SHARED PHYSICS REPOSITORY for WRF, MPAS, and CM1

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2022 JOINT WRF/MPAS USERS' WORKSHOP (6th-9th June 2022), Boulder, Colorado

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.

INTRODUCTION

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The new infrastructure is built on:

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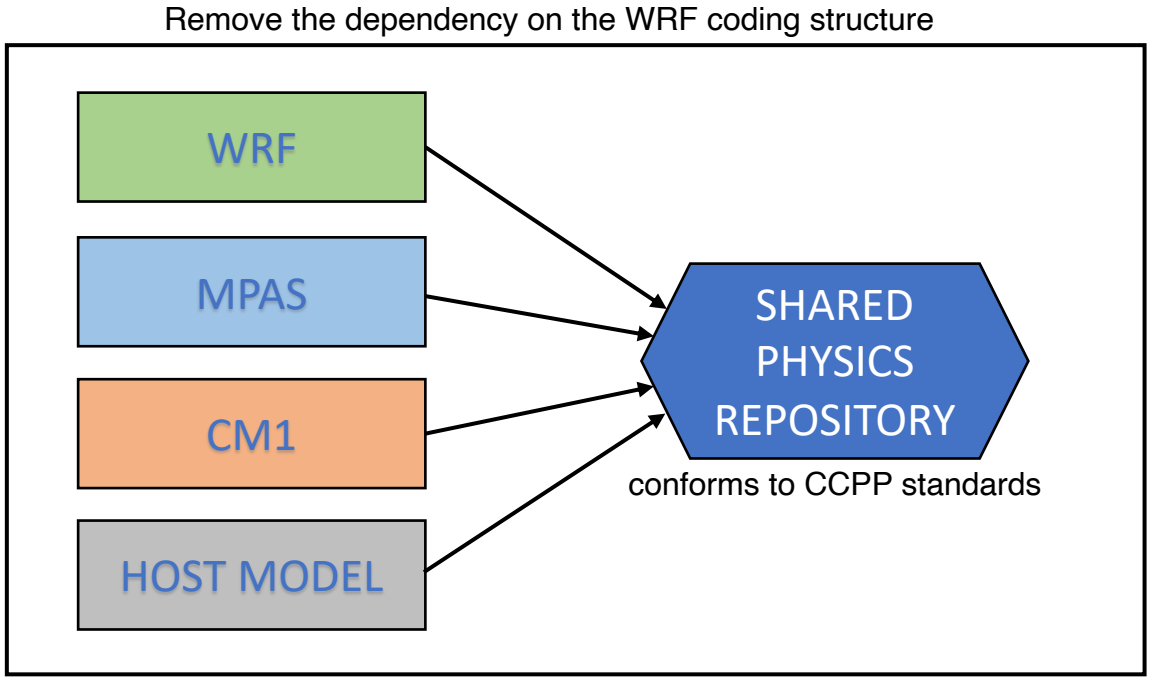

FACTS AND MOTIVATIONS

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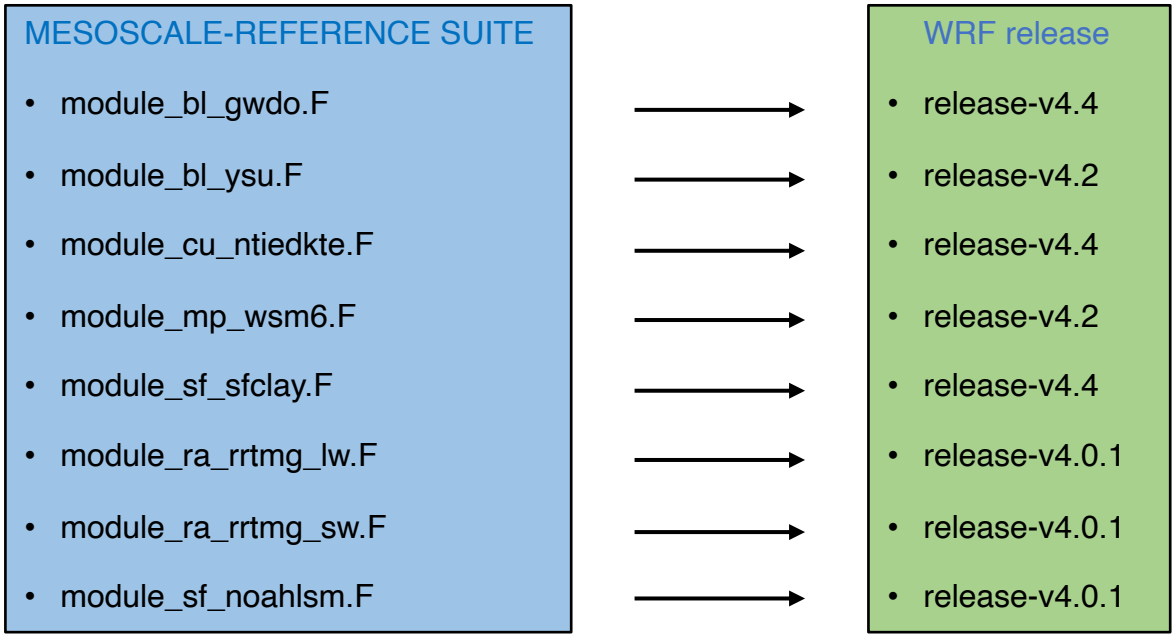

