

TRUTHS PAYLOAD, THE HYPERSPECTRAL IMAGER TRACEABLE IN FLIGHT TO SI STANDARDS: STATUS AT PDR AND PROJECT CANCELLATION

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ABSTRACT

TRUTHS (Traceable Radiometry Underpinning Terrestrial- and Helio- Studies) was planned to be a hyperspectral climate mission which, with the support of an innovative on-board calibration system traceable to international standards, would have enhanced our understanding of the Earth's changing radiation budget by an order of magnitude, targeting an Absolute Radiometric Accuracy of 0.3% ($k = 2$). TRUTHS would have been an "SI-traceable metrology laboratory" in space for cross calibration of other satellites, also providing SI-traceable measurements of the Solar Spectrum.

The biggest funding source was the UK, along with participation from other Countries such as Switzerland, Spain, Czech Republic, Greece, Romania. However, at the end of 2025 the UK withdrew funding, resulting in the suspension of development after successful PDR.

This paper summarizes the challenging payload development, led by Airbus UK, focusing on the achievements of the three instruments forming the payload, namely the Hyperspectral Imager (HIS), capable of high spatial and spectral resolution covering a large part of the sun spectrum with a single focal plane, the Cryogenic Solar Absolute Radiometer (CSAR), capable of performing Total Solar Irradiance (TSI) measurements and spectral optical measurements to provide SI traceability to HIS measurements via three high precision temperature-controlled cavities traceable to the SI standards, and the On-Board Calibration System (OBCS), a complex system formed by a spectrometer, relays and cavities – all parts reached TRL6. The complex calibration sequence and the achieved performances, in particular for the Absolute Radiometric Accuracy, are also presented, together with lessons learnt and criticalities acknowledged during the developments.

Keywords: Calibration, Remote Sensing, Hyperspectral, Radiometer

1. INTRODUCTION AND MISSION SUMMARY

TRUTHS ("*Traceable Radiometry Underpinning Terrestrial- and Helio- Studies*") was primarily an operational climate mission, aiming to enhance by an order-of-magnitude our ability to estimate the Earth radiation budget through direct measurements and to establish a 'metrology laboratory in space' to create a fiducial, SI-traceable (International System of Units) reference data set of spectral Earth radiance, Sun irradiance and Lunar irradiance to cross-calibrate other sensors and improve the quality of their data.

The main objective was to establish a reference baseline measurement (benchmark) of the state of the planet, against which future observations can be compared to a) allow climate model improvements and forecast testing, and b) provide observational evidence of climate change including mitigation strategies in the shortest time possible.

To this end, TRUTHS was planned to primarily measure the incoming & outgoing energy from the Earth system, including the spectral fingerprint needed to observationally attribute climate processes, with an accuracy needed to detect climate trends in the shortest possible time.

TRUTHS was designed as an agile satellite carrying a Hyperspectral Imaging Spectrometer (HIS) measuring continuously calibrated solar and lunar irradiance and top-of-atmosphere Earth-reflected radiance from 320 to 2400 nm. A Cryogenic Solar Absolute Radiometer (CSAR) and innovative On-Board Calibration System (OBCS) would enable radiometric accuracy up to ten times better than other missions. The payload design provides a 100 km swath, with products at 100 m over land and coasts, 200 m over oceans, and 50 m for selected sensor cross-calibration and PICS observations.

The payload and orbit were optimised for climate-quality radiometry and cross-calibration. TRUTHS was designed to fly on VEGA-C into a ~604 km polar, non-sun-synchronous orbit. Its drifting local time samples the full diurnal cycle over a 61-day revisit, creating frequent matchups with GEO and LEO sensors while supporting global nadir Earth observations.

The core TRUTHS products are:

- Level 1 Earth-reflected spectral radiance for climate applications (320–2400 nm).
- Level 1 solar and lunar spectral irradiance (320–2400 nm).
- Level 1 total solar irradiance (0.2–30 μm , integrated).
- Inter-calibration matchup products for flagship sensors, including Sentinel-2 and Sentinel-3 NG0.
- Bidirectional reflectance distribution function (BRDF) characterisation of reference Pseudo-Invariant Calibration Sites (PICS).
- Level 2 spectral surface reflectance (320–2400 nm).

TRUTHS required extensive system and performance simulations to validate products and prototype algorithms. An End-to-End Metrology Simulator (E2EMS) was planned to trace observation uncertainties using rigorous methods such as FIDUCEO (Fidelity and uncertainty in climate data records from Earth Observations).

During daylight, HIS observes Earth. At least daily, the spacecraft views the Sun for HIS solar spectral irradiance and CSAR total solar irradiance measurements; lunar irradiance is measured several times per month. Sun views also support HIS calibration through the SPC and DISA. Calibration activities are scheduled to preserve priority for routine Earth-reflected solar radiance observations.

2. HISTORY OF FUNDING AND DEVELOPMENTS, LEGACY OF THE TRUTHS PROJECT

In 2019, the current TRUTHS mission was proposed by UK Space Agency to ESA for implementation as an element of the Earth Watch programme, i.e. as a multi-partner operational mission, with major contribution and Industrial Prime Contractor from UK, and the scientific support led by NPL. Phase A/B1 was kicked off in October 2020. In parallel to the technological pre-developments and the definition of the mission, ESA supported a User Requirements Study to establish operational climate user requirements. The TMAC (“*TRUTHS Mission Accompanying Consolidation*”) Study had the goal to study performance and calibration analyses, algorithms for level 2 products, metrology and cross-calibration performance modules and reference scenes. The science readiness was demonstrated at the end of Phase B1 (June 2022). At the Ministerial Council Meeting 2022 (C-MIN 22), TRUTHS was subscribed mainly by UK, with Switzerland, Czech Republic, Spain, Greece and Romania as participating states, permitting to kick off Phase B2 of the Space Segment in November 2023, with primary objective to derisk the Payload development by bringing critical technologies to TRL-6. A successful SRR was held in April 24, and the PDR part-I (focussing on the Payload developments, system performance and overall mission) was successfully held in July/August 2025.

In September 2025, while the TRUTHS team was completing Phase B2 and getting ready for the next steps of the implementation, ESA was informed of the decision of the main supporting country - UK - to no longer fund the program. Accordingly, all the ESA member states who had supported TRUTHS decided for the discontinuation of the programme, however not without completing all designs, technology developments and science activities already committed for the ongoing study phase.

