~~The~~ A role for tropical-extratropical teleconnections in the seasonal progression of the tropical circulation in southern Spring.

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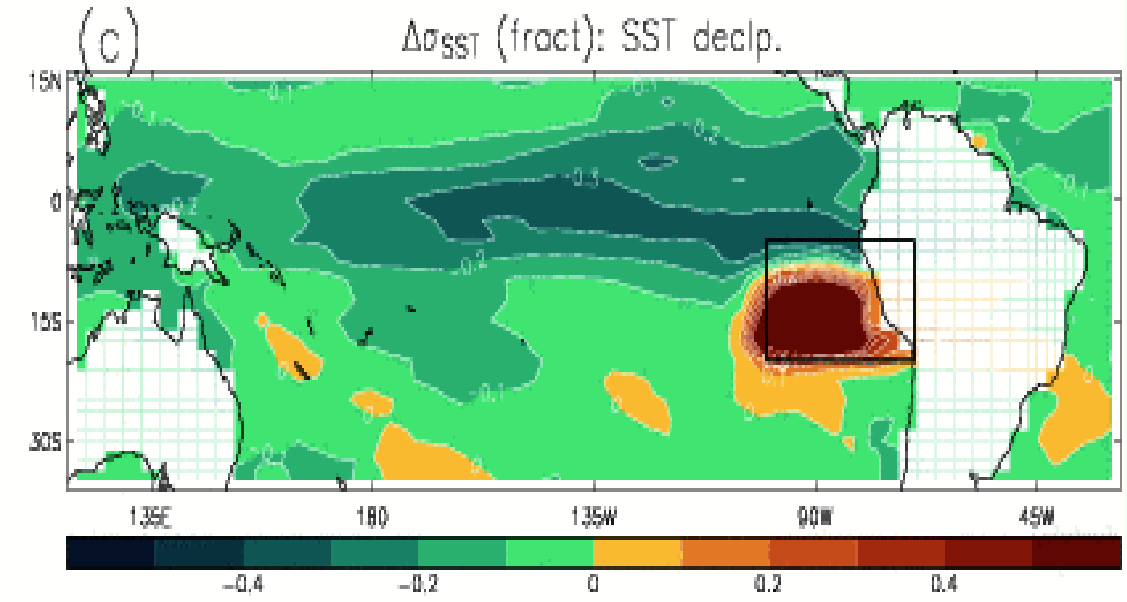
EGU General Assembly, 5 April 2011

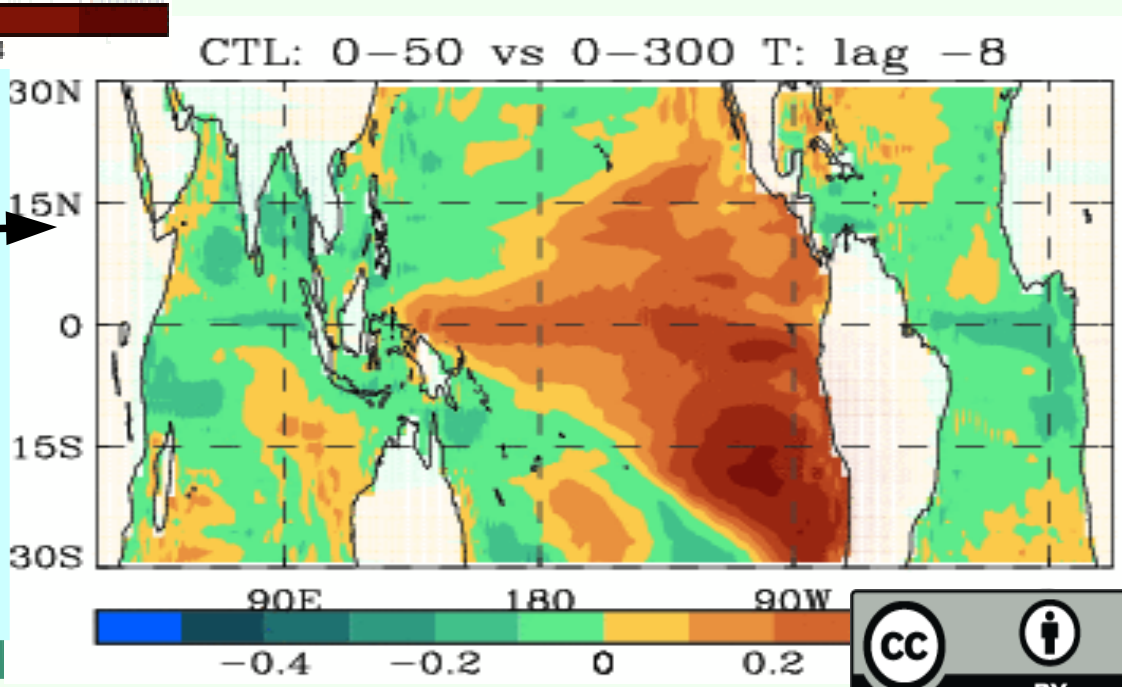
SST variability in the SEP and ENSO

Toniazzo (2010, Clim. Dyn.) on ENSO variability in HadCM3 (shallow mode):



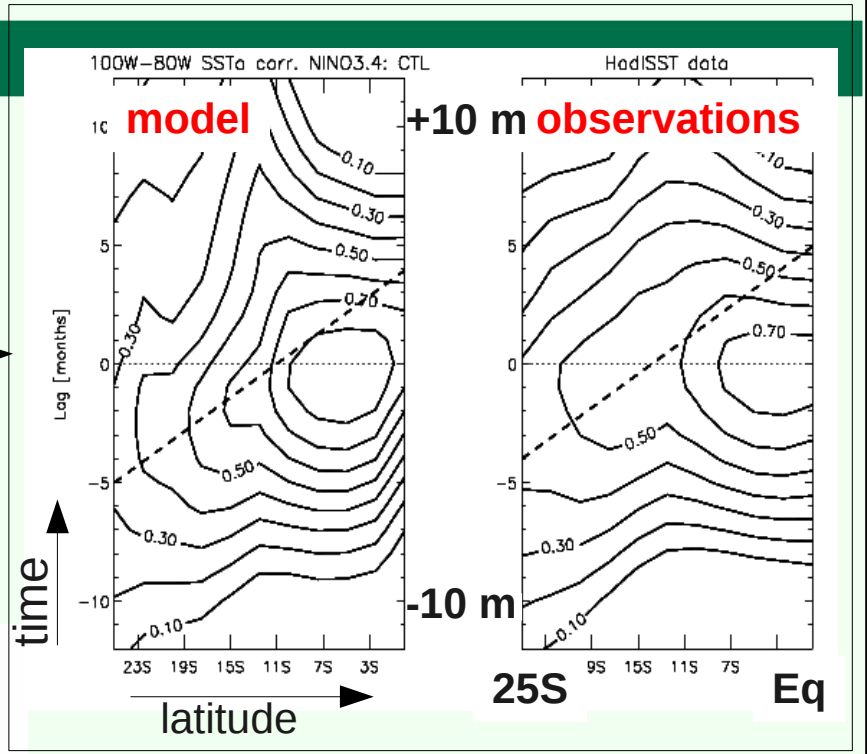
1) ENSO variability is suppressed (-70%) when inter-annual SST anomalies in the SEP are damped or de-coupled

