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Identifying best performing empirical, statistical Downscaling approaches linking large-scale atmospheric evolutions to regional-scale occurrences of floods, landslides and heat waves in the European Alps

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Here we present the selection of empirical, statistical downscaling methods (ESD), which are suitable for the generation of projections of so-called Climate Indices (CIs). CIs refer to local-scale weather conditions that are likely to trigger floods, landslides and heat waves in the complex Austrian topography. Via the identification, calibration and validation of well performing ESD techniques we contribute to a broad cooperation initiated by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), the Vienna University of Technology, the Zentralanstalt für Meteorologie und Geodynamik (ZAMG) and the University of Vienna that is concerned with the development of a warning system designed to support Austrian civil protection organizations.

Since our focus is on daily based weather conditions (CIs) pictured by temperature (minimum, average and maximum) and precipitation fields provided by the SPARTACUS dataset (Hiebl and Frei 2016, 2017) we first consider the Analogue Method based on (i) weighting sequences taking into account various large-scale atmospheric evolutions prior to the occurrence of floods, landslides and heat waves, (ii) different space dimensions defined by the amount of Empirical Orthogonal Function (EOF) retained and (iii) similarity measures determining the closeness of atmospheric pattern (e.g. Matulla et al. 2008) as well as miscellaneous setups of the so-called EPISODES technique (Kreienkamp et al. 2018). These (and in case of need further) ESD approaches are thoroughly evaluated in various validation experiments.

In order to picture potential, climate driven future evolutions of flood, landslide and heat wave occurrences, appropriate and robust setups of the above mentioned ESD techniques (and perhaps other ESD approaches) have to be identified via their performance in several validation experiments. As such we will carry out ‘classical’, season-sensitive validation setups, like so-called ‘split sample’ tests (forward and backward) and ‘temporal cross validation’ experiments. Besides these procedures we will conduct experiments that are based on special arrangements of the observation period – as, for instance, such that are strung together according to their seasonal temperatures in ascending and descending order.

By focusing on the evaluation of different statistical downscaling strategies linking GCM output to occurrences of floods, landslides and heat waves and finally identifying best performing ESD approaches we aim at contributing to the project introduced at the beginning of the text.

Matulla, C. et al. (2008): Influence of similarity measures on the performance of the analog method for downscaling daily precipitation. Climate Dynamics 30, 133-144

Hiebl J., Frei C. (2016): Daily temperature grids for Austria since 1961 – concept, creation and applicability. Theoretical and Applied Climatology 124, 161–178

Hiebl J., Frei C. (2017): Daily precipitation grids for Austria since 1961 – development and evaluation of a spatial dataset for hydro-climatic monitoring and modelling. Theoretical and Applied Climatology

Kreienkamp F., Paxian A., Früh B., Lorenz P., Matulla, C. (2018): Evaluation of the Empirical-Statistical Downscaling method EPISODES, Climate Dynamics, revised version under review