CONTINENTAL SCALE SIMULATION OF THE SOUTH AMERICAN MONSOON
(plus ACC simulations)

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1. CONTINENTAL SCALE WRF SIMULATIONS

CONTEX

* VAMOS modeling plan stresses the use of multi-scale approach to capture interactions between the local scale processes and regional and larger scale variability.

* DGF has ample experience with WRF and MM5 for short term simulations. Both models allow an easy way to test parameterizations, modify topography and other BC.

LONG TERM GOAL

- Use the WRF model as a modeling framework for *quantitatively* testing hypothesis on the impacts of different types of forcing on SAMS variability over a wide range of timescales (diurnal to inter-annual). e.g, SST, Soil moisture, **Transient eddies (i.e, cold surges)**

SHORT TERM GOALS…

- Verify that WRF gives a reasonable simulation of SAMS precipitation and circulation patterns
- 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

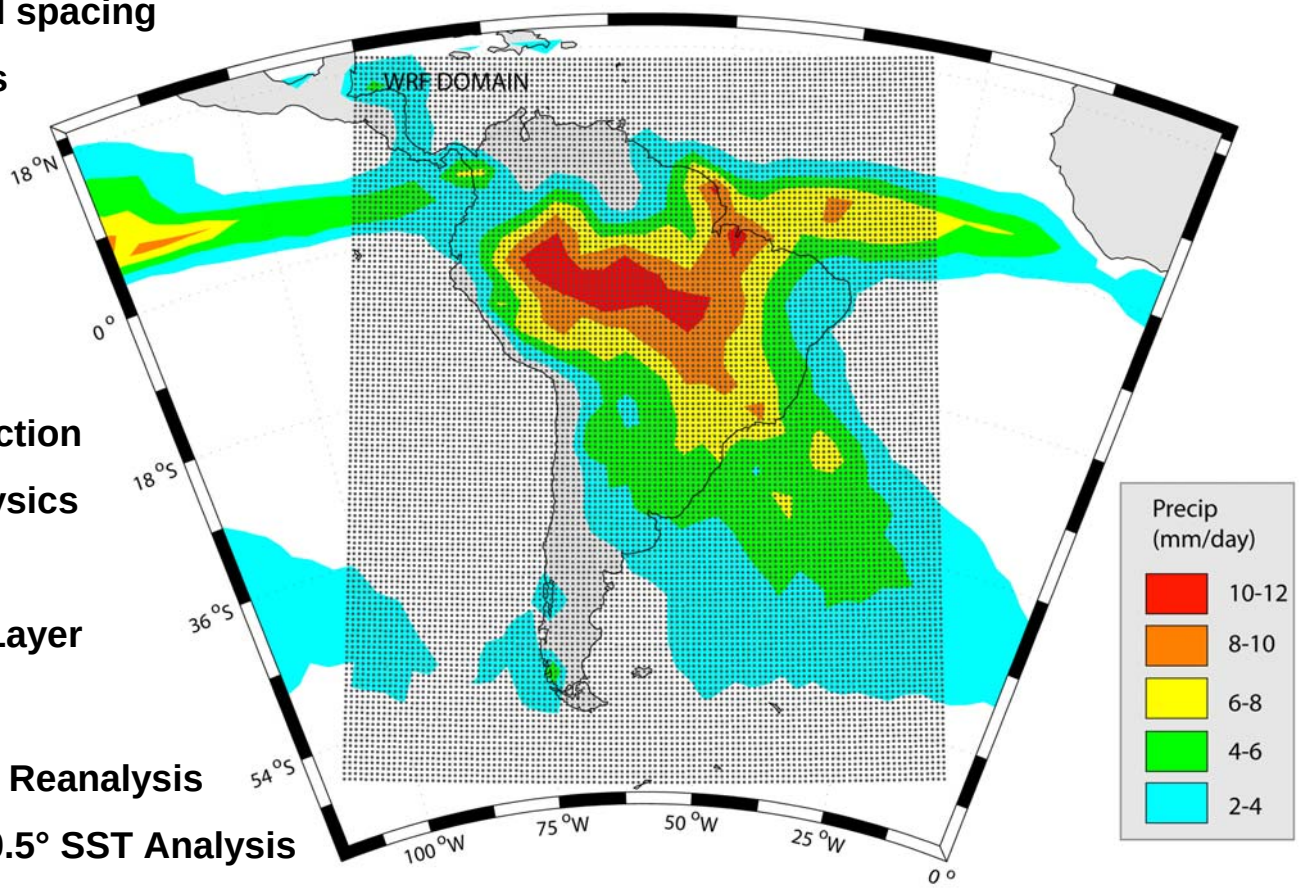
MYJ Boundary Layer

Boundary Condition:

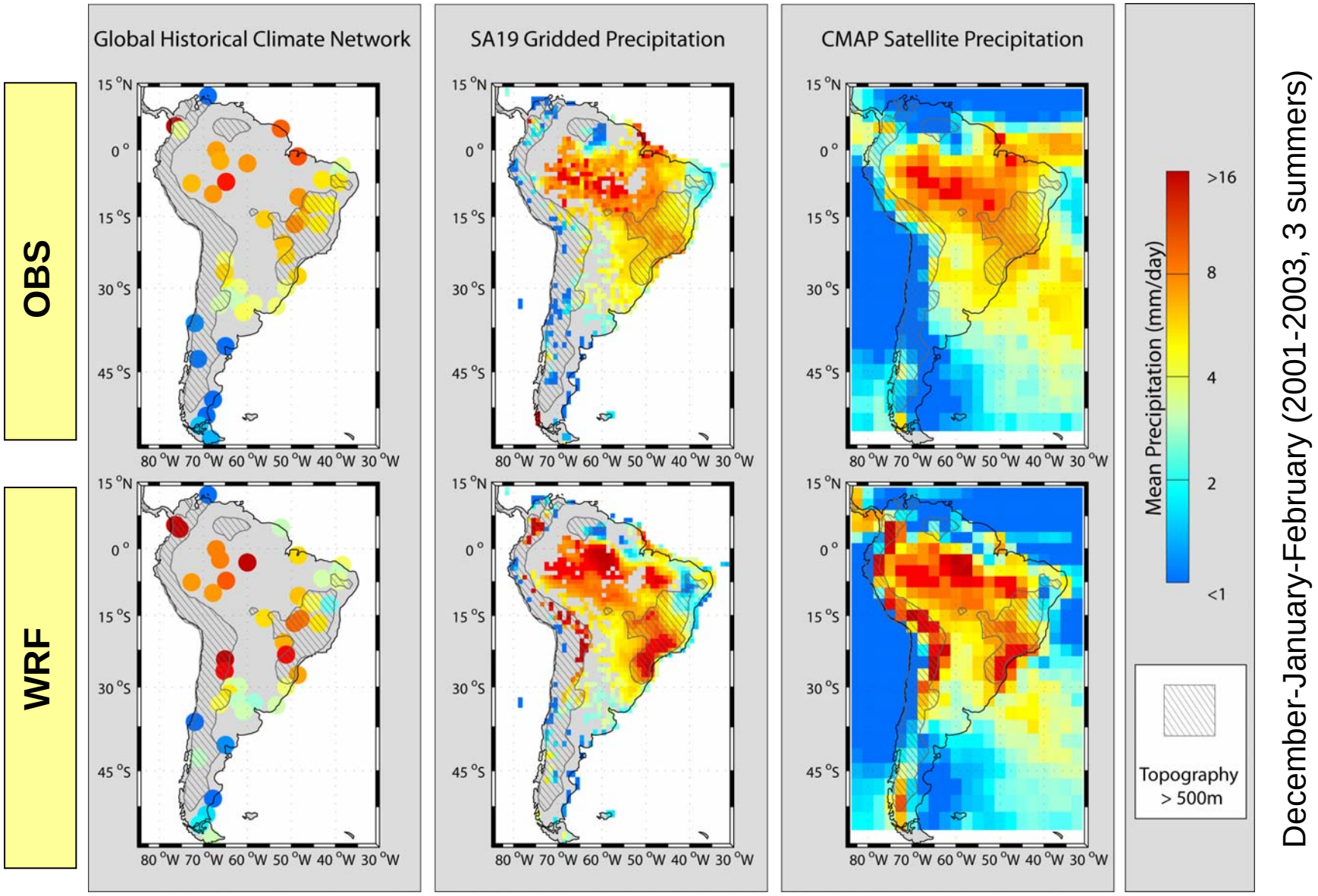
6 h NCEP/NCAR Reanalysis

Monthly SODA 0.5° SST Analysis

Integrated continuously, no nudging, no re-initialization

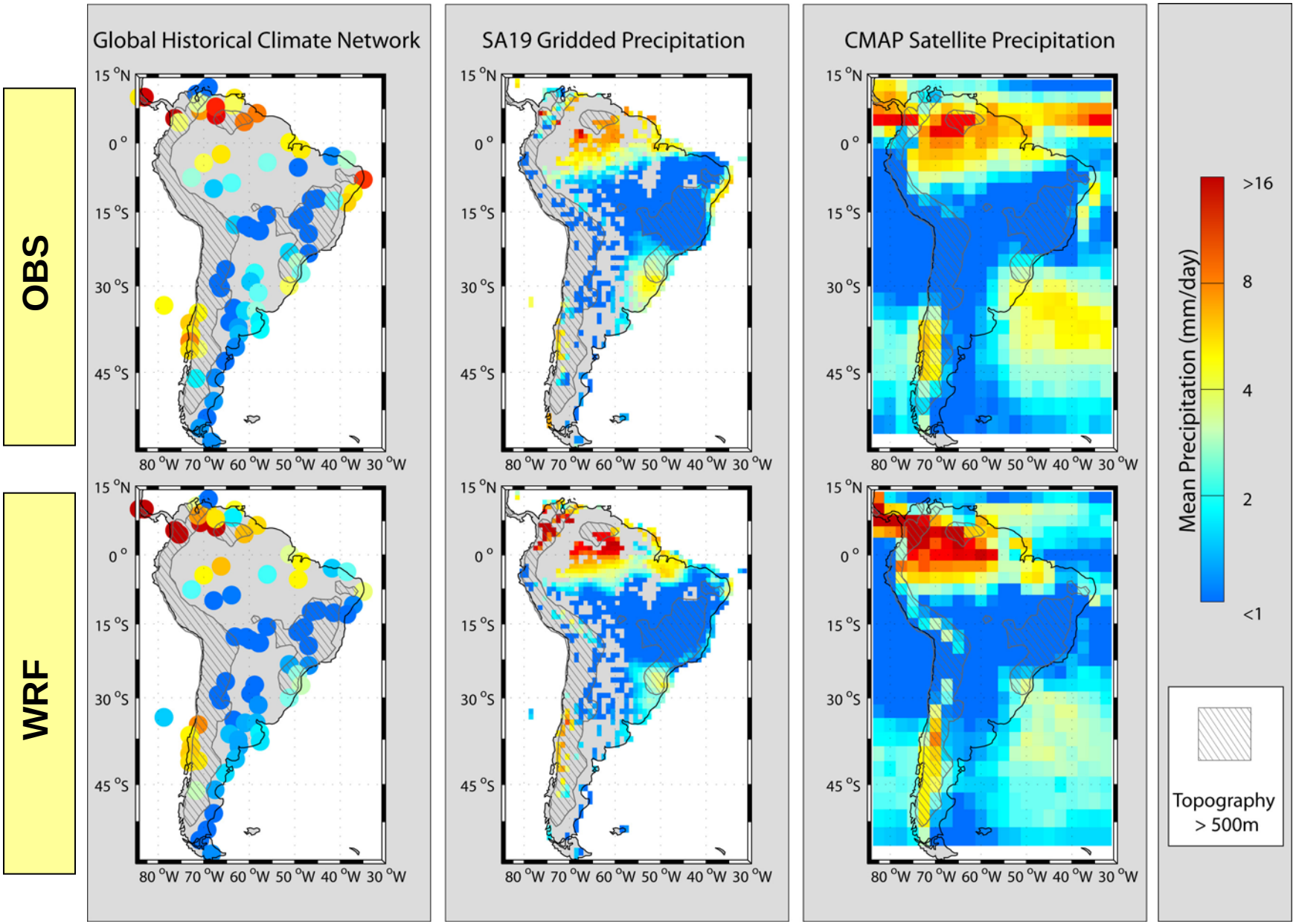


MEAN SUMMER PRECIPITATION

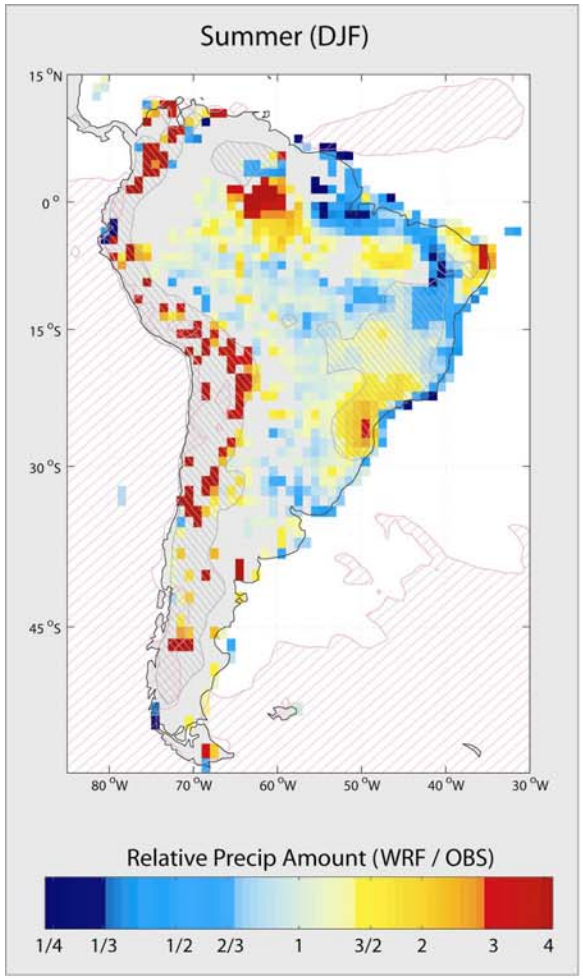


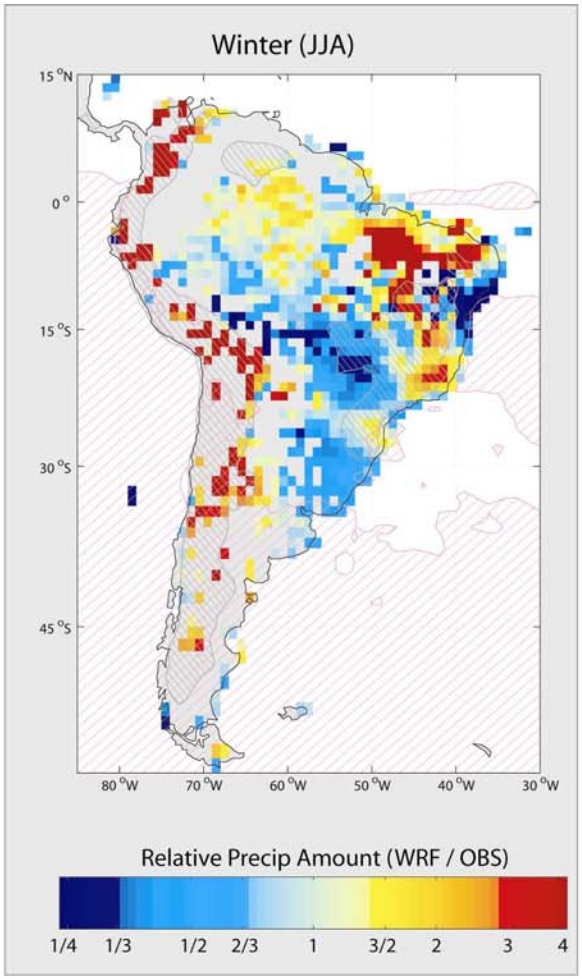
Liebmann and Allured, 2005
1° Analysis of Daily Raingauge

