SEEDS

Revealing emission sources from space

The EU Air Quality Directive defines specific responsibilities for EU Member States to monitor, report on and effectively manage air quality. Despite these guidelines, numerous major cities continue to surpass prescribed limit values for various pollutants. Enhancing air quality remains a priority for safeguarding public health.

The use of satellite observations allows an independent assessment of emissions, referred to as “top-down approach”. SEEDS project uses satellite data, innovative inverse modelling and data assimilation approaches to deliver cutting edge up-to-date estimates of surface pollutant fluxes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme.

Why develop new methods?

Current practices to estimate pollutant emissions use a method called the ‘bottom-up approach’. In this approach, in situ measurements of emission factors are usually available only on a sparse spatial and temporal network. They are therefore extrapolated using geographical and statistical data to obtain a global vision of emissions.

This extrapolation of local measurements generates important errors, due to high spatio-temporal variability of emission fluxes. As a result, despite considerable efforts to improve their accuracy, the current emission inventories still bear large uncertainties.

The significant advances in remote sensing technologies and improved satellite observation datasets have made possible the development of a top-down approach for estimating emissions from space.

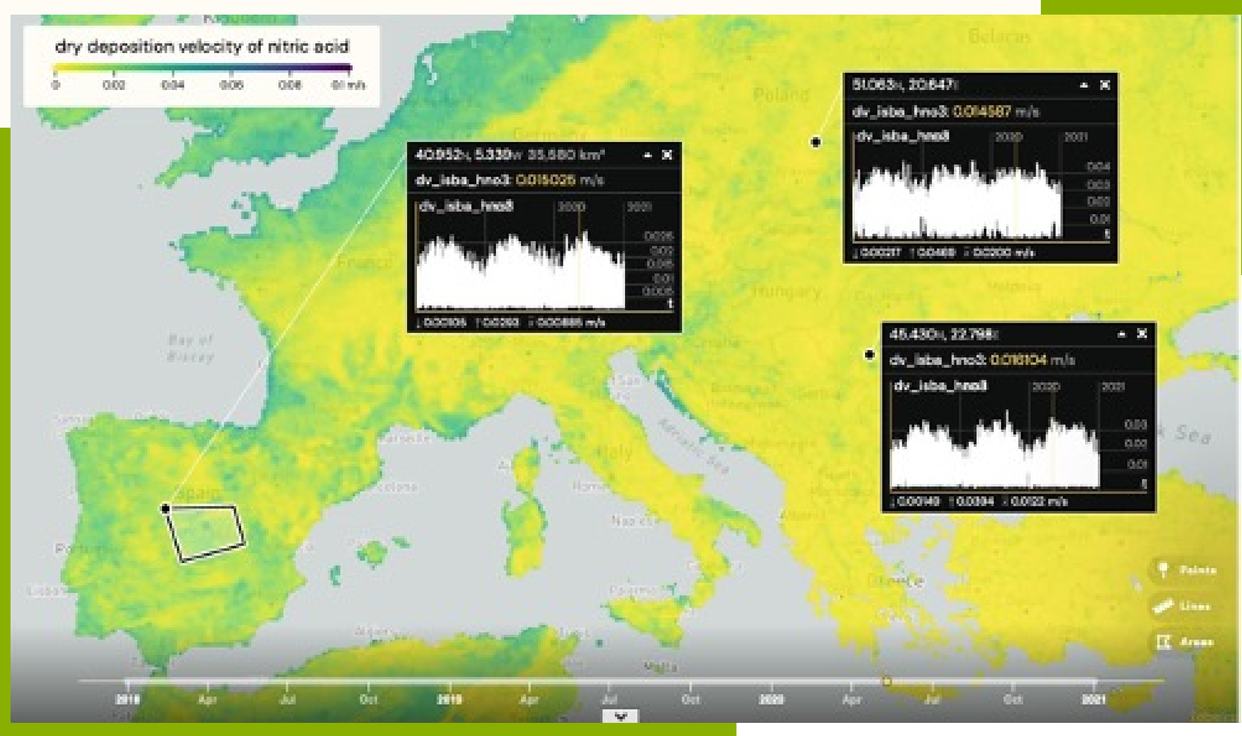
This approach relies on satellite observations, atmospheric models and on advanced state-of-the-art inversion techniques, which, when combined, allow us to ‘adjust’ the emissions of the model in order to reproduce as closely as possible the satellite observations.

