Plans for ***global*** high-resolution using CAM

Other efforts
NASA
GFDL

Goals
Better seasonal means?
Regional predictions?
Better statistics/extreme events?

Parameterization Issues
Evaluation and tuning

Proposal: …

Plans for ***global*** high-resolution: **Other efforts**

NASA/GMAO

FV dycore on cubed sphere grid, - 14, 10, 7 and 3.5-km resolutions, 10-day runs at 3.5-km and longer runs monthly to seasonal at 7- to 10-km, and a series of year-long runs at 14-km. ***Nonhydrostatic core*** for resolutions finer than 14 km. Projecting "operational" use at 14 km soon.

Physics: Stochastically-modulated RAS, prognostic clouds, Lock PBL,

GFDL

FV dycore on cubed sphere grid 50, 25, 12, and 5-km resolutions. AR5 timeslices with 25 km resolution later this year. NWP runs at 12 km.

Physics: HIRAM *(Tuned for hurricane climatology, Zhao et al. 2009)* modified UW shallow convection, no deep scheme. (Clouds use diagnostic PDF - SA Klein).

Running coupled with AM2 physics at 50 km - "looks pretty good" except for tropical cyclones

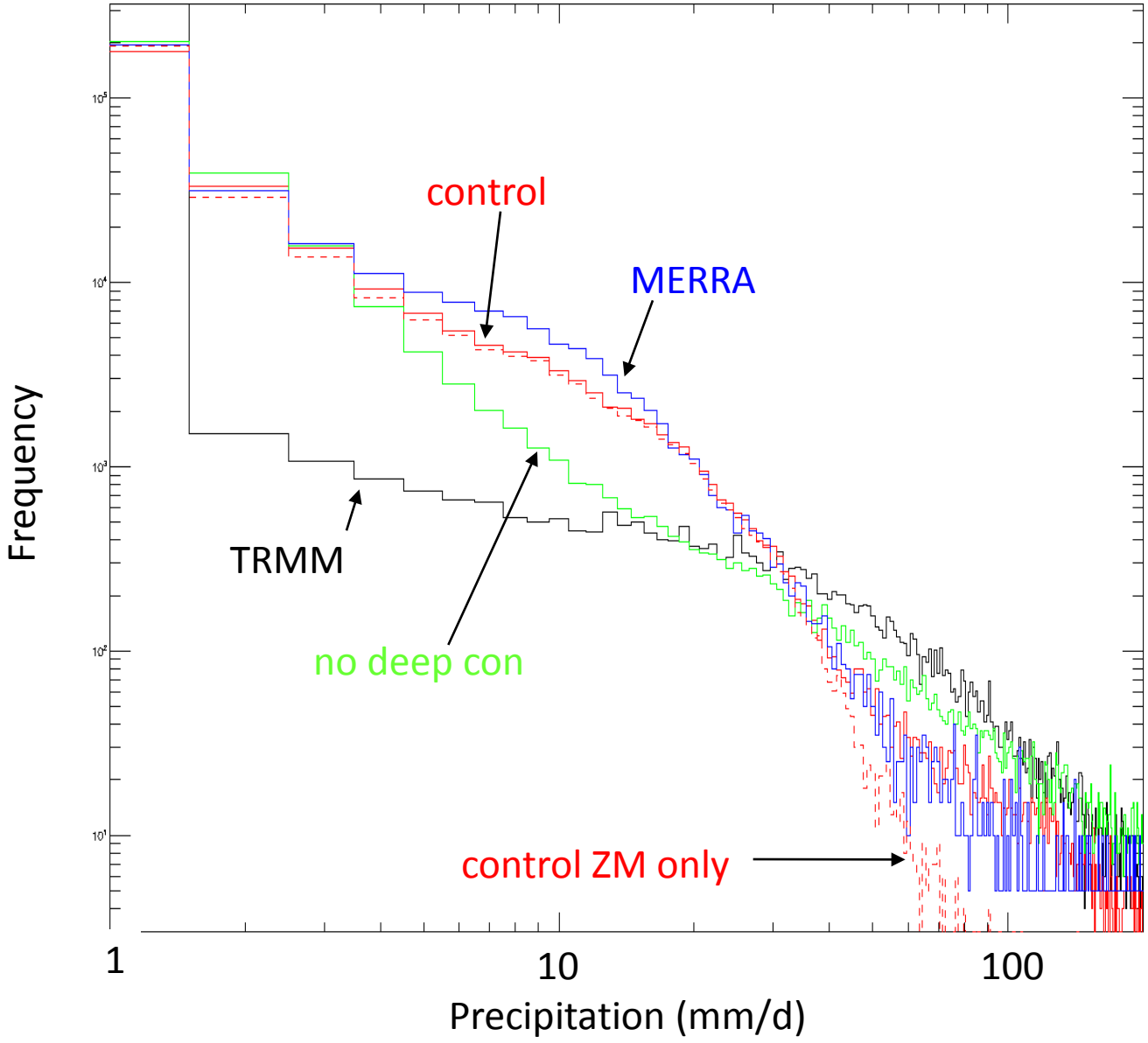
Plans for ***global*** high-resolution using CAM: **Goals**

