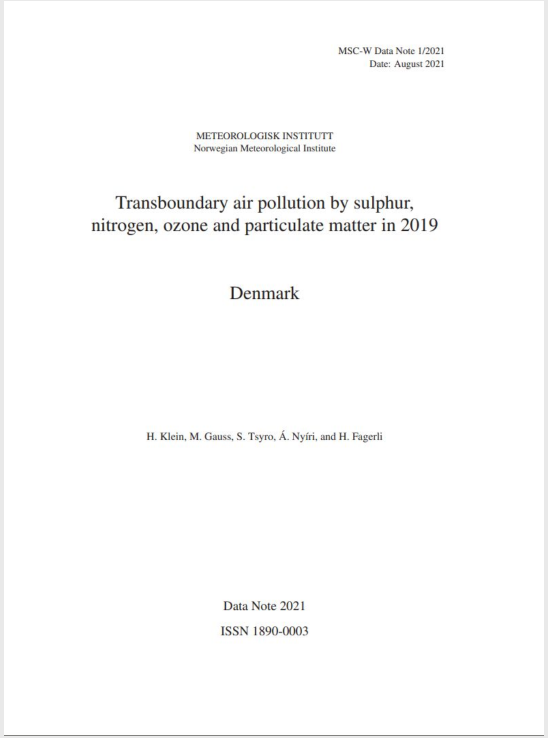
MSC-W: Progress in 2020/2021

Hilde Fagerli, David Simpson, Svetlana Tsyro, Agnes Nyiri, Jonas Gliss, Eivind Grøtting Wærsted, Hans Brenna, Anna Benedicow, Jan Eiof Jonson, Heiko Klein, Jan Griesfeller, Augustin Mortier, Peter Wind, Bruce Denby, Qing Mu, Michael Gauss

EMEP & WGE Steering Body, September 2021



MSC-W Data Note 1/2021
Date: August 2021

METEOROLOGISK INSTITUTT
Norwegian Meteorological Institute

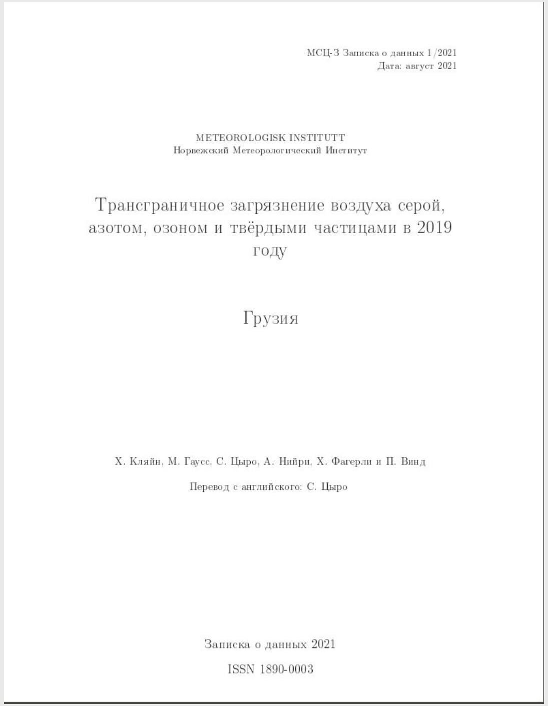
Transboundary air pollution by sulphur, nitrogen, ozone and particulate matter in 2019

Denmark

H. Klein, M. Gauss, S. Tsyro, Á. Nyíri, and H. Fagerli

Data Note 2021

ISSN 1890-0003



МСЦ-З Записка о данных 1/2021
Дата: август 2021

METEOROLOGISK INSTITUTT
Норвежский Метеорологический Институт

Трансграничное загрязнение воздуха серой, азотом, озоном и твёрдыми частицами в 2019 году

Грузия

Х. Кляйн, М. Гаусс, С. Цыро, А. Нийри, Х. Фагерли и П. Винд

Перевод с английского: С. Цыро

Записка о данных 2021

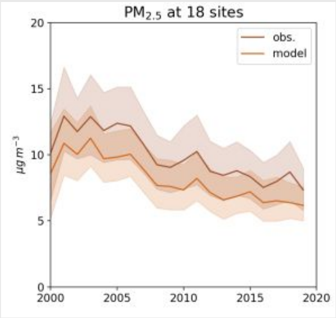
ISSN 1890-0003

Country reports (also in Russian for a number of countries)

