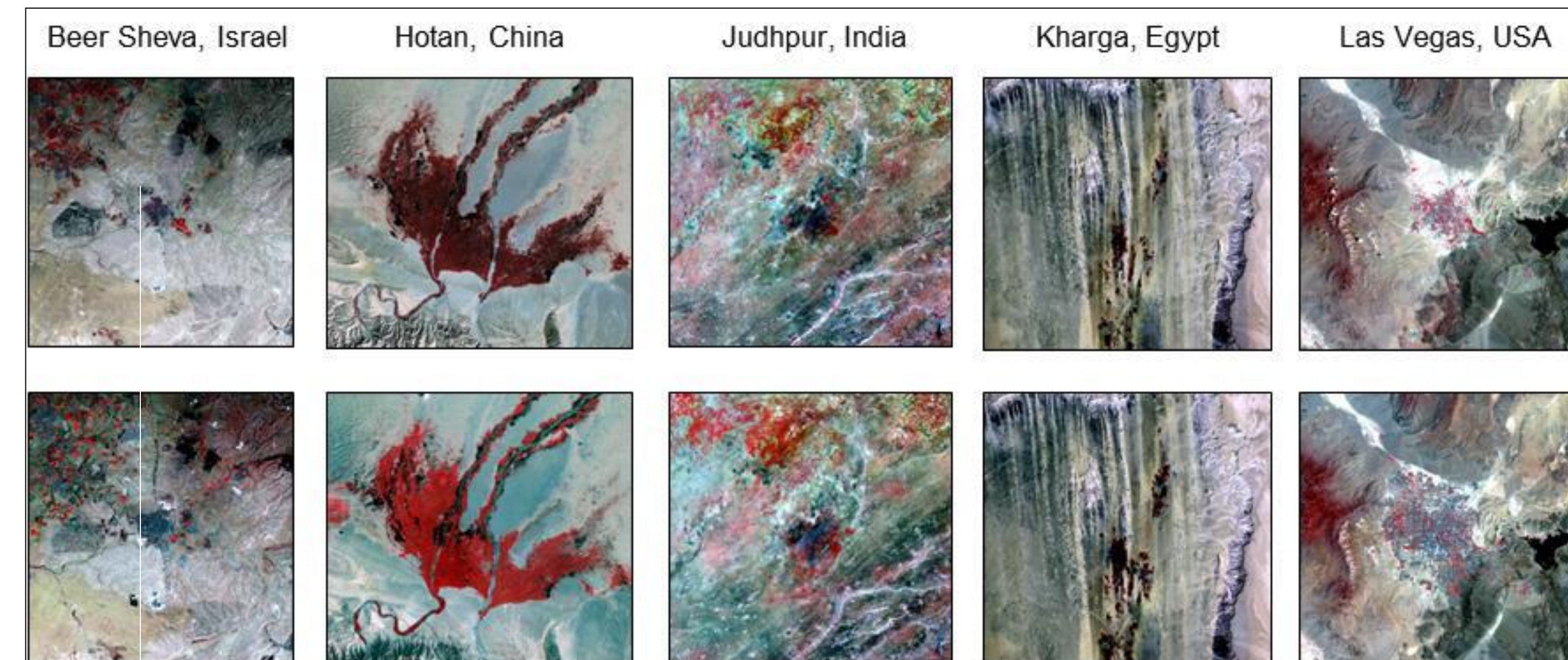


# Understanding Impacts of Desert Urbanization on Climate and Surrounding Environments to Foster Sustainable Cities Using Remote Sensing and Numerical Modeling

