NATIONAL WEATHER SERVICE

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

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16 January 2025 NOAA's S2S Applications: Stakeholder Needs, Modeling Systems and Analysis

105th AMS Annual Meeting



Introduction and Motivation

- Subseasonal forecasts are important for decision support across numerous economic sectors
- Subseasonal forecasts provide guidance to forecasters, emergency managers, and other end users for keeping the public informed and prepared for various weather phenomena
- The National Centers for Environmental Prediction (NCEP)'s Global Ensemble Forecast System (GEFS) and the Climate Forecast System (CFS) cover the subseasonal forecast period (Days 1-35)
- The current operational version of the GEFS is version 12.3 as of 19 October 2022 and the current operational version of the CFS is version 2.3 as of 9 March 2022

Outline

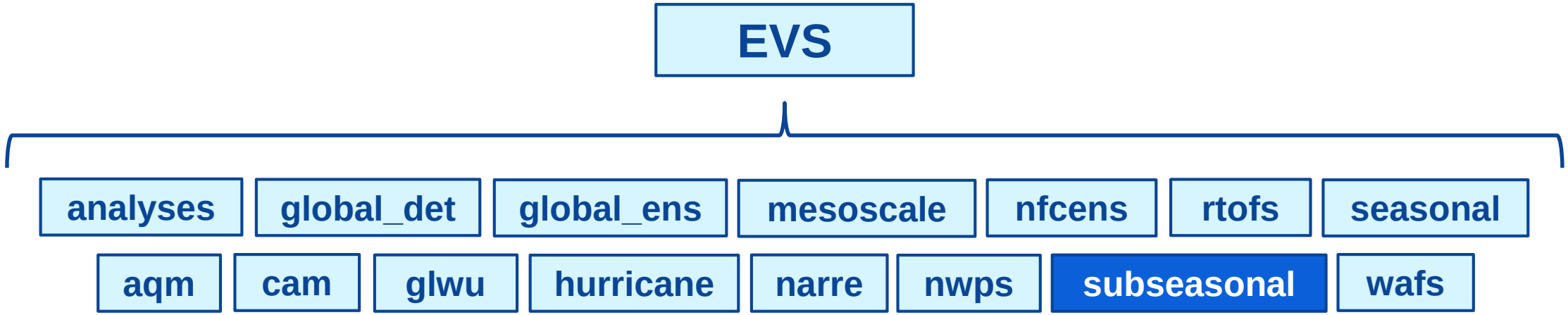
- EMC Verification System (EVS) Subseasonal Component
- EVS v1.0 Subseasonal Website
- Future EVS Development
- Summary

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EMC Verification System (EVS)

- EVS is a new software system used to assess **operational** NCEP model performance
  - Utilizes the Model Evaluation Tools (METplus) software from DTC and Python
- EVS routinely creates verification statistics and graphics in NCEP operations, allowing EMC to monitor **operational** NCEP model performance in near real time
- EVS v1.0 became operational on 26 March 2024 and EVS v2.0 is in development



EMC Verification System (EVS) v1.0: subseasonal

- The subseasonal component of EVS v1.0 verifies GEFS and CFS forecasts at Days 1–35 (for 0000 UTC cycles only)

