

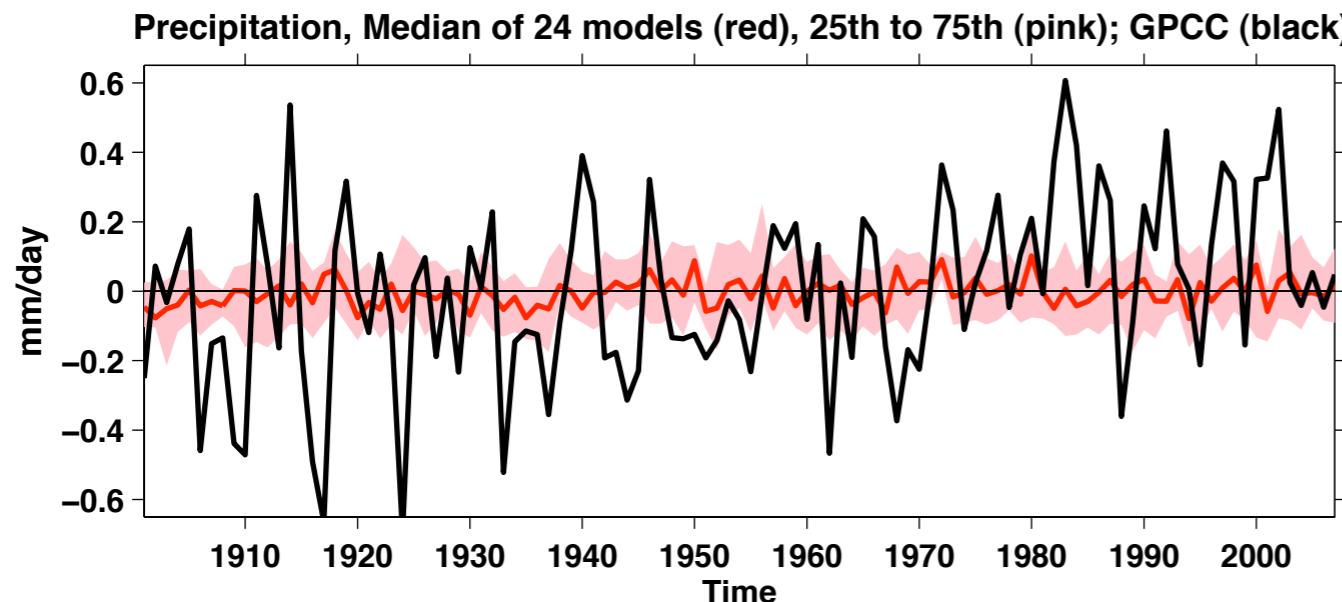
Interannual to multidecadal precipitation variability over Southeast South America

Richard Seager, Naomi Naik, Walter Baethgen, Yochanan Kushnir, Andy Robertson, Jennifer Nakamura and Stephanie Jurburg

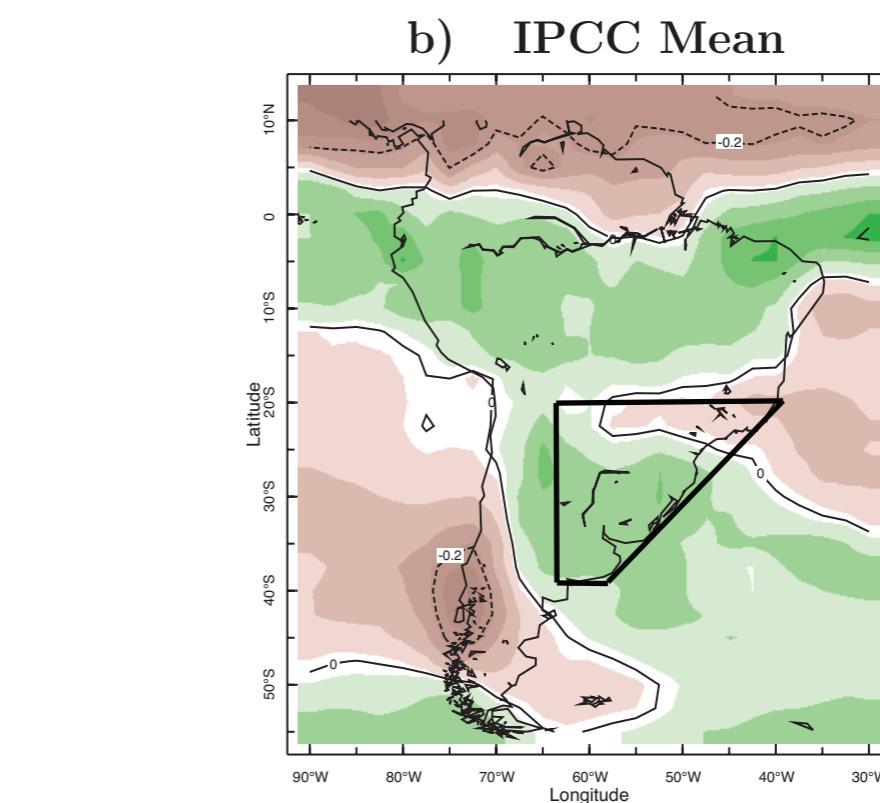
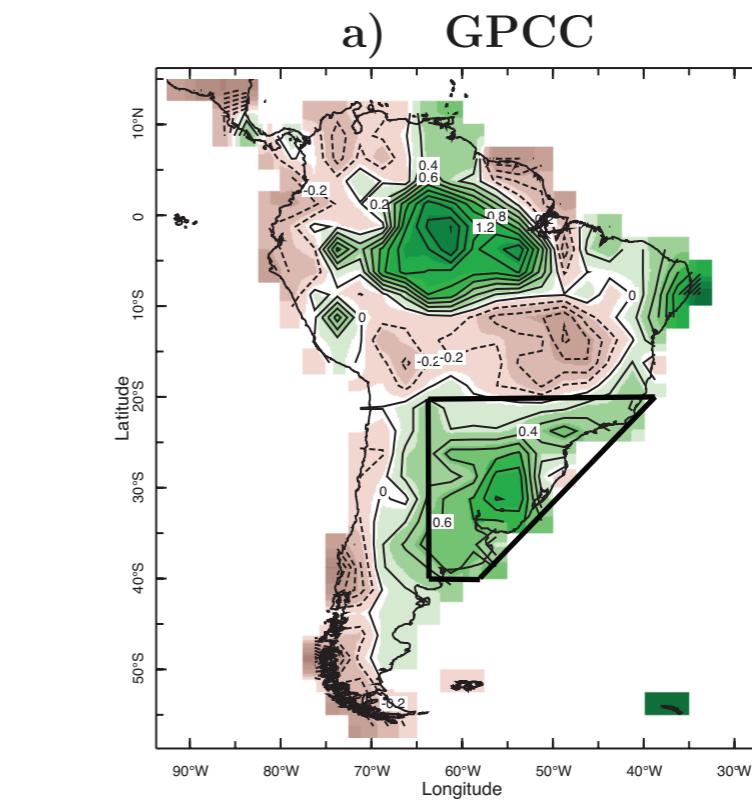
Lamont, IRI and Columbia College

