Atmospheric Transport Contribution to Coastal Eutrophication

30 June 2014

A cross discipline and cross border integrated project on eutrophication offering information, education and science to stakeholders and the public at large in the Interreg 2 Seas Zone (Belgium, England, France and the Netherlands).
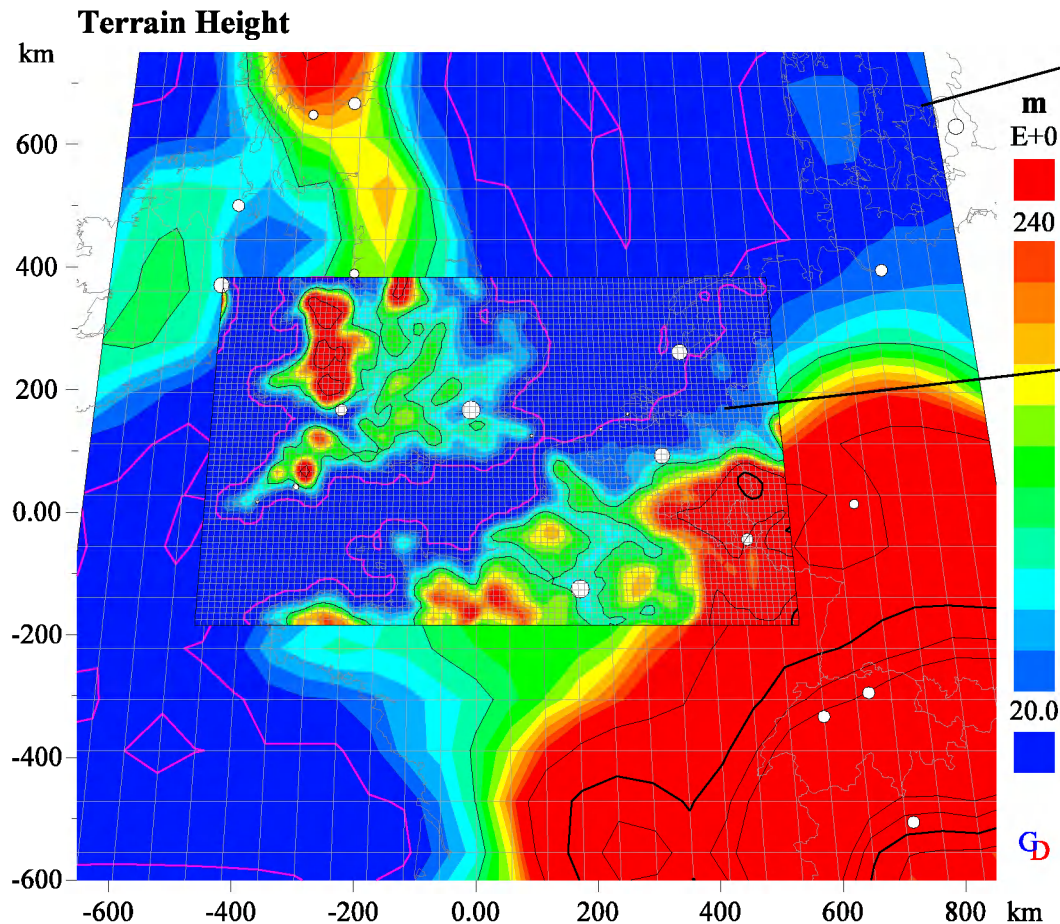
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Contents

- Region and scope of ISECA atmospheric model
- Nitrogen bearing pollutants tracing and deposition
  - assumptions
  - influence of emissions quantities
 - influence of the weather
- Conclusions

Domain and Grids

Terrain Height

- Coarse weather grid
  - 9° W to 12° E
  - 44° N to 57° N

- Fine-grid emissions data from VITO
  - In the ISECA region:
- **6° West to 7° East**
- **48° to 54° North**
  - Maes et al., Atmospheric Environment, 2009, 43, 1246-1254

S1 - Combustion in energy and
     transformation industries
S2 - Non-industrial combustion plants
S3 - Combustion in manufacturing industry
S4 - Production processes
S5 - Extraction and distribution of fossil fuels
     and geothermal energy
S6 - Solvent use and other product use
S7 - Road transport
S8 - Other mobile sources and machinery
S9 - Waste treatment and disposal
S10 - Agriculture
S11 - Other sources and sinks

Gg/year, *in ISECA 'region of interest'*

Legend: 1990 Nox, 1990 NH3, 2000 Nox, 2000 NH3, 2009 Nox, 2009 NH3
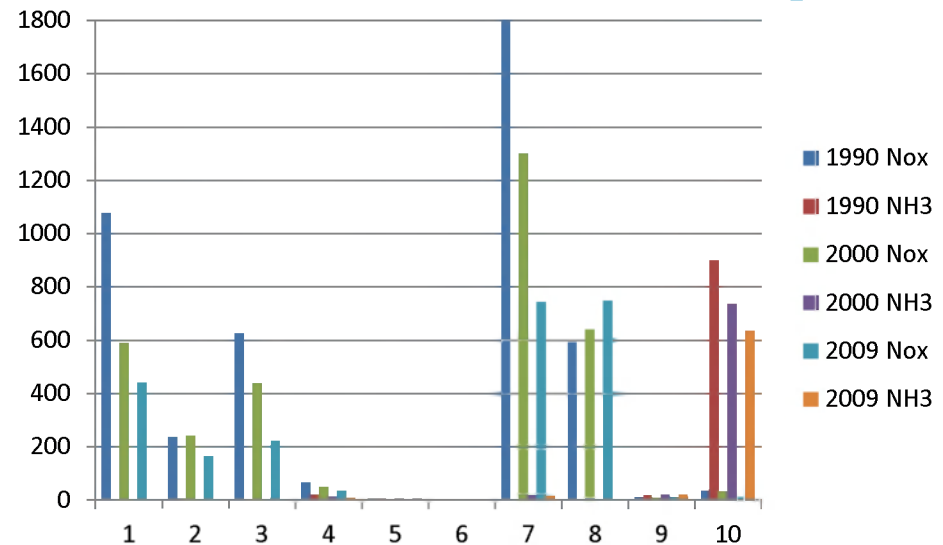
Standardized Nomenclature for Air Pollutants (SNAP) Sector number

