EXAMINATION OF THE HIGH RESOLUTION CAM EASTERN TROPICAL PACIFIC PRECIPITATION BIAS VIA CAPT FORECASTS

David Williamson
Sungsu Park

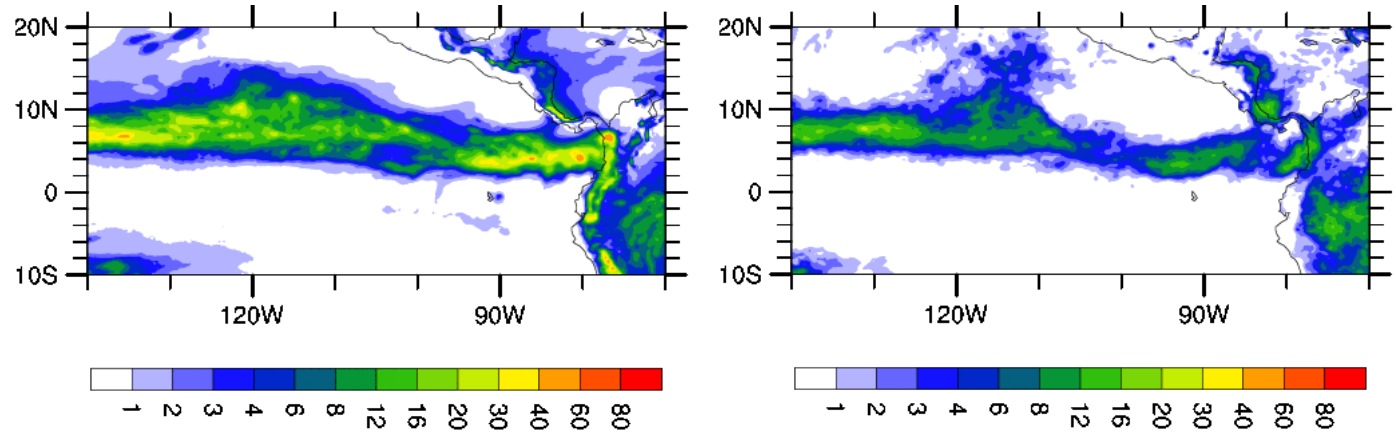
24-HR PRECIPITATION (mm/day)

CLIMATOLOGIY

CAM5

January 2006

TRMM



Standard CAM 5.2

- 0.25 degree Finite Volume Dynamical Core
  - 1 degree physics tuning parameters
  - 15 minute physics time step

5-day forecasts initialized from

- ECMWF YOTC analyses
  - 00Z January 3 to January 24, 2009

Compared to

- Precipitation from 3-hourly 0.25 degree TRMM (3B42)
- State from ECMWF and GMAO YOTC analyses

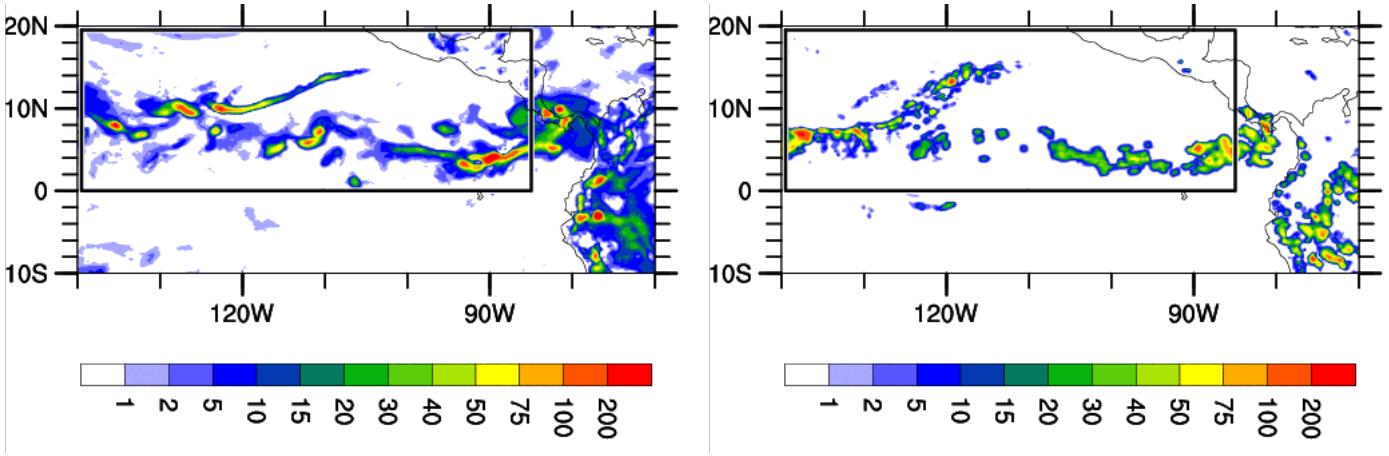
3-HR PRECIPITATION (mm/day)