Annual Precipitation Trend 1901-2007

Precipitation averaged over SESA



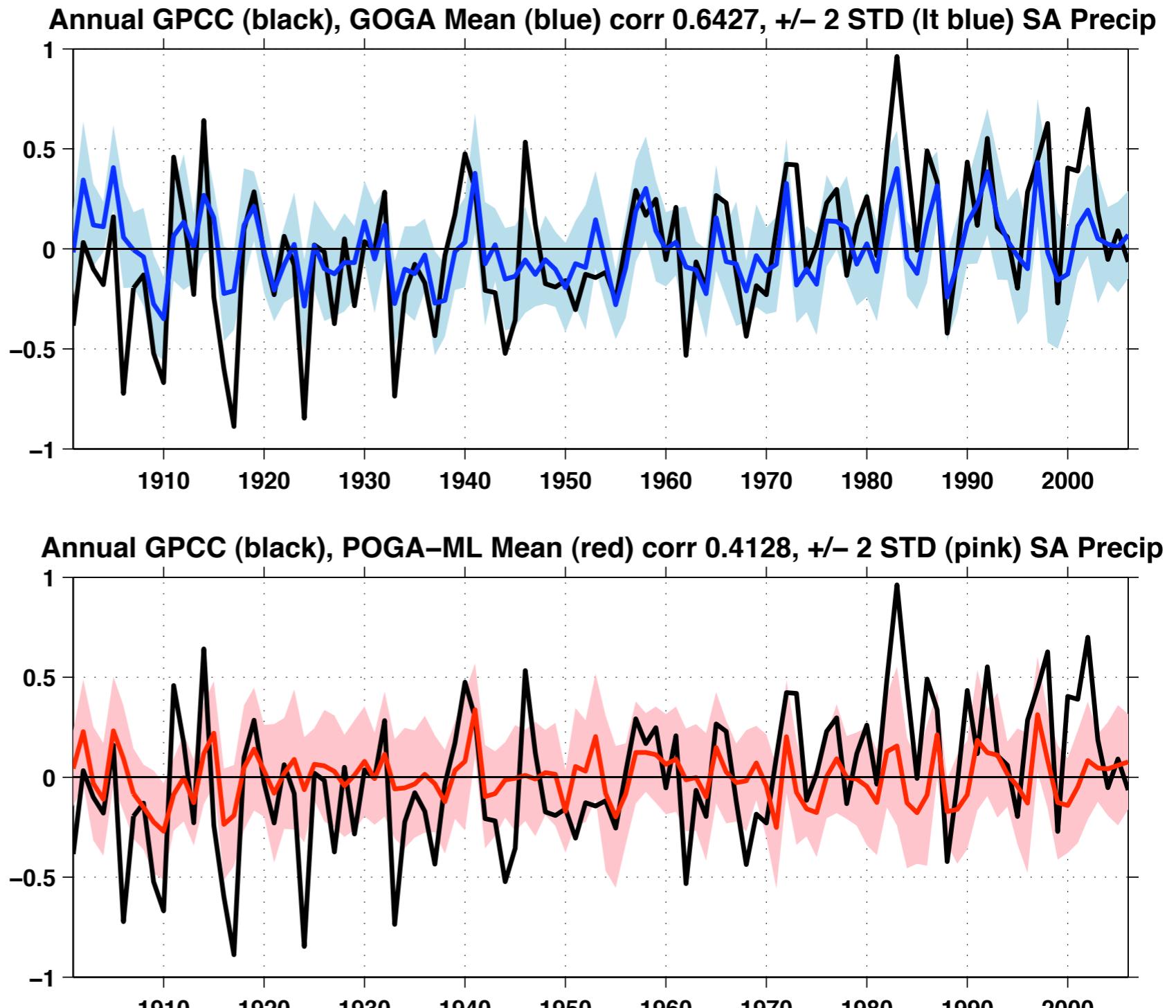
Strong variability year to year, decade to decade.
Observed wetting trend much stronger than predicted by AR4 models.



