

Performance Validation of a Commercial Radiometer - is it sufficient for climate change detection?

Suitable for:	UG Project	Project Hosted By:  RAL Space (https://www.ralspace.stfc.ac.uk/)
Application Closes:	15 th November 2026	
Expected duration:	3-4 months	
Latest start date:	31 st January 2027	
Application link:	https://forms.gle/TwRySH2qT3sU56ej7	

Project Description

RAL Space propose a project on [ASTeRN](#) (Advanced Sea-surface Temperature Radiometer Network), the next-generation instrument to [SISTeR](#) (Scanning Infrared Sea Surface Temperature Radiometer). ASTeRN is being developed to provide highly accurate radiometric measurements of sea, land and ice surface temperature for the validation of satellite Earth observation missions and climate datasets.

Radiometers (devices that quantifies the power of electromagnetic radiation by converting light energy into a measurable physical or electronic signal) are usually supplied with a calibration certificate from the manufacturer that defines the instrument's response characteristics and associated uncertainties. However, with calibration drift, environmental influences, detector non-linearity, and systematic measurement biases can affect instrument performance over time. Independent validation of the manufacturer's calibration is important to establish measurement traceability, quantify uncertainty budgets, and ensure confidence in scientific observations.

By understanding how radiometers are calibrated, by planning and carrying out a testing campaign in comparison with a reference blackbody, the manufacturer's calibration can be validated. The student will examine the theoretical principles of thermal infrared radiometry, blackbody radiation, calibration traceability, and uncertainty analysis before designing and executing a comprehensive calibration campaign on a COTS radiometer.

An experimental campaign will be undertaken at RAL Space (Rutherford Appleton Laboratory, Harwell Campus, Didcot, Oxfordshire, OX11 0QX), during which the student will collect radiometric measurements across a range of controlled temperatures

representative of the instrument's operational environment. The data collected will be analysed to assess instrument accuracy, stability, repeatability, and calibration uncertainty. Statistical techniques will be applied to compare measured responses against both the reference blackbody and the manufacturer's calibration, identifying any offsets or temperature-dependent effects.

The project provides an opportunity to gain hands-on experience in instrument calibration, experimental design, uncertainty quantification, environmental sensing instrumentation, and scientific data analysis. The results will contribute to the validation of a key instrument supporting satellite sea surface temperature measurements and broader climate-monitoring activities.

Project Objectives

1. Review the scientific principles of thermal infrared radiometry and calibration, including blackbody radiation, traceability, and uncertainty estimation.
2. Design and implement a radiometer calibration campaign using a precision reference blackbody source.
3. Acquire and quality-control experimental calibration data across a representative temperature range.
4. Develop a data processing and analysis workflow to evaluate instrument performance, repeatability, and calibration stability.
5. Compare experimental results with manufacturer-provided calibration data, quantifying measurement differences and uncertainty contributions.
6. Assess the accuracy and suitability of the instrument for scientific applications, identifying potential sources of systematic error.
7. Share the project impact. Produce a technical report and presentation documenting methodology, results, uncertainty analysis, and recommendations for future calibration activities. Produce a blog and support public communication activities.

Candidate Profile

Degree courses accepted:

Aerospace Engineering

Space Engineering

Physics

Instrumentation and Control Engineering

Electronic Engineering

Mechanical Engineering

Earth Observation

Environmental Science with a strong quantitative component

Other closely related STEM disciplines

Essential:

- Technical and analytical skills
- Understanding of experimental methods and scientific measurement principles.
- Data processing skills such as Python (preferred), MATLAB or equivalent software
- Knowledge of statistics and uncertainty analysis.
- Research skills
- Effective written and verbal communication skills.
- Over 18 at the time of the project

Desirable:

- Interest in space instrumentation, Earth observation, remote sensing, or climate science.
- Experience with hands on laboratory work
- Experience with sensor calibration, environmental measurements, or thermal imaging systems.
- Familiarity with signal processing and measurement uncertainty assessment.
- Experience handling large experimental datasets.

Organisation Description

For more than sixty years, [RAL Space](#) has been a cornerstone of the UK's space ambitions and a driving force behind the scientific and technological breakthroughs that shape our world. Today, they continue to power discoveries that improve our future – advancing science, enabling innovation and strengthening the UK's position as a global space leader.

RAL Space occupies a unique position at the centre of the UK's space ecosystem — the place where science meets policy, innovation meets infrastructure, and national priorities meet global collaboration.

As an integral part of the [Science and Technology Facilities Council](#) (STFC), RAL Space is the space hub for [UK Research and Innovation](#), supporting its mission to advance knowledge, improve lives and drive growth.

This project is with the [Optical Systems Calibration and Validation Group](#), which aims to help satellite instrument developers deliver high-quality data that remains reliable throughout a mission lifetime. Most recently they worked on the calibration and commissioning of the [SLSTR](#) (Sea and Land Surface Temperature) instrument on Copernicus Sentinel 3 which launched from French Guiana on 15th September 2026.