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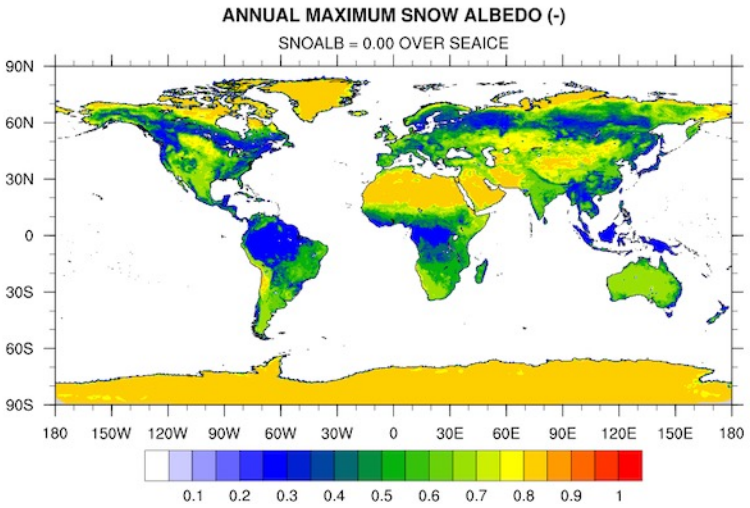
   a. Regression tests need to be developed.

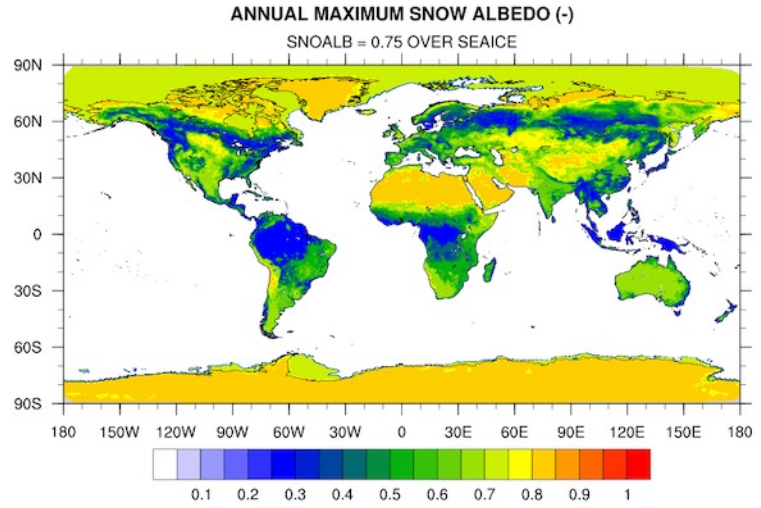
   b. Regional MPAS is a great tool for comparison against WRF and bugs fixes (see Wong et al., Session 4).

Example of using regional MPAS

a) before correction



b) after correction



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3. For simplicity, MPAS physics drivers are WRF-centric (dimensions of local arrays, order of array index, leading to lengthy drivers and overhead).

   Extensive use of *from_MPAS* and *to_MPAS* interstitial subroutines.

   real, dimension(its:ite,kts:kte,jts:jte) where is the *j* dimension is not needed.

THE CCPP

Singletrack Physics (Gettelman and Gill, WRF/MPAS workshop 2018)

1. In 2018, NOAA, NCAR, and other agencies started to collaborate on the development of a Common Physics Framework (CPF), now referred to as the Common Community Physics Package (CCPP, refer to https://ccpp-techdoc.readthedocs.io/en/v5.0.0/Overview.html for details)

2. A few of the basic principles:

    a. Build a library of physics parameterizations that conforms to selected standards.

    b. Scientifically consistent suites of parameterizations,

    c. Compatibility with current NOAA and NCAR models (for NCAR: CESM, MPAS, WRF).

    d. Agnostic to dynamical core.

