emep

Co–operative programme for monitoring and evaluation of the long–range transmissions of air pollutants in Europe

LRTAP
Long-range Transboundary Air Pollution

MSC-W: Activities in 2022/2023

Hilde Fagerli, Willem van Caspel, Peter Wind, David Simpson, Yao Ge & rest of the EMEP/MSC-W team

EMEP & WGE Steering Body 11-15th September 2023

Meteorologisk institutt

Content

1. EMEP status report & products 2023
2. Ozone - impact of future emission policies
3. Country-to-country blame matrixes for ozone with the Local Fraction Methodology
4. EMEP MSC-W model & EMEP campaign summer 2022
5. Workplan

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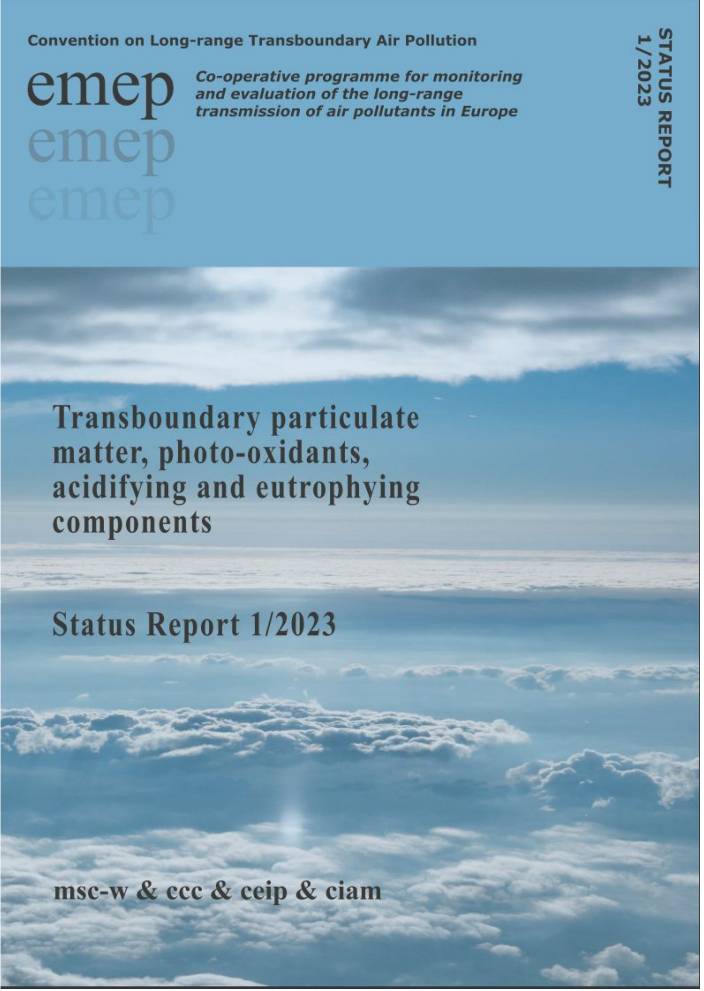

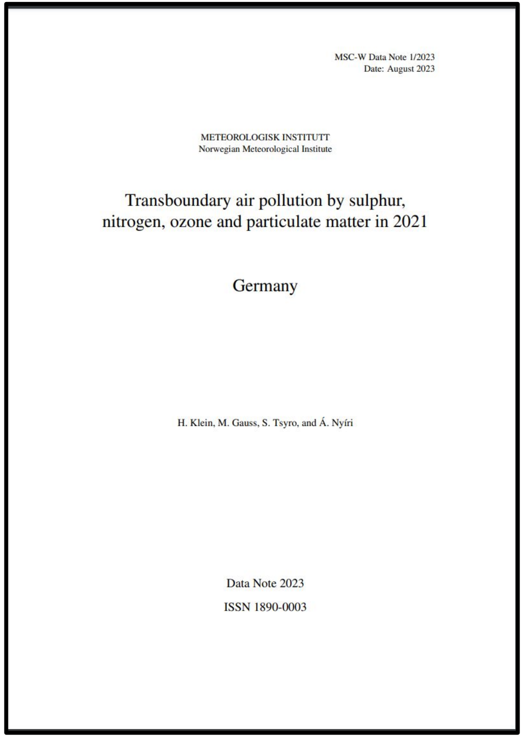
MSC-W Data Note 1/2023
Date: August 2023

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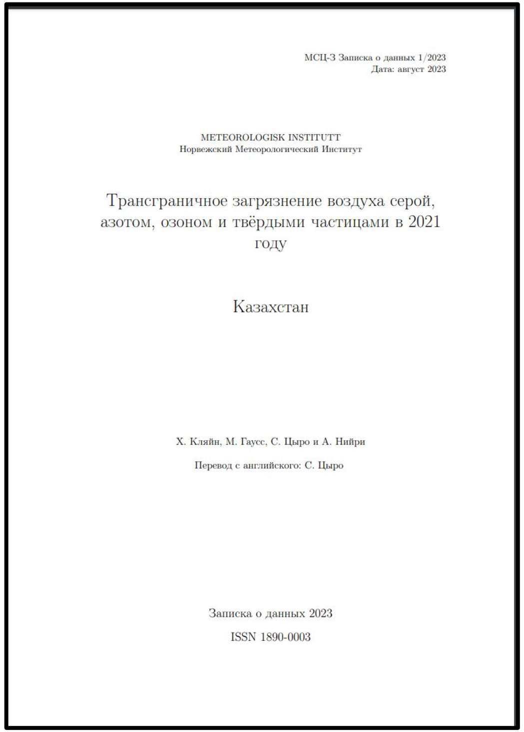
Transboundary air pollution by sulphur, nitrogen, ozone and particulate matter in 2021

Germany

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

Data Note 2023
ISSN 1890-0003


МСЦ-З Записка о данных 1/2023
Дата: август 2023

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Трансграничное загрязнение воздуха серой, азотом, озоном и твёрдыми частицами в 2021 году

Казахстан

Х. Кляйн, М. Гаусс, С. Цыро и А. Нийри

Перевод с английского: С. Цыро

Записка о данных 2023
ISSN 1890-0003

- Assessment of air pollution in 2021, source receptor matrixes, country reports done with emissions ‘including condensables’
- Overview of assessment, research & technical activities

