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Local climate change impacts - new insights for mountain regions of Salzburg based on high resolution climate simulations

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Climate change impacts are accelerating and intensifying, as observed over the past years, especially in the past year 2023.The current CMIP6 global climate simulations (GCMs) show higher climate sensitivity resulting in stronger warming and related impacts than previous simulations. Mountain regions are especially vulnerable as the warming climate relates to thawing of permafrost destabilising slopes and the emerging risk of heat and altered precipitation pattern that cause (extreme) flooding. Furthermore, the occurrence of compound events has gained increased attention as those pose substantial threat to the prevailing settlements and infrastructure.

Nevertheless, the available GCM simulations are spatially too coarse to investigate the mentioned extreme events in complex terrain. Therefore, statistical and dynamical downscaling is performed within the ICARIA project (Russo et al., 2023) to better analyse future climate impacts for the mountain regions of Salzburg. For the dynamical downscaling two regional climate models (RCMs), the WRF and COSMO-CLM (CCLM) are used to simulate the future climate conditions for the SSP126, SSP585 at spatial resolution of 2-5 km^2 until 2100.

The verification of the two RCMs with respect to CHELSA (Karger et al., 2017) display that the 5km^2 WRF model simulations overestimate the precipitation intensities, especially in mountainous regions, the same goes for CCLM. With respect to temperature, WRF and CCLM display an underestimation of temperature in higher altitudes (above 600m) and a good representation below.

Additionally, statistical downscaling has also been performed within ICARIA following the FICLIMA method. For this procedure, a set of 59 weather observations were used together with 10 CMIP6 GCMs. ERA5-Land and statistics such as MAE, Bias or Kolmogorov-Smirnov test were used for verification purposes of the methodology for each spot and model. Those that passed filters of quality and performance in the representation of past climate produced local downscaled climate projections at daily resolution for each location for the Tier 1 SSPs (1.26, 2.45, 3.70 and 5.85). Both the statistical and dynamical downscaling methods' outputs will serve to compare results and better assess the inherent uncertainties of climate projections.

Since the focus is on extreme events, the prevailing simulations are analysed with respect to the global warming levels (1.5°C, 2°C, 3°C and 4°C) and their related local impacts. To investigate extreme events related to precipitation and wind, as well as their compound occurrence, suitable indicators are investigated, such as precipitation intensity estimates through future IDF curves and wind gust events with return periods of 1, 2, 5, 10, 20, 50, 100, 500 years. Further, consecutive events, that have a compound impact on the system, are considered through investigating the region and hazard specific time period before and after the occurrence of the extreme event.

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Karger, D. N., Conrad, O., Böhner, J., Kawohl, T., Kreft, H., Soria-Auza, R. W., ... & Kessler, M. (2017). Climatologies at high resolution for the earth's land surface areas. Scientific data, 4(1), 1-20.

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