Sentinel-5 Precursor – Overview and Status

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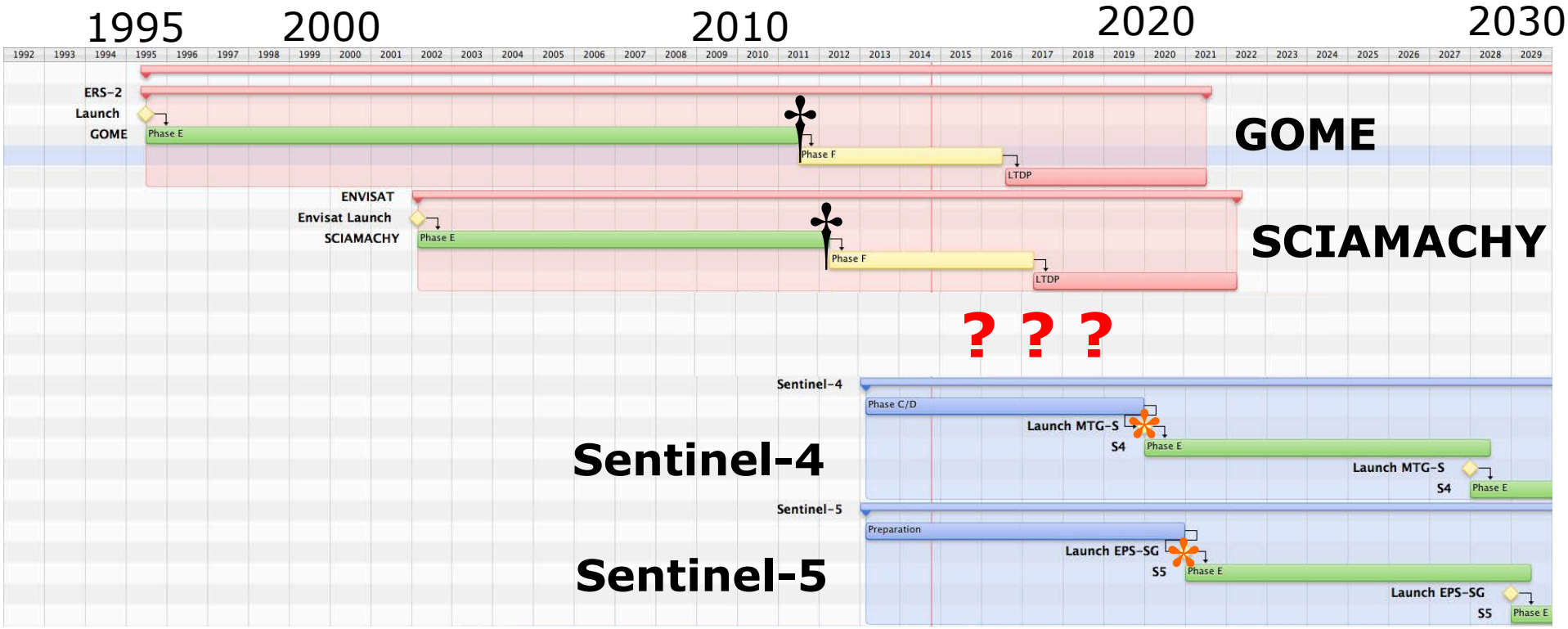
on behalf of the Sentinel-5 Precursor Project team

