

MRC-PHE
Centre for Environment & Health



Communicating risk and uncertainty to policymakers and the public

24 June 2014

King's College, London

Professor Martin Williams

The easy things have been done.....

Policy didn't need to wait for sophisticated science when undertakers ran out of coffins.....

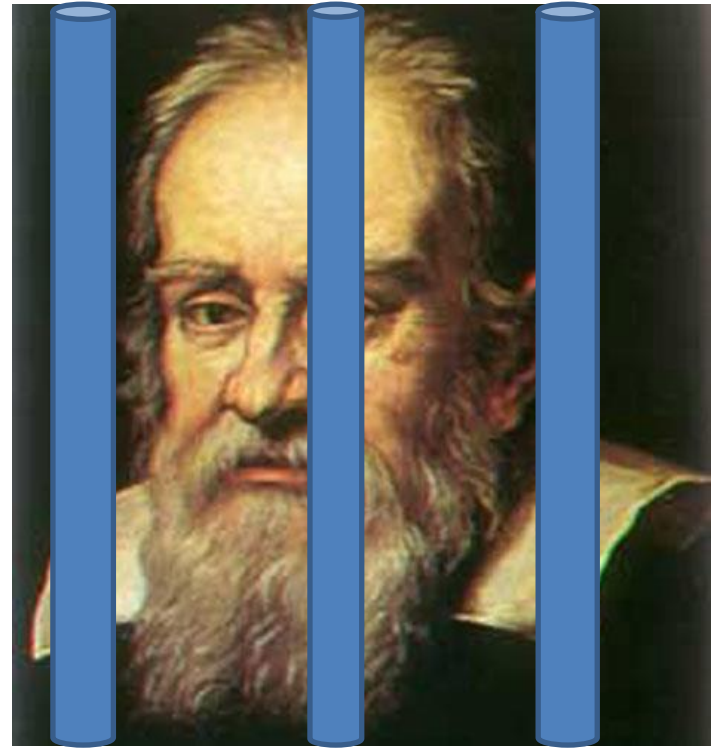


....nowadays ***scientific consensus*** plays a much more important role

IPCC, WHO, Defra and Dept. of Health Expert Groups.....

.....but beware the 'herd effect' and vested interests...

....and 'lamp-post science'!



Galileo Galilei

Uncertainty in the policy process

- **Uncertainty in Basic Science**
 - Causality?
 - Is it something we can control?
 - Go/No-go
- **Uncertainty over the size of the effect**
 - How aggressive does the policy response need to be?
 - Hazard/Risk assessment
- **Uncertainty in the policy analysis**
 - Numerical uncertainty in models and projections
 - Sign of the response?
 - Risk management

Scale of importance

Causality – is it a real effect?	∞
Size of the effect	10^n
Policy evaluation	+/- factor of 2-3? Correct sign?!

Are the associations between PM and health effects causal?

- In the early 1990s there was considerable scepticism
- COMEAP report, 1995, “Non-biological particles and health” :
 - ‘.....it would be *imprudent not* to regard the associations as causal....’

Man-made climate change?

IPCC 'Likelihood scale'

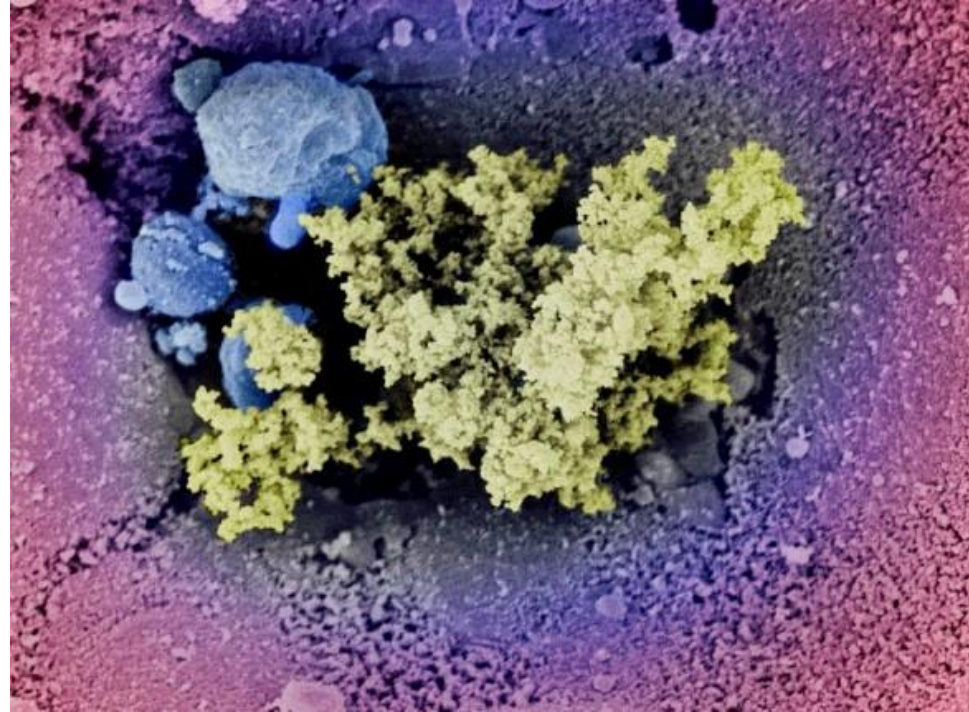
Virtually certain	99-100% probability
Extremely likely	95-100%
Very likely	90-100%
Likely	66-100%
More likely than not	>50-100%
About as likely as not	33 to 66%
Unlikely	0-33%
Very unlikely	0-10%
Exceptionally unlikely	0-1%

