Using the Global Modeling TestBed Single Column Model to Test a Newly Developed Convective Parameterization

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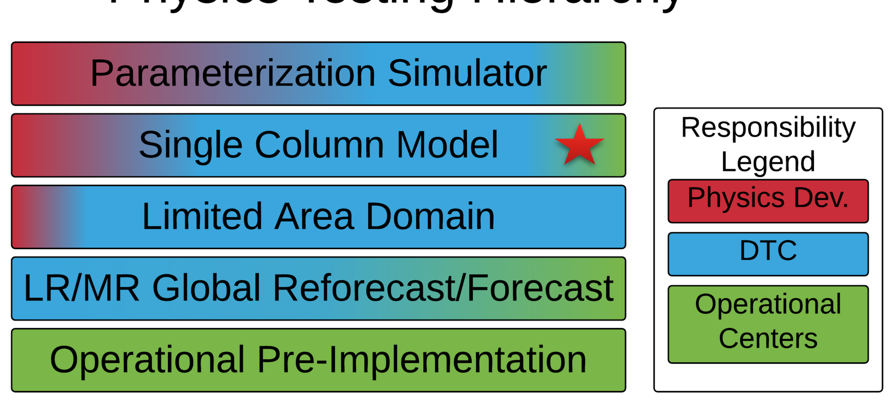
DTC Developmental Testbed Center

Motivation

The initial focus of the Global Modeling TestBed (GMTB), a collaborative project between NOAA GSD and NCAR through the Developmental Testbed Center, is to develop a framework to evaluate advancements in physics parameterizations for future use in operational NWP. Such a framework consists of an Interoperable Physics Driver (IPD), a Common Community Physics Package (CCPP), and a physics test harness. The physics driver provides a common interface for physics packages, the test harness provides a uniform testing and evaluation functionality, and the CCPP provides a repository of supported physics suites to the research and operational communities. The purpose of this poster is to report on the initial test of one component of the physics test harness, the GMTB single column model.

Physics Test Harness



- Common infrastructure for testing physics development
- Simple-to-complex progression, conceptually and computationally
- Researchers can "enter" test harness at whichever level is appropriate