Southeast South America

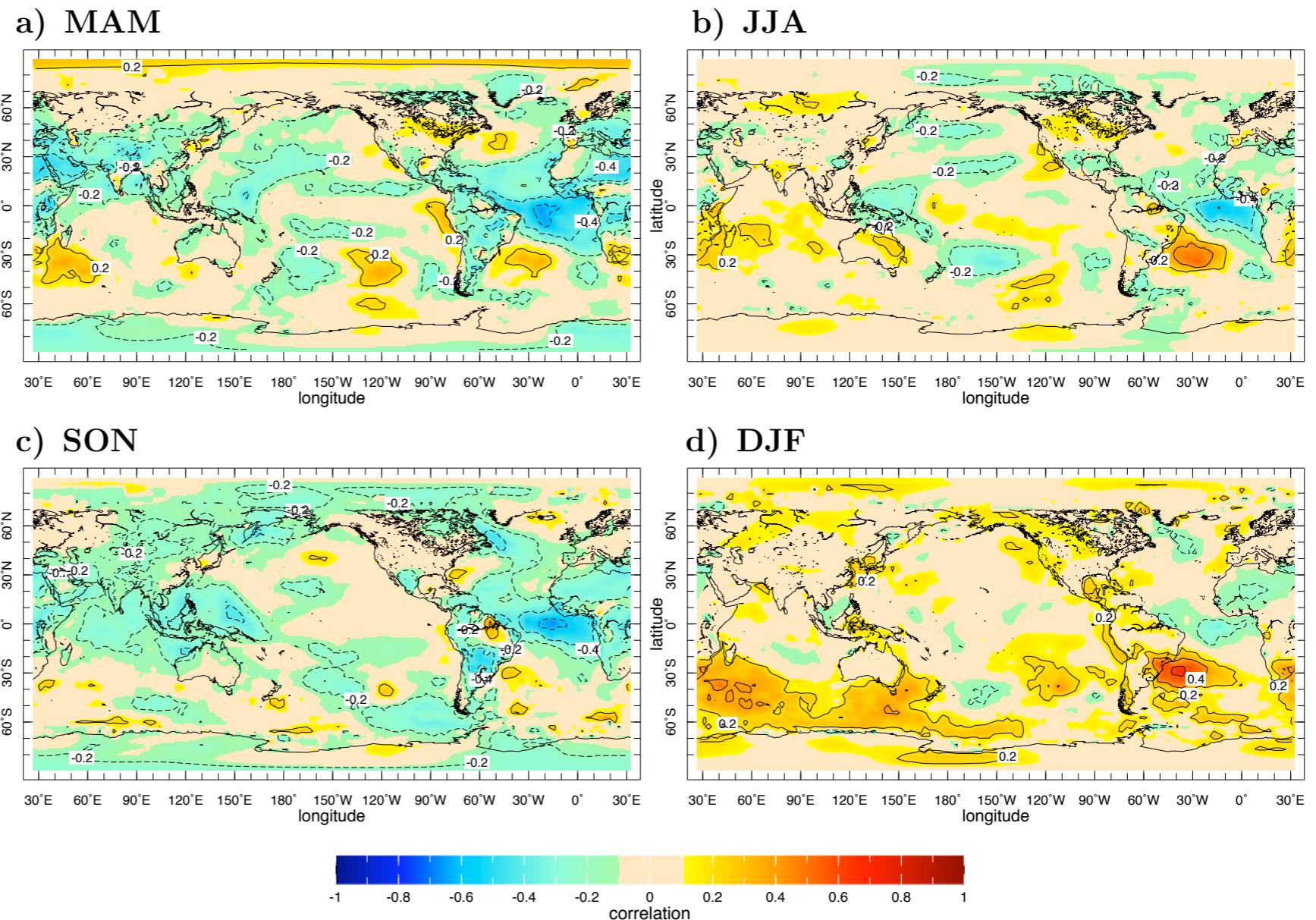
Over past century,
global SST forced
model simulates
observed precip
very well.

Tropical Pacific
influence is large
but other oceans
help provide
multidecadal
variability



The Atlantic
influence on
ENSO-removed
SESA
precipitation is
strong in the
global SST-
forced model