High frequency Statistics
Precipitation intensity and timing

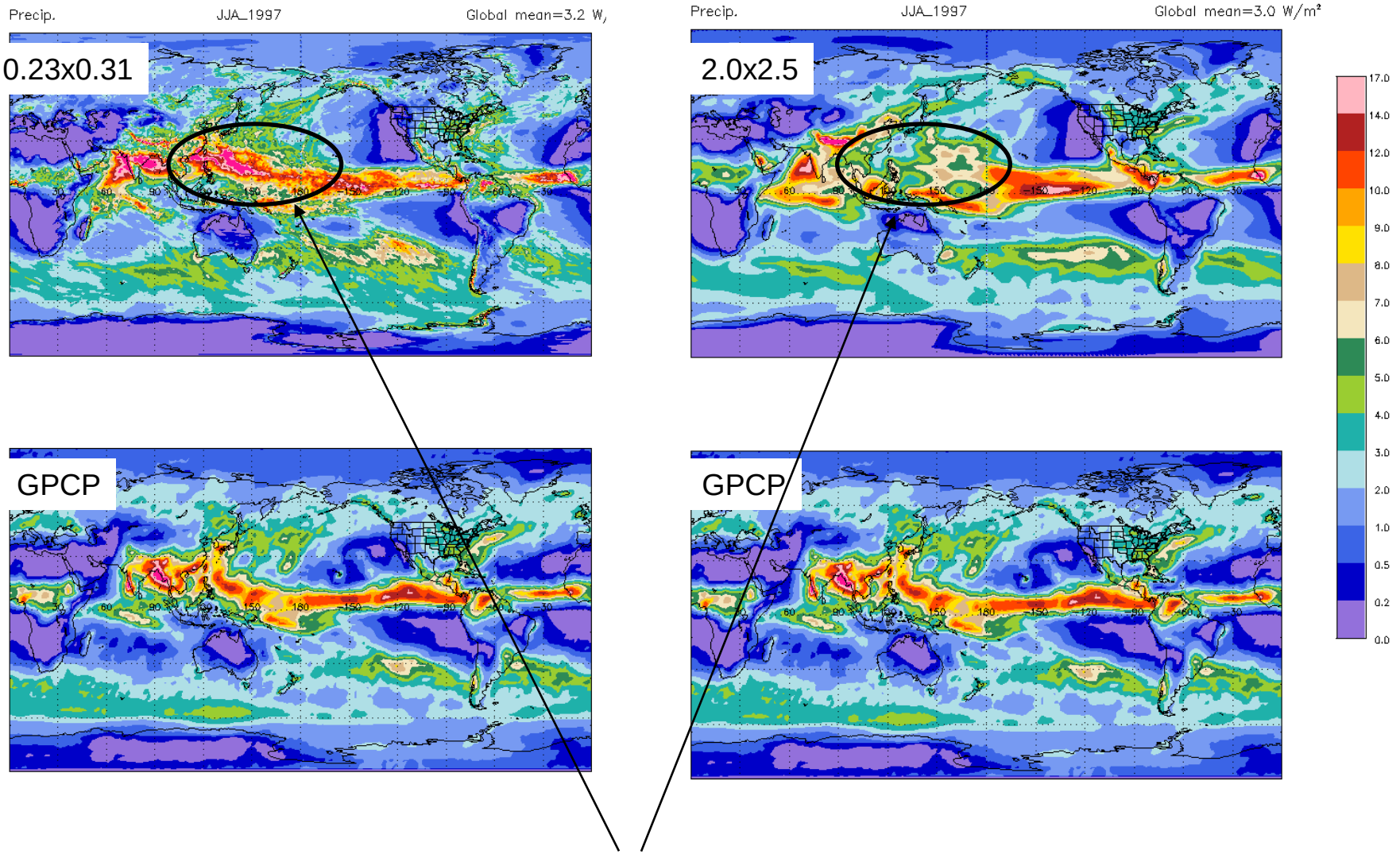
Improved Seasonal Means in Global Simulations
Probably requires retuning of convection and GW schemes at a minimum

Specific phenomena/Regional climate
-Typhoon, hurricane climatologies
-Midwest MCCs
-Continental diurnal cycles
-Coastal upwelling regimes

PDFs of precipitation intensity (log-log) 30S - 30N



Seasonal Mean precipitation JJA 1997



A real seasonal mean difference/improvement due to increased resolution!!!

Plans for ***global*** high-resolution using CAM:
Parameterization Issues

Deep Convection
More intermittency seems required. Tuning of this could probably take place in CAPT framework

Gravity Waves
Difficult. Direct global observations of key quanitity ($\rho u'w'$) not available. Climate effects (Psfc , U_{200}) require multiple seasons to establish with confidence.
-Cross-grid effects
-resolved vs unresolved (for orographic, convective, frontal sources)

