CONTINENTAL SCALE SIMULATION OF THE SOUTH AMERICAN MONSOON

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WRF WORKSHOP – JUNE 2007

MOTIVATION

LONG TERM GOAL

- Use the WRF model as a modeling framework for *quantitatively* testing hypothesis on the impacts of different types of forcing (SST, soil moisture, transient eddies, etc) to SAMS variability over a wide range of timescales (diurnal to inter-annual)

SHORT TERM GOALS…

- Verify that WRF gives a reasonable simulation of SAMS precipitation and circulation patterns (*Topic of this talk*)
- Determine ‘optimal’ model settings

EXPERIMENTAL SETUP

Time Period:

July 30 2000 – April 1 2003

Includes SALLJEX observing period

Domain:

72 km horizontal spacing

38 vertical levels

Dynamics:

ARW core (v2.2)

Hydrostatic

Physics:

KF (new) Convection

Ferrier Microphysics

NOAA LSM

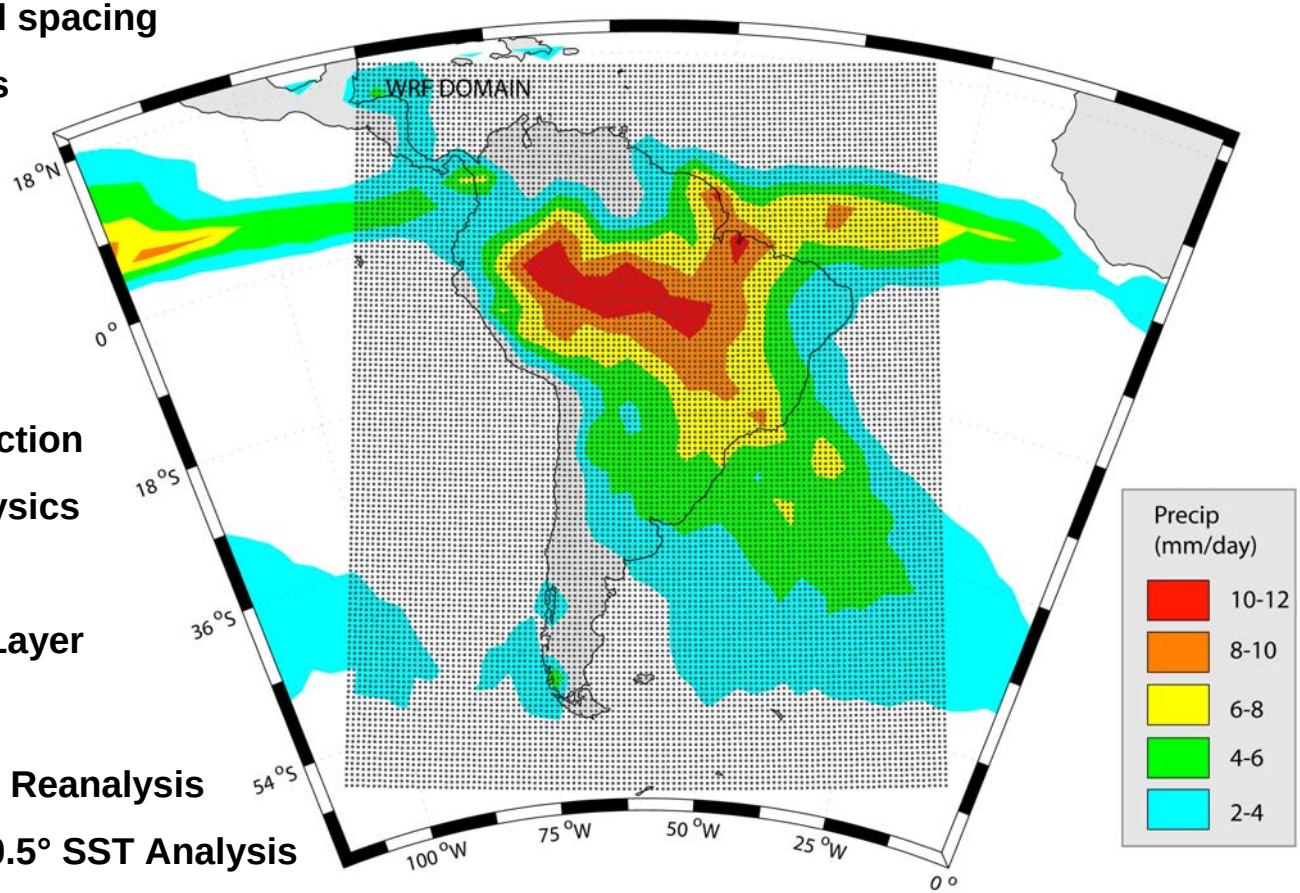
MYJ Boundary Layer

Boundary Condition:

