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Effect of latitudinal variations in low-level baroclinicity on eddy life cycles and upper-tropospheric wave-breaking processes

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Storm tracks play a crucial role in the dynamics of the general circulation of the atmosphere and particularly of the teleconnections such as the North Atlantic Oscillation (NAO). Baroclinic waves may displace the large-scale jets during their breaking with anticyclonic and cyclonic wave breaking leading generally to a northward and southward displacement of the jets respectively. For example, it has been recently shown by different authors that the positive and the negative phases of the NAO are closely related to anticyclonic and cyclonic wave breaking respectively. The purpose of our study is to look at the reverse side: the impact of the jet latitude onto wave-breaking processes by performing idealized numerical simulations using a primitive-equation model on the sphere (the PUMA model).

We first focus on normal mode analysis. By prescribing different types of jets, we study the effects of their latitude on normal mode structures and their breaking using nonlinear simulations. A second stage consists in forcing the model by relaxing the temperature field toward a given restoration temperature. Sensitivity runs are performed by using different restoration temperature fields to look at the effect of the latitude of the low-level baroclinicity on eddy life cycles. Implication for the eddy feedback onto the large-scale circulation is more precisely investigated. Our results reveal that eddies exert a positive feedback onto the latitudinal variations of the large-scale jets. Finally, these results are used to interpret some wave-breaking processes found in the observations of the Northern Hemisphere.