

The logo for SatVu, featuring the word "SatVu" in a light blue, rounded sans-serif font. Each letter has a small orange circle at its top or bottom end, resembling a satellite or a data point. The logo is centered against a background of a blue and white Earth horizon seen from space, with a bright sun or star at the bottom center.

SatVu

Calibration and validation methodology for the SatVu HotSat-1 MWIR thermal imager

Commercial in Confidence

Introductions


Who am I?

- Temperature metrologist
- Calibration of radiation thermometers and thermal imagers in a laboratory
- Application of low uncertainty measurement using thermal imagers for customer environments

My [arXiv](#) and [ResearchGate](#) profiles

Traceable thermal imaging in harsh environments

by
Jamie Luke McMillan

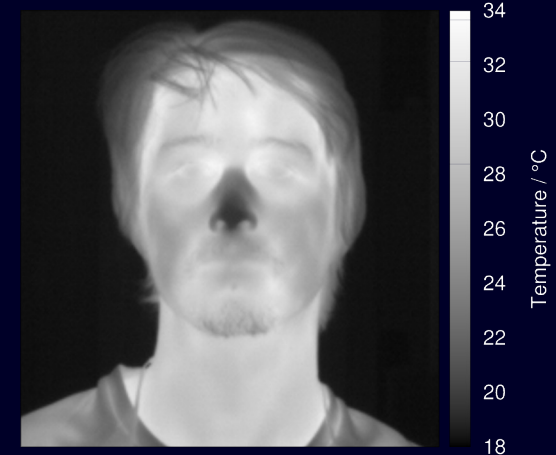


Submitted for the Degree of Doctor of Philosophy
Advanced Technology Institute and Department of Physics
Faculty of Engineering and Physical Sciences
University of Surrey

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February 2023

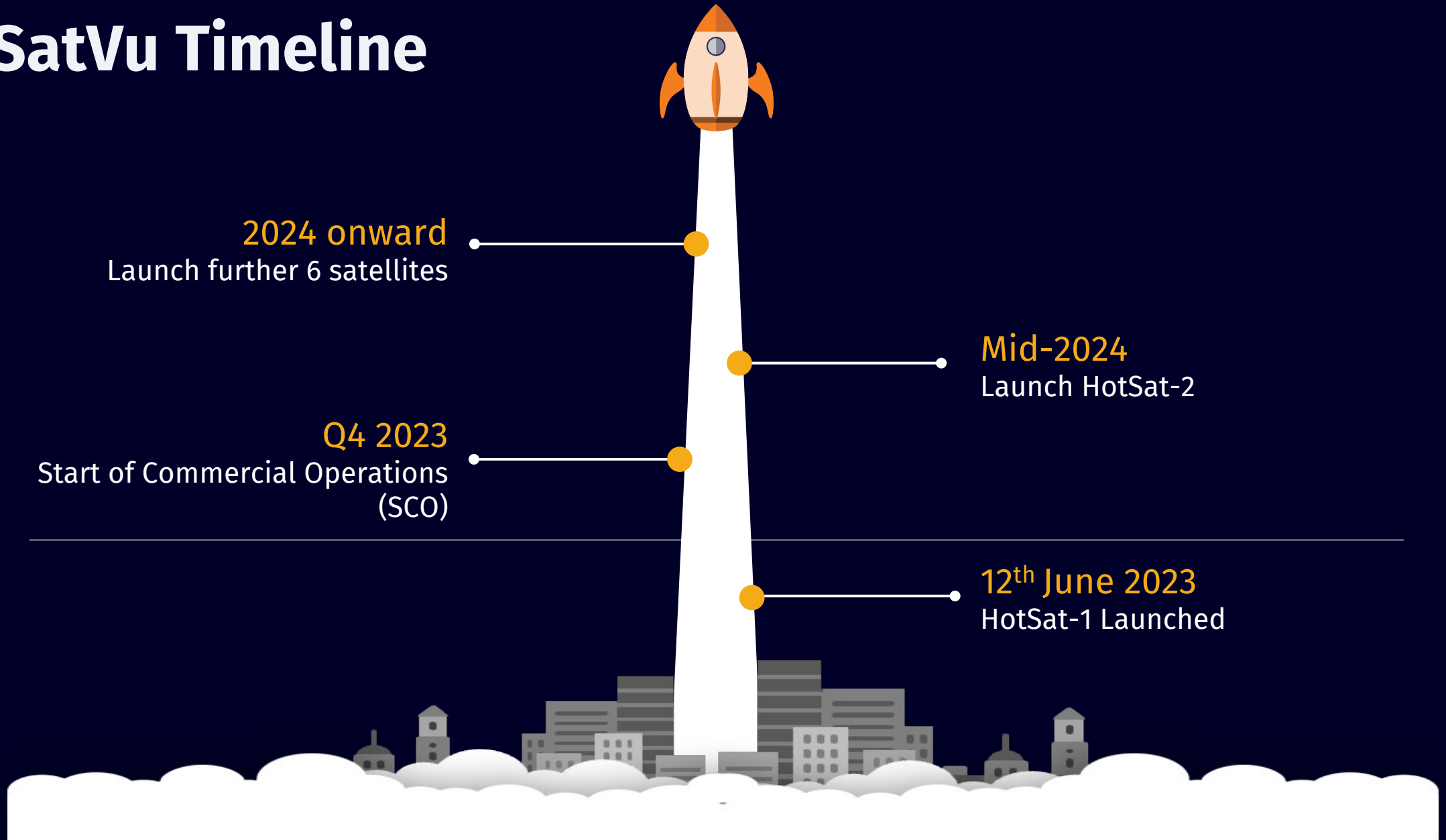
arXiv:2302.05198v1 [physics.ins-det] 10 Feb 2023



