DEVELOPING LAND SURFACE TEMPERATURE PRODUCT FROM GOES IMAGER DATA

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1. INTRODUCTION

Information on land surface temperature (LST) is important for understanding climate change, modeling the hydrological and biogeochemical cycles, and is a prime candidate parameter for Numerical Weather Prediction assimilation models. In particular, the LST data derived from geostationary operational environmental satellite (GOES) provides unique opportunity for studying LST diurnal variation. Current GOES LST at the U.S. NOAA NESDIS is an intermediate product derived from sounder data which is limited in resolution and accuracy. High resolution GOES LSTs with better accuracy are required from users such as the U.S. NCEP Weather forecast and data assimilation model. Further, the LSTs derived from GOES-East (centered at 75^0 W) and GOES-West (centered at 135^0 W) may be significantly different because of algorithm inconsistency. In order to support the NOAA mission goals in climate, weather, and water, we are developing a consistent LST product derived from GOES satellite imagers. This paper introduces some of results obtained from this project.

2. ALGORITHM

Emissivity variation and heterogeneity of land surface is the most challenging issue in producing satellite LSTs. Prata *et al*. [1] and Jin [2] showed that satellite LST may have about 0.7^0 C differences per 1% emissivity uncertainty. Yu *et al*. [3] tested the sensitivity of 10 different split window algorithms and found that these split window algorithms were sensitive to emissivity accuracy. Emissivities derived from MODIS data [4] are applied in our algorithm considering that it is practically realistic and relatively reliable. Linear regression LST algorithm is adapted for the GOES LST producing since it has been developed over decades and has been applied in a number of satellite missions. Yet, the linear regression LST algorithm is robust, stable and efficient. One of major concerns in our development of GOES LST algorithm is to minimize the LST derived from different GOES Imagers. In specific, due to the lack of split window channels in the GOES M

(12)-Q era, dual window LST algorithm has been developed [5] and applied to those GOES(e.g., GOES-12 and GOES-14) Imagers without the split window channels. For the LSTs derived from same satellite Imager, it is also a concern to minimize the LST difference due to applying different algorithm coefficients for different atmospheric conditions. A comprehensive simulation dataset has been generated for analyzing the above issues.

3. DATA AND RESULTS

In our LST algorithm development, we used simulation data generated from a forward radiative transfer model, as well as real satellite data of GOES-8, 10 and 12 Imagers. Ground LST estimations collected from the U.S. SURFRAD stations were used for algorithm evaluation. The simulation dataset were applied for testing algorithm accuracy in different range of surface temperature values. Figure 1 shows the testing results on the algorithms developed from different authors.