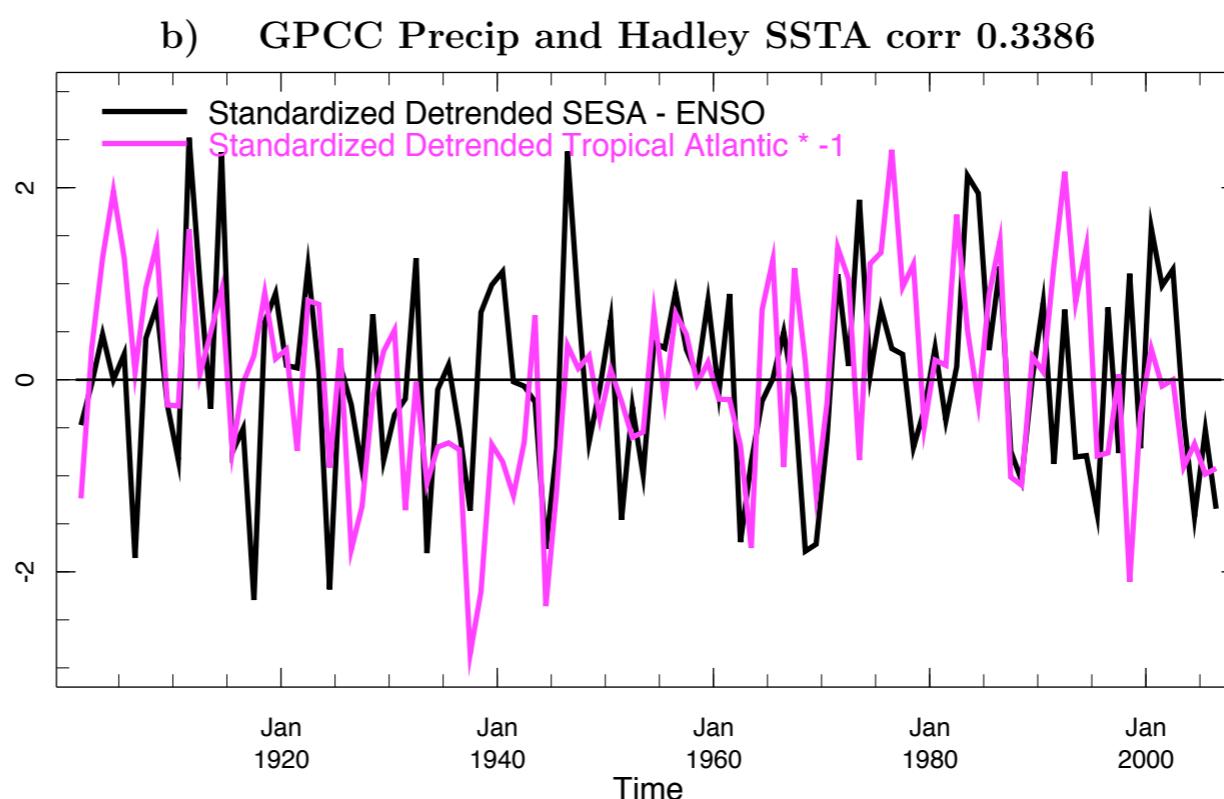
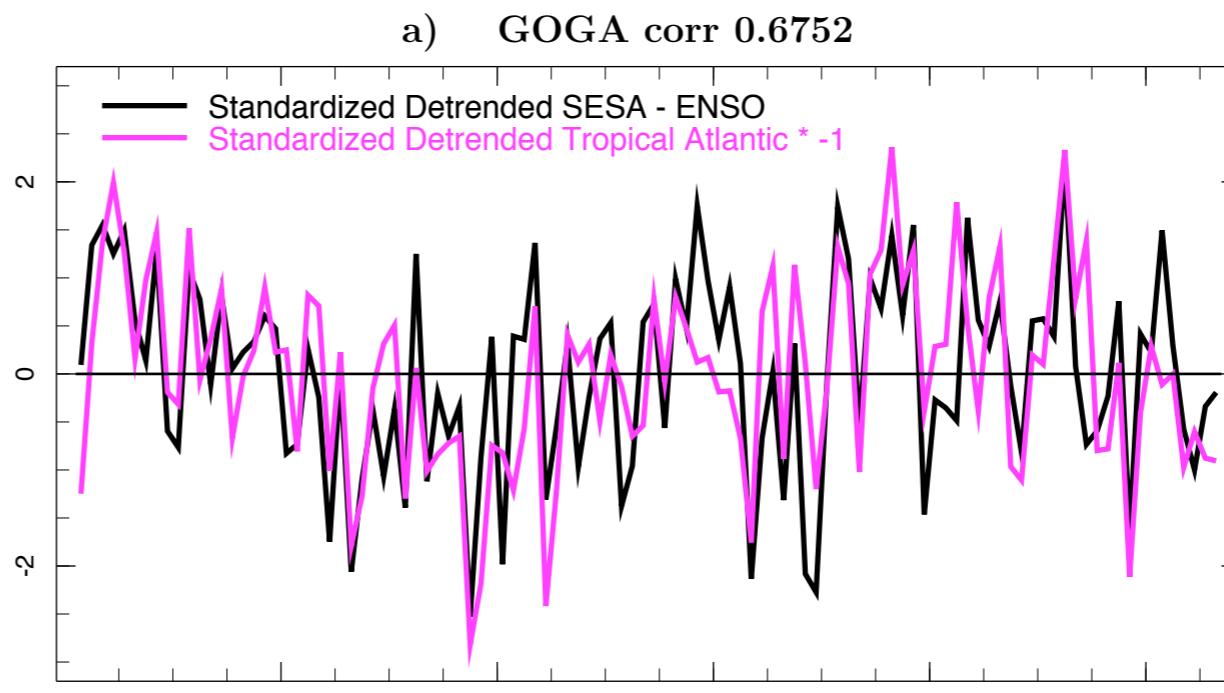
Seasonal Correlation of GOGA TS on SESA - ENSO 1901-2006/2007



Time history of tropical Atlantic SSTs (detrended) have a reasonable match to non-ENSO, detrended, SESA precipitation and provide multidecadal variability.

Det. Std. Annual SESA - ENSO (black) and Tropical Atlantic * -1 (Pink)

