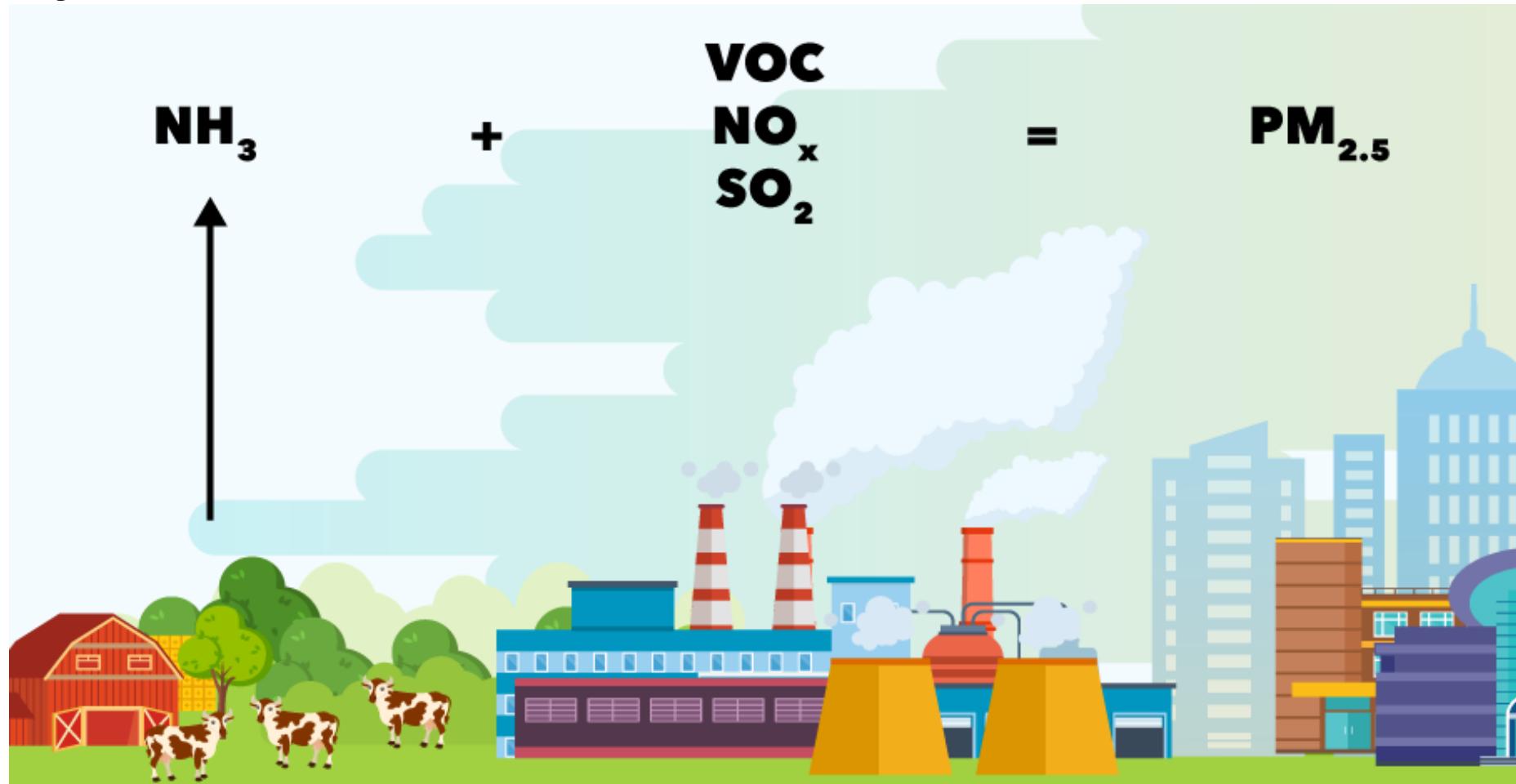


# UK NH<sub>3</sub> emissions derived with IASI and GEOS-Chem

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