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Derivation of ensembles of local-scale, bias corrected climate change projections across two Austrian river catchment areas – a contribution to UnLoadC3

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UnloadC3, a project funded by the Austrian Climate Research Program (ACRP), investigates (i) climate change impacts on water regimes, nutrient transport rates and discharges of two Austrian rivers – the river Schwechat and the river Mur – until the end of this century, as well as (ii) the propagation of uncertainties along the applied model-chain.

This study describes the derivation of ensembles containing local-scale, bias-corrected climate change projections - across the catchment areas of the rivers Schwechat and Mur - which are driven by two different Representative Concentration Pathways (RCP8.5, indicating a 'business as usual' scenario, and RCP4.5, representing a more climate-friendly pathway).
These RCPs are used as forcings applied to Global Climate Models (GCMs), which simulate their potential impact on the evolution of future climates all across the globe. GCMs have skillful scales of about 1.1 Mio km^2. This entails thatGCM-climate-change-projections provide meaningful results on global and continental scales, but not below.
GCM projections may be cascaded down to regional-scales via dynamical downscaling (DD) – i.e. GCMs' output around the edges of the area of interest (e.g. Europe) is entered into so-called Regional Climate Models (RCMs), which calculate climate processes within this area at an about ten times higher resolution than GCMs. Hence, RCMs have skillful scales that are about 100 times smaller than those of GCMs.

EURO-CORDEX provides for each RCP-pathway an ensemble of ten regional-scale climate change projections, which are derived from GCM runs by DD. These ensembles are used here. However, corresponding RCM-projections carry – particularly within the complex orography of the European Alps - significant biases concerning past climatological states of temperature and precipitation (e.g. Haslinger et al. 2013).
In order to (i) remove these biases and to (ii) enhance the skillful scale of these projections we apply (i) a so-called bias correction method and (ii) empirical statistical downscaling (ESD) to the 1 km SPARTACUS-grid that stretches across Austria (Hiebl and Frei 2016). Resulting ensembles show now (i) past temperature and precipitation states, whose averages are rather close to the observed ones across the catchment areas of the rivers Schwechat and Mur as well as (ii) a local-scale skillful scale of 1 km2.
Results referring to the end of this century and to temperatures across the catchment areas show larger increases in winter than during summer whereby changes associated with RCP8.5 amount up to +3.6°C, while those referring to RCP4.5 come with +1.9°C on average. Precipitation totals show slight increases in any case.

These bias-corrected, local-scale climate-change projections are entered into a hydrological model ('SWAT') in order to simulate future, RCP driven impacts on the above mentioned rivers - in terms of altered water regimes, discharges and nutrient transport rates along their courses.

Haslinger, K, Anders, I, Hofstätter, M 2013:Clim Dyn(2013)40: 511 doi: 10.1007/s00382-012-1452-7

Hiebl J, Frei C 2016: Daily temperature grids for Austria since 1961—concept, creation and applicability. Theoretical and Applied Climatology 124:161–178 doi: 10.1007/s00704-015-1411-4