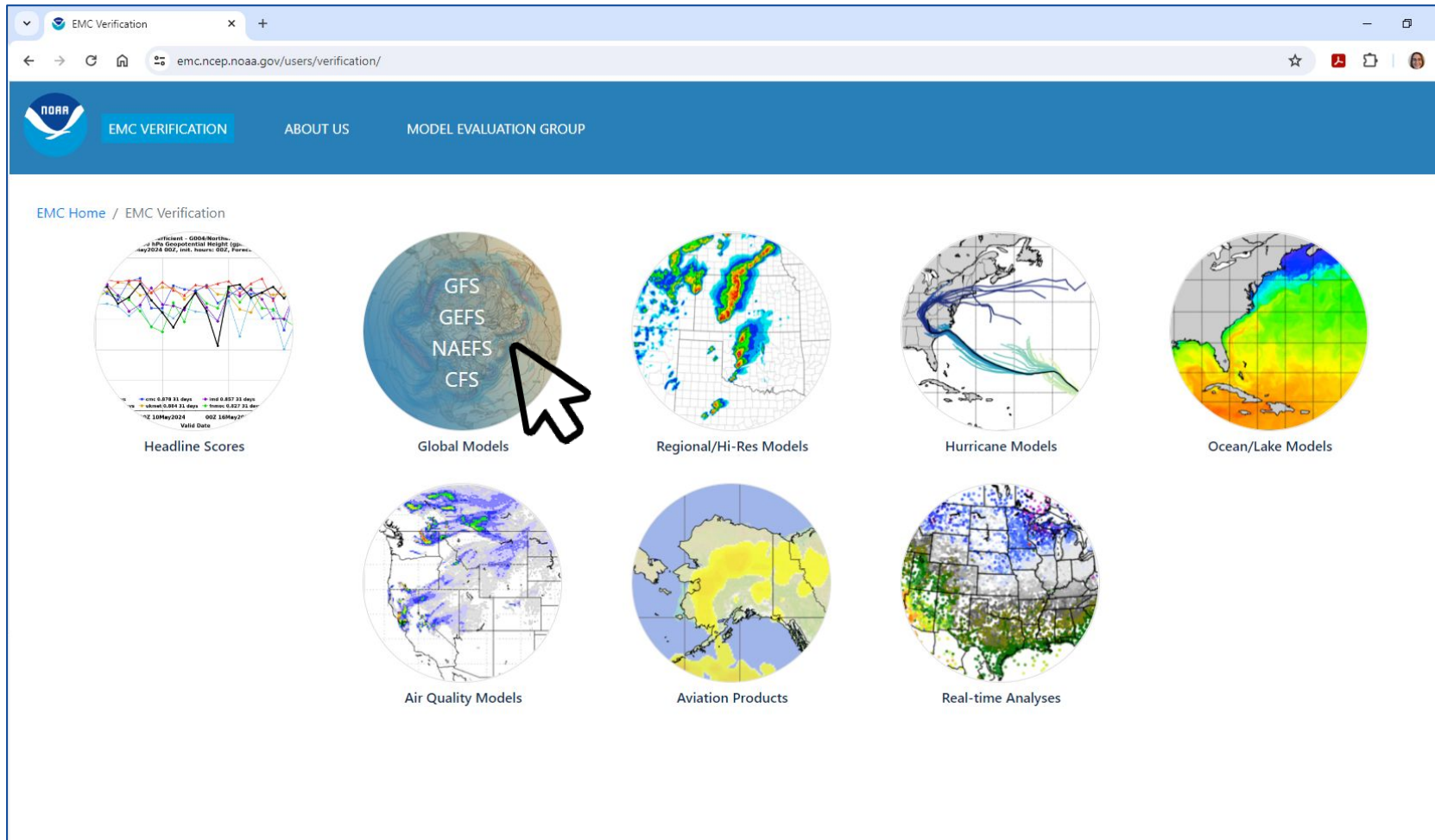
- EVS v1.0 graphics are displayed on EMC's verification website