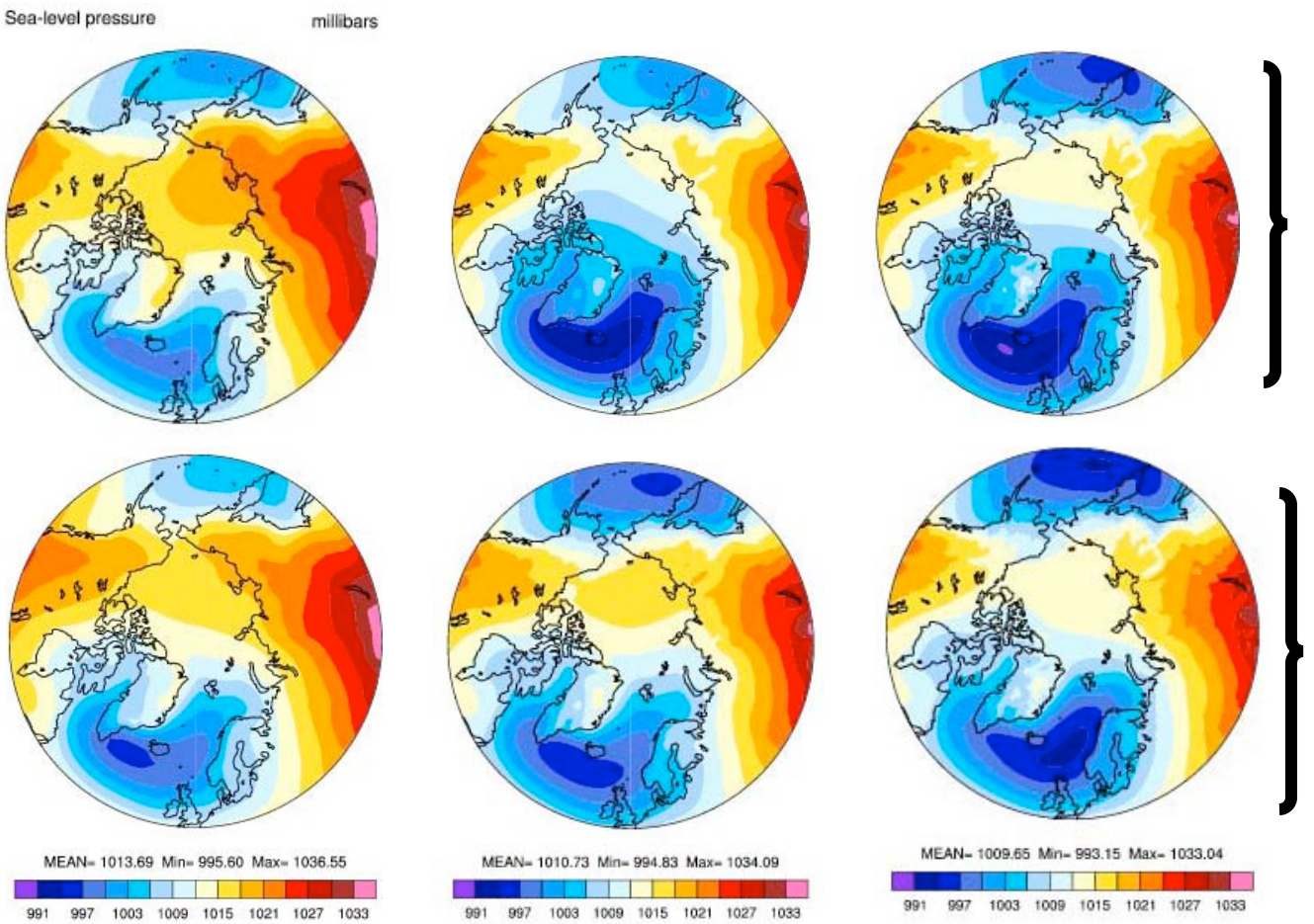
Shallow convection/PBL
No special concerns as DX~10 km

TOA balances/Coupled tuning /Aerosols ...

Sea-level pressure

CAM3.5 (DJF zonal average over years 2-11)