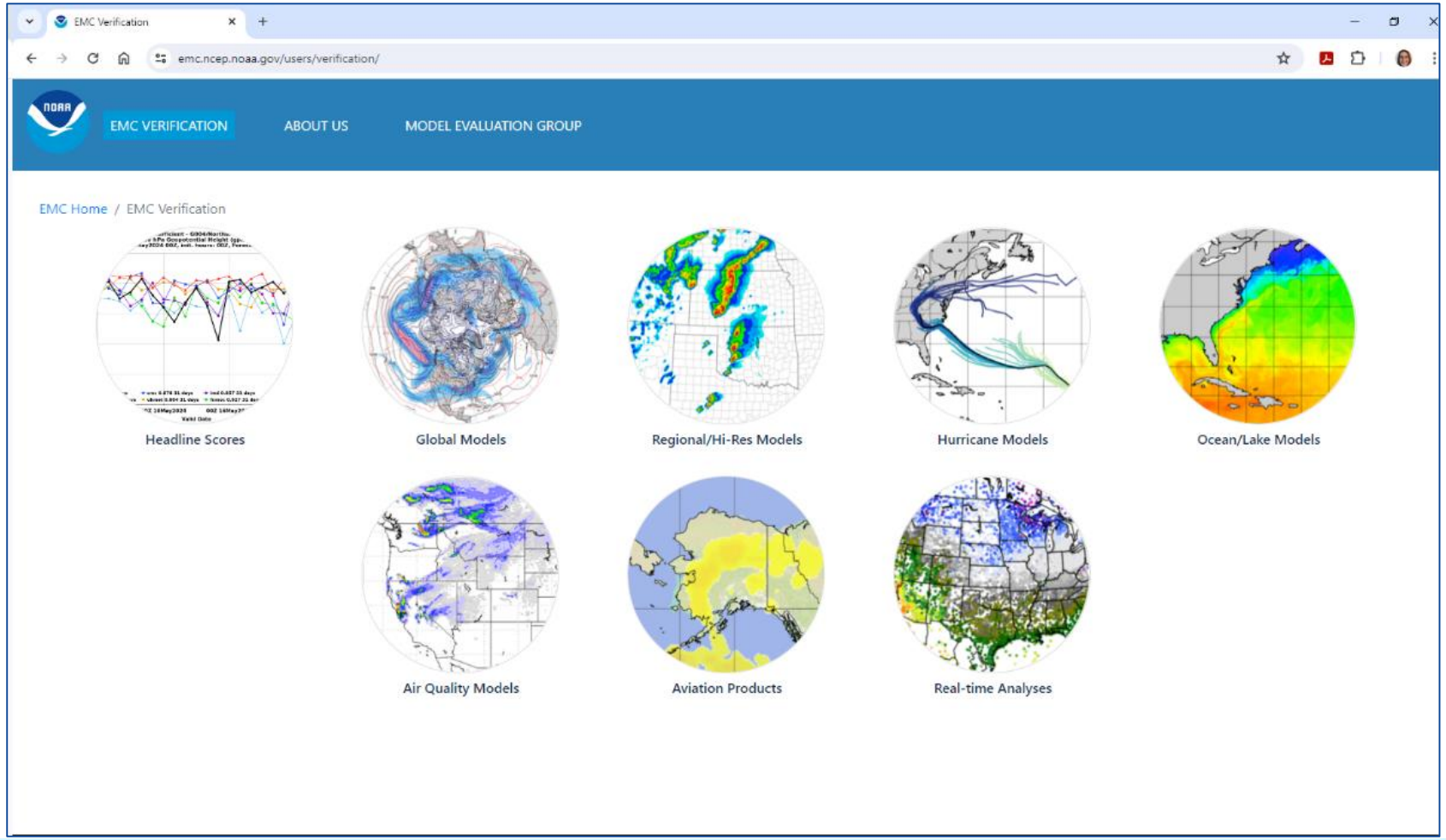
Variable	Avg Period	Metric	Threshold	Region	Verif. Approach	Validation Dataset	Climo
500-hPa Geopotential Height Anomaly	Days 6-10, Weekly, Weeks 3-4	Bias, RMSE	None	NH, SH, Tropics, CONUS, AK, HI	grid2grid	GFS analysis	ERA5
2-m Temperature Anomaly	Days 6-10, Weekly, Weeks 3-4	Bias, RMSE	None	Global, CONUS, AK, HI	grid2grid	ECMWF analysis	ERA5
2-m Temperature Anomaly	Days 6-10, Weekly, Weeks 3-4	Bias, RMSE	None	Global, CONUS, AK, HI	grid2obs	METARS	ERA5
Sea Surface Temperature	Daily, Weekly, Monthly	Bias, RMSE	None	NH, SH, Tropics	grid2grid	GHRSST OSPO	None
Sea Ice Concentration	Weekly, Monthly	Bias, RMSE, CSI	>=15, 40, 80%	Arctic, Antarctic	grid2grid	OSI-SAF	None

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EMC Verification Website

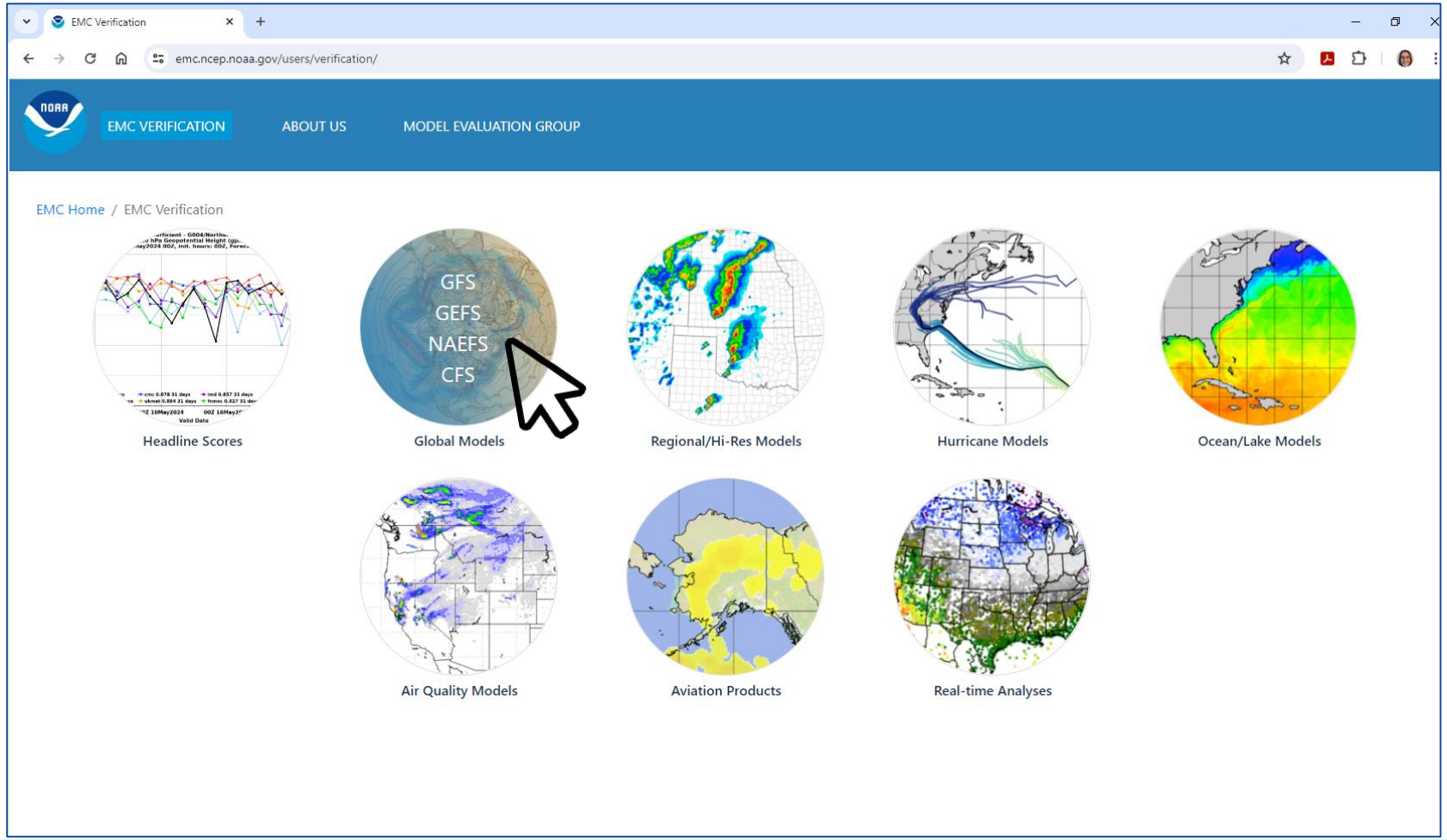
- EVS v1.0 graphics are displayed on EMC's verification website