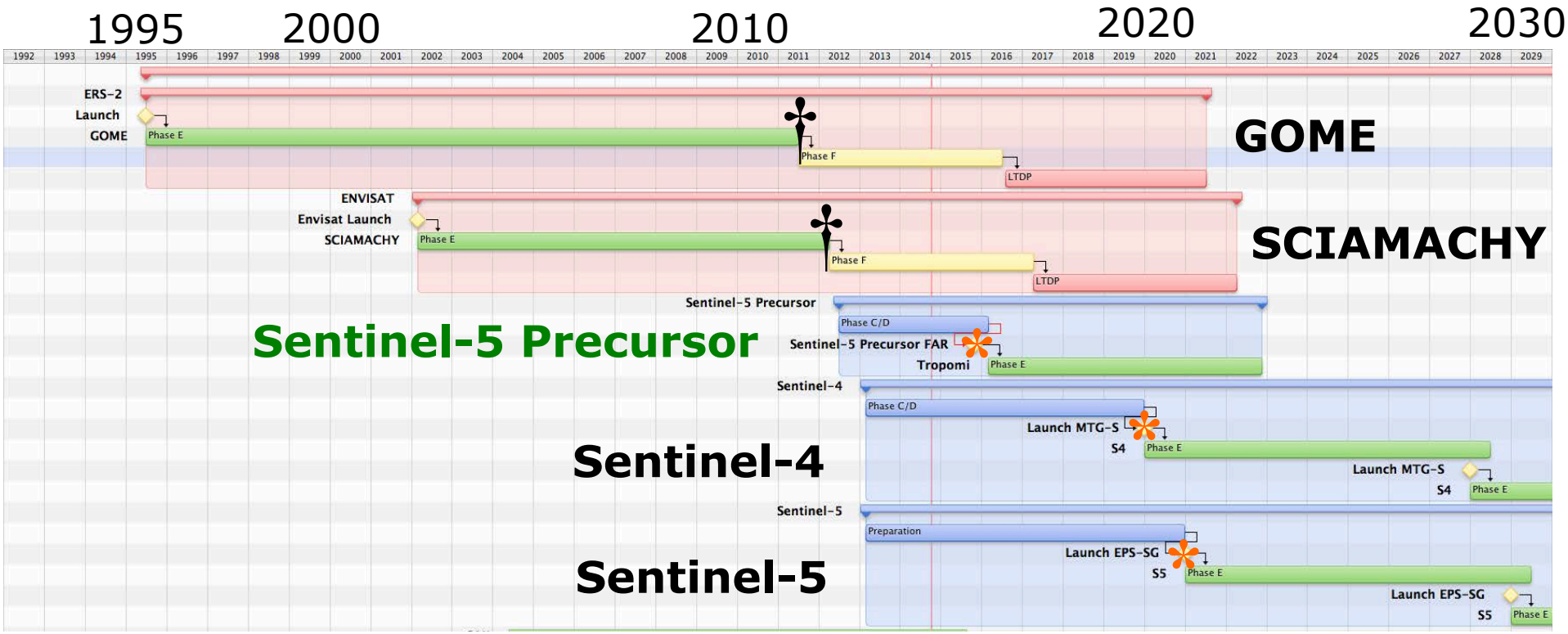
Sentinel-5 Precursor Copernicus Requirements

- Information requirements on three themes for operational services:
  - Stratospheric Ozone and Surface UV radiation
  - Air Quality
  - Climate
- Main drivers for operational space-borne observations:
  - Provision of information on treaty verification and protocol monitoring
  - Facilitation and improvement of operational applications and services on the atmospheric composition
  - Contribution to scientific understanding for environmental assessments to support policy
- Support the Copernicus Atmospheric Core and Downstream
  - macc -III

