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Current and future moisture sources for extreme precipitation events in the European low countries

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For a warming climate, it is projected that mid-latitude extreme precipitation events will increase in intensity in winter and, for short localised events, possibly also in summer despite a mean drying trend. Whilst it is the multiday extremes that are important for determining flood risk for major river basins, single-day events can wreak havoc on local scales.

Recent studies of the current climate (e.g. Stohl et al. 2008, Bao et al. 2005) suggest that 1) low-latitude moisture sources are more important for the stronger mid-latitude precipitation events and 2) tropospheric rivers (bands of particularly large vertically integrated water vapour fluxes) are sometimes implicated in the long-distance transport and convergence of moisture in these events. This study is concerned with the mechanisms for the future increase in precipitation intensity for both single and multiple day events. Whilst intensity changes may be linked to the atmosphere's increased water vapour-holding capacity (Clausius-Clapeyron relation) and higher rates of local evaporation, changes to the large-scale circulation and tropical-extratropical interactions could additionally impact long range moisture transport.

A number of the most significant recent single and multiday precipitation events occurring in the European low countries during the last half century are explored from a collective and single-case standpoint. Lagrangian backward trajectories and a water vapour budget analysis following Sodemann et al. (2008) are applied to ECMWF analysis fields to give insight into the surface sources of moisture that contributed to the events. We consider the following questions: Are tropospheric rivers an important transport mechanism in recent extreme events? Are they realistically captured by global climate models? What can we deduce from global climate models about their characteristics in a warmer future climate? What is the impact of circulation changes on moisture source regions in a future climate?