



# **Application of the UK Integrated Assessment Model in the UK**

**Imperial College London in collaboration with the Centre for  
Ecology and Hydrology, EMRC and Wood Plc**

**TFIAM Berlin 23-24 April 2019**

- 1. UK Clean Air Strategy and PM2.5**
- 2. Shipping in seas round the UK**
- 3. Eutrophication and ecosystem protection**

# CLEAN AIR STRATEGY

**Includes aim to reduce PM2.5-> halving number of people exceeding WHO standard of 10 ug/m<sup>3</sup> by 2025**

**-> application of UKIAM to scenarios to 2030 to achieve NECD and work further towards achieving the WHO standard**

**-> reflects reduction in imported contribution from other countries compliance with emission ceilings**

**Report produced and will be published by Defra shortly**



**PM2.5 exposure and reduction towards achievement of WHO standards**

**SNAPCS contract Report**

Revised 28 March 2019

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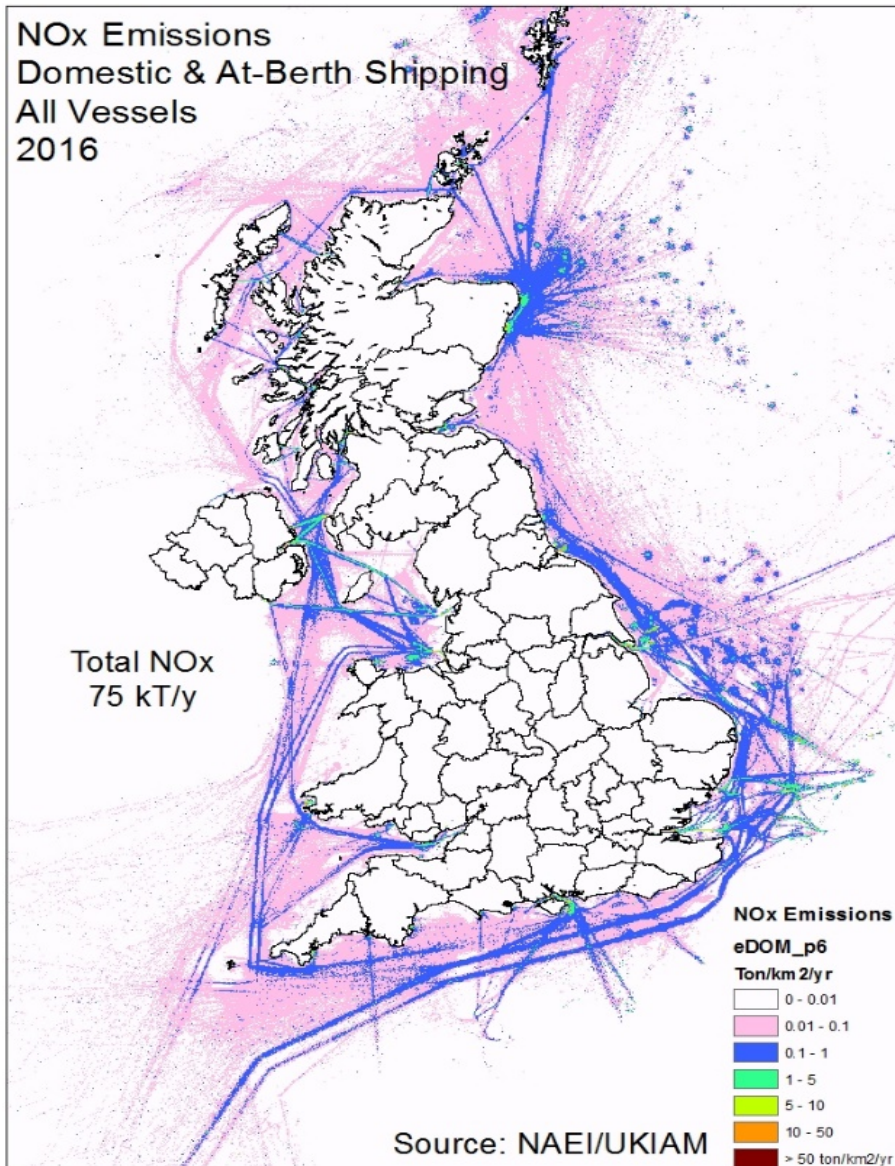
*Centre for Environmental Policy, Imperial College London*