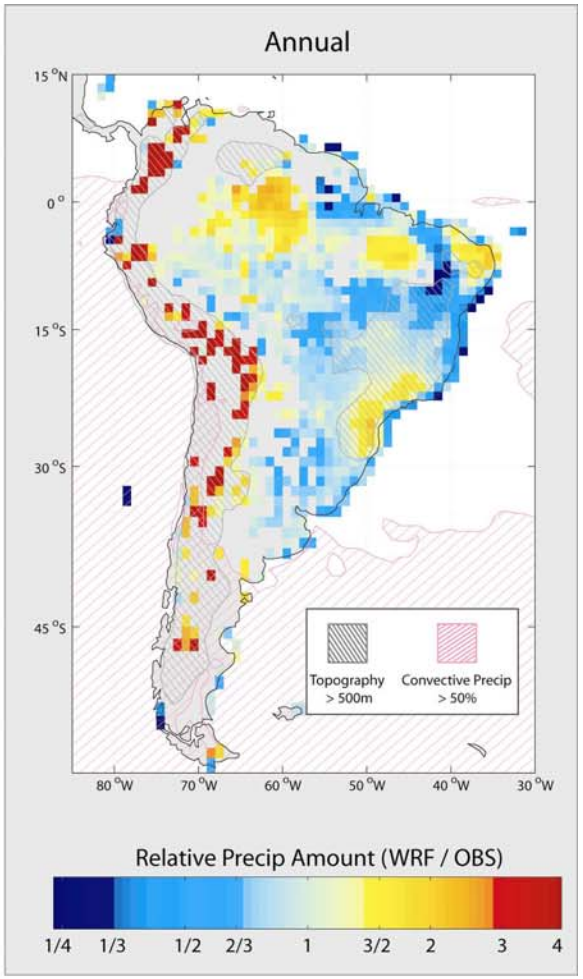
MEAN WINTER PRECIPITATION



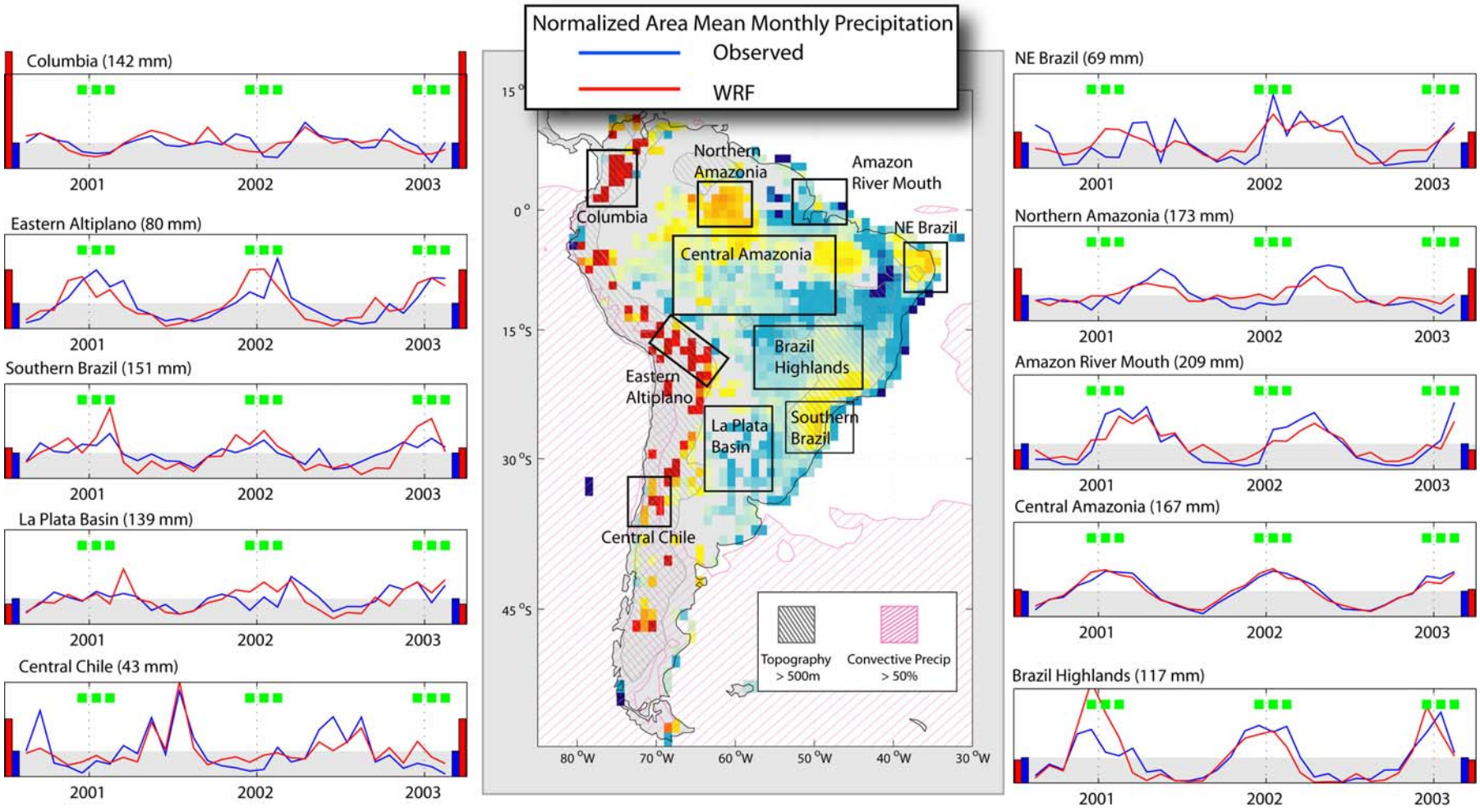
PRECIPITATION ERRORS



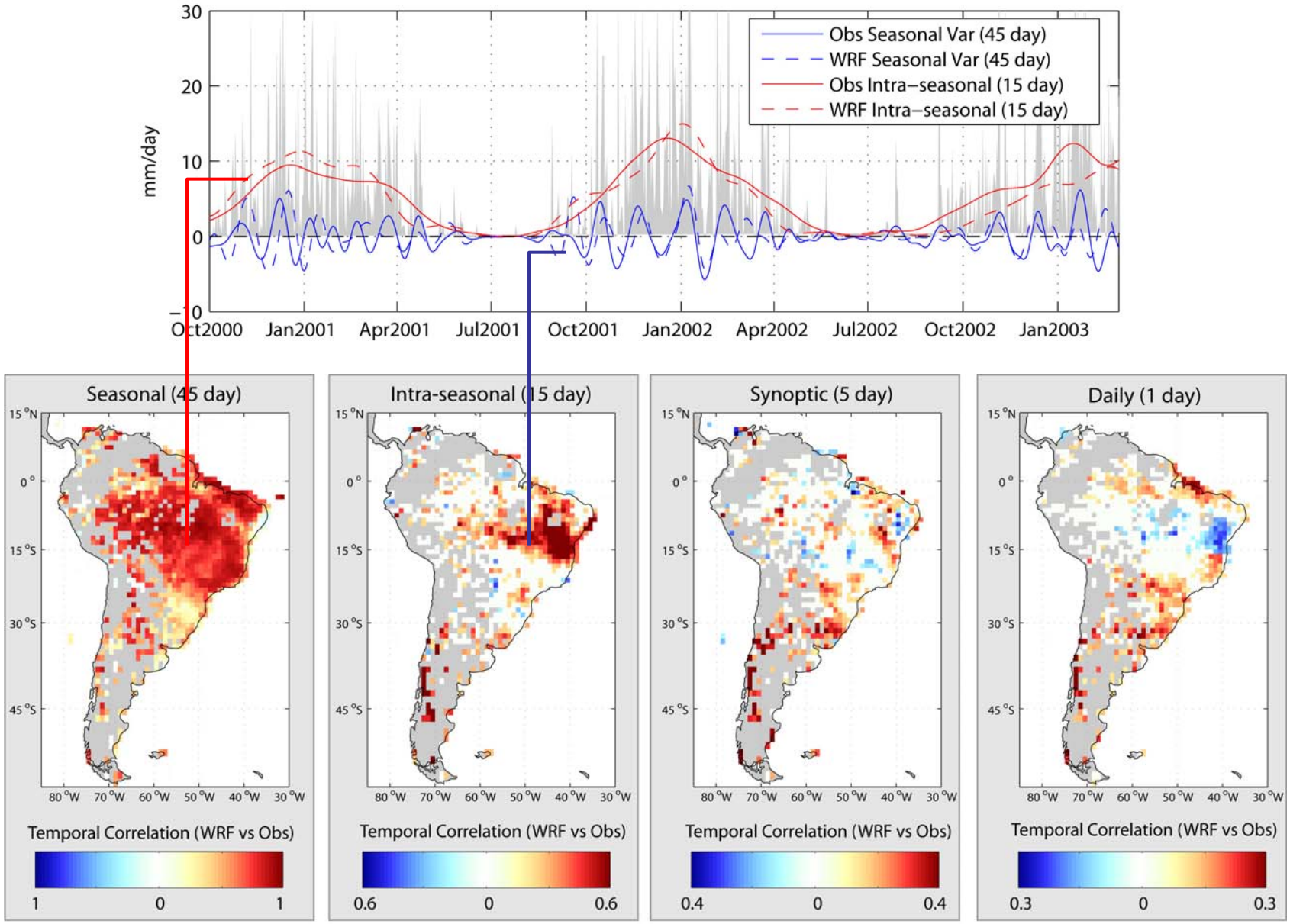




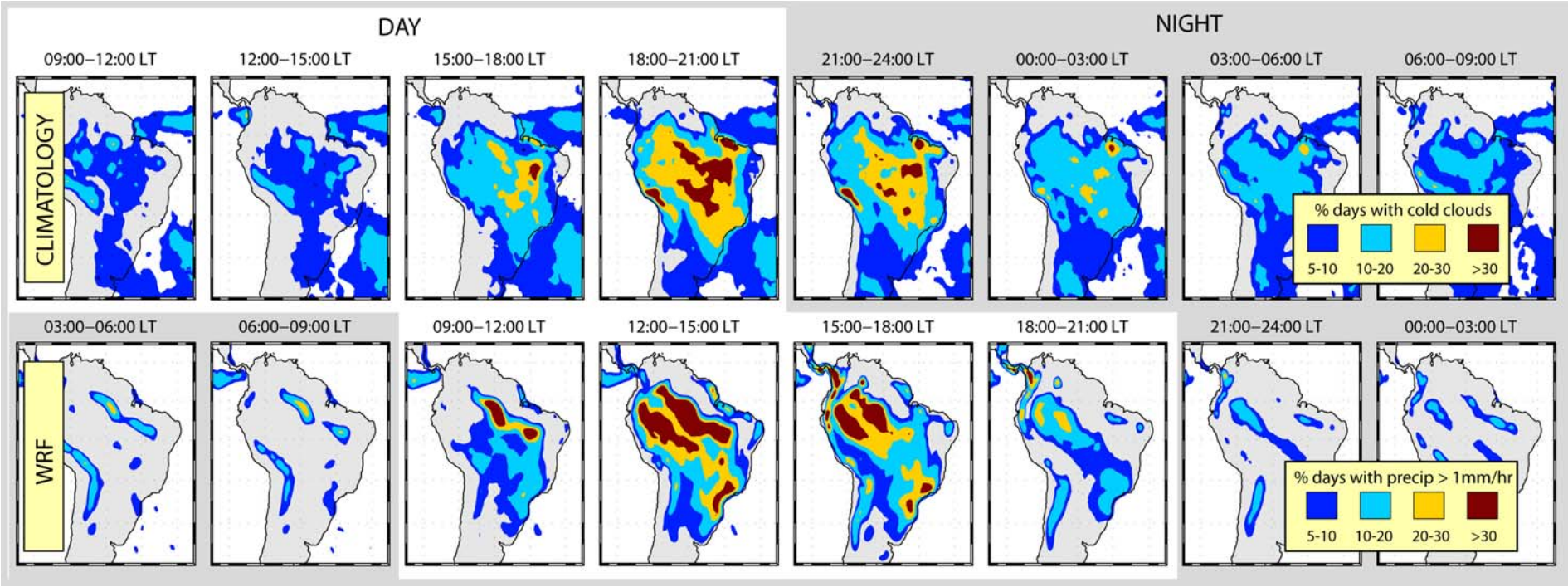
ANNUAL CYCLE



SEASONAL AND SUB-SEASONAL VARIABILITY

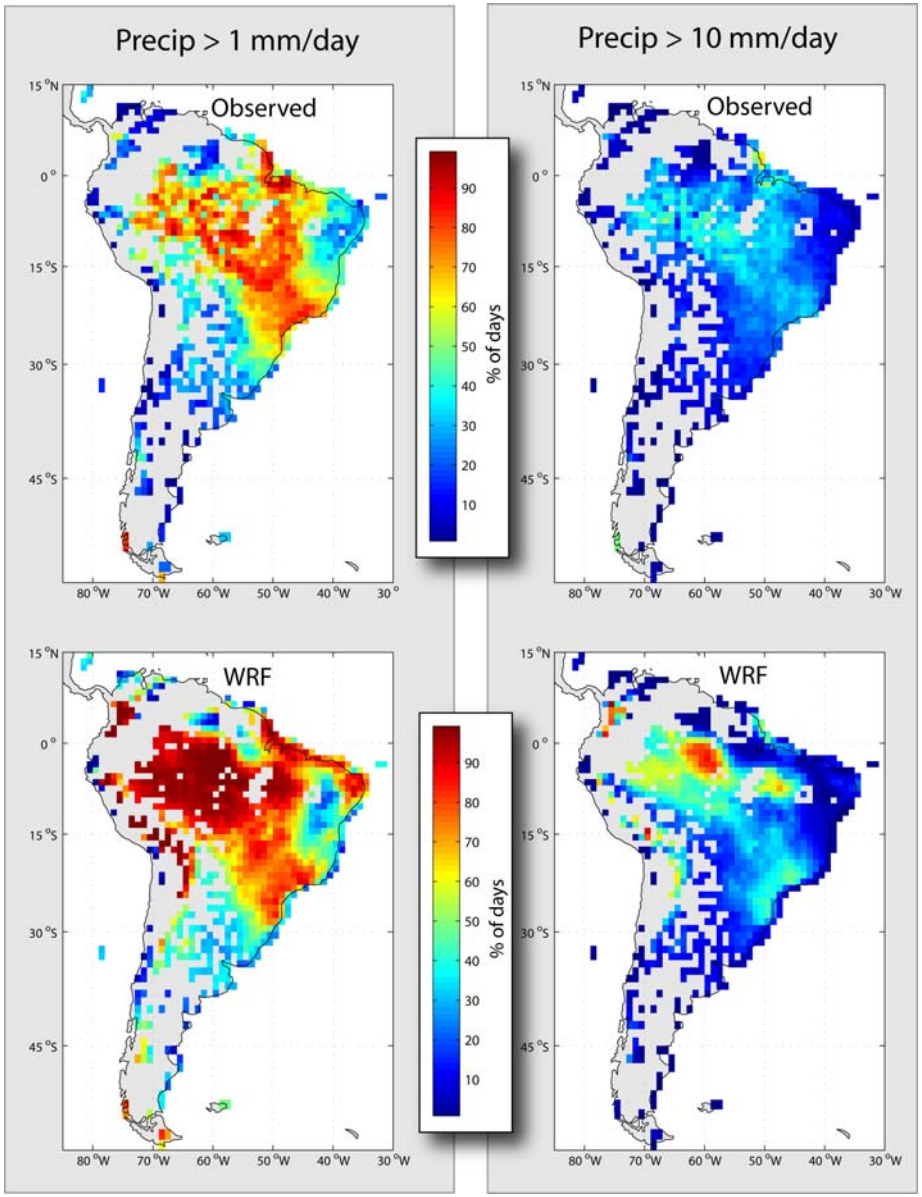


DIURNAL CYCLE