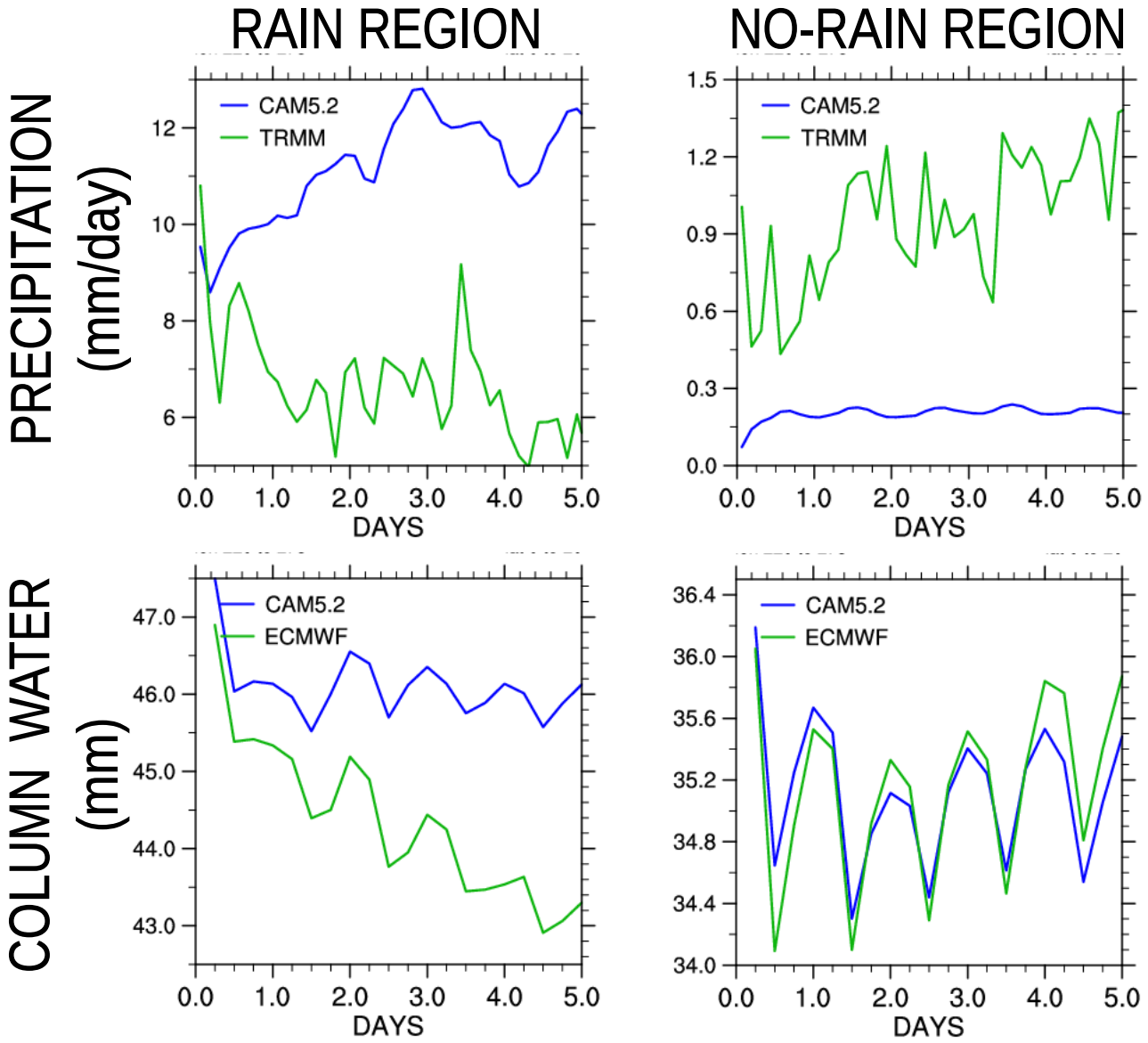
SINGLE FORECAST DAY 5

CAM5.1

TRMM

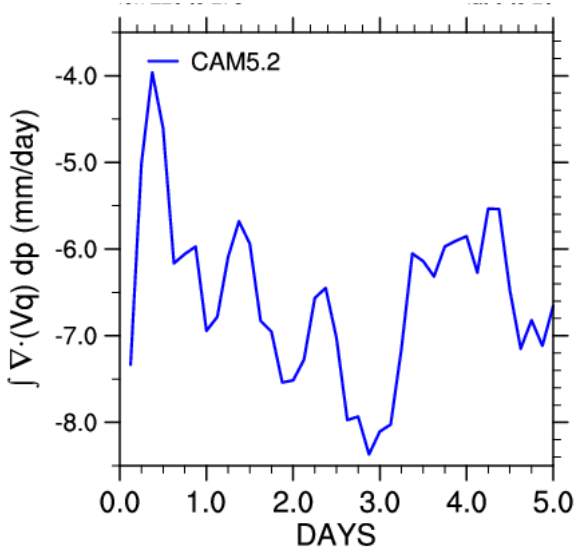
IC = 3 January 2009



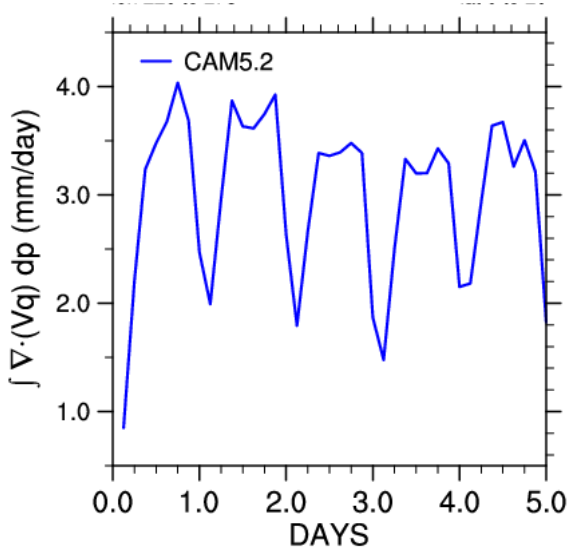

RAIN REGION
NO-RAIN REGION
PRECIPITATION (mm/day)
COLUMN WATER (mm)
CAM5.2
TRMM
ECMWF
DAYS
0.0
1.0
2.0
3.0
4.0
5.0
6
8
10
12
0.0
0.3
0.6
0.9
1.2
1.5
43.0
44.0
45.0
46.0
47.0
34.0
34.4
34.8
35.2
35.6
36.0
36.4

VERTICAL INTEGRAL OF MOISTURE DIVERGENCE (mm/day)

