Development of the Common Community Physics Package (CCPP) for Operational Predictions from Hours to Seasonal

Linlin Pan[1,2,3], Dom Heinzeller[1,2,3] , Ligia Bernardet[1,3], Grant Firl[3,4], Laurie Carson[3,4], Man Zhang[3,4], Julie Schramm[3,4]

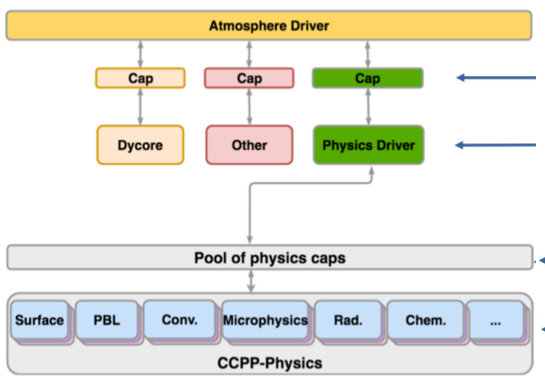
[1] NOAA/GSL, [2]CU/CIRES,[3]DTC, and [4]NCAR

System unification and interoperability

The Common Community Physics Package (CCPP) is co-developed by the Developmental Testbed Center (DTC) and includes a collection of physical parameterizations and a software framework to connect the physics to host models. Establishing the CCPP framework as a common infrastructure for sharing physics between SCM, UFS, CESM, and MPAS opens the door to a wider involvement of modeling communities and will accelerate the addition and transfer of physics improvements between these models.

The CCPP has been selected for use in the upcoming operational implementations of NOAA's Global Forecast System (GFS) v17 and NOAA's Global Ensemble Forecast System (GEFS) v13 in the 2024 time frame, It is now being tested at various scales and configurations, ranging from short-term, convective weather to seasonal, coupled applications.

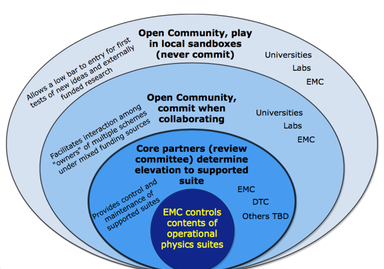
Common Community Physics Package



host application cap with auto-generated code from metadata

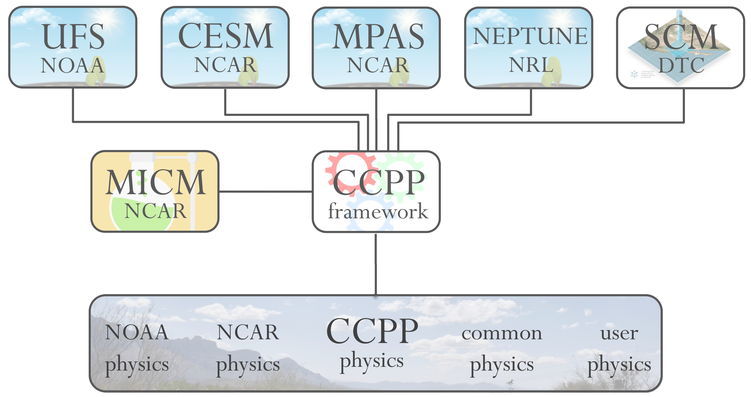
CCPP-framework used before and at compile time and during run

physics caps (auto generated) parameterizations from one or more physics libraries



Research to Operations: CCPP contains operational physics plus candidates for future operational implementations. DTC will facilitate ongoing development and testing.

