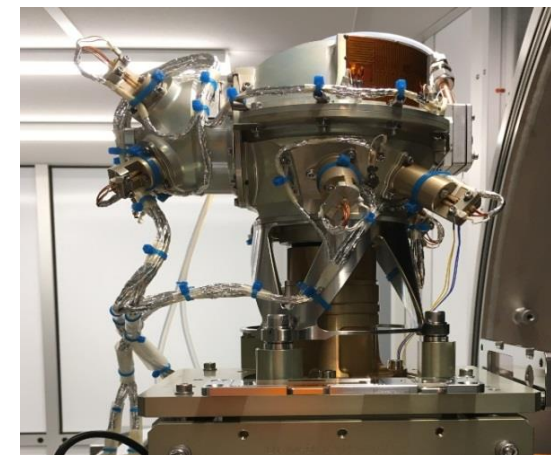
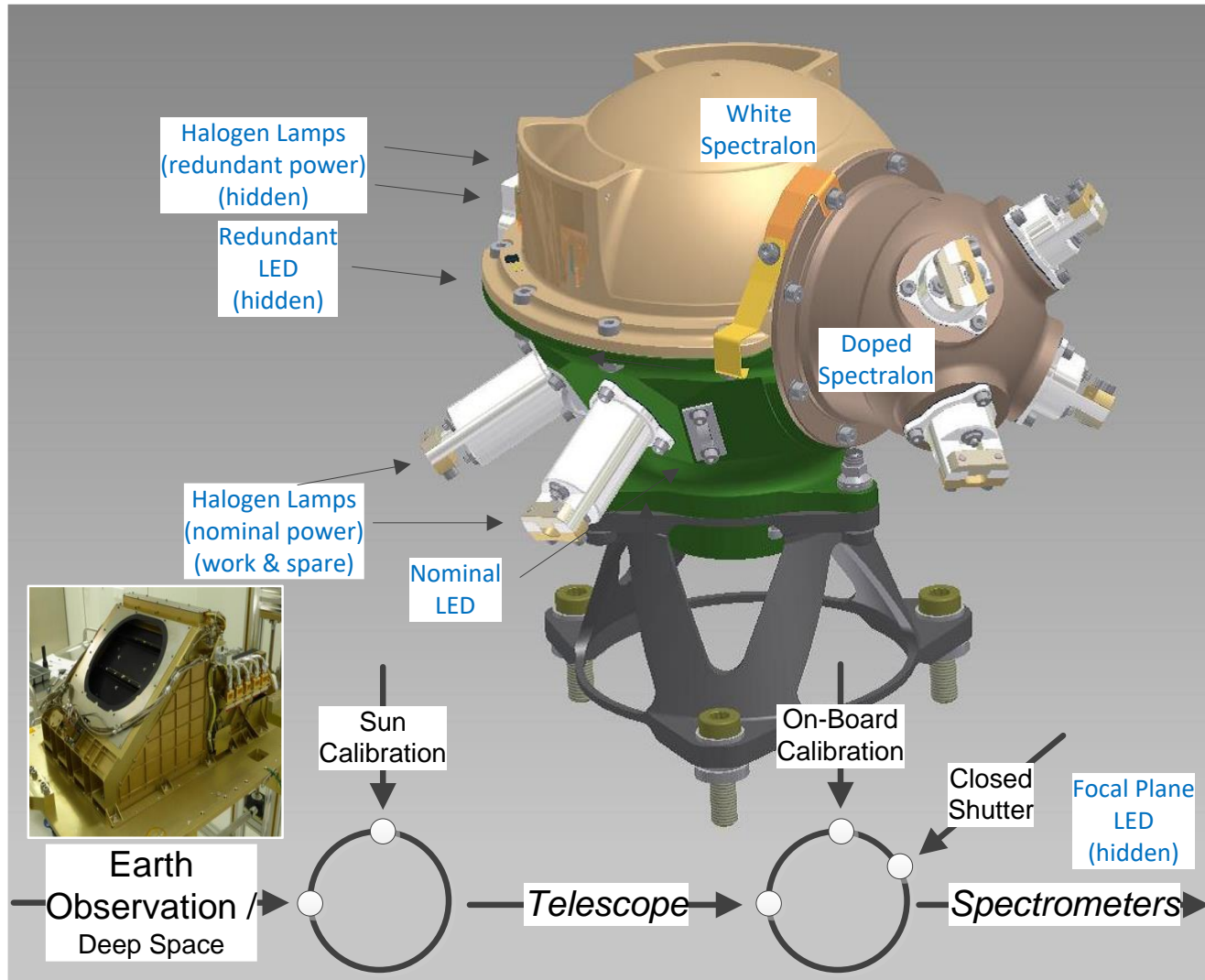