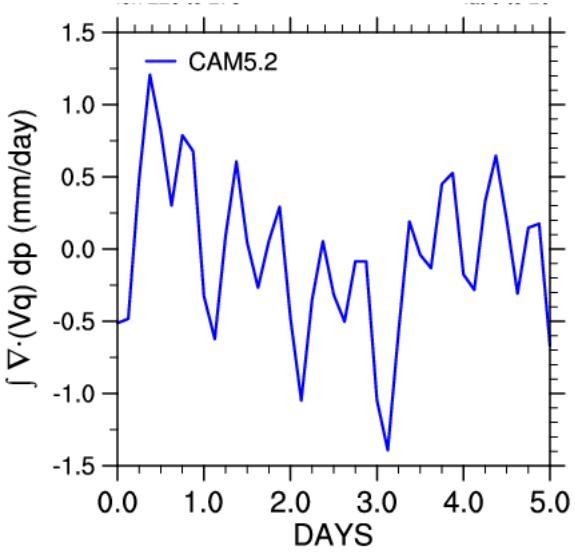
RAIN REGION

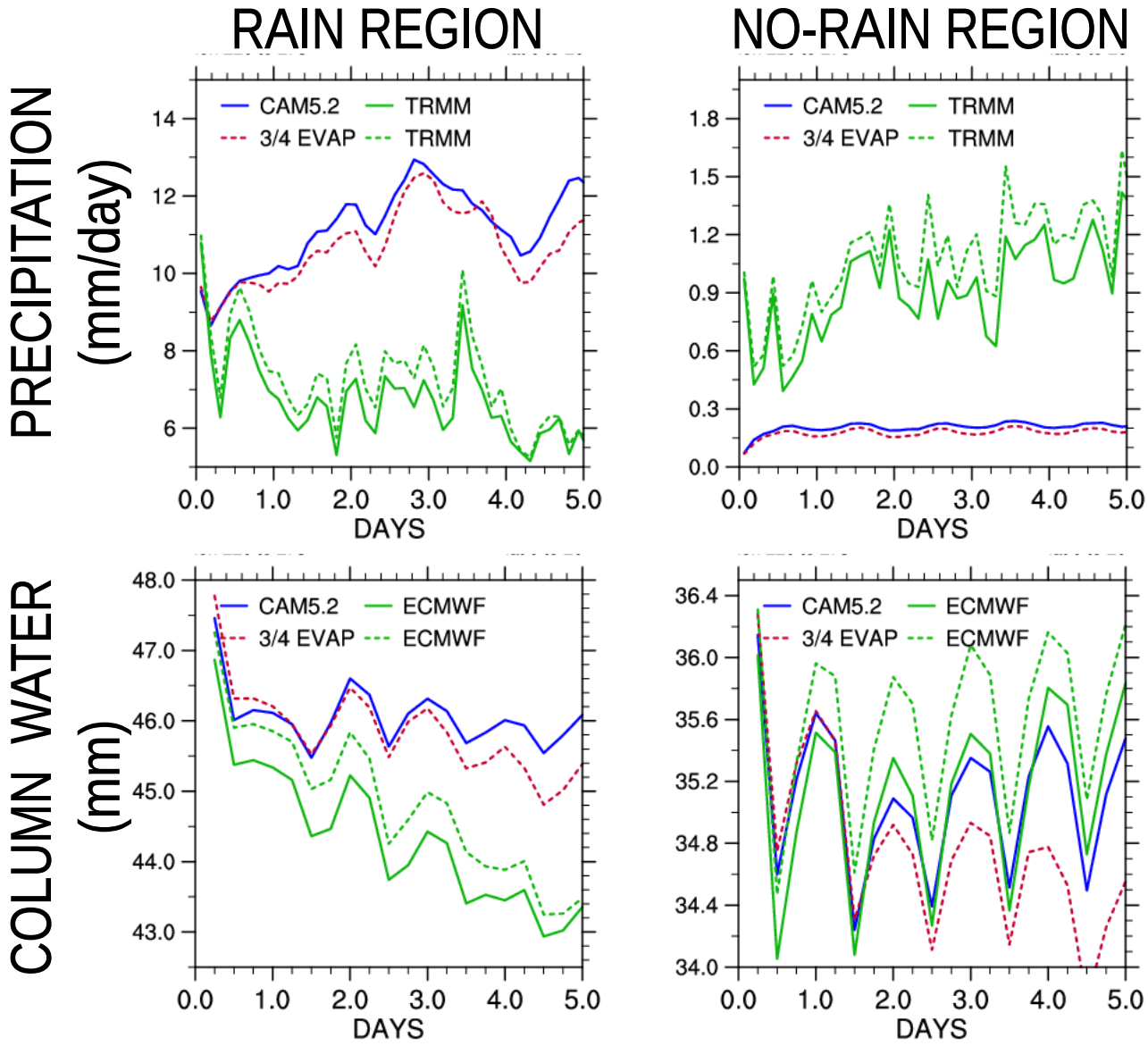


NO-RAIN REGION



TOTAL REGION

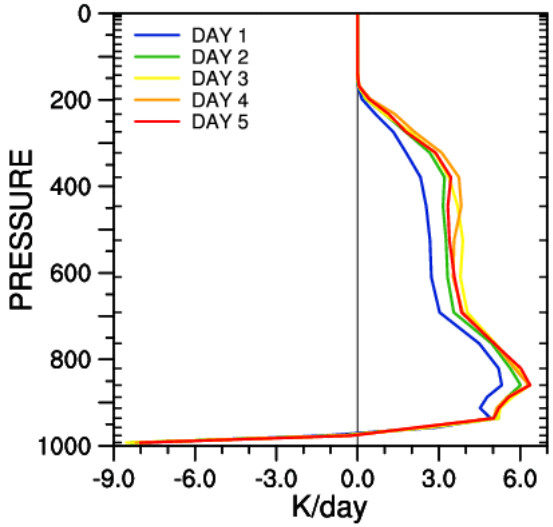



RAIN REGION
NO-RAIN REGION
PRECIPITATION (mm/day)
COLUMN WATER (mm)
CAM5.2
3/4 EVAP
TRMM
ECMWF
DAYS
0.0
1.0
2.0
3.0
4.0
5.0
6
8
10
12
14
0.0
0.3
0.6
0.9
1.2
1.5
1.8
43.0
44.0
45.0
46.0
47.0
48.0
34.0
34.4
34.8
35.2
35.6
36.0
36.4