Assessment of air pollution in 2019, source receptor matrixes, country reports done with emissions 'including condensables'

https://emep.int/publ/reports/2021/

Trends in air pollution

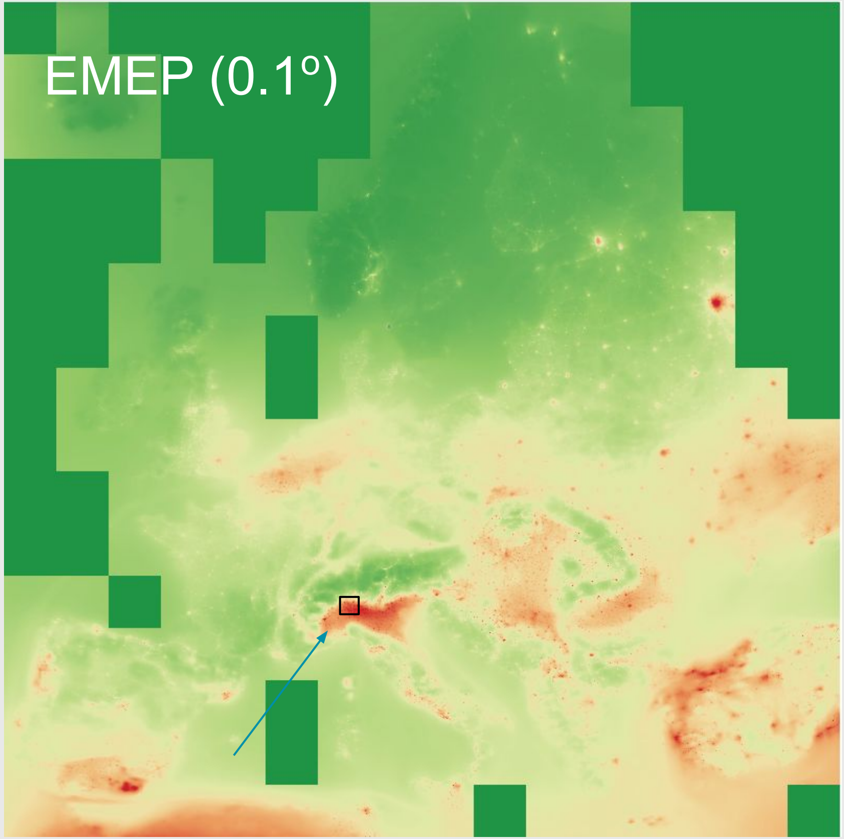


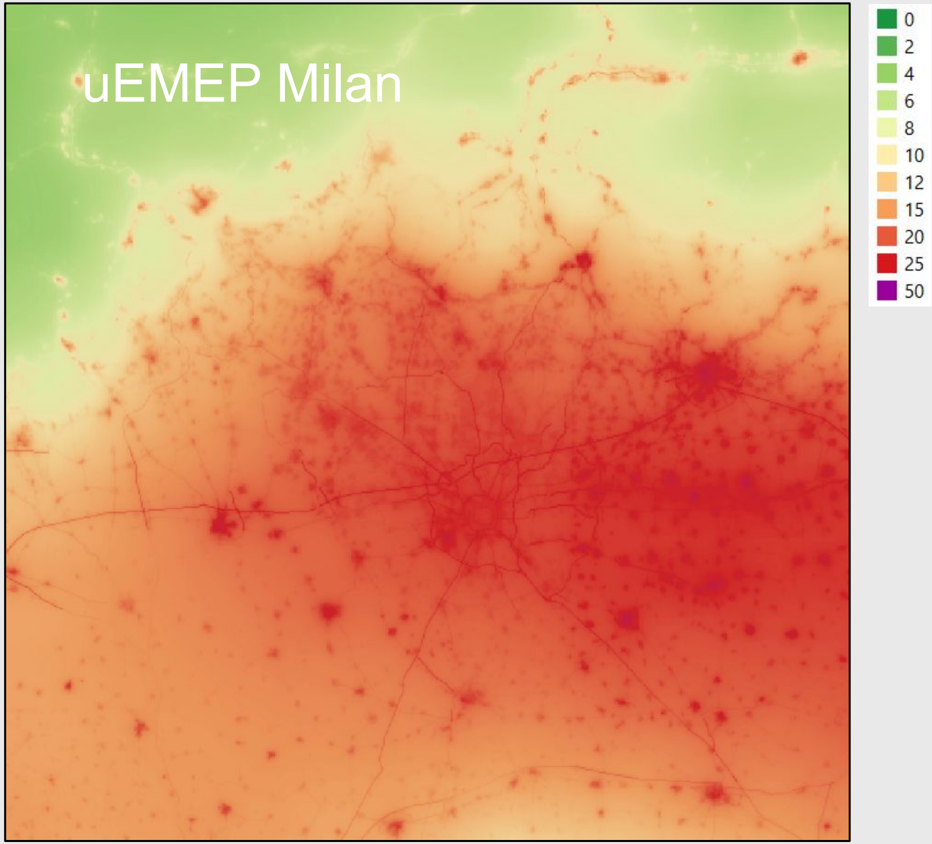
- Analysis of trends 2000-2019 (to be presented in GP review session)
  - Model calculations in 0.1x0.1 with revised emissions (total and gridding)
  - EMEP observations
  - Sulphur (SO_2, SO_4^{2-}, wet dep), oxidized nitrogen (NO_2, HNO_3, NO_3^-, wet dep), reduced nitrogen (NH_3, NH_4^+, wet dep), $PM_{2.5}$ and PM_{10} (chemical species, including EC/OC from 2010-2019), ozone
- Issues: trends for EECCA (and western Balkan) countries are not presented as reported emissions to a large extent is missing and observations are lacking - large uncertainties
- For PM: ‘condensables’ are included *as they are in reported EMEP emissions*, thus they are not consistently included (historical data set including condensables do not yet exist)

