Global Model Test Bed

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Developmental Testbed Center

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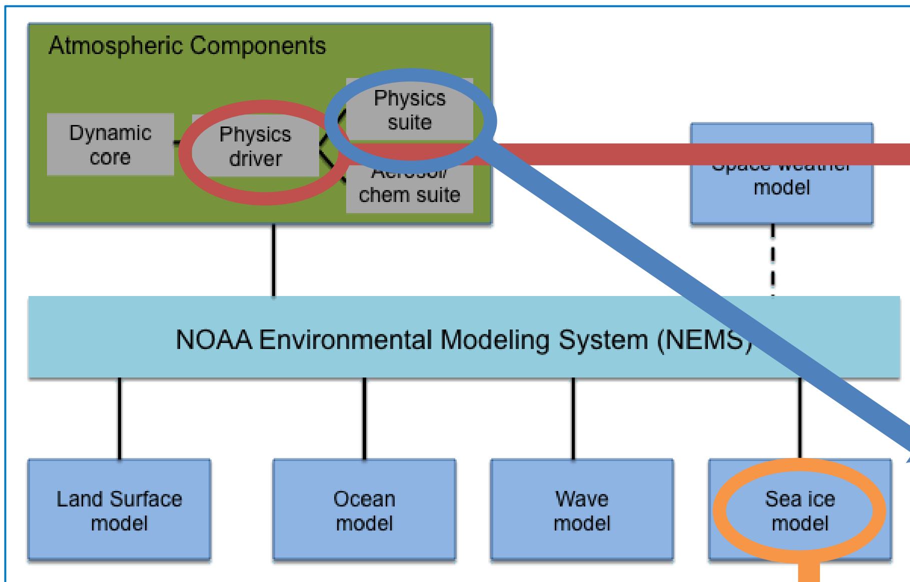
NGGPS Workshop, 4 August 2016

Next-Generation Global Prediction System (NGGPS)

Community participation & solid support for Research to Operations (R2O) key to accelerating development to meet planned 2019 deployment



Interoperable Physics Driver (IPD): Standards that allow testing new parameterizations/suites in various dynamic cores, enabling inter-agency collaboration

Common Community Physics Package (CCPP): Engaging community to address identified priorities for development in physical parameterizations

Sea Ice Model Baseline: Assist NGGPS PO with selection of baseline & establishing community framework

GMTB – Year 1

Activities – Atmospheric Physics	Status
IPD/CCPP deliverables:	
• Requirements document	Complete
• Coding standards	Complete
• Code management plan	Complete
• Technical documentation	Complete
Testing & evaluation deliverables:	
• Design & development plan for Physics Testbed	Complete
• Initial implementation of Physics Testbed	Complete: Single column model and global model workflow
• Report on physics parameterization test	Grell-Freitas Cu scheme selected for testing – finalizing code
Community outreach:	
Physics PI Workshop	Dates: **7-9 November 2016** Scope broadened to include Physics Team meeting