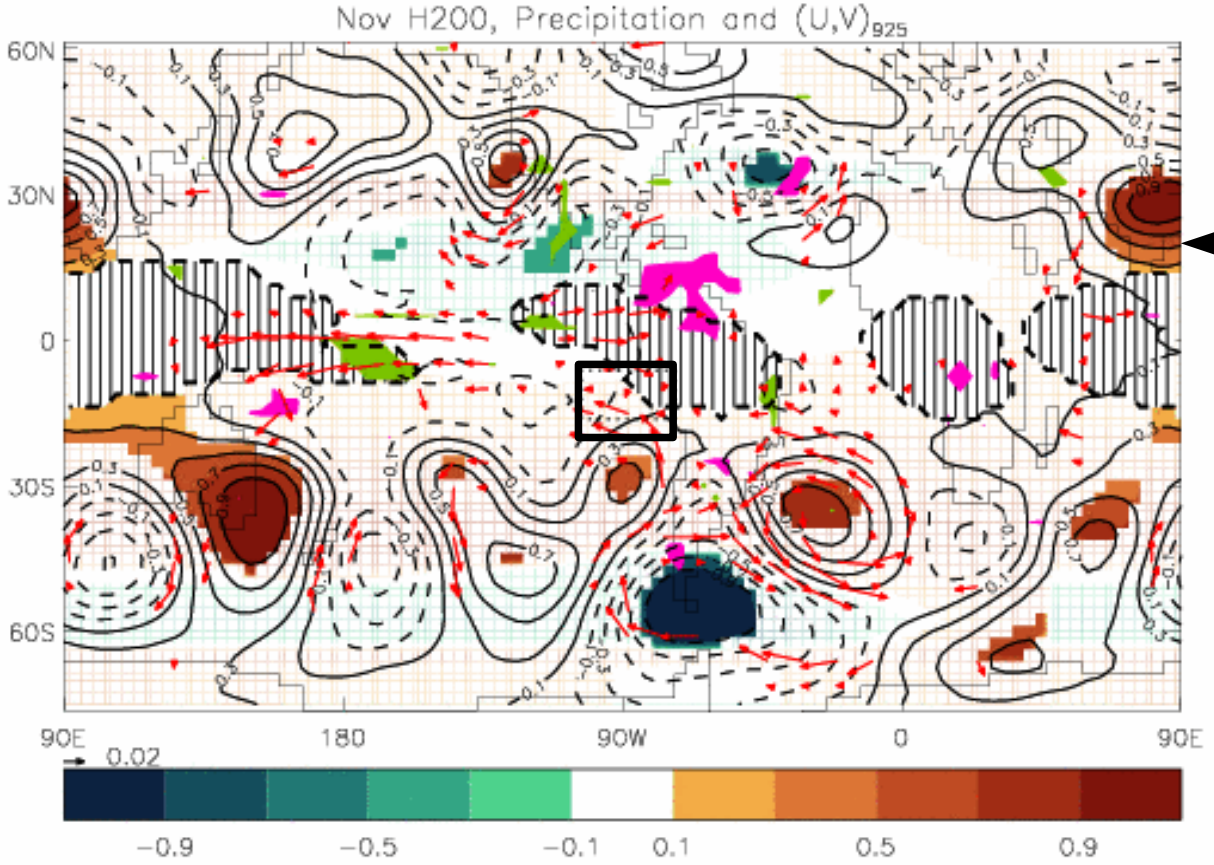
2) The suppression marks the disappearance of a shallow, meridionally propagating mode associated with substantial **diabatic** heat-content anomalies



Forcing of the variability in the SEP

3) Surface evaporation-wind coupling supports propagating SST anomalies (no ocean dynamics!) , but it is dissipative and requires forcing





4) SW anomalies are important in spring (SON), are **NOT** coupled with local SSTs, but show tropical and extra-tropical **teleconnections** of the subtropical anticyclone

Yes interesting [*I hope!*] but...

1. **These are model results: is there a correspondence with the observable climate?**

2. **How specific to ENSO are such surface-flux driven SST anomalies? Can they be seen & understood in the context of the "normal" annual cycle?**

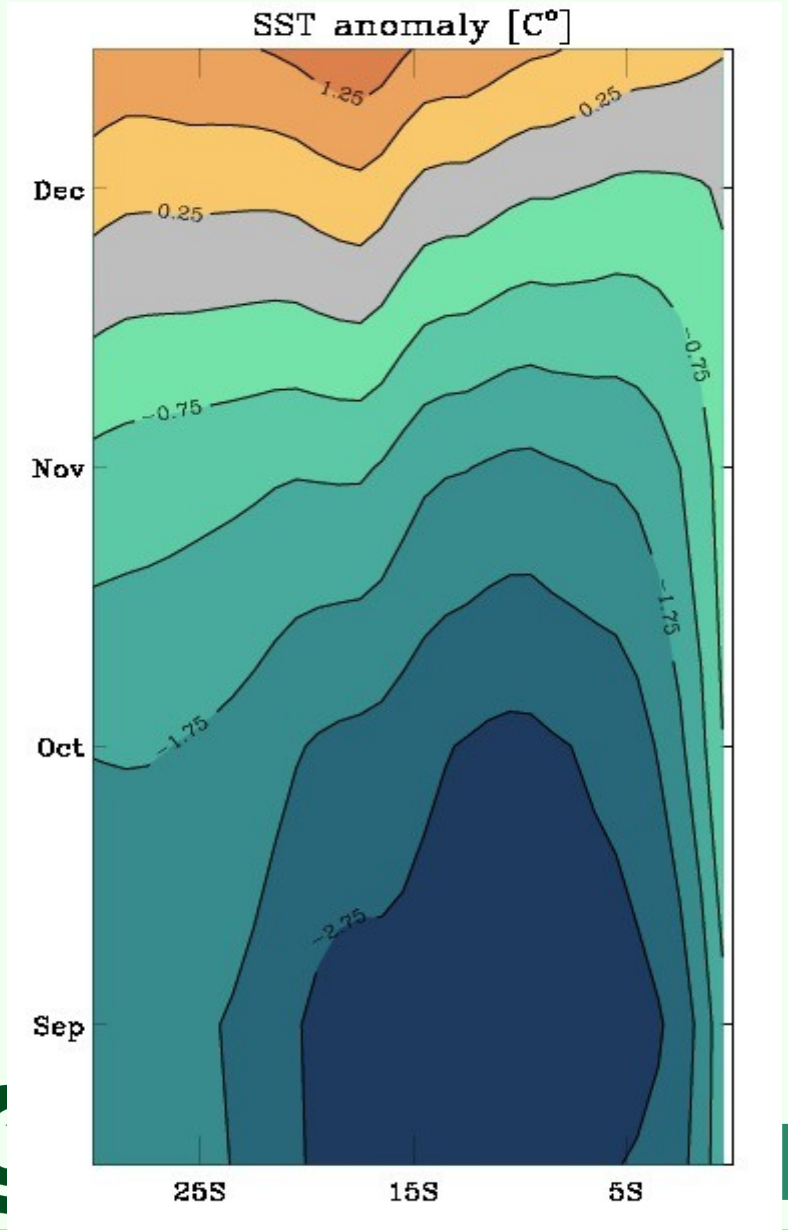
3. **Can some of the observed inter-annual variability be seen as fluctuations of the annual cycle?**

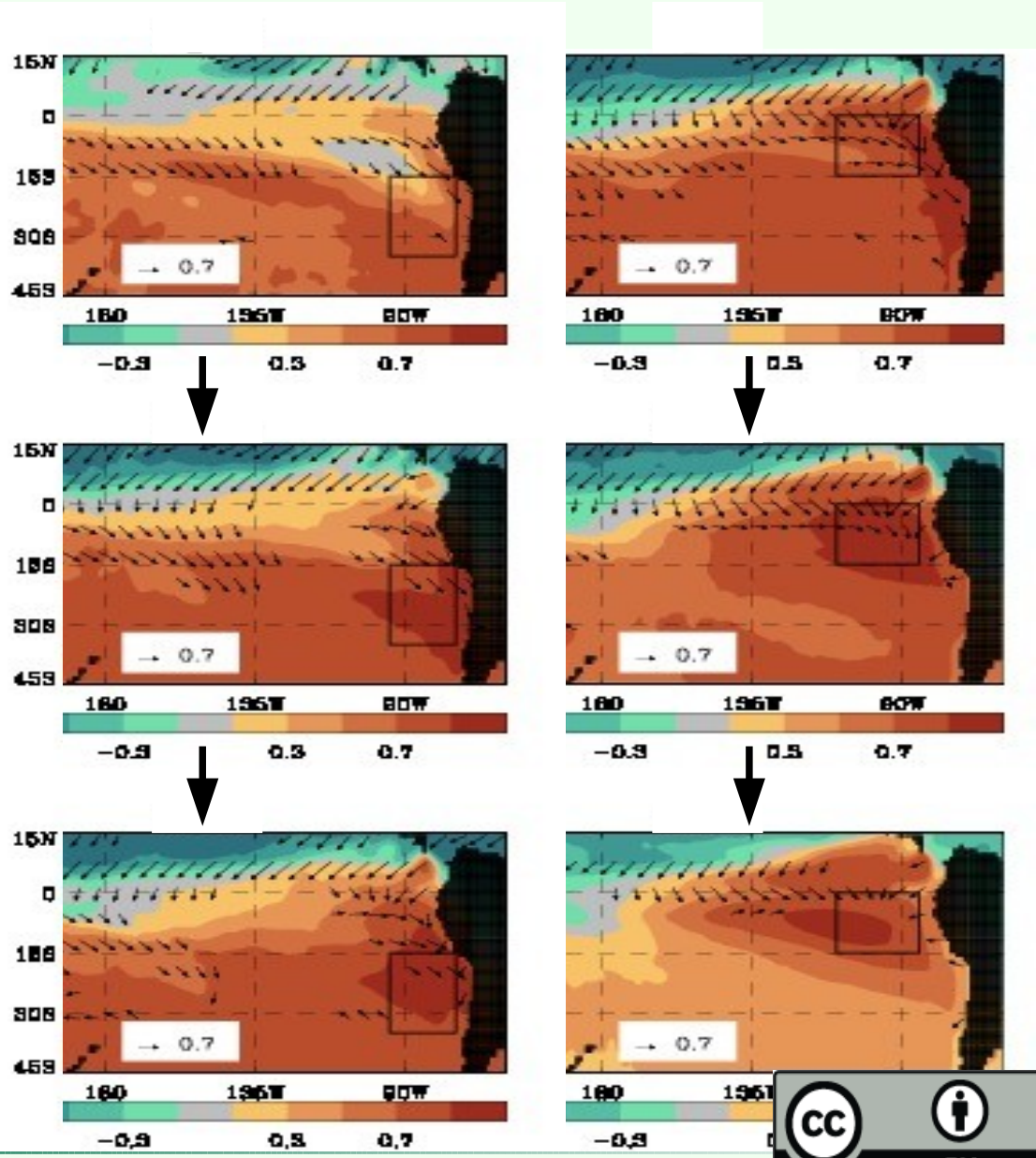
→ ***Attempt an assessment of the processes controlling the seasonal cycle of surface fluxes and SSTs***