What are projected trends? (including distance to WHO targets) MSC-W & CIAM

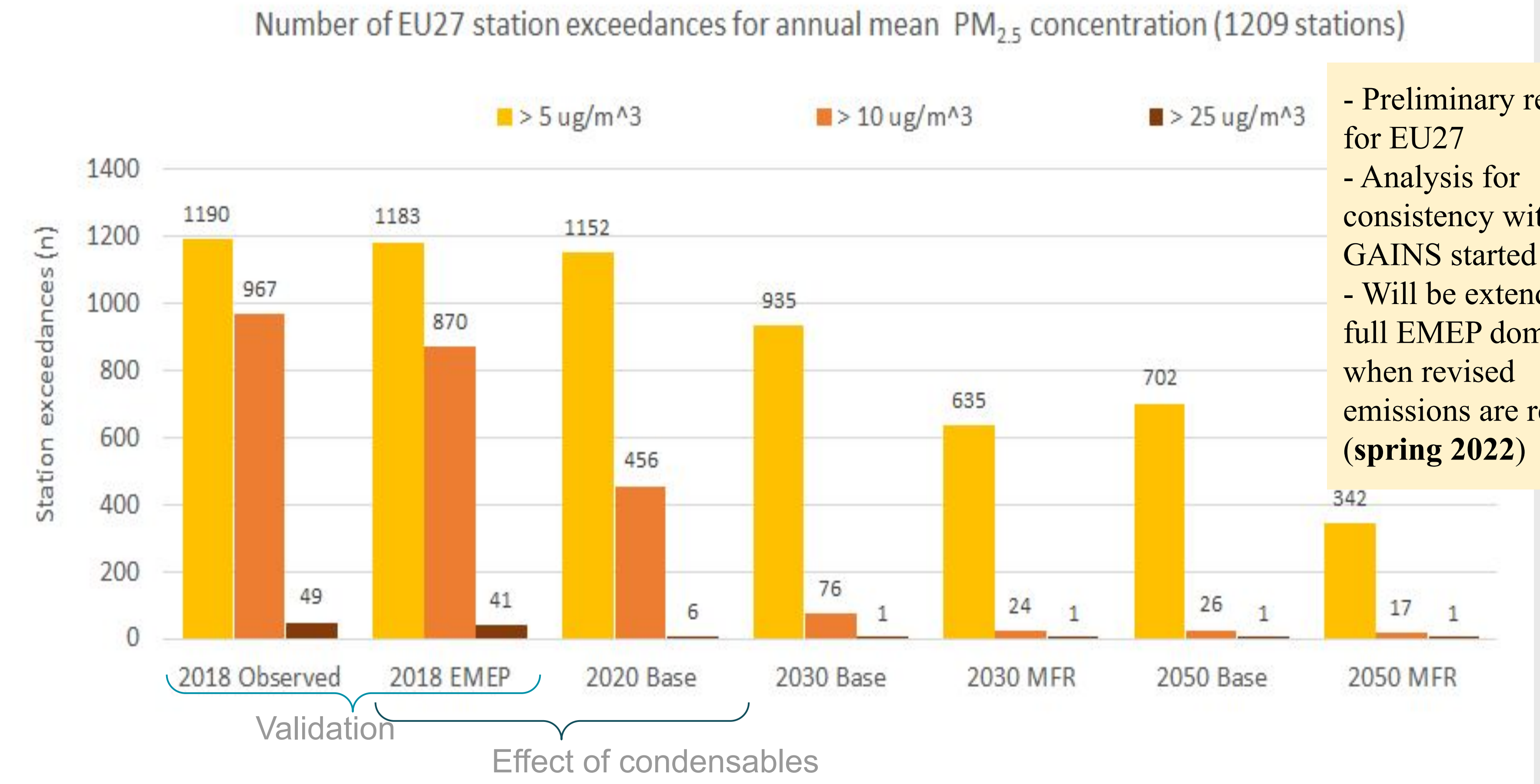
- Ongoing work - so far only ‘West EMEP’
- Emissions:
  - Present day (2018 - EMEPwREF2C) + GAINS 2020
  - **Baseline** (including Green Deal, 2nd CAO) for 2030 + 2050
  - **MFR** 2030 + 2050
  - **MISSING: emissions/projections for EECCA/western Balkan (available end 2021)**
- Method:
  - EMEP + uEMEP (downscaling to ca 250 m) modelling of PM, NO_2, ozone
  - Comparison at AirBase stations for 2018 (check of methodology etc for present day)
  - Comparison to GAINS for consistency checks etc.
- Will be expanded to full EMEP domain **spring 2022** (providing ‘best possible’ modelling data for future scenarios, including e.g. depositions, POD etc)

