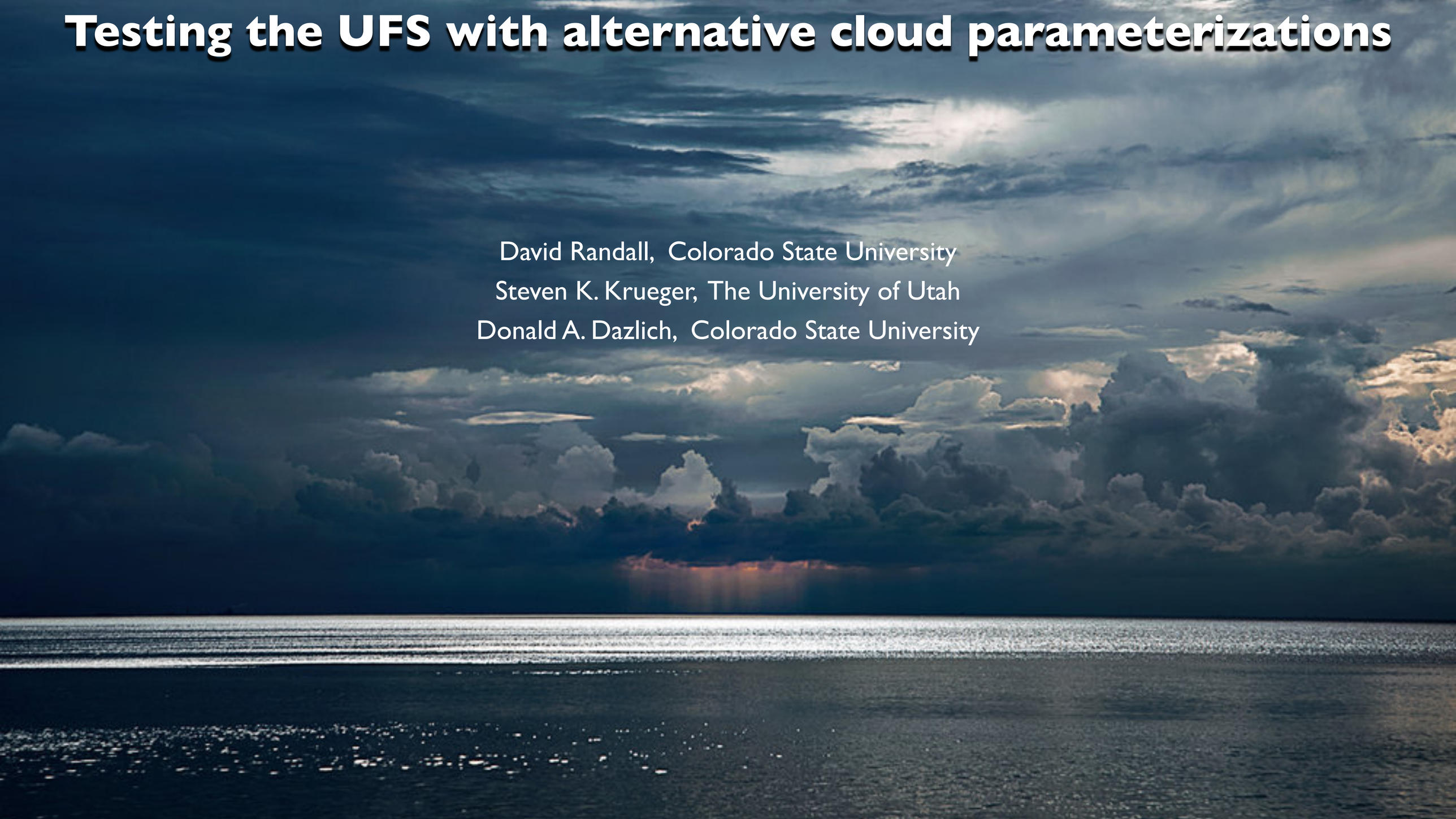
Testing the UFS with alternative cloud parameterizations



David Randall, Colorado State University
Steven K. Krueger, The University of Utah
Donald A. Dazlich, Colorado State University

Acknowledgments

Steve Krueger

Don Dazlich

National Oceanic and Atmospheric Administration

Award #: NA18NWS4680046

Title: Improving Cloud Processes in the NCEP Global Models

PI: Steve Krueger, University of Utah and David Randall, CSU

National Oceanic and Atmospheric Administration

Award #: NA19OAR4590155

Title: S2S Forecasting of North American Precipitation Anomalies: Using Empirical Forecasts to Challenge Dynamical Forecasts

PI: David Randall, Colorado State University

We will show some model results, but the main purpose of this talk is to give an account of our experiences modifying first the GFS and more recently the UFS.

