SAB recommendations from September 2017 meeting

General: *Compiled and synthesized by Adam Clark, 2017 SAB meeting chair*

1) The SAB tentatively supports the re-organization proposed by Bill Kuo.
It appears that the re-organization would simplify DTC structure and could be a way to strengthen the connections between the currently existing tasks.

2) Work to clearly define DTC's role in transition to FV3.
The DTC's roles include global, regional, verification, data assimilation, hurricanes, and ensembles. It will be very important to stay current with FV3 development efforts, and identify areas where DTC can contribute with their expertise.

3) For FV3 testing and evaluation, leverage FV3 simulations from collaborators.
Several groups (e.g., GFDL, EMC, CAPS, and NSSL) have plans for or are already conducting real-time, experimental FV3 simulations using convection-allowing resolutions over the CONUS. DTC should figure out how they can leverage these and other FV3 runs since DTC's computational resources are limited. It is likely that these collaborations would be mutually beneficial to DTC and external collaborators.

4) DTC should target Visitor Program projects based on where DTC staff would get maximum benefit.
The SAB believes that recent changes to how Visitor Program projects are considered have had positive results. These changes included instituting an open, year-round call for proposals, with focus areas based on input from Task Leads who are encouraged to actively pursue connections with the research community. The SAB believes the DTC could go even further in targeting Visitor Program projects in order for DTC staff to get maximum benefit, which should include co-authoring publications. This would result in more collaboration between DTC staff and visitors and enhance R2O.

5) The DTC should work to define metrics of success, which could increase R2O activity and productivity.
Based on feedback from DTC staff, the SAB acknowledges that success metrics can be difficult to quantify and vary widely depending on the type of project or activity. However, the SAB believes that one particularly important metric that should be closely documented is the DTC's contributions to decision-making for operational model configurations and model development.

6) DTC should explore the feasibility of cloud computing for storage (and later modeling) since multiple tasks could potentially benefit.
Although there is potential for cloud computing to help DTC in the longer term, it is currently low priority, and the SAB believes that DTC could partner/leverage bigger players with more knowledge and experience in this area.

7) Continue to work toward putting DTC-supported codes in containers for community use.

As in the 2016 SAB report, the SAB believes that putting supported codes into Docker containers can ease many of the challenges with setting up and running codes on different platforms. Thus, we recommend that these efforts continue.

8) Continue to work on sustaining continuity in testing and evaluation efforts from one year to the next.
This is important because it allows DTC staff to have more time to obtain in-depth knowledge of systems they work with, which should eventually result in increased productivity. In some areas, the DTC has sustained continuity effectively (e.g., stochastic physics, hurricanes, convective parameterization, HRRR, etc.), so the SAB believes these efforts should continue.

9) Continue to pay close attention to where future DTC funding might be anticipated, and fill openings on SAB with expertise in these areas.
Clearly, the DTC took into account the future outlook when they nominated new SAB members for 2017 (e.g., Rusty Benson at GFDL who works closely with FV3 development efforts), and I felt like this enhanced the effectiveness of our 2017 SAB meeting and recommendations. So, the SAB recommends continuing this strategy for new SAB nominations.

10) Continue efforts to not lose sight of the unique function that DTC serves: to objectively evaluate model performance in a variety of applications and variables.
DTC is unique because they are regarded as an unbiased party for NWP evaluation. This should not be lost amid other activities (e.g., supporting community codes and developing new tools). The SAB recognizes that funding is limited for these types of activities, so they should continue to closely guard the funding opportunities for participating in and conducting extensive evaluations.

Regional Ensemble Working Group: *Philip Pegion (lead), David Vollmer, Adam Clark, Isidora Jankov, Jamie Wolff, Jeff Beck, Michelle Harrold, Tracy Hertneky*

1) Spinning up FV3 support and expertise should be priority.
Given that NOAA has selected the FV3 dynamical core as the future global model, and there is a strong push to make this the regional (or nested) model in the future, DTC needs to obtain the expertise with this new system in order to support the community and to be relevant in testing and evaluation. Since DTC does receive regional ensemble support from outside NOAA, there still must be support for the WRF modeling system. Specifically we recommend continuing support for NCAR/ MMM for users workshop and repository maintenance. But work on WRF should be prioritized according to portability/suitability for future modeling (FV3) systems.

2) We recommend that the DTC support NGGPS Post-Processing SIP working group proposal to have DTC involved with "Comparison and validation of post-processing techniques".
Ensemble post processing requires large sets of historical forecasts and observations. The computational requirements needed for post-process is relatively small in terms of CPU requirements, but large in terms of disk space needed. We recommend that DTC procure storage to host forecast and observation datasets that are available to the public.

3) Shift current efforts relating to stochastic physics for both DA & forecasting to the FV3 based model.
The testing and evaluations of regional ensemble performance with different stochastic perturbation methods should transition to the FV3 based system since the first generation of stochastic physics (SPPT,SKEB, and SHUM) is now available.

