

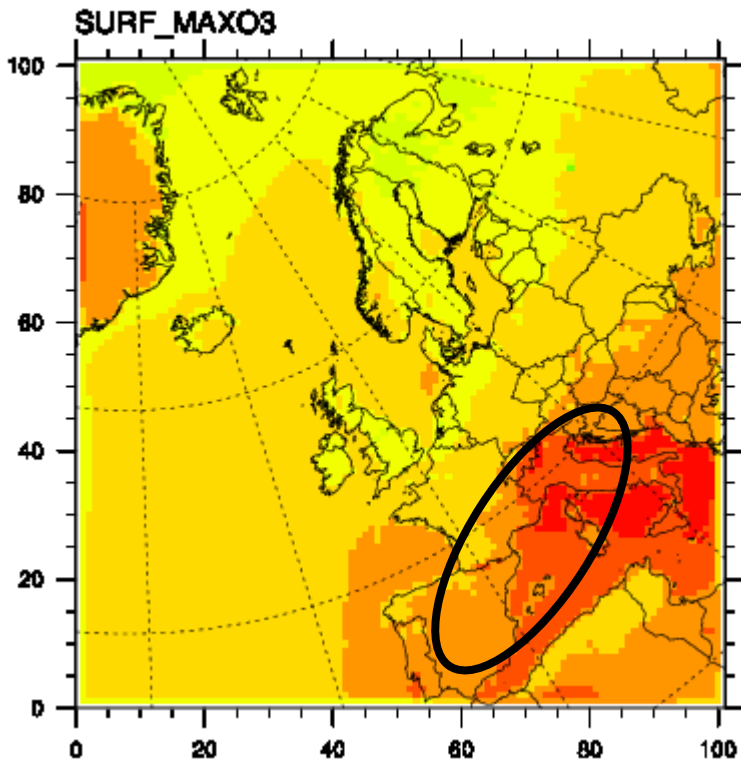
Modelling of ozone impacts to crops and forests

Gina Mills (ICP Vegetation) and David Simpson (EMEP)

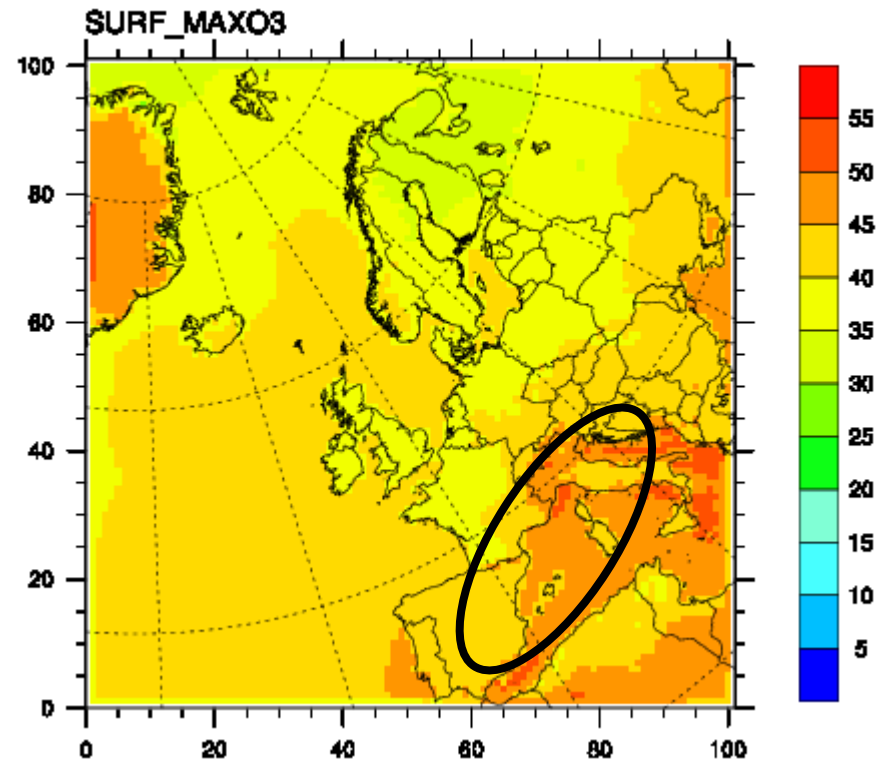
Content

- Latest maps for GP2005 and GP2030CLE
 - Surface maximum O₃ concentration
 - POD1 for deciduous forests
 - POD3 and POD6 for crops
- Effect of “Y” in PODY
- Ozone, Ecosystem Services and biodiversity

Surface maximum O₃ conc. (annual mean)

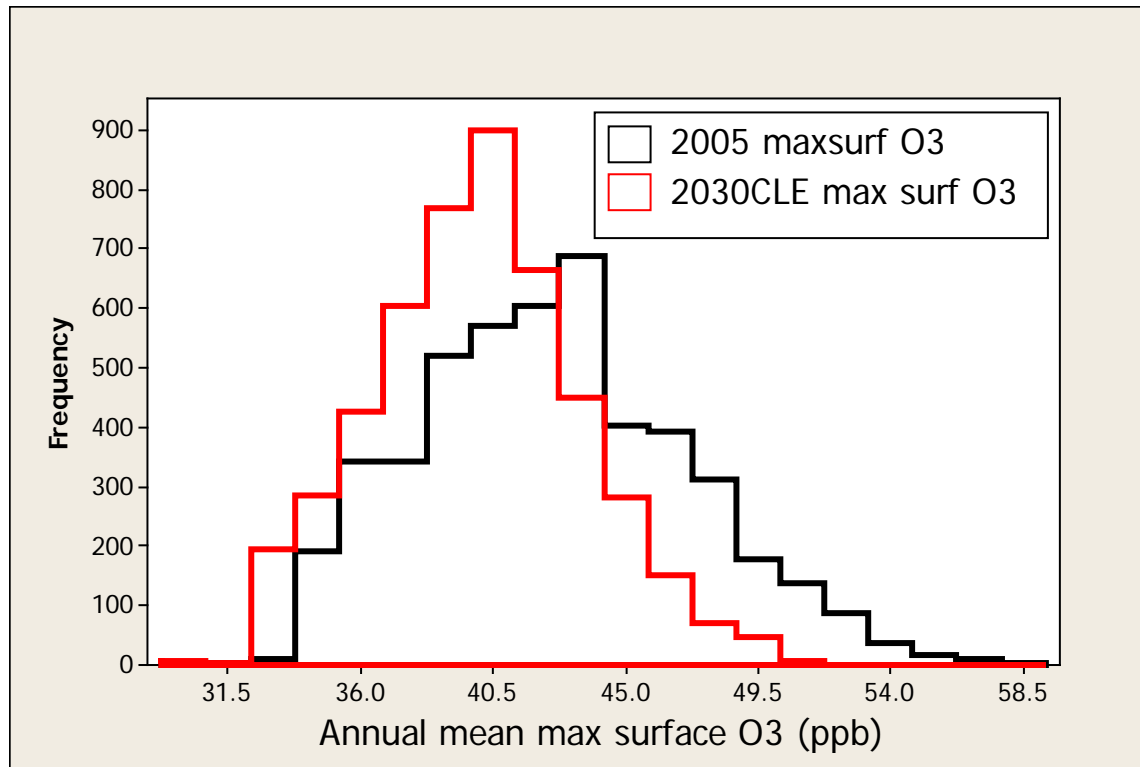


2005 Max surface ozone,
annual mean, ppb



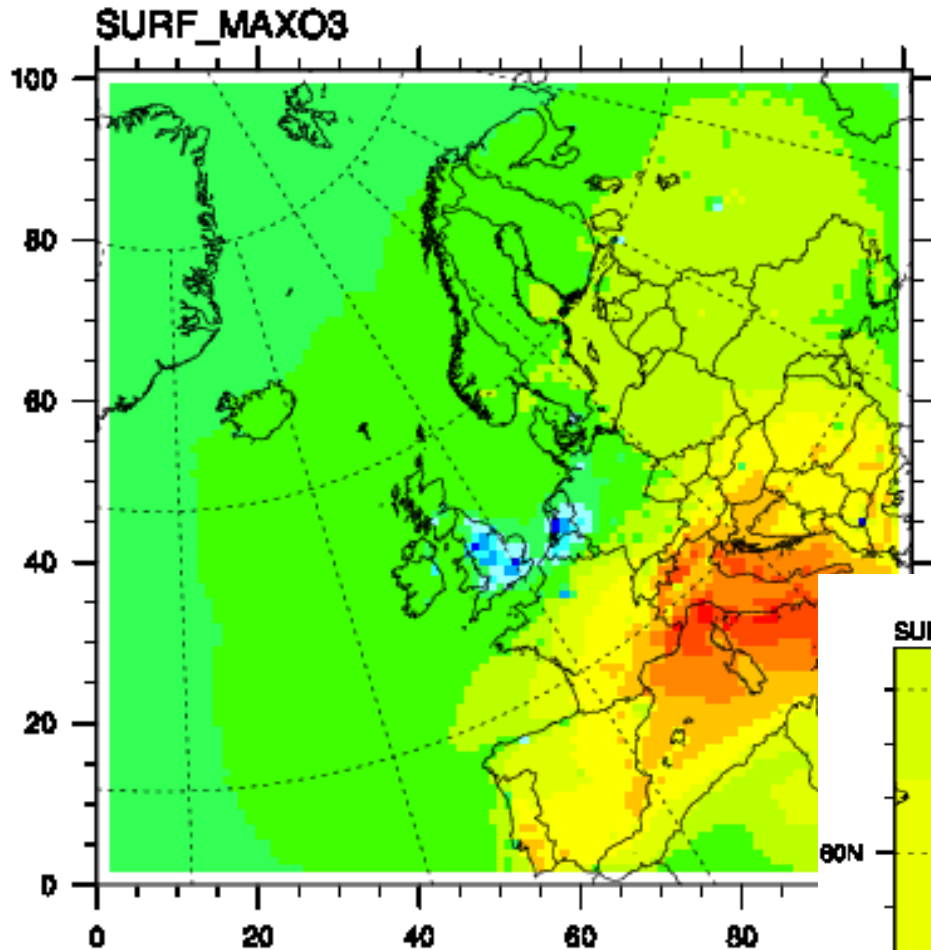
2030CLE Max surface ozone,
annual mean, ppb

Surface maximum O3 conc. (annual mean)