SCAN ME!

EMC Verification Website

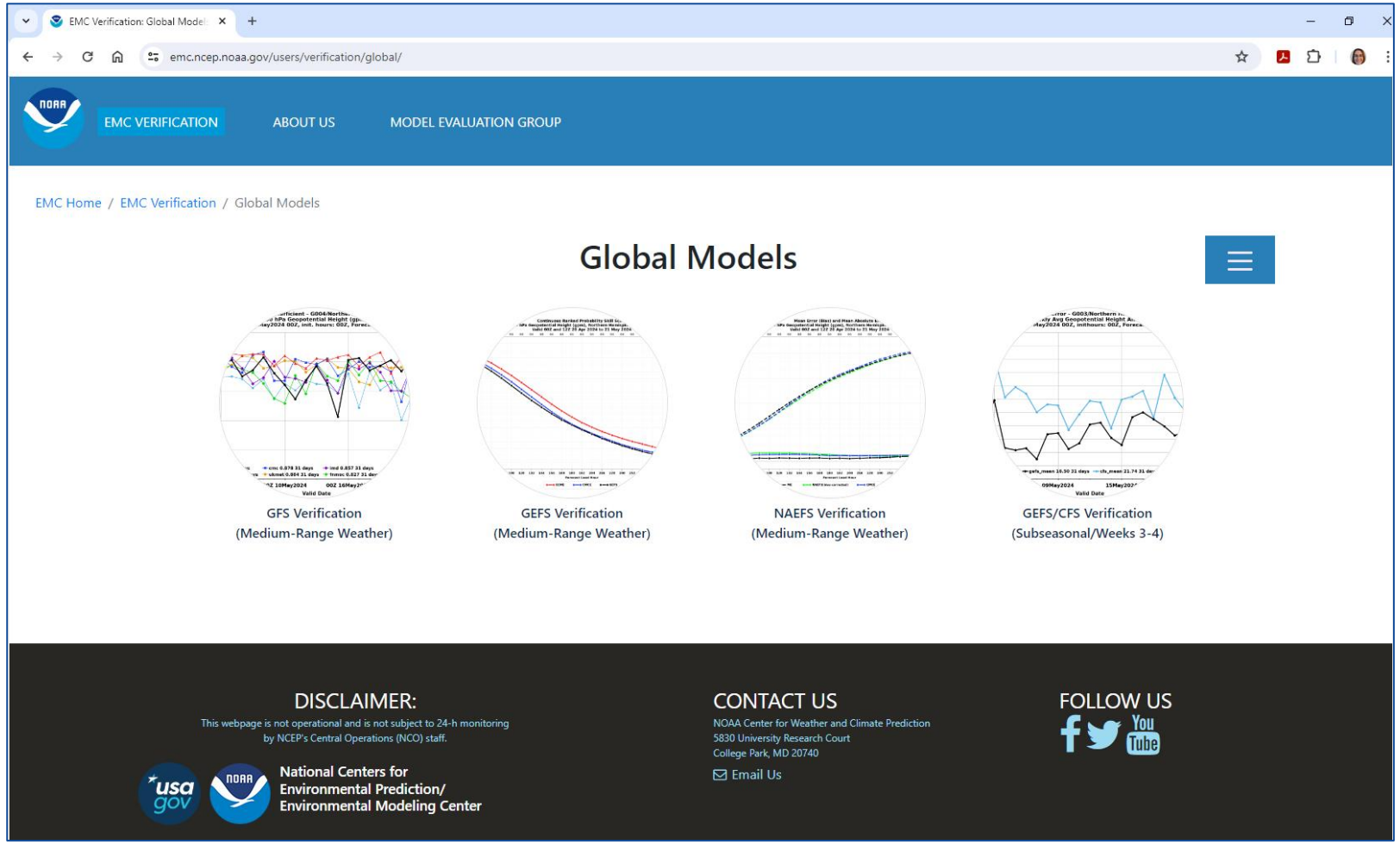
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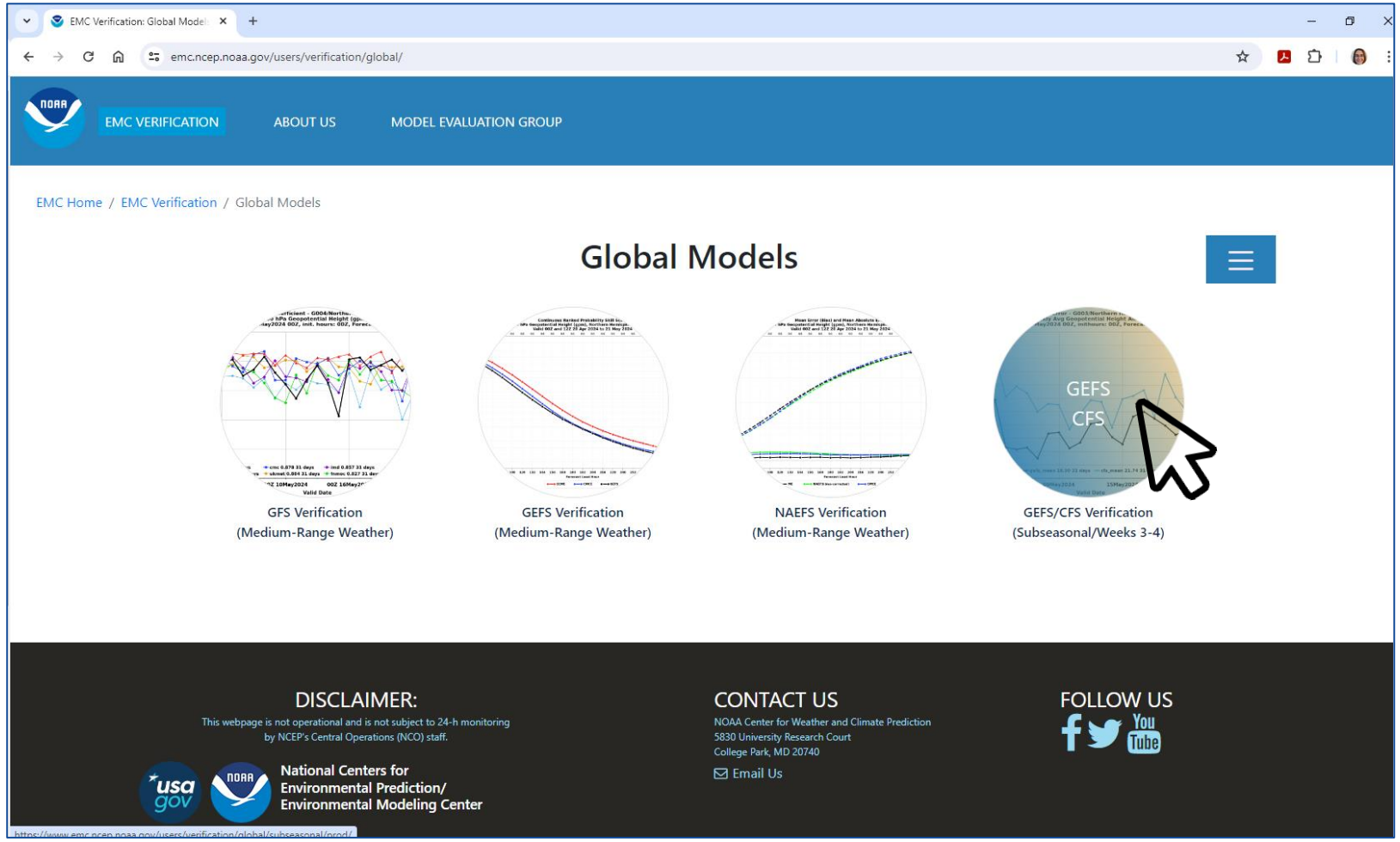