# HYPERSENSPECTRAL Workshop 2022

## EnMAP In-flight Calibration Status

K. Alonso, D. Marshall, M. Schneider, M. Bachmann,  
E. Carmona, R. de los Reyes, B. Gerasch, S.  
Holzwarth, M. Langheinrich, M. Figueiredo Vaz Pato,  
H. Krawczyck, P. Schwind, T. Storch

# EnMAP – On-Board Calibration Equipment

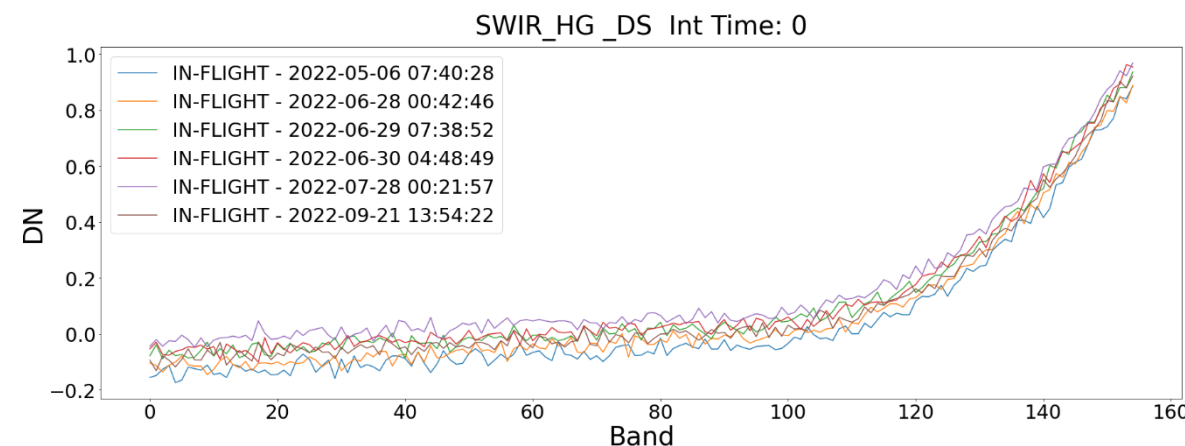
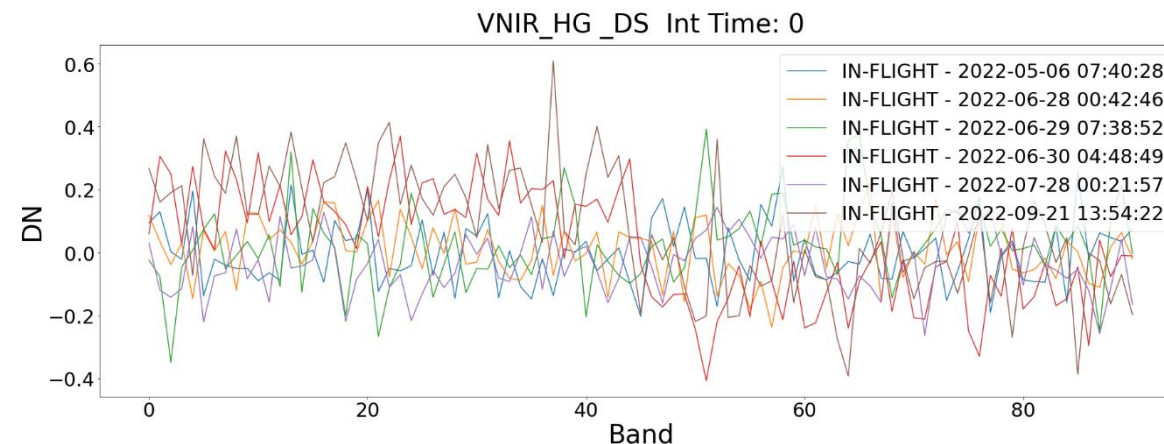