**SCAN ME!**

# EMC Verification Website

- EVS v1.0 subseasonal graphics are displayed under Global Models

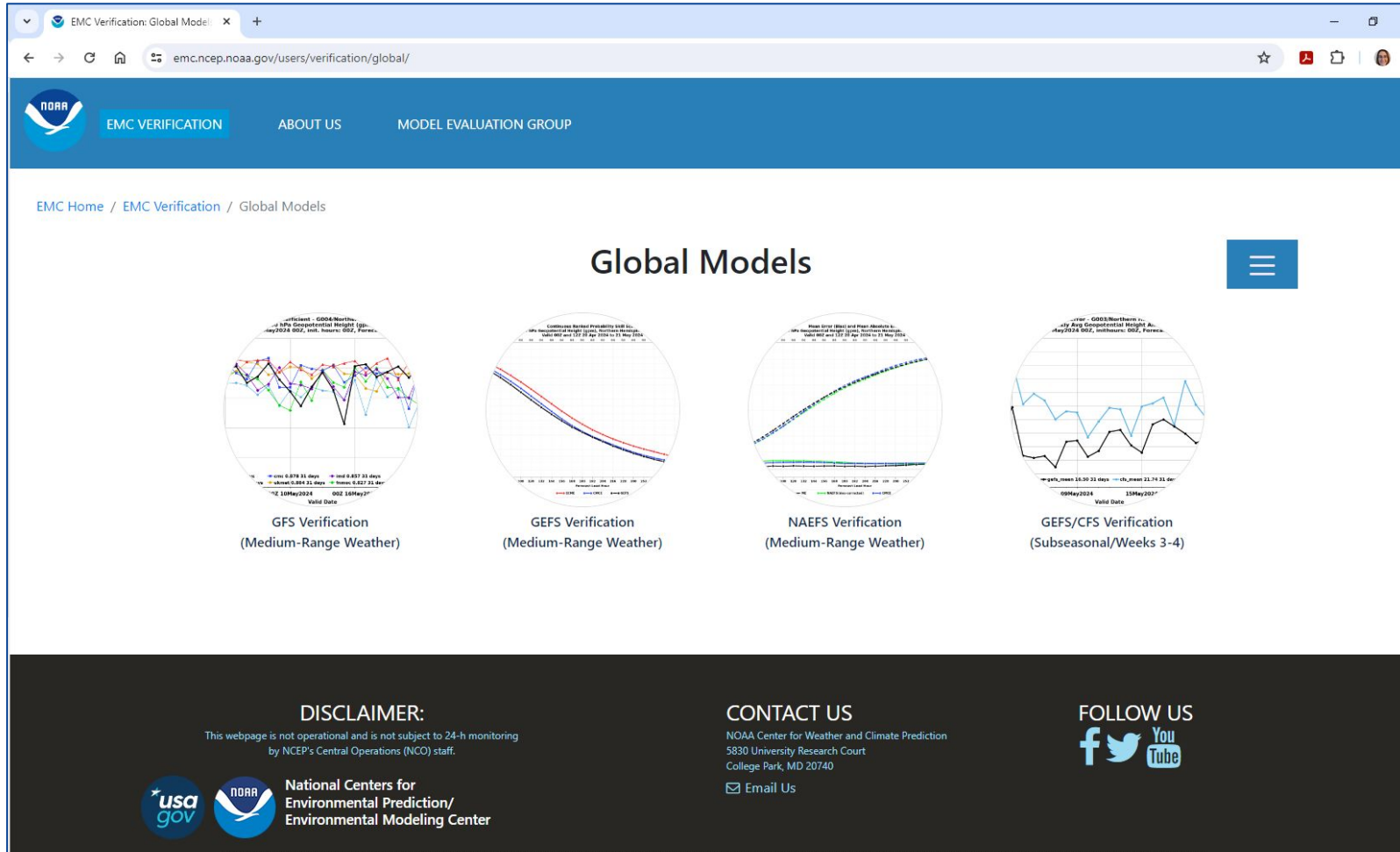


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# EMC Verification Website

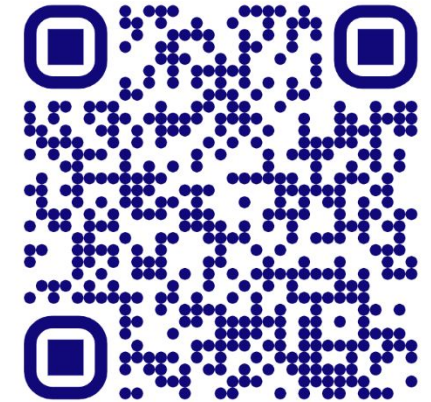
- EVS v1.0 subseasonal graphics are displayed under Global Models