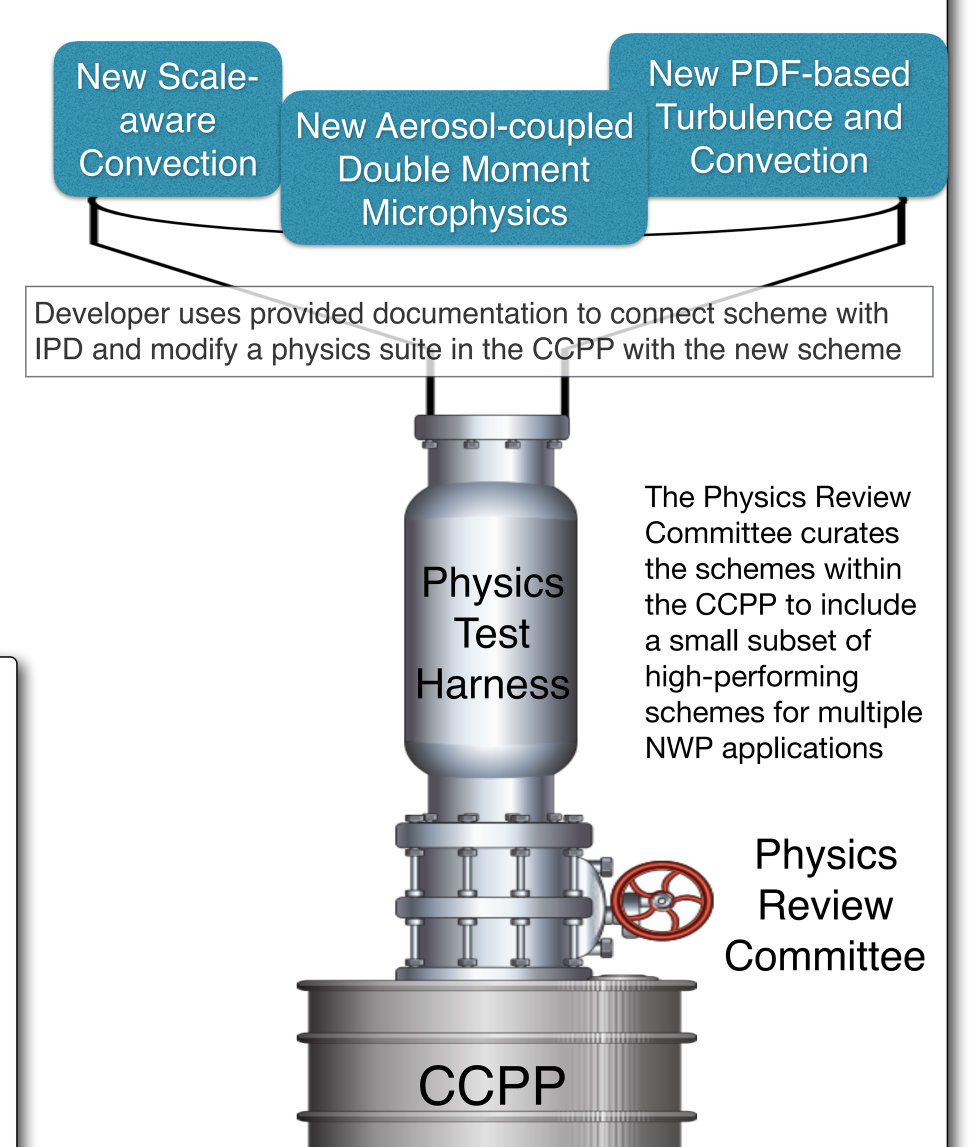
Tools and Data Provided by DTC for Physics Test Harness

- 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

Research-to-Operations Pipeline

Basic Steps

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

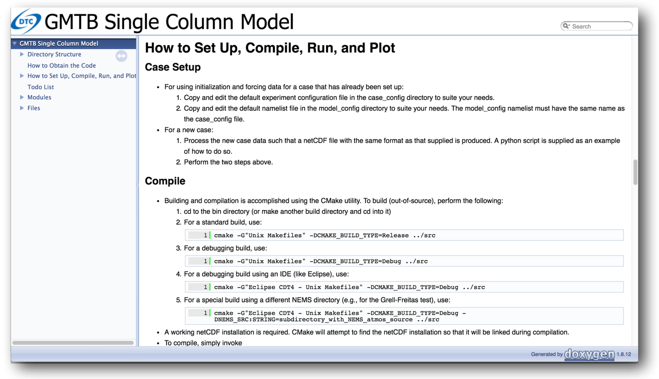


Outcomes

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

SCM Description

- Uses IPD to connect to operational GFS physics suite
- Portable code uses minimal dependencies
- Updated to reflect ongoing changes in IPD and GFS physics
- Driven from observationally-based cases (GCSS-style)
- Features complete documentation and User's Guide