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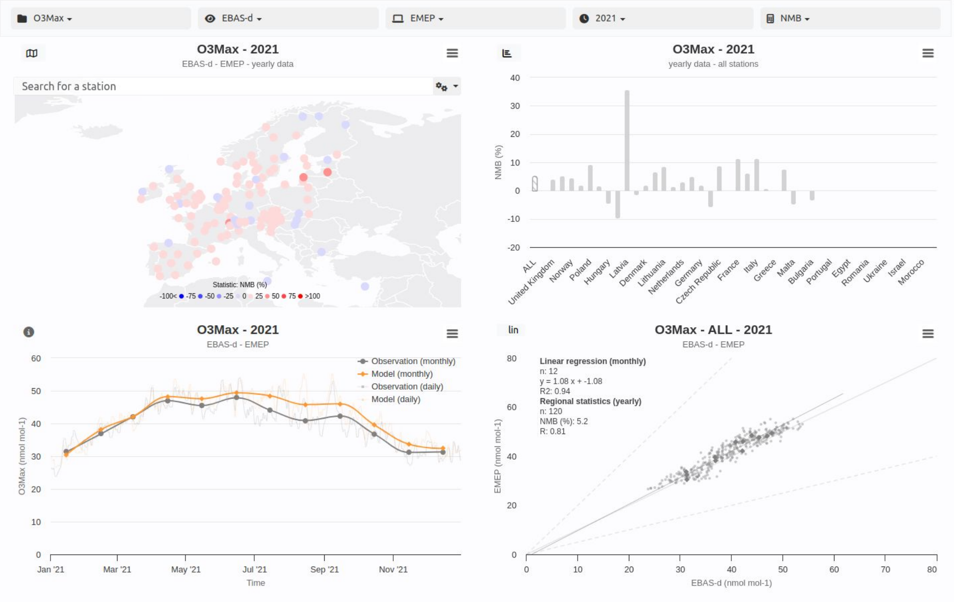
https://emep.int/publ/reports/2023/EMEP_Status_Report_1_2023.pdf

Additional products from reporting 2023

- **EMEP MSC-W model runs for 1990-2022** available (33 years!) with updated emissions (by CEIP) and a consistent model version. Available from *https://emep.int/mscw/mscw_moddata.html*
  NB: ‘Condensables’ consistent from 2005

- **Online model evaluation** (and observation assessment) on AeroVal:
  https://aeroval.met.no/evaluation.php?project=emep&exp_name=2023-reporting&station=ALL



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Ozone - Importance of European, non-European and CH_4 mitigation

- What is it possible to achieve for ozone by 2030/2050 by
  - reducing CH_4 emissions
  - reducing European emissions
  - reducing emissions outside of Europe (ROW)
- What can be achieved compared to ‘no further policy’ (CLE)?

- What is new compared to TFHTAP/TFMM work:
  - Gothenburg Protocol Review emission scenarios (CLE, LOW)
  - Including new indicators for ozone such as Peak Season MDA8

2050 LOW scenario - *Ambitious global action on air pollution and methane, including non-technical measures*

How?

- Global EMEP MSC-W model runs for 2015, 2050 (CLE, LOW) and in addition with CH_4 concentrations changed -> **Boundary and initial conditions**
- European EMEP MSC-W model runs for 2015, 2050 (CLE, LOW) and CH_4 concentrations

Simulated ozone concentrations in the future and the impact of European NOx/VOC, Rest of World (ROW) NOx/VOC and CH4 emission mitigation

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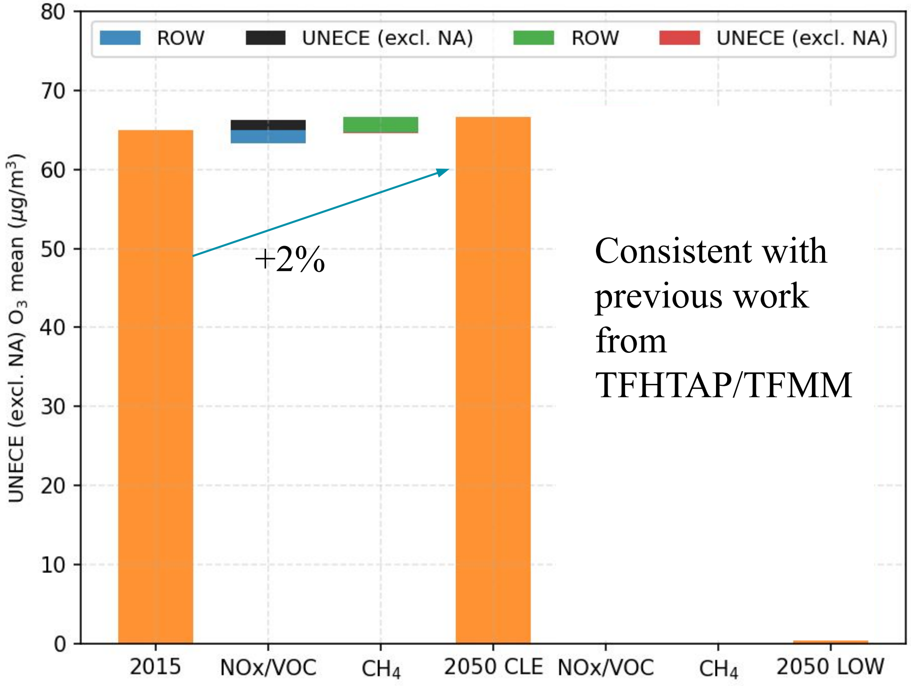
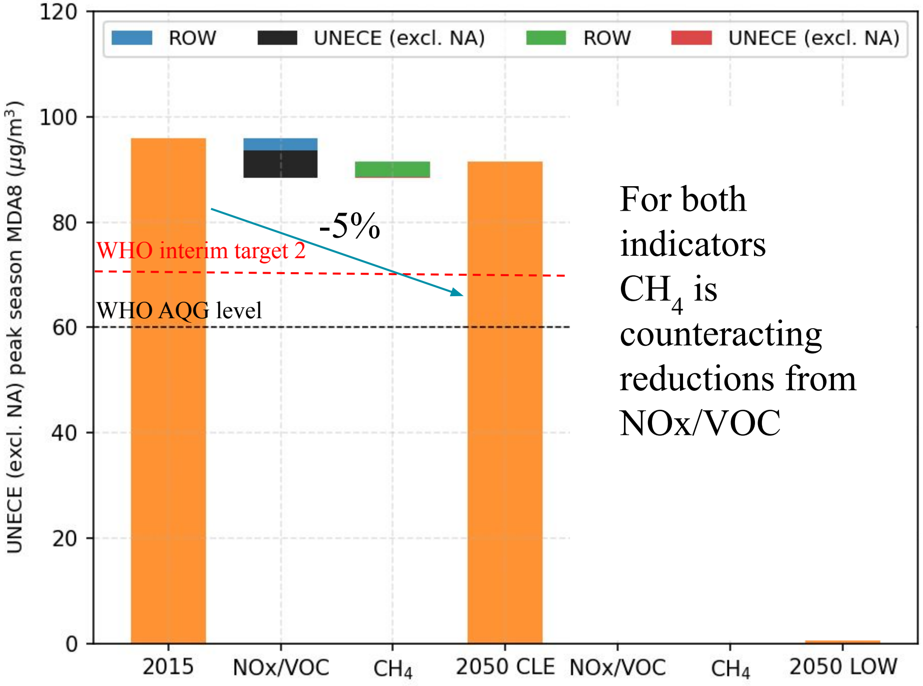
Potential ozone changes in UNECE (excluding North America) of ozone policies