*in collaboration with*

*the Centre for Ecology and Hydrology, Wood Plc. & EMRC*

# SHIPPING

- 1. Revised emissions NO<sub>x</sub>,SO<sub>2</sub>,PM<sub>10</sub>, VOCs, CO<sub>2</sub>,CH<sub>4</sub>,CO & NO<sub>2</sub> by Ricardo based on AIS data.** *(A review of the NAEI shipping emissions methodology. Ricardo report for BEIS, December 2017)*
  - 2. Projected emissions to 2030 by Wood Plc distinguishing ECA (Channel and North Sea) and non-ECA areas (Irish Sea to West of UK)**
  - 3. Assessment of contribution to PM<sub>2.5</sub> & NO<sub>x</sub> concentrations and nitrogen deposition across the UK**
- ? Beyond 2030. IMO commitment to reduce CO<sub>2</sub> by 50%.
- ? Alternative fuels e.g. NH<sub>3</sub>



# SHIPPING

## UK domestic shipping: UK to UK port and at berth

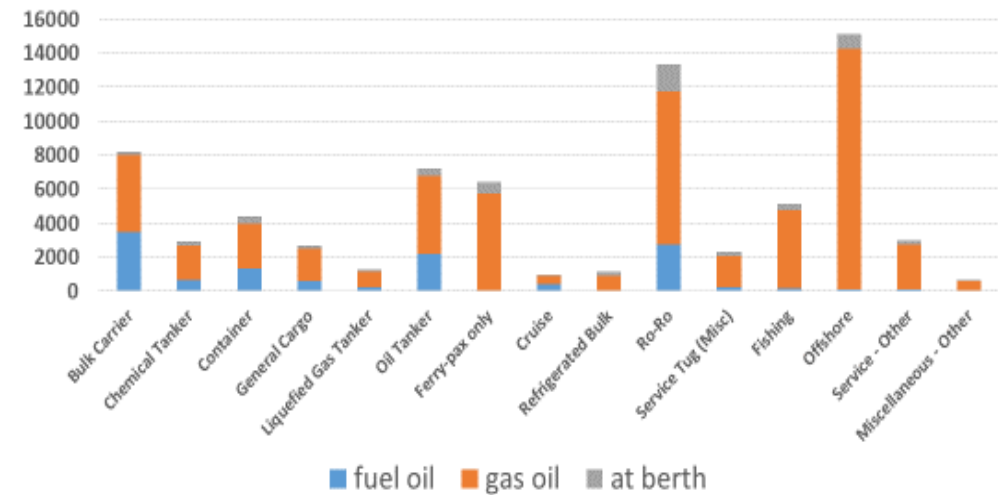
2016: 75 kt of NOx in 2016 (48 kt within ECA)

2030: 61 kt of NOx in 2030 (35 kt within ECA)

