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Rossby wave-breaking analysis of explosive cyclones in the Euro-Atlantic sector

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The two-way relationship between Rossby wave-breaking (RWB) and intensification of extratropical cyclones is analysed over the Euro-Atlantic sector. In particular, the timing, intensity and location of cyclone development are related to RWB occurrences. For this purpose, two indices based on potential temperature are used to detect and classify anticyclonic and cyclonic RWB episodes from ERA-40 reanalysis data. Results show that explosive cyclogenesis over the North Atlantic (NA) is fostered by enhanced occurrence of RWB on days prior to the cyclone's maximum intensification. Under such conditions, the eddy-driven jet stream is accelerated over the NA, thus enhancing conditions for cyclogenesis. For explosive cyclogenesis over the eastern NA, enhanced cyclonic RWB over eastern Greenland and anticyclonic RWB over the subtropical NA are observed. Typically only one of these is present in any given case, with the RWB over eastern Greenland being more frequent than its southern counterpart. This leads to an intensification of the jet over the eastern NA and enhanced probability of windstorms reaching western Europe. Explosive cyclones evolving under simultaneous RWB on both sides of the jet feature a higher mean intensity and deepening rates than cyclones preceded by a single RWB event. Explosive developments over the western NA are typically linked to a single area of enhanced cyclonic RWB over western Greenland. Here, the eddy-driven jet is accelerated over the western NA. Enhanced occurrence of cyclonic RWB over southern Greenland and anticyclonic RWB over Europe is also observed after explosive cyclogenesis, potentially leading to the onset of Scandinavian blocking. However, only very intense developments have a considerable influence on the large-scale atmospheric flow. Non-explosive cyclones depict no sign of enhanced RWB over the whole NA area. We conclude that the links between RWB and cyclogenesis over the Euro-Atlantic sector are sensitive to the cyclone's maximum intensity, deepening rate and location.