**NASA DEVELOP National Program**

****International Research Institute for Climate and Society

**Fall 2015**

**Short Title: New Jersey Health & Air Quality**

**Subtitle:** Modeling Near Surface Air Temperature Profile of Complex Urban Systems Based on Land Surface Properties and Correlating On-Site and Satellite Data to Better Understand Temperature Profiles in Urban Microclimates.

**VPS Title:** Forecast is what you expect; Near Surface Temperature is what you get

**Project Team & Partners**

**Project Team:**

Maryam Karimi (Project Lead), MKarimi@gradcenter.cuny.edu

Jerrod Lessel

**Advisors & Mentors:**

Pietro Ceccato (Research Scientist, Lead Environmental Monitoring Program, The International Research institute for Climate and Society, The Earth Institute, Columbia University)

**Partner Organizations:**

Bureau of Environmental Surveillance and Policy, New York City Department of Health and Mental Hygiene (End User, POC: Thomas Matte)

We Act for Environmental Justice (End User, POC: Aurash Khawarzad)

Columbia University, Mailman School of Public Health (Collaborator, POC: Patrick Kinney)

Consortium for Climate Risk in the Urban Northeast (CCRUN), (Collaborator, POC: Brian Vant-Hull)

**Project Details**

**Applied Sciences National Applications Addressed:** Health and Air Quality

**Study Area:** NJ

**Study Period:** September 2015 – November 2015

**Earth Observations & Parameters:**

Terra, MODIS – Temperature

Aqua, MODIS – Temperature

Landsat 7, ETM+ - Land Cover, Temperature

Landsat 8, OLI/TIRS – Land cover, Temperature

**Ancillary Datasets Utilized:**

* Field Measurement- wind speed and direction, temperature, luminosity, and relative humidity
* USGS National Land Cover Dataset (NLCD) - land cover and thermal

**Models Utilized:**

* MODIS aerosol algorithm, cloud clearing
* MODIS aerosol retrieval - atmospheric correction in solar bands
* LandSat imagery - deriving surface temperature, vegetation and albedo
* SBDART radiative transfer code

**Software Utilized:**

Excel – statistical analysis of data

ArcGIS – raster manipulation/analysis, map creation of Landsat ETM+/OLI/TIRS, Aqua/Terra MODIS data

**Project Overview**

**80-100 Word Objectives Overview:**

To improve understanding of the effect of the Urban Heat Island (UHI) on the near surface air temperature where humans interact and how to mitigate these effects, develop a correlation identifying the role of surface features on near surface air temperature where humans in urban settings operate for new perspectives in urban design for developers and city management.

**Abstract:**

Urbanization has created an increase in what is known as the urban heat island (UHI) effect. UHI reflects an elevated temperature in cities as compared with nearby rural areas. This is due to the change in landscape from grass and vegetative cover to concrete and asphalt with three-dimensional structures. The excess heat in these urban environments has led to a rise in heat related illnesses in urban environments. There exists an understanding in the change of temperature beginning at a kilometer above the Earth’s surface (roughly 9.8 °C drop every kilometer) but no understanding exists of the microclimate. As such, a quantitative study was completed, analyzing on-site locations representing varied microclimates and analyzing satellite imagery of southern New Jersey. A correlation is being developed to be able to obtain the surface temperature and near surface air temperature of a microclimate based on the environmental factors. The on-site study revealed that varied environments (grass, water, and concrete) result in different temperature profiles within the range of 0 to 10 feet. Grass was the coolest environment, water was the most temperate, and concrete had the highest peak temperatures. The satellite study revealed that increased levels of urbanization, with no methods of heat mitigation, resulted in higher average temperatures. Both the on-site and satellite data confirm that the increased urbanization leads to increased temperatures within microclimates.

**Community Concerns:**

* Urbanization has created an increase in the Urban Heat Island (UHI) effect, which has adverse health effects on both humans and animals within the region.
* Vertical temperature variation at micro scale has been a crucial missing part of UHI research.
* Businesses and community leaders can benefit from the understanding of the effects of urban structures on the UHI effect through strategic implementation of methods of heat mitigation, which can be used in locations that are deemed to be at risk for high urban heat island effect in order to reduce the overall heating effect of cities.

**Current Management Practices & Policies**:

Most studies focusing on urban heat island using satellites have the highest resolution of 60 to100 meters in thermal infrared bands. The main challenge in using satellite data to study UHI is the complexity of the system and lack of information on near surface air temperature in fine scale. However, to identify vulnerable neighborhoods and target interventions to reduce health risks, the health departments need finer scale information on health risks. The final product of this project will help cities to strategize mitigation efforts in cooling the identified hot spots. The mitigation efforts include, but are not limited to, planting trees and adding green areas such as community parks with water fountains. Department of Health (DOH) could use the product to issue targeted warning to the residents in the hotspots and help the neighborhood hospitals to allocate staff and resources before and during heat waves.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| True Surface Temperature-Forecasting (TST) model | Landsat 7 ETM+, Landsat 8 OLI/TIRS, Aqua/Terra MODIS | Obtain the true surface temperature and near surface air temperature of a microclimate based on the environmental factors visible via satellite. The TST model can help in predicting actual surface temperature for any surface type at highest resolution. |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)

**Software Release Requirements**

What category do the tools your project is creating fall within? Category I