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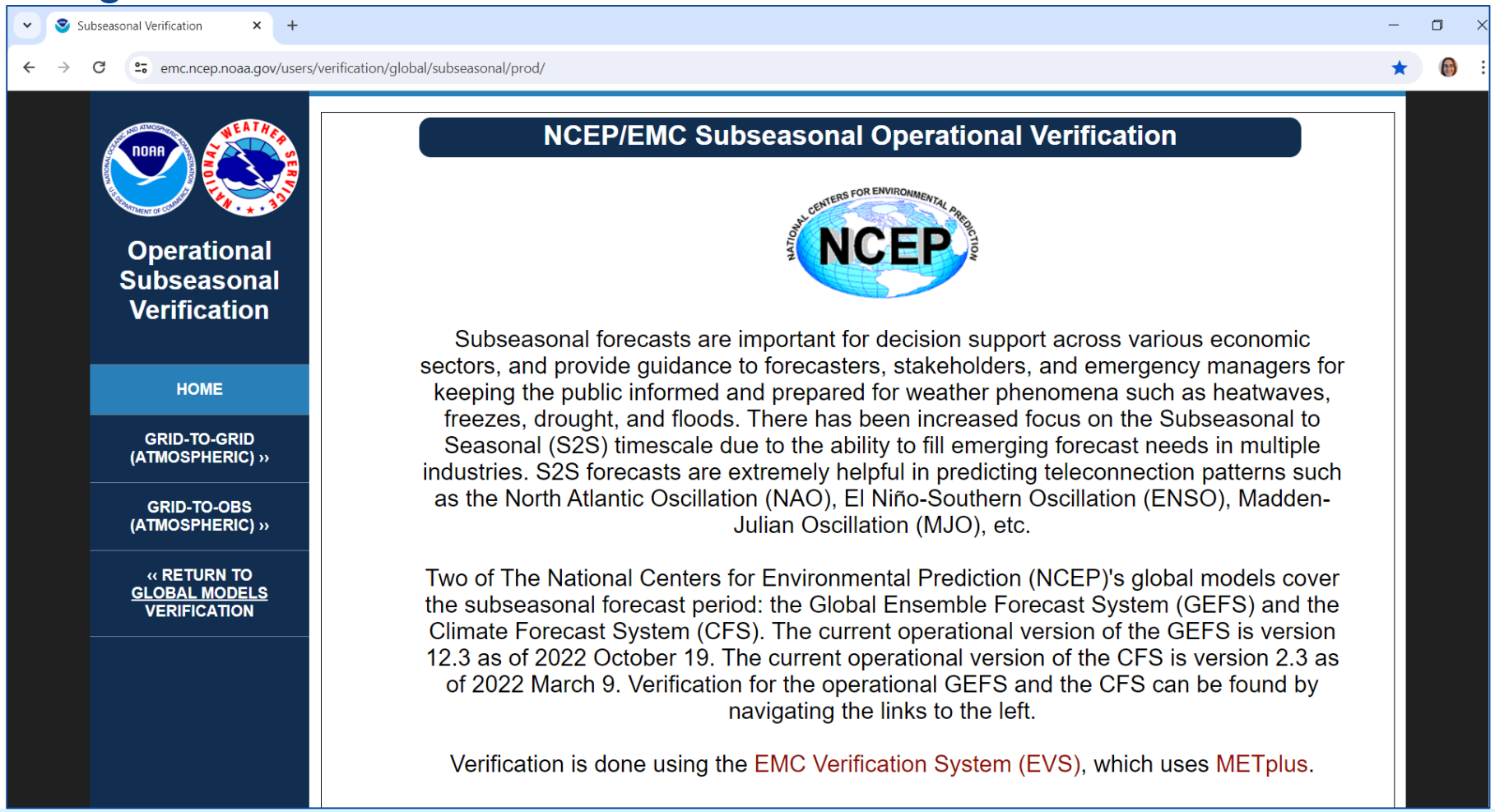
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EMC Verification Subseasonal Website