http://www.dtcenter.org/GMTB/gmtb_scm_doc/

Available to friendly users on NOAA's VLab

Case Setup

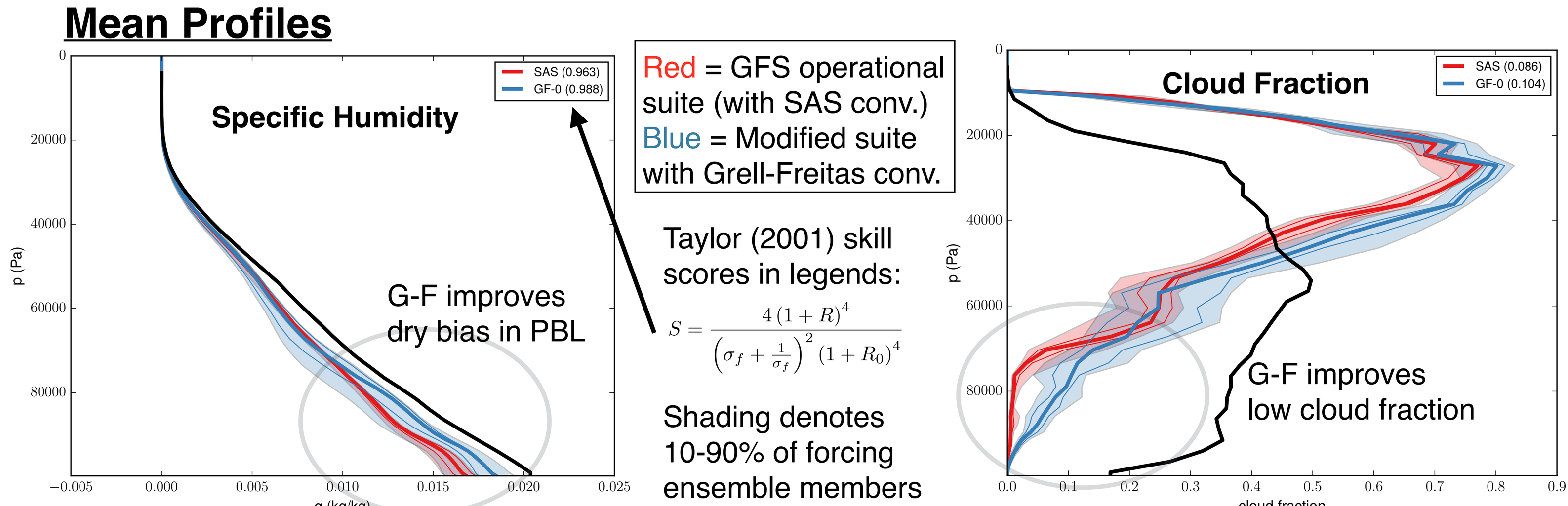
- GCSS case built from ARM TWP-ICE field campaign data
- Features deep and suppressed convection near Darwin Australia during 1/20/2006 - 2/12/2006
- 64 hybrid-sigma levels, 10 min $\triangle$t
- Forced by fixed SST, prescribed hor. advective tendencies of T, q, prescribed vertical velocity, and nudged u, v
- Uses 100-member forcing ensemble that varies forcing based on uncertainty in precipitation measurement
- Analysis follows Fridland et al. (2012) and Davies et al (2013)

Physics Scheme	Control / Grell-Freitas
Surface	NOAH (ocean surface)
Radiation	RRTMG
PBL	Hybrid EDMF
Microphysics	Zhao-Carr
Deep & Shallow Convection	SAS (latest) / Grell-Freitas

