Air filtration: leading questions

1. What are we valuing?
   - Units
   - Institutional arrangements
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   - Strengths and weaknesses?
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Department for Environment Food & Rural Affairs

Valuation of selected regulating services

Air filtration

Expert meeting on ecosystem valuation

Bonn

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Rocky Harris

Defra, UK

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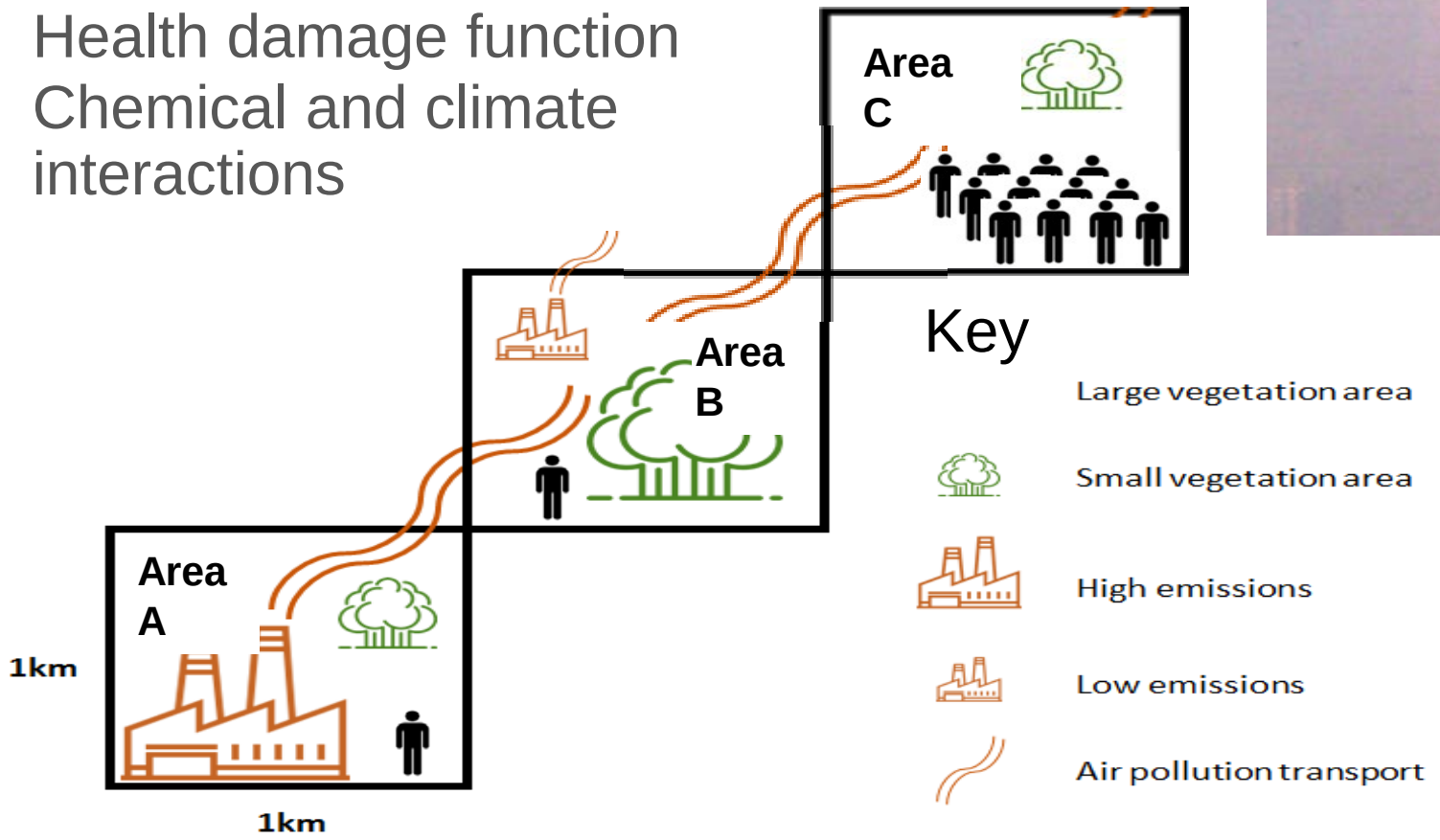
Spatial context of service and beneficiaries

