SEEDS

Sentinel EO-based Emission and Deposition Service

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SEEDS soil NOx emissions

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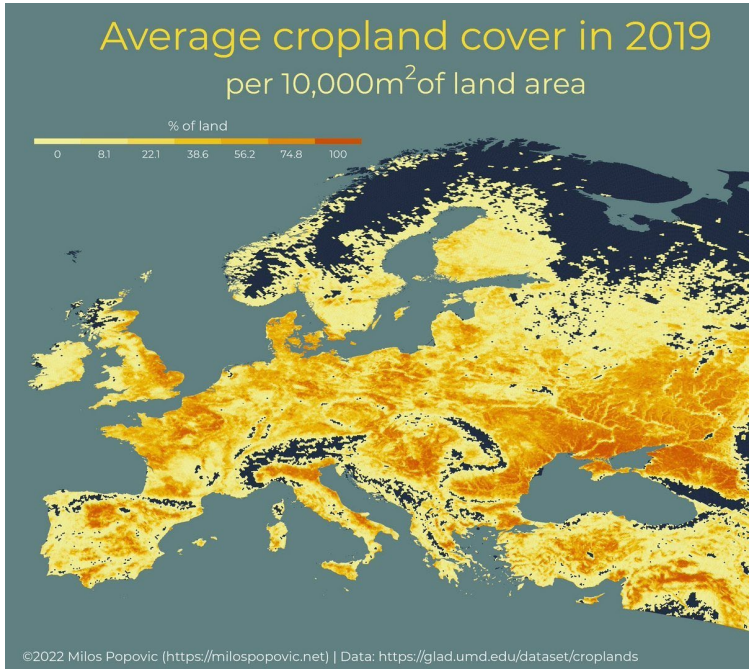
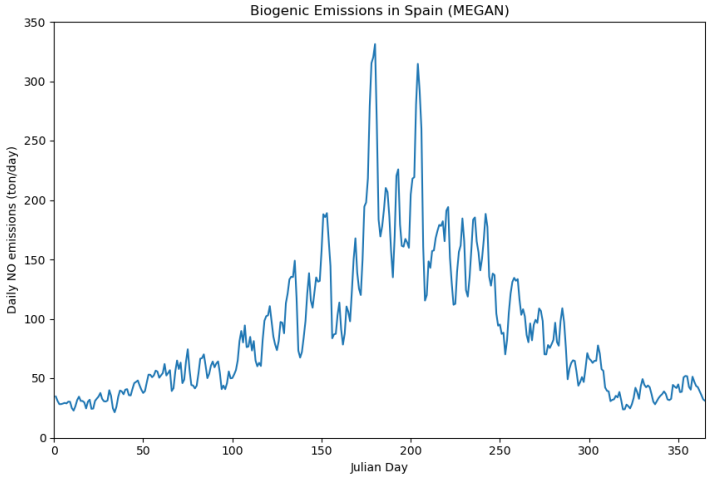
Introduction – biogenic emissions

- Soil emissions come from bacterial activity in the soil.
- Emissions are from cropland, grassland, and forest, thus almost every grid cell contain biogenic emissions.
- Emissions have a strong temperature (and rainfall) dependence, which show up in the seasonal cycle.
- Emissions are highly variable from day-to-day, but not on a monthly scale
- Satellites see only total emissions, thus a post-processing is applied based on the seasonal cycle and land-use information