- Simulations carried out for:
  - NO$_x$ – SNAP: 1, 2, 3, 7 and 8
  - NH$_3$ – SNAP: 10

|	Weather Data	
Emissions 2009	2009	2011
Emissions 2000	2009	2011

Pollutant Tracing

Fine-grid Lagrangian Particle Dispersion: 2009, 2011 runs

- Simulated period: from 0:00 h, 1 Jan to 24:00 h, 31 Dec

- Nitrogen oxides and ammonia traced
  - separately for 6 chosen anthropogenic source-sectors denoted by SNAP codes
  - 'raw' output every 6 days: <u>Dry deposition</u>, <u>Wet deposition</u> and <u>Concentrations</u>

- Each release is at its specific height in a 7✕7 km zone (or single point release)
  - refined (by VITO) with disaggregation maps for the 10 SNAP sectors
  - Only sources in the ISECA chosen window (-6..7 ^{o}E, 48..54 ^{o}N) are included in the simulation – to highlight the *local contribution* to the *local eutrophication*
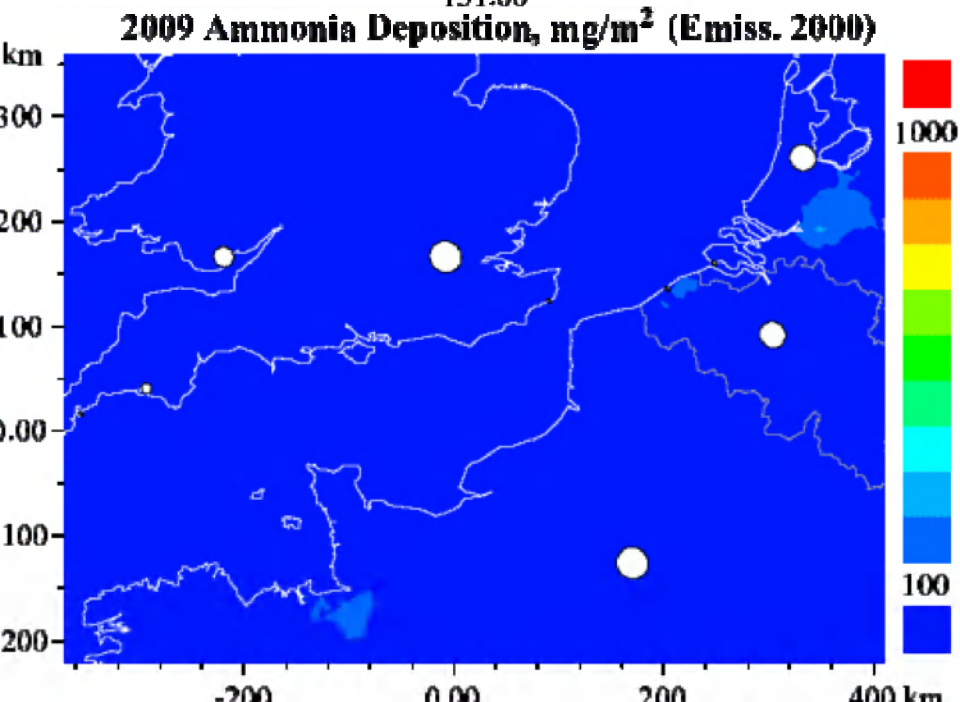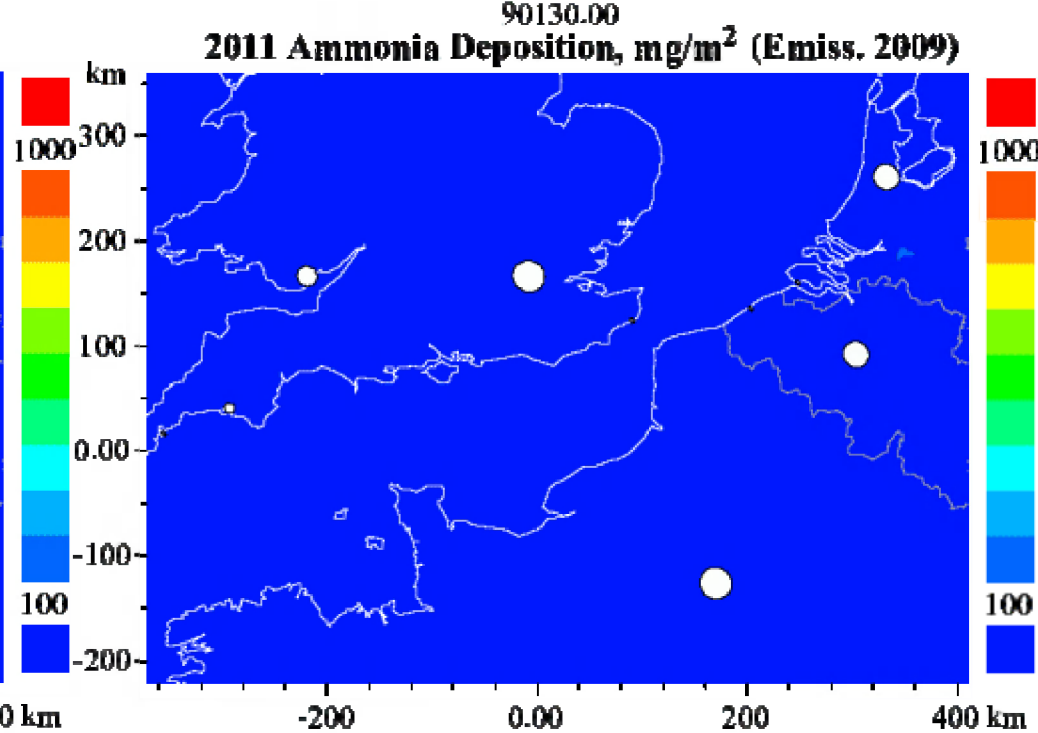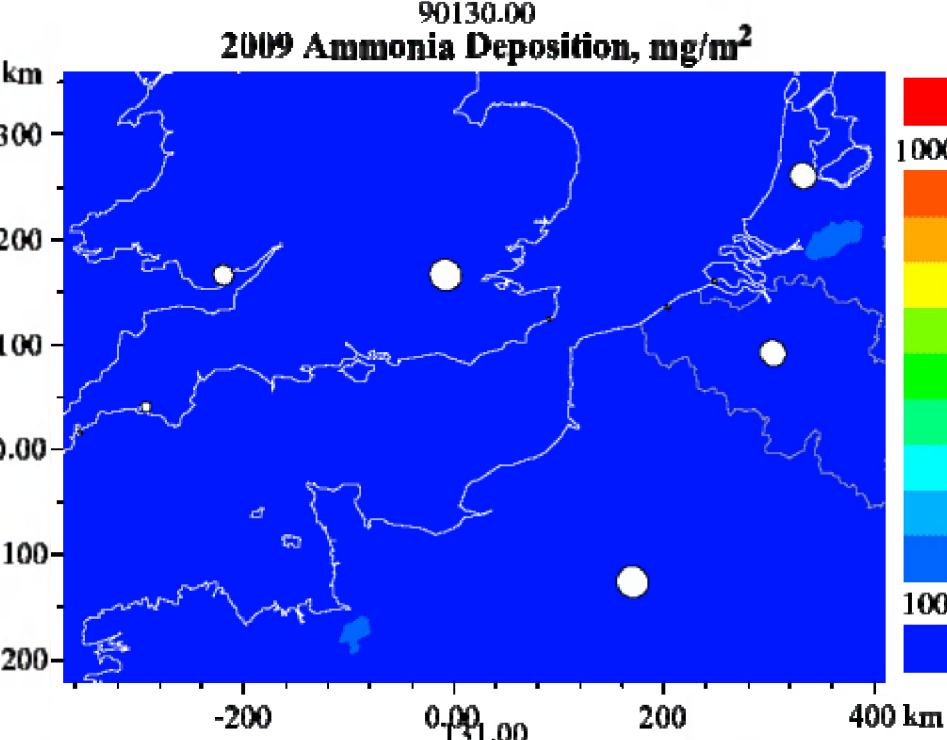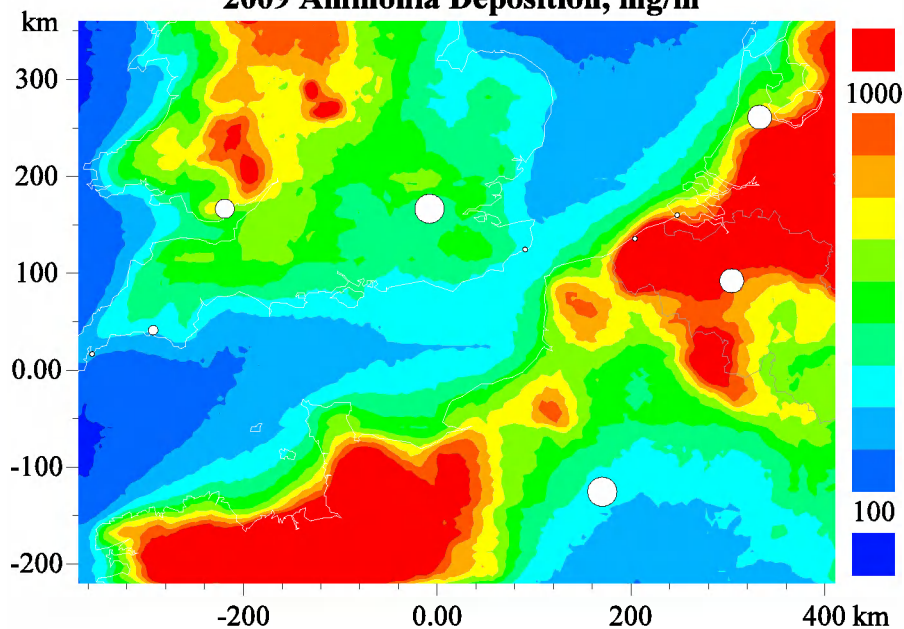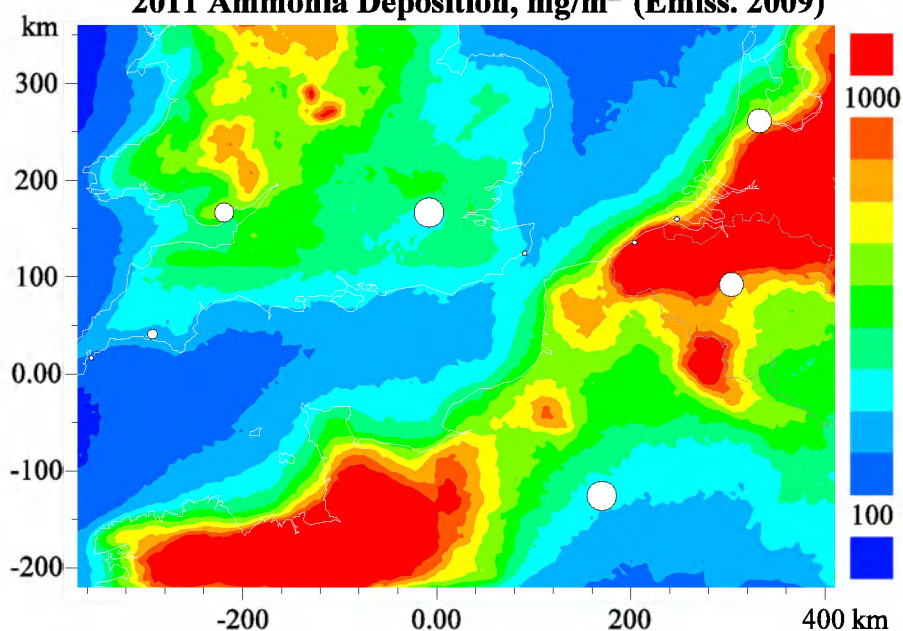
SNAP 10 – Agriculture (Animation)