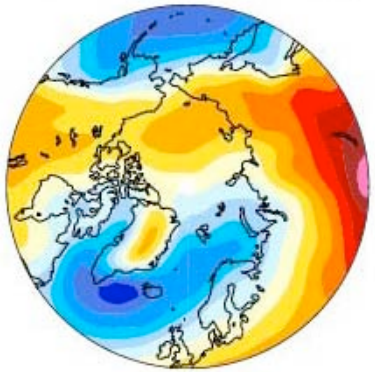
2 degree **1 degree** **0.5 degree**



Div2

Del2

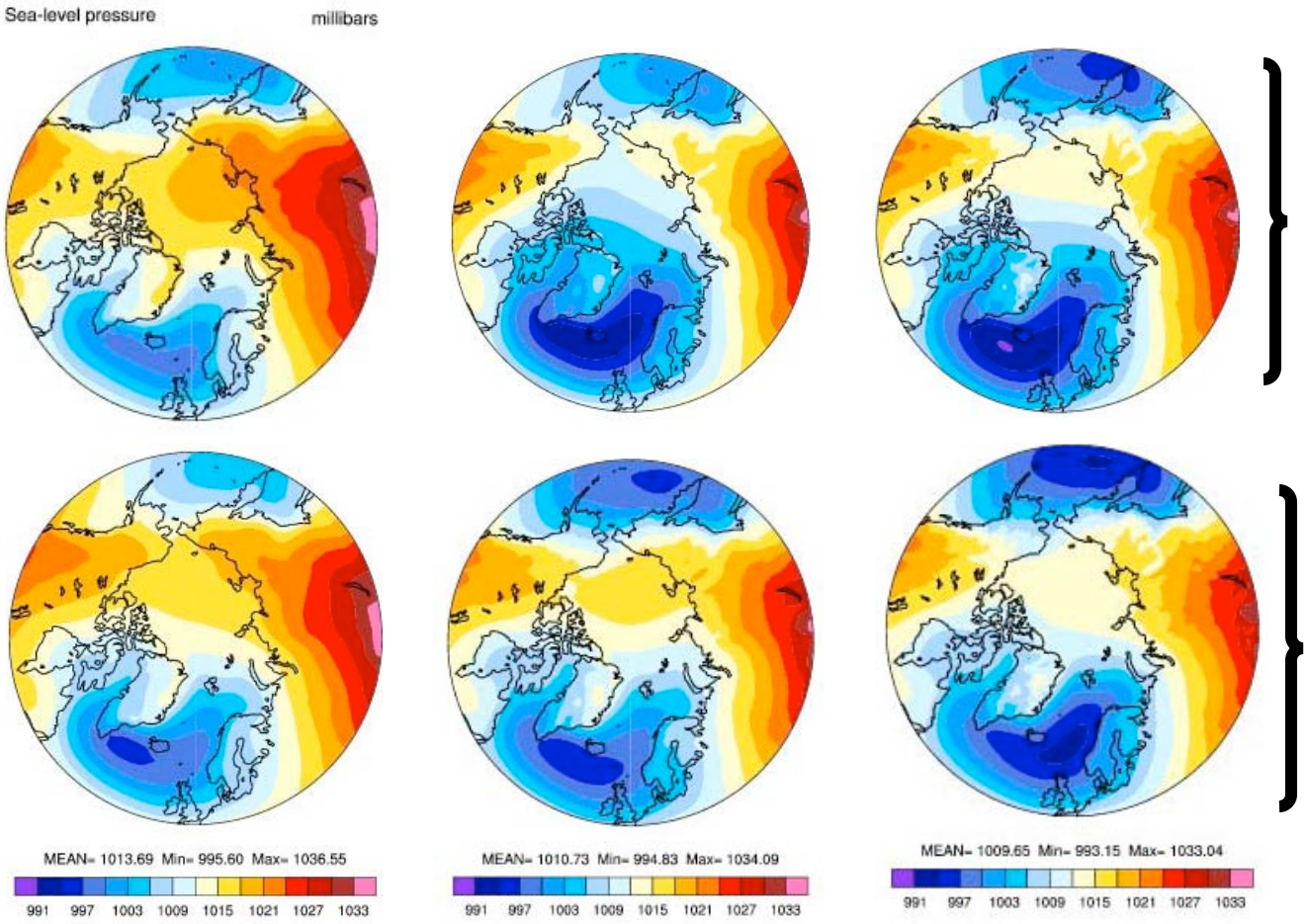
NCEP



Sea-level pressure

CAM3.5 (DJF zonal average over years 2-11)