The screenshot shows the NOAA EMC Verification website. The browser address bar displays `emc.ncep.noaa.gov/users/verification/global/`. The page features a blue header with the NOAA logo and navigation links for "EMC VERIFICATION", "ABOUT US", and "MODEL EVALUATION GROUP". Below the header, the breadcrumb trail reads "EMC Home / EMC Verification / Global Models". The main content area is titled "Global Models" and contains four circular verification graphics:

- GFS Verification (Medium-Range Weather)**: A line graph showing verification metrics for GFS.
- GEFS Verification (Medium-Range Weather)**: A line graph showing verification metrics for GEFS.
- NAEFS Verification (Medium-Range Weather)**: A line graph showing verification metrics for NAEFS.
- GEFS/CFS Verification (Subseasonal/Weeks 3-4)**: A line graph showing verification metrics for GEFS/CFS.

The footer contains a disclaimer, contact information for the NOAA Center for Weather and Climate Prediction, and social media links for Facebook, Twitter, and YouTube.

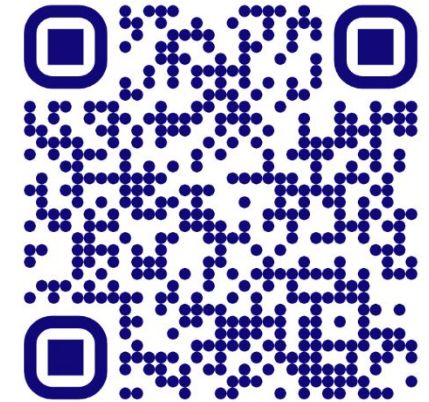


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# EMC Verification Website

- EVS v1.0 subseasonal graphics are displayed under Global Models

The screenshot shows the EMC Verification website interface. At the top, there is a navigation bar with the NOAA logo and links for "EMC VERIFICATION", "ABOUT US", and "MODEL EVALUATION GROUP". Below the navigation bar, the breadcrumb trail reads "EMC Home / EMC Verification / Global Models". The main content area is titled "Global Models" and features a grid of four circular verification graphics. From left to right, they are: "GFS Verification (Medium-Range Weather)", "GEFS Verification (Medium-Range Weather)", "NAEFS Verification (Medium-Range Weather)", and "GEFS/CFS Verification (Subseasonal/Weeks 3-4)". A mouse cursor is pointing at the GEFS/CFS graphic. The footer contains a disclaimer, contact information for the NOAA Center for Weather and Climate Prediction, and social media links for Facebook, Twitter, and YouTube.



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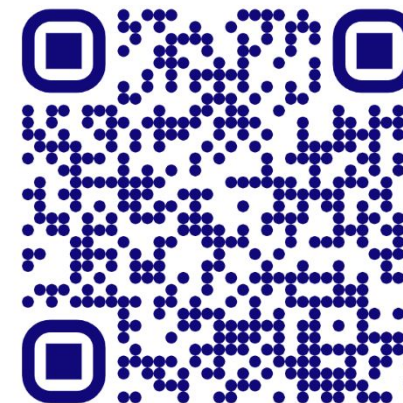
# EMC Verification Subseasonal Website

- The EVS v1.0 subseasonal home page displays an introduction, as well as grid-to-grid and grid-to-obs verification links

Subseasonal forecasts are important for decision support across various economic sectors, and provide guidance to forecasters, stakeholders, and emergency managers for keeping the public informed and prepared for weather phenomena such as heatwaves, freezes, drought, and floods. There has been increased focus on the Subseasonal to Seasonal (S2S) timescale due to the ability to fill emerging forecast needs in multiple industries. S2S forecasts are extremely helpful in predicting teleconnection patterns such as the North Atlantic Oscillation (NAO), El Niño-Southern Oscillation (ENSO), Madden-Julian Oscillation (MJO), etc.

Two of The National Centers for Environmental Prediction (NCEP)'s global models cover the subseasonal forecast period: the Global Ensemble Forecast System (GEFS) and the Climate Forecast System (CFS). The current operational version of the GEFS is version 12.3 as of 2022 October 19. The current operational version of the CFS is version 2.3 as of 2022 March 9. Verification for the operational GEFS and the CFS can be found by navigating the links to the left.