Atmospheric transport:

I. Location of beneficiaries
II. Health damage function
III. Chemical and climate interactions



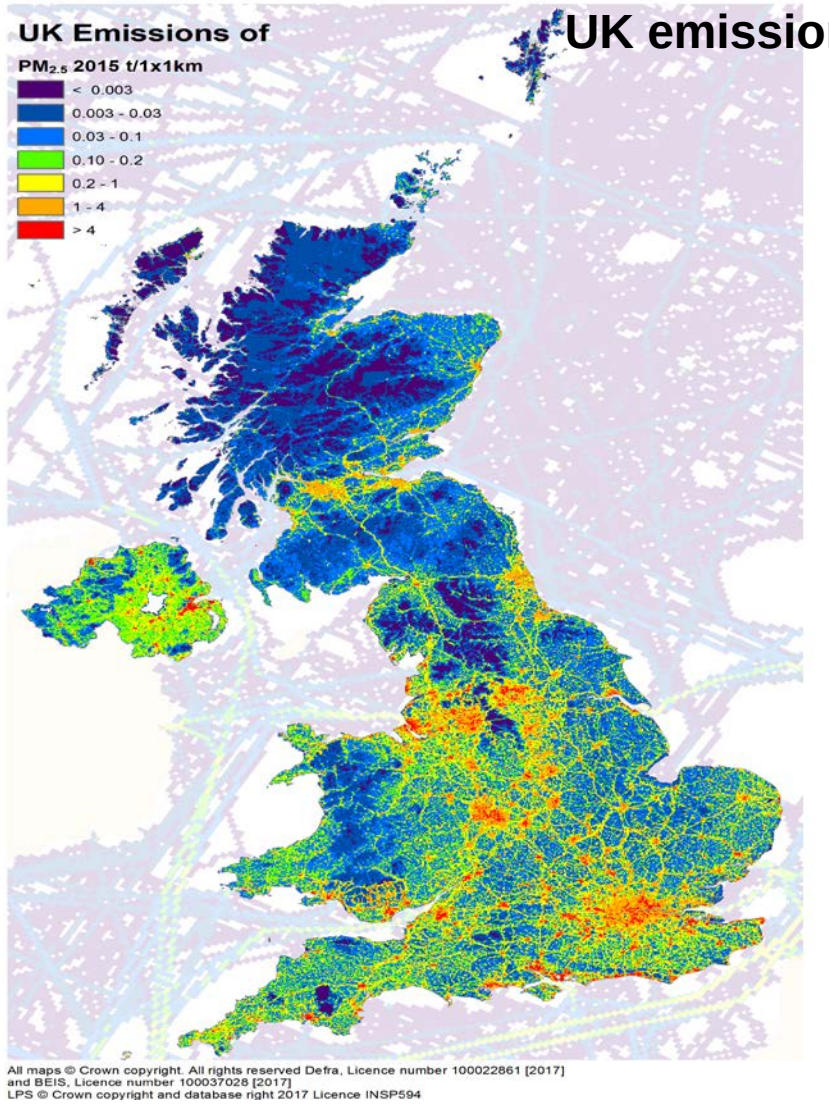
Atmospheric chemistry modelling

Physical account

- 5 km x 5 km (~1.5 x 2km)
- Hourly time step
- Generates concentrations from emissions, including
  - Chemical & meteorological interactions and
  - Atmospheric transport
- Five pollutants of interest:

  ($PM_{2.5}$, SO_2, NH_3, NO_2, O_3)

http://www.emep4uk.ceh.ac.uk/



UK emissions

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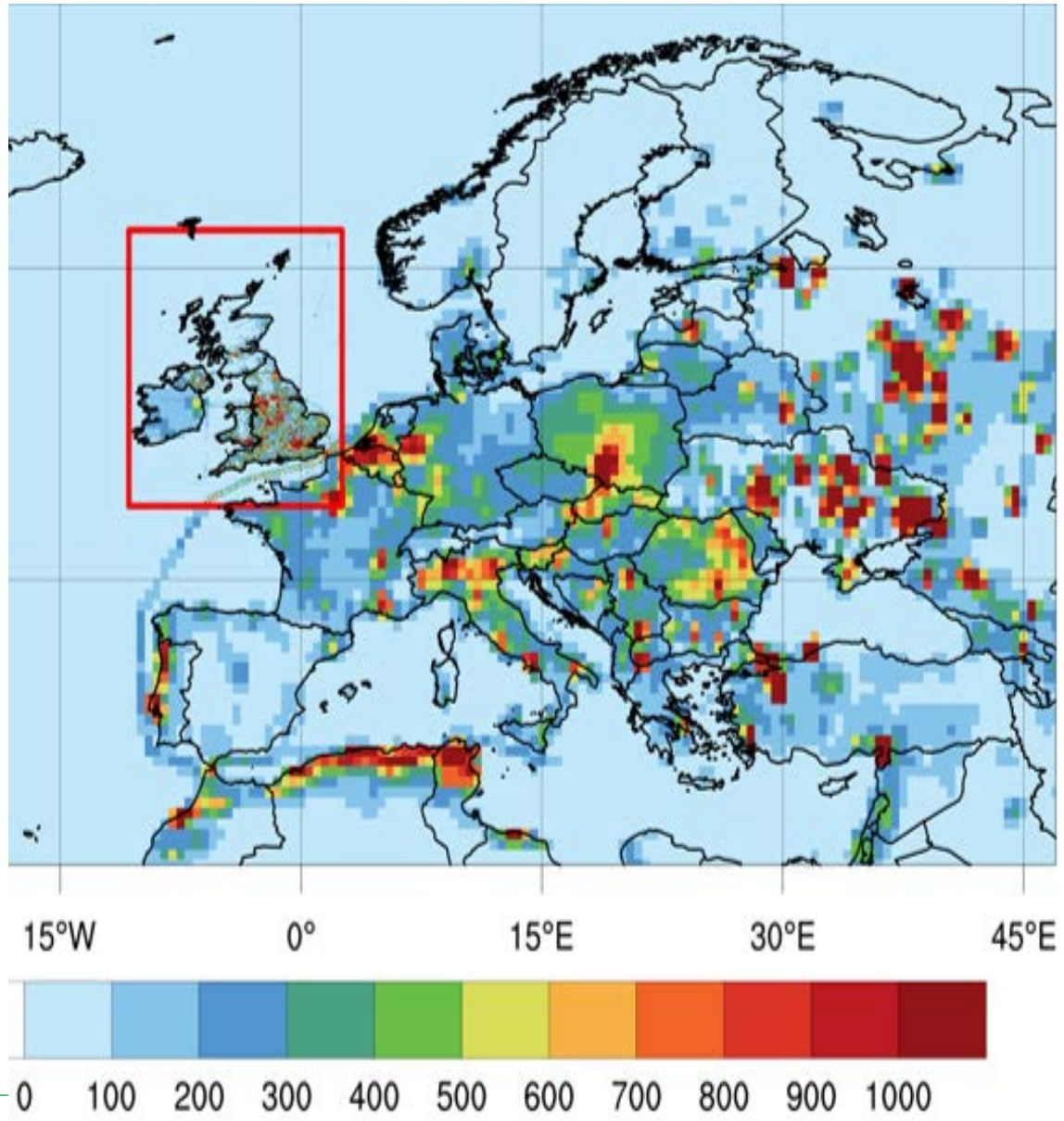

