MDTF x UFS

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MDTF

The Model Diagnostics Task Force (MDTF) Diagnostics package is an open-source platform that applies "process-oriented diagnostics" to Earth system models. The MDTF-Diagnostics Framework allows subject-matter experts to easily develop and deploy these PODs for universal application to supported model output data. The design goal of the MDTF framework is to provide a portable and adaptable means to run process-oriented diagnostic scripts (PODs). "Portability", is the ideal of "run once, run anywhere": the purpose of the framework is to automate various technical data preprocessing tasks. This empowers the POD to be run by a wider range of researchers on a wider range of models.

The MDTF was originally designed to analyze climate models and manages a range of support tasks such as data management, data retrieval, runtime configuration requirements, subsetting, and creating the output on a webpage.

The MDTF includes a wide range of PODs contributed by many authors, including extra-tropical storm track diagnostics, blocking frequency and Rossby wave source, precipitation diurnal cycle and convective transition, ocean dynamics, MJO and ENSO diagnostics, coupling diagnostics between soil-atmosphere and stratosphere-troposphere, Tropical cyclones and extremes. A full list of diagnostics can be found here: `https://github.com/NOAA-GFDL/MDTF-diagnostics`

NOAA Model Diagnostics Task Force

Maloney et al. (2019): Process-Oriented Evaluation of Climate and Weather Forecasting Models. BAMS, 100 (9), 1665-1686, doi:10.1175/BAMS-D-18-0042.1.

UFS Seasonal Forecast System

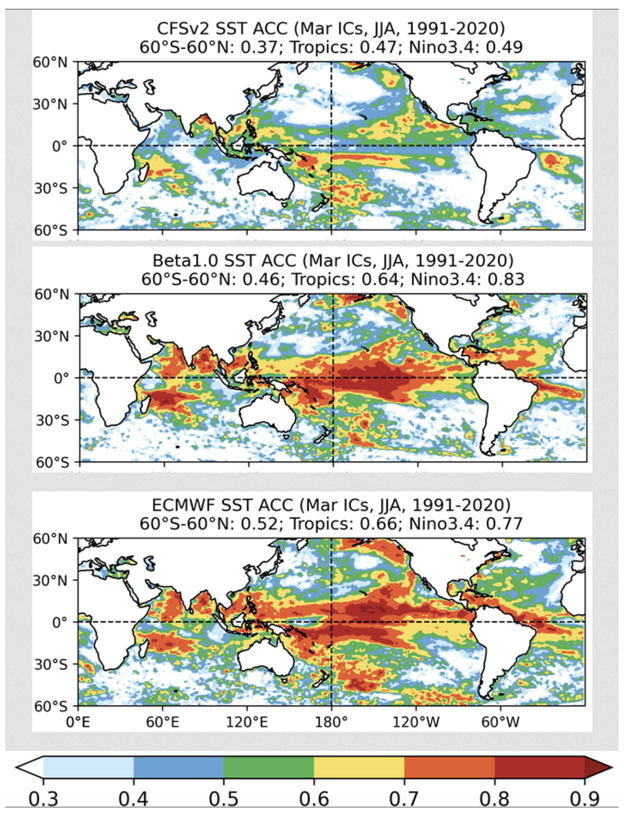


Figure: SST anomaly correlation coefficient for target season June-July-August (JJA) from hindcasts initialized from March 1 in 1991-2020. Top: CFSv2, Middle: SFS Beta 1.0, Bottom: ECMWF SEAS5.

The UFS Seasonal Forecast System (SFS) is currently under development at NOAA and a beta version (SFS-betaV1.0) is running in realtime with monthly initializations, including 30 years of reforecasts for the same month. In addition, several experiments have been completed running the SFS in climate mode at C192 (about 0.5 degree) and C96 (about 1 degree) resolution.

Realtime SFS data and corresponding reforecasts are available to the public from AWS. This includes forecasts at monthly resolution out to 12 months and at daily resolution out to 46 days. `https://noaa-oar-sfsdev-pds.s3.amazonaws.com/index.html#experiments/beta1/`

`https://epic.noaa.gov/seasonal-forecast-system-sfs-beta-near-real-time-capability-launched/`

The SFS is expected to go operational in 2027 and to be a major improvement from the currently operational CSFv2. In the meantime, it is valuable to have knowledge of any model errors and biases in the SFS, both at short and long lead times.

Combining the capabilities of the MDTF with the SFS (and other UFS applications) would significantly decrease delays in SFS model evaluation for the current realtime forecasts and future developmental model versions. It would also allow community users to access diagnostics to apply to their UFS model output.

However, adapting the MDTF to forecast model data is not trivial. Below we describe the current status of this project, requirements, and challenges.

