Evaluation of Infrared Land Surface Emissivity over the Taklimakan Desert

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1. Introduction

Infrared (IR) land Surface emissivity (LSE) plays a vital role in numerical weather prediction (NWP) models through the satellite radiances assimilation. However, due to the large uncertainties in LSE over the desert, many land-surface sensitive channels of satellite IR sensors cannot be assimilated. This calls for further assessments of the satellite retrieved LSE quality in these desert regions.

2. Data and Methods

A set of LSE observation from field experiments was conducted in 26-28, Oct, 2013 along a south/north desert road in the Taklimakan Desert (TD) (Figure 1), and the observed LSE are thus used in this study as the reference to validate the quality of Combined ASTER MODIS Emissivity over Land (CAMEL) (Figure 3).

The CAMEL LSE with only 7 wavelength (Figure 3)was expended to high spectrum in order to scientifically compare with the observed LSE, which has approximately over than 400 wavelength.

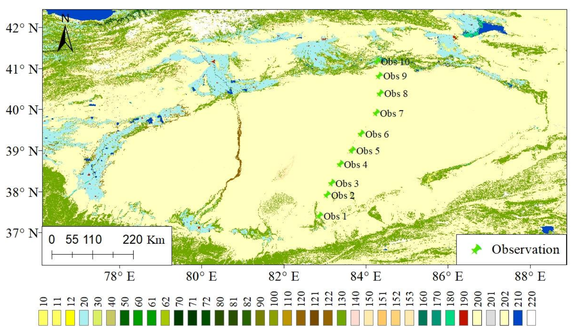

Figure 1. Locations of field experimental Observations

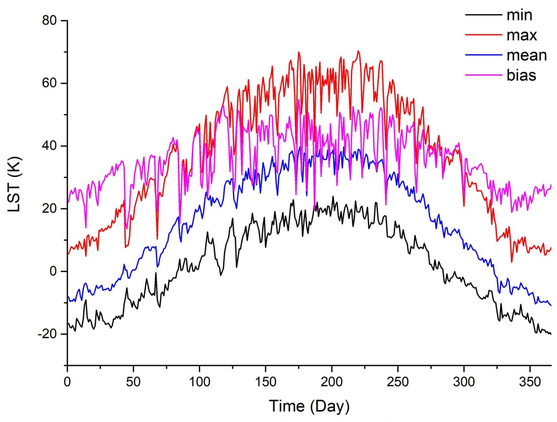

Figure 4. Observed LST of 2020 at Site 5

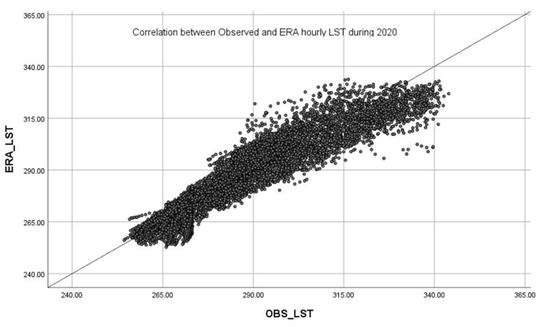

Figure 5. Observed LST of 2020 at Site 5

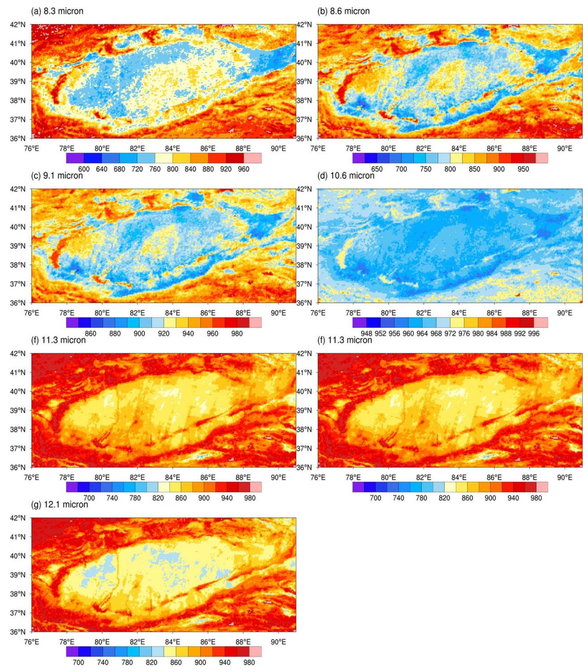

Figure 2. CAMEL LSE in TD

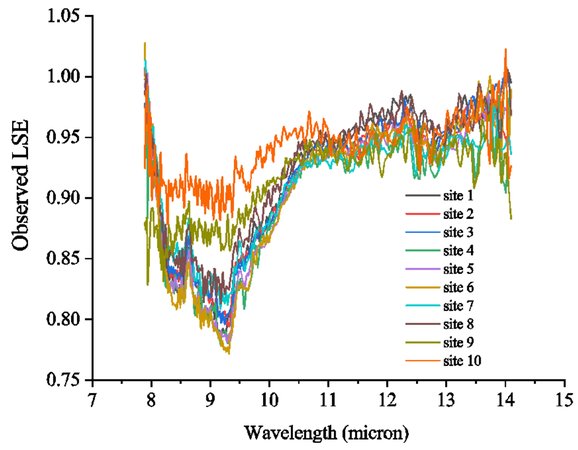

Figure 3. CAMEL LSE at 10 sites in TD

In addition, simulated AIRS radiances, with the measured and the CAMEL LSE along with ERA5 profiles as input, will be compared with observations, and the results will be presented. To do this, the quality assessment of Land Surface Temperature (LST) from ERA5 at site 5 in the hinterland of TD are further presented, as is shown in Figure 5. is quite essential, which thus would be the following work of this study. The daily variation and annually variation of LST in TD is high (Figure 4), while the ERA5 LSTs are generally higher than the corresponding in situ LST (Figure 5), especially when the LSTs are higher.