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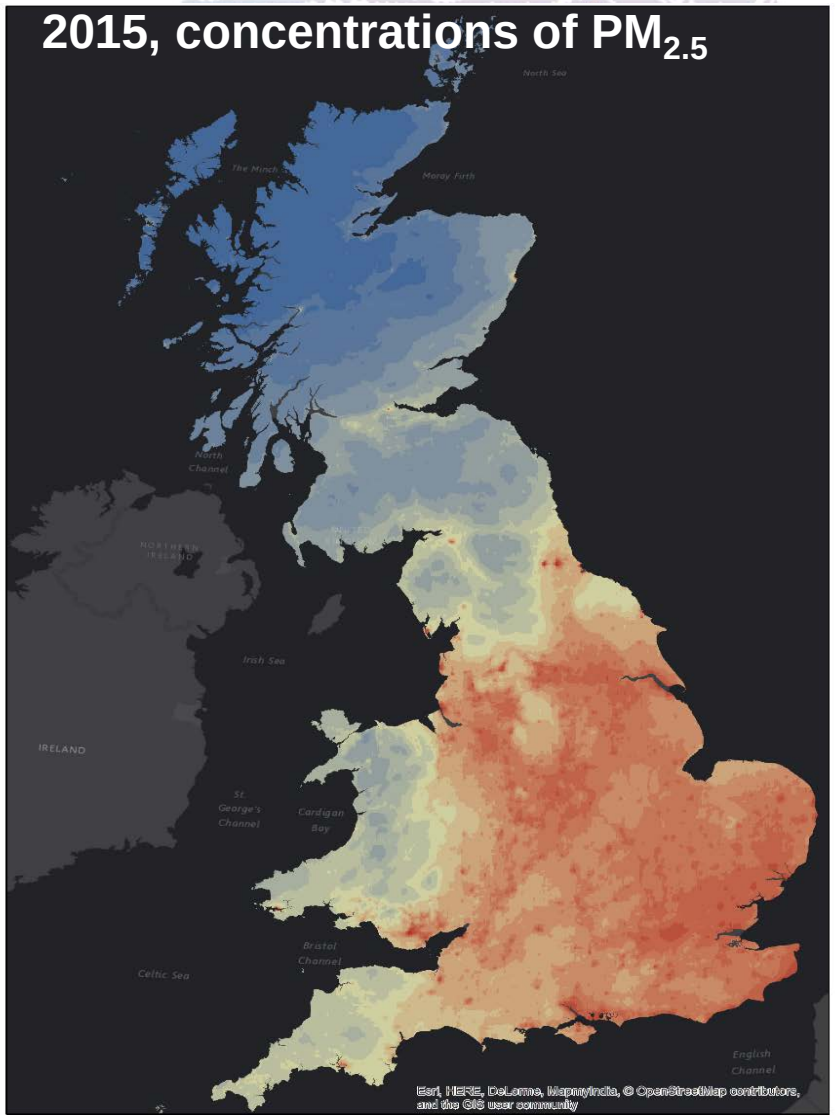
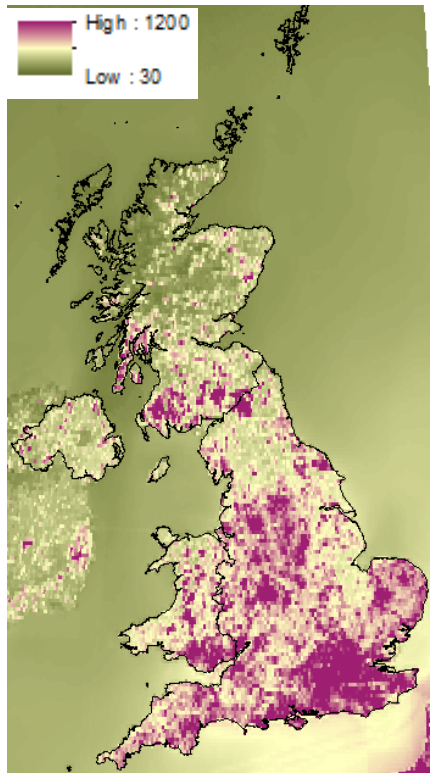


