



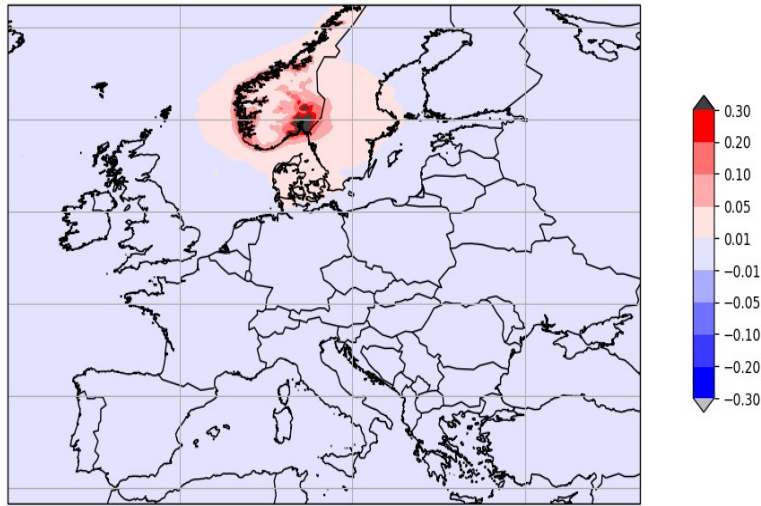
Norwegian  
Meteorological  
Institute

# Condensable organics - Summary of issues and NMR workshop

David Simpson & Hilde Fagerli (EMEP MSC-W), Hugo Denier van der Gon (TNO) & other participants of NMR workshop

6<sup>th</sup> TFTEI Annual Meeting, 22.10.2020

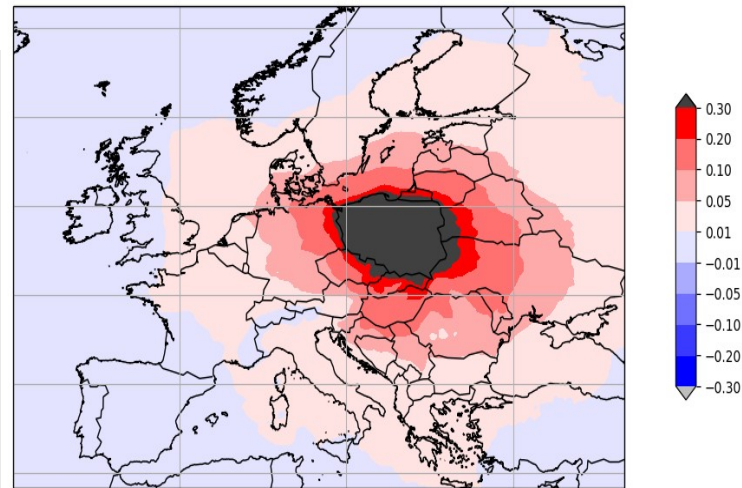
# EMEP MSC-W key output: 'blame-matrices'



EMEP model calculates:

$$\Delta PM_{2.5} / \Delta Emis^{pm,i}$$

.. for all emitter countries: *i*



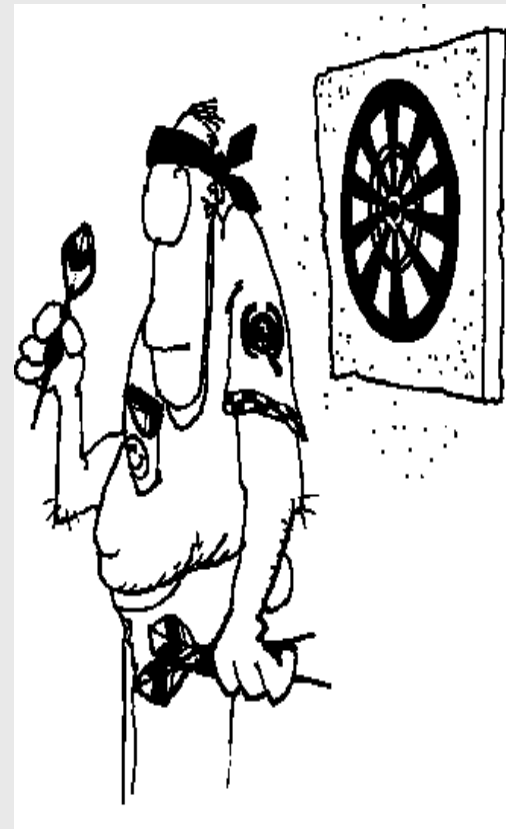
# EMEP MSC-W 'blame-matrices'