2 degree **1 degree** **0.5 degree**

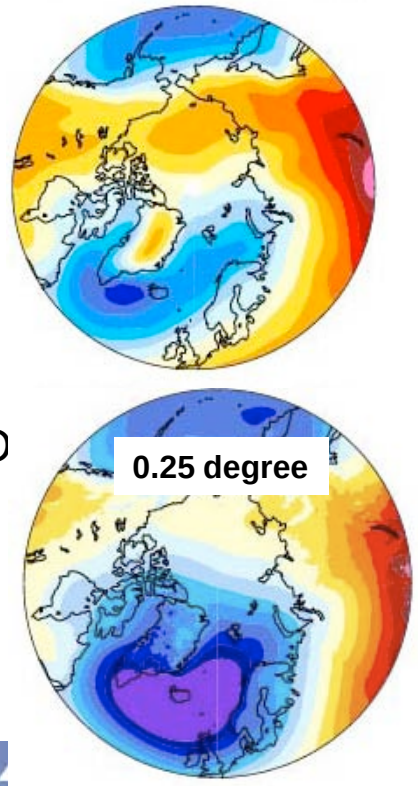


Div2

NCEP

D

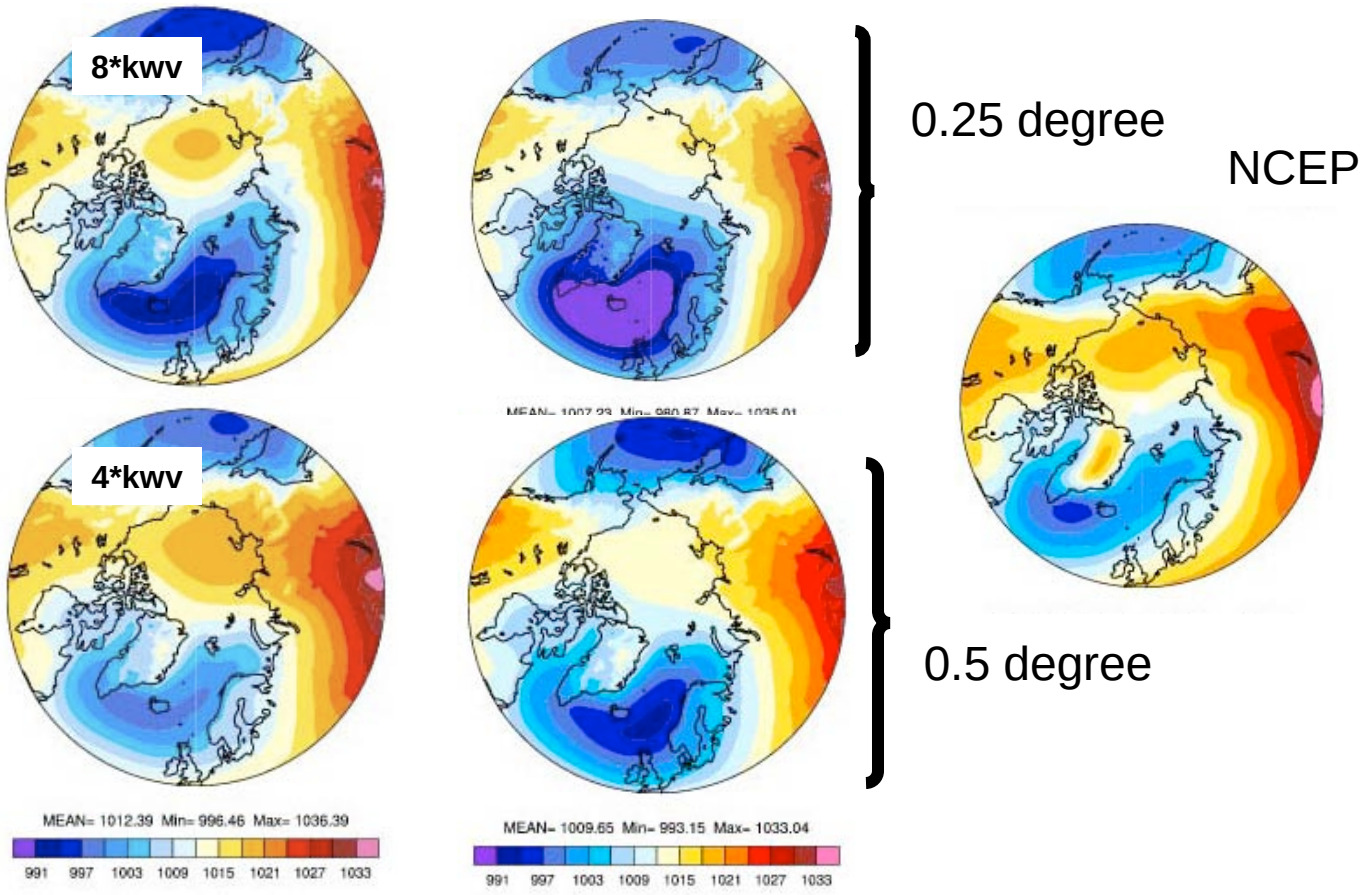
0.25 degree



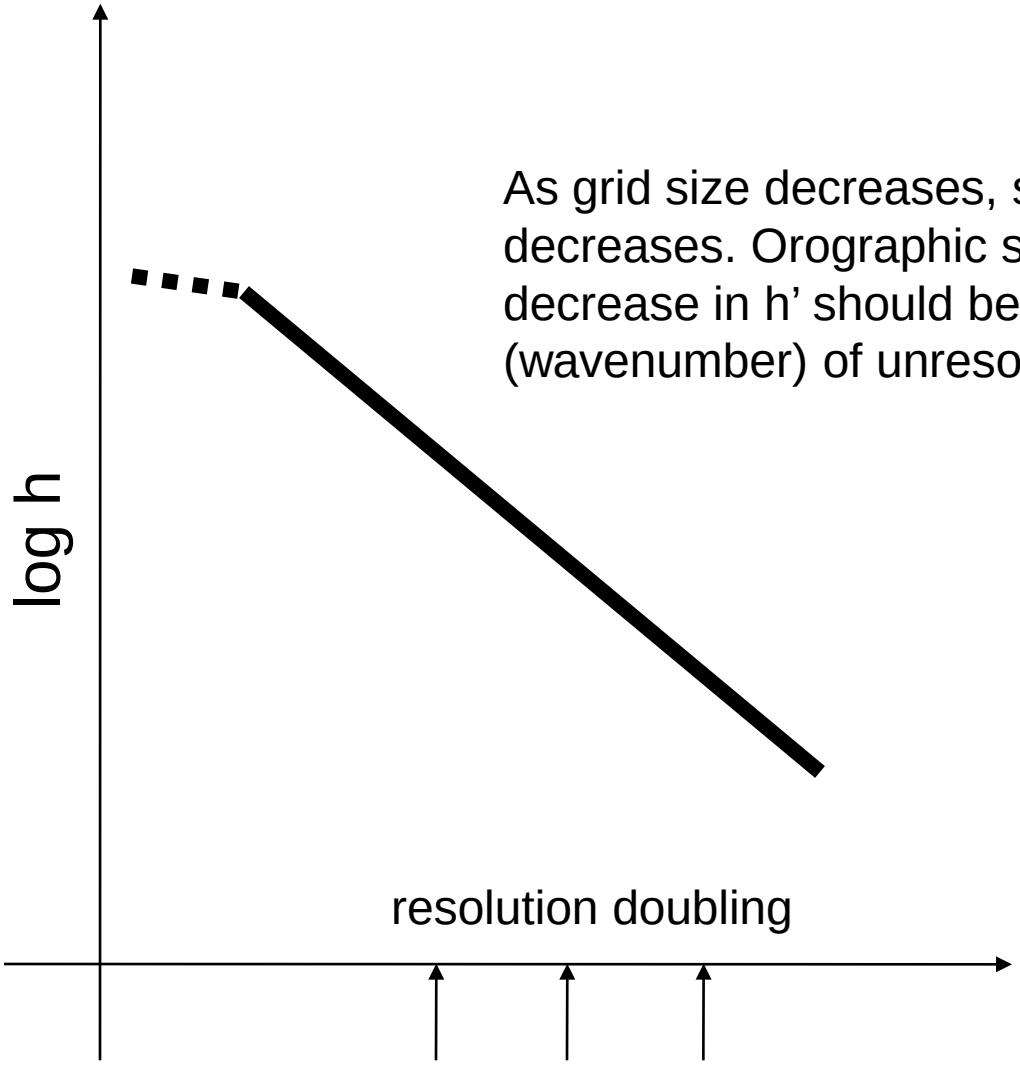
Sea-level pressure

CAM3.5 (DJF zonal average over years 2-11)

“Appropriately re-tuned” GW **Std GW**



Power law spectrum for topographic heights



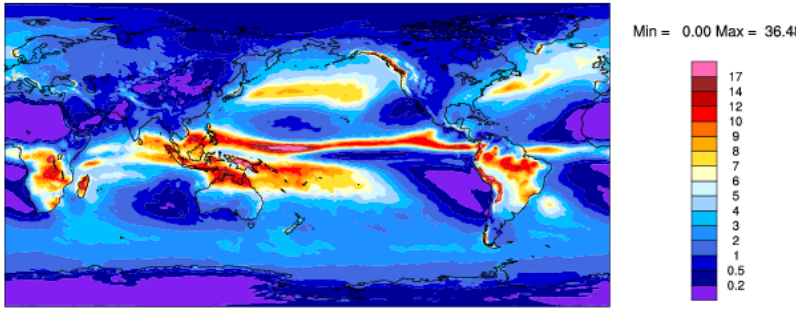
As grid size decreases, subgrid orographic variance h' decreases. Orographic stress $\rho u'w' \sim \rho NUkh'^2$ so decrease in h' should be partially offset by increased k (wavenumber) of unresolved waves.

Unfortunately, even at 0.25 we aren't finished with orographic GW tuning

fvdd128_13_13_128_2_1664tr351hi603E5NCdel2 (yrs 2-11)

