Ozone Research at Lancaster

People	Research Interests	Projects
Nick Hewitt	O_3 precursor concentration/flux measurements, measurement campaigns, biogenic VOC	OP3, CLAIRE-UK
Oliver Wild	Chemistry transport models, long-range transport, past/future global O_3 budget, bVOC, deposition	HTAP, ACITES
Paul Young	Chemistry climate models, global O_3 hindcasts, bVOC, stratospheric and tropospheric chemistry and climate	ACCMIP, CCMI
Duncan Whyatt	Local and regional modelling, air quality, conditional analysis, Environment Agency links	Urban Futures
Bill Davies, Sally Wilkinson	Stomatal damage from O_3, biochemical pathways, sustainable agriculture	

Nick Hewitt

Measuring surface-atmosphere fluxes of O_3 precursors

Current activities (NERC-funded):

Emissions of biogenic VOC emissions from tropical forests

- Amazonia, as part of CLAIRE-UK, with Nemitz and Langford (CEH)
- Tower-based virtual disjunct eddy covariance with PTR-MS
- July 2013 for 12 months

Development and demonstration of airborne VOC and NOx flux measurement capability

- Using NERC ARSF Dornier 228 aircraft
- Ionicon PTR-MS and Air Quality Design Inc chemiluminescence NOx sensor
- Virtual disjunct eddy covariance
- June/July 2013 over London and SE England

Oliver Wild

LANCASTER UNIVERSITY

Modelling surface-atmosphere interactions

Biofuel cultivation and the O_3 impacts of bVOC emissions

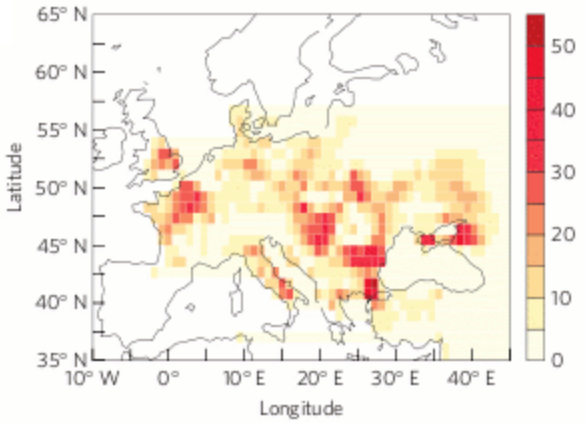


Figure 3 | Impact of increasing ground-level ozone concentrations on crop yield. a, Wheat and maize yield (Mt) in 2000[11]. **b**, Changes to the AOT40 metric (accumulated exposure to ozone over a threshold of 40 ppbv) in units of ppmv h (ref. 15). **c**, Wheat and maize production losses (kt) as a result of planting 72 Mha of SRC.

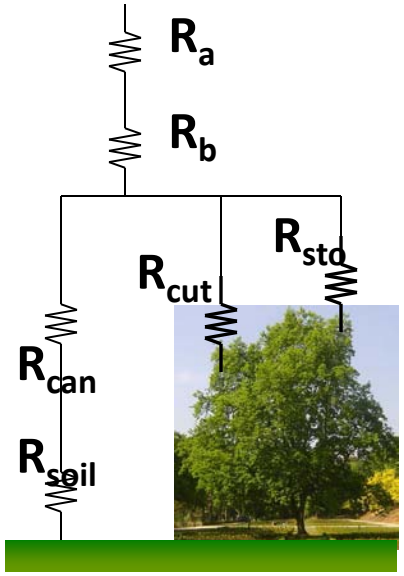
Ashworth et al., Impacts of biofuel cultivation on mortality and crop yields, Nature Climate Change, 2013

ACITES: Atmospheric Chemistry in the Earth System

Focus on modelling dry deposition in large-scale models

Aiming for:

- Traceability from process models up to ESM
- Definition of observation-based metrics for testing models