This has permitted in the course of 2025 up to early 2026:

- to complete the preliminary design of the satellite and of the payload and the system concept design of the Ground Segment with its complete driving requirements,
- to demonstrate that the key (challenging) performance of the payload can be met,
- to demonstrate the achievement of the TRL-6 (Technology Readiness Level) of all critical functions of the payload,

- to complete the science studies and the use cases for the benefit of TRUTHS in improving different data systems and enhancing applications.

The legacy of TRUTHS is therefore solidly funded on demonstrated results and a solid science case, a set of building blocks for any future mission concept evolving from TRUTHS, as could be a Radiometric Referencing Calibration mission, anchoring the data of institutional or commercial satellites to a SI-traceable common reference.

3. TRUTHS PAYLOAD DEVELOPMENT AT PDR

The main Instrument of TRUTHS Payload is the Hyperspectral Imaging Spectrometer (HIS), with continuous spectral sampling extending across the UV-VIS-SWIR (320 nm to 2400 nm) and ≤ 50 m Ground Sampling Distance (GSD) (native, un-binned). The disruptive innovation stems from incorporating a space-adapted primary SI-standard (Cryogenic Solar Absolute Radiometer - CSAR) operated at 67 K by means of an active cryo-cooler and its use with a novel On-Board Calibration System (OBCS), which provides the spectral and radiative references over the spectral range to “anchor” the observed radiance samples and univocally calibrate the Earth, Sun and Moon observations. This process mimics those used terrestrially at National Metrology Institutes (NMIs), allowing TRUTHS to provide hyperspectral data immune from the effect of drift or biases for the lifetime of the mission. This enables, for example, globally-sampled, spectrally-resolved radiances of the Earth at a maximal 50 m Spatial Sampling Distance (SSD) with the goal of an Absolute Radiometric Accuracy of 0.3 % (2σ), an order of magnitude improvement when compared to other existing or planned EO missions.

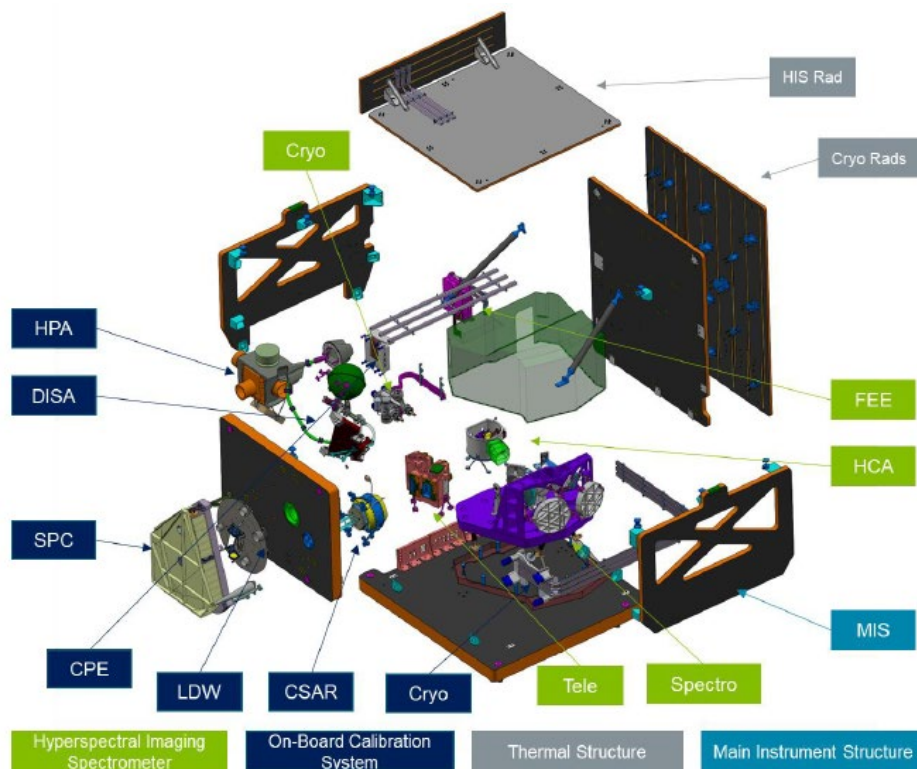


Figure 1. TRUTHS Payload (at PDR) exploded view.

The Phase B2 TRL6 programme established a disciplined maturity framework for the critical payload technologies needed to secure PDR Part I and reduce development risk before flight-model manufacture. Critical functions and relevant environments were defined and agreed between Prime and ESA, representative form-fit-function models were defined, and evidence was structured against the ESA TRL standards (evaluated with an internal “ESA calculator”). The resulting work converted key mission concepts into breadboards, engineering models, test plans, environmental campaigns and performance evidence across the SI-traceable calibration chain, the hyperspectral detection chain, payload electronics and calibration mechanisms.

3.1 Hyperspectral Imaging Spectrometer (HIS) and Front-End Electronics

The HIS optics is composed of a 4-mirror anastigmat telescope, designed to be telecentric at the slit plane, with a 70 mm Entrance Pupil Diameter and 9° across track Field of View (FoV), a slit assembly, a quartz dual-Babinet polarisation scrambler and a dual-Fery prisms Offner Spectrometer (Figure 2).

The HIS instrument has a single Focal Plane equipped with a MCT (Mercurium Cadmium Telluride) 2k x 1k pixels matrix detector and dedicated Anti-Reflection Coating (ARC) (pre-developed in Phase B1), providing high electro-optic efficiency in the whole spectral range (320 to 2400 nm). The MCT matrix detector relies on the same technology of the Chroma-D detectors family used for instance in CHIME, it is hybridized (Chip + Read-Out Integrated Circuit) in US and then packaged and tested at Teledyne-E2V (UK). The device operates at 150K, it is kept in a dedicated cryostat equipped with a quartz window and is cooled by means of a cryocooler system and dedicated radiators (Figures 2 & 3).