IPCC 2013 5th Assessment Report

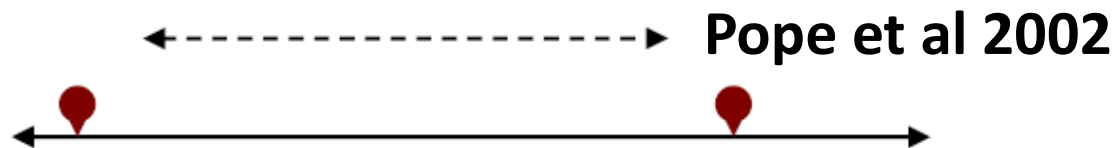
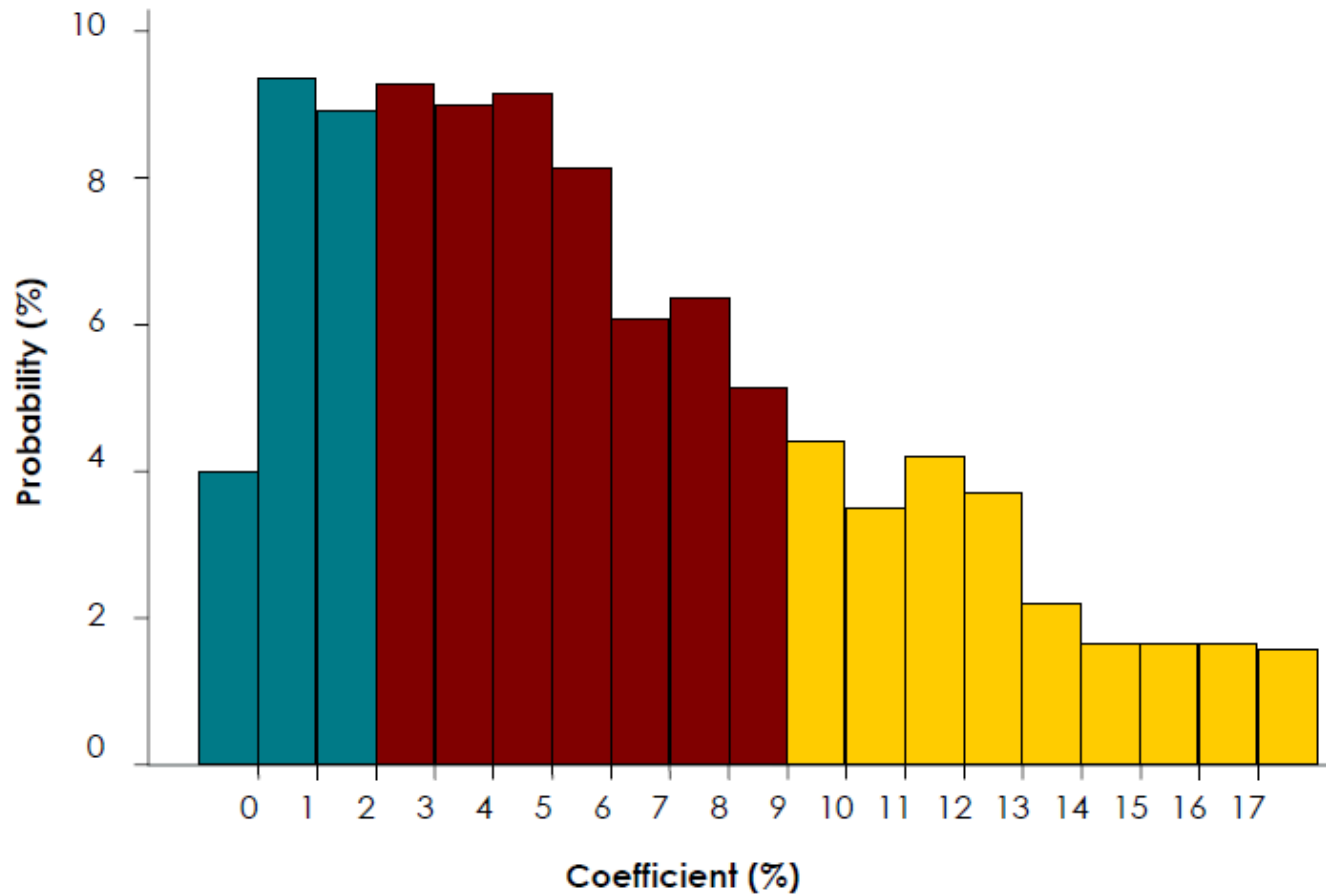
- ‘.....evidence for human influence has grown since AR4. It is ***extremely likely*** that human influence has been the dominant cause of the observed warming since the mid-20th century.’
- AR4 stated that the changing climate ‘is ***very likely*** due to the observed increase in anthropogenic greenhouse gases.’

Uncertainty in the size of the effect?

- Health impact of current levels of air pollution in the UK is valued at a cost of **£15 Bn/annum**
- PM impact (2008) equivalent to **29,000 premature deaths**, loss of life expectancy of **~6 months**