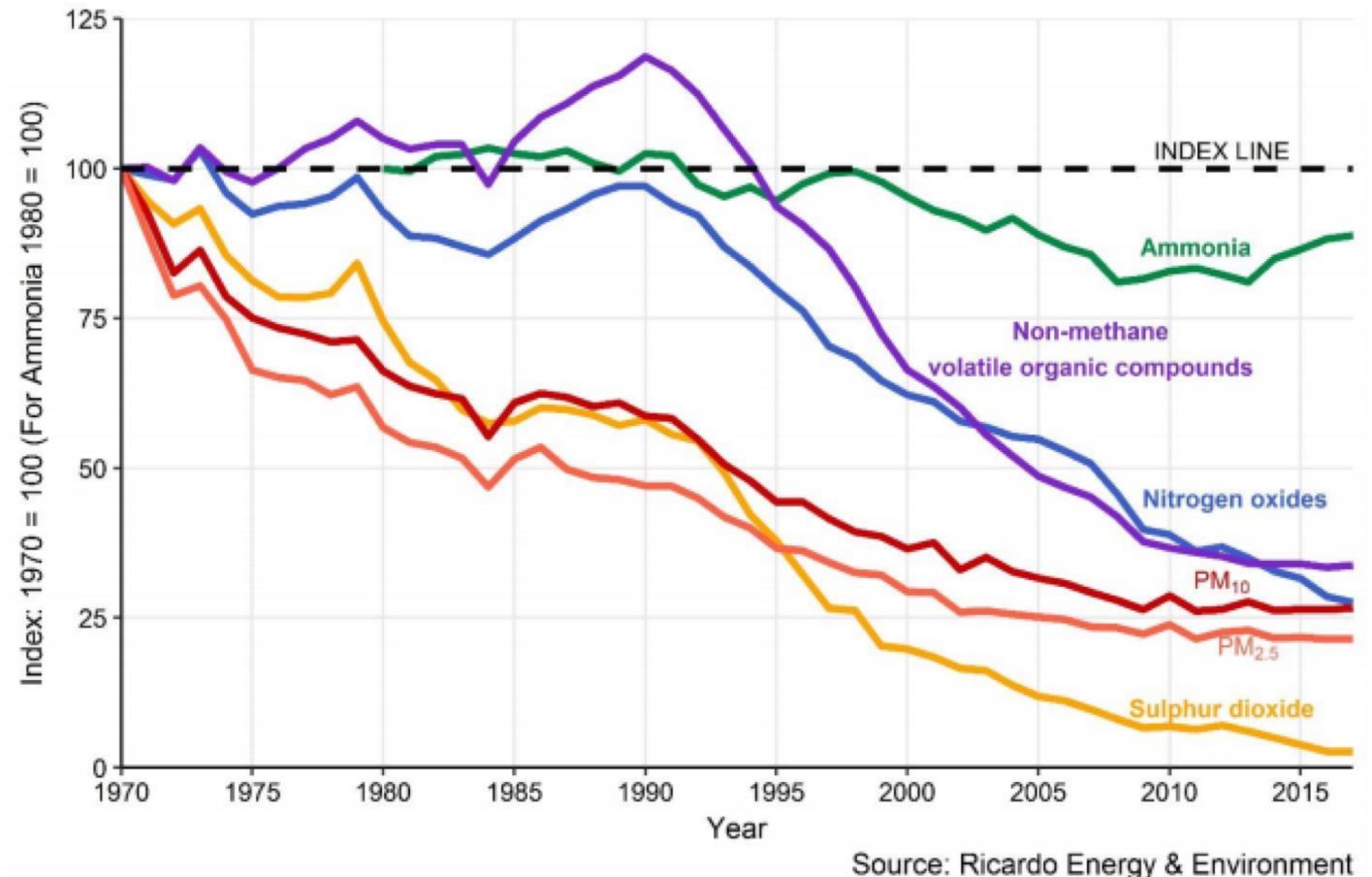
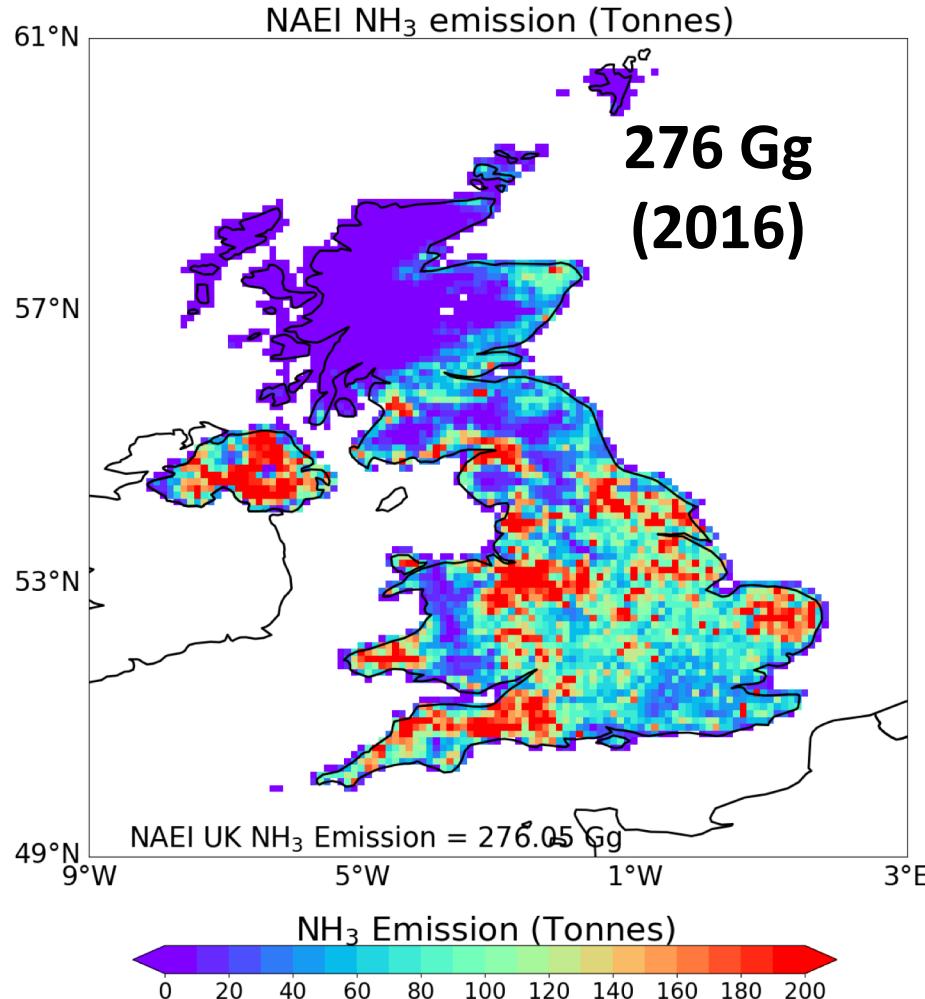
First GEOS-Chem Europe User's Meeting  
1 - 2 September 2020



