



Climatology and dynamics of the link between dry intrusions and cold fronts

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The conceptual picture of an extratropical cyclone typically includes warm and cold fronts and various cyclone-related airstreams, including the dry intrusion (DI). The DI is a stream of air descending slantwise from the upper troposphere, towards the boundary layer at lower latitudes behind the cold front. The relatively dry and cold DI air potentially impacts dynamically the cold front and the cyclone cold sector behind it, helping to produce potential instability, convective activity and precipitation.

Based on the ECMWF ERA-Interim dataset for 1979-2014 winters of both hemispheres, we computed the co-occurrence of DIs and cold fronts trailing from extratropical cyclones, using objective identification techniques. We combine a case study with feature-based climatologies and composite analysis, to quantify the climatological link between DIs and cold fronts, and understand the role of DIs in shaping the frontal environment and its impact in terms of precipitation and wind gusts.

The global distribution of cold fronts linked to DIs indicates that roughly a third of DIs are linked to fronts, while about 20% of fronts are associated with DIs. Generally, fronts that occur with DIs are substantially longer, sharper and more impactful in terms of precipitation and 10-m wind gusts, even when controlled for the front intensity. Moreover, with DIs, trailing fronts occur with stronger SLP dipole, deeper upper-tropospheric trough and enhanced ocean sensible and latent heat fluxes in the cyclone cold sector, compared to similar fronts without DIs in their vicinity.