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Downscaling of rainfall in Peru using Generalised Linear Models

E. Bergin, W. Buytaert, C. Onof, and H. Wheater
United Kingdom (e.ward09@imperial.ac.uk)

The assessment of water resources in the Peruvian Andes is particularly important because the Peruvian economy relies heavily on agriculture. Much of the agricultural land is situated near to the coast and relies on large quantities of water for irrigation. The simulation of synthetic rainfall series is thus important to evaluate the reliability of water supplies for current and future scenarios of climate change. In addition to water resources concerns, there is also a need to understand extreme heavy rainfall events, as there was significant flooding in Machu Picchu in 2010.

The region exhibits a reduction of rainfall in 1983, associated with El Nino Southern Oscillation (SOI). NCEP Reanalysis 1 data was used to provide weather variable data. Correlations were calculated for several weather variables using raingauge data in the Andes. These were used to evaluate teleconnections and provide suggested covariates for the downscaling model. External covariates used in the model include sea level pressure and sea surface temperature over the region of the Humboldt Current. Relative humidity and temperature data over the region are also included. The SOI teleconnection is also used. Covariates are standardised using observations for 1960-1990.

The GlimClim downscaling model was used to fit a stochastic daily rainfall model to 13 sites in the Peruvian Andes. Results indicate that the model is able to reproduce rainfall statistics well, despite the large area used. Although the correlation between individual rain gauges is generally quite low, all sites are affected by similar weather patterns. This is an assumption of the GlimClim downscaling model. Climate change scenarios are considered using several GCM outputs for the A1B scenario. GCM data was corrected for bias using 1960-1990 outputs from the 20C3M scenario.

Rainfall statistics for current and future scenarios are compared. The region shows an overall decrease in mean rainfall but with an increase in variance.