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Do regional climate models capture links between circulation types and precipitation in Central Europe?

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The study investigates relationships between large-scale atmospheric circulation (represented by circulation indices and circulation types derived from gridded mean sea level pressure) and daily precipitation amounts over 3 regions in the Czech Republic with different precipitation regimes. We examine how ENSEMBLES regional climate model (RCM) simulations driven by re-analysis reproduce the observed links and capture differences in the links between given regions (lowland vs. highland ones) and seasons. We study the links of circulation to (i) mean precipitation over the regions, (ii) probability of wet days, and (iii) probability of heavy precipitation (exceeding threshold defined by a high quantile of precipitation distribution in a given region and season).
There are quite strong links in the observed data between atmospheric circulation and these precipitation characteristics. The links are generally more pronounced for highland than lowland regions. More wet days and higher precipitation amounts are found for cyclonic and stronger flows, and for westerly and north-easterly flows. The RCMs are generally able to capture basic features of the links. However, they have difficulties to reproduce some more specific features (e.g. relatively larger mean precipitation for south-westerly flow, the magnitude of the link between precipitation and vorticity) and differences in the links between the regions. Results also suggest that good performance in some precipitation characteristics may be due to compensating errors rather than model's perfection.