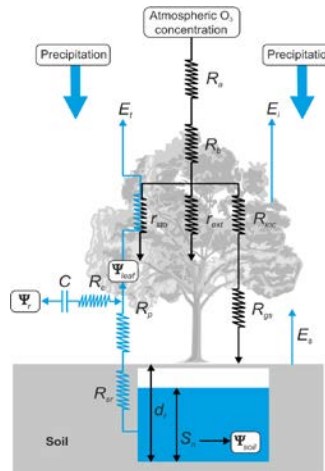


Assessing HTAP effects on Ecosystems: Ozone (and Aerosols)

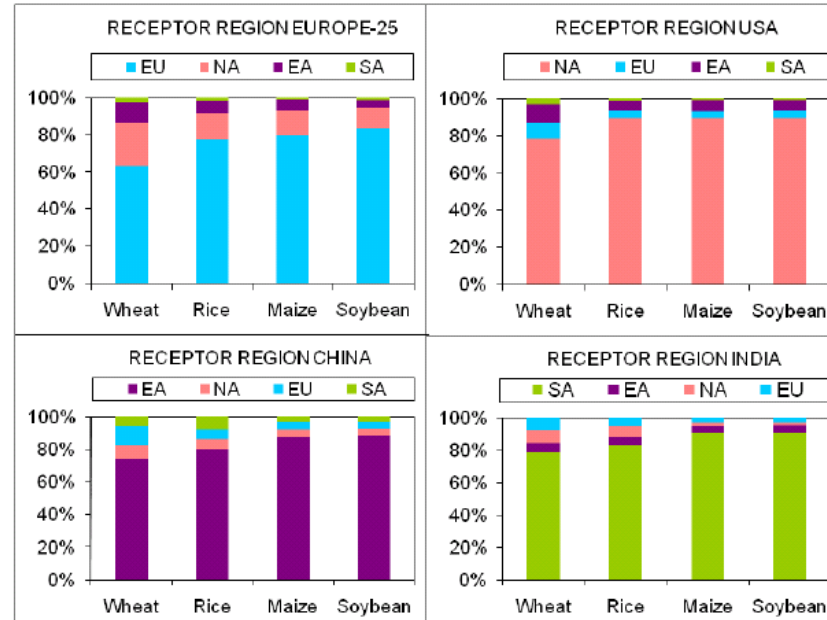


Lisa Emberson
Stockholm Environment Institute,
Environment Department
University of York, UK