PROJECT PERIOD: August 1, 2012 - July 31, 2015

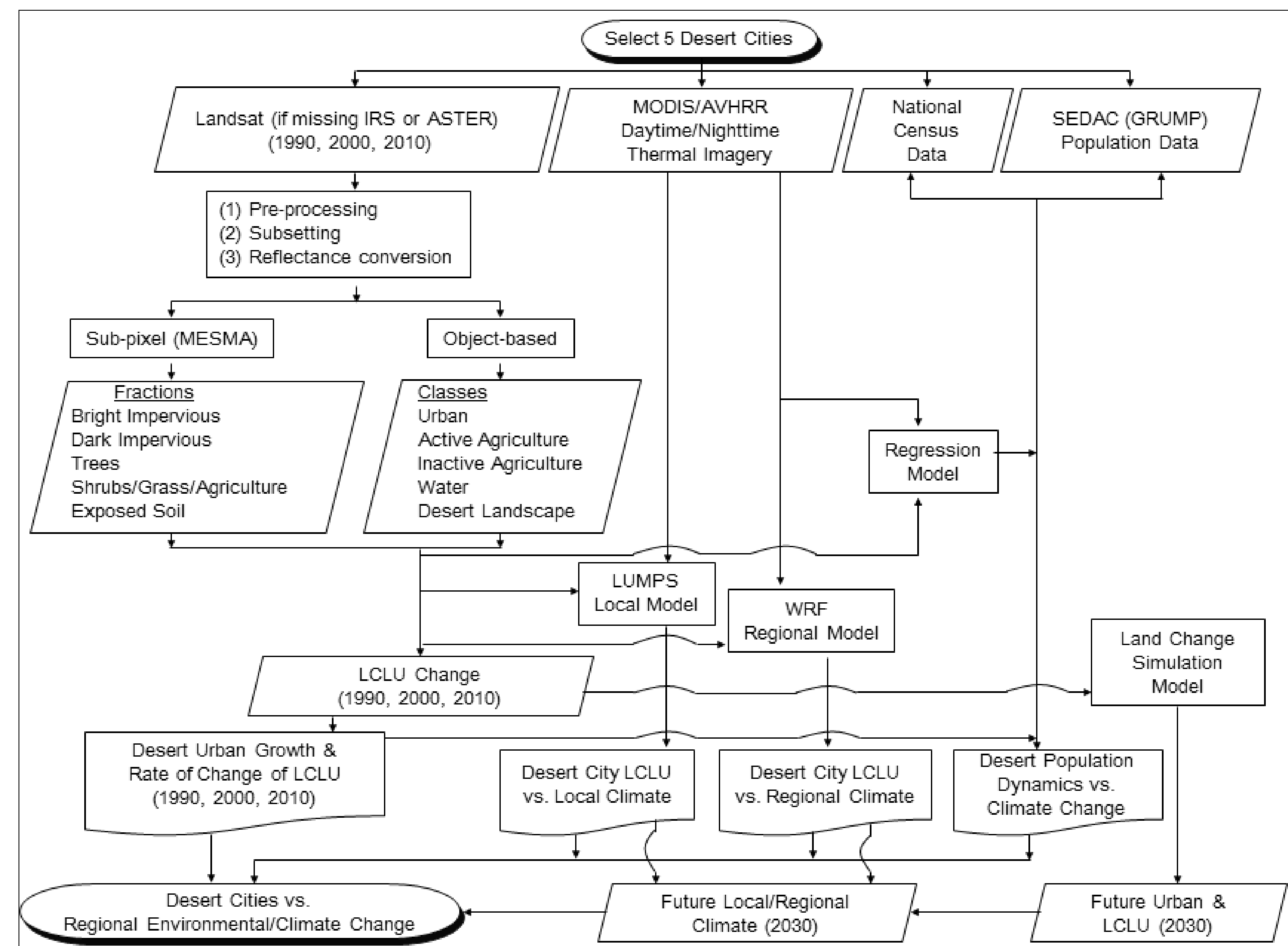
**Goal:** To better understand the impacts of changing land cover spatial distribution, patterns and arrangements within and around these cities in relation to climate change and to use this knowledge to support adaptive management and foster sustainable desert cities.

To achieve this, we seek to address the following: (a) The influences of internal urban features, land fragmentation and spatial arrangements of land cover and land use (LCLU) in both the urban space and surrounding areas; (b) LCLU patterns and rates of change within and around selected cities over time (1990-2010); (c) Warming and climate change/variability impacts on the livability, resources, sustainability and growth of the cities; (d) The balances between oasis cooling, surface morphology and fabric infrastructure heat storage and warming effects and their impacts over space and time; (e) The magnitude and long-term influence of desert urbanization on regional precipitation, temperatures and airflow patterns; and (f) Adaptation, alternate management and land use planning scenarios for sustainable city development in these environments.



