EMS Annual Meeting Abstracts
Vol. 11, EMS2014-128, 2014
14th EMS / 10th ECAC

Projected changes in precipitation intensity and frequency over complex topography: a multi-model perspective

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Fundamental changes in the hydrological cycle are expected in a future warmer climate. This is particularly relevant for the Alps as a source and reservoir of several major rivers in Europe and being prone to extreme events such as floodings. For this region, climate change assessments from the ENSEMBLES regional model projections reveal a significant decrease in summer mean precipitation under the A1B emission scenario toward the end of this century, while winter mean precipitation in the south is expected to rise. From an impact perspective, seasonal mean changes, however, are often insufficient to adequately address the multifaceted challenges of climate change adaptation.

Here, we revisit the full matrix of the ENSEMBLES projections regarding changes in frequency and intensity, precipitation-type (convective versus stratiform) and temporal structure (wet/dry spells and transition probabilities) over Switzerland and surroundings. As proxies for rain-type changes, we rely on the model parameterized convective and large-scale precipitation components. Part of the analysis involves a multi-model combination algorithm to infer changes from the ensemble.

The analysis suggests a summer drying that evolves altitude-specific: over low-land regions it is associated with wet-day frequency decreases of convective and large-scale precipitation, while over elevated regions it is primarily associated with a decline in large-scale precipitation only. As a consequence, almost all the models project an increase in the convective fraction at elevated altitudes. The decrease in wet day frequency is accompanied by decreases (increases) in multi-day wet (dry) spells.
For spring and autumn the combined multi-model projections indicate slightly higher mean precipitation intensity to the north of the Alps, while a similar tendency is expected for the winter season over most of Switzerland.