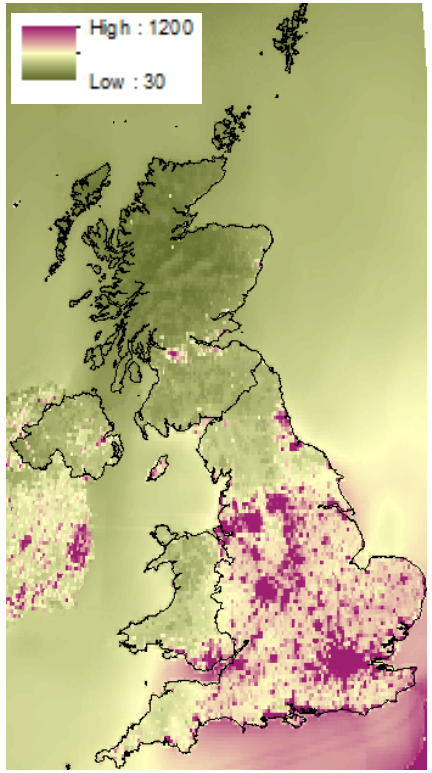
EMEP outputs – national run, all vegetation

Quantity of $PM_{2.5}$ removed (mg/m^2)

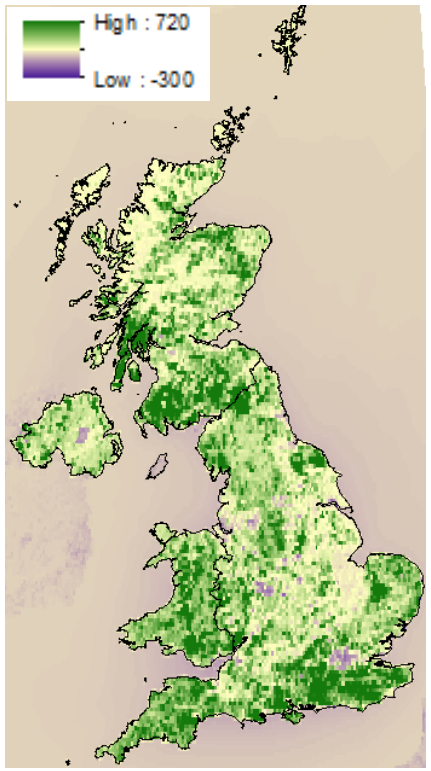
Base map, 2015



No vegetation (neutral) scenario

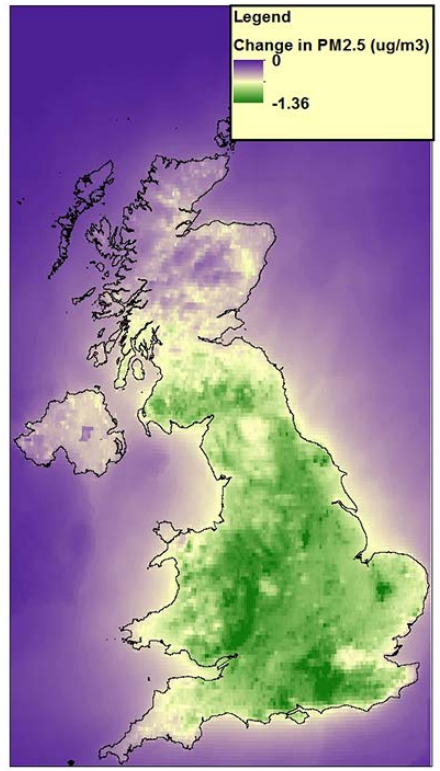


Difference map



Change in exposure to $PM_{2.5}$ ($\mu g/m^3$)

Avg: -0.55 (-10%)



Change in health outcomes (physical terms)

