SuperParameterized CESM: Multi-Instance Land

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Superparameterization

- GCM timestep; tens of minutes
- CRM timestep; seconds

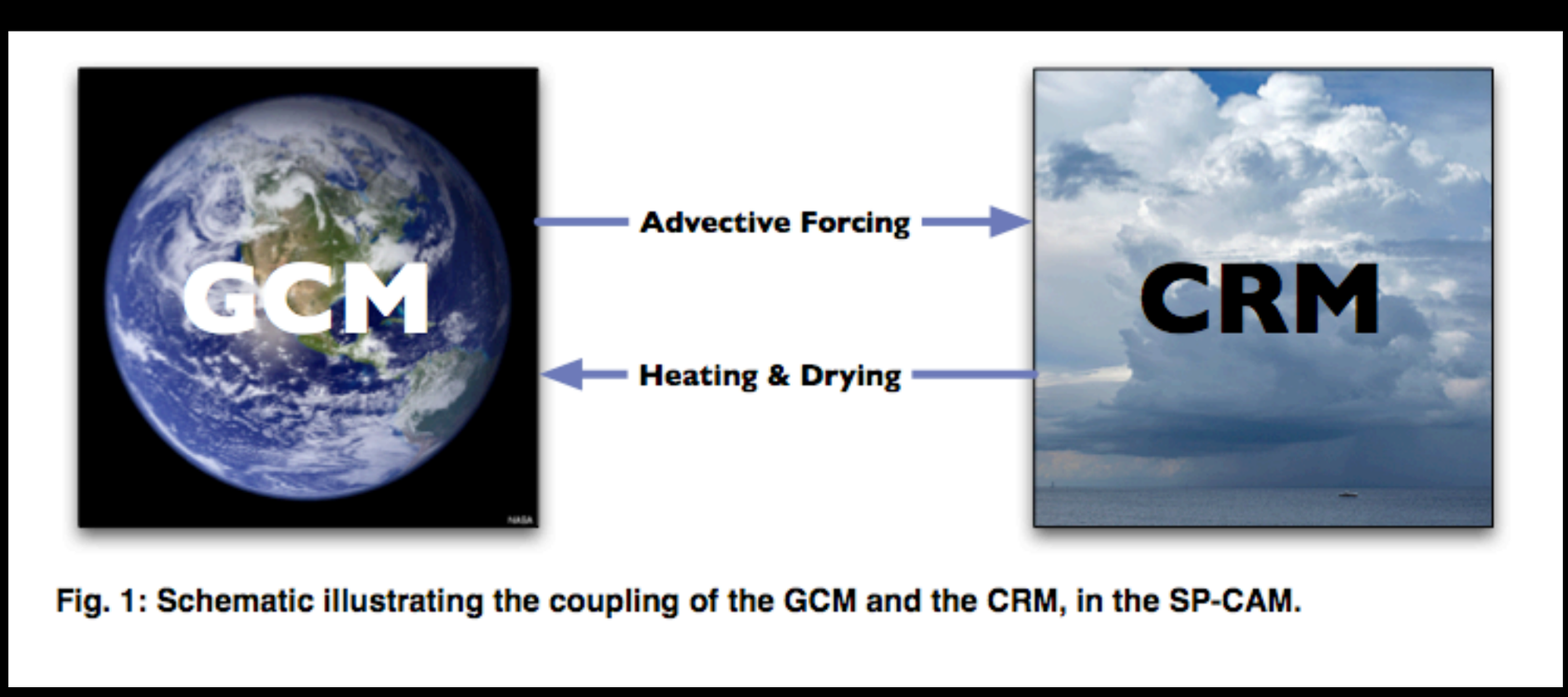
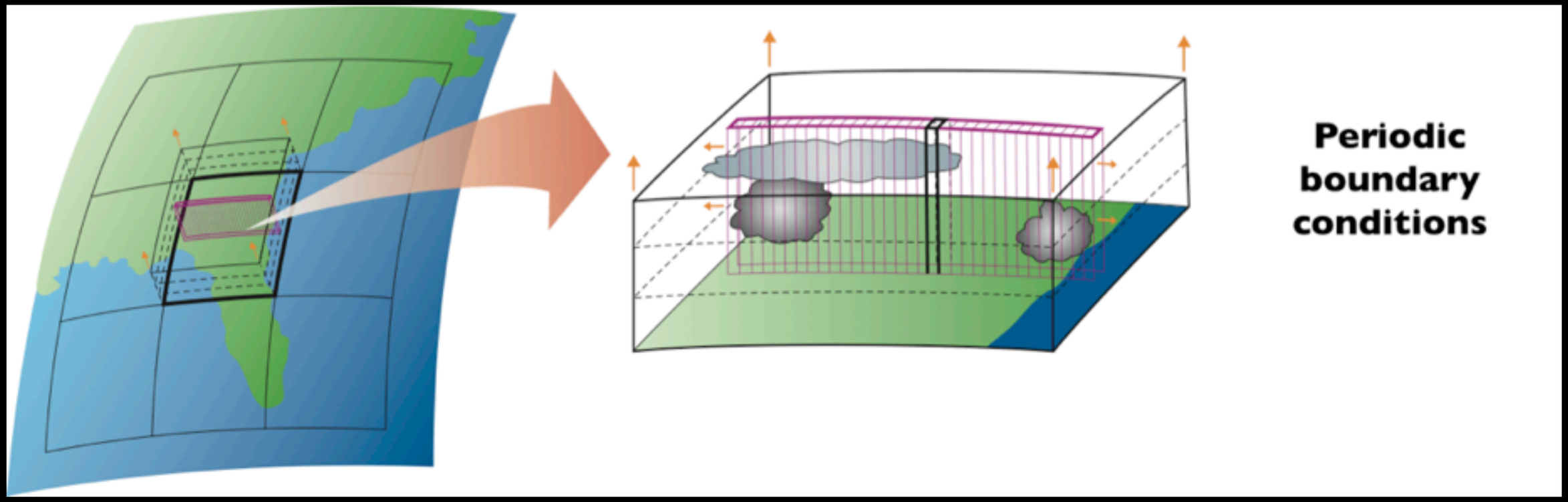


Fig. 1: Schematic illustrating the coupling of the GCM and the CRM, in the SP-CAM.

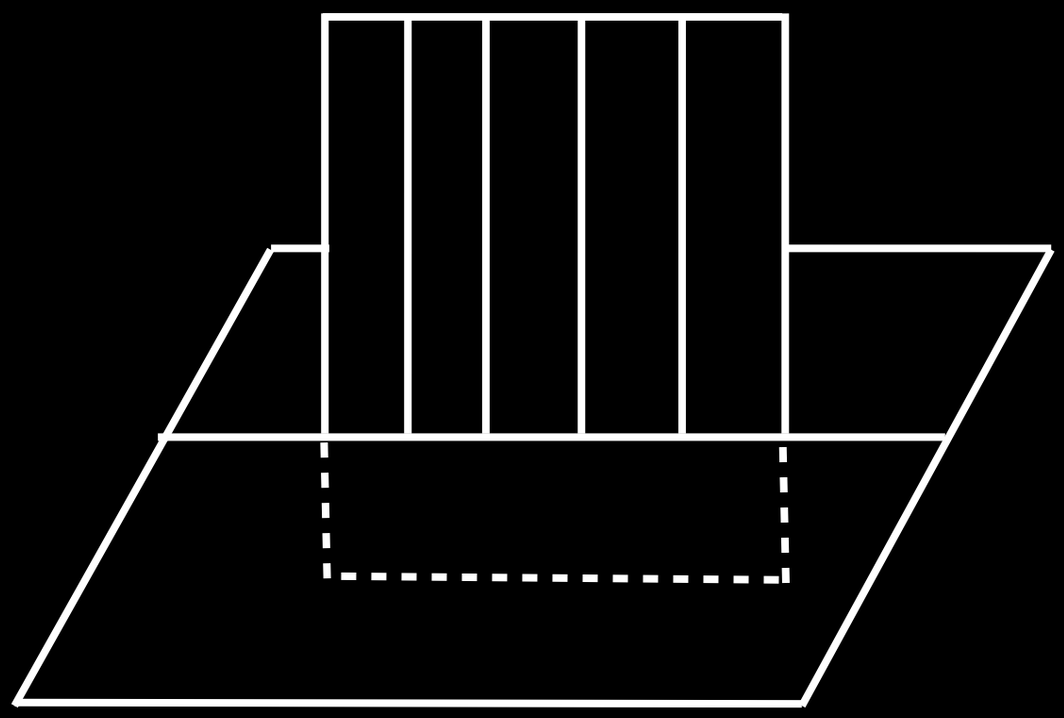
Superparameterization

- ‘Curtain’ of CRMs in a single GCM gridcell
- Current Version: CAM/SAM/CLM
- How do we represent land in this configuration?



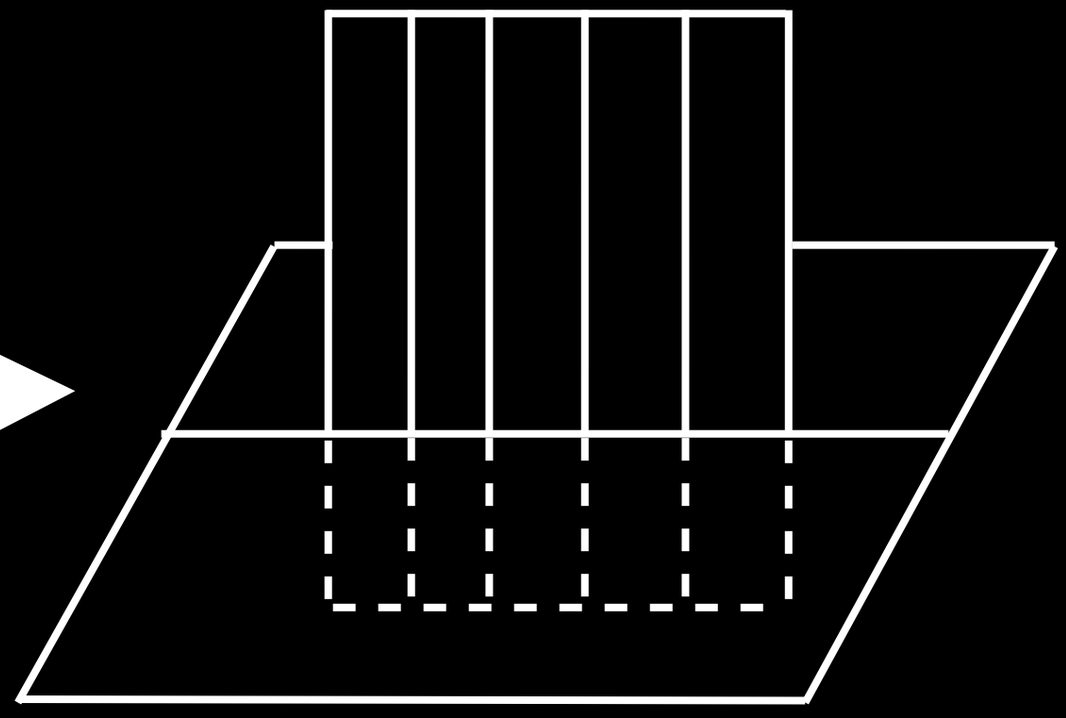
Superparameterized CESM (SP-CESM)

