Design and Implementation of a Collaborative Physics Evaluation Framework

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DTC Developmental Testbed Center

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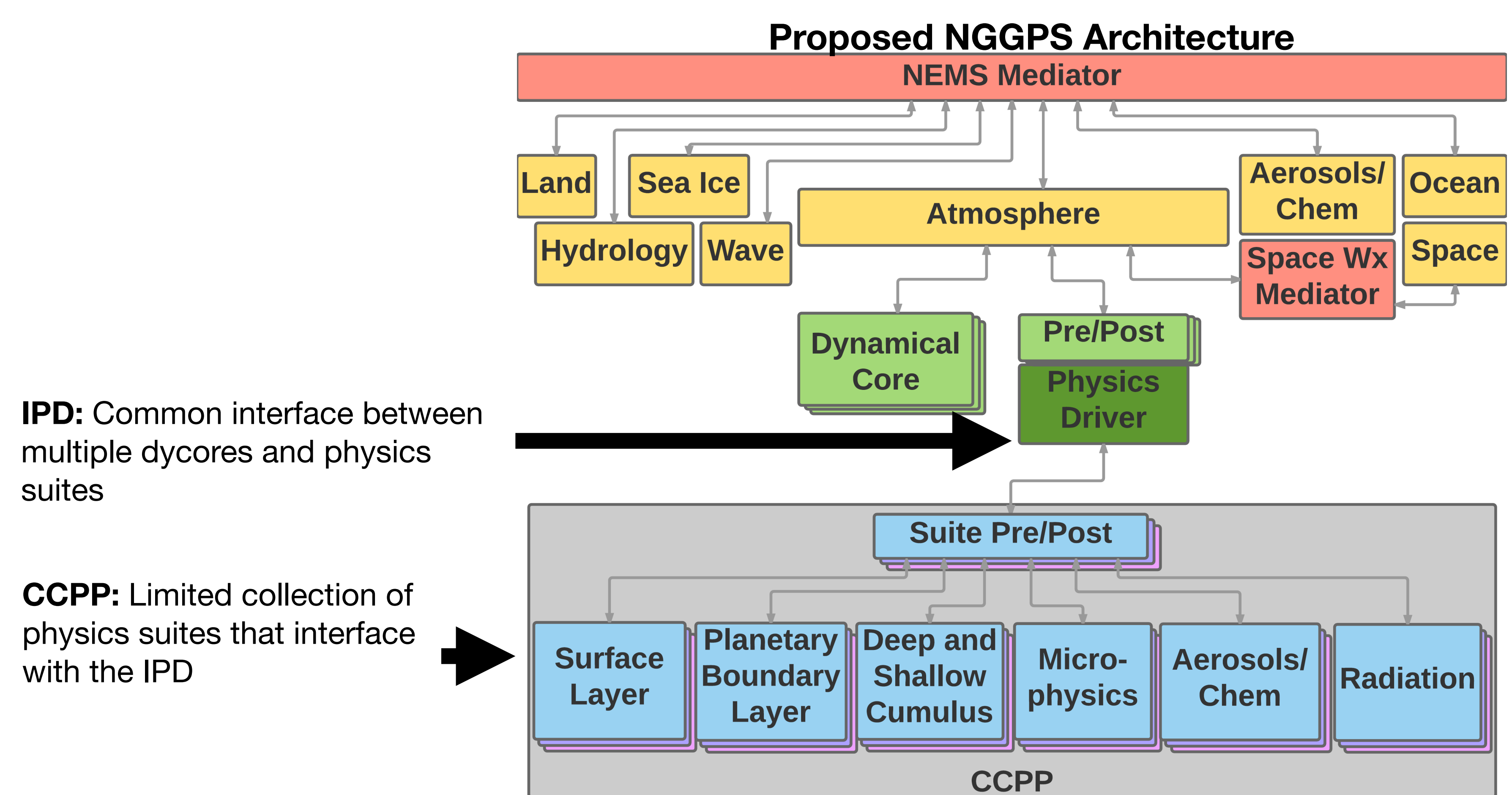
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Motivation

NOAA's long term plan seeks to integrate the capabilities of its short-term (GFS), ensemble (GEFS), and sub-seasonal (CFS) NWP applications under the infrastructure of the Next Generation Global Prediction System (NGGPS). One of the key challenges during this process is to develop a common physics infrastructure that works across all temporal and spatial scales of interest and to accommodate an efficient research-to-operations pipeline. As part of this effort, the Global Model Testbed (GMTB) team is collaborating with NOAA EMC and the research community to develop an Interoperable Physics Driver (IPD), a Common Community Physics Package (CCPP), and a physics test harness.