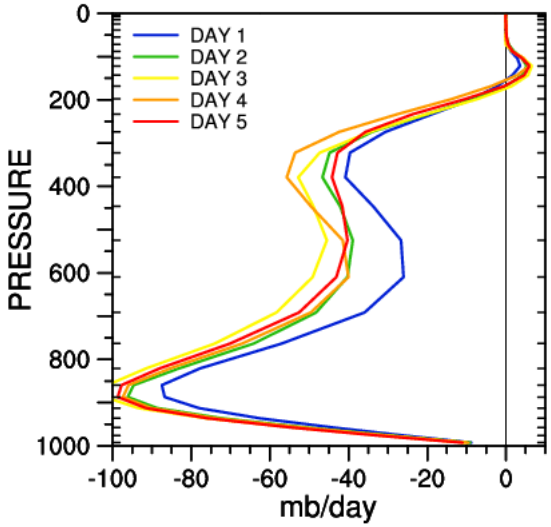
RAIN REGION

CAM5.2

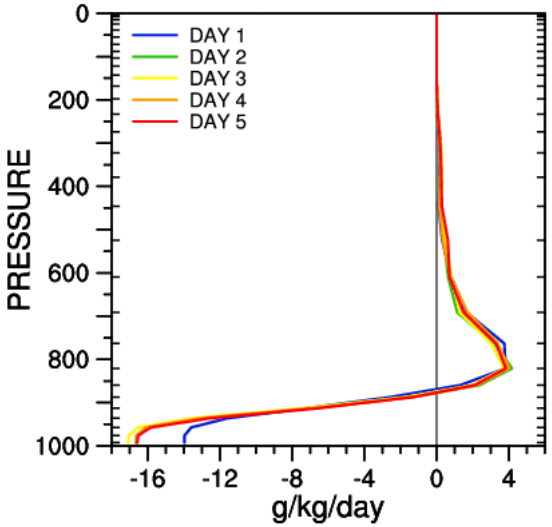
HEATING



OMEGA



qV DIVERGENCE



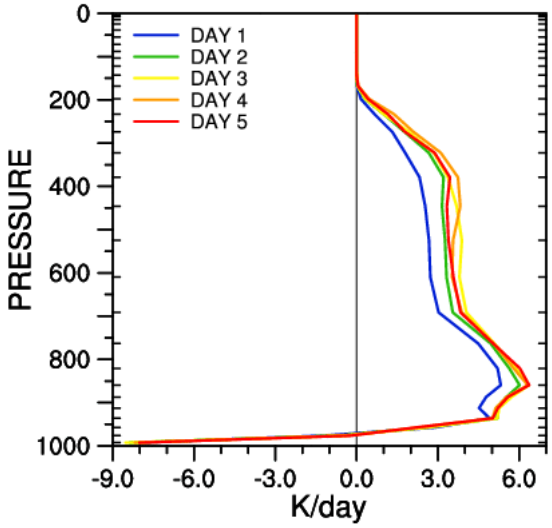
RAIN REGION

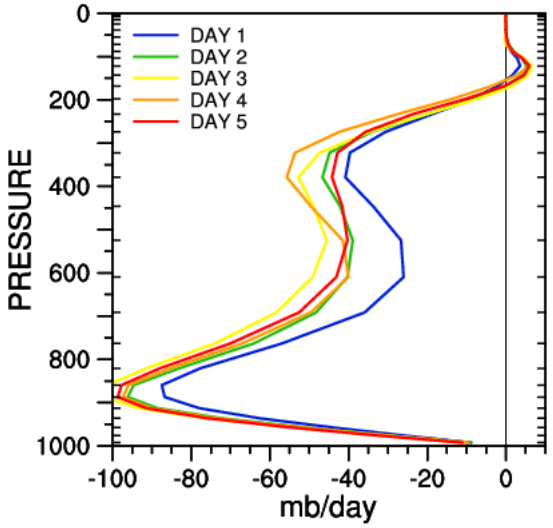
HEATING

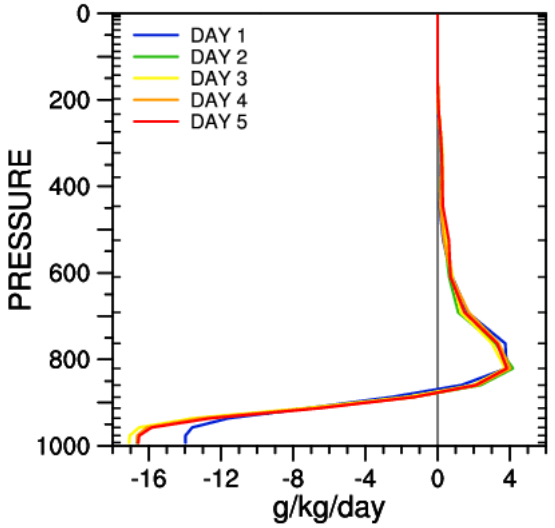
OMEGA

qV DIVERGENCE

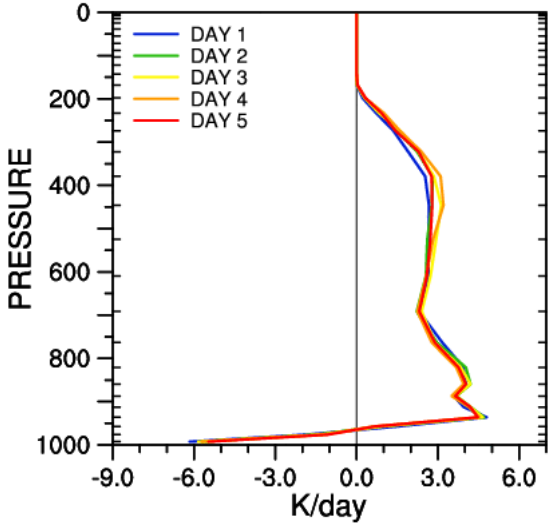
CAM5.2

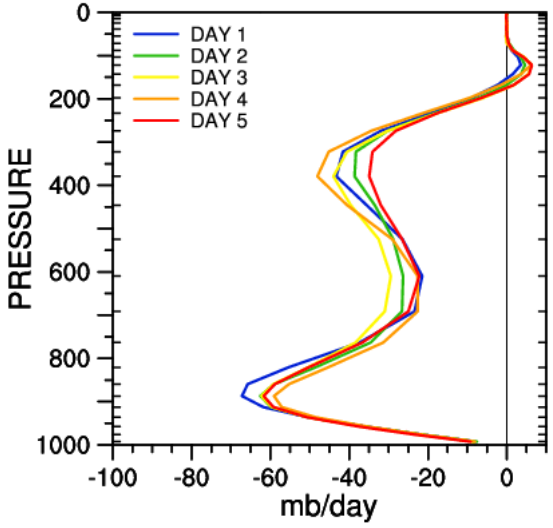


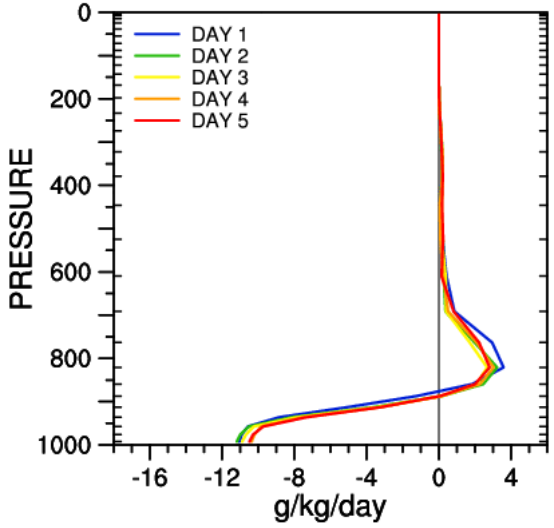




CONSERVE



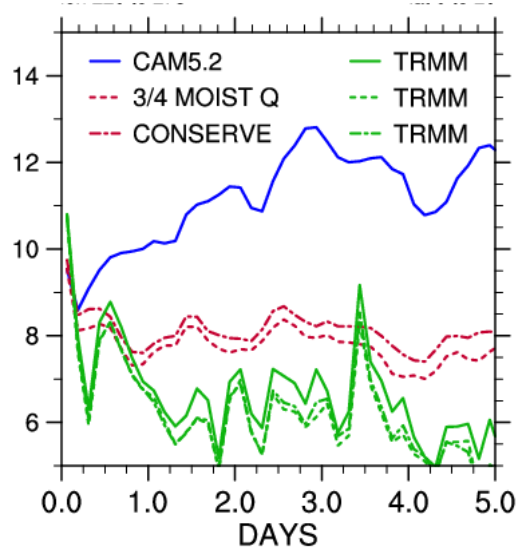


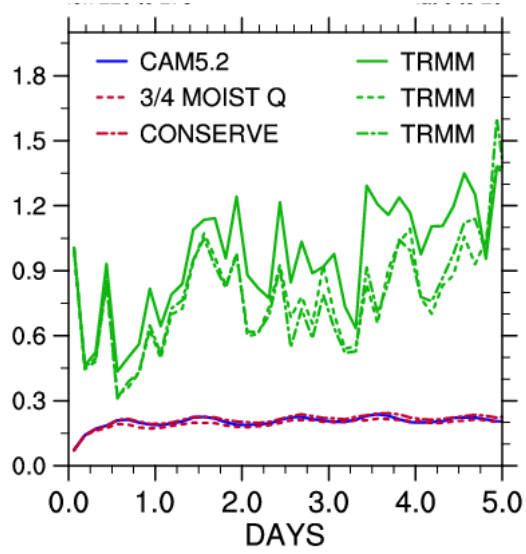


RAIN REGION

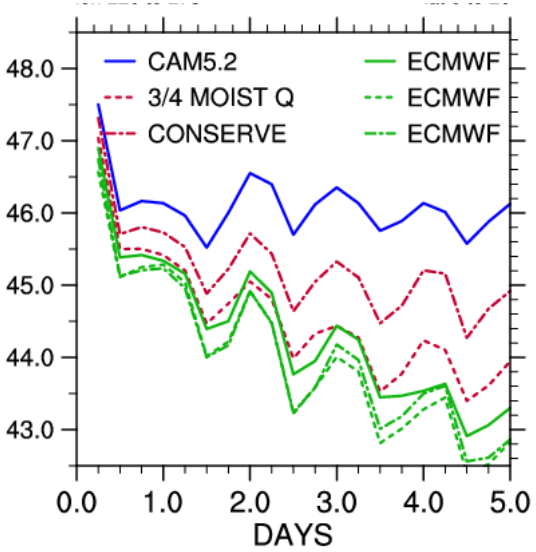
NO-RAIN REGION

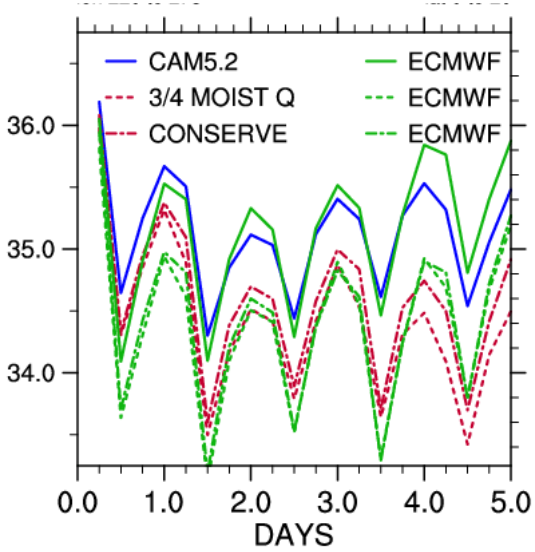
PRECIPITATION (mm/day)





COLUMN WATER (mm)