$$\Delta PM_{2.5} / \Delta Emis^{pm,i}$$

... for all emitter countries:  $i$

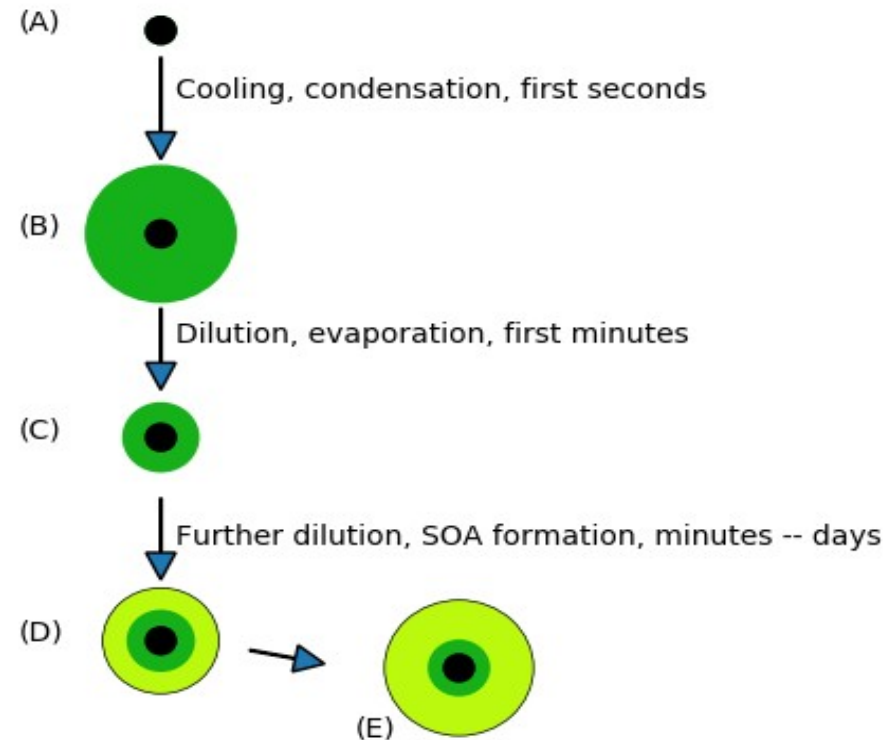
???

- Of course, this only works if one knows  $Emis^{pm,i}$  !



# POA emissions

- Problems of OA emissions by now well known...
- Mainly semi-volatiles: SVOC
- Can be intermediate volatility VOC: IVOC
- Europe: Denier van der Gon et al., ACP, 2015, EMEP Reports 2015 2019, 2020, Ots et al., ACP, 2016, Jiang et al, 2019
- Basically, countries report **apples** and **oranges**!



## Trickiness of PM emissions – start of the story ...

### Rethinking Organic Aerosols: Semivolatile Emissions and Photochemical Aging

Science 2007

Allen L. Robinson,<sup>1\*</sup> Neil M. Donahue,<sup>1\*</sup> Manish K. Shrivastava,<sup>1</sup> Emily A. Weitkamp,<sup>1</sup>  
Amy M. Sage,<sup>1</sup> Andrew P. Grieshop,<sup>1</sup> Timothy E. Lane,<sup>1</sup> Jeffrey R. Pierce,<sup>1</sup> Spyros N. Pandis<sup>1,2</sup>

#### Messages:

- PM are not inert
- Inventories may have serious problems!