Presented by Frank Dentener at HTAP meeting in San Francisco- 2013

Conclusions from 2010 Assessment

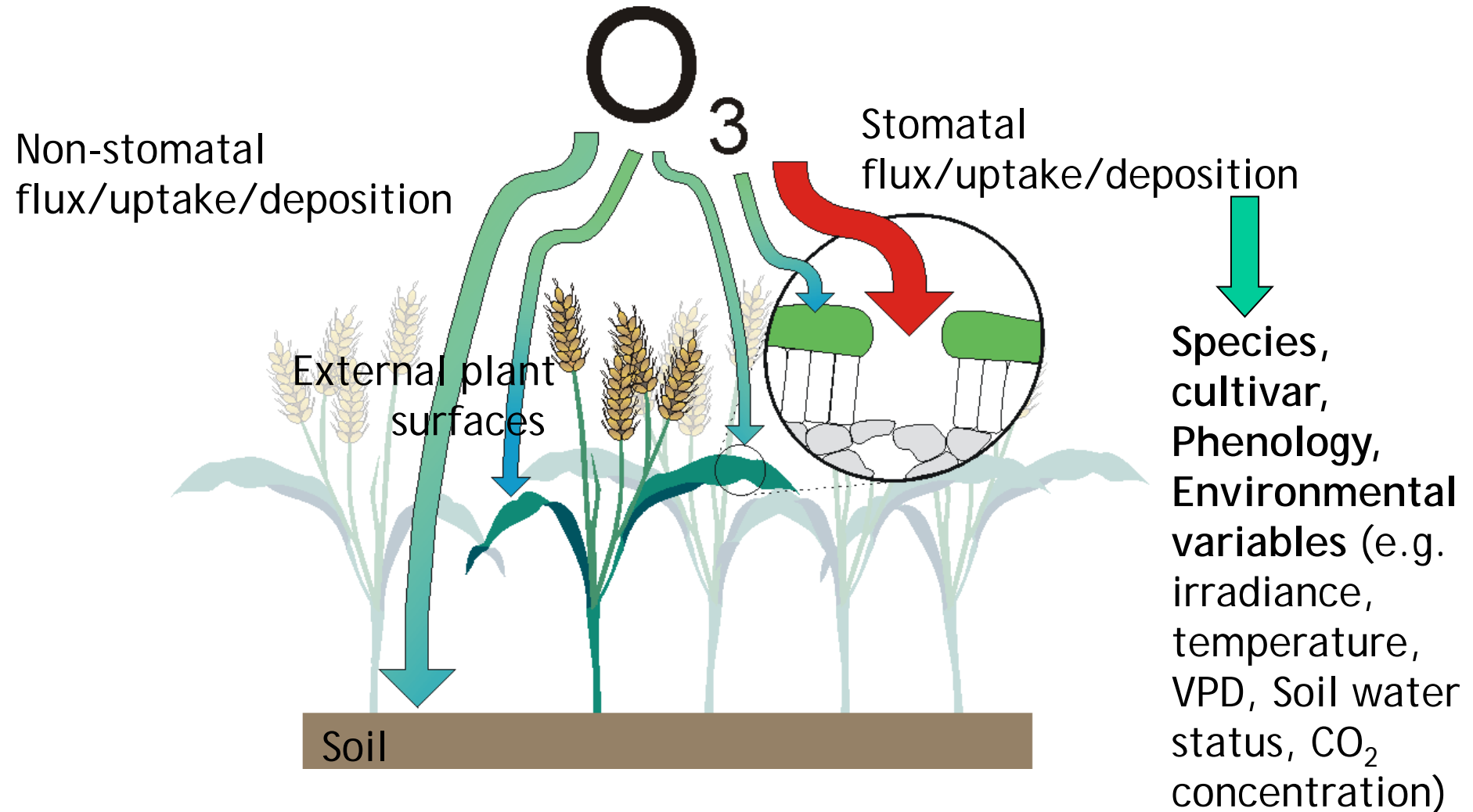
Showed fairly substantial effect of HTAP on