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Moisture transport and meteorological drought episodes around the world

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The purpose of this work is to investigate the moisture transport during significant meteorological drought episodes observed around the world over the past few decades. The most severe event in the period 1980-2015 was identified for each one of the 27 reference regions (RR) defined in the 5th IPCC Assessment Report through the multi-scalar Standardized Precipitation Evapotranspiration Index (SPEI). SPEI-1 values were computed using time series of monthly CRU (TS3.24.01) precipitation and potential evapotranspiration averaged over each RR. The approach applied both to identify the climatological moisture sources and to investigate anomalies in the moisture transport is based on the Lagrangian model FLEXPART integrated with the ERA-Interim data set at the 1º horizontal resolution. For each RR, the following anomalous patterns are analysed during the selected episode: a) evaporative conditions over the respective sources through land and oceanic evaporation (from GLEAM and OAFLUX data sets, respectively); b) the partial moisture budget over sources (considering only particles travelling from the sources towards the RR) through the Lagrangian backward in time experiment from the RR (BW exp); and c) the moisture transport from the sources towards the RR through the Lagrangian forward in time experiments from each source (FF exp). Results obtained for the Central Europe region (CEU) are showed in order to illustrate the global analysis. Climatologically, this RR receives moisture from nine different oceanic and terrestrial moisture sources: North Atlantic (NAT), Mediterranean Sea (MDS), Baltic Sea (BAS), Black Sea (BLS), Caspian Sea (CPS), North African Coast (NAC), Bay of Biscay (BIS), terrestrial moisture sources surrounding the region (TER), and itself (CEU). The most severe drought episode in CEU, identified on SPEI-1 time scale, lasted from February 2003 to June 2003. The episode was characterized by anomalous subsidence, increased potential evapotranspiration, and reduced precipitation. During 2003, negative anomalies of evaporation over NAT and positive anomalies over MDS prevailed mainly during the beginning of the episode. Moisture uptake (from the BW exp) by the particles travelling towards the CEU decreased over MDS and NAT sources during this episode. From the FF exp, MDS and CEU were the sources presenting the most intensive reduction in the moisture supply for the CEU during this event. We believe that investigating not only the water vapour transport between sources/sinks of moisture, but also its variability associated with extreme conditions, may contribute for a deeper understanding of these natural hazards.