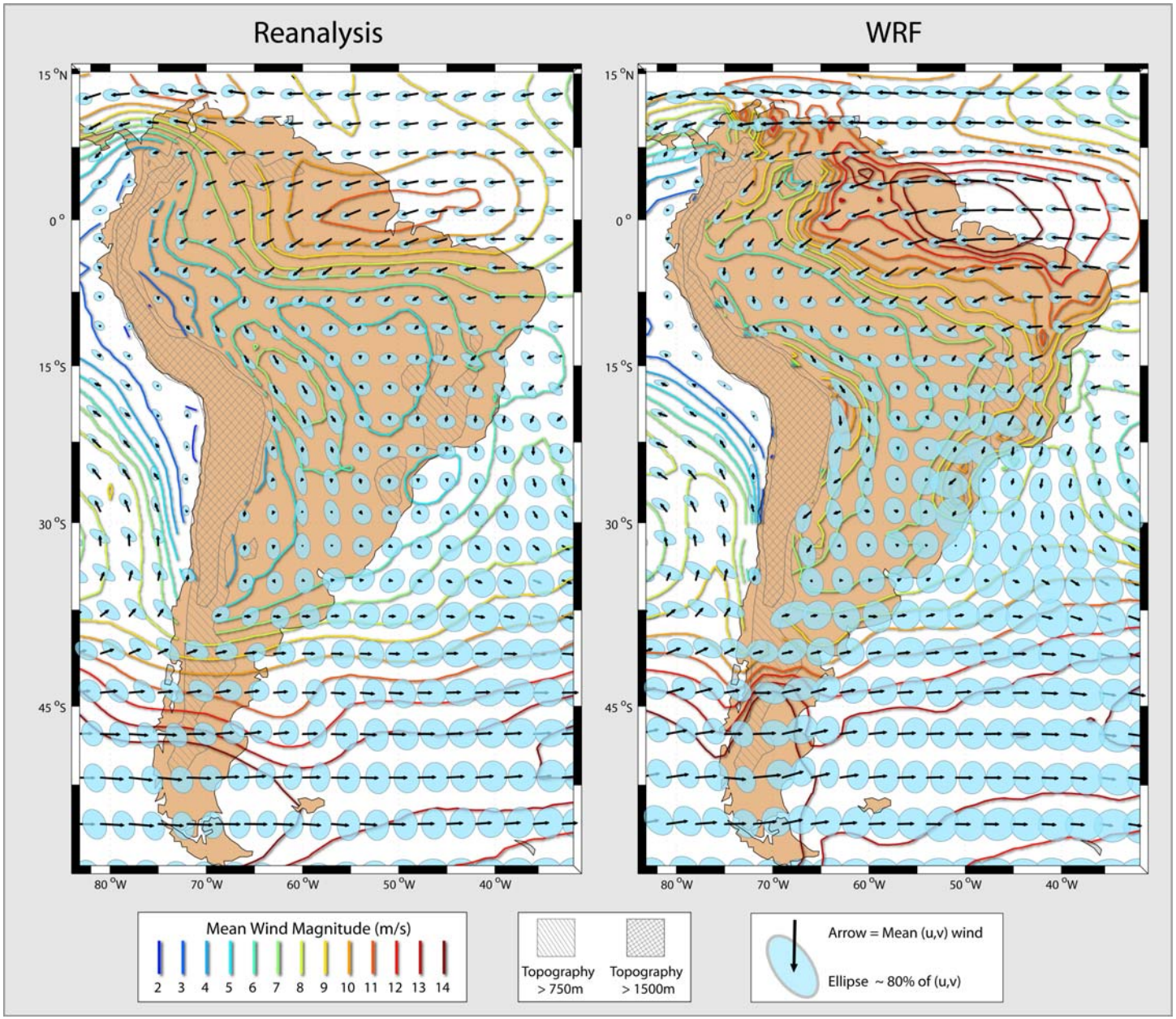
- WRF convective precipitation precedes cloudiness observations by 6 hours
- But WRF's precipitation maxima between 1200-1500 UTC agrees with TRMM climatologies (not shown)

FREQUENCY OF PRECIPITATION OCCURANCE



Monsoon (DJF) Only

VALDATION : LOW LEVEL CIRCULATION (850 hPa)