From this



Multiple atmospheres, single land

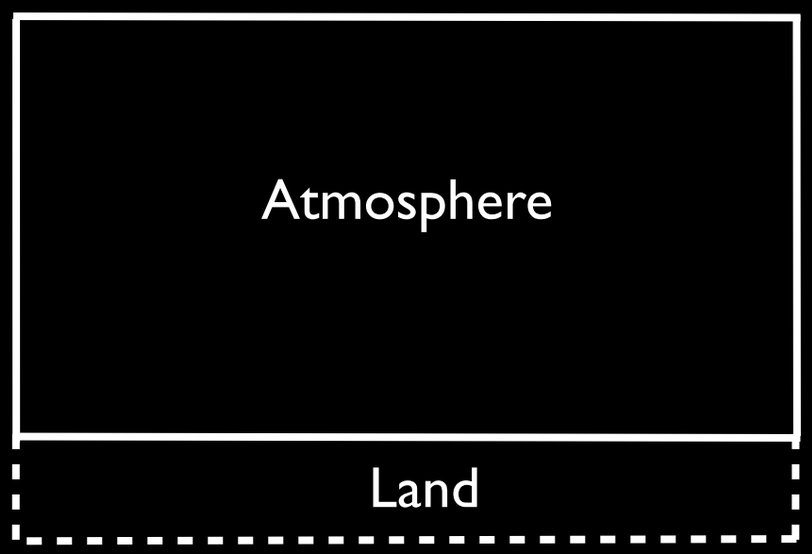
To this



Multiple atmospheres, multiple land

TESTING: Superparameterized Single Column Model (Super-SCM) (NOT CESM)

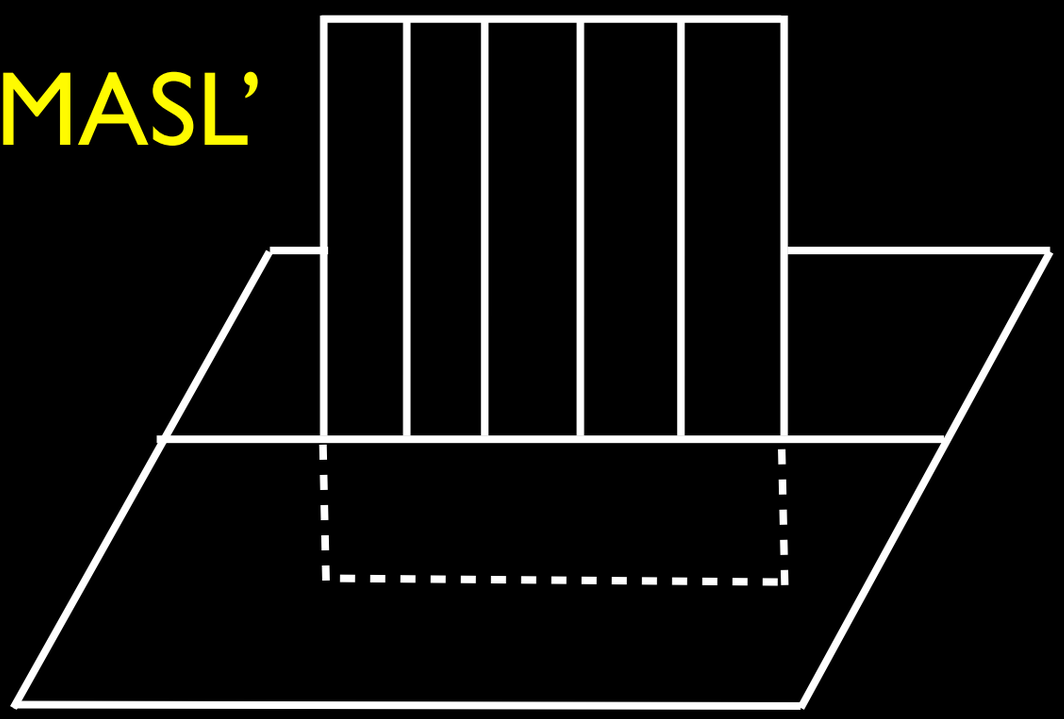
From this



'SASL'

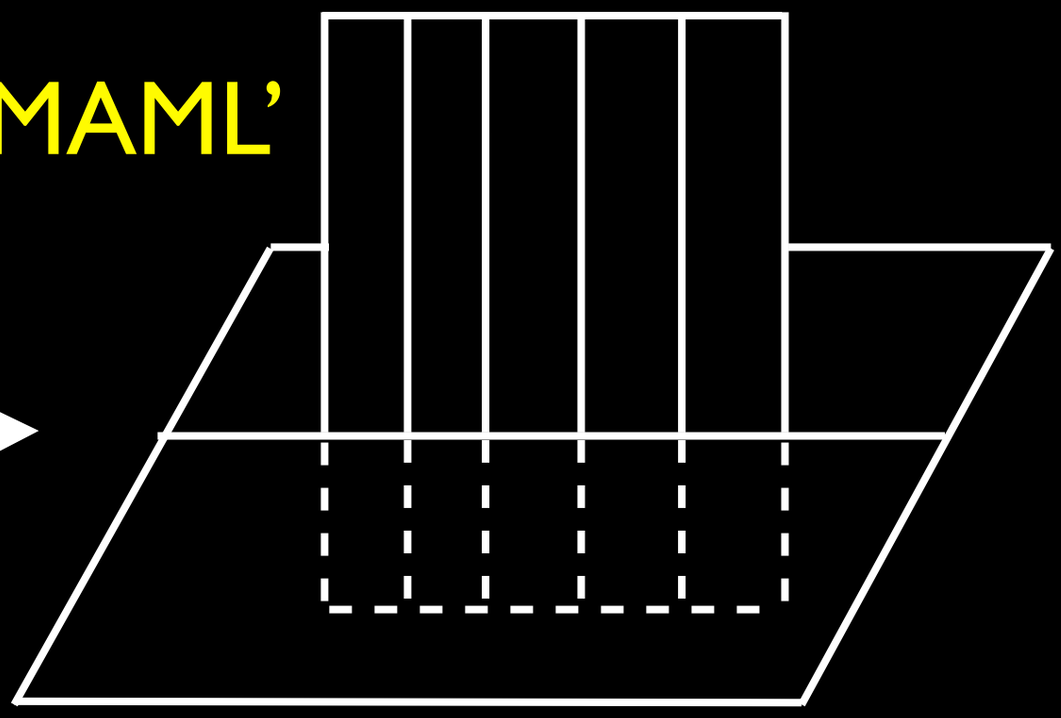
To this

'MASL'

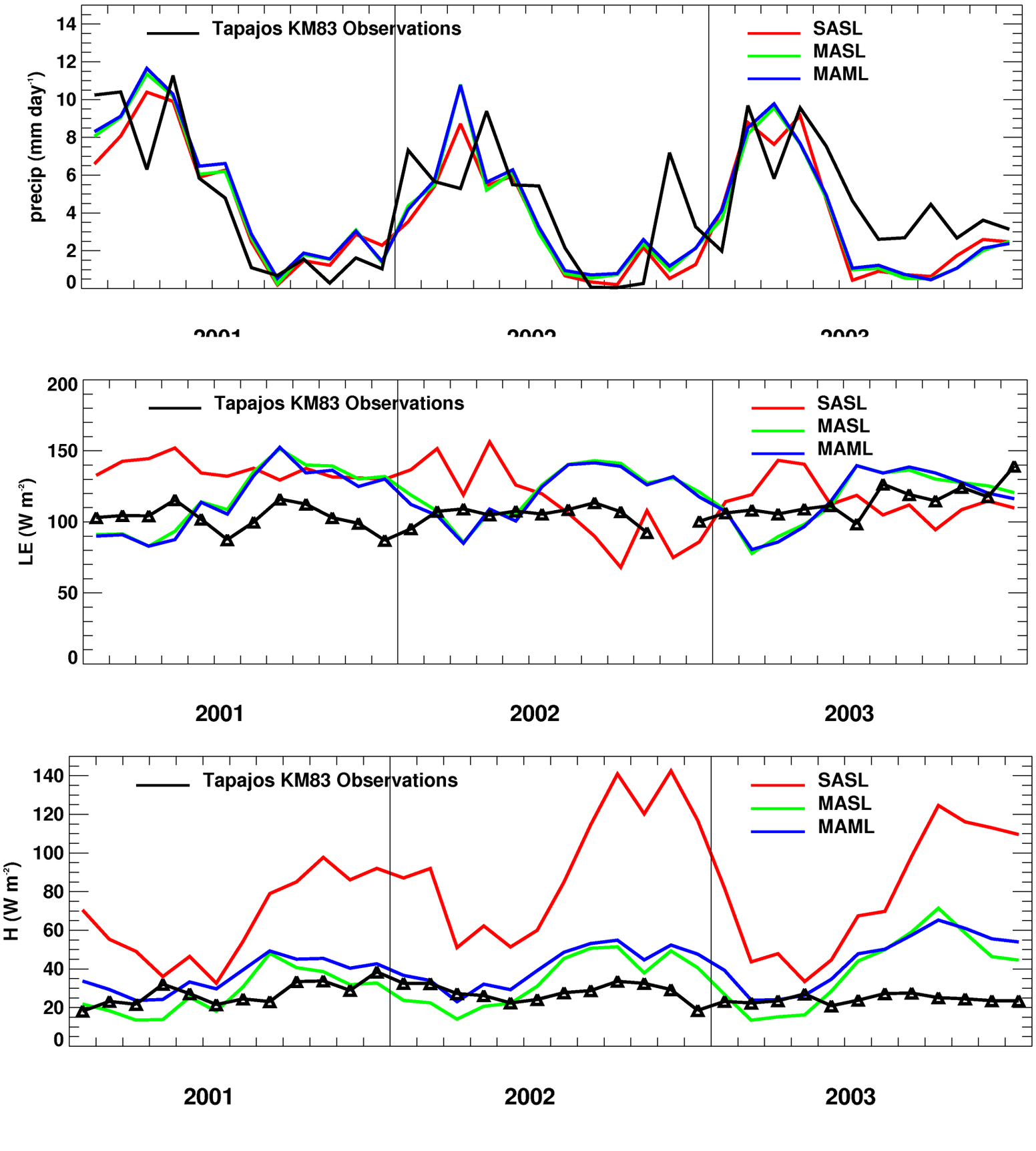


To this

'MAML'

