An analysis of seasonal variability of satellite detected land surface temperatures and urban heat islands

Q. Weng

Center for Urban and Environmental Change, Department of Geography, Geology, and Anthropology, Indiana State University, Terre Haute, IN 47809, USA (qweng@indstate.edu / Phone: 812-237-2255 / Fax: 812-237-8029)

This research intends to develop a diffusive UHI model and to compare it with UHIs based on impervious coverage as well as those based on population distribution, using Indianapolis as a case study. Land surface temperatures (LSTs) in the four seasons were extracted from thermal infrared data of Terra's ASTER imagery and calibrated with emissivity and other parameters. Heat islands were modeled as a three-dimensional surface protruding from a planar surface of the surrounding non-urban land cover. The complexity of urban heat islands were measured by fractal dimensions. Spectral mixture analysis was applied to transform ASTER reflective bands into fraction images, including high albedo, low albedo, green vegetation, and soil with a constrained least-square solution. Based on the result of the spectral unmixing, impervious surface was calculated. The spatial variability of texture in LST was found to be highly correlated with those in the fractions and in the population density surface. It is suggested that these variables had a direct correspondence with the radiative, thermal, and moisture properties of the Earth's surface that determine LST and heat islands. In order to develop a generalized model of urban heat islands that has a global application, fractals and numerical modeling should be combined to develop a guiding framework.