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SEEDS - Sentinel EO-based Emission and Deposition Service

SEEDS
Sentinel EO-based Emission and Deposition Service

SEEDS 1st Stakeholder Information Meeting

23rd March 2022

NILU · Koninklijk Nederlands Meteorologisch Instituut, Ministerie van Infrastructuur en Waters · CERFACS, Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique · Météo France · cnrs · isardSAT · lobelia.

SEEDS

Sentinel EO-based Emission and Deposition Service

Sentinel 5P & Preparation for Sentinel 4

SEEDS develops a new service of air pollutant emissions and depositions products.

It is to demonstrate that enhanced satellite data use in emissions and depositions will not only improve the quality of the existing **Copernicus Atmospheric Monitoring Service (CAMS)** products but will also enable new products and methods for increased stakeholder uptake.

SEEDS – New Products

I. Anthropogenic emissions

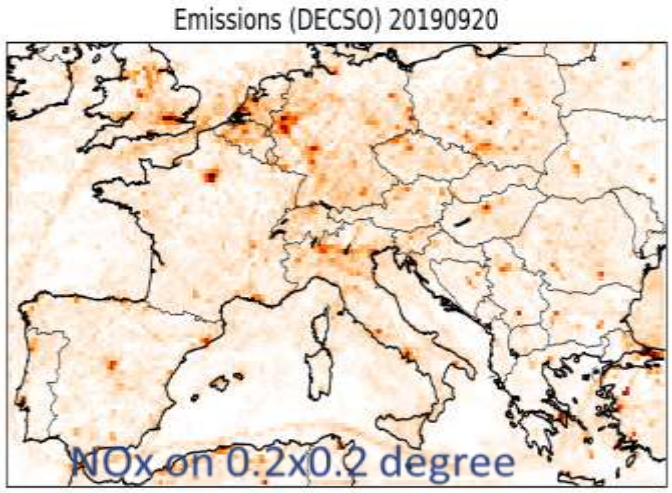
SEEDS uses inverse modelling to produce up-to-date high-resolution estimates of NOx, NH_3 and biomass burning emissions.

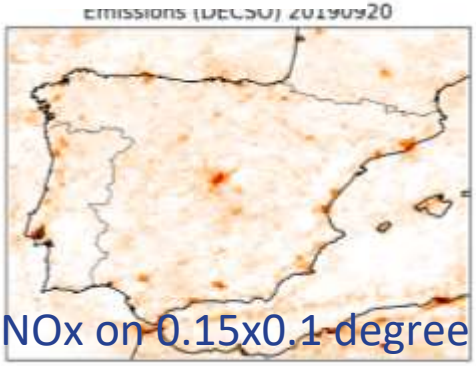
- **NOx** - 2019-2022 Monthly anthropogenic NOx emissions at up to 5 km resolution
- **NH_3** - 2019-2022 Monthly NH_3 emissions with 20 km resolution
- **Fires** - 2018-2022 Monthly biomass burning emissions at up to 10 km resolution

SEEDS – New Products

SEEDS
Sentinel EO-based Emission and Deposition Service

I. Anthropogenic emissions





- **NOx** Sentinel-5P TROPOMI observations and the inverse model DECSO (Daily Emission estimation Constrained by Satellite Observations).
- **Ammonia (NH_3)** DECSO model applied to IASI or CrIS observations.
- **Biomass burning (Fires)** via HCHO observations of S-5P TROPOMI using an adjoint of MAGRITTE model.

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SEEDS – New Products

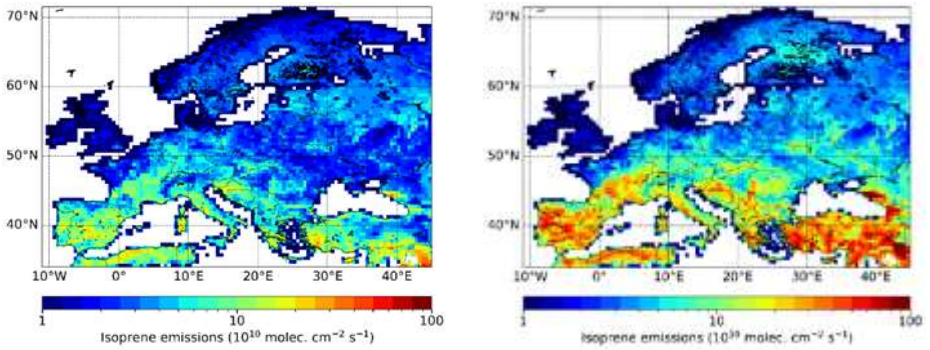
II. Biogenic emissions

SEEDS combines top-down inverse monitoring approach with high-resolution land-surface models to provide enhanced resolution biogenic emission products from satellite observations