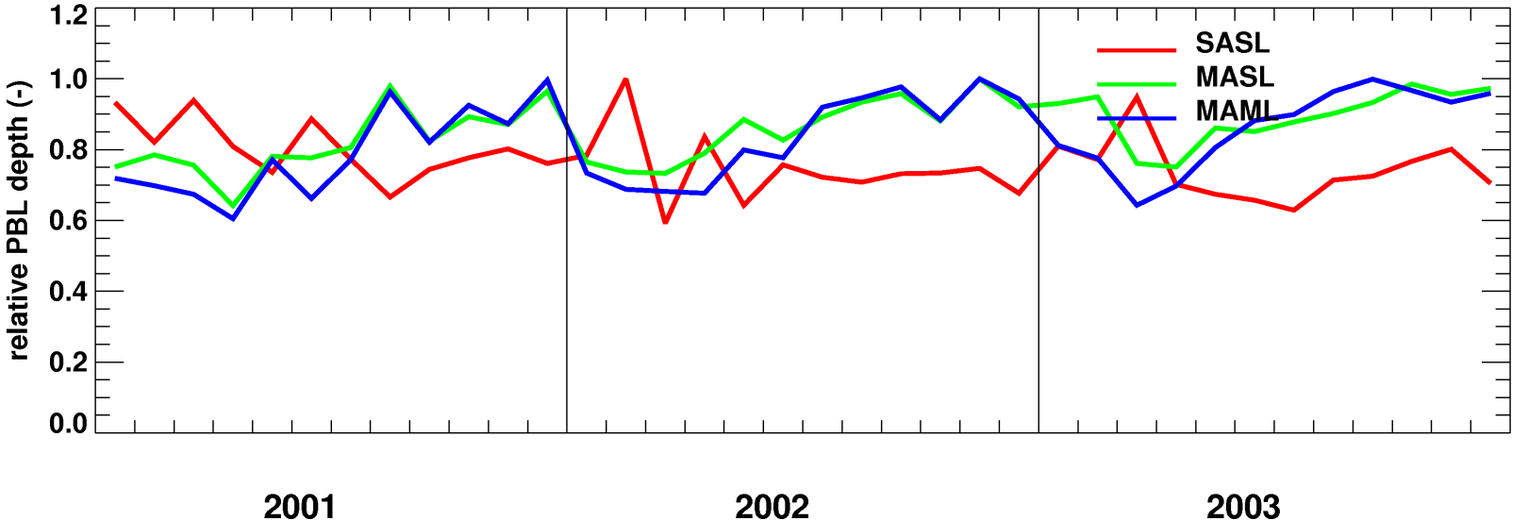


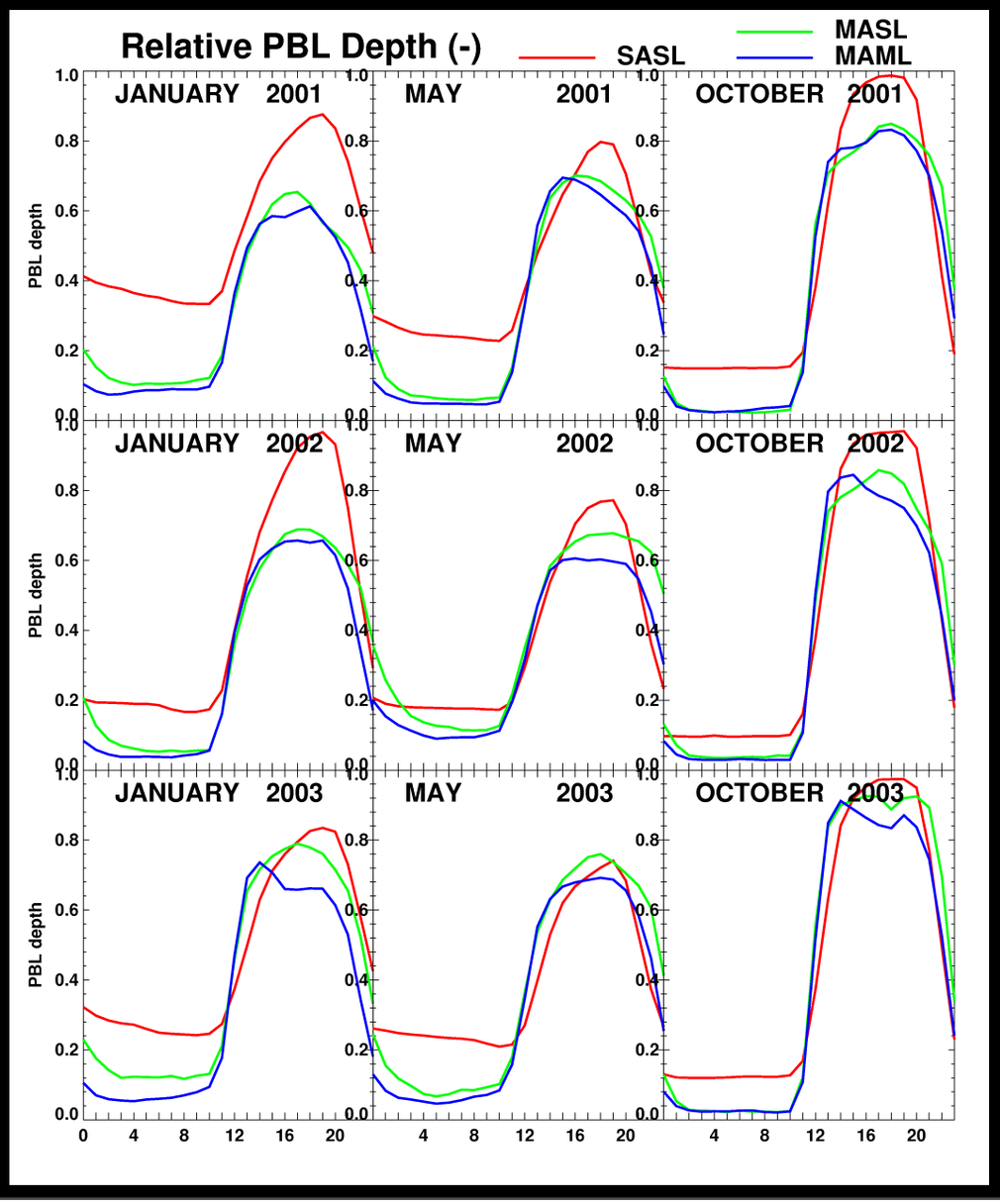
SCM Testing: K83



- Precip similar in all configurations
- SASL: larger LE (wet season), H
- SASL: Radiation
- Diurnal precip patterns similar (not shown)