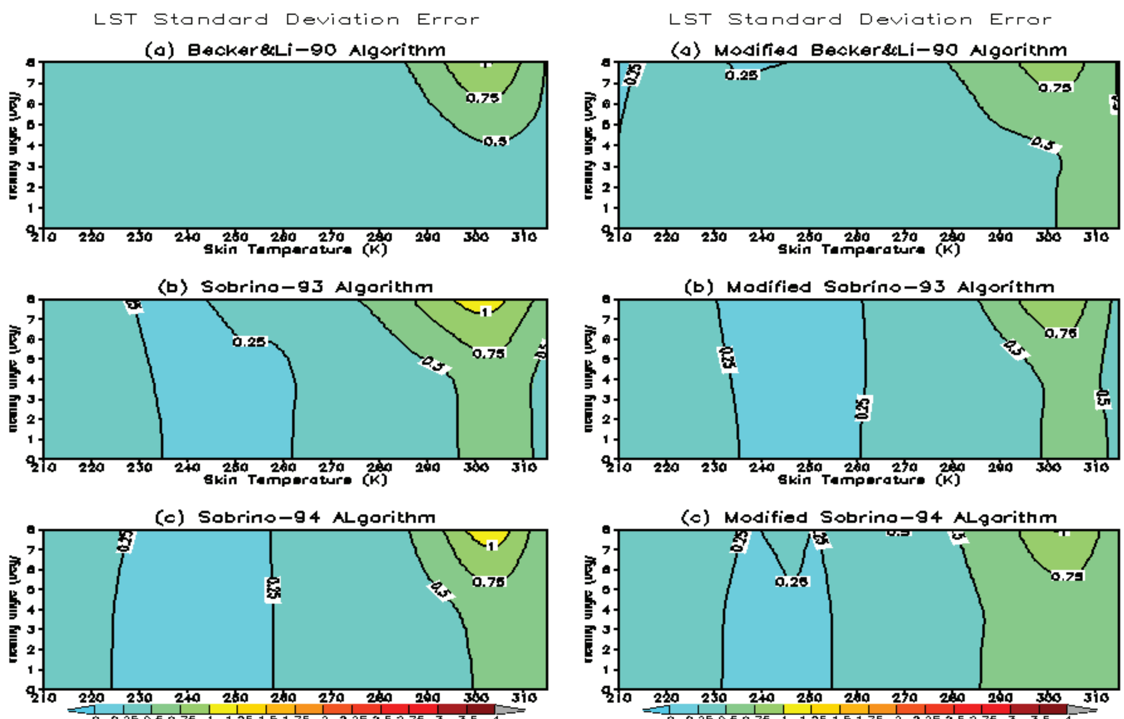

***Figure 1**. The standard deviation errors of LST retrieval from the forward GOES-8 simulations for the 9 inherited algorithms and their modified forms.*

The algorithm is tested using real satellite data such as GOES-10 and GOES-12. Figure 2 shows a sample result of LST distribution in the continental United States from the GOES-12 Imager data.

