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Risk analysis of infrastructure damage induced by extreme weather events for Austria in the 21st century

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This study contributes to the development of a warning system protecting the population against weather-induced damage events. The entire project was initiated by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), the Vienna University of Technology (TU Vienna), the Central Institute for Meteorology and Geodynamics (ZAMG) and the University of Vienna. It aims at supporting decision-makers in the short, medium and long term by providing information on upcoming damage events. This should help maintaining the high level of civil protection in a future characterized by an increasingly rapid changing climate.

Here we present the derivation of potential changes concerning local-scale, weather-triggered hazards causing damage events across Austria until the end of the 21st century as well as an assessment of related protection measures.

As for the hazards we focus on landslides, floods and heat waves, which are pictured via so-called Climate Indices (CIs) made up of meteorological elements like daily temperatures and precipitation. Guzetti et al. 2008, for instance, characterize shallow landslides and debris flows by daily totals exceeding certain thresholds. Other such CIs may be found in Matulla et al. 2017. Potential changes of associated CIs are derived by the application of empirical, statistical downscaling (ESD) methods to sets of GCM scenario-runs driven by two Representative Concentration Pathways. These are the so-called ‘business as usual’ pathway: RCP8.5 and the more ‘climate friendly’ pathway: RCP4.5. Resulting local-scale ensembles consist of 30 members for each RCP. Therefrom we calculate probability distributions of potential changes in hazard occurrences (frequency, intensity and duration) on a 1 km grid across Austria for different future climate states.

For particularly risk prone spots and perhaps representative areas we investigate different adaption strategies (mitigating the impact of damage events) in terms of their suitability under changed climate conditions. This shall be done e.g. by the Bernoulli principle, via which cost-risk assessments amongst various alternatives can be carried out. Thereby this study aims to make a contribution to the BMLFUW project, which is introduced at the beginning of the text.

By the help of ensembles of climate change projections derived in this study (driven by RCP4.5 and RCP8.5), cost-risk analyses of various adaptation measures (e. g. resource and deployment planning of organizations, which are concerned with population protection and disaster relief) can be carried out for the near (2021-2050) and farther future (2071-2100). Thereby and via comparisons to the present situation most efficient and effective strategies can be detected. In this way the present study attempts to contribute to maintaining the high level of public protection in the future.

Guzzetti F, Peruccacci S, Rossi M, Stark CP (2008) The rainfall intensity duration control of shallow landslides and debris flows: an update. Landslides 5:3–17

Matulla C, et al. (2017): Climate Change driven evolution of hazards to Europe’s transport infrastructure throughout the twenty-first century. Theoretical and Applied Climatology, 2017, S. 1-16.