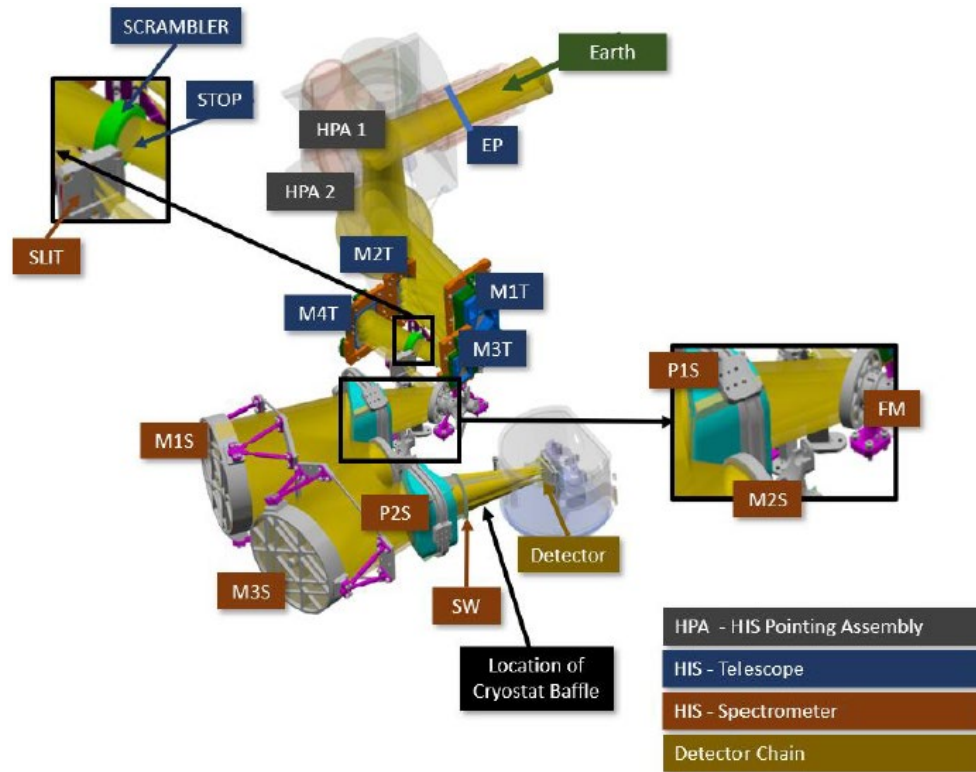


Figure 2. Optical layout of TRUTHS HIS.

A specific wide-band mirror coating (High Reflective Coating - HRC) was subject of a technology predevelopment in Phase A/B1, with good results in terms of reflectivity across the wide spectral range. Breadboarding activities have been conducted in Phase B2 for the key HIS optical elements: the spectrometer prisms, the polarization scrambler, a freeform coated mirror. In addition, an activity aimed at building a simpler version of the HIS telescope + spectrometer has been established, to reduce the risks of the future AIT process, by learning from the manufacturing and alignment (the AIT “Risk Reduction Model”, RRM).

Achievements in optics, hyperspectral detection and processing chain post-PDR

Optical technologies

The scrambler and anti-reflective coating activities focused on supplier capability and TRUTHS-specific performance. Scrambler’s space heritage reduced the underlying TRL risk, while Phase B2 manufacturing and test work addressed adhesive suitability, depolarisation, transmitted wavefront error and spatial uniformity. A customized coating, alternative to the baseline MgF2 anti-reflective coating that was considered already space-qualified, was explored in order to improve transmission and polarisation performance through optical, physical, environmental, radiation and solar-exposure testing.

HIS detector

At the end of Phase B2 the HIS detector was assessed to be at TRL6. Two representative breadboard detectors completed successfully mechanical testing (shock, sine and random vibration), followed by electro-optical verification, geometrical inspection and destructive physical analysis. Three devices of the TRUTHS package design completed thermal cycling campaign (130 K - 323 K) without reported major issues and performance degradation. Electro-optical testing covered offset stability, gain stability, non-linearity, quantum efficiency and spatially modulated response at the representative 150 K operating condition (Figure 3).

Front End Electronics (FEE) and Payload Processing Unit (PPU)

The FEE breadboard established the representative detector-interface and thermal-chamber test configuration. Electrical interface tests at 15 °C and 25 °C were completed with expected results. The remaining campaign addressed power sequencing, short- and long-term supply stability, data transmission and latch-up protection. For the PPU, breadboard testing demonstrated successful operation of selected receive and transmit channels, measured interface bit-error performance and prepared proof-of-concept testing for binning, pixel correction and compression. These developments materially reduced interface and data-chain risk.

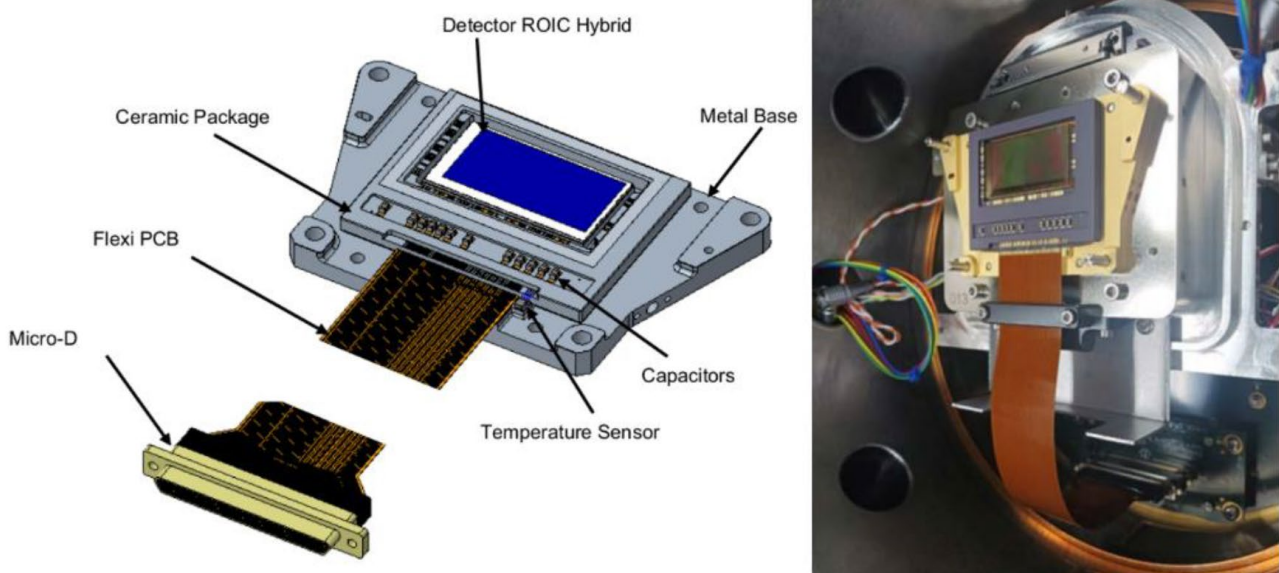


Figure 3. HIS detector: design of the detector package (left) and a prototype detector manufactured in Phase B2 (right, credit Teledyne e2V).