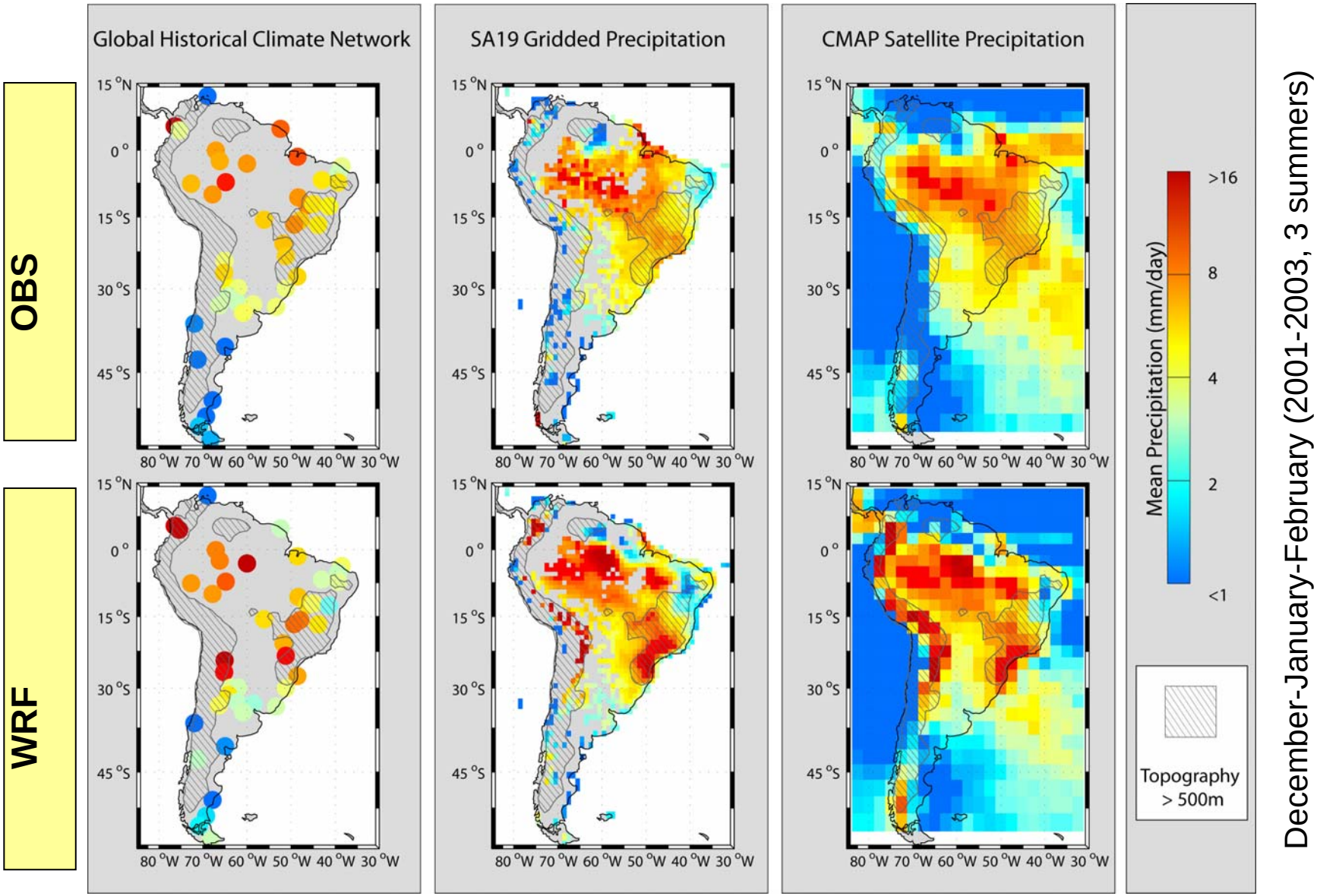
6 h NCEP/NCAR Reanalysis

Monthly SODA 0.5° SST Analysis

Integrated continuously, no nudging, no re-initialization

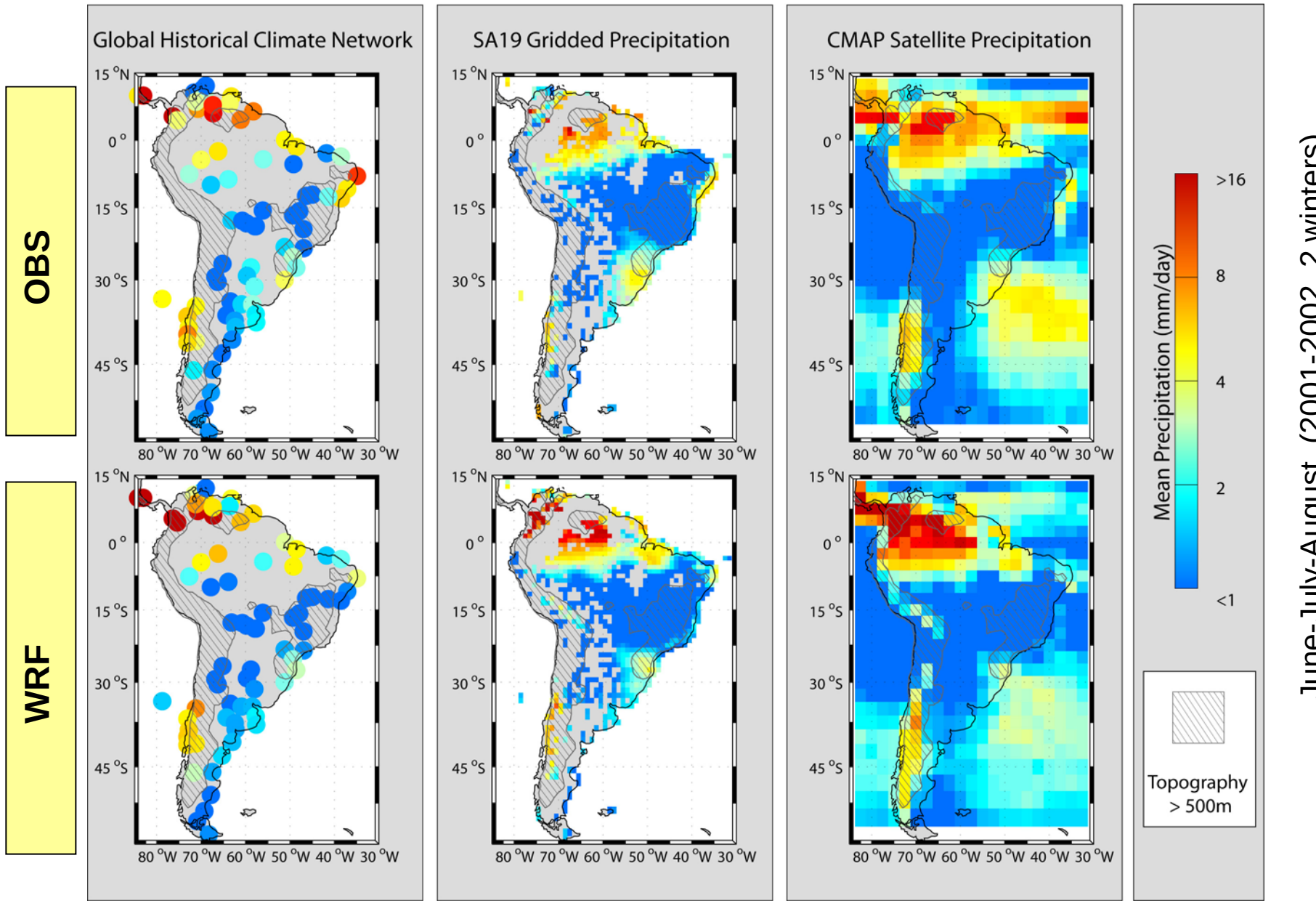


