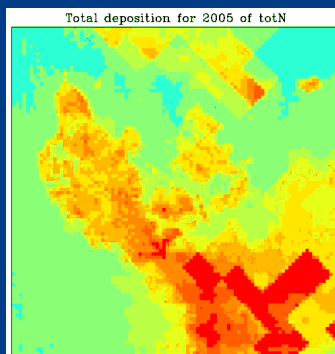


Evaluation of SEEDS agricultural NH_3 emissions in Denmark

Camilla Geels, Lise M. Frohn, Jesper H. Christensen, Carsten A. Skjøth, Thomas Ellermann, Anne Sofie Lansø, Steen Gyldenkærne
and
Jieying Ding, Ronald van der A, Henk Eskes



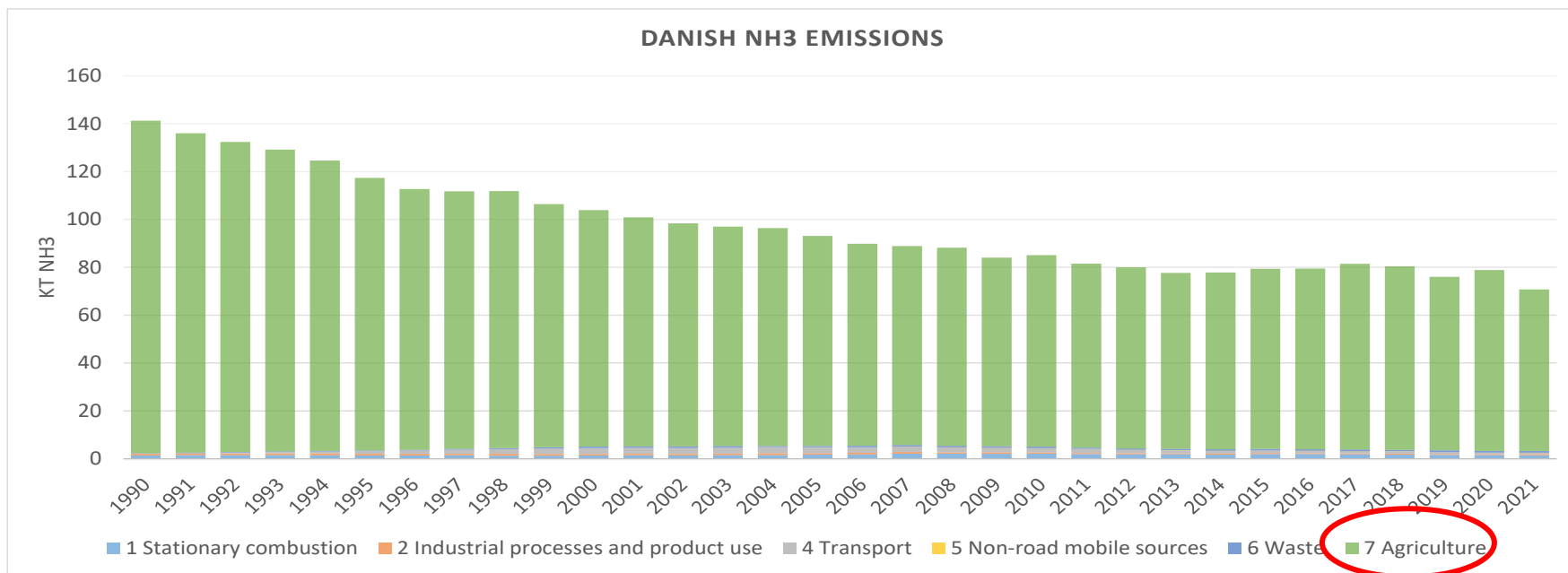
AARHUS
UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL SCIENCE



Danish context:

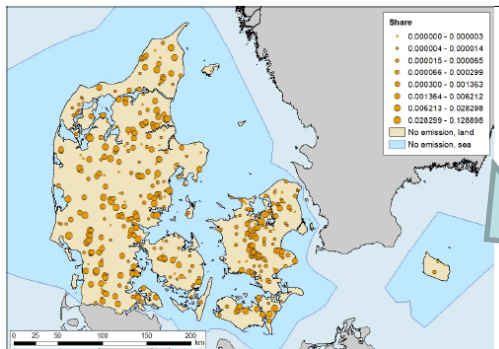
- Large agricultural sector (e.g. >10 mio. pigs).
- >60% of the Danish land area.
- **Active national environmental policy** - to reduce the loss of nitrogen to the aquatic environment.