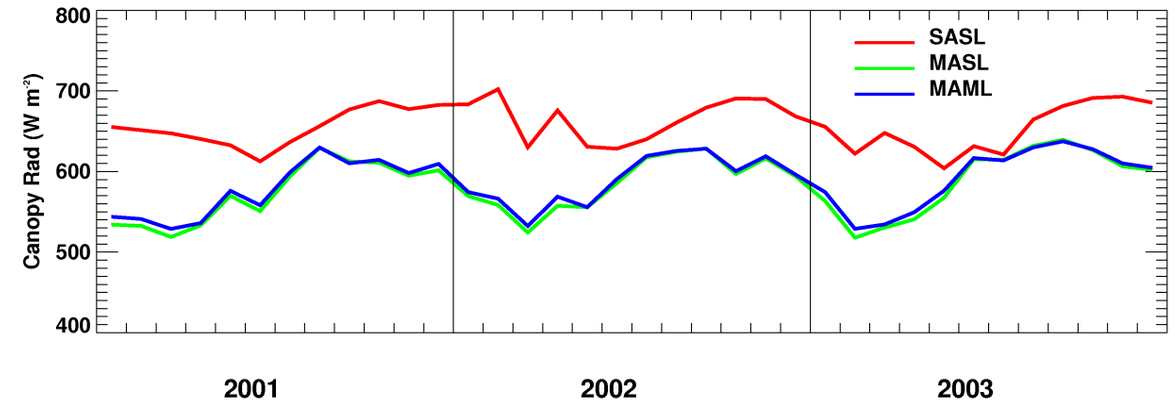
SCM Testing: K83: PBL

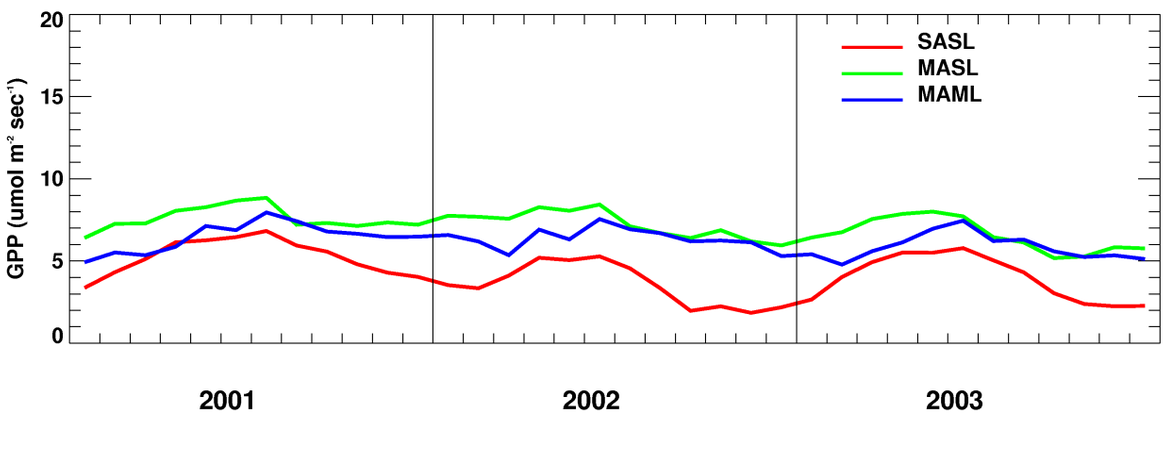


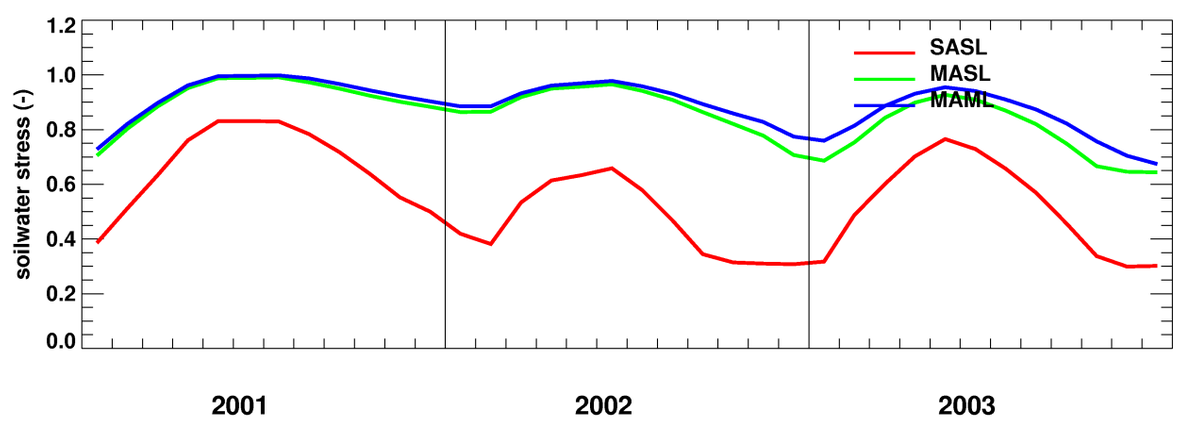


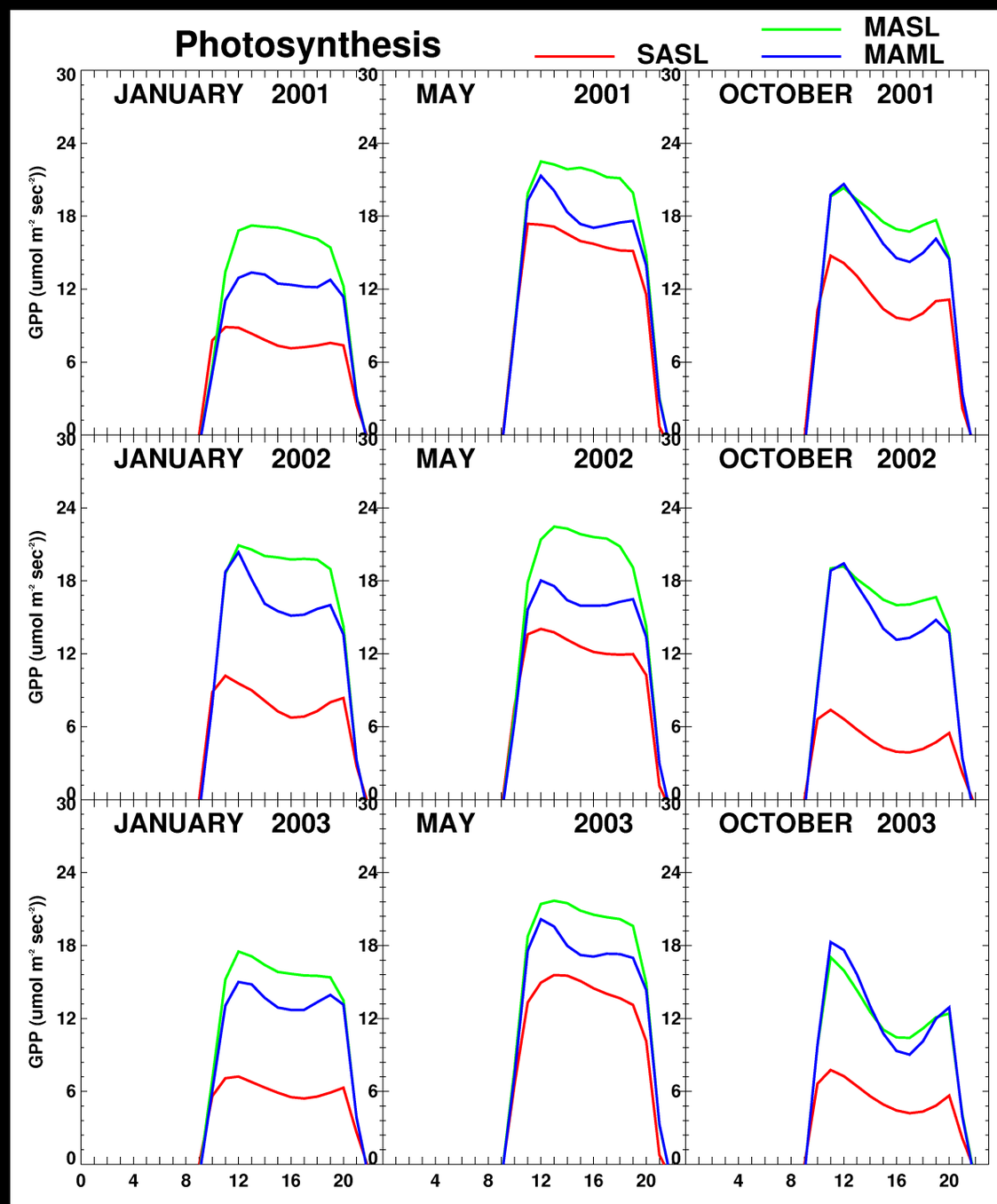
- 'Apples and Oranges': meters vs. pressure height
- SASL: deeper mean PBL in wet season - no nocturnal collapse
- MASL/MAML : Similar behavior, larger annual 'peak' amplitude than SASL

SCM Testing: K83: carbon cycle

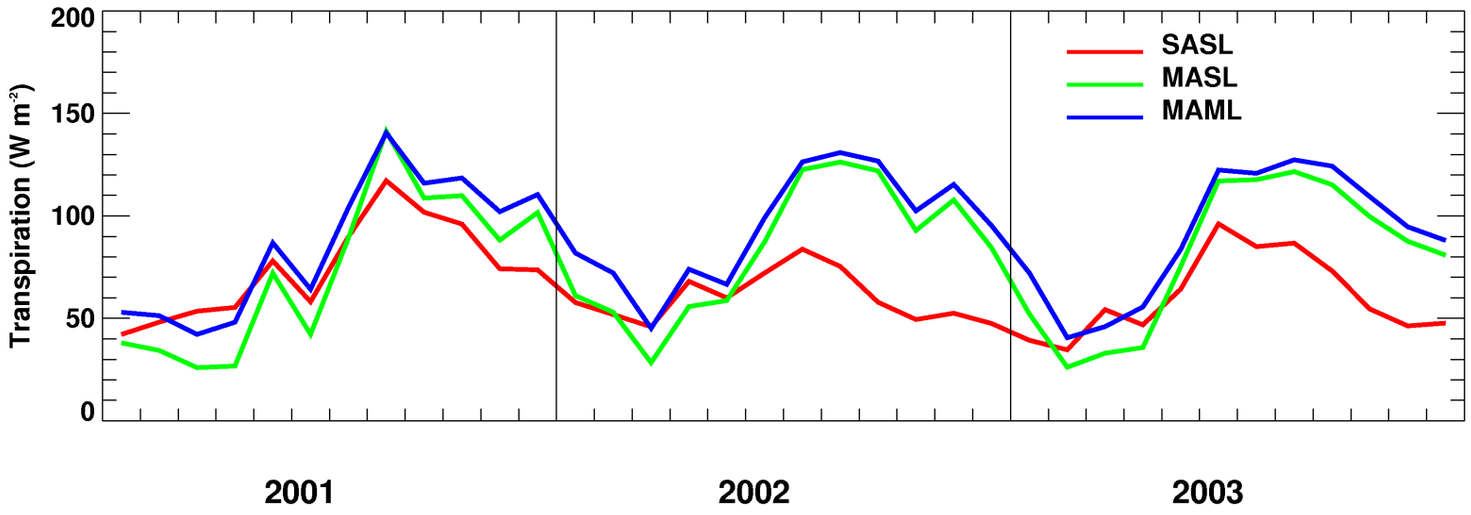


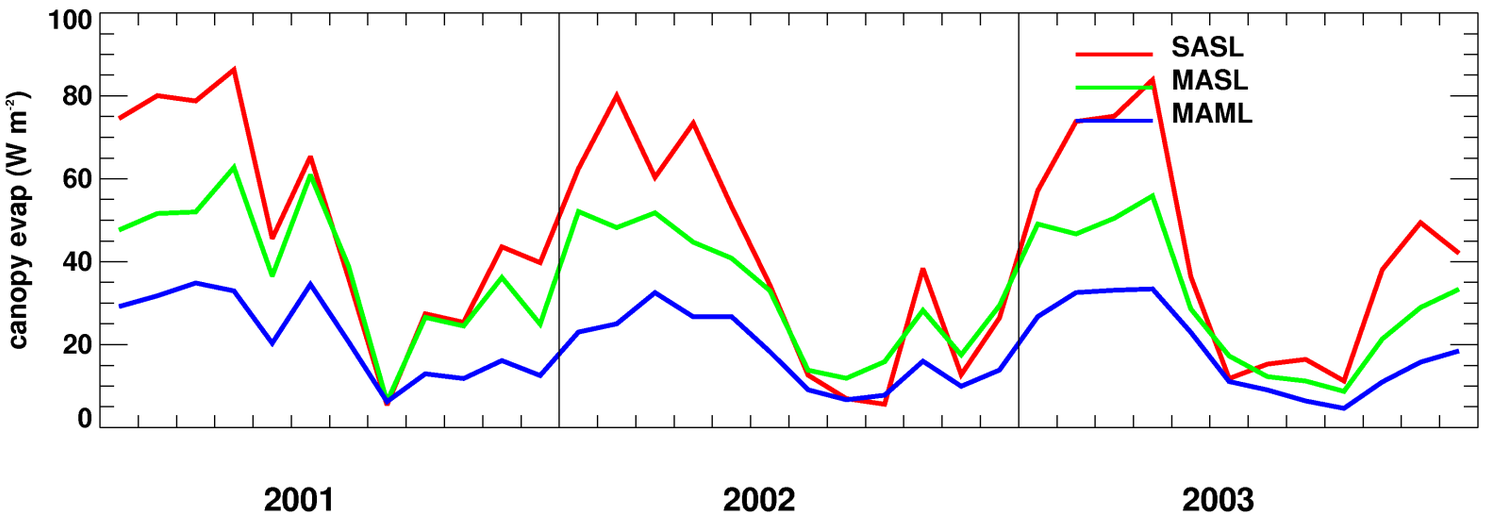


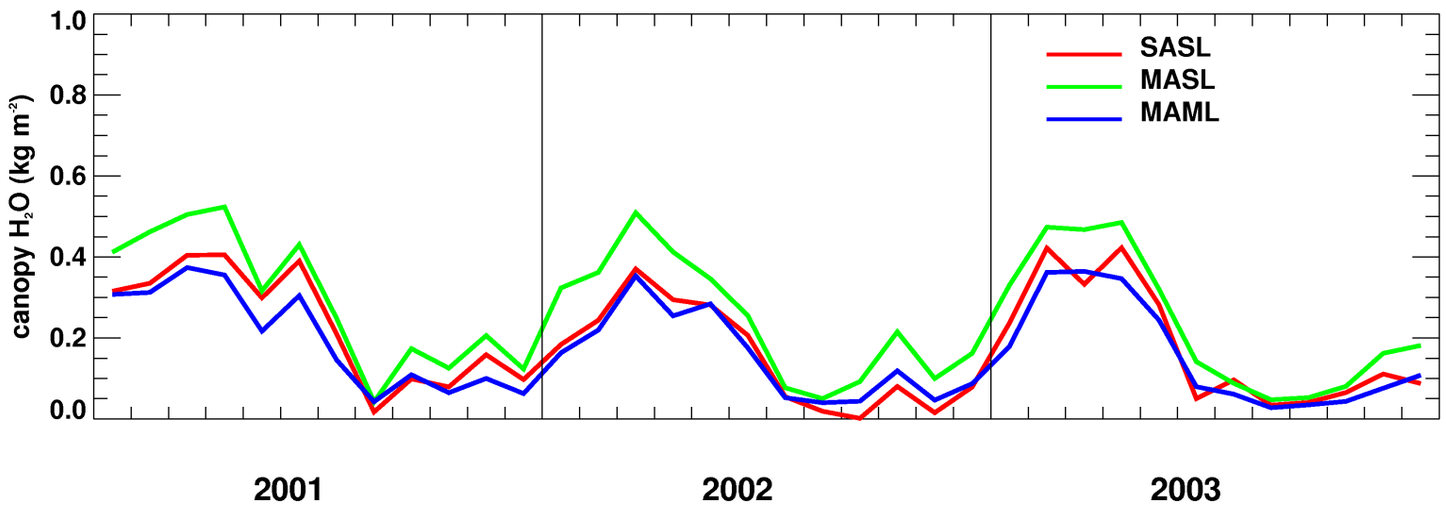




- SASL: most radiation, smallest GPP
- MASL: Larger GPP, less midday reduction
- SASL: if precip is similar, why so much stress?



