DECADAL CHANGES IN THE ATLANTIC EQUATORIAL MODE AND TROPICAL IMPACTS.

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METODOLOGICAL APPROACH

AGCM SENSITIVITY EXPERIMENTS
MODELS:
UCLA AGCM v7.3
ICTP AGCM v40

EXP 1: ATL_pre79: spatial structure of the Equatorial Mode in period 50-69 + climatology of 1950-1994.

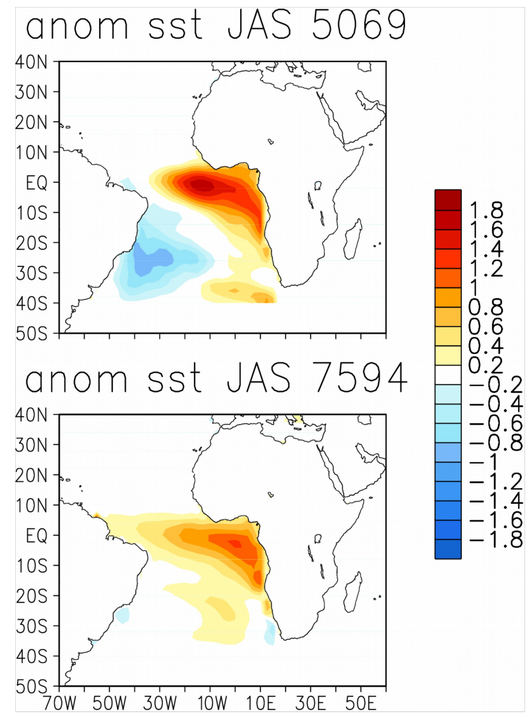
EXP 2: ATL_post70: spatial structure of the Equatorial Mode in period 75-94 + climatology of 1950-1994.

CONTROL: climatology of 1950-1994.

THE ATLANTIC EQUATORIAL MODE BEFORE AND AFTER THE 1970's

Before the 1970's the the mode shows a dipolar structure with positive anomalies in the NE and negative in the SW. This mode is similar to the one described by Nnamchi et al. (2011)

After the 1970's the SW pole of the mode disappears and the positive anomalies of SST reach the coast of South America. This mode is similar to the one that Losada et al. (2010) and Rodriguez-Fonseca et al. (2009) found to have an impact in the tropical Pacific.



GLOBAL ATMOSPHERIC RESPONSES

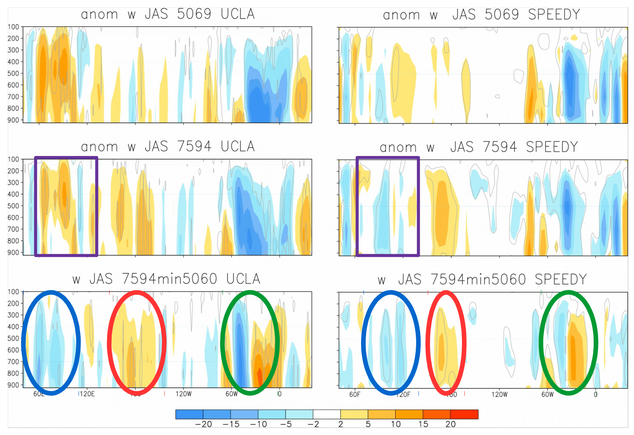


Fig. 1: JAS anomalous vertical velocity averaged between 4S-4N

In ATL_post70 the maximum upward motions over the tropical Atlantic are shifted to the west with respect to ATL_pre70 (green ovals, fig. 1).

The response over the equatorial Pacific is weaker and more noisy before the 1970's.

Over the Pacific sector, around 180, the difference between simulations is positive (red ovals, fig. 1), which indicates that the downward motions there are stronger after the 1970's.

Over the Indian ocean, the difference between ATL_post70 and ATL_pre70 is negative (blue ovals, fig. 1), meaning that the downward motions there are stronger before the 1970's.

This configuration would lead to a **reinforcement of the trade winds form the date line to the Indian ocean, favouring the development of a La Niña event** and consistently with recent works (Martin-Rey et al. 2014; Polo et al., 2015).

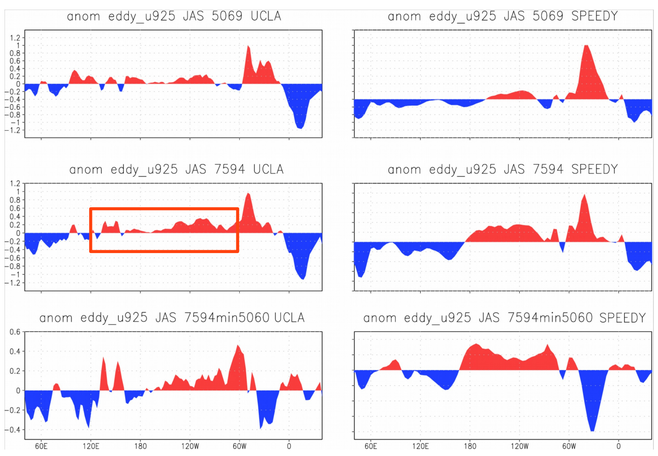


Fig. 2: JAS anomalous 925 hPa zonal wind at the equator

Nevertheless, UCLA model fails to produce such strengthening of the trades (orange rectangle, fig. 2), possibly because the model fails to produce anomalous upward motions over the equatorial Indian and Maritime Continent (IMC), east of 120E, as response to the EM (purple rectangles, fig. 1).

