Facilitating Research to Operation Transition in NWP

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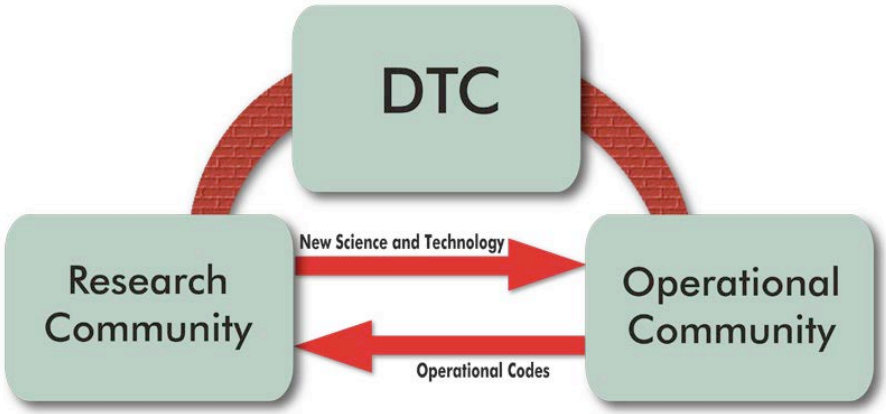
Developmental Testbed Center

What is DTC?

- **Purpose**: Facilitate the interaction & transition of NWP technology between research & operations
  - **O2R**: Support operational NWP systems to the community
  - **R2O**: Perform T&E on promising NWP innovations for possible operational implementation
  - **Community**: Visitor Program, Workshops, Newsletter
- Jointly sponsored by NOAA, Air Force, NSF, & NCAR



Publicly-released packages

Software	Type	Developers	Repository	DTC's role
WRF	mesoscale model	NCAR, GSD	NCAR	Assist w/ rep maintenance & community contributions
UPP	post-processor	EMC	EMC Community	Maintain community repository (sync & portability) Community support
GSI & EnKF	DA	EMC, NASA, ERSL, NCAR, NESDIS, JCSDA	EMC Community	Chair DA Review Committee Maintain community repository (sync & portability) Assist w/ community contributions Community support
HWRF	tropical cyclone	EMC, HRD, URI, GFDL	Community (10 components)	Transition ops capability to component repositories Repository maintenance Support for system run scripts Community support
MET	verification	NCAR	NCAR	Maintain repository and advance capability Community support

Code releases and tutorials

Software	Code releases	Onsite tutorials
WRF	1 Major - Apr 1 Minor - Aug	Bi-annual
HWRF	1 Major	Annual
GSI/EnKF	1 Major	Annual
MET	1 Major – Winter 1 Minor – Summer/Fall	Annual