Danish methodology – spatial distribution : (emission and modeling group)

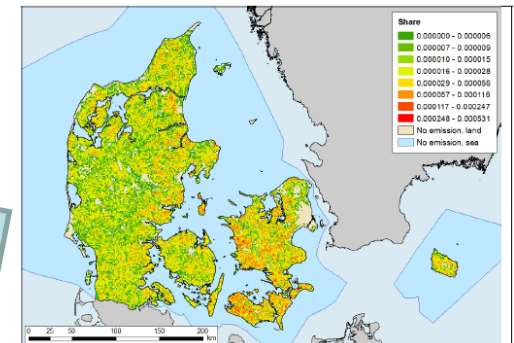
- Bottom-up emission inventory – standard reporting.
- The SPREAD model^[1]: Spatial mapping - based on high resolution spatial distribution keys (regulation-> detailed data).



Examples:

Chicken farms (point sources).

Application of fertilizers
(a field scale – 100 m x 100 m).



[1]Plejdrup et al., 2018. Spatial high-resolution distribution of emissions to air – SPREAD 2.0. Aarhus University, Technical Report from DCE No. 131 <http://dce2.au.dk/pub/TR131.pdf>

Danish methodology –temporal distribution :

- A dynamic NH_3 emission model developed for Denmark^[1,2] and Northern Europe^[3].
- 16 different functions describing the temporal variation in NH_3 emissions from various activities.
- Driven by e.g. T and crop growth/ application of manure described by Gauss functions^[2].

Function	Description
<i>Fkt 1</i>	Animal houses with forced ventilation
<i>Fkt 2</i>	Open animal houses (non-forced ventilation)
<i>Fkt 3</i>	Manure storages
<i>Fkt 4</i>	Winter crops (no emission simulated in this study)
<i>Fkt 5</i>	Spring crops (no emission simulated in this study)
<i>Fkt 6</i>	Late spring crops (no emission simulated in this study)
<i>Fkt 7</i>	Grass
<i>Fkt 8</i>	Spring application of manure on bare soil
<i>Fkt 9</i>	Application of manure on crops
<i>Fkt 10</i>	Summer application of manure
<i>Fkt 11</i>	Autumn application of manure
<i>Fkt 12</i>	Spring application of fertilizer (90% of all fertilizer)
<i>Fkt 13</i>	Summer application of fertilizer (10% of all fertilizer)
<i>Fkt 14</i>	Emission related to grassing cattle
<i>Fkt 15</i>	Emissions related to ammonia treated straw
<i>Fkt 16</i>	Emissions related to personal vehicles with catalytic converters

[1] Skjøth et al.(2004) Implementing a dynamical ammonia emission parameterization in the large-scale air pollution model ACDEP109, D06306, doi:10.1029/2003JD003895.

