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Atmospheric icing of structures: Observations and simulations

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This study compares observed icing in a test span in complex orography at Hallormsstaðaháls (575 m) in East-Iceland with parameterized icing based on an icing model and dynamically downscaled weather at high horizontal resolution. Four icing events have been selected from an extensive dataset of observed atmospheric icing in Iceland. A total of 86 test-spans have been erected since 1972 at 56 locations in complex terrain with more than 1000 icing events documented. The events used here have peak observed ice load between 4 and 36 kg/m. Most of the ice accretion is in-cloud icing but it may partly be mixed with freezing drizzle and wet snow icing. The calculation of atmospheric icing is made in two steps. First the atmospheric data is created by dynamically downscaling the ECMWF-analysis to high resolution using the non-hydrostatic mesoscale Advanced Research WRF-model. The horizontal resolution of 9, 3, 1 and 0.33 km is necessary to allow the atmospheric model to reproduce correctly local weather in the complex terrain of Iceland. Secondly, the Makkonen-model is used to calculate the ice accretion rate on the conductors based on the simulated temperature, wind, cloud and precipitation variables from the atmospheric data. In general, the atmospheric model correctly simulates the atmospheric variables and icing calculations based on the atmospheric variables correctly identify the observed icing events, but underestimate the load due to too slow ice accretion. This is most obvious when the temperature is slightly below 0°C and the observed icing is most intense. The model results improve significantly when additional observations of weather from an upstream weather station are used to nudge the atmospheric model. However, the large variability in the simulated atmospheric variables results in high temporal and spatial variability in the calculated ice accretion. Furthermore, there is high sensitivity of the icing model to the droplet size and the possibility that some of the icing may be due to freezing drizzle or wet snow instead of in-cloud icing of super-cooled droplets. In addition, the icing model (Makkonen) may not be accurate for the highest icing loads observed.