Ozone mean, population weighted



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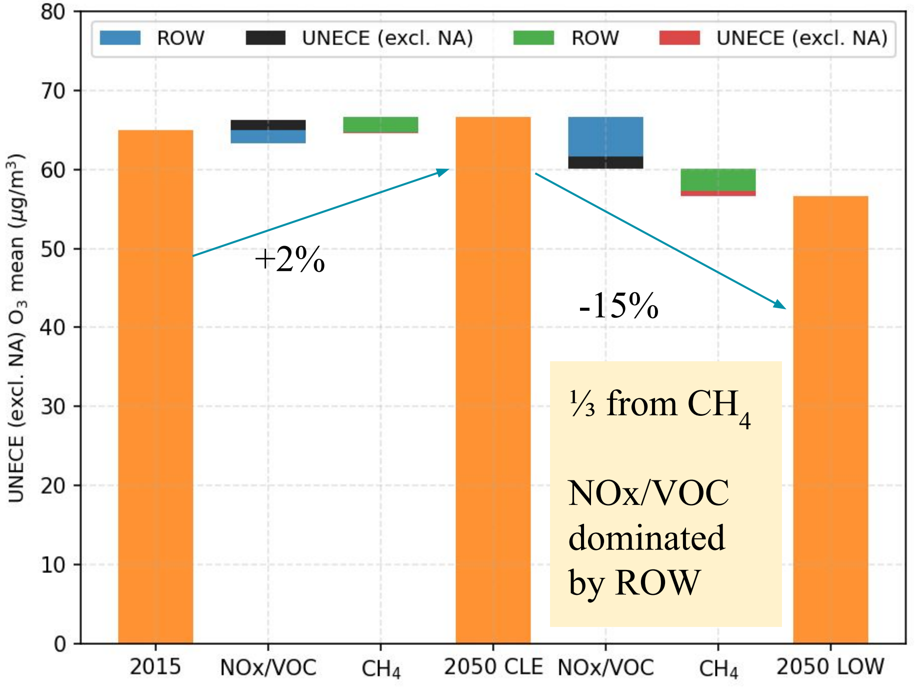
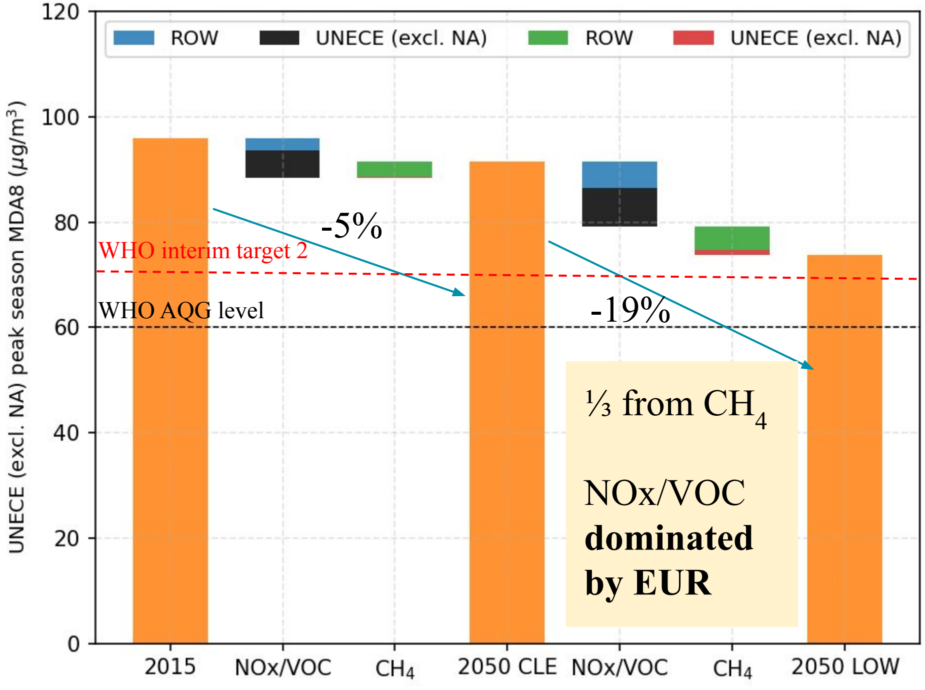
Peak season MDA8, population weighted

Potential ozone changes in UNECE (excluding North America) of ozone policies



Ozone mean, population weighted



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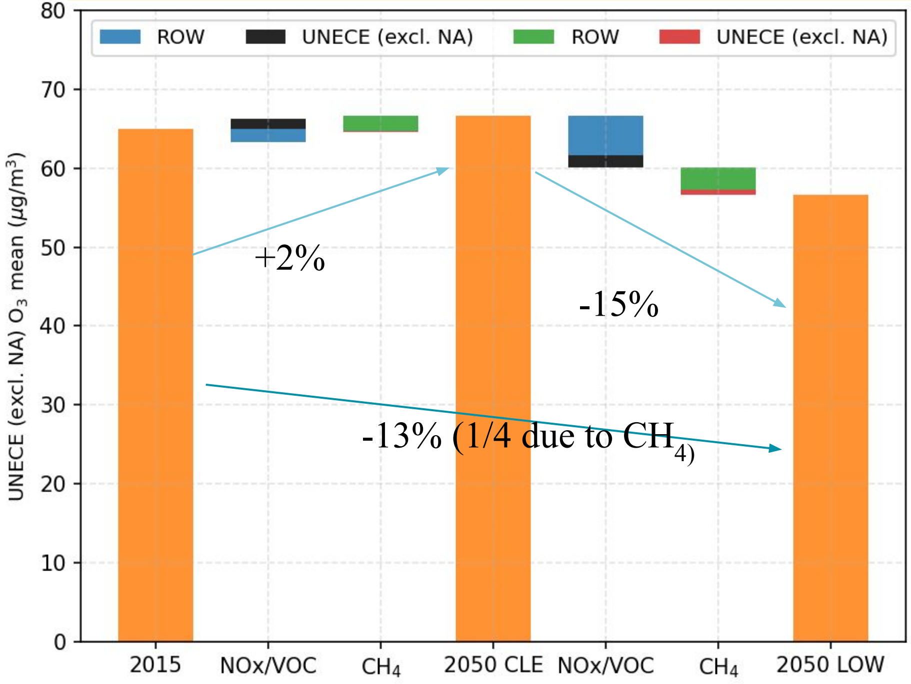
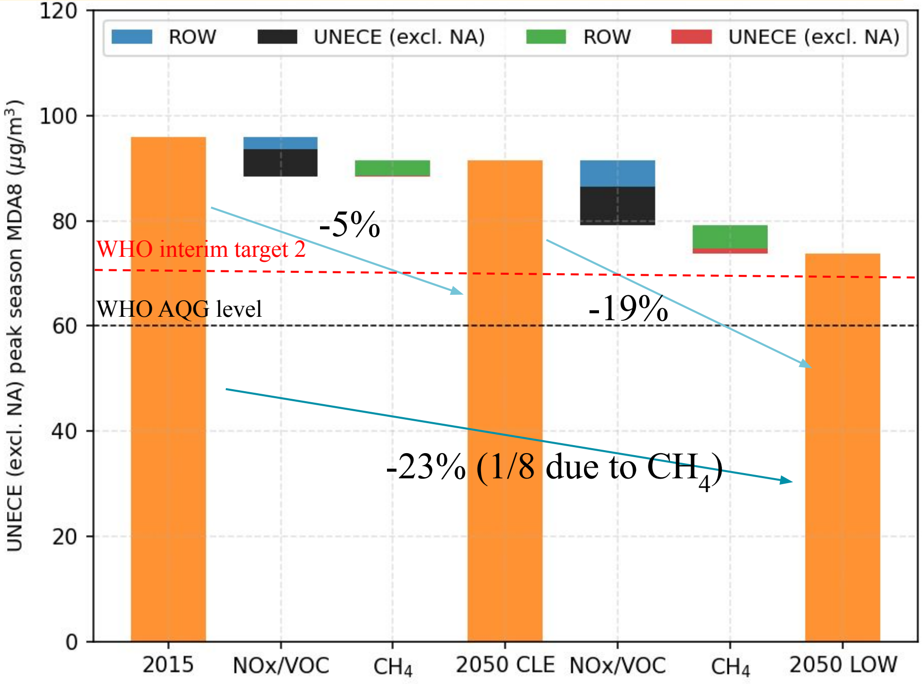
Peak season MDA8, population weighted