Sentinel-5 Precursor: Heritage and Future Missions

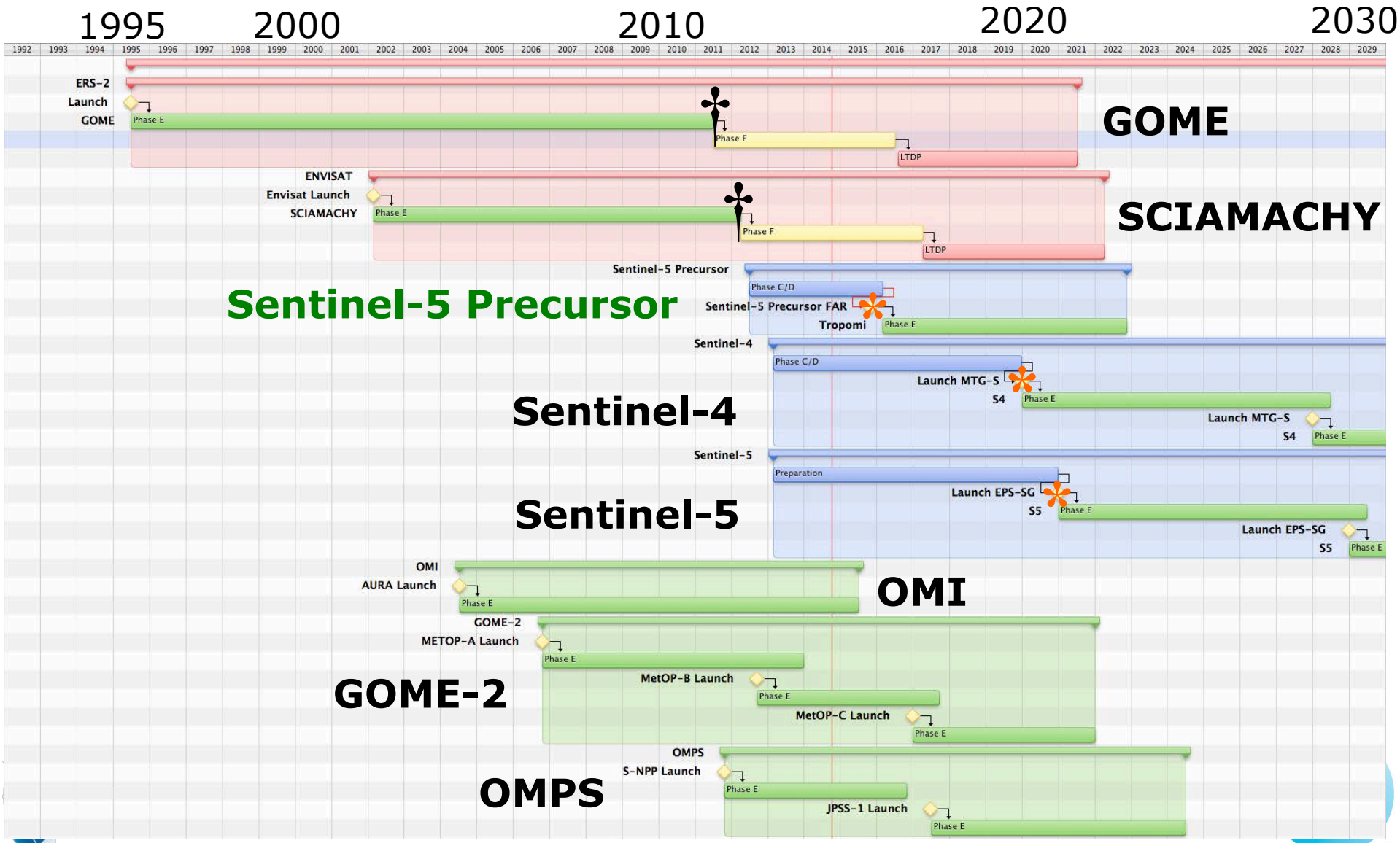


Sentinel-5 Precursor: Heritage and Future Missions

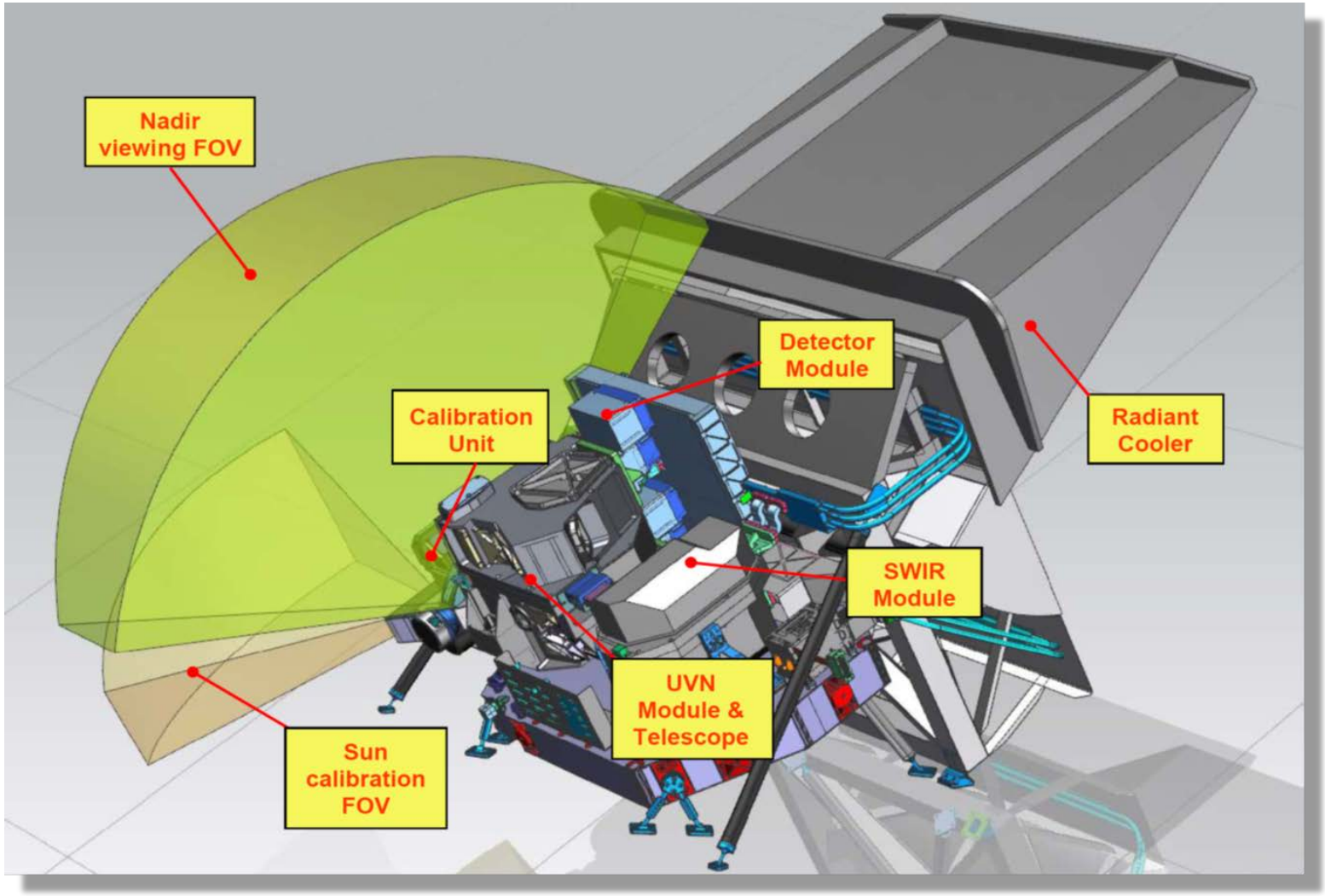


- S5p is narrowing the gap between Envisat and Sentinel-5
- Towards 40 years of similar atmospheric composition observations!
- Sentinel-5 Precursor is a cooperative undertaking between ESA and the Kingdom of the Netherlands for the provision of the TROPOMI payload