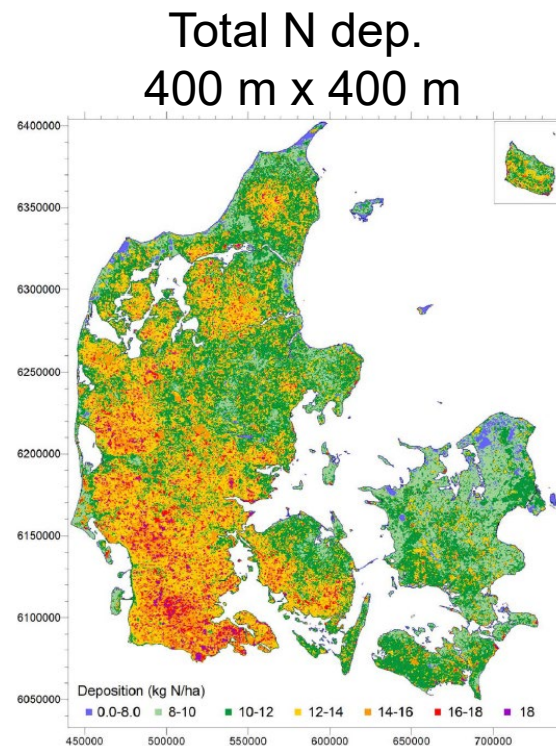
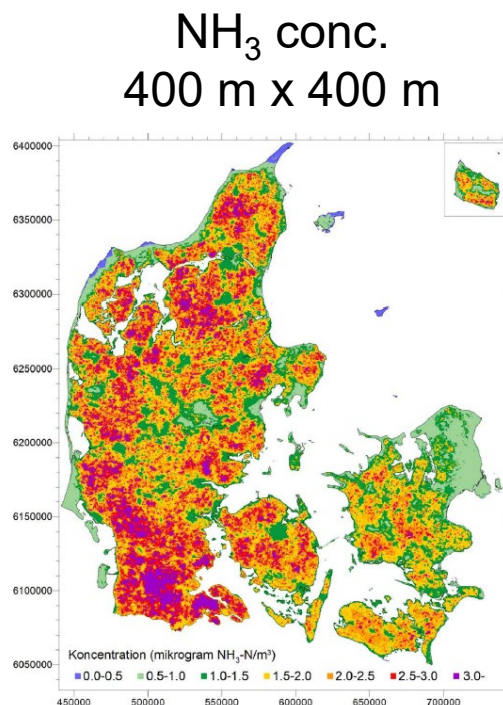
[2] Gyldenkerne et al (2005) A dynamical ammonia emission parameterization for use in air pollution models, JGR, 110, D07108, doi:10.1029/2004JD005459.

[3] Skjøth et al (2011). Spatial and temporal variations in ammonia emissions - a freely accessible model code for Europe: Atmos. Chem. Phys., 11, 5221-5236.



Danish methodology –N deposition:

- Regional to local scale modeling^[1] for Denmark – DEHM/ OML-dep.
- Annual reporting to the Danish EPA^[2].



^[1]Geels, C., Andersen, H. V., Skjoth, C. A., Christensen, J. H., Ellermann, T., Lofstrom, P., Gyldenkaerne, S., Brandt, J., Hansen, K. M., Frohn, L. M., and Hertel, O.: Improved modelling of atmospheric ammonia over Denmark using the coupled modelling system DAMOS, Biogeosciences, 9, 2625-2647, 10.5194/bg-9-2625-2012, 2012.

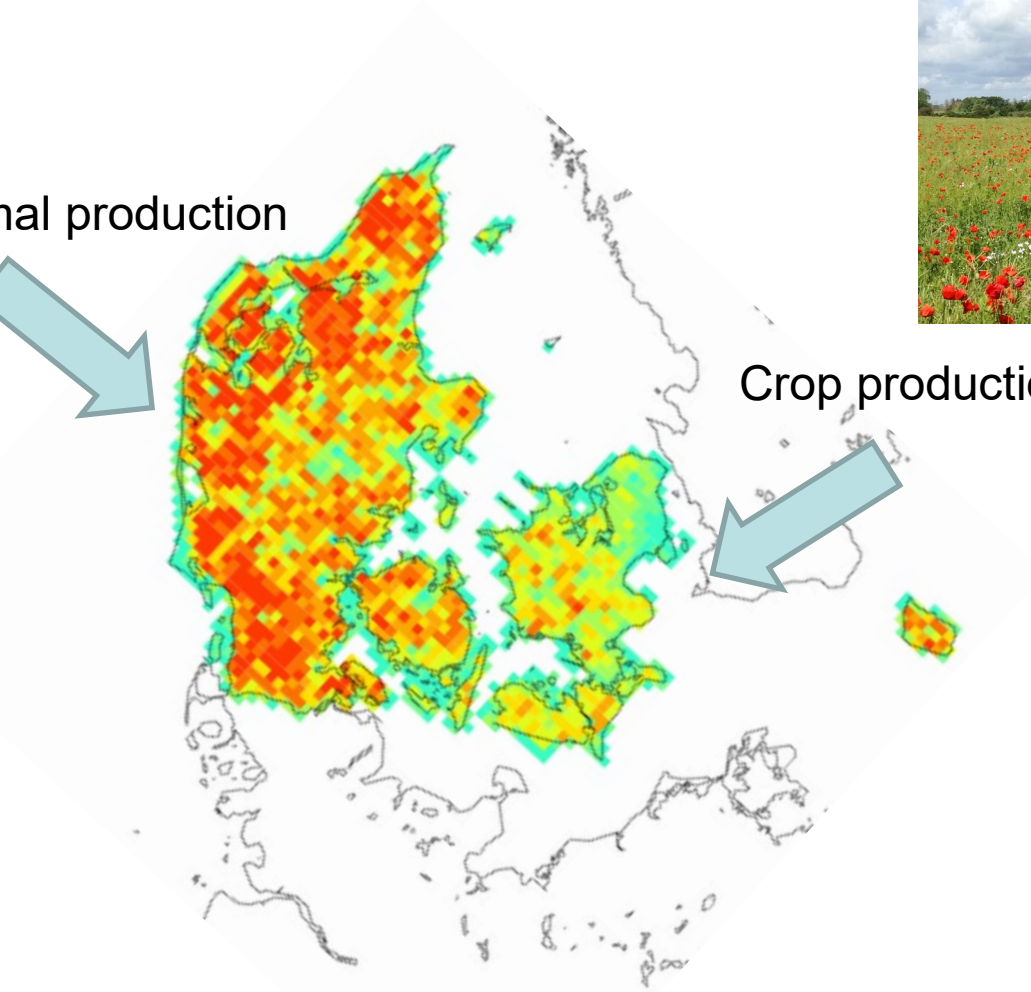
^[2]Ellermann, T., Bossi, R., Sørensen, M.O.B., Christensen, J., Løfstrøm, P., Lansø, A. S., Monies, C., Geels, C., & Poulsen, M. B., 202x: Atmosfærisk deposition 2020. NOVANA. Aarhus Universitet, DCE nr. 471. <http://dce2.au.dk/pub/SR471.pdf>