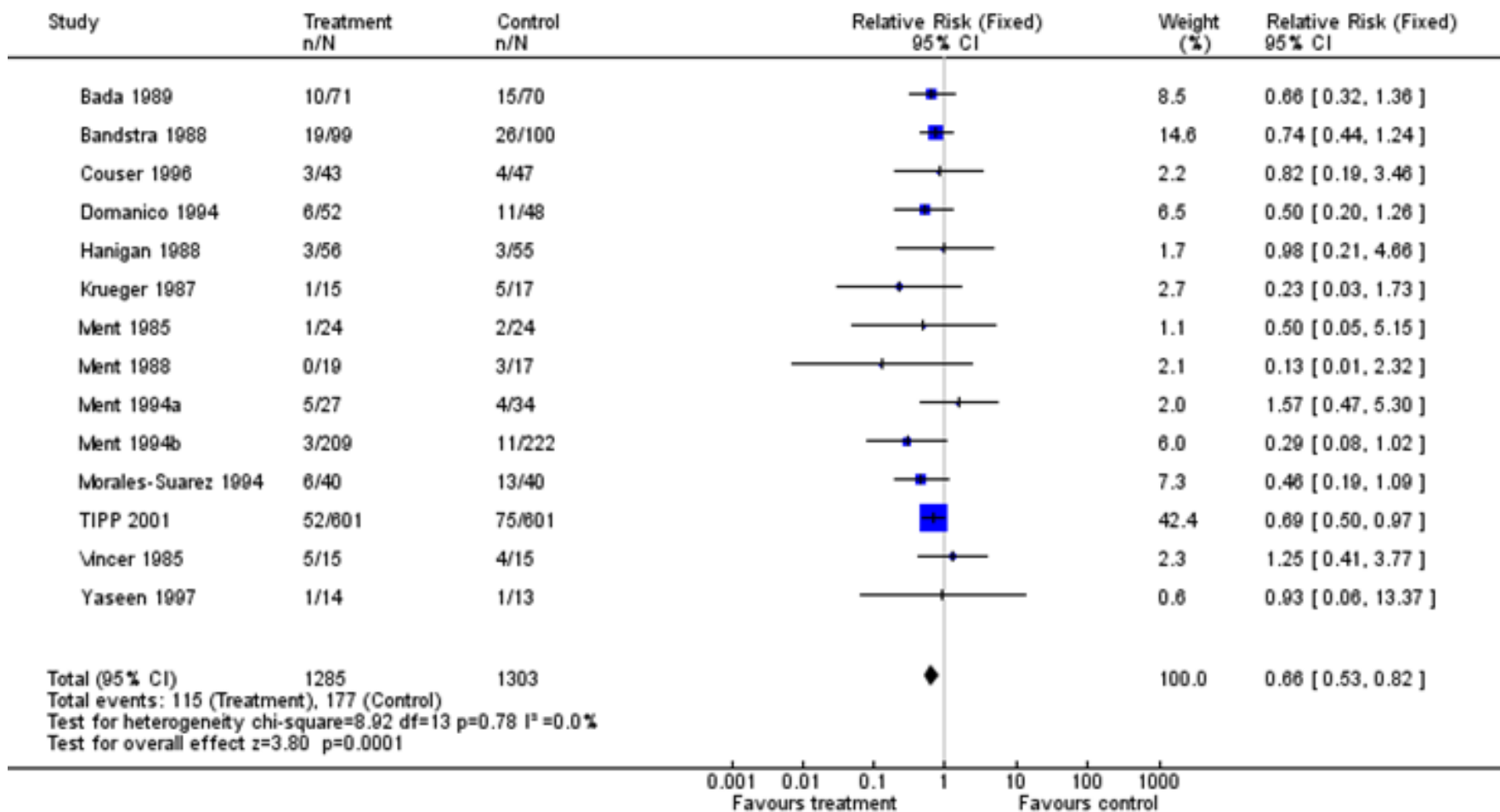


Distribution of COMEAP (2009) members' views of the uncertainty around the coefficient linking PM2.5 and all-cause mortality



There are better methods when many studies exist – Meta Analysis:

Review: Prophylactic intravenous indomethacin for preventing mortality and morbidity in preterm infants
 Comparison: 01 Prophylactic indomethacin vs. control
 Outcome: 04 IVH Grade 3 and 4



Communicating the risk in terms of premature deaths is a significant change

- 2007 Air Quality Strategy ***did not mention premature deaths*** (evidence based on COMEAP 2006 Interim report)
- COMEAP 2010 report on Mortality effects of Long-Term Exposure...stated:
 - COMEAP has over the years considered expressing the mortality implications of reduced long-term exposure to air pollution in terms of ***life expectancy and the number of life-years gained*** over the population, ***as more informative*** than annual reductions in ***numbers of deaths*** sometimes described as 'lives saved'
- Now in line with other outcomes – road accidents, obesity etc

FREE METRO
 Friday, April 11, 2014 The world's most popular free newspaper
THE VAMPS: Like 1D...but less edgy »p45



Killed by the air that we breathe



TENS of thousands of people are killed every year by the world's toxic air. The 29,000 deaths of over-25s caused by pollution annually, say experts. England, where one in 20 deaths is blamed on the particulates we breathe in every day, is more dangerous than Scotland, Wales or Northern Ireland.

by **NICOLE LE MARIE**

These are hotspots in many areas of the UK, including Greater Manchester and the East Midlands. Parts of Cumbria have the cleanest air in England, with pollution deaths as low as 3.4 per cent, but Eilean Siar in the Outer Hebrides has the lowest pollution deaths.

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17 April 2012 Last updated at 14:45



Traffic pollution kills 5,000 a year in UK, says study

COMMENTS (234)