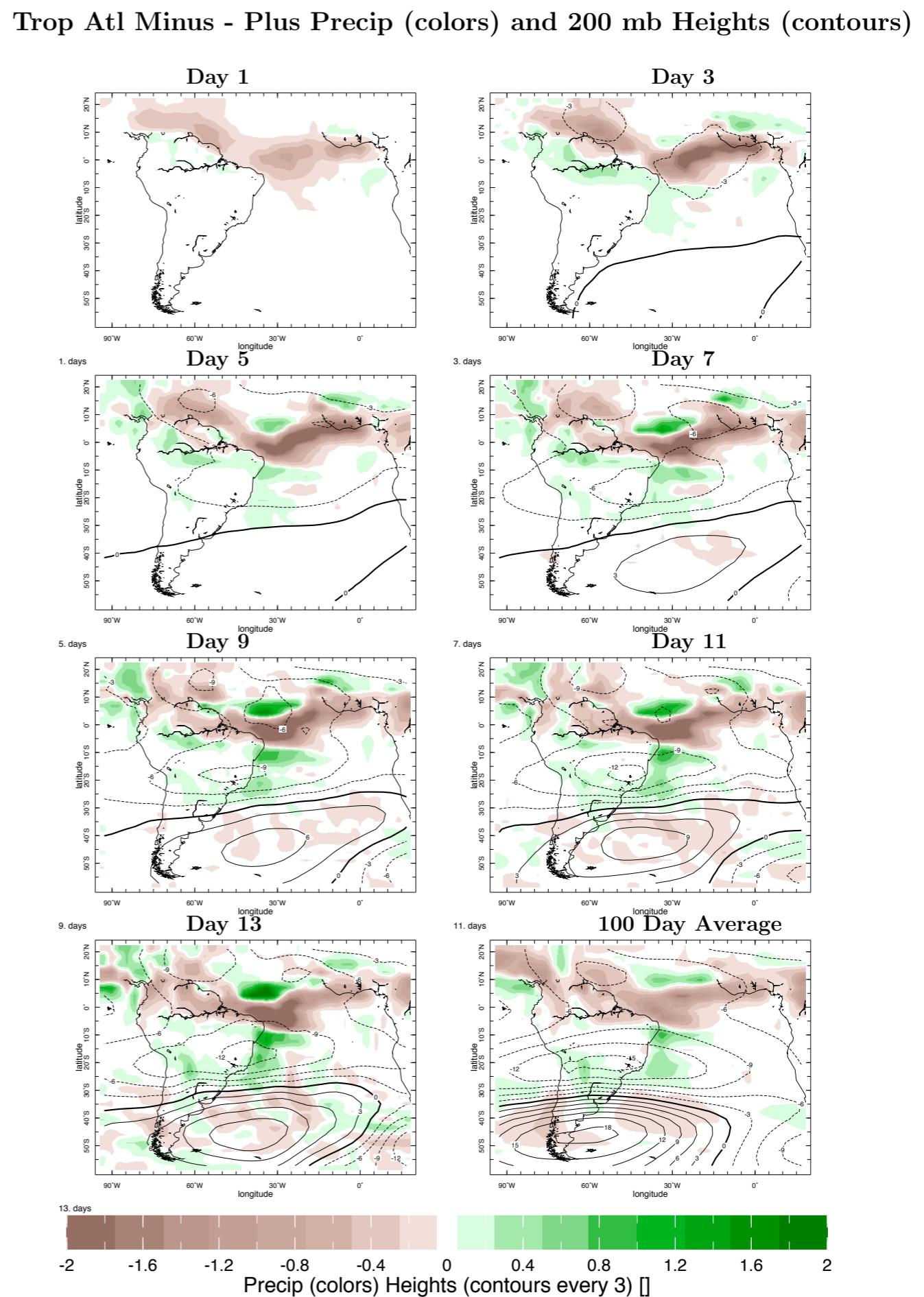
Global
SST-forced
model



observations

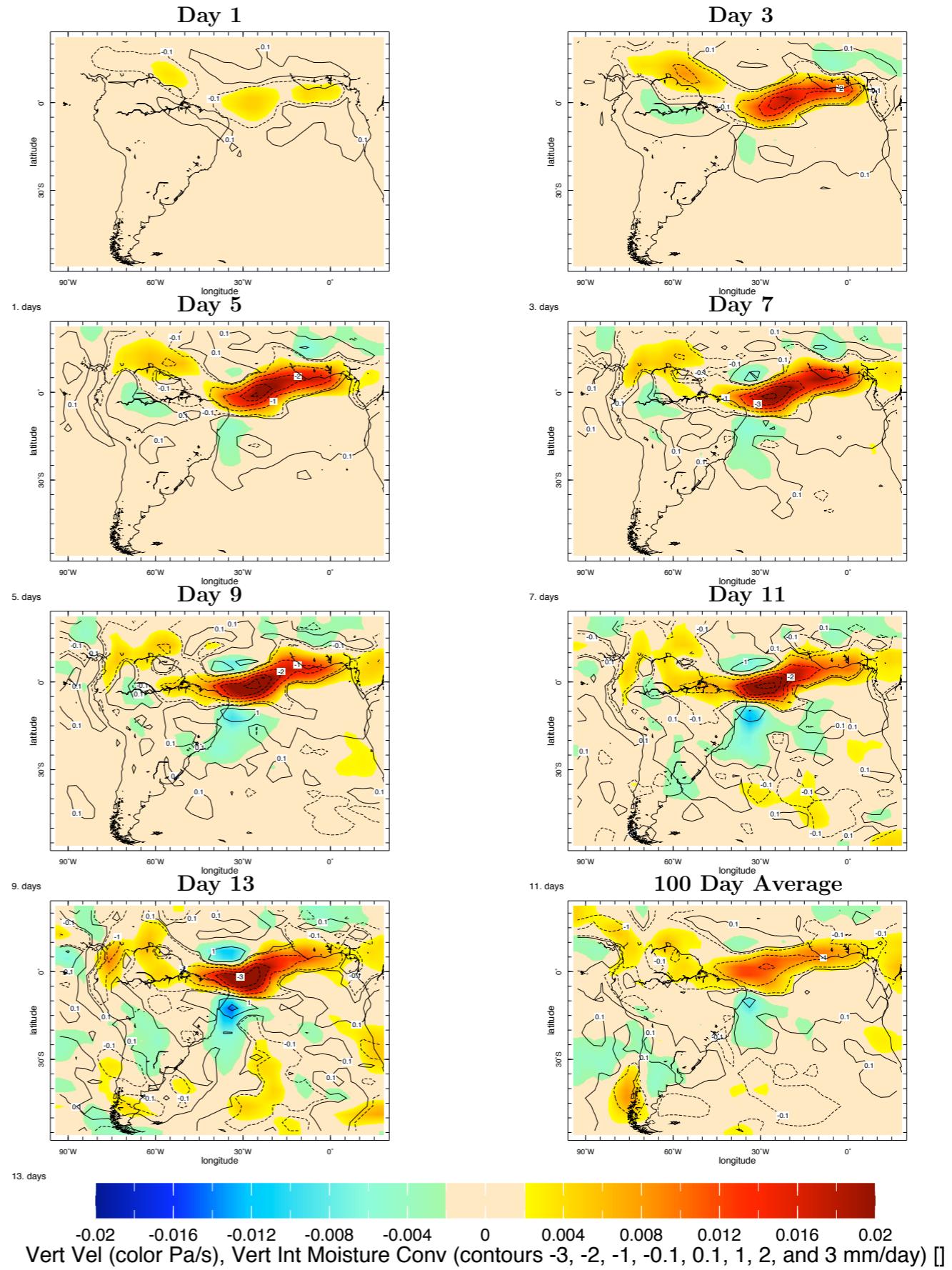
Examine mechanism
for tropical Atlantic-
SESA link in
simulations with
turn-on of SST
anomaly on June 1.
100 runs for 100
days.