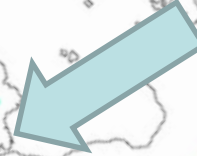
Focus on 2020 NH_3 emissions: Spatial distribution



Animal production

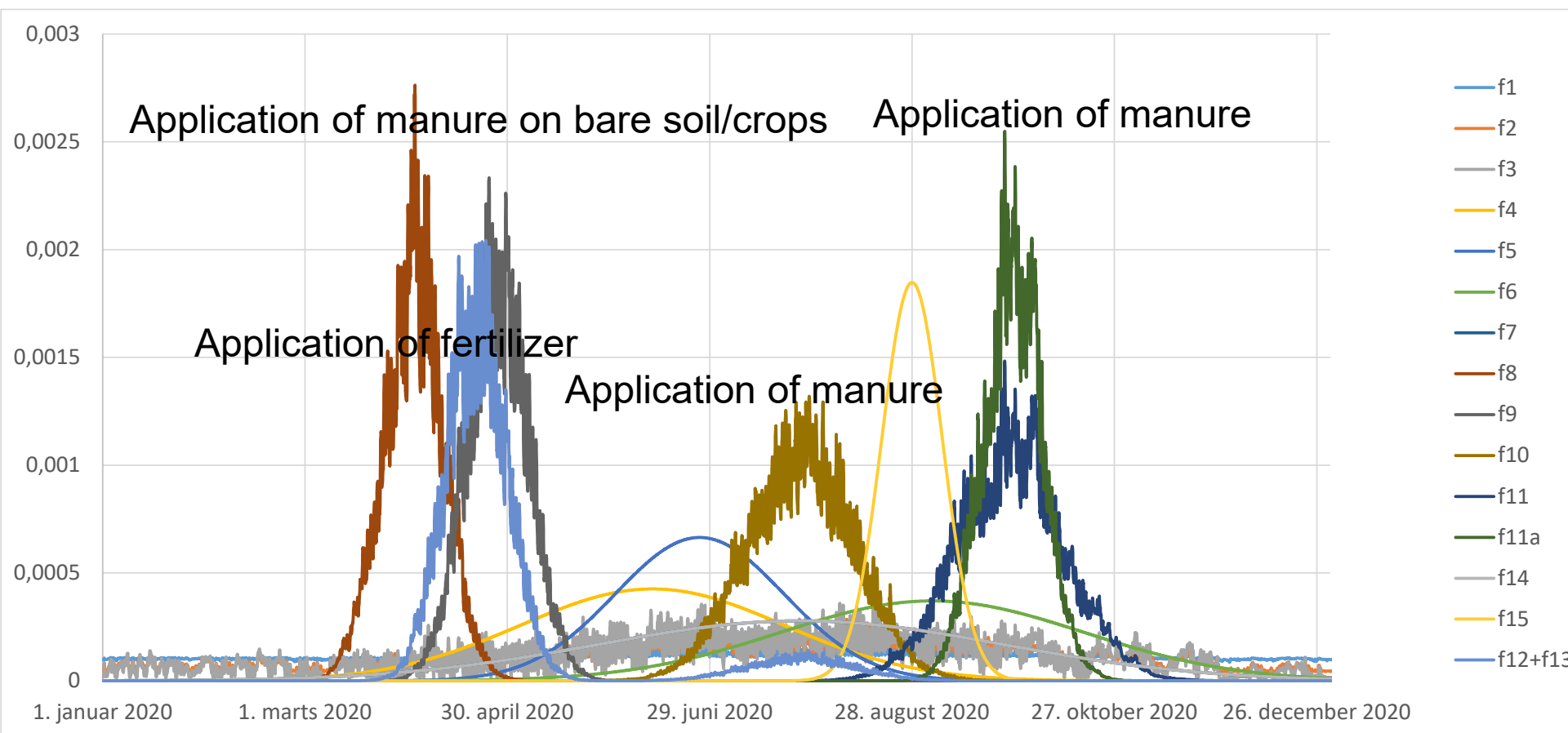


Crop production





