SEEDS

Sentinel EO-based Emission and Deposition Service

WP 1: Anthropogenic Top-down Emissions

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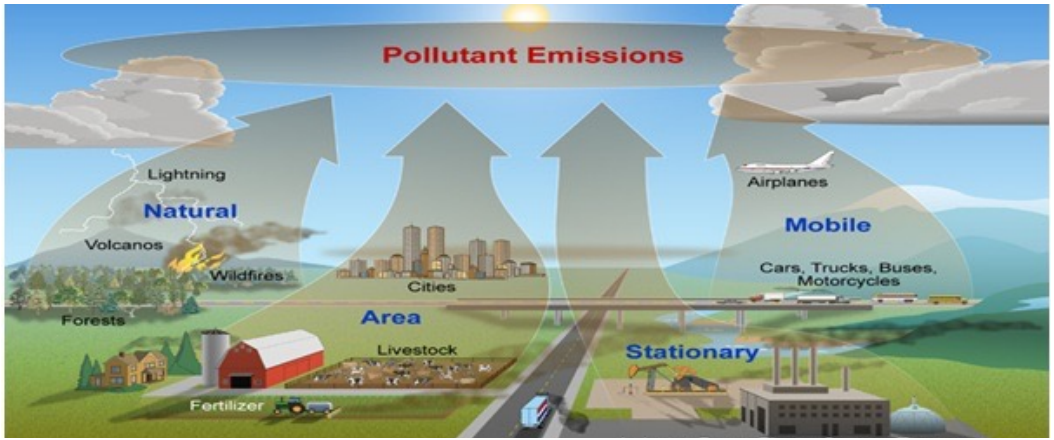
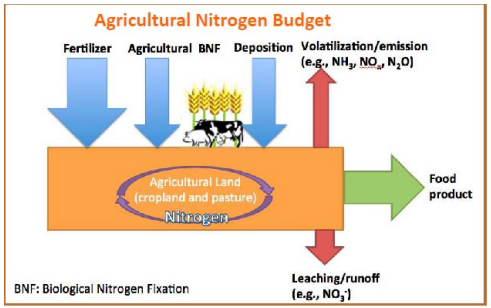
Kick-off meeting, 19 January 2021

Introduction





NH_3

NO_x

Themes:

- Nitrogen cycle
- Air pollution
- Eutrophication

Anthropogenic sources:

- Industry (VOC, NOx)
- Power plants (NOx)
- Traffic (NOx)
- Agriculture (NOx, NH3)

Biogenic sources:

- Fires (VOC, NOx, NH3)
- Soil (NOx)
- Forest (VOC)

Goals of WP1

- Delivery of up-to-date anthropogenic emissions of
  - NOx (energy sector, industry, traffic)
  - Ammonia (NH3) from agriculture and fires
  - Biomass burning (VOC emissions from fires)
- Up-to-date = satellite-based (Sentinel 5p and MetOp)
- Uncertainties will be quantified
- Data ready for use in CAMS
- Demonstration for Sentinel 4 of diurnal cycle.

Links with other WPs

- WP2: related methods and deliverables
- WP3: information exchange on ammonia fluxes
- WP4: delivery of input related to error covariances
- WP5: emission input for application in MOCAGE
- WP6: input for dissemination, innovation pathway. Flexible in responding to user requirements.

Approach

- NOx: DECSO method applied to TROPOMI observations. For various domains/resolutions. In addition, a distinction between anthropogenic and biogenic emissions will be made.

- Ammonia (NH3): DECSO method applied to IASI or CrIS observations.

- Biomass burning (VOC) via HCHO observations of TROPOMI using an adjoint of MAGRITTE model.

