



Sentinel-4 Status Update

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sentinel-4



Copernicus

- European system for monitoring land, marine, atmosphere, climate change, emergency management, security
- Observations from satellites, ground-based, air-borne sensors
- Space Component: Sentinel missions by European Space Agency
- For policymakers, public authorities, ..., citizens

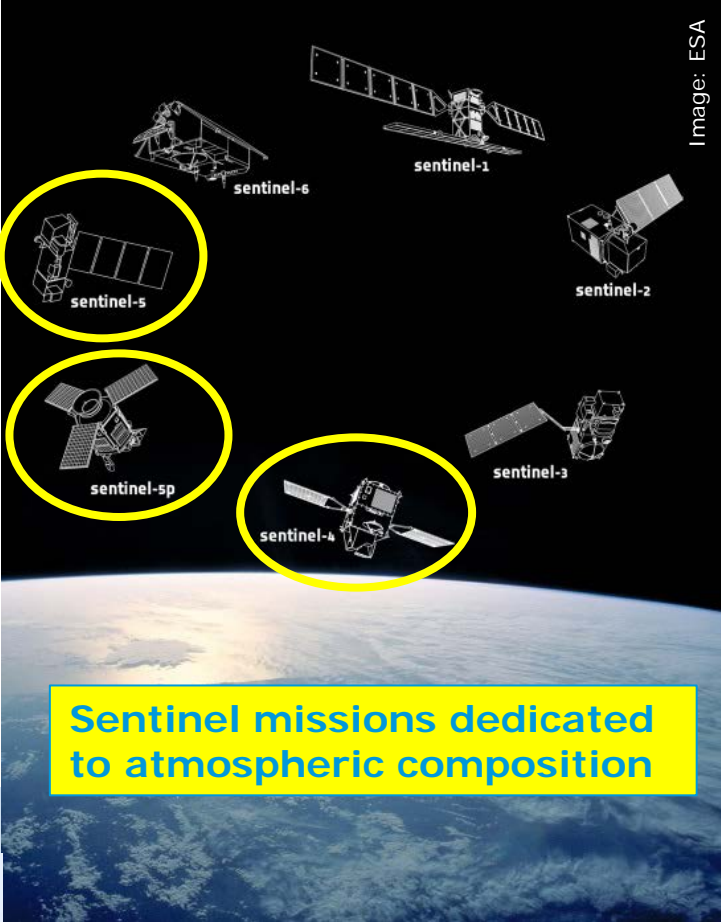


Image: ESA

Copernicus Atmosphere Monitoring Services



Air Quality and Atmospheric Composition

Climate Forcing

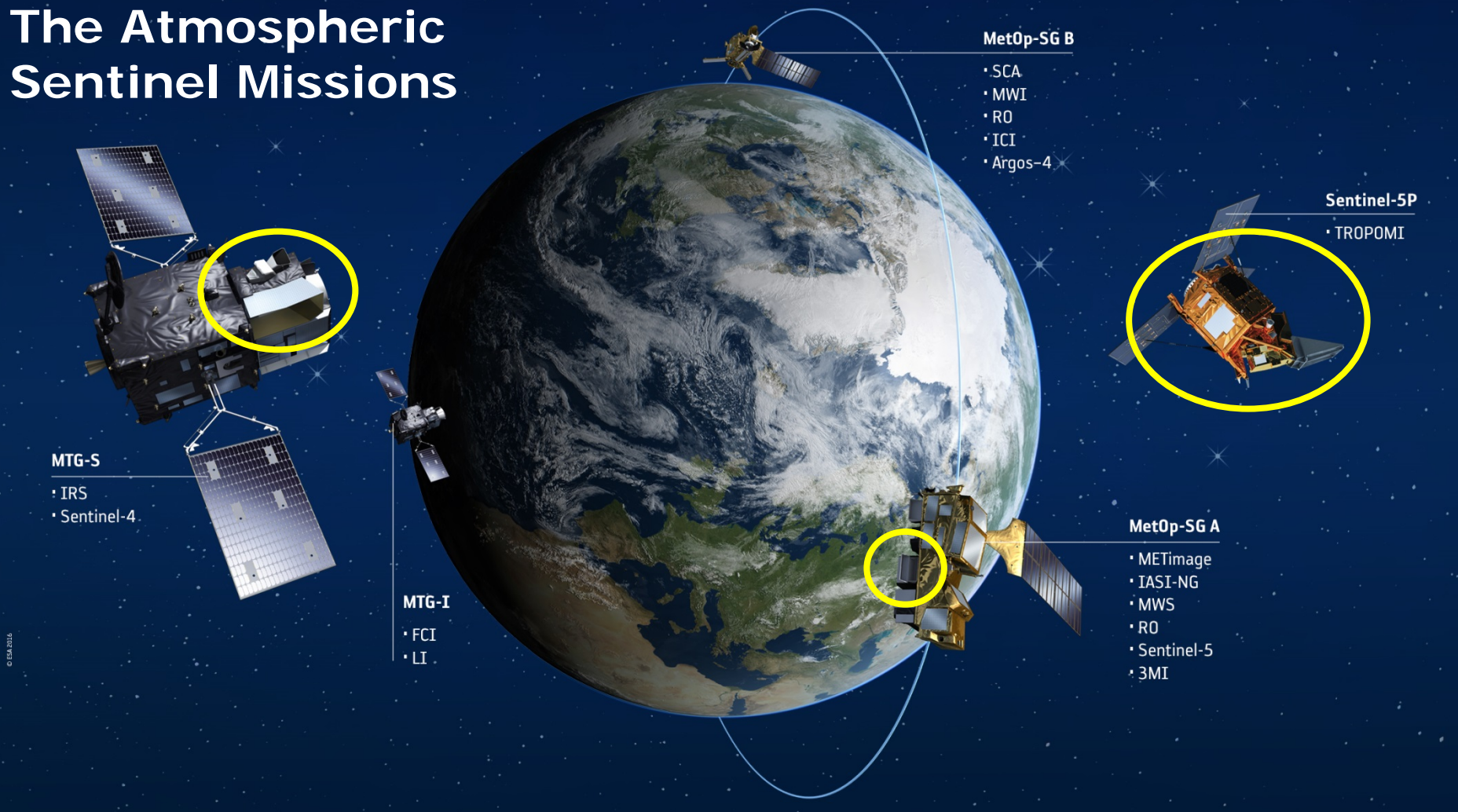
Ozone Layer & UV

Solar Radiation

Emissions and Surface Fluxes



The Atmospheric Sentinel Missions



	L.T.	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040			
Sentinel-5p	13.30h		█																										
