ABSTRACT

The present study investigates the impact of soil moisture and soil temperature (SMST) on the simulation of two Bay of Bengal cyclones (a pre-monsoon cyclone Aila and a post-monsoon cyclone Phailin) after landfall by employing Weather Research and Forecasting (WRF) Model. The results reveal that a cooler (warmer) soil surface generates a smaller (larger), more (less) intense cyclone approaching land that moves faster (slower) over land. After landfall, wetter soil allows the cyclonic system to persist for longer time than drier soil. SMST are provided to WRF as lower boundary conditions (LBC) by the Noah Land Surface Model (LSM). The LSM needs to come to an equilibrium state through the process of spin-up for the better simulation of LBC. An attempt is made to understand the influence of land surface parameters and forcing parameters on the model spin up behavior of an offline one-dimensional Noah LSM, over the Indian subcontinent in different seasons. A principle component analysis has been carried out to identify the parameters that have a dominant influence on the model spin-up. The simulation skill of the one-dimensional Noah LSM is evaluated using available *in-situ* measurements of SMST at two sites in India, Kharagpur (22°3′N, 87°2′E) and Ranchi (23°25′N, 85°26′E). The model shows dry bias in the monsoon and a wet bias in spring and winter and appears to have as lower infiltration rate and higher evaporation rate. Numerical experiments are performed by using different combinations of surface runoff parameter (RefKdt) and the land-atmosphere coupling strength (represented by the Zilitinkevich coefficient CZIL) in Noah LSM. Based on validation exercises with available observations, an optimum value of CZIL and RefKdt are proposed for each season. These values are incorporated in a customized WRF model and the subsequent simulations of the two cyclones are compared with control simulations. The results reveal that the optimized, weaker land-atmosphere coupling leads to improved simulations in both cyclone cases. The present study advocates the importance of optimizing LSM in terms of CZIL and RefKdt using a network of in-situ observations for possible improvement in the mesoscale simulation of cyclones after landfall.

Keywords: Soil moisture, Noah Land Surface Model, Spin-up time, WRF model, Landfalling cyclone, Land-atmosphere coupling strength, Runoff.