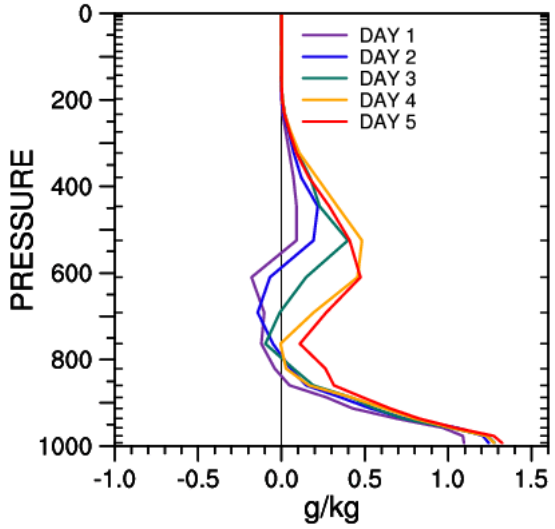




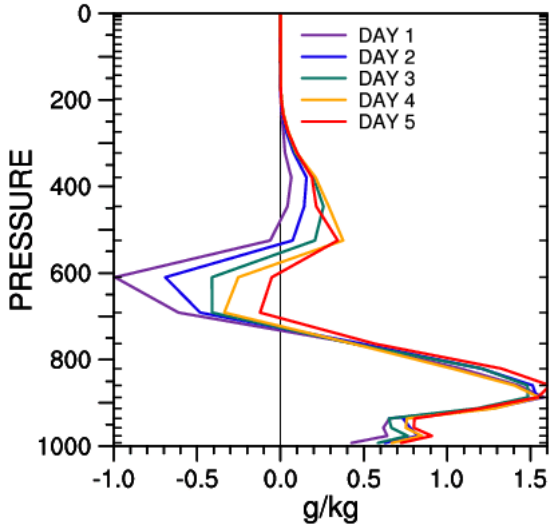
SPECIFIC HUMIDITY “ERROR”
RAIN REGION

CAM5.2

VERSUS ECMWF

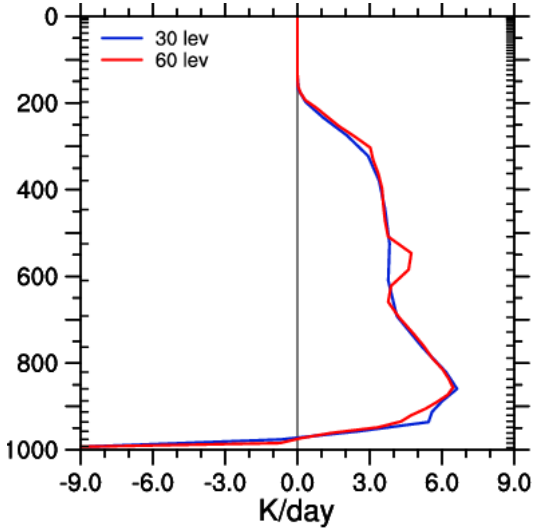


VERSUS GMAO

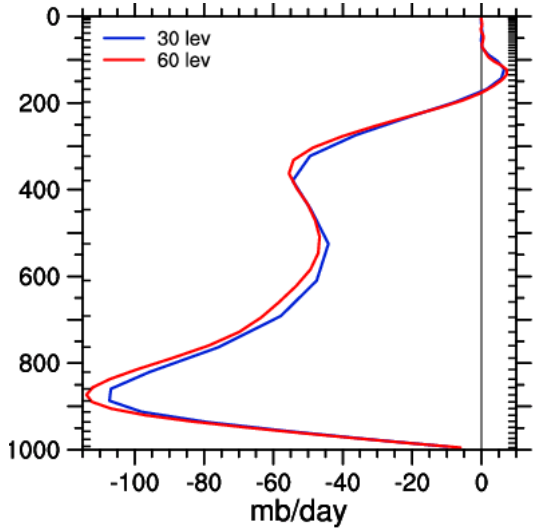


60 versus 30 levels
RAIN REGION DAY 3

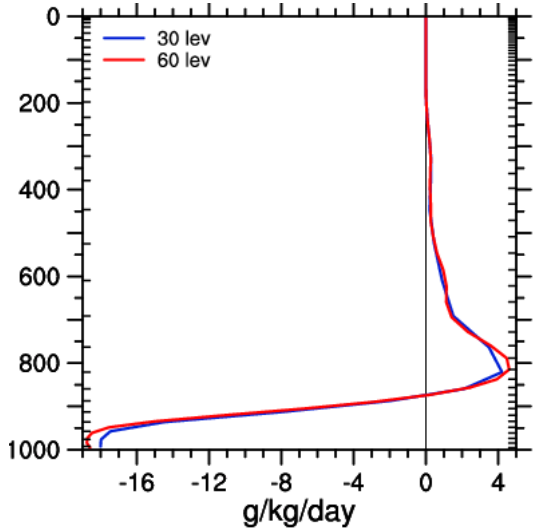
HEATING



OMEGA

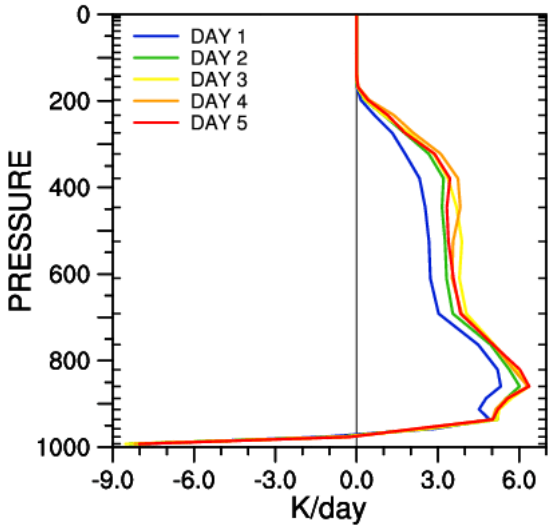


qV DIVERGENCE

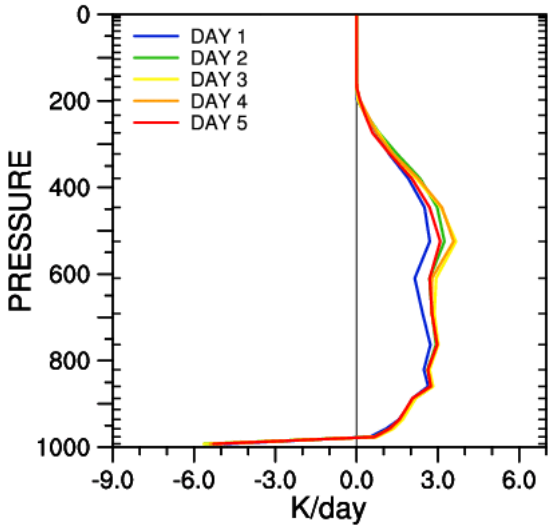


MOIST PARAMETERIZATION HEATING
RAIN REGION

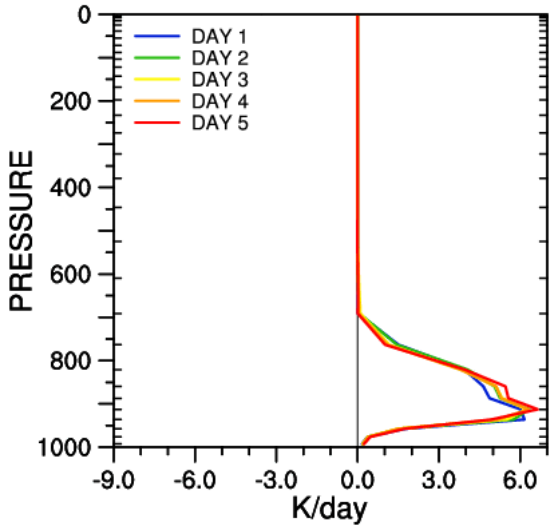
TOTAL



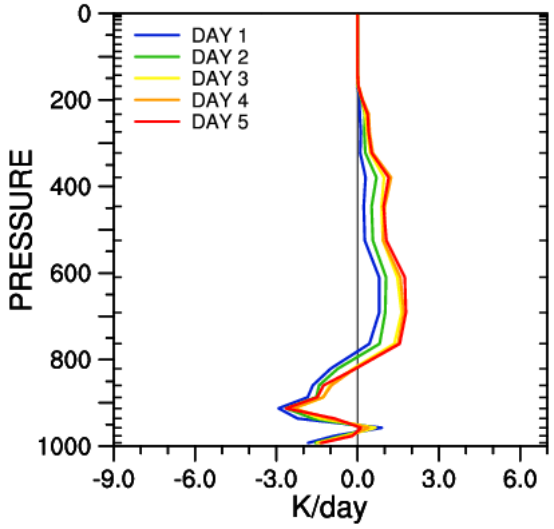
DEEP CONVECT



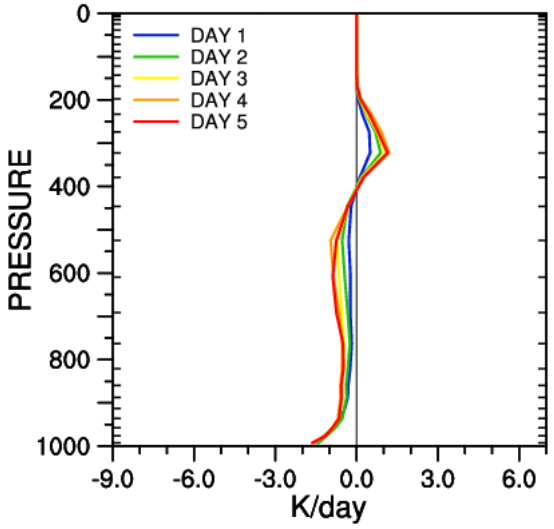
SHALLOW CONVECT



MACROPHYSICS



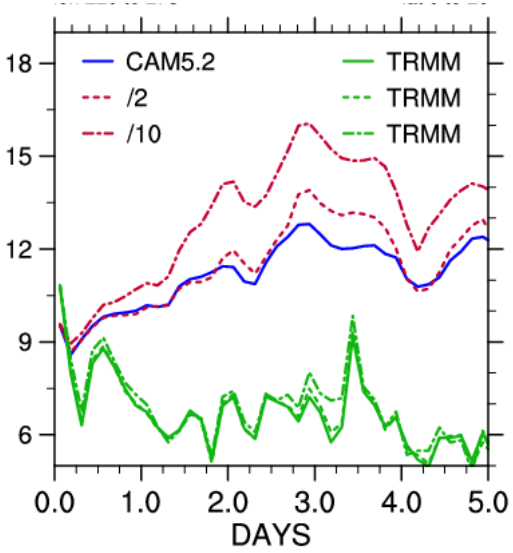
MICROPHYSICS



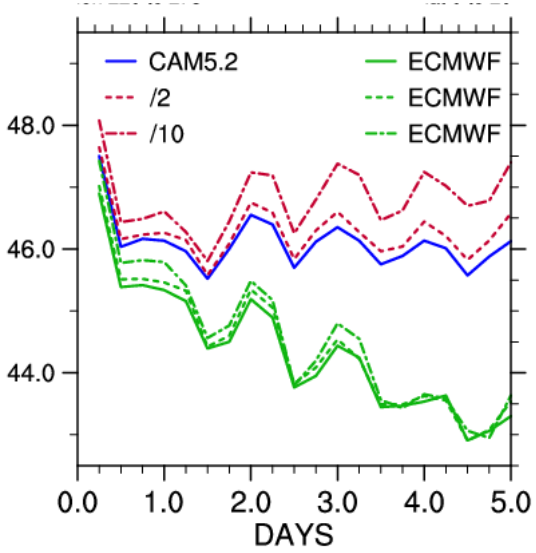
Decrease maximum shallow convection updraft fractional area by a factor of 2 and 10