- Monthly cumulative maps
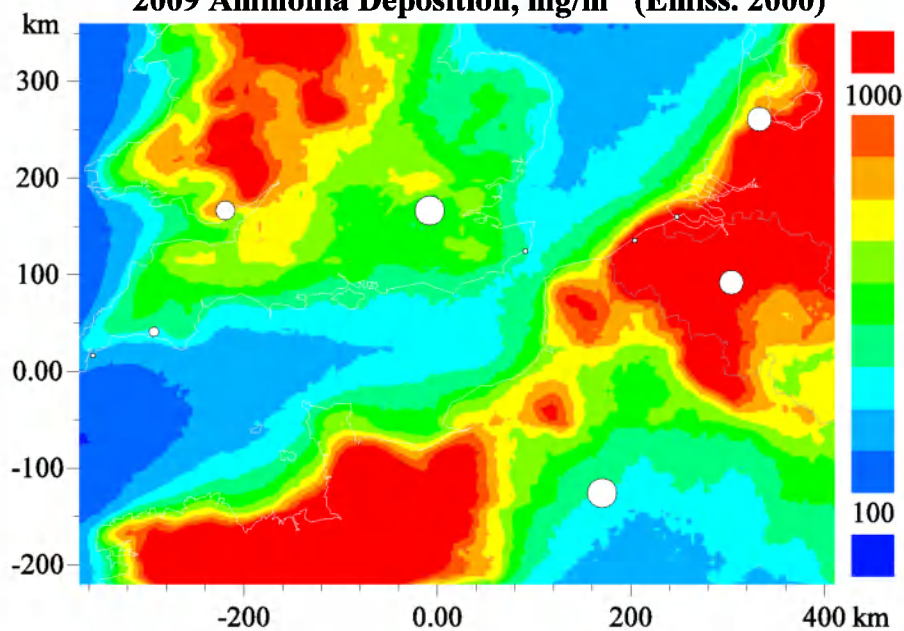- NH_3 mainly deposited near the source, i.e. inland and close to the coasts
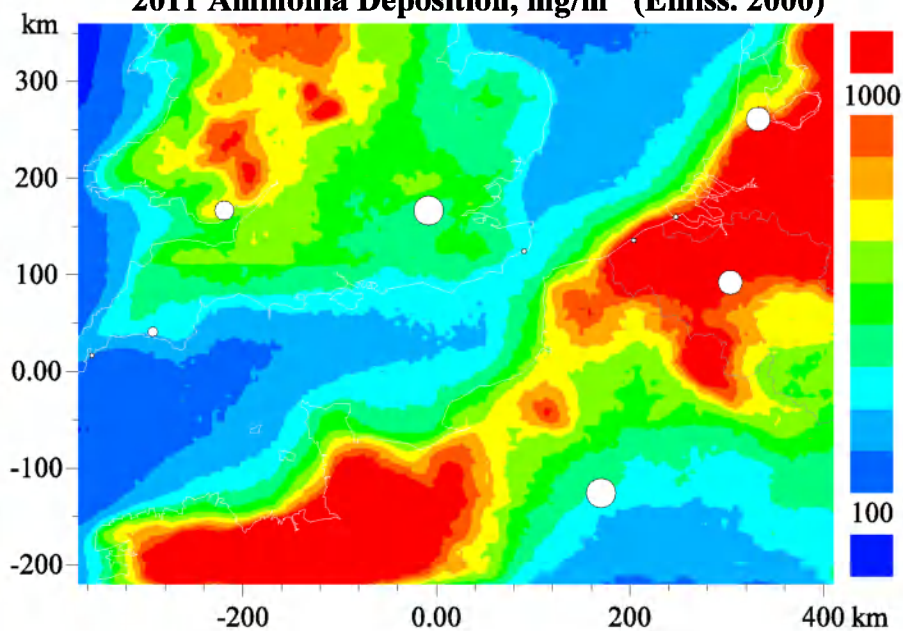
2009 Ammonia Deposition, mg/m^2

2011 Ammonia Deposition, mg/m^2 (Emiss. 2009)
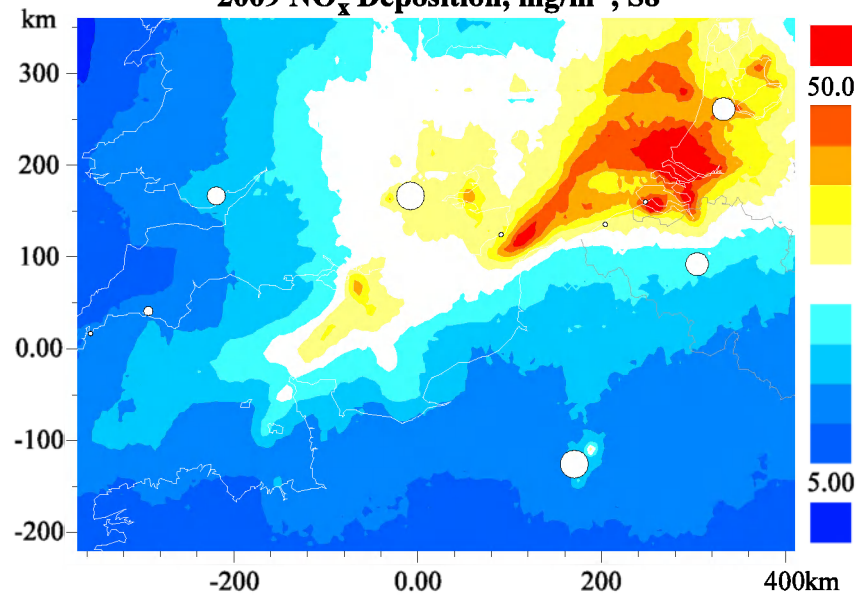
2009 Ammonia Deposition, mg/m^2 (Emiss. 2000)