MEAN SUMMER PRECIPITATION

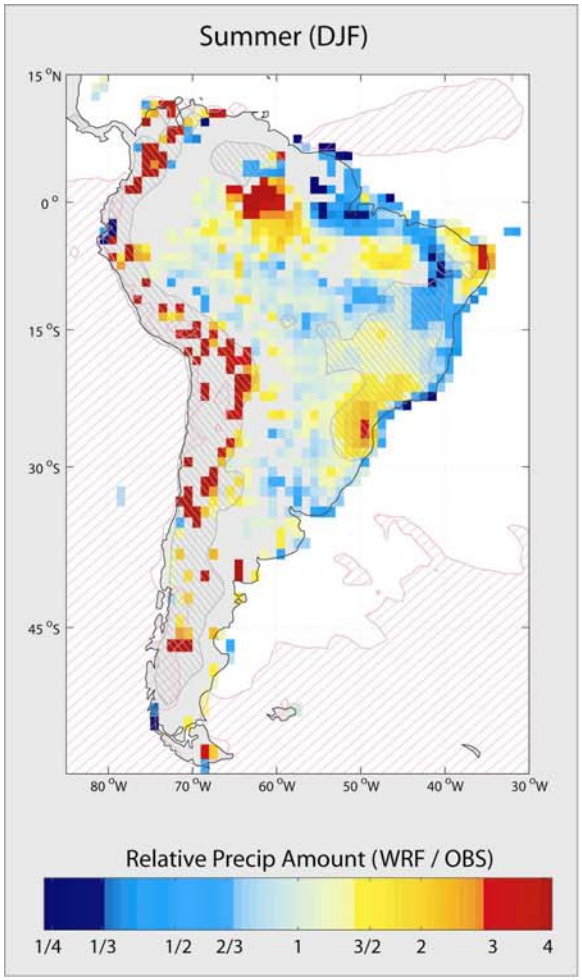


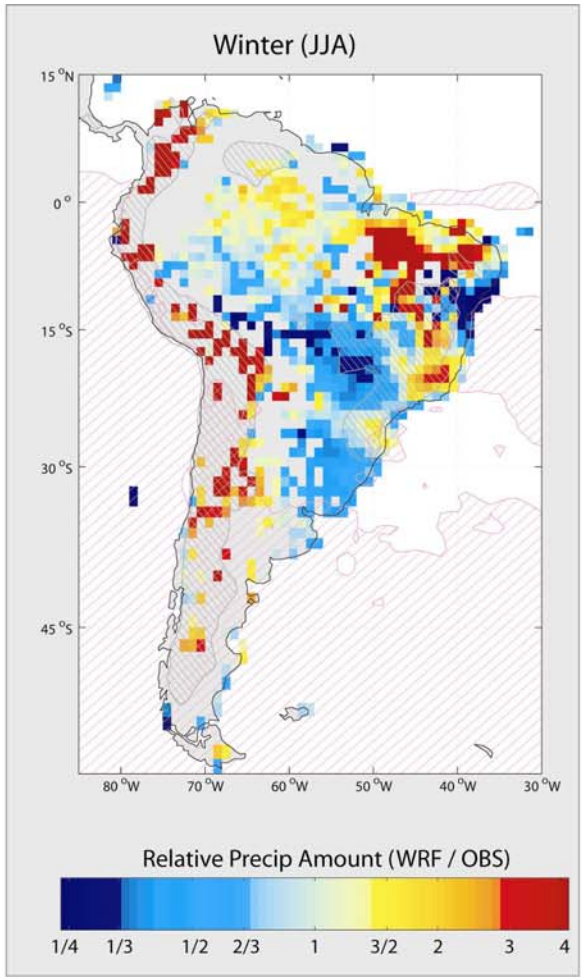
Liebmann and Allured, 2005
1° Analysis of Daily Raingauge

