10. 2 EFFECT OF LAND-USE INDUCED MESOSCALE VARIABILITY ON THE CLIMATE OF THE CAROLINAS

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Sandwiched between the Piedmont and the Coastal Plain in the Carolinas is an elongated area of sandy rolling hills. Surrounding the sandhills are different soil types that exhibit varying characteristics such as albedo, and hydraulic conductivity. This can create differential heating of the surface. These differential surface-heating patterns can create mesoscale circulations and at times intense convection. We hypothesize that the changes in the mesoscale soil patterns has a significant impact on the Carolina climate. Since surface heating is most intense during the summer months, the presence of mesoscale convective processes and circulations are most frequently identifiable during this time period. Climatological observations indicate that the sandhills region has increased convection during the summer months. By examining climatological records and performing numerical simulations in this and surrounding areas, the effects of the sandhills region on enhanced convection and precipitation patterns can be investigated.

To investigate this process, we adopted two mesoscale models, MM5 and ARPS, coupled with a detailed land surface scheme to simulate mesoscale processes over the sandhills, a complex land-use and land cover region, during the summer over the Carolinas. Investigation of the effect of these mesoscale processes has significant importance in the understanding of circulation patterns and regional scale predictability. Two specific weather events are simulated to understand the impact of the surface heterogeneity on the regional climate. MM5 is integrated for a convective, non-precipitating case and a convective case including precipitation with a 5-km domain centered over the Carolinas. Model integration is for 72 hours from 0000Z August 15, 2000 to 0000Z August 18, 2000 for the non-precipitating case and from 0000Z August 1, 2000 to 0000Z August 4, 2000 for the precipitating case. ARPS is integrated with 1km grid spacing.

Model simulations show development of locally induced mesoscale circulations during the daytime hours in the sandhills region. Additionally, sensible and latent heat fluxes indicate a strong gradient in this region as well. A compa rison of the location of this gradient with surface characteristics show a strong correlation of theses heat flux gradient with the land use and soil type. The results are interpreted in wake of a localized positive rainfall anomaly observed in the vicinity of the sandhills region. Increased precipitation in this area has implications relating to water resource management as well as socioeconomic practices. The combination of numerical simulations with the use of climatological observational data present an avenue of investigation for the role of land-use induced mesoscale processes in the sandhills and its effect on the climate variability in the Carolinas.

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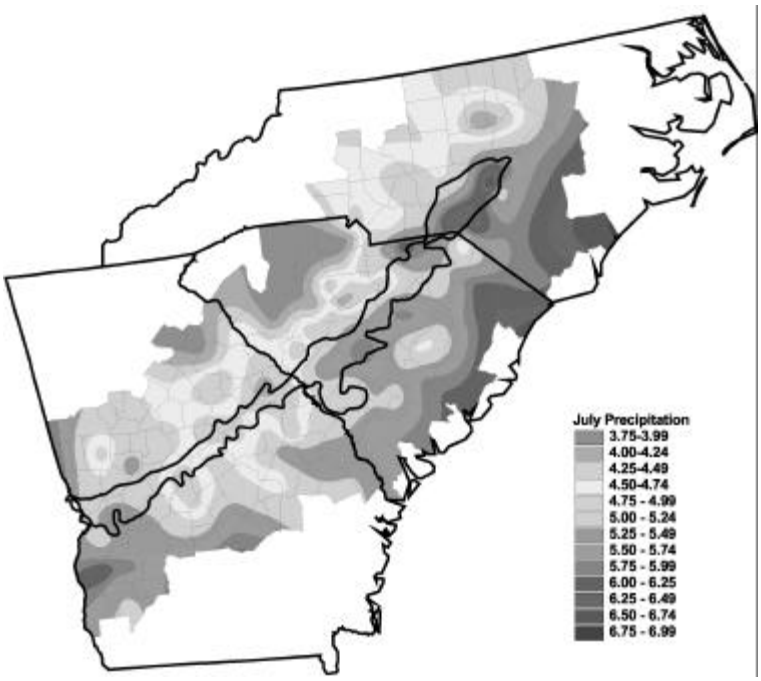

Figure 1. Observed July precipitation (1960 – 1999) in the Carolinas and the Sandhills region.

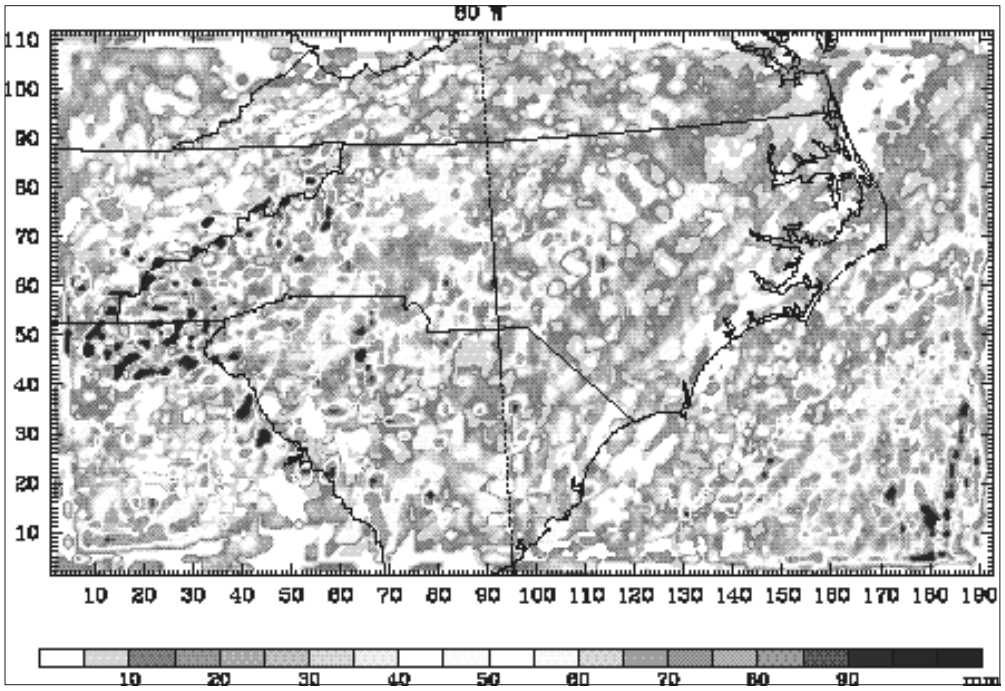

Figure 2. Model simulated precipitation for a typical summertime condition. The regions in vicinity of the Sandhills show significantly higher precipitation amounts, as hypothesized.