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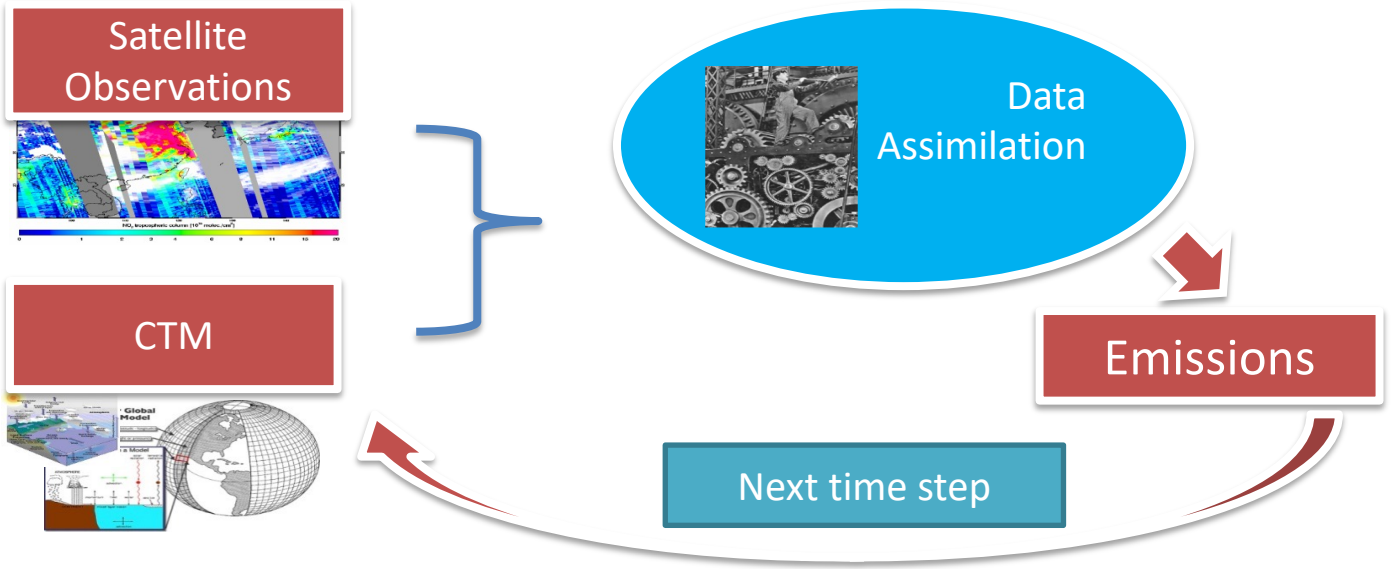
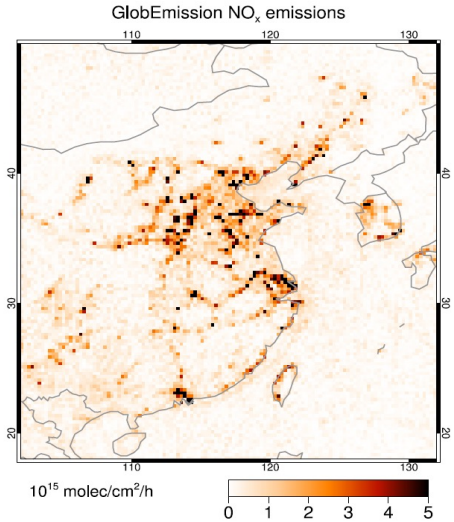
DECSO