Atmos. Chem. Phys., 15, 6503–6519, 2015  
www.atmos-chem-phys.net/15/6503/2015/  
doi:10.5194/acp-15-6503-2015  
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Atmospheric  
Chemistry  
and Physics  
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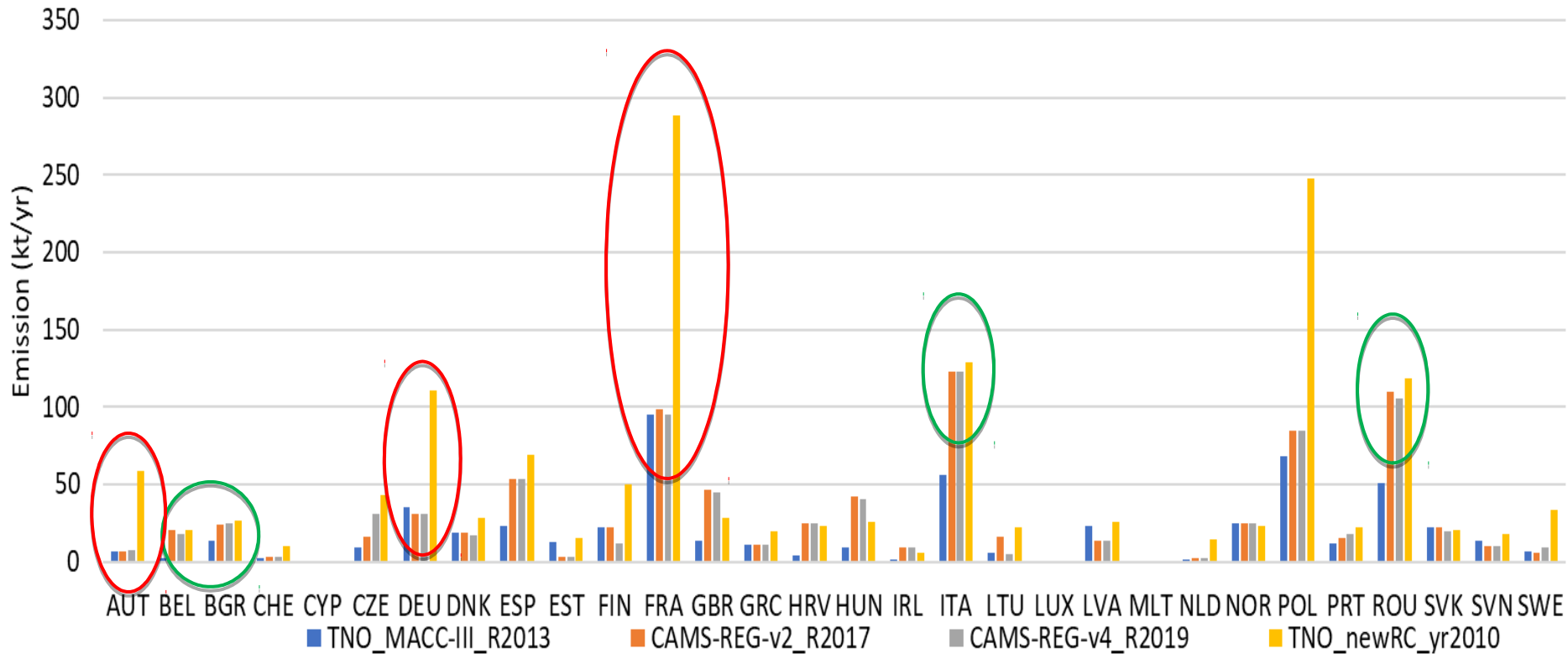


### Particulate emissions from residential wood combustion in Europe – revised estimates and an evaluation

H. A. C. Denier van der Gon<sup>1</sup>, R. Bergström<sup>2,3</sup>, C. Fountoukis<sup>4</sup>, C. Johansson<sup>5,6</sup>, S. N. Pandis<sup>4,7</sup>, D. Simpson<sup>8,9</sup>, and  
A. J. H. Visschedijk<sup>1</sup>