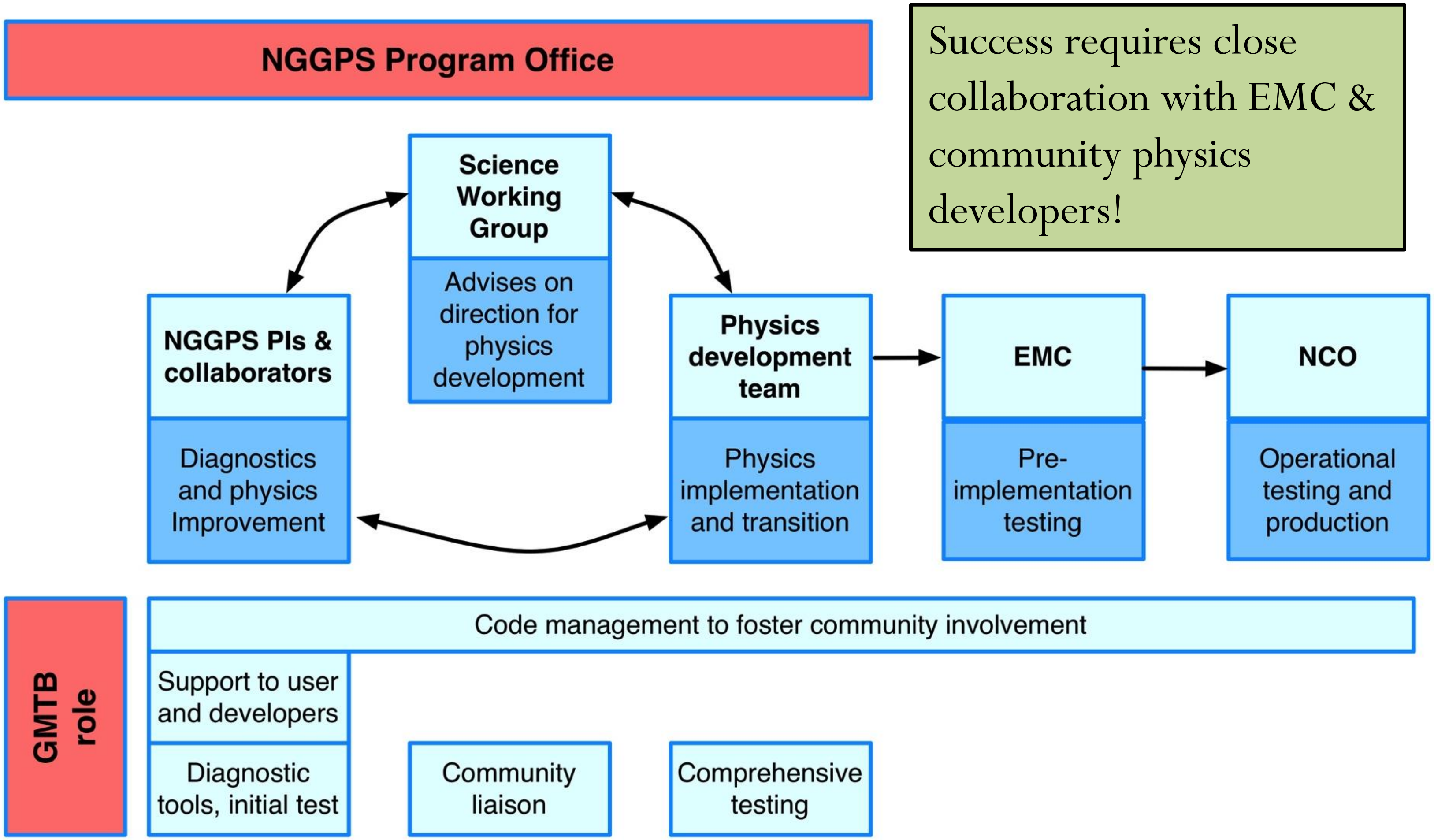
DTC Developmental Testbed Center

GMTB – Year 1

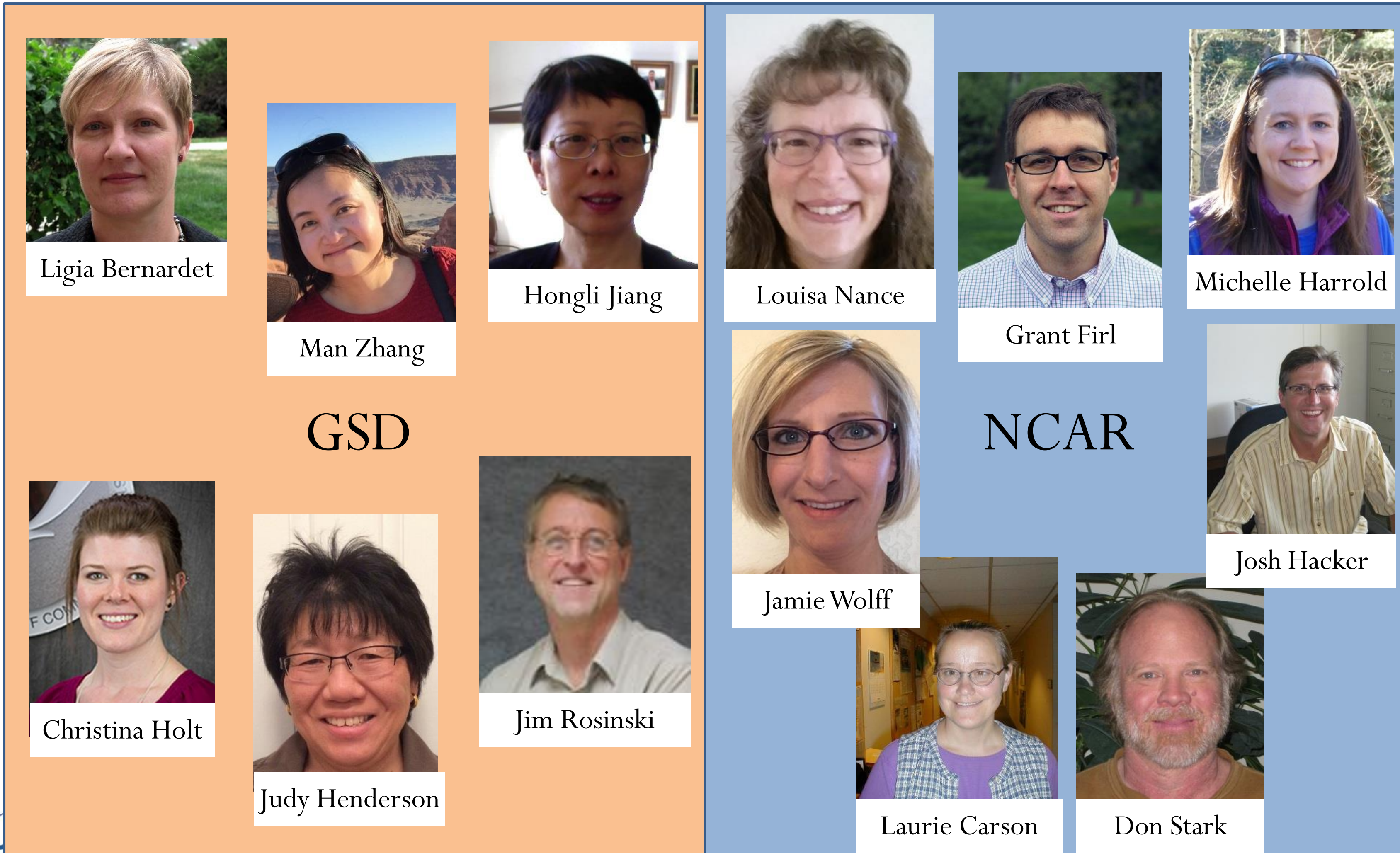
Activities – Sea Ice Model	Status
Deliverables:	
• Sea Ice Modeling Workshop	Complete: **2-4 February 2016** – report posted on DTC website
• Recommendation on sea ice model baseline	Complete: included in workshop report
• Demonstration test of sea ice model within a global application	Test of CICE underway