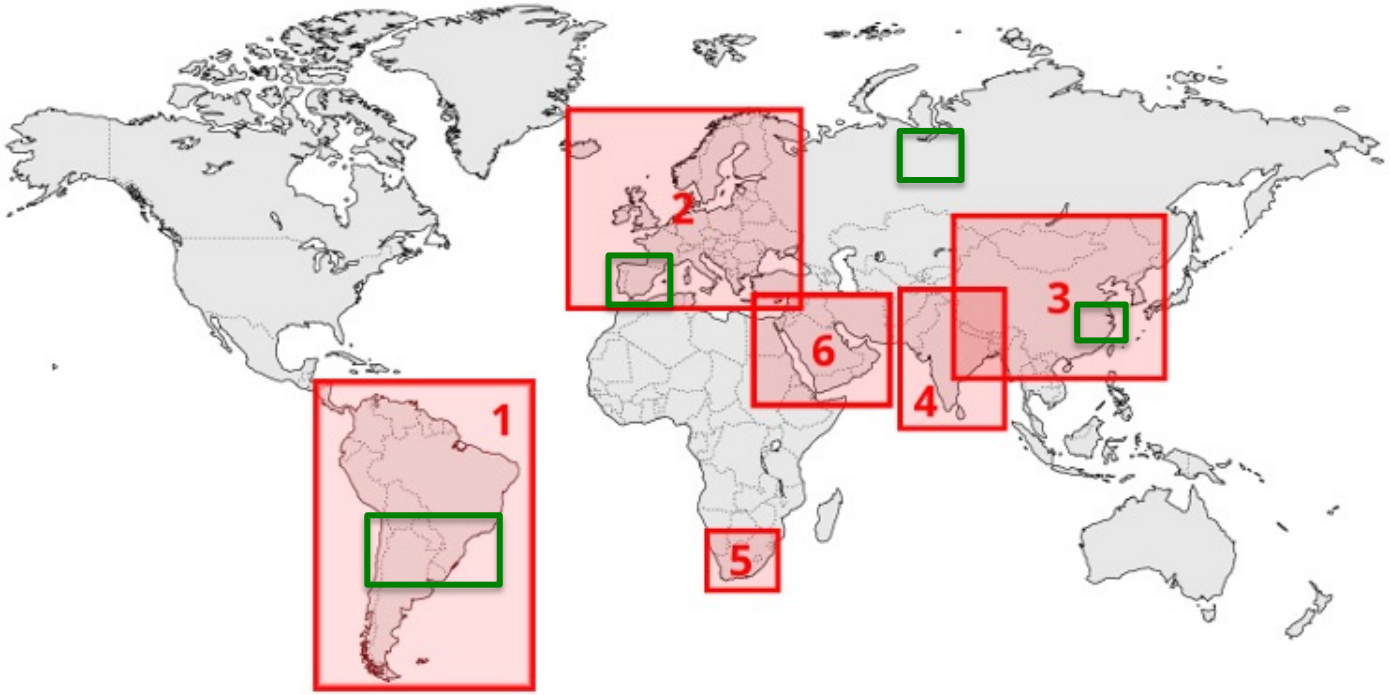
- method -

- Emissions adapted to match satellite data and model results using data assimilation (Kalman Filter)





DECSO applications

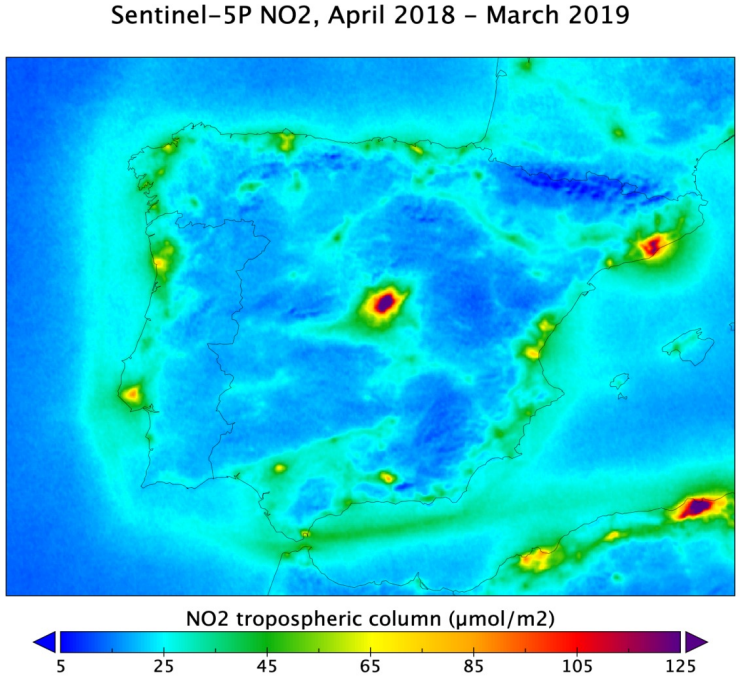


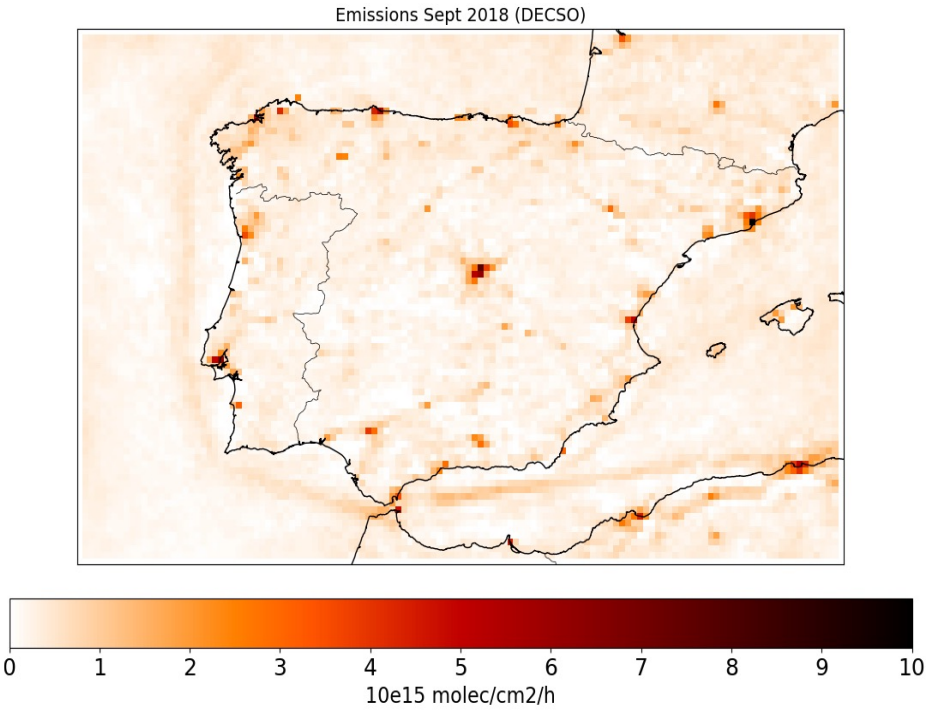
Red: applied to OMI or GOME-2 (except 1)