UCLA shows anomalous upper level convergence over the whole equatorial IMC sector in both ATL_pre70 and ATL_post70, although weaker in ATL_post70 (fig. 3).

On the contrary, ICTP ATL_post70 shows anomalous divergence and thus anomalous upward motions east of 120E.

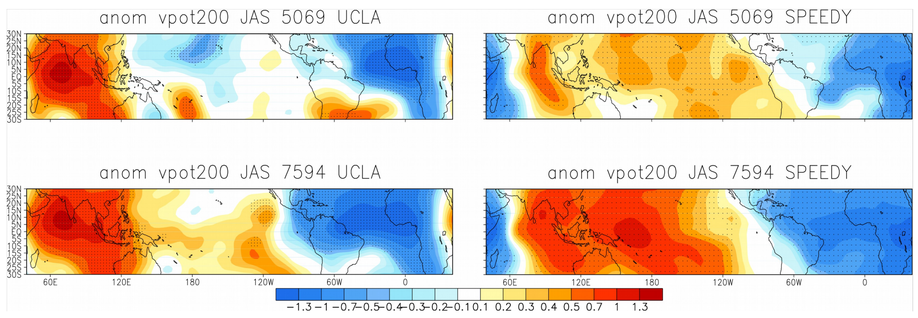


Fig. 3: JAS anomalous 200 hPa velocity potential

CONCLUSIONS

The differences in the spatial configuration of the EM before and after de 1970's seem to have an impact in the atmospheric response to the EM over the tropical Pacific sector.

Both configurations of the EM produce downward motions over both the Indian subcontinent and the equatorial Pacific sectors (Kucharski et al., 2007; 2009; Rodriguez-Fosneca et al. ,2009; Losada et al., 2010; Ding et al., 2011).

After the 1970's the downward motions are stronger in the equatorial Pacific, but weaker in the equatorial IMC, enhancing the trade winds in the western equatorial Pacific, favouring a developement of a La Niña in the Pacific, in agreement with recent results (Martin-Rey et al. 2014; Polo et al., 2015).

The reason for this change appears to be the chagne in the location of the maximum upper level divergence over the tropical Atlantic.

Results are model dependent, and the response over the IMC sector seems to be crutial for a fair representation of the Atlantic-Pacific connection reported by Rodríguez-Fonseca et al. (2009).

References: **Ding H.**, N. S. Keenlyside, M. Latif (2011): Impact of the Equatorial Atlantic on El Niño Southern Oscillation. *Clim. Dyn.*; **Kucharski F**, Bracco A, Yoo JH, Molteni F (2007) Low-frequency variability of the Indian Monsoon-ENSO relationship and the Tropical Atlantic: The "Weakening" of the 1980s and 1990s. *J. Clim.*; **Kucharski F**, Bracco A, Yoo JH, Molteni F (2009) A Gill-Matsuno-type 1 mechanism explains the tropical Atlantic influence on African and Indian monsoon rainfall. *Q. J. R. Meteorol. Soc.*; **Losada T.**, B. Rodriguez-Fonseca, I. Polo, S. Janicot, S. Gervois, F. Chauvin, and P. Ruti (2010), Tropical response to the Atlantic Equatorial mode: AGCM multimodel approach. *Clim. Dyn.*; **Martin-Rey M.**, B. Rodriguez-Fonseca, I. Polo, F. Kucharski (2014) On the Atlantic-Pacific Niños connection: a multidecadal modulated mode. *Clim. Dyn.*; **Nnamchi H.C.**, J. Li, R. N. C. Anyadike (2011): Does a dipole mode really exist in the South Atlantic Ocean? *J. Geoph. Res.*; Polo I., M. Martin-Rey, B. Rodriguez-Fonseca, F. Kucharski, C. R. Mechoso (2015) Processes in the Pacific La Niña onset triggered by the Atlantic Niño. *Clim. Dyn.*; **Rodríguez-Fonseca B.**, I. Polo, J. García-Serrano, T. Losada, E. Mohino, C. R. Mechoso, and F. Kucharski (2009): Are Atlantic Niños enhancing Pacific ENSO events in recent decades?, *Geophys. Res. Lett.* ;

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