1-13-2020

Impacts of Future Land-Use Land Cover on Boundary Layer Development in the North-Central United States

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  Monday, January 13, 2020, 04:00 PM - 06:00 PM

  - Boston Convention and Exhibition Center- Hall B

Land-use Land-cover change (LULCC) has become a particularly important topic of study over the central United States, due to the extensive development of the natural prairie into agricultural land, especially in the northern sections of the Great Plains. Owing to this, shifts in the natural climate of the northern Great Plains have been seen, primarily a cooling of daytime temperatures, increases in nighttime minimum temperatures and increases in planetary boundary layer (PBL) moisture, all of which can be attributed to the increases of agricultural practices in the region. Thus, it is necessary to understand how further changes to the surface will impact the near-surface boundary layer. To this end, this study will utilize the Forecasting Scenarios of Land-Use Change (FORE-SCE) modeled future land-use dataset to investigate the influence of future land-use on daily PBL development. WRF simulations using different FORE-SCE scenarios show how different economic and natural land-use development plans could change the evolution of the PBL under quiescent conditions. The 4 different simulations show that utilizing the FORE-SCE dataset with WRF changes key features in the PBL development, namely low-level moisture and temperature fields. Overall, it was seen that utilizing the FORE-SCE dataset within WRF produces significant differences between the simulations, further showing that LULCC can influence day-to-day weather and that WRF, when incorporating the FORE-SCE land-use, could detect these PBL modifications.

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https://ams.confex.com/ams/2020Annual/meetingapp.cgi/Paper/368012