Results

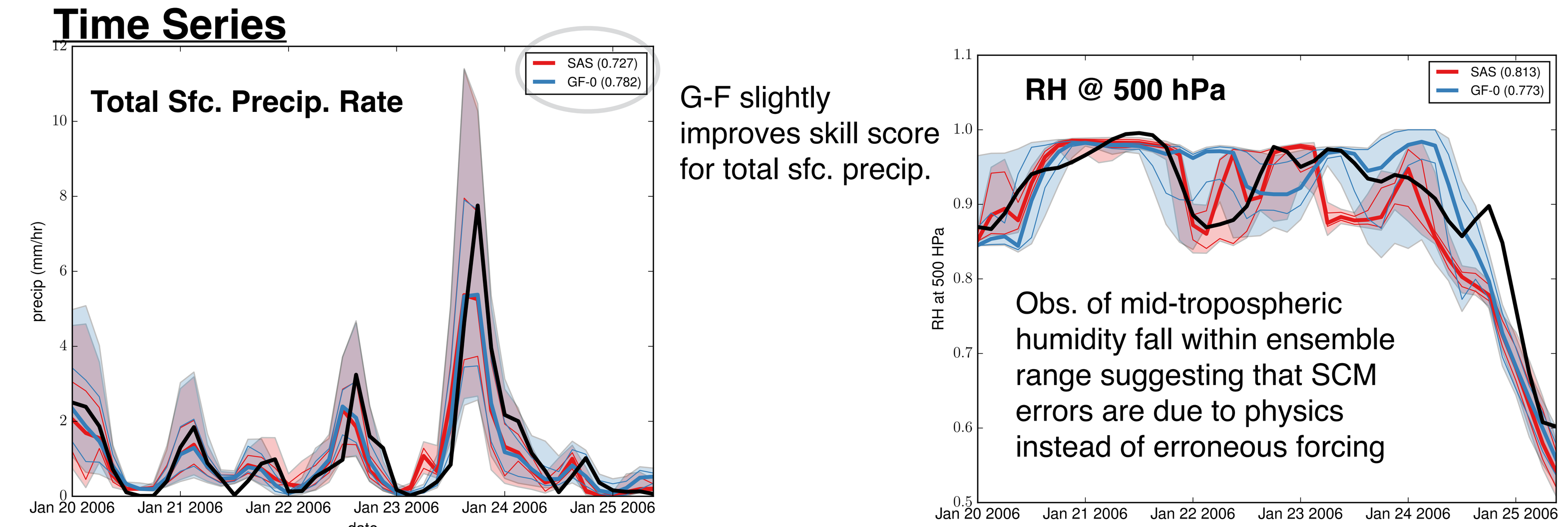
Active Convective Period

Mean Profiles



$$S = \frac{4(1+R)^4}{\left(\sigma_f + \frac{1}{\sigma_f}\right)^2 (1+R_0)^4}$$

