Submitted Abstract

ID IMC22-FSAbstr- 373

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Country	Austria
Region	Western Europe
Title	Projected Increases In Climate Extremes And Temperature-Induced Drought Over The Peruvian Andes, 1980-2100.
Keywords	Climate Change, Temperature Increase, Downscaling, Extremes, Drought
Type	List Of Focus Session
Focus Session ID	83

Abstract

Precipitation, snow and ice melt from Andean river basins provide a crucial water source to mountain and downstream communities equally. Precipitation and temperature changes due to global climate change are likely to affect agriculture, hydropower generation and hazard risks, but are poorly constrained, especially in future projections.

Here we focus on two heavily glacierised regions of the Peruvian Andes, the Cordillera Blanca, and the Cordillera Vilcanota-Urubamba, to assess projected changes in extreme meteorological events and droughts. Previous work suggests increasing temperatures in both regions in the 21st century, with contrasting projections of precipitation trends. There has been little focus, however, on how extremes in precipitation and temperature might vary in the future. Having created a bias-corrected regional climate model from 1980-2018, we use empirical quantile mapping to statistically downscale 30 CMIP5 models. This ensemble is analysed to determine future changes in climate extremes.

Both minimum and maximum daily temperatures are projected to increase in the from 2018 to 2100. This leads to a large reduction in the number of frost days in both regions, and suggests that under a high-emissions scenario, almost every day in the late 21st century will be in the 90th percentile of temperatures experienced during 1980-2018. The number of wet and dry days is not projected to change, but precipitation falling on very wet days (in the 95th percentile of the 1980-2018 period) is projected to increase significantly.

Lastly, we consider changes in future meteorological droughts using the standardised precipitation evapotranspiration index (SPEI) which considers potential evapotranspiration, as well as precipitation. We estimate potential evapotranspiration from temperature projections, using the Hargreaves method. Despite projected precipitation increases, temperature increases leading to an increase in evaporation may be large enough to increase meteorological droughts in the future, with the total number of drought months projected to almost double under high emission scenarios by the end of the 21st century. In a region that already experiences water stress and hazards, these changes to both extreme rainfall and drought could have a significant impact for communities in the Peruvian Andes, and for the downstream urban areas and industry that rely on mountain river flow.