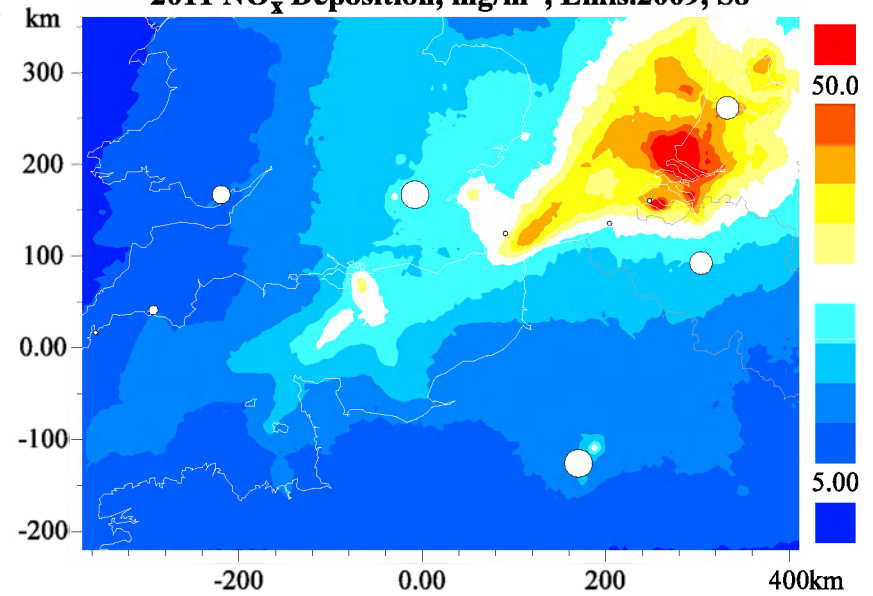**2011 Ammonia Deposition, mg/m^2 (Emiss. 2000)**
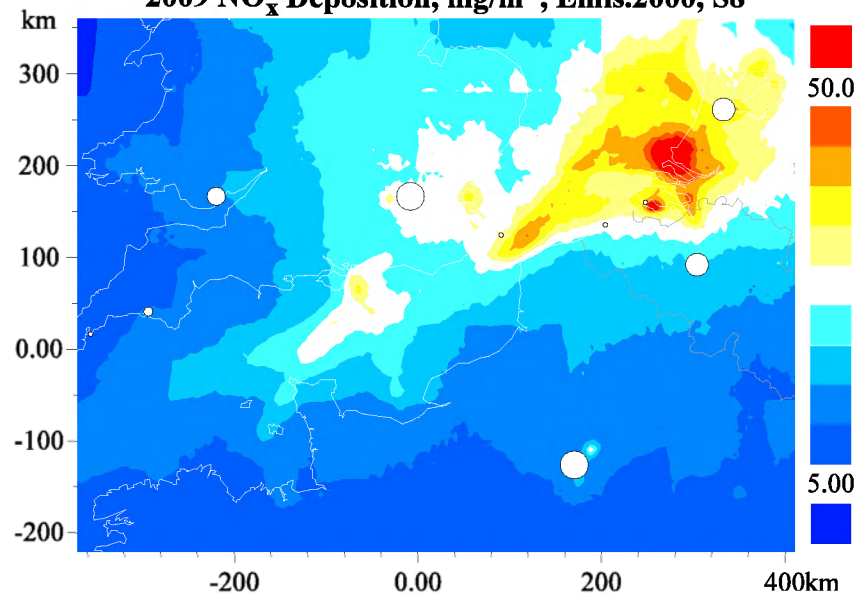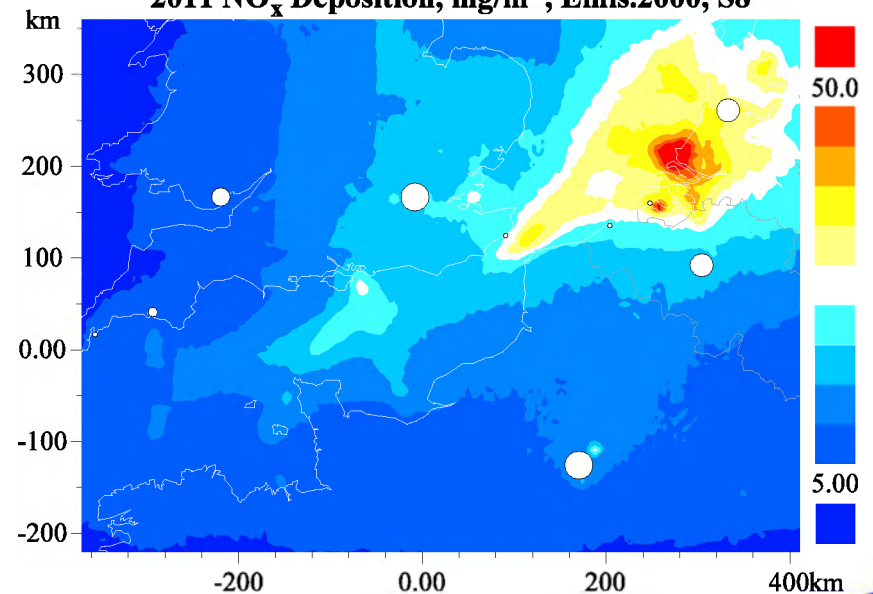
NO$_X$

