Process for Downscaling Urban Area Land Surface Temperature Satellite Data

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ABSTRACT

Urban Heat Islands (UHI) are one of the leading environmental issues in densely populated urban areas. Accurate characterization of the surface energy balance is required to better predict the dynamics of the UHI and its impact on extreme heat events. However, a better complete knowledge of urban surface energy balance is needed to accurately understand climate processes revolving around high-density urban environments. The goal of this study, using satellite data, is to enhance the understanding the urban surface energy budget and observe land surface temperatures. Using a linear regression model, GOES-16 LST data, which has a spatial resolution of 2km and a temporal resolution of 5 minutes, was combined with Landsat 8 LST data, which has a spatial resolution of 30m and a temporal resolution of 16 days to get a high spatio-temporal resolution (30m every 5 minutes) LST product. The downscaled estimates showed a reasonable agreement (-0.09 to 3.30 K) when they were validated against independent Landsat images.

MOTIVATION

- Available Satellite LST data are either a low spatial resolution and high temporal resolution or a high spatial resolution and low temporal resolution.
- Urban areas have a complex heterogeneous surface texture that can be lost in coarse resolution.

STUDY AREA

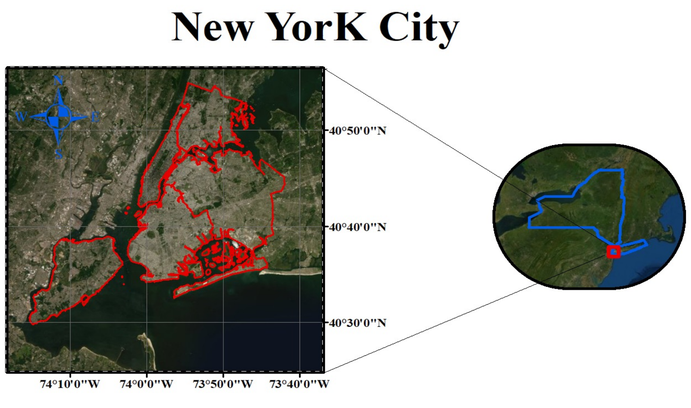

Figure 1. Study Area

METHODOLOGY

- Dataset: daily land surface temperature over NYC from July 2017 to July 2020
- Obtain from Landsat 8 and GOES-R
- Time: 11:30pm EST
- Spatial resolution: 2 km to 30 m

