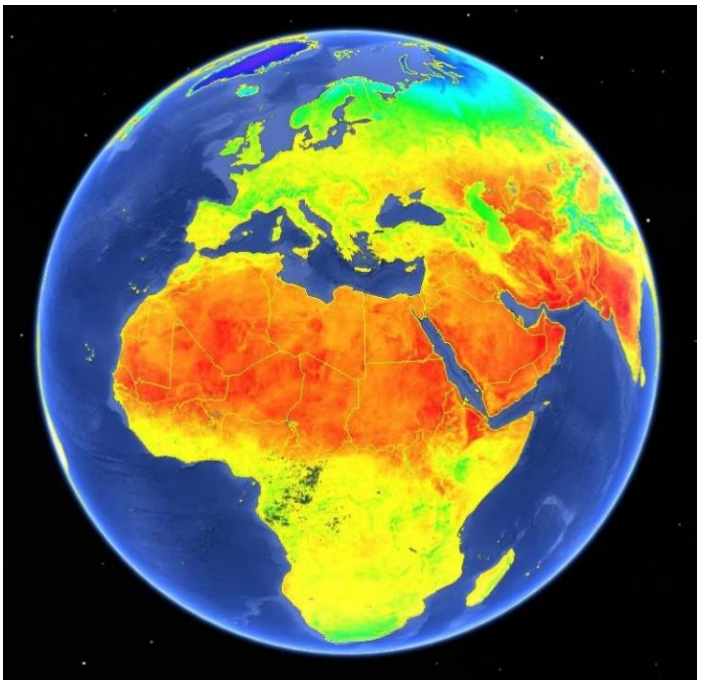
climate change initiative

→ 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 will use data from a variety of satellites to provide an accurate view of temperatures across land surfaces globally over the past 20 to 25 years. This will involve developing innovative techniques to merge data from different satellites into combined long-term satellite records for climate. These will all be evaluated by scientists working at leading climate centres.

land surface temperature cci

Science highlights

The science and data products from LST CCI are driven by the needs of the climate community. User Requirements from 77 responses to a detailed online user survey and one-to-one discussions with members of the Climate Research Group (CRG) have produced a set of climate requirements for LST (Table 1). **The project will deliver on these requirements from climate users while also providing crucial inputs for the next update to the GCOS Implementation Plan.**

Table 1: User requirements for climate quality LST

	Threshold	Breakthrough	Objective
Dataset length	10 years	30 years	> 30 years
Spatial resolution	1 km	< 1 km	< 1 km
Temporal resolution	6 hours	1 hour	< 1 hour
Accuracy	1 K	0.5 K	0.3 K
Precision	1 K	0.5 K	0.3 K
Stability	0.3 K / decade	0.2 K / decade	0.1 K / decade

To elicit the highest quality LST products for climate studies it is critical to implement the optimum retrieval algorithm. An algorithm intercomparison ("round robin") has been carried out selecting the best infrared algorithms (from six tested for three infrared sensors), and the best microwave algorithms (from the seven tested). **This is the first time a multiple algorithm multiple sensor algorithm intercomparison study has been performed for LST, and a paper is in preparation.** To facilitate this, a unique Benchmark Database (BDB) for training, testing and selection of algorithms was designed and developed. This will be utilised throughout the project for ongoing improvements to the optimum algorithms.

The first LST datasets have now been created using the best algorithms in the first end-to-end processing chains for LST ECV Products (

Table 2). These include both global gridded products at 0.05° and high resolution (1 km) products in their native grids.

The products are both LST ECV products from single sensors and a first multi-sensor Climate Data Record (CDR) implementing a robust approach to resolving differences in local overpass times. These are now being made available to the Validation Team, CRG and Climate Modelling User Group (CMUG) on the UK JASMIN system. We welcome interest from the wider science community who wish to use these first datasets as beta-users. Please contact the Science Lead (Darren Ghent – djg20@le.ac.uk) to request access.

Sensor	Level	Res.	Time
ATSR_2	L2P	1 km	1 Aug 1995 – 22 Jun 2003
	L3C	0.05°	
AATSR	L2P	1 km	24 Jul 2002 – 8 Apr 2012
	L3C	0.05°	
Terra MODIS	L2P	1 km	24 Feb 2000 – 31 Dec 2018
	L3C	0.05°	
Aqua MODIS	L2P	1 km	4 Jul 2002 – 31 Dec 2018
	L3C	0.05°	
Sentinel 3A	L2P	1 km	29 Oct 2016 – 31 Dec 2018
	L3C	0.05°	
SEVIRI	L3C	0.05°	1 Jan 2008 – 31 Dec 2010
SSM/I	L3C	0.25°	1 Jan 1998 – 31 Dec 2015
ATSR CDR	L3C	0.05°	1 Aug 1995 – 8 Apr 2012

Table 2: LST ECV Products produced in the first year

The maturity of these Earth Observation products is enhanced with the first development of robust uncertainty estimates for LST data products (Figure 1 and Figure 2). The approach here is to construct an uncertainty budget where error effects are grouped into categories according to their correlation length scale.

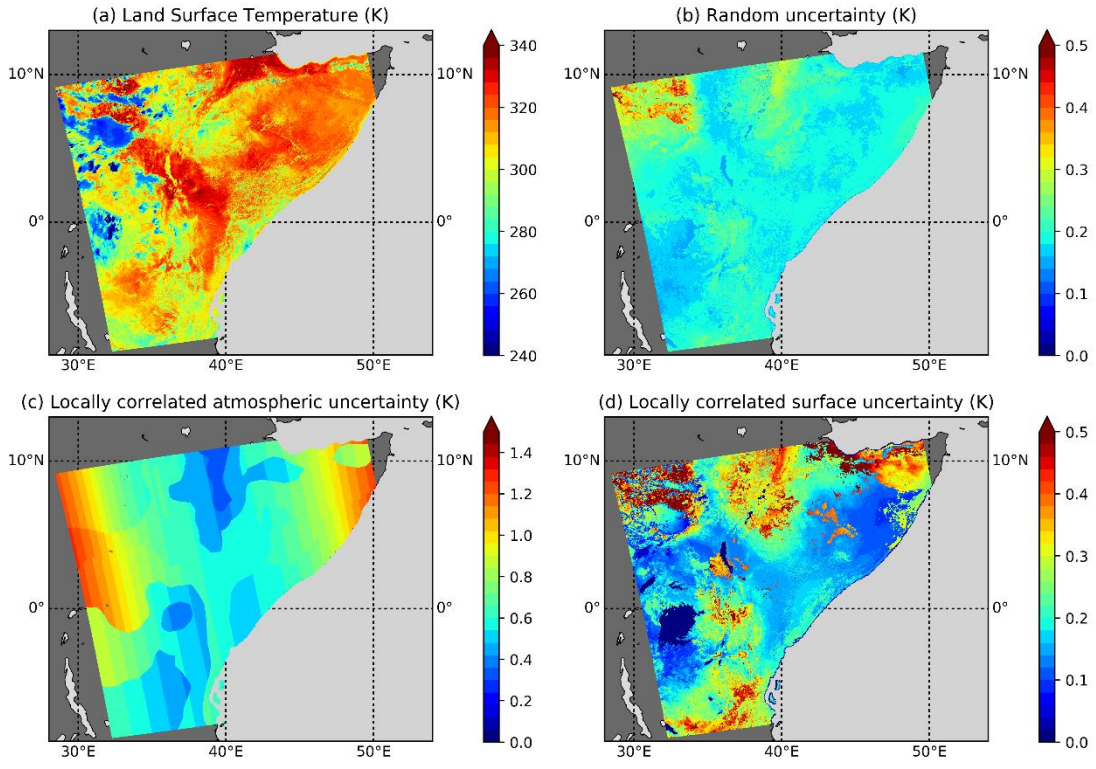

Figure 1: Example Level-2P LST and LST uncertainty components for Terra-MODIS on 1st June 2010

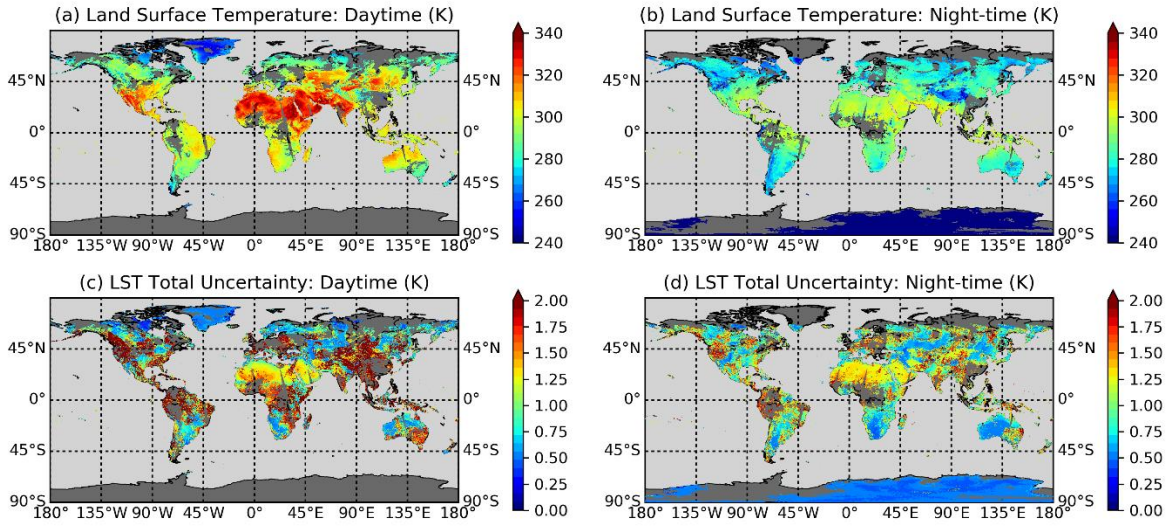

Figure 2: Example daily daytime (left) and night-time (right) Level-3C LST and total uncertainty composites for Aqua-MODIS on 1st June 2010

During the next year the algorithms, cloud detection methods, uncertainty models and processing chains will be advanced. Project documents are available on the Project website http://cci.esa.int/lst.

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
- UVEG: University of Valencia
- KIT: Karlsruhe Institute of Technology
- IPMA: Instituto Português do Mar e da Atmosfera
- Ruhr University
- DMI: Danish Meteorological Institute
- Max Plank Institute
- LIST: Luxembourg Institute of Science and Technology
- Meteo Romania

Science Lead is Darren Ghent, University of Leicester and NCEO (djg20@leicester.ac.uk)

Project Manager is Jerome Bruniquel, ACRI-ST, (jerome.bruniquel@acri-st.fr)

Events

We invite all climate users of LST data to participate in a User Workshop to be held at the UK Met Office in June 2020. Full details will be released in the coming weeks on the LST CCI website.

Presentations on LST CCI will be made at the AGU Fall Meeting in December 2019 in the

EarthTemp session chaired by the International LST and Emissivity Working Group (ILSTE).