# APPLES & ORANGES

PM2.5 Residential combustion Year 2010 reported in different years

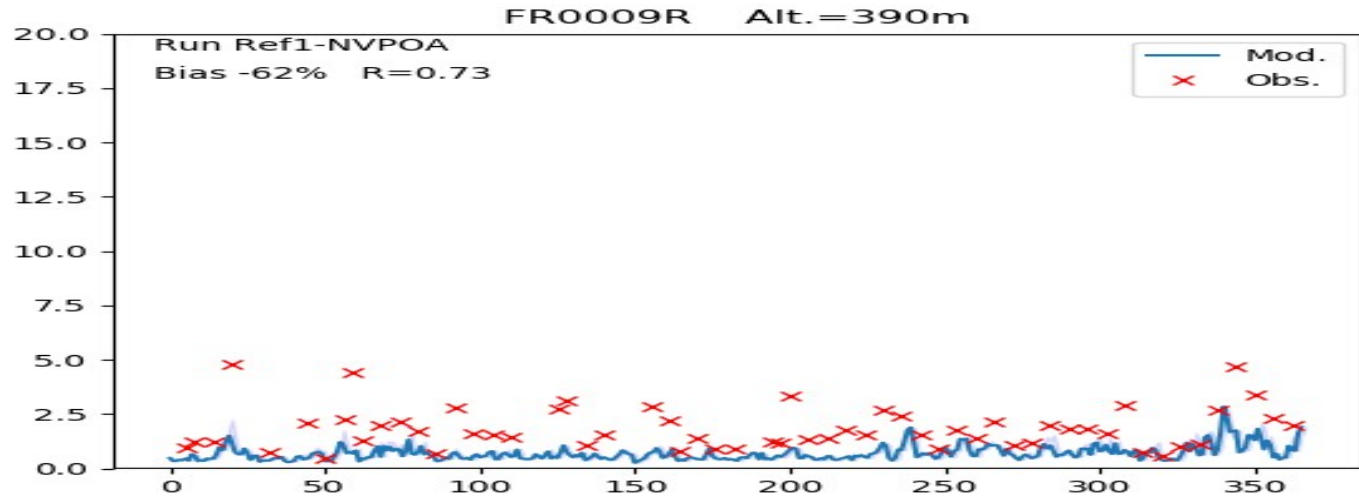


Comparison to a consistent bottom-up highlights inconsistencies (yellow bars)

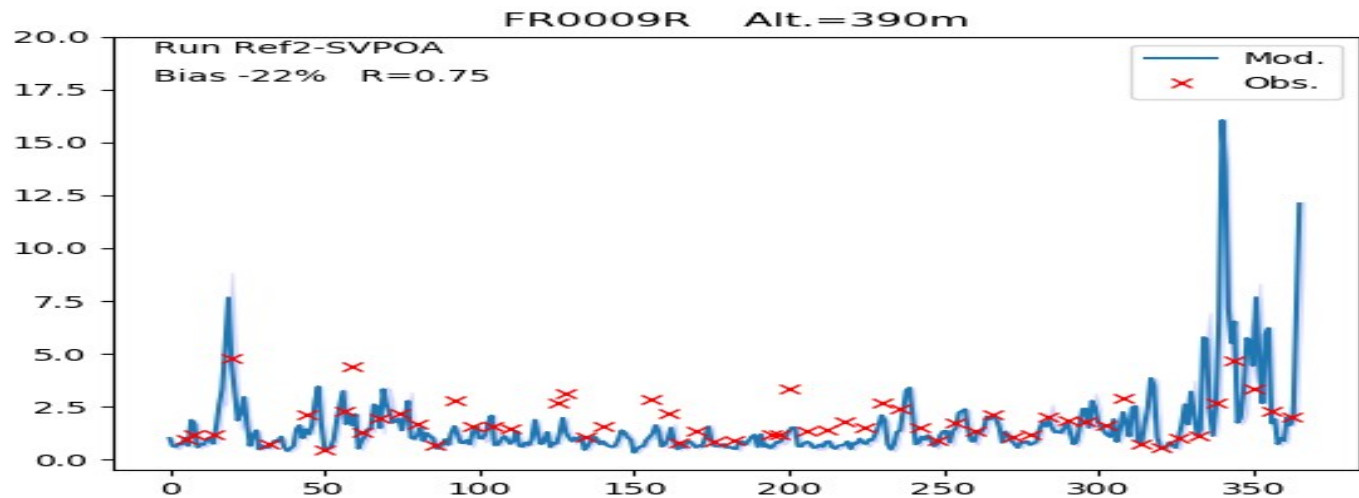
TNO-newRC is the same method for all, but not the “truth” – Large uncertainties! ... but equal