## Proposed Methodology

We will employ seven intertwined and interconnected research approaches: (1) remotely sensed image analysis; (2) regional climate simulations for assessing the impact of desert urbanization (WRF); (3) local scale climate analysis (LUMPS); (4) social demographic analysis and climate change; (5) land fragmentation and LCLU change vs. regional climate change; (6) forecasting urban growth and (7) predicting future regional climate patterns.

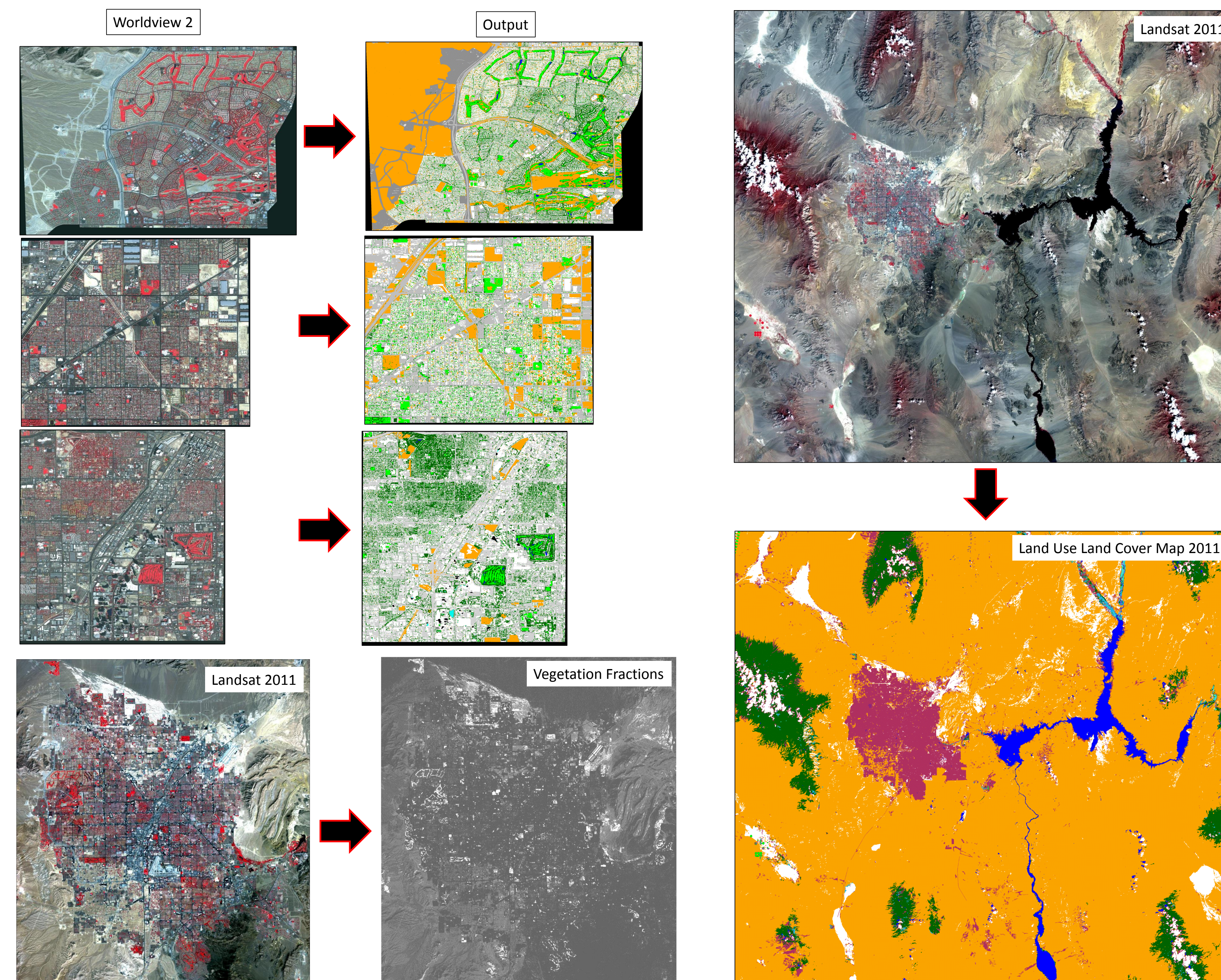


## Expected Outcomes and Deliverables

- LCLU maps of the five study areas for 1990, 2000 and 2010.
- Pattern and rate of LCLU change (i.e., dark impervious, bright impervious, trees/shrubs, grass) including desert vegetation and agriculture within and around the desert cities over time (1990-2010).
- The variation and intensity of the oasis effect of cities in desert environments over space and time.
- Local climate data for selected differing zones in the study areas, emphasizing the variable mix of impervious surfaces and oasis components (tree, grass, water surface).
- The spatial arrangements and patterns of LCLU in relation to surface temperatures.
- The impact of the spatial arrangements of land cover within and around the study cities or land fragmentation on the surrounding environments.
- How precipitation, temperature and regional airflow patterns are associated with the oasis effect.
- Dynamics, pattern, and rate of change of the population growth for the study cities and the relation to surface temperatures in comparison to non-desert cities, and whether the pattern of demographic growth in different cities is related to surface temperatures.
- Predicted urban growth and associated LCLU maps over the selected study areas for 2030 using different urban planning scenarios.
- Future precipitation, temperature and regional airflow patterns using the predicted LCLU changes for 2030.
- Adaptive options, alternate management opportunities and land-use planning scenarios through changes in manmade and natural landscapes for sustainable city development in desert environments.

## Accomplishments and Activities to date

- Ron Rindfuss (Project Consultant) came to ASU and worked with the project team members from Oct 28, 2013 to Nov. 3, 2013.
