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Abstract: **Evaluation of MODIS land surface temperature with in situ snow surface temperature from CREST-SAFE**

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This paper presents the procedure and results of a temperature-based validation approach for the Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature (LST) product provided by the National Aeronautics and Space Administration (NASA) Terra and Aqua Earth Observing System satellites using in situ LST observations recorded at the Cooperative Remote Sensing Science and Technology Center - Snow Analysis and Field Experiment (CREST-SAFE) during the years of 2013 (January-April) and 2014 (February-April). A total of 314 day and night clear-sky thermal images, acquired by the Terra and Aqua satellites, were processed and compared to ground-truth data from CREST-SAFE with a frequency of one measurement every 3 min. CREST-SAFE is a synoptic ground station, located in the cold county of Caribou in Maine, USA, with a distinct advantage over most meteorological stations because it provides automated and continuous LST observations via an Apogee Model SI-111 Infrared Radiometer. This paper also attempts to answer the question of whether a single pixel (1km2) or several spatially averaged pixels should be used for satellite LST validation by increasing the MODIS window size to 5x5, 9x9, and 25x25 windows.

Several trends in the MODIS LST data were observed, including the underestimation of daytime values and night-time values. Results indicate that, although all the data sets (Terra and Aqua, diurnal and nocturnal) showed high correlation with ground measurements, day values yielded slightly higher accuracy (~1°C), both suggesting that MODIS LST retrievals are reliable for similar land cover classes and atmospheric conditions.

Increasing the MODIS window size showed an overestimation of in situ LST and some improvement in the daytime Terra and nighttime Aqua biases, with the highest accuracy achieved with the 5x5 window. A comparison between MODIS emmisivity from bands 31, 32, and in situ emissivity showed that emissivity errors (Relative error = -.003) were insignificant.