Making forecasts better – community infrastructure for facilitating improvement and testing of physical parameterizations

About the Global Model Test Bed

- GMTB fosters and facilitates community engagement in atmospheric physics by providing a physics library and driver that allow distributed development in a model-agnostic setting
- supporting users with porting code to this library
- maintaining and supporting a comprehensive testing platform for the emerging NOAA Unified Forecast System (UFS)
- conducting testing and evaluation of innovations
- bringing together research and operational groups

Common Community Physics Package

- The Common Community Physics Package (CCPP) is made up of two components (repositories), the CCPP physics library ccpp-physics and the CCPP physics driver ccpp-framework.
- ccpp-physics is a collection of vetted, dycore-agnostic, physical parameterizations. There can be multiple of each type (PBL, cumulus etc.) to support various applications (high-res, seasonal etc.) and maturity level (operational, developmental).
- Vetted means that there is a governance process to determine what is included in CCPP.
- Dycore agnostic means that the parameterizations can be used with any dycore through the CCPP driver ccpp-framework with caps on both sides.
- Runtime selection of parameterizations/suites
- Configurable order/frequency of physics calls
- User-specified grouping of schemes, subcycling

CCPP Status

- Under active development at NOAA GSD and NCAR RAL
- V1 release March/April 2018 with GMTB SCM v2
- V2 release June/July 2018 with NOAA FV3-GFS v1

Behind the scenes: CCPP technical implementation

- Metadata tables on host side provide information on parameters available from the host model.
- Required variables must be provided by host model, incl. memory management (allocation).
- Python script ccpp_prebuild.py runs before build time, matches variables by standard_name.
- Consistency checks of units, rank, etc.
- Auto-generates caps for physics schemes.
- Auto-generates code inside host model cap to populate cdata structure (see below)
- Auto-generates makefiles for schemes, caps.
- cdata: lookup table standard_name → address in memory in C space

Adding a scheme to CCPP

- Write CCPP-compliant scheme (see below)
- Add scheme to list of schemes in CCPP prebuild config, handle optional arguments
- Add scheme to runtime suite definition file
- Done (really!)

Adding CCPP to host model

- Is nearly as easy as adding a new scheme
- Add config for CCPP prebuild (see below)
- Write host model cap to abstract away CCPP calls from dycore (init, run, finalize)
- Add prebuild script & CCPP to build system

Tested environments

- CCPP is implemented in the GMTB Single Column Model SCM and the Geophysical Fluid Dynamics Laboratory Finite Volume Cubed-Sphere FV3-based NOAA GFS
- Hierarchical model development: SCM allows for setting a physics suite using external forcing w/o dycore feedbacks
- FV3: selected as dycore for Next Generation Global Prediction System (NGGPS) to replace GSM core of GFS
- Runs as a unified, fully-coupled system, in NOAA’s Environmental Modeling System infrastructure.

Host cap – runtime physics selection

- runtime suite definition file
- add host model vars to cdata structure

Runtime suite definition file

- suitespec-internal
- subsuite
- suite
- cap
- cdata
- caps
- runtime
- scheme
- cdata
- compile
- execute
- finalize

Using CCPP for Atmospheric Physics

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