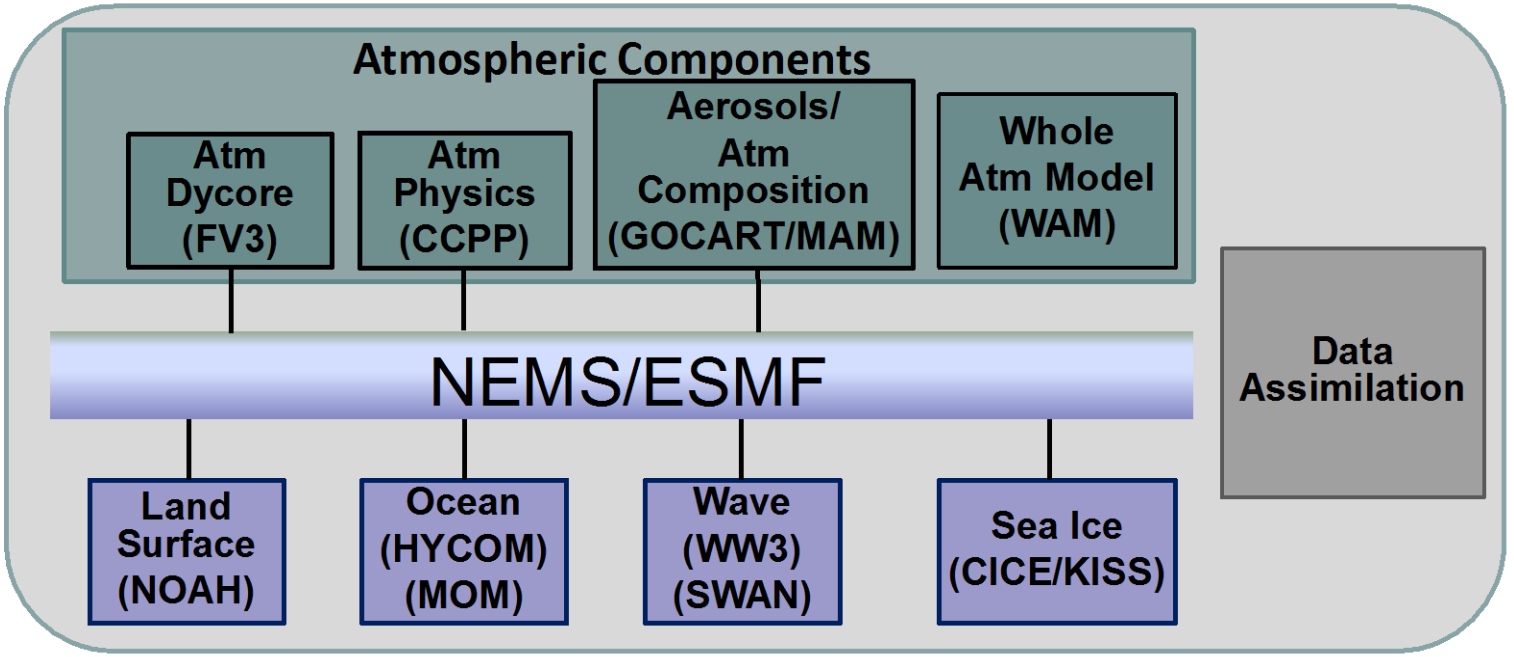
Preparation for tutorials

- Obtain and test latest codes
- Update documentation and user guide
- Prepare all the necessary data sets for test cases, including initial conditions, boundary conditions, verification data and graphics
- Identify suitable computing platform for tutorial
- Request access to computing platform for tutorial students
- Provide access to identified computing platform from the laptop of tutorial students

Access to dedicated computing platform is often the biggest challenge for tutorial. Because of tight cyber security, it is very difficult to use NOAA computing platform for tutorials.

Next Generation Global Prediction System

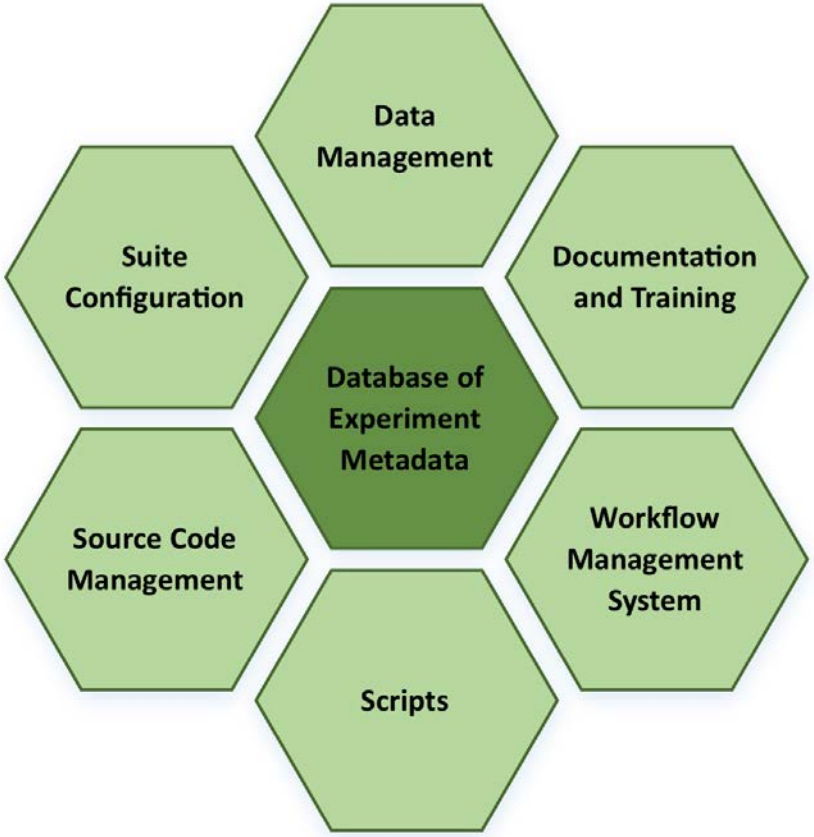
- Fully coupled system: ocean, waves, sea ice, land surface, atmosphere, aerosols, ionosphere, and atmospheric composition
- Built using NESM/Earth System Modeling Framework
- Each component model will be community code