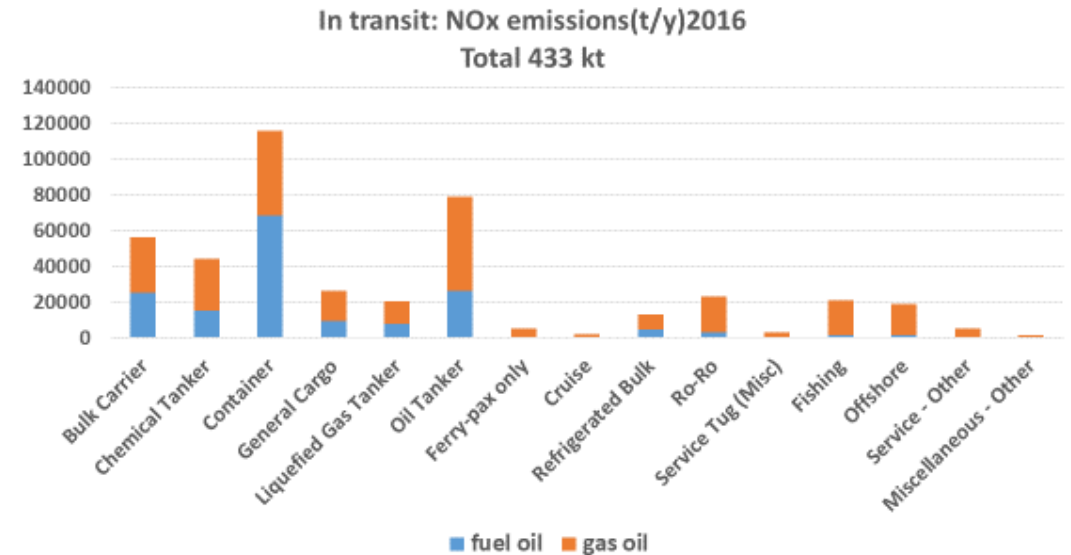
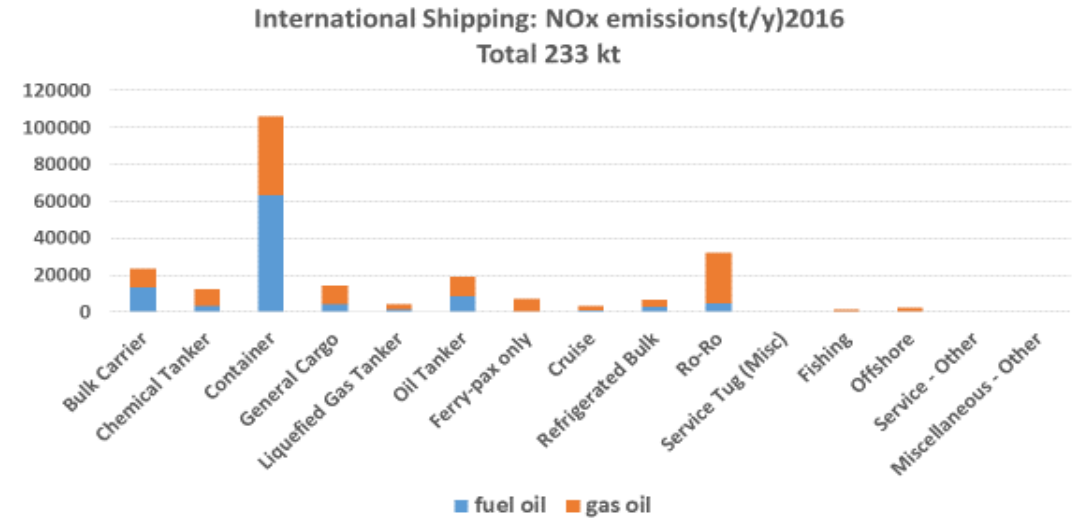
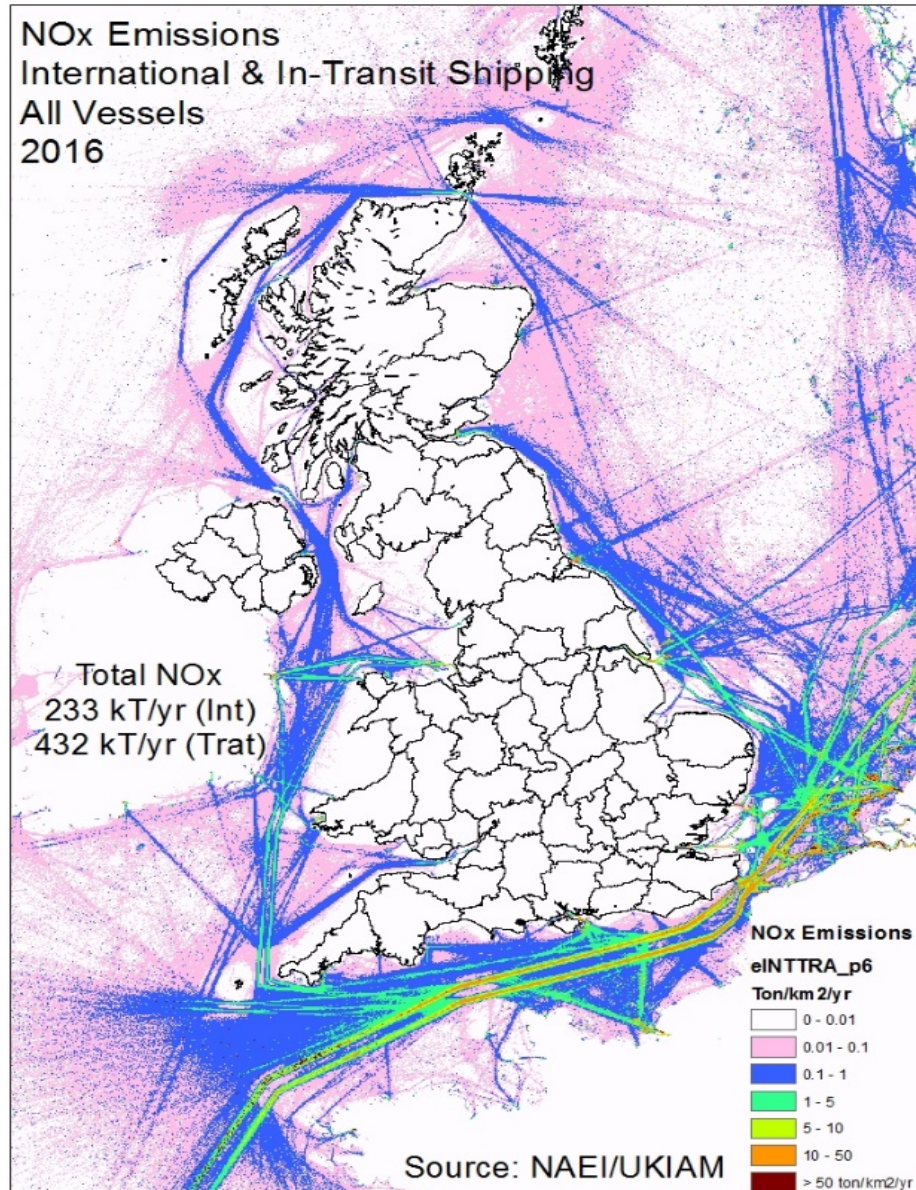
SO<sub>2</sub> 11kt in 2016 to 5.6 in 2030