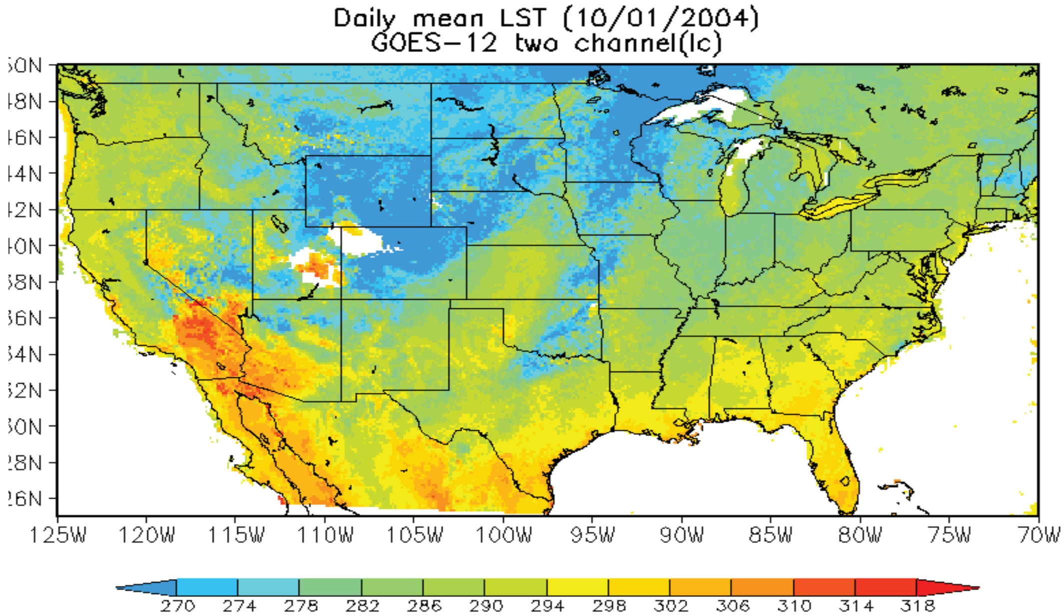

__Figure 2.__ Sample LST images derived from GOES-12 Imager data.

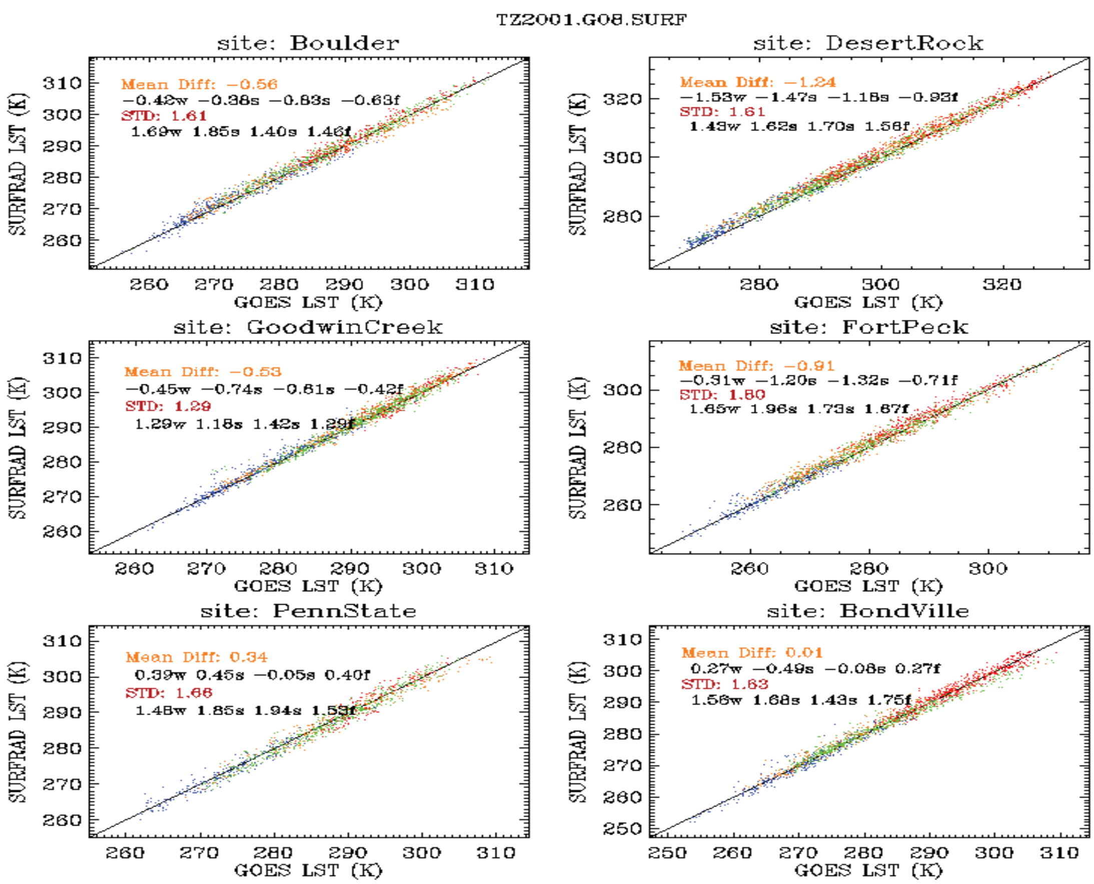

__Figure 3.__ Sample evaluation results of GOES LST using six SURFRAD ground station data.

In Figure 3 we present the ground evaluation results using the SURFRAD ground data. Note that the SURFRAD site LSTs were estimated from upwelling and downwelling irradiances measured at the tower of the sites.

4. SUMMARY

New algorithms for LST retrieval from GOES series imagers have been developed and adapted. Especially, due to the lack of split window channels for the GOES M (12)-Q series satellites. New surface temperature algorithms are developed by using the characteristics of the mid-infrared channel (*3.9 μm*) with less atmospheric (water vapor) absorption and one channel (*11 μm*) plus water vapor correction algorithm. The LST algorithms are tested and evaluated with a comprehensive forward simulation database for four seasons by using the latest radiative transfer model MODTRAN. The algorithms are applied to real GOES imager observations, and evaluated against ground observations, and show reasonable accuracy.

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