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Increasing deforestation at the Arc of Deforestation in Brazil

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In this study we investigated the impact on regional climate due to the deforestation of Amazonian region. The deforestation was applied specifically to the area at the edge of the Amazonian region in Brazil, named Arc of Deforestation, where the deforestation actually occurs. The numerical experiments were conducted with the regional climate model RegCM3, used by many scientific groups around the world. The simulations performed by the model were conducted for the Brazil's central-southeast region rainy season, which can be defined between October and March. Each rainy season was separately simulated, being July-1st always the first day and March-31th the last one. Some alterations were made in the model specifications in order to better simulate the climate over South America. Land cover information was updated by more recent data. The older data compiled for 1992 was replaced by that compiled for 2005 (GLCC2005). Besides the global coverage updating, Cerrado information over Brazil obtained from the Brazilian Environmental Ministry was included to cover information. Based on results from others studies, carried out to South America, we changed the root and total soil layers depth, they were enlarged to 3.0 and 4.5 meters, respectively. This change can provide more humidity to the atmosphere and then increase the amount of convective precipitation. The spatial and time resolution considered for all simulations were, respectively, 50 km and 30 min. The domain was defined considering the South America region centered in 55W e 22S, with 160 and 120 points in longitudinal and latitudinal directions, respectively. The vertical resolution was described by 18 levels. The convective precipitation was computed by Grell scheme. Initial and boundary conditions were defined by Reanalysis I dataset. Sea surface temperature was those compiled by NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, and was obtained from their Web site. Spatial patterns of simulated air temperature at low levels are similar to those related to observed-CRU data for all month. More specifically, the mean air temperature is usually underestimated throughout the major part of the spatial domain. These negative mean biases range between -4 and -1oC. The underestimation of mean air temperature results from a combination between over and underestimation of minimum and maximum temperature, respectively, being the underestimation higher than the overestimation. Although being underestimated by RegCM3, spatial patterns of precipitation over South America are similar to those shown by CRU data. The precipitation increases over the north region and over the northwest-southeast band through South America, which are related to the local convection increasing. The South Atlantic Convergence Zone presence during the rainy season is well simulated by the model. In general, the underestimation of monthly precipitation ranges between 30 and 120 mm, reaching values between 120 and 180 mm over the rainiest regions. The replacement of rain tropical forest by grass over a band that follows the Arc of Deforestation on Amazonian region provided many impacts on climate. The major impacts at low levels occurred throughout the north and west portions of Brazil, east of Bolivia, northeast of Argentine and over Paraguay, including changes in air temperature, surface pressure, vertical movement, moisture at the upper and root zone soil layers. The observed changes are related to maximum air convergence just over the Arc of Deforestation as extra deforestation is taken in account. This convergence is directly linked to the temperature elevation at the degraded area. For the last months in each rainy season, as February, for example, almost all Brazilian territory is reached by anomalies of lower surface pressure. In all simulated month, air advection anomalies at the low levels from north-northeast of South America are directed to southern regions. This may be possibly related to the combination between air convergence due to the achieved heating, and the normal condition of aliseos advection from east and northeast directions. At the end of each rainy season, a relatively extended area with intense negative pressure anomalies over South Atlantic, adjacent to the southeast region of Brazil, is formed in comparison to the control experiment. This process must also be linked to air advection anomalies to south and southeast of South America.