SatVu mission

Delivering transparency to global climate challenges with unique actionable insights from the highest resolution thermal data from space

SatVu Timeline



2024 onward
Launch further 6 satellites

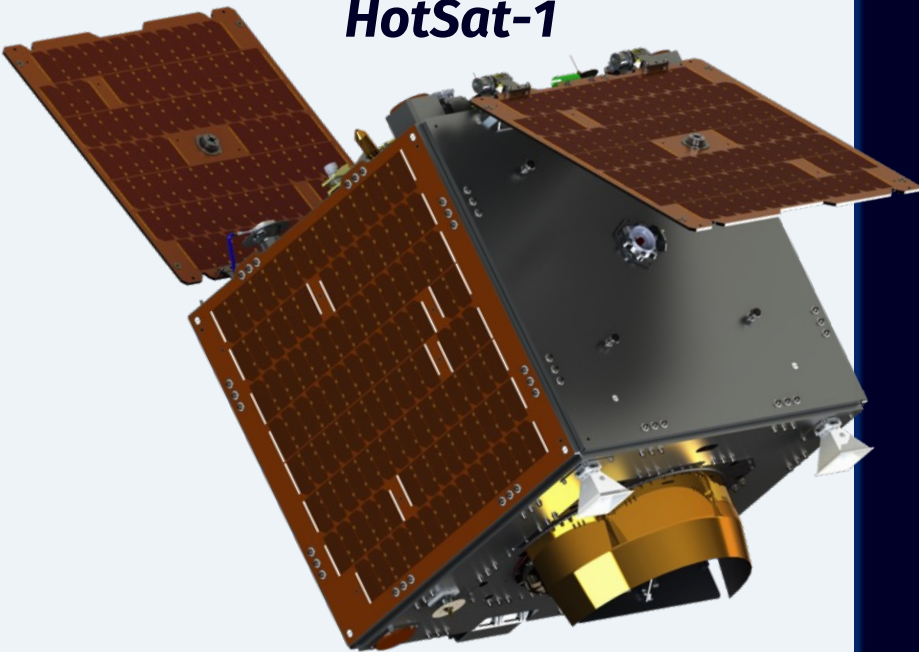
Mid-2024
Launch HotSat-2

Q4 2023
Start of Commercial Operations
(SCO)