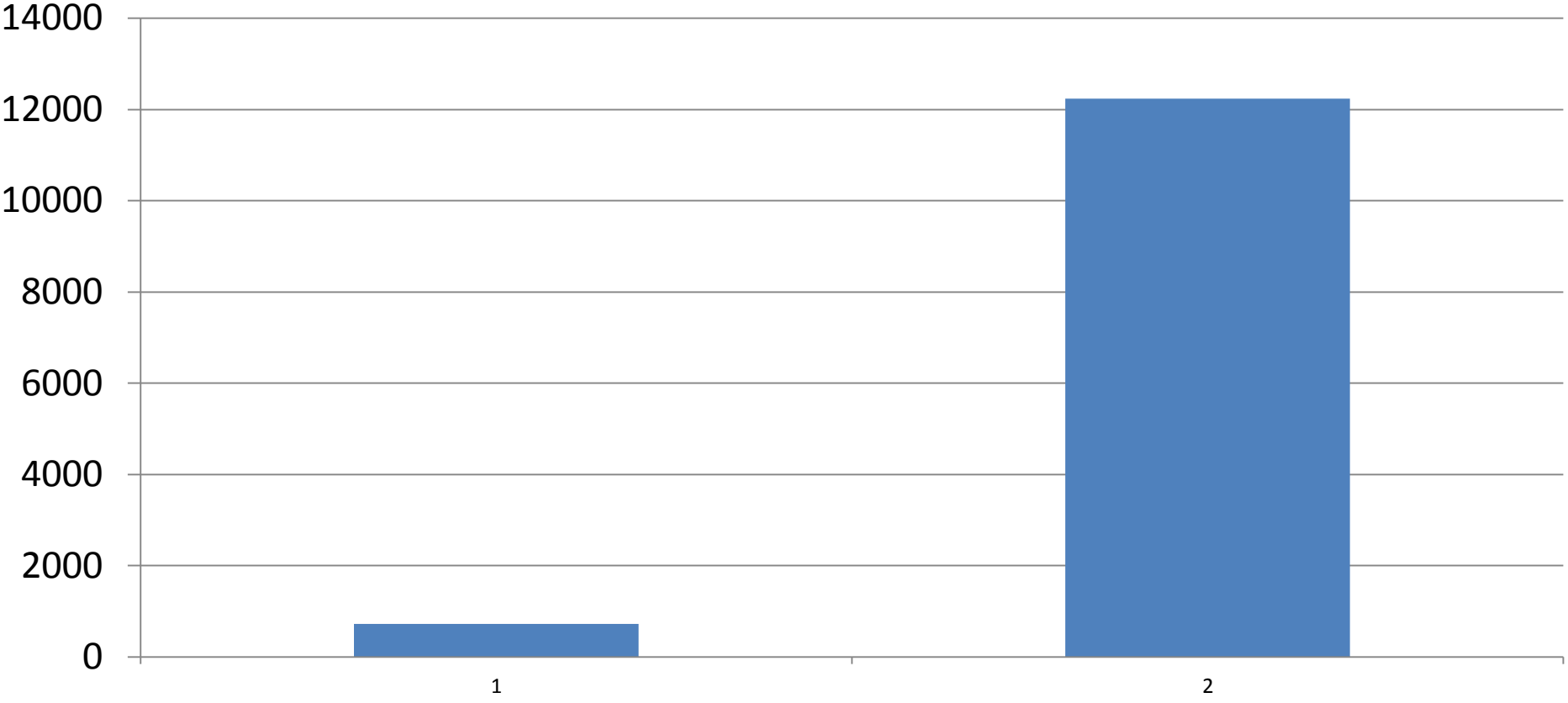
By **Roland Pease**
 BBC Radio Science Unit

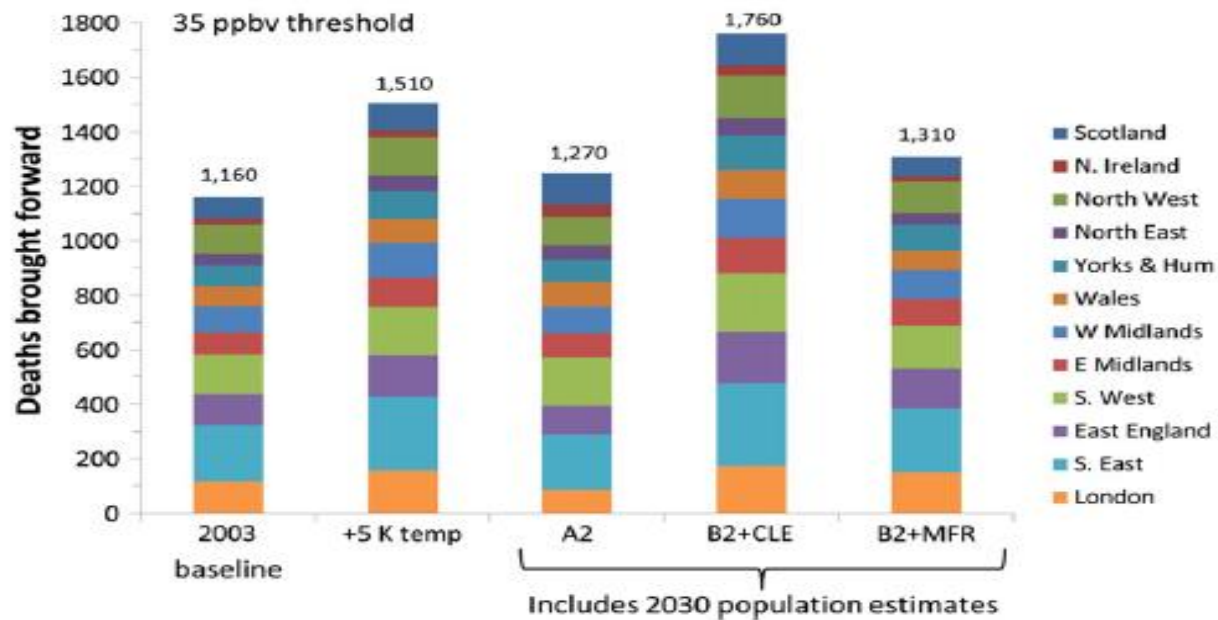
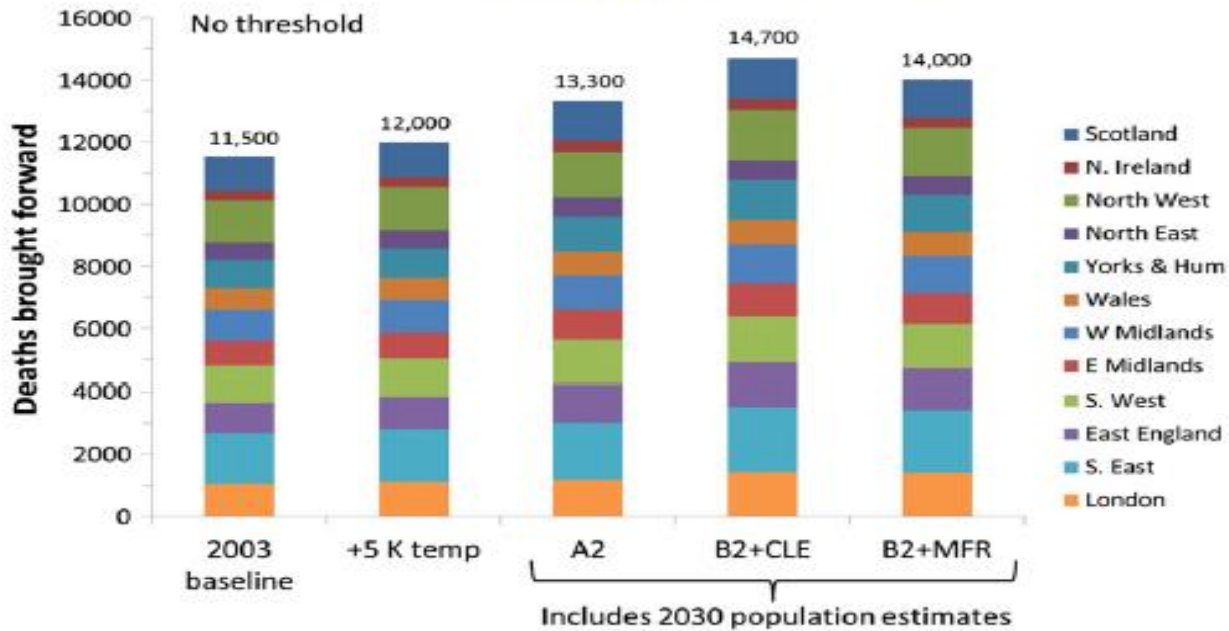
Road pollution is more than twice as deadly as traffic accidents, according to a study of UK air quality.