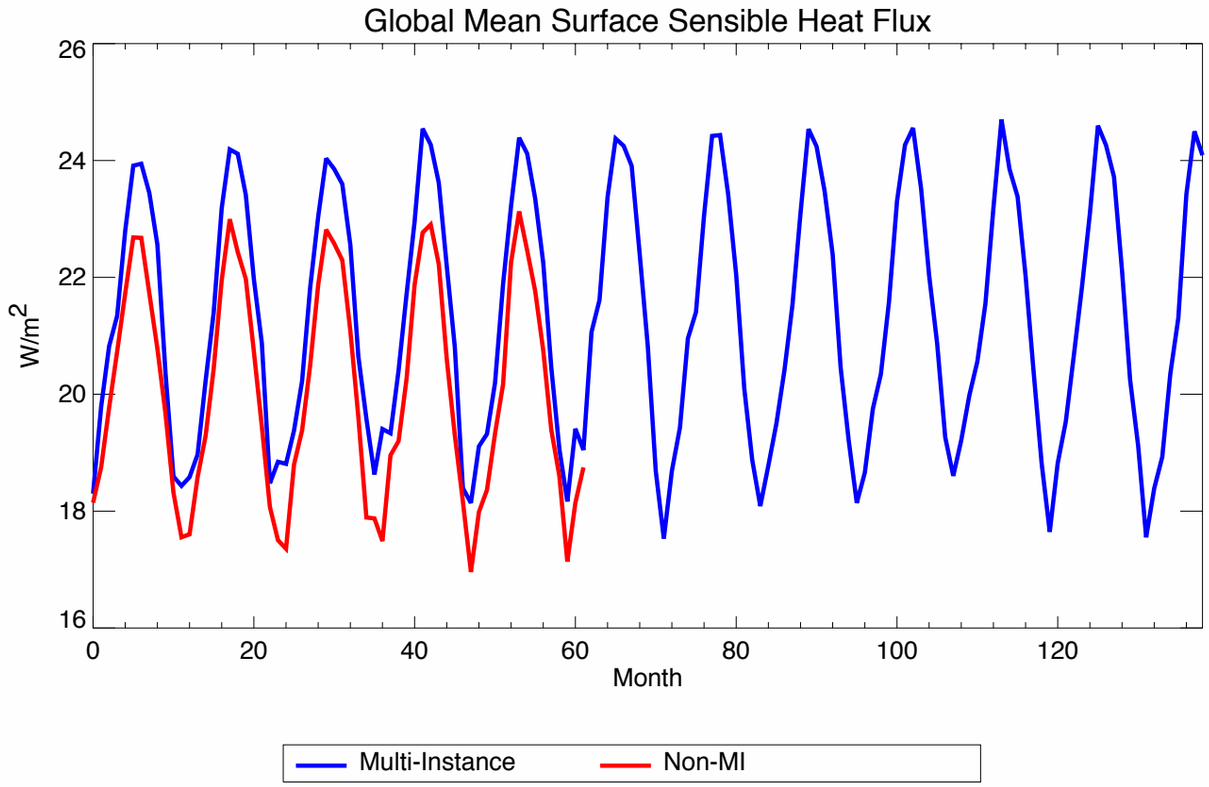


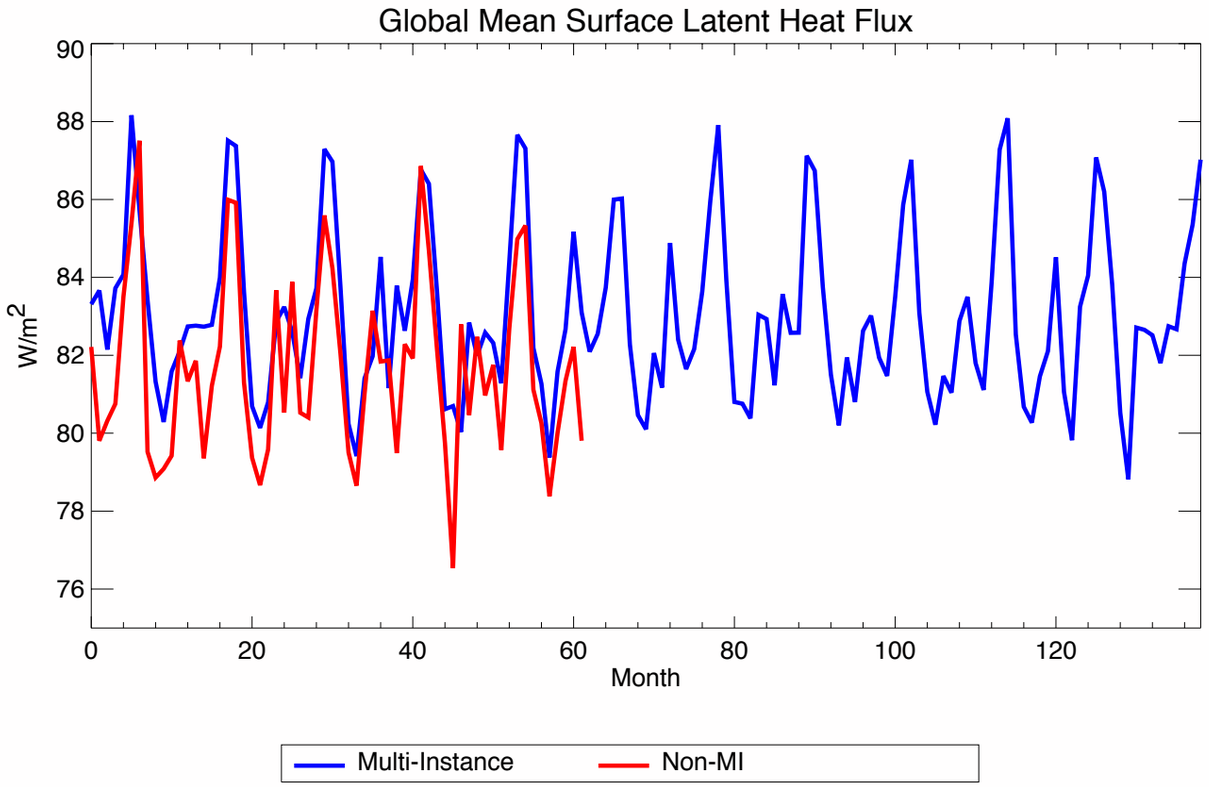


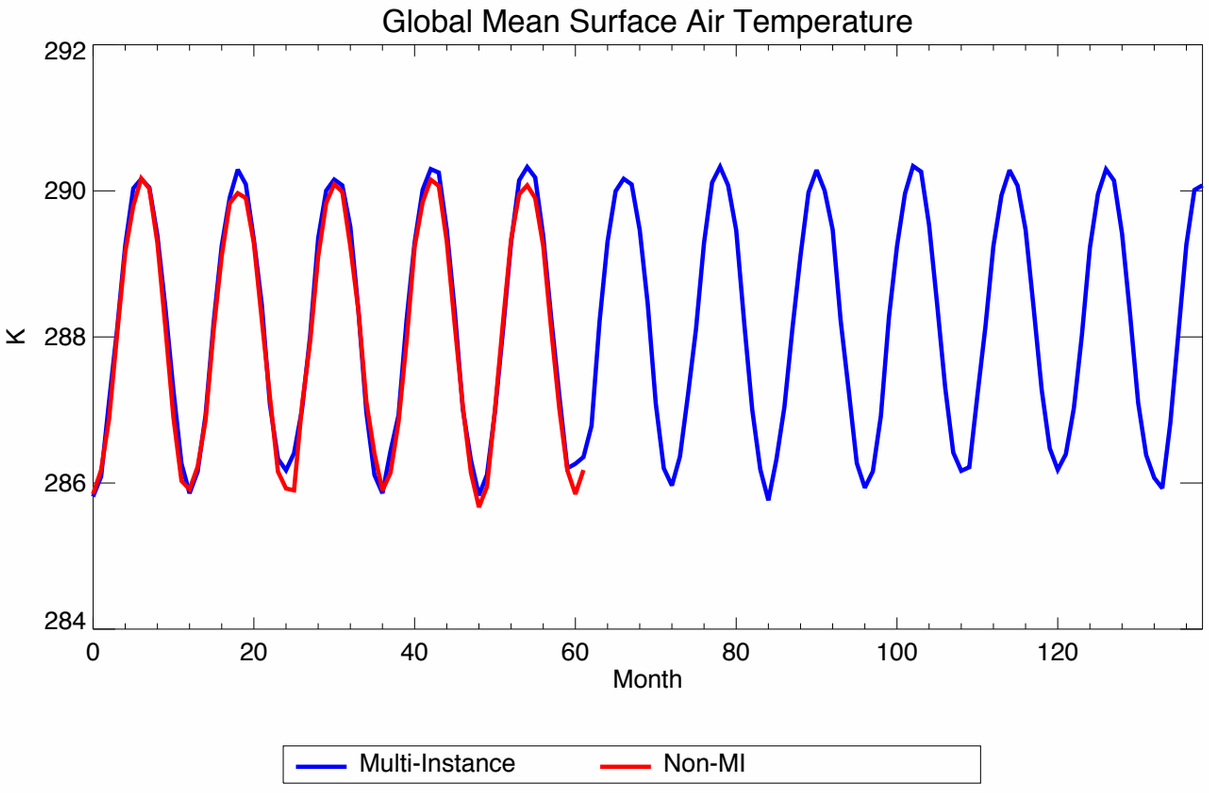
SCM Testing: K83: canopy

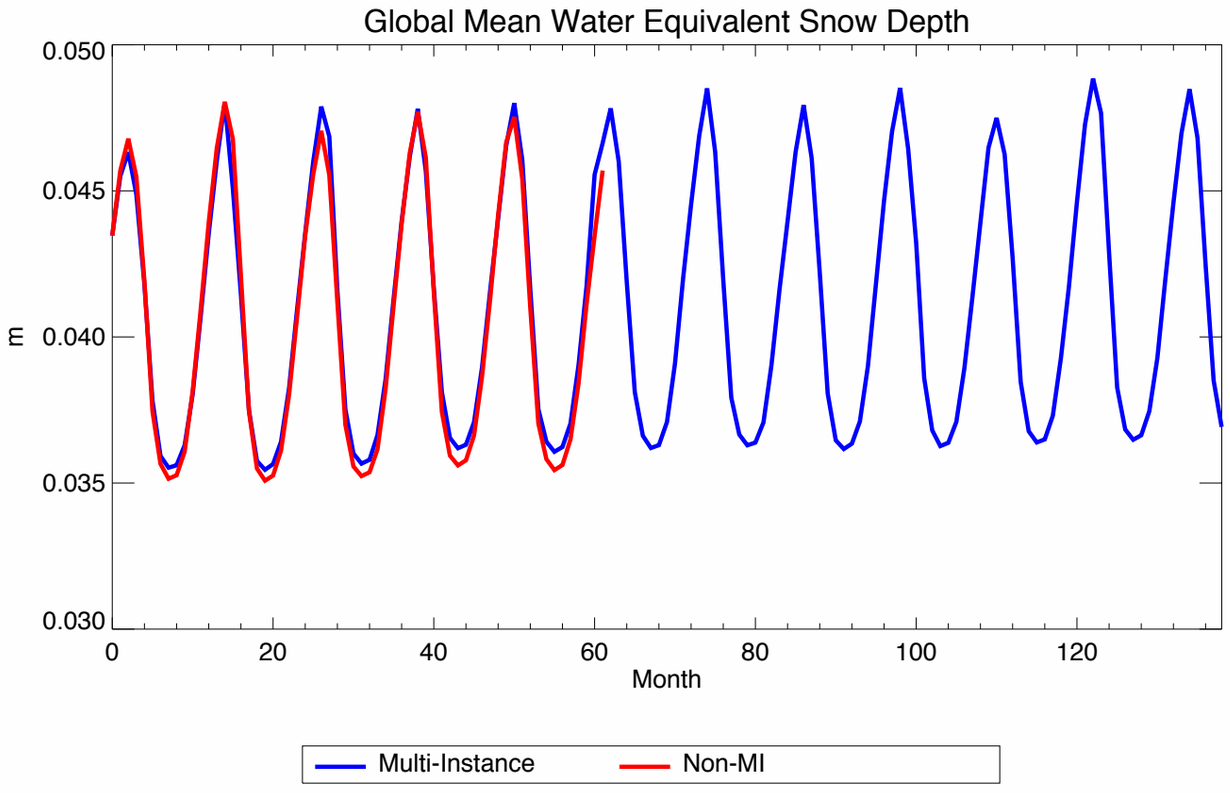
- SASL: water evaporates off leaves, not available to roots
- MASL: Less leaf water than SASL, more than MAML
- Re-partitioning of canopy processes can have large influence on overall behavior
- Other sites (ARM)?