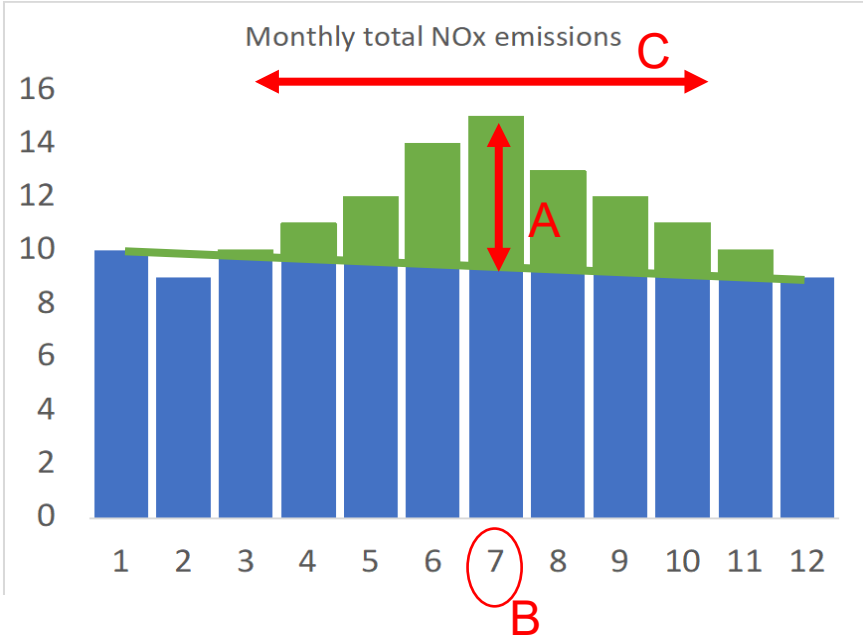


How to differentiate between anthropogenic and soil NOx

Assumption:

- Monthly averaged soil emissions follow the seasons in Europe with a peak in summer. The emissions over a year can be described by a symmetrical function, for example a gaussian function.

$$f(t) = A\, e^{\frac{-(t-B)^2}{2C^2}}$$



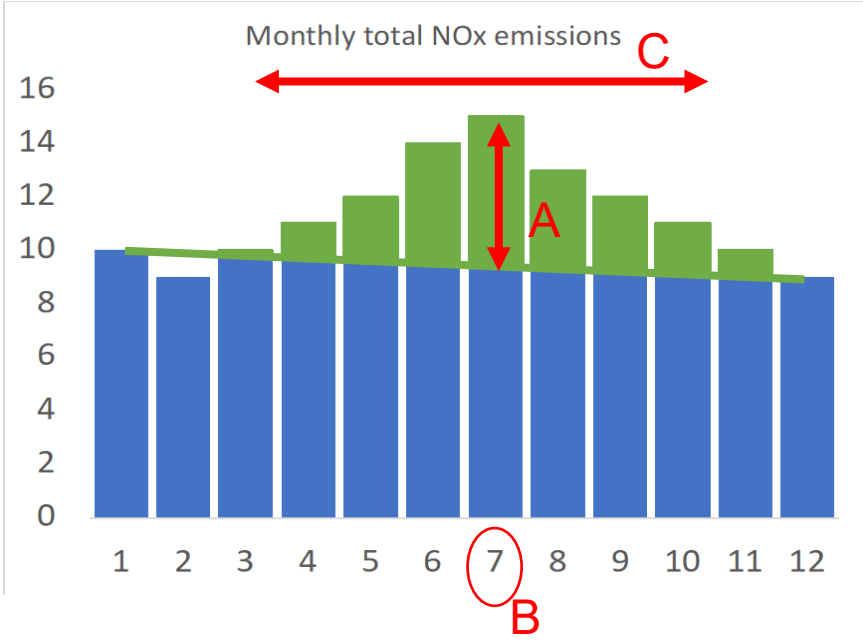
Method to derive the soil NOx

$$f(t) = A\, e^{\frac{-(t-B)^2}{2C^2}}$$

A, B, C?