The analysis appears in **Environmental Science and Technology**, carried out by Steve Yim and Steven Barrett, pollution experts from MIT in Massachusetts.



Deaths brought forward from ozone, no threshold and 50ppb threshold (Health effects of climate change in the UK, Dept. Health)





Uncertainty in policy analysis



Defra Phase 2 urban model evaluation

King's College London
Cambridge Environmental Research Consultants
Imperial College London
Ricardo-AEA

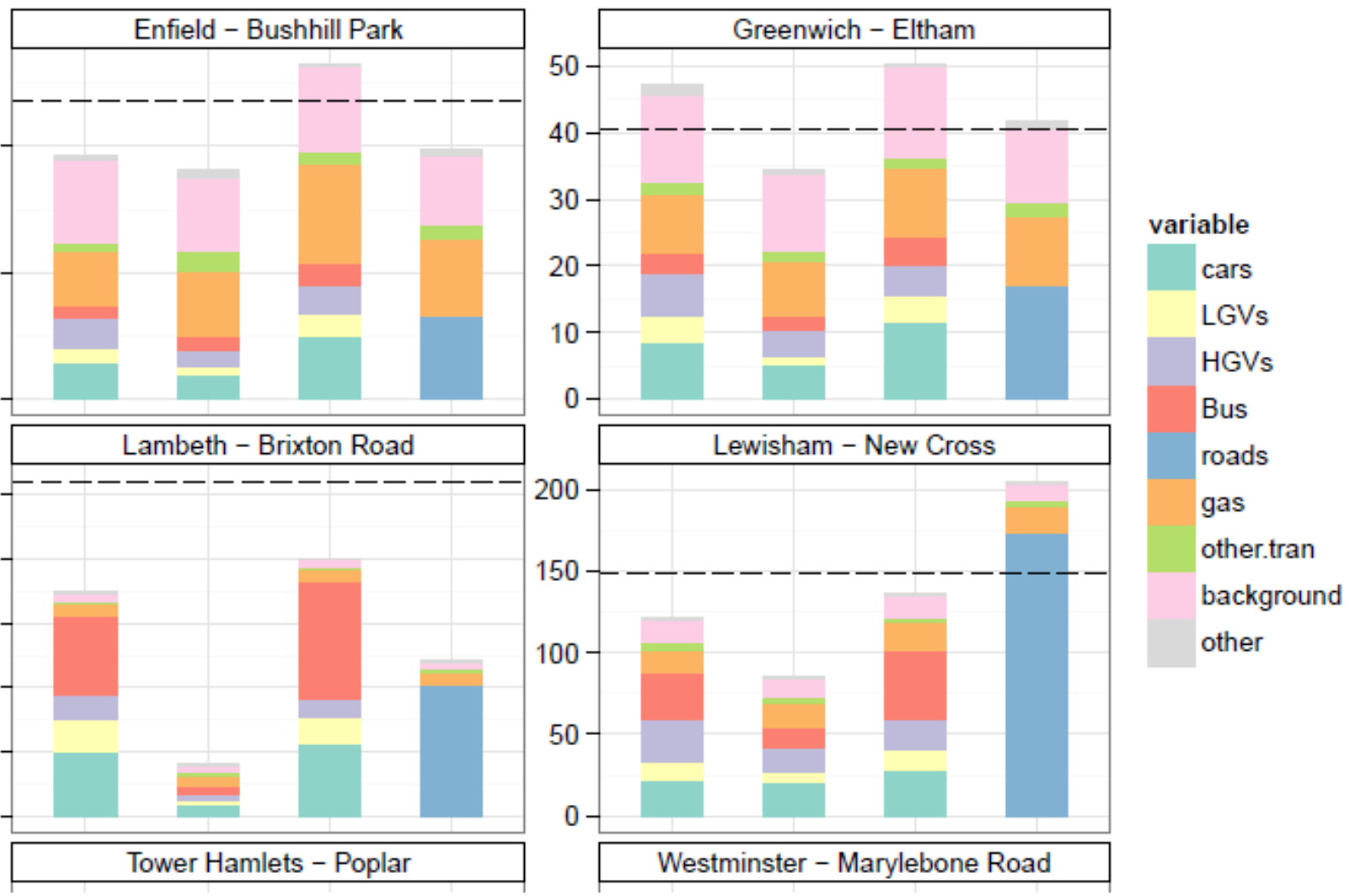