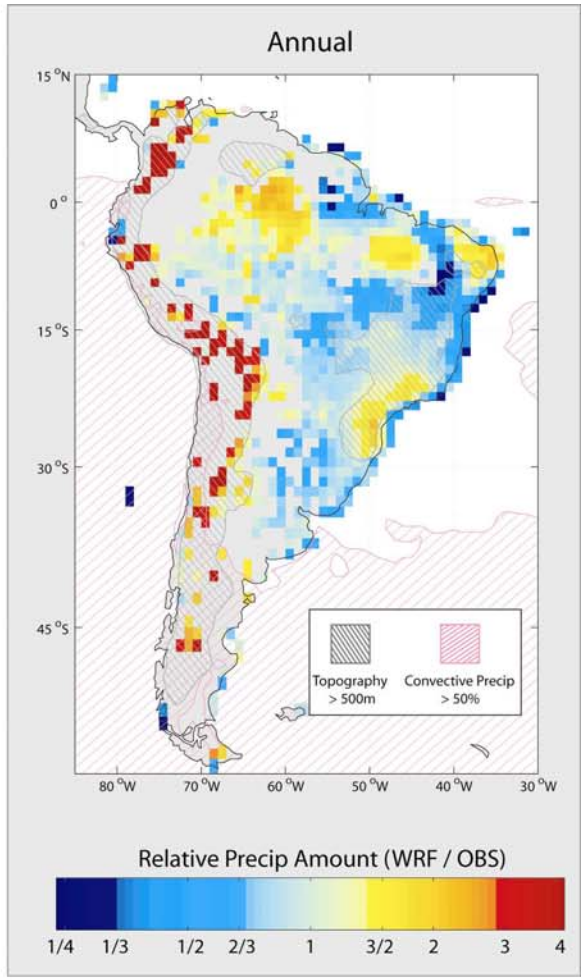
MEAN WINTER PRECIPITATION



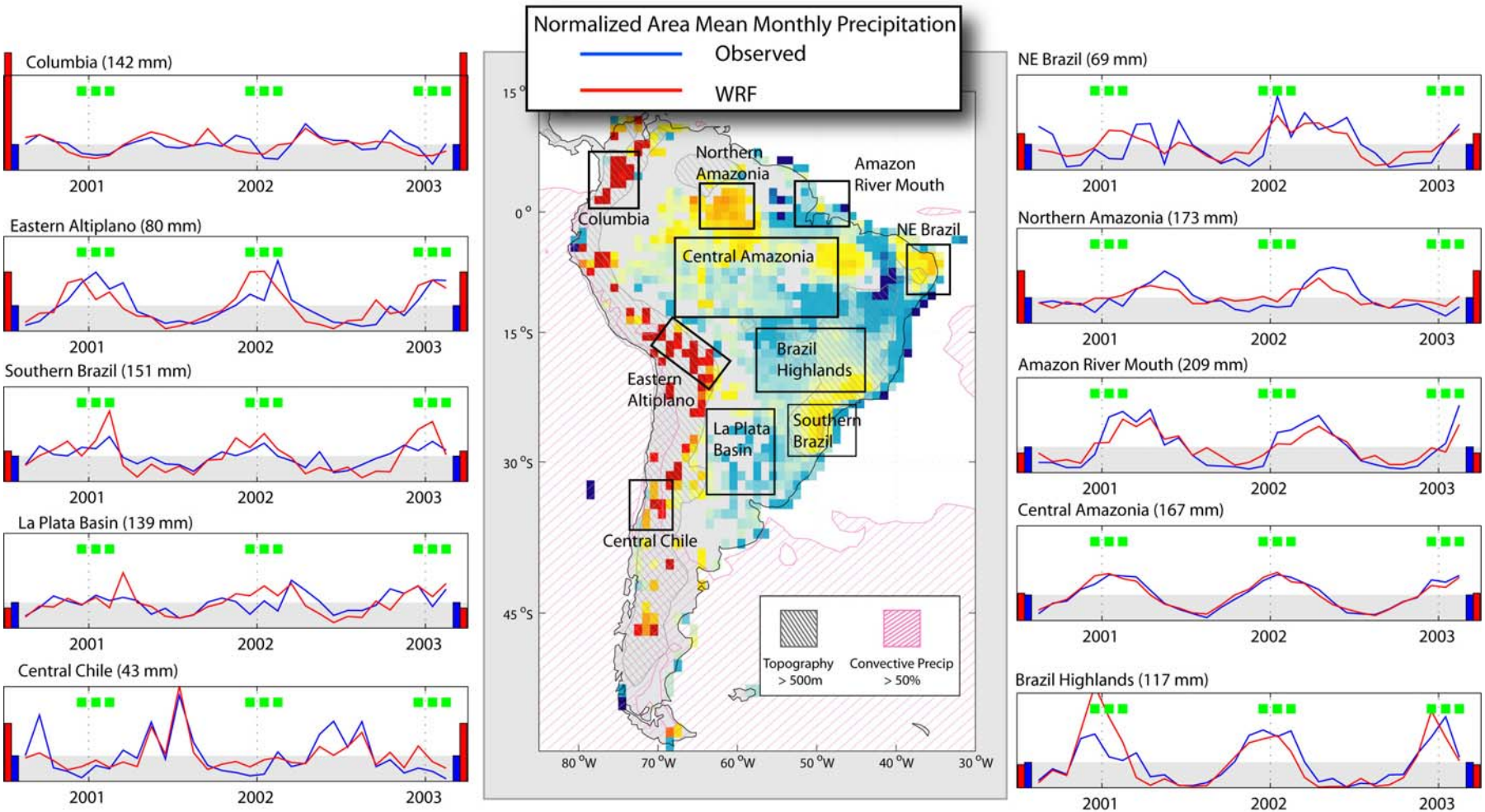
RELATIVE PRECIPITATION ERRORS