12th June 2023
HotSat-1 Launched

HotSat specifications

HotSat-1



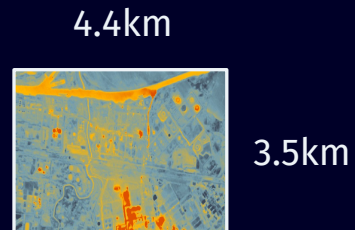
SPECIFICATIONS

Imaging type: MCT staring thermal imager
High resolution: 3.5m GSD (NADIR)
Single band: 3.7-5.0 μm
Video: up to 60 sec @ 25 frames/sec
Imaging time: Day & Night

CONSTELLATION

First launch completed: 12th June 2023
8 satellite constellation - 2 x polar orbit, 6 x mid-incline orbit
10 – 20 revisits/day over same target
Global coverage
Agile bus/camera
Fully tasked from web-based platform

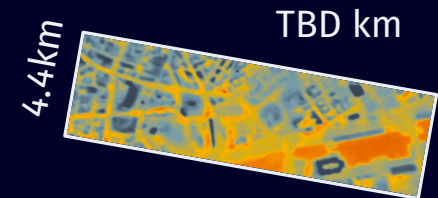
IMAGING MODES



Single Image



Video Mode



Strip Mode

HotSat Calibration and Validation

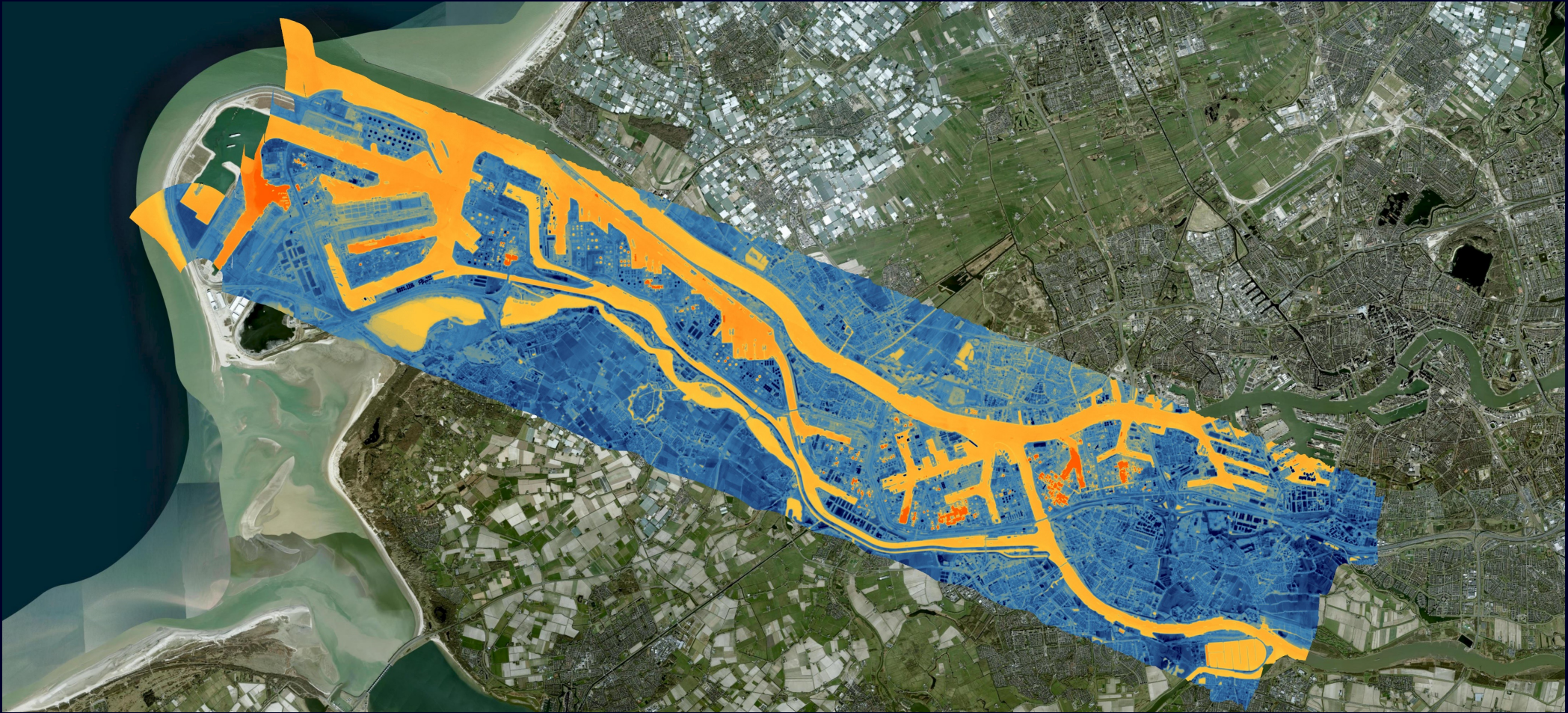
Guiding principles

Multiple sources of comparison