crop yields...causing between 5 to 35 % of the O₃ induced crop yield loss.



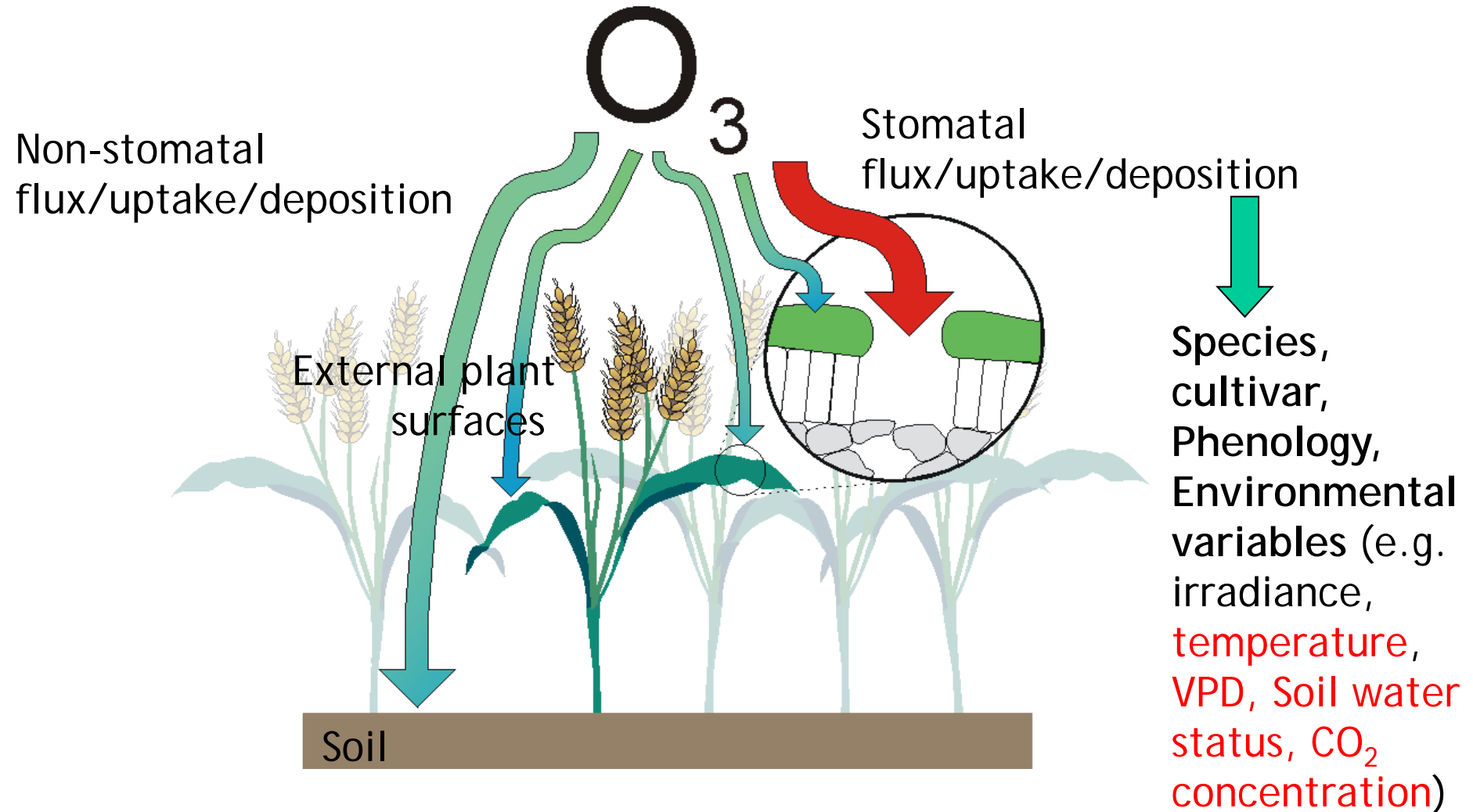
BUT.... By necessity, assessment used Concentration based indices....