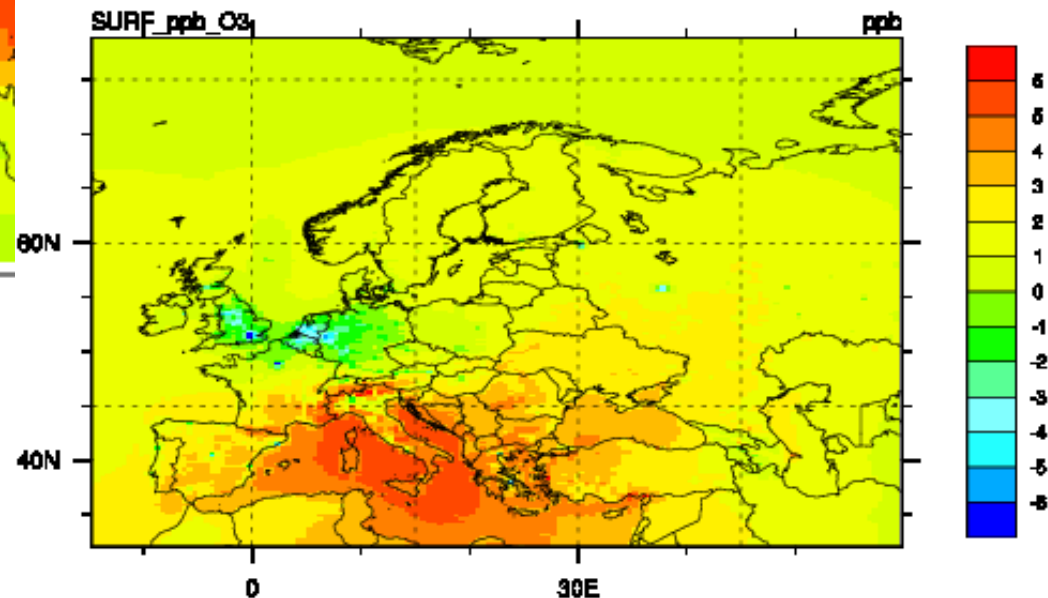


	2005	2030CLE	% reduction
mean	42.5	40.0	5.9%
25 th centile	39.3	37.7	4.1%
75 th centile	45.6	42.2	7.5%

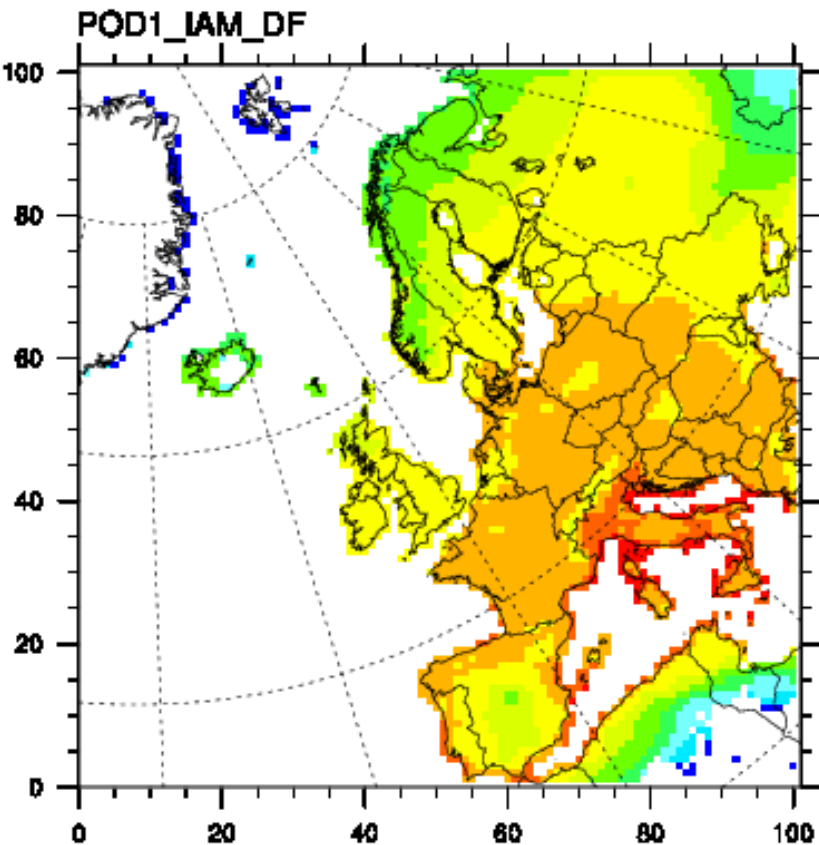
Surface maximum ozone concentration



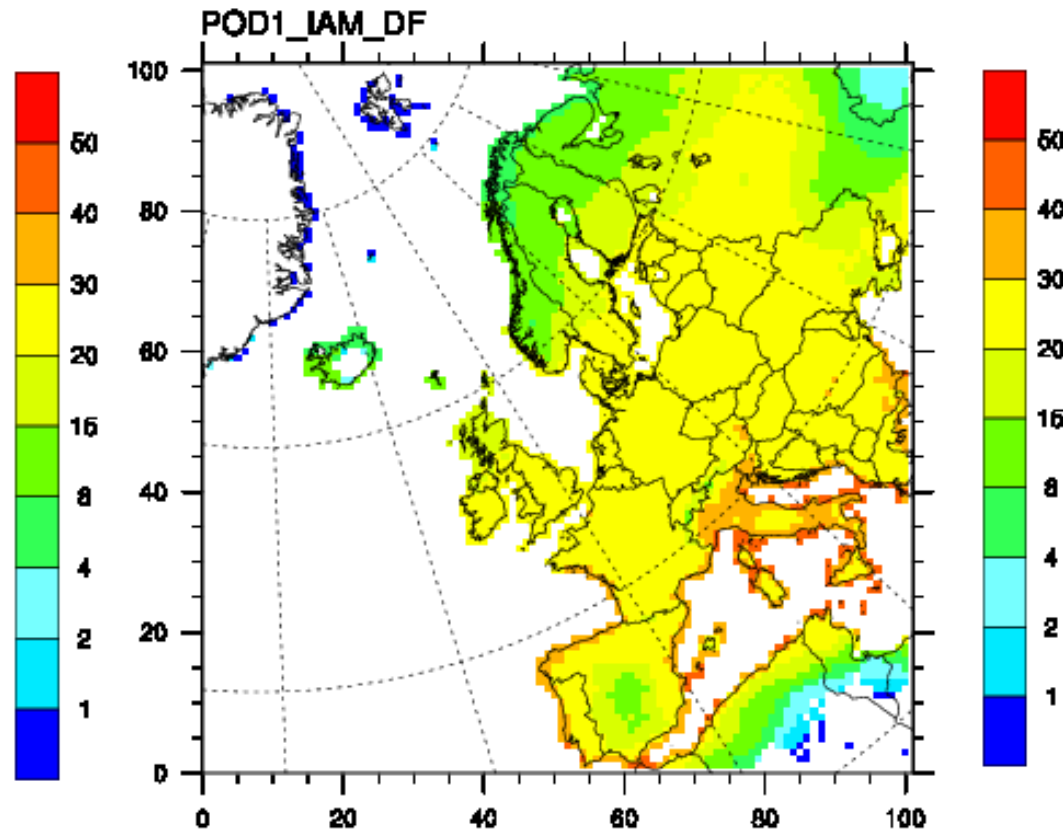
**Difference between
2005 and 2030CLE,
ppb**