CSAW

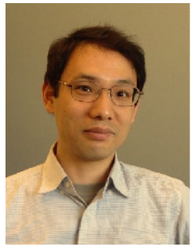
The Chikira-Sugiyama (CS) parameterization has multiple updraft types, a state-dependent entrainment rate, and a prognostic closure.

CS was first tested in MIROC by Chikira and Sugiyama.

We modified CS for use in the scale-aware framework of Arakawa & Wu. The result is called CSAW.

We first implemented CSAW in the GFS with help from Shrinivas Moorthi and others.

Later we implemented it in the UFS, using the Common Community Physics Package (CCPP).



Minoru Chikira

Masahiro Sugiyama

Akio Arakawa

Chien-Ming Wu

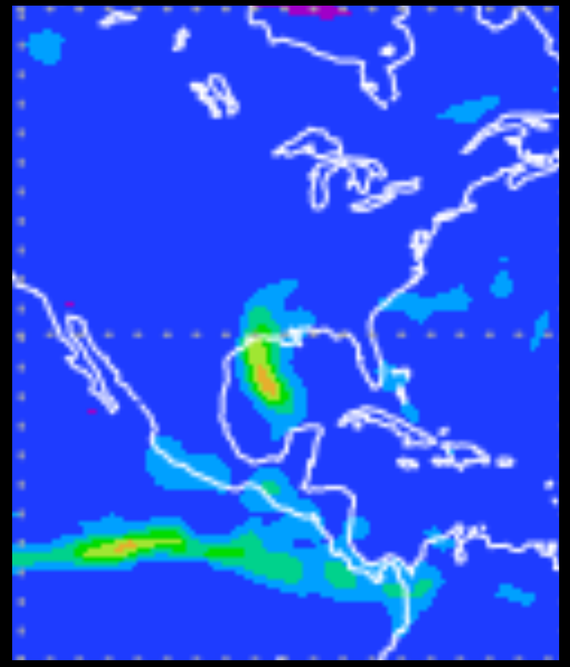
We will show results from the UFS with C96 (~100 km grid spacing) and 64 levels, of which ~35 are in the troposphere.