Initial focus: ozone

Co-I: Lisa Emberson
PDRA: Catherine Hardacre

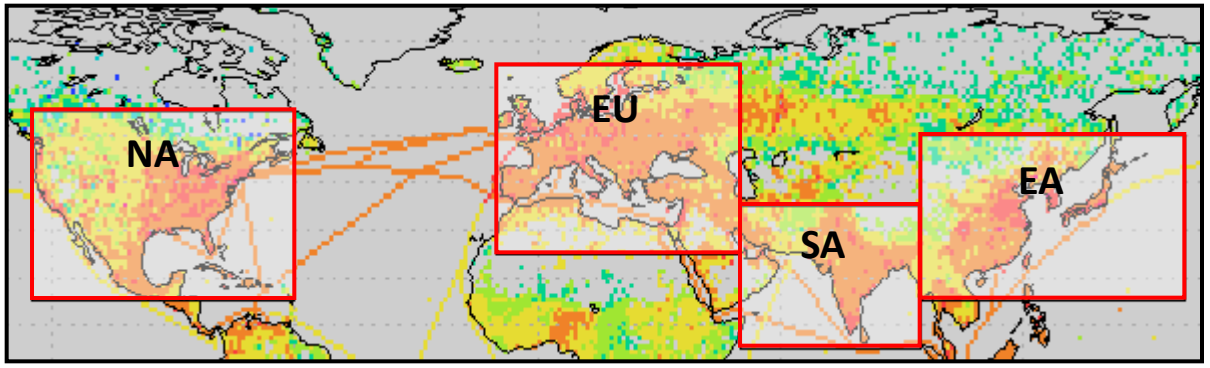
Oliver Wild

Global Modelling: HTAP

LANCASTER UNIVERSITY

LRTAP Long-range Transboundary Air Pollution

Task Force on Hemispheric Transport of Air Pollution



HTAP: Quantify impacts of major anthropogenic source regions on surface O_3 under 2001 conditions using 20% precursor emission changes, ~30 models contributed.

Fiore et al., 2009

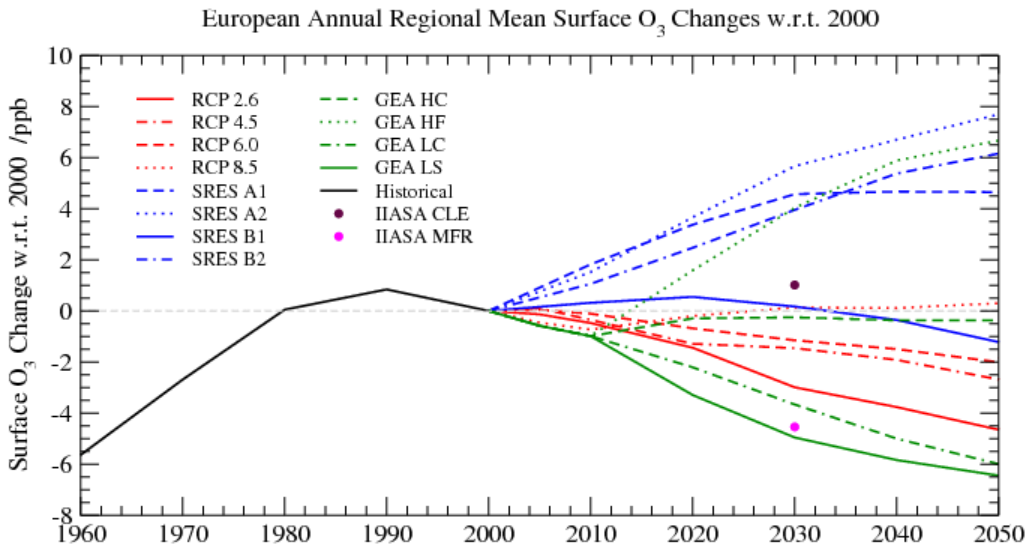
Future changes in surface O_3 and input to policy process