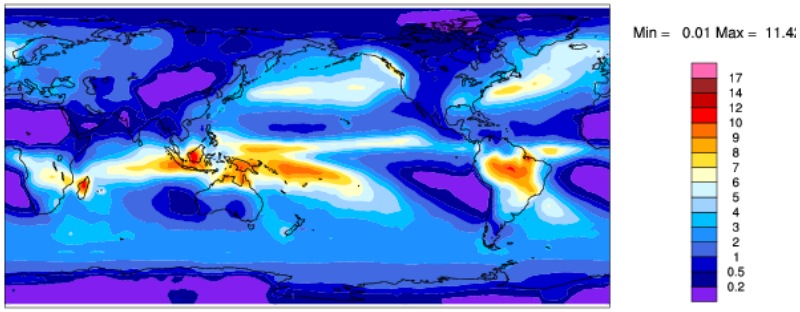
DJF

Precipitation rate mean= 2.96 mm/day



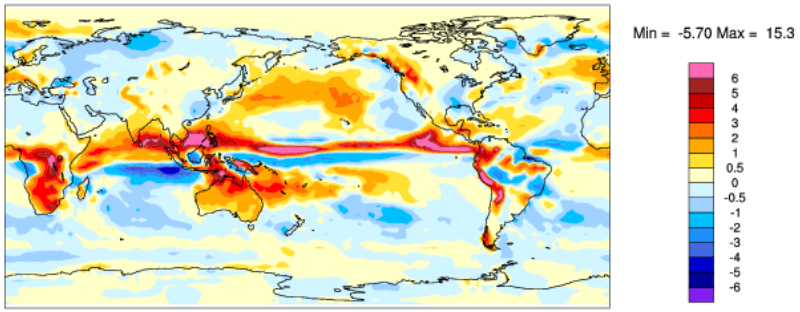
GPCP

Precipitation rate mean= 2.61 mm/day



fvdd128_13_13_128_2_1664tr351hi603E5NCdel2 - GPCP

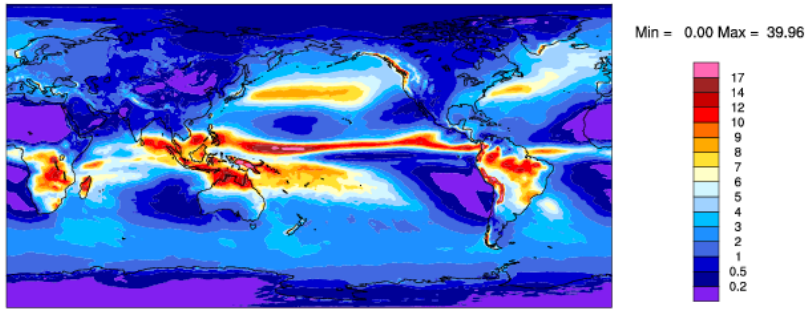
mean = 0.35 rmse = 1.52 mm/day



fvdd128_13_13_128_2_1664tr351hi603E5del2kwv (yrs 2-11)

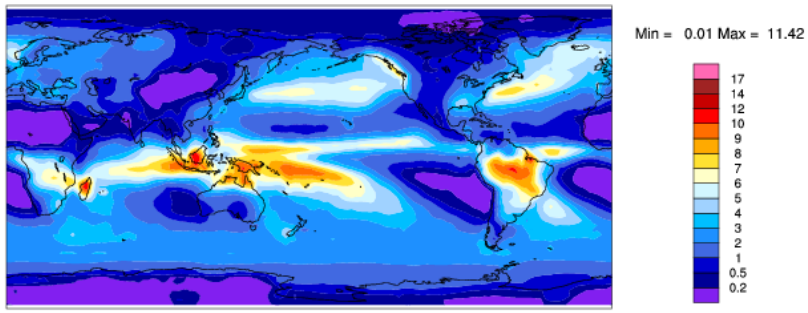
DJF

Precipitation rate mean= 2.95 mm/day



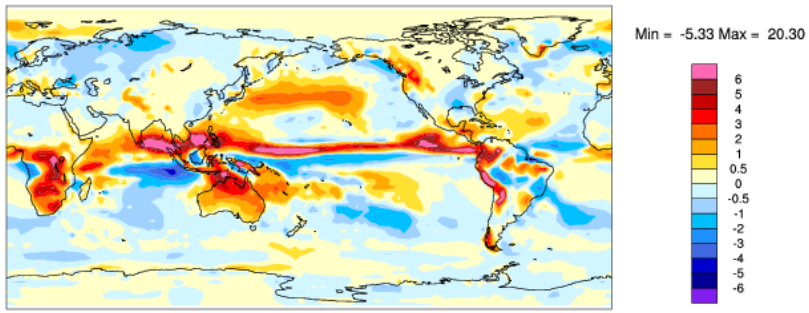
GPCP

Precipitation rate mean= 2.61 mm/day



fvdd128_13_13_128_2_1664tr351hi603E5del2kwv - GPCP

mean = 0.34 rmse = 1.52 mm/day



Plans for ***global*** high-resolution using CAM: **Proposed *short term* plan**

Scalable Dycore (HOMME, MPAS) + CAM5 physics with minor mods.

Concrete Goal: Good typhoon/hurricane climatology (as honestly as possible)

Deep Convection
Stochastic or other grid dependent inhibition applied to ZM/NR and/or modified UW scheme. Org variable?

Prescribed aerosol option

Plans for ***global*** high-resolution using CAM: **How to stay honest**

CAPT runs
Current problems in convection statistics show up immediately. Improve things in CAPT mode first.

Satellite radiance simulators (e.g. COSP)
CAPT results compared versus high resolution satellite data in case-study mode.
YOTC data sets (Hi res analyses satellite data sets)

Doubly-periodic CAM configuration with idealized forcing for physics testing at high resolutions (quasi-CRM).

Gravity Waves

Catch up with WACCM
Frontal,, convective sources

High resolution/future version
Less arbitrary orographic forcing – anisotropy? Replace TMS with blocking and non-local (e.g. Beljaars) stress

Horizontal non-locality??

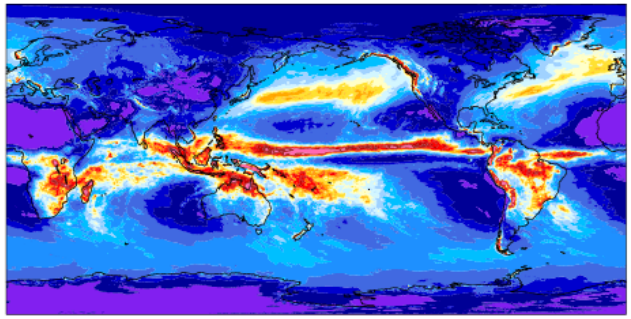
Novel Validation ideas?
Test in doubly-periodic CAM (quasi-CRM)??
High-res satellite data (e.g. AMSU) for T’

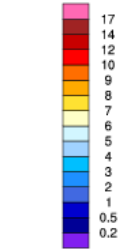
fvee256_7_7_256_2_1792tr351hi603E5NCdel2 (yrs 7-8)

