

Impact of urban induced land-use change over eastern and southern Indian cities

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This work considers both observational and numerical modeling techniques to quantify the urban sprawl and dynamics, analyse the long-term urban climatology and examines the role of urban induced land use (LU) change during extreme weather events like heatwaves (HW), thunderstorms (TS) and convectively driven rain events. Urban dynamics of cities using satellite data and ‘spatial metrics’ based indices are analyzed to quantify the LU change in different cities. Observational data is used to understand the effect of urban growth on long-term climatology. Multiple numerical simulation-based experiments were carried out considering the mentioned weather events over eastern and southern Indian cities. The urban induced LU change impact is examined using different types of LU data in the Weather Research and Forecasting (WRF) model with varying urban fractions. The cities, considered in this study, experienced a massive load of population inflow, industrialization, and economic development. The analysis suggests the growth of the cities expanding the boundary (e.g. Figures 1 a-b) irrespective of their geographical location and type. Long-term climatological analysis suggests both an increase and a decrease of the diurnal temperature range over different cities. An overall increase in rainfall and lightning activity is seen for pre and post-monsoon days indicating the enhancement of convective processes over cities. LU change simulations during HW events revealed that the maximum temperature is hardly affected due to the LU change while the most prominent increment in minimum temperature is seen. Computed urban heat island shows higher values for updated LU considerations indicating the feedback from larger impervious areas (e.g. Figure 1d). Experiments during TS events predict most of the rainfall inside the city boundary or in its neighborhood in the downwind direction and high-density urban areas (e.g. Figure 1c) with significant improvements in the rainfall amount.

Keywords: WRF, Urbanization, Thunderstorms, Heat Wave, Land use

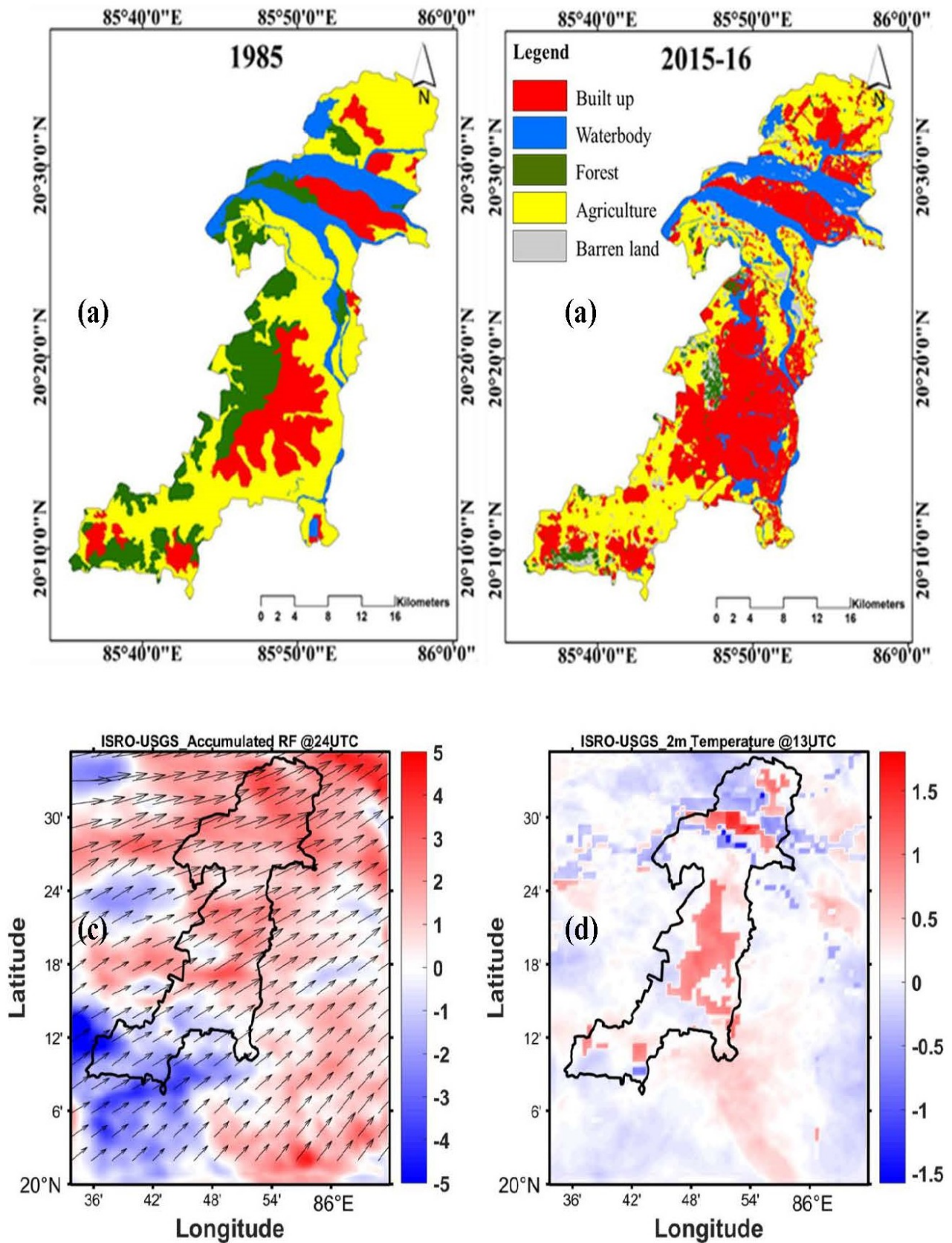


Figure 1: LU map for Bhubaneswar-Cuttack showing urban areas in red colour for (a) USGS and (b) ISRO. Difference between ISRO and USGS LU simulations for (c) accumulated rainfall and (d) near-surface temperature during the considered cases of convectively driven rain events.