POD1 for Deciduous forests

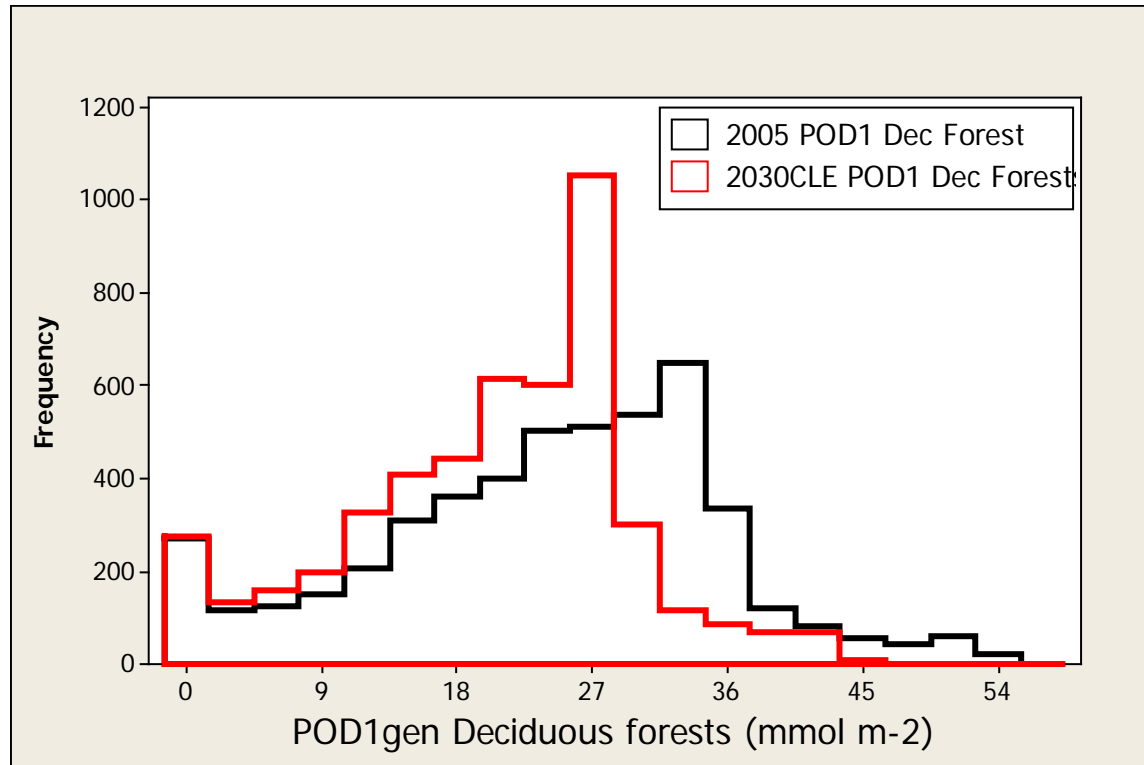


2005 POD1
Deciduous forest



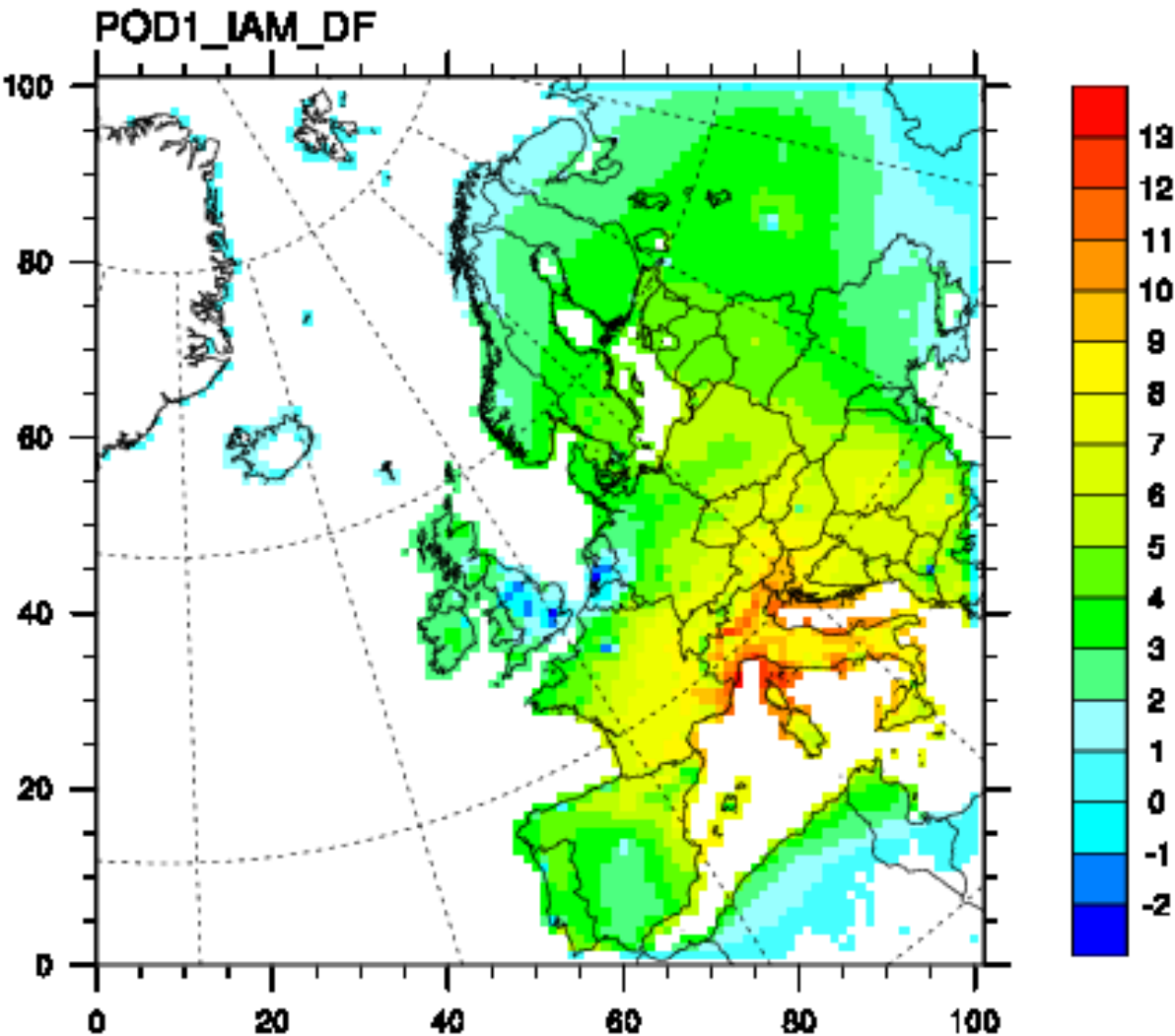
2030CLE POD1
Deciduous forest

POD1 for Deciduous forests



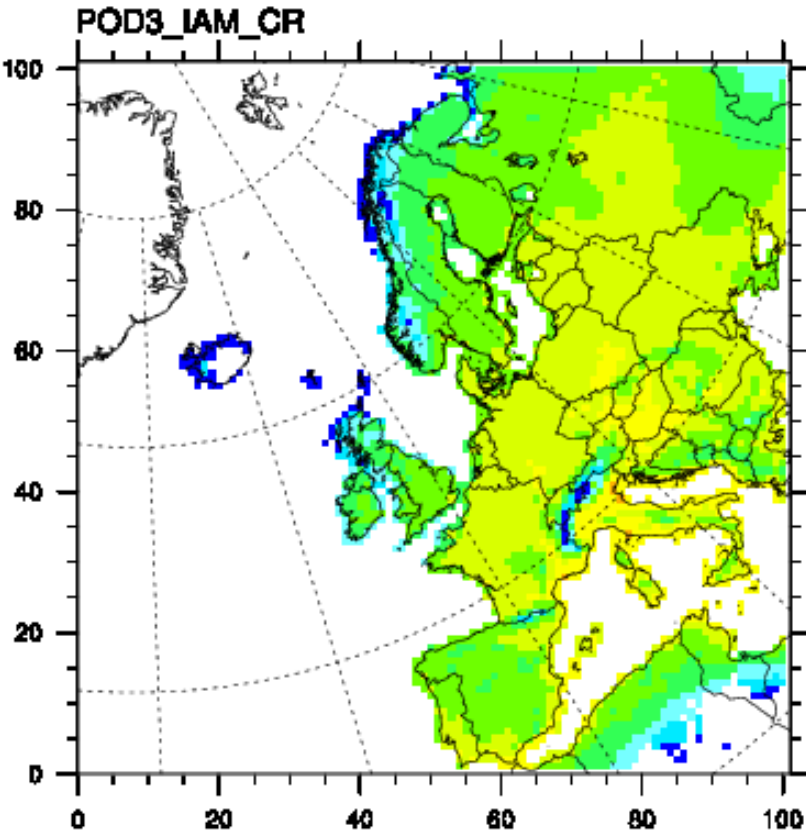
	2005	2030CLE	% reduction
mean	24.0	20.3	15.4%
25 th centile	16.7	14.4	13.8%
75 th centile	32.2	27.0	16.1%

POD1 for Deciduous forests

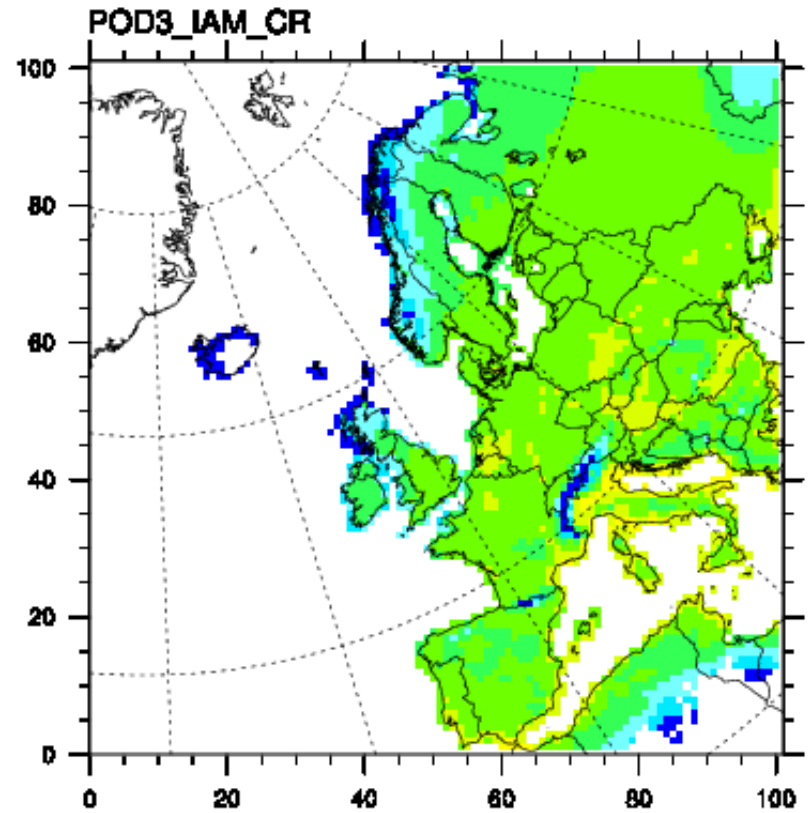


POD1
Deciduous forests,
difference between
2005 and 2030CLE

POD3 for Crops (wheat)