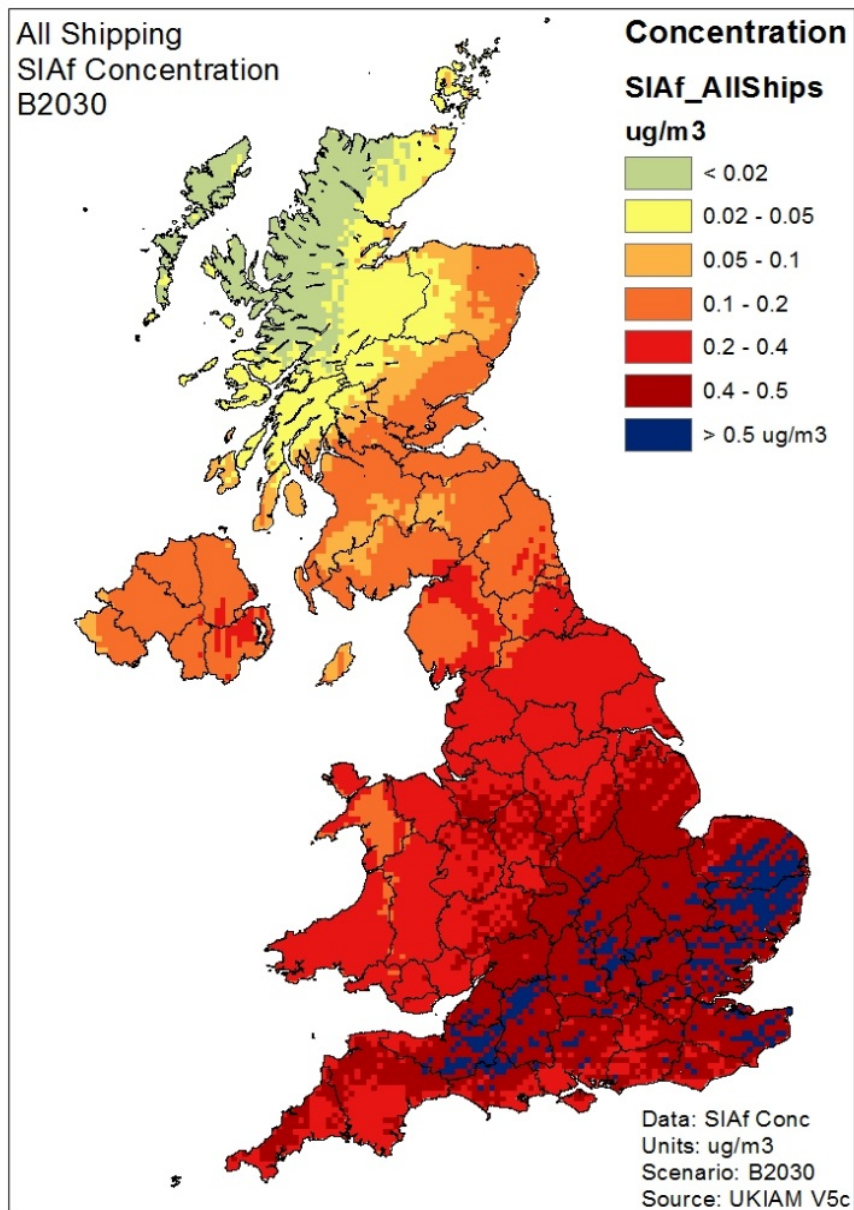
PM<sub>10</sub> 1.6kt in 2016 to 1.2 kt in 2030