IPD/CCPP Framework

Proposed NGGPS Architecture

IPD: Common interface between multiple dycores and physics suites

CCPP: Limited collection of physics suites that interface with the IPD
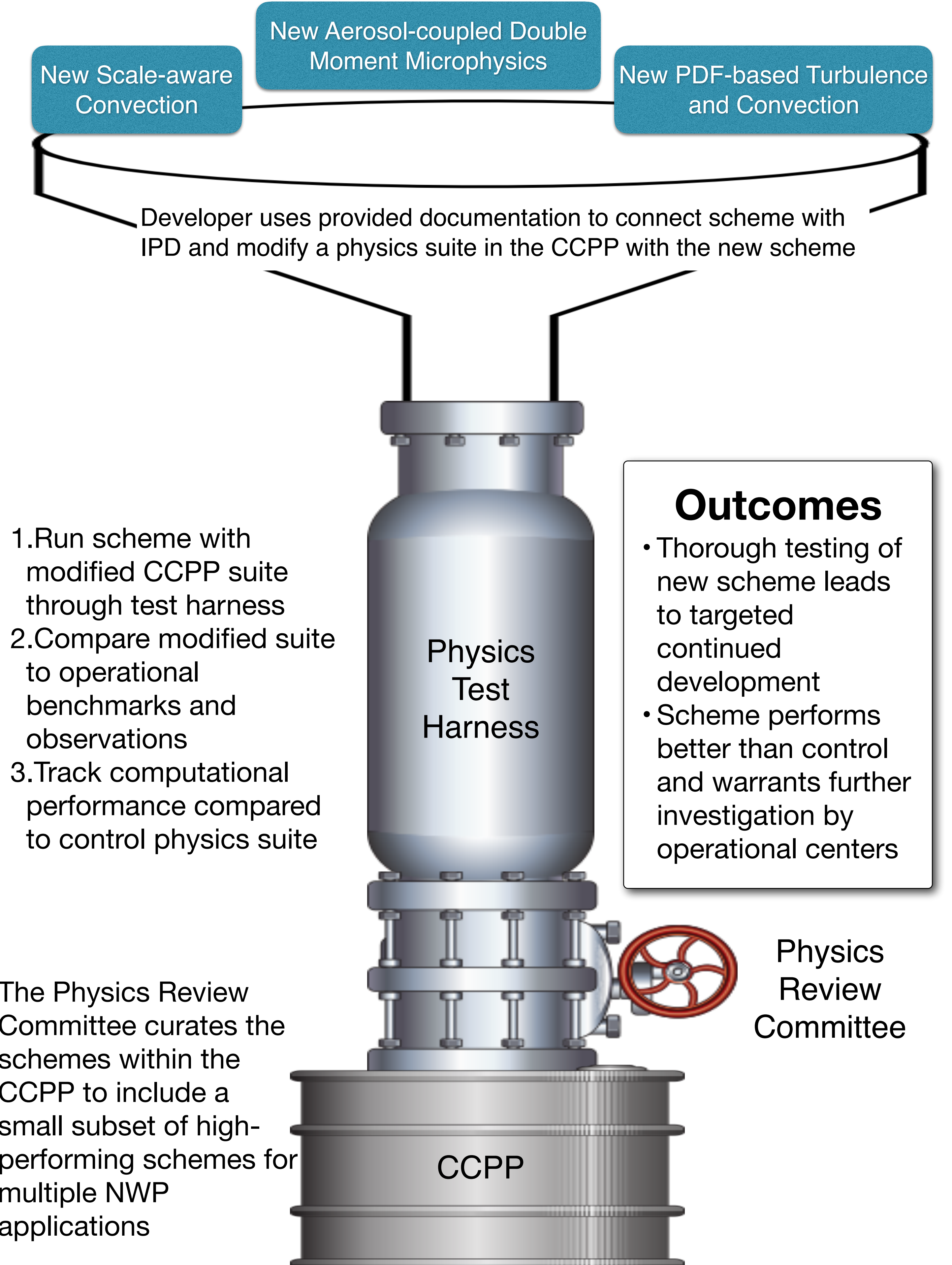
Status

IPD
- Version 1 developed at NOAA EMC has one-way interoperability (multiple dycores using GFS physics)
- Design is underway to add two-way interoperability (IPD to call different suites or schemes independently)
- Incremental implementation of requirements put forth by GMTB and NUOPC

CCPP
- "Jumping off" point for physics development in priority areas
- To be curated by multi-organizational Physics Review Committee
- Will house suites to be used operationally and by research community
- Rolling out full web-based documentation

