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Simulation of an extreme heat wave in NE Argentina in the SMHI-RCA4 RCM

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Heat waves are associated with significant societal and economic impacts. The occurrence of heat waves over subtropical South America is related to many factors: the activity of synoptic-scale waves, intraseasonal variability and the soil moisture–atmosphere interactions. For a credible simulation of heat waves, models must be capable of representing those processes accurately. The main objective of this study was to evaluate the performance of the SMHI-RCA4 RCM driven by ERA-Interim to simulate the most severe heat wave that occurred in the 1980-2010 period in northeastern Argentina and its related circulation pattern. This extreme heat wave occurred in November 1985 and lasted 10 days. A heat wave was defined as a period of three consecutive days at least, when daily maximum temperature (Tmax) was above the daily 90th percentile estimated in 1981-2010. To characterize its intensity, we calculated the sum of Tmax excesses above the 90th percentile for each heat wave. We employed daily Tmax, sea level pressure and precipitation data from the SMHI-RCA4 RCM and reanalyses (NCEP/DOE R2 and ERA-Interim); and daily observed Tmax and precipitation in Posadas city. The comparison between observed and simulated data in Posadas showed the model underestimated Tmax during all days of the heat wave. Moreover, comparing SMHI-RCA4 to R2, we found higher anomalies of Tmax in northeastern Argentina and southern Brazil in the reanalysis data. Even the ERA-Interim reanalysis, which was used as the driving data for SMHI-RCA4, showed higher Tmax anomalies in the region. Possible reasons for this underestimation may be related to an erroneous reproduction of mean sea level pressure and preceding precipitation. The mean sea level pressure fields showed that ERA-Interim and R2 reanalyses had a larger anticyclonic anomaly and gradient in the region than SMHI-RCA4 that favors an increased northerly advection which is responsible for the rise of Tmax. Another disagreement between SMHI-RCA4 and reanalyses could be seen in the field of precipitation anomalies in the previous month: R2 revealed drier conditions than SMHI-RCA4 in northeastern Argentina. ERA-Interim also exhibited negative (although less pronounced) anomalies of precipitation near Posadas. In addition, we estimated the observed and modeled accumulated precipitation in October 1985 at Posadas and found an overestimation in the model. Nevertheless, both observed and modeled values are below the October climatology for Posadas. The large difference between the climatological values in observed data and SMHI-RCA4 indicates that the model has difficulties in representing rainfall in this region. We conclude that the differences in the circulation patterns and precipitation rates might be responsible for the underestimation of the heat wave by the model. These results emphasize the need for further RCM improvements to attain a better representation of the observed climate over the South American continent.