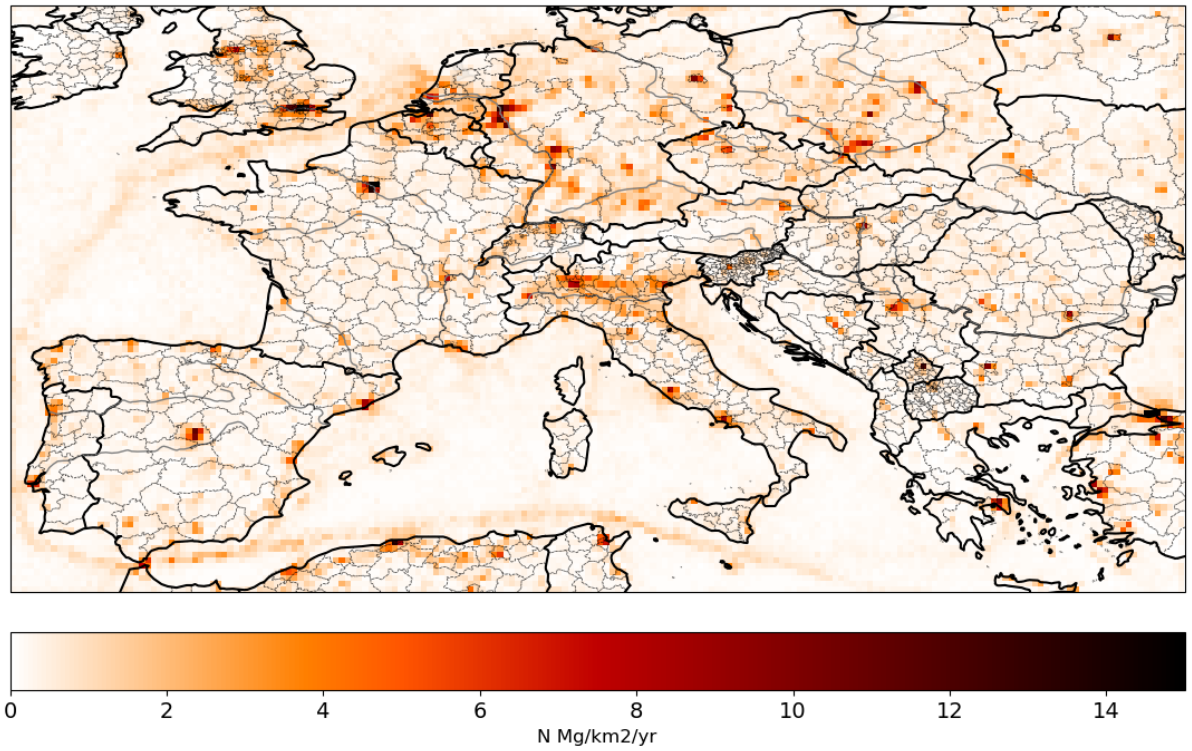
1. Select purely non-urban pixels
2. Fit parameters *A,B,C* per land-use type (crop, forest, and “other”)
3. Interpolate the parameters spatially.
4. Calculate soil emissions per pixel using land cover fraction (from Copernicus Global Land Service)