RAIN REGION

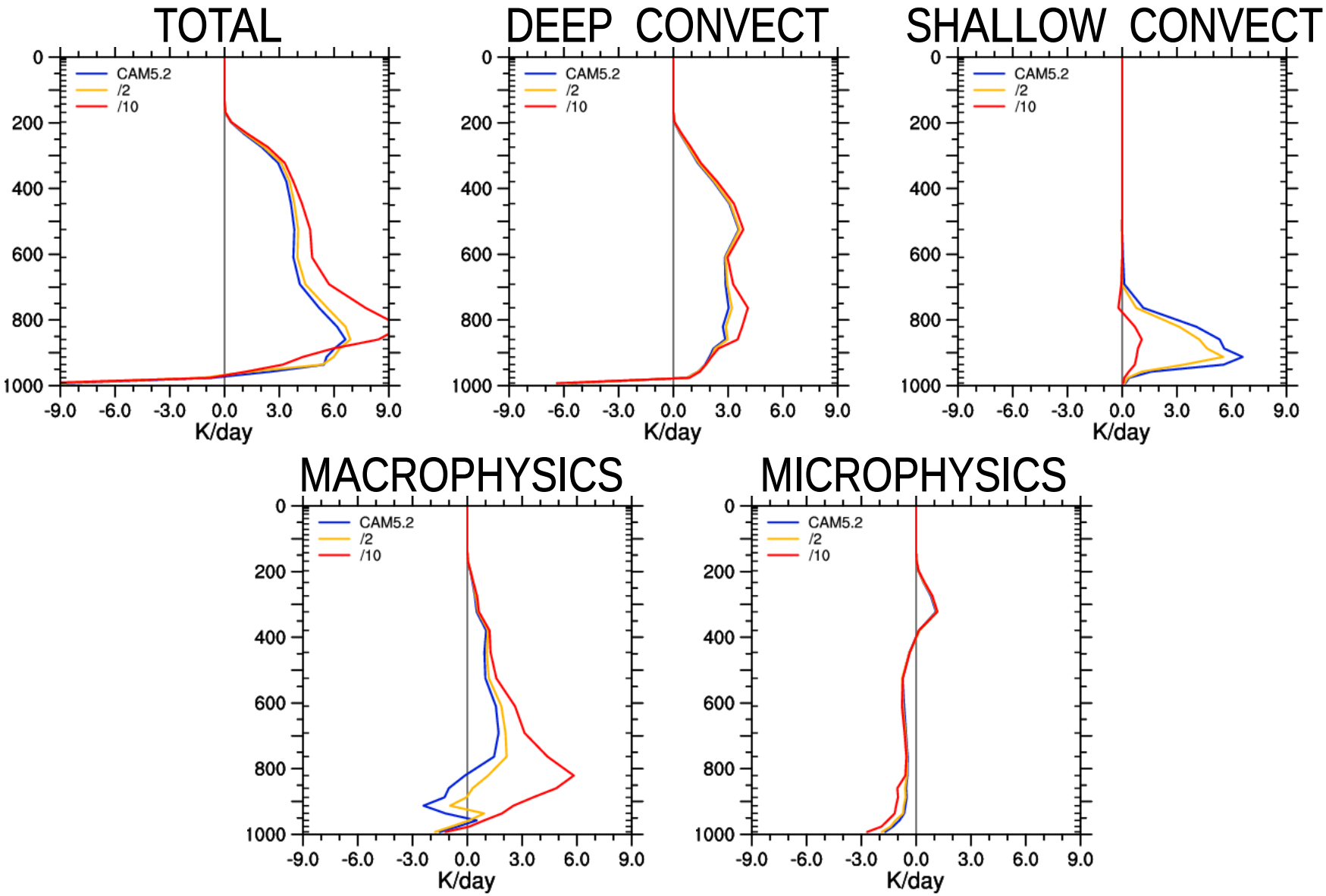
PRECIPITATION (mm/day)



COLUMN WATER (mm)



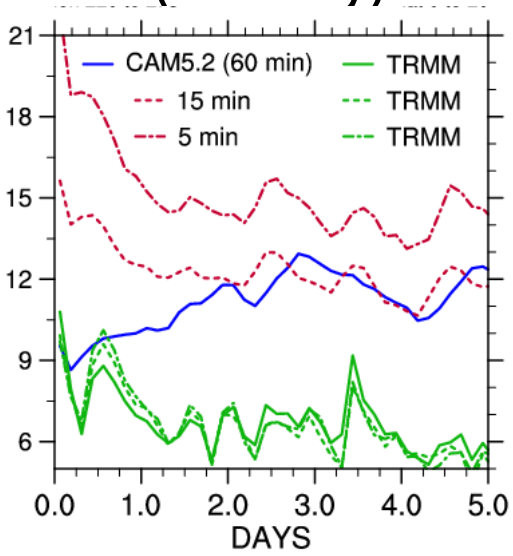
Decrease maximum shallow convection updraft fractional area by a factor of 2 and 10 RAIN REGION DAY 3



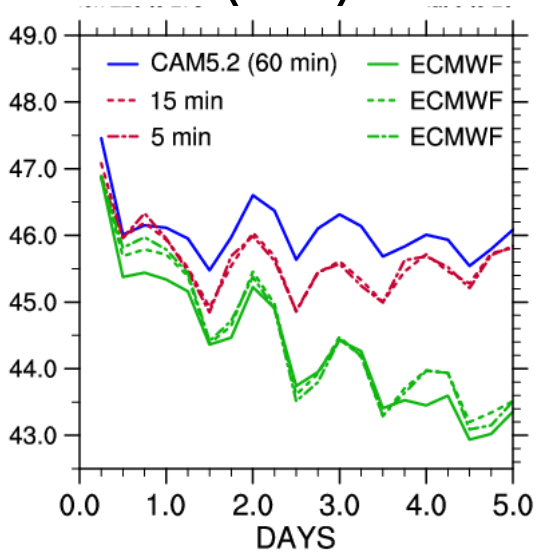
Deep convection time scale
60 min, 15 min, 5 min

RAIN REGION

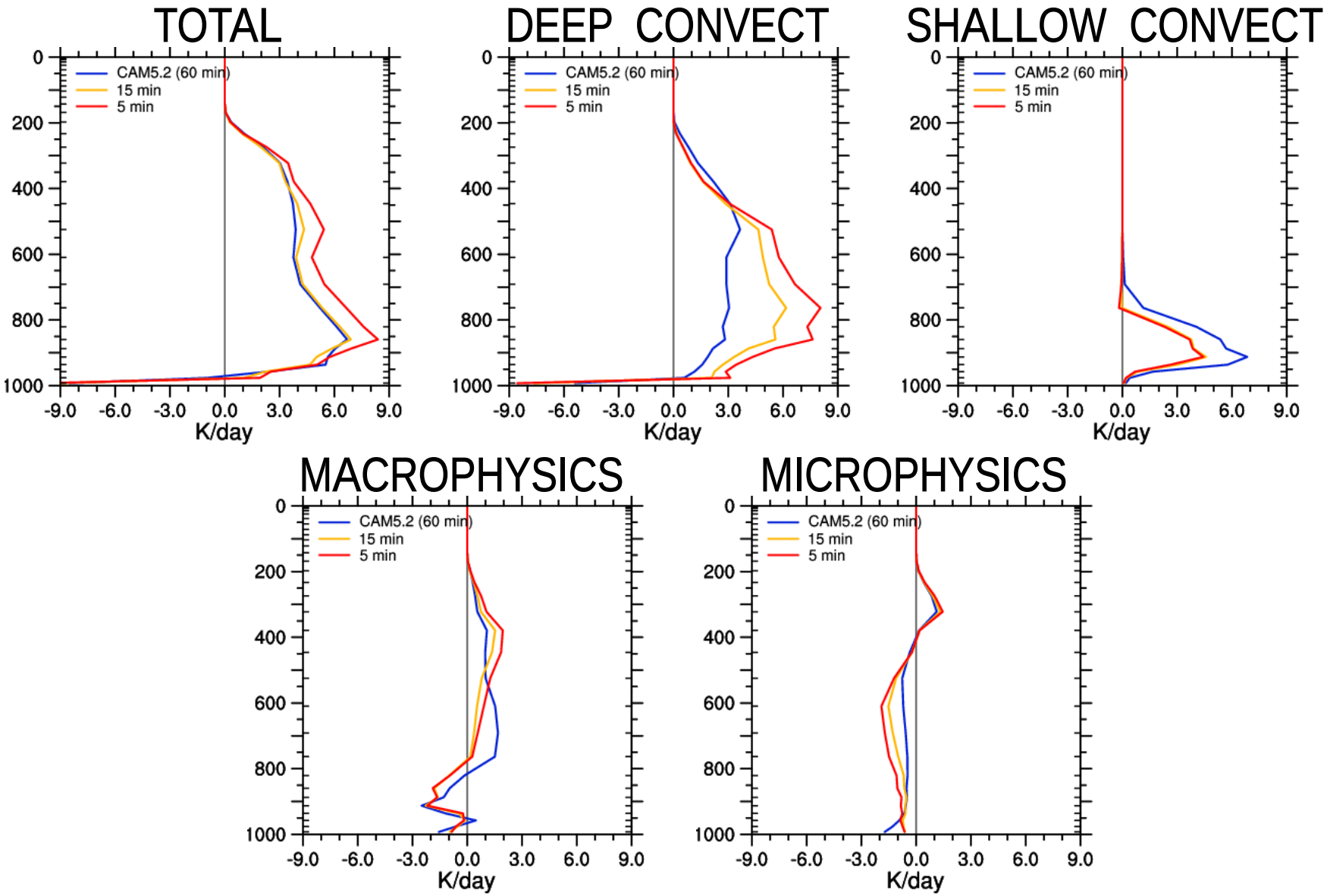
PRECIPITATION (mm/day)