- Substantial reductions can be achieved, but WHO AQG levels not attained even in LOW
- CH_4 becomes more important because of its projected increase in CLE.
- Action on methane would only be part of the solution; (UNECE) NOx/VOC emission reductions would still be very important to reduce surface O_3
- Model data can be delivered to WGE/ICP Vegetation (POD)



Ozone mean, population weighted



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Peak season MDA8, population weighted

Ozone source receptor calculations using the Local Fraction Methodology

Why use/develop the Local Fraction (LF) method?

- Originally developed for uEMEP downscaling
- Much less CPU demanding
- Offers additional information

- LF gives you the effect of very small emission changes (BF often give you changes due to 15%)
- For linear species Brute Force (BF) and LF are in principle identical

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Comparison of LF and BF

- Source receptor calculations for 2021 with EMEP MSC-W model and LF method was set up identically to the Brute Force (BF) calculations done this year

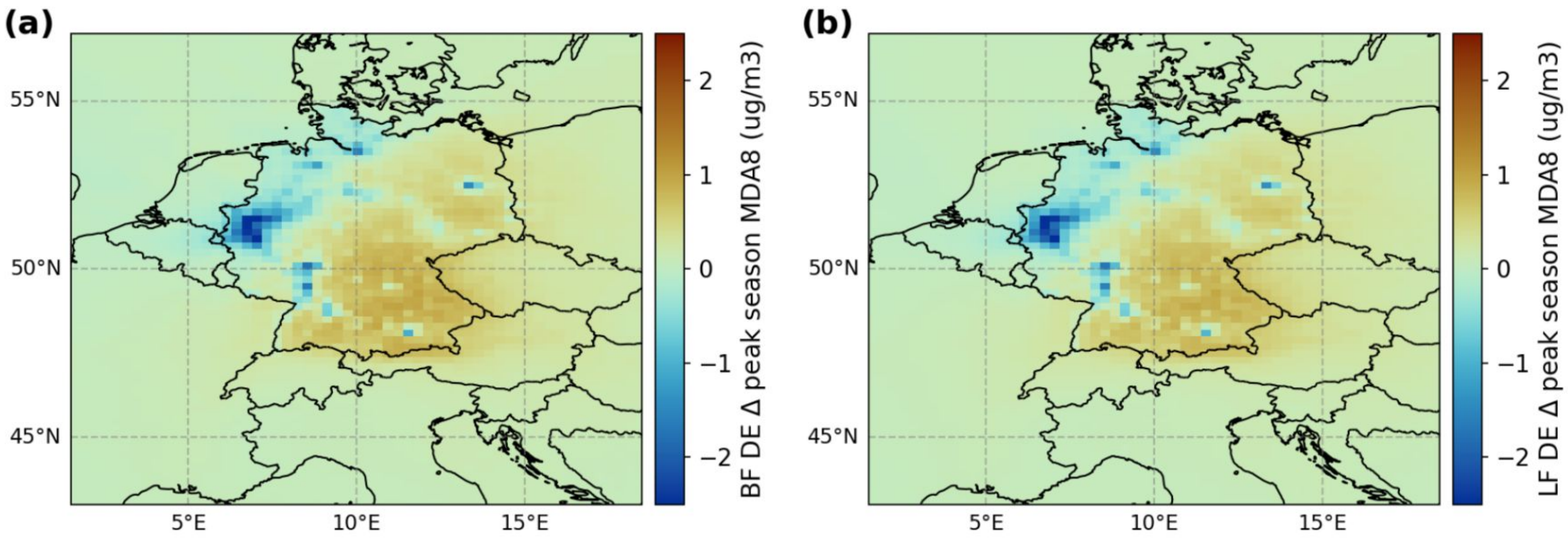
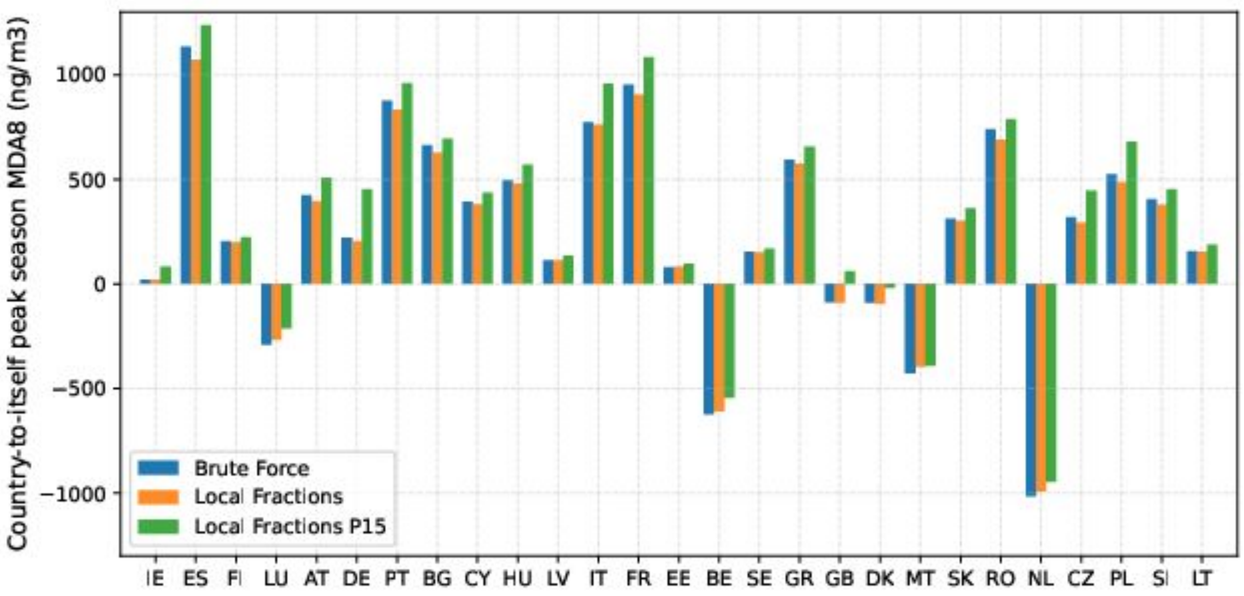


Figure 5.1: Comparison of the impact of a 15% NOx emission reduction from Germany (DE) on peak season MDA8 calculated using the BF **(a)** and LF **(b)** methods.