Global Model Test Bed (GMTB): Facilitating NGGPS physics development

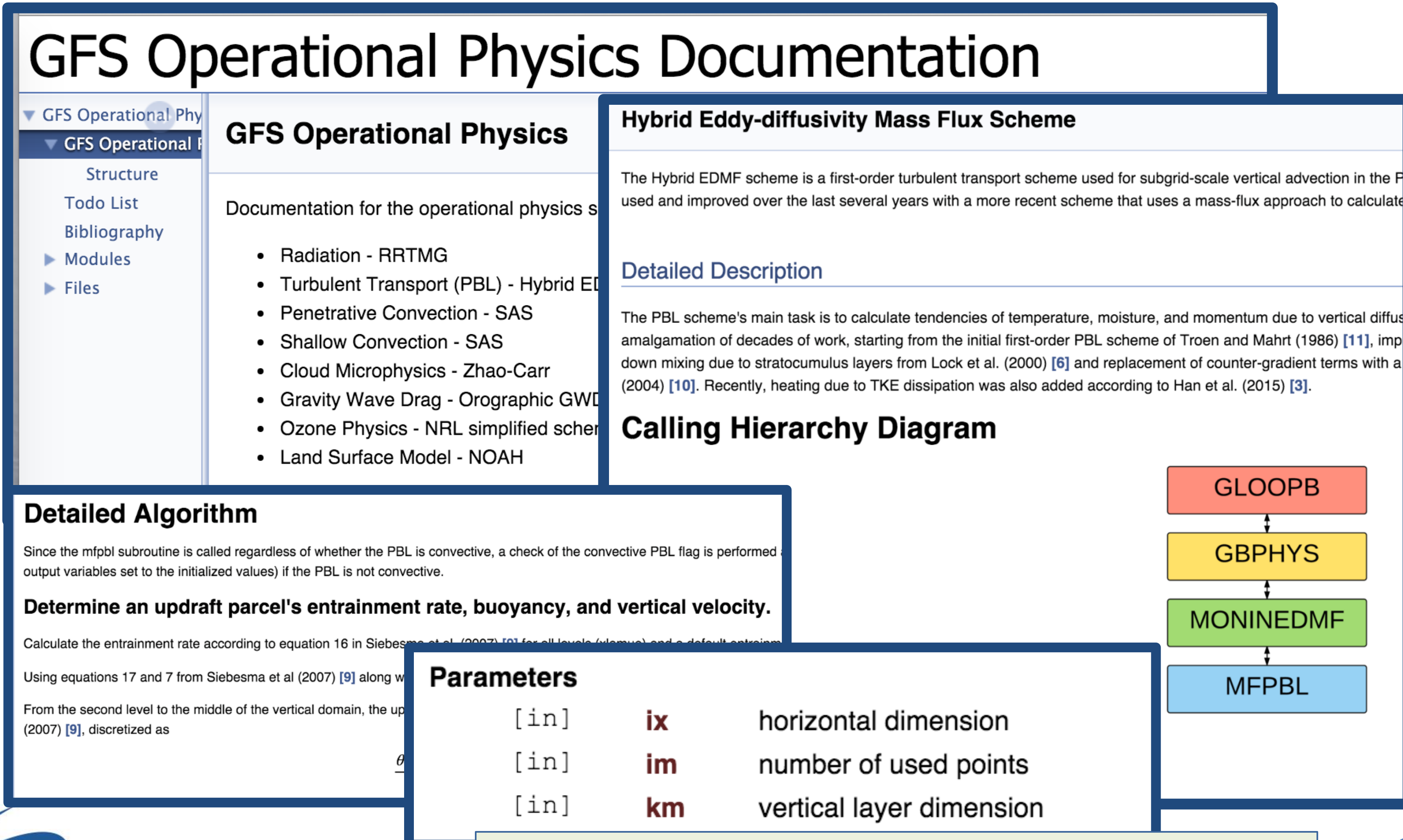
Success requires close collaboration with EMC & community physics developers!



GMTB physics team members



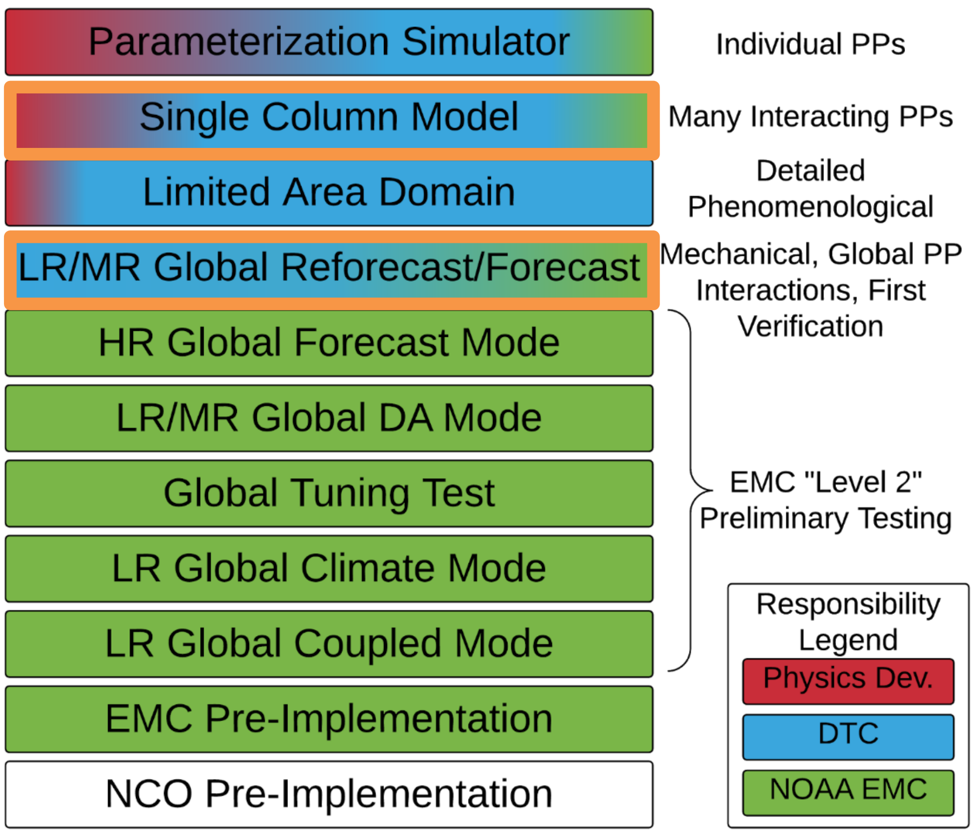
Doxygen-based documentation for GFS physics suite



Available through EMC page on Vlab and at DTC website

Hierarchical testing

GMTB/EMC Testing Hierarchy



LR/MR/HR=low/medium/high-resolution

GMTB is developing a test harness (initial tiers) the research community can use for conducting tests of physical parameterizations