Sentinel-5 Precursor: Heritage and Future Missions

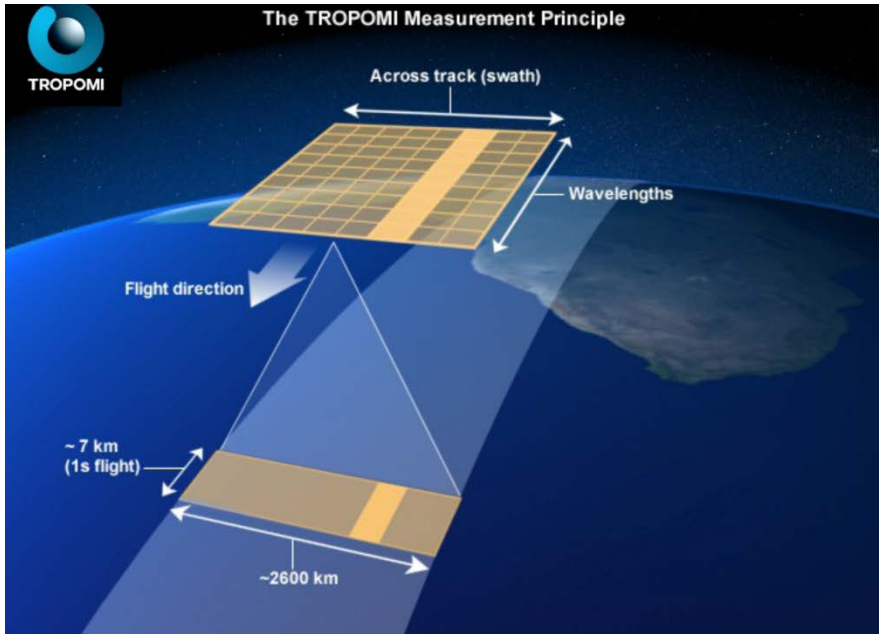


Instrument: Tropomi

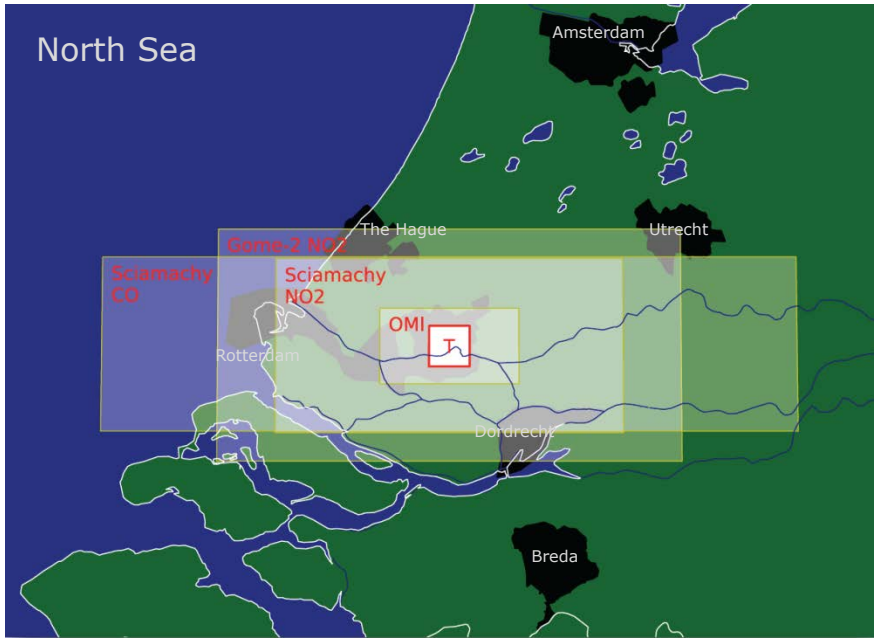


Instrument: Tropomi

- Push-broom Imaging Spectrometer
- High spatial resolution



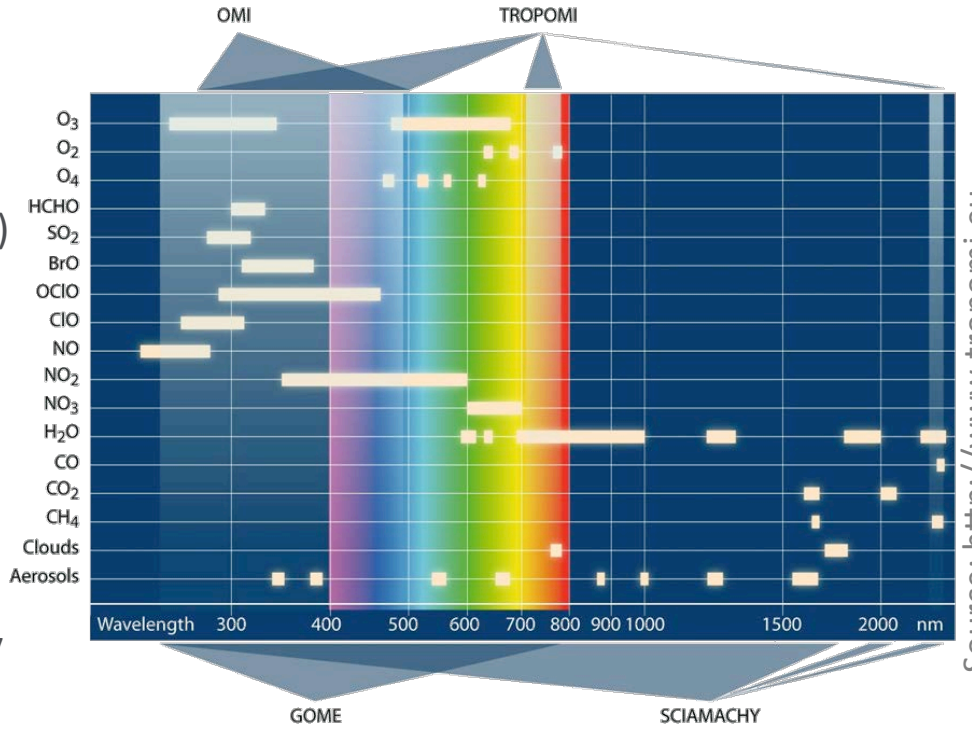
Source: KNMI



Source: KNMI

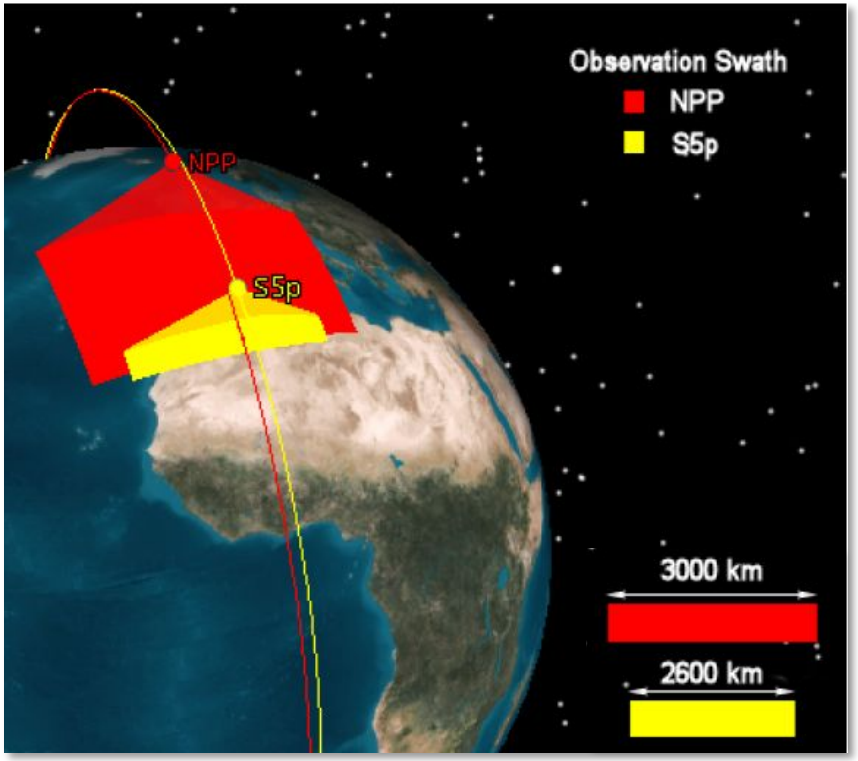
From SCIAMACHY to TROPOMI

- Significantly improved spatial resolution (7-28 x 7 km^2 vs. 60-120 x 30 km^2)
- 1-20 times better Signal-to-Noise Ratio
- Measurement swath allows global daily coverage at equator (2600 km vs. 960 km)
- Push-broom concept vs. scanning instrument
- SWIR module based on immerse grating
- Reduced spectral range
- Only nadir viewing
- Afternoon orbit to optimise for air-quality