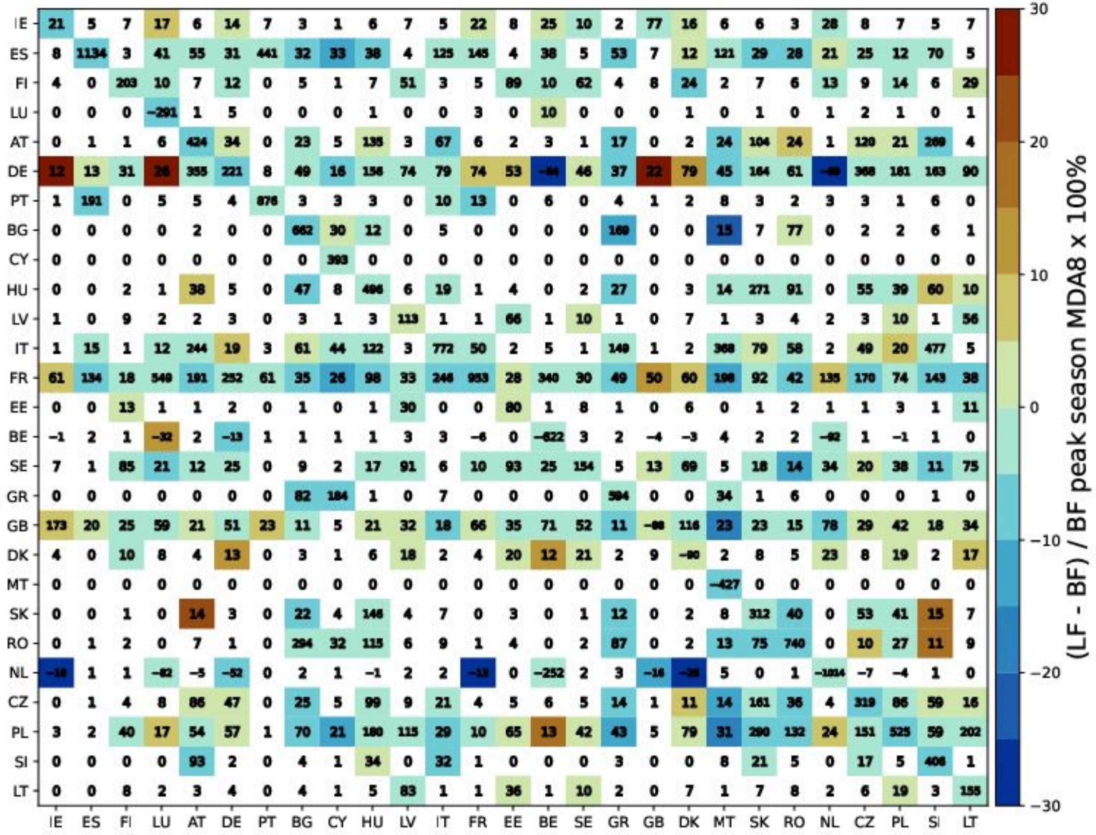
Country-to-itself contributions to Peak season MDA8 in 2021 (with 15% NOx emis reductions)



- Local Fractions: results (derivatives) calculated at 100% emissions
- Local Fractions P15: results (derivatives) calculated at 85% emissions
- BF and LF gives similar results (difference usually smaller than non-linearity