Global Runs-Sanity Checks

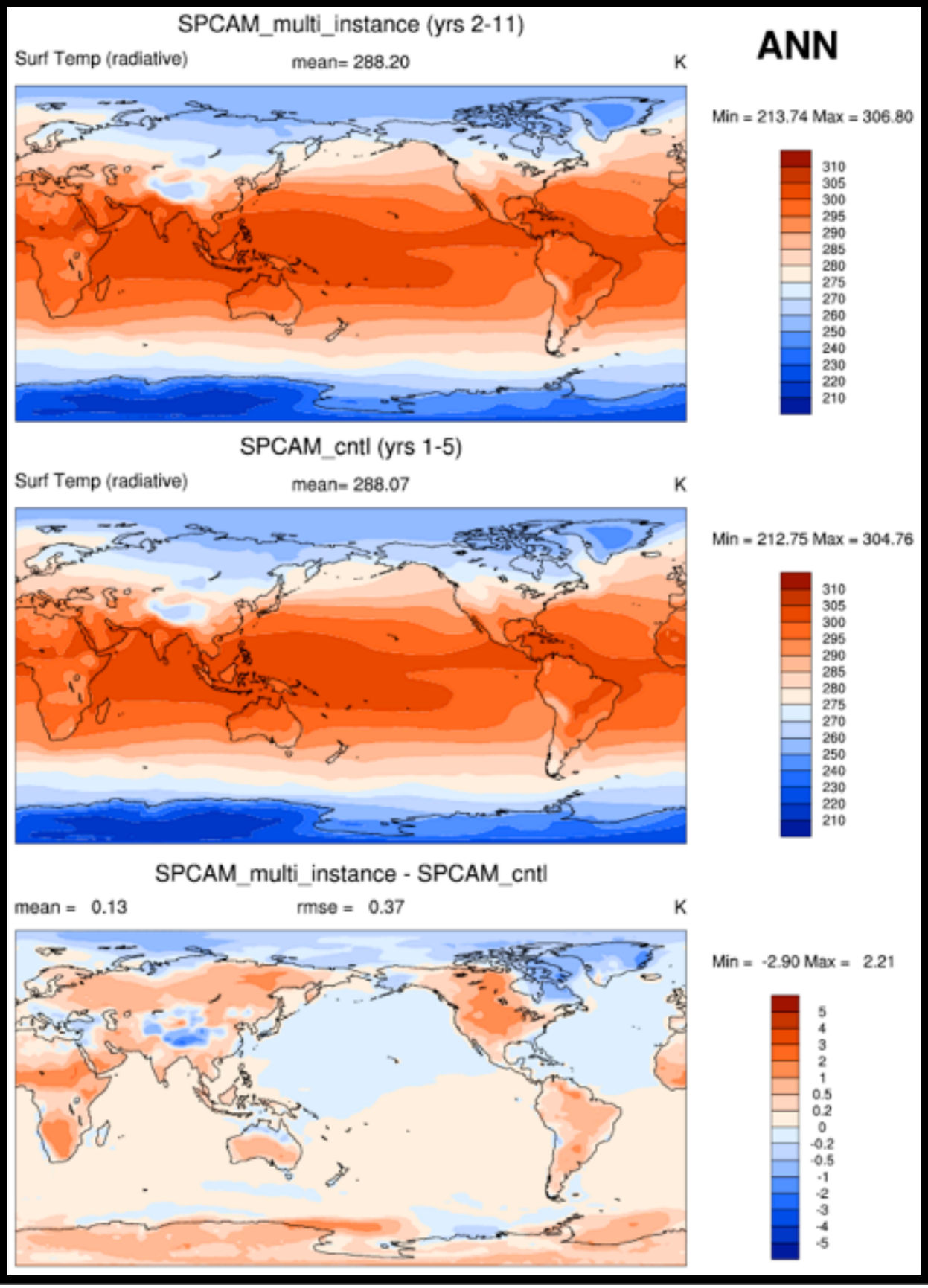


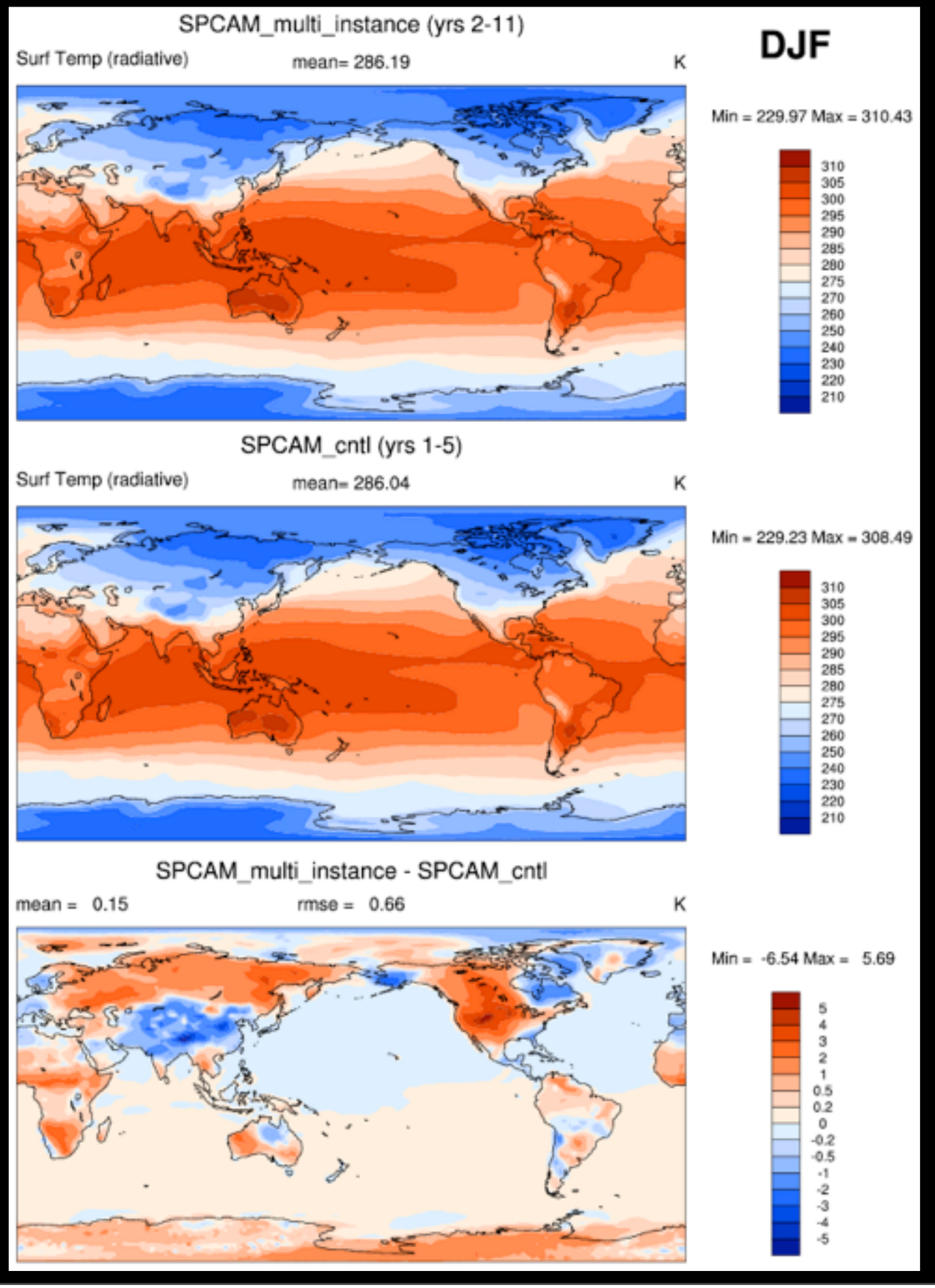




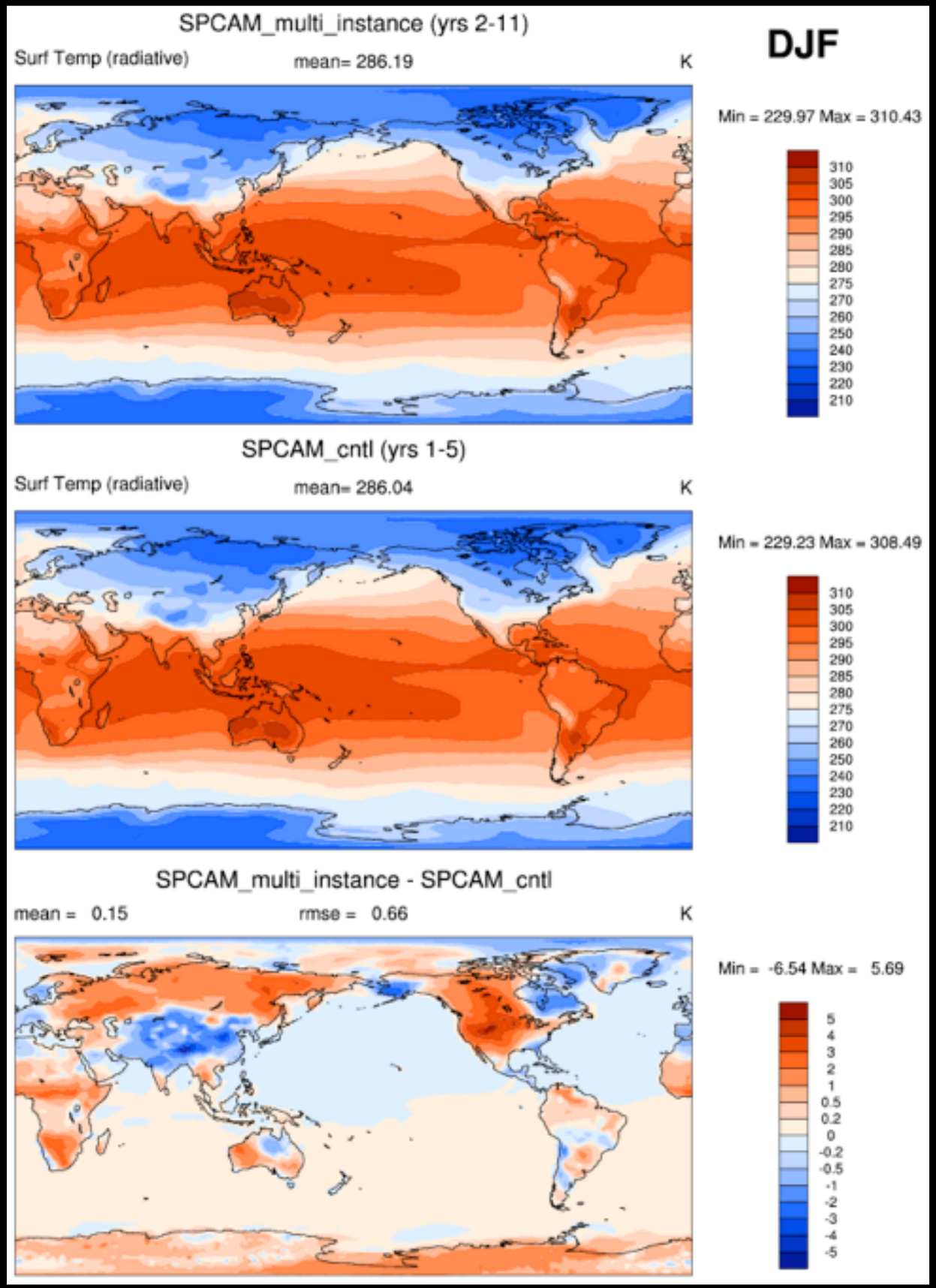


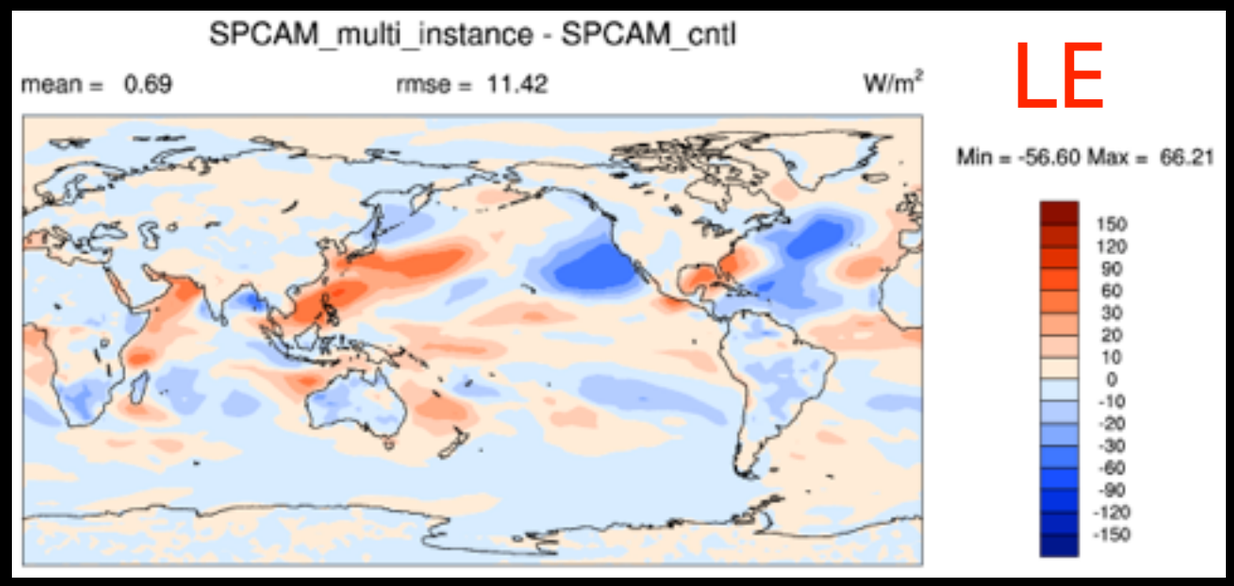
Global Runs - Surface Temperature

