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A Wind-Direction Dependent Downscaling Method for Precipitation Fields

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Regional climate models (RCMs), initialized and driven by global circulation models (GCMs), are able to represent the general atmospheric conditions of a limited research area quite well. The relatively high resolution of an RCM enables capturing significant meteorological effects such as orographic precipitation. Within the interdisciplinary project GLOWA-Danube, highly-resolved spatial rainfall distributions are needed as input for hydrological models. The project area covers the Upper-Danube catchment area consisting of a mountainous part in the south and a relatively flat part in the north. A common horizontal resolution of 1 km is chosen by the meteorological and hydrological groups in the project to capture the most significant effects playing a role in the water cycle of such an area. 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. The meteorological model used here is MM5, which is the Fifth-Generation NCAR/Penn State Mesoscale Model. To allow for simulating longer time periods (20 years and longer), which is one of the requirements within the GLOWA-Danube project, the horizontal model resolution was restricted to 45 km. This coarse resolution resulted in a general bias of the precipitation patterns due to a poor representation of the Alpine topography. This study presents the results of a downscaling method based on long term precipitation biases between simulations and observations, taking into account the wind direction at Alpine crest level. Although other meteorological parameters, like humidity and temperature, may have an effect on the precipitation distribution as well, the wind direction turned out to have a dominant impact on the structure of the precipitation bias. An additional advantage of wind direction dependent downscaling is a decoupling of the method from the reference

period. This is important because the climatological distribution of wind directions might change in a future climate. The downscaling method resulted in a significant improvement of the simulation results. Although this is not the case for every single day, it shows very good results for periods of about 10 days and longer.