$PM_{2.5}$ map of Europe at 250 m



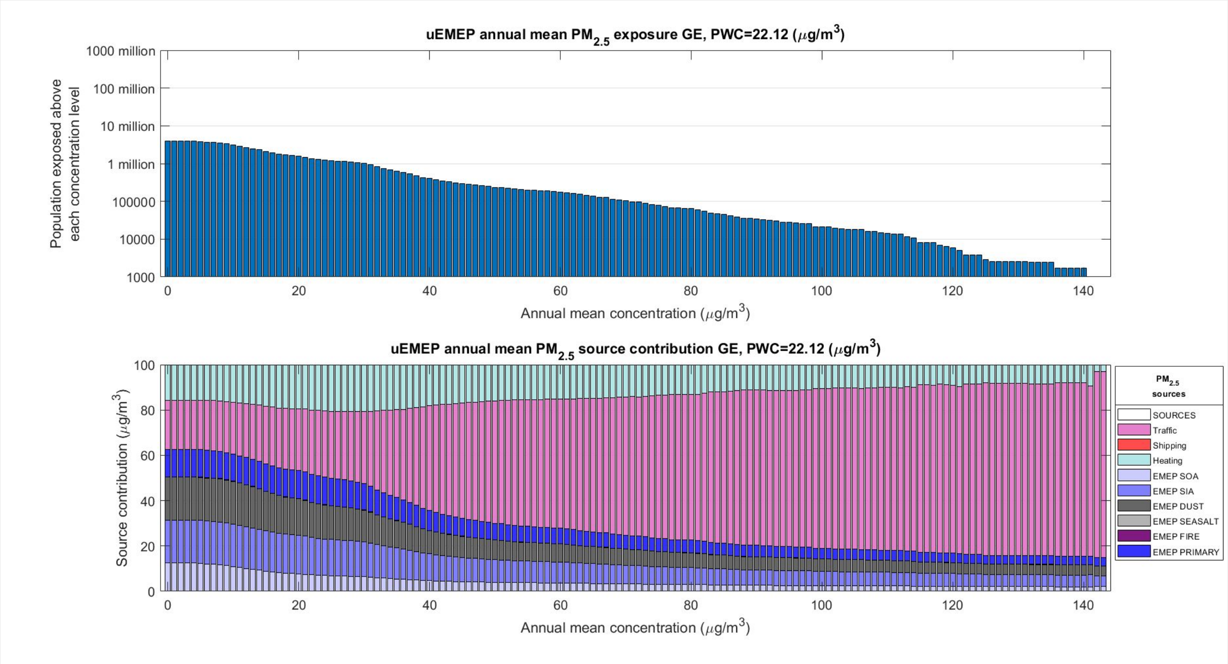


Number of sites above three threshold levels for $PM_{2.5}$ (1376)