Physics Test Harness

GMTB/EMC Testing Hierarchy

Responsibility Legend
- Physics Dev.
- DTC
- NOAA EMC
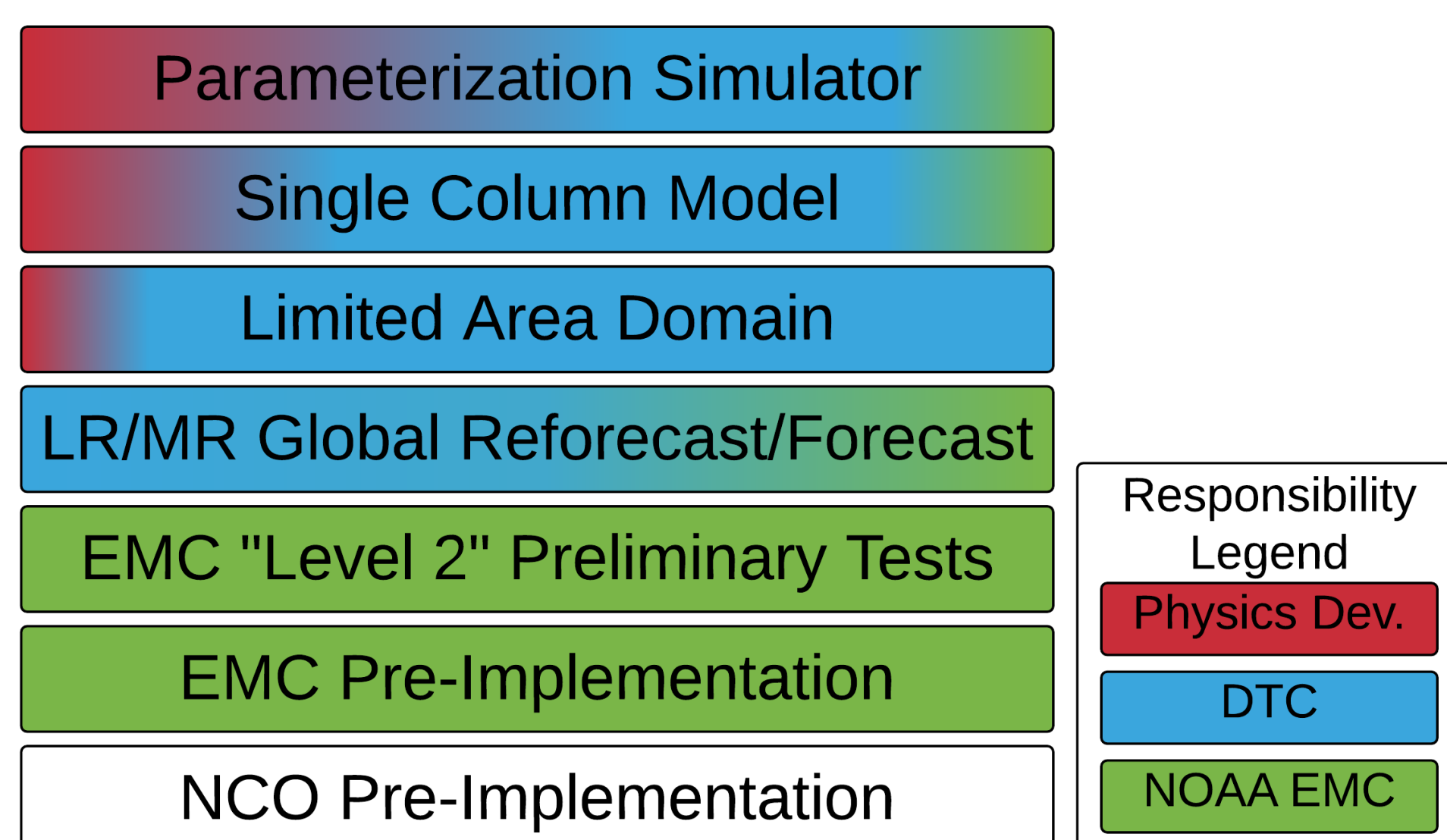
- Common infrastructure for testing physics development
- Simple-to-complex progression, conceptually and computationally
- Researchers can "enter" test harness at whichever level is appropriate

Tools and Data Provided by DTC for Physics Test Harness
- documentation and access to IPD and CCPP code
- test case catalog with initialization and forcing data, observational data for comparison, benchmark data from operational physics suites
- support for using SCM and global model workflow
- basic plotting and evaluation routines

Current Status
- SCM that is connected to IPD and GFS operational physics suite works; development to follow IPD
- Workflow to run sub-operational resolution global GFS on NOAA R&D machine works
- Building out SCM case catalog

Plans
- Hook in parameterization simulators for different physics types
- Choose an appropriate limited-area domain model and build out a case catalog

Research-to-Operations Pipeline

The adoption of physical parameterization advances originating within the research community by the operational community can be a slow and arduous process. Through use of the IPD/CCPP framework together with the physics test harness, this may be considerably streamlined.

Developer uses provided documentation to connect scheme with IPD and modify a physics suite in the CCPP with the new scheme

1. Run scheme with modified CCPP suite through test harness
2. Compare modified suite to operational benchmarks and observations
3. Track computational performance compared to control physics suite

Outcomes
- Thorough testing of new scheme leads to targeted continued development
- Scheme performs better than control and warrants further investigation by operational centers

The Physics Review Committee curates the schemes within the CCPP to include a small subset of high-performing schemes for multiple NWP applications

How to Participate
1. Suggest appropriate test cases for any level of the test harness hierarchy.
2. After physics test harness rollout, download and use the testbed tools.

Acknowledgements