Modeling Urban Land-Atmosphere Interactions

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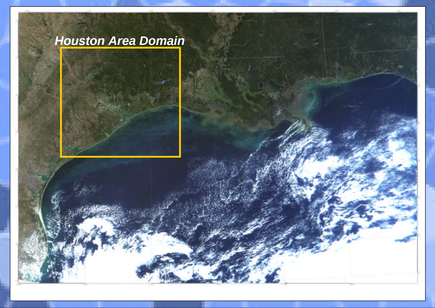
I- Project Goals

- To develop a capability that models observed impacts of urban areas, such as precipitation and aerosols.
- To evaluate a model of urban land-atmosphere interactions based on remote estimation of surface properties for the Houston, Texas region; using advanced urban canopy parameterization, including internal boundary layer models capable of resolving the unique water, energy and momentum dynamics in an urban setting.



True-color image of the Texas Gulf Coast acquired on September 29, 2000 by the Moderate Resolution Imaging Spectroradiometer (MODIS.)

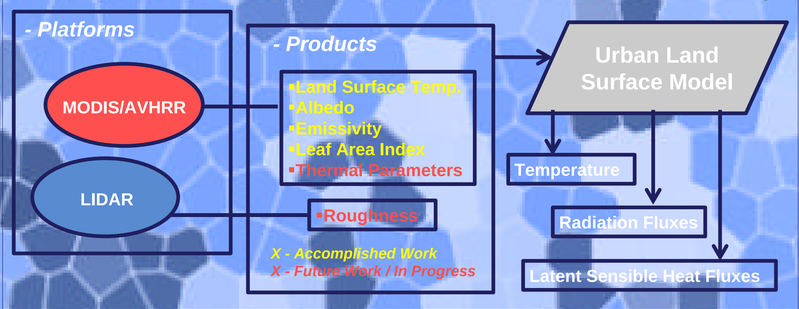
II- Background

Recent projections of urbanization rates suggest that more than 60% of the world's population will live in cities by the year 2030. In the United States, much of Europe, and Japan, more than 80% of the population lives in urbanized areas. As cities grow, natural land covers are removed and replaced by buildings, roads, parking lots, sidewalks, and other impervious surfaces.

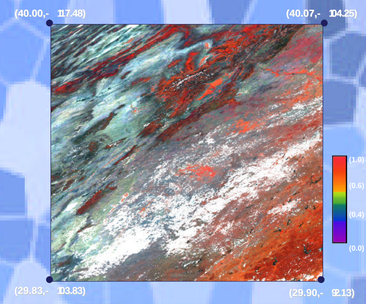
Current NASA EOS platforms such as MODIS can simultaneously monitor global surface, biosphere, and atmosphere at high resolutions.

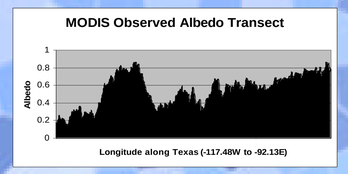
Consequently, various observational and modeling results have highlighted the unique characteristics of urban land-atmosphere interactions caused by the modification of the climate interface.

III- Project Scope



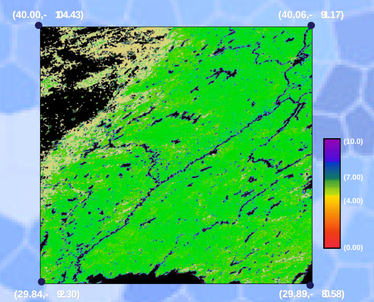
IV- Albedo

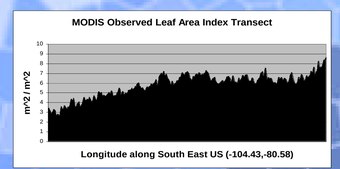




July 2001 averaged Albedo for the Houston, TX area. MOD43B3 (Albedo) relies on multi-date, atmospherically corrected, cloud-cleared data to determine a global set of parameters describing the Bidirectional Reflectance Distribution Function (BRDF) of the surface.

V- Leaf Area Index

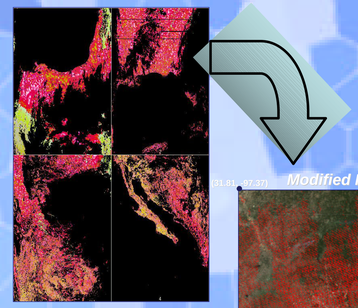


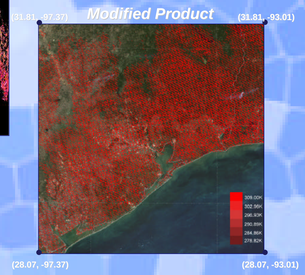


July 2001 averaged LAI for the Southeast US Region

MODIS-15A (LAI) defines an important structural property of a plant canopy as the one-sided leaf area per unit ground area. It has been used extensively as a satellite derived parameter for calculation of surface photosynthesis, evapotranspiration, and annual net primary production.

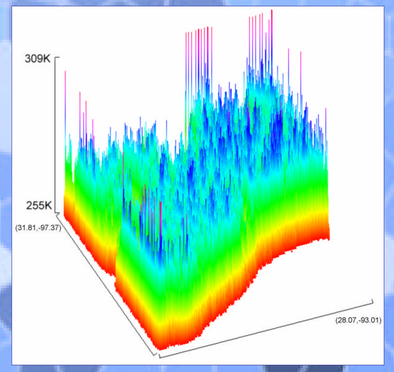
VI- Land Surface Temperature





Land Surface Temperature mosaic product of the Houston area for September 15, 2001

We used the MODIS Reprojection Tool to interpret HDF-EOS Swath-Projection to Miller Cylindrical and to resample the pixel values for LST using bilinear interpolations.



Land Surface Temperature mosaic product of the domain area for September 15, 2001

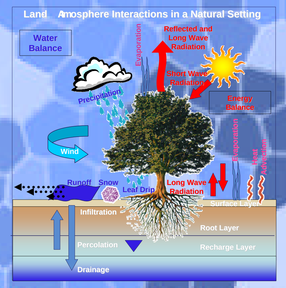
Land surface skin temperature (LST), retrieved from upward long wave radiation, is closely related to surface energy budget and may be more suitable in studies of climate change. On land, soil and canopy temperature are among the main determinants of the rate of growth of vegetation and they govern seasonal starting and termination of growth. Hydrologic processes such as evapotranspiration and snow and ice melt are highly sensitive to surface temperature fluctuation, which is also an important discriminating factor in classification of land surface types.

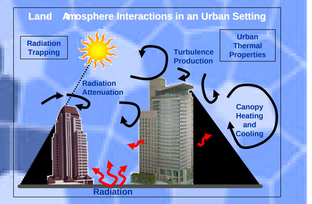
VII- Urban Model Application:

The results of this project provide the tools to develop and evaluate models of Urban Land Surface-Atmosphere Processes: Water, Energy, Mass, Momentum.

Modeling urban land-atmosphere interactions at 1km or finer resolutions also enables:

- Coupled prediction of urbanization effects on water, energy, carbon cycles
- Information reconnaissance for future sensor/mission needs (e.g. Urban Observing Mission)





VIII- FUTURE WORK

Additional models estimating Urban Aerodynamic Roughness using frontal area density determined from satellite imagery will enhance the modeled products discussed here.

IX- ACKNOWLEDGEMENTS

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