Green: applied to TROPOMI

DECSO

- application to TROPOMI (1) -



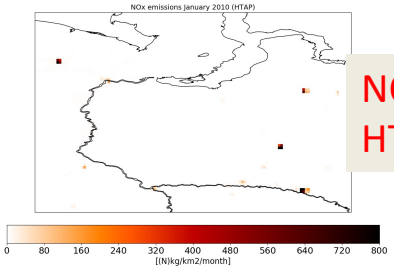


- Results from the H2020 project AirQast

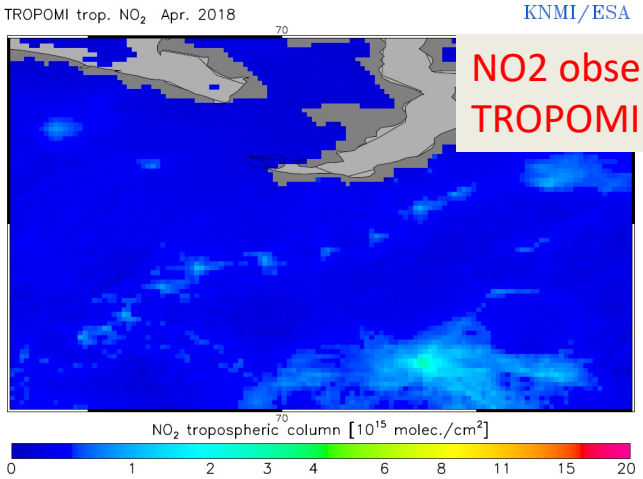
DECSO

- application to TROPOMI (2) -

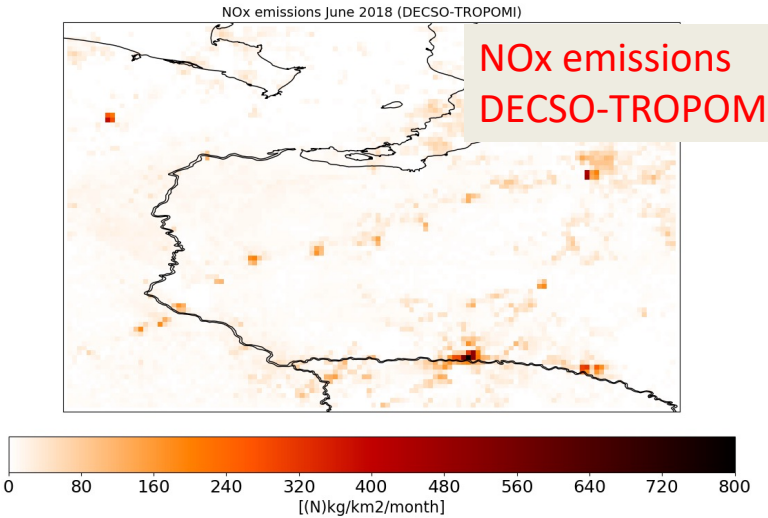
West Siberia: gas compressor stations along pipeline to transport gas to Europe show up in map of NOx emissions



NOx emissions HTAP



NO2 observations TROPOMI



NOx emissions DECSO-TROPOMI

Tasks SEEDS-WP1

T1.1 Split of anthropogenic and biogenic NOx emissions for Europe

T1.2 High resolution NOx emissions on 0.05 degree

T1.3 Satellite-derived ammonia emissions for Europe

T1.4 Derivation of S5p-based biomass burning emissions (see also WP2)

