Improving Observations from Space with Aqua MODIS Surface Temperature Anomaly to Close the Energy Budget of the Earth

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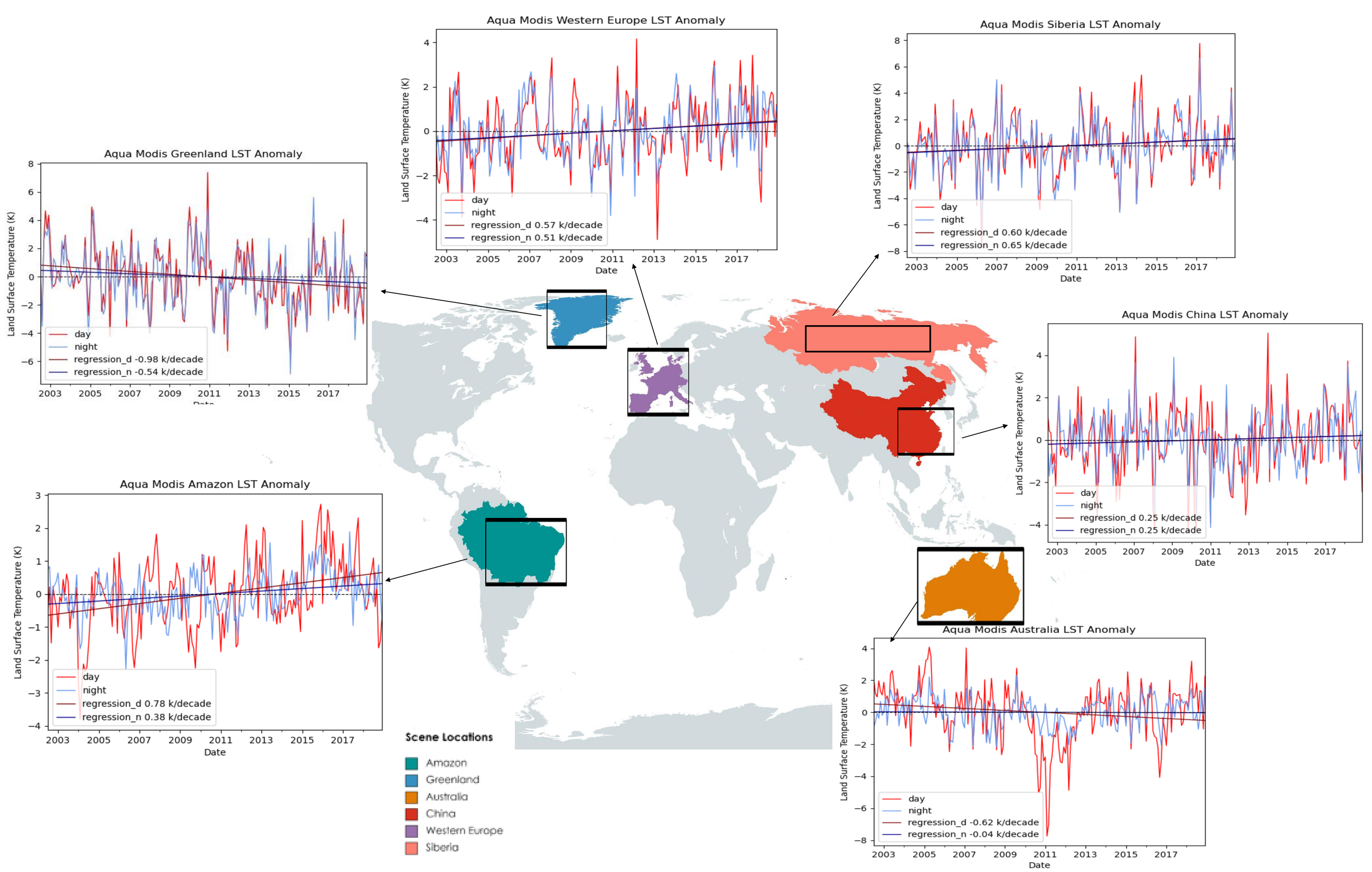
Land Surface Temperature

LST is a key measurement of surface energy processes and described as an essential climate variable (ECV) by the Global Climate Observing System (GCOS). In response to the UNFCCC framework, the European Space Agency (ESA) launched the Climate Change Initiative (CCI). As a dedicated CCI LST team to analyse changes in global temperatures of land surfaces. With the aim to utilise IR and MW instruments and satellites to provide single sensor datasets and combined long-term climate records. Principal application to climate research requiring long-term, stable, low bias records of LST

LST Aqua MODIS Data Record

The Moderate Resolution Imaging Spectroradiometer (MODIS) series of infrared sensors comprises of two sensors on the Aqua and Terra Satellites. The LST_cci Aqua MODIS LST data record (internally coded as MODISA) is a climate data record from the single sensor satellite sensor data archive. It is a global datasets covering the time period from July 2002 to December 2018, with a daily (day/night) temporal resolution and 0.01deg spatial resolution.



MODISA LST Anomaly Analysis

Amazon	*Change per decade: 0.78 K day, 0.38 K night.* A substantial increase in daily temperature anomaly over 16 years with peak anomalies in summer 2015 reaching over 2.5K at night. The dramatic rise could be due to increased deforestation.
Greenland	*Change per decade: -0.98 K day, -0.54 K night.* Potential explanation for the downward trend during the time window might include; a positive phase of the North Atlantic Oscillation and low surface pressure and geopotential height indices, resulting in reduced Greenland Blocking Index. Cloud contamination is also large challenge for accurate LST retrieval.
Western Europe	*Change per decade: 0.57 K day, 0.51 K night.* A steady temperature change rising relatively uniformly between day and night is expected with the EU's temperate climate and its developed, urban cities.
Siberia	*Change per decade: 0.60 K day, 0.65 K night* Consistent upward trajectory of temperatures within the region, with a 0.5 K increase at night. Peak day/night winter temperature increase in Jan 2017 more than 1K more than Jan 2016.
China	*Change per decade: 0.25 K day, 0.25 K night* SE China showing consistent increase over time, showing an increase in winter temperature peaks post 2013. Expected results with its significant growth in urban and city development
Australia	*Change per decade -0.62 K day, -0.04 K night* A positive La Nina can explain the reduction in temperatures from 2009, most significant drop occurring in Jan 2011 of almost -8 K at night.

Future Work and PhD Research Motive

All-sky LST observations are required and crucial for many climate applications. Clear-sky bias is a key problem with infrared observations and is a challenge for climate science. While the lower accuracy and spatial resolution of microwave (MW) LSTs can also be an issue, particularly as observations are required at increasingly higher resolution for model simulations.

What do we do?

Aim to combine both IR and MW LSTs remains a key step forward. We will use information on the differences between the validation and the inter-comparison activity products to correct the least accurate LST product. We will also use the relationship between LST and land surface air temperature to improve our understanding of the clear-sky bias.

PhD Research:

We aim to better understand the diurnal variability in global LST. By creating the first fully integrated all-weather LST dataset using IR and MW, that can be utilised against climate models and other temperature datasets.

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