Confidence built over time

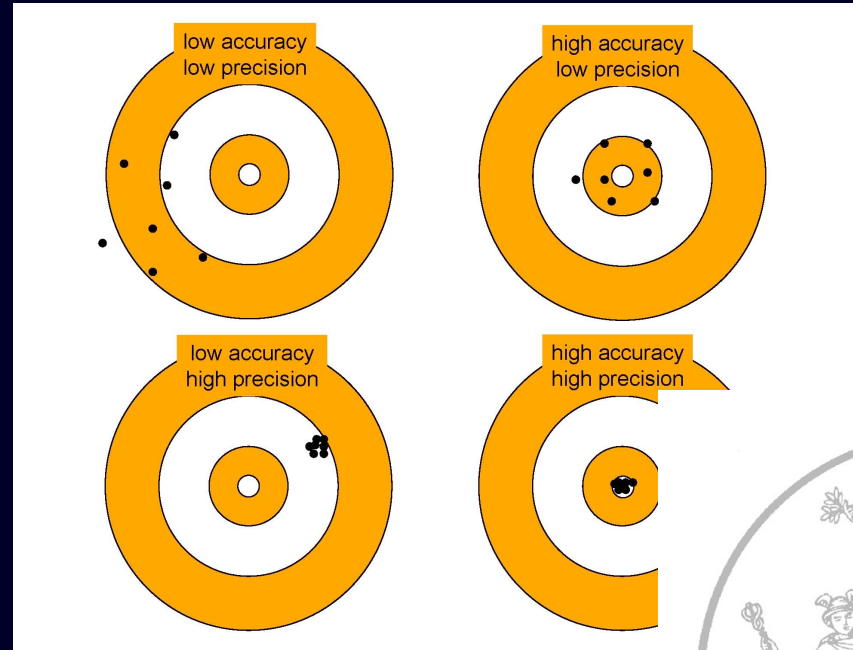
Defendable uncertainty budget

Towards TOA Brightness Temperature



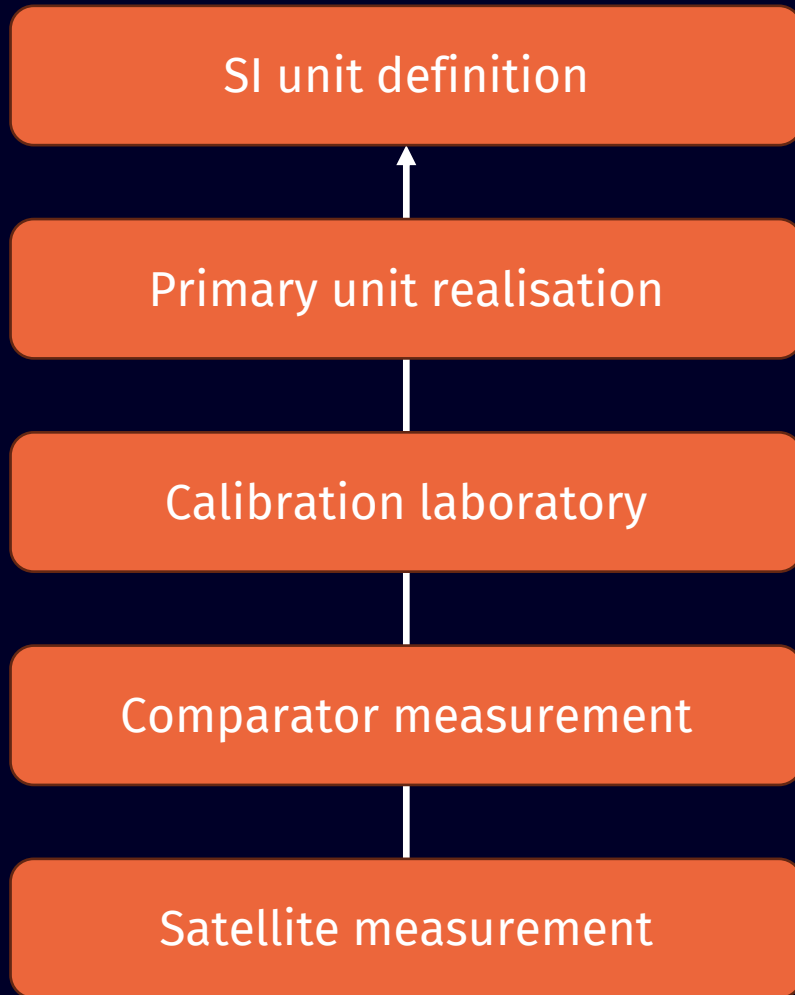
Uncertainty

- Each product image will be delivered with associated uncertainties
- To be described by a comprehensive uncertainty budget
- Reporting on covariance between uncertainty components?



