Meteosat and MODIS land surface temperature product validation with a new environmental satellite data calibration and validation station: Kapiti, Kenya

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Aim

- Establish a representative cal-val facility over savannah range-land in a previously unvalidated region.
- Validate and explore the use of (all-weather) LST products for use in agricultural applications.

Site

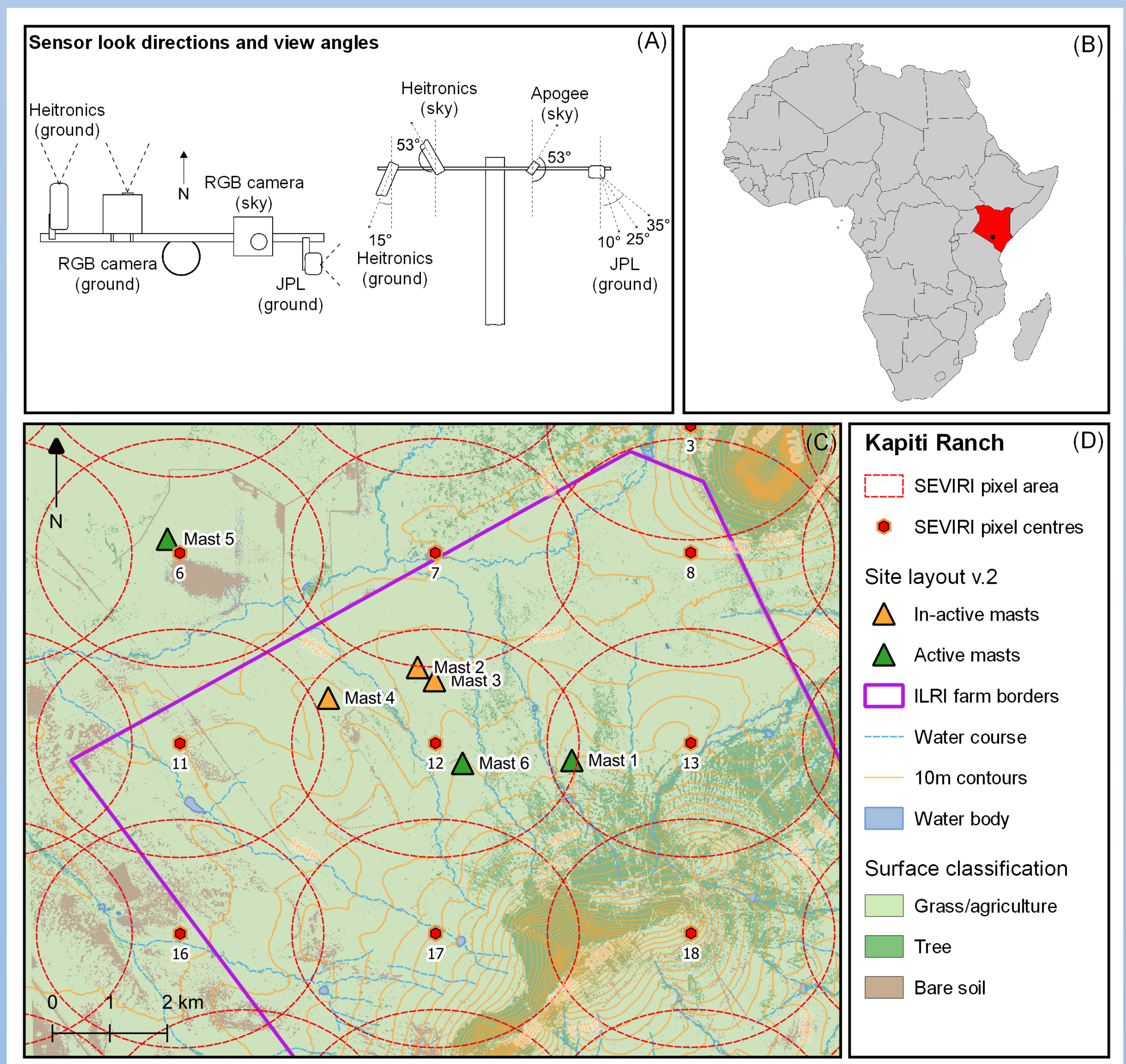

Figure 1. The location of the Kapiti Research Ranch and location of the sensor masts across Kapiti. Panel (A): sensor look directions and view angles for the standard set of instruments mounted on a mast. Panel (B): location of Kapiti (black dot) in Kenya (red), set in the context of Africa. Panel (C): map of the northern half of Kapiti Ranch, with LST measurement sites and (MeteoSat 8 (MS-8)) SEVIRI approximate pixel response area. The number of the pixel is number assigned from the subset of the MS-8 disc used in the validation effort. Panel (D): key for panel-C. Landcover classification generated from Sentinel 2 using manually generated training data and a Random Forest based classification.

Method

- Thermal infrared radiometers are pointed at a range of different surface types (Fig. 2).