UNIVERSITY OF  
LEICESTER

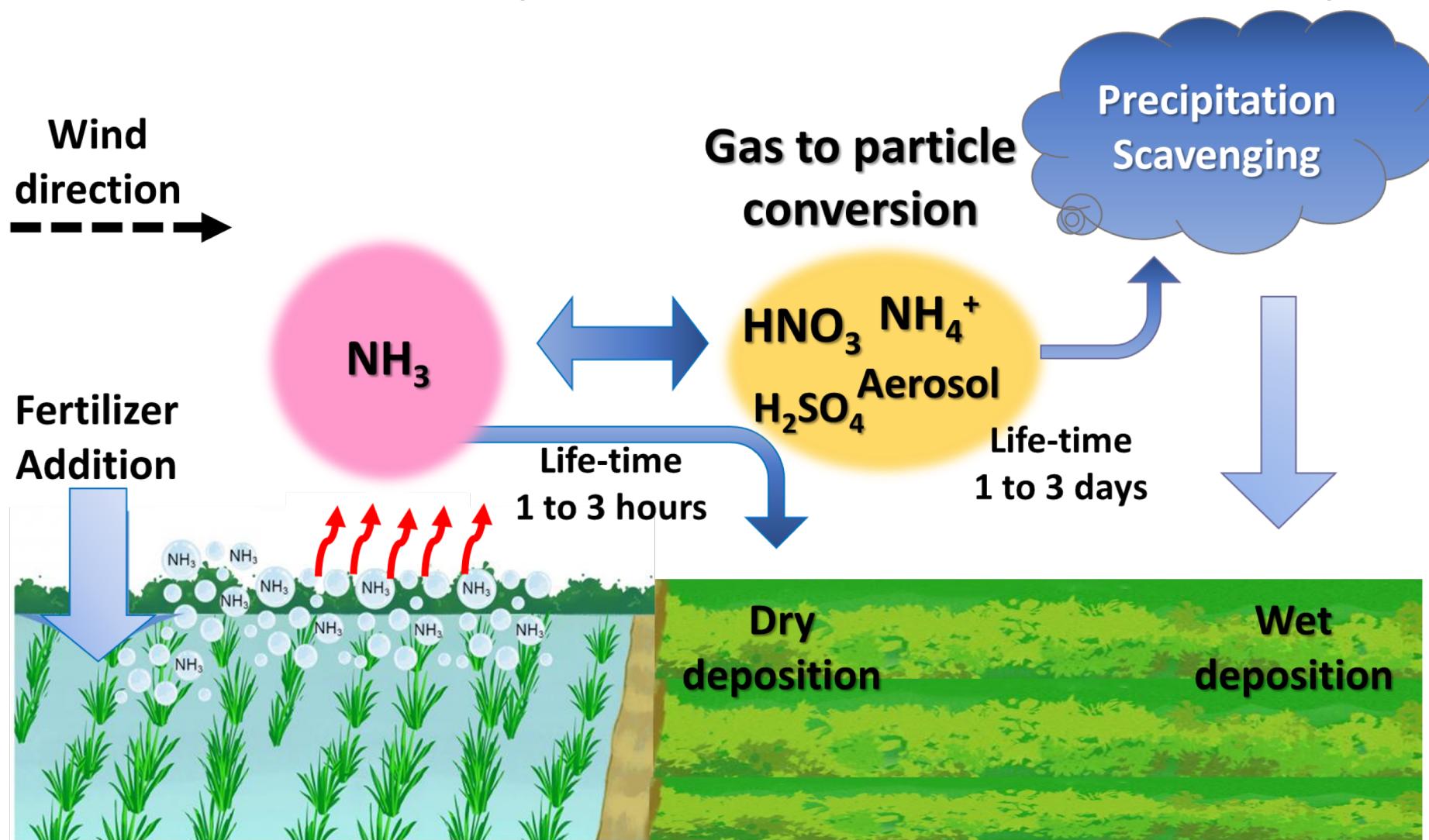


# Ammonia Emission and trends in the UK



Reported uncertainty in