- Closed Shutter [Dark Measurement]
- Deep Space [Dark Measurement / Shutter Emission]
- Sun Calibration [Absolute Radiometry]
- White Spectralon [Relative Radiometry]
- Doped Spectralon [Spectral]
- Focal Plane LED [Linearity]

Source: OHB

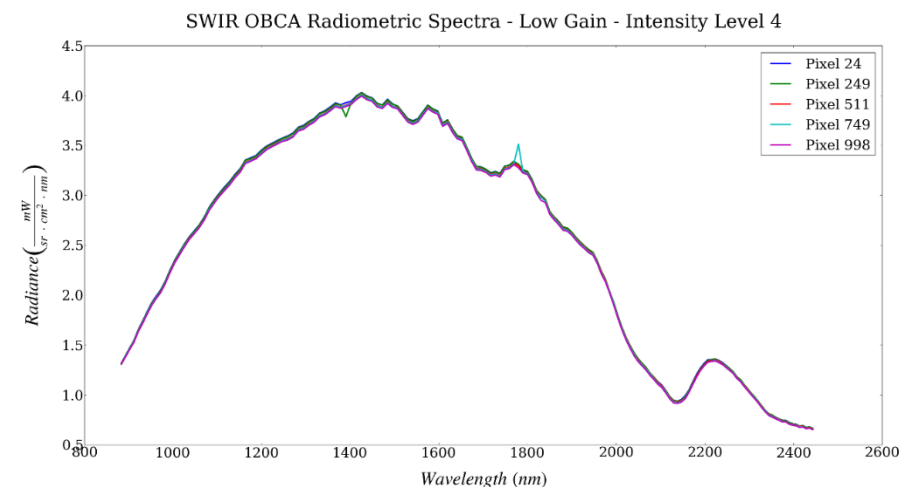
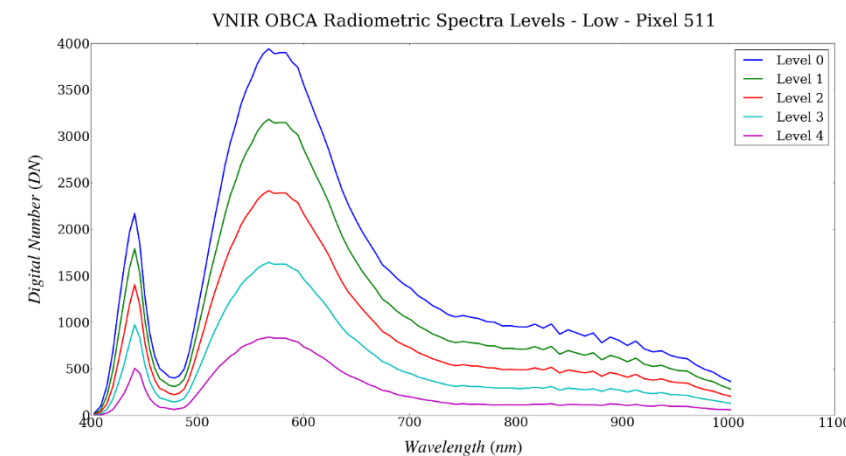
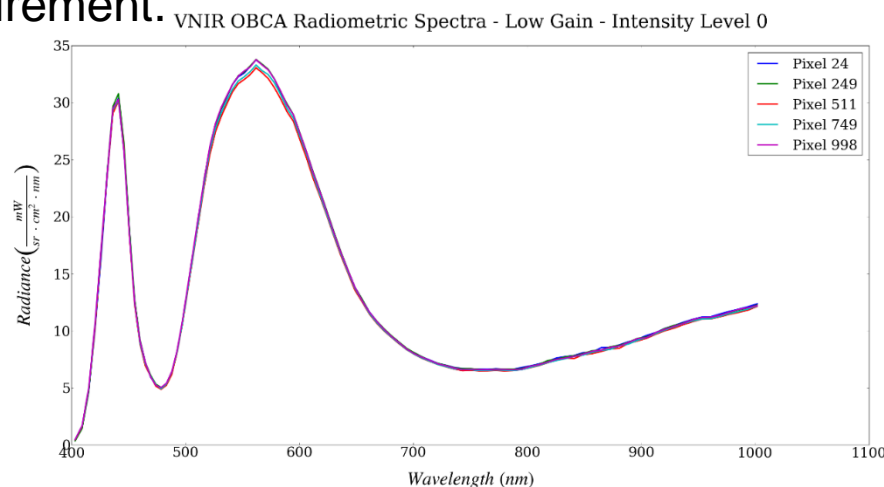
# EnMAP – Dark Signal and Deep Space Measurement