2009 NO$_X$ Deposition, mg/m^2, S8

2011 NO$_X$ Deposition, mg/m^2, Emis.2009, S8
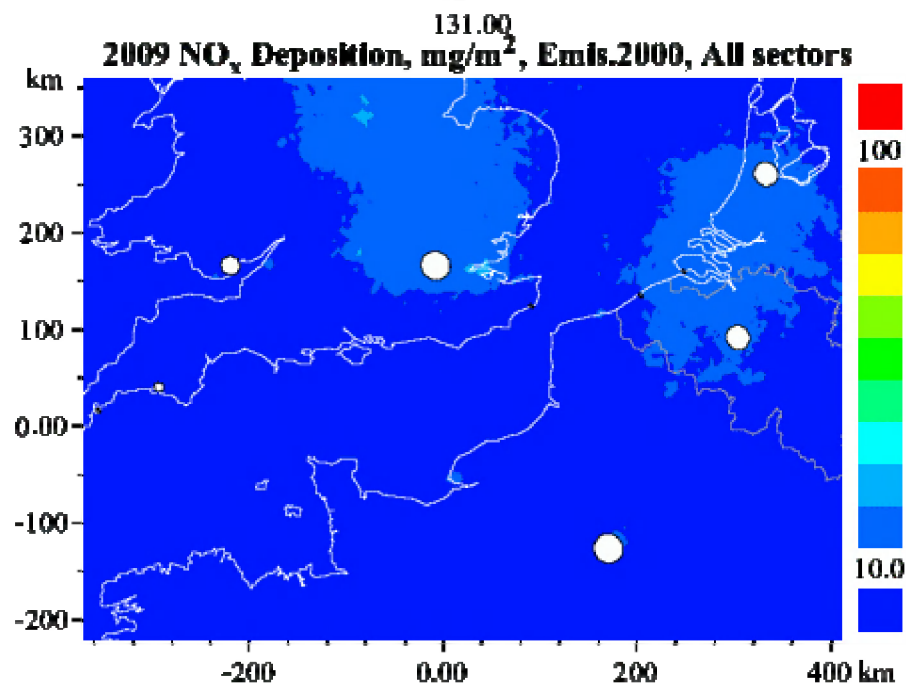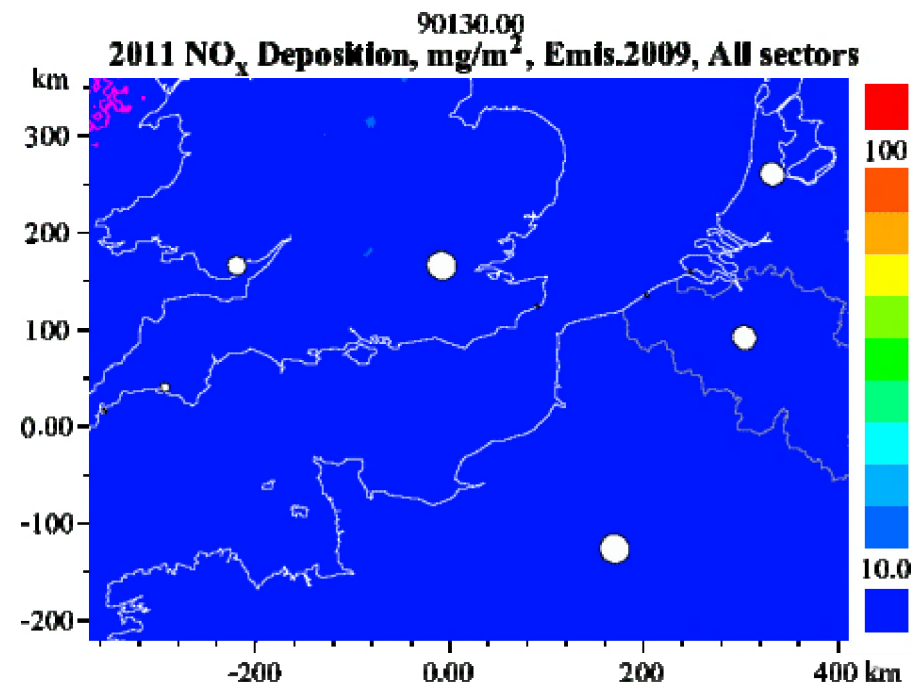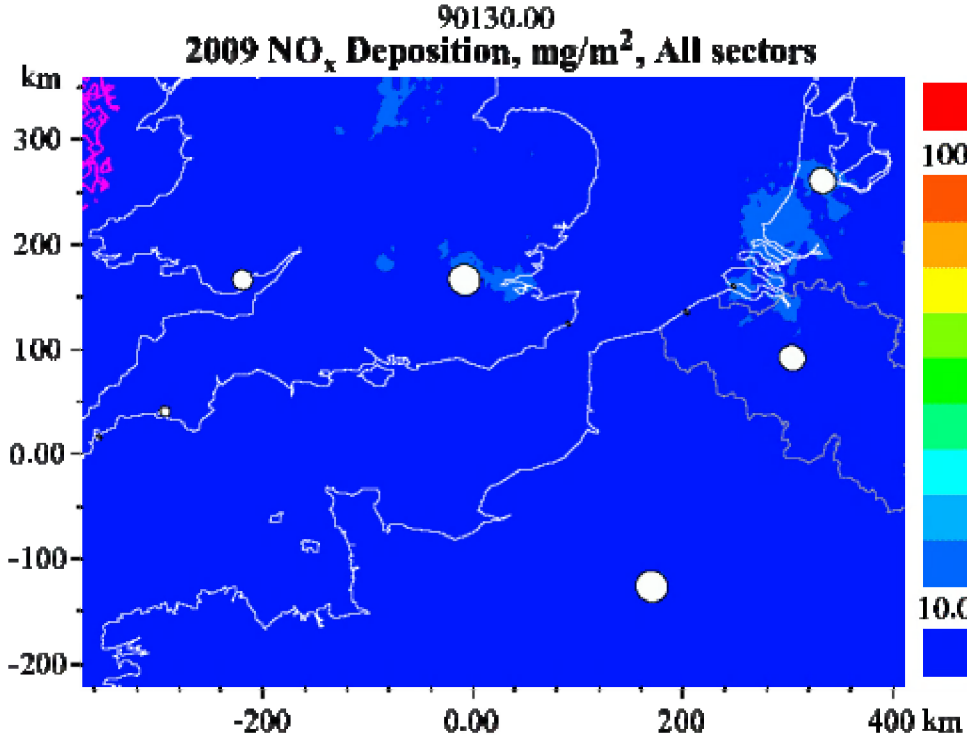
2009 NO$_X$ Deposition, mg/m^2, Emis.2000, S8