		Change in no. of hospital admissions/life years lost/deaths attributable to presence of UK vegetation			
		2007	2011	2015	2030
		no./yr	no./yr	no./yr	no./yr
PM2.5	Respiratory hospital admissons	-814	-693	-533	-318
	Cardiovascular hospital admissons	-715	-609	-469	-279
	Life years lost	-42,736	-34,656	-25,209	-12,725
SO2	Respiratory hospital admissons	-308	-240	-181	-110
NO2	Respiratory hospital admissons	-346	-188	-125	-3
	Cardiovascular hospital admissons	-294	-160	-106	-3
	Life years lost	-5,618	-2,913	-1,843	-16
O3	Respiratory hospital admissons	-4,679	-4,889	-5,017	-5,861
	Cardiovascular hospital admissons	-722	-755	-775	-905
	Deaths	-1,798	-1,743	-1,899	-2,110
All pollutants c	Respiratory hospital admissons	-6,146	-6,011	-5,856	-6,291
	Cardiovascular hospital admissons	-1,731	-1,524	-1,349	-1,186
	Life years lost	-48,354	-37,568	-27,051	-12,741
	Deaths	-1,798	-1,743	-1,899	-2,110

Mortality and morbidity functions used in the evaluation of air filtration health benefits (PM2.5)

	Change in risk per 10 µg/m3	Age group	Rate per person	Value, £	Source
Respiratory hospital admissions	1.09%	All ages	0.01139	6,650	Atkinson et al (2014)
Cardiovascular hospital admissions	0.91%	All ages	0.013	6,450	Atkinson et al (2014)
Life years lost (as a result of long-term exposure)	6.00%	All - % change fed into life tables to generate adjustment factor	1	20,000-60,000	NICE, COMEAP

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Air filtration – questions for discussion

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What is it we are valuing?

- Effect of vegetation in reducing impact of air pollutants on human health
  - Air pollution concentrations spatially modelled using map of emissions
  - Absorption by vegetation modelled against no vegetation (neutral) scenario
  - Dynamic model of population exposure to concentrations
  - Resulting health benefits in terms of reduced hospital admissions and reduced life years lost
- Valuation is the monetary value of these benefits

What methods are most commonly used when valuing this service?

- Damage costs Willingness to Pay (WTP) values (£35,000 to £60,000) – average value of Quality-adjusted Life Year (QALY)
  - A measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life
- Governments only pay costs which minimise burdens on taxpayers and provide comparable cost-benefit ratios to other options
  - The Government body responsible for health costs (NICE) uses a threshold of £20,000
- Avoided costs (savings from reduced hospital admissions) also used but these may not necessarily be paid if the health benefits were not provided by vegetation

What pathways (from service to beneficiary) are commonly assumed?

Logic chain

- Vegetation absorbs air pollutants
- This results in a reduction in concentrations of pollutants – which may be elsewhere to where the pollutants are absorbed
- Results in a reduction in exposure to pollution by the local population
- Generates a health benefit which can be valued in different ways

What institutional setting do we assume for these valuations?

Damage costs

- Government will pay for health services which provide benefits above a certain level
  - The ecosystem is a price-taker, only accounting for a 10% reduction in air pollution
  - In effect the demand curve is horizontal

Costs avoided

- Hospital costs (or increased insurance premiums) would be met if the service were not provided
  - Health care providers have monopsony power and a strong incentive to procure air pollution reductions cost-effectively

Is it possible to isolate this service from other services?

- Broadly yes. The valuation only concerns health benefits from air filtration. There are health benefits from other ecosystem services and they are assumed to be additive
- NB Air filtration benefits may also be reflected in hedonic measures of property close to greenspaces

What are strengths and weaknesses of these methods?

- Unit values uprated by 2% per year – an evidence based convention
- Based on rather old studies – needs reviewing
- Modelling approaches obscure some of the logic chain (not a simple PxQ)
- Based on average (mean) values – median values may be more appropriate
- Pure exchange values (actual spending on substitute air filtration services such as cycling masks) would face serious challenges in e.g. identifying and calculating a single replacement cost or assessing to what extent such aversive behaviours would be adopted in practice