3.2 Cryogenic Solar Absolute Radiometer (CSAR)

The heart of the calibration system is the primary standard, called the Cryogenic Solar Absolute Radiometer (CSAR). The CSAR is a flight version of the primary standard cryogenic radiometers, adopted by most NMIs worldwide. The cryogenic radiometer is an extension of the Electrical Substitution Radiometer concept, cooled to 67 K thus reducing uncertainty levels to $<0.01\%$ (2σ). In addition to serving as a primary standard for power measurements on-board TRUTHS, the CSAR was designed to also provide independent science measurements of TSI with an accuracy of 0.02% (2σ).

The underpinning principle behind CSAR is that the only optical interface that is subject to potential change is a black cavity. Whilst the carbon nanotube black coating (S-VIS, ©Surrey Nanosystems) is inherently insensitive to change, particularly in the cavity configuration, TRUTHS has 3 cavities for redundancy, each of them equipped with a shutter.

The operation works with a dual (or compensating) cavity concept (Figure 4). The cavities are mounted to the reference block and the measurement cavity is complemented with a compensating cavity. The compensating cavity is electrically heated with a constant power P_0 and the measuring cavity is electrically heated (shutter closed) with power P_0' (nominally equal to P_0) such that the differential signal is zero. Once the system is stable, the shutter is opened, and the heating power of the measuring cavity is decreased such that the differential signal remains zero and the final power P_1 is reached. Then the incoming optical power is calculated as $P_0' - P_1$. The reference block is designed to maintain the cryogenic temperature stable at the CSAR cavity interfaces and is connected to the cryocooler head with a thermal strap.

Achievements in CSAR post-PDR

The CSAR breadboarding has been conducted in Phase B2, including the reference block, two coated cavities and the dedicated electronics (Figure 4). The CSAR development demonstrated substantial maturity of the mission's primary radiometric standard. The cavity manufacturing and assembly process was improved by introducing acoustic cleaning with respect to previous manufacturing attempts. The reported breadboard evidence showed no structural damage after thermal cycling. All the testing results strengthened confidence in the cavity, shutter and control concepts required for Total Solar Irradiance and on-board calibration measurements. In particular, cavity absorptivity measurements, shunt-resistor stability assessments and system performance analyses supported the radiometric error budget. TSI performance and Continuous Acquisition Mode (CAM) performance [1] – the most novel and critical performance operation-related aspect – were assessed as compliant.

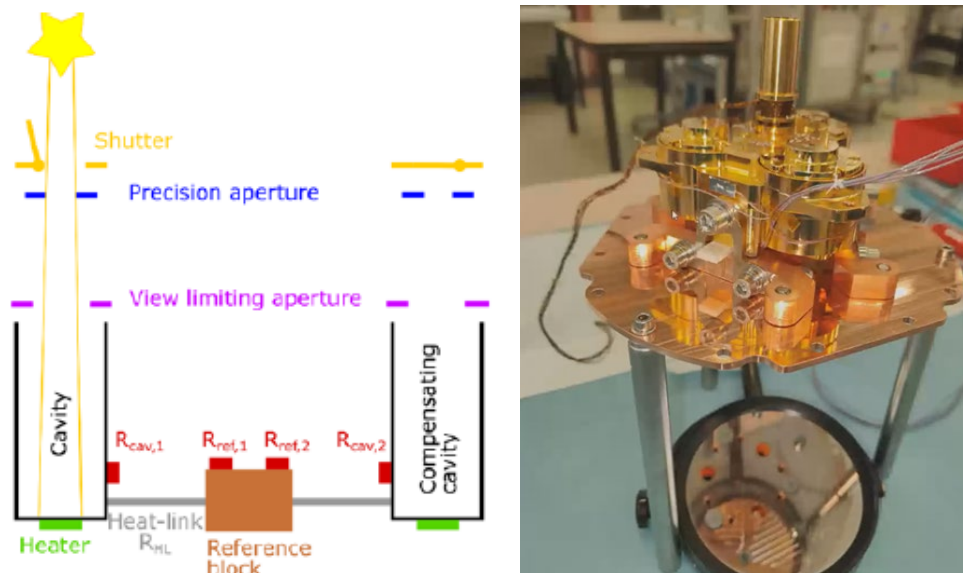


Figure 4. CSAR: compensating cavities principle (left) and CSAR breadboard model with reference block, a cavity and electronics (right, credit TAS-CH & PMOD)

3.3 On-Board Calibration System (OBCS)

Central to TRUTHS philosophy is the calibration system, which puts SI traceability into orbit. The calibration system mimics the steps used by National Metrology Institutes (NMIs) to transfer calibration traceability from the SI defining power measurement (the cryogenic radiometer) to a full spectrally resolved radiance calibration of an instrument (the Hyperspectral Imaging Spectrometer). This transfer is optimised using the solar radiation itself, spectrally separated on board by a dedicated monochromator.

The OBCS, permitting the HIS calibration for the Earth radiance, the Sun and Moon irradiance and the SSI measurements traceable to the CSAR, consists of:

- a Solar Power-Chromator (SPC),
- a Double Integrating Sphere Assembly (DISA),
- a Light Distribution Wheel (LDW),
- a HIS Pointing Assembly (HPA).

The layout of the OBCS and its main components are shown in Figure 1. The subsystems forming the OBCS are all supported by the Calibration Support Bench (CSB), which holds the SPC and LDW on the outer part, and the DISA and HPA (and the CSAR) on the inner part, facing the HIS.

The DISA configuration was subject of evolutions in order to optimise its performance in the SI-traceable calibration chain, in particular regarding aging of the components and sufficient radiance collection in the different operating modes of the instrument within the HIS calibration sequence. The configuration post-PDR sees the DISA composed of one integrating sphere, i.e. the Calibration Integrating Sphere (CIS), and the HIS Source Converter (HSC) which receives light from CIS and directly from the sun via a mechanism-driven rotating light pipe. The HSC consists of a multi-lens array, a rotating light pipe, a fixed light pipe and a fibre bundle (Figure 5).

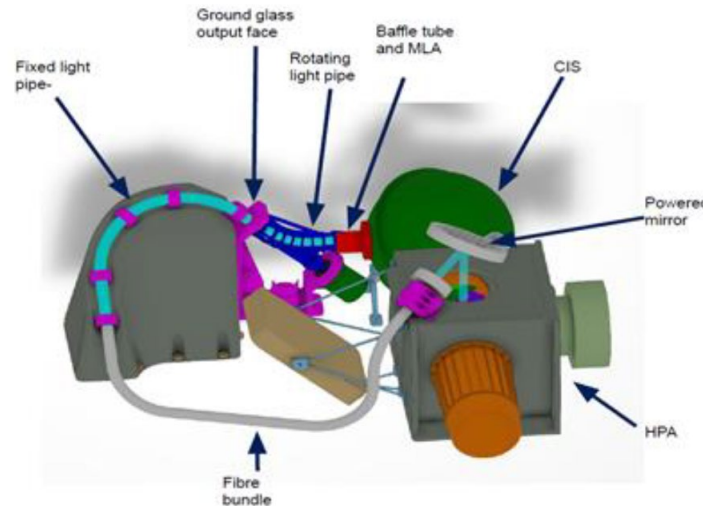


Figure 5: DISA layout post-PDR.