Verification is done using the **EMC Verification System (EVS)**, which uses **METplus**.



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# EMC Verification Subseasonal Website

- The EVS v1.0 subseasonal home page displays an introduction, as well as grid-to-grid and grid-to-obs verification links

**NCEP/EMC Subseasonal Operational Verification**

Subseasonal forecasts are important for decision support across various economic sectors, and provide guidance to forecasters, stakeholders, and emergency managers for the public informed and prepared for weather phenomena such as heatwaves, drought, and floods. There has been increased focus on the Subseasonal to Global (SS) timescale due to the ability to fill emerging forecast needs in multiple sectors. Subseasonal forecasts are extremely helpful in predicting teleconnection patterns such as the North Atlantic Oscillation (NAO), El Niño-Southern Oscillation (ENSO), Madden-Julian Oscillation (MJO), etc.

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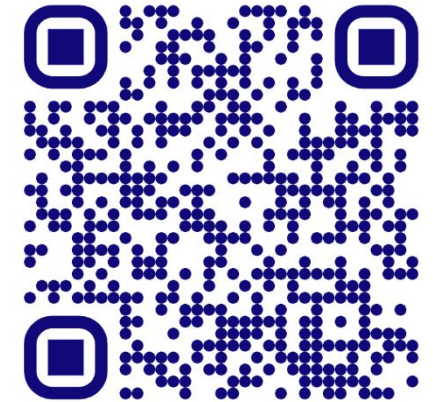
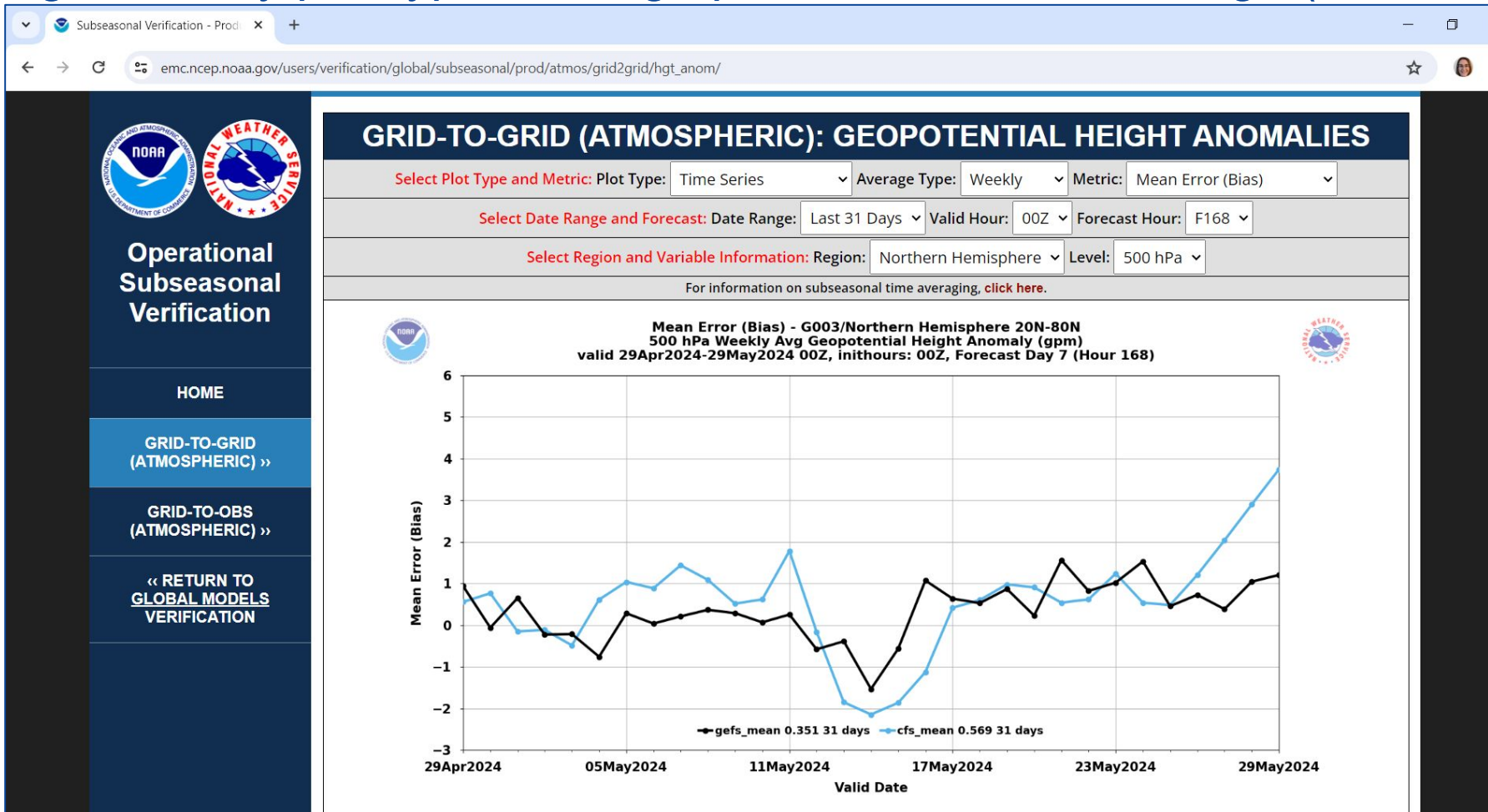