ammonia emissions ( $\pm 20\%$ )

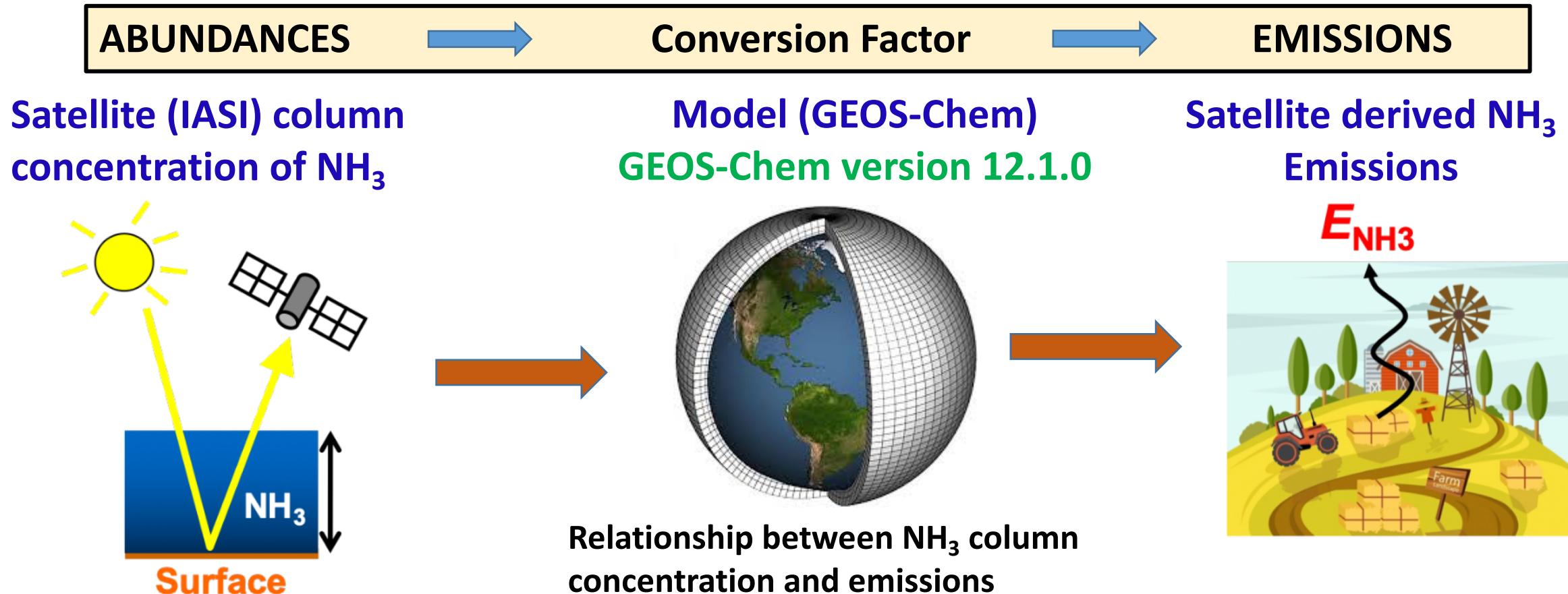
# Physical and chemical process of ammonia in atmosphere