VALDATION : COLD SURGES

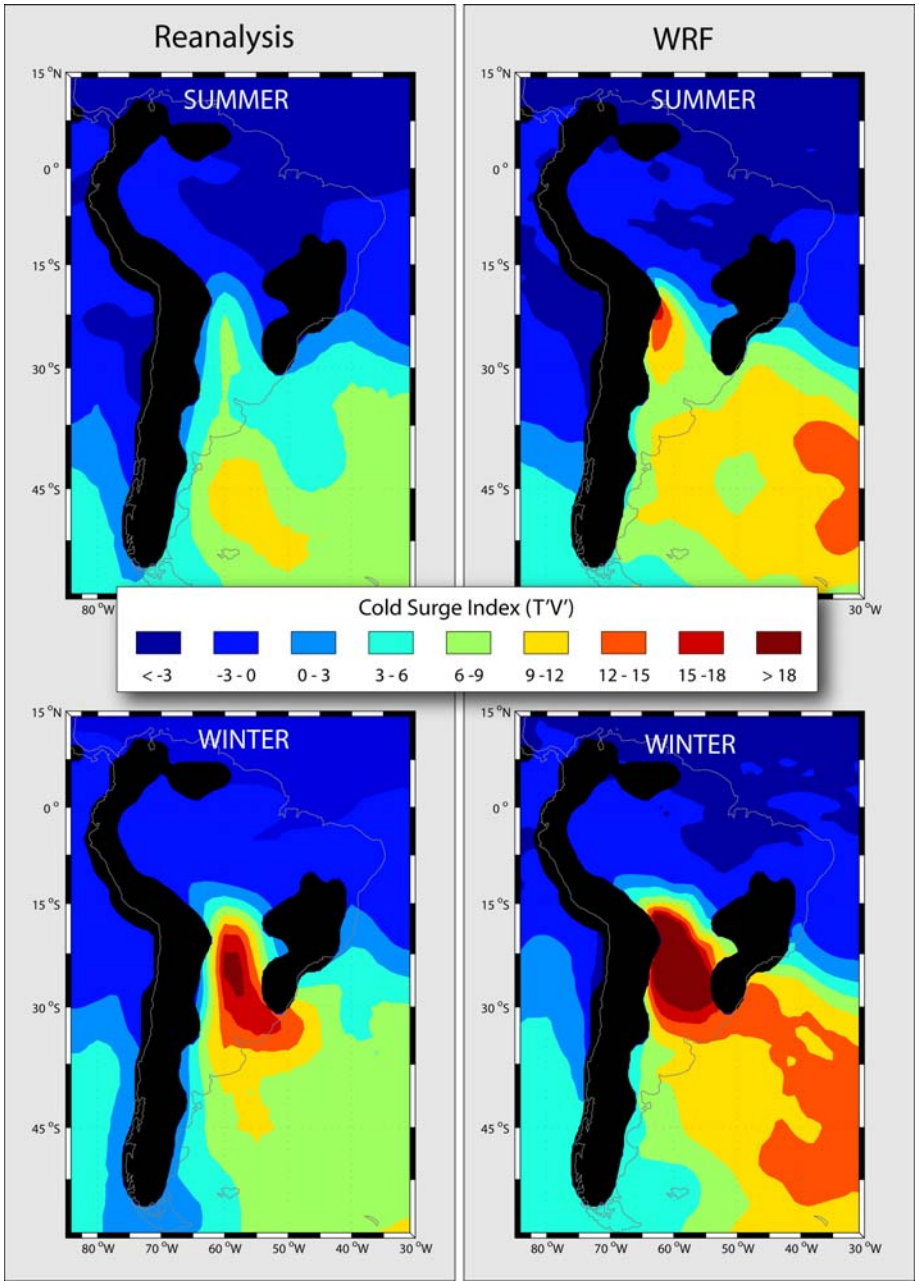
It has been suggested that cold surges east of the Andes may have an important influence on the south-east extension of precipitation in the SAMS (e.g., Li and Fu, 2006)

Therefore it is relevant to examine whether WRF is able to reproduce cold surges:

Cold Surge Index (CSI) = -(T' V') (Km/s)

Where T' and V' are the anomalies of temperature and meridional wind with respect to their monthly means.

Positive CSI means unusually cold, northerly flow (or unusually warm southerly flow)

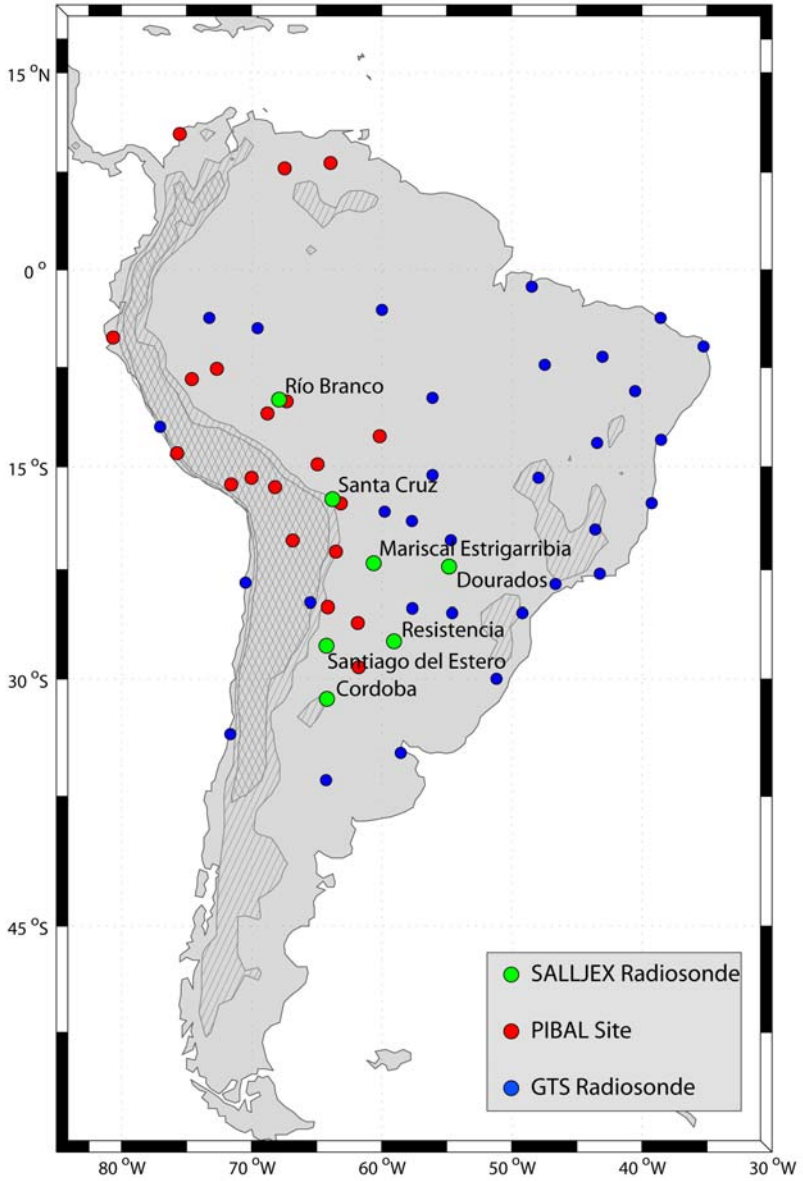


VALDATION : SALLJEX OBSERVATIONS

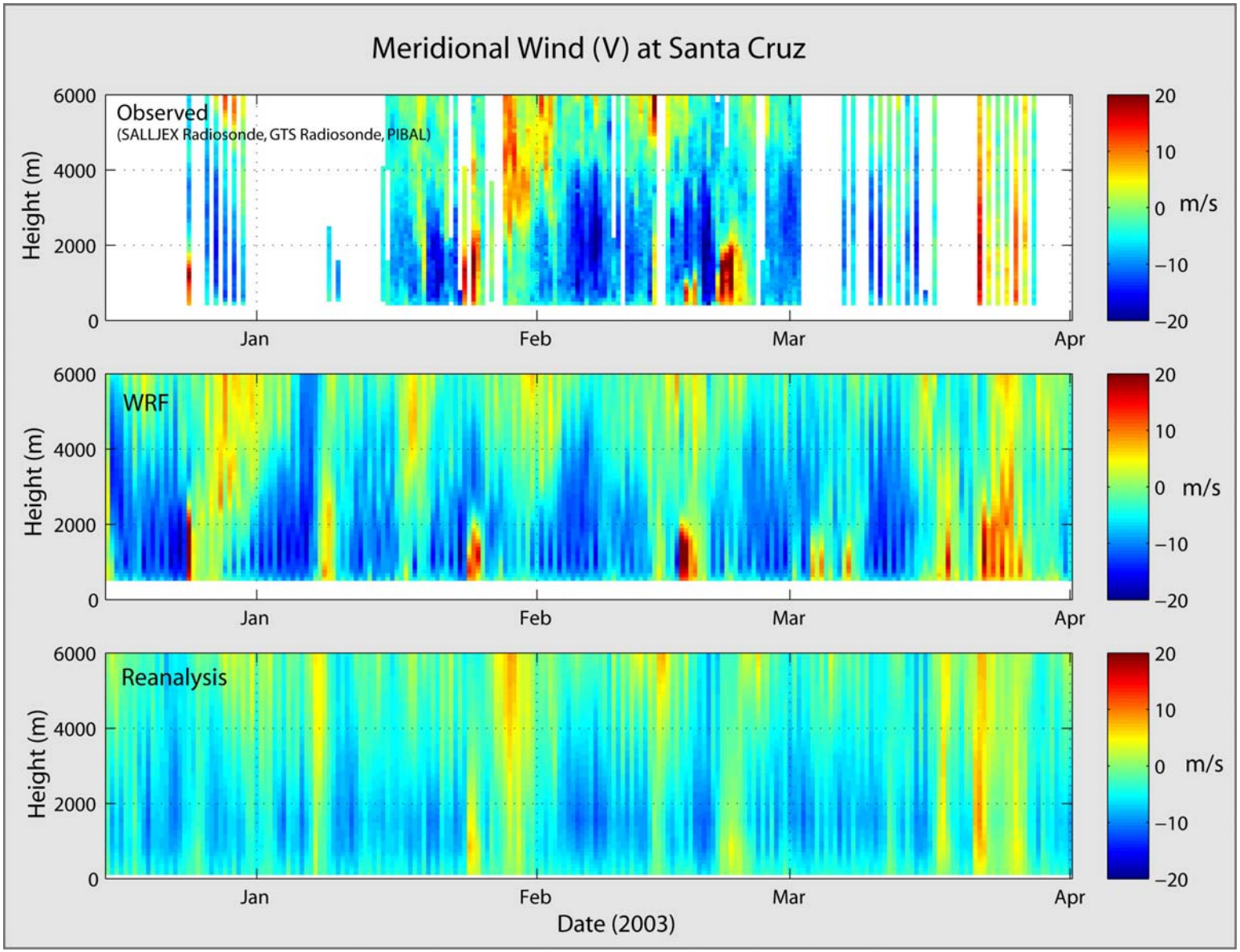
- Observing Period = December 2002 – March 2003