- **Soil NOx** - 2019-2022 Agricultural soil NOx emissions at up to 5 km resolution
- **BVOC** -2019-2022 Top-down and bottom-up estimates of Biogenic Organic Compounds with 10 km resolution

SEEDS – New Products

II. Biogenic emissions



Isoprene emission maps of Europe before (left) and after (right) inversion

- Soil NOx emissions are derived from the DECSO inverse model and Sentinel 5P observations. This is a new product of SEEDS currently not available in CAMS.
- Top-down BVOCs flux estimates are inferred based on the MAGRITTE v1.1 regional atmospheric chemistry-transport model and Sentinel-5P TROPOMI data of formaldehyde columns.
- Bottom-up BVOCs are based on the MEGAN code linked to SURFEX land surface model

SEEDS – New Products

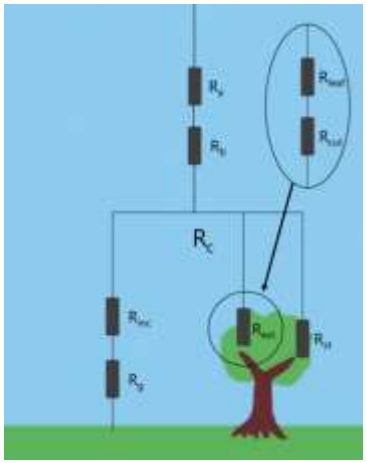
III. Land surface and deposition

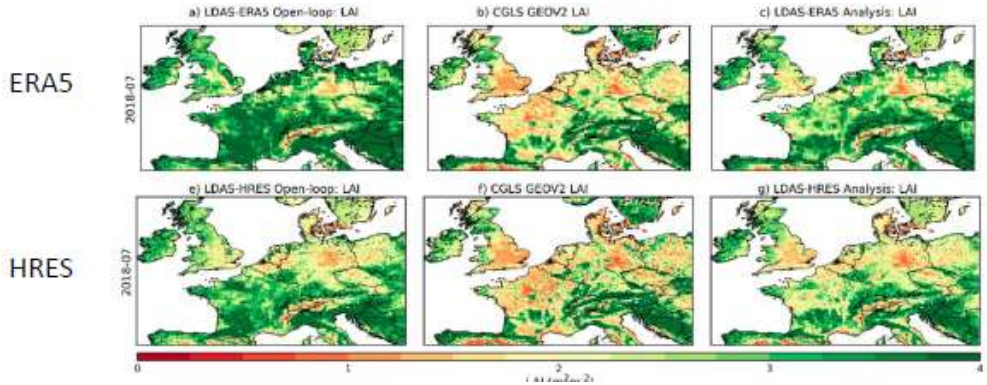
SEEDS offers EO-based estimates of soil moisture, vegetation variables, and deposition fluxes based on a coupled atmosphere-land-vegetation approach for direct use in precision agriculture applications.

- **LAI** - 2018-2022 Leaf area index data sets at 10 km spatial resolution
- **Soil Moisture** - 2018-2022 Soil moisture datasets at 10 km spatial resolution
- **Deposition** - 2018-2022 Deposition fluxes and diagnostics (e.g., stomatal resistance) for ozone and nitrogen at 10 km spatial resolution

SEEDS – New Products

III. Land surface and deposition





Impact of the 2018 heat wave in central Eupe on LAI (Albergel et al. 2019)

- **Soil moisture** products are derived from the SURFEX_LDAS_MONDE model combined with EO data the ASCAT-Metop series, in 10km resolution
- **LAI** products using the SURFEX_LDAS_MONDE combined PROBA-V and ASCAT satellite observations, also in 10km resolution.
- **Deposition fluxes** are linked to the land-surface SURFEX_LDAS_MONDE and produced based on the EMEP dry deposition scheme implemented in the MOCAGE model.

SEEDS – New Products

IV. Advanced data assimilation algorithm

SEEDS develops an advanced data assimilation algorithm (4DEnVar) to prepare the way for better exploitation of the hourly data from Sentinel 4 and improve air quality forecasts in the CAMS operational system

- **Open-source code** with the 4DEnVAr algorithm for use by a wide range of researchers and scientific experts.