Supporting NGGPS as a Community Model through NITE (NWP IT Environment)

Creating a strong community for NGGPS will require easy access to a highly configurable modeling system that can be used for research. Operational configuration should be a subset of the community system

Source codes need to be accessible to all developers, with a well defined path for contributing innovations



Bernardet, L., L. Carson, and V. Tallapragada 2017: The design of a modern information technology infrastructure to facilitate research to operations transition for NCEP's modeling suites. BAMS, http://dx.doi.org/10.1175/BAMS-D-15-00139.1.

Challenges

- As a fully coupled Earth System model, it would be very challenging to download the entire NGGPS system to user's local machine, and run the model on a local machine
- To accelerate R2O, it would be desirable to have one single repository for the entire system, supporting both research and operation
- Research community needs access to data used in operation
- It would be best for NOAA to support a dedicated computing platform to support R2O

If a dedicated NOAA R2O computing platform is difficult to obtain, can "cloud computing" be a possible solution?

Testing protocol for R2O transition

NWP Workshop on Model Physics with an Emphasis on Short-Range Prediction - Summer 2011

Three Stage Testing Protocol Process

Stage I:

Proving ground for research community

- Code development
- Initial stage of testing; Utilize MMET cases
- Communicate results to DTC to progress to Stage II

Stage II:

Comprehensive T&E performed by the DTC

- Conduct comprehensive testing for a broad range of weather regimes
- Evaluate based on extensive objective verification statistics

Stage III:

Pre-implementation testing at op. centers

- Decision to proceed made by the operational centers
- Testing specifics depend on target production configuration

*Critical to foster an environment of active development and testing with **open communication** of results among the three participating partners in the process*

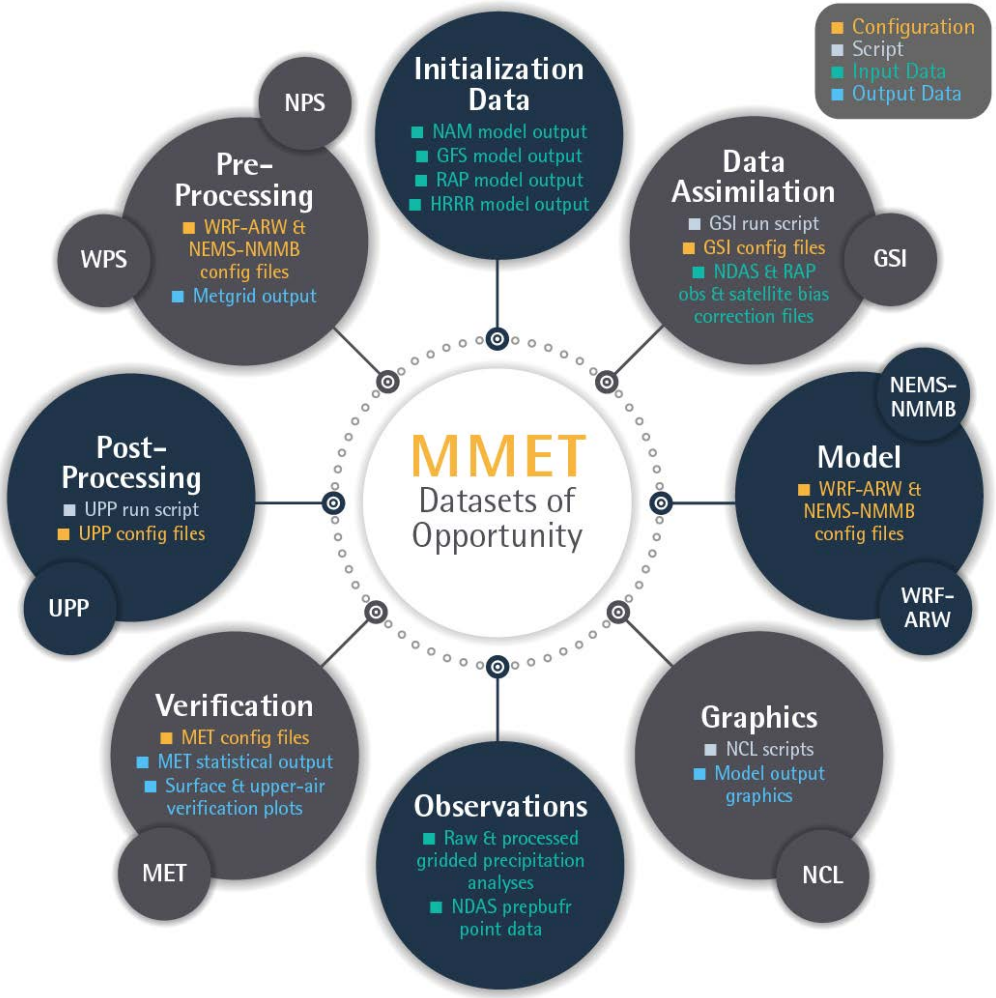
Mesoscale Model Evaluation Testbed (MMET)

