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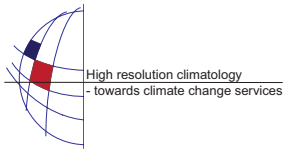

Observed changes in extreme winter events in Europe with implication for transport system

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Extreme weather events, such as heavy rain and snow events, storms, strong winds, low visibility, hail and extreme temperatures can have negative impact on transport sector, causing severe damages and large economic losses. Weather and climate extremes have been changed over the last few decades and are likely to continue to change in the future due to the projected climate change. Consequences of changes may be both negative and positive for transportation. Extreme winter conditions have implications for the mobility and safety of operations, leading to significant transport disruptions, increased accident risk and costs of damage.

In the present study we provide a comprehensive climatology of extreme winter weather events over the European continent relevant to the transport system with primary focus on recent decades (1971-2000). Individual phenomena, such as heavy snowfall, freezing temperatures, strong winds and wind gust and also their combinations, blizzard, freezing rain are considered. The estimation of the recent and past severe events is based on the observed data available from the meteorological services, from the E-OBS dataset and the ERA40 re-analysis dataset. The analysis of the relevant hazardous weather phenomena takes into account the ranking and impact threshold values defined from the viewpoint of different transport modes, such as road, rail, aviation, waterways and light, and infrastructure. A range of statistical methods are applied to define the features of these extremes, such as their probability, changes in the spatial extension, intensity and temporal duration. In order to assess the changes in regional extremes and their effects, a European regionalization regarding similar impacts on transport network is performed. The results of extreme weather and climate events classification are also shown through a set of geographical maps.