Defra Phase 2 regional model evaluation

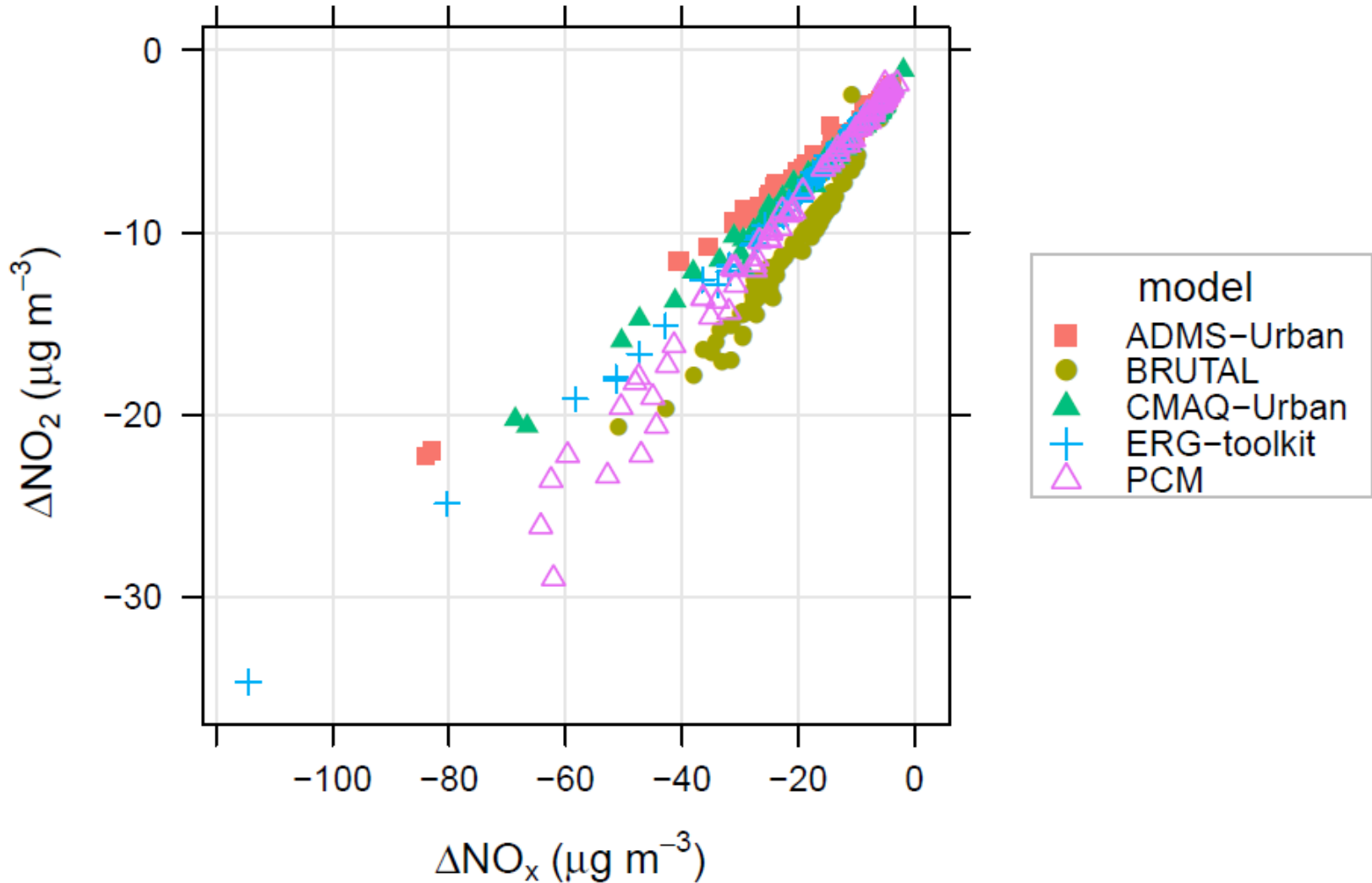
King's College London
Centre for Ecology and Hydrology
Met Office
rdscientific
Ricardo-AEA
University of Hertfordshire
University of Manchester

Source apportionment from models is crucial for policy

NOx
(ug/
m3)



Source app. needs to be right but also model response to emission changes



Non-linear chemistry is a challenge for policy analysis

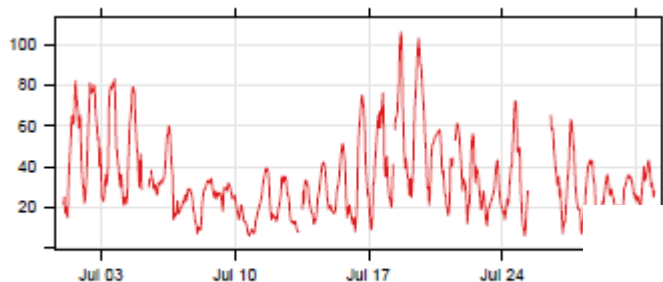
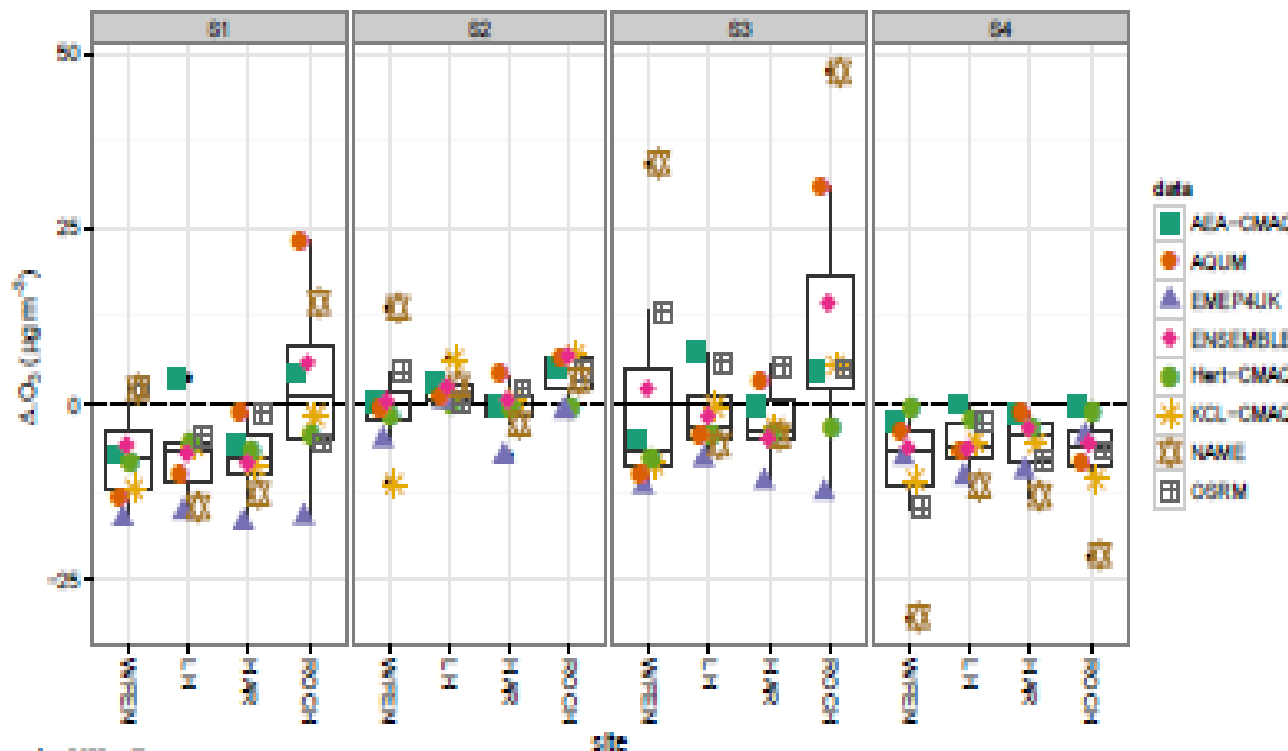