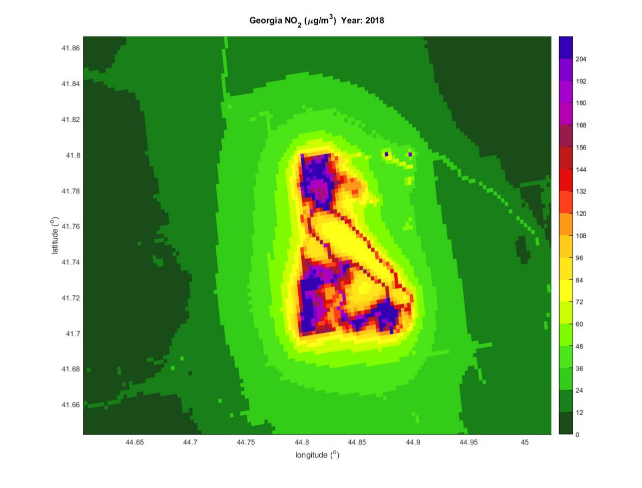
- Preliminary results for EU27
- Analysis for consistency with GAINS started
- Will be extended for full EMEP domain when revised emissions are ready (**spring 2022**)

Example of preliminary assessment for EECCA: $PM_{2.5}$ population exposure Georgia (*needs revised emissions*!)



Extremely high traffic contribution in and around the capital Tbilisi, responsible for almost all concentrations over 25 ug/m3 (pop 1.1 mill)

Note: Accumulative population frequency distribution



Indicates overestimate of traffic emissions in general

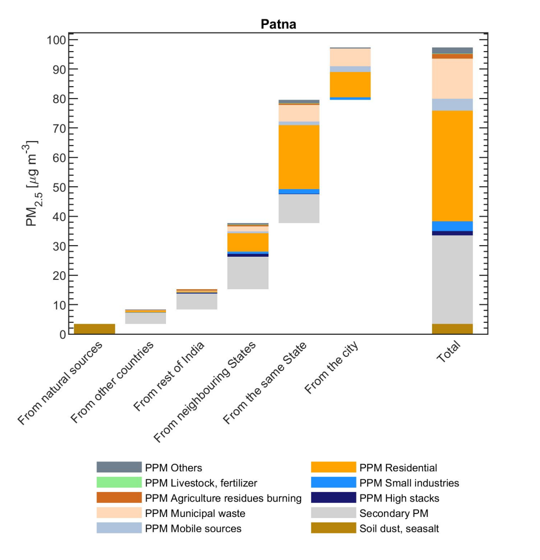
Ongoing work (with CIAM) : input to ‘revised GAINS’

Why?

- Better emissions & model data for EECCA (& increased domain for GAINS)
- Consistent multi-scale approach for GAINS for full EMEP domain using the EMEP MSC-W multiscale developments (local fraction methodology and uEMEP)
- Prepare for use of condensables
- Some new parameters implemented, e.g. new seminatural vegetation for POD calculations in Mediterrenean (in cooperation with WGE)

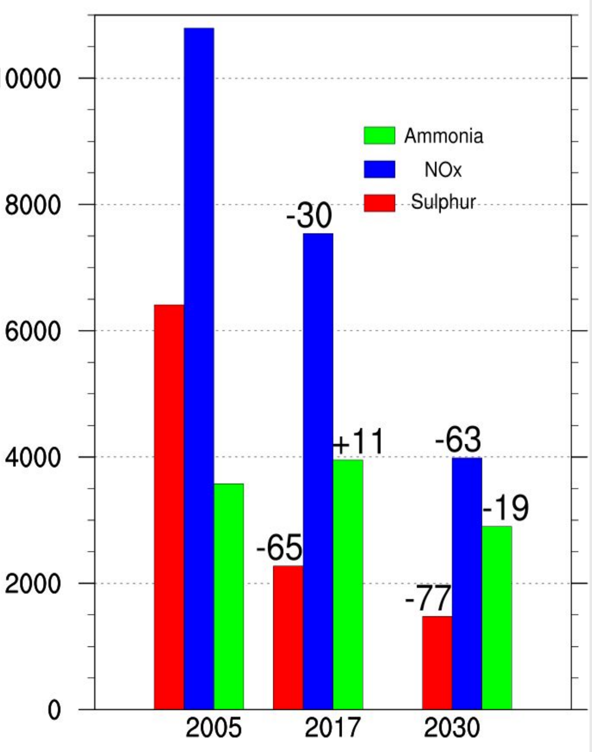
Timeline:

- Emissions: ~ a couple of weeks
- Model simulations (5 yr meteo), local fraction calculations, uEMEP (exposure correction factor, exceedance distribution correction) **fall 2021**
- Implementation in extended GAINS **early 2022**
- Scenario assessment relevant for GP review (GAINS + EMEP/uEMEP) **spring 2022**

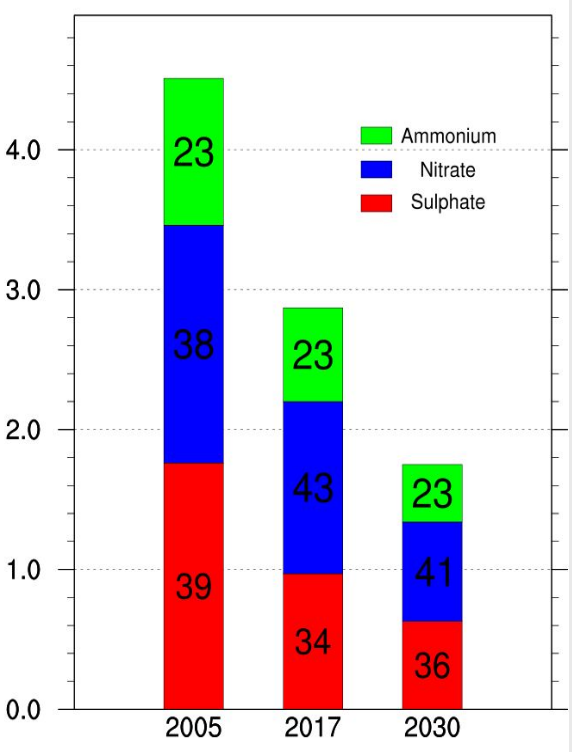


Example from Asian work, courtesy IIASA

How relative changes in SO_x, NO_x, NH_3 emissions 2005-2030 affects SIA, depositions and efficiency of reducing NH_3 emissions to reduce $PM_{2.5}$



Emissions (numbers in % rel to 2005)



$SIA_{2.5}$(numbers % contribution to SIA)

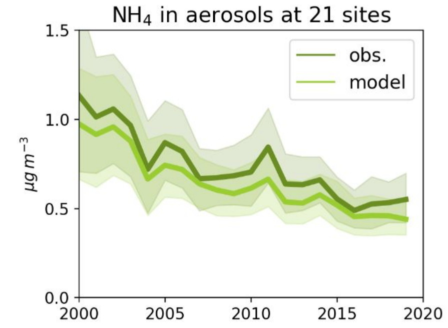
EMEP/MSC-W model calculations

- Emissions 2005, 2017 and 2030 (assuming NECD 2030)
- Meteorology 2017

Note that between 2005 and 2030 the percentage contribution of ammonium to SIA remain at 23% even though ammonia emissions have changed far less SOx and NOx

A much smaller part of NH_3 is converted to NH_4^+ aerosol. Confirmed by observational trends.

Jonson et al, in review acpd



Change 2000-2019

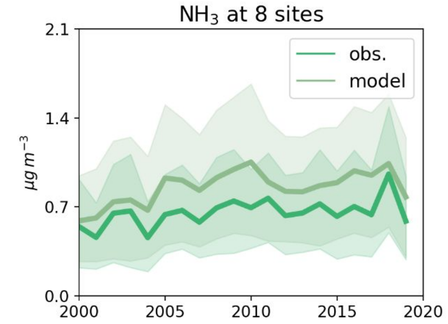
NH_3 emissions: -12% (west EMEP)

NH_4^+ aerosol:

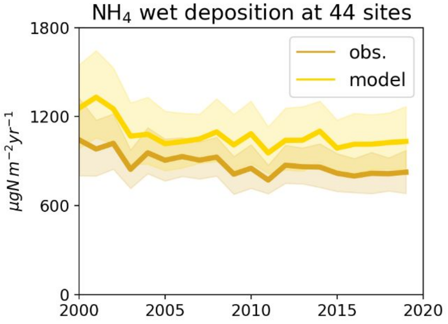
Obs: -49 %

Mod: -49 %

The reduced efficiency of ammonia emissions in forming aerosols is supported by observational trends