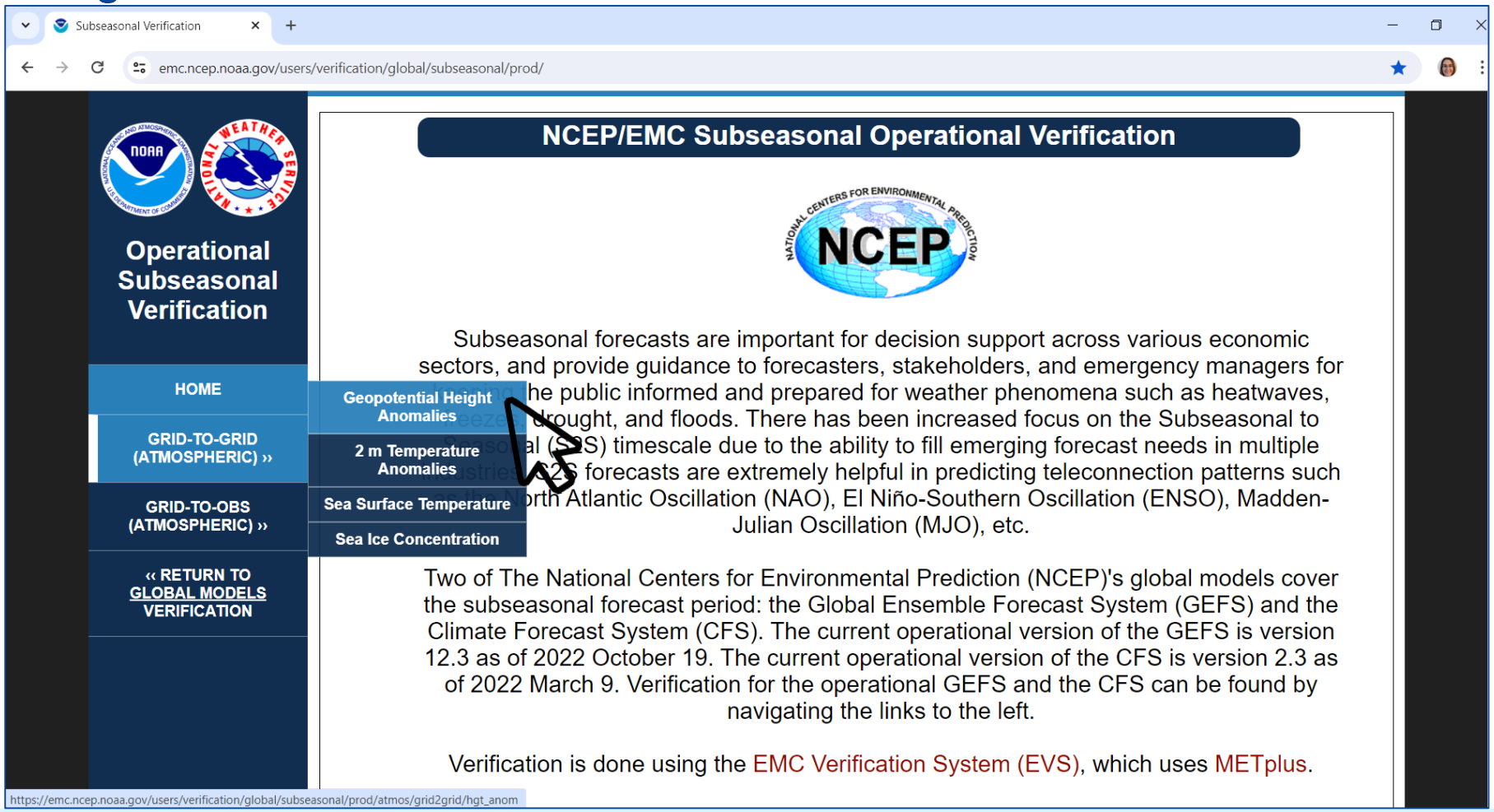
- The EVS v1.0 subseasonal home page displays an introduction, as well as grid-to-grid and grid-to-obs verification links



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EMC Verification Subseasonal Website