Sentinel-4 - 1	geo						█																						
Sentinel-4 - 2	geo																			█									
Sentinel-5 - 1	09.30h						█																						
Sentinel-5 - 2	09.30h																												
Sentinel-5 - 3	09.30h																												

Sentinel-4 Mission Objective



Sentinel-4 is designed to provide

- Tropospheric composition measurements
- With fast revisit time
- At high spatial resolution over Europe
- Operationally over 15 years
- For the Copernicus Atmosphere Monitoring Services

<http://atmosphere.copernicus.eu>

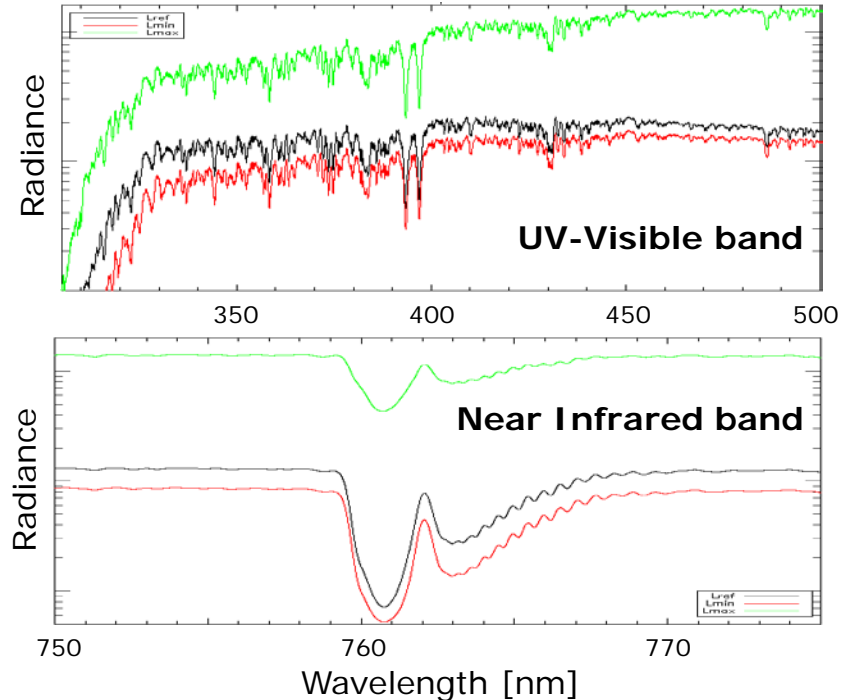


Sentinel-4/UVN: Key Requirements



Instrument Spectral Coverage

Band ID	Wavelength range [nm]	Spectral resolution [nm]	Spectral sampling ratio
UV	305 - 400	0.5	3
VIS	400 - 500	0.5	3
NIR	750 - 775	0.12	3