Complex physical and chemical processes of ammonia makes it challenging to derive emissions using standard approaches

# Top-down Estimate of Ammonia in the UK

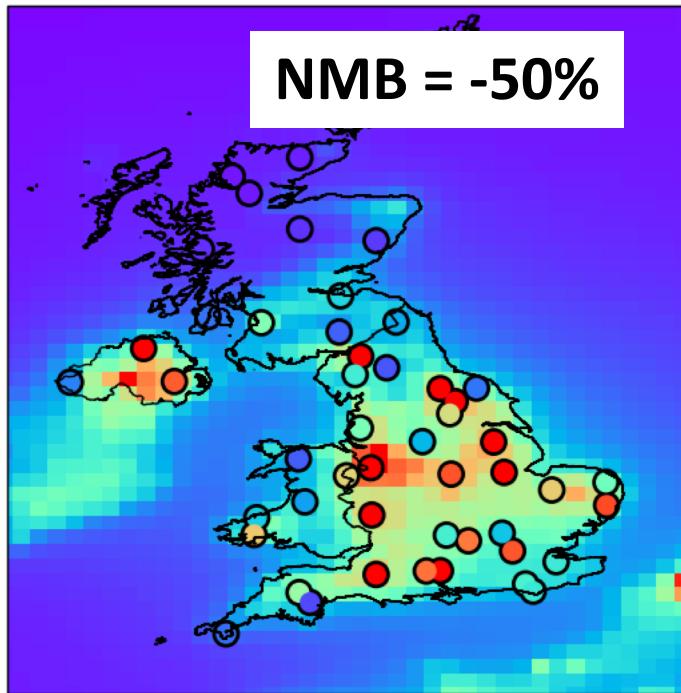
## APPROACH:



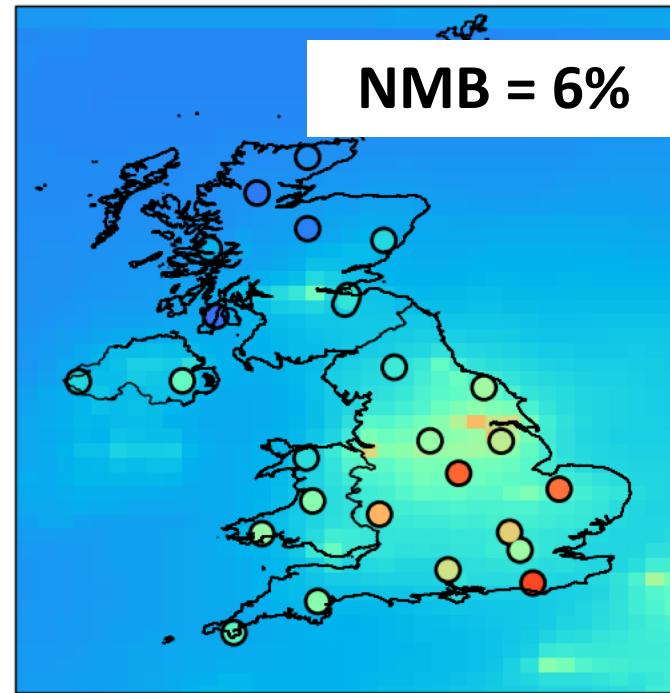
- IASI Level 2 reanalysis product version 3R for clear-sky conditions (cloud fraction < 10 %)
- GEOS-Chem includes updated national emissions (NAEI) and Europe emissions (EMEP).