The SPC, at its post-PDR concept, is composed of 3 powered mirrors, 3 prisms, 2 folding mirrors, a field and an aperture stop, and a sun homogenizer. The wavelength scanning is performed by rotating a flat scanning mirror by means of a Wavelength Scan Mechanism (WSM). The rotation of the flat mirror can be performed in either continuous or step-and-stare scans, the former being the favorite option from operations point of view (hence the CAM operation of the CSAR). The design was planned to be further upgraded, taking into consideration the performance analyses made during PDR and the performance tests done with the breadboard (Figure 6).

The Light Distribution Wheel (LDW) distributes sunlight and light output from the SPC into different calibration subsystems (Figure 6). The wheel is made of a machined aluminum, and its main function is to support the mirrors, to accommodate the precision apertures and the doped filter (for in-orbit spectral calibration). The wheel is actuated by a high-heritage Light Distribution Mechanism (LDM). The currently adopted actuator, with flight heritage, is the DTA 10, and consists of a stepper motor, harmonic drive, bearing assembly and potentiometer.

The LDW Relay Optics (LRO) transports the SPC optical beam to the calibration subsystems (the DISA and the CSAR). The design is made of 2 conic mirrors and 2 folding mirrors. Precision apertures (for irradiance-to-power conversion) are also located on the wheel to allow direct sunlight input into the two DISA spheres and into the CSAR.

The rare-Earth-doped glass filter generates wavelength absorption references over the whole spectral range of TRUTHS and permits to enhance the spectral calibration capabilities on top of the detection of the solar Fraunhofer lines (mostly efficient in the 320-800 nm wavelength range).

The HPA, considered as the optical front-end of the HIS, distributes light from different sources (Earth, CIS and HSC) and directs it towards the HIS: light is directed to the HIS by means of a rotating HIS Pointing Mechanism (HPM) that uses a steerable folding mirror to be rotated depending on the light source to be directed to the HIS. Eventually, a fourth position is added to “close” the HIS.

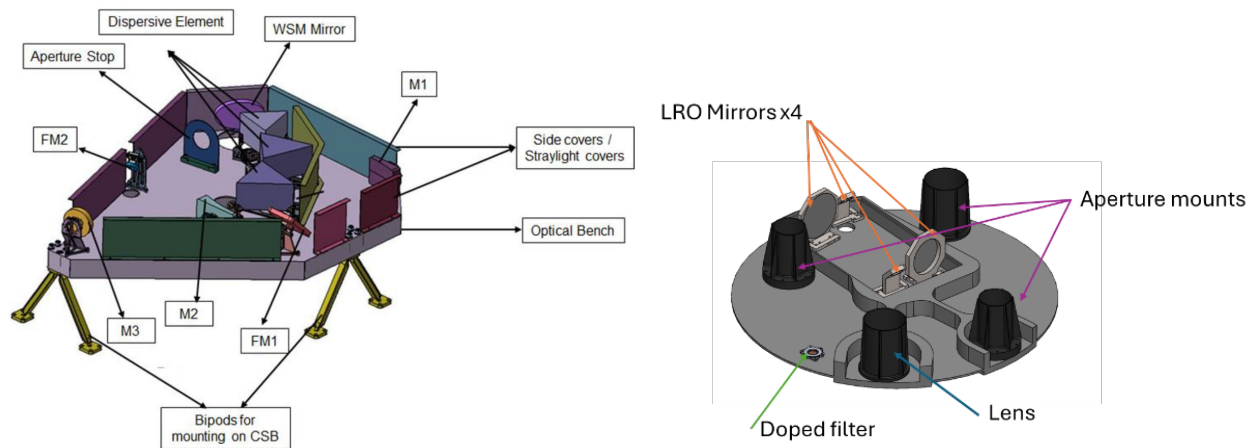


Figure 6. SPC opto/mechanical design (left); LDW layout (right).

Achievements in the SI-traceable calibration chain

The DISA breadboard (Figure 7) verified important elements of the calibration-transfer concept. Gain-degradation equivalence between different observation modes was confirmed within the reported measurement uncertainty, and the optical transfer efficiency and sensitivity to source-angle variation were characterised. The work also identified ultraviolet diffuser degradation as a specific design issue, which would imply further testing and possible mitigation measures, were the Project to be continued.

Overall, though, the DISA analysis was compatible with payload performance requirements, with specific mechanical confidence tests to be added for future developments.

For the SPC, the wavelength-scan mechanism's TRL6 basis was established through heritage from another ESA mission, while a reduced dispersive-element breadboard was built to verify spectral response, output power, out-of-band transmission and straylight through test-to-model correlation (Figure 7).

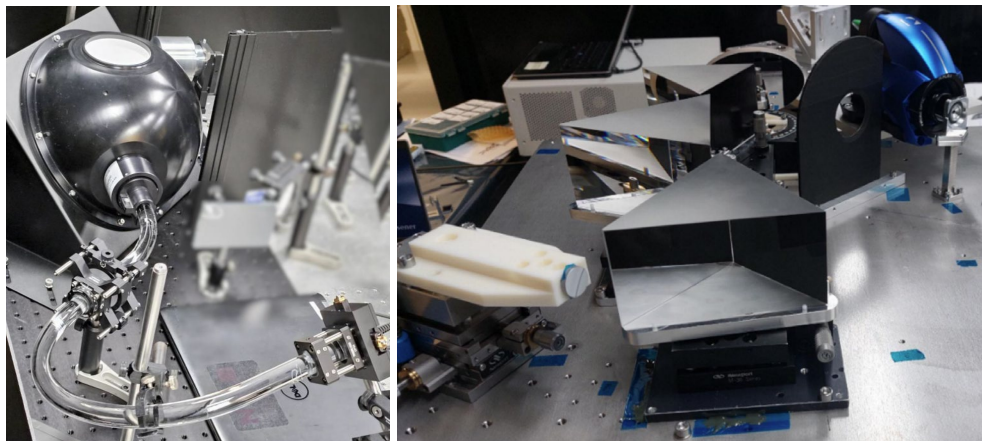


Figure 7. DISA breadboard (left, credit Airbus DS); SPC breadboard (right, credit Sener).