*Uncertainty is an art form.
It represents the current perception of a system.*

Traceability



NIST

NPL 

National Physical Laboratory

Measurement Comparisons



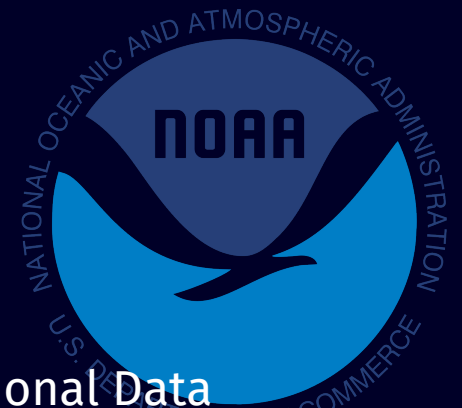
Orbit to Earth



Lake Tahoe

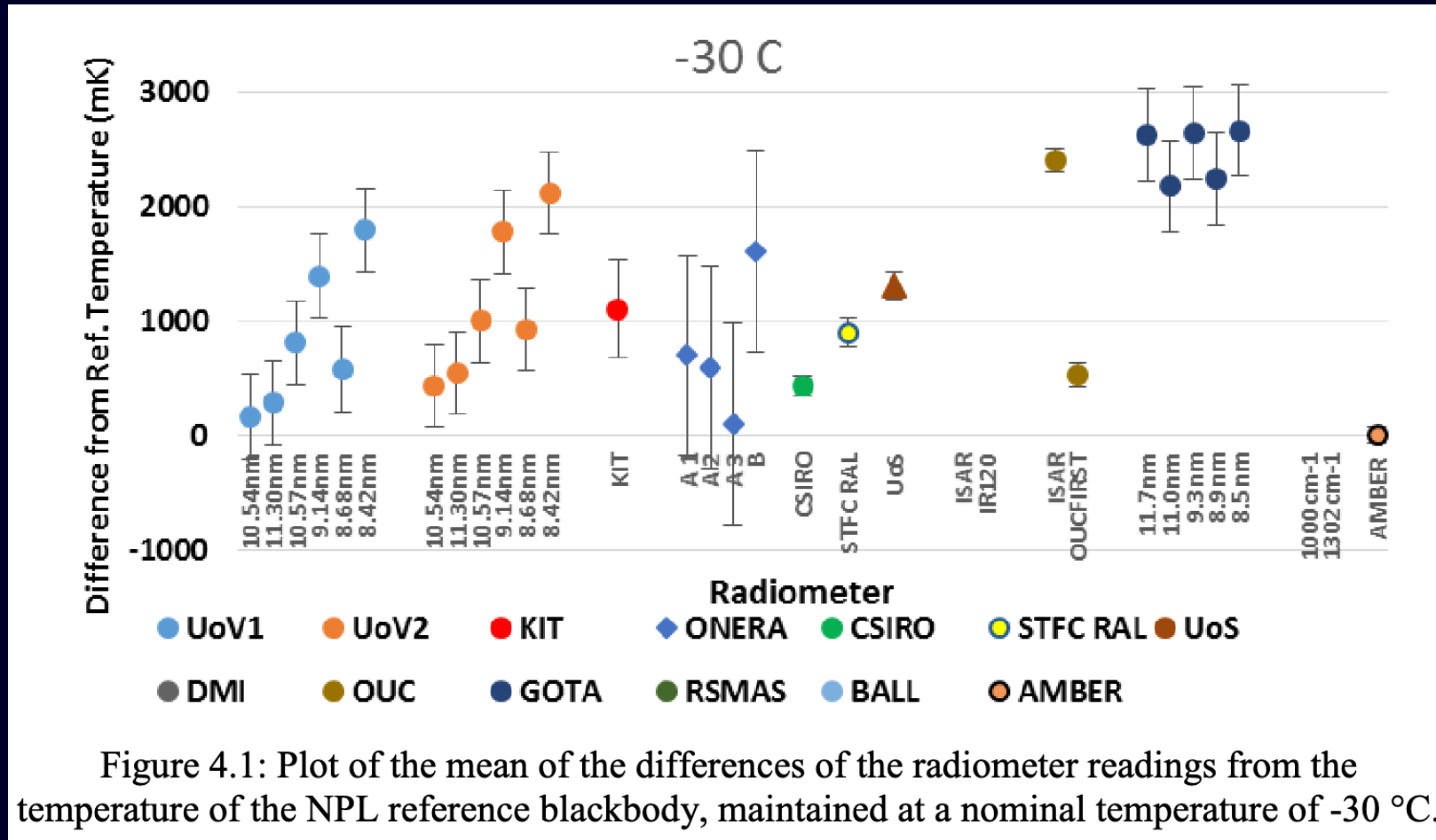


Orbit to Orbit



National Data
Buoy Center

On-going comparison monitoring



Source: [FRM4STS D100-2, 2017](#)

Community requirements

- Equivalent facilities for high spatial resolution medium wave infrared (e.g. PICS, RadCalNet, HYPERNETS)
- CEOS-ARD requirements are not achievable
 - Is there some gradation (e.g. maturity matrix) to this?

A detailed illustration of a satellite in orbit above the Earth. The satellite is a rectangular box with a silver body and four large, gold-colored solar panel arrays extending from its sides. A prominent gold-colored cylindrical antenna or sensor is mounted on the front. The Earth is shown as a curved horizon with a blue atmosphere and a bright sun or light source at the bottom center, creating a lens flare effect. The background is a dark space filled with stars and a faint, golden, abstract pattern resembling a constellation or data trail.

SatVu