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# EMC Verification Subseasonal Website

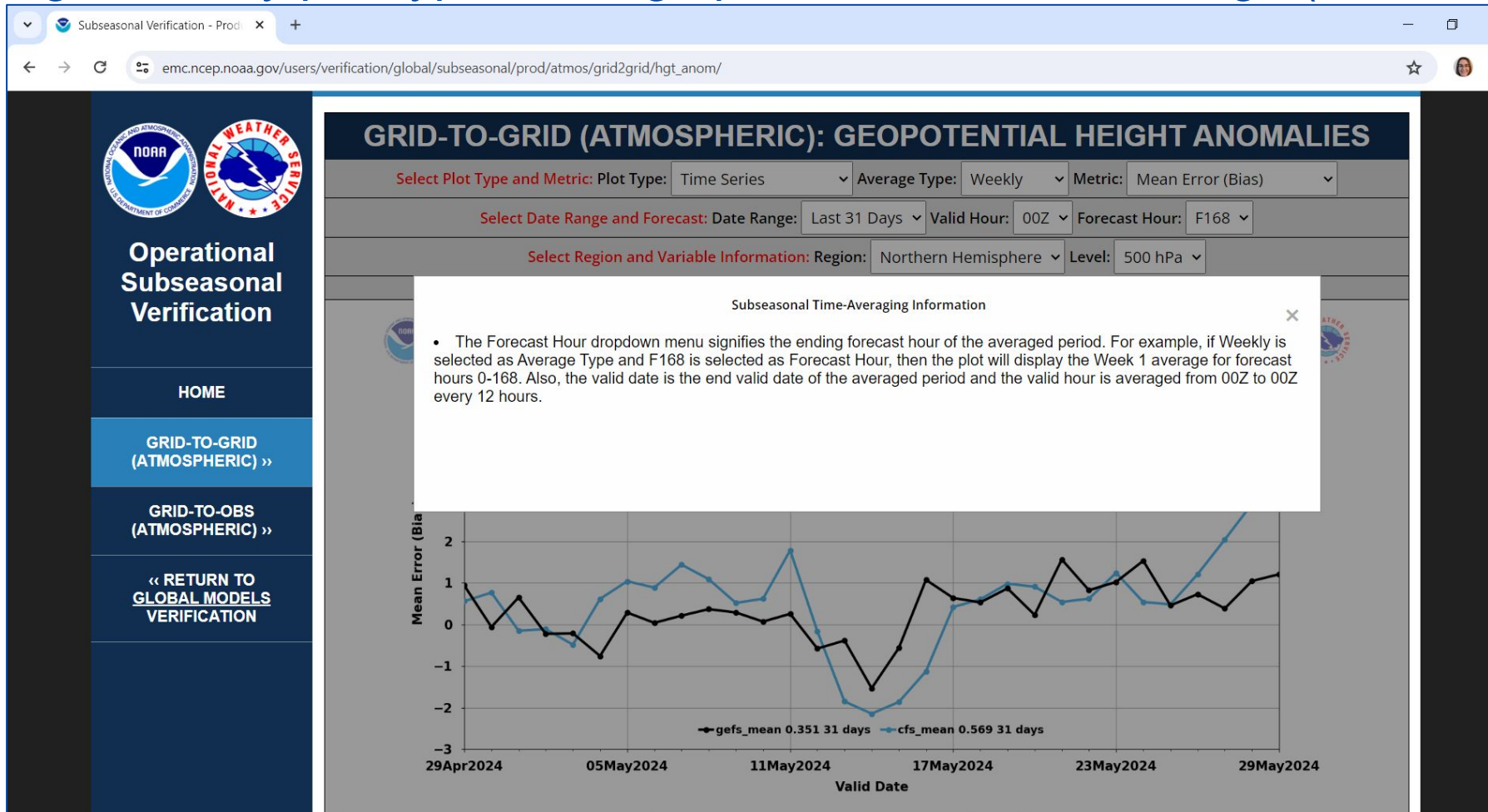
- 500-hPa geopotential height anomalies are displayed under grid-to-grid verification and organized by plot type, average period, metric, date range (31 or 90 days), and region