FIGURE 5.1: Hourly O₃ concentrations in July 2006 at the Harwell site



S1 Reduce total anthropogenic NO_x and VOC by 30% across the UK + Europe

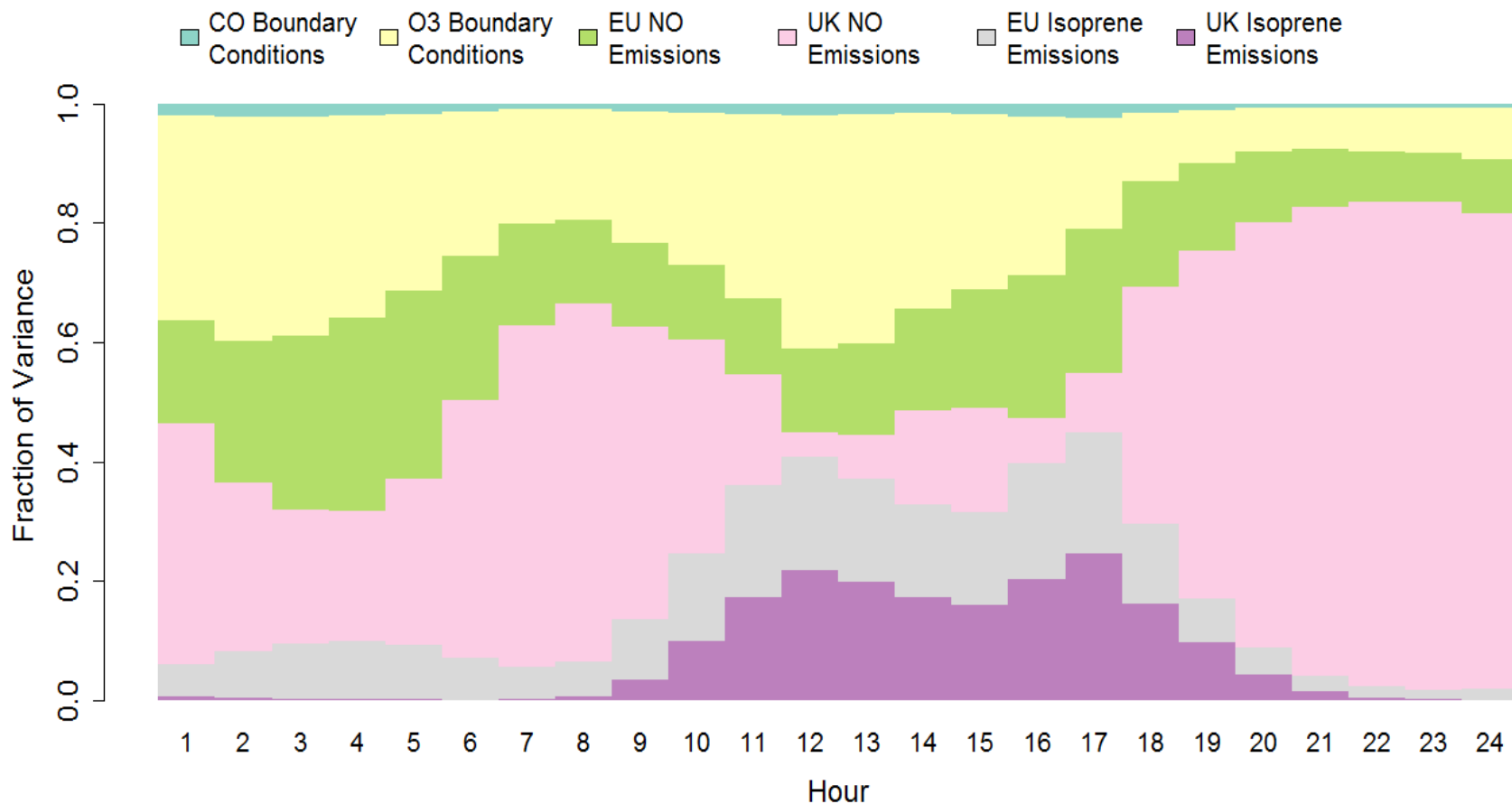
S2 Reduce total anthropogenic NO_x and VOC by 30% across the UK only