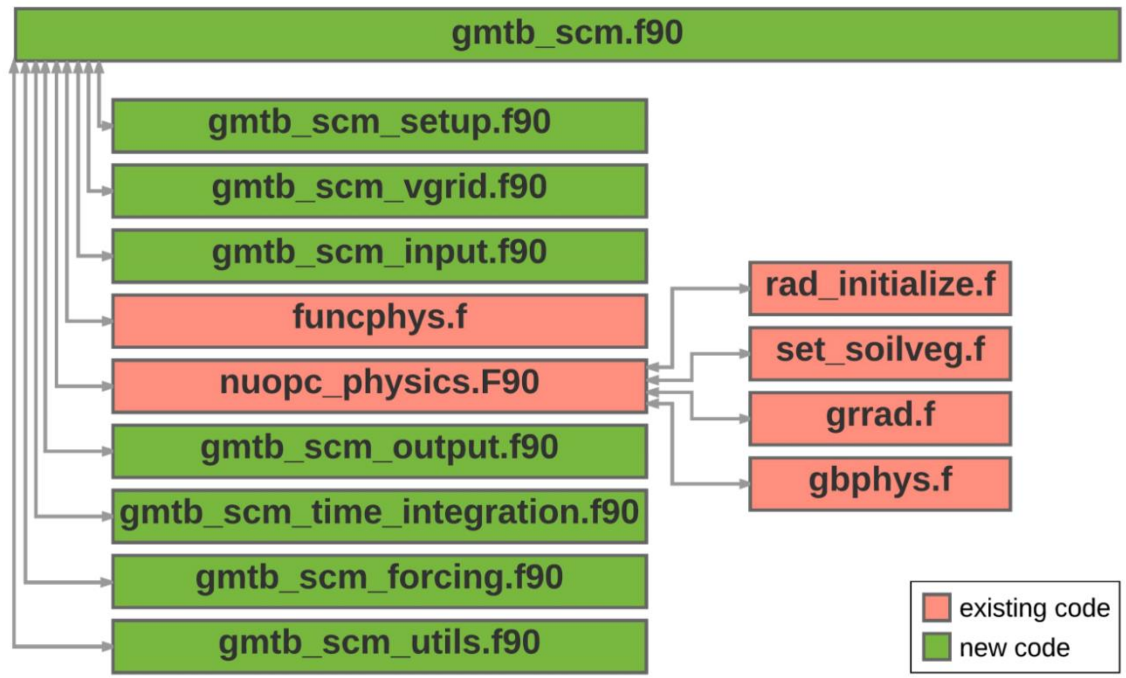
Physical parameterizations that pass initial tests can be transferred to EMC for further testing

Initial implementation of physics testbed: Single Column Model

Development, configuration for testing convective schemes, and preliminary results

SCM development

- Code utilizes IPD, which calls the GFS physics suite
- SCM forcing, vertical grid, and numerical methods are configurable and expandable



SCM configuration

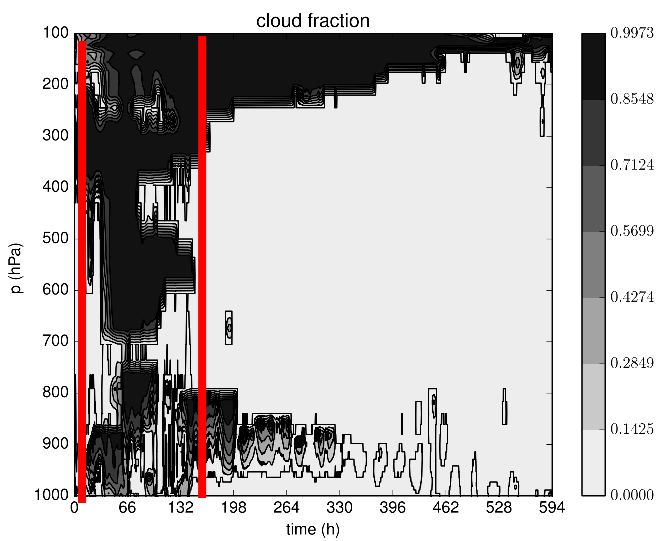
- 25-day runs with 10-min timesteps (20 min for radiation)
- 64 sigma levels as GFS, T574 (35km)
- Forcing used in the preliminary tests
  - Fixed SST
  - Prescribed temporally variable horizontal advection terms and vertical motion

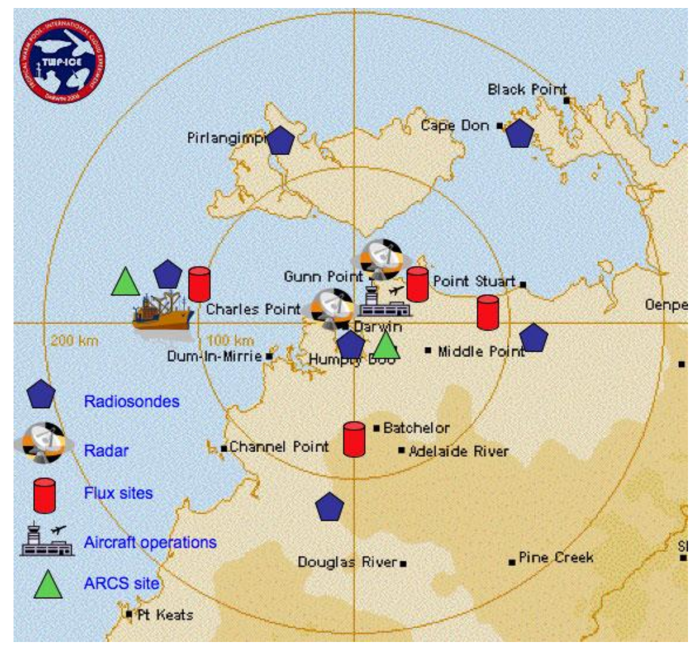
Physics Scheme	Control	GF
Surface	Noah (run over ocean)	Same
Radiation	RRTMG	Same
PBL	Hybrid EDMF	Same
Microphysics	Zhao-Carr	Same
Convection (deep & shallow)	**SAS (latest)**	**Grell-Freitas**

Case description

- Deep convective GCSS case based on TWP-ICE field campaign
  - Near Darwin, Australia from 20 Jan – 12 Feb 2006
  - Features "active" and "suppressed" convective states
  - Model intercomparison studies using this case
    - For CRMs: Fridland et al. (2012, JGR)
    - For SCMs: Davies et al. (2013, JGR)