NH_3 in air: very few statistically significant trends (and few sites), but on average a positive trends (by ca. 30%)

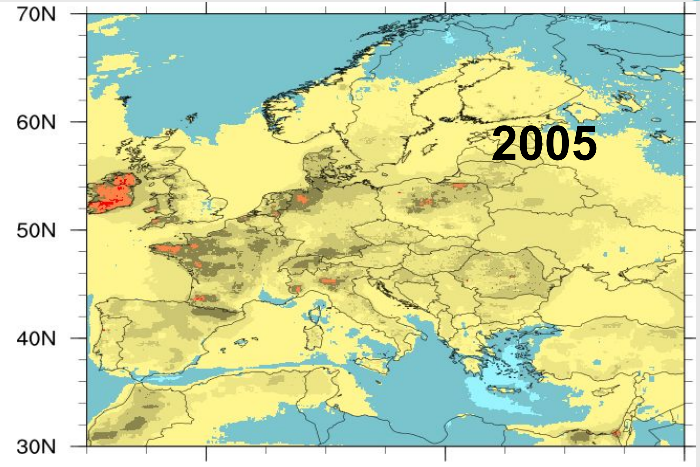


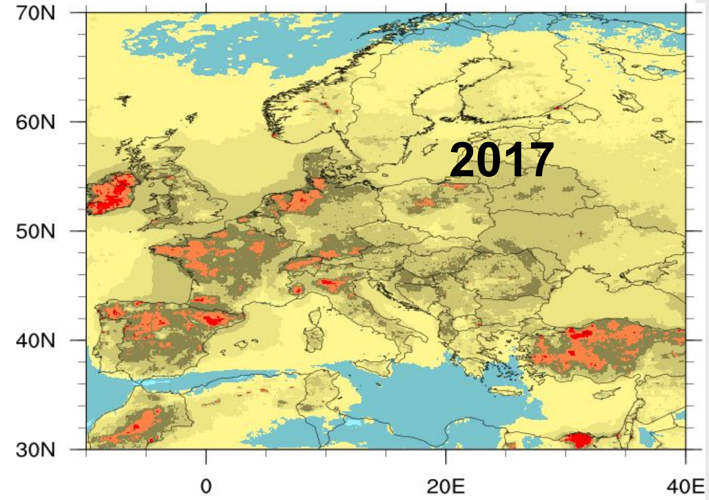
Reduced N wet deposition: Few statistically significant trends