Domestic shipping: NOx Emissions (t/y) 2016.  
Total 75kt



# International shipping: 665 kt of NOx in 2016 ->644 kt in 2030) NB UK emissions 870kt-> 470 kt by 2030





## Contribution of shipping to PM2.5 concentrations over UK

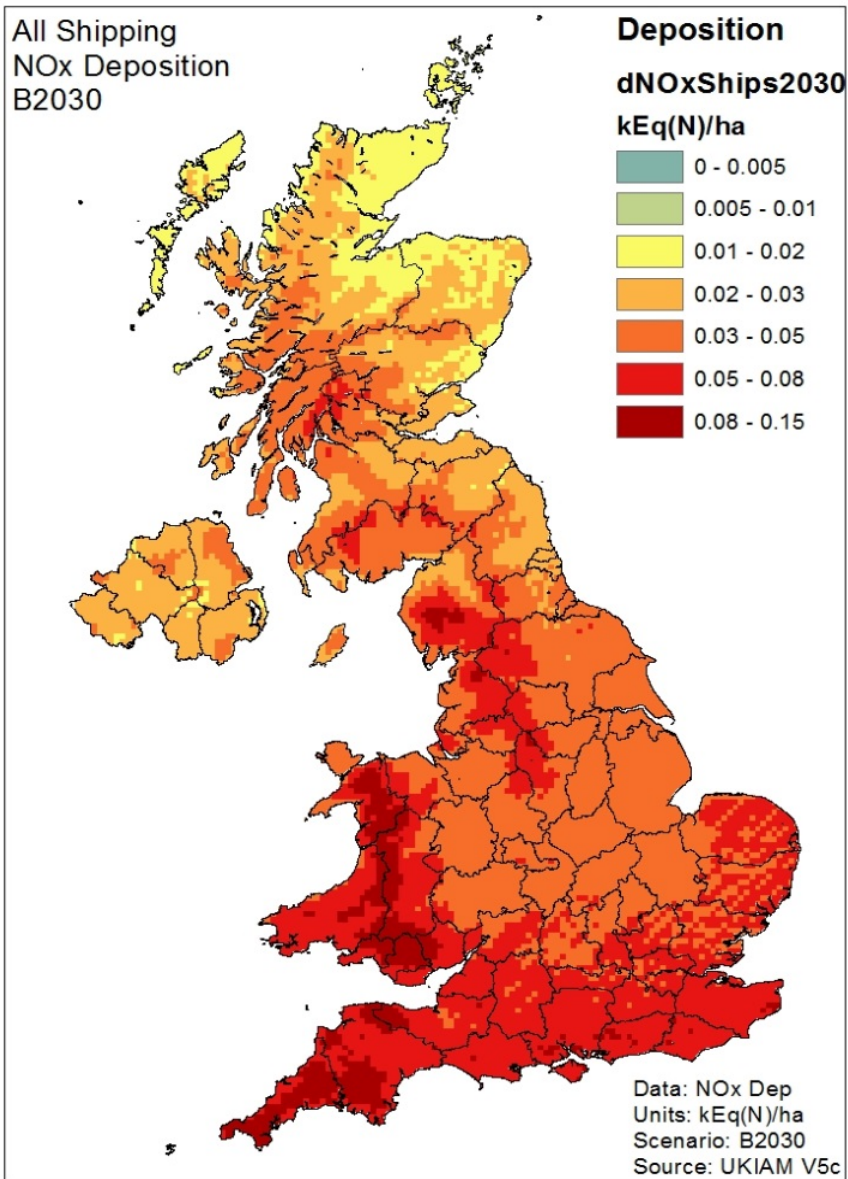
Mainly secondary inorganic aerosol, SIA, and UK domestic contribution small

Modest changes overall between 2016 and 2030

Large area of UK with concentrations ~0.4/0.5 ug/m<sup>3</sup>

-> health impacts of international shipping  
~£1 billion per year in UK

Contribution to NO<sub>x</sub> small but may be important in ports, including at berth emissions superimposed on other port activities



## Contribution of shipping to N deposition across UK

Significant wet deposition of oxidised nitrogen, enhanced over sensitive upland areas

