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Identifying the freezing rain events in European gridded climate datasets

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Freezing rain is a common phenomenon in Europe resulting in severe damages for society and industry, thus it is essential to detect freezing rain events and associated icing phenomena as well as to assess potential changes in the frequency and intensity of freezing rain in the future climate. However, the low vertical and time resolution of the publicly available climate model data makes the interpretation of the generated precipitation form difficult. To overcome this problem, we investigated the large-scale synoptic structures in the ERA-Interim gridded reanalysis dataset ($0.75^\circ \times 0.75^\circ$ spatial resolution), and assessed their predictive power on the observed freezing rain events in SYNOP weather stations in Finland. In order to classify a precipitation case as freezing rain event, the following requirements were presumed: 1) an existing wintertime warm front, and 2) a suitable vertical temperature profile. Finally the calibrated identification filter was applied to 13 CORDEX EUR-44 regional climate models ($0.44^\circ \times 0.44^\circ$ spatial resolution) in Fennoscandia and the changes in the frequency of the freezing rain events in the future climate were assessed. The differences between the baseline (1971-2010) and future (2060-2099) periods indicate an increase in the occurrence of freezing rain in inland areas, no change in coastal areas, and decreasing over and near the Baltic Sea. The result is nearly immune to selection of the emission scenario: RCP4.5 and RCP8.5 were studied.