In situ and satellite measurements of land surface skin temperature

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Goals

•To quantify the spatial variability and representativeness of the single-point skin temperature measurement made at United States Climate Reference Network (USCRN) sites.

•To validate satellite land surface temperature measurements, such as those that will be made from the NOAA NPP/JPSS VIIRS satellite by scaling land skin surface temperature measurements up to satellite measurement scales.

•To improve the land-surface parameterization of existing up-scaling methods which are based on a land surface model coupled with a radiative transfer model and combined with ground-based measurements and high-resolution satellite data.

Approaches

NOAA/Atmospheric Turbulence and Diffusion Division is collaborating with the University of Tennessee Space Institute's Aviation Systems and Flight Research Department in Tullahoma, TN to utilize an instrumented aircraft to perform measurements of Earth's skin temperature over selected U.S. Climate Reference Network (USCRN) sites in the continental U.S. The aircraft-based land surface temperature measurements are compared to in situ, tower based land surface skin temperature measurements. Using land surface modeling to account for sub-pixel scale heterogeneity in the satellite measurements, the in situ and aircraft measurements are also compared to MODIS and ASTER land surface temperature products.

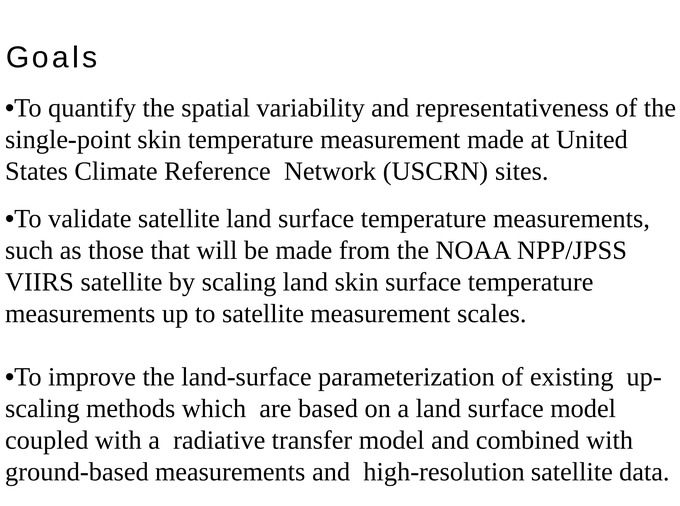

Figure 1. Aircraft-based land surface temperature measurements over the Crossville, TN USCRN site on November 19, 2010.

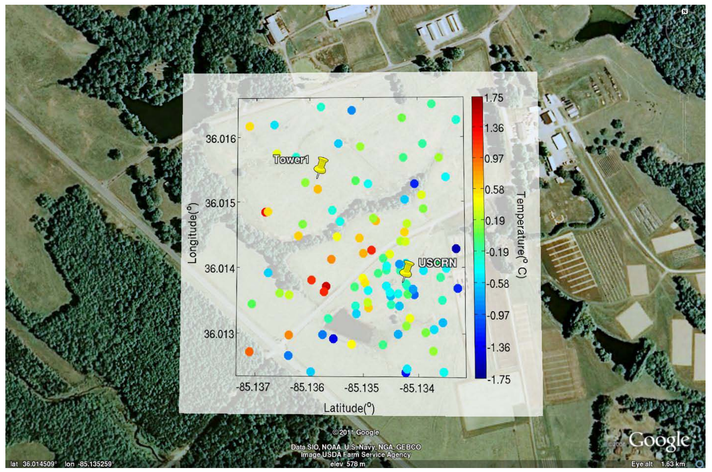

Figure 2. The difference between the individual aircraft surface temperature measurements and the simultaneous in situ measurements at the Crossville, TN USCRN site. Four in situ infrared thermometer measurements recorded at two separate locations (Tower1 and USCRN) are compared to the aircraft data.

Accomplishments

•Methodologies and collaborations are maturing

•Excellent agreement between in situ and aircraft measurements

•Development of a defensible method for satellite calibration/validation

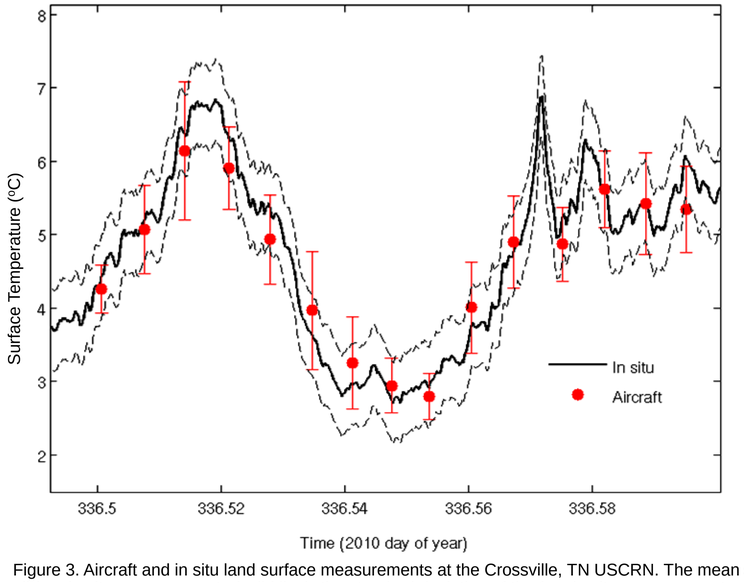

Figure 3. Aircraft and in situ land surface measurements at the Crossville, TN USCRN. The mean of all four in situ measurements (solid line), the standard deviation of the four in situ measurements (dashed line), the spatially averaged aircraft measurements (red circles), and the standard deviation of the aircraft measurements (red vertical bars) at the site are shown.

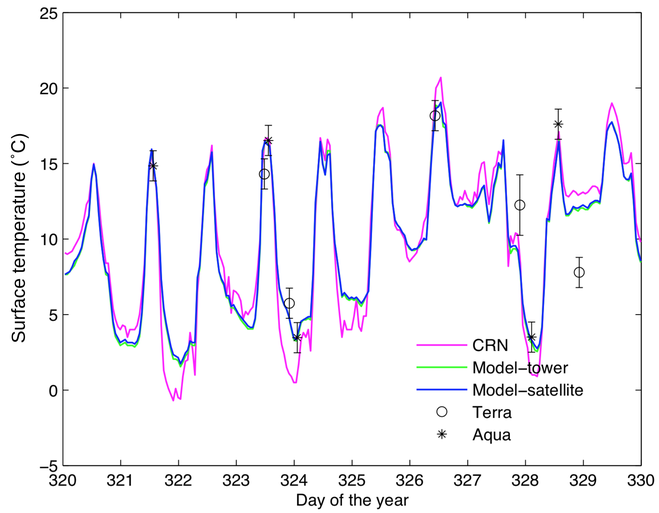

Figure 4. Surface temperatures at the Crossville, TN USCRN location. The in situ CRN measurement (pink line), the modeled tower location surface temperature (green line), the modeled MODIS pixel (1 km x 1 km) surface temperature (blue line), and the Terra (circles) and Aqua (asterisks) satellite based MODIS surface temperature measurements.

Collaborators and Partners

Future Direction

- Refine up-scaling techniques between in situ, aircraft, and satellite measurements
- Examine land surface changes for different climate regimes and seasons and the effects on up-scaling techniques
- Develop regional scale parameterizations for existing up-scaling techniques using USCRN skin temperature measurements.
- Develop a long-term strategy for validation of satellite measurements of skin temperature using in situ and aircraft observations