COLUMN WATER (mm)



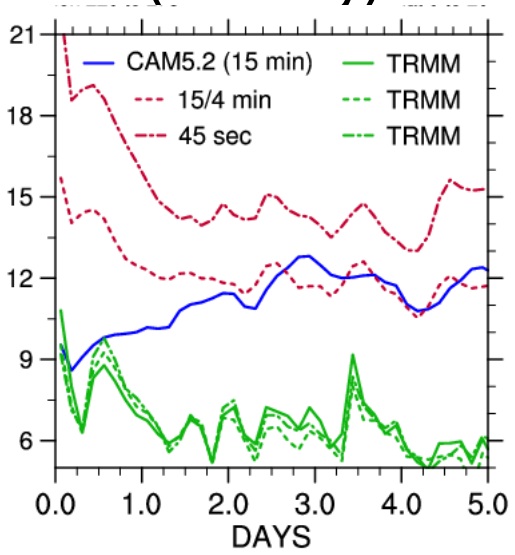
Deep convection time scale 60 min, 15 min, 5 min
RAIN REGION DAY 3



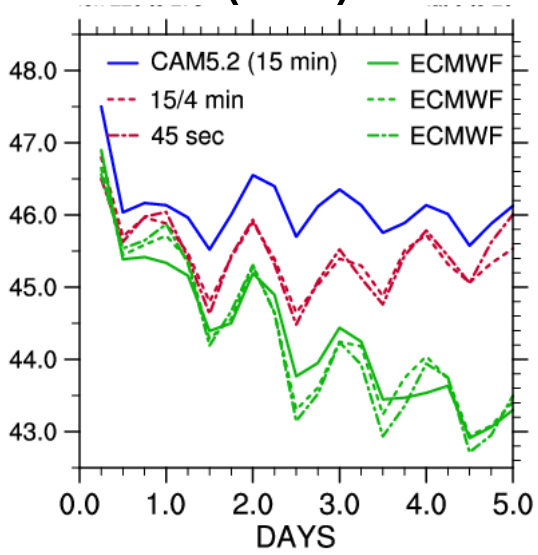
Decrease parameterization time step
15 min, 15/4 min, 45 sec

RAIN REGION

PRECIPITATION (mm/day)



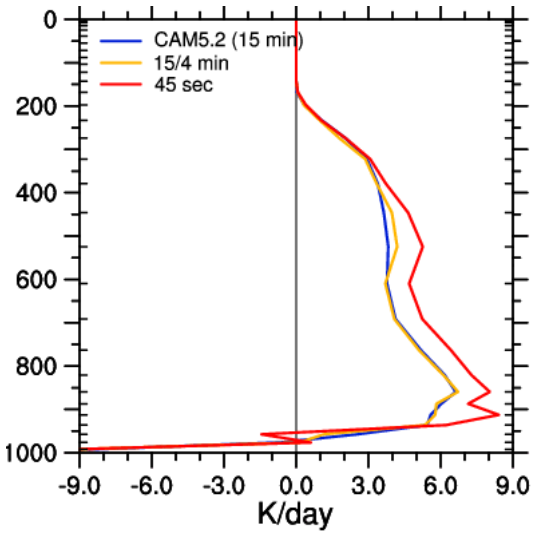
COLUMN WATER (mm)



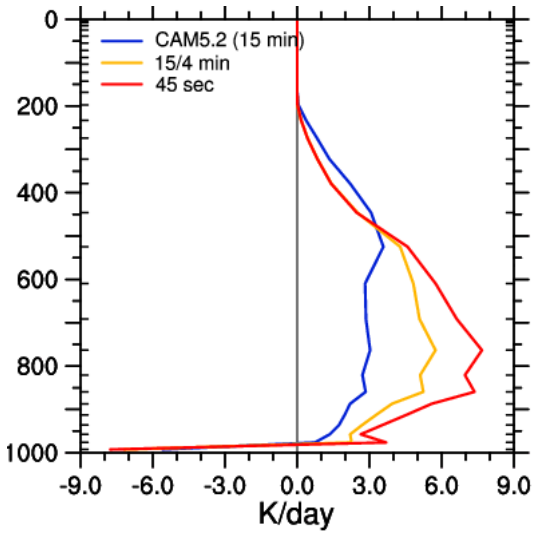
Decrease parameterization time step 15 min, 15/4 min, 45 sec