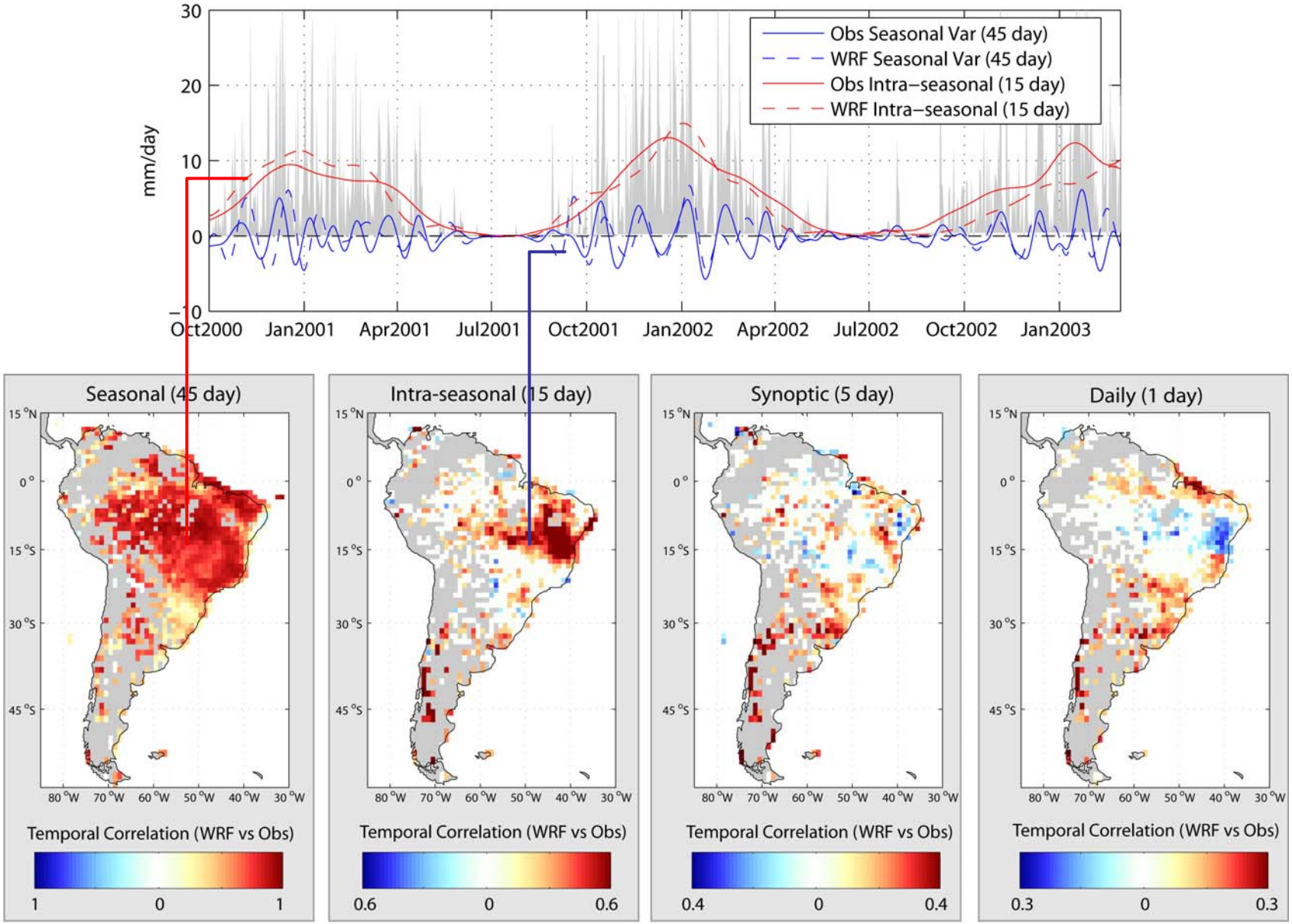




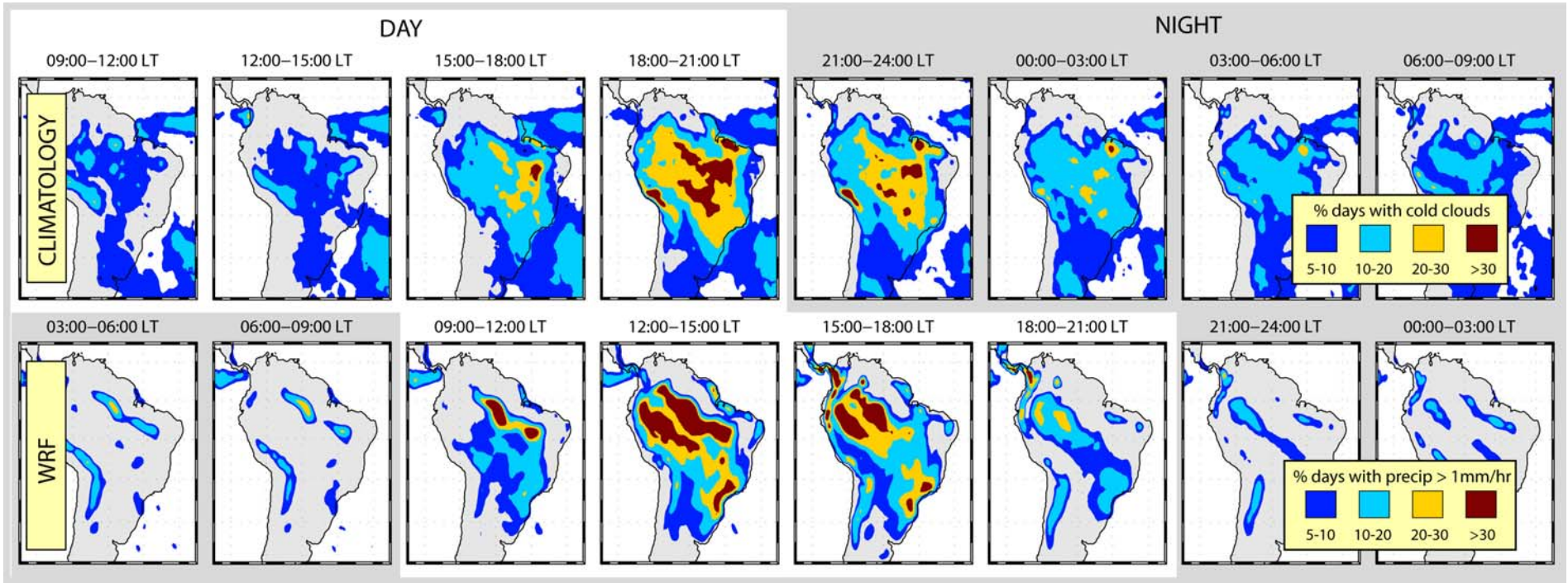
ANNUAL CYCLE



SEASONAL AND SUB-SEASONAL VARIABILITY