Harvey 120 hr forecasts from 22 August

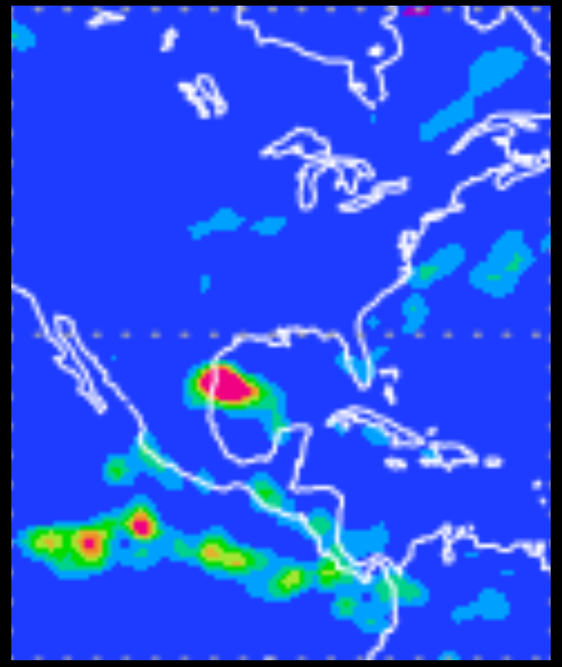
Run on Hera

Total precipitation rate

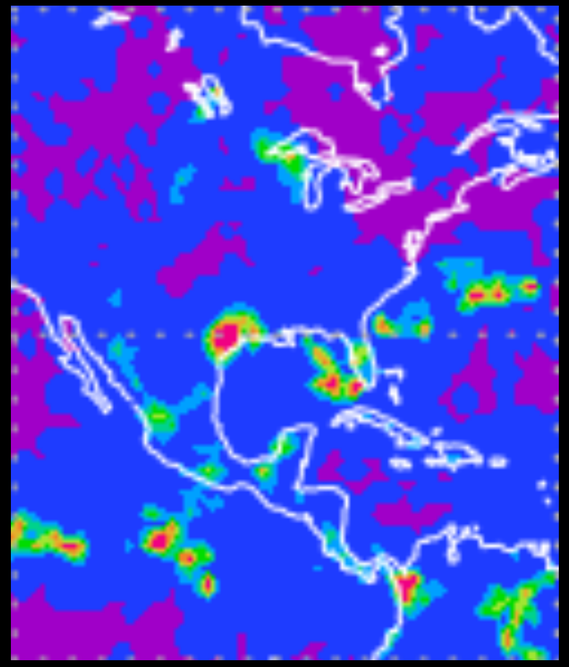
Control, UFS with GFS_v15p2



Experiment, UFS with CSAW



Obs, GPM



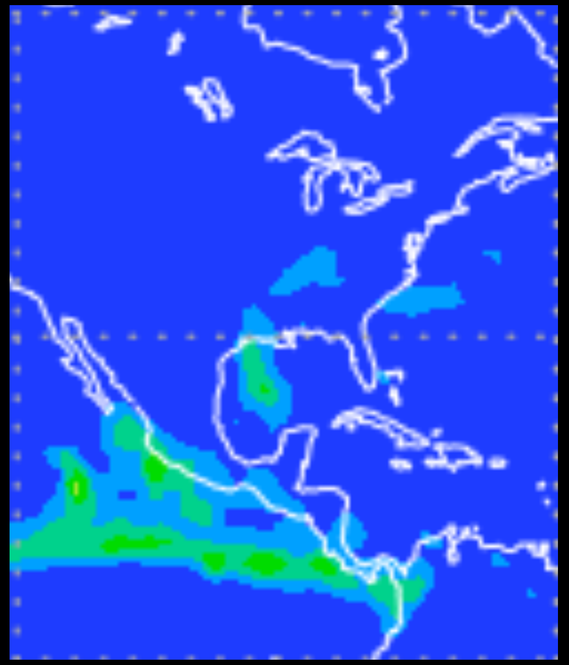
mm day^{-1}