# Evaluation of annual mean ammonia, ammonium and NH<sub>x</sub>

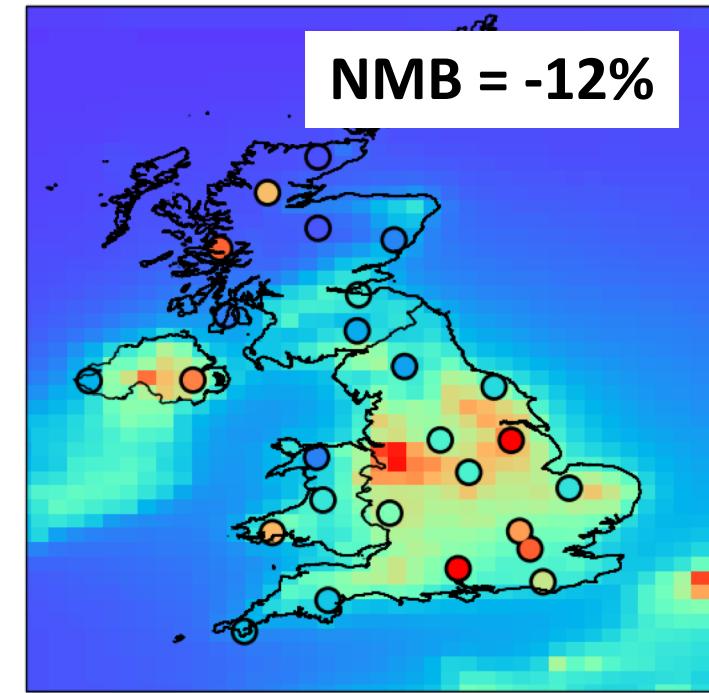
Ammonia



Ammonium



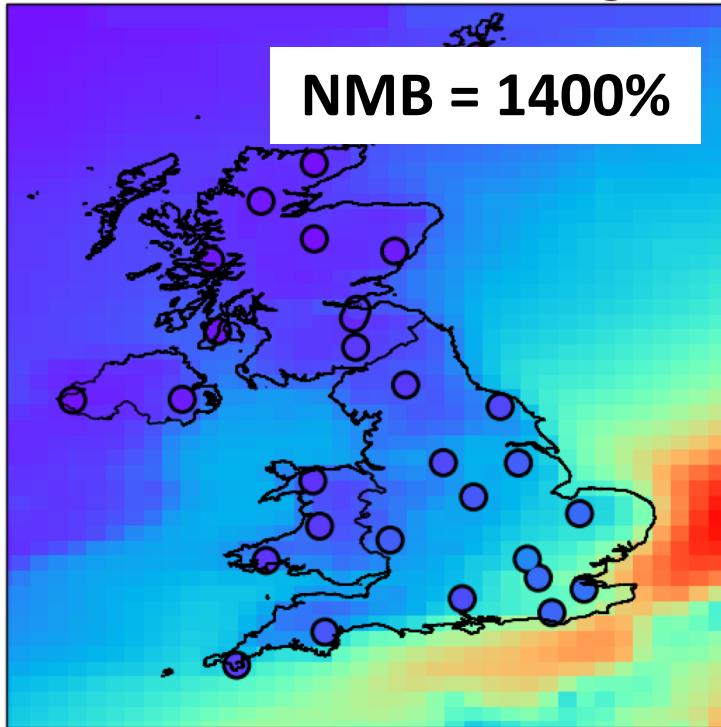
NHx



- Circles show Department for Environment, Food and Rural Affairs (DEFRA) network observations; background is model
- Model underestimates NHx due to large underestimate in ammonia