Spatial Sampling: 8 km at 45°N

Coverage: Europe + Sahara

Repeat Cycle: 1 hour

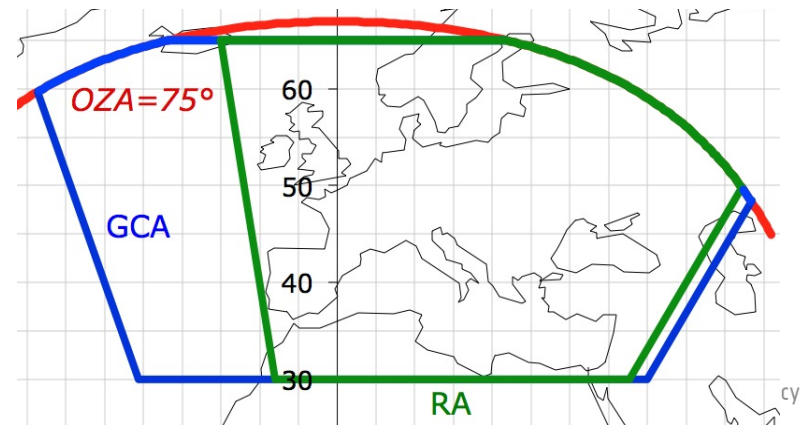
Low sensitivity to polarisation (1%)

Low level of spectral features (0.05%)

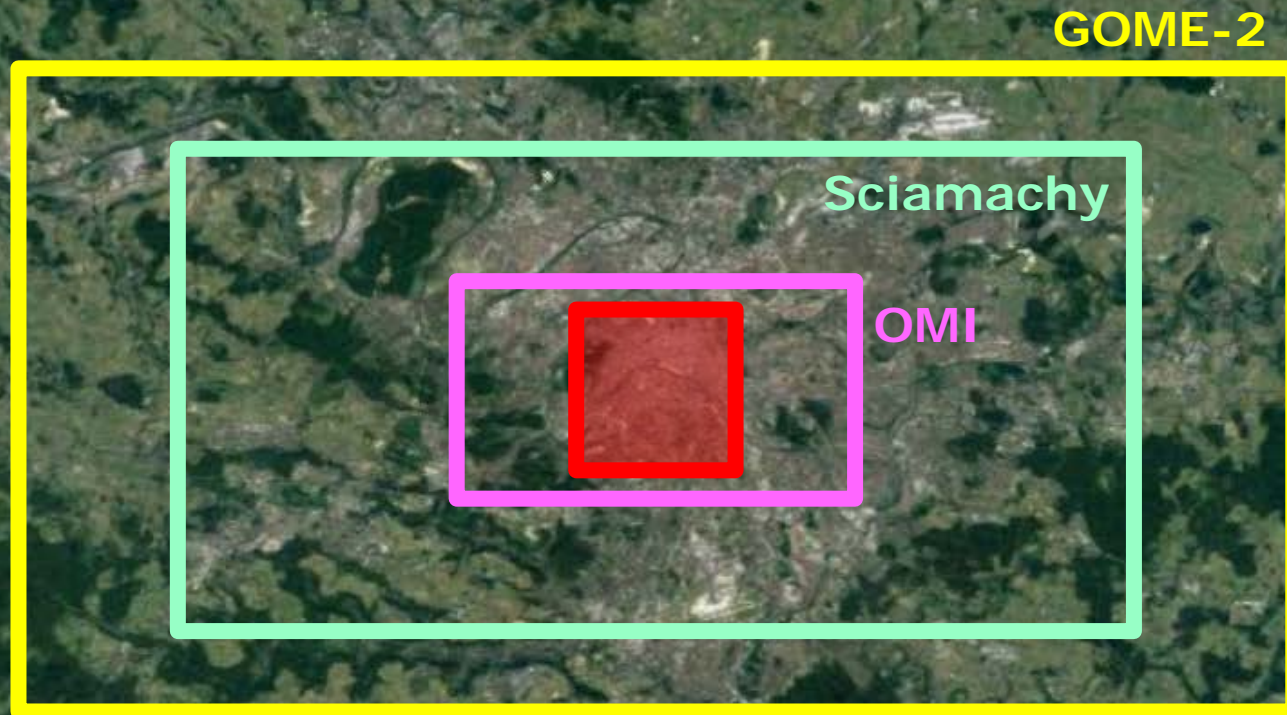
High radiometric accuracy: 3% (thresh.), 2% (goal)

High Signal to Noise Ratio (goal 1800 in vis)