- Dark Current measurements are available for all Calibration and Earth datatakes.
- No significant changes were noticed in the dark measurements (less than 2 DNs for both sensors and both gains)
- Deep Space analysis computed: shows negligible shutter thermal contribution (around 1 DN for higher SWIR wavelengths).



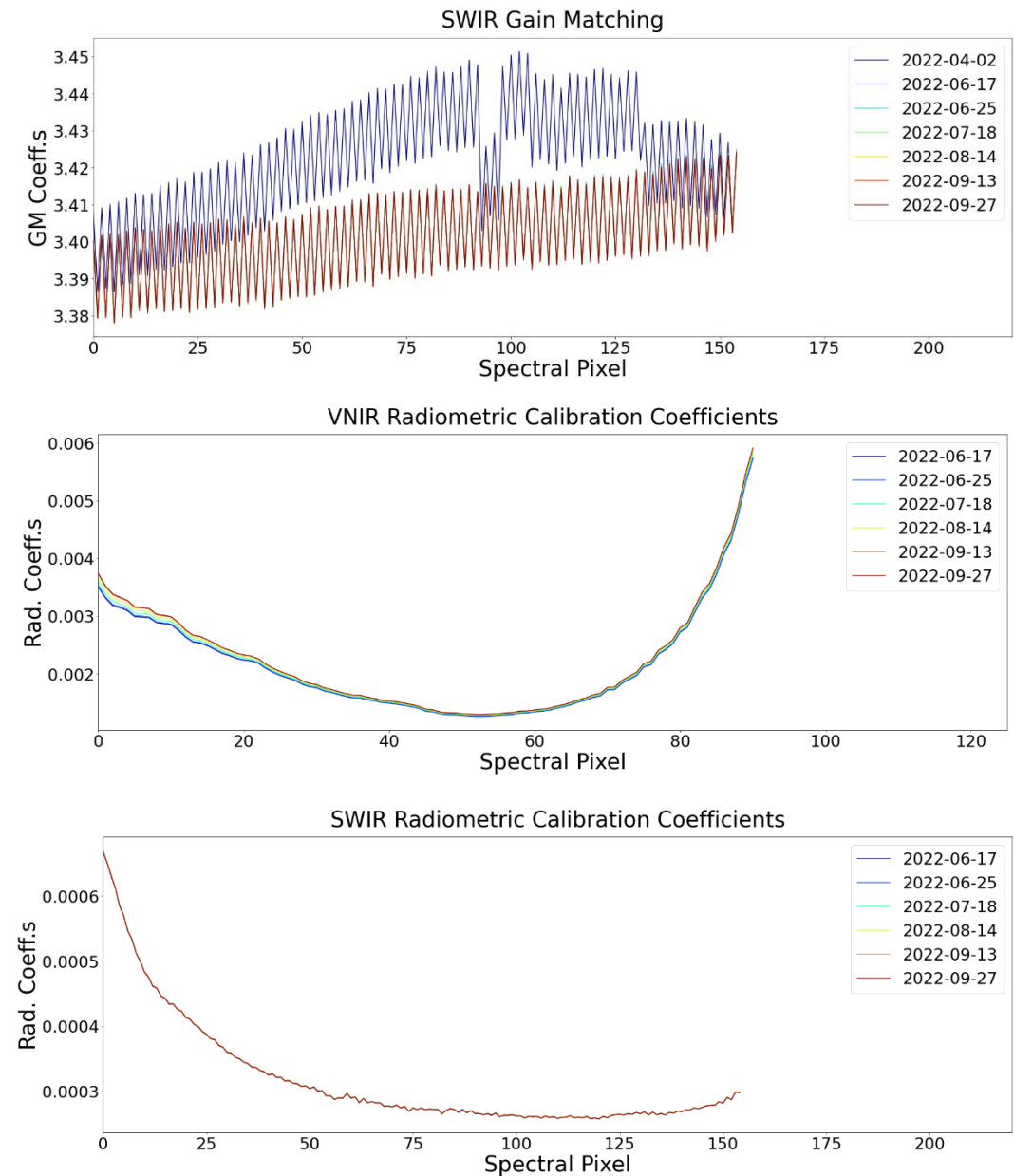
# EnMAP – Relative Radiometric Measurement