   Check: No monthly NOx can be higher than total NOx

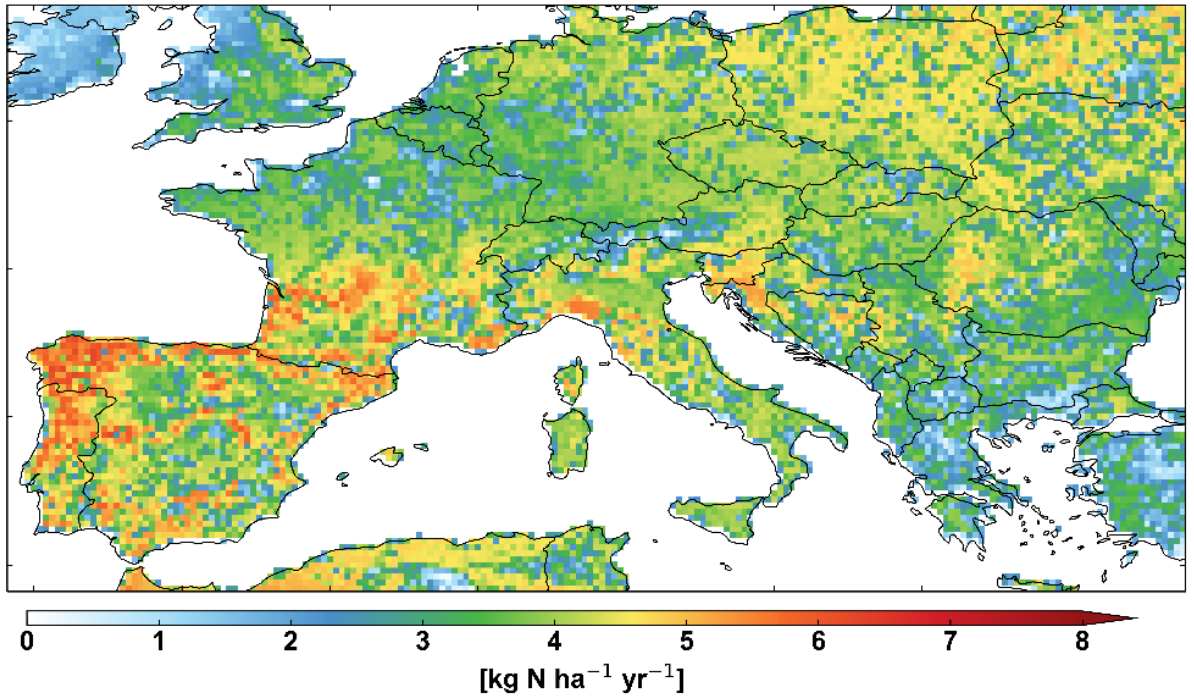


Derived NOx emissions for Europe (2019)

