

DTC Science Advisory Board 2021 Report

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Meeting Dates: Sep. 28-29, 2021

Overview

The SAB meeting was again conducted virtually this year due to the ongoing COVID-19 pandemic. Pre-recorded presentations on DTC activities were provided to the SAB, and live presentations and open discussions were held via Google Meet and coordinated via a Slack channel.

The SAB had engaging discussions about the expected roles and responsibilities of the DTC in the near future. The transition of some of DTC's responsibilities to the Earth Prediction Innovation Center (EPIC) is seen by the SAB as being a potentially promising development. There is hope that the DTC will be able to direct resources away from software management toward scientific roles such as the development of Testing and Evaluation (T&E) resources, assisting model physics parameterization developers to incorporate innovations into the Unified Forecasting System (UFS), and in training and outreach of the UFS to the broader community. There are also concerns that handoff of responsibilities to EPIC could occur too quickly, causing some confusion over responsibilities and gaps therein. The SAB suggests that the DTC communicate the plan and status of the transition to the community as it unfolds.

A theme that came up during the discussions was a lack of understanding of exactly what the role of the DTC is, particularly amongst community members in academia and in the private

sector, and how it can be better communicated. (It was also expressed that folks in the wider community could take an active role in reaching out to the DTC for information on the services they can provide.) Regarding the DTC's flagship T&E tool, METplus, the SAB hopes that it can be made more accessible to people in the wider community. The SAB recognizes that the DTC has recently made progress towards this goal by providing more online training tools, and by holding an upcoming training workshop.

The specific comments and suggestions provided by SAB members during our discussions are provided below.

Comments and Suggestions from the SAB

1) **The DTC should continue to build its identity as the main T&E “clearinghouse” to the community.**

This suggestion follows on from one made at last year's SAB meeting that the DTC should be a leader in developing T&E best practices, provide training and outreach to the community on the tools it develops, and work with the broader community to incorporate metrics from a physics and process-based standpoint for analysis. The UFS Evaluation Metrics Workshop, held in February 2021, was very productive in this area, and continued engagement with the community is encouraged.

Some thoughts to consider in moving forward are:

- a) The SAB suggests focussing on T&E of physical processes of interest to the community. A suggestion from the SAB this year was a focus on continental warm-season PBL structure.
- b) Continue to solicit metrics and physical processes of interest to the broader community besides the main funding institutions.
- c) Use EMC's Model Evaluation Group pre-implementation operational model evaluation reports to identify T&E opportunities to facilitate subsequent model improvements. In this paradigm, DTC would sit in the third of Hendrik Tolman's five UFSR20 “gates”, just before EMC/MEG in the fourth gate. If executed well, it would establish an R2O (third -> fourth gate) and O2R (fourth -> third gate) feedback loop that could benefit future operational model implementations. From an academic perspective, DTC could provide an O2R conduit that spurs new research directions. The academic community is not always aware of the research that would benefit operations. DTC could help make the academic community aware of what those areas are.
- d) Establish a way to work with model developers to test and evaluate innovations without slowing down the research to operations process. It is advised that DTC could emphasize the “Testing component” of “DTC” to a larger extent. Currently the DTC is somewhat dependent on others to provide model runs for their evaluation, which becomes an additional step for the model developers who often

have their own tools and metrics to test their developments quickly. In addition, the threshold to use METplus is currently too large for developers, thus imposing that the developers should use this tool for evaluation currently slows down the R2O process as it simply would be quicker for the developers to use their own process-level evaluation.

2) Extend the Hierarchical Testing Framework (HTF).

The SAB believes that the HTF is a powerful tool for the UFS development community. There was a suggestion to add additional steps to the hierarchy of test model complexity, such as the UFS configured for aquaplanet and large-eddy simulations. The DTC should partner with the community on the development of the testing framework. The SAB also noted that the HTF, that was presented to the advisory board, contained elements like a 'physics process simulator' and a '2-D model', that do not seem to exist. The DTC could play an active role in extending the HTF to support model development and to ensure that all advertised HTF elements are functional. It should also be clarified how the 'limited-area domain' configuration is different from the 'regional model' configuration.

3) Participate in physics parameterization development and model tuning via HTF.

Does DTC have the resources to take a more active role, with the guidance of subject matter experts, at model tuning when new physical parameterizations are introduced? New innovations often lead to degraded results due to compensating errors introduced in prior physics tunings. Using the HTF, the DTC could provide specialized expertise, gained through past experience, to expedite the introduction of new schemes.

4) Facilitate the portability of UFS code.

The DTC, and eventually, EPIC, should continue its role of containerizing the UFS source code. However, a concern arose that community members in some organizations may have restrictions on the type of containerization they have access to. The DTC should take this into consideration.

5) Simplify and provide better documentation of the available UFS workflows.

There are a myriad of workflows available to UFS users for different aspects of the UFS, e.g., global modeling, limited-area modeling, METplus verification. Another difficulty is that the operational workflows differ from the workflows of the publicly-released UFS code bases, and that the workflows are difficult to port to new HPC systems. The SAB suggests that the workflows be unified somehow, or their parts be modularized so that they use common "config" files and scripts. The SAB suggests that the DTC could play an active role in documenting and, if possible, unifying the UFS workflows to support a broader use of the UFS.

6) Further improve training options for T&E tools.

There is a need to expand the use of METplus by increasing the accessibility to training. Virtual training modules have worked well for the UFS-SRW and the UFS-MRW. The DTC has improved METplus virtual training access through its website over the past year, and the

SAB anticipates increased adoption of the tool by the wider community as a result of the 2021/22 METplus Workshop.

7) Extend T&E tools to include atmospheric composition and land modeling.

The T&E tools have been mainly applied to weather-related parameters. Given the large community (including the current DTC partners, NOAA and NCAR) involved in air quality study and land process modeling, the SAB suggests engaging the AQ and land communities for T&E, including the current DTC partners and exploring ways to collaborate with other agencies.

8) Improve the visibility of the DTC Visitor Program.

One of the best means to expand the UFS community is through the DTC Visitor Program. The program needs to be more visible to the academic community and the process for enrolling in the program more streamlined. This could be achieved by:

- a) Revisiting how the program is advertised and promoted
- b) Making virtual options more prominent/available for remote visitors
- c) Remove administrative hurdles for non-sabbatical visitors. The DTC pays visitors directly, instead of awarding a subcontract, so the visitor essentially changes employers during that time. Any employment benefits the visitor typically gets from their home institution (e.g., healthcare, 401K matching/access, etc.) now become an issue. Ideally DTC would instead be able to pass the money to the visitor's home institution with an agreed-upon admin/overhead percentage to pay for the costs of contracting. This percentage could be smaller than typical OH percentages charged when receiving grant money, but that would have to be agreed on within DTC and the home institution.

9) Increase flexibility for users to provide their own verification data for T&E tools.

DTC should facilitate the ability for modeling centers who have their own T&E tools to incorporate them into METplus. It should be easier to incorporate specialized datasets into METplus (e.g., NASA's satellite observations, or observations from previous field experiments). The DTC should consider how other modeling centers can benefit from DTC T&E tools when others already have their own tools.

10) Have DTC operate a parallel real-time forecast model system.

If resources are available, the SAB supports the idea of having DTC maintain an operational-like UFS that runs in parallel with the real-time forecast system. This would be an invaluable testbed for incorporating model innovations in data assimilation and physics parameterizations. If computational resources for a full operational-like UFS are not available, the SAB recommends exploring intermediate measures, such as regular runs but at a less frequent tempo, to still allow for testing of model innovations in a quasi-operational setting.

11) The DTC should improve communication and collaboration with other testbeds.

The DTC should collaborate and coordinate on a regular basis with the other NOAA

testbeds to identify common projects, activities, and interests. In addition, DTC should highlight the various experiments and other activities occurring on a semi-regular basis to other NOAA testbeds and the community at large.

12) Develop a light-weight “Data Portal” on the DTC website.

Observational and model data are not easily accessible to UFS community members, and locating NOAA and UFS data sources can be difficult. They are currently widely scattered among various NOAA servers and various cloud providers and curated by different NOAA labs. It would be helpful to the community if the DTC could provide on their website a light-weight “Data Portal” that would be a starting point to orient users and provide access, where possible, to the various data sources that could be used for T&E activities. A suitable starting point could be a webpage that provides links to and explanations of existing publicly-available UFS/NOAA weather simulation data sets and model verification data. The web links should point to both data and visuals (if provided) from operational model configurations (e.g., the GFS15/16 and HRRRv3/v4) and development data. Examples of the latter are the UFS S2S prototype simulations and data from the RRFS or HAFS development versions.

Alternatively, perhaps the proposed portal could be a weather-focused version of UCAR's excellent Climate Data Guide (<https://climatedataguide.ucar.edu/>). That site categorizes available data for multiple applications, describes their characteristics and strengths/weaknesses, and provides links to and references for the data.

13) Solicit ways to increase visibility of DTC activities, including through website improvements.

Finally, during the meeting, DTC personnel mentioned that feedback on ways to improve the DTC website are welcome. In addition to surveys, the SAB recommends the DTC explore other methods and tools to increase the visibility of the outreach to the community. One potential idea would be to develop a form that allows individuals to provide input on improvements from the website itself.