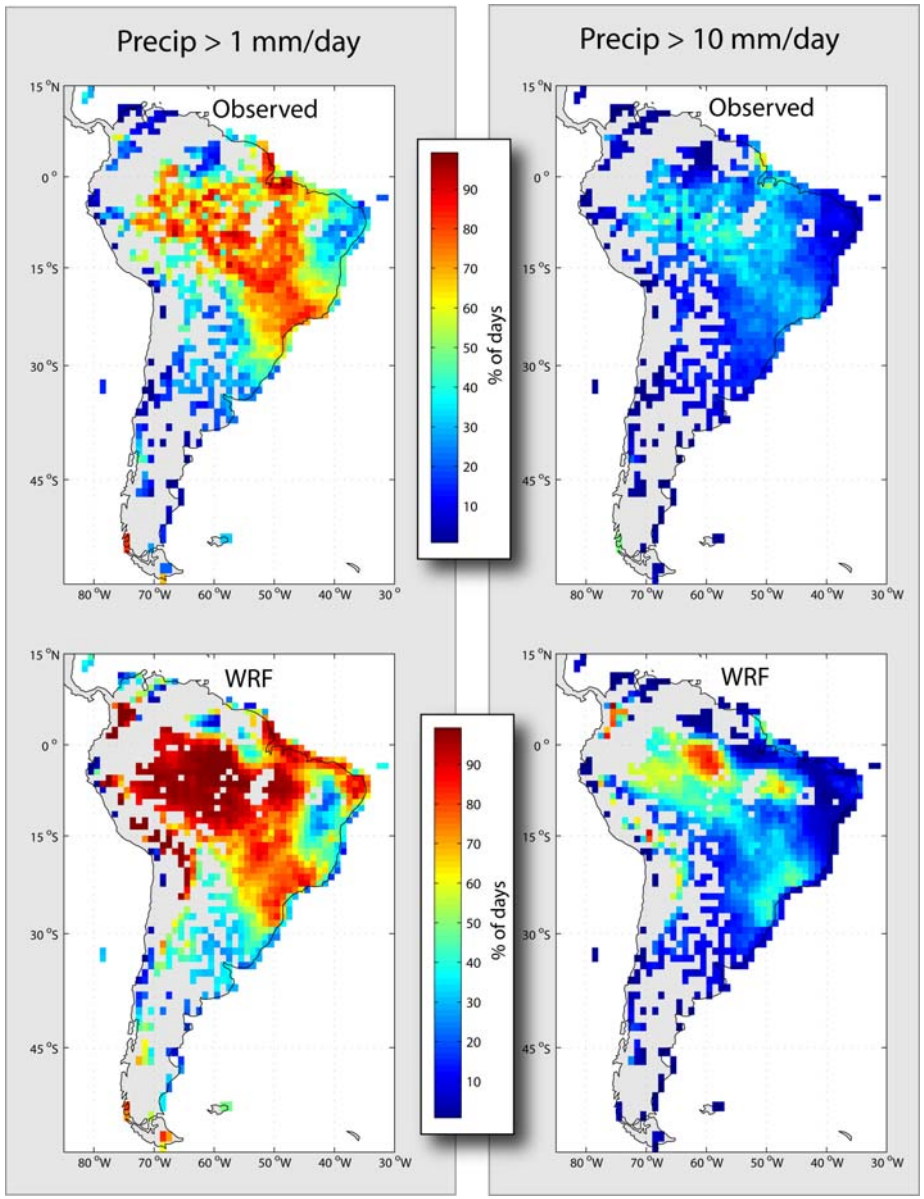


DIURNAL CYCLE

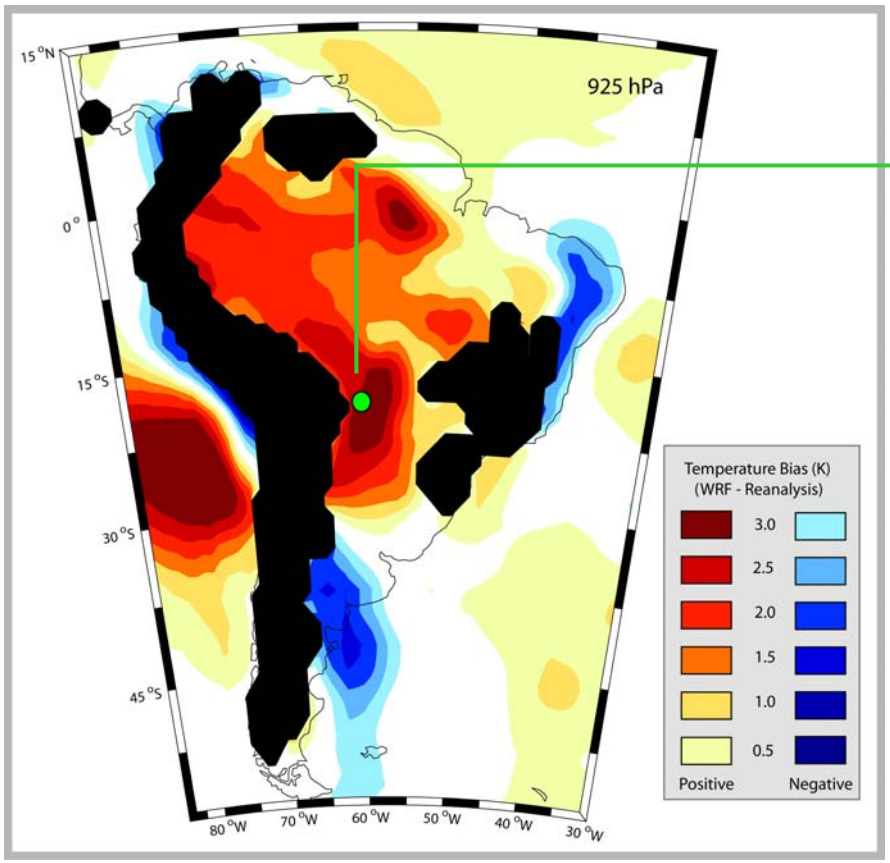


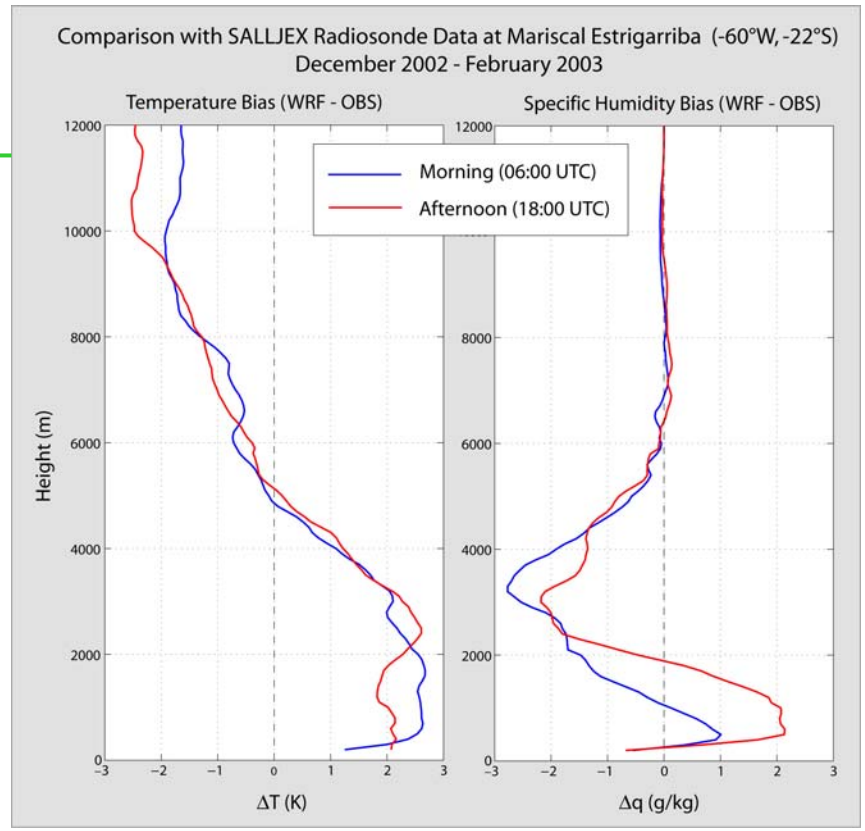
- WRF convective precipitation precedes cloudiness observations by 6 hours
- But WRF's precipitation maxima between 1200-1500 UTC agrees with TRMM climatologies (not shown)