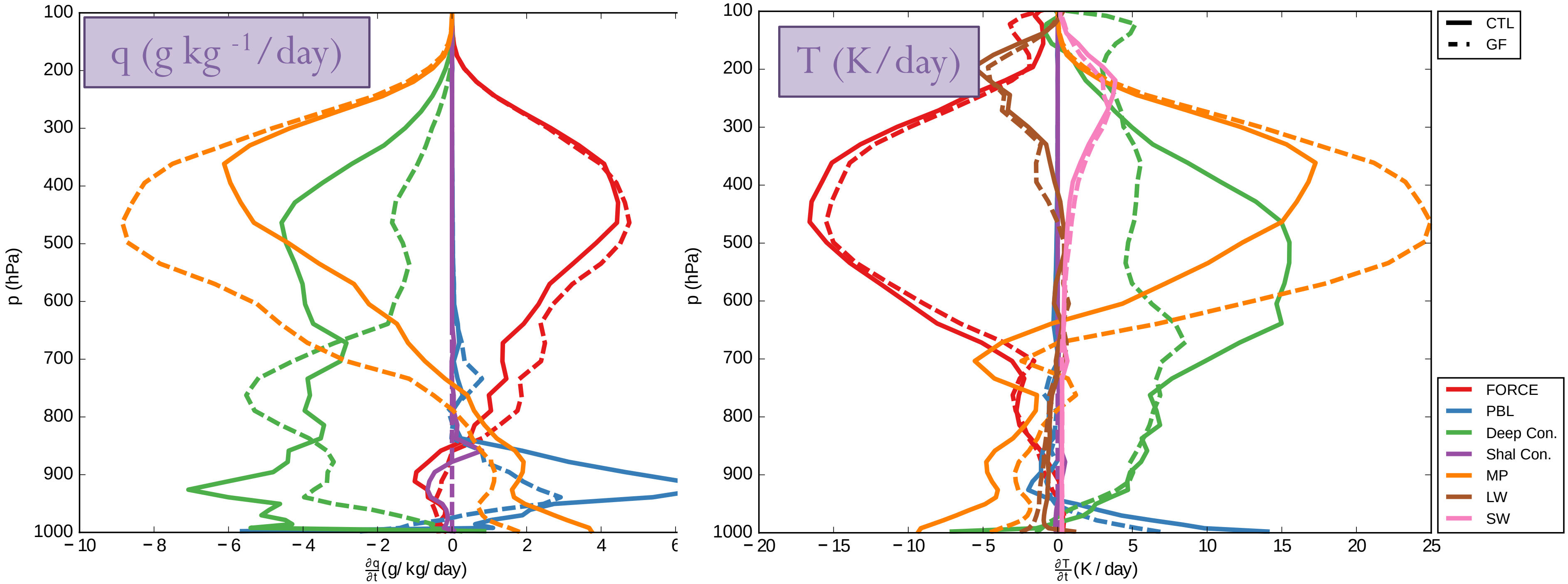
Both active and suppressed regimes occur, as depicted in the simulated cloud fraction field





TWP-ICE field campaign domain

Analysis of tendencies



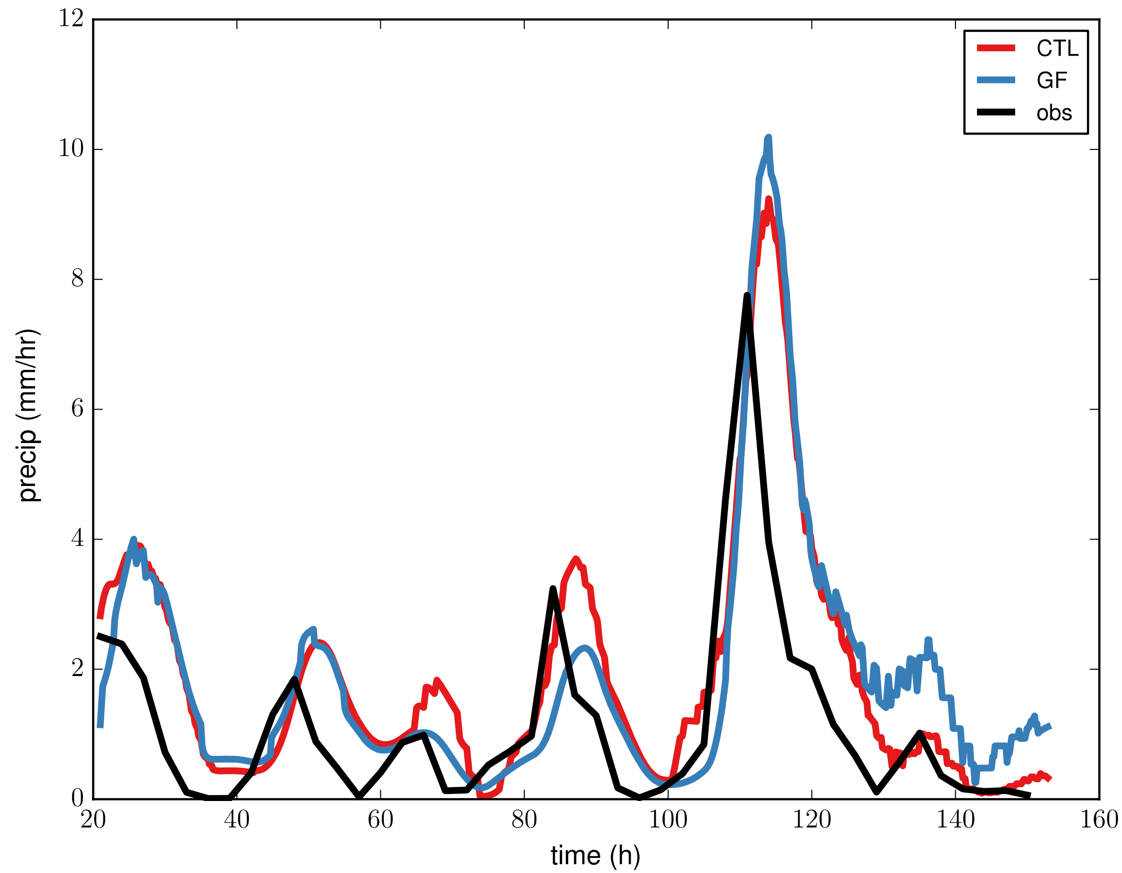
SCM results reveal contribution from each parameterization

- Forcing approximates effect of environment on column
- G-F produces weaker tendencies due to deep convection with stronger microphysical tendencies

Precipitation during active phase

Subtle differences between simulations with SAS and GF

- Both schemes are in ballpark of observations, but overestimate peaks
- Both schemes capture temporal variability but last 4-6 hours longer