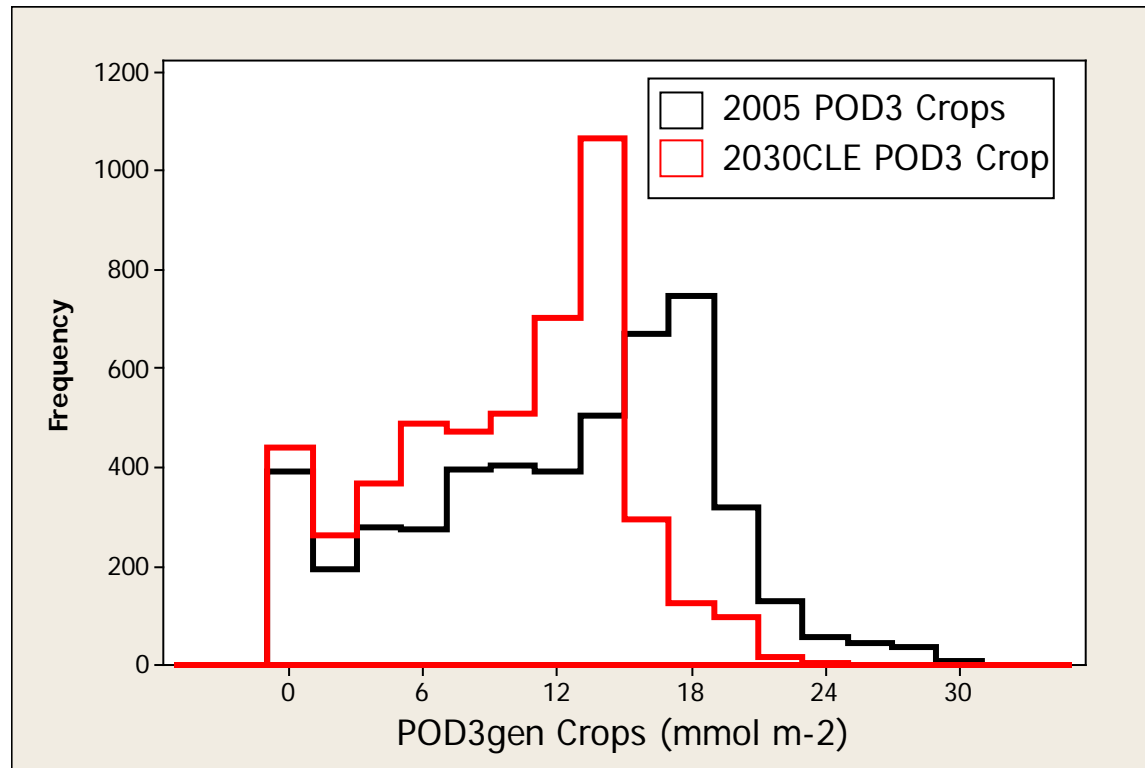
2005 Crops POD3



2030CLE Crops POD3

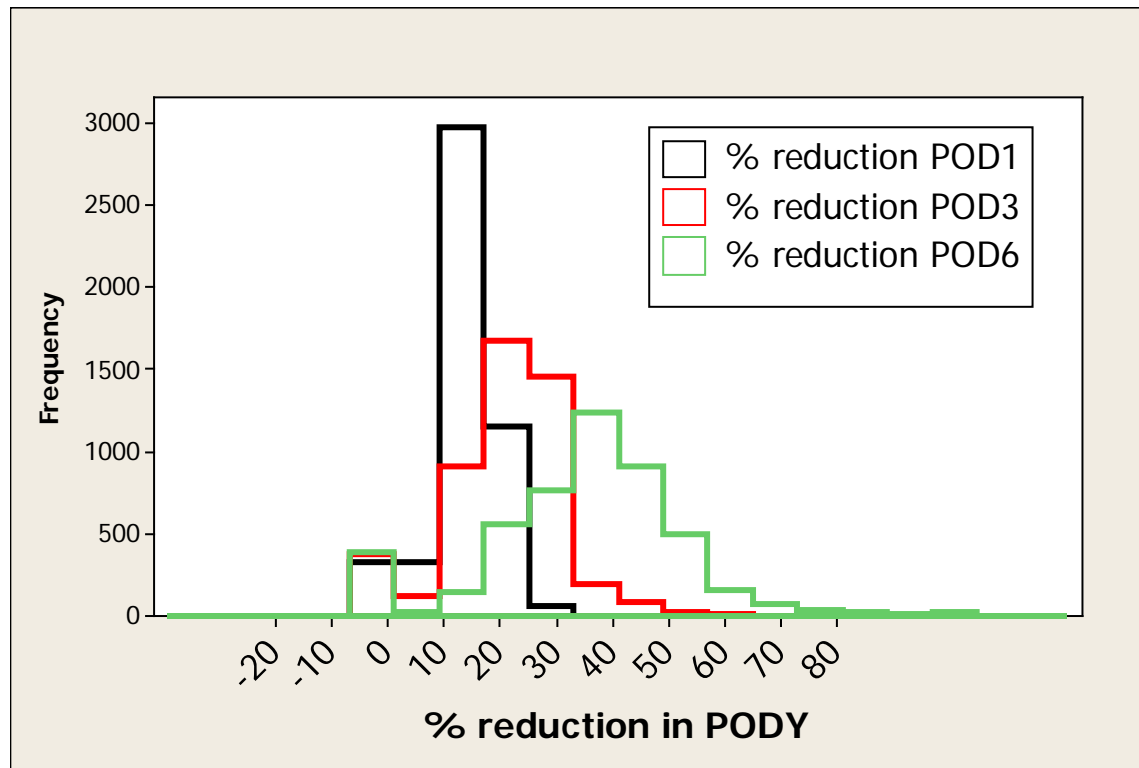


POD3 for Crops (wheat)



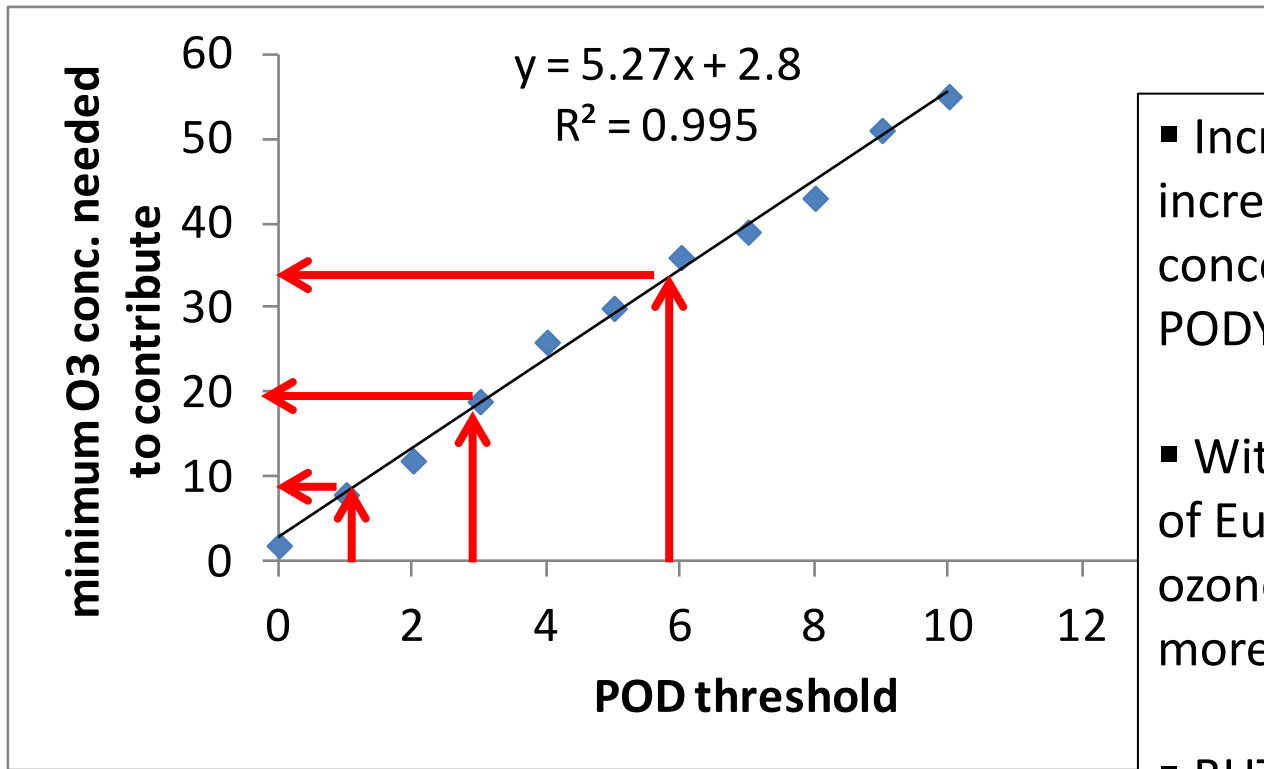
	2005	2030CLE	% reduction
mean	12.2	9.6	21.3
25 th centile	7.4	5.8	21.6
75 th centile	17.3	13.8	20.2

% reduction, 2005 to 2030CLE



	POD1	POD3	POD6
mean	15.4%	21.2%	35.5%
25 th centile	13.8%	15.7%	26.1%
75 th centile	16.1%	27.0%	45.5%

Effect of “Y”



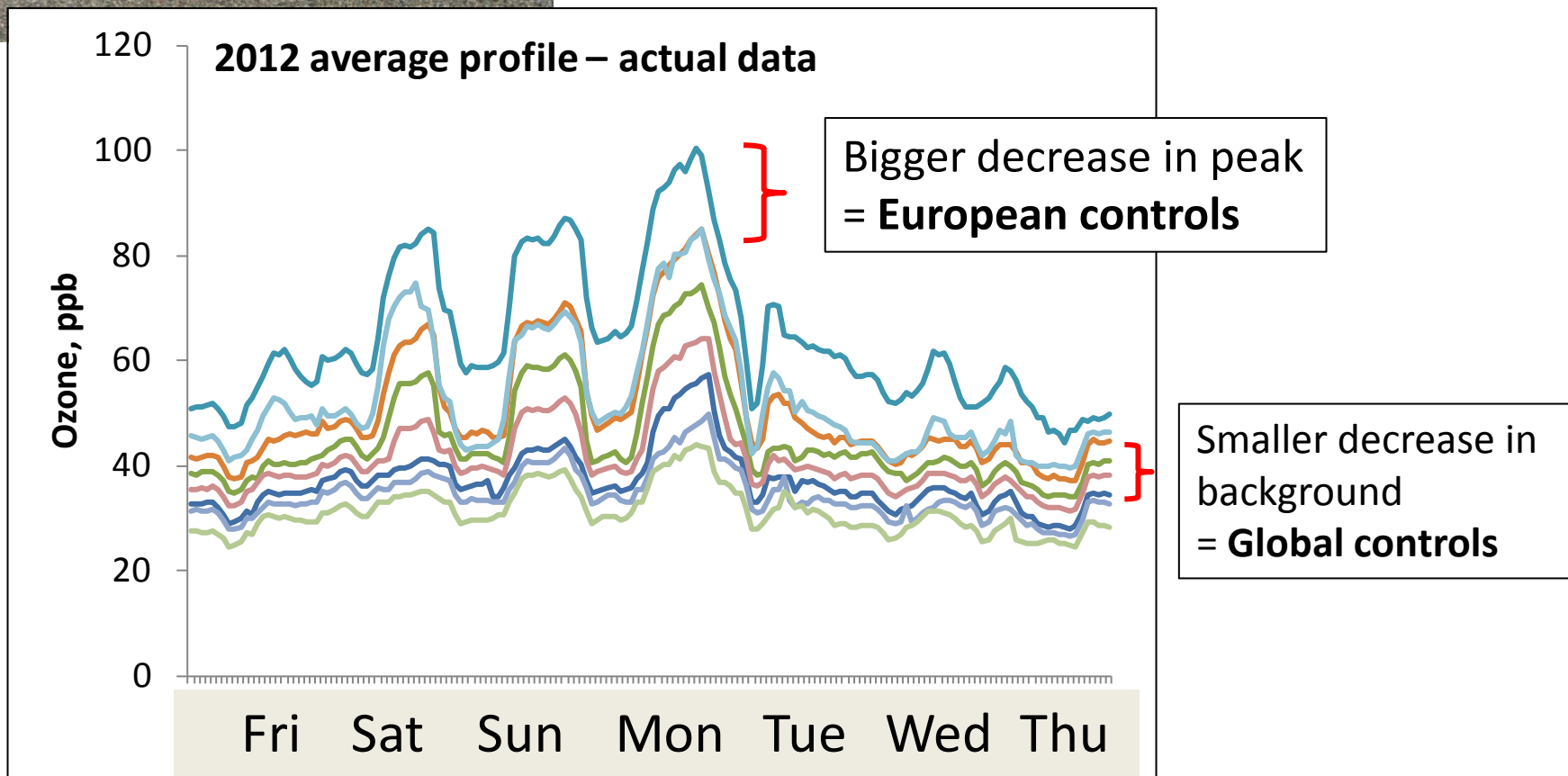
Example:
a generic flux model for grass species

- Increasing the “Y” in PODY increases the ozone concentration above which PODY is accumulated
- With a high “Y”, the benefit of European controls of peak ozone concentration are more clearly shown
- BUT (message from Dave): mapping becomes less accurate...