- Halogem Lamp and LED illuminate the White Spectralon at 5 different illumination levels.
- VNIR sensor showed unexpected overtime variability that has been closely monitored (1% between consecutive measurements) and there is a consistent indication that it is reducing in intensity.
- The SWIR sensor is very stable in both gain settings.
- New reference tables have been created following each measurement.



# EnMAP – Absolute Radiometric Measurement

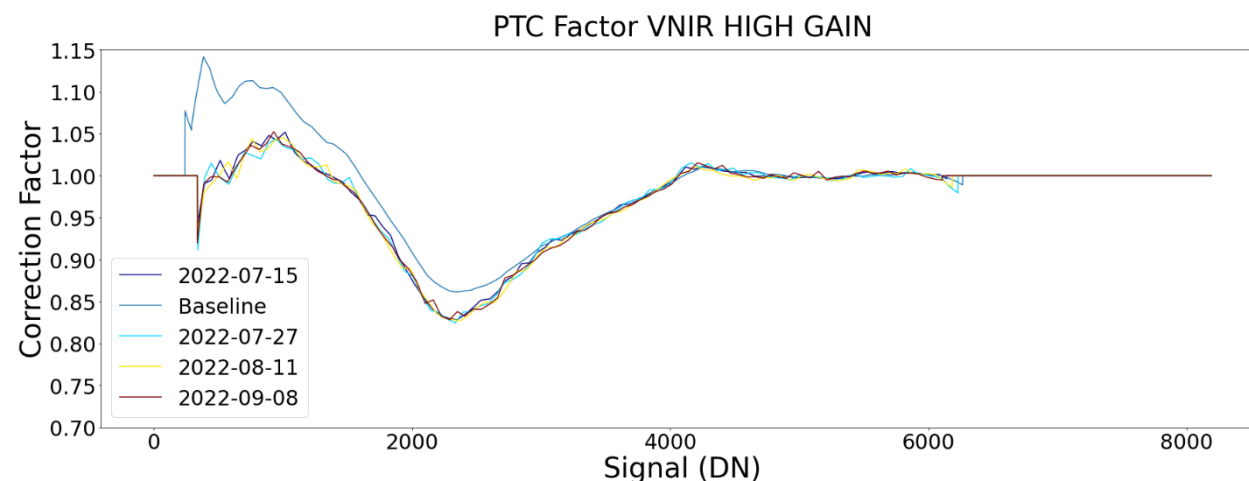
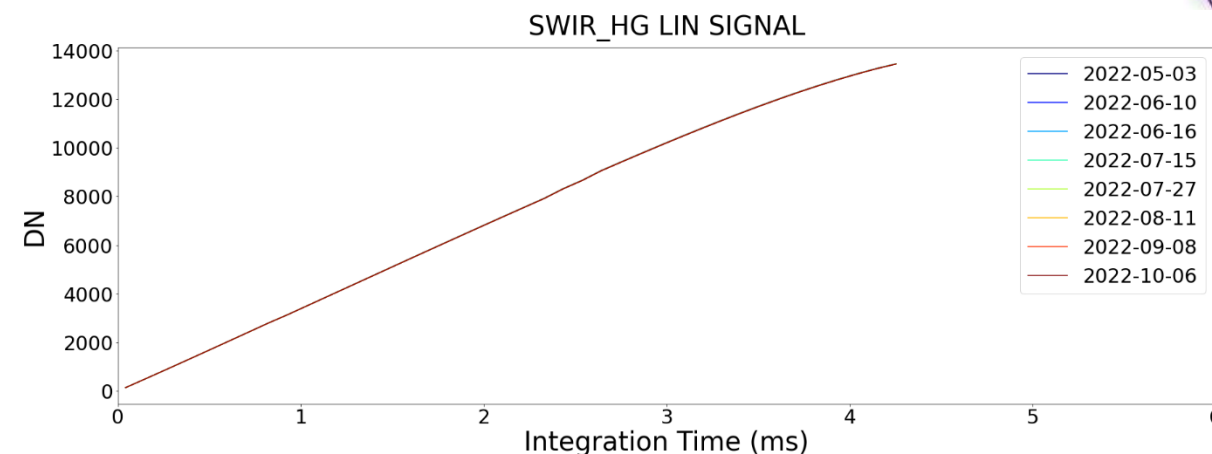
- The Full Aperture solar Diffuser Assembly (FADA) is used for absolute radiometric calibration.
- Initial RNU coefficient update provided significant improvement with respect to preflight values on early images.