- LST is derived from the radiometer brightness temperatures, correcting for downwelling and applying the emissivity used by the product that is being tested.

Figure 2. (A) Part grazed grass canopy during the rainy season, viewed from a mast vegetation monitoring camera on Mast 1. (B) Heavily grazed grass canopy with significant invasive species penetration in the dry season viewed from Mast 2. (C) Acacia tree canopy at the start of the dry season viewed from Mast 3. (D) Over-grazed soil-grass complex a month intro the dry season at Mast 4. (E) Dense senesced grass canopy at Mast 3 at the hight of the dry season. (F) General view of Mast 3 after a week of rains.

- 'Ground LST' is found by combining the variety of surface types temperature observations in their respective proportions and then upscaling based on the Ermida et al (2014) geometric model.
- Two types of ground radiometer, Heitronics and NASA-JPL Apogee.

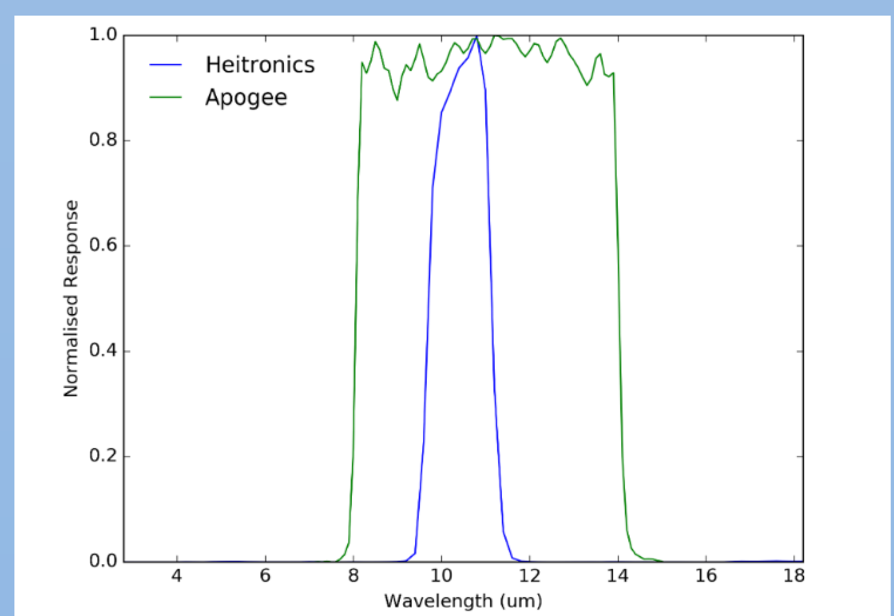

Figure 3. Normalised spectral response functions for a Heitronics KT15.83 IIP radiometer (blue line) and an Apogee SI series radiometer as used by the NASA-JPL radiometers (green line). The Heitronics is considered a narrow-band radiometer whilst the Apogee sits on the border between narrow- and broad-band types.