....for 2015 we have the possibility to perform stomatal ozone flux based ecosystem assessments in line with adopted LRTAP methods

What do we mean by flux/dry deposition?

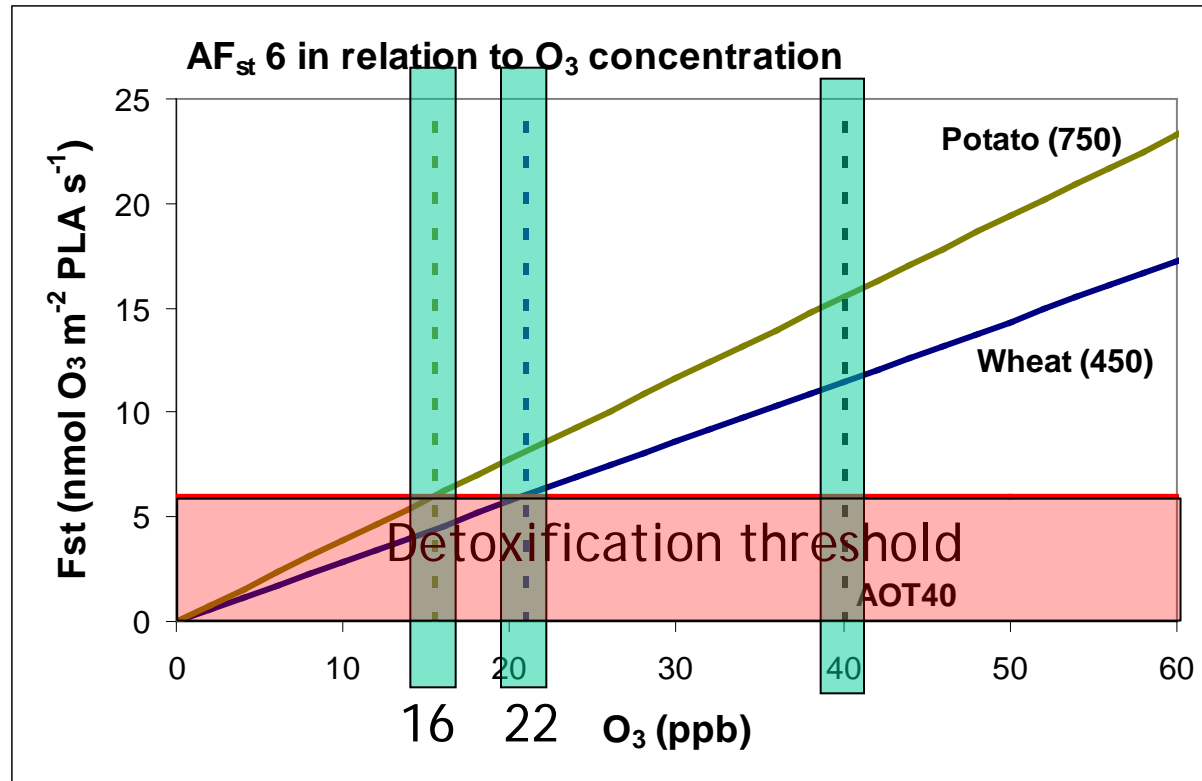


What do we mean by flux/dry deposition?



Why flux is less sensitive to O₃ peaks And better for HTAP damage estimates ???

Assuming g_{\max} and $r_b = 50 \text{ s/m}$



AOT40 - only able to incorporate effect of rising global background concentration above 40ppb

AFstY - able to differentiate species sensitivity to rising background concentration

What tools exist to estimate flux and response ?

DO₃SE: Ozone dry deposition and stomatal O₃ flux model

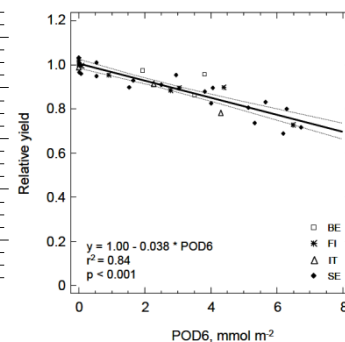
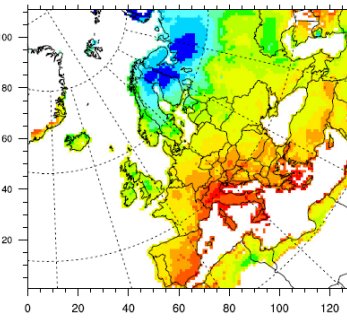
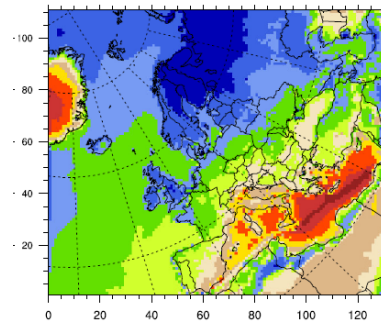
$$F_{O_3} = Vg * [O_3]$$



