SENTINEL-5P

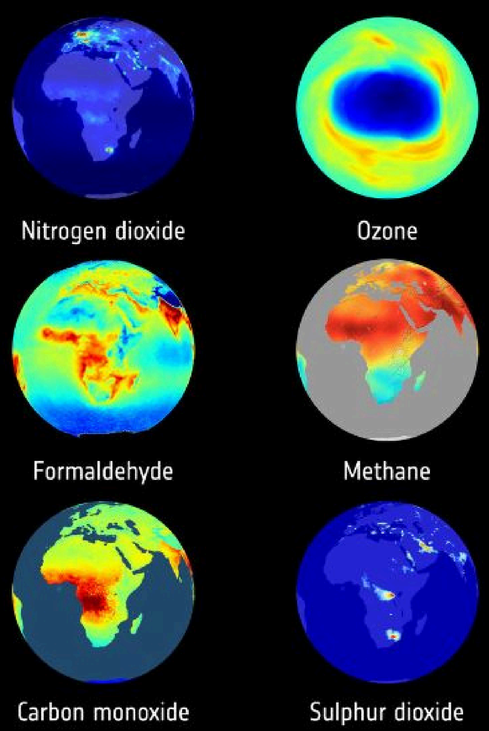
MONITORING AIR QUALITY WORLDWIDE

SENSOR OVERVIEW

Sentinel-5P, part of the Copernicus Program, was launched by ESA in 2017 to provide detailed atmospheric air composition data. The satellite carries the TROPOspheric Monitoring Instrument (TROPOMI), a passive grating imaging spectrometer operating in a push-broom configuration with nadir viewing.
TROPOMI records high-resolution spectra in the ultraviolet, visible, near-infrared, and shortwave infrared ranges, enabling the detection of key atmospheric constituents such as NO_2, O_3, SO_2, CO, CH_4, HCHO, as well as aerosols and clouds. It flies in a sun-synchronous low Earth orbit at ~824 km altitude, providing daily global coverage with a wide swath of 2,600km. The instrument consists of four spectrometers, each split into two bands, covering eight spectral channels with varying resolutions. [1],[2]

Spectral Band	Wavelength [nm]	Spectral resolution [nm]	Spatial resolution [km^2]
UV-1	270-300	0.50	7x7
UV-2	300-320	0.50	7x7
UVIS-1	310-405	0.55	7x7
UVIS-2	405-500	0.55	7x7
NIR-1	675-725	0.5	7x7
NIR-2	725-775	0.50	7x7
SWIR-1	2305-2345	0.25	7x7
SWIR-2	2345-2385	0.25	7x7

[1]



CHALLENGES

Although Sentinel-5P delivers unprecedented atmospheric observations, several limitations remain. The instrument measures total atmospheric columns rather than direct surface concentrations, which can make it difficult to assess human exposure without additional modelling. Data quality is reduced under cloudy or hazy conditions, and gaps may occur in polluted or complex environments. Furthermore, even with improved resolution, the observations cannot capture fine-scale variations within cities (7km resolution). These issues highlight the need for validation with ground stations and integration with complementary datasets. [2],[3]

APPLICATION IN AIR QUALITY

TROPOMI data are used to monitor urban and regional NO_2, industrial and volcanic SO_2, and greenhouse gases like CO and CH_4. Aerosol indices and smoke plume data are valuable for wildfire monitoring. The data of the satellite are one of the main sources integrated into air-quality models such as CAMS (Copernicus Atmosphere Monitoring Service), helping evaluate policy, support regulation, and protect human health. [3],[4]

WHY SENTINEL-5P FITS

Sentinel-5P is well suited for air quality monitoring because its TROPOMI instrument measures sunlight reflected by Earth in different parts of the spectrum, from ultraviolet to shortwave infrared. Each gas leaves a distinct ‘fingerprint’ in these wavelengths, allowing the satellite to detect pollutants such as nitrogen dioxide, ozone, carbon monoxide, sulfur dioxide, and methane with great precision. This spectral sensitivity makes Sentinel-5P a powerful tool to track harmful gases that directly affect human health and climate. [3],[4]

EVERYDAY IMPACT

Thanks to open-access data from satellite Sentinel-5P, applications such as the Swiss app IQAir have been developed. IQAir uses this atmospheric information to provide people with real-time air quality maps, pollution forecasts, and health recommendations. This helps individuals make informed decisions in their daily lives, such as when to exercise outside or how to protect themselves from harmful pollution. [5]

EPFL

REFERENCES

[1] https://www.eoportal.org/satellite-missions/copernicus-sentinel-5p#mission-capabilities
[2] https://sentiwiki.copernicus.eu/web/s5p-mission#S5P-Mission-Satellite-Description
[3] www.copernicus.eu/en/sentinel-5p-air-we-breathe
[4] https://sentinels.copernicus.eu/web/success-stories/-/monitoring-air-quality
[5] https://www.iqair.com/switzerland