Harvey 240 hr forecasts from 22 August

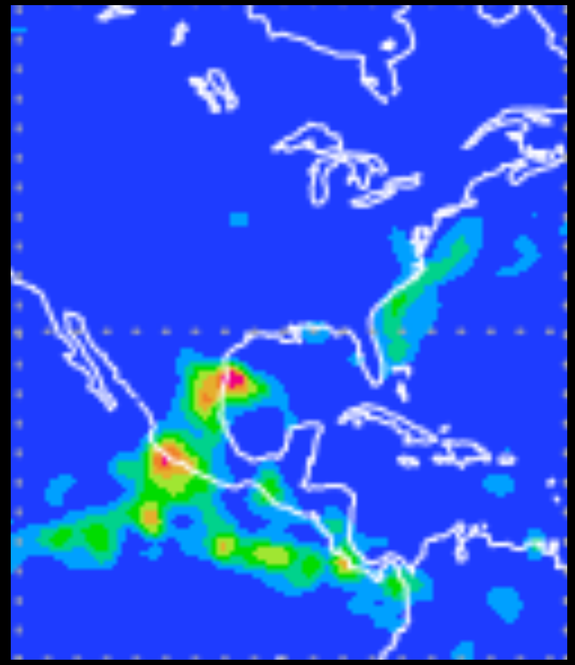
Run on Hera

Total precipitation rate

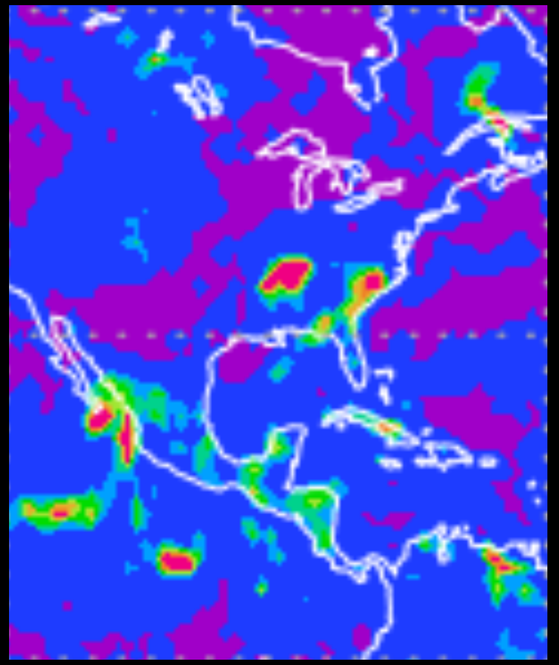
Control, UFS with GFS_v15p2



Experiment, UFS with CSAW

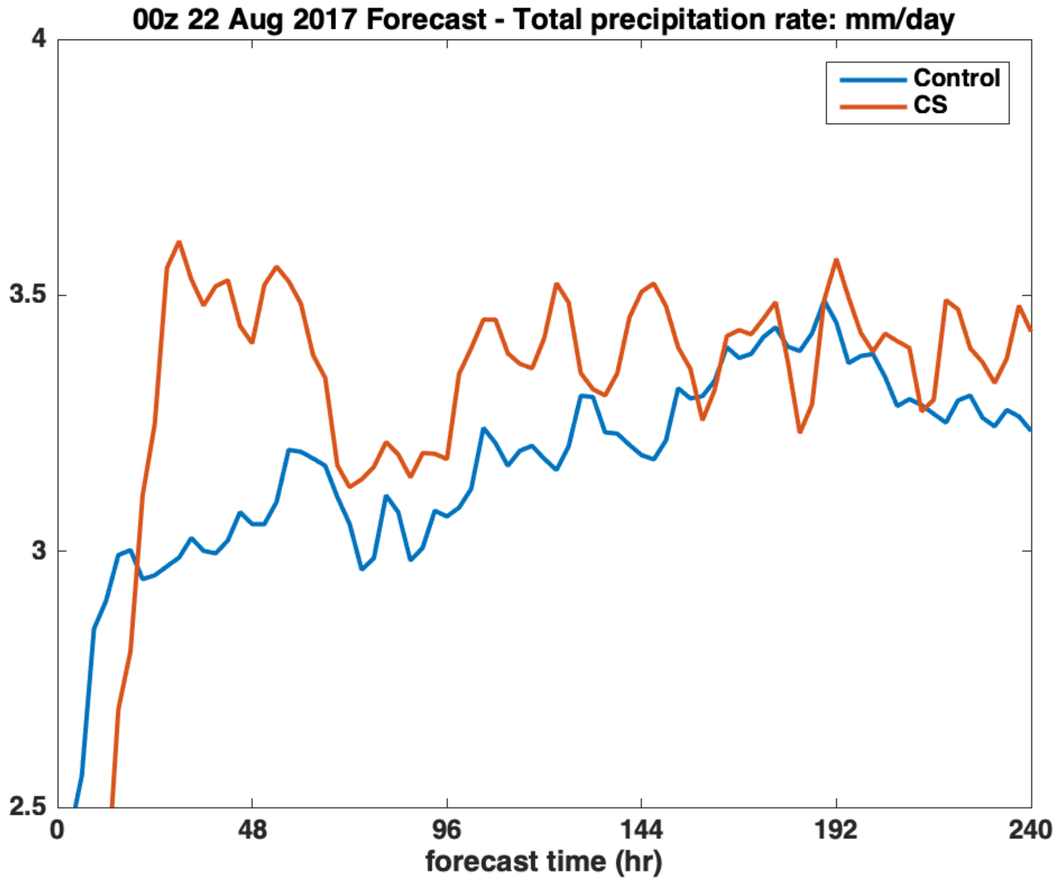


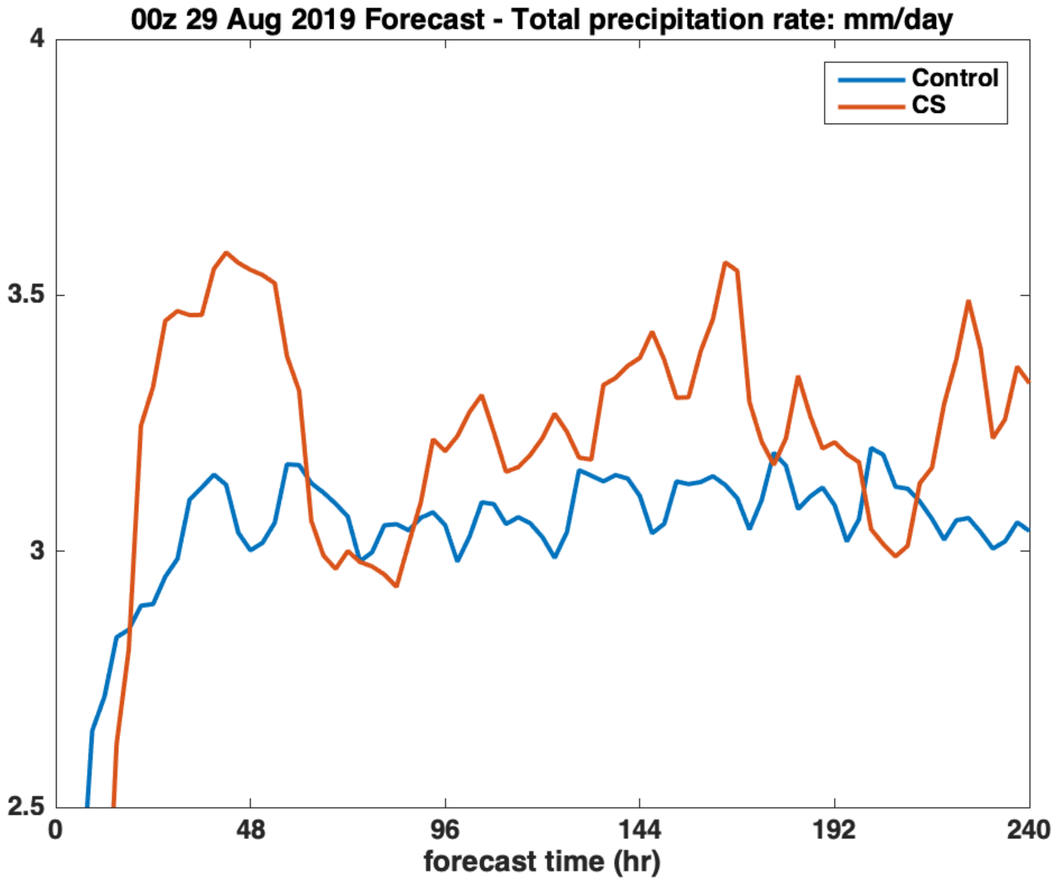
Obs, GPM