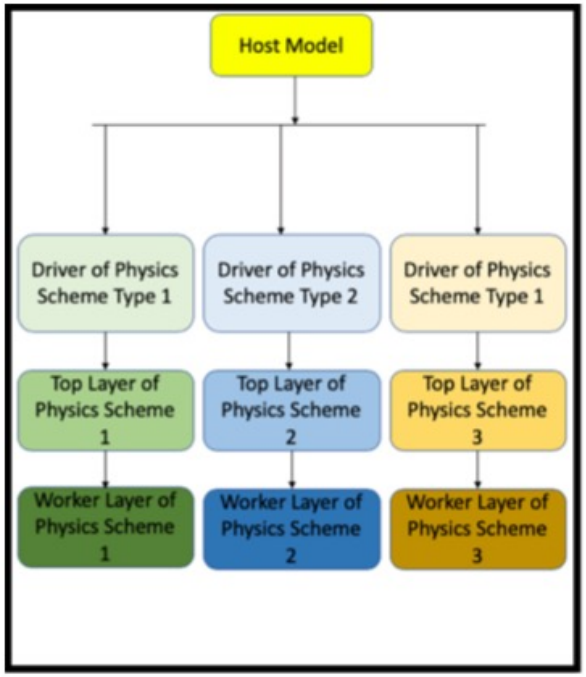
    e. Scale insensitive physics to weather & climate.

3. Host models are responsible for their interface to the physics drivers.

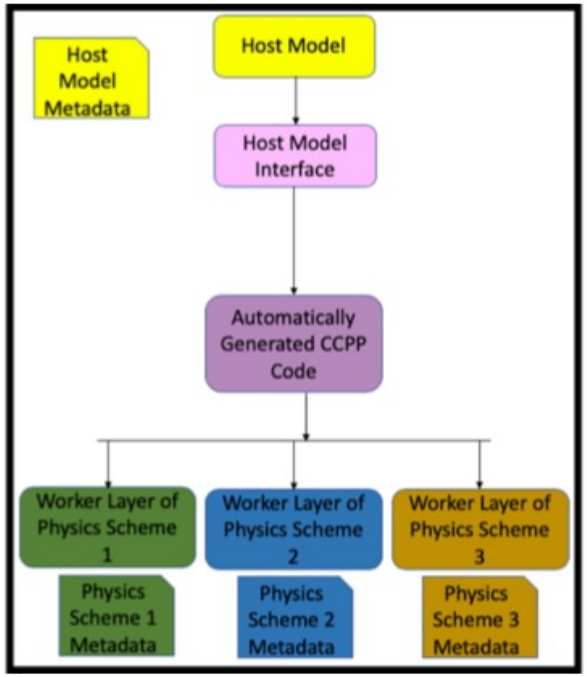
THE CCPP

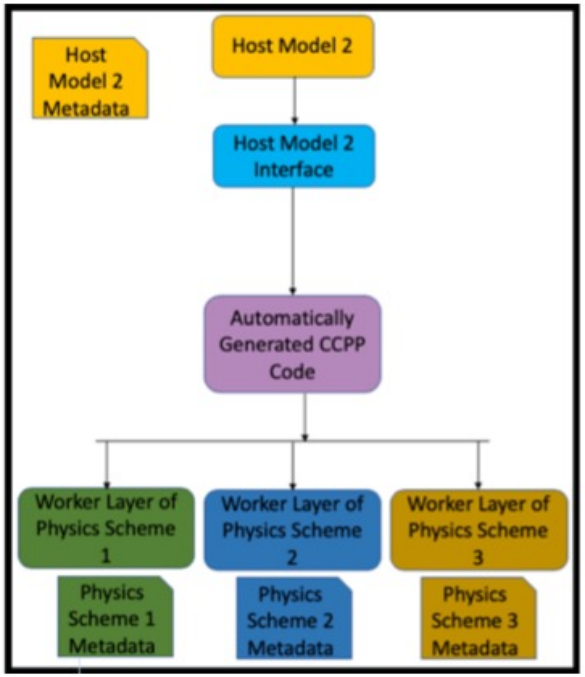
Sharing Physics between WRF and MPAS with CCPP (Gill et al., WRF/MPAS workshop 2020)

Big Picture: Why are we doing this



Original interface to physics and host model.





The CCPP interface permits the same physics to be used with both the original and a new host model.