Blame matrix for peak season MDA8

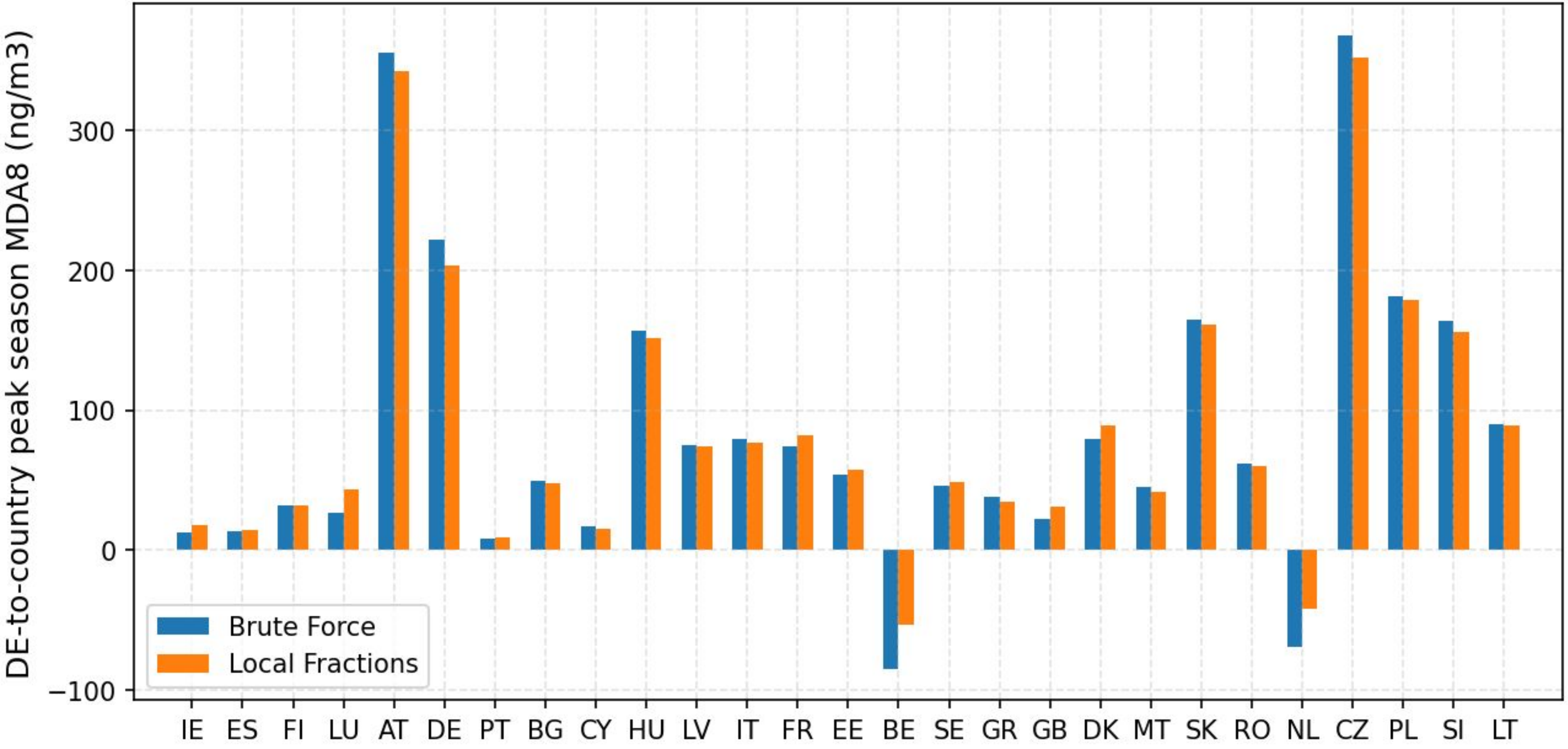
Emitters



Numbers: Contributions for a 15% NOx reduction (BF)
Colours: Percentage difference

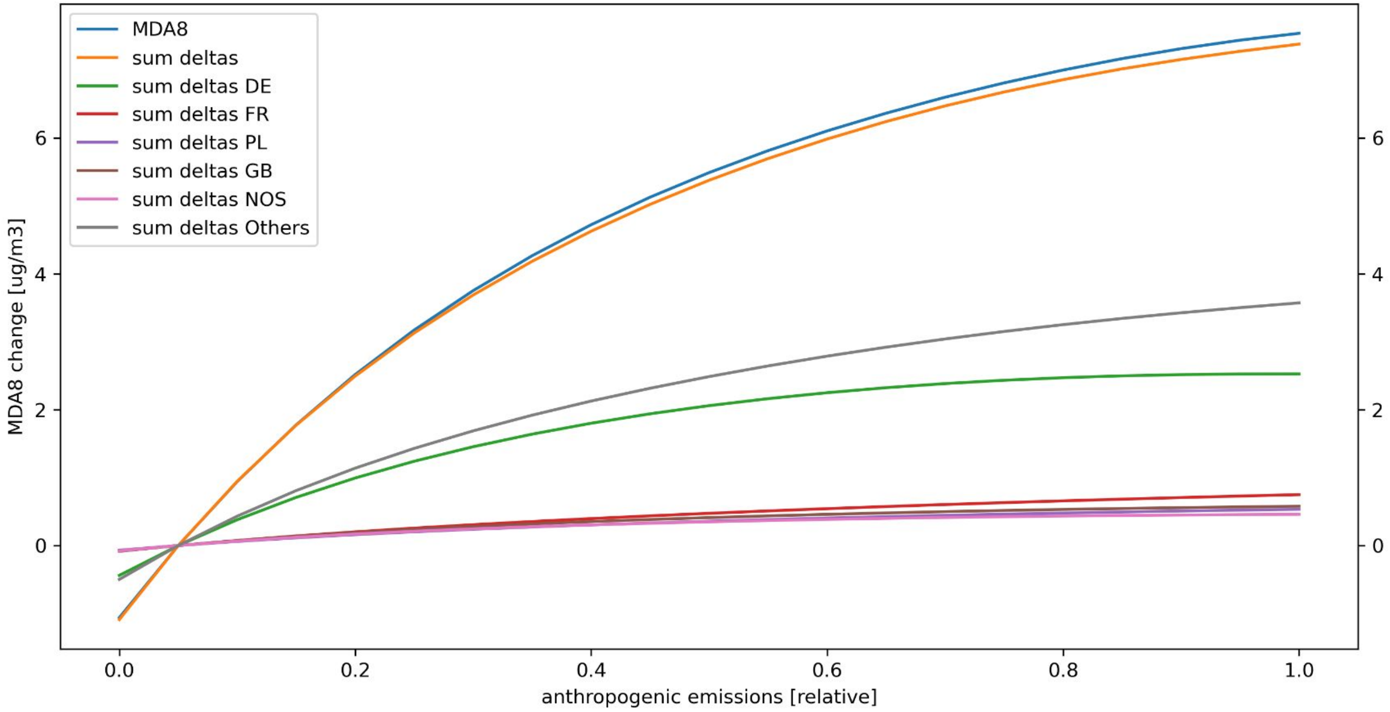
Receptor

DE to countries
15% NOx reductions (BF15, LF)



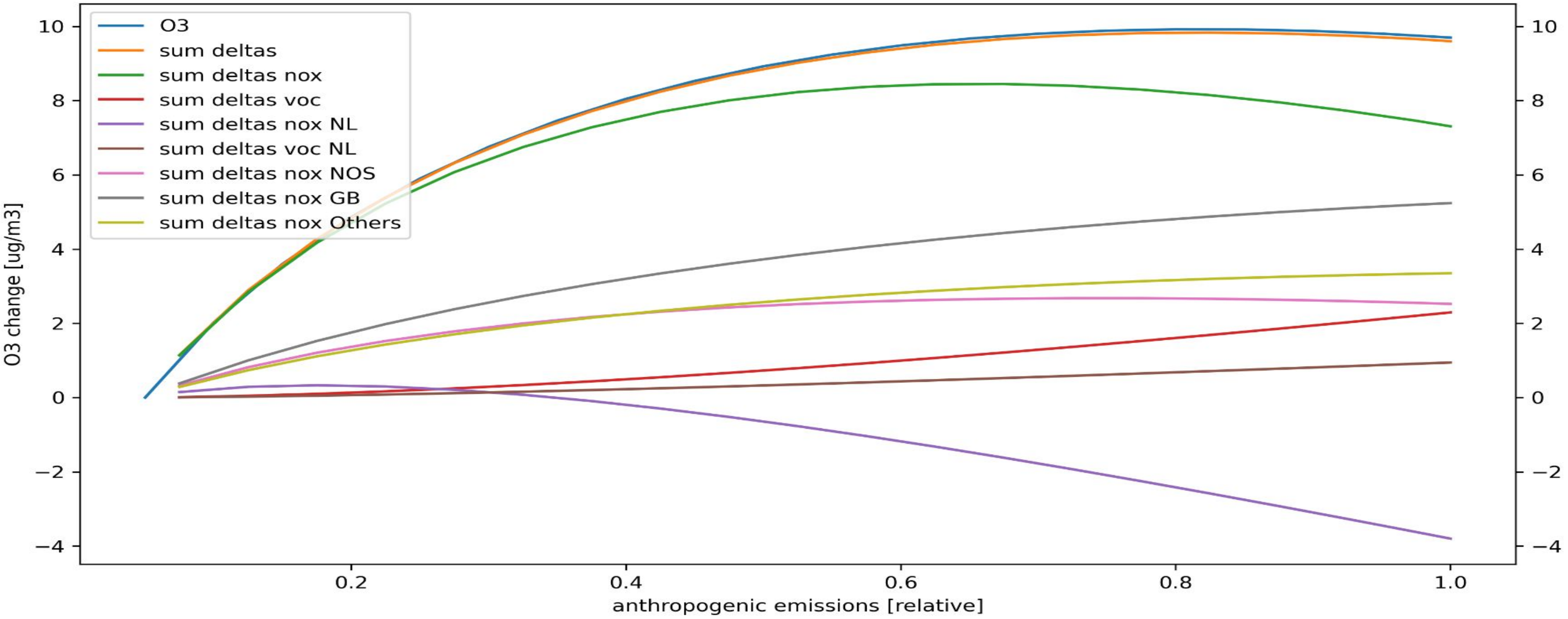
Very small absolute differences that can be explained