# Modelling of condensables, France (FR09)

Ref1-  
NVPOA



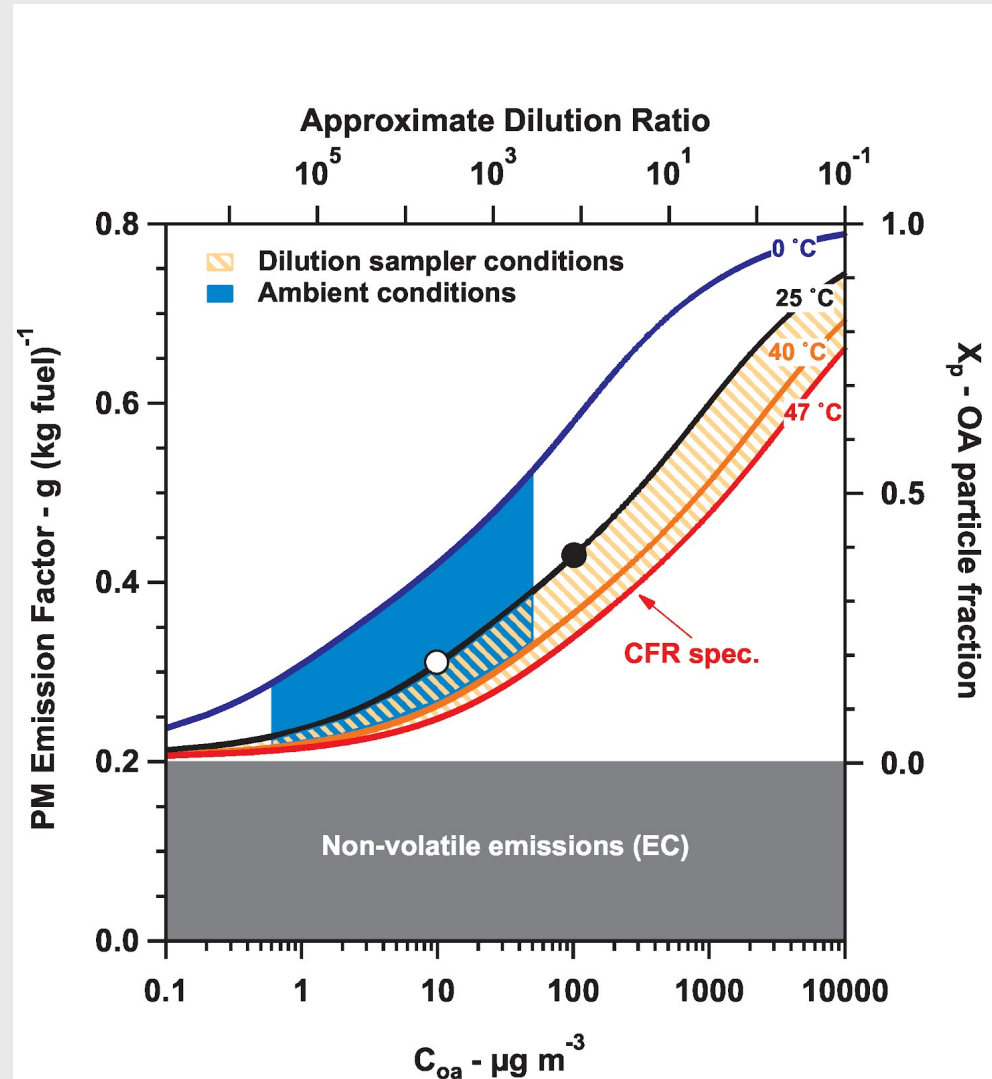
Ref2-  
SVPOA



# Condensables “in” or “out” - it ain't that easy!

● Emission factors depend on:

- source
- measurement conditions
- Ambient temperature
- Ambient  $C_{OM}$
- Operating conditions
- etc.!



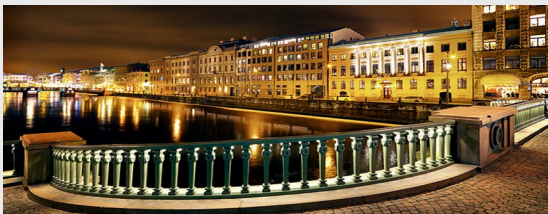
Needs pragmatic definitions!

Robinson et al., 2010, JAWMA

Norwegian Meteorological Institute



# => NMR-SVOC Workshop, March 2020



- Workshop to bring together experts in:
  - emission measurements,
  - atmospheric chemistry,
  - inventory experts, and
  - Modellers
- to systematically consider and recommend best approaches for dealing with semi-volatile emission with regard to PM<sub>2.5</sub>.
- => guidance for UN-ECE, EU

## The main questions:

- For which source categories are condensable organics important?
- How much condensables are produced from different:
  - combustion technologies?
  - measurement techniques?
- What is included in EMEP and other emission inventories?
- Can we specify the volatility distribution of condensables from major sources?
- Can we recommend a practical approach for inclusion (or exclusion) of condensables in (a) inventories, and (b) chemical transport models?