UFS UNIFIED FORECAST SYSTEM

MDTF x UFS

Project Goals

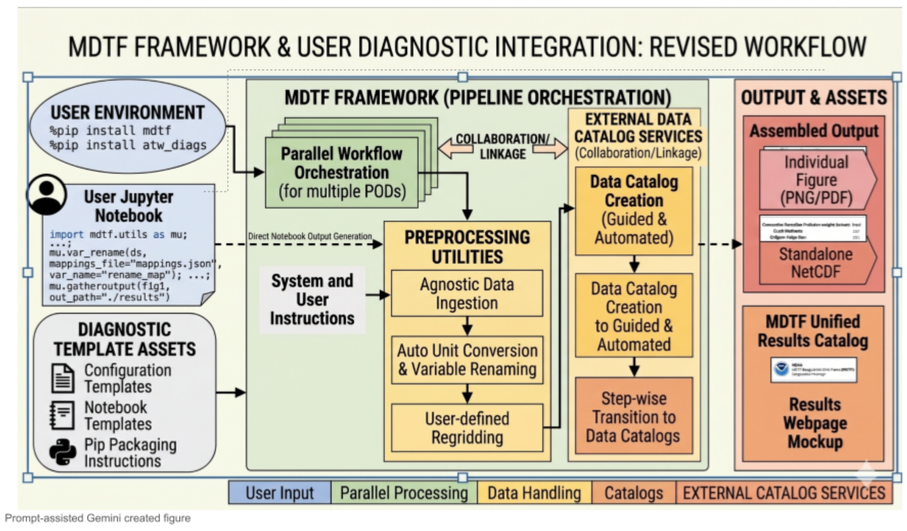
A tool like MDTF-Diagnostics would greatly benefit the Unified Forecast System (UFS) model development activities. However, the current framework is focused on climate applications and only supports free-running model data spanning multiple years. This design does not accommodate typical forecast datasets, which are frequently initialized, include ensembles, and run only to specific lead times.

This work aims to extend the MDTF-Diagnostics package to support this "forecast paradigm". This extension will provide NOAA and the research community with a crucial platform for process-oriented evaluation of short-range to seasonal forecast models.

Project Challenges

Requirements for the adaptation to SFS forecast data:

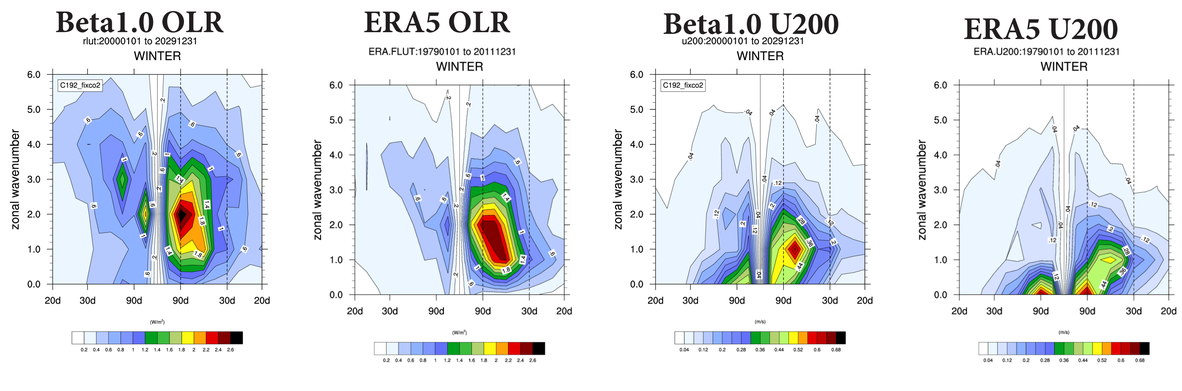
- Read data directly from AWS (zarr compatible). This can be easily done with jupyter notebooks, but the MDTF does not (yet) work with jupyter notebooks.
- Adapt several PODs to be applicable by leadtime. This will need some more preprocessing to be done either within the MDTF, or by the user.
- Adapt the data catalogs to work with UFS model output.
- The MDTF itself is currently in flux. Updates are expected to include jupyter notebook capabilities and may make the preprocessing of forecast data more straight forward.



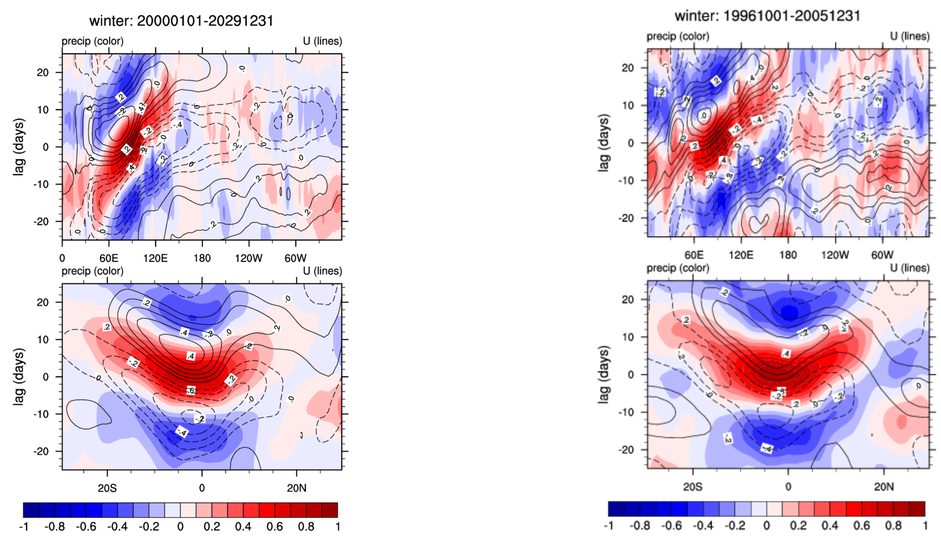
Prompt-assisted Gemini created figure

Current Status

We have applied the MDTF MJO POD to a climate run of the SFS. This required changing the file metadata to match the expected MDTF file structure, which is not ideal and is addressed in the project requirements.



Applying MDTF's MJO diagnostics to SFS helps quantitatively examine different aspects in the performance of the model's MJO with multiple tools.



SFS propagation speed of the MJO is slower than ERA5, and the balance between wavenumbers 1 and 2 is shifted too much to wavenumber 2 in the SFS for OLR.