Measuring hourly surface air temperature variability across topographically diverse locales to improve near-real time geolocated temperature reports

Eric Anderson

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Abstract

Digital weather applications that provide near-real time (NRT) surface air temperature data often receive data from scattered weather stations across the United States. In topographically diverse locales, temperature may vary greatly, rendering these weather applications inaccurate depending on a user's exact geographic coordinates. This research is meant to correct this by integrating other factors of surface air temperature, such as land surface type, sunlight angle and intensity, slope, and proximity to coasts, with live regional weather reports. To determine this correction, I compared hourly in-situ weather observations in the state of Washington from January to December 2019 with cloudless, remotely sensed land surface temperatures from the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) sensor at a 70-meter spatial resolution. Cross-referencing this with Washington State slope and land cover GIS data, I computed an algorithm to assign temperature "penalties" for each hour or the day at each distinct surface type. These penalties were affixed to the nearest live ground station temperature and visualized using fine-scale isopleth maps. With these corrections integrated into digital weather applications, a mobile user could have more confidence in receiving a temperature that matches a thermometer at the same location. These corrections could also help scientists identify locations that may be unusually warm or cold. Preliminary results demonstrate that flat, inland urban industrial surfaces grow hotter and colder than any other surface each day. Because this research relies on sunny and stable weather data, future research should produce more precise results by accounting for other atmospheric effects such as humidity, barometric pressure, or wind.

Keywords

- Land Surface Temperature (LST)
- Land Use Land Cover (LULC)
- Urban Heat Island (UHI)
- ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS)
- Surface Air Temperature (SAT)
- Remote Sensing
- Spatio-temporality