- Radiosonde and PIBAL (Pilot Balloon) measurements at several stations that are NOT included in the Reanalysis

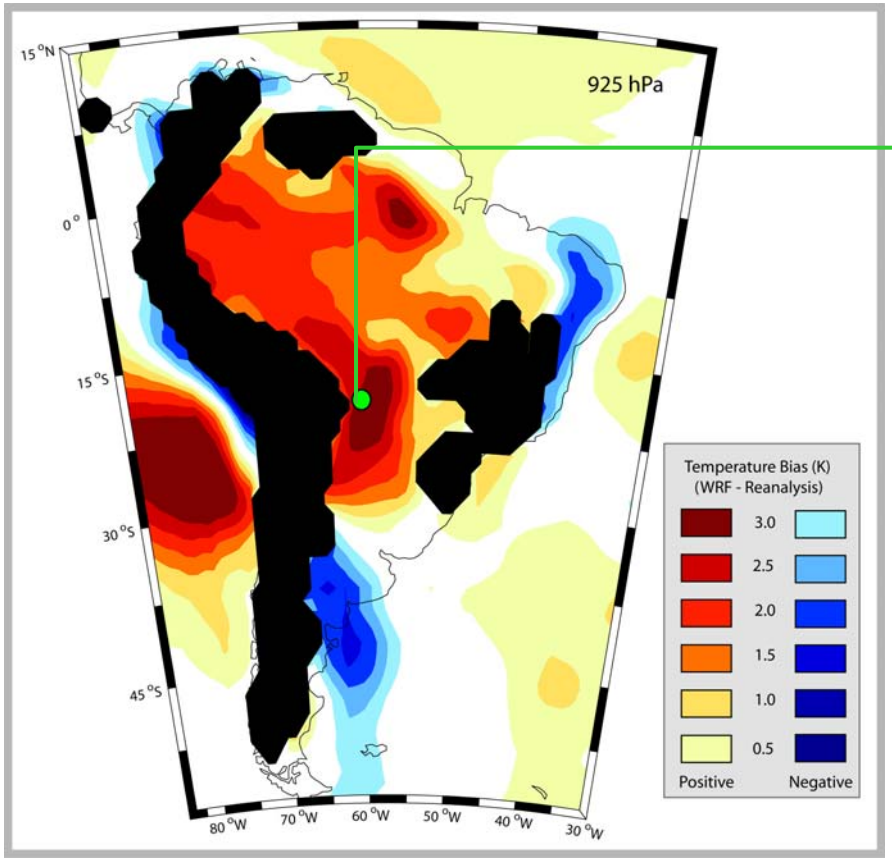
- Region of the SALLJ is one of those where large differences between WRF and Reanalysis are found…