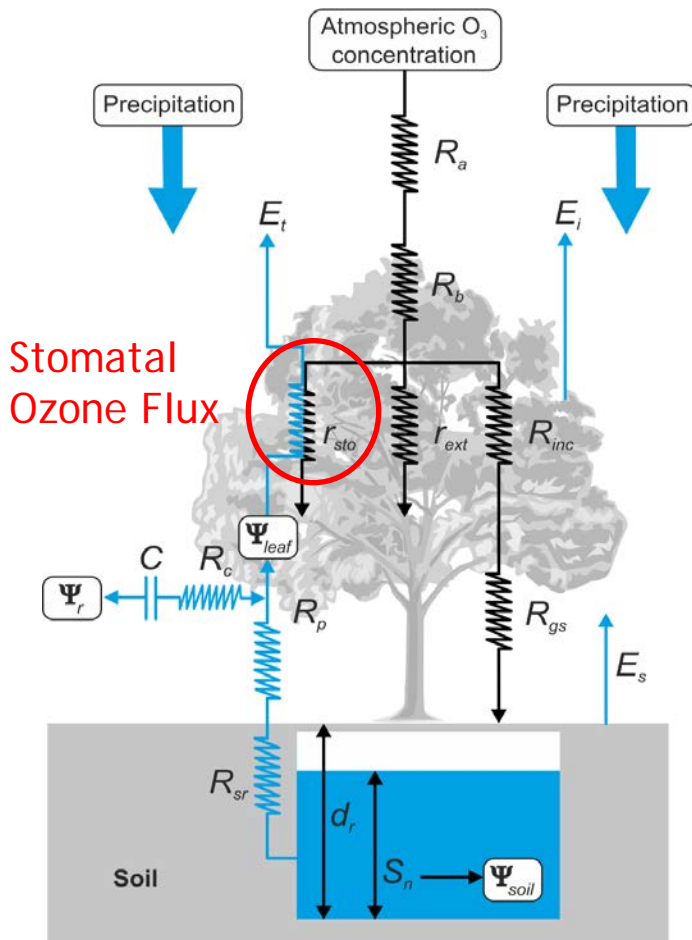
Human health

Ecosystems

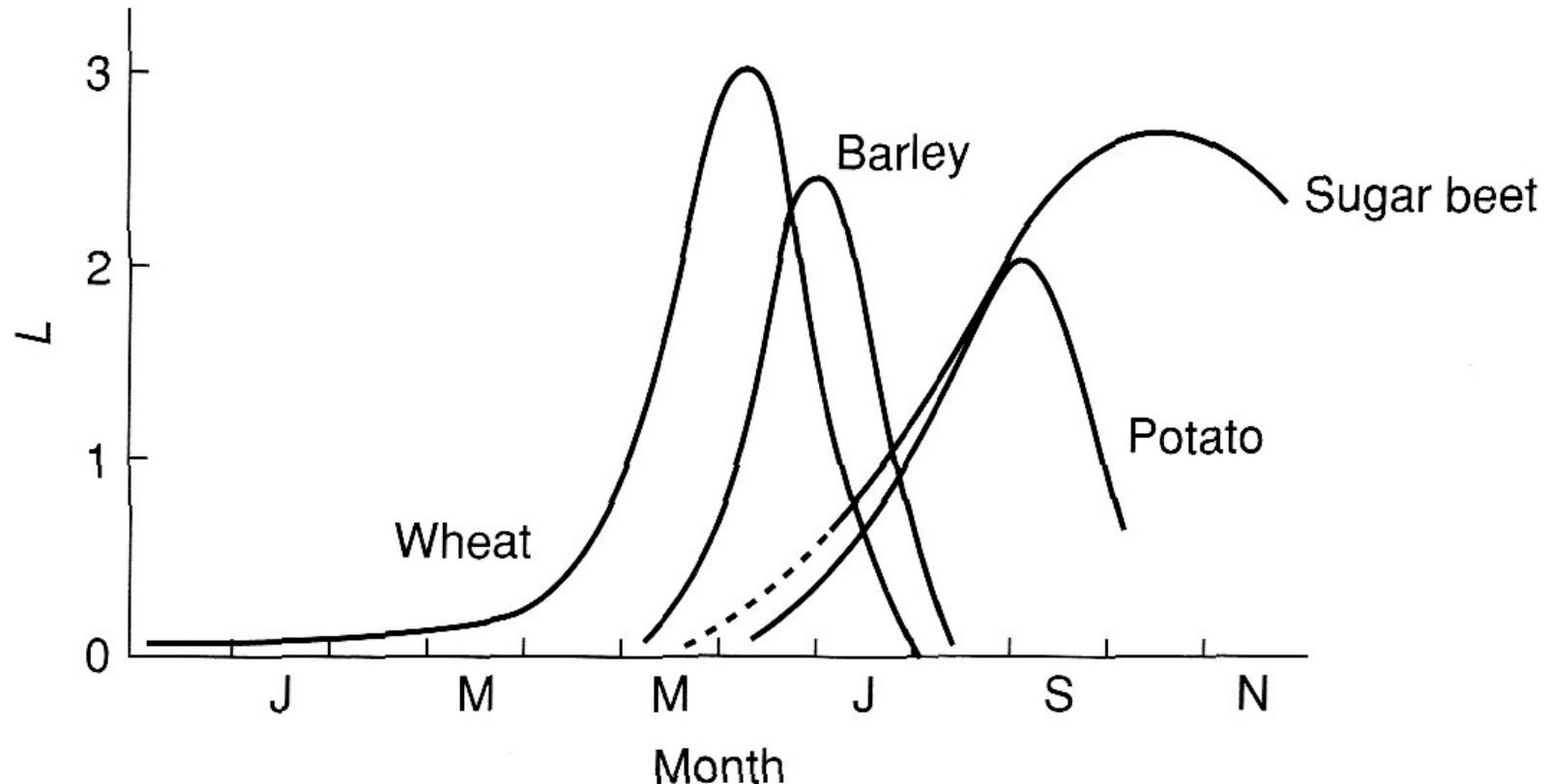
Flux-R relationships



Derived from experimental fumigation studies using the DO₃SE stomatal algorithm



Variation in the length of crop growing seasons in the UK
Perhaps need to consider the early and late crops that might be more susceptible to HTAP