4) Define expectations and roles for DTC in testing FV3 as a convection resolving forecast system once regional system is available.
The development of a regional FV3 based model is a new effort between involving GFDL, ESRL, NSSL, and DTC. It is not clear who will claim ownership of this model, but DTC is well suited to be involved in testing and evaluation of this new system.
Recommend testing regional vs nested performance in ensembles. Does interactive lateral boundary improve ensemble performance?

5) Continue involvement in the CLUE collaboration (HWT initiative)
The CLUE collaboration has been very successful, and it is recommended that DTC support testing 2018 FV3 nested configuration with current global stochastic physics suite (SPPT, SKEB, SHUM) and then the 2019 FV3 regional configuration with new stochastic physics such as stochastically perturbed parameters (SPP) and other methods currently being developed.

6) Stochastic physics requirements must be addressed by the GMTB/CCPP developers.
The future of stochastic physics development is to address model uncertainty at the process level of the parameterization, this adds a new requirement for the CCPP, which is that random numbers from outside the physics need to be able to be passed down to the particular physics routines.

Hurricanes Working Group: *Thomas Galarneau (lead) and S. G. Gopalakrishnan*

1) Community linkages
Expanding the DTC interactive research community
Continue consideration of building interactive community of active users through monthly online research "events" as suggested in 2016 SAB recommendations. The idea is that quasi-regular informal themed discussions will occur, with one user or a small group of users taking the lead to begin the discussion. The discussion can cover new results, solved problems, or issues impeding progress, thus potentially serving a link between research and operations.

Synergize DTC efforts with Hurricane Forecast Improvement Program (HFIP) foci
Considering the large degree of overlap in efforts at the DTC and the HFIP research community overall, it is suggested that DTC staff regularly attend and present emerging science results at the HFIP bi-weekly teleconference meetings. In addition to DTC staff, community members that receive funding through the DTC Visitor Program or have active collaboration with DTC scientist can regularly attend and present as well.

2) Hurricane modeling
Testing and evaluation efforts during evolution of model dynamical cores

As discussed in the 2016 SAB recommendations, the transition from HWRF to FV3 is going to bring challenges. The continuing recommendation is that DTC provides a roadmap to help guide academic researchers in efforts that contribute to the development of FV3. One suggestion is to enhance the DTC Visitor Program to increase the testing and evaluation efforts on HWRF and expanding to FV3 by targeting PIs or solicit proposals that directly sync with ongoing and future efforts in this area at the DTC. Additionally, close communication and collaboration with EMC will help augment the pre-implementation tests for the FV3 core.

Hurricanes in global models needs more attention

The prediction of hurricanes, particularly at medium-range forecast leads, is a global problem. Continued development of a physics-related core for the FV3 global model is a must, and a high-resolution version of global FV3 should be made available to the community for testing, perhaps through the DTC visitor program.

There is an opportunity to leverage ongoing efforts in the Global Model Testbed (GMTB) with application to the hurricane problem. Coordinating efforts between the GMTB and hurricane tasks will help to build up internal DTC expertise on FV3 global model in advance of transition to operations.

3) Science issues

Physics development in global model framework

DTC can work toward developing hurricane-relevant physics for the FV3 global modeling framework. As discussed above, hurricane prediction is a global-scale problem particularly for medium-range prediction of track, intensity, and *genesis*. Leveraging expertise in the GMTB will help make strides in this area without adding substantial responsibilities to DTC staff already working on hurricanes.

Development of model agnostic diagnostics

DTC should continue hosting community-contributed model agnostic diagnostics to facilitate model inter-comparison (e.g., FV3 versus basin-scale HWRF). Again, this is an area where coordination/collaboration between DTC hurricane and GMTB groups, and can lead to contributions to MET/METTC packages. The model agnostic diagnostics should expand beyond the usual track and intensity metrics and focus on structures ranging from storm-scale to synoptic-scale (e.g., blocking frequency, divergent circulations, water vapor structure).

Expand hurricane work to post-landfall threats

This area is of interest to NWS and HFIP efforts, and includes the rainfall intensity and distribution and severe thunderstorms (wind and tornado). As suggested in 2016, use rainfall relocation to assess against analyses and observational data. Object-based verification can be used to assess forecast errors associated with rainbands near the storm and regions of heavy rainfall farther away from the storm (predecessor rain events). Finally, using existing verification products for severe weather reports developed as part of the Hazardous Weather Testbed can help determine forecast errors of severe weather threats typically found in rainbands of hurricanes after landfall. A good test case from 2017 is Harvey.

Verification Working Group: *Kathryn Gilbert (NWS), Zhuo Wang (U of Illinois), Tim Whitcomb (Navy), Tara Jensen, Bonny Strong, Dave Turner, John Halley Gotway*

1) Provide MET+ in a container
The SAB believes MET+ in a container will be a good resource for researchers. Ideally, a centralized location for reference input data to MET (such as climatologies for anomaly correlation computation) would be identified, possibly cloud storage. Given the user restrictions on the NOAA operational platforms it is uncertain how widely this could currently be utilized in an operational setting, but DTC can advocate with NCEP's Environmental Modeling Center and NCEP Central Operations for better support for containers.

