VALIDATION OF A HIGH-RESOLUTION AIR QUALITY MODELLING CHAIN FOR NITROGEN IN FLANDERS

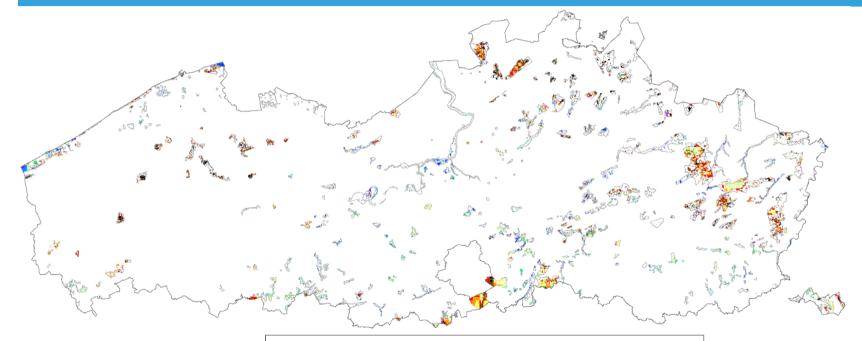Wouter Lefebvre, Felix Deutsch, Jeroen Staelens, David Roet, Wendy Swaans

INTRODUCTION

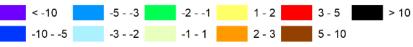- Deposition of reactive nitrogen is important problem (biodiversity)
- Any plan or project […] likely to have a significant effect thereon, either individually or in combination with other plans or projects […] the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public. (article 6.3 habitats directive)
- But how can they assess? => modelling

- Modelling needs validation
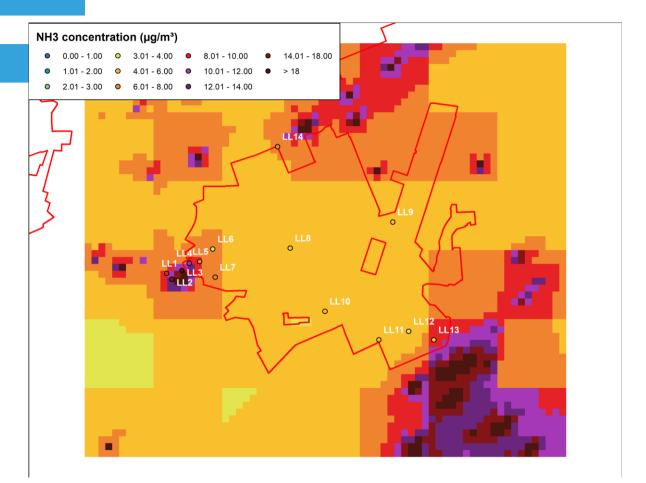
EXCEEDANCE OF WHAT NATURE CAN HANDLE

Overschrijding KDW in 2015 (kgN/ha/jaar)

< -10	-2 - -1	3 - 5
-5 - -3	1 - 2	> 10
-10 - -5	-1 - 1	5 - 10
-3 - -2	2 - 3	

MODEL SYSTEM

- Coupling of the Lagrangian plume VLOPS-model (based on the Dutch OPS-model) with the local scale Gaussian plume IFDM model, coupled with a similar scheme as in Lefebvre et al. (2013). Dry deposition velocities calculated by VLOPS (using DEPAC) are transferred to IFDM.

- VLOPS is calibrated on a fixed set of measurement locations.

- An independent set of measurements (60 locations, in and around 6 nature areas) ammonia concentrations (passive samplers, 13 measurement periods of 4 weeks each) are used to validate the model.