Data sources

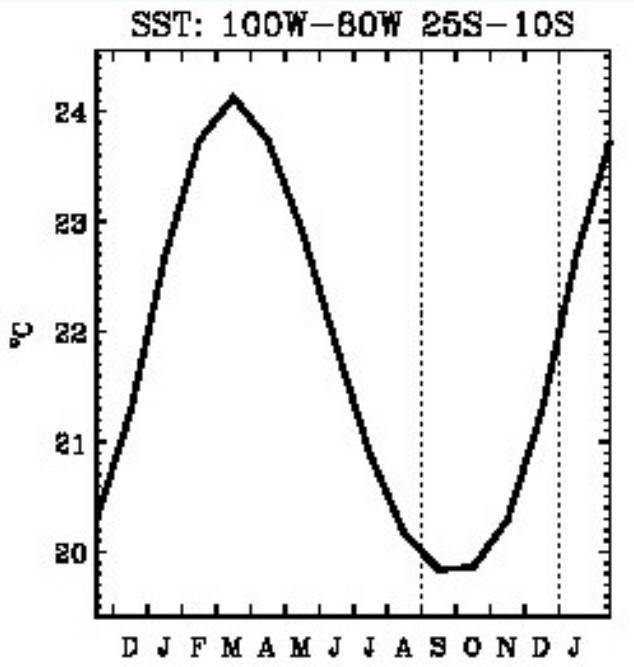
ERA-Interim (dynamical fields); UKMO operational data (VOCALS-REx); GOES-10 (IR radiances); WHOI OAFlux (SST, surface fluxes); ISSCP (radiation and cloud); NCEP (OLR); GPCP (precipitation); Matt Wheeler's homepage (projection coefficients of Wheeler-Hendon MJO indices).

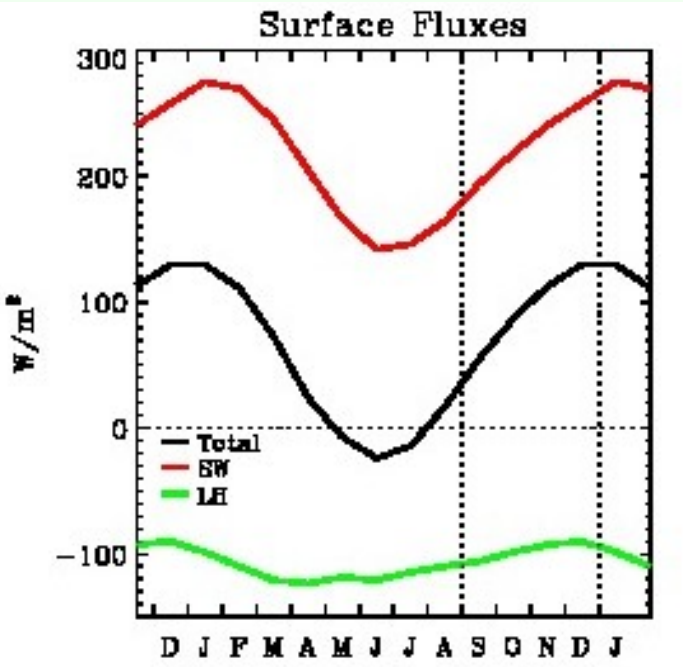
The meridional propagation of SSTa accompanied by LHF anomalies is a regular feature of the warming phase (late summer/early autumn) of the seasonal cycle in the SEP

