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A fast statistical dynamical downscaling Method applied to the Alpine Region

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Regional climate models (RCMs) have become a major meteorological research topic for simulating precipitation in recent years. In contrast to global circulation models (GCMs), which try to simulate precipitation as well as other meteorological parameters on a global scale, regional models focus on particular research areas. At the border of a research area, an RCM is provided by a GCM with all necessary parameters. The higher resolution of an RCM enables to capture significant meteorological effects as there is for example upslope precipitation.

This study developed from the interdisciplinary project called GLOWA-Danube in which is tried to couple various scientific models to desribe the water cycle. The applied meteorological model is MM5, which is the Fifth-Generation NCAR/Penn State Mesoscale Model. The projects area roughly includes the Upper-Danube catchment area with a horizontal resolution of 1 km in order to capture most effects playing a significant role in the water cycle. Because one of the aims the GLOWA-project is to simulate current and future scenarios over several years, the resolution of the MM5 model had to be 45 km in order to lower computational costs. The observations are taken form the standard network of the German Weather Service (DWD) and the Austrian Weather Service (ZAMG) and are interpolated to a 1 km grid.

Here, we present a statistical dynamical downscaling method to overcome differences between the 45 km resolution of the model and the 1 km resolution of the observations. Our main interest focuses on the areal distribution of simulated and observed climatological precipitation patterns. In our method we did not only correct for small orographic features, like dryer valleys compared to wet mountain tops, but also corrected for a general shift of the maximum precipitation amount to the foreland of the

Alps. This so-called bias is typical for wind regimes with wind directions from the north due to the East-West orientation of the Alps.

After comparing the simulated climatological precipitation patterns with the observed ones, we found monthly downscaling factors for different wind regimes. When applying these factors to our data, highly resolved downscaled precipitation patterns were retrieved correcting for small orographic detais, general rainfall distribution, and typical wind regimes. Because our method is based on climatological relationships, the method produces a precipitation pattern, which is most likely to occur. Although this does not apply for every single day, it gives very good results for periods of 10 days and longer.