SEEDS – Demonstration

V. Improved CAMS products

The added-value of the **SEEDS** emission and deposition products is demonstrated though their capabilities to improve the current **CAMS** operational type chain to prepare further production and use in downstream applications.

The capabilities of

- SEEDS up-to date emission data
- SEEDS deposition and land surface data
- SEEDS 4DEnVar DA algorithm
- the combined SEEDS methods and data

to **improve current CAMS regional forecasting products** will be systematically evaluated in a part of the CAMS production chain

SEEDS – Demonstration

V. Improved CAMS products

- The performance of the new SEEDS emission and deposition products and the 4DEnVar algorithm are to be assessed individually and collectively against existing CAMS air-quality forecast and analyses.
- The basis of the evaluation is the MOCAGE modelling chain that is currently operational in the CAMS production system.
- The focus is on forecasting results for ozone, NO_2, PM10 and PM2.5 as they represent the most critical air quality species and the ones that are chemically related to the new emission products.

SEEDS – Demonstration

VI. Stakeholder engagement

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Explore the possibilities

Agriculture and forestry

SEEDS products on soil moisture and leaf area index can support environmental management practices in precision agriculture while the SEEDS deposition products for ozone and nitrogen can inform control options for eutrophication and crop yield damage.

Urban planning

SEEDS products for urban planning include both anthropogenic and biogenic emissions products as well as improved air pollution forecast of NOx, ozone and PM that can support local administrations in cities develop sustainable zero-pollution city plans.

Industry

SEEDS anthropogenic emission products can be used by industry (metallurgy, cement, energy, oil and gas production sectors) as independent and scientifically sound data to validate monthly emissions from space.

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SEEDS – Demonstration

VI. Stakeholder engagement

SEEDS events

Webinar: Stakeholder insights for product development

March 2022 Online

A first webinar will take place in 2022 to understand stakeholders' needs and expectations from the SEEDS products.

SEEDS

Stakeholder information meeting

23rd March 2022

Webinar from 9:30 to 12:30 CET

Final Agenda

09:30 - 09:35	Welcome
09:35 - 09:45	The SEEDS project goals and products (Leonor Tarrasón, NILU)
09:45 - 09:55	SEEDS and CAMS User Uptake (Cristina Ananasso, ECMWF, CAMS)
09:55 - 11:30	**SEEDS Emission products** *(what they are, how are they different from other existing products, how are they useful, who are they intended to)*
09:55 - 10:00	NOx anthropogenic emissions (Ronald van der A, KNMI)
10:00 - 10:05	Industrial plant emission validation products (Henk Eskes, KNMI)
10:05 - 10:10	Fire emission products (Maite Bauwens&Jenny Stavrakou, BIRA-IASB)
10:10 - 10:15	NOx soil products and NH_3 emissions (Jieying Ding, KNMI)
10:15 - 10:20	Biogenic emission products (Glenn-Michael Oomen. BIRA-IASB)
10:20 - 10:30	EEA expectations on emission validation from satellite (Federico Antognazza, EEA)
10:30 - 10:40	SEEDS emissions added value to CAMS (Jeroen Kuenen, TNO)
10:40 - 11:10	Open discussion on emission products *(incl. polls and questions to the audience via Slido)*
11:10 - 11:15	*Comfort break*
11:15 - 12:30	**SEEDS Deposition and agriculture relevant products** *(what they are, how are they different from other existing products, how are they useful, who are they intended to)*
11:15 - 11:20	Soil moisture and LAI products (Jean-Christophe Calvet, MF-CNRM)
11:20 - 11:25	Deposition of Nitrogen and Ozone products (Paul Hamer, NILU)
11:25 - 11:35	Environmental impacts of Nitrogen and Ozone and relevance for precision agriculture (Isaura Rábago, CIEMAT)
11:35 - 11:45	Use of soil land surface data in precision agriculture (Suzanne Higgings, AFBINI)
11:45 - 12:15	Open discussion on soil and deposition products *(incl. polls and questions to the audience via Slido)*
12:15 - 12:30	Summary and conclusions
12:30	End of meeting

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SEEDS – Stakeholder engagement

VI. Stakeholder engagement

Join at slido.com
#874761

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SEEDS Consortium team

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Sentinel EO-based Emission and Deposition Service

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CERFACS - E. Emili, P. Piacentini

MF-CNRM J. Arteta, J.-C. Calvet, V. Guidard, V. Marécal

ISAT – Lobelia Earth – A. Naranjo, Pau Moreno, C. Costa

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Thank you

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