Geographic Coverage Area, Observation Zenith Angle, Reference Area



Sentinel-4/UVN Footprint Size



**Sentinel-4 Footprint Size
Similar to Sentinel-5, -5P
→ Big step toward resolving sources**

Sentinel-4 Level-2 Product Portfolio



Product	Relevance
O ₃ total column	Controls surface UV, greenhouse gas, controls oxidising capacity of atmosphere
O ₃ tropospheric column	Near surface O ₃ ^(*) irritates lung and soft tissue and reduces plant growth, greenhouse gas, controls oxidising capacity of atmosphere
NO ₂ tropospheric column	Near surface NO ₂ ^(*) toxic, production of O ₃ and nitrate aerosol, acid rain
SO ₂ total column	Near surface SO ₂ ^(*) toxic, production of sulphate aerosol, acid rain, tracer for volcanic emissions
HCHO total column	Influences production of O ₃ and CO, VOC emission estimates
CHOCHO total column	Influences production of O ₃ and CO, VOC emission estimates
Aerosol Layer Height	Near surface PM ^(*) causes pulmonary and cardiovascular diseases, direct and indirect climate effect, controls cloud formation, aviation control (volcanic ash). AOD jointly retrieved with surface characteristics.
Aerosol index	
Aerosol Optical Depth	
Cloud characteristics	Auxiliary for other products
Surface	Surface BRF auxiliary for other products

*) regulated by European Standards: <http://ec.europa.eu/environment/air/quality/standards.htm>

S4 Level-2 Target Performances



Product	Threshold	Goal	Goal applies to	Scenario#
O ₃ total column	4%	3%		all clouds
O ₃ tropospheric col	40%	25%		
NO ₂ tropospheric col	1.5*10 ¹⁵ molec/cm ²		< 5*10 ¹⁵ molec/cm ²	
	50 %	30%	> 5*10 ¹⁵ molec/cm ²	
SO ₂ total column	3.0*10 ¹⁶ molec/cm ²		< 5*10 ¹⁶ molec/cm ²	Pollution
	100%	60 %	> 5*10 ¹⁶ molec/cm ²	
HCHO total column	1.5*10 ¹⁶ molec/cm ²		< 3*10 ¹⁶ molec/cm ²	
	100%	50%	> 3*10 ¹⁶ molec/cm ²	
CHOCHO total column	n/a	7*10 ¹⁴ molec/cm ²	< 1.4*10 ¹⁵ molec/cm ²	
	n/a	50%	> 1.4*10 ¹⁵ molec/cm ²	
Aerosol Layer Height	1 km	n/a		AOD>0.3, ALH>1.5 km
Aerosol Index	0.5	0.3		
Cloud characteristics	fraction 20%, top height 1 km, optical thickness (albedo) 30%	fraction 10%, top height 0.5 km, optical thickness (albedo) 20%		CF>10%, COT>5
Surface	First BRF parameter 0.01	n/a		cloud free, homogeneous

#) SZA < 60°, VZA < 60°, CF < 20%, unless specified otherwise

Implementation Status: S4/UVN Space Component



- Airbus Defence & Space prime contractor
- UVN Instrument & Instrument Quality Tool, incl Instrument Data Simulator and Level-1b Prototype Processor
- Unit level detailed design and implementation, H/W and S/W development, manufacturing, and testing
- Critical Design Review almost completed
- Proto Flight Model and Flight Model 2 delivery to MTG 2019

Implementation Status: S4 Level-2 Algorithms



- Consortium lead by DLR
- Level-2 Algorithm breadboarding (lead by RAL)
 - Start development of glyoxal product after PDR closure
- Independent Verification (lead by MPIC)
 - Breadboard versus independent algorithm
 - Test data: diurnal cycle at 17 sites + dedicated aerosol and SO₂ scenarios
 - First results encouraging
- Operational processor (lead by DLR)
 - Harmonization of products and formats with S5 and S5P
- Preliminary Design Review almost completed
- External ATBD review ongoing
- Acceptance Reviews: AR1 end 2018, AR2 end 2019, AR3 after launch

S4 Implementation Status: Relevant Developments



- Ground Segment Development and Operations lead by EUMETSAT
 - Ground Station Facilities
 - Mission Operations Facility
 - Instrument Data Processing Facility for processing up to Level-1
 - Level-2 Processing Facility (in which S4 L2 processor will run)
 - Multi-mission elements for data archiving, distribution, and product quality monitoring
- Copernicus Atmosphere Monitoring Service (CAMS)
 - Implemented by ECMWF
 - Operational → <http://atmosphere.copernicus.eu>
- Claus Zehner ESA Mission Manager for Sentinel-4/-5/-5P