The HPA maturity strategy used read across from the LDW because the pointing mechanism was based on the same mechanism and it had similar or less demanding requirements. This avoided duplicate testing while maintaining representative evidence.

The LDW breadboard incorporated representative structure and mechanism hardware, with the campaign defined to demonstrate repeatability, stability and vibration robustness (Figure 8).

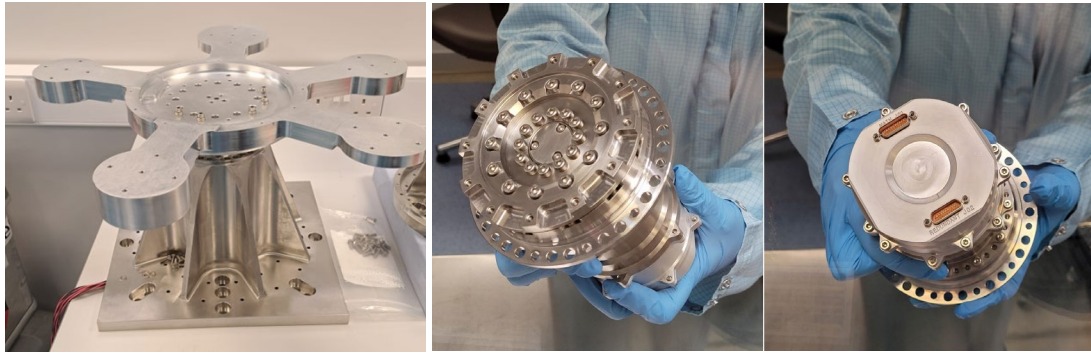


Figure 8. LDW rotation wheel breadboard (left); LDW DTA10 actuator (right). Credit AVS UK.

3.4. Overall significance

Taken together, the Phase B2 activities provided a coherent evidence base for the TRUTHS payload architecture: an SI-traceable CSAR primary standard, an on-board calibration transfer chain, a mechanically robust and characterised hyperspectral detector and representative electronics and mechanisms.

The strongest – and most complicated – completed achievements at the end of the PDR were the HIS detector and the CSAR campaigns. The other subsystems generated substantial design, breadboard and test evidence to support either a full TRL6 achievement in terms of ad-hoc hardware development or maturity of the same development by the selected subcontracting companies. The conclusion at PDR is a major risk retirement and a credible route to the preparation of the PFM activities.

4. ON-BOARD CALIBRATION CONCEPT

Using the CSAR and the aforementioned on-board calibration system it is possible to calibrate the HIS with SI standards, by using the FIDUCEO approach (FIDUCEO stems for “Fidelity and Uncertainty in Climate data records from Earth Observations”). This activity aims at creating EO climate datasets with rigorous treatment of uncertainties informed by the discipline of metrology. The effects caused by each uncertainty are interconnected, considering sensitivity coefficients to propagate the uncertainties and the correlation structure over spatial, spectral and temporal scales.

TRUTHS was designed to split the operational time in various sequences (“observation modes”, called MT below), for Earth/Sun/Moon observations and for the different calibration steps (see [1] for more details).

The modes can be summarized as (Figure 9 & 10):

- Earth imaging (MT1).
- Sun measurements TSI (MT2) and SSI (MT3). In detail, the sun power collected by the LDW Precision Aperture is converted into radiance by the CIS, that is then measured by the HIS, providing the Sun spectrum. The SSI is determined from the measured radiance based on the accurate calibration of the CIS, the HIS and the LDW Precision Aperture area.
- HIS and CIS calibration (MT4,5,6,7,11). In detail, the MT6 and MT7 measurements calibrate the HIS while the MT4 and MT5 measurements calibrate the Calibration Integrating Sphere (CIS). The MT11 measurement is used for the in-orbit spectral calibration of the HIS. A doped filter with calibrated absorption bands is introduced on the sun light path. The processing of the acquired spectrum mixed with Fraunhofer lines and doped filter bands provides the required spectral calibration.
- Lunar measurement LSI (MT10).

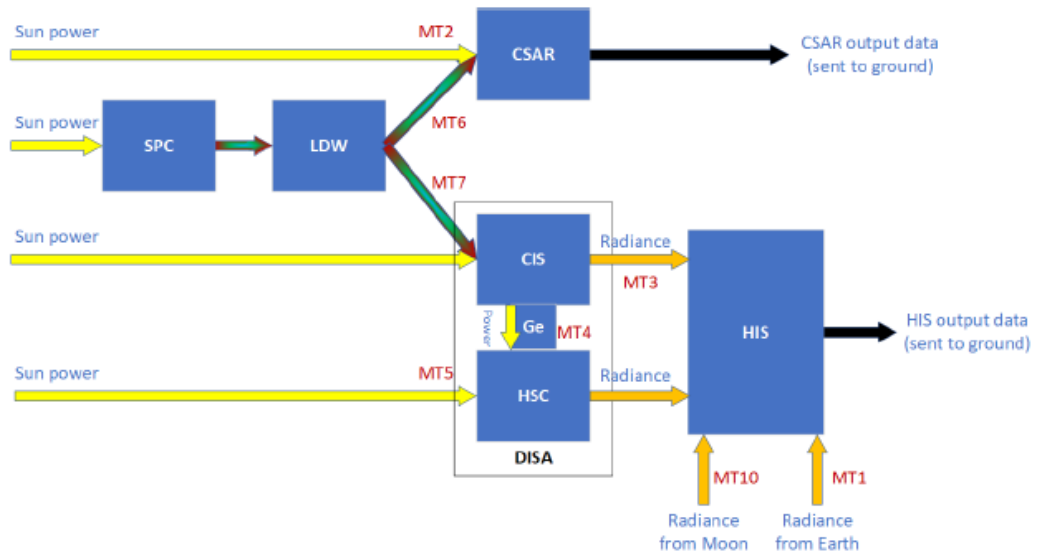


Figure 9. Light paths in the mentioned configurations.