Focus on 2020 NH₃ emissions: Seasonal variation – the functions from the dynamic model

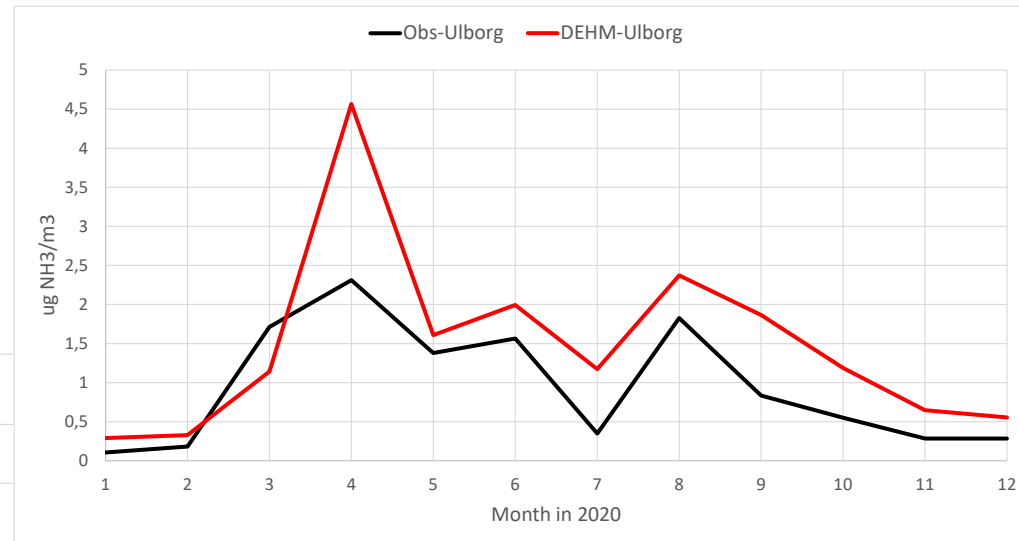
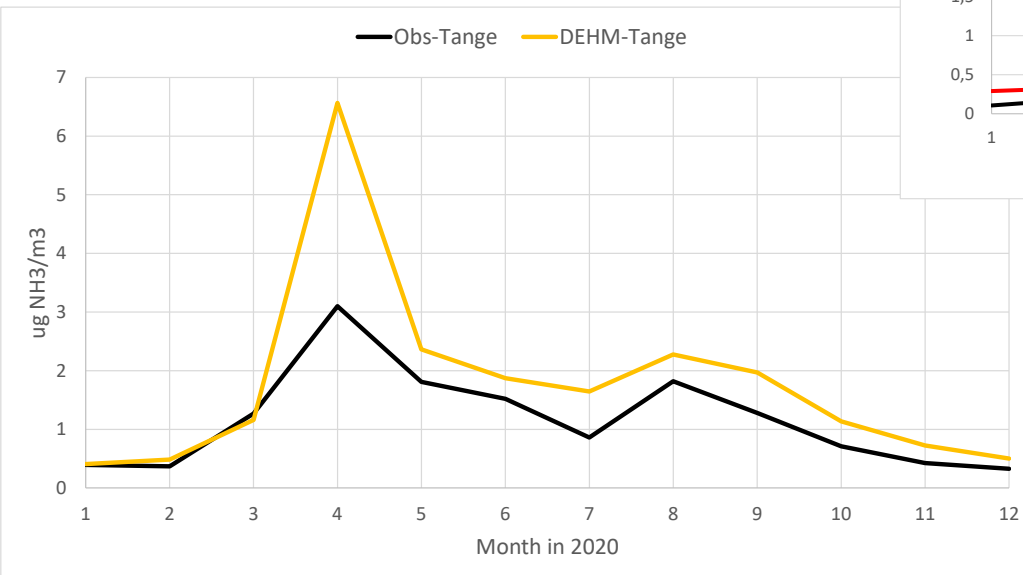