For cold Atlantic,
wet conditions
develop over SESA
in days.



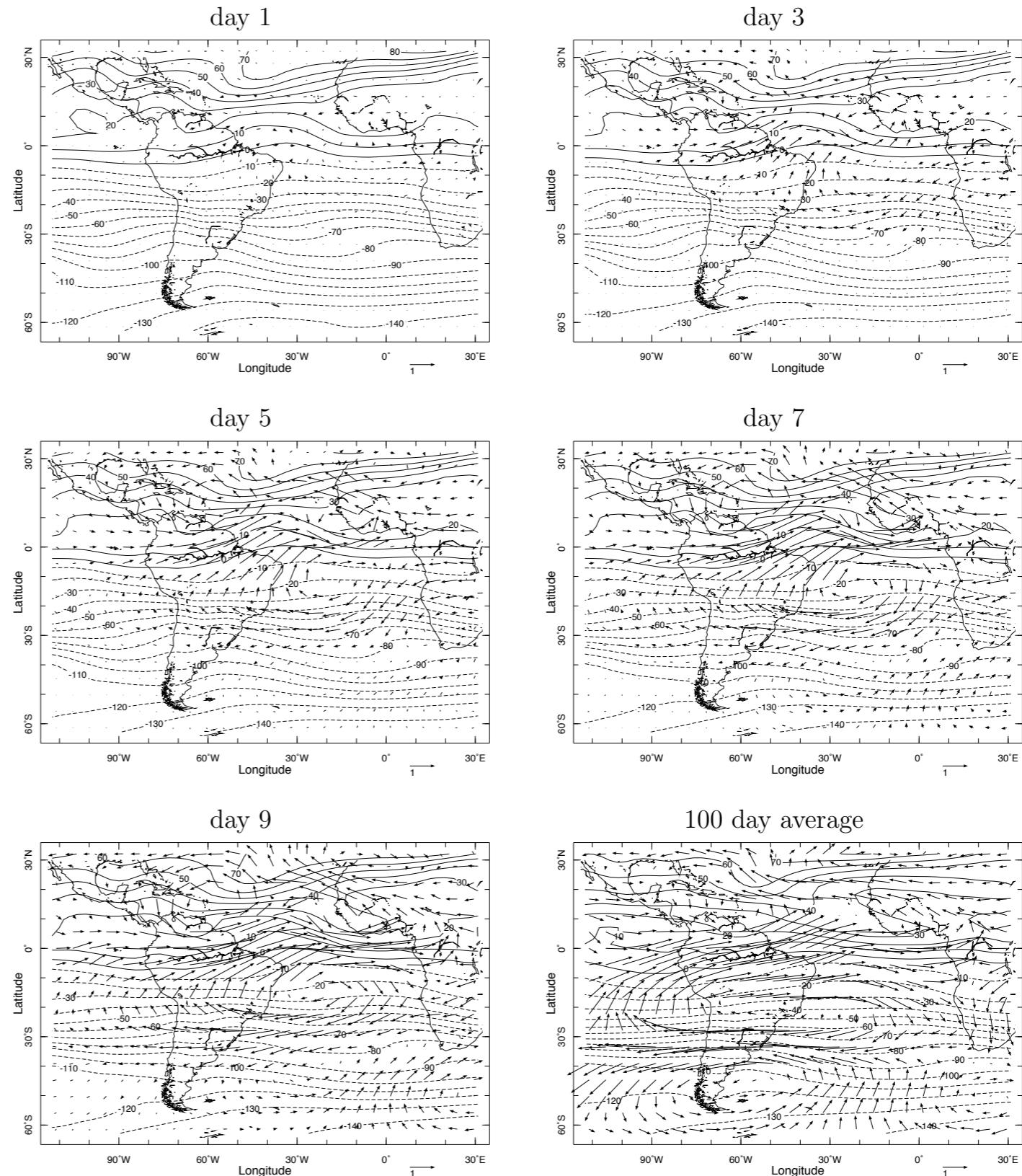
**SESA wet
anomaly
related to
upward
motion and
increased
moisture
convergence**

Trop Atl Minus - Plus Vert Int Moisture Conv (contours) and Vert Vel (colors)



cold-warm tropical atlantic 100 day runs, 200mb
wind difference (vectors) and mean absolute vorticity (contours)

The upward motion related to the anomalous upper level winds flowing across the mean absolute vorticity gradients



Cold-Warm Tropical Atlantic, 200mb

Stretching term balances the vorticity advection.