Results

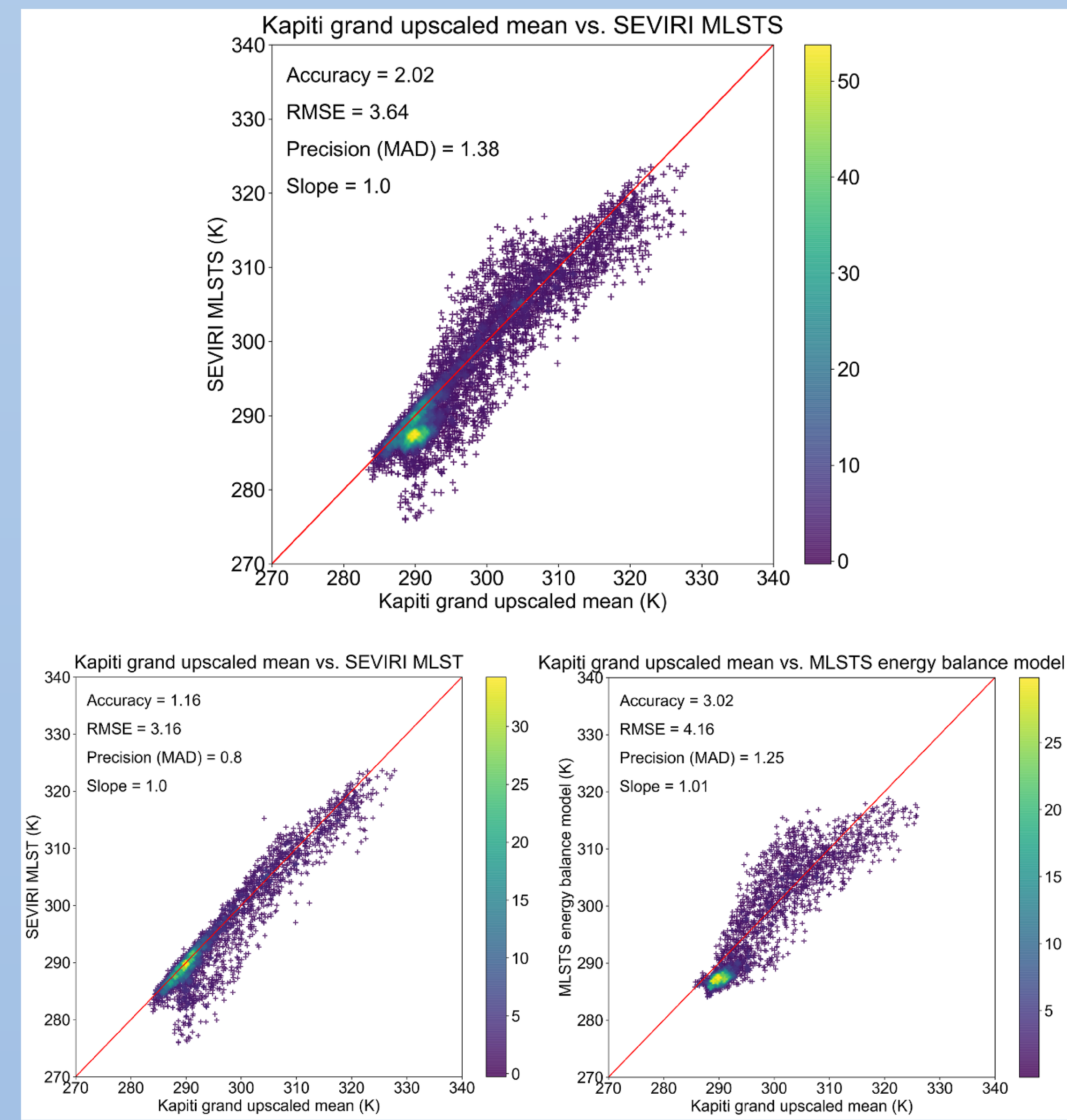

Figure 4.

Top: Mean upscaled Kapiti ground LST against the new LSA-SAF all weather product.

Bottom left: at times of clear sky, SEVIRI TIR observations.

Bottom right: output of the energy balance model alone, at times of cloud.

Clear sky and cloud defined by the SEVIRI cloud mask.

Performance is generally good.