S3 Reduce anthropogenic NO_x by 30% across UK + Europe

S4 Reduce anthropogenic VOC by 30% across UK + Europe

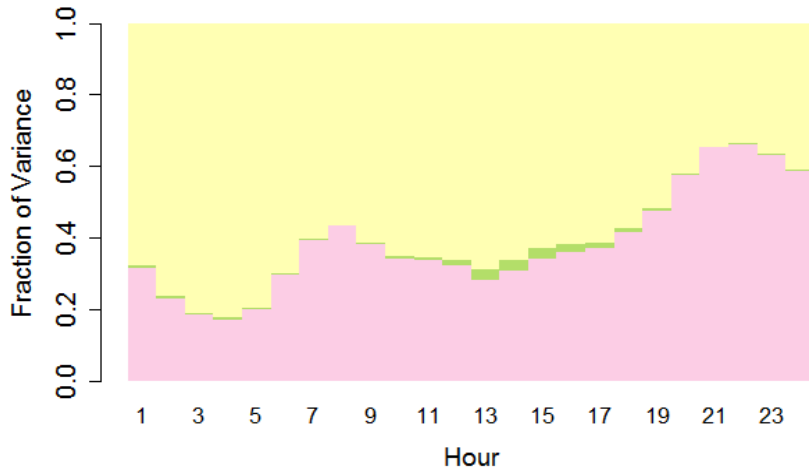
Emulator approach to uncertainty analysis – with messages for policy? (Andrew Beddows)

- Sensitivity analysis identifies which of the uncertain inputs has the most influence on model output
- The graph below shows this for CMAQ over a 24hr period, calculated by using the emulator in place of the model
- Monte Carlo uncertainty estimation and any other sensitivity/uncertainty analysis techniques can be carried out in the same way.

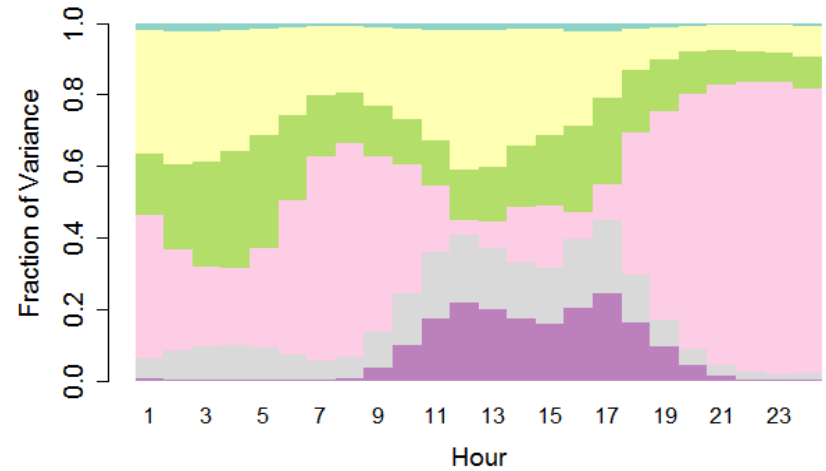


Sensitivity analysis of two ozone episodes

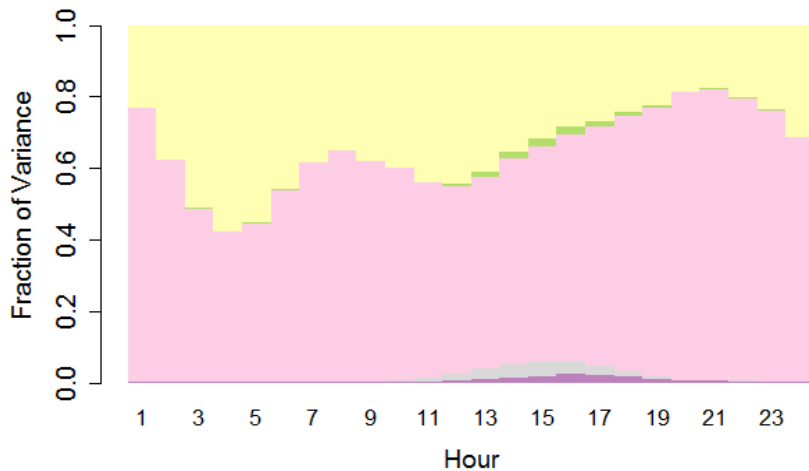
Manchester Picadilly - May



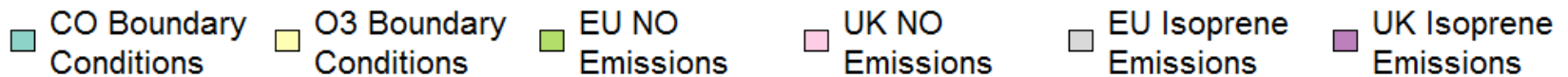
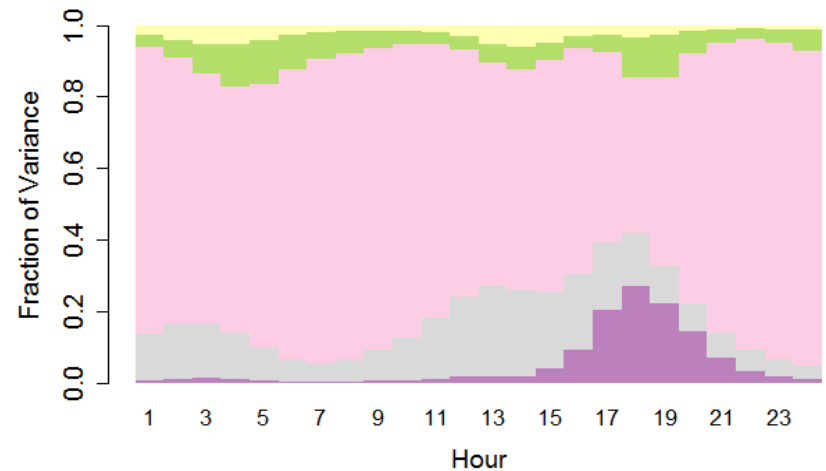
Manchester Picadilly - July



Bloomsbury - May



Bloomsbury - July



“

*Uncertainty is an
uncomfortable position.
But certainty is an absurd
one.*

~ Voltaire ~