DJF

Precipitation rate mean= 2.99 mm/day

Min = 0.00 Max = 66.27

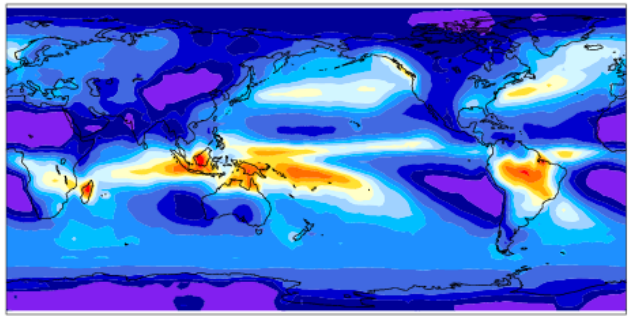


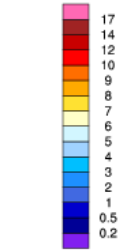


GPCP

Precipitation rate mean= 2.61 mm/day

Min = 0.01 Max = 11.42

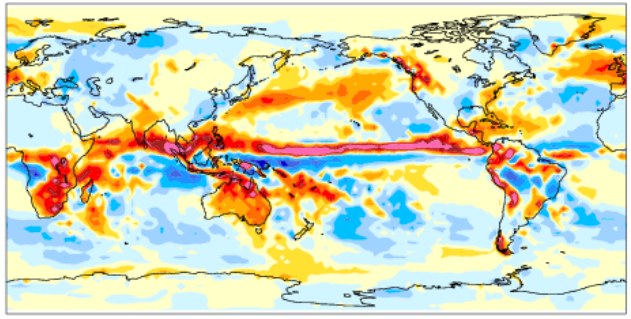


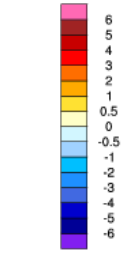


fvee256_7_7_256_2_1792tr351hi603E5NCdel2 - GPCP

mean = 0.38 rmse = 1.92 mm/day

Min = -4.97 Max = 47.44



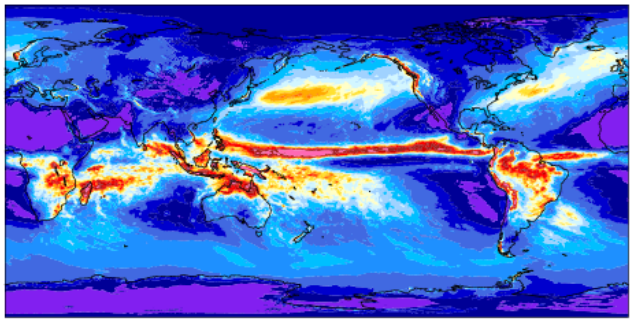


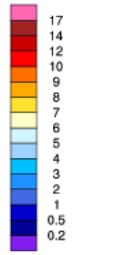
fvee256_7_7_256_2_1792tr351hi603E5NCdel2kwv (yrs 7-8)

DJF

Precipitation rate mean= 2.96 mm/day

Min = 0.00 Max = 68.02

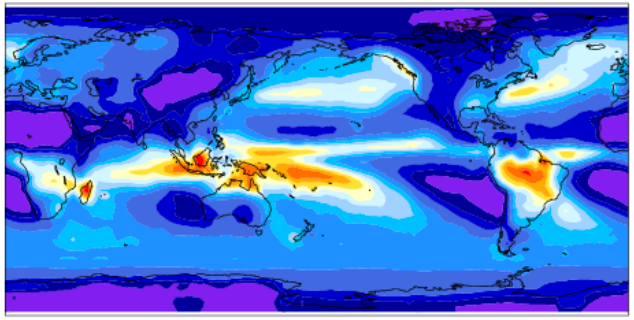


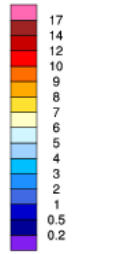


GPCP

Precipitation rate mean= 2.61 mm/day

Min = 0.01 Max = 11.42

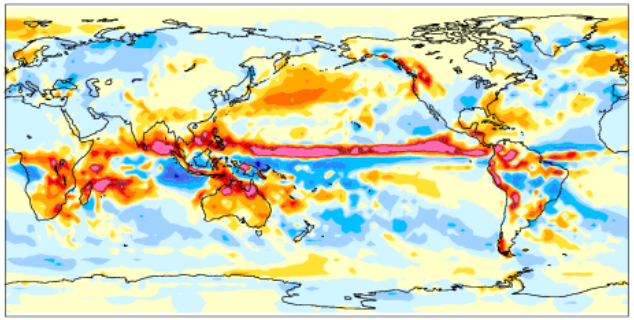


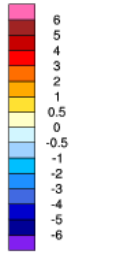


fvee256_7_7_256_2_1792tr351hi603E5NCdel2kwv - GPCP

mean = 0.34 rmse = 1.88 mm/day

Min = -5.66 Max = 48.88





0.25 degree resolution, del2 configuration: U & PSL

CAM3.5 (DJF zonal average over years 7-8; using "spun-up" initial condition from a 6 year del2 run with del2=4e6)

8*kwv | **Del2=3e5** | **Del2=4e5 (years 2-6)** | **NCEP**