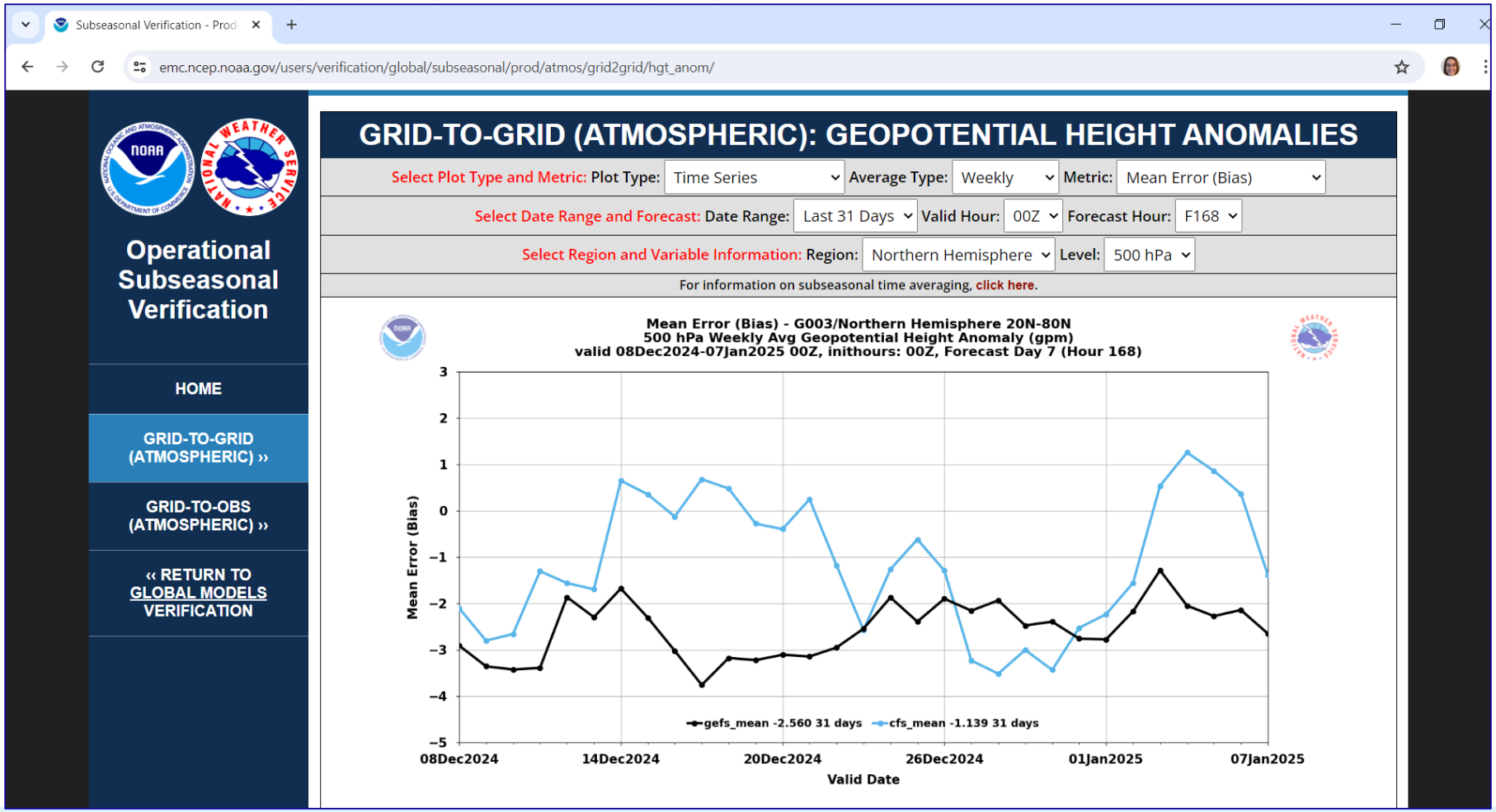
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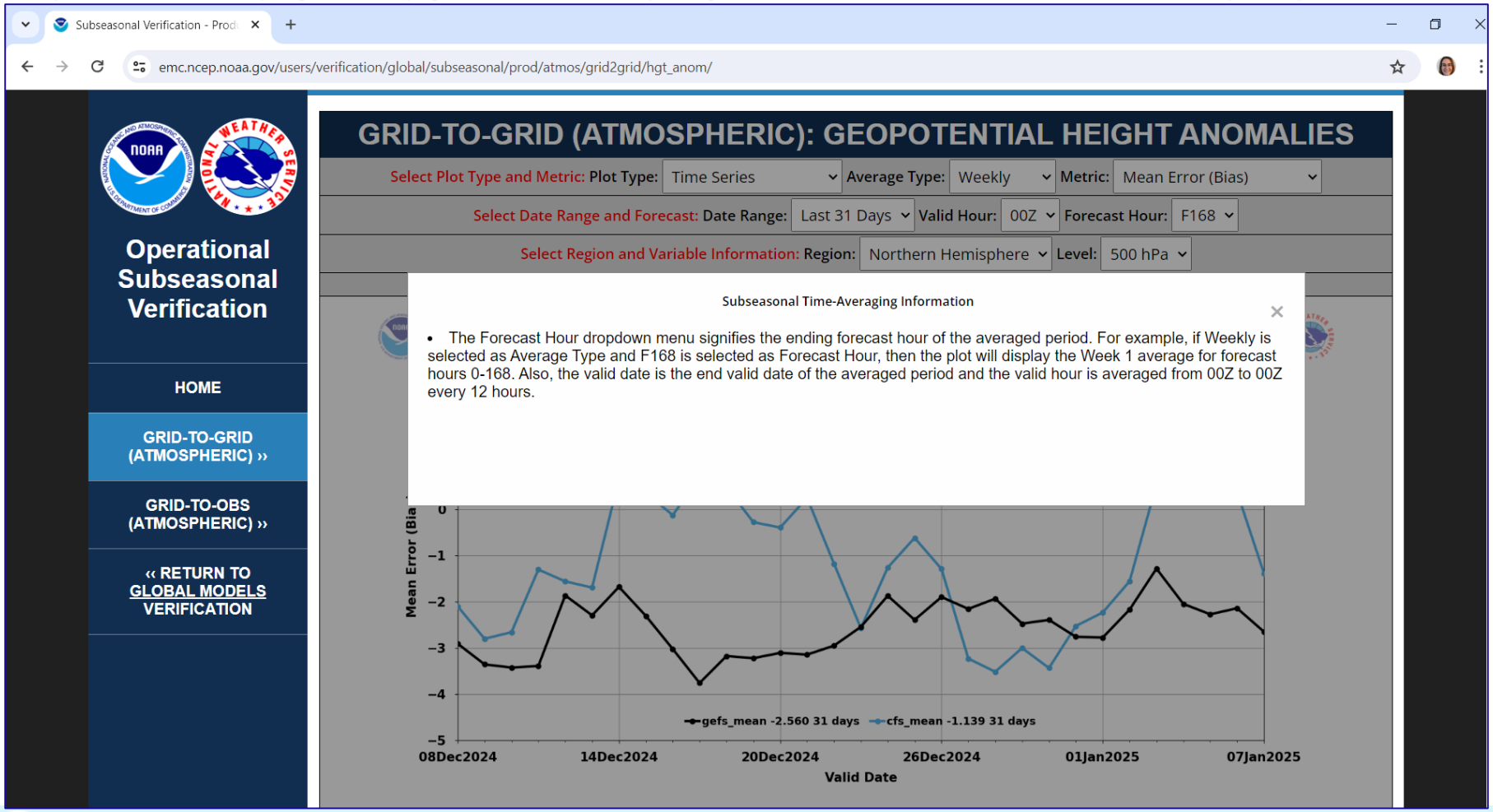
- 500-hPa geopotential height anomalies are displayed under grid-to-grid verification and organized by plot type, average period, metric, date range (31 or 90 days), and region