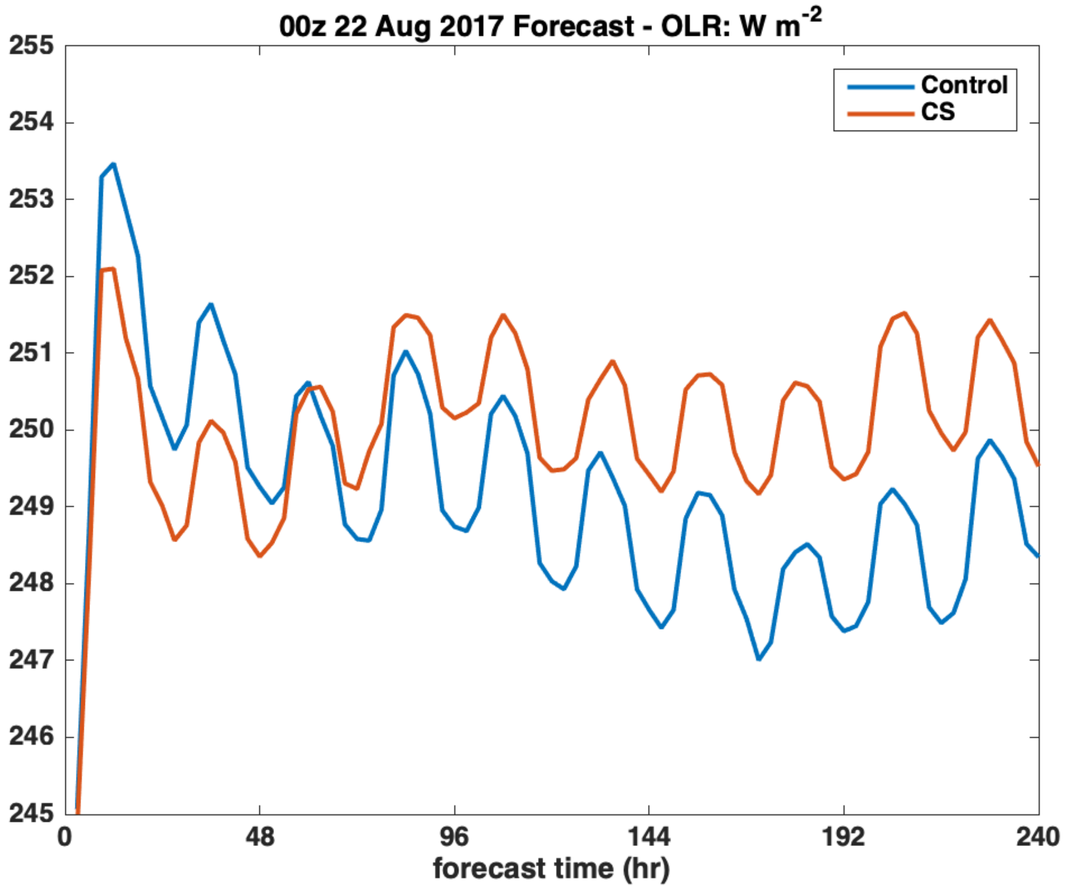
mm day^{-1}

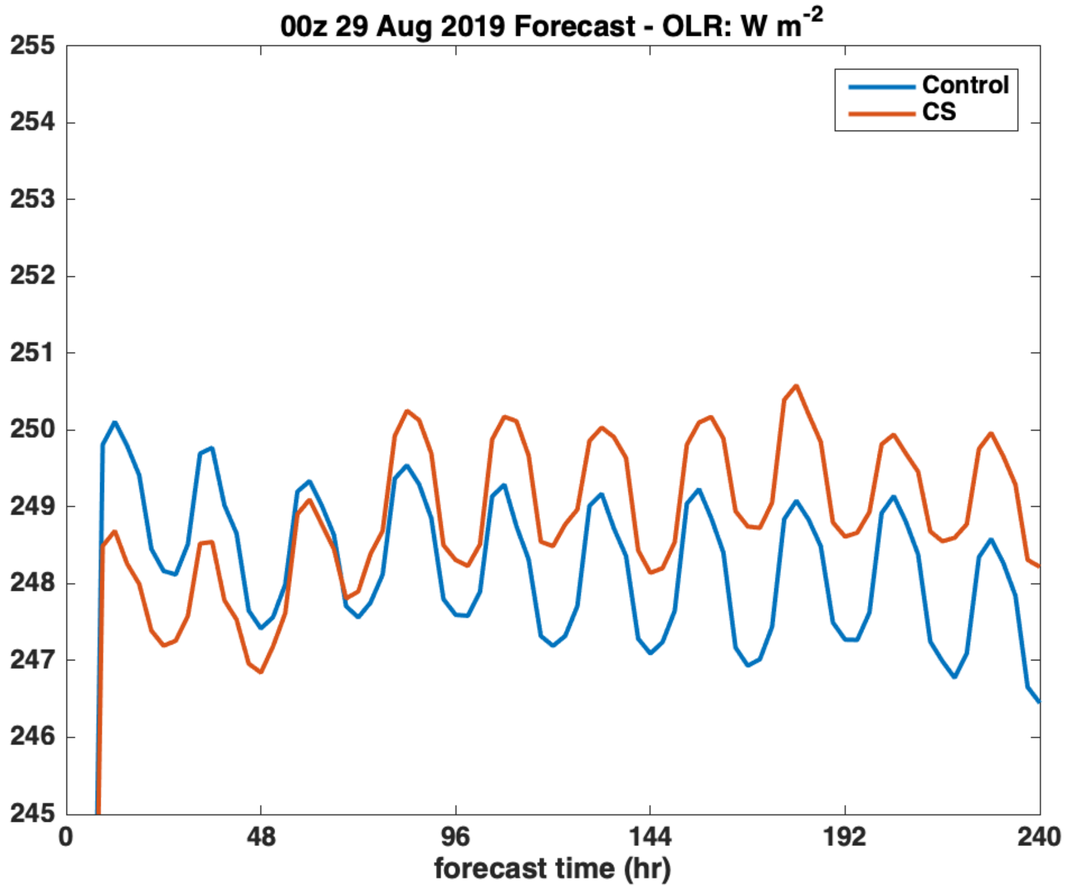
Precipitation Spin-Up





OLR


00z 22 Aug 2017 Forecast - OLR: W m-2
Control
CS
255
254
253
252
251
250
249
248
247
246
245
0
48
96
144
192
240
forecast time (hr)


00z 29 Aug 2019 Forecast - OLR: W m-2
Control
CS
255
254
253
252
251
250
249
248
247
246
245
0
48
96
144
192
240
forecast time (hr)

Multi-Instance Super-Parameterization

We implemented super-parameterization first in the spectral GFS, and later in the FV3 version of GFS.

We are now in the process of installing it in the UFS, using CCPP.

