Geophysical Research Abstracts
Vol. 13, EGU2011-2555, 2011
EGU General Assembly 2011

On the dynamical evolution of North Atlantic ridges and poleward jet stream displacements

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The development of a particular wintertime atmospheric circulation regime over the North Atlantic, comprising a northward shift of the North Atlantic eddy-driven jet stream and an associated strong and persistent ridge in the subtropics, is investigated. We combine several different methods of analysis to describe the temporal evolution of the events and relate it to shifts in the phase of the North Atlantic Oscillation and East Atlantic pattern. First, we identify a close relationship between northward shifts of the eddy-driven jet, the establishment and maintenance of strong and persistent ridges in the subtropics, and the occurrence of upper-tropospheric anti-cyclonic Rossby wave breaking over Iberia. Clear tropospheric precursors are evident prior to the development of the regime, suggesting a pre-conditioning of the Atlantic jet stream and an upstream influence via a large-scale Rossby wave train from the North Pacific. Transient (2-6 days) eddy forcing plays a dual role, contributing to both the initiation and then the maintenance of the circulation anomalies. During the regime there is enhanced occurrence of anticyclonic Rossby wave-breaking, which may be described as low latitude blocking-like events over the South-eastern North Atlantic. A strong ridge is already established at the time of wave-breaking onset, suggesting that the role of wave breaking events is to amplify the circulation anomalies rather than to initiate them. Wave-breaking also seems to enhance the persistence, since it is unlikely that a persistent ridge event occurs without being also accompanied by wave-breaking.