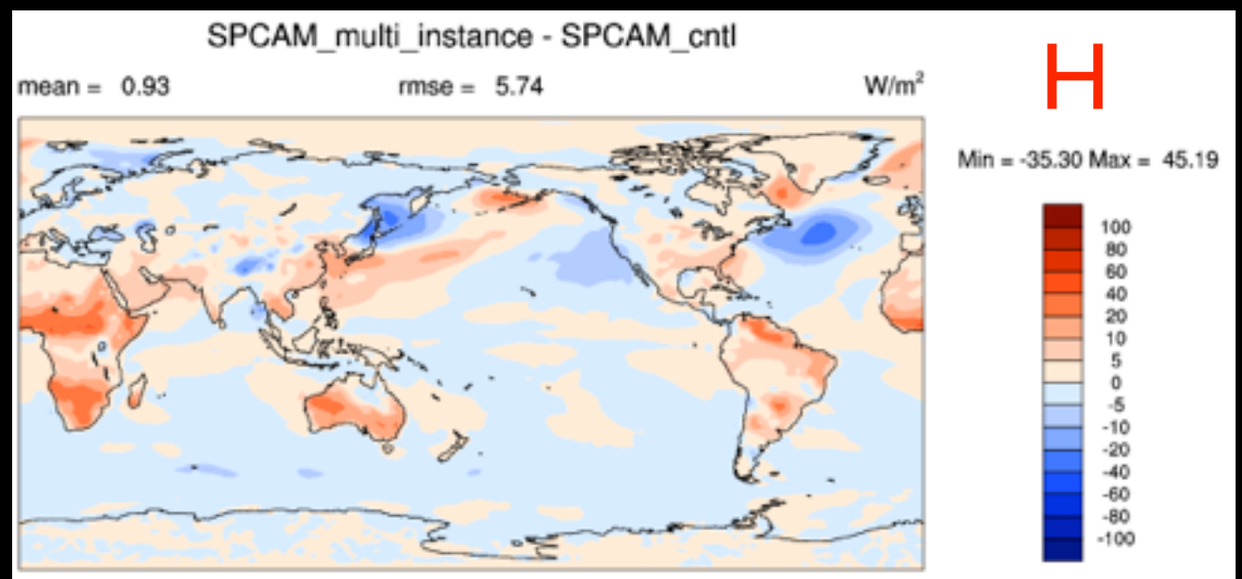




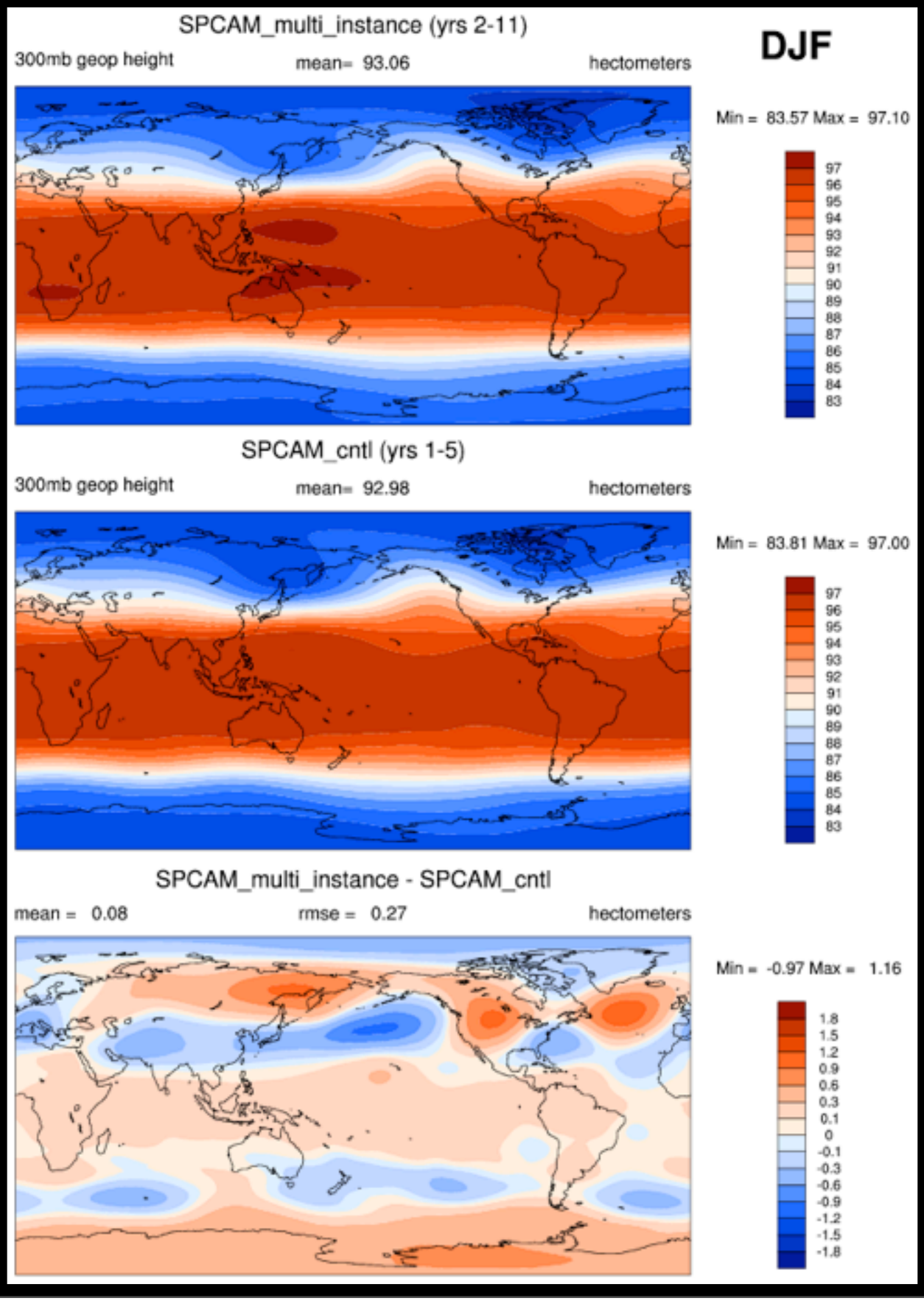
Global Runs - DJF

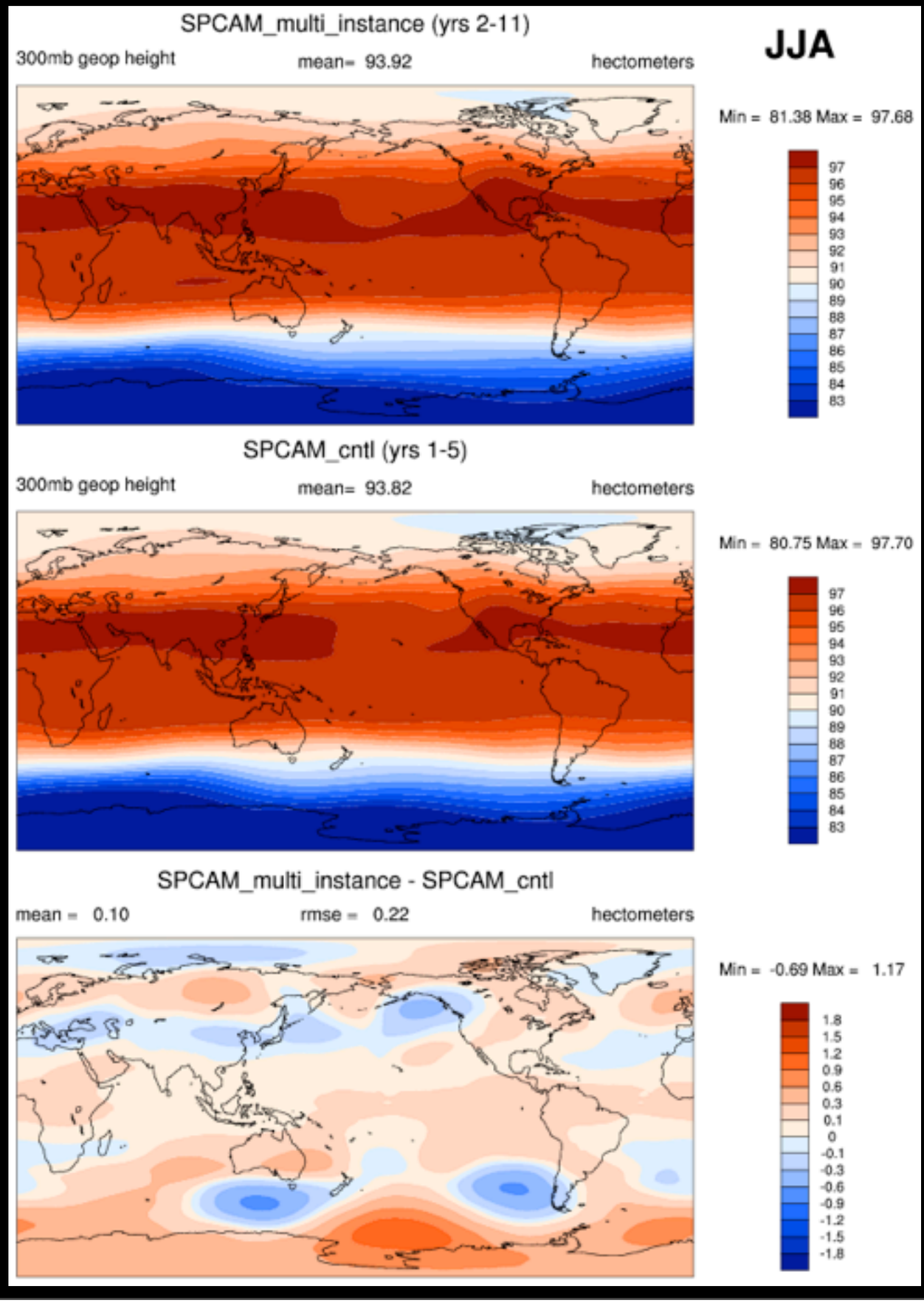






Global Runs - 300mb Height





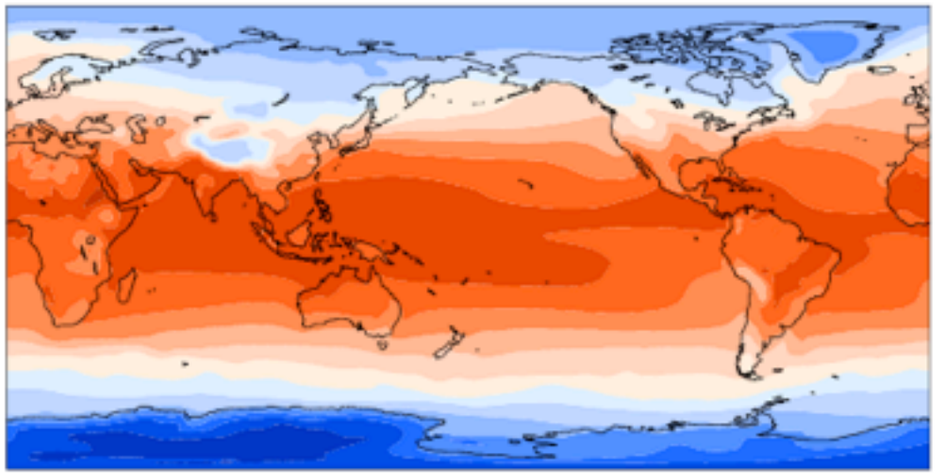
Hotter Land: Bug or a Feature?