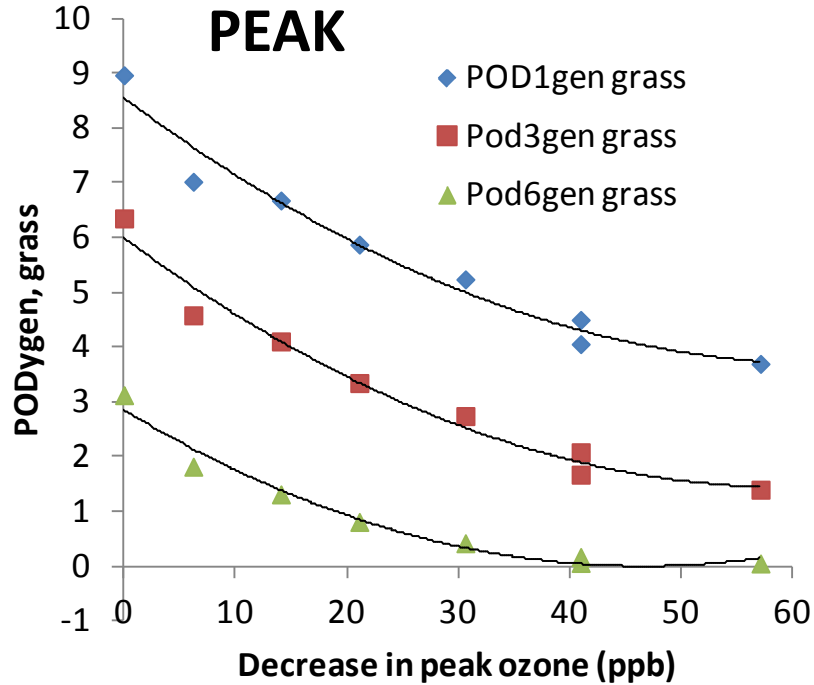
Ozone exposure experiments



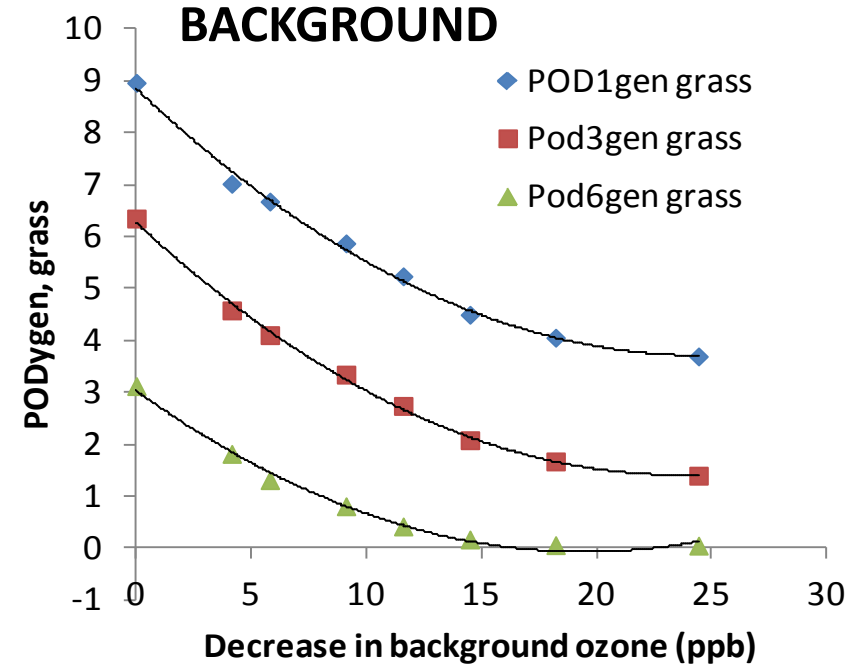
**Ozone episode repeated every week
in highest treatment, 7 treatments**



Effects of different “Y” on PODY



(Range in peak conc 43 – 100 ppb)



(Range in background conc 27 to 51 ppb)

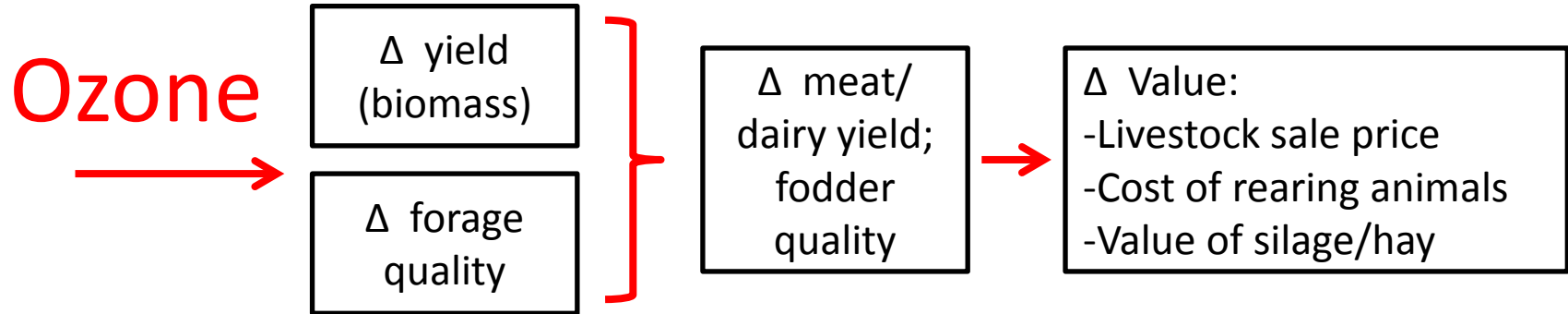
- Small decrease in peak/background = big benefit
- Never get to zero POD1 or POD3 as accumulating ozone at concs. below background

Ozone: Ecosystem Services & Biodiversity



- Ecological processes and supporting services:
 - Primary production (and C cycling)
 - Nutrient cycling
 - Stomatal functioning (and water cycling)
- Provisioning services:
 - Crop production
 - Timber production* **New analysis being conducted**
- Biodiversity (including case-study Mediterranean)
- Regulating services:
 - C sequestration and global warming
 - Air quality (via effects on vegetation)
 - Methane emissions
 - Water cycling
 - Flowering, pollination, insect signalling
- Cultural services (leisure, recreation, amenity)
- Valuing ozone impacts on ecosystem services
- Conclusions and research recommendations
- Contributions from Germany, Italy, Sweden, Switzerland and UK

UK Study: Impact pathway for pasture quality



	2012 number	Range 2005 – 2012
Beef cattle > 2 years old	1.7 million	1.7 – 1.8 million
Dairy cattle > 2 years old	1.8 million	1.8 – 2.0 million
Sheep + lambs*	32 million*	31 – 32 million

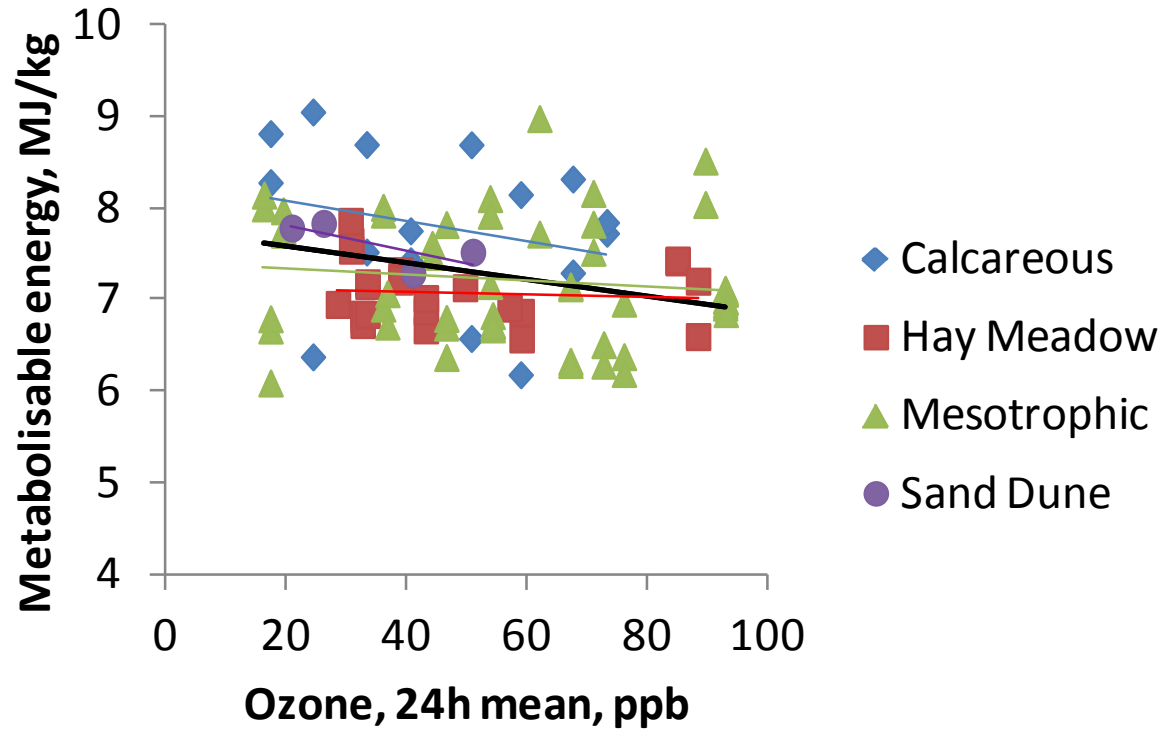


* Value £1.1 billion (€ 1.3billion)

Sample preparation

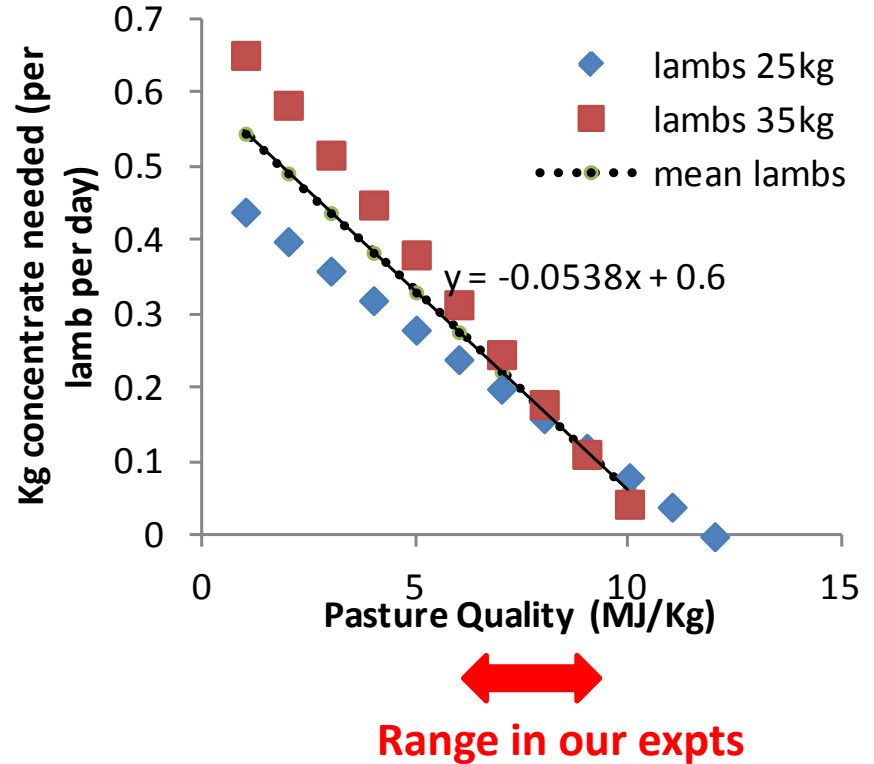
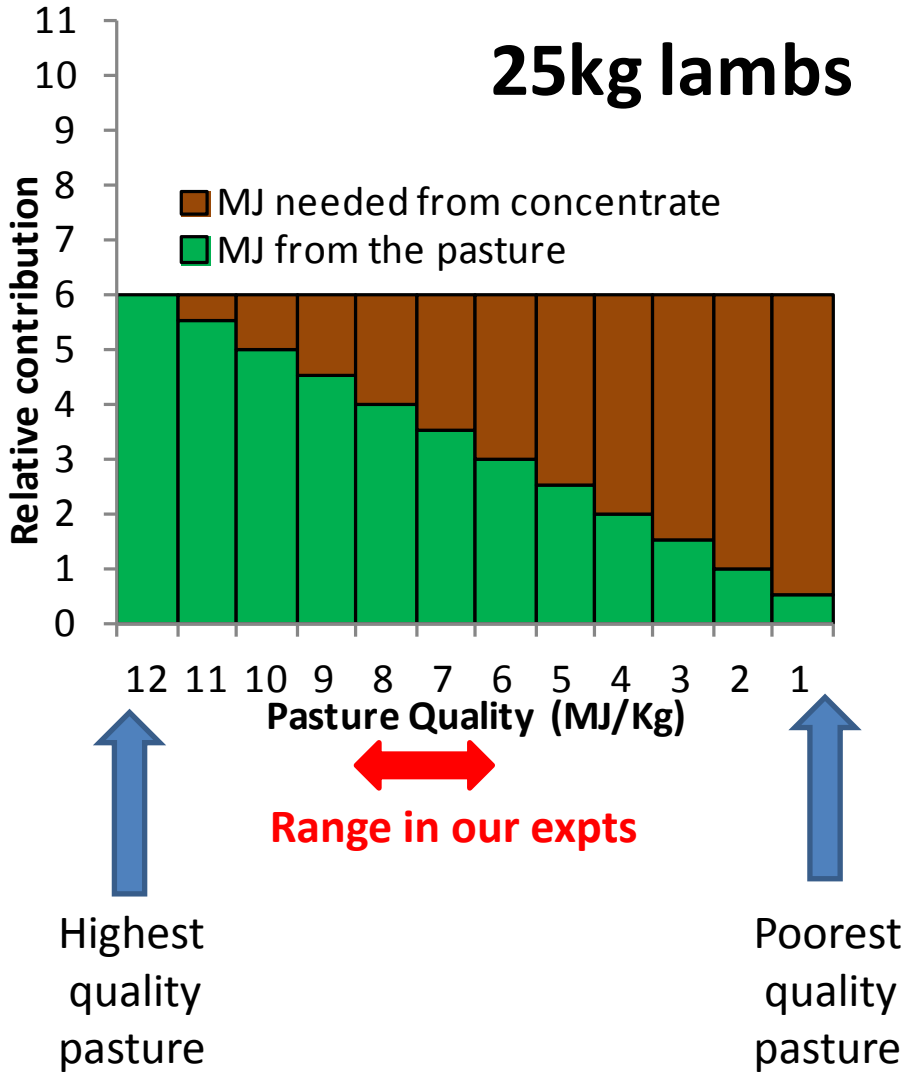