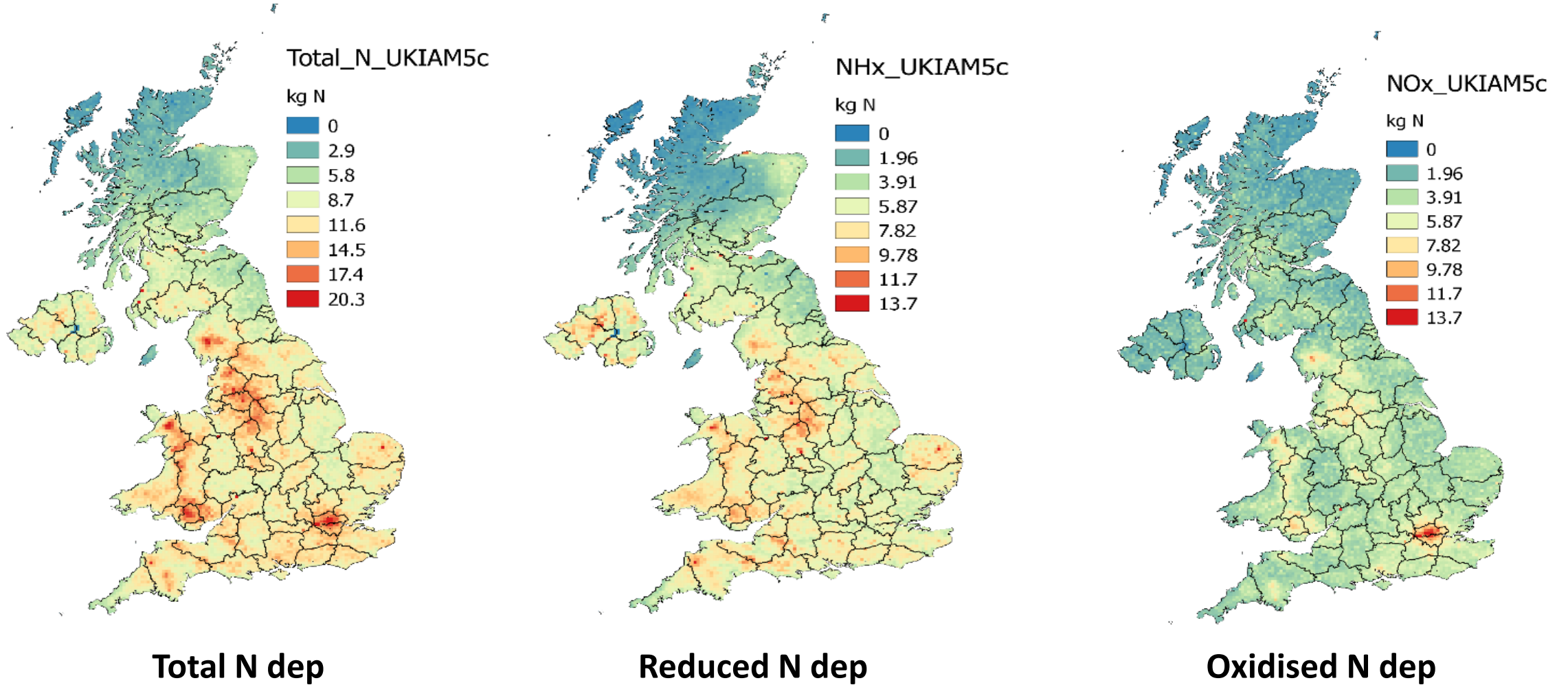
~ 16 kt of N deposited across UK (13kt from international shipping as conservative estimate)

