Geophysical Research Abstracts
Vol. 17, EGU2015-6046, 2015
EGU General Assembly 2015

Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster?

Nikolina Ban, Juerg Schmidli, and Christoph Schär
ETH Zurich, Institute for Atmospheric and Climate Science, Zurich, Switzerland

Climate models project that heavy precipitation events intensify with climate change. It is generally accepted that extreme day-long events will increase at a rate of about 6-7% per degree warming, consistent with the Clausius-Clapeyron relation. However, recent studies suggest that sub-daily (e.g. hourly) precipitation extremes may increase at about twice this rate (referred to as super-adiabatic scaling). Conventional climate models are not suited to assess such events, due to the limited spatial resolution and the need to parameterize convective precipitation (i.e. thunderstorms and rain showers).
Here we employ a convection-resolving version of the COSMO model across an extended region (1100 km x 1100 km) covering the European Alps to investigate the differences between parameterized and explicit convection in climate-change scenarios. We conduct 10-year long integrations at resolutions of 12 and 2km. Validation using ERA-Interim driven simulations reveals major improvements with the 2km resolution, in particular regarding the diurnal cycle of mean precipitation and the representation of hourly extremes. In addition, 2km simulations replicate the observed super-adiabatic scaling at precipitation stations, i.e. peak hourly events increase faster with environmental temperature than the Clausius-Clapeyron scaling of 7%/K (see Ban et al. 2014).
Convection-resolving climate change scenarios are conducted using control (1991-2000) and scenario (2081-2090) simulations driven by a CMIP5 GCM (i.e. the MPI-ESM-LR) under the IPCC RCP8.5 scenario. Consistent with previous results, projections reveal a significant decrease of mean summer precipitation (by 30%). However, unlike previous studies, we find that increase in both extreme day-long and hour-long precipitation events asymptotically intensify with the Clausius-Clapeyron relation in 2km simulation (Ban et al. 2015). Differences to previous studies might be due to the model or region considered, but we also show that it is inconsistent to extrapolate from present-day super-adiabatic precipitation scaling into the future. The applicability of the Clausius-Clapeyron scaling across the whole event spectrum is a potentially useful result for climate impact adaptation.

Ban, N., J. Schmidli and C. Schär (2015): Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster? Submitted to GRL.
Ban, N., J. Schmidli and C. Schär (2014): Evaluation of the convection-resolving regional climate modeling approach in decade-long simulations. J. Geophys. Res. Atmos.,119, 7889-7907, doi:10.1002/2014JD021478