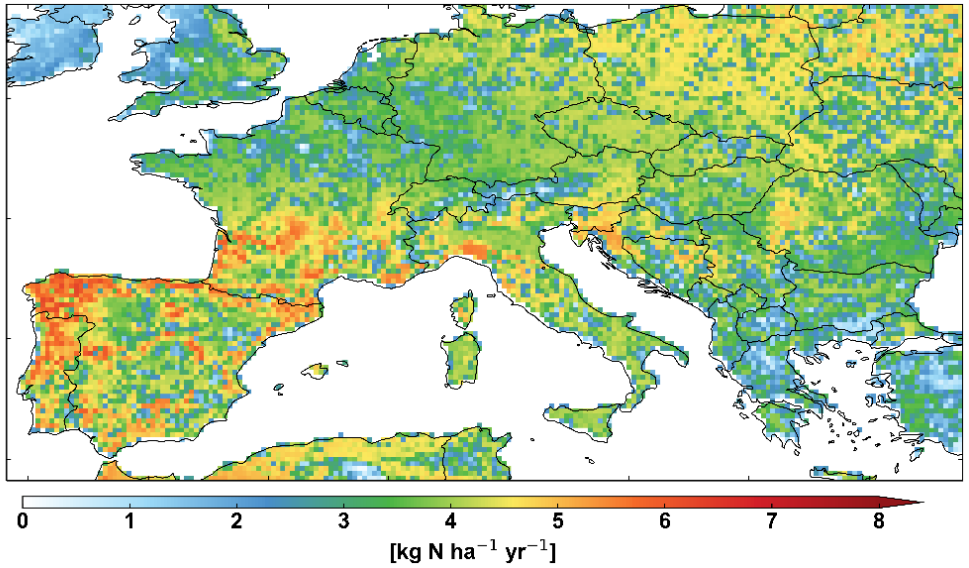
Anthropogenic NOx



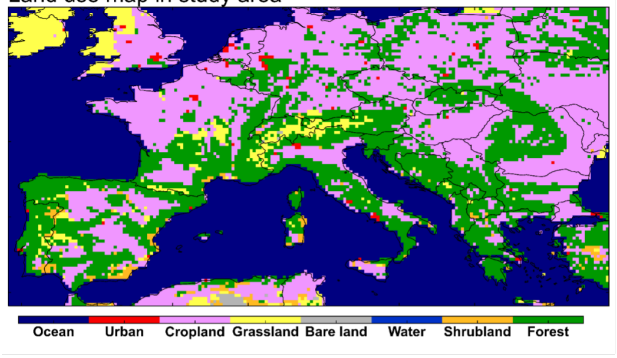
Soil NOx



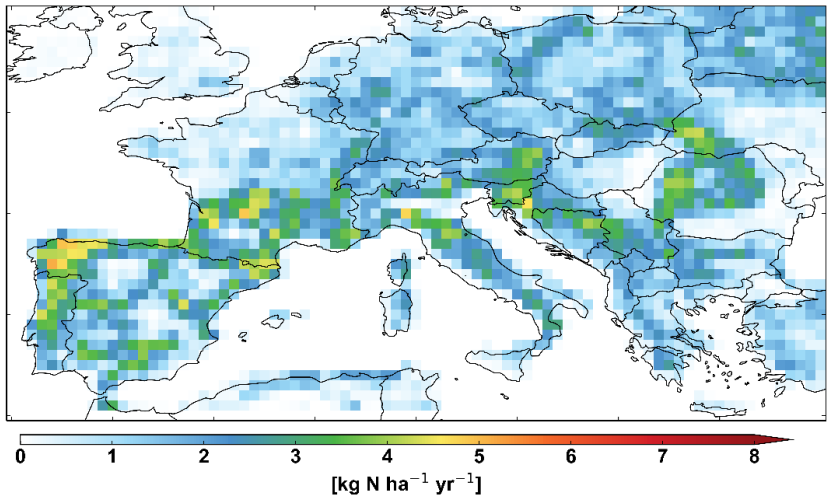
Differentation between cropland and forestry