Counteracts efforts of UK farmers to reduce emissions of NH<sub>3</sub>



# Nitrogen deposition and Eutrophication

## Maps of N deposition in 2016 kg N/ha

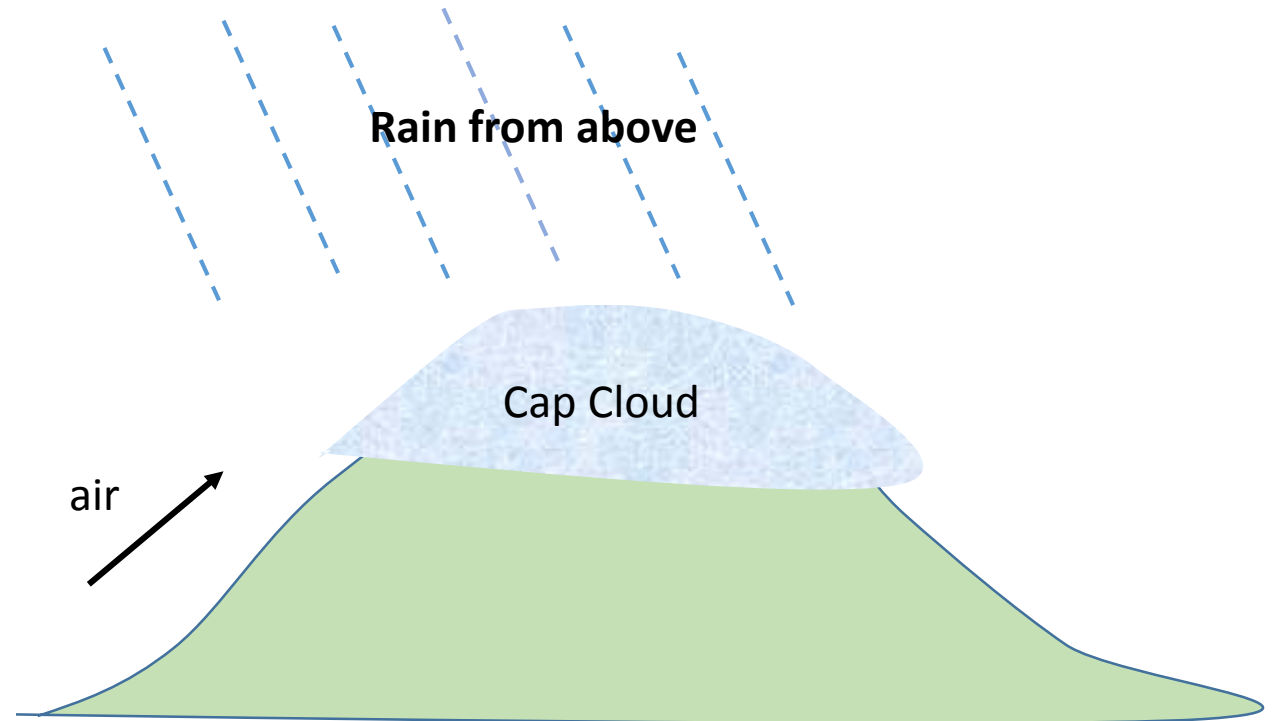


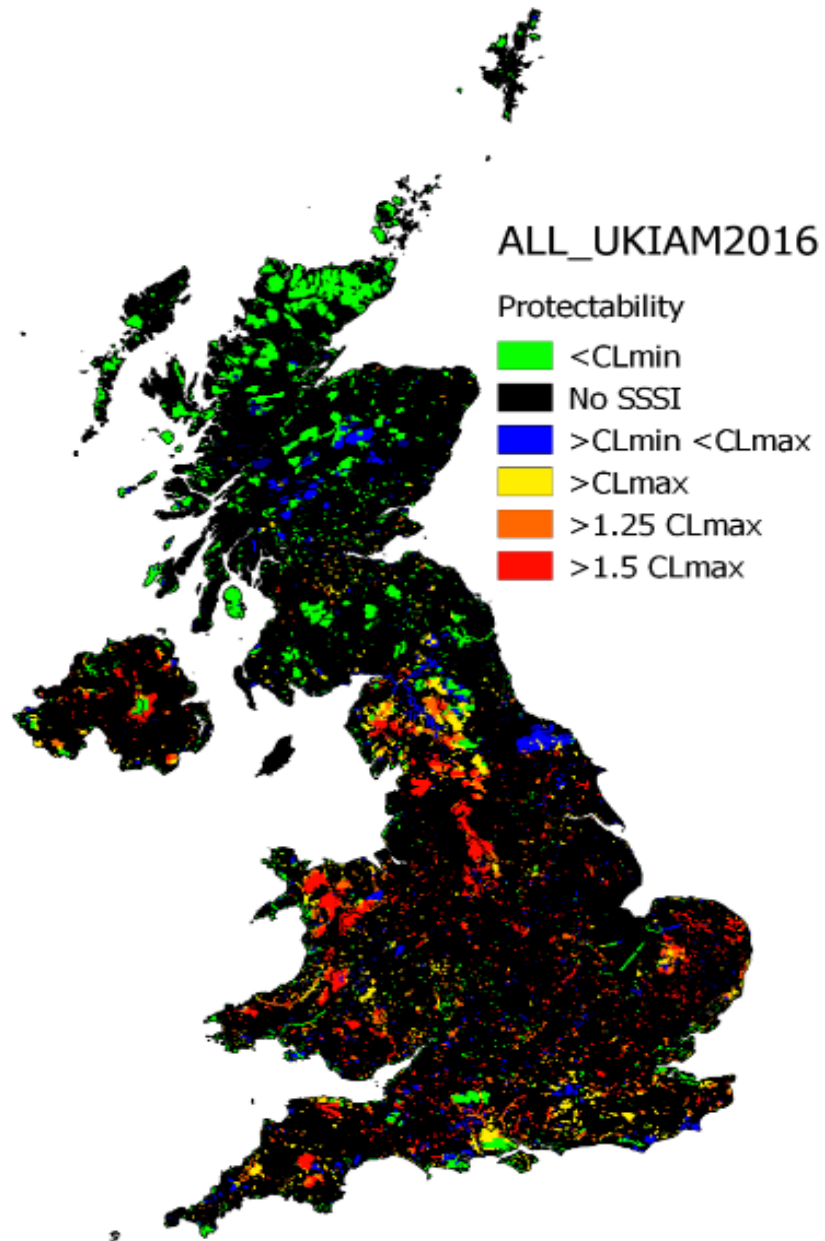
**Deposition enhanced over hills and mountains where there are many sensitive ecosystem areas**