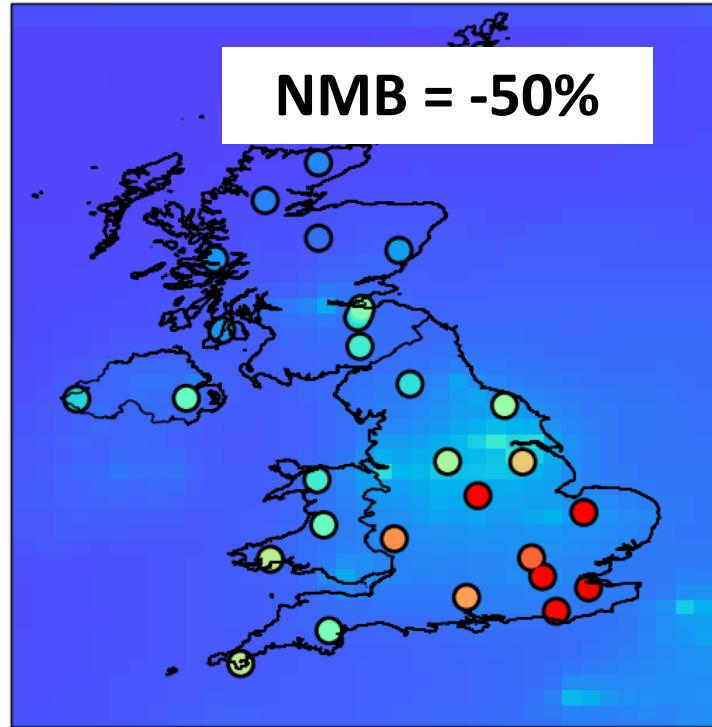
# Evaluation of annual mean $\text{HNO}_3$ , nitrate and sulfate

$\text{HNO}_3$



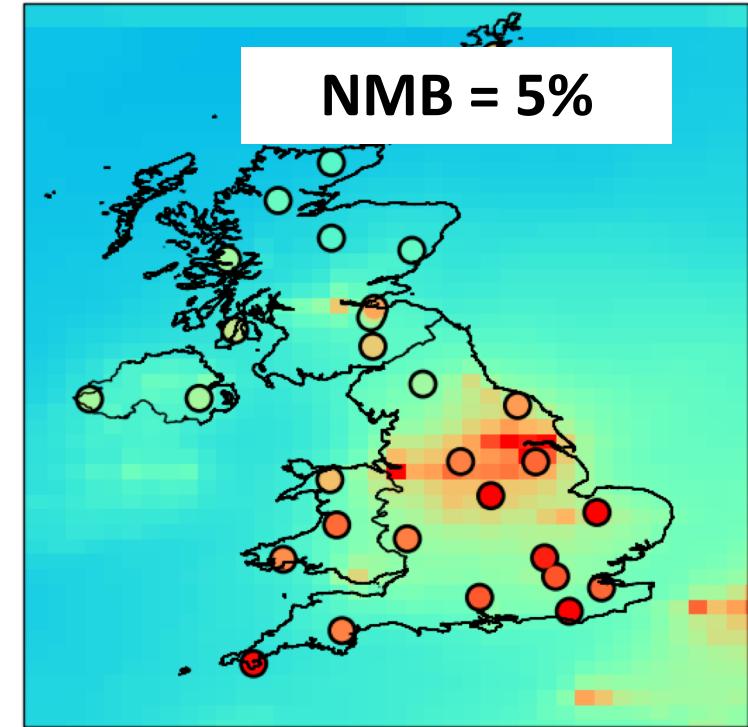
0.0 0.5 1.0 1.5 2.0  
GEOS-Chem & DEFRA  $\text{HNO}_3$  ( $\mu\text{g m}^{-3}$ )

Nitrate



0 1 2 3  
GEOS-Chem & DEFRA nitrate ( $\mu\text{g m}^{-3}$ )