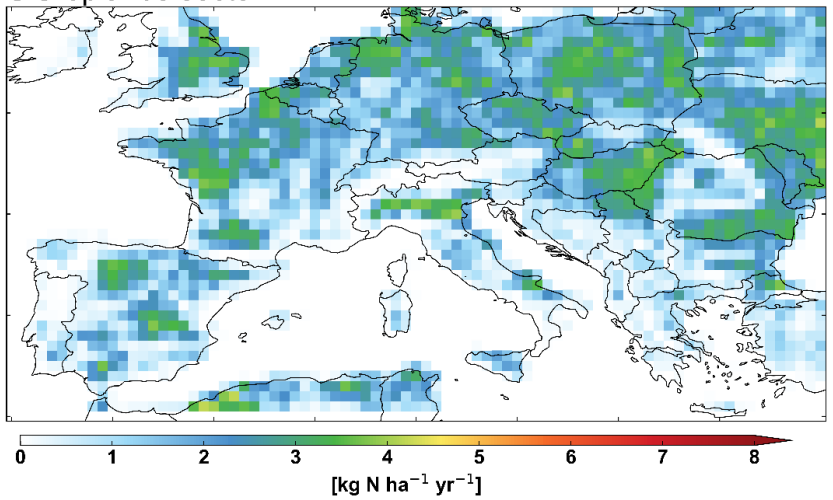
Land use map in study area



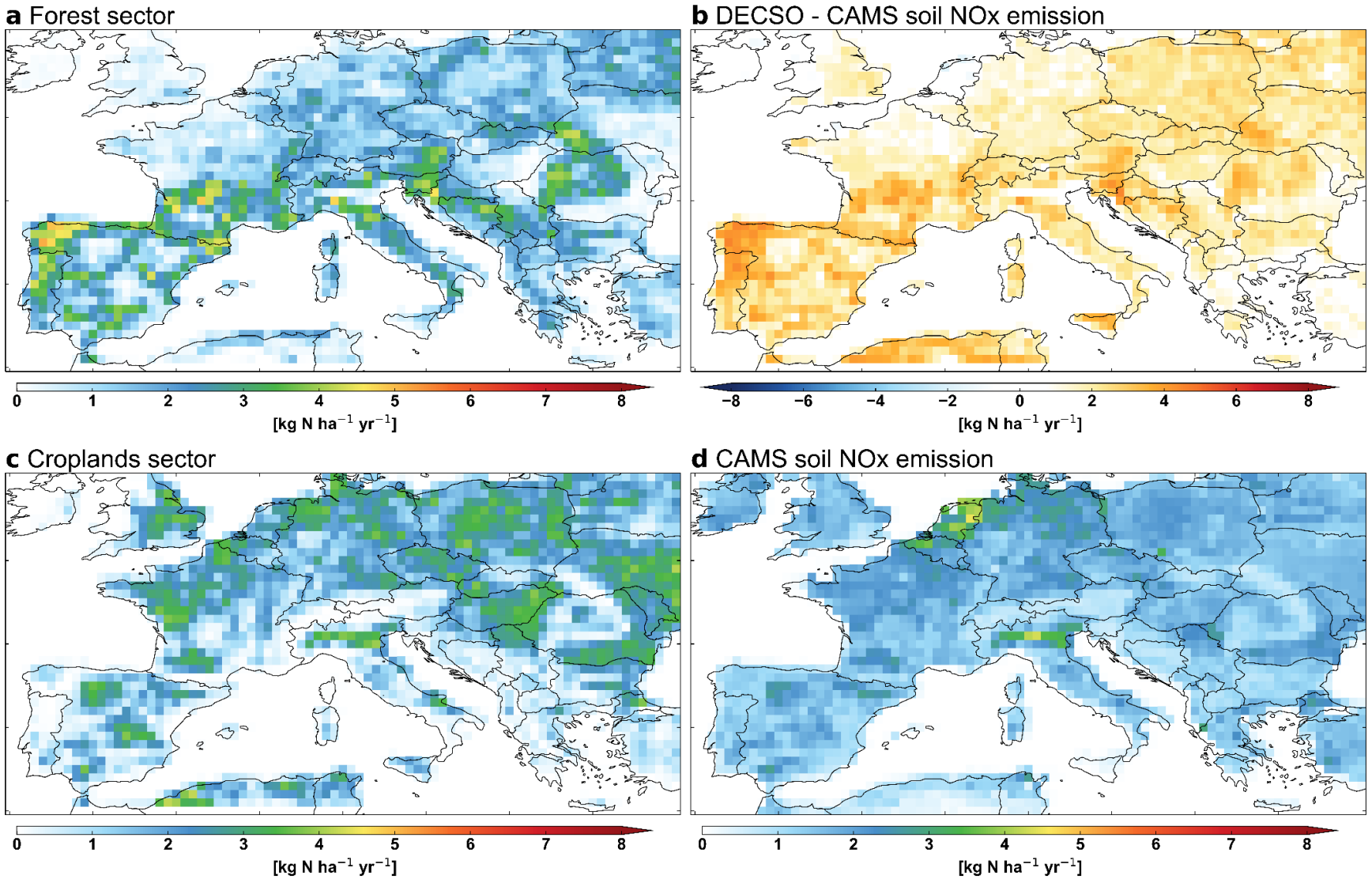
a Forest sector



c Croplands sector



Comparison to CAMS



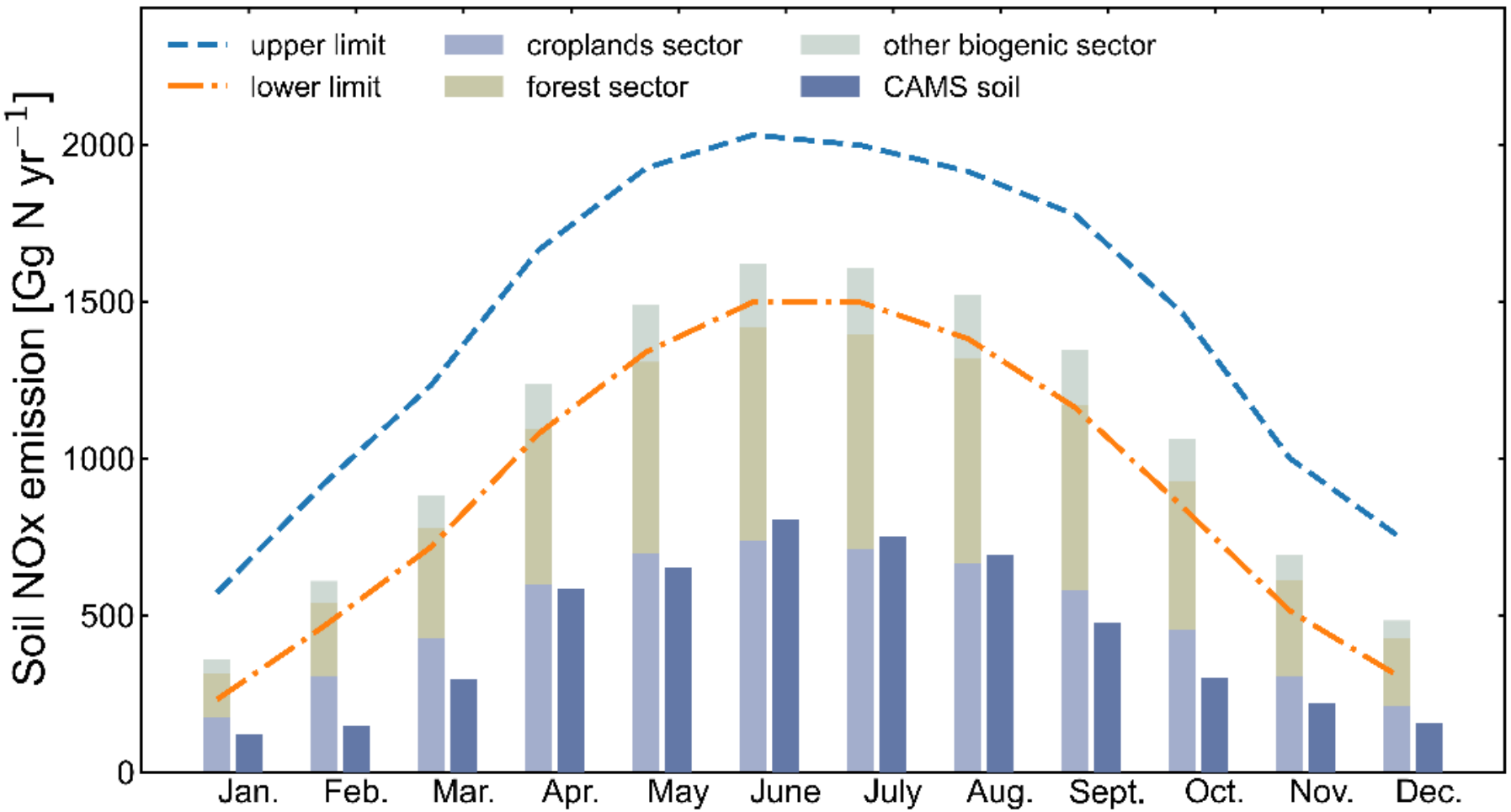
Evaluation of total emissions

- Total emissions:

	Other (Tg N yr^{-1})	Forest (Tg N yr^{-1})	Croplands (Tg N yr^{-1})	Total soil (Tg N yr^{-1})
CAMS	N/A	N/A	N/A	0.4
DECSO	0.1	0.5	0.5	1.1
DECSO-lower limit	0.1	0.4	0.4	0.9

