Methods and Models

Land Cover Change; Urban Expansion

Trends in land cover change around Urumqi, surrounded by desert regions, have changed drastically since the economic reforms in the late 1980s. Climate models project that the region will experience higher temperatures and a correspondingly higher threat of desertification due to extended periods of drought, along with deforestation in the Tian Shan mountains. Our investigation is focusing on the impacts of these particular climate changes on urban residents, cities, and disadvantaged groups. In particular by modeling changes in land use and the corresponding climate. Higher wind speeds, for example, may better disperse pollutants and lead to relatively higher air quality.

RAMS 6.0 Configuration

We used RAMS (Regional Atmospheric Modeling System) 6.0, a state-of-the-art regional climate model that has been improved in numerous ways over RAMS 4.4 – perhaps most importantly by adding NDVI and other remote sensing variables directly into the land surface model. Figure 3 shows the innermost 2 grids (8-km and 2-km grid spacing respectively; the outermost 32-km grid is not shown). Ultimately, we will examine historical changes in climate to identify climatic trends: change will be simulated under IPCC scenario A1B using RAMS driven by boundary conditions from CCSM IPCC scenarios. Again, selection of time periods will be done in such a way as to capture not only average temperature or average rainfall periods but also to capture extreme events. RAMS can be configured to have multiple nested grids with two-way communication. This feature allows RAMS to have very close landscape resolution.

Preliminary Results

The initial trials of four landscapes show that classification error has a significant impact on sensible heat flux (SHF) in areas where mixed pasture and farming are involved—particularly in the Karez system areas that are rapidly becoming important agriculturally. Small changes (reduced SHF) are evident in the high areas where forest misclassification occurs.

- Figure 4 shows some examples of differences in SHF patterns due to selected error introductions.

- Figure 5 shows the standard deviation of vertical velocity at noon for all four cases at or around the top of the boundary layer. These perturbations show locally strong effects on atmospheric circulation that could enhance rainfall.

Potential Impacts on convection

In Xinjiang, most rainfall arrives via fronts. These fronts can be modified locally by convection. Convection can be enhanced or suppressed by land cover change: more heterogeneity can lead to stronger differences in heating, and thus in vertical motion.

Figure 4A: SHF differences for 00111111-01011111 (W/m²)

Figure 4B: SHF differences for 01011111-01101111 (W/m²)

Figure 5: standard deviation of precipitation differences in convection at top of PBL