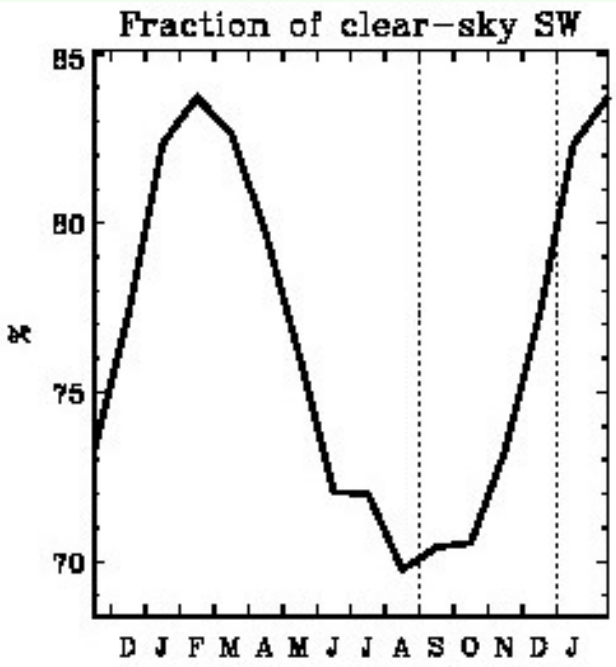


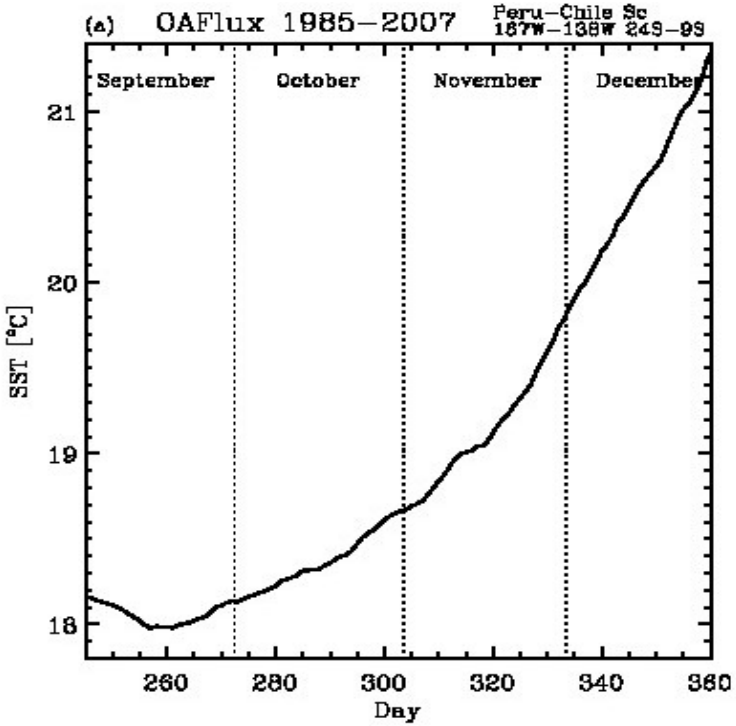


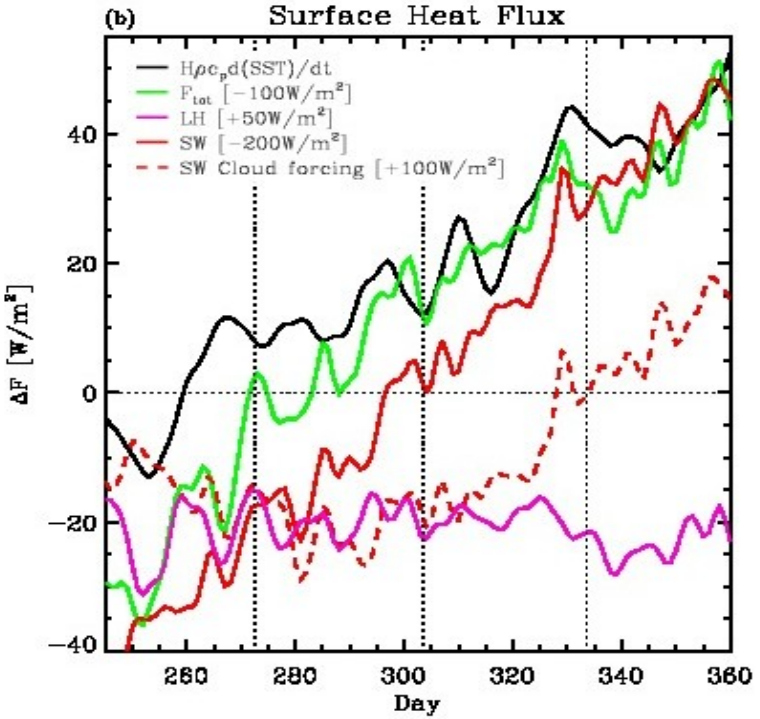
SOND seasonal evolution of SSTs: LH, SW, and cloud





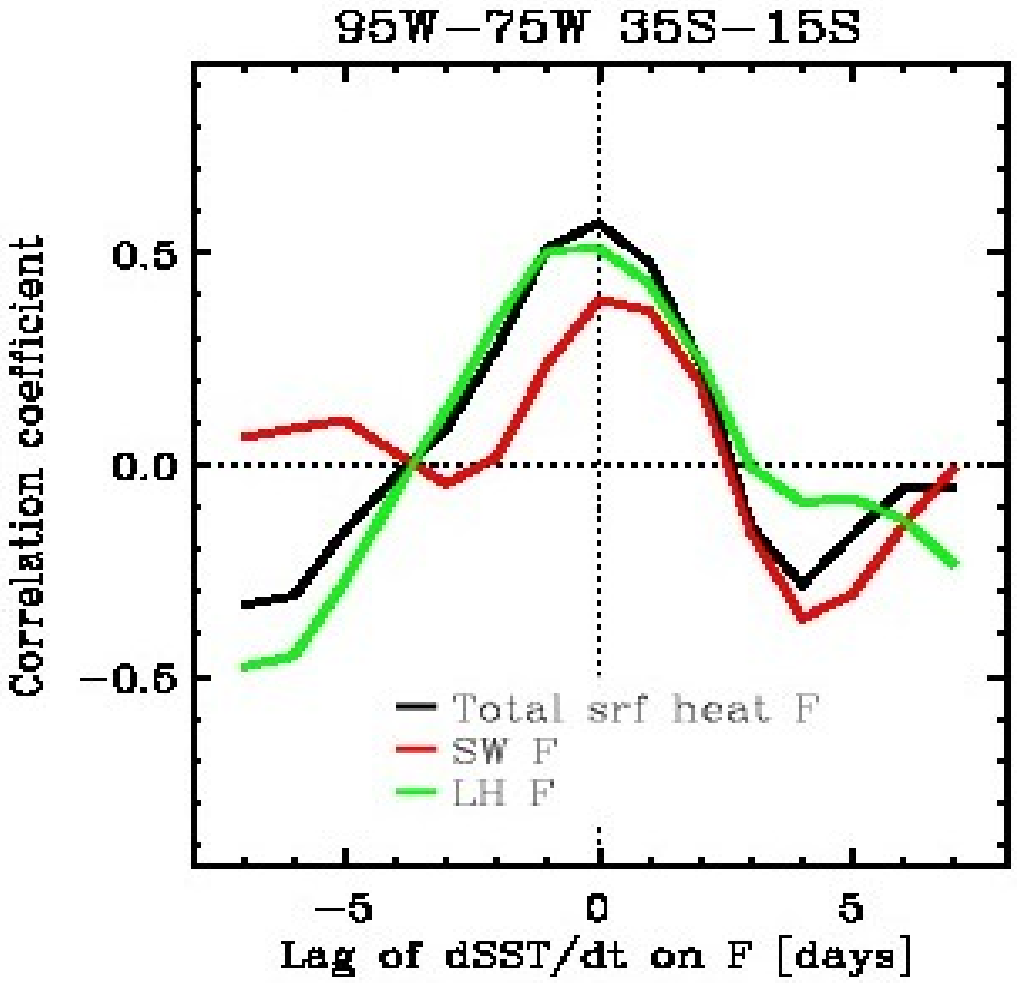






- SW dominant
- regulated by cloud forcing
- Strong pick-up in Nov

Lag-correlations between daily dSST/dt and surface heat fluxes



Consistently with the model results of Toniazzo (2010):

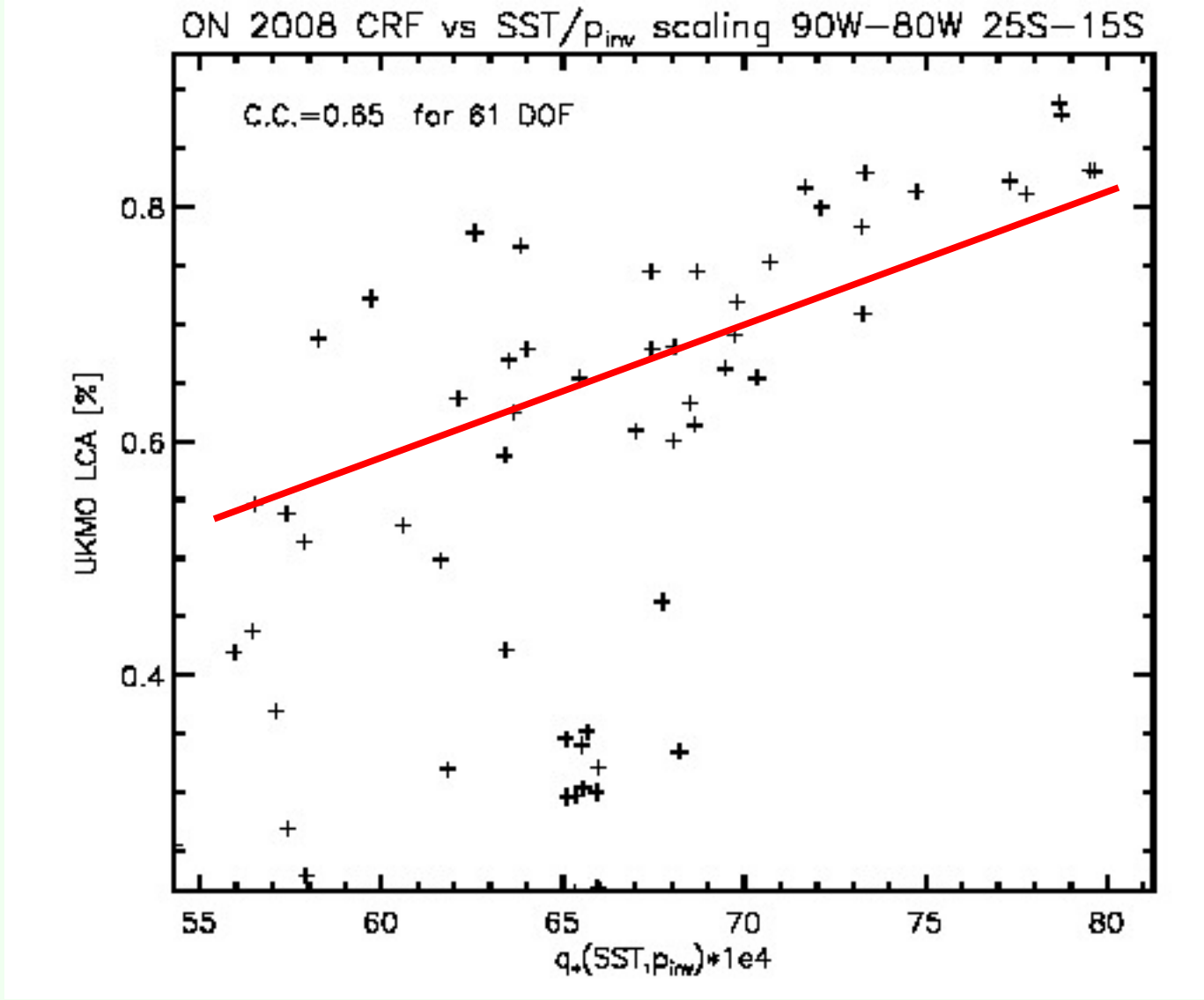
- **SW appears as a forcing and not as a feedback.**
- **Controlled by cloud surface SW forcing.**
- **Spatially co-located LHF have a damping role.**

A result from the analysis (Toniazzo et al. 2011, ACPD) of the meteorology during the VOCALS-REx campaign

Good relationship of Sc cover with tropospheric temperature.