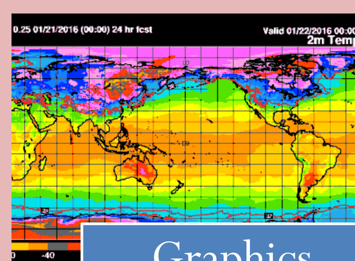
Initial implementation of physics testbed: Global workflow

Global reforecast/forecast workflow

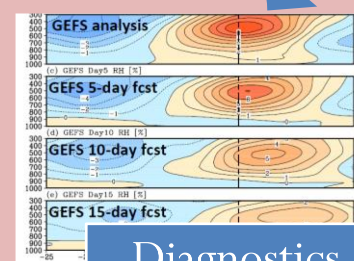
Initialization data sets → Pre-processing → Global Atmospheric Model → Post-processing

Global model workflow – GSM scripts transitioned from EMC to GMTB

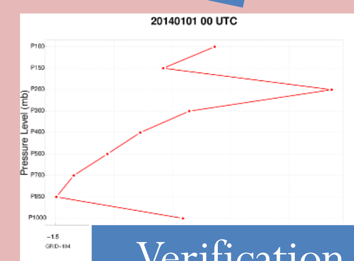
Flexible & portable framework developed by GMTB



Graphics



Diagnostics

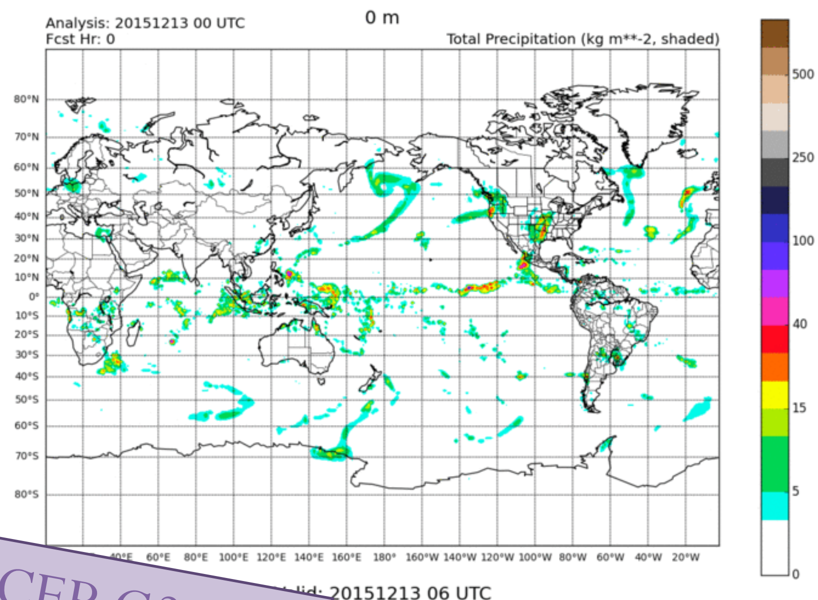


Verification

Community contributions

GMTB workflow: Graphics

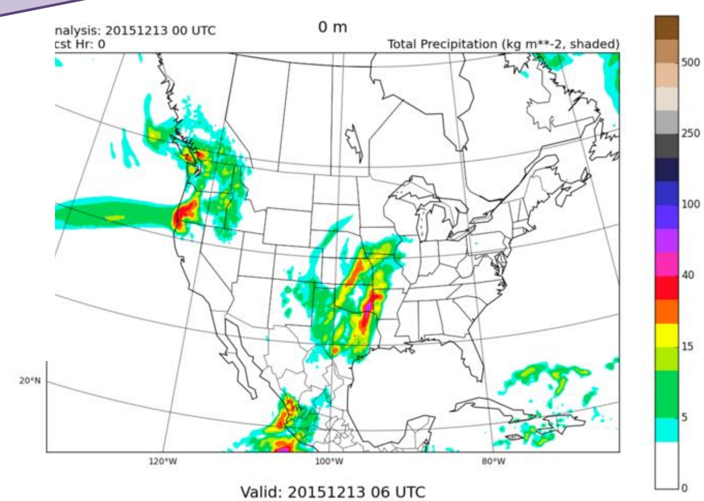
Accumulated Total Precipitation



NCEP G3 Grid

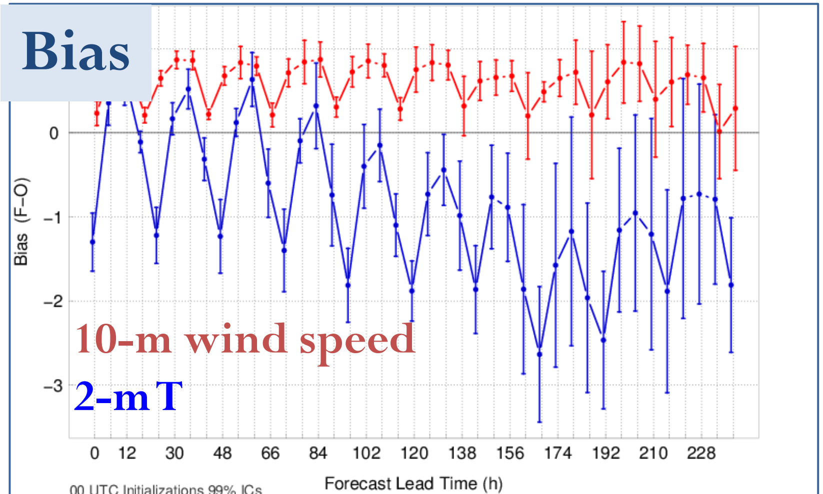
Flexible Python graphics with configuration options for different regions