'Standard way' to evaluate

–comparing the modelled NH_3 concentration to observations.

➤ The DEHM model captures the temporal variability, but overestimates the spring peak.



Top in April, June and August.

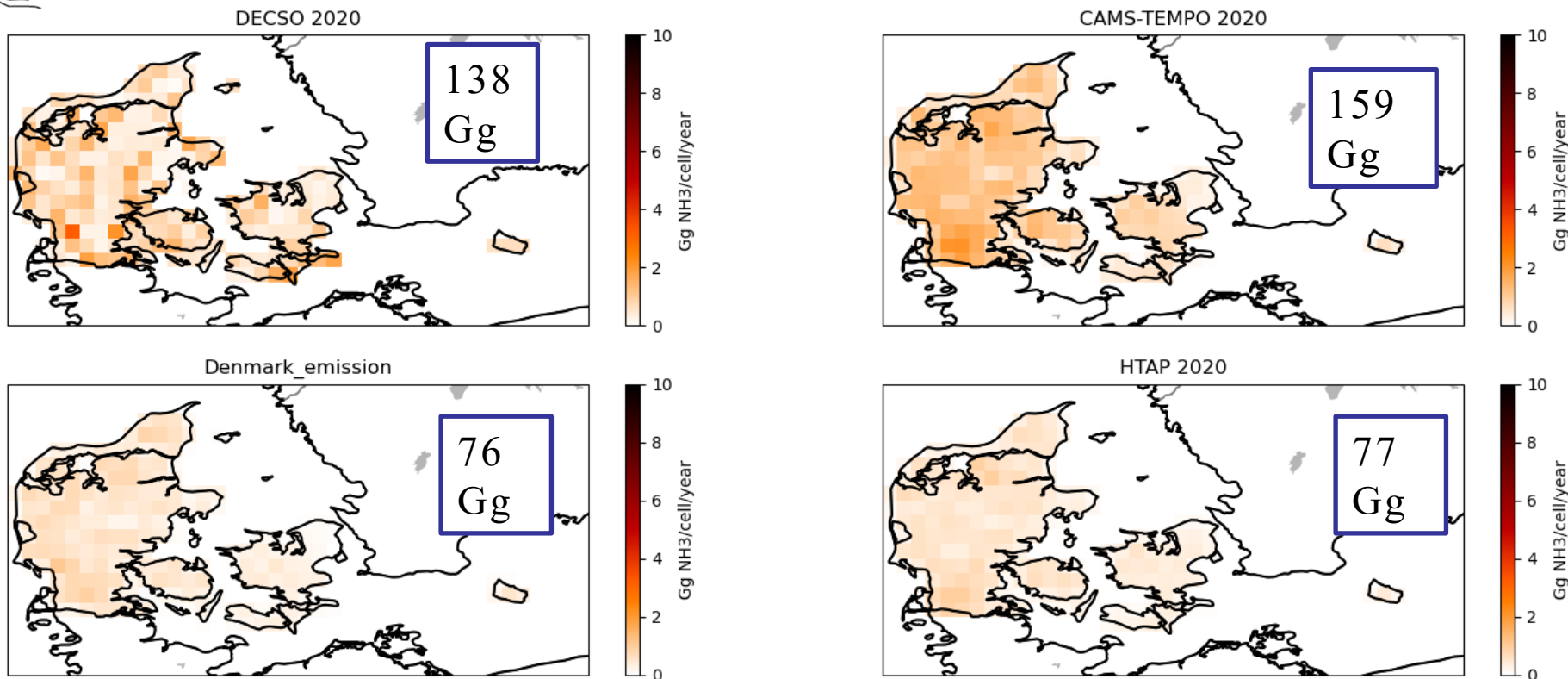


Additional ways to evaluate

–comparing the Danish NH₃ emissions to other emissions estimates.



Total NH₃ emissions in 2020.



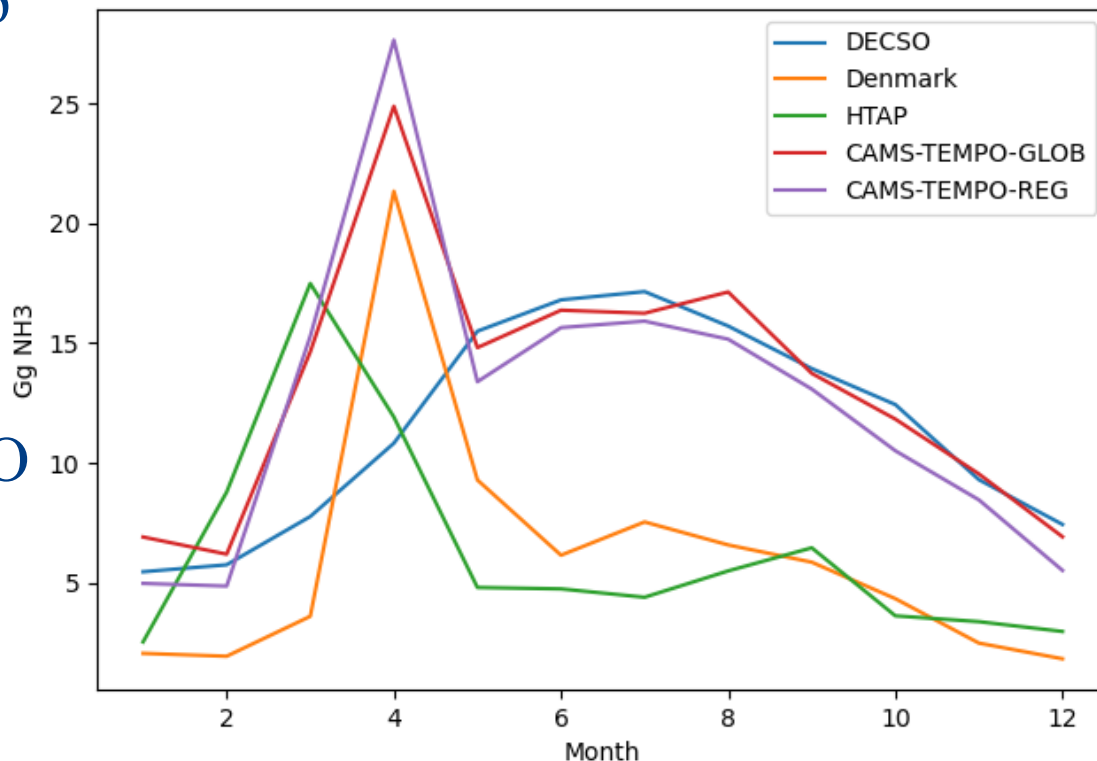
Plots provided by Jieying Ding.



Evaluating the temporal variation

–comparing the Danish NH₃ emissions to other emissions estimates.

- According to Danish NH₃ observations: top in April, June and August.
- The top in April only slightly larger...
- The top-down DECSO estimate is not capturing this...



Plots provided by Jieying Ding.

Perspectives:

- Independent evaluation of our national emissions are highly relevant.
- Standard bottom -up estimates are e.g. not accounting for higher emissions in warm years.
- A more detailed comparison covering several years is needed to give a better view on the pros and cons related to top-down and bottom -up estimates for Denmark.
- Thanks for this opportunity!