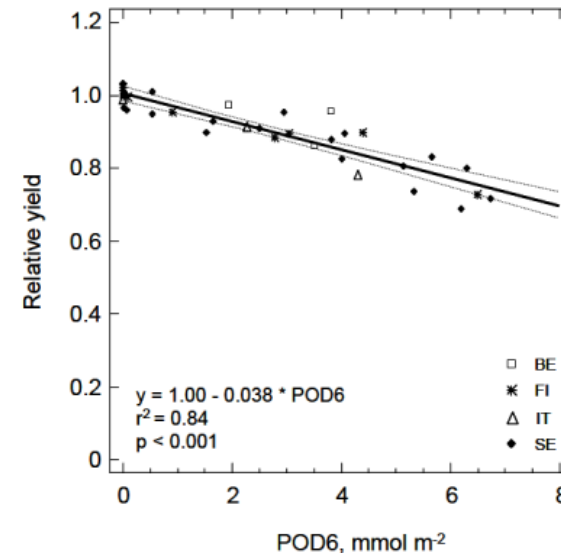
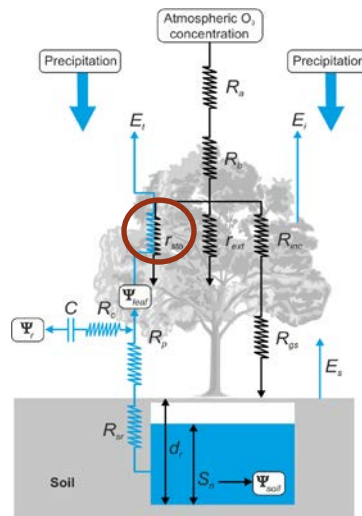
Forests and grasslands
Extending to higher
elevations

Watson, (1947)

How can the flux based method be applied ?

The bad news is that these CTMs embedded dry deposition schemes use different methods....

....and only one of these scheme, the DO₃SE model, relates stomatal deposition directly to ecosystem effects....



What can be done within HTAP ?

- to improve estimates of O_3 dry deposition and estimate stomatal O_3 flux for ecosystem effects

1. Literature review of O_3 dry deposition methods identify those most commonly used within global scale CTMs
2. Identification of the key differences in these dry deposition schemes
3. Identification of the key differences in the parameterization (for different land cover types)
4. Off-line assessment of the implications of differences in O_3 dry deposition schemes...comparison with observations from site-specific flux data

What can be done within HTAP ?

-to improve estimates of O_3 dry deposition and estimate stomatal O_3 flux for ecosystem effects

1. On-line assessment of the effect O_3 dry deposition schemes on hemispheric transport of O_3 ; regional O_3 concentrations and regional O_3 induced ecosystem damage.

Global modeling could show spatial fields of

- i. stomatal O_3 flux;
- ii. total O_3 deposition;
- iii. Effect on atmospheric O_3 concentration

2. HTAP modeling experiments

- i. investigate S-R relationship for stomatal O_3 flux;
- ii. alter key climate relevant characteristics (i.e. simulate an extended drought period, elevated CO_2 effects on stomatal conductance, changes in surface ToC and RH% etc...) on resulting stomatal O_3 flux to indicate how ecosystem risk might change under future climates.
- iii. Investigate the role of landcover on O_3 deposition and stomatal O_3 flux

Variables requested to estimate O₃ fluxes into stomata:

- Growing season start and end date
- Leaf Area Index
- Soil moisture
- Dry deposition of O₃
- Dry deposition of O₃ into stomata
- Hourly ozone at 3 height levels
- Lancaster information (see next slide)- annual.

Iterated with Lisa Emberson/O. Wild:

Are we asking enough; does this work?

Variables requested to estimate O3 fluxes into stomata- Landcover information

Broadleaf Forest		
Needleleaf Forest		
Crops and Pasture	Crops and Pasture C3	Crops and Pasture C4
Savanna	Savanna C3	Savanna C4
Grasslands/Steppes	Grasslands/Steppes C3	Grasslands/Steppes C4
Shrub-Tundra		
Bare Soils		
Water		
Other		

'Ozone and Plants' to be held in China in May 18-21, 2014

(<http://www.bj-ozone.com/index.html>).

HTAP session questions:

What are the most important atmospheric pollutants and related processes, impacting natural vegetