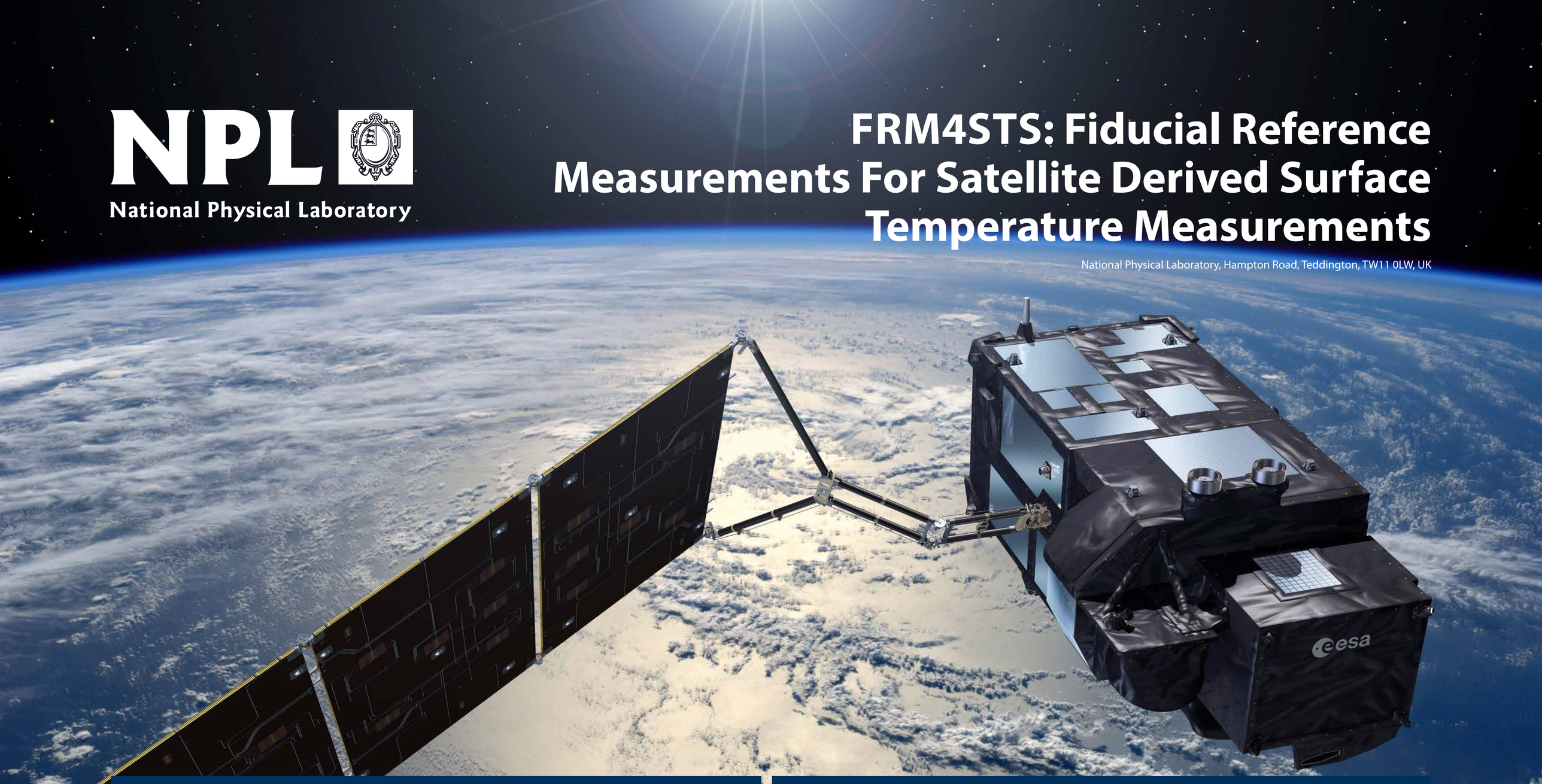
NPL
National Physical Laboratory

FRM4STS: Fiducial Reference Measurements For Satellite Derived Surface Temperature Measurements

National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, UK



Project aim

FRM4STS is an ESA funded project, to establish and maintain SI traceability of global Fiducial Reference Measurements (FRM) for satellite derived surface temperature product validation. The project will facilitate international harmonisation and interoperability through organisation of a set of inter comparisons under the Committee for Earth Observation Satellites (CEOS) and its Working Group on Calibration and Validation (WGCV).

Why?

Satellite remote sensing of the Earth's surface is essential to help develop our understanding of the effects and reasons for weather patterns and impacts of climate change. For example by following the trends of surface temperature across the world, we can further our understanding of the air-sea-land-ice interaction and use this as a stepping stone to improve our predictions of the scale and impact of climate change.

However, the trends are very small and subject to a range of regional and seasonal fluctuations. Satellite measurements, therefore, need to be as accurate as possible and provide long term (multi-decadal), data that can be robustly linked between different sensors of many space agencies flying now and with those of the past and future.

Comparisons

It is essential for long-term records that satellite measurements are fully anchored to SI units (to provide traceability). At the moment field-deployed infrared radiometers are used to provide surface-based measurements which are used for Calibration/Validation. These radiometers are in principle calibrated traceably to SI units, generally through a blackbody radiator. However, blackbodies and radiometers used are of varying design and are operated by different teams in different parts of the globe. It is essential for the integrity of their use, that any differences in their measurements are understood, so that any potential biases are removed and are not assigned to satellite sensors.

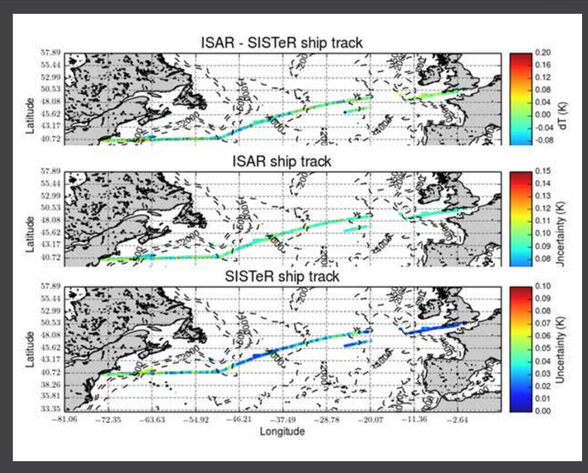
Laboratory Intercomparison

For the Laboratory Intercomparisons there were three types of validation:

- **Controlled laboratory testing (blackbody and radiometer comparisons,**
- **Water Surface Temperature (WST), and**
- **Land Surface Temperature measurements (LST)**

All useful for validation of satellite temperature data.

Sea Surface Temperature Intercomparison



A successful Sea Surface Temperature (SST) Intercomparison was carried out on the Cunard Queen Mary 2. The two instruments participating in the SST Field Inter-Comparison Experiment (FICE) were the Rutherford Appleton Laboratory SISTeR and the University of Southampton ISAR instruments.

The Figure shows the path the QM2 took across the Atlantic Ocean. Top: shows the difference in temperature measured by the ISAR and SISTeR radiometers. Middle: shows the uncertainty in the temperature measured by the ISAR radiometer. Bottom: shows the uncertainty in temperature measured by the SISTeR radiometer.

Ice Surface Temperature Intercomparison

A successful FICE experiment over sea ice was conducted in March-April, 2016 on the sea ice off Qaanaaq, in Northwest Greenland. The site is well suited for conducting a field campaign on the sea ice and for measuring the ice surface temperature with radiometers. It is well within the high Arctic at 77°N with a dry Arctic atmosphere and cold temperatures in April.

Land Surface Comparison

Inter-comparison experiments in the field cannot be controlled to the same extent as in the laboratory: therefore, selecting naturally homogenous sites is of key importance. The plan currently is for the LST FICE to be performed on the Namib gravel plains and sand sea.

To evaluate measurements of LST, a field comparison campaign is planned for 2017 in Namibia at the Gobabeb research centre and additionally, subject to interest by participants at the higher altitude Kalahari site.

International Workshop: 16 – 18 October 2017

The objective of this ESA sponsored workshop is to bring together the worlds expertise in Earth surface (Land, Water, Ice) temperature measurements under the auspices of Committee on Earth Observation Satellites (CEOS) to review the current state of the art in measurement accuracy for satellite validation.

The workshop will consider the outputs and results from the recent CEOS comparison of fiducial reference measurements/instruments and will look to conclude with the development of an internationally coordinated strategy to ensure that the global reference measurement infrastructure is adequate to meet the future needs and aspirations of all users.

Department for Business, Energy & Industrial Strategy

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