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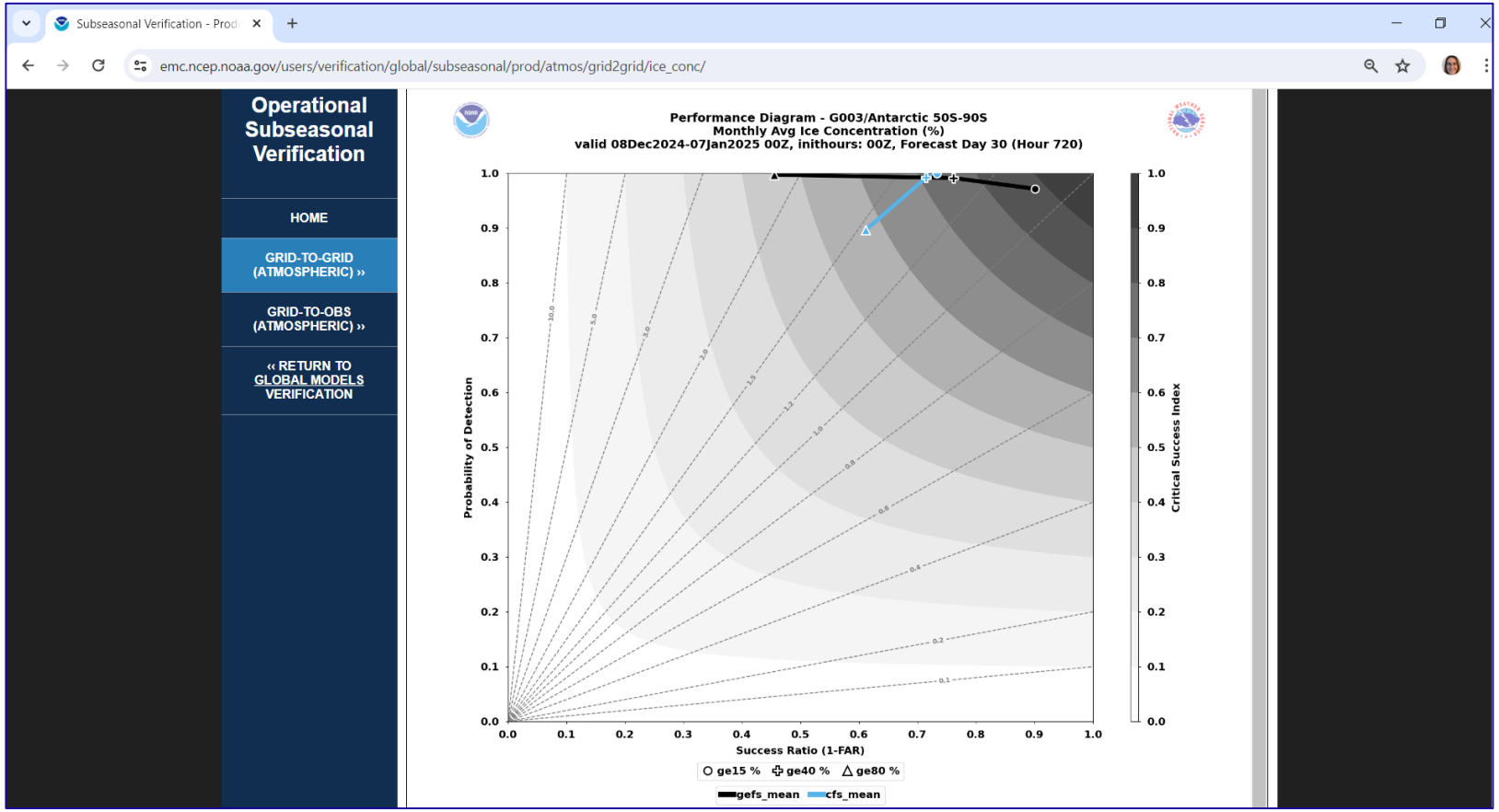
- 500-hPa geopotential height anomalies are displayed under grid-to-grid verification and organized by plot type, average period, metric, date range (31 or 90 days), and region