- ~35 experts, including: Chairs EMEP, TFIAM, TFMM, TFEIP, TFTEI
  - Centres: MSC-W, CEIP, CIAM; Inventories: TNO, CIAM, COPERT
  - European Commission, CONCAWE, US EPA
  - Experts: UBA - Germany, SINTEF - Norway, IVL, ACES, Swedish EPA - Sweden, CITEPA, INERIS France, ECCC - Canada, Univ. Patras – Greece, PSI - Switzerland, INERIS - France, Univ. York - England, NC State University – USA

# Key Messages (short version)

- 1 The current situation is untenable and unfair, in that the same activity produces very different PM emissions in national reporting.
- 2 Condensables should be included in future emission inventories and modelling.
- 3 If included, need to know how they are included!
- 4 The issues are complex! Emission factors depend on measurement technology and even weather!
- 5 Need to increase knowledge of activity data and condensables in national reporting and emissions methodologies.
- 6 Emission limit values for residential wood burning (eg EcoDesign) omit condensables. Need standards which are aimed at air quality issues.

## Key Messages (short version)

- 7 Current PM-NMVOC split is artificial, and some organic compounds fall between the gaps. Ideally we would capture all compounds in emission inventories.
- 8 An interim solution might be to report PM component separately, e.g. EC, solid organic matter (OM), condensable OM, etc.
- 9 Don't forget intermediate volatility compounds (IVOC))
- 10 Use of the TNO REF2 emissions is a good first no-regret step, but these should be replaced by national estimates in due course... see roadmap Fig.
- 11 Longer term: many activities needed!
  - See longer note

# Key Messages (short version)

## 12 Roadmap

- Next slides....

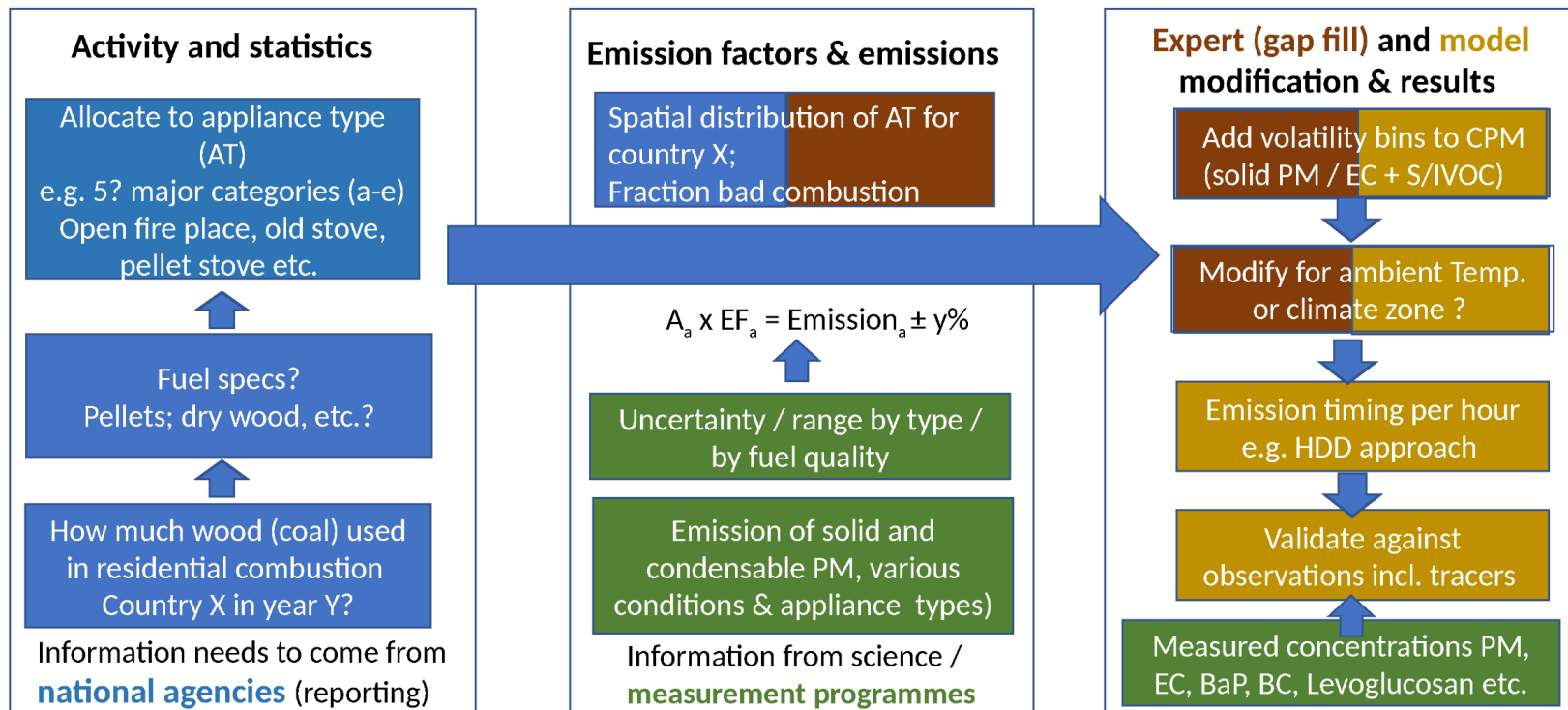
13 Policy makers to consider possible implications with respect to potential adjustments of policy targets and base-year emissions.