Metabolisable energy (sheep)



Pasture quality vs supplementary feed

25kg lambs



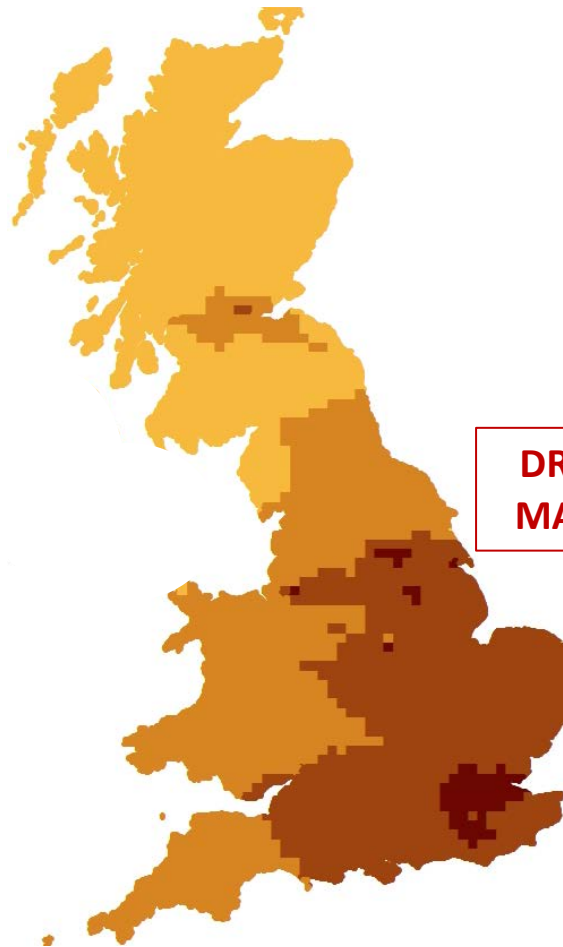
* Relationships varies by lamb size

Ozone impacts on lamb liveweight gain

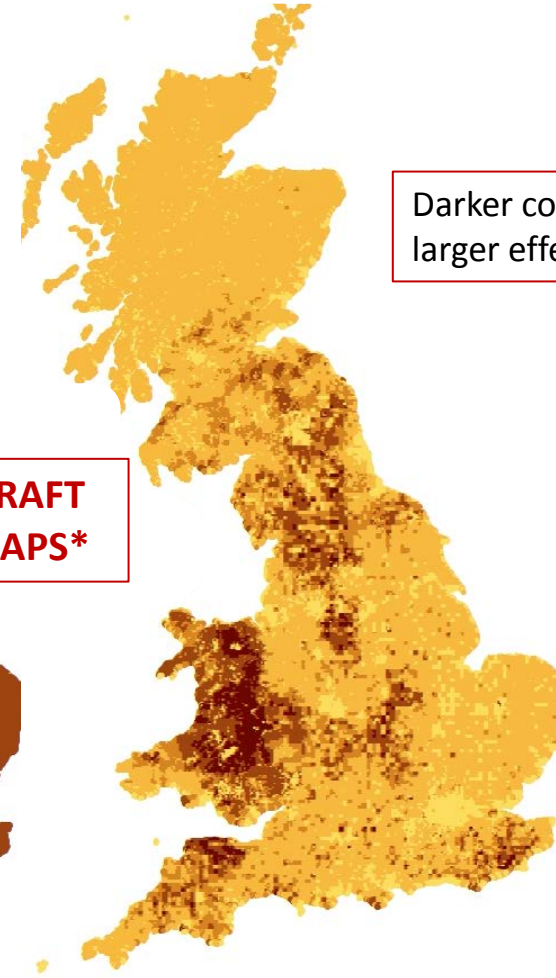
From 2007 to 2020

- ❑ In the UK the effects are largest where the ozone increase is moderate but there are many lambs
- ❑ Total liveweight gain of lambs per day is predicted to be **decreased by 4%** in 2020 compared to 2007
- ❑ Economic valuation being finalised

Decrease in pasture quality



Liveweight gain per square



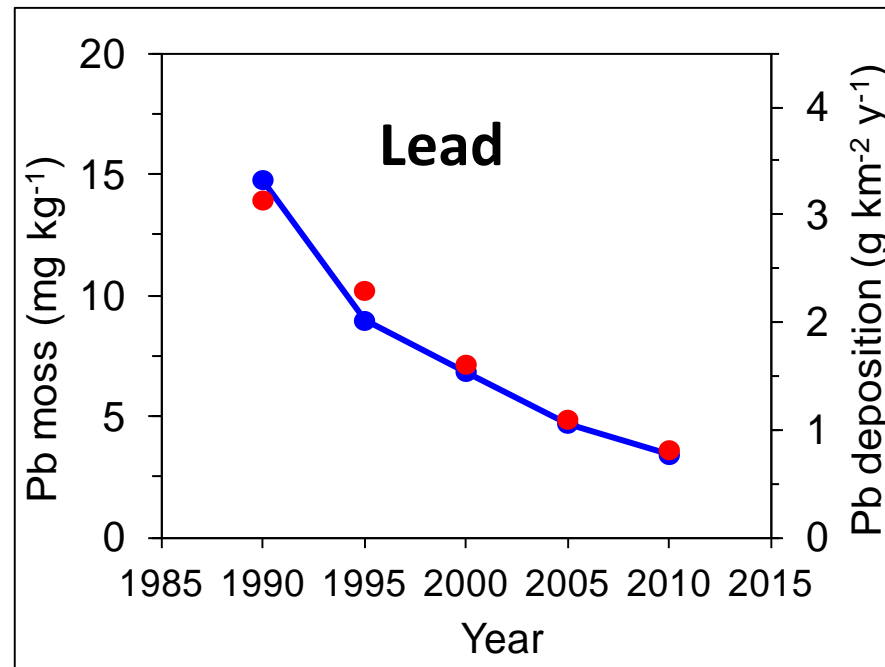
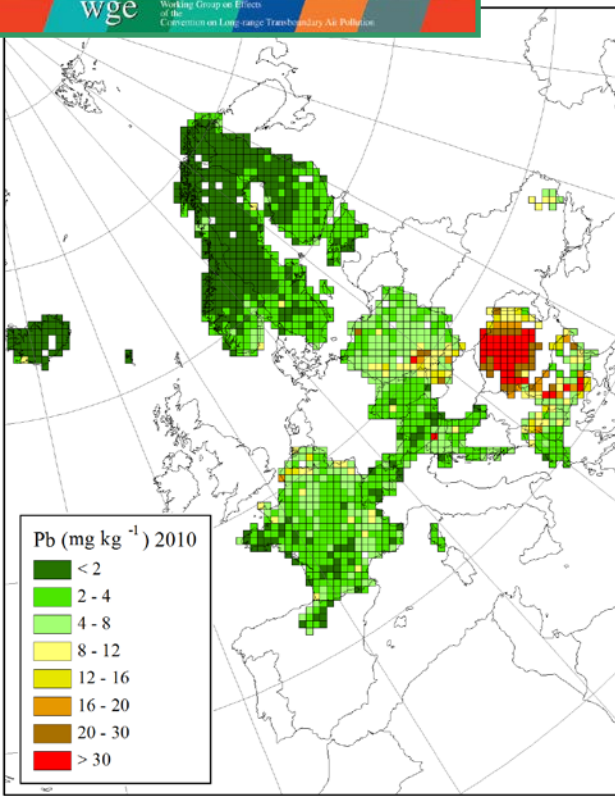
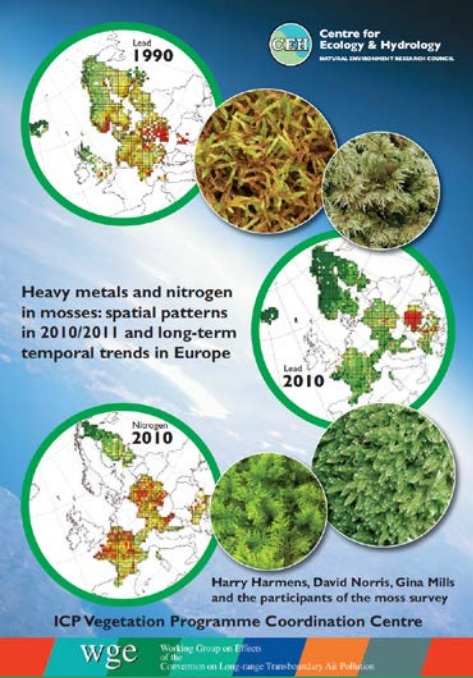
Darker colour =
larger effect