- Group meetings with regards to project management and planning (October 30th and 31st 2013) were organized at ASU (Myint, Rindfuss, Huang, Middel, Brazel, Kaplan) were organized. Each team member presented proposed research and related matters for clarification. The meeting set the workplan and milestones for the NASA project period between Nov 2012 and Nov 2013.
- PI and Graduate Research Assistant traveled to Israel for data collection and attended Drylands, Desert, and Desertification Conference at Ben-Gurion University (9 Nov 2012 – 17 Nov. 2012). Due to the conflict along Gaza strip we were not able to meet with our collaborator. However, we have been in contact with him and continue to collect data.
- Huei-Ping Huang (Co-I) used a mesoscale atmospheric model called Weather Research and Forecasting (WRF) to quantify the changes in precipitation and regional airflow pattern associated with land-surface changes due to urbanization in Las Vegas study area. This initial case study used NLCD data in 1992 and 2006.
- We collected spectroradiometer readings of natural and anthropogenic features in and around Las Vegas.
- Classification of detailed urban land cover classes using 3 QuickBird imagery over Las Vegas was completed (object-oriented approach).
- Land cover fractions of Las Vegas for 1986 and 2011 were generated using Multiple Endmember Spectral Mixture Analysis (MESMA).
- General land use and land cover classes were identified using Landsat TM acquired in 2011 (object-oriented approach).
- PI and Graduate Research Assistant traveled to India (16 March – 25 March 2013) for collecting socio-economic and biophysical data of the study area (Jodhpur city). We received census data and took spectroradiometer readings as well as air and surface temperatures of natural and anthropogenic features in and around Jodhpur city. Our project collaborator Dr. Rahman will continue to collect boundary of census unit (ward level) in shape file format and link the database to the shape files for 1991, 2001, and 2011.
- We explored how and if spatial pattern of buildings influences surface temperatures in Las Vegas. This is treated as an initial case study to understand if spatial pattern of a land cover type play in important role in lowering or escalating surface or air temperatures. We discovered the relation between spatial pattern and surface temperatures.



## Spatial Pattern of Buildings and Surface Temperatures