FREQUENCY OF PRECIPITATION OCCURANCE

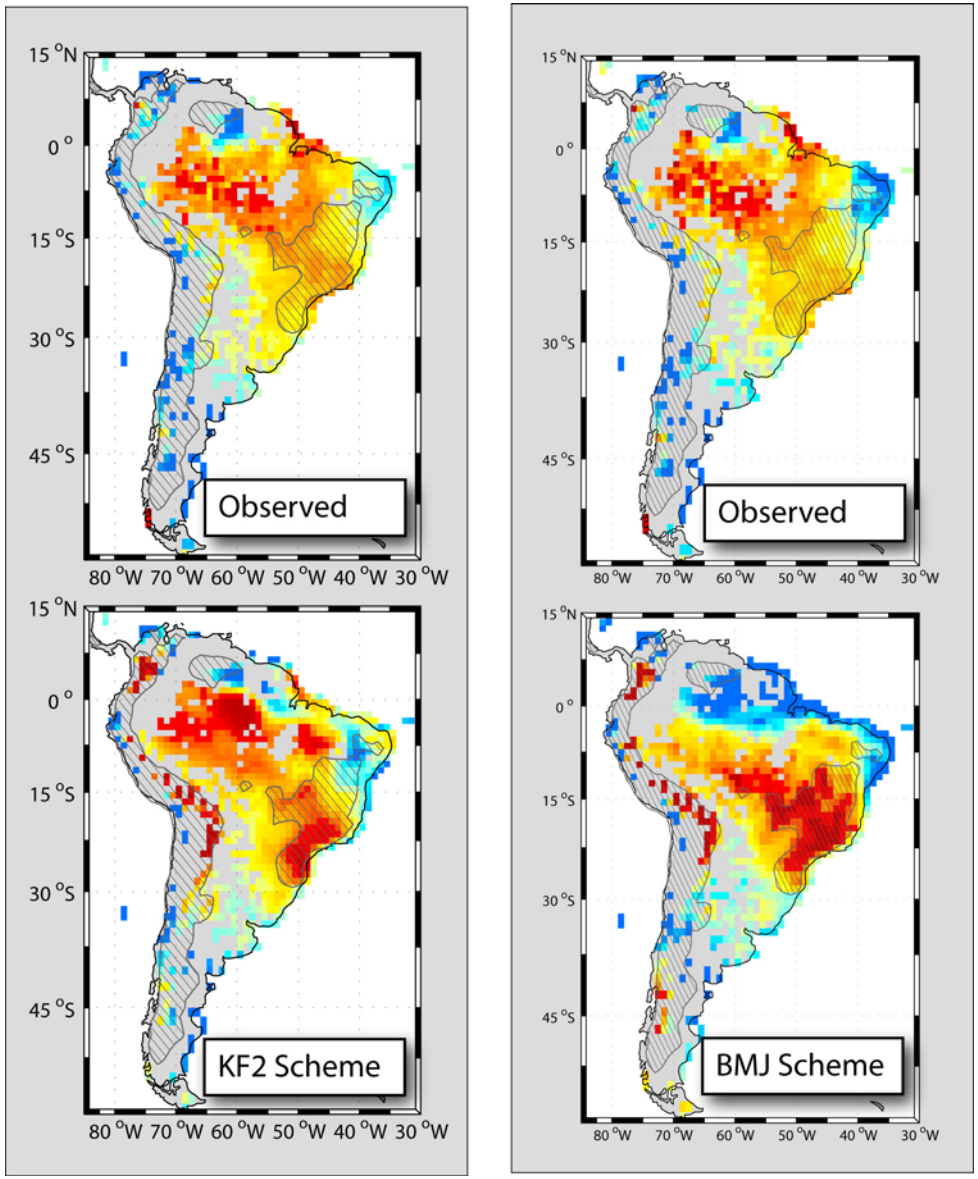


VALDATION OF ATMOSPERIC FIELDS: TEMPERATURE



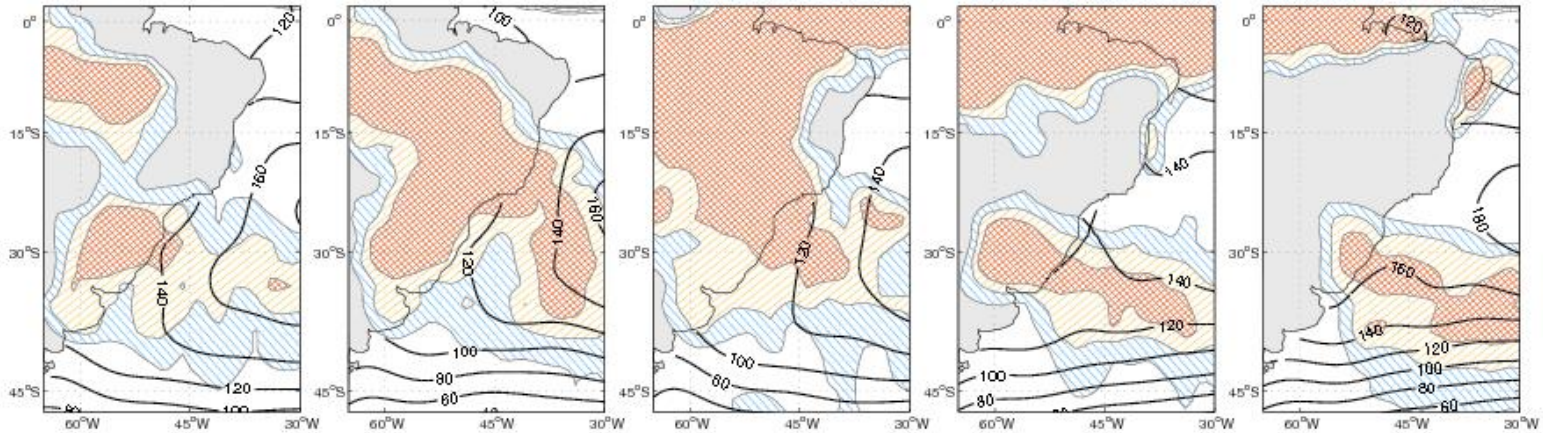


KAIN FRITSCH VS BETTS-MILLER-JANJIC



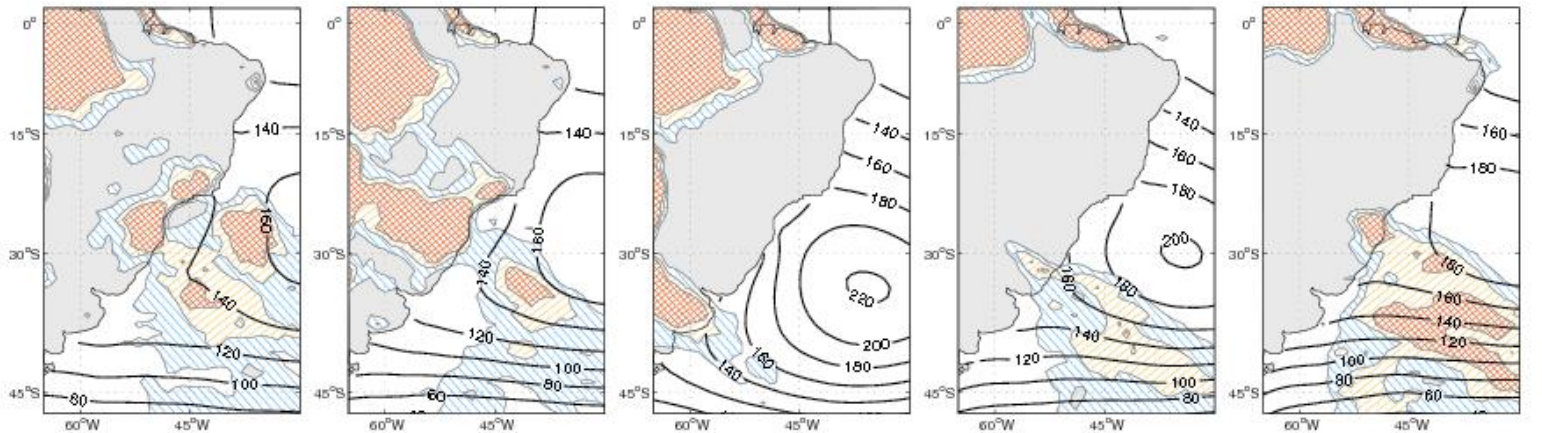
ALTERNATIVE SEA SURFACE TEMPERATURES

Reanalysis/CMAP



WRF constant winter SST

Dec Feb Apr May



Unrealistic SST = disaster for the SAM…

CONCLUSIONS

The WRF model has been run continuously over three years over the entire South American continent at low resolution.

- Precipitation is generally well simulated: Major spatial patterns are captured and annual cycles, intra-seasonal variability, diurnal cycles and precipitation occurrence frequencies are well reproduced.
- But there are regions where (*orographic*) rainfall is over greatly predicted, including NE Brazil, Northern Amazonia, the entire length of the Andes (E and W sides)
- Kain-Fristch CP seems to work better than Betts-Miller-Janjic in this case
- A reasonable SST is essential

Future Work = More simulations: Other physics schemes, Higher spatial resolution, longer time periods (> 10 years)