- Gain Matching coefficient showed variations with respect to the preflight values in particular on the SWIR sensor with considerable pattern change.
- VNIR variability requires regular calibration coefficient updates in order to maintain the sensor inside the mission requirements.
- The SWIR sensor shows stable in-flight performance.





# EnMAP – Linearity Measurement

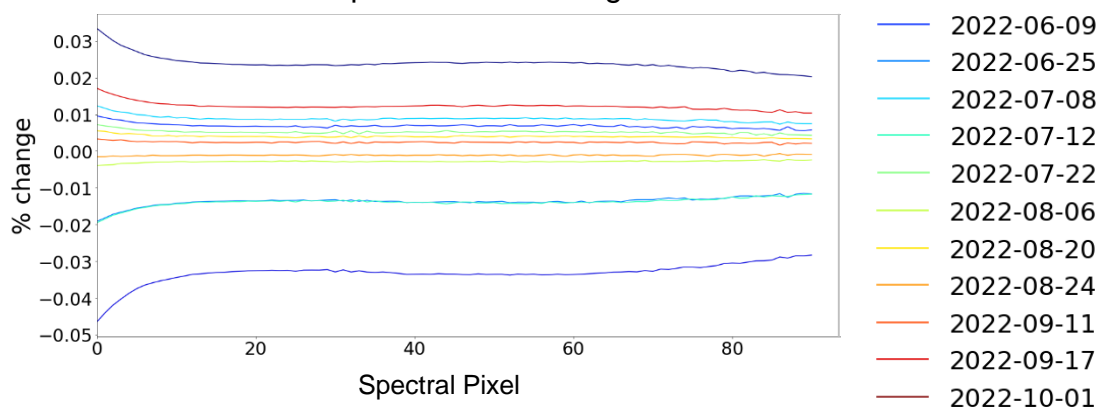
- Linearity Measurement is composed of multiple cycles of acquisitions at increasing integration times using the Focal Plane LED with a fixed illumination level.
- No changes were detected on the PTC curve during commissioning but there has been a change in the correction factors in VNIR high gain from preflight to inflight.
- No relevant changes in the SWIR linearity correction were detected.
- No new Linearity Calibration tables have been created.



