Geophysical Research Abstracts
Vol. 14, EGU2012-7730-1, 2012
EGU General Assembly 2012
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Two types of Atlantic Niños: ENSO-like vs. off-equatorially forced events

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Warm events in the eastern equatorial Atlantic (Atlantic Niños) are commonly thought to arise from equatorial dynamics akin to the Pacific El Niño/Southern Oscillation (ENSO), with equatorial surface winds playing a crucial role. In the present analysis we use observations, reanalyses, and GCM output to study the evolution of equatorial surface winds, heat content, and SST during Atlantic Niños. The results suggest that there are two types of Atlantic Niños. The first is indeed dominated by ENSO-like dynamics. In this type of event western equatorial wind stress forcing leads to a deepening of the eastern equatorial thermocline in MAM followed by a rapid onset of SST warming in JJA. The second type of event, on the other hand, is characterized by the influence of off-equatorial heat content. This type is associated with widespread warming that is typically most pronounced in the northern tropical Atlantic in MAM and gradually shifts to the equator in JJA, where it is amplified by the Bjerknes feedback. While the ENSO-like events are tightly linked to equatorial wind stress forcing in MAM, the off-equatorially forced events are not. Thus they cannot be predicted based on equatorial dynamics alone. Instead, predictability of these events might arise from their potential association with ENSO and the Atlantic meridional gradient mode.

Coupled GCMs are notorious for their difficulties in simulating the mean state of the tropical Atlantic but there are a few comparatively successful models. These models, however, tend to be unrealistically dominated by ENSO-like events. Such unrealistic behavior will likely have a negative impact on the models' ability to predict Atlantic Niños. Thus even models with a comparatively realistic mean state might have low prediction skills in the equatorial Atlantic.