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An investigation of the spatial correlations between Euro-Atlantic atmospheric teleconnections and winter solar radiation in NW Europe

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Increased utilisation of solar photovoltaic electricity production requires a better understanding of the impact of large-scale atmospheric pressure patterns on the spatial patterns of incident shortwave (SW) solar radiation. We focus on the spatial relationships between winter SW radiation in north-west Europe and the dominant Euro-Atlantic atmospheric pressure teleconnection patterns using multiple observational and gridded reanalysis datasets, with a particular focus on the island of Ireland,the UK mainland and adjacent areas. Our study uses multi-decadal datasets considerably longer and more detailed than those used in previous studies. We show that the previously reported westeast seesaw behaviour in the spatial correlation pattern between the winter North Atlantic Oscillation (NAO) index and winter SW radiation across the UK actually involve several zonal changes in the NAO-SW correlations (multiple 'seesaws'). Compared with the NAO, the East Atlantic (EA) pattern exerts only a weak control on winter SW radiation on the region, but high values of the Scandinavian pattern index (SCAND) exhibit a similar spatial, but opposite correlation behaviour to the NAO-SW zonal relationship. Our study also provides new insights into the physical processes that drive the correlations between the large-scale atmospheric pressure patterns and local winter SW radiation. Inter-seasonal variations in the dominant atmospheric flow and moisture transport direction, steered by large-scale atmospheric pressure patterns, followed by orographic uplift and rainout on the windward side of topographic highs are interpreted to be the main causal mechanisms for the observed zonal variations and reversals in the sign of the spatial correlations between winter SW anomalies and the NAO index.