**DRAFT
MAPS***

* To be corrected for pasture location

European moss survey

- ❑ Conducted every 5 year since 1990
 - ❑ Heavy metals, nitrogen since 2005, POPs since 2010
 - ❑ Coordination by ICP Vegetation: since 2000
 - ❑ Indication of spatial patterns and temporal trends of deposition
- atmospheric pollutants to vegetation

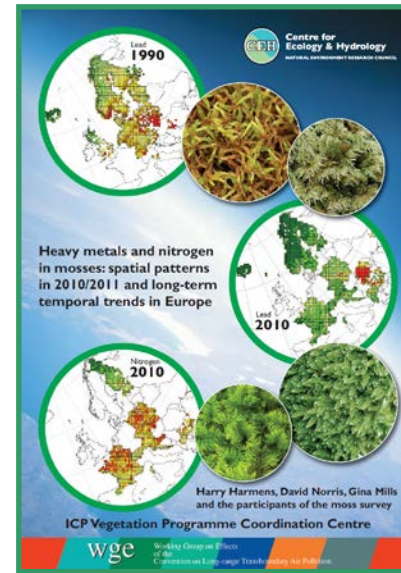


Summary: Modelling ozone

Comparing GP2005 and GP2030CLE for ozone

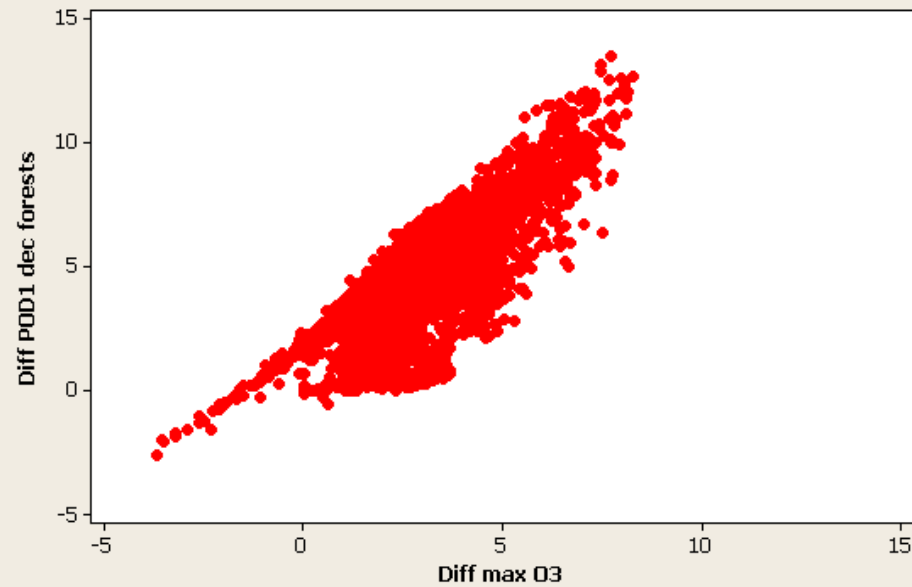
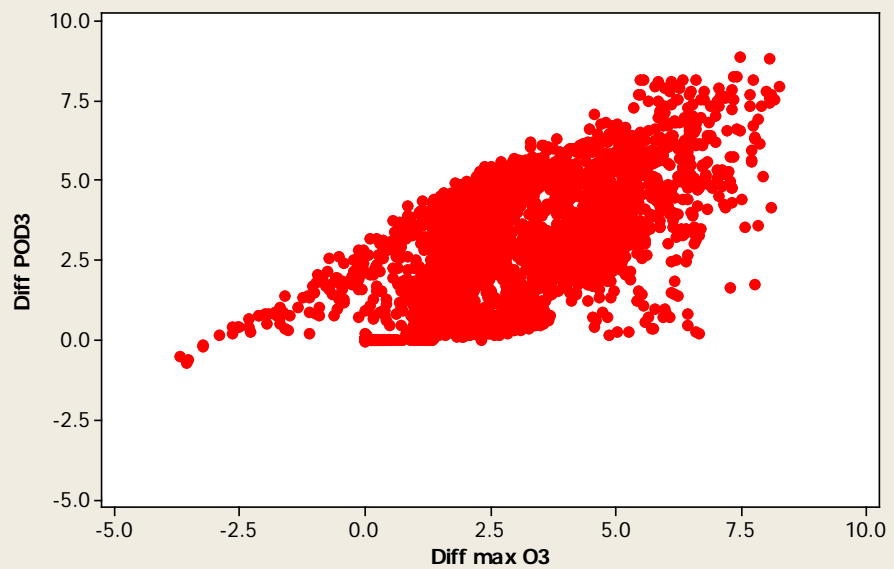
- ❑ Mean 6% decrease in surface maximum ozone concentration
 - largest in Med. Europe, small increase in NW Europe
- ❑ POD1 for trees decreases by 15% and POD3 for crops by 21%
- ❑ Using a higher “Y” in PODY shows beneficial effects of European policy to control peak O₃
- ❑ Low Y (e.g. POD1) accumulates ozone at concentrations well below the background, therefore European controls are less apparent

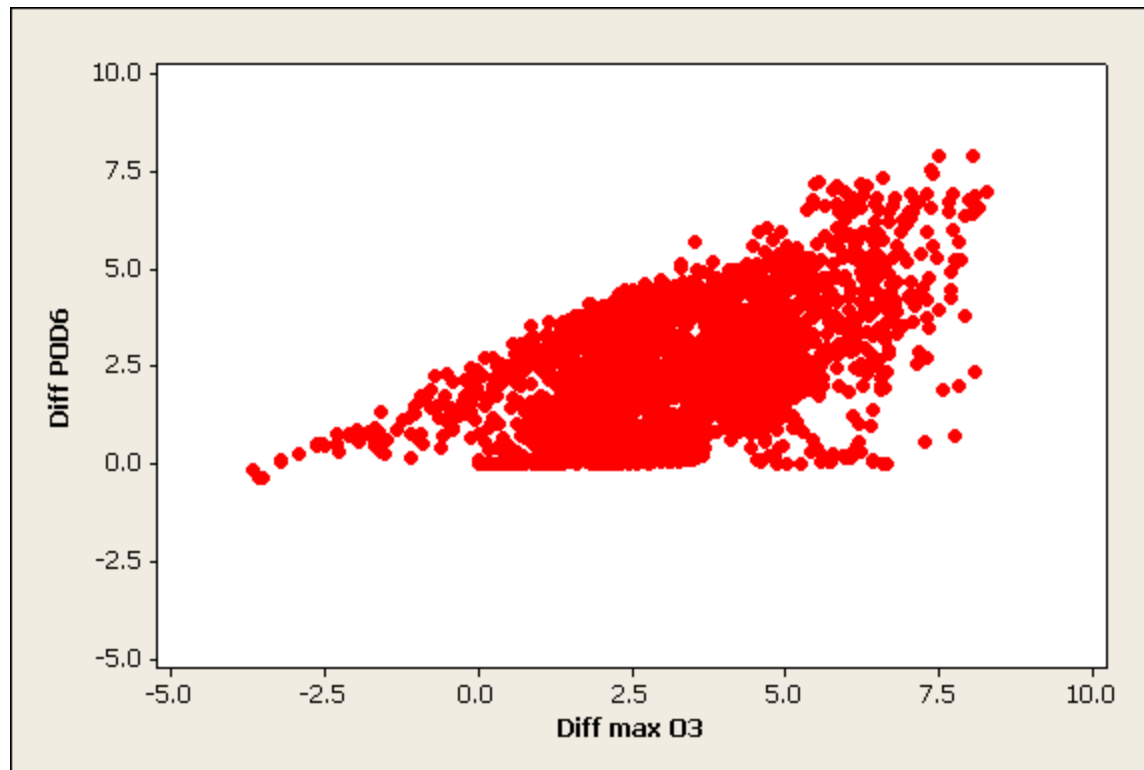
New ICP Vegetation reports



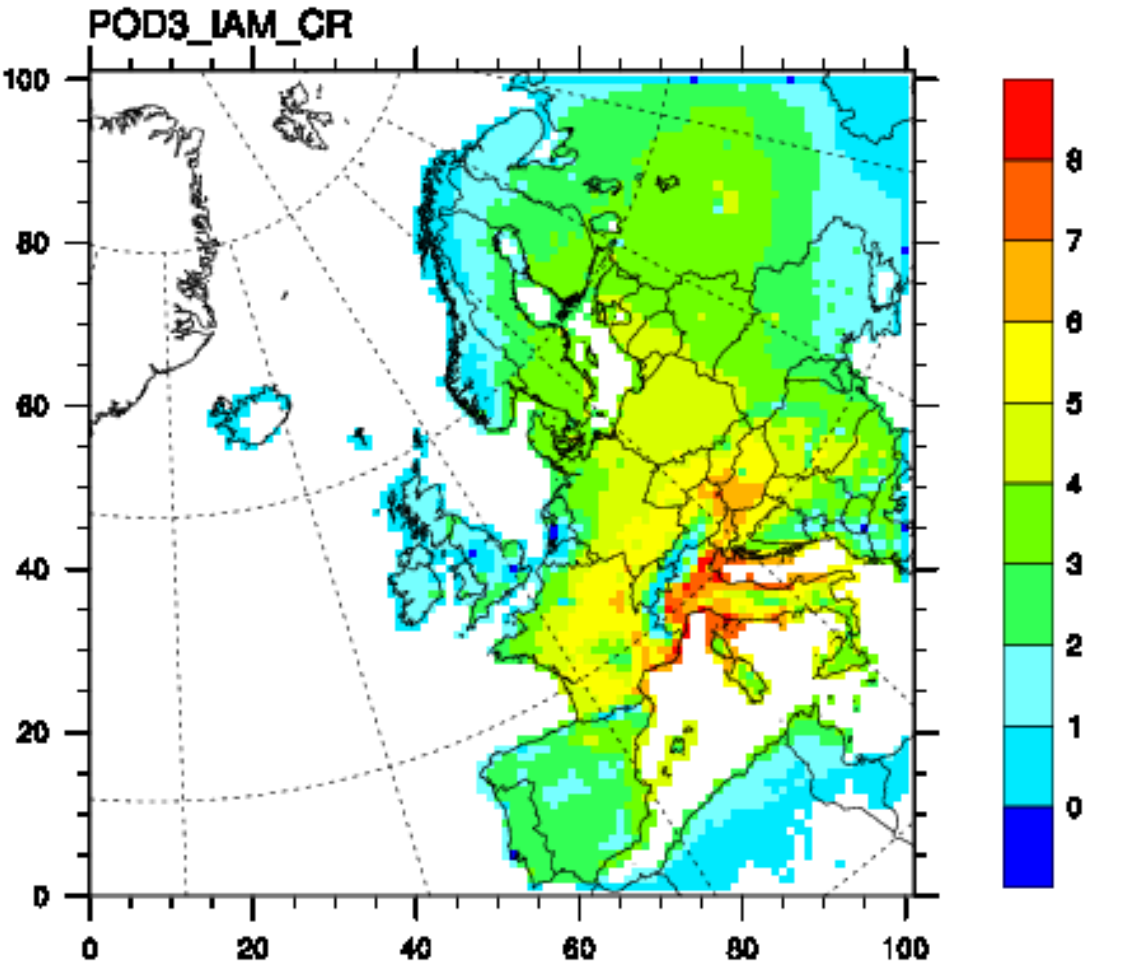
Thank you to Defra, LRTAP and NERC for funding