Obs: -6%

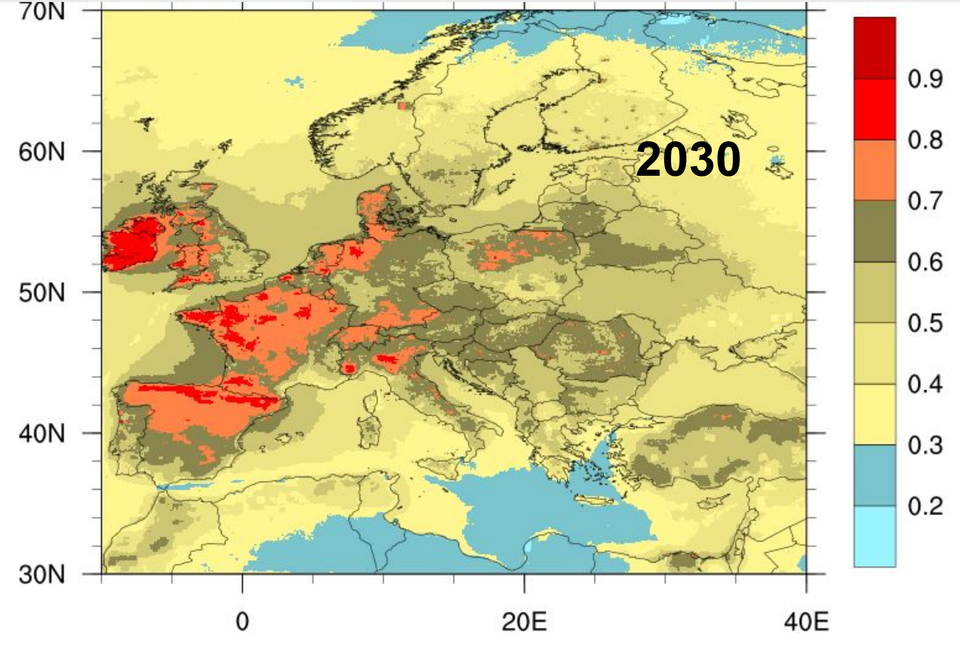
Mod: -5%

Fraction of nitrogen deposited as reduced nitrogen

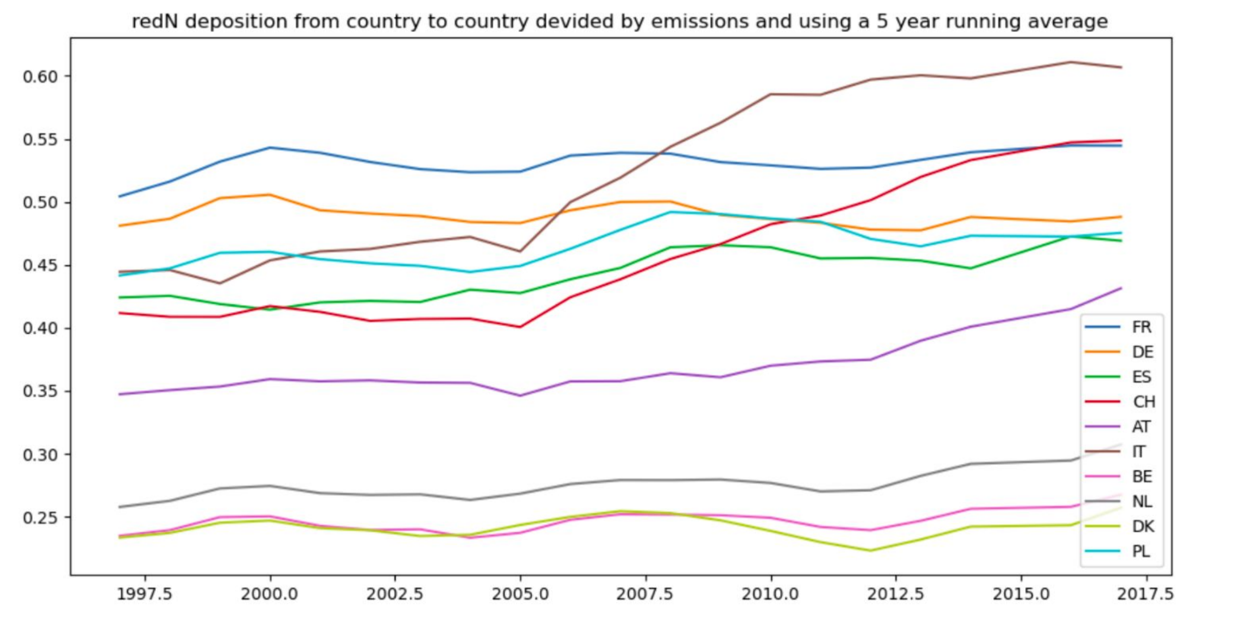




In large parts of Europe more than 70% of the total deposition of N in 2030 is reduced nitrogen.



Does this mean that the transport distance of ammonia is decreasing? (e.g. that we get more local effects of ammonia?)



Fraction of ammonia emissions deposited in own country

Preliminary analysis of **historical source receptor calculations** 1995-2016

Caveats:Changes in the model, the emissions, the meteorological driver.

Workplan 2022: Use local fraction methodology for consistent results

Workplan 2022-2023

(in addition to WP suggested by HTAP/TFMM etc)

- **Preparation of data (e.g. updated emissions for EECCA) and (u)EMEP MSC-W model calculations that are necessary for 'new GAINS'. Implementation for multiscale GAINS (CIAM) across the whole extended EMEP domain** (MSC-W & CIAM). Start *autumn 2021, end 2022*
- **Assess the importance of condensables and the implication for the review of Gothenburg protocol.** *Spring 2022* (MSC-W, CIAM, CCC, TNO, NCM project)
    - Consistent set of PM emissions including condensables for 2005-2018
    - EMEP MSC-W model calculation of PM trends and SR matrices
    - Contribution of condensables to population exposure and health impacts
- **Focus on EECCA and West Balkan countries** (trends, projections, assessments). MSC-W, CIAM, CEIP. *2022-2023*
- **Analyse how the changing chemical regime impacts N aerosols and depositions** (transport distance). *2022*
- **Scenario assessment relevant for GP review and potential GP revision using multiscale GAINS and EMEP/uEMEP** (CIAM and MSC-W) 2022-2023