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# EMC Verification Subseasonal Website

- 500-hPa geopotential height anomalies are displayed under grid-to-grid verification and organized by plot type, average period, metric, date range (31 or 90 days), and region

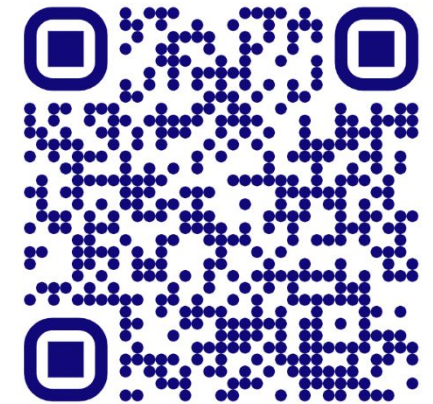
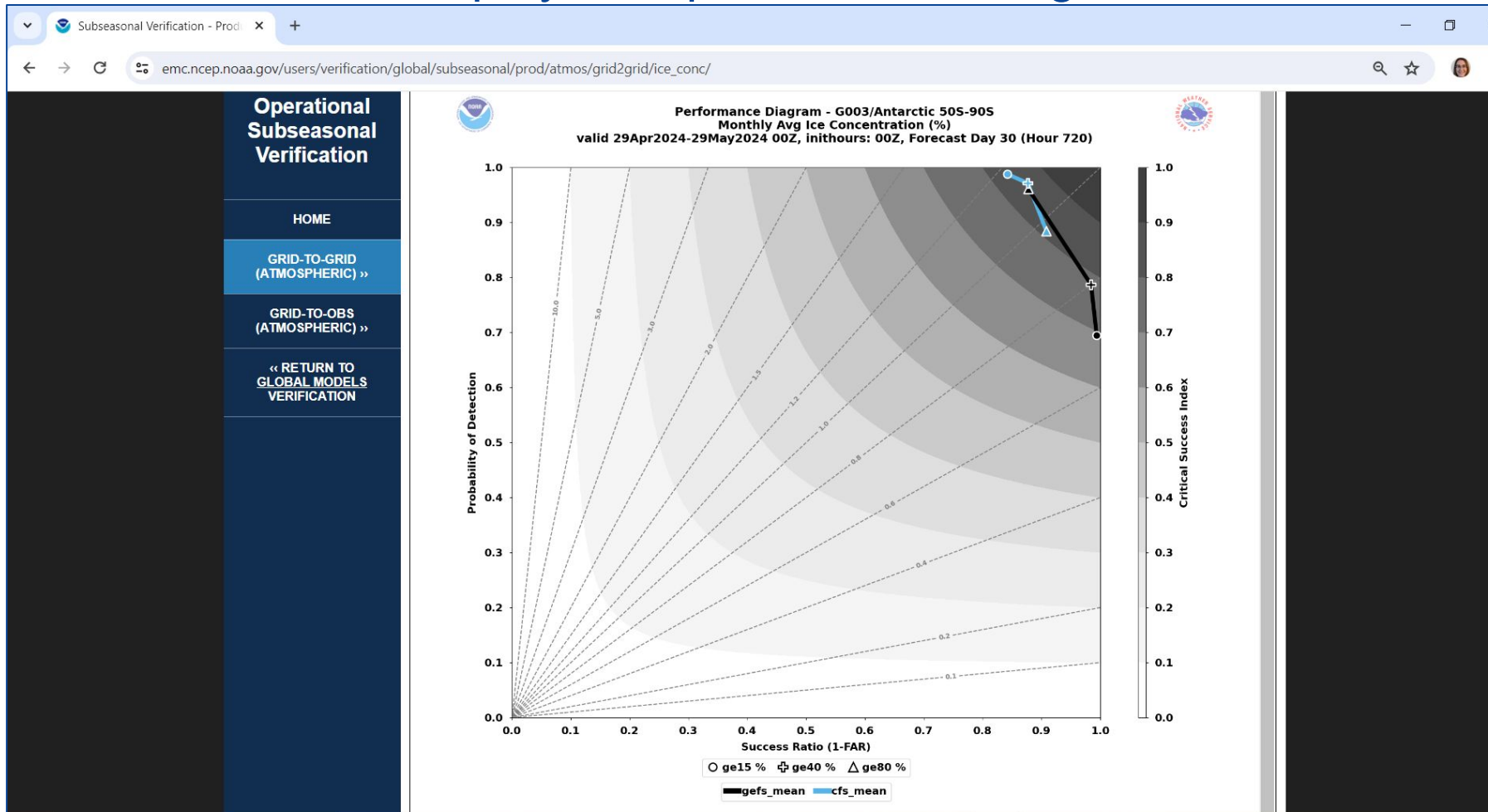