Attributing O_3 changes to changes in anthropogenic precursor sources

Parameterizing O_3 simulations

Quantifying model uncertainty

Wild et al., 2012



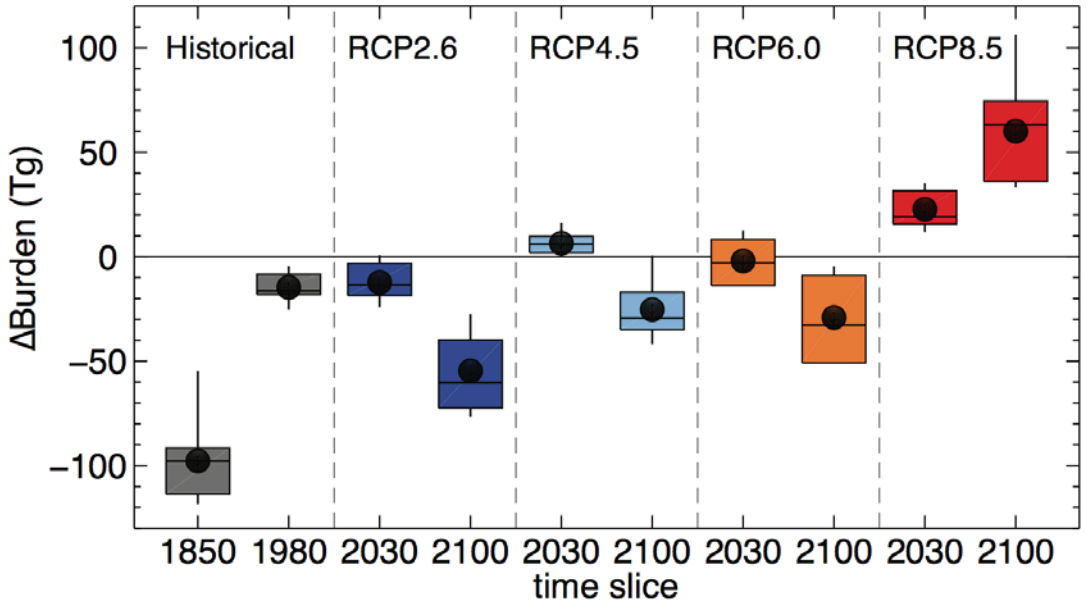
Paul Young

Global Modelling: CCMI

Coupled Chemistry Modelling Initiative: stratospheric and tropospheric global chemistry-climate models (successor to ACCMIP and CCMVal projects)

- What drove the last 40 years of composition change?
- What controls pre-industrial and future projections of ozone?
- What drives the model spread?

