Supplementary information 1 – ground data

Figure S1 presents an example of the data used to calibrate and validate the method described in this paper. An observation is made every 5 minutes and the data recorded by a Campbell C300 logger. The sensor package for each mast consists of a vegetation monitoring camera (Canon 500D DSLR RGB), a surface-looking Heitronics KT15.85 IIP precision radiometer (9.6 - 11.5 μm), a surface-looking quasi-nulling Series 500 radiometer manufactured by NASA's Jet Propulsion Laboratory (NASA-JPL) (8 – 14 μm). The outcome of operational issues was that in the first full year of operation the instruments installed at Kapiti research station capture one full rainy season and vegetation cycle across three masts. This time series suffers one data gap of approximately seven days due to power failure at two of the masts. We therefore have a total observation period for site configuration 1 of ~6 months.

The radiometric observations have been corrected for target emissivity and atmospheric conditions and the surface temperature found using the Planck equation (Göttsche et al., 2016; Guillevic et al., 2017). The emissivity used (convolved to sensor) is that provided by LSA-SAF for their SEVIRI LST product- which is found via a fractional vegetation cover analysis (Trigo et al., 2006; Trigo et al., 2008). The observed surface and sky temperature absolute uncertainty with error propagation is calculated as per Guillevic et al. (2017). The value given is the combination of uncertainty from the logger and all the sensors that contribute to a final observed value. If the calculated uncertainty is less than the value of the temperature resolution (0.5 K), the temperature resolution is given instead of the calculated uncertainty. Observations with an uncertainty greater than 5 K are removed from the time series. Mean observation uncertainty is 0.5 K for the surface (grass) brightness temperature and likewise ±0.5 K for the sky brightness temperature .

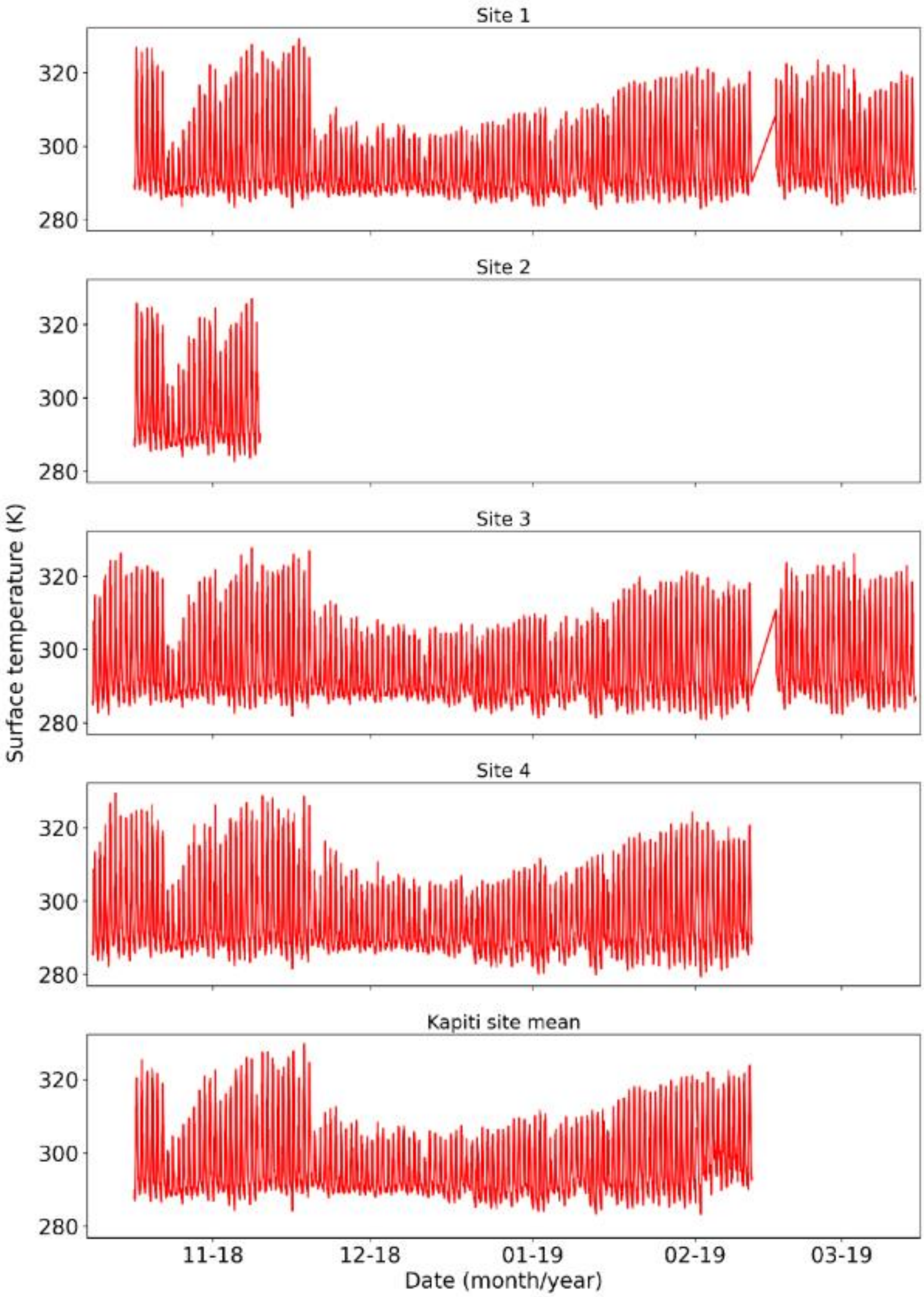

Figure S1. Summary of the available in situ LST record (Kelvin) for Kapiti site configuration 1. Data is available when at least one ground observing radiometer is active and returning admissible data. The upscaled mean is only available when at least two radiometer observations are available across all masts. Site time series are the downwelling and emissivity corrected LST values for each mast upscaled to the SEVIRI pixel scale. The final (E) time series is the Kapiti mean LST derived from all four sites and upscaled to the SEVIRI pixel scale.

Supplementary information 2 – cloud cover

The sky pointing Heitronic radiometer is used to detect and analyse the presence and stability of cloud cover over Mast 3. This was carried out using a two-step filter on the unfiltered Heitronic derived sky temperatures. Filter 1 is a simple threshold that decides if cloud is present or not in the radiometer field of view, a sky reading of less than 243.15 K is considered to represent a clear sky.

Filter 2 is a moving window z-score that assesses stability of the reading in a 25-minute (5 observations) and 15-minute (3 observations) window. A fault catching step was first applied to these z-scores at -50/50 standard deviations to remove grossly erroneous readings. The stability filter was then applied for 25 minutes and 15 minutes. Values within 1 standard deviation for 25 minutes and 2 standard deviations for 15 minutes are considered to be an observation of stable cloud for the indicated length of time prior to said observation. The standard deviation threshold was set by comparing the resulting classification for a time period against the cloud camera record from Mast 1. This is output as a binary time series that identifies periods of stable cloud cover (Figure S2). The binary stable cloud time series generated by the 25-minute window filter and by the 15-minute window filter were then used respectively to calculate a daily cloud duration fraction (CDF). Based on the comparison to the cloud camera imagery and cross-checked against the typical diurnal cycle, it was decided that the 15-minute window and subsequent CDF would be taken forward as the ground-based cloud cover measure.

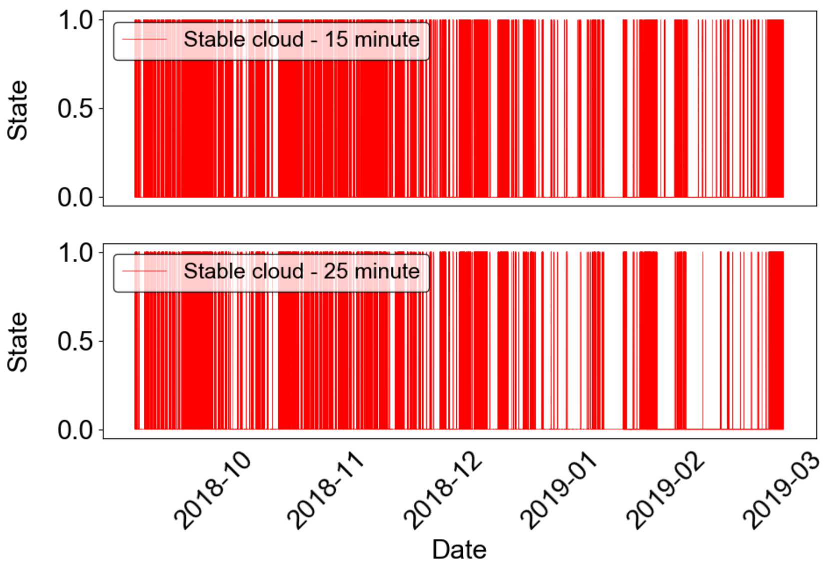

Figure S2 Stable cloud cover analysis for Mast 3. 1 is stable cloud present. 0 is stable cloud not present.

Supplementary material references

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