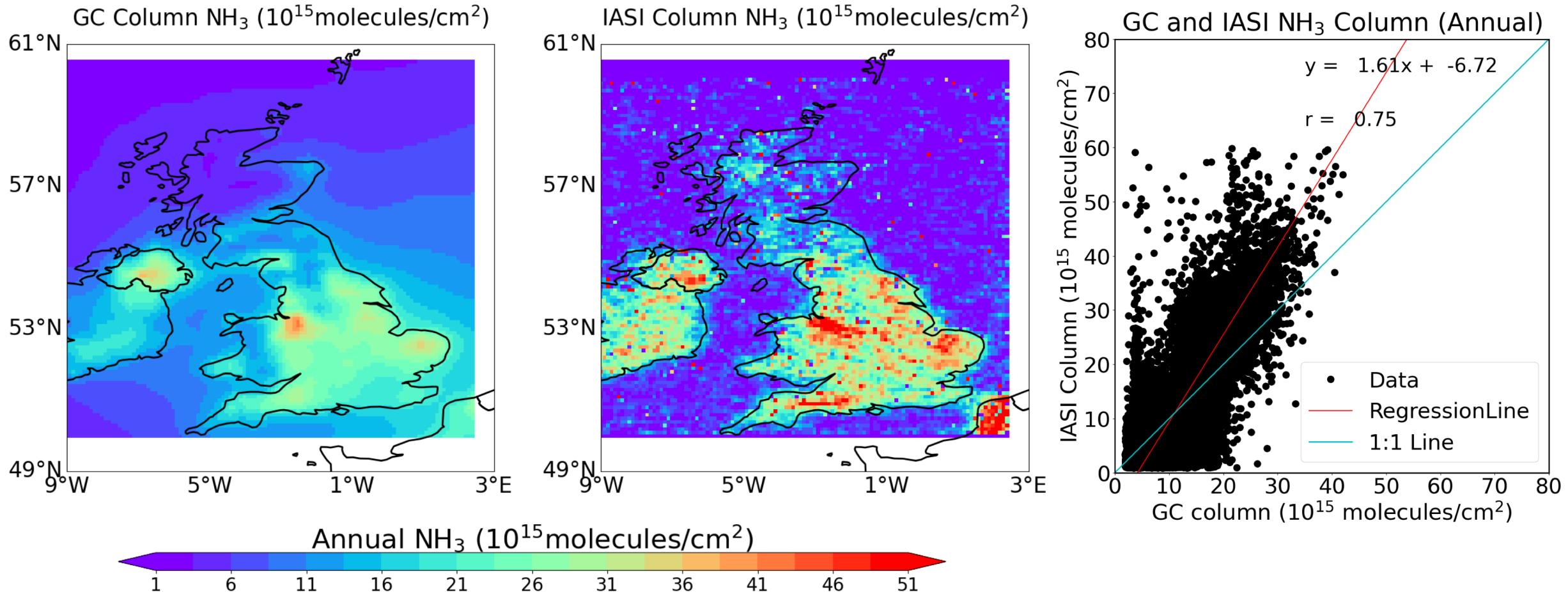
Sulfate



0.00 0.25 0.50 0.75 1.00  
GEOS-Chem & DEFRA sulfate ( $\mu\text{g m}^{-3}$ )

**GEOS-Chem overestimate in  $\text{HNO}_3$  and underestimate in nitrate**

# Comparison of GEOS-Chem and IASI NH<sub>3</sub> Columns



IASI and GEOS-Chem annual NH<sub>3</sub> column concentrations are correlated, but there is a 60% difference between the two datasets

# Concluding Remarks

- GEOS-Chem NH<sub>3</sub> is biased low compared to both the surface (UKEAP) and satellite (IASI) observations
- Size of underestimate suggests 60% underestimate in NH<sub>3</sub> emissions
- GEOS-Chem overestimates HNO<sub>3</sub> and underestimates nitrate supports.
- Suggests air quality and chemical transport models underestimate the contribution of NO<sub>x</sub> sources (like ships) and distant sources (mainland Europe) emissions to local PM<sub>2.5</sub>
- Next step is to evaluate UK national emissions with IASI-derived NH<sub>3</sub> emissions

Any Questions? Contact Alok ([ap744@leicester.ac.uk](mailto:ap744@leicester.ac.uk))

Thank You