CCPP used in different systems



Four CCPP releases, and v5 on the horizon

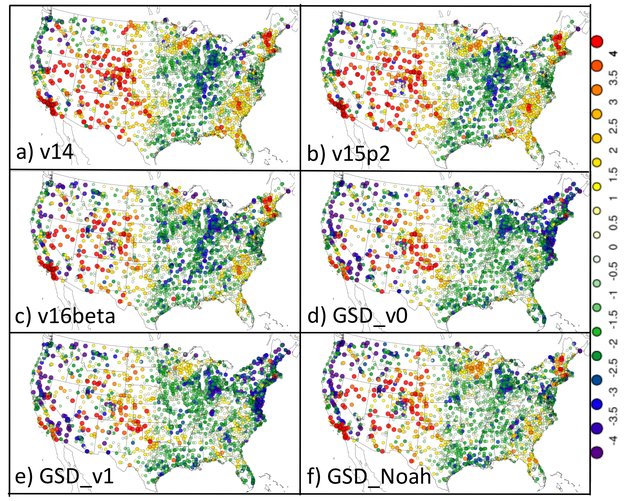
Versions	Release Dates	Physics	Host Model
V1	2018 Apr	GFS v14 operational	SCM
V2	2018 Aug	GFS v14 operational updated GFDL microphysics	SCM UFS WM for developers
V3	2019 Jul	GFS v15 operational Developmental Schemes/suites	SCM UFS WM for developers
V4	2020 Mar	GFS v15 (v16beta) operational Developmental schemes/suites	SCM UFS WM/UFS MRW App
V5	2020 Nov	GFS v15 (v16beta) operational Developmental schemes/suites	SCM UFS WM/UFS SRW APP

CCPP supported suites

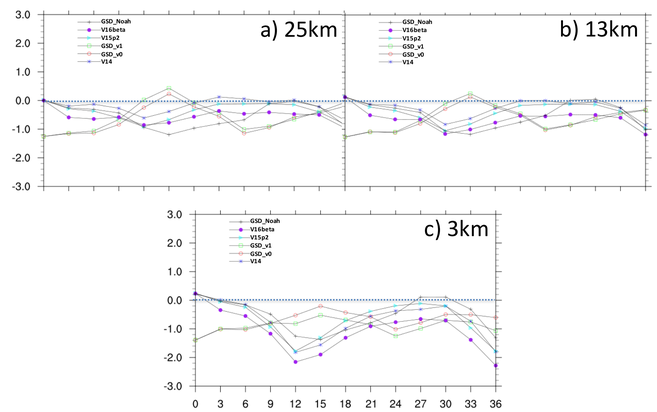
	Operational	Experimental (* with SCM only; ** CCPP V5 only)			
	GFSv15p2	**GFSv16beta**	**csawmg***	**GSD_v1***	**RRFS_v1beta****
Microphysics	GFDL	GFDL	M-G3	Thompson	Thompson
PBL	K-EDMF	Moist TKE-EDMF	K-EDMF	saMYNN	saMYNN
Surface layer	GFS	GFS	GFS	GFS	MYNN
Deep Convection	SAS	saSAS	Chikira-Sugiyama	Grell-Freitas	Off
Shallow Convection	SAS	saSAS	saSAS	MYNN and GF	Off
Radiation	RRTMG	RRTMG	RRTMG	RRTMG	RRTMG
Gravity Wave Drag	uGWP	uGWP	uGWP	uGWP	GSL
LSM	Noah	Noah	Noah	RUC	NoahMP

Tests of different suites for R2O

The used in past (v14) and current (v15p2) operational implementations of the Global Forecast System (GFS) were tested against candidates for future operational implementations. All the suites can be found in the dtc/develop branch of the CCPP-physics code repository in GitHub. Tests show that the v16beta has a negative temperature bias at surface over the eastern United States. Further improvements of this suite are under development for implementation in the operational GFSv16 in 2021.



2-m temperature bias for different suites for the 13-km resolution at a 24-hour forecast. The model was initialized at 12z, July 15, 2019.



2-m temperature bias for different suites v14 (blue star), v15p2 (cyan filled triangle). v16beta (purple filled circle), GSD_v0 (red open circle), GSD_v1 (green open square), and GSD_Noah (black cross) as a function of forecast time for different horizontal grid spacings: a) 25km, b) 13km, and c) 3km.

- Scientific/Tech Docs, Users Guide, FAQ: https://dtcenter.org/ccpp
- UFS Users' Support Forums: https://forums.ufscommunity.org
- Helpdesk: gmtb-help@ucar.edu