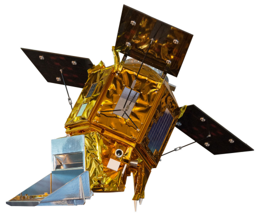
Master of Science Project

Remote Sensing of the Atmosphere / Geoscience and Remote

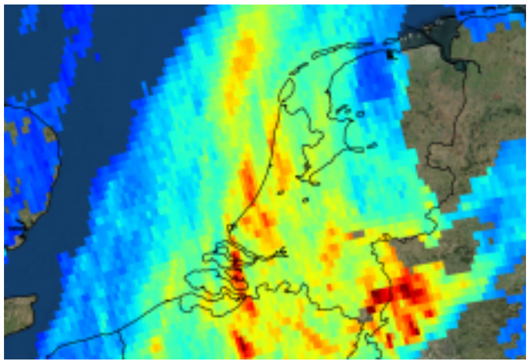
TROPOMI

How big is a TROPOMI pixel?

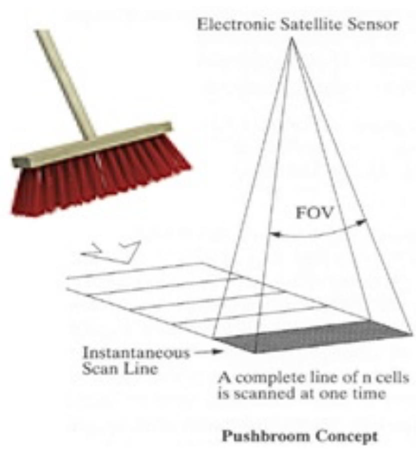


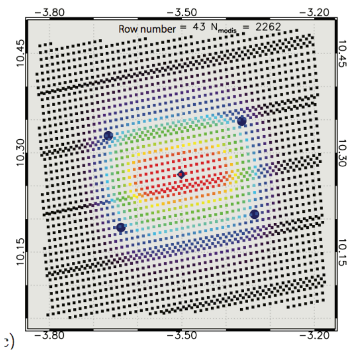
Summary

In October 2017, ESA launched the Sentinel-5 precursor satellite, with TROPOMI as its single payload. TROPOMI is a wide-field imaging spectrometer of Dutch design. Revolutionary new optical designs, developed by Dutch industry and Dutch space institutes, have resulted in unprecedented images of the Earth's atmosphere, showing air pollution and trace gases at a very high resolution.



The optical design of TROPOMI uses Dutch innovations like immersed grating and freeform optics, to measure the sunlight reflected from the Earth's atmosphere and surface. It builds on the experiences gained from previous missions in which The Netherlands had increasingly large contributions, like GOME, SCIAMACHY and OMI. Earlier instruments implemented a scanning mirror to image light onto a detector, referred to as the whisk-broom concept. For OMI, the static push-broom concept was developed, in which sunlight is imaged on a CCD (charged-coupled device) detector array, which has no moving parts. This optical design proved to be very successful, but has consequences for the instrument's instantaneous Field of View (iFoV), or pixel footprint. The footprint can be estimated from measurements of the response function of the optics from a point source, which has been performed before launch, but must be verified post-launch. For OMI this proved to be done extremely well, but it turned out that OMI pixel have a large overlap which is often neglected in algorithms. This can have negative consequences for pixel-area-dependent applications, like cloud fraction products. The footprint can be verified by comparing the reflectances from scenes as observed by TROPOMI and other instruments, like e.g. Suomi NPP/VIIRS, which flies in very close formation with Sentinel-5P (within five minutes).





Objective

Define the TROPOMI footprint, by comparing cloud-free scenes as seen by TROPOMI and Suomi NPP/VIIRS.
Verify the pre-launched determine iFoV and define a point spread function for the optical system.

Student profile

A student with interest in space-based Earth observation and a good physical background. Programming (python/Matlab) and data processing skills are essential. The project is preferably performed at KNMI.

Obligatory committee members:
Dr. Martin de Graaf (TU Delft, Geoscience and Remote Sensing, KNMI)
Prof. dr. Herman Russchenberg (TU Delft, Geoscience and Remote Sensing)

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For students of Geosciences and Remote Sensing and similar backgrounds.