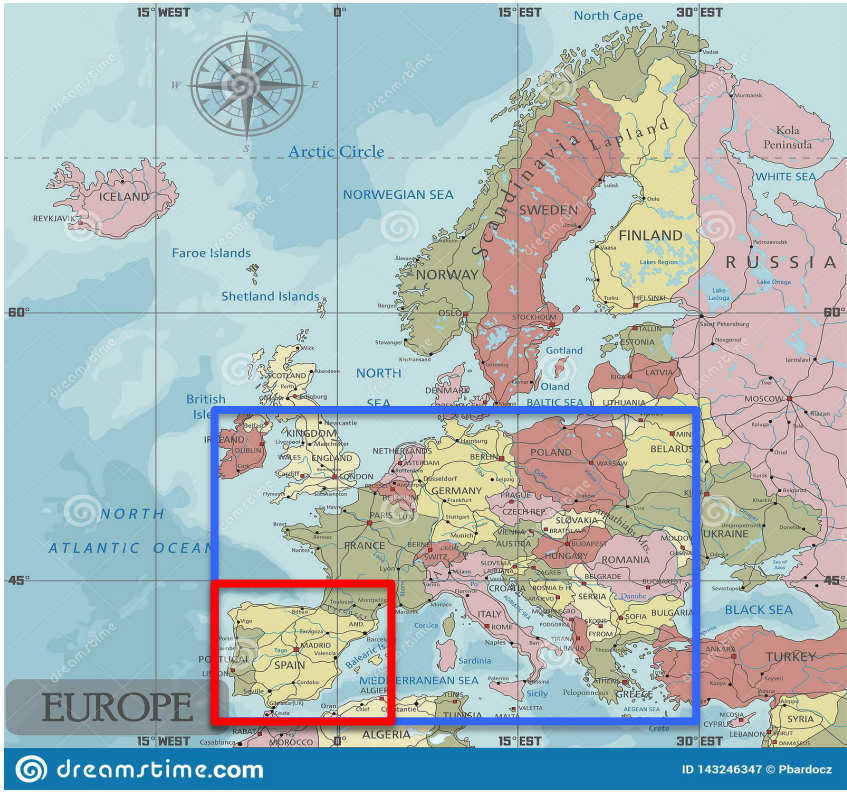
T1.5 Uncertainties in S5p-based biomass burning emissions

T1.6 Demonstration of possibilities of NOx emissions from S4-simulations

Task 1.1 (delivery M15, M30)

- Anthropogenic and biogenic NOx emissions for Europe

- Development steps:
  - 0.25 x 0.25 degree for Europe for (-10W-30E, 35-55N).
  - Separate version for Spain on 0.1 x 0.15 for (-10W-4E, 35-45 N) for testing.
  - Spain will be used for evaluation of the divergence method



Task 1.2 (deadline M18, M30)

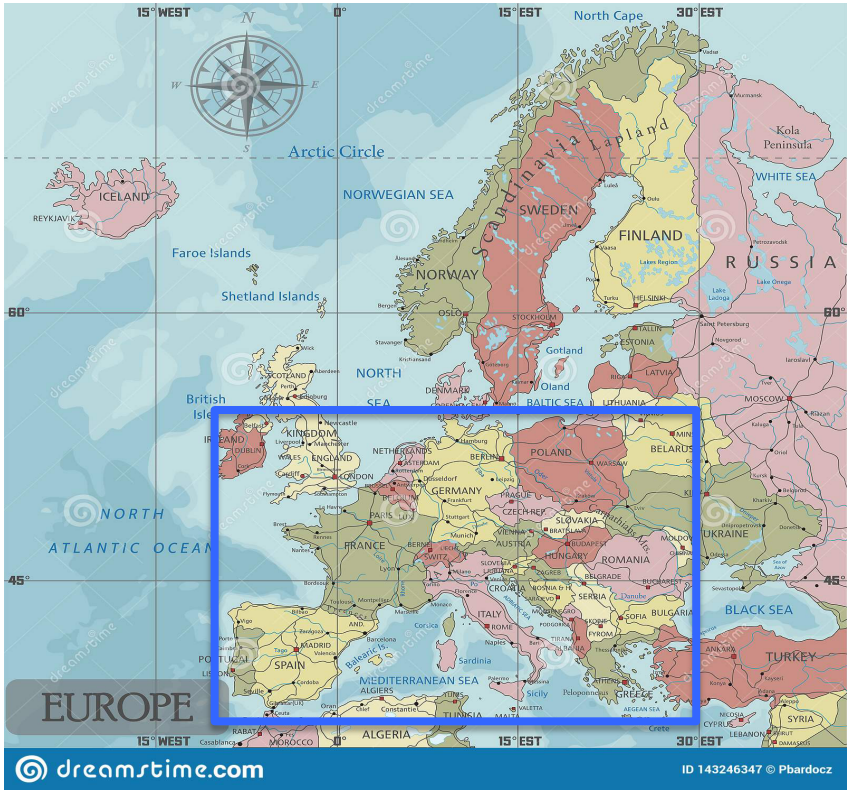
- High resolution NOx emissions on 0.05 degree for part of Europe (50-54N,2-9E)

