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Observational and model time-varying atmospheric response to the Atlantic Equatorial mode

J. Garcia-Serrano, T. Losada, B. Rodriguez-Fonseca, I. Polo

Dept. Geofisica y Meteorologia, UCM, Madrid, Spain

javigarcia@fis.ucm.es

The atmospheric response in relation to the leading coupled mode between the summer Tropical Atlantic sea surface temperature (SST) and the summer-to-winter Atlantic basin precipitation is described based on observational data and model results. The study analyses the impact of the SST anomalies applying a statistical tool named Extended Maximum Covariance Analysis (EMCA), which is able to isolate time-evolving covariability modes. The 4-months JJAS sequence is chosen to study the influence of the summer tropical SST on the time-varying Atlantic anomalous rainfall, selecting different 4-months precipitation sequences, centred in JJAS and lagging one month forward (JJAS to DJFM).

The study is focused on 1979/80-2001/02 time period. Monthly CMAP precipitation and NOAA Extended Reconstructed SST (ERSST) datasets have been used to perform the observed SST-precipitation EMCA. The observed atmospheric response has been described by regressing the EMCA-SST expansion coefficient onto different ERA-40 reanalysis fields. A 4-members ensemble simulation with observed ERSST was also performed using the high resolution UCLA-AGCM (2ºlat-2.5ºlon, 29 sigma levels). The same methodology has been applied to the model output in order to better understand the forced response. Complementarily, to isolate the tropical oceanic forcing, the first canonical mode obtained in the observed EMCA has been used as the boundary condition in a 10-member ensemble sensitivity experiment (Equatorial Mode Positive simulation).

The first EMCA mode, which accounts for more than 40% (50%) of the observed

(modelled) squared covariance fraction, involves SST anomalies related to the Equatorial mode (or Atlantic Niño). Both the EMCA and the sensitivity experiment precipitation evolutions point out a rainfall pattern which evolves from the whole Atlantic equatorial band (JJAS-JASO), following the westward restoring of deep convection (ASON-ONDJ), and confining over western Brazil (EQ-10S; NDJF-DJFM). The associated atmospheric response shows variations of the Atlantic Hadley and Ferrel circulations, displacements of the Atlantic Walker circulation, and the excitation of Rossby waves which are trapped into the North African-Asian jet.

No significant response has been evidenced over the North Atlantic-western Europe during these seasons.