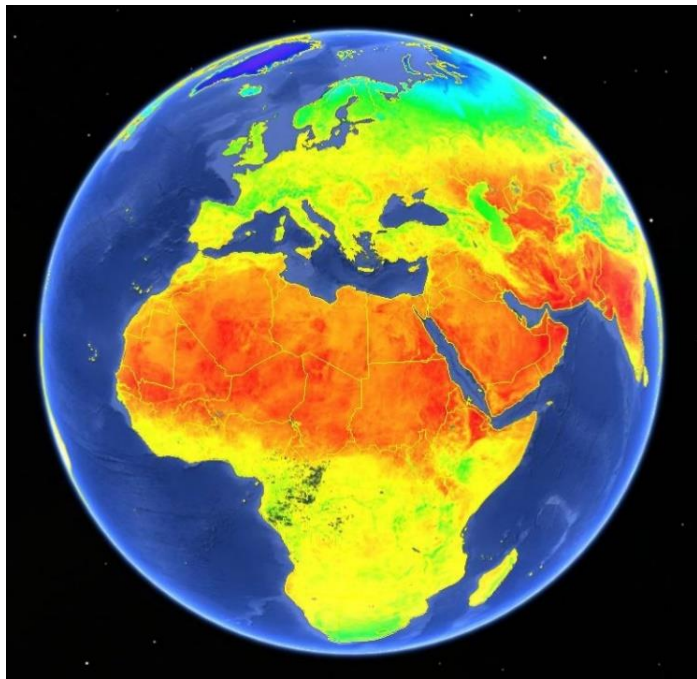


climate change initiative

→ LAND SURFACE TEMPERATURE NEWSLETTER



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Objectives of the project

The land surface temperature (LST) CCI project, which is funded by the European Space Agency (ESA) as part of the Agency's Climate Change Initiative (CCI) Programme, aims to deliver a significant improvement on the capability of current satellite LST data records to meet the challenging Global Climate Observing System (GCOS) requirements for climate applications to realise the full potential of long-term LST data for climate science.

Accurate knowledge of LST plays a key role in describing the physics of land-surface processes at regional and global scales as they combine information on both the surface-atmosphere interactions and

energy fluxes within the Earth Climate System. LST provides a metric of surface state when combined with vegetation parameters and soil moisture and is one of the drivers of vegetation phenology. Furthermore, LST is an independent temperature data set for quantifying climate change complementary to the near-surface air temperature ECV based on in situ measurements and reanalyses.

The team has produced data products from a variety of satellites to provide an accurate view of temperatures across land surfaces both regionally and globally of over 20 years currently. Consistency between products and better characterisation of uncertainties are key advancements with these products. These data are delivering new insights to scientists working at leading climate centres.



Science highlights

As ESA’s CCI project targets the production of data sets that can be used for climate research, a crucial requirement is to assess the quality and utility of these data from a climate-science perspective. The LST_cci project funds six different User Case Studies (UCS) (Table 1). Based on UCS results, together with the feedback from the wider LST_cci Climate Research Group (CRG) studies and dedicated User Workshops, **user needs continue to be comprehensively captured and addressed by the project.**

Team	Title
Met Office Hadley Centre	Investigate the feasibility of a satellite moderate temperature extremes data set based on satellite LST
Danish Meteorological Institute	Impact of LST_cci Ice Surface Temperature (IST) products from MODIS and SLSTR on the Arctic Sea and IST Multi-Year Product for the Copernicus Marine Services (CMEMS)
Ruhr University Bochum	Global Surface Urban Heat Islands (SUHI) Trend Analysis
Met Office Hadley Centre	Comparison between LST and reanalysis ‘skin’ temperature time series
MeteoRomania	Evaluating the Surface Urban Heat Island Intensity using LST_cci data
Luxembourg Institute of Science and Technology	Evaluating Diurnal Dynamics of Evaporation and Temporal Integration Impacts in Evaporation Modeling (UNITY)

Four of these UCS are now well underway, with the LIST UCS and second Met Office UCS starting imminently. In its first UCS, the Met Office has produced a sub-set of the [Climpact air temperature \(T2m\) indices](#) using LST_cci microwave (MW) data over each of the [IPCC AR6 regions](#). Initial study results suggest that some of the LST-based indices, e.g. percentile-based, could be used to provide additional and independent information on extremes in some regions. In the DMI UCS, validation of the new LST_cci IST from MODIS and SLSTR with sea-ice buoys and other satellite-based IST data demonstrate that these data are performing well. These new IST data are expected to significantly improve the [CMEMS](#) IST dataset due to increased data availability. Ruhr University Bochum have been using LST_cci MODIS data to calculate LST trends over global cities and surrounding rural areas. Initial results show a significant increasing trend in urban surface temperatures, with continental cities warming faster than non-continental cities, and northern-hemisphere cities warming the faster than southern-hemisphere cities. The MeteoRomania UCS has used LST_cci data to develop a [web-based platform](#) designed to supply free information on the seasonal characteristics of the SUHI Intensity. The results of these UCS and other CRG studies are summarised in the [LST_cci Climate Assessment Report](#).

Each UCS will submit a publication describing their study to a leading scientific journal in 2025.

The Version 3.0 release of the LST_cci products are all available on the ESA CCI Open Data Portal (<https://climate.esa.int/en/data/#/dashboard>). These products are implemented with consistency between datasets a key aspect. **This means products are using common algorithms, cloud detection methods, uncertainty models and calibration databases to deliver the best possible climate data records for LST.** New products have also been developed. These include **global and regional cloud free data** from AVHRR and Himawari respectively, and **global all sky data** from AMSR sensors (Figure 1).

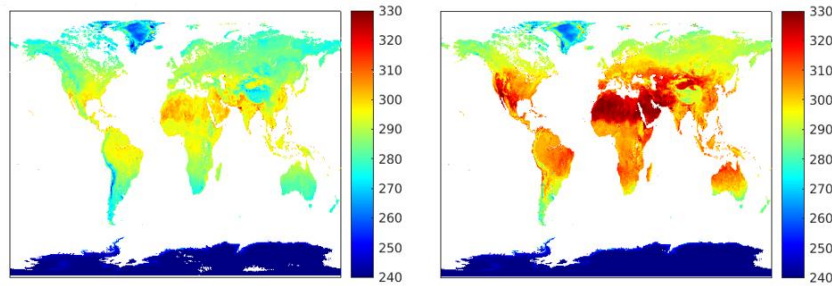


Figure 1: Example LST_cci monthly microwave product from AMSR2 for August 2018 at 01:30 (left) and 13:30 (right)

A

pplication

A first stability assessment of the LST ECV products over Europe (*Good et al., 2022*) showed that some of these met the requirements for climate trend analysis. We applied one of these datasets from Aqua MODIS to investigate regional climate trends (**Error! Reference source not found.**).

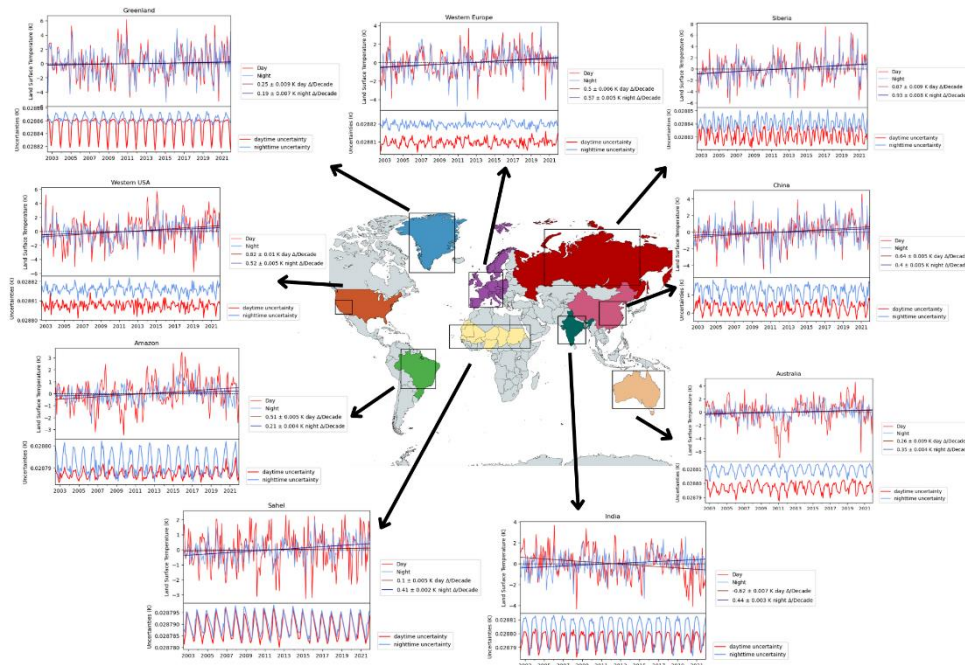


Figure 2: Regional climate trend analysis using the LST_cci Aqua MODIS LST ECV product (from Waring et al., 2023).

Innovation

Many applications need both high spatial and temporal resolutions. For this to be achieved at the very highest spatial resolutions requires some innovative approaches. Using Optimal Estimation techniques developed in LST_cci, and in collaboration with NCEO, a first **high quality downscaled LST product at high spatial resolution** (~100m) has been prototyped from daily MODIS and Sentinel-3 SLSTR data. This activity will better deliver objectives through the exploitation and distribution of thermal infra-red satellite data **to decision makers at the national and local level to address issues of Heat Risk, Vulnerability, Urbanisation** and understanding the natural environment (Figure 3).

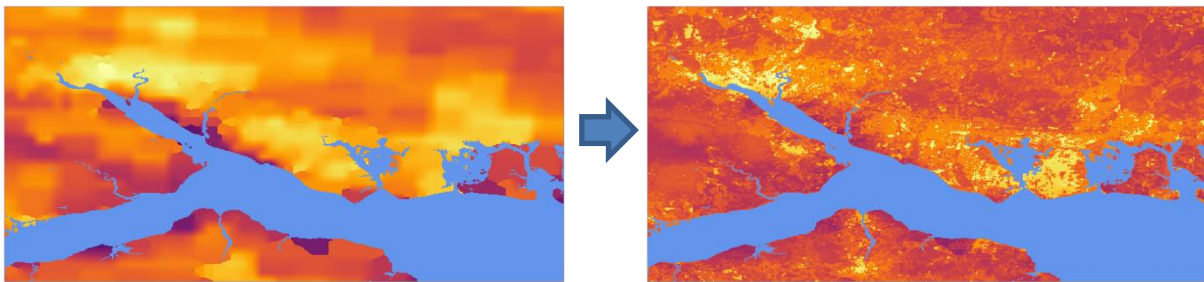


Figure 3: LST_cci downscaling technique applied to MODIS data over the Solent area of the southern UK to go from ~1 km spatial resolution to ~100m

Project Team

The Consortium is based on a close collaboration between the following partners:

- [University of Leicester](#) (primary)
- [ACRI-ST](#)
- [NCEO](#): National Centre for Earth Observation
- [University of Reading](#)
- [UK Met Office](#)
- [ESTELLUS](#)
- [KIT](#): Karlsruhe Institute of Technology
- [IPMA](#): Instituto Português do Mar e da Atmosfera
- [Ruhr University Bochum](#)
- [DMI](#): Danish Meteorological Institute
- [LIST](#): Luxembourg Institute of Science and Technology
- [Meteo Romania](#)

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Events

The 3rd User Workshop will be held 5-6 December 2024 at Space Park Leicester in conjunction with a Thermal Remote Sensing Workshop

2-4 December 2024
<https://climate.esa.int/en/projects/land-surface-temperature/news-and-events/news/land-surface-temperature-2024-user-workshop/>)