14 Process faces several competing challenges – e.g. speed versus practical difficulties and scientific completeness.

# Towards Transparency (essential) and choices (who does what?)

## A flow chart as a way forward?

Towards Transparency (essential) and choices (who to do what?)



\* Colours indicate different disciplinary groups; agencies; measurements; emission experts; modellers

Suggestion from Hugo Denier van der Gon

# Roadmap – a cyclic approach?

Start with RWC and/or road transport

- First cycle 12 months?
- Top-down expert role in Year 1 can be large – e.g. TNO data set
- Invite improvement through a TFEIP cycle
- Repeat cycle when more data come in Year 2 or 3?
- Suggest milestones when data delivery is needed (e.g. EMEP meetings etc.)
- Needs guidance and support! Making the process depend on (only) voluntary contributions leads to a new fruit basket with apples & oranges and more....
- In parallel research programmes needed which fuels the progress & uptake of new things (e.g. from US)
- Needs activity/discussion among TFEIP, TFTEI and modellers.

# Update: MSC-W source-receptor calculations.

- Two sets of emissions in EMEP/MS-CW model calculations:
  - EMEP
  - **EMEPwRef2C** : small combustion replaced with TNO Ref2 estimate for PM
- 2018 status run and source receptor matrices run for both sets
- PM assumed inert
  
- **Status Report 1/2020**: [https://www.emep.int/publ/emep2020\\_publications.html](https://www.emep.int/publ/emep2020_publications.html)
  - Overall results, comparison to observations
  - Source Receptor tables for EMEP and EMEPwRef2C
  
- Country reports:
  - Detailed results per country (e.g. [https://www.emep.int/publ/reports/2020/Country\\_Reports/report\\_NL.pdf](https://www.emep.int/publ/reports/2020/Country_Reports/report_NL.pdf) )
  
- Web interface: [https://aerocom-evaluation.met.no/main.php?project=emep&exp=EMEP\\_rep20](https://aerocom-evaluation.met.no/main.php?project=emep&exp=EMEP_rep20)