Consistent with equilibrim scaling
LCA ~ q*[θ_{PBL}, p_i]

Based on mass and energy equilibrium argument for the PBL top.



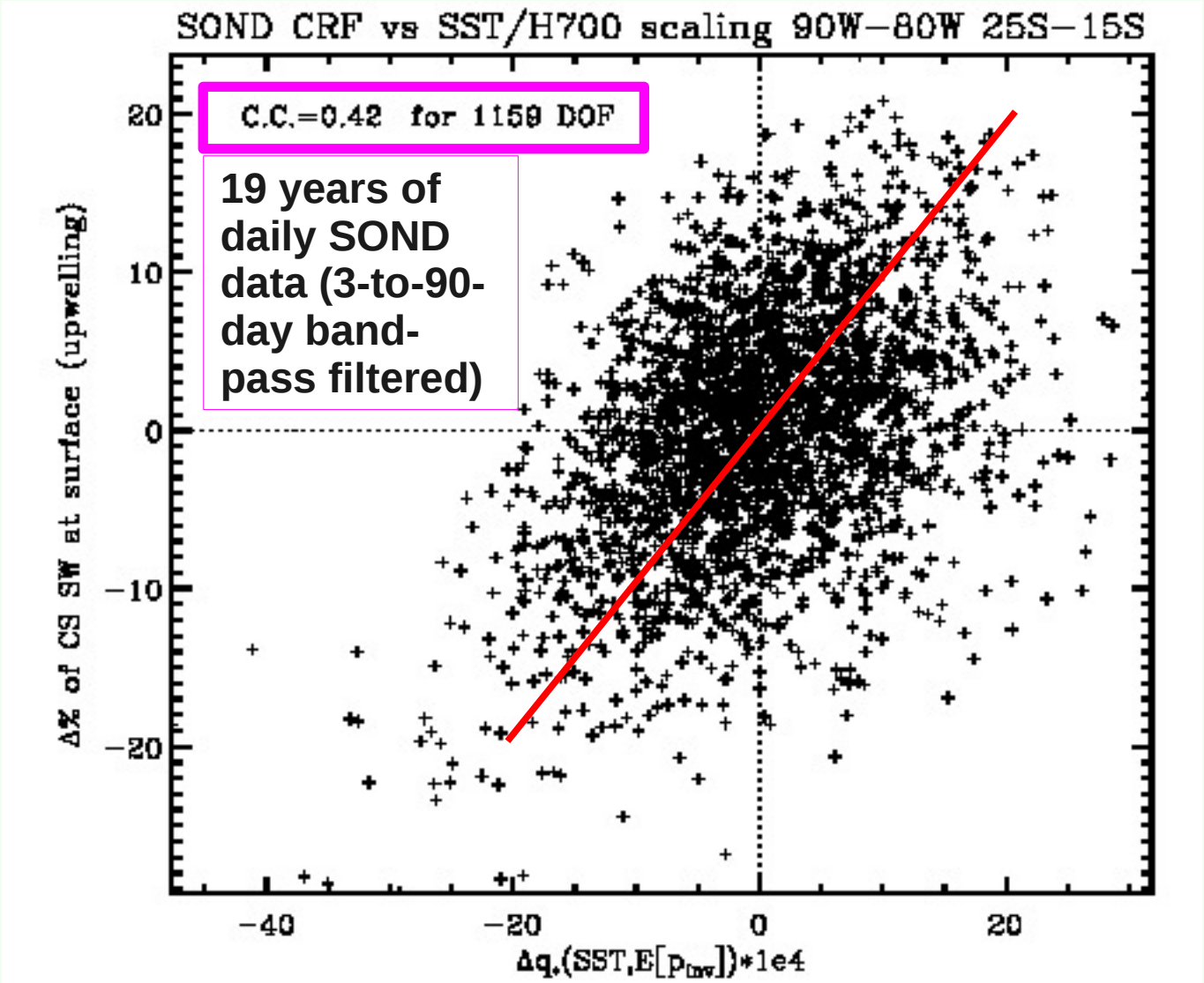
For details, see poster XY21 , Friday 13:30-1:00 (EGU2011-10257)

Consistency with longer data records

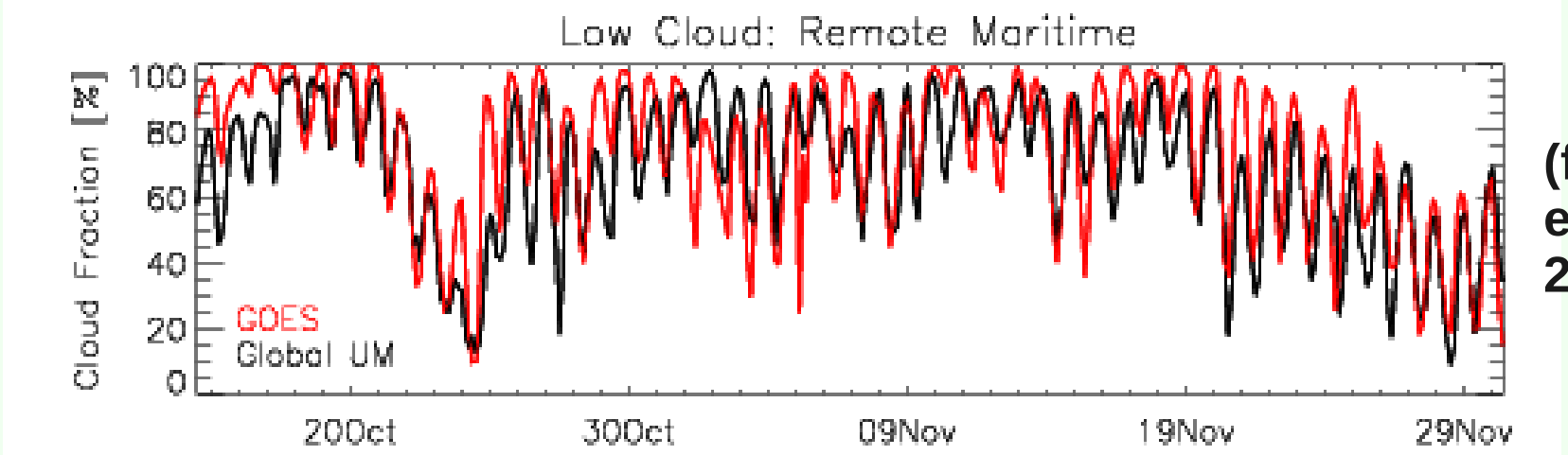
- A large part of the variability in SW cloud forcing is explained by dynamical perturbations

- Relation with free-tropospheric height:

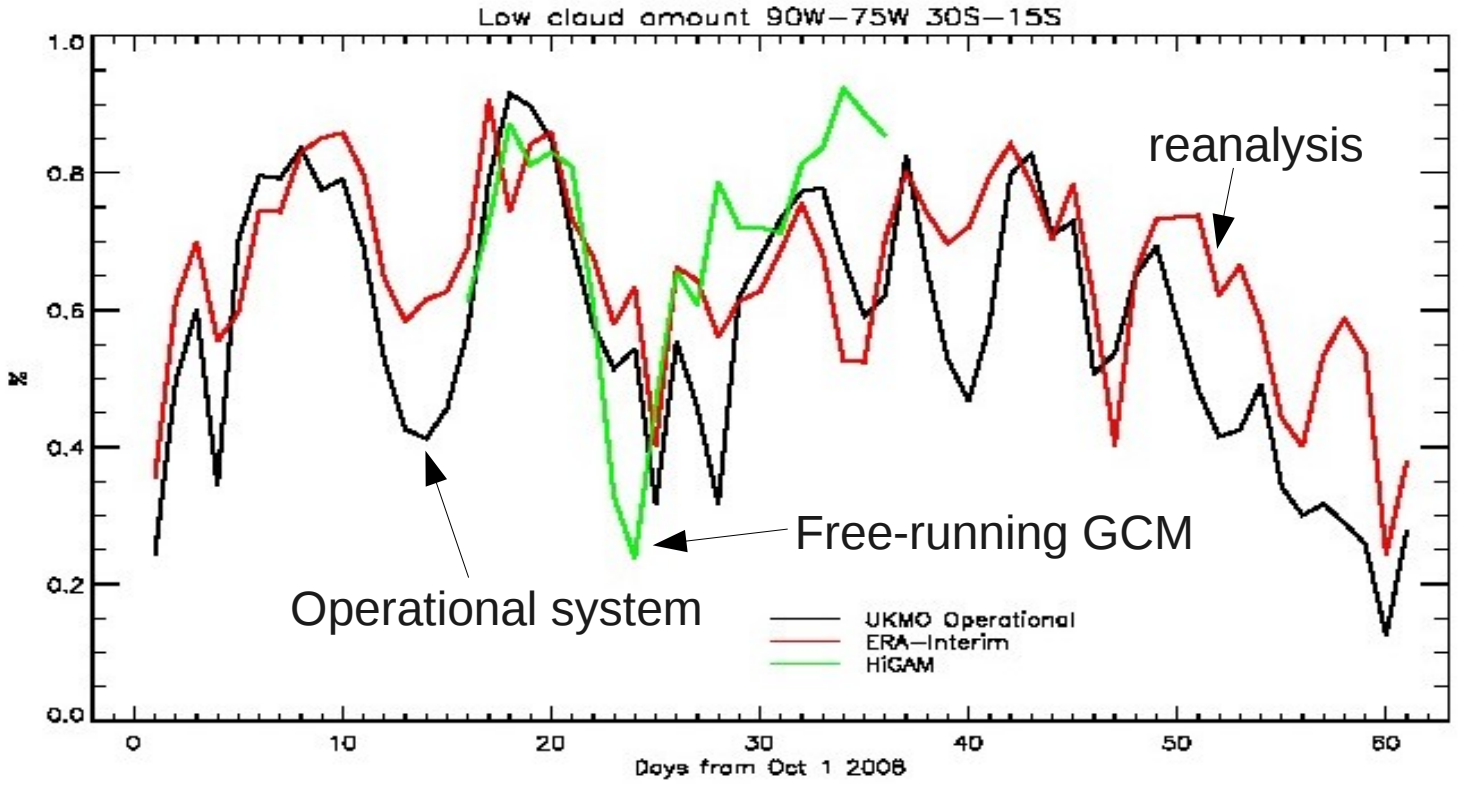
low H ↔ low c.c.



A piece of good news



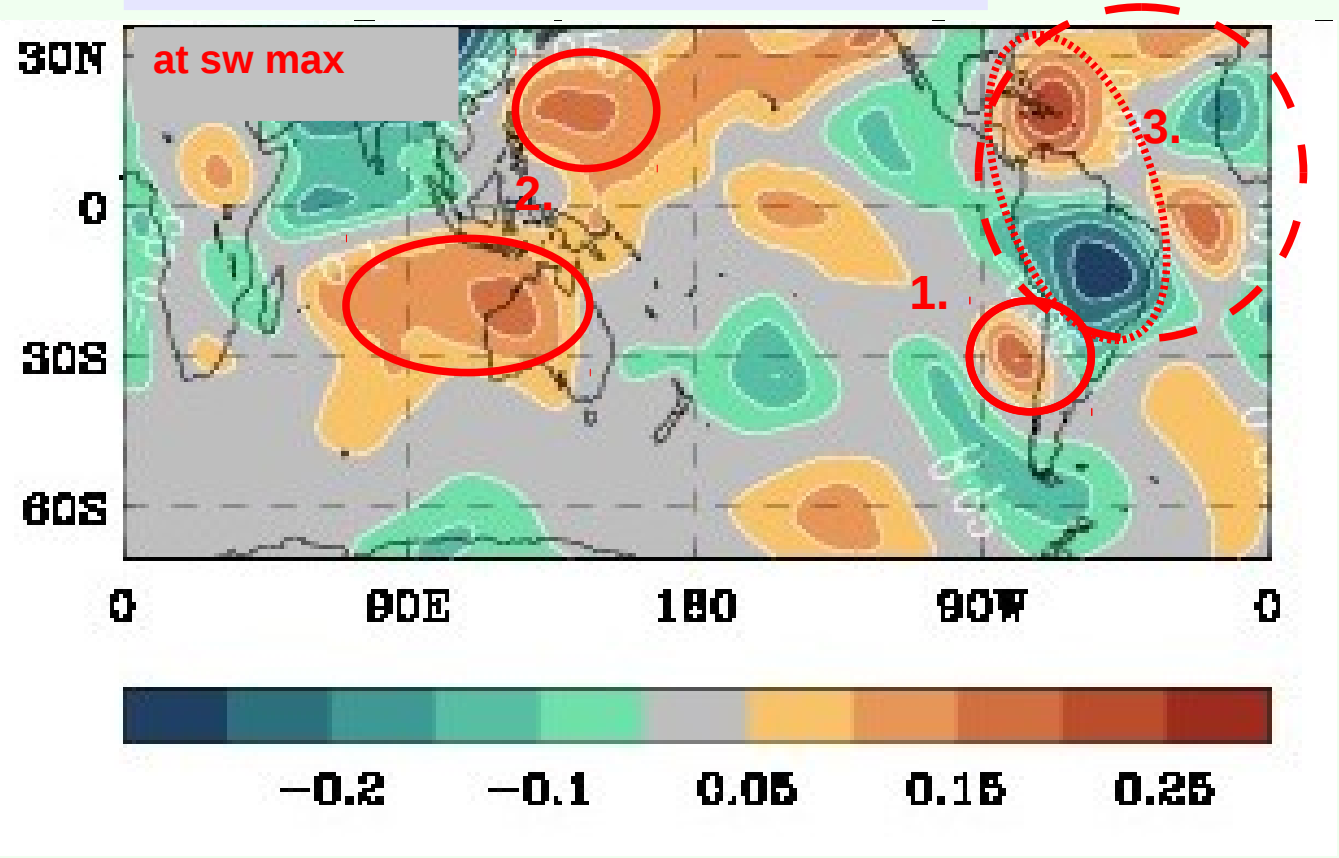
(from Abel et al., ACPD 2010)



Models do capture the dynamically forced cloud variability

The large-scale circulation signature of reduced SW cloud forcing

Lead-lag correlation of daily 200hPa STRF with cloud opacity (SON)