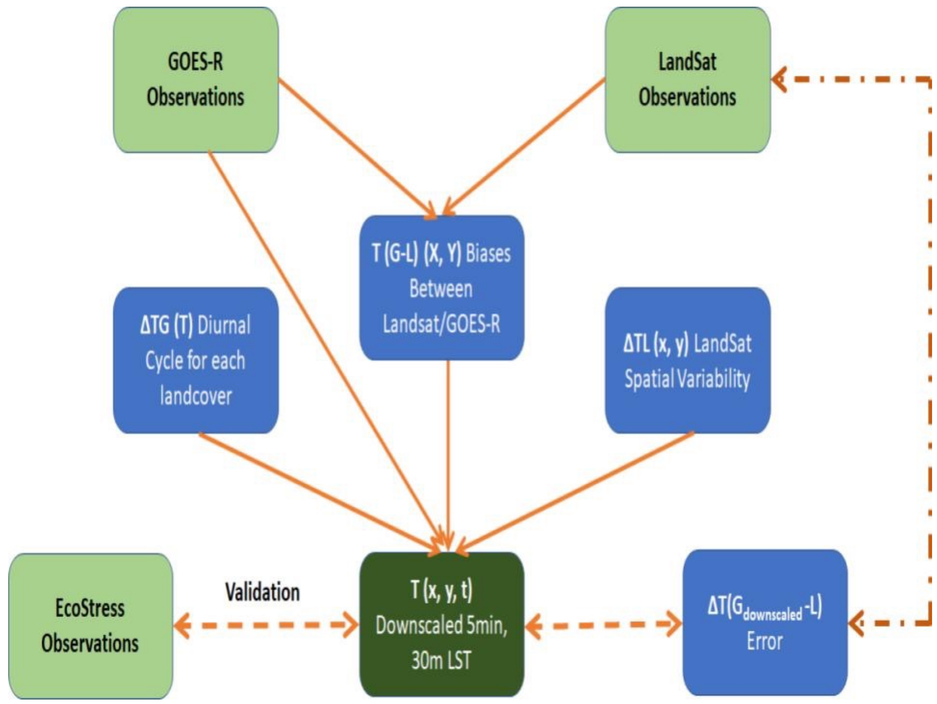

Figure 2. Flowchart for Downscaling Process

RESULTS

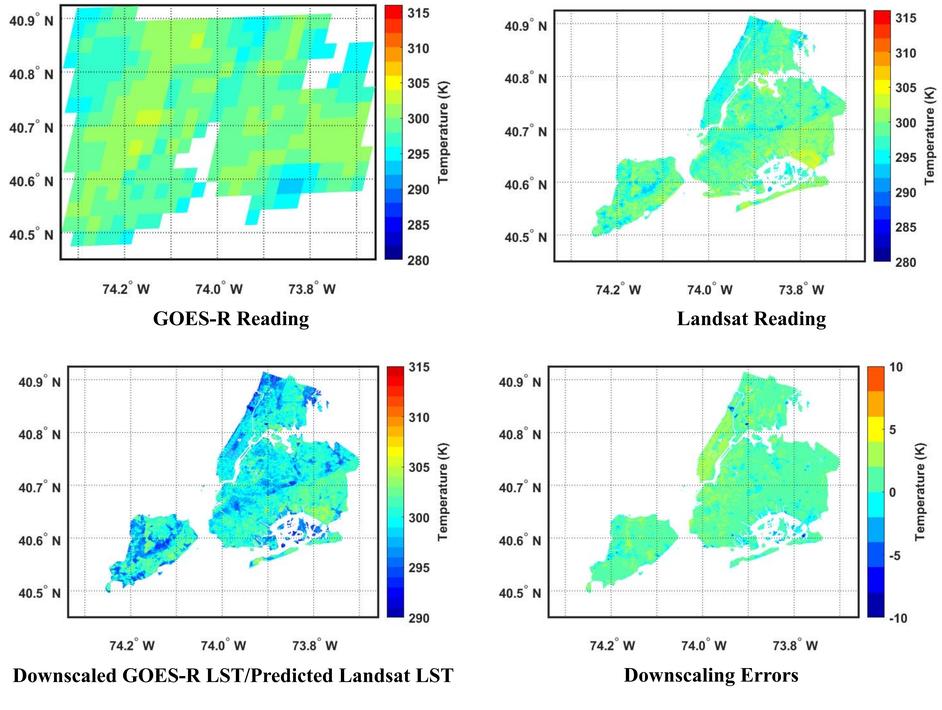

Figure 3. Downscaling GOES-R: October 2017

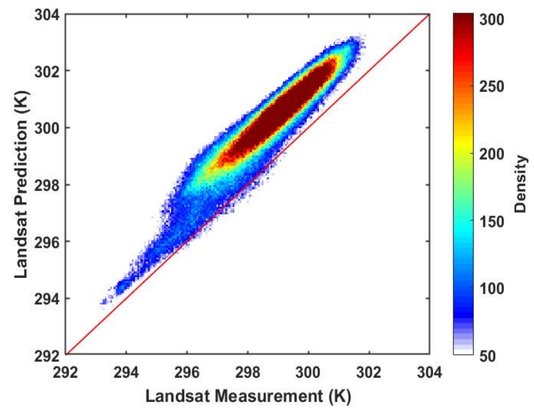

Figure 4. Measurement versus prediction scatter plot

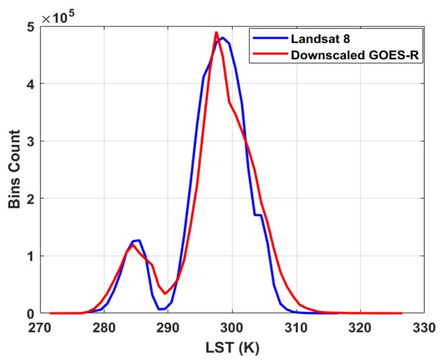

Figure 5. Distribution of Temperature for GOES-R and Landsat Readings

CONCLUSION AND NEXT STEPS:

The differences between the Landsat LST measurements and predicted LSTs were between -0.09 to 3.30 K.
The RMSE is less than 1.7 K.
60 – 80% of the variation are explained by the model.
ECOSTRESS data and ground-based measurements from infrared cameras and drones were used to validate the model.

ACKNOWLEDGEMENT:

This This study was funded by the Department of Defense (DOD) under Grant # W911NF – 18 – 0371. The statements contained within the manuscript/research article are not the opinions of the funding agency of the U.S. government but reflect the author's opinions. The authors also thank the Center for Remote Sensing and Earth Systems Science at the New York City College of Technology for resource assistance.

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- Qihao et al., 2014, Generating Daily Land Surface Temperature at Landsat Resolution by Fusing Landsat and MODIS data