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Constructing and simulating a rain-on-snow climatology for Norway

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Rain-on-snow (ROS) events are multivariate hydrometeorological phenomena requiring a combination of rain and snowpack, with complex processes occurring on and within the snowpack. Impacts include floods and landslides, and rain may freeze within the snowpack or on bare ground, potentially affecting vegetation, wildlife, and permafrost. ROS events occur mainly in high-latitude and mountainous areas, where sparse observational networks hinder accurate quantification – as does a scale mismatch between coarse (50-100 km) resolution re-analysis products and localised events. A recent study (Pall et al., submitted; available at: https://eartharxiv.org/k72ej/) uses a high (1km) resolution observational data set for mainland Norway to construct a ROS climatology for recent decades. Its main result is that, compared to 1961-1990, ROS events in the 1981-2010 period decrease most in the southwest in winter, southeast in spring, and north in summer (consistent with less snow cover in a warming climate), and increase most in the southwest, southern mountains, and north in winter-spring (consistent with increased precipitation and/or more snow falling as rain in a warming climate). The pattern of ROS winter-spring events also broadly correlated with the North Atlantic Oscillation, and the Scandinavia pattern – and more so with the Arctic Oscillation, particularly in the southern mountain region where long-term ROS trends are significant. Here we investigate this result further, by using a high-resolution climate model to simulate a Norwegian ROS climatology and evaluate it against the aforementioned observed climatology (1981-2010). Using insights from the evaluation, simulations for a future period (2070-2100; under the IPCC RCP8.5) will also be performed. A particular focus is on the connection between large-scale meteorology and local ROS events. This work forms a contribution to the LATICE (Land-ATmosphere Interactions in Cold Environments) and EMERALD (Terrestrial ecosystem-climate interactions of our EMERALD planet) projects at the University of Oslo.