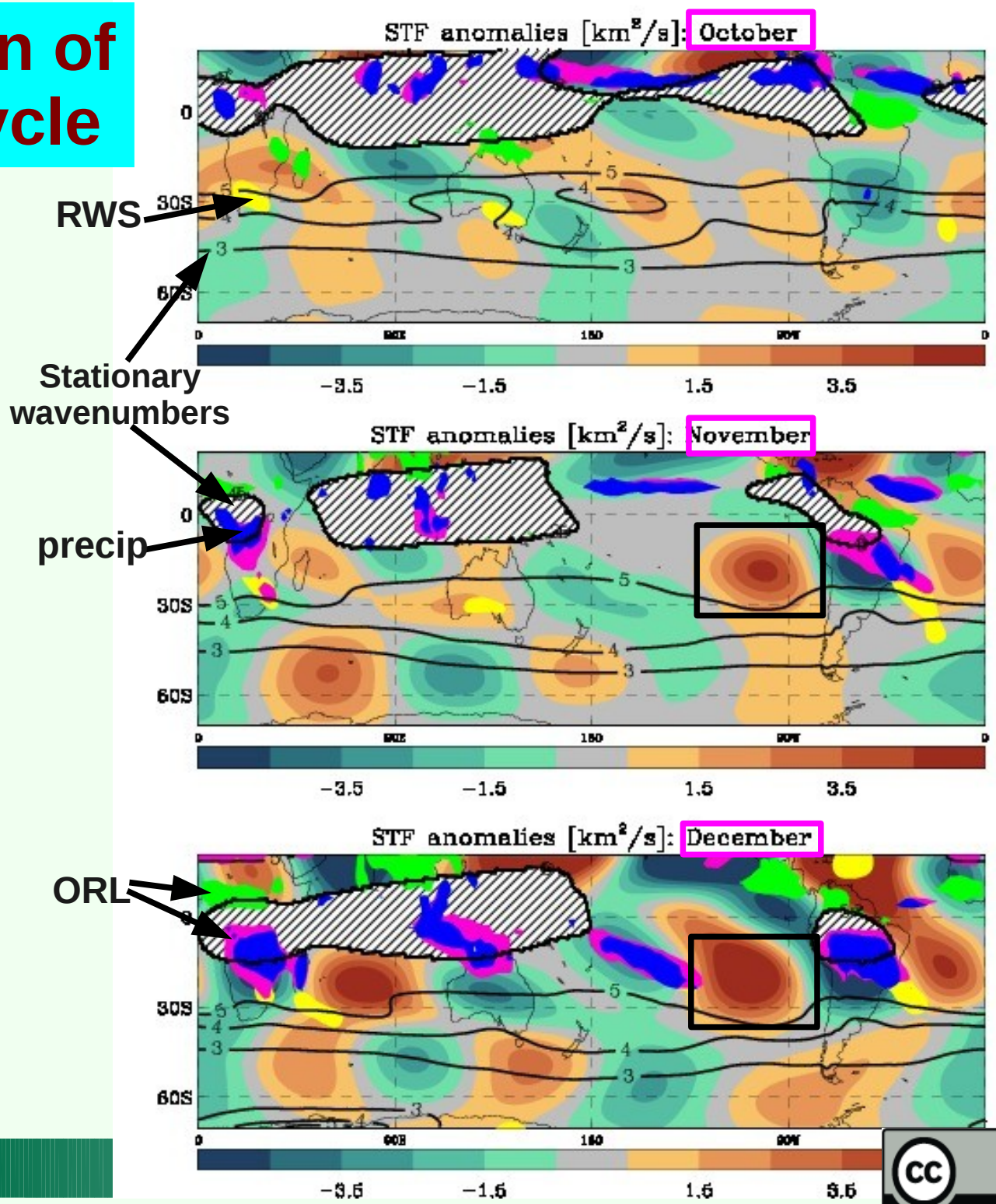
On daily time-scales, one finds:

1. Cyclonic anomaly over Sc area
2. Intensified NW Pac STH and weakened STJ over W Australia – leading
3. Strengthened AC over SA Monsoon region and Caribbean (Matsuno pattern) – lagging?

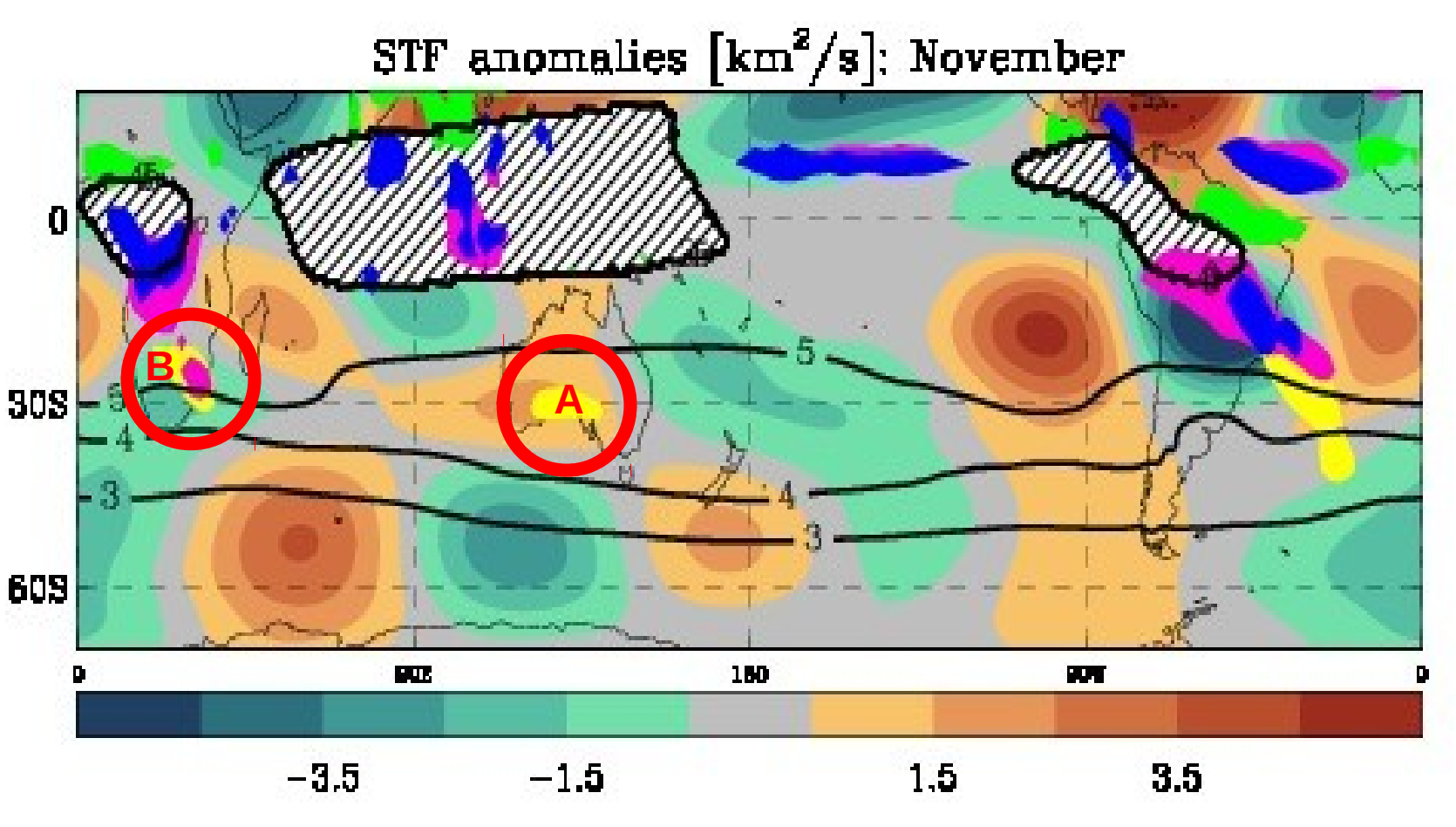
For connection with 3., cf Wang, Lee, & Mechoso (2009) J.Clim.