RAIN REGION DAY 3

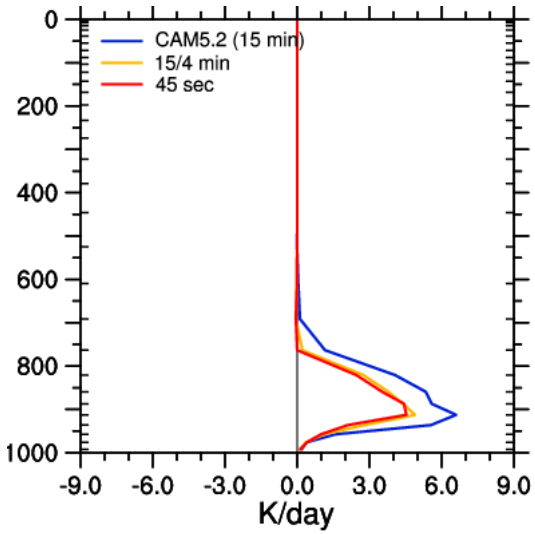
TOTAL



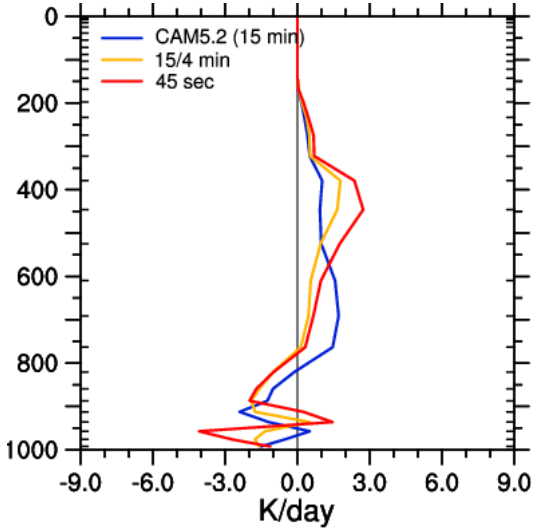
DEEP CONVECT



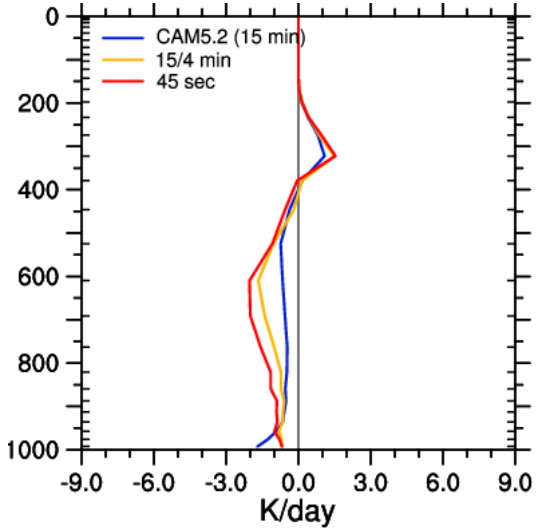
SHALLOW CONVECT



MACROPHYSICS



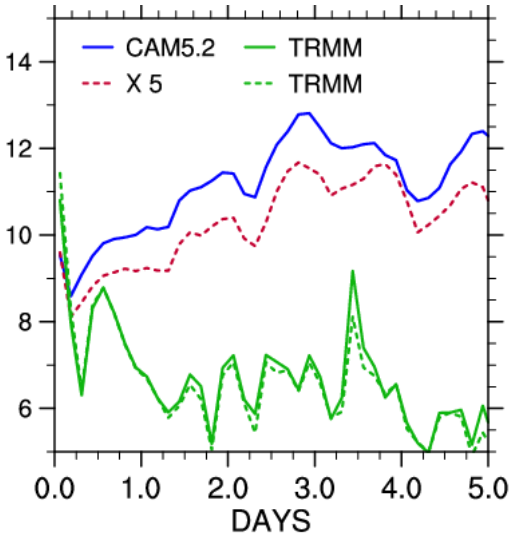
MICROPHYSICS



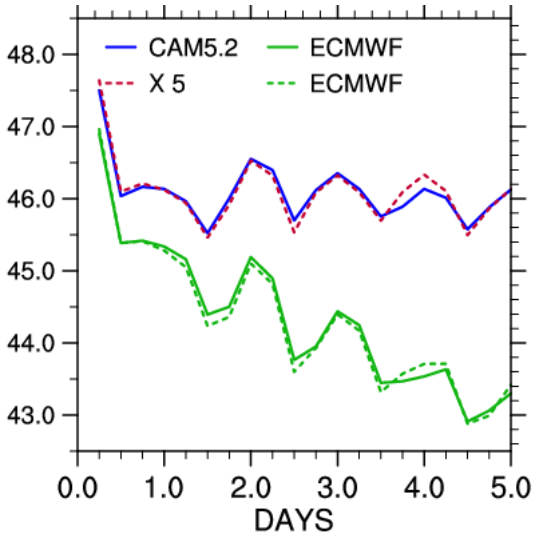
Increase deep convection evaporation efficiency by a factor of 5

RAIN REGION

PRECIPITATION (mm/day)

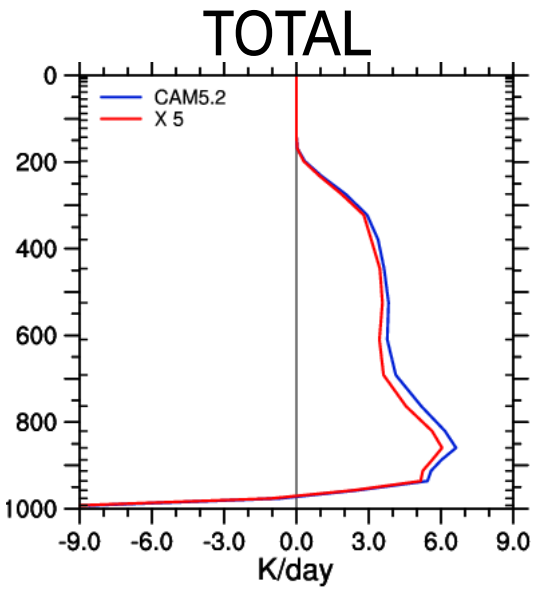


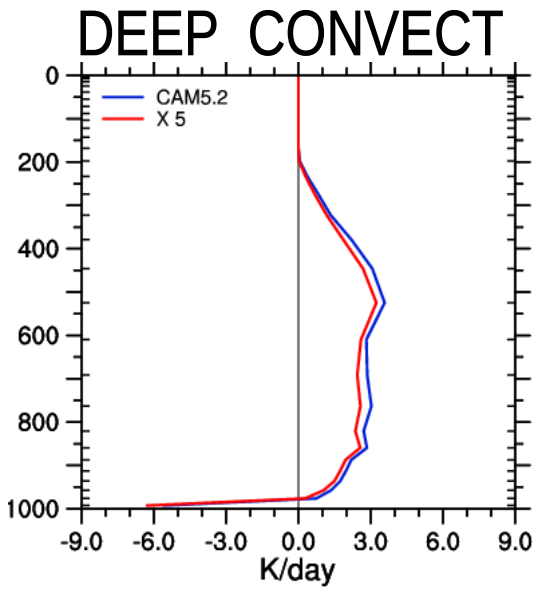
COLUMN WATER (mm)

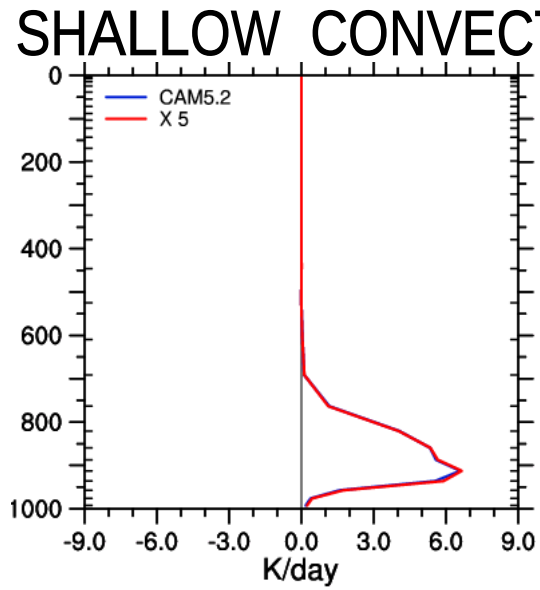


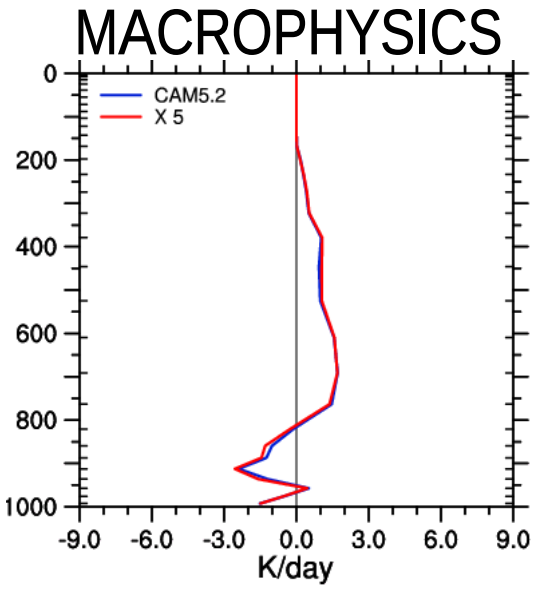
Increase deep convection evaporation efficiency by a factor of 5

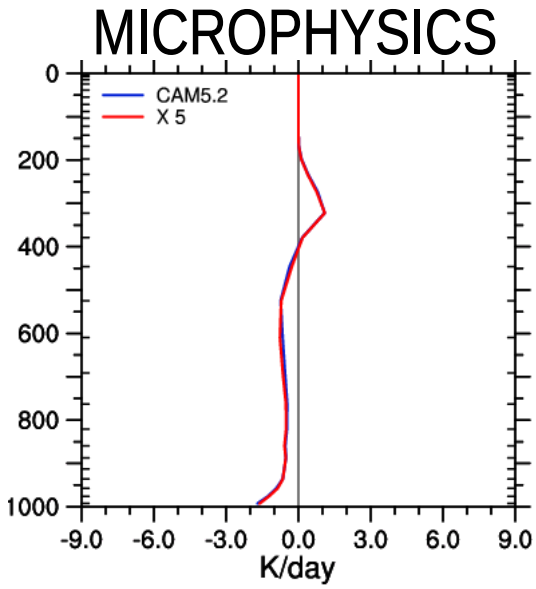
RAIN REGION DAY 3

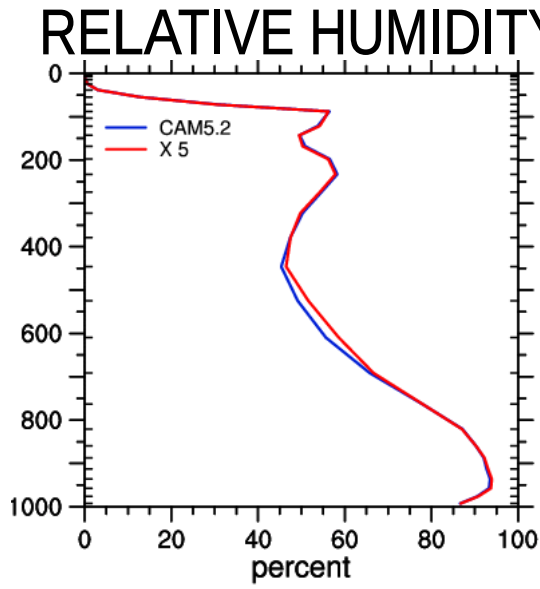












Where it is not raining, precipitable water is correct

Where it is raining,
- precipitable water is too large
- rain is too strong (although region is reasonable)

Resolved dynamics transports moisture
- from no-rain region to rain region

Resolved low level moisture convergence is forced by
- release of latent heat in lower troposphere

Elevating the heating breakes the dynamical feedback
- and results in correct precipitation and precipitable water

Two possible sources: resolved dynamics and parameterization