I. Cold Atl SSTs, less precip

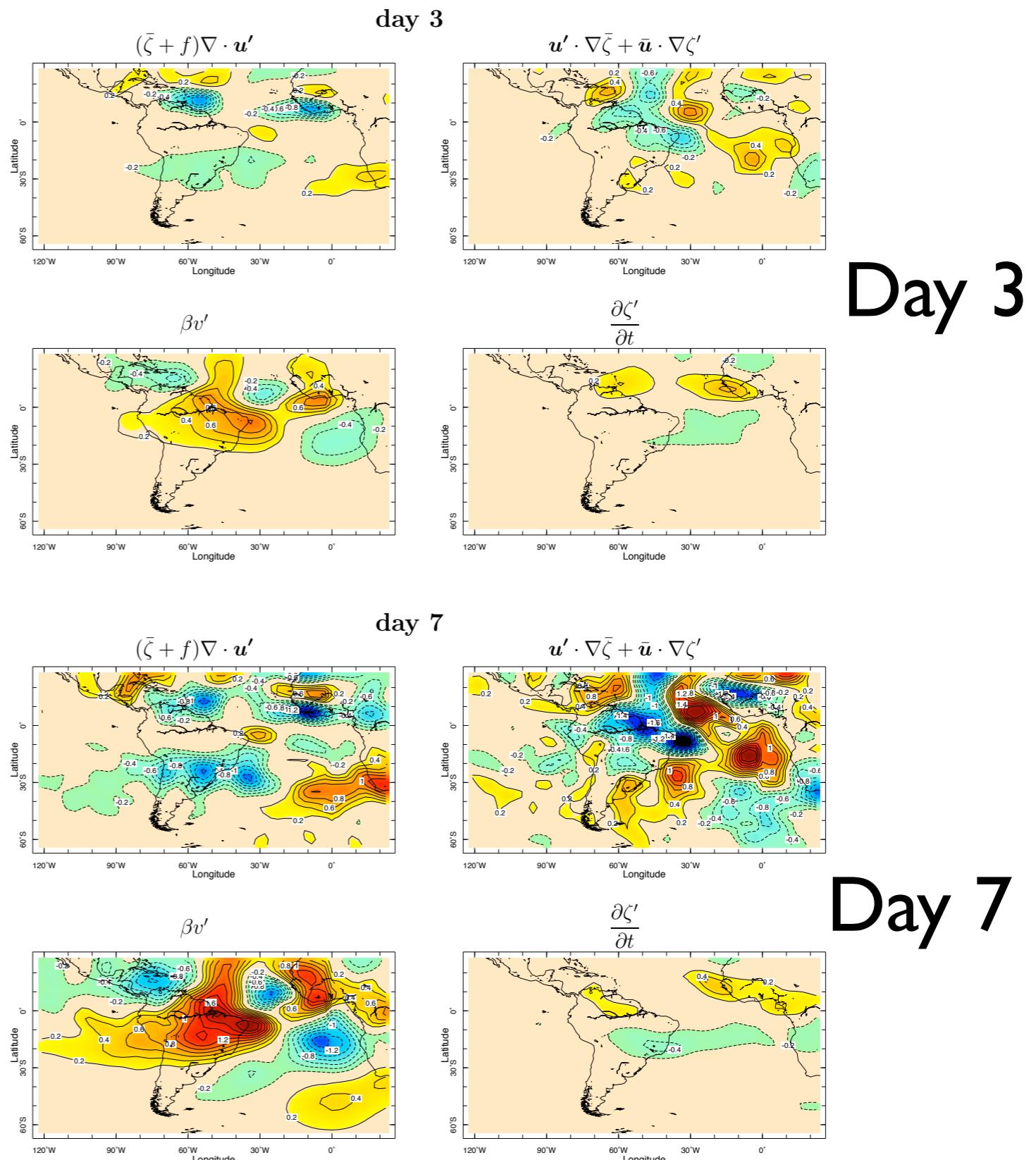
2. Upper level convergence

3. Vorticity advection, stretching balances

4. Forced ascent over SESA

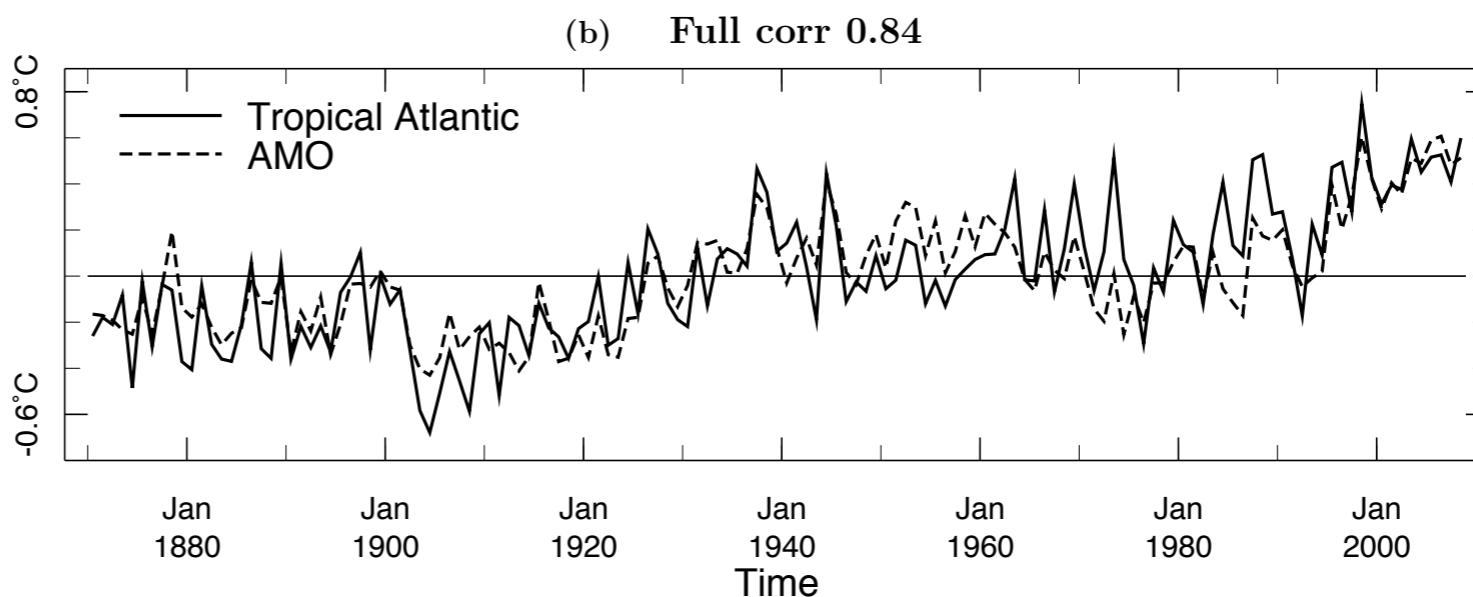
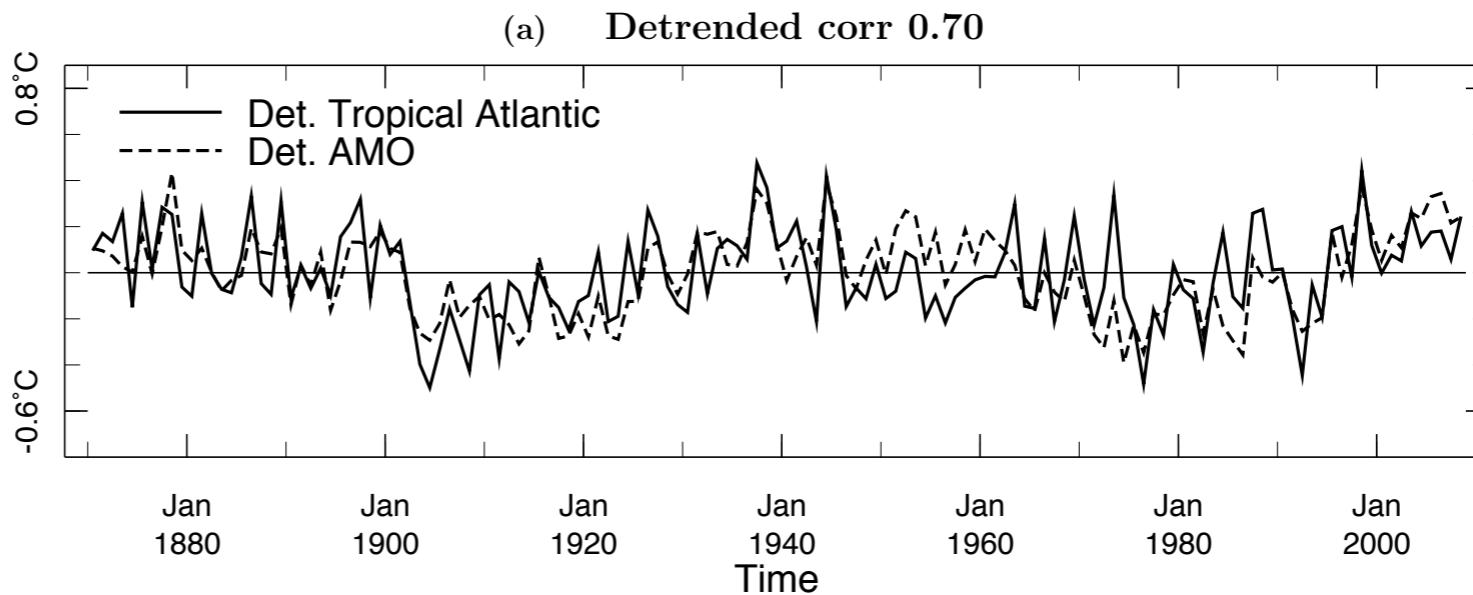
5. Wet SESA

$$\frac{\partial \zeta'}{\partial t} + v' \frac{\partial \bar{\zeta}}{\partial y} + \bar{u} \frac{\partial \zeta'}{\partial x} + (\bar{\zeta} + f) \nabla \cdot \mathbf{u}' + \beta v' = 0.$$



The tropical
Atlantic SST
variations
are an
expression
of N. Atlantic
AMV

Annual SSTA Indices: Tropical Atlantic (solid), AMO (dashed)



Conclusions

1. Interannual variations of SESA precipitation strongly influenced by ENSO (we knew that)
2. Multidecadal variability has origins in tropical Atlantic (expression of AMV) via an established dynamical mechanism that begins with SST-induced heating anomalies in the Atlantic ITCZ
3. Century long wetting trend, if real, still requires an explanation. If anthropogenic, AR4 models are very wrong. If natural, what are the causes?