3. Results

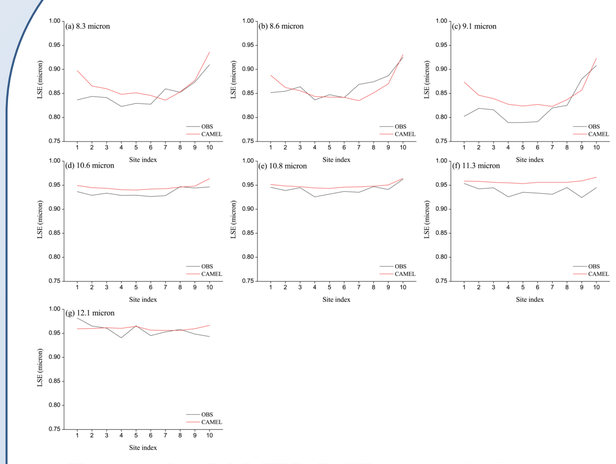

Figure 6 . CAMEL LSE expended to high spectrum and its comparison with observed LSE

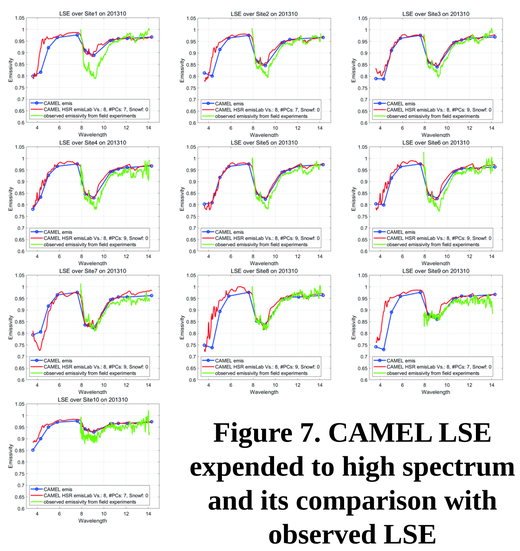

Figure 7. CAMEL LSE expended to high spectrum and its comparison with observed LSE

Figure 6 shows that, The results show that the measured LSE correlates well with CAMEL at the ten observation sites, with the observed LSE slightly smaller than CAMEL in general. The quartz reststrahlen band around 8.6 μm sees largest discrepancy, possibly due to the diurnal variations associated with soil moisture change. In addition, the spectral variation of the observed LSE and CAMEL at the last two observing sites with clay ground surface are smaller than that from sheer desert sites. Furthermore, from the site 1 at the south edge of the Taklimakan Desert to the site 10 at the north edge, the measured LSE and the corresponding CAMEL in the quartzreststrahlen band firstly decreases, and reach their minimum around sites 4-6 at the hinterland of the Taklimakan Desert. Then the LSE increases gradually and finally get their maximum at site 10 with clay ground surface. For the split window region, the LSE remains almost the same at all 10 observing sites.

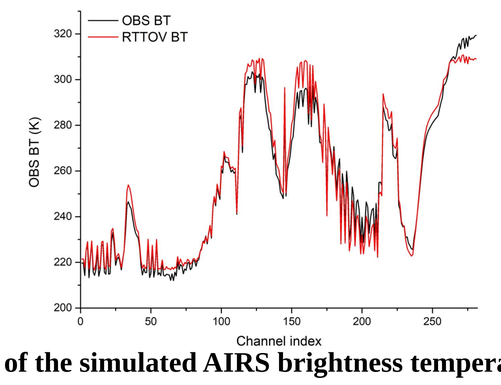

Figure 8. Comparison of the simulated AIRS brightness temperature (BT) and the AIRS obs

The AIRS observed BT are firstly temporally and spatially matched to the experimental observation. Only one of ten has been successfully matched with relax approximation. As is shown in Figure 8, The simulated AIRS BT with the temporal and spatial matched fit well with the correspond AIRS observed BT for the selected 281 channels ordinarily used in operational assimilation in Numerical Weather Prediction (NWP) .

4. Conclusions

(1) The measured LSE correlates well with CAMEL at the ten observation sites, with the observed LSE slightly smaller than CAMEL in general.

(2) The measured LSE and the corresponding CAMEL in the quartz reststrahlen band firstly decreases, and reach their minimum at the hinterland of the Taklimakan Desert. With sheer desert land surface category, then increases gradually and finally get their maximum at site 10 with clay ground surface.

(3) Further study are needed for the influence of difference LSE upon ARIS BT simulation with RTTOV and their assimilation effects.