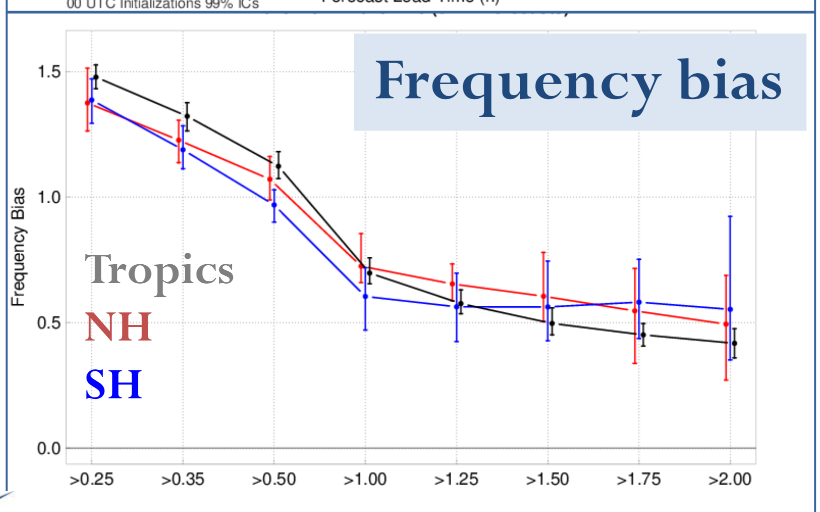
NCEP G218 Grid

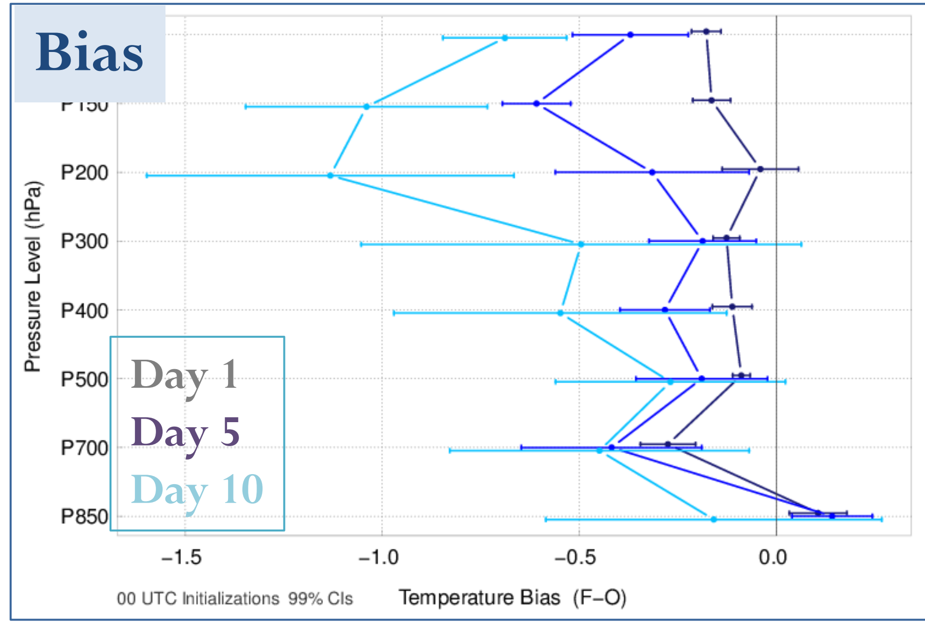


Standard, automated graphics on the same grids as verification

GMTB workflow: Verification with MET



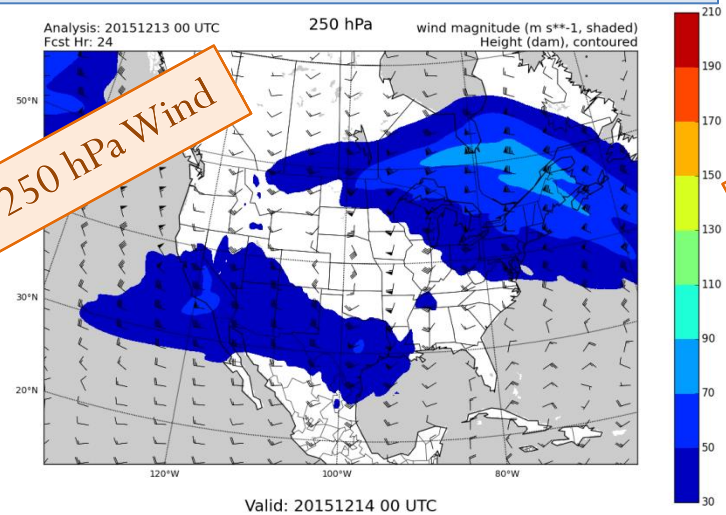


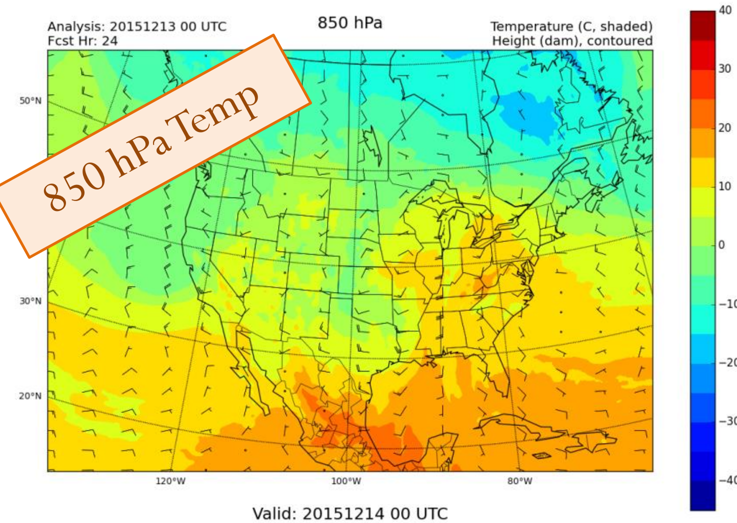


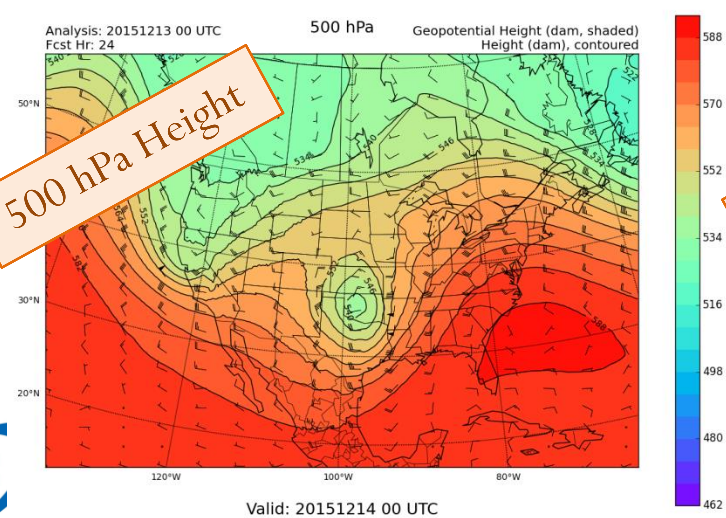
Sample of two-week evaluation of reforecast GFS (against surface obs, RAOB, and CMORPH) using MET