**UKIAM/FRAME give less enhancement than empirical model CBED.**

**Low and high estimates using UKIAM straight and calibrated to CBED**

### **Seeder-feeder mechanism and occult deposition**



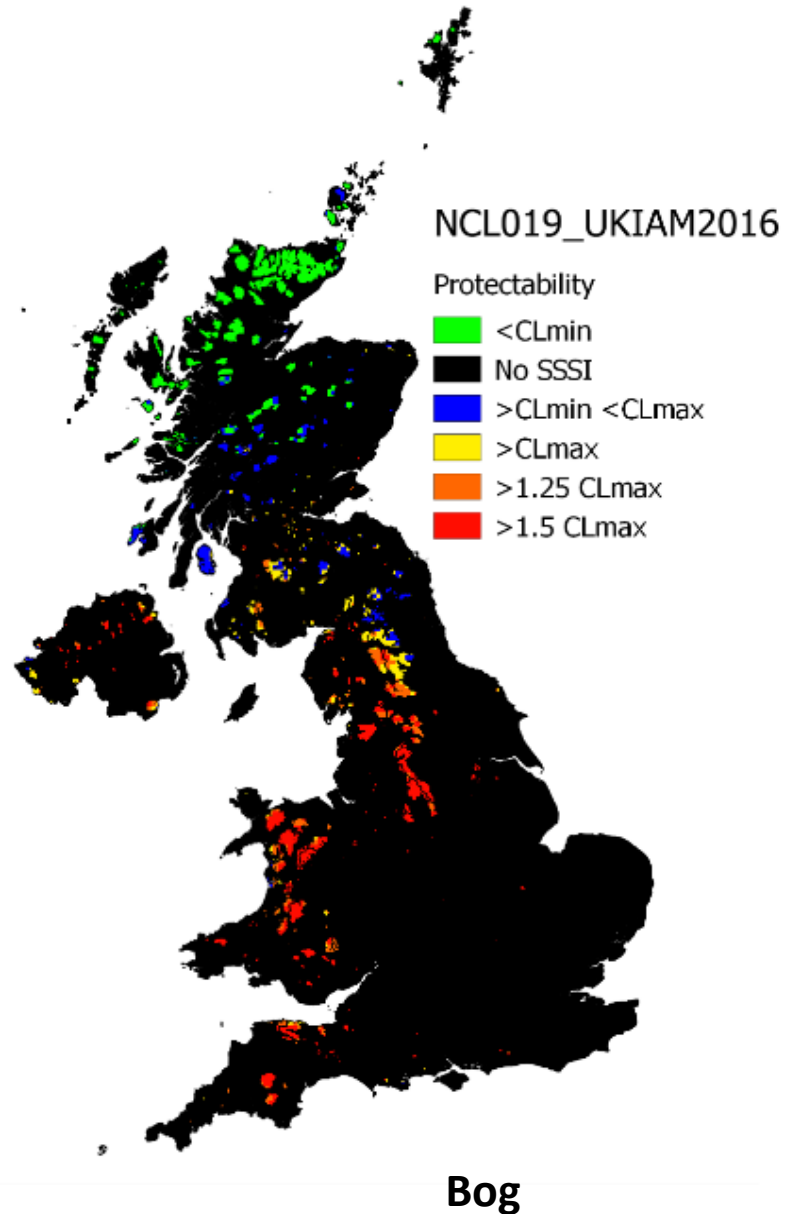


## “Risk” map for Sites of Special Scientific Interest and NATURA 2000 sites

**Red is high risk** **Green is protected**

Shows correlation with mountain areas and also higher NH<sub>3</sub> emissions

NB Based on most sensitive ecosystem in each SSSI. Need better data on ecosystem locations with sites.



Can look at most threatened ecosystems individually  
*e.g. raised and blanket bog with CL of 5-10 kg N/ ha/y*

Investigating NH<sub>3</sub> abatement scenarios using both UKIAM and calibrated to CBED.

Interest in embedding field scale model LADD within 5x5 km grid to look at local scale



## **Future work**

**Scenario analysis and source apportionment, including PM2.5**

**Transport: electric vehicles and new technologies plus electricity generation and infrastructure**

**? embedding more detailed urban modelling down to street scale.**

NB MAGIC project [www.magic-air.uk](http://www.magic-air.uk) (Managing Air in Green Inner Cities) with even more detailed modelling of traffic, streets and buildings in modern cities

**? Embedding more detailed treatment of agriculture and ecosystems**