

Dry air intrusions: climatology and their relevance for strong surface winds

Shira Raveh-Rubin and Heini Wernli

Institute of Atmospheric and Climate Science, Department of Environmental Systems Science, ETH Zurich, Switzerland
(shira.raveh@env.ethz.ch)

Dry air intrusions (DIs) are large-scale descending airstreams. A DI is typically referred to as a coherent airstream in the cold sector of an extratropical cyclone. Emerging evidence suggests that DIs are linked to severe surface wind gusts. However, there is yet no strict Lagrangian definition of DIs, and so their climatological frequency, physical characteristics as well as their seasonal and spatial distributions are unknown. Furthermore, the dynamical interaction between DIs and strong surface winds is not fully understood.

Here, we suggest a Lagrangian definition for DI air parcels, namely a minimum pressure increase along a trajectory of 400 hPa in 48 hours. Based on this criterion, the open questions are addressed by: (i) a novel global Lagrangian climatology and statistical analysis for the ECMWF ERA-Interim reanalysis dataset for the years 1979-2014; (ii) examples for the interaction between DIs and strong surface winds, shown with case studies for the Mediterranean region, using a mesoscale regional model simulation.

We find that DIs occur predominantly in winter. DIs coherently descend from the upper troposphere (its stratospheric origin is small), to the mid- and low levels, where they mix with their environment and diverge. Different physical characteristics typify DIs in the different regions and seasons, with unique features in the Mediterranean region. Finally, we demonstrate the different mechanisms by which DIs can destabilize the boundary layer and facilitate the formation of strong surface winds.