ACCMIP model ΔO3 tropospheric burden



Young et al. 2013, ACP

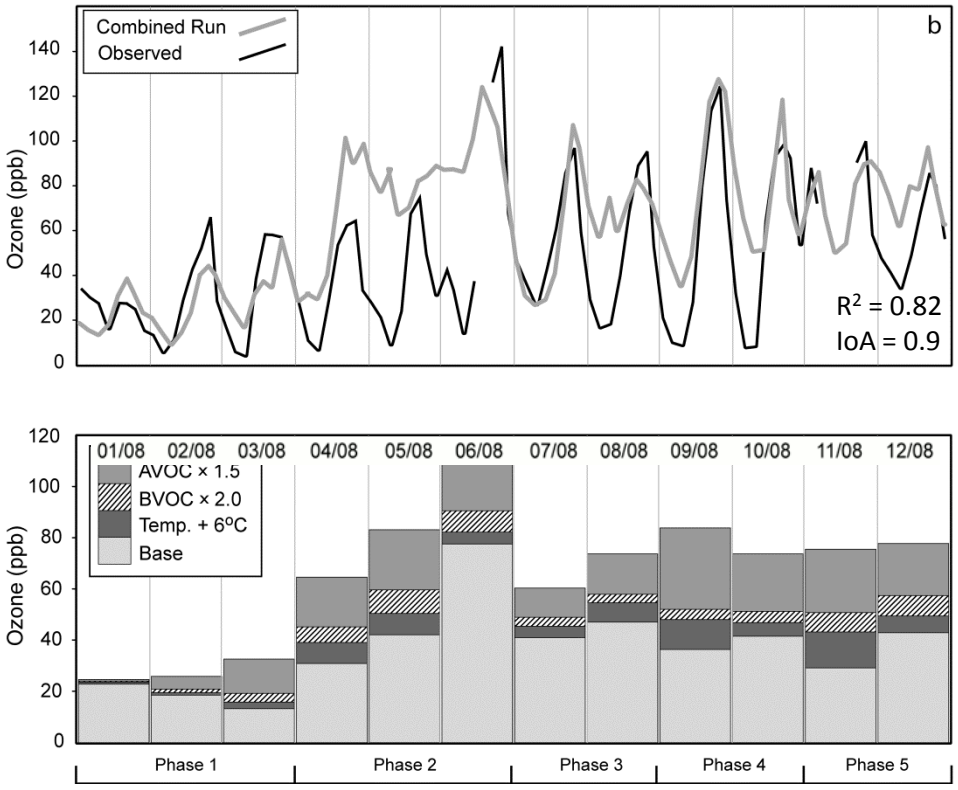
First meeting in Boulder 13-15 May 2013
More information: www.igacproject.org/CCMI
Results to inform WMO ozone report

Looking for observations that provide constraints on key tropospheric processes!

Duncan Whyatt

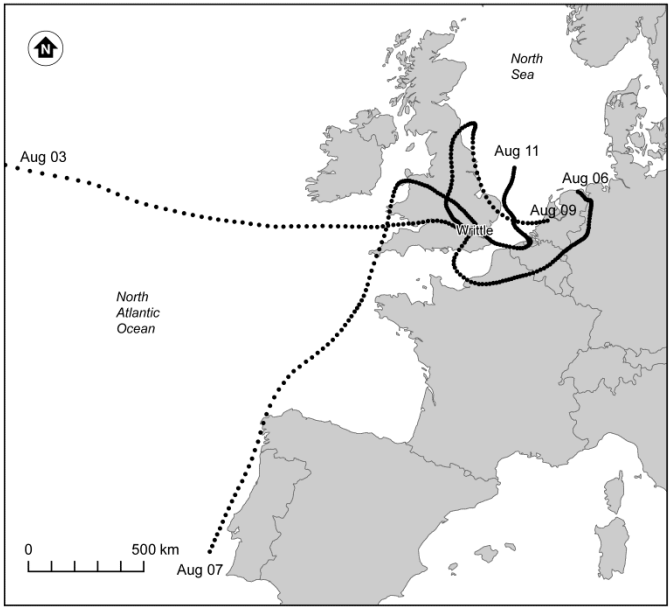
Exploring the origins of elevated ozone at Writtle, August 2003

Selected inputs to the ELMO model (Lagrangian CTM) scaled to reproduced peak ozone levels recorded at Writtle during TORCH campaign August 2003



Source attribution studies

- aVOC emissions (UK+EMEP) x 1.5
- bVOC emissions (UK+EMEP) x 2.0
- Temperature + 6ºC



Strong, J., Whyatt, J.D., Metcalfe, S.E., Derwent, R.G and Hewitt, C.N., 2013. Investigating the impacts of anthropogenic and biogenic VOC emissions and elevated temperatures during the 2003 ozone episode in the UK. Forthcoming in **Atmospheric Environment**

Plans, Aspirations, Needs, Barriers…

LANCASTER UNIVERSITY

- Deeper understanding of role of O_3 in the Earth System
  - Further measurements and modelling of surf-atmos interactions
- Improved policy relevance of model results
  - Better understanding/assessment of impacts (health/crops)
  - Clearer quantification/attribution of observed O_3 trends
- More critical testing of key processes in models
  - Need more process-targeted observations