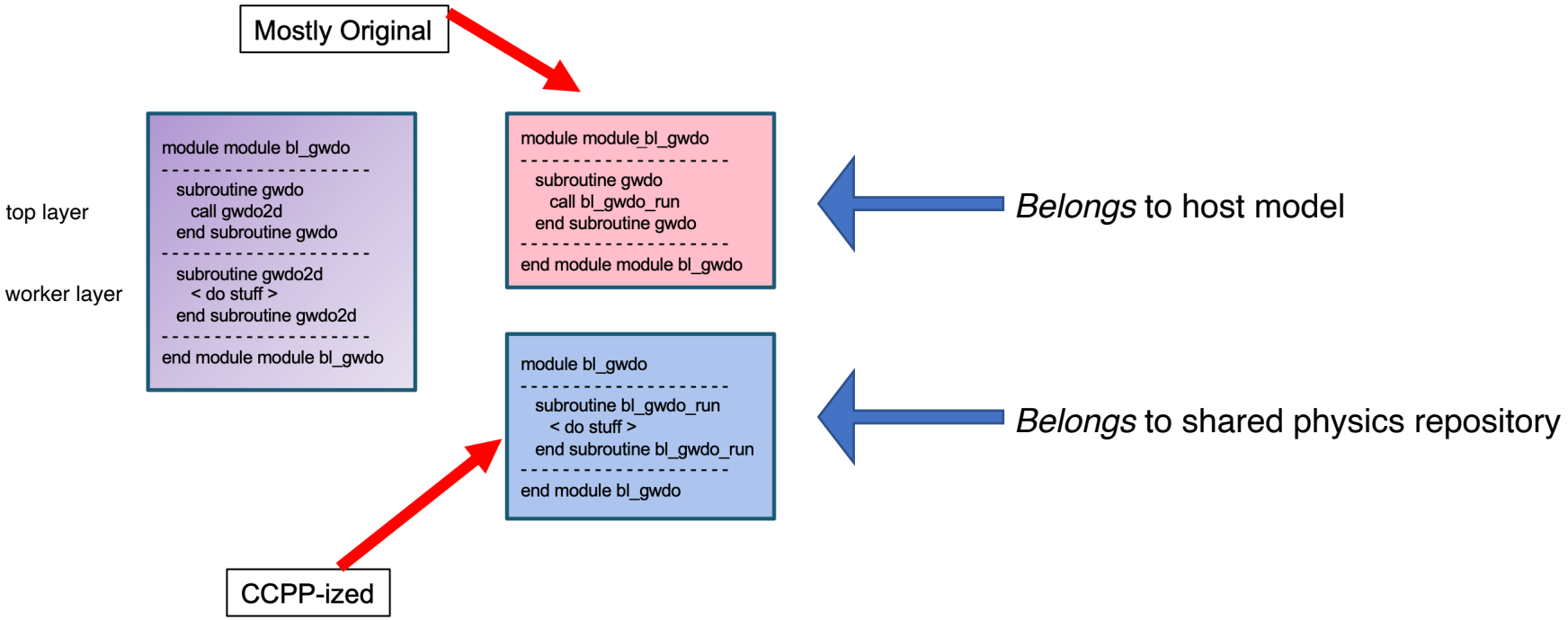
from Gill et al. (2020)

STATUS

The MPAS mesoscale-reference / WRF tropical suite updated to WRF release-4.4

- ❖ Revised surface layer scheme
- ❖ YSU Planetary Boundary Layer scheme
- ❖ New Tiedtke convection scheme
- ❖ WSM6 cloud microphysics scheme
- ❖ Xu-Randall cloud scheme
- ❖ GWDO scheme
- ❖ RRTMG longwave radiation scheme
- ❖ RRTMG shortwave radiation scheme

Parameterizations have been modified to be CCPP-compliant



from Gill et al. (2020)

STATUS
The shared physics repository

1. The shared physics repository is a github repository. It contains:
    a. thoroughly tested schemes organized as suites.
    b. each scheme itself is completely agnostic from host models.

2. The shared physics repository is downloaded at compile time to the host model using the CESM external management utility (https://github.com/ESMCI/manage_externals).
    a. two branches: a main branch and a develop branch.
    b. A tag keeps track of the state of the shared repository, and its compatibility with the host models.

CONCLUSIONS

1. There is a need to centralize physics parameterizations for use in different models (WRF, MPAS, CM1).
2. Physics parameterizations are modified to CCPP coding standards.
3. The shared physics repository will be available using the manage_externals utility.