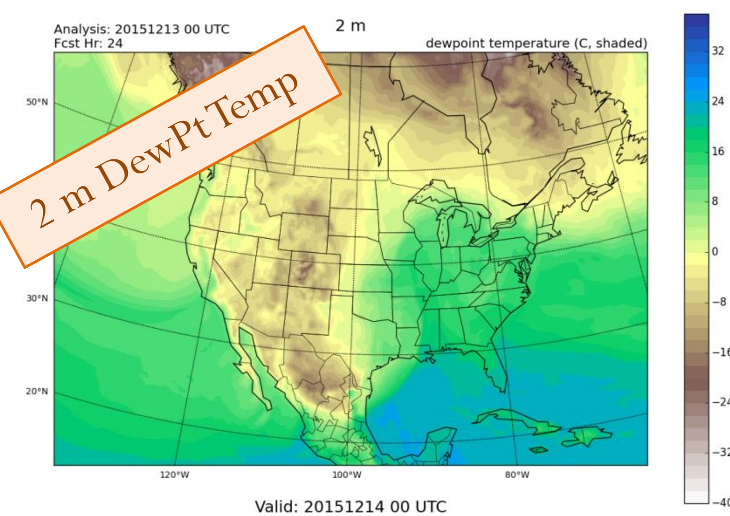
GMTB workflow: Graphics

Upper air and surface fields









Many more…
- 2 m: T, Td
- 850: T, RH, HGT
- 700: T, W
- 500: T, HGT
- 250: T, Wind

Developmental Testbed Center

GMTB – Year 2

Activities – Atmospheric Physics
IPD/CCPP deliverables: • Software design that meets the requirements for the IPD/CCPP concept • Implementation plan for IPD/CCPP capability • Initial IPD/CCPP capability • Code management plan and testing suite that are consistent with current IPD/CCPP capability • Refined/enhanced documentation for GFS operational physics suite within CCPP
Physics Testbed infrastructure: • Enhanced SCM capabilities • Initial parameterization simulator capability • Enhanced workflow capability for low/medium resolution global reforecast/forecast mode
Testing and Evaluation: Report(s) on physics testing activities Manuscript on Physics Testbed submitted to appropriate journal

GMTB – Year 2

Activities – Sea Ice Model
Deliverables: • Support to NGGPS Program Office for engaging the sea ice modeling community in the process of setting up a community sea ice modeling framework CICE Consortium Workshop scheduled for 25-27 October 2016

Moving forward…

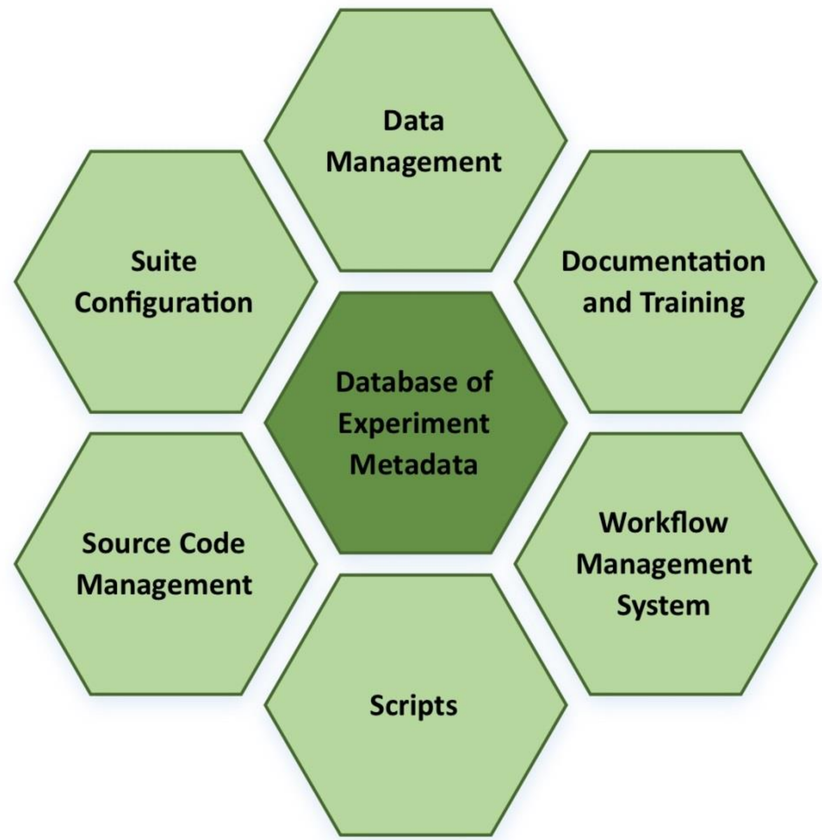
- **Community support (O2R)**
  - Provide community support for NGGPS modeling system (expanding beyond support to atmospheric physics)
  - Facilitate community participation in NGGPS physics development
  - Make CCPP/driver available to other modeling systems
- **Transfer of innovations to operations (R2O), with focus on atmospheric physics**
  - Expand CCPP to include advanced physical parameterizations, expanding the options for NGGPS
    - Improvement in driver needed
    - Additions to CCPP vetted through Physics Review Committee
  - Facilitate testing and evaluation of innovations

These are collaborative activities with EMC and the NGGPS community

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 2016: The design of a modern information technology infrastructure to facilitate research to operations transition for NCEP's modeling suites. BAMS, accepted.

http://www.dtcenter.org/eval/NITE/

Access needed for effective R2O

- All source codes
- Datasets used in operations
- Scripts and workflows to run and evaluate the experiments
- HPC platforms, migrating toward cloud computing
- Database to record and retrieve experiment configurations, so EMC is sure of their relevance
- Documentation, tutorials, and user/developer support