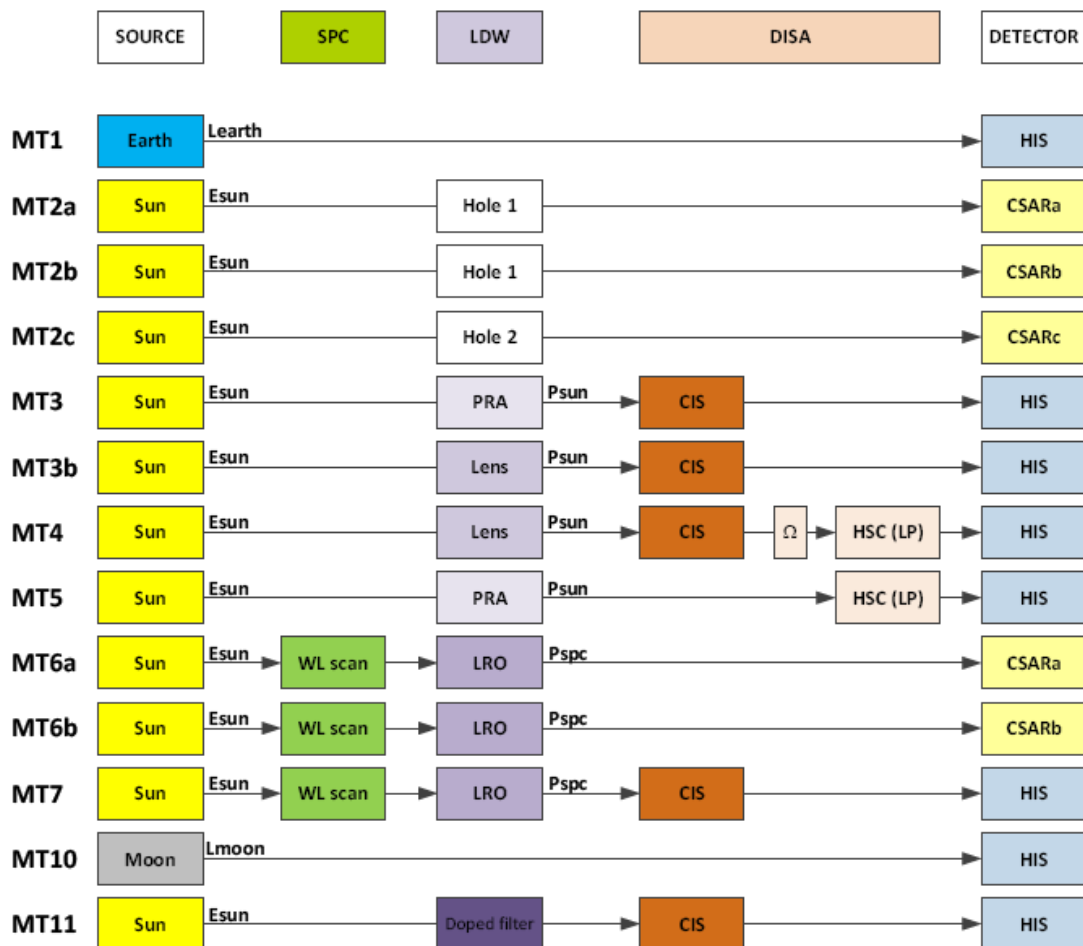


Figure 10. TRUTHS measurement configurations (MTs).

5. RADIOMETRIC PERFORMANCE AT PDR: ARA AND SNR

The Absolute Radiometric Accuracy requirement is the key performance metric for TRUTHS. The requirement reads: “*The Absolute Radiometric Requirement for both Earth Spectral Radiance and Solar / Lunar Spectral Irradiance measurement shall be better than 0.3% (Goal) / 1% (Threshold), traceable to International Standards, over the whole spectral range and with $k = 2$ coverage factor*”. The requirement is valid for homogeneous scenes at a defined Reference Radiance.

The budgeting of this performance parameter is quite challenging, as it involves all parts of the Payload and their uncertainty control. Currently, the budget has more than 100 contributors to uncertainty, each one with its weight to the overall calculation. The evolution of ARA budgeting was the most important performance analysis carried on in the past months to guarantee an overall ARA budget appropriate for the needs of the mission. The analysis was continuously fed back with the updates of the corresponding hardware analysis and tests, in particular about DISA.

The major sources of uncertainty are (Figure 11):

- MT1 measurement error – dominated by straylight (brown lines).
- HIS gain error – dominated by inter-MT variations and errors, for instance gain changes between MTs between on-ground and end-of-life.
- MT6 measurement errors – dominated by CSAR power measurement error.
- MT7 measurement errors – dominated by uncertainty and change of spectral barycentres.
- HIS Gain retrieval error – dominated by algorithm error due to thermal background and straylight (light blue lines)
- MT4/5 measurement error – dominated by change in conversion factors and thermal background.

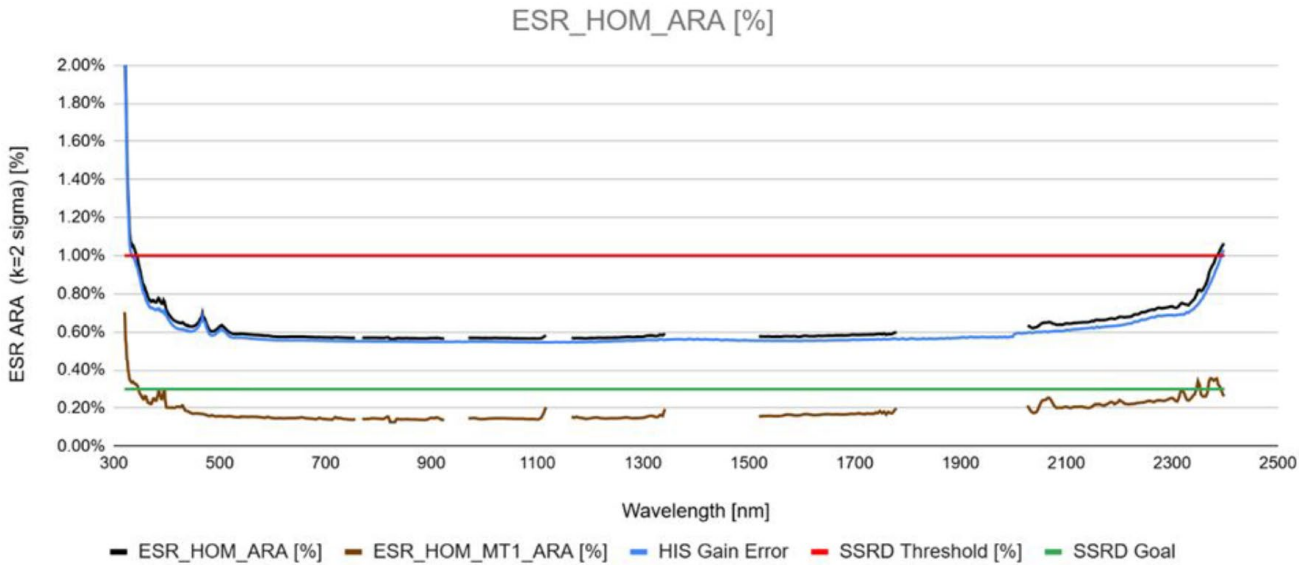


Figure 11. ARA performance (post PDR) for Earth Spectral Radiance, homogeneous case. Note: the spectral areas not traced correspond to spectral exclusion zones (i.e. absorption bands) where the ARA requirement is not applicable

The non-homogenous scene case was also calculated, as well as for lunar and solar irradiance, but they are not reported here, focusing the paper on the most important ARA performance requirement.