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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

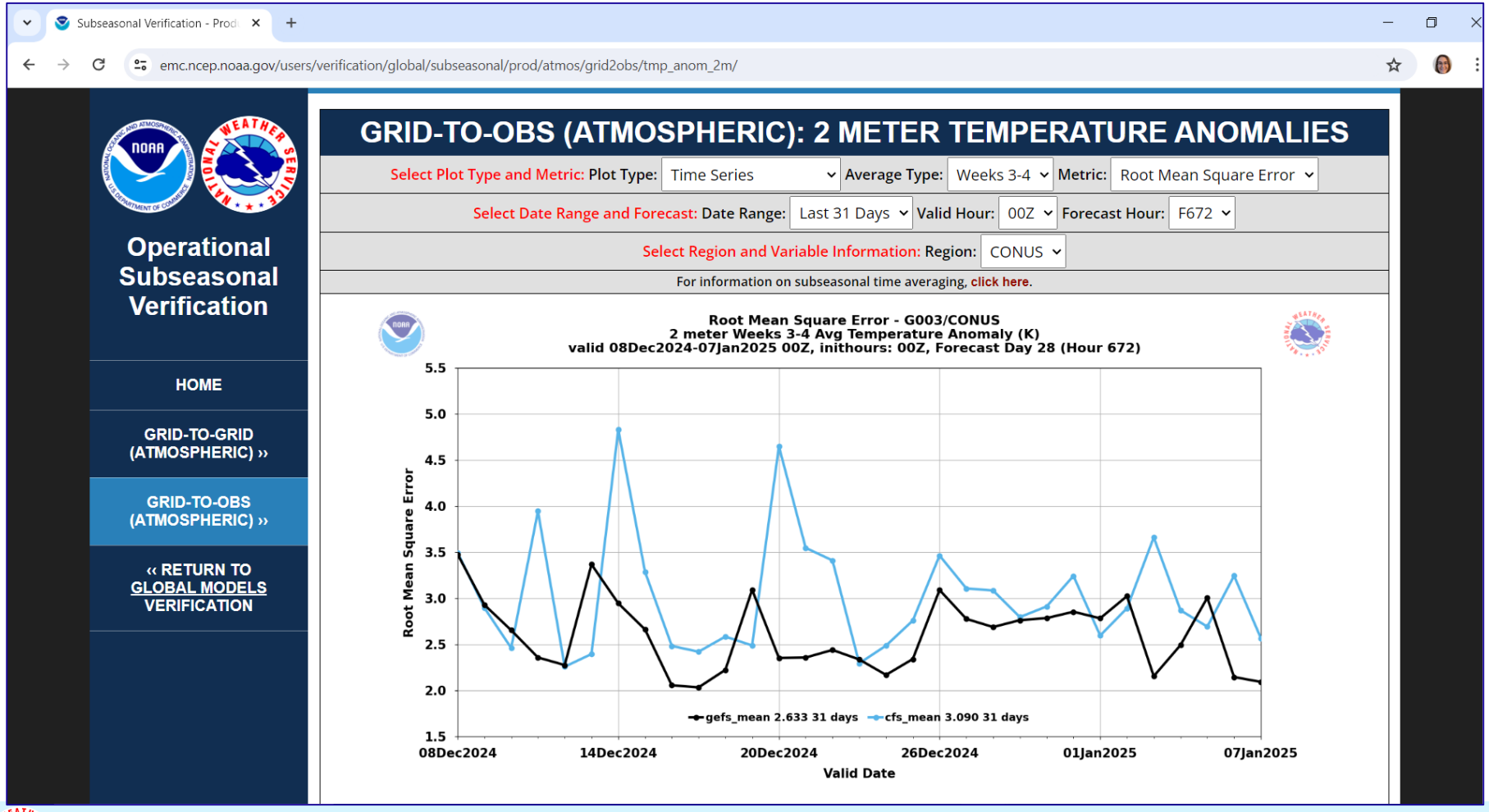


- Legend:
  - x-axis: Success Ratio (1-FAR)
  - y-axis: Probability of Detection (POD)
  - dashed lines: Frequency Bias (Fbias)
  - grayscale: Critical Success Index (CSI)
- All values would equal 1 in a perfectly performing model

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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 will be included in EVS v2.0:
  - 500-hPa geopotential height
  - 2-m temperature
  - General fixes/additions
  - Bugfixes

- The following variables are planned to be included in future versions of EVS:
  - 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, GEFSv13 and the new Seasonal Forecast System (SFSv1.0), which will replace CFSv2.3, will be verified in 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 from DTC and Python
- 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 SFSv1)

EMC Verification Contact Information

- Subseasonal Verification Developer and Webmaster
  - Shannon.Shields@noaa.gov
- Seasonal Verification Project Lead
  - Lydia.B.Stefanova@noaa.gov

Questions?

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 negative sea ice concentration bias and higher RMSE in the Arctic compared to the CFS mean, and a higher bias and RMSE in the Antarctic