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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Near–surface air temperature and snow skin temperature comparison from CREST-SAFE station data with MODIS land surface temperature data" *by* C. L. Pérez Díaz et al.

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General comments

The paper compares MODIS skin temperature (LST) and near-surface air (Ta) and skin (T-skin) temperature from ground measurements under snow conditions. All comparisons of ground data with satellite data are useful, but the findings need to be weighted by the spatial and time representativeness of the data sets inter-compared and the limitations of each measurement technique. The paper is perhaps lacking a better



discussion around these issues, and can be in my opinion largely improved.

My specific concerns are:

1. The introduction is confusing regarding the remotely sensed LST and how it relates to Ta. For instance, the sentence 'Normally, LST satellite readings can be compared accurately to near surface air temperature because the algorithms have been developed this way' is quite confusing. What algorithms, the LST or Ta? I guess it means the Ta (and not the LST) algorithms using as proxy LST. Or, the use of the word 'suspicion'. If satellite LST fails to reproduce ground LST, it is because of the challenges of measuring LST over snowed surfaces, not because the try to reproduce Ta. Previous work cited seems related to exploiting LST as a proxy for Ta, given the current challenge to derive near-surface Ta from remote sensors.

2. More information about the sensors and auxiliary data would be good. For instance, cloudiness seems a critical variable in the study but until the very end of the article we do not get a hint of how it measured or estimated.

3. Given the large miss-match between the ground radiometer and the 1km MODIS footprint, the exact location of the MODIS inversion cell is of importance. From aerial pictures we can see that the terrain surrounding the ground location is a mixture of man-made objects, soil, and canopies. If the MODIS cell was including a relatively large fraction of canopy, that would be of importance to interpret the comparison findings, as the canopy can be in many occasions closer to the air temperature than to the soil skin temperature.

4. Wondering if CREST-SAFE left the IR radiometer operating also when snow was not present. If so, it will be very interesting to also compare before and after the snow period. Lack of good agreement for the non-snow conditions could hint a lack of representativeness of the radiometer location (compared with the MODIS footprint). Also, the switch from non-snow to snow conditions is typically difficult for the inversion algorithms, i.e., the same inversion is not applied in both conditions and identifying the

presence of snow is critical for the remote sensing algorithm to perform well.

5. I do not think that there is any mention in the paper that all comparisons with the MODIS product are under clear-sky conditions (although cloud contamination happens often). In that sense, the study of the LST-Ta difference as function of cloudiness, though of interest, it may not add much to the specific goal of the paper (which according to the introduction is to evaluate the remotely sensed LST). I do not think it is any surprise that the LST and Ta are further apart under clear conditions for the reasons well exposed in the paper. The same about the dependence in wind speed of the LST-Ta difference. Given that cloudiness is available, it may have been more interesting to study if some of the large observed differences in LST and ground skin temperature are related to cloud contamination in the MODIS product, and if so, try to filter the MODIS LST to remove those cases before analyzing the data.

6. Table 1 and 2 may need more thinking and discussion. Overall, Aqua LST agrees better than Terra, compared with the ground skin or air temperature (average correlations including both surface and air temperature of 0.78 versus 0.64, respectively). Given that, as far as I know, sensor and inversion algorithms are common for both platforms, the differences should be related to time overpass and period of the winter sampled, assuming that the ground radiometer operates without issues (Terra day and nighttime overpasses are more distinct due to its local times, while Aqua day and night distinction depends much more on the length of the day and time of the year).

7. Figure 3 clearly shows more scatter for the nighttime than for the daytime. For many surface conditions, better agreement is typically observed between satellite LST and ground data for nighttime, due to issues of daytime shadowing related to orography, thermal gradients due to insolation, and so. I am not sure how this will play over snow conditions, but I suspect that in this case the larger scatter for nighttime is partly due to more cloud contamination and the likely difficulties of the cloud mask to operate properly without visible imagery.



8. The discussion around the Figures 4 and 5 is somehow confusing. For instance, I do not see the relevance of stating that 'the fact that MODIS LST better resembles near-surface air temperature helps explaining the low correlation values between MODIS LST and the T-skin'. We use a pool of data under clear-sky conditions (so when T-skin is further away from Ta) to check that MODIS LST correlates worse with T-skin than with Ta, I do not see how the large T-skin – Ta difference explain the better agreement of Ta with MODIS LST. The goal is not that MODIS LST gets closer to ground T-skin because T-skin is closer to the Ta, but that MODIS LST can capture T-skin in all conditions.

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