Why: Assist the research community in efficiently demonstrating the merits of a new development

What: Datasets of opportunity

- Model input and observational datasets to utilize for testing and evaluation
- Common framework for testing; allow for direct comparisons
- DTC established baseline results for select operational models
- Community contributed results

Where: Hosted by the DTC; served through **R**epository for **A**rchiving, **M**anaging and **A**ccessing **D**iverse **DA**ta (RAMADDA)



http://www.dtcenter.org/eval/meso_mod/mmet/index.php

What does MMET provide?

Initialization datasets

Pre-processing datasets

Model configurations

Post-processing scripts

Graphics of model output and scripts

Observation datasets

Verification output and scripts

MMET Case Inventory

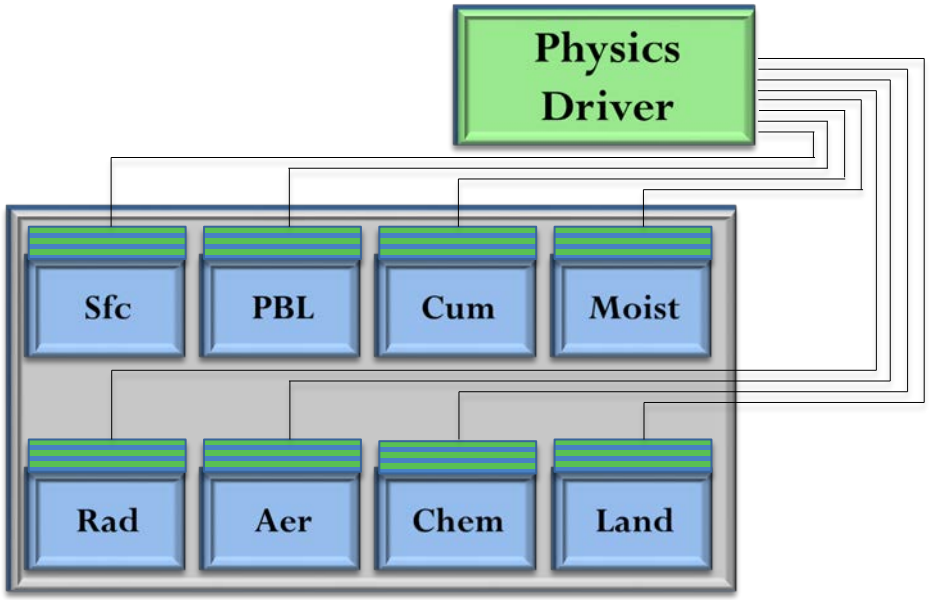
- Routine and high-impact cases selected in collaboration with operational centers
  - Currently 14 cases
  - Single-case and multi-day events
  - Open solicitation to the community for new cases
- To illustrate versatility of innovation, recommend running several cases/weather regimes