Peak season MDA8 due to NOx reductions, DE



Could potentially be parametrized and implemented in GAINS

O_3 concentrations, July, due to NOx/VOC reductions, NL



Summary

- Local Fractions allow to compute the concentration/emissions relationship over a large emission range **very efficiently**
- Differences to BF are small, in general within 10%
- Work now and further:
  - Include more indicators (e.g. POD)
  - Investigate non-linearities, e.g. vary levels of emissions
  - Discuss & work with CIAM above inclusion in GAINS
  - Compare methodologies, e.g. TFHTAP

- Working on how to use and present all this information

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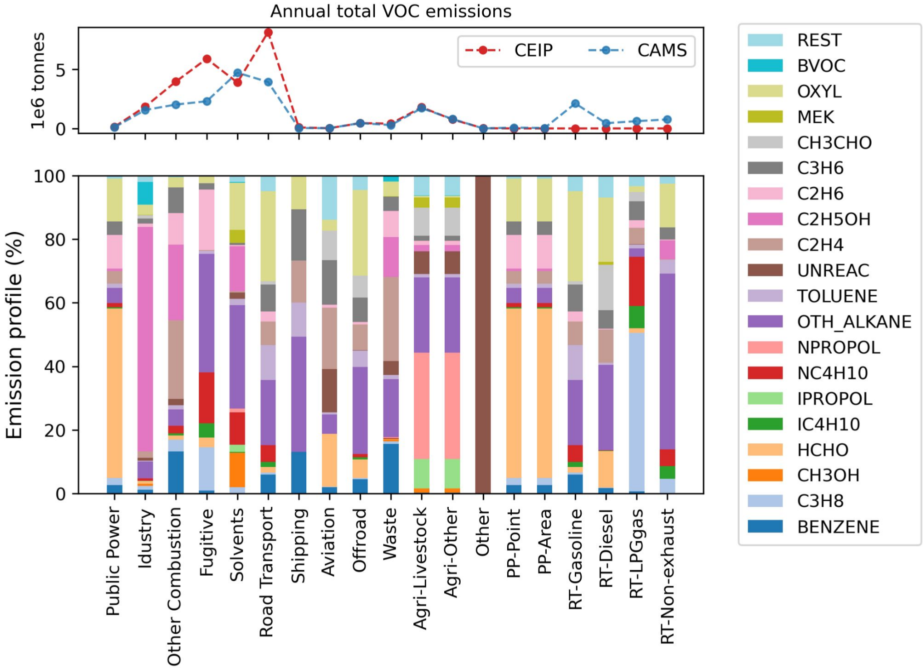
VOC model measurement comparisons & EMEP IMP

- **Speciation**: explicit emission splits are created for individual VOCs, based on UK NAEI and several other studies
- **VOC Tracers**: take pure emissions and follow species-specific chemistry to yield pure concentrations
- **Large emitting sector**: Fugitive, Solvents, Road transport
- **Large emitting VOCs**: ethane, propane, benzene, toluene

Groups	Species			
Alkane	C2H6	C3H8_T	NC4H10	IC4H10_T
Alkene	C2H4	C3H6	C4H8_T	
Alkyne	C2H2_T			
Aromatics	C6H6	C6H5CH3	C6H4(CH3)2	
Alcohol	CH3OH	C2H5OH	N-PrOH_T	I-PrOH_T
Aldehyde	HCHO	CH3CHO	C2H5CHO_T	
Dialdehyde	OCHCHO	CH3COCHO		
Ketone	CH3COCH3_T	MEK		
Carboxylic acid	HCOOH_T	CH3COOH_T		
Biogenic VOC	C5H8	α-Pinene	β-Pinene_T	
Rest†	Oth_alkane_T			

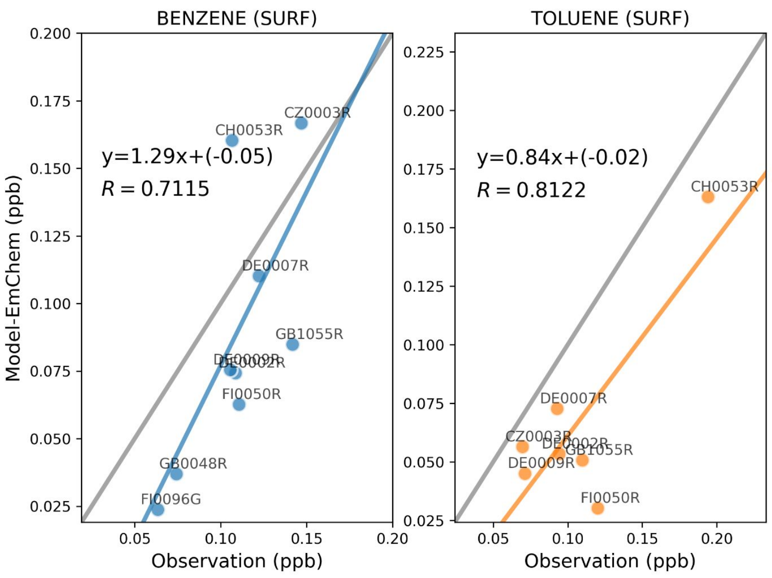
Notes †: Rest includes alkane and some other species.