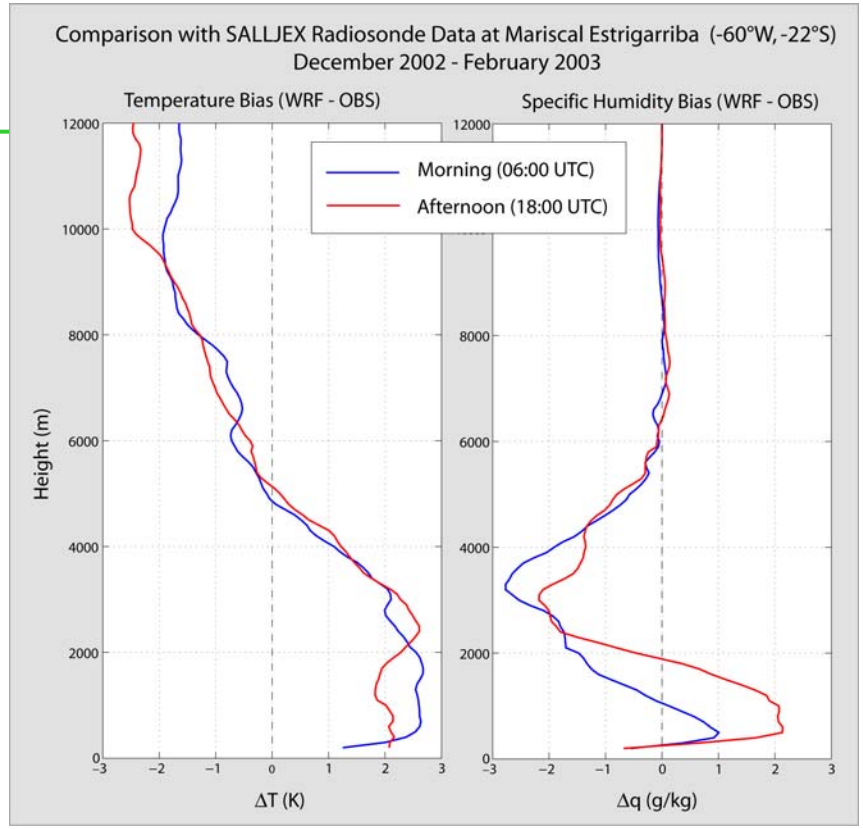


VALDATION OF ATMOSPERIC FIELDS: LOW LEVEL JET AND COLD SURGES

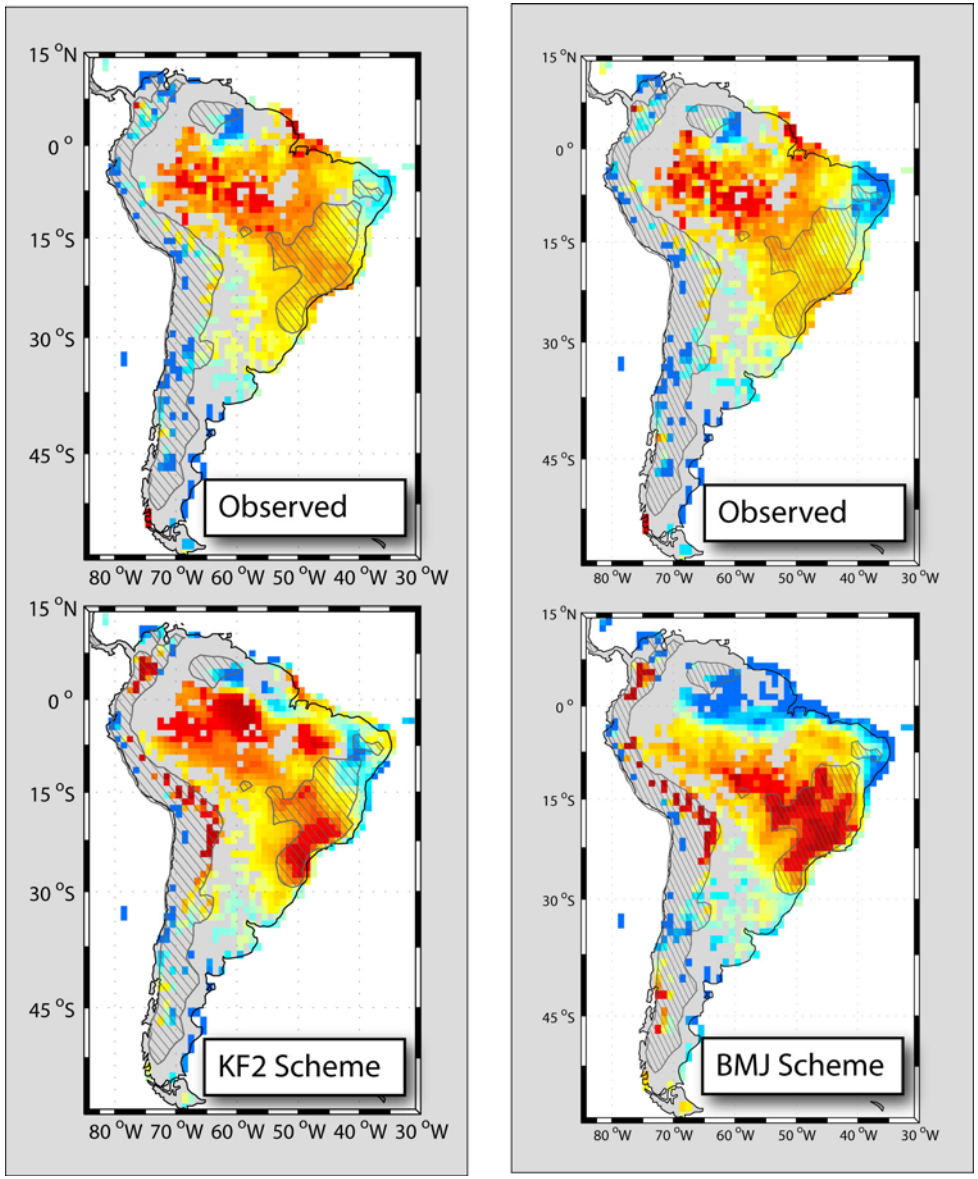


VALDATION OF ATMOSPERIC FIELDS: TEMPERATURE



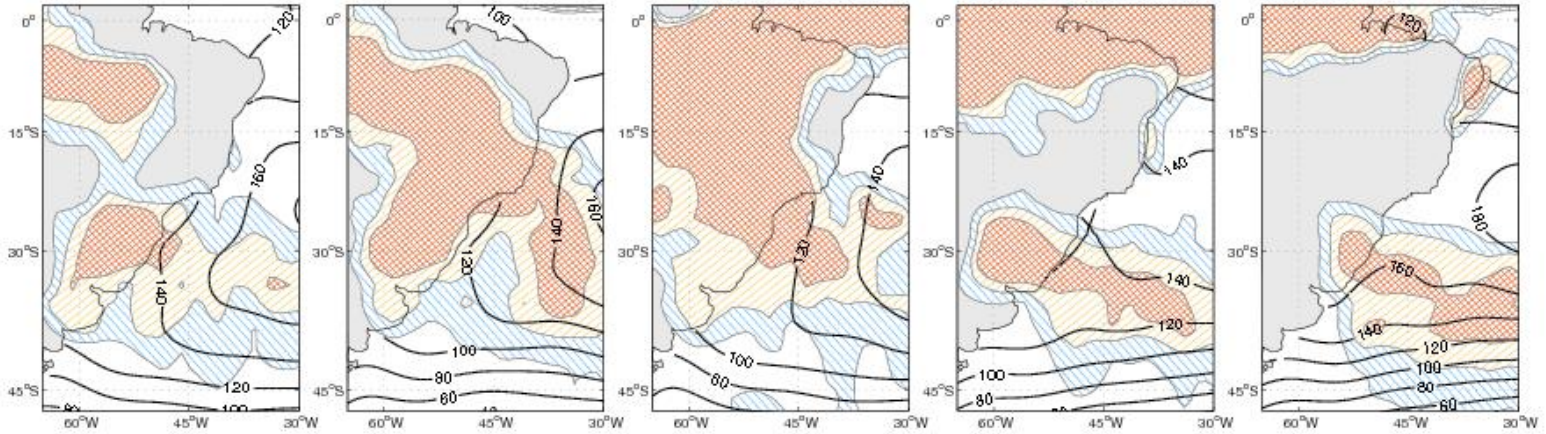


CONVECTIVE PARAMETERIZATION: KF vs BMJ



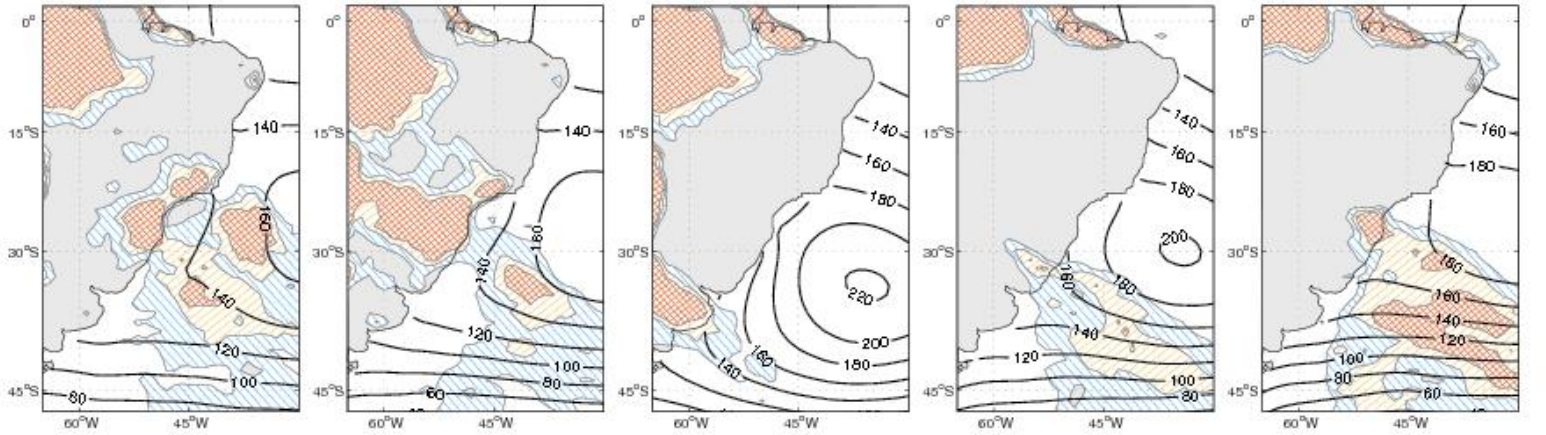
ALTERNATIVE SEA SURFACE TEMPERATURES

Reanalysis/CMAP



WRF constant winter SST

Dec Feb Apr May



Unrealistic SST = disaster for the SAMS…

SAMS SIMULATIONS - CONCLUSIONS

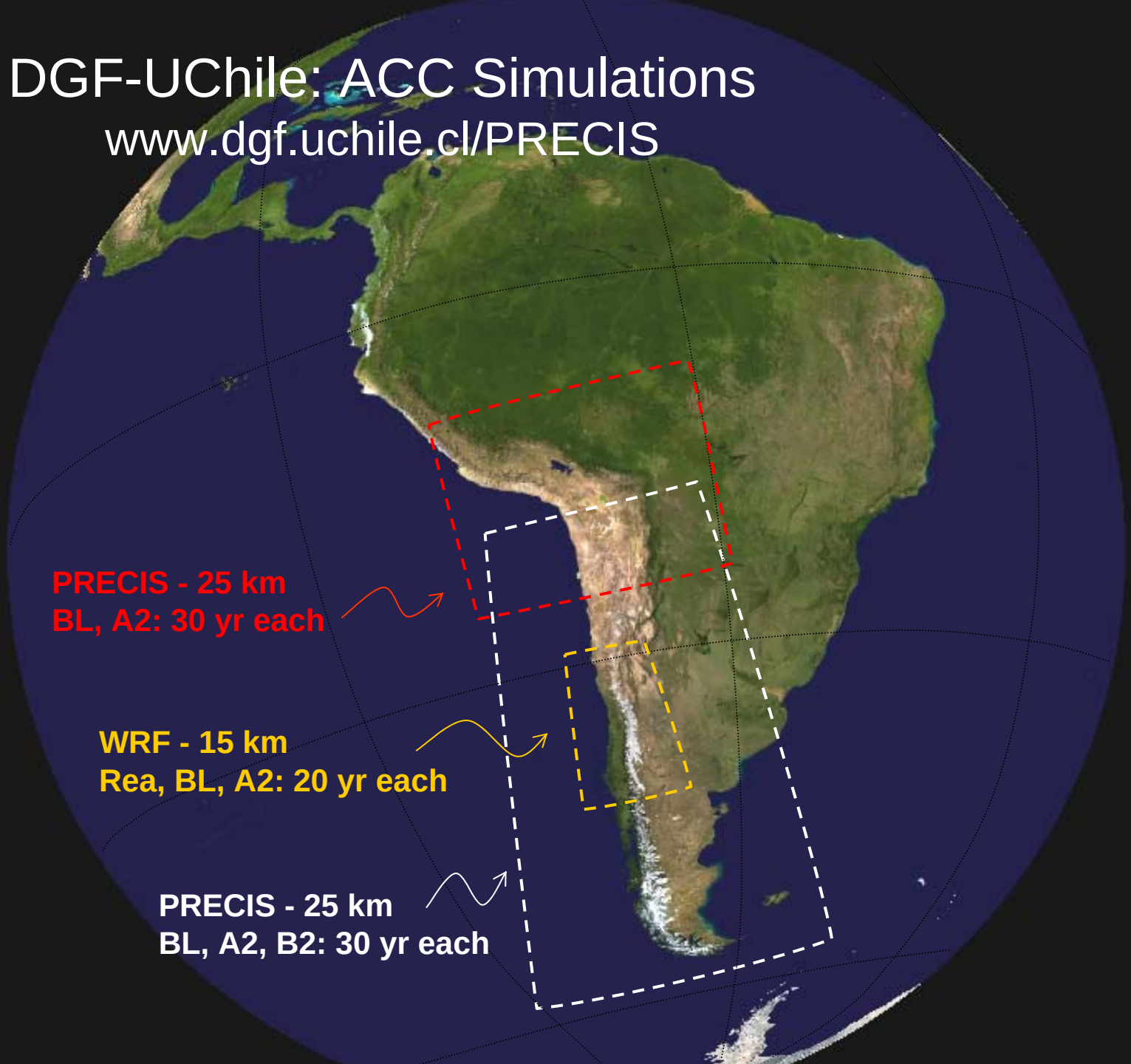
The WRF model has been run continuously over three years over the entire South American continent at low resolution.