The final outcome of the SEEDS project is a Data portal that disseminates top-down emission and deposition inventories, which are based on space borne chemical observations obtained from the Sentinel-5P TROPOMI sounder.

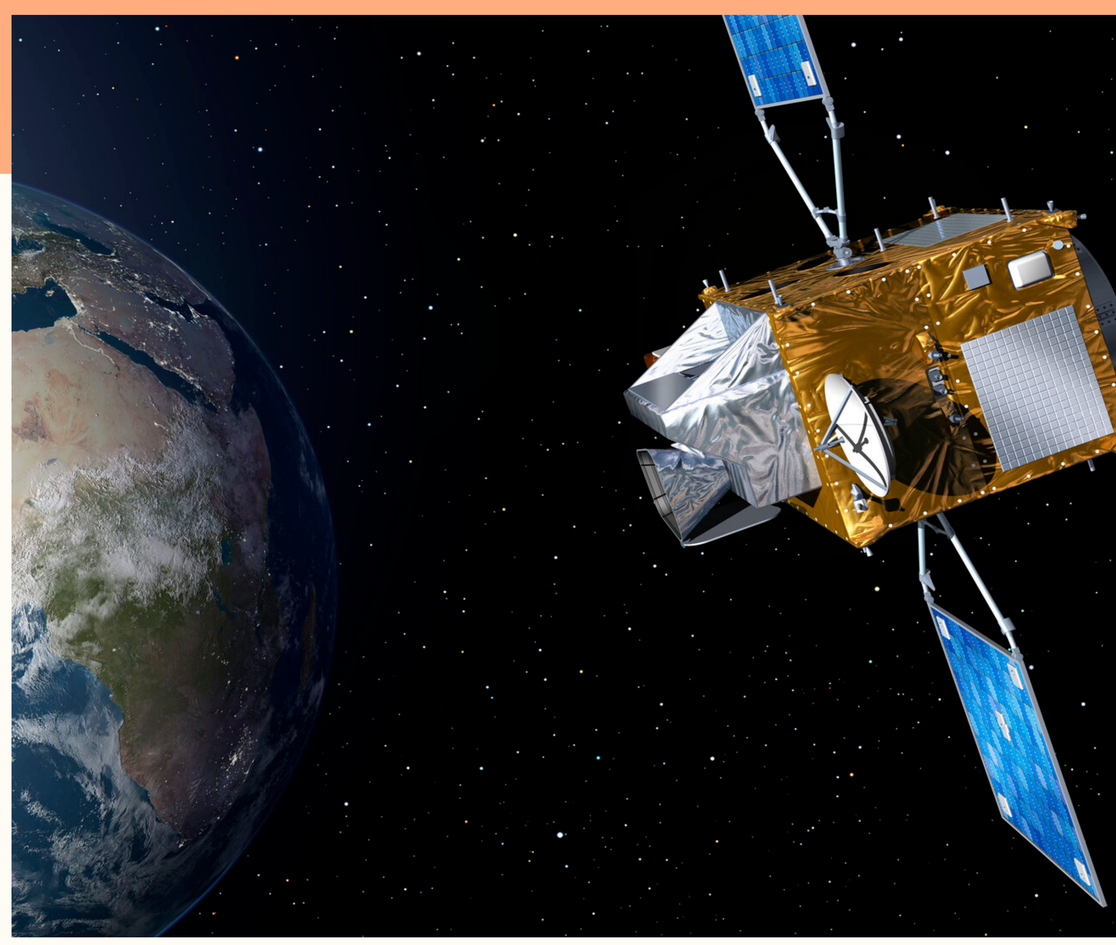
SEEDS data portal

The SEEDS data portal allows users to browse datasets of top-down emissions and deposition estimates derived from satellite observations. It is an interactive viewer which provides a global view over Europe, allowing users to select specific areas and generate time series plots for those areas.
All datasets are available for download.

