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Diabatic Rossby-waves as precursors for explosively deepening cyclones: dynamics and climatology

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Diabatic Rossby waves (DRWs) are low-tropospheric positive potential vorticity (PV) anomalies that are continuously regenerated through diabatic processes, leading to a rapid propagation along an intense baroclinic zone. It has been hypothesized that DRWs can be important precursors for rapid cyclone development. Previously, the mechanism of DRWs has been studied mainly in idealized channel flows. Here a detailed case study is presented of a DRW that is involved in explosive cyclone development over the North Atlantic.

The general features of the event are investigated using operational ECMWF analyses and satellite images. Then, results from sensitivity experiments with the regional COSMO model are shown to examine the influence of enviromnental conditions on the DRW dynamics and evolution. It is found that the DRW is a rather robust system during its propagation phase but sensitive to various factors during its intensification.

In a second part, key results from a 5-year climatology of DRWs will be presented. For this purpose a tracking algorithm has been created that identifies positive PV anomalies in the lower troposphere as DRWs in case they are located over a baroclinic zone, propagate rapidly, and are not forced by upper-level waves during a time period of at least 12 hours. It is shown that DRWs occur more frequently over the North Pacific than over the North Atlantic basin and that only a minor part of them intensify - although some of them very rapidly.