Geophysical Research Abstracts
Vol. 12, EGU2010-1799, 2010
EGU General Assembly 2010
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The link between Rossby wave breaking in the upper troposphere and weather regimes transitions

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Several recent studies have shown that Rossby wave breaking (RWB) are closely connected to teleconnections such as the North Atlantic Oscillation (NAO). More precisely, cyclonic and anticyclonic RWB form the key synoptic features of the positive and negative NAO phases, respectively. The aim of our study is to determine in the Atlantic sector the relation between RWB and another notion of low frequency atmospheric variability, the so-called weather regimes. There are four main weather regimes in the Atlantic: the blocking, the Greenland anticyclone, the Atlantic ridge and the zonal regime. To do this, a RWB detection method is developed that first detects all the regions where there is a local reversal of the potential vorticity gradient and then determines the nature of the breaking (cyclonic or anticyclonic).

By applying the RWB detection algorithm to the extended winter from 1958 to 2001 of ERA40 reanalysis, a climatology of the different RWB frequencies of occurrence is provided for the four weather regimes. Furthermore, by separating the onset and decay stages of each weather regime, RWBs are found to occur more frequently during the onset stage. Therefore, RWBs tend usually to reinforce the weather regime.

Composites of RWB frequencies of occurrence are then made during weather regimes transitions. RWBs are shown to play a key role in triggering specific transitions and their impact is quantified by analyzing the tendency equation of the low frequency streamfunction.

To conclude, our study shows that in most cases, RWBs maintain and reinforce the weather regime but in more specific cases they may participate to the change of the weather regime.