# Relative importance

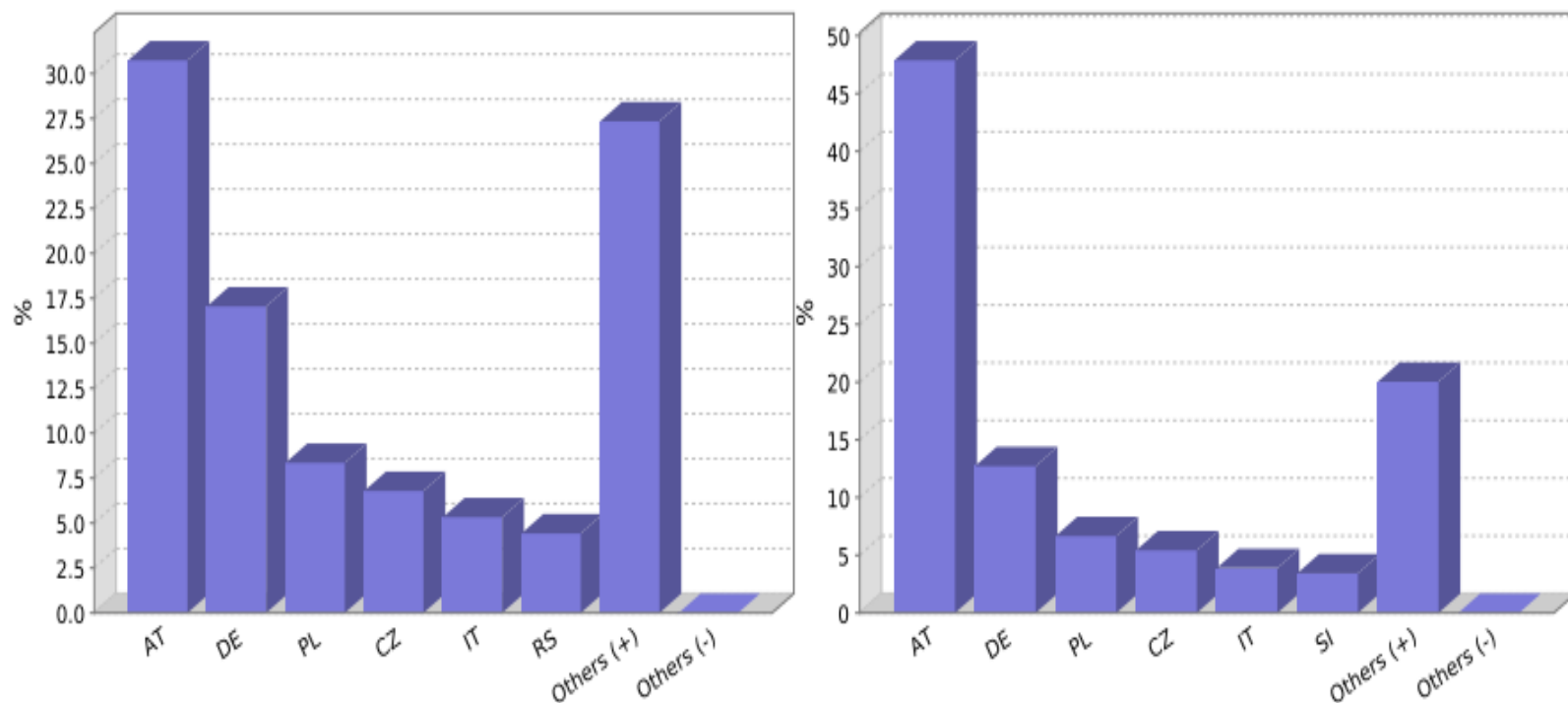


Figure 22: The six most important emitter countries or regions, with respect to their effects on  $PM_{2.5}$  in Austria that would result from reduction in emissions. Left: using EMEP emissions, right: using EMEPwRef2C emissions. For information about EMEPwRef2C see the paragraph about *Emissions* in Section 1.1.

# Summary condensable organics

- Better comparison to observations of  $PM_{2.5}$  (also OC) when ‘including condensables’ consistently with TNO Ref2 estimate
- Country-to-itself increases up to factor 2-5 in most extreme cases, little for some countries - varies a lot
- Country-to-itself versus import contributions change for some countries (sector contributions)
- Visit country report/SR tables for more details for your country, or web interface for comparison to observations
- Caveat: PM assumed inert!

## Other comments

- Many countries will need help in implementing new methods for estimating condensables - this help should be available through comparison with data from similar countries, with Ref2 assumptions, the Guidebook, TFEIP, TFTEI, and from participants of this workshop.
- Much data and experience is available from the US EPA, and work towards consideration of this can begin now.
- Move towards more explicit PM emission split - SO<sub>4</sub>, EC, OM25\_filt, OM25\_condensables would help
- **Generally - prepare for more detailed emission reporting requirements - nationally and in Guidebook.**
- **Don't let the perfect be the enemy of the good!**

# Acknowledgements

Main funding from:

- Nordic Council of Ministers - for meeting and follow-up work

And also:

- EMEP under UN-ECE - additional funding for Met Norway
- Participants - also for flexibility and helpful responses to corona-complications!
- Stefan Åström for zooming us out of trouble when the meeting was covid-cancelled.

Shame we missed Göteborg!