Time Series



Acknowledgements

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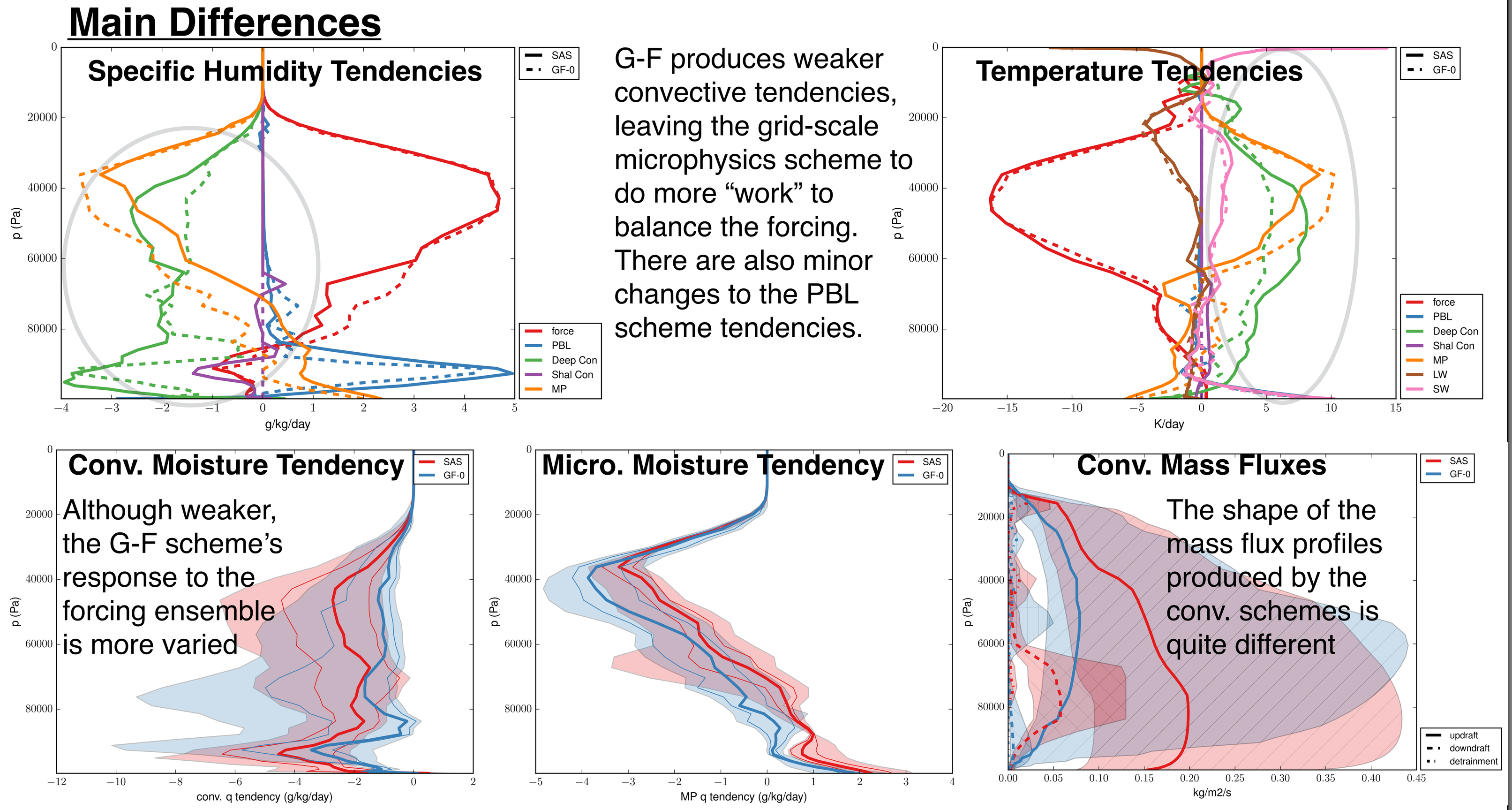
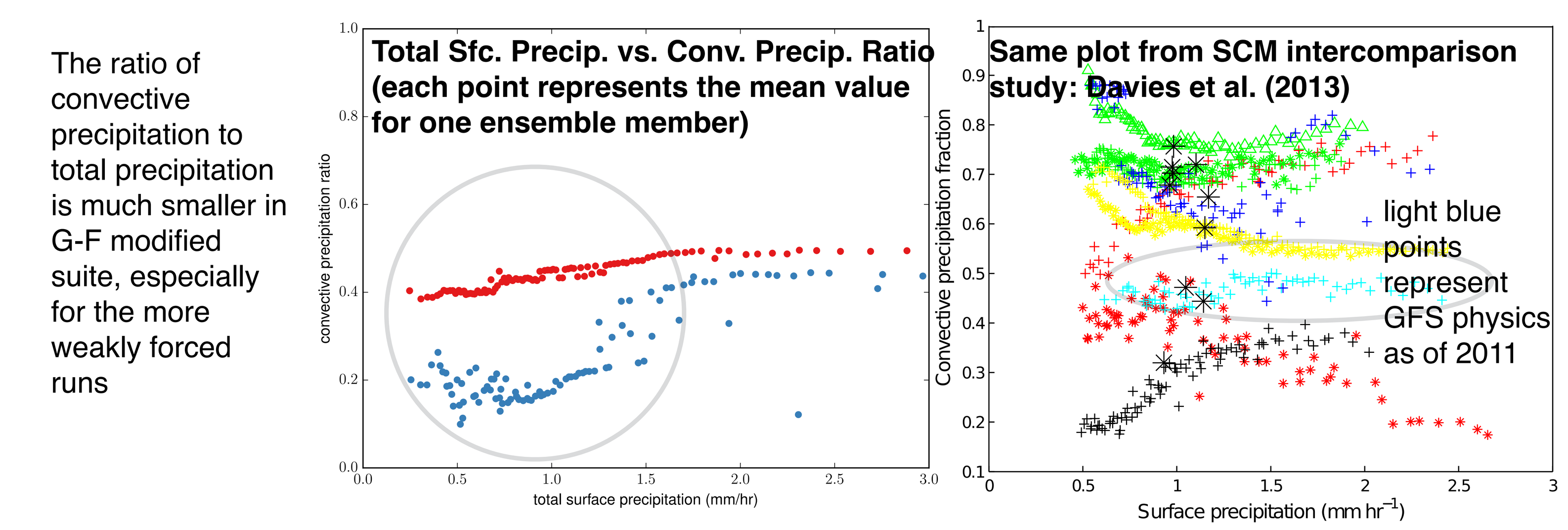
Results

