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Research Article

The response of precipitation and surface hydrology to tropical macro-climate forcing in Colombia

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 ENSO • Colombia • RAMS • HBV • precipitation • mesoscale • forecast

ABSTRACT

In tropical South America, weather and climate are affected by the meridional oscillation of the inter-tropical convergence zone, the Pacific and Atlantic oceans, the Amazon basin, and the Andes Mountains. The dominant mode of the inter-annual climate variability in the tropical Pacific is the El Niño/Southern Oscillation (ENSO) phenomenon. Colombia is among the South American countries that experiences large climate anomalies because of ENSO. However, the hydrologic response in Colombia to a particular ENSO event is highly complex and non-linear.

To describe this complex, non-linear hydro-climatic response to large-scale atmospheric forcing in Colombia, a one-way coupled atmospheric-land surface hydrologic modelling approach is implemented whose main components are Colorado State University's Regional Atmospheric Modelling System (RAMS) and the Swedish Hydrologiska Byråns Vattenbalansavdelning-Hydrologic Modelling System (HBV-HMS). RAMS is implemented in a two-nested grid domain for seasonal simulations and a four-nested grid domain for daily simulations. Seasonal simulations emphasize the annual cycle at regional scales, while daily simulations focus on describing the diurnal cycle for specific watersheds. The HBV-HMS is

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implemented for a specific watershed and used to examine its response at daily time scales. Results of the seasonal simulations reproduce quite well the observed spatial and temporal patterns of the hydro-climatic variables: simulated temperature, pressure, wind velocity, and precipitation distributions show good agreement with observations. Results also show that the 1992 warm phase of ENSO led to a generalized decrease of precipitation along the Andes ranges and that the low lands of Colombia received more precipitation than during the 1989 cold ENSO phase. Similarly, daily-simulated fields show good agreement with observed values. However, the simulated diurnal cycle of precipitation exhibits a temporal phase lag of several hours and simulated precipitation tends to underestimate both the total amount of precipitation and the duration of precipitation events. Despite these discrepancies, the results of the modelling effort clearly demonstrate the ability of this approach to capture the non-linear and complex interactions of large-scale atmospheric forcing and local characteristics as indicated by the satisfactory simulation of stream flow responses for a set of small watersheds. Copyright © 2006 John Wiley & Sons, Ltd.

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