The biggest contributor being the HIS gain error, the ARA budget for the Earth Spectral Radiance at the reference radiance level in homogenous scene is overall compliant with the target requirement (apart from the far UV). The process of improving the knowledge of the uncertainties and reducing the source of errors was not complete at the time of the PDR, and ways ahead had been identified. Together with that process, the discussions with the scientists were still ongoing in order to define the most important scientific spectral areas where performance had to be kept as good as possible. These two processes together would have defined an optimal performance for the mission.

The Signal-to-Noise Ratio (SNR) requirement reads (for L_{ref}): “*The SNR shall be higher than the following values, with the exclusion of the specified absorption bands and with $k = 2$ coverage factor*”:

For Land observations: SNR > 15 in 320-350 nm; SNR > 25 in 350-380 nm, SNR > 100 in 380-1950 nm, SNR > 75 in 1950-2200 nm, SNR > 50 in 2200-2400 nm, for native 50 m SSD and the specified spectral resolution.
For Ocean/water observations: SNR > 300 at 250 m SSD, in 380-1000 nm the specified spectral resolution.”

At PDR the SNR was also computed using a so-called “mixed binning” scheme, made to improve the SNR itself. This scheme uses a weighting factor 1 up to 641 nm, while above an optimized binning (implemented on ground) uses binning weighting factors scaling linearly from the central pixel, both computed with identical input assumptions on transmission, QE, etc. used for all PDR performance analyses (Figure 12). Although this scheme does not violate the spectral resolution requirement, it may have a negative impact on the correlation structure between spectral samples, which was a topic still under assessment and discussion with the scientists.

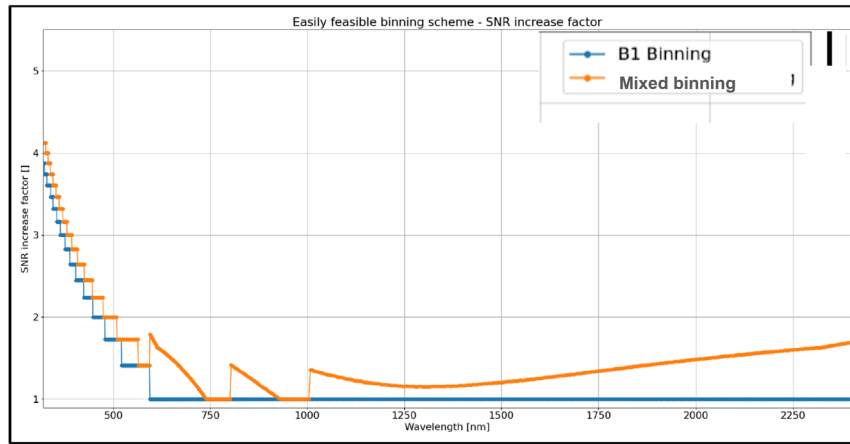


Figure 12. “standard” vs. “mixed” binning used for computation of SNR.

The HIS spectral resolution performance for ESR and SSI products, including requirements, is shown in Figure 13. The applied spectral binning scheme (Figure 12) allows to enhance the SNR. Currently, the SNR performance, for Land use and Reference Radiance (L_{ref}), is mostly compliant with the requirement.

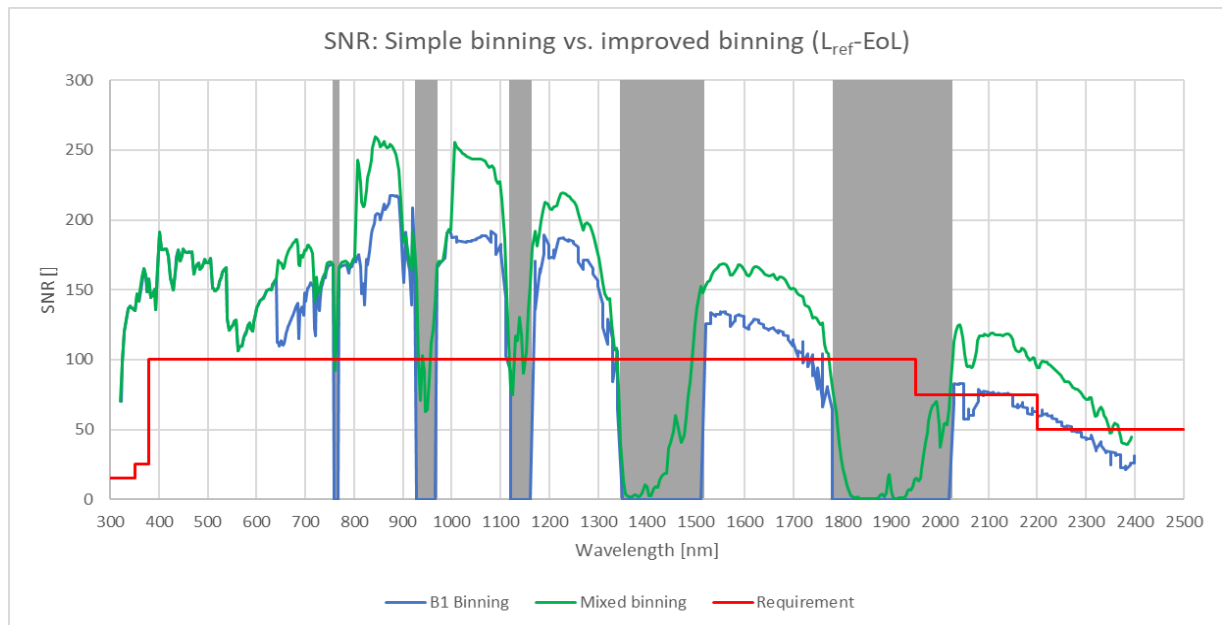


Figure 13. SNR performance vs. requirement for Land observation at L_{ref} , with exclusion zones highlighted in gray, for simple vs. mixed (improved) binning. Latest result post-PDR.

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