2011 NO$_X$ Deposition, mg/m^2, Emis.2000, S8

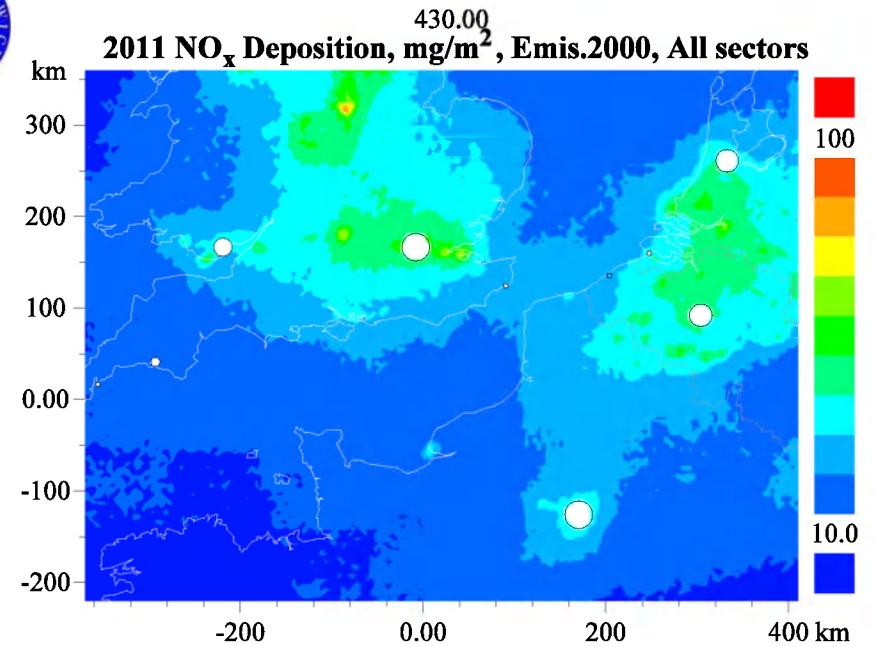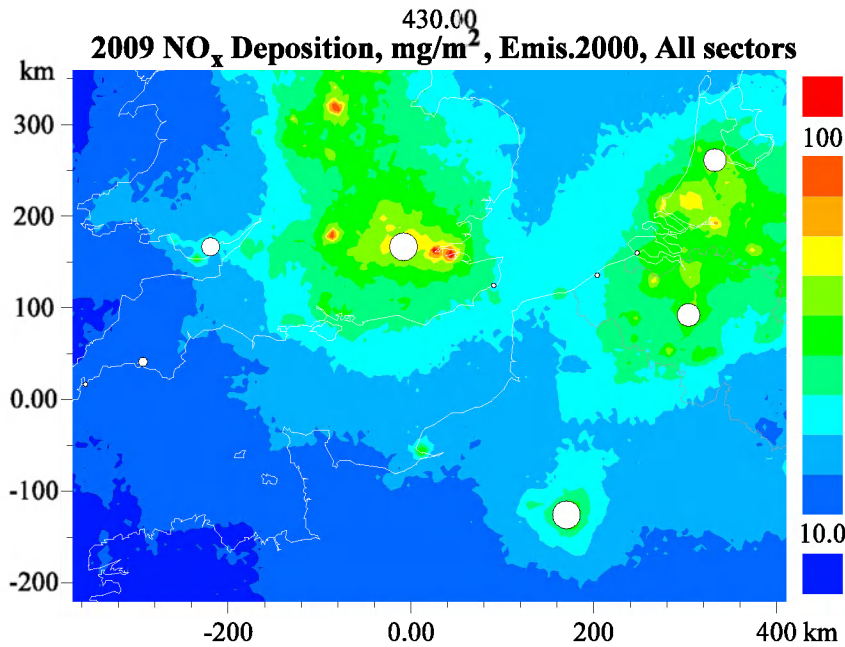➢ Deposition from ships included in SNAP sector 8

SNAPs: 1, +2, +3, +7, +8

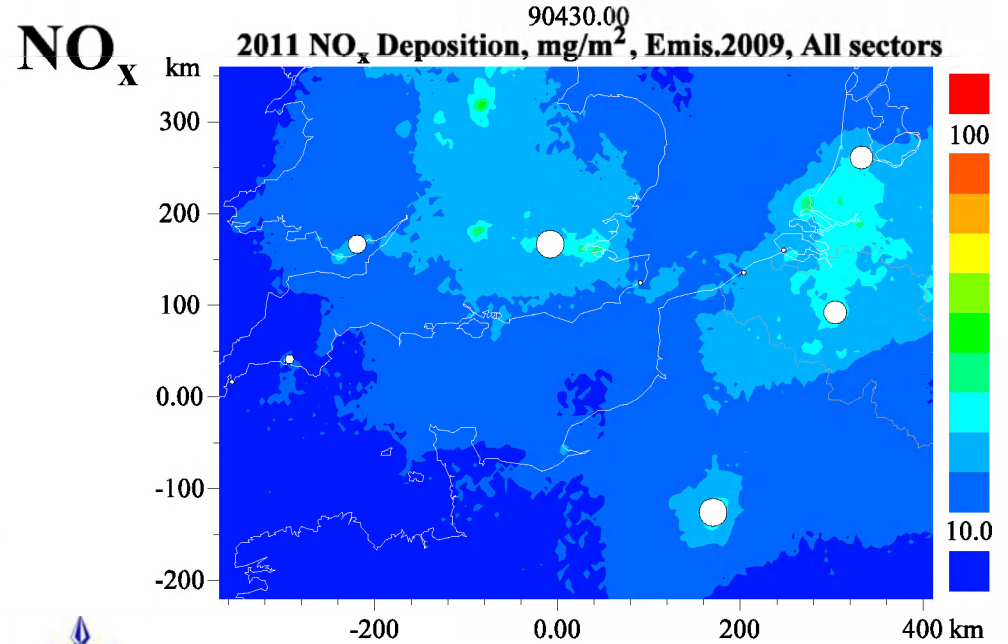- Monthly cumulative maps
- NO$_x$ deposited further away from the source, i.e. a lot leaves calculation domain

NO$_x$

2009 NO$_x$ Deposition, mg/m^2, All sectors

2011 NO$_x$ Deposition, mg/m^2, Emis.2009, All sectors

2009 NO$_x$ Deposition, mg/m^2, Emis.2000, All sectors

2011 NO$_x$ Deposition, mg/m^2, Emis.2000, All sectors
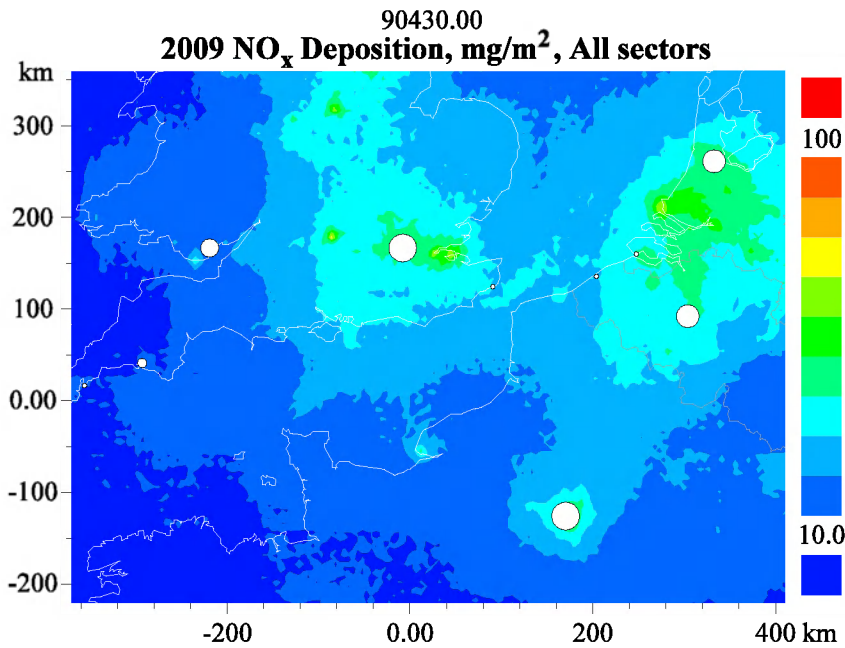
➢ Deposition from 1 January to 30 April, all SNAP sectors