- Additional:
  - A version of DECSO for Spain on 0.1 x 0.15 degree for (-10W-5E, 35-45 N).
  - Test superobservations for speed and accuracy.

Task 1.3 (delivery M17, M30)

- NH3 emissions

- Development:
  - 0.25 x 0.25 degree for Europe for (-10W-30E, 35-55N). Same as NOx.
  - Can we use recent years for IASI (and/or CrIS) like for TROPOMI?



Task 1.6 (deadline M36)

- For S4-simulation we use overlapping orbits of S5p on high latitudes, for example Norilsk (69N) or Murmansk (68N) where we have at least 8 orbits per day in the summer.

- To be prepared:
  - Domain around Murmansk (*) with 0.1 x 0.3 degree?
  - Use DECSO or divergence method?

- We will start with a preparational study to arctic sources.

Planning for the next 6 months in WP1: KNMI

List of activities:

- New definition of modelling grids in correspondence with CAMS grid. (already done)
- Collection of satellite data and meteo data (2018-2020). (started)
- Evaluation of using the faster super-observations. (started)
- Evaluation of cloud-computing of DECSO.
- Experiments with biogenic/anthropogenic split.
- Processing NOx emissions for Spain. Evaluation of new divergence method for Spain.
- Preparing satellite data as input for NH3 inversions.

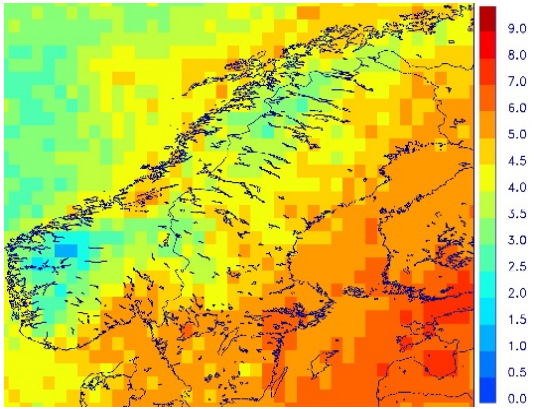
Deliverables:

- No official deliverables planned, but communication with other groups/work package is important in this phase.

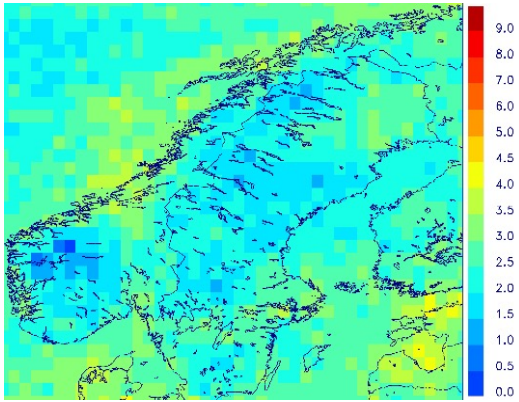
Planning for the next 6 months in WP1: BIRA-IASB

- Implement GFED4 fluxes as a priori in MAGRITTE model; Compare with fire estimates from the GFAS inventory during 2018-2019
- Use proxies, e.g. MODIS fire counts or AOD to identify fire scenes and possibly improve top-down biogenic emission estimates
- Perform MAGRITTE simulations to quantify the impact of fires on HCHO columns

- Challenge: co-occurrence of fires and biogenic emissions in warm conditions; E.g. both high biogenic emissions and fires contributed to the strong HCHO columns detected in Sweden in July 2018



TROPOMI HCHO - July 2018



TROPOMI HCHO - July 2019

About MAGRITTE and inversion method to constrain VOC fluxes, cf. WP2 presentation