The progression of the seasonal cycle

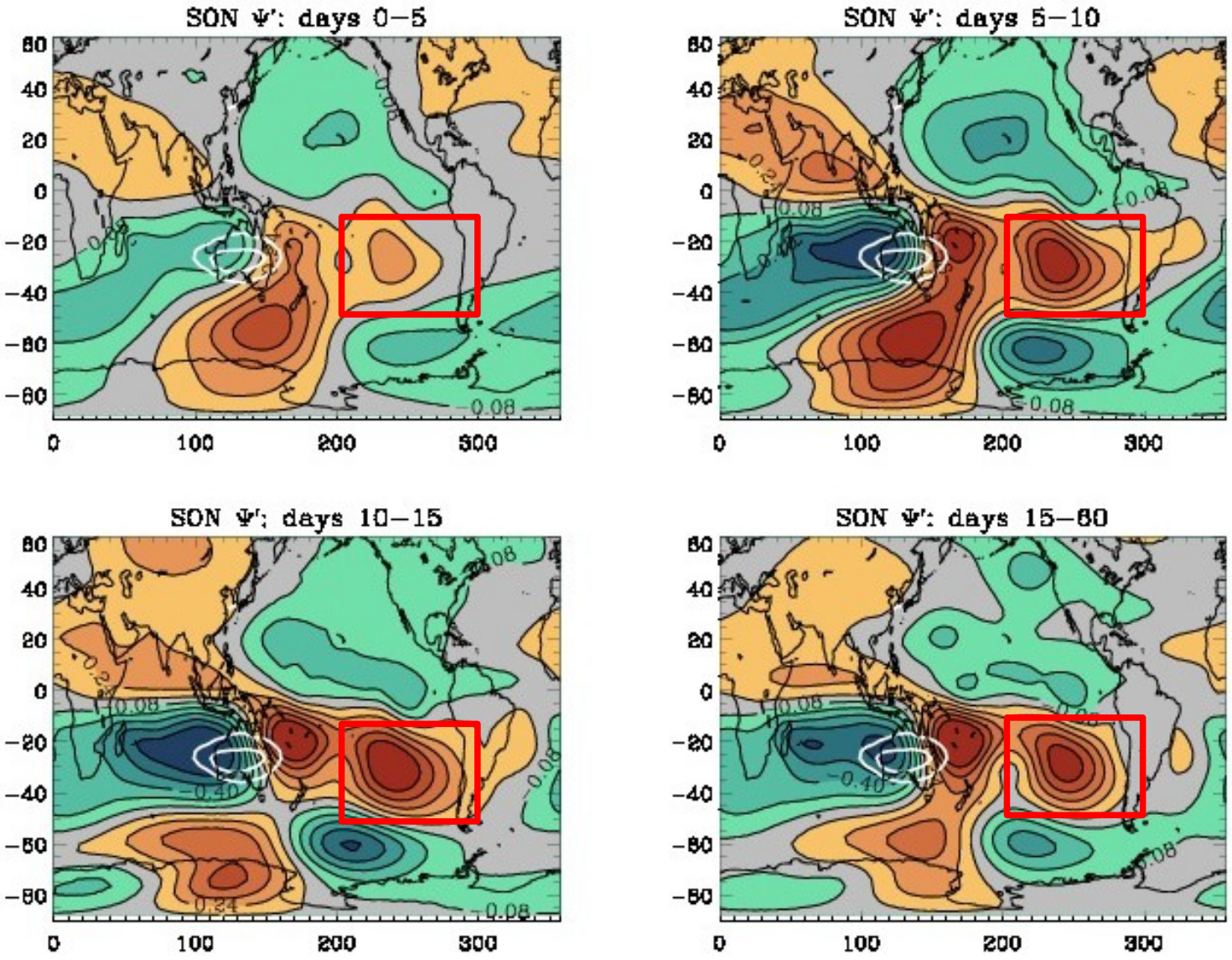
- **October:** central African ITCZ; S'ward shift of STJ over Tasman Sea.
- **November:** strong African ITCZ; SA Monsoon; S'ward shift of STJ; broadening of supported stat.wave spectrum; opening of inter-hemispheric wave pathway.
- **December:** SPCZ and Australian Monsoon; partial re-closure of IH pathway.

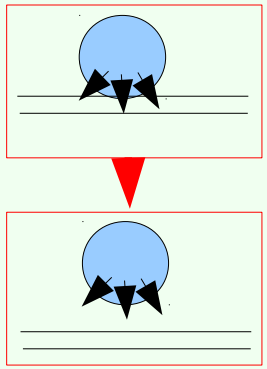


Forcing from African and Australian sectors



A.: the southward shift of the subtropical jet as a source of seasonal anomalies...

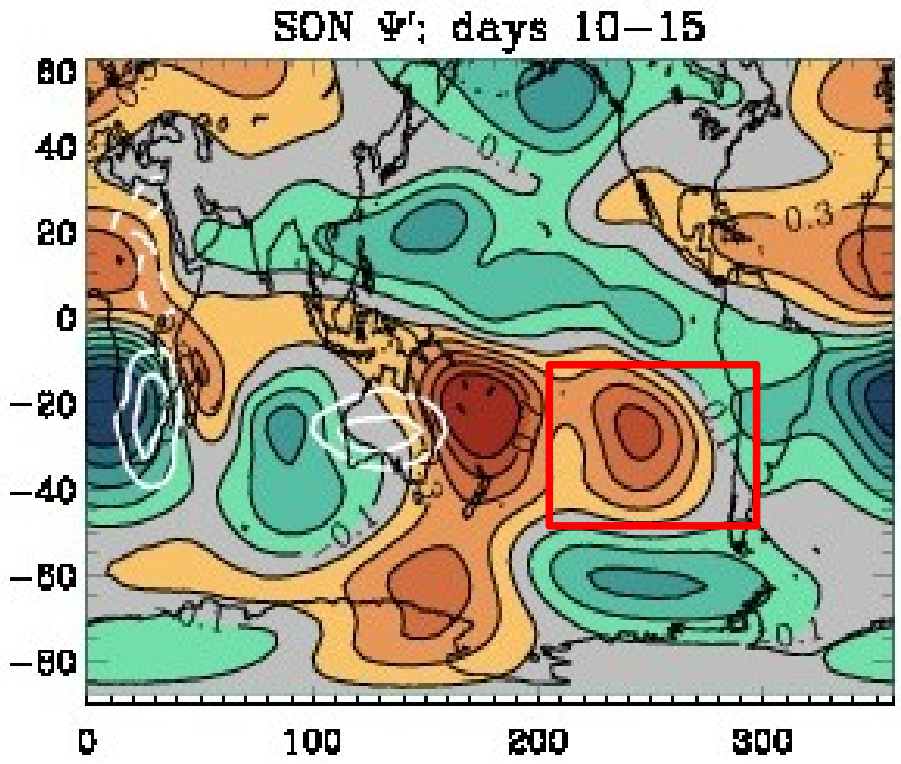


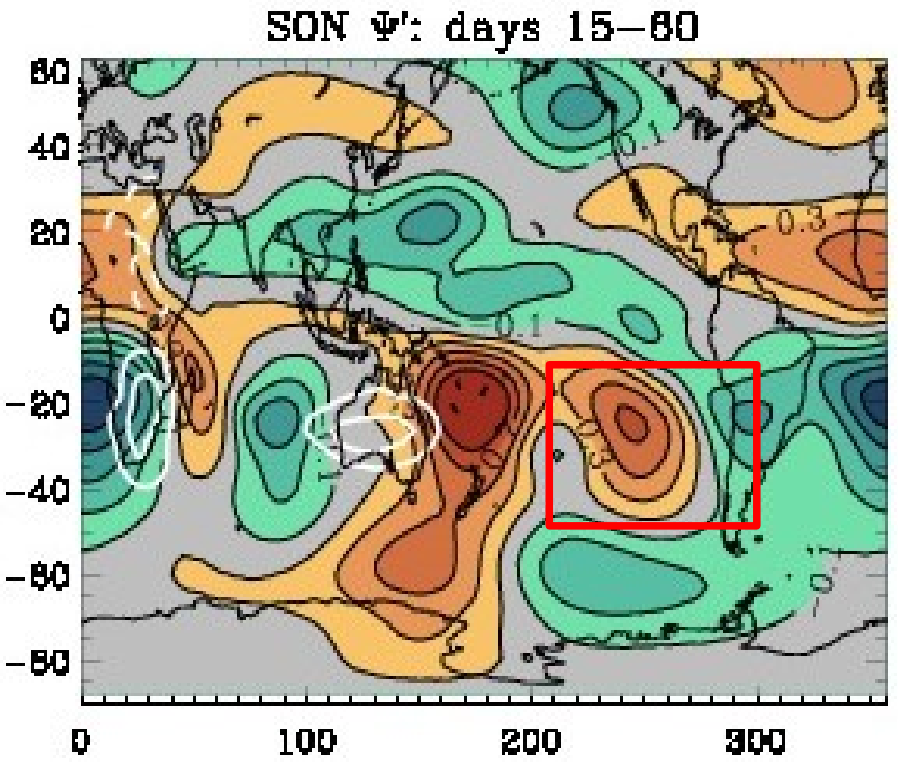


Anomalous vorticity forcing on the displaced jet-stream generated both tropical and extra-tropical quasi-stationary wave-trains.

→ **Persistent low GPH anomaly over SEP**

A.+B.: ...combined with forcing from central-African ITCZ





Small counter-action, mostly on extra-tropical component - net effect unchanged

Summary

1. The seasonal SST warming in the SEP during Spring precedes that over the eastern equatorial Pacific in late winter and has the potential of triggering ENSO-like variability as seen in coupled GCMs.

2. Surface SW fluxes play a leading role in the Spring warming

3. They in turn are controlled to a significant extend by radiative forcing from the Sc cloud deck

4. Variability in the Sc CRF is chiefly associated with dynamical forcing of non-local origin, in the sense of reduced cloud cover for cyclonic tropospheric anomalies.

5. GCMs capture this dependence fairly well.

6. The regular progression of the season generates cyclonic anomalies in the SEP via teleconnections with the reactivated areas of deep convection and with the poleward displacement of the sub-tropical jet.