MODEL SYSTEM

Example model results
With validation locations

NH3 concentration (µg/m³)

- 0.00 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 12.00
- 12.01 - 14.00
- 14.01 - 18.00
- > 18

EMISSIONS

- Ammonia emissions are taken from the emission inventory of the Flanders Environment Agency (VMM).
- For agricultural emissions, these are derived from the EMAV model.
  - We have two versions: version 2.0 and 2.1 that we can compare. In the latter version (2.1), the emission factors, mainly for cows have been updated with the latest knowledge

VALIDATION RESULTS

VLOPS-IFDM = spatial resolution of 100x100 m²; VLOPS = resolution of 1x1 km²

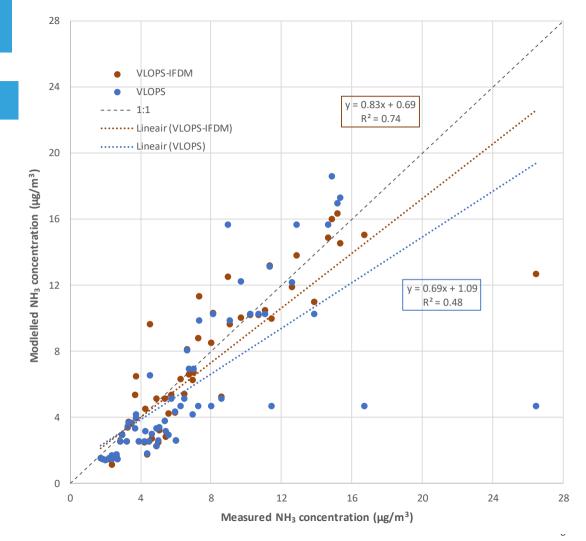|	Spatial		Temporal		Spatio-temporal	
	VLOPS-IFDM	VLOPS	VLOPS-IFDM	VLOPS	VLOPS-IFDM	VLOPS
BIAS (µg/m³)	-0,52 (-0,82)	-1,08	-0,83	-1,16	-0,83	-1,16
BIAS (%)	-7,45 (-11,69)	-15,3	-10,8	-15,2	-10,8	-15,2
RMSE (µg/m³)	2,43 (-2,92)	3,78	1,69	1,83	4,08	4,82
RMSE (%)	34,5 (41,5)	53,7	22,1	24,0	53,5	63,2
R² (-)	0,74 (0,63)	0,48	0,48	0,52	0,52	0,38
BCRMSE (µg/m³)	2,37 (2,80)	3,62	1,47	1,41	3,99	4,68

Older emission dataset between brackets

Improvement of spatial validation due to higher resolution!

Improvement of validation with newer emission dataset

VALIDATION RESULTS

- Improvement of spatial validation due to higher resolution
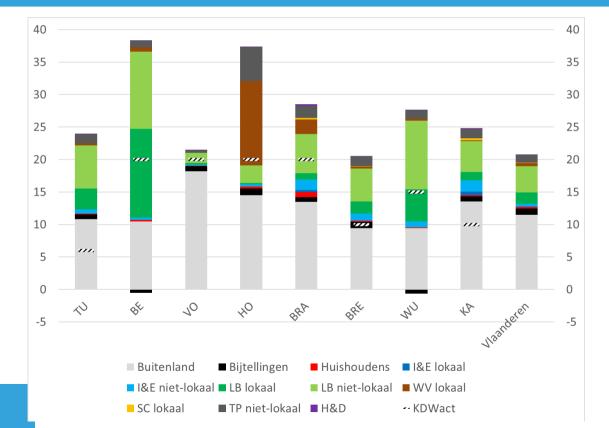- One outlier: very close to emission source. IFDM solves part of it, but cannot solve everything.

CONCLUSIONS AND DISCUSSION

- Modelling nitrogen deposition is possible
- High spatial resolution can be necessary
- Reliable emission data are crucial
- Uncertainties on deposition velocities remain large => main source of uncertainty

- How to tackle uncertainty if directive states: Any plan or project [...] likely to have a significant effect thereon, either individually or in combination with other plans or projects [...] the competent national authorities shall agree to the plan or project only **after having ascertained that it will not adversely affect** the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.