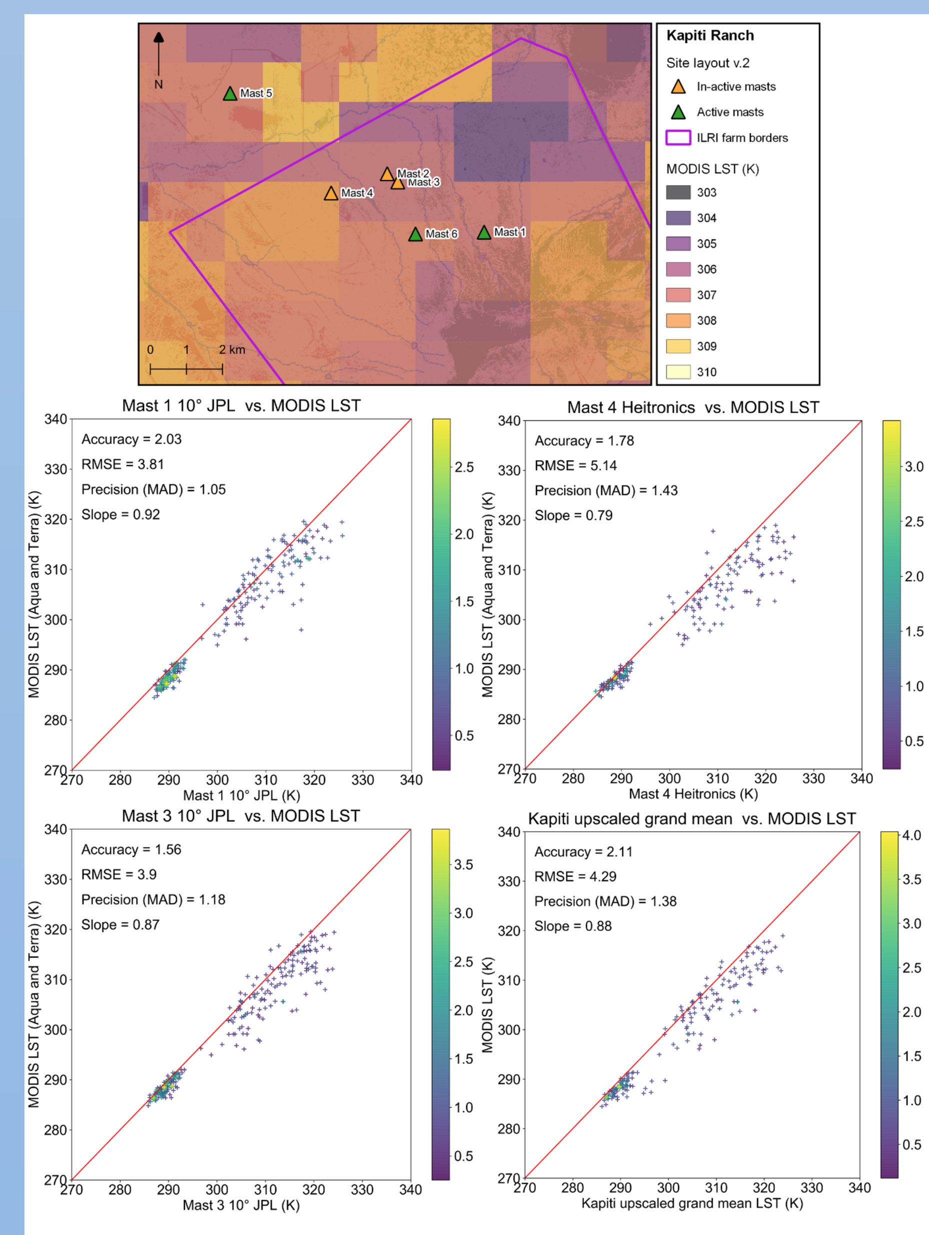

Figure 5.

Upper panel: example MODIS LST data from 2018-08-01 at 07:30 UTC, Level 2 LST Terra (MYD11).

Lower panels: MODIS LST against the ground radiometers at each Mast. Aqua and Terra are both used.

Colour bar is the density of overlain points for a given observation time.

Night observations are generally good. Day observations are generally poor.

References

Ermida, S.L., Trigo, I.F., DaCamara, C.C., Göttsche, F.M., Olesen, F.S. and Hulley, G., 2014. Validation of remotely sensed surface temperature over an oak woodland landscape—The problem of viewing and illumination geometries. Remote Sensing of Environment, 148, pp.16-27.

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