S-5p and S-NPP Loose Formation Flight

- Goals:
  - Reliable cloud clearing (optically thin layers, cirrus …) in particular for Methane retrievals
  - Synergistic use SNPP & S-5p products
- "Loose formation" with separation 5 min +/- 5 min
- Routine delivery of S-NPP/VIIRS products to the S-5p Ground Segment
- Interface ESA-NOAA/NASA for planning and product exchange



Tropomi: Performance Parameters

Spectrometer		UV		UVVIS		NIR		SWIR	
Band ID		1	2	3	4	5	6	7	8
Full Range	[nm]	270-320		310-495		675-775		2305-2385	
Performance Range	[nm]	270-300	300-320	320-405	405-495	675-725	725-775	2305-2345	2345-2385
Spectral Resolution FWHM	[nm]	0.48	0.49	0.54	0.54	0.38	0.38	0.25	0.25
Spectral Sampling	[nm]	0.071	0.073	0.22	0.22	0.14	0.14	0.1	0.1
Sampling Sampling Ratio		6.8	6.7	2.5	2.5	2.8	2.8	2.5	2.5
Slit Width	[µm]	560	560	280	280	280	280	560	560
Spectral magnification		0.327	0.319	0.231	0.231	0.263	0.263	TBD	TBD
Spatial Sampling at nadir	[km^2]	28x7	7x7	7x7		7x7	3.5x7	7x7	
Required Signal-to-noise		100-800	90-700	800-1000		100-500		100-120	

Source: S5P JPT, KNMI

Level 2 Products: Expected Accuracy/Precision

Parameter	Data Product	Vertical Resolution	Accuracy	Precision
Ozone	Ozone Profile	6 km	10-30%	10%
	Total Ozone	total column	3.5-5%	1.6-2.5%
	Tropospheric Ozone	trop column		
NO_2	Stratospheric NO_2	strat column	<10%	0.5e15
	Tropospheric NO_2	trop column	25-50%	0.7e15
SO_2	SO_2 enhanced	total column	30%	0.15-0.3 (0.06-0.12) DU
	Total SO_2	total column	30-50%	1-3 (0.4-1.2) DU
Formaldehyde	Total HCHO	total column	40-80%	1.2e16 (4e15)
CO	Total CO	total column	15%	<10%
Methane	Total CH_4	total column	1.5%	1%
Irradiance	Spectral UV solar irradiance	n/a		
Cloud	Cloud Fraction	total column	<20%	0.05
	Albedo (Optical Thickness)	total column	<20%	0.05 (10)
	Cloud Height (Pressure)	total column	<20%	<0.5 km (<30hPa)
Aerosol	Aerosol Layer Height	total column	<100hPa	<50hPa
	Aerosol Type	total column	~1 AAI	<0.1 AAI

Source: S5P Level 2 Working Group

Data Distribution

- Data Volume:
  - Level 1b, one orbit: 35.60 GByte (~ 200 x SCIAMACHY)
  - Level 2, one orbit: 4.25 GByte (~150 x SCIAMACHY)

- Data Organisation
  - Level 1b radiance is provided as separate files per Band
    - UV-UVIS-NIR and SWIR solar irradiance product
  - Each geophysical Level 2 parameter is provided in a dedicated product
  - Data format is netCDF-4 using Climate and Forecasting Metadata Standards

- Data Access to users
  - Provided via Copernicus Space Component Data Access System

CSC Data Access

Copernicus Space Component Data Access Portal

sentinel.esa.int

- **Copernicus Services Access**
- **Scientific / Other Access Hub**
- **Collaborative Access Hub**
- **International Agreements Access Hub**

Project Status

- Satellite systems development well advanced
  - Critical Design Review July '13
- TROPOMI instrument environmental testing and calibration ongoing
- Ground Segment Critical Design Review successfully passed (June '14)
- Level 1b and Level 2 processor baseline developments on track
- Sentinel-5 Precursor Cal/Val Announcement of Opportunity Call
  - Proposals under review
- Flight Acceptance Review: November 2015 (with Launch Q1/Q2 2016)