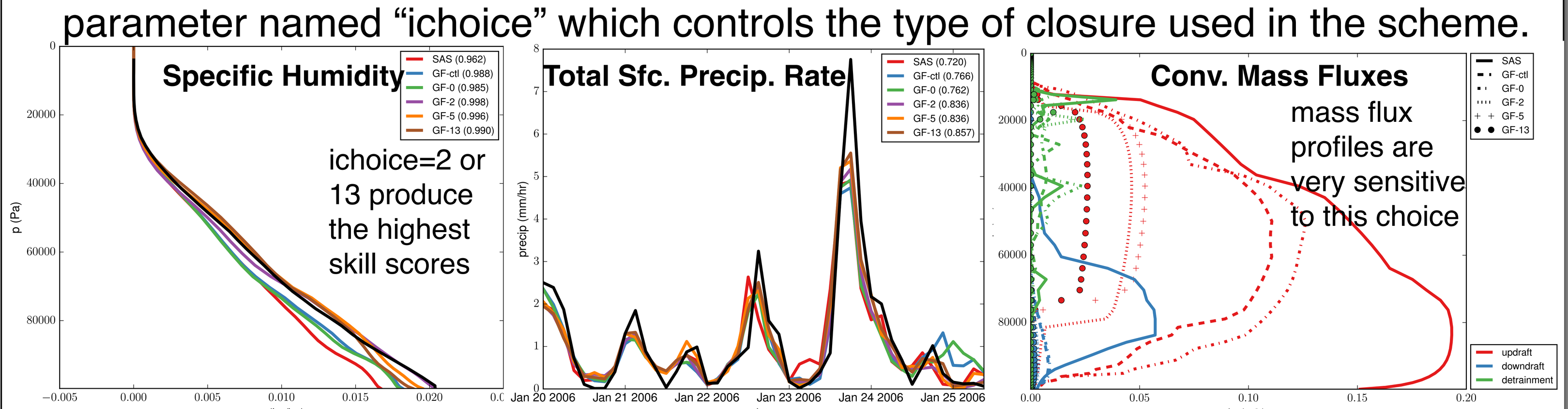
Main Differences





Sensitivity to Grell-Freitas Closure Choice

A SCM can be a valuable tool for determining sensitivities to parameterization options. For the Grell-Frietas sheme, this case was most sensitive to the parameter named "ichoice" which controls the type of closure used in the scheme.



Summary

- SCM that works with an interoperable physics driver as part of a physics test harness has been developed and can be a valuable tool for physics developers
- G-F scheme seems to reduce the dry bias from operational GFS scheme in PBL
- G-F scheme exhibits generally higher skill scores despite it's "untuned" state
- G-F scheme generates a more varied response to the forcing ensemble
- G-F produces weaker convective tendencies, leaving grid-scale MP to do more work
- G-F mass fluxes have different shape (and weaker) than SAS
- G-F has lower convective precip. ratio (and interesting response to forcing strength)
- The sensitivity to the closure choice in the G-F scheme is greater than the improvement indicated over the operational GFS configuration

References

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