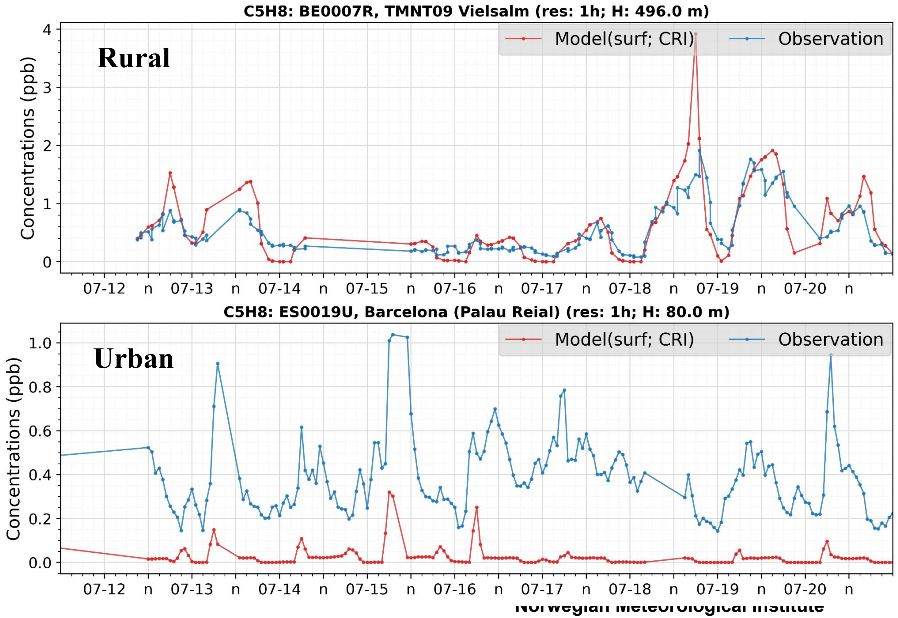
VOC model measurement comparisons

- This tracer method has been used for comparisons in 2018 and during the 2022 campaign
- Mixed results: e.g., aromatics show good agreements, while model underestimates isoprene at urban sites
- Further investigations into the emissions and boundary conditions for some VOCs are in progress.

2018 annual averages comparison

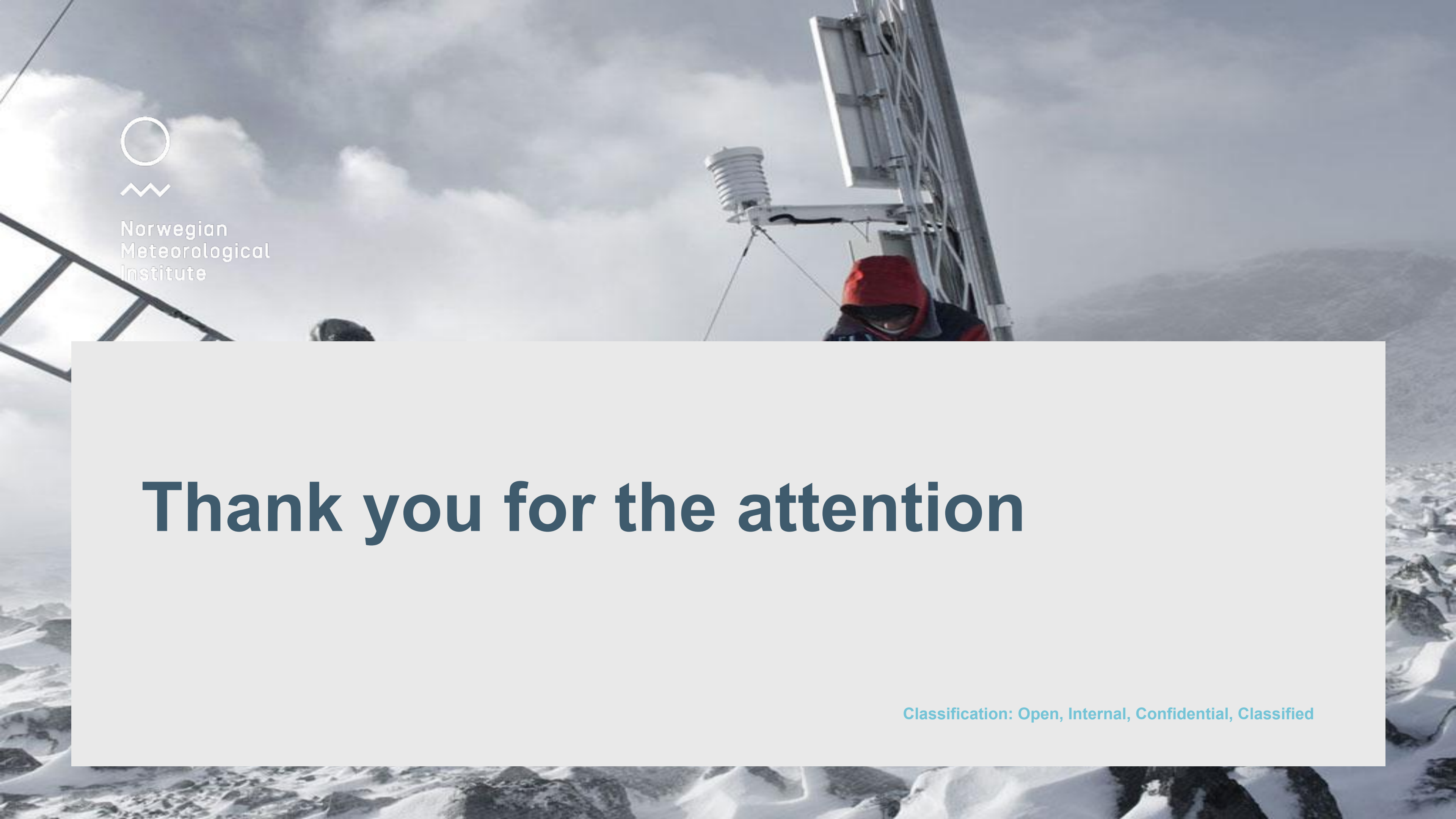


2022 campaign time series comparison



WP elements for MSC-W 2024/2025

- **The role of VOC in high ozone episodes.** Evaluation EMEP/MSC-W model against in-situ VOC measurements from IMP 2022 and EMEP network (and HCHO from satellites) 1.1.1.1
- **Condensable organics/OC** (make better use of the EMEP/ACTRIS/COLOSSAL campaign and other data to understand sources), (MSC-W, CCC, TFMM) 1.1.1.4
- Review of **methodologies for source receptor calculations**: brute force & local fractions and their applicability, 1.1.1.5
- Inclusion of **ozone response to precursor emission reductions in GAINS**, 1.1.1.6
- **Ozone mitigation options** and the role of methane, 1.1.1.7
- **Scenario assessment** relevant for a potential GP revision using multiscale GAINS and EMEP/uEMEP 1.1.3.1/1.1.3.2/1.1.3.4
- **Contribute to TFHTAP** multi-model exercises, especially related to scenarios for Gothenburg Protocol 1.1.4.2
- **Focus on EECCA and West Balkan** countries (trends, spatial distribution, projections, assessments including use of satellite data). Stimulate national integrated application of assessment capacity. 1.2.2
- In addition: Contribution to 1.1.1.3, 1.1.2.3, 1.1.2.6, 1.3.8



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Thank you for the attention

Classification: Open, Internal, Confidential, Classified

Evaluation EMEP/MSC-W model against in-situ VOC measurements including 2022 summer Campaign

- Observations of VOC are difficult to use:
  - Varying quality
  - Varying sampling times and duration
  - Not many stations, and many mountain sites
- Detailed data on VOC split from UK
- Implemented an additional chemical scheme in the EMEP model (CRIv2R5) in order to have more detailed VOCs
- Included more VOCs in the EMEP chemical scheme

> ➢ The first intensive comparisons of VOCs between EMEP model and measurements for many years