Check it out!
https://www.seedsproject.eu/data



Enhancing emission estimations with Sentinel 5P

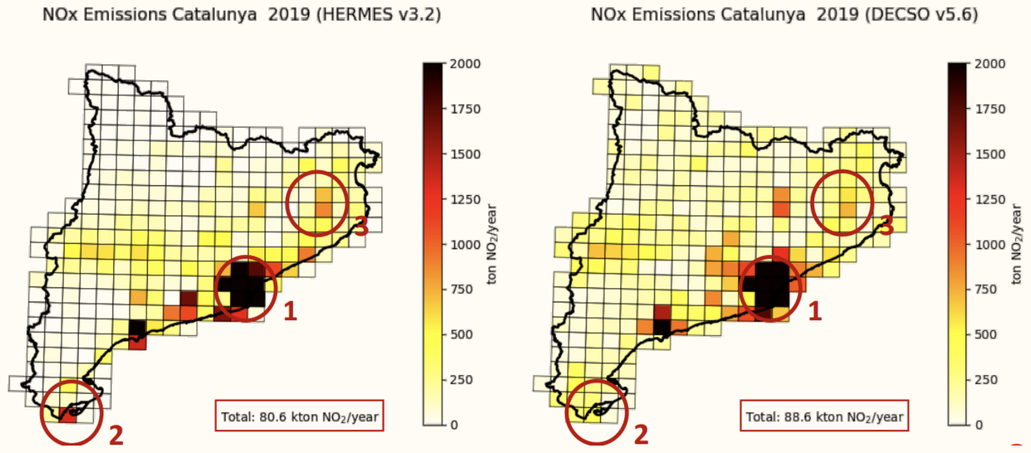


Sentinel-5P is the first Copernicus mission dedicated to monitoring our atmosphere, launched in 2017. Aboard is the TROPOspheric Monitoring Instrument (TROPOMI), a spectrometer which continuously orbits the Earth while taking measurements, which allows us to create daily global maps of atmospheric species, such as NO2, relevant for air quality and climate monitoring.

The top-down approach uses the distribution of atmospheric pollutants measured by TROPOMI in order to deduce the spatio-temporal distributions of emissions and depositions. It also allows to detect and quantify emissions from point sources, which are often misrepresented or missing from bottom-up emission inventories. This reverses the logic of the current bottom-up approaches based on emission inventories and dispersion models.

TROPOMI provides daily data with a resolution of 5.5x3.5 km2 at a global scale while overpassing at 13:30 local time. This data is then assimilated in inverse modelling algorithms such as DECSO and the adjoint of the MAGRITTE model in order to estimate emissions of pollutants over Europe.

The possibility of comparing top-down and bottom-up approaches is key to assess the value of satellite data for emissions estimates.



Comparison of 2019 emission estimations between a bottom-up approach (left) and SEEDS's top-down approach (right)

Stronger together

While the bottom-up approach is more accurate in situations with reliable emission data, the top-down approach offers an overall view which includes both direct and indirect emission sources.

Thus, both methods are complementary, as potential discrepancies between the two can be used to improve inversion algorithms or reveal unregistered emission sources.

The SEEDS endeavour to enhance emission assessment accuracy in the top-down approach has led to considerable improvements. The medium-term goal of the project is to make a valuable contribution with new quality data and products for the Copernicus Atmosphere Monitoring Service (CAMS).

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