http://www.dtcenter.org/eval/meso_mod/mmet/cases.php

The Common Community Physics Package (CCPP) - under development

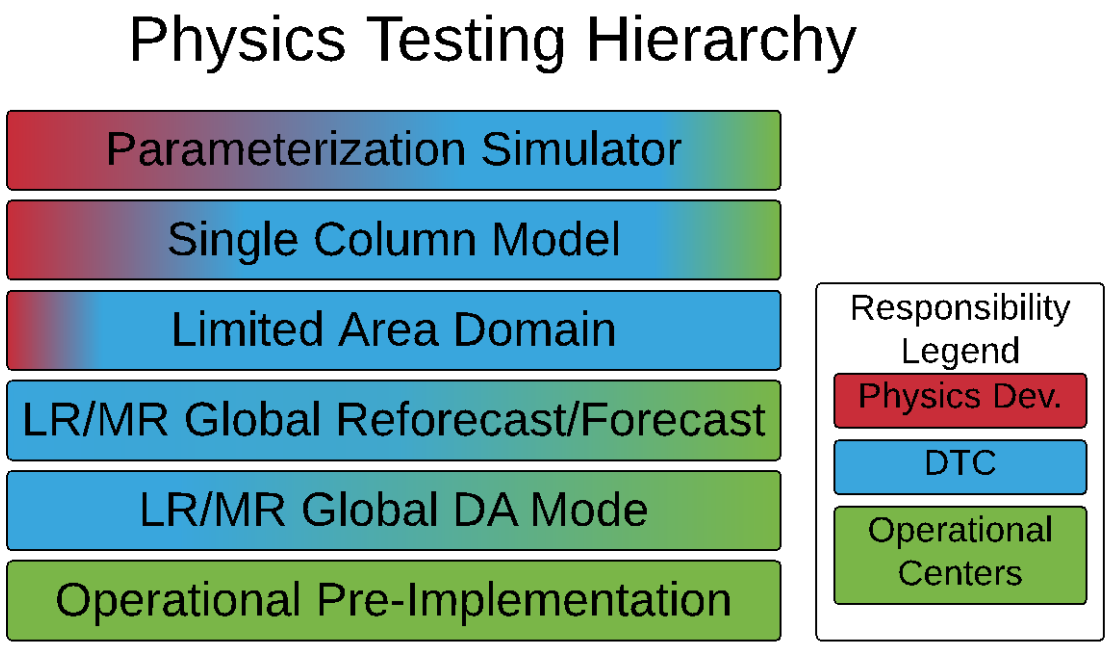
- CCPP is a collection of **dycore-agnostic**, **vetted**, physical parameterizations. There can be multiple of each type (PBL, cumulus etc.) to support various applications (high-res, climate etc.) and maturity level (operational, developmental)

- **Dycore agnostic** means that parameterizations can be used with any dycore
- **Vetted** means that there is a process to determine what is included in CCPP at each layer



Testing and Evaluation of Parameterizations

- The CCPP will be used for tests of varying complexity
- Having a common framework/platform for testing by the community can facilitate sharing and collaborations



Challenges for Community Model Testing

- Access to adequate computing resources – It has been very difficult for NOAA to provide sufficient computing resources to support R2O
- Variation of model results due to differences in computing platform, compilers, and operating systems
- Sharing and comparison of results on the same case with different innovations conducted by different researchers
- Bringing model outputs to local machines for detailed analysis and diagnostics

If a dedicated NOAA computing resources is hard to obtain, can "cloud computing" be a possible solution?

Summary

- DTC would like to explore the use of cloud computing for tutorial of community modeling systems
  - Greatly reduces the complexity associated with the need for dedicated computing platform and users' access to the computer
  - Allows international students to participate remotely
- DTC would like to explore model testing and evaluation in the cloud
  - Allowing researchers to focus on the science instead of computer differences
- DTC is interested in partnering with collaborators on these activities
- DTC Visitor Program can potentially support such collaboration