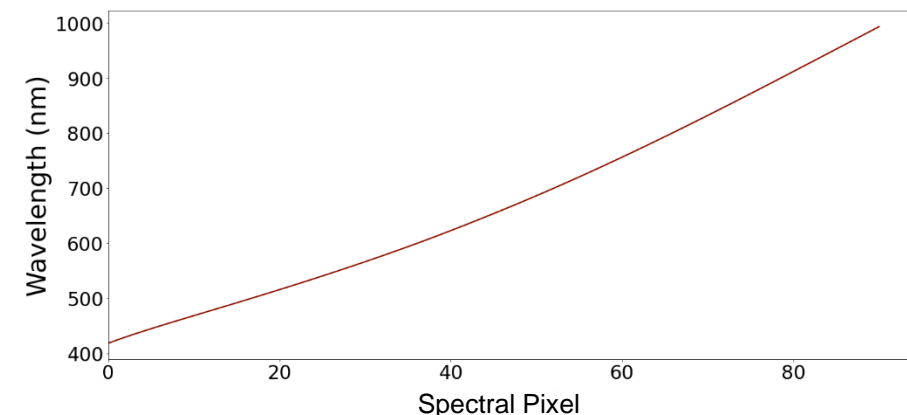
# EnMAP – Spectral Measurement

- Central Wavelengths changed after launch:
  - 0.5% change in VNIR
  - 0.17% in SWIR
- In-Flight Measurements show good spectral stability
- Two Spectral Calibration Updates performed
  - Latest on 25.06.2022

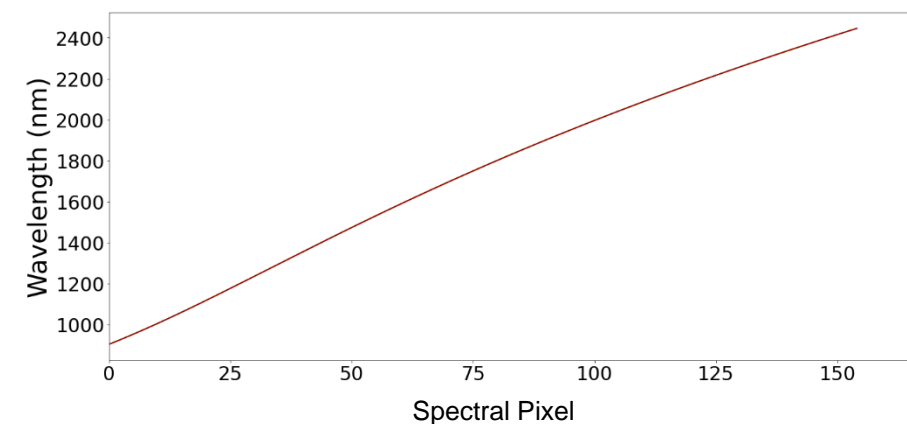
VNIR Spectral Shift Change



VNIR Central Wavelengths



SWIR Central Wavelengths



# Summary of the Commissioning Activities

- Major Activities
  - Execution of CAL procedures and generation of new in-flight calibration tables
  - Generation of quarterly reports for Radiometric and Spectral calibration
  - Analysis of results and issues during commissioning
- Statistics
  - Analysis of 53 calibration datatakes
  - 1 CTB\_DPM update (in-flight)
  - 5 CTB\_RAD updates (in-flight, first calibration 17.06.2022)
  - 2 CTB\_SPC updates (in-flight, first calibration 10.05.2022)
  - 1 REF\_DPM update (in-flight)
  - 1 REF\_DRK update (in-flight)
  - 3 REF\_LIN update (in-flight)
  - 5 REF\_LMP updates (in-flight)
  - 1 REF\_SPC update (in-flight)
  - 5 REF\_SUN updates (in-flight)