Table of Results

Emissions	Pollutant	Polluter	SNAP Sectors	2009 Simulation	2011 Simulation
2000	Nitrogen Oxides	All Sources	1, 2, 3, 7, 8	NOx_00_09	NOx_00_11
2000	Nitrogen Oxides	Road Transport	7	NOx_Roads_00_09	NOx_Roads_00_11
2000	Nitrogen Oxides	Shipping +	8	NOx_Ships_00_09	NOx_Ships_00_11
2000	Ammonia	Agriculture	10	NH3_00_09	NH3_00_11
2009	Nitrogen Oxides	All Sources	1, 2, 3, 7, 8	NOx_09_09	NOx_09_11
2009	Nitrogen Oxides	Road Transport	7	NOx_Roads_09_09	NOx_Roads_09_11
2009	Nitrogen Oxides	Shipping +	8	NOx_Ships_09_09	NOx_Ships_09_11
2009	Ammonia	Agriculture	10	NH3_09_09	NH3_09_11

- http://w3.gre.ac.uk/~dg12/iseca/

Measured vs. Computed NO2 deposition in Kent (UK)
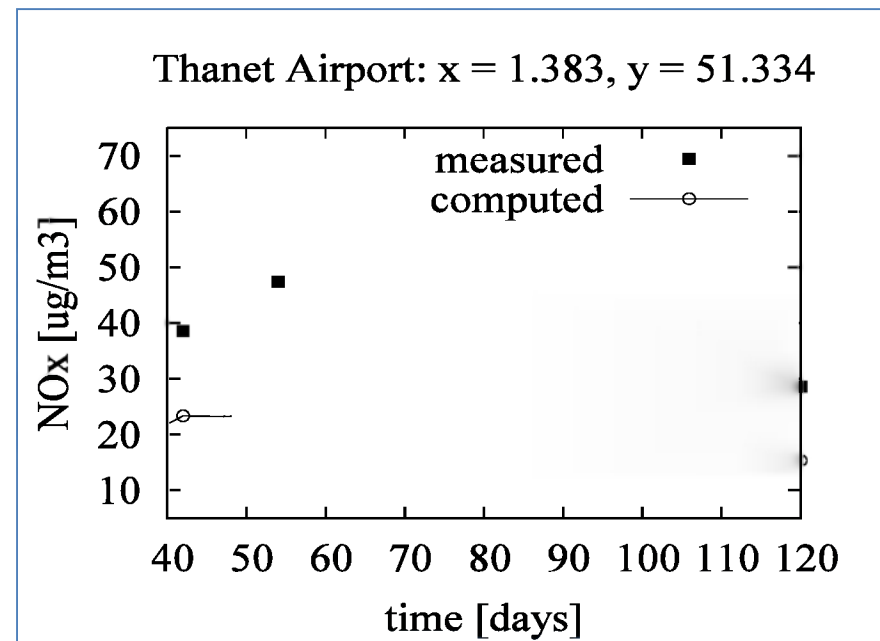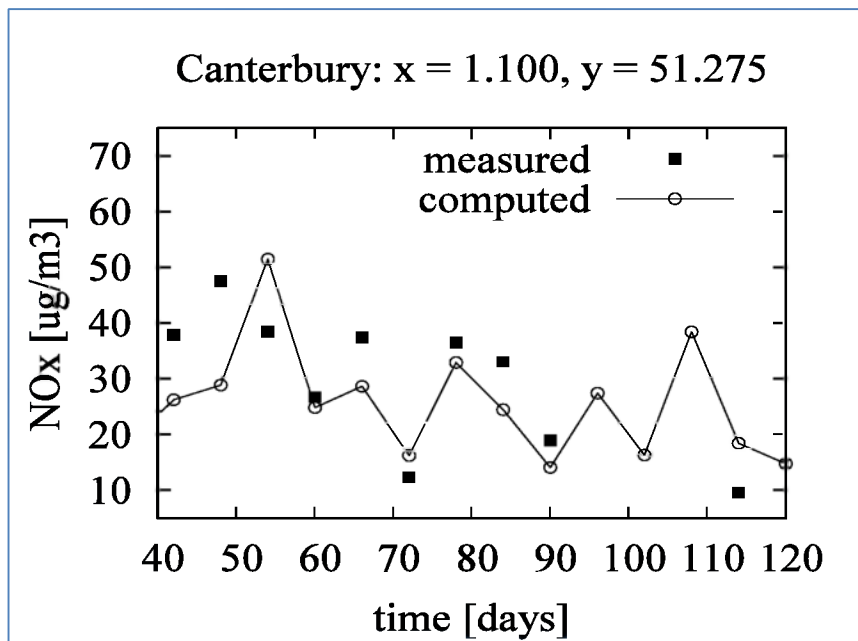
Sample validation comparisons between modelled and measured concentrations of NO_2 , February - April 2009

- Data source http://www.kentair.org.uk/data/

Conclusions

- Atmospheric transport & deposition models use weather and detailed emissions data to provide deposition results for ISECA

- Ammonia is responsible for the largest share of nitrogen deposits from the atmosphere

- Nitrogen oxides emissions are more likely to leave the region and be deposited elsewhere
  - Far-away emissions which may be deposited in the 2Seas region are not part of these simulations.

- Heavy nutrient load onto the coastal waters of Belgium and the Netherlands is confirmed in all model cases.