SPARES



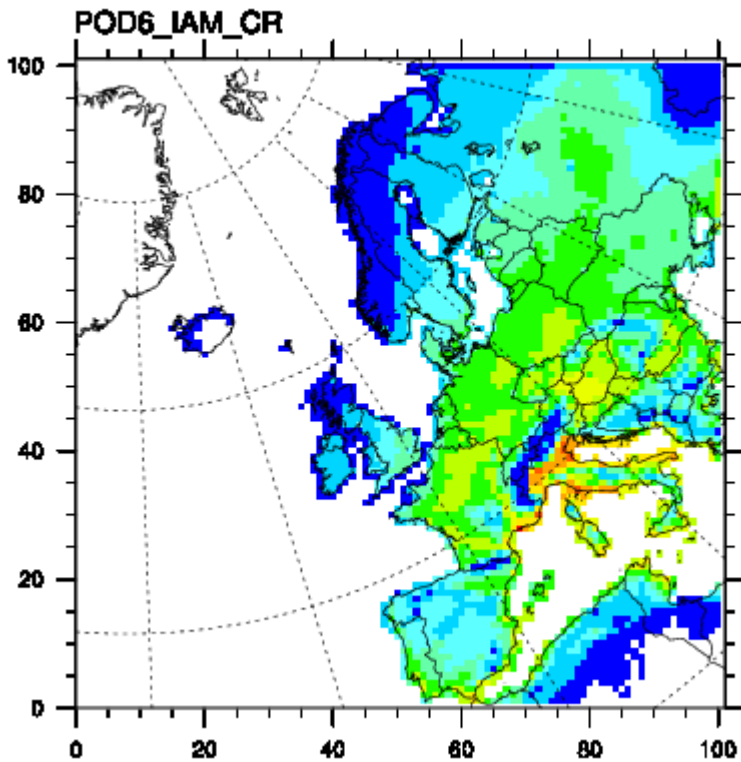


POD3 for Crops (wheat)

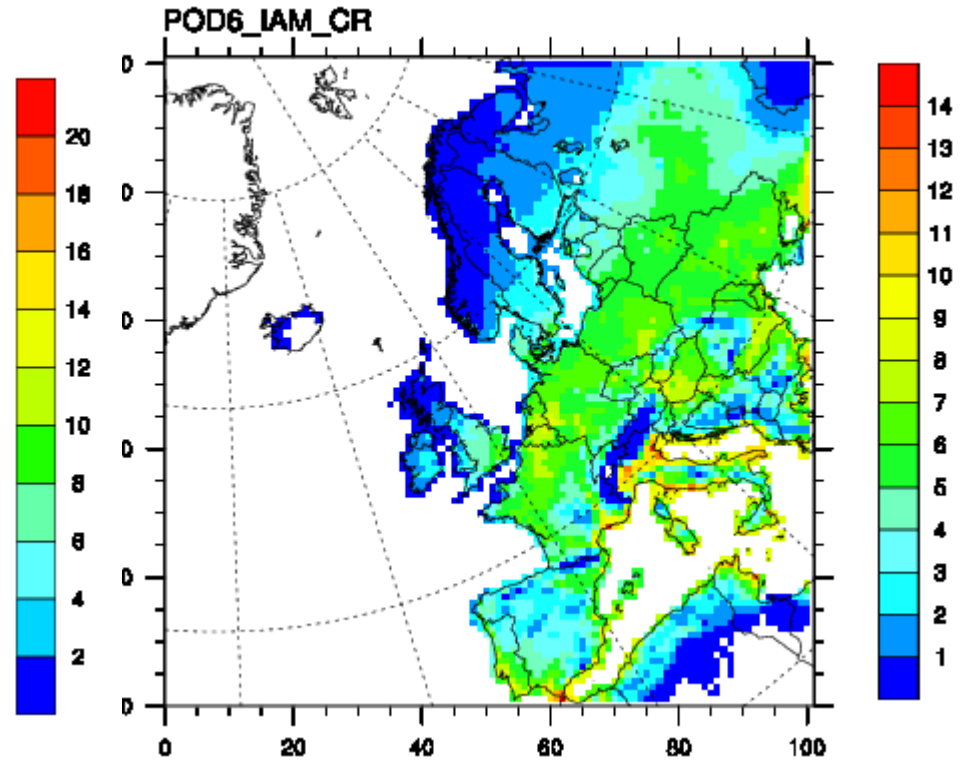


**POD3 Crops
Difference between
2005 and 2030CLE**

POD6 for crops

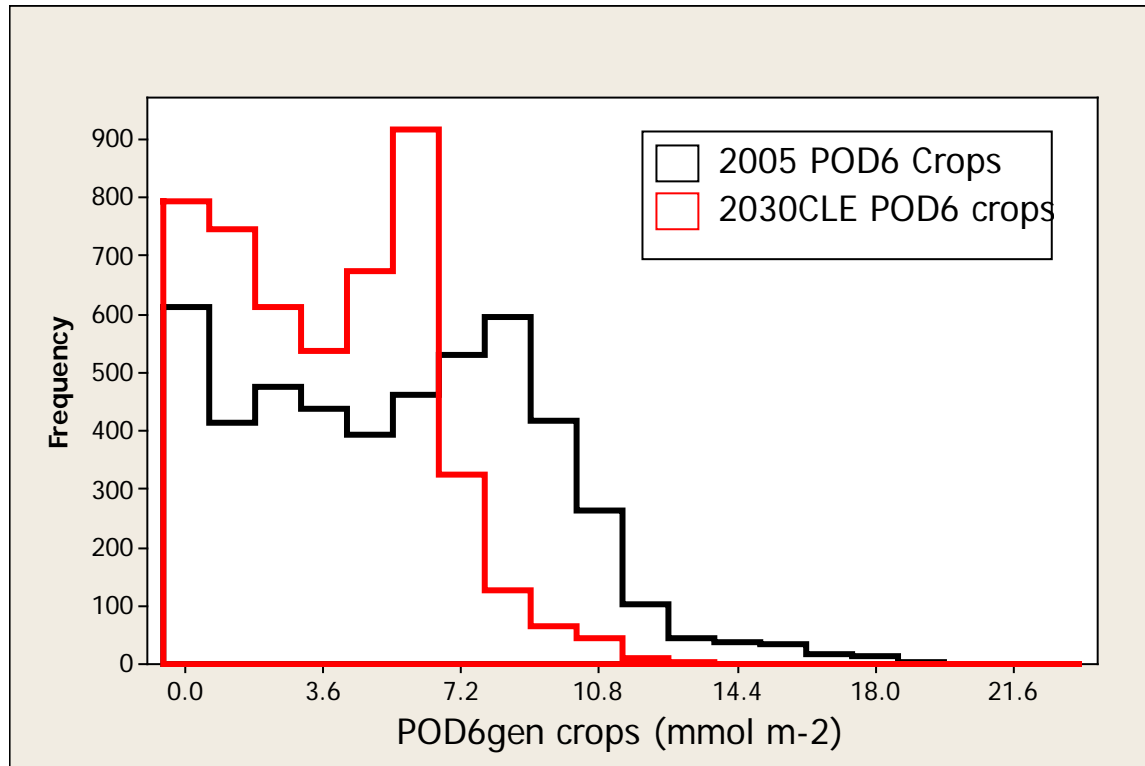


2005CLE crops POD6



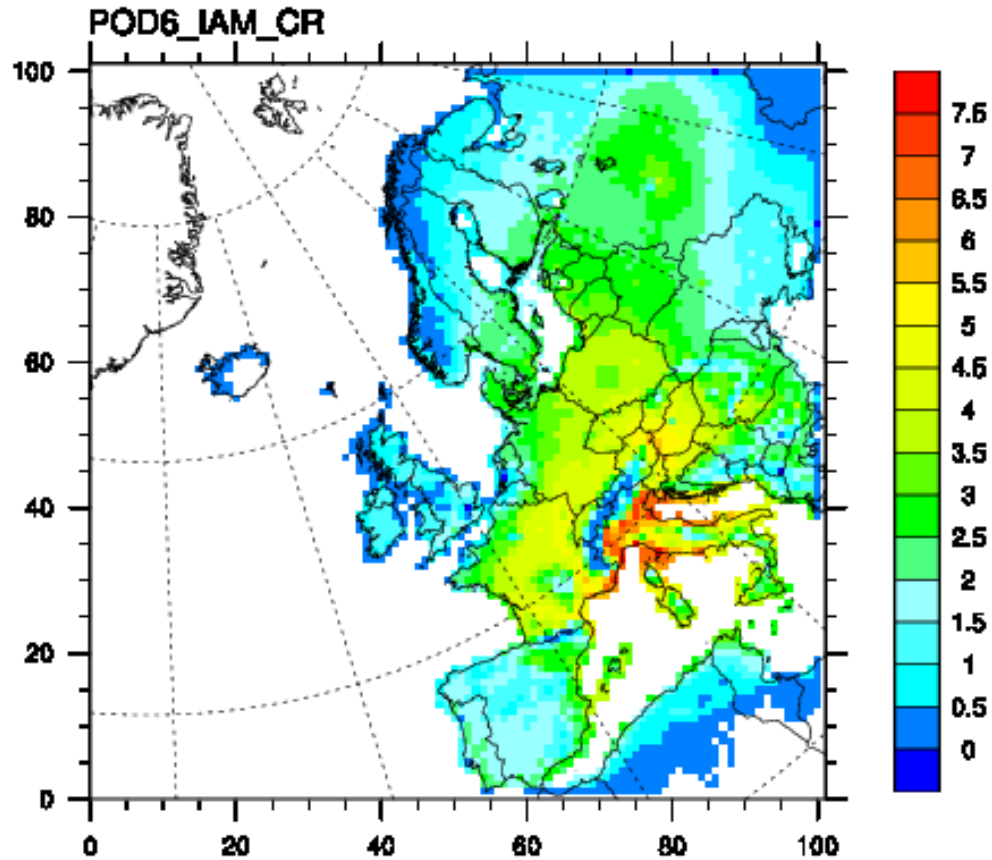
2030CLE crops POD6

POD6 for crops



	2005	2030CLE	% reduction
mean	5.6	3.6	35.7
25 th centile	2.4	1.3	45.8
75 th centile	8.3	5.7	31.3

POD6 for crops



POD6 gen Crops difference between 2005 and 2030CLE