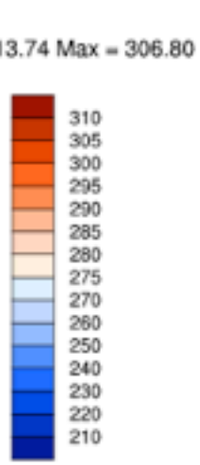
SPCAM_multi_instance (yrs 2-11)

Surf Temp (radiative) mean= 288.20 K

ANN

Min = 213.74 Max = 306.80

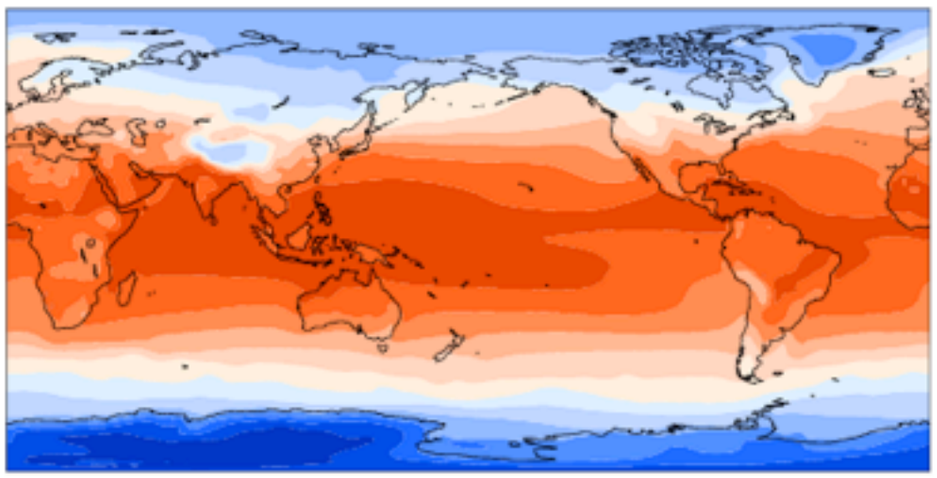


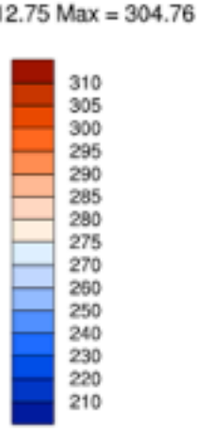


SPCAM_cntl (yrs 1-5)

Surf Temp (radiative) mean= 288.07 K

Min = 212.75 Max = 304.76

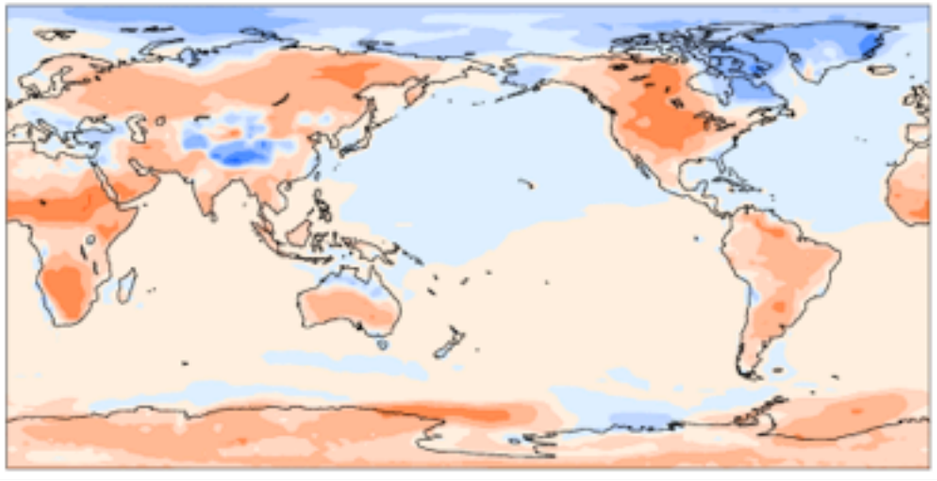


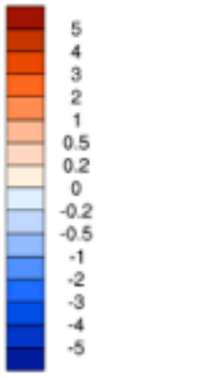


SPCAM_multi_instance - SPCAM_cntl

mean = 0.13 rmse = 0.37 K

Min = -2.90 Max = 2.21



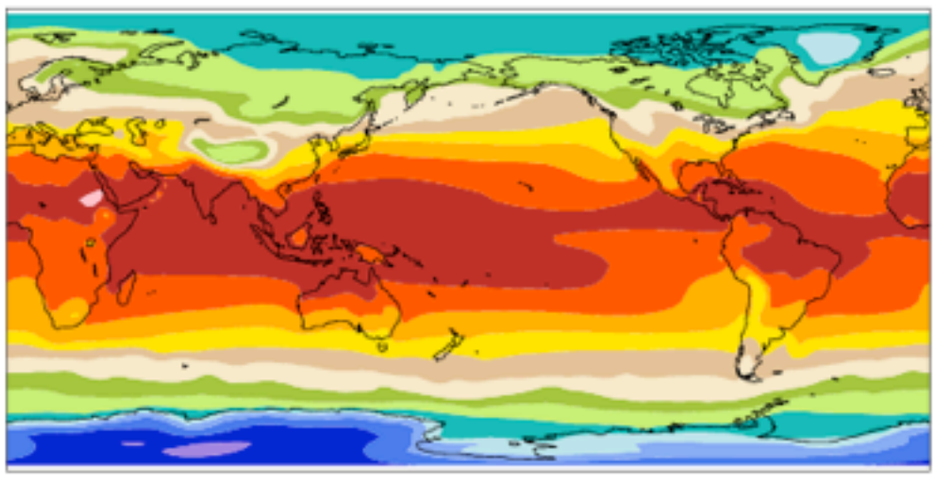


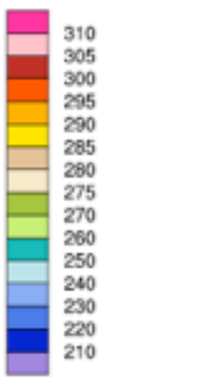
SPCAM3.0 (yrs 1986-2003)

Surf Temp (radiative) mean= 288.06 K

ANN

Min = 208.41 Max = 306.81

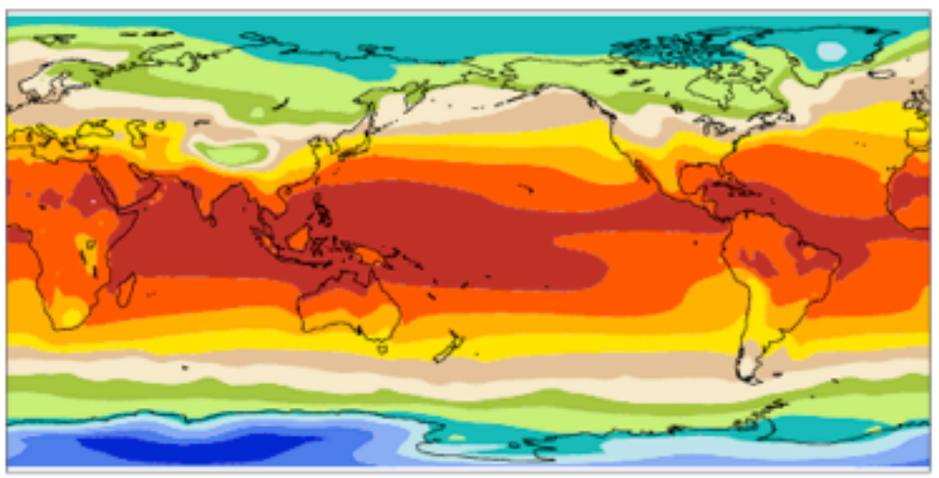


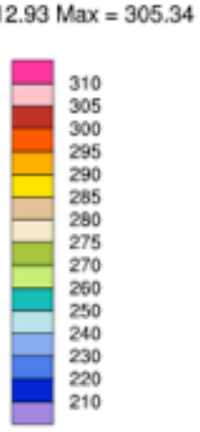


CAM3.0 (yrs 1986-2003)

Surf Temp (radiative) mean= 288.25 K

Min = 212.93 Max = 305.34

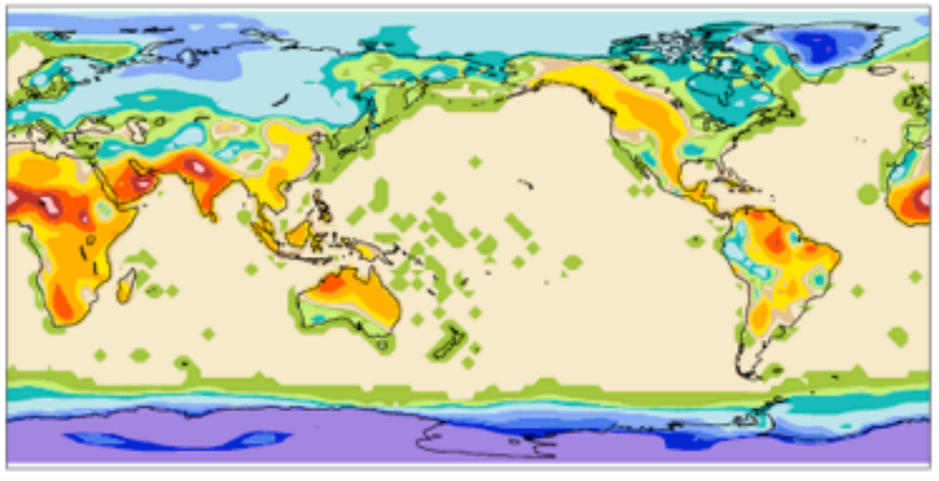


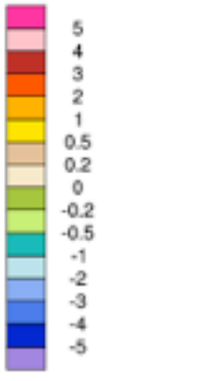


SPCAM3.0 - CAM3.0

mean = -0.19 rmse = 1.54 K

Min = -13.40 Max = 4.77





Summary

- We have distributed land working in SP-CESM
- We still have work to do
  - Tracers (CO2)
  - code compliance
  - testing
- Code should be available for checkout within 1 year