2) Increase support for METViewer
METViewer is needed to build the ladder for expanded use of MET+ by university students who will become the next generation workforce for both research and operational community. SAB wants to see sustained support for METViewer from DTC for external users. DTC may consider releasing METViewer as a component of MET+. SAB also recommends use of container technology to aid deployment of METViewer.

3) Develop a MET Users Forum
Develop a MET Users Form to allow the community to support each other and provide useful tips and examples. Open software development to a broader developer base, and provide external APIs to allow others to develop metrics and tools either outside the mission of DTC or lower in priority to DTC. If we focus on getting a core community using a tool – the community will grow quickly.

4) Build standards and enforce for output format
DTC should not support every format in existence for use with MET, but should focus on creating standards that can be used by others in adapting their own custom formats for use with the MET verification packages. Efforts should be placed on supporting meteorological data standards recognized by the WMO and other commonly used data formats as agreed upon.

5) Highlight the Role of Verification in the DTC evolution
In the context of the NGGPS development, DTC verification can serve as the gatekeeper to R2O by providing verification metrics, testing cases, and diagnostics tools. To be really forward-looking, DTC should consider what will be needed by the operational and research communities in the upcoming years. Given NOAA's goal to develop a seamless weather-climate prediction system, DTC may want to develop the Seasonal to Sub-seasonal (S2S) verification and diagnostic tools by leveraging ongoing work in the R&O communities, such as the NOAA S2S task force and CPC S2S efforts.

6) Development of Process-oriented diagnostics
Process-oriented diagnostics focus on the representations of key physical processes in a model and provide insights into model improvement. A focused workshop or series of telecons might be useful to discuss this topic given the diversity of specialized interests in the modeling community. For example, evaluation of cloud and convection processes (in both single-column models and global models) using in-situ data and satellite data will benefit the physics

parameterization development in the NGGPS framework; the MJO and associated teleconnection may be evaluated regarding the S2S prediction. Process-oriented diagnostics facilitate R2O transition, and we recommend that more diagnostics be made available via the DTC (although such diagnostics may be developed externally using the previously-discussed MET API). Such diagnostics may be provided in containers as the MET+.

Global Model Test Bed Working Group: *Vincent Larson (lead), Rusty Benson, Vijay Tallapragada, Jeff Cunningham, Ligia Bernardet, Grant Firl, Dave Gill, Laurie Carson*

1) GMTB evaluates parameterizations, but after the initial evaluation, parameterizations will often require further modifications or tuning by the parameterization developer before the parameterization is ready for detailed analysis by EMC. To incentivize interested developers to work closely with GMTB while investigating a parameterization, GMTB should be paired with other funding for the developer(s) of that parameterization. The funding could potentially come either from a DTC Visitor Fellowship or from NWS (GMTB's current funding source). In addition, GMTB should emphasize ease of use of its tools (e.g. CCPP) in order to attract and retain interest from developers.

2) As presented by Chris Davis, NCAR has its own desire to develop a "common physics repository". It is envisioned to be a git repository that will contain physics parameterizations from the community with a common software interface. The NCAR approach conflicts with GMTB's CCPP. GMTB should unite with this effort or else at least avoid duplication of effort in developing the common physics repository and the CCPP.

3) GMTB should review the percentage effort devoted to GMTB work by each of the NCAR and GSD personnel funded to work on GMTB. In particular, make sure that personnel are not splitting their time between too many projects.

4) Although GMTB is solely funded by NWS, it should seek to diversify funding to encompass projects with similar or identical scope.

5) The chart (see hierarchical testing protocol) of roles and responsibilities needs to be revisited to reflect a continuous integration and engagement throughout the entire process of R20.

Data Assimilation Working Group: *Xuguang Wang (lead), Tom Auligne, Kayo Ide, Hui Shao, Ming Hu, Chunhua Zhou, Guoqing Ge*

<u>Community support and interaction with community</u>

1) Reach out more actively to entrain the data assimilation (DA) community to participate the visitor program. One approach would be to identify and contact the PIs with funded R2O DA projects.

2) Define how to evaluate the success of DTC by working with sponsors and communities

3) In the near future conitune hosting the GSI/EnKF User's workshop and providing community support, and develop expertise in preparation for the next generation modeling and DA systems.

4) Identify ways to encourage the research community to contribute data assimilation codes developed

Testing and Evaluation

1) Improve testing efficiency to increase the number of well designed tests for a given testing period. This can be achieved through carefully designing testing suites and improving portability issue. It is also recommended to test DA in EMC's CROW work flow.

2) Given limited resources and DTC's current DA expertise, in the next 1-2 years (2018-2019) focus on regional high resolution DA testing:

- HRRR/HRRRE (ARW and GSI/EnKF) is planned to be delivered to NWS for pre-implementation testing in June 2019. DTC can contribute testing this system through enhancing coordination with NOAA organizations and reseach communities to facilitate meeting the June 2019 timeline.

- In the mean time, stay tuned and current about FV3 and JEDI deveopment, and begin invovling testing when codes are available and ready.