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Climate Variability and Trends in Bolivia

C. Seiler (1)

(1) Wageningen University and Research Centre (WUR), Earth System Science and Climate Change Group, Wageningen, Netherlands (christian.seiler@wur.nl), (2) Fundación Amigos de la Naturaleza (FAN), Bolivia

Bolivia's historic climate variability and trends were analyzed and compared to climate projections from multiple Global Circulation Models (GCMs). Data consisted of (i) daily temperature and precipitation measurements from 68 meteorological stations with time series lasting on average from 1960-2009 and (ii) 36 GCMs from the 3rd and 5th phase of the Coupled Model Intercomparison Project (CMIP3/5), covering 3 Emission Scenarios (SRES) and 2 Representative Concentration Pathways (RCPs). Methods included data quality control and homogenization, analysis of variance (ANOVA), principal component analysis (PCA), linear trend analysis and statistical tests. Historic impacts of the Pacific Decadal Oscillation (PDO) and the El Niño Southern Oscillation (ENSO) on anomalies and trends were assessed for climatologically contrasting regions. GCMs were validated against observations and projected changes were compared to historic trends. Results showed that historic temperatures were generally higher during the warm compared to the cold phase of PDO, while rainfall was generally higher (lower) in Bolivia's lowlands in DJF (JJA) and lower (higher) in the Andes in DJF (JJA). During El Niño (La Niña) events, temperatures were generally higher (lower) in DJF and lower (higher) in JJA compared to neutral years. Rainfall was generally lower (higher) in DJF (JJA) during El Niño events and higher during La Niña events. After the switch from the cold to the warm PDO phase in 1976/77, temperatures in the dry season (JJA) have increased while, rainfall has mainly decreased. The first two principal components of temperature and precipitation time series may partly be associated with the PDO and ENSO index. GCMs showed significant correlations with observed values; however, most GCMs had a cold and wet bias. The skills of corresponding GCMs generally improved from CMIP3 to CMIP5. Historic and projected changes agreed regarding strongest increases in temperature during the dry season and a decrease of rainfall also during the dry season in the Bolivian lowlands. Such trends favor conditions for droughts and wild fires, potentially leading to profound changes in ecosystems.