Advective Forcing

Heating & Drying

Parameterized

Convection
Microphysics
Radiation
Turbulence

Advective Forcing

Heating & Drying

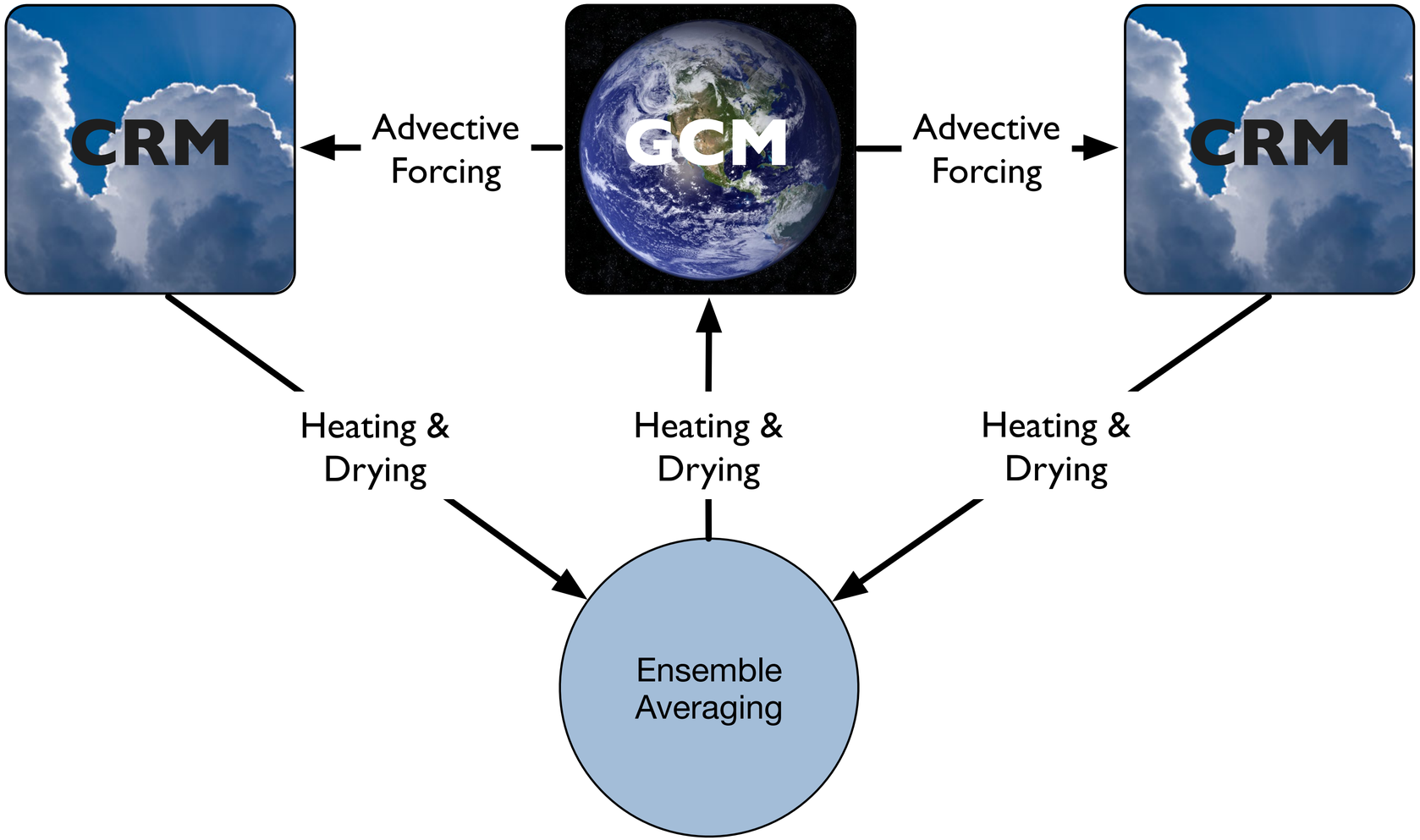
Advective Forcing

Heating & Drying

Parameterized

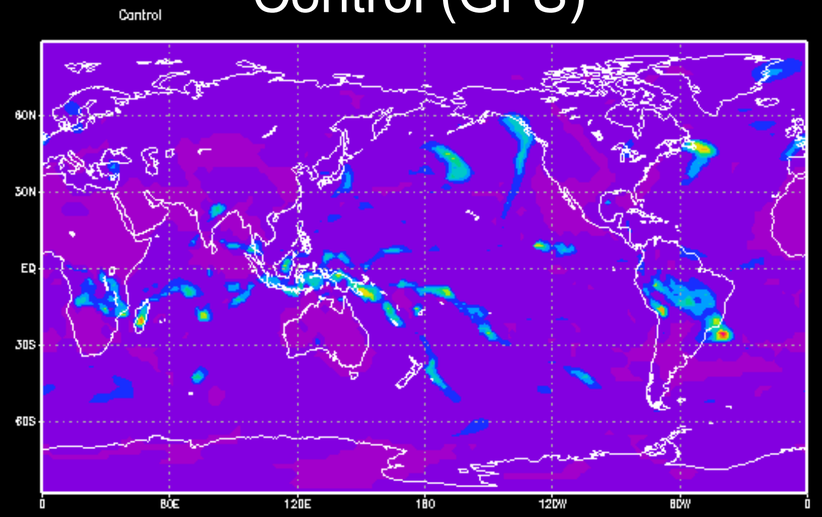
Microphysics
Radiation
Turbulence

Super-Parameterization

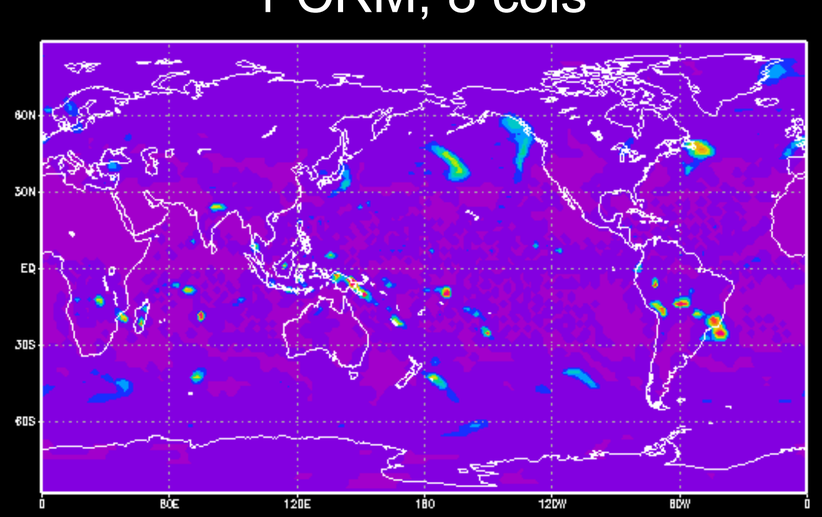

CRM
Advective Forcing
GCM
Advective Forcing
CRM
Heating & Drying
Heating & Drying
Heating & Drying
Ensemble Averaging

Total precipitation rate

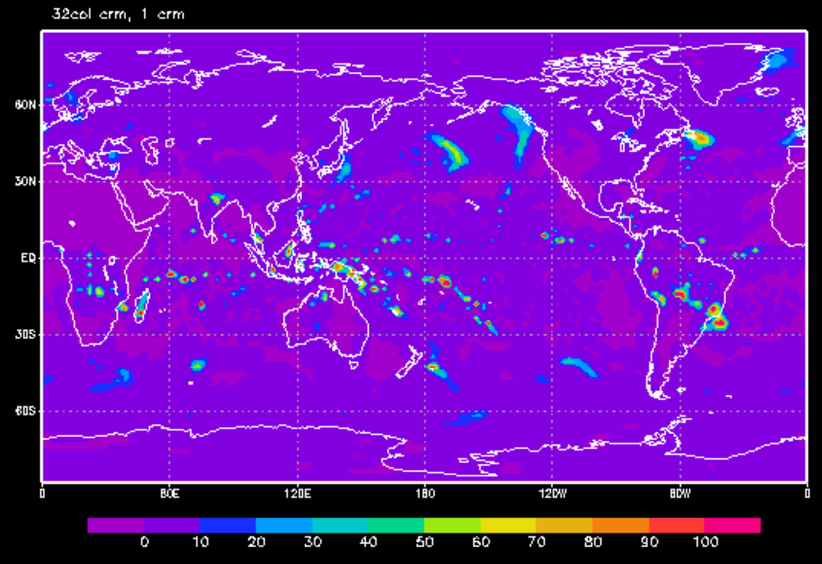
Control (GFS)



1 CRM, 8 cols

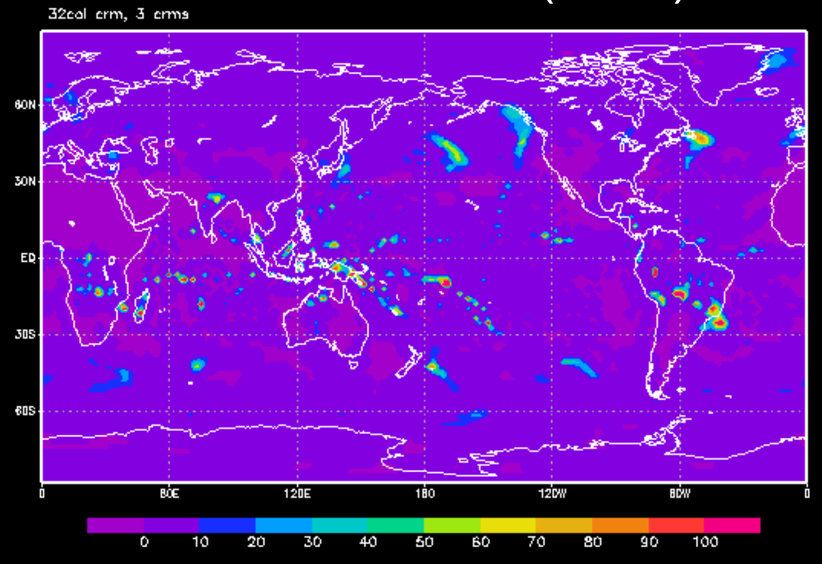


1 CRM, 32 cols



mm day^{-1}

3 CRMs, 32 cols (each)



mm day^{-1}

Conclusions

We have run the UFS with CSAW on Hera and Cheyenne. On both machines the setup was straightforward and we had results within half an hour of checking out the code.

CIME is orders of magnitude easier to work with than the old GFS scripts.

We implemented CSAW in the UFS via CCPP. We are currently implementing SP in the UFS using CCPP. It's been a good experience so far.

We want to be able to use the UFS to do runs with climatological SSTs, and also AMIP runs, if possible before the S2S release. Grant Firl, Dom Heinzeller and Ligia Bernadet have been helping us, and we are getting there.


Thanks