- 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 NW 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

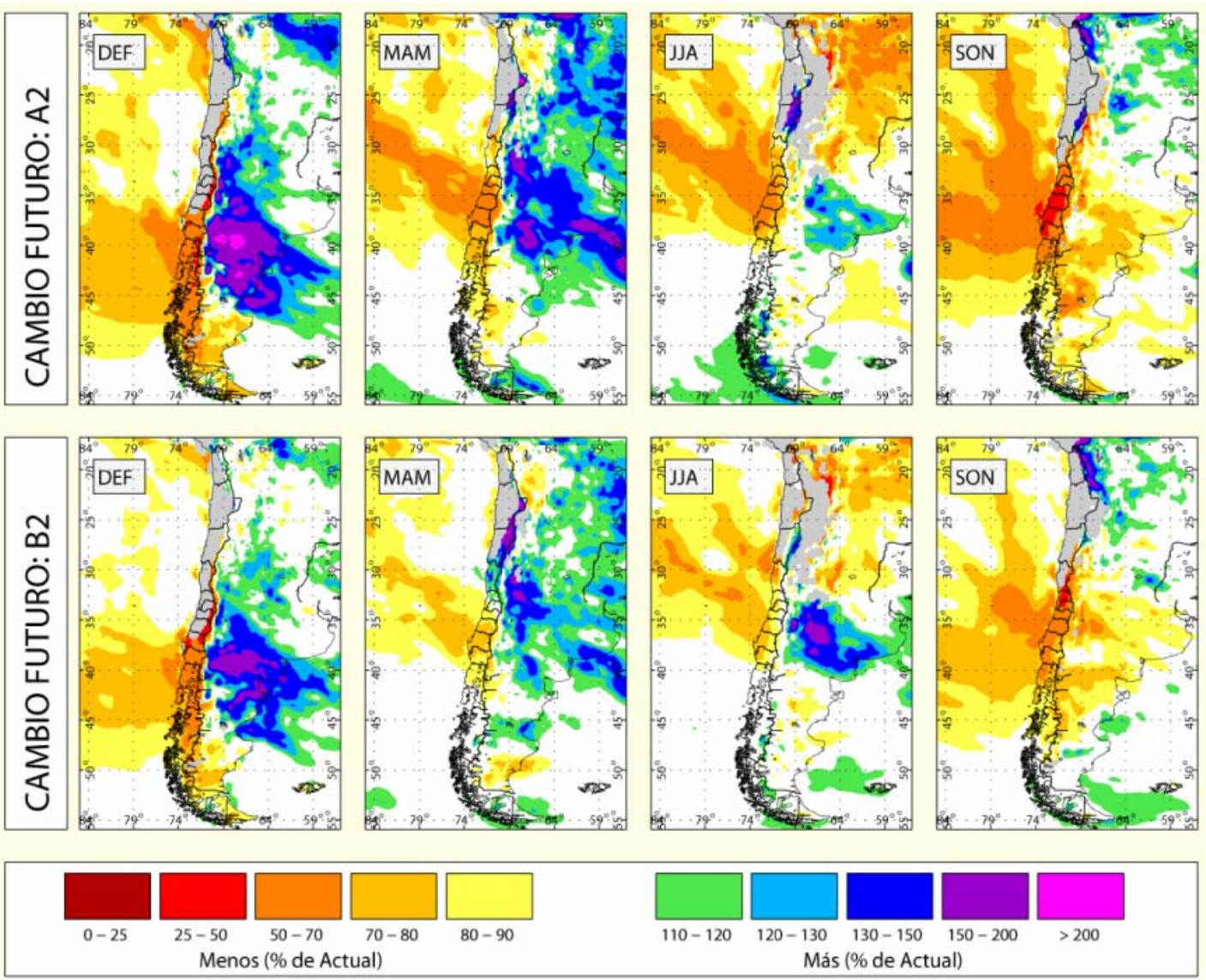
Future Work = More simulations: Other physics schemes, Higher spatial resolution, longer time periods (> 10 years)

DGF-UChile: ACC Simulations

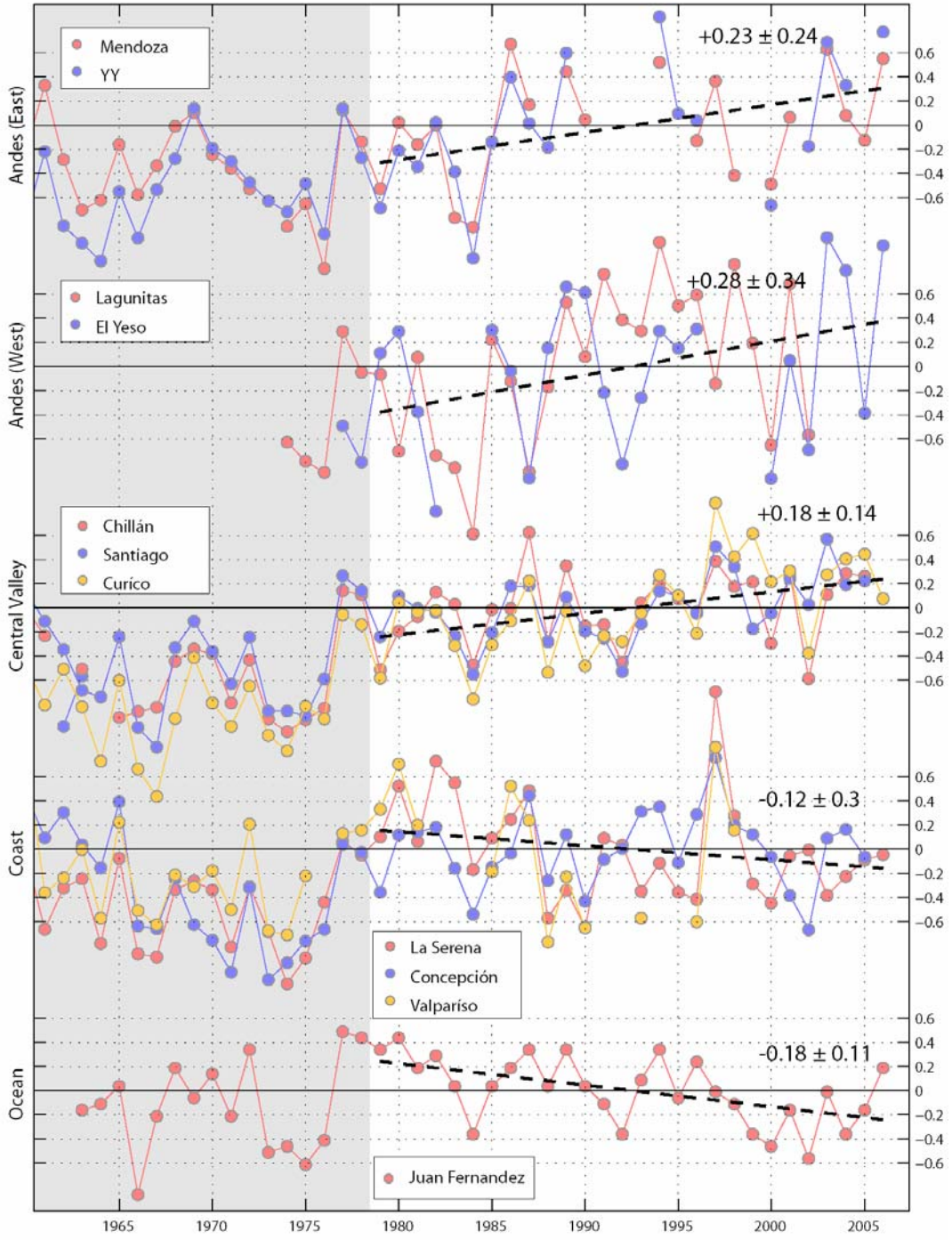
www.dgf.uchile.cl/PRECIS



PRECIS-DGF R_{futuro} / R_{presente}



Futuro: 2071-2100 / Presente: 1961-1990


Andes (East)
Mendoza
YY
+0.23 ± 0.24
Andes (West)
Lagunitas
El Yeso
+0.28 ± 0.34
Central Valley
Chillán
Santiago
Curico
+0.18 ± 0.14
Coast
La Serena
Concepción
Valparíso
-0.12 ± 0.3
Ocean
Juan Fernandez
-0.18 ± 0.11
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
1965
1970
1975
1980
1985
1990
1995
2000
2005