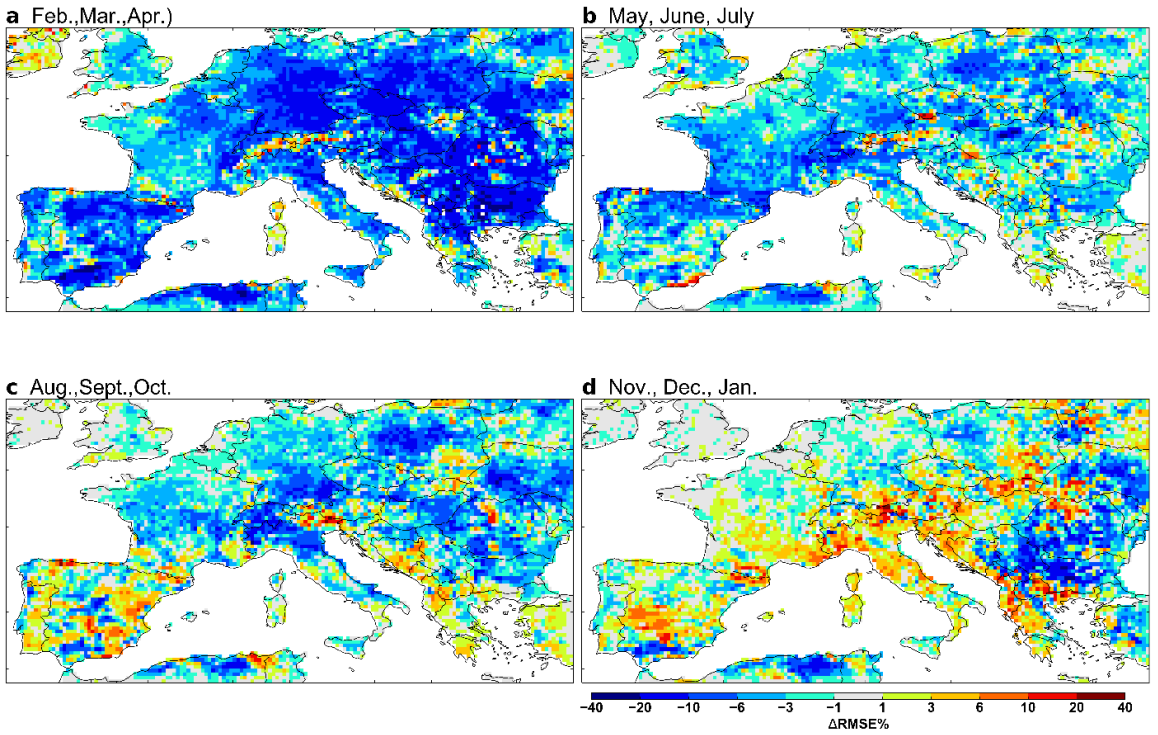
- DECSO-lower limit:
  - Assuming there is a bias inTROPOMI or DECSO, then we can remove this bias by assuming that in the winter (December-January) all emissions in Europe are anthropogenic and recalculate the soil-emissions.

Seasonal cycle



Evaluation by chemical transport model IFS-COMPO and comparison with TROPOMI observations

1. IFS-COMPO with CAMS emissions
2. IFS-COMPO with CAMS emissions & DECSO replacing the soil NOx emissions



Green/blue: IFS closer to TROPOMI
Yellow/red: IFS further from TROPOMI

SEEDS Biogenic NOx emissions

Summary

- Post-processing method to distinguish anthropogenic and biogenic emissions. Biogenic emissions are split in emissions of croplands, forestry and ‘other’ (eg. shrubland).
- Cropland emissions agree with CAMS, but forest emissions of DECSO are much higher.