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# EMC Verification Subseasonal Website

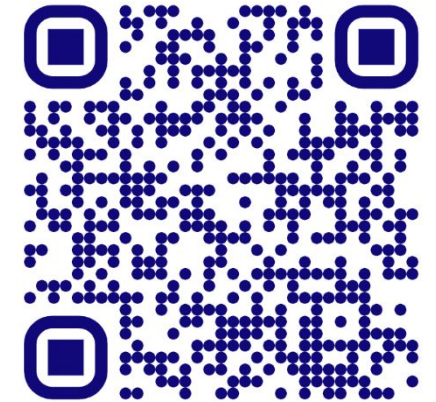
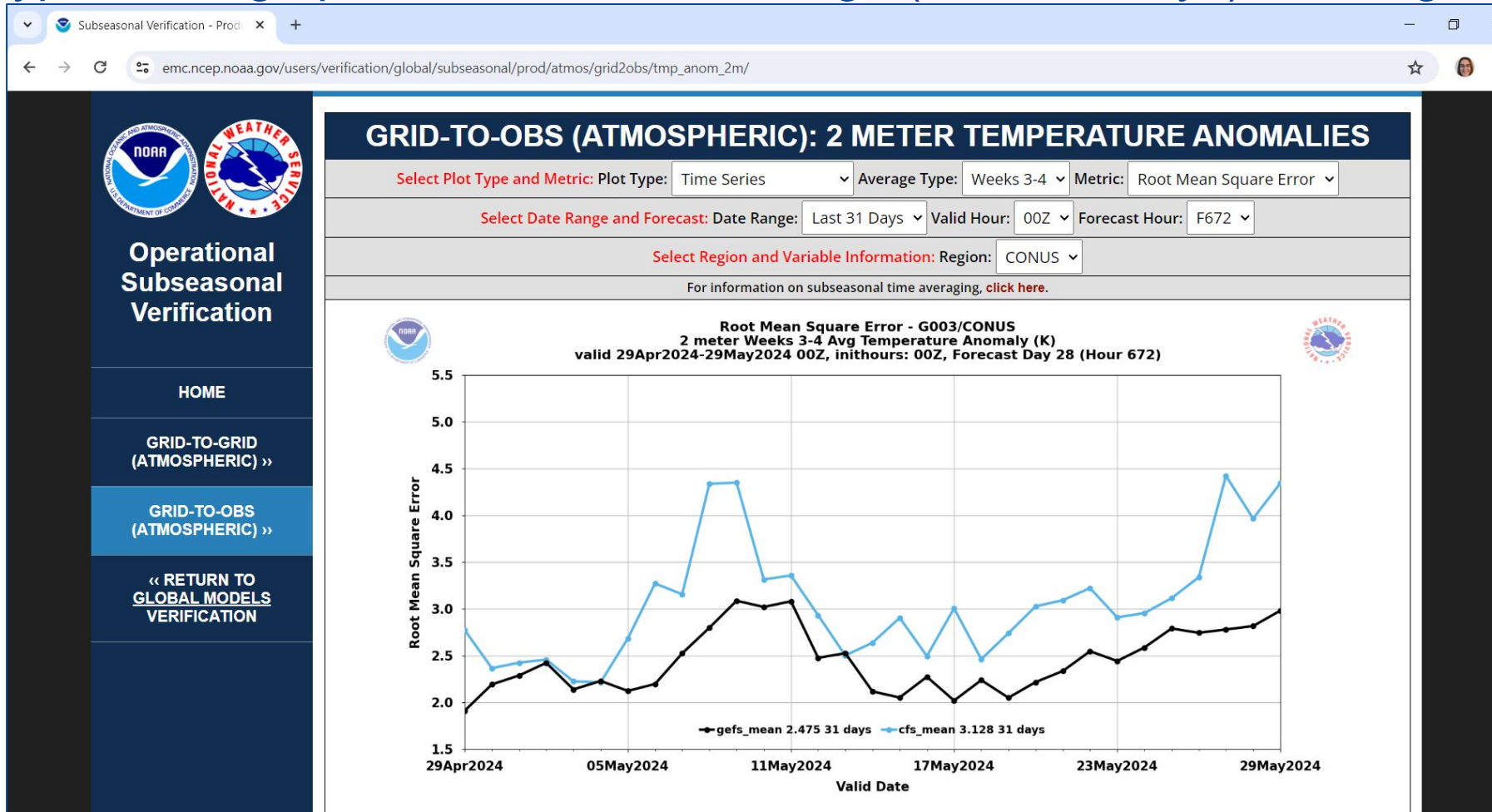
- In addition to time series and forecast hour mean plot types, sea ice concentration verification is also displayed in performance diagrams



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# EMC Verification Subseasonal Website

- Grid-to-obs verification contains 2-m temperature anomalies, and is organized by plot type, average period, metric, date range (31 or 90 days), and region



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# EVS Subseasonal Future Development

- The following variables are planned to be included in EVS v2.0:
  - 500-hPa geopotential height
  - 2-m temperature
  - 200-hPa and 850-hPa U/V wind and anomalies
  - Surface precipitation
  - ENSO-region SST anomalies
  - Outgoing longwave radiation (OLR) and anomalies
- In future versions of EVS, GEFs v13 and the Seasonal Forecast System (SFS) will be verified for the subseasonal component



# Summary: EVS v1.0 Subseasonal Verification

- The EMC Verification System (EVS) v1.0 is a new software system used to assess **operational** NCEP model performance (both global and regional models)
  - Utilizes the Model Evaluation Tools (METplus) software package from DTC
- The subseasonal component of EVS v1.0 verifies GEFs and CFS forecasts at Days 1–35 for 500-hPa geopotential height anomalies, 2-m temp anomalies, SST, and sea ice concentration
- EVS v1.0 subseasonal graphics are being displayed on EMC's verification website:
  - <https://www.emc.ncep.noaa.gov/users/verification/global/subseasonal/prod/>
- Future versions of EVS will include new subseasonal variables/metrics and be used for model evaluations (GEFSv13 and SFS)

# Subseasonal Verification Analysis (last 31 days)

- The CFS mean has a more negative 500-hPa height anomaly bias and slightly higher Root Mean Square Error (RMSE) compared to the GEFS mean for most average periods and regions
- The CFS mean has a similar (near zero) 2-m temp anomaly (G2G and G2O) bias and a similar (or slightly higher) RMSE as the GEFS mean for most average periods and regions
- The CFS mean has an overall slightly less negative SST bias and a similar (or slightly less) RMSE compared to the GEFS mean for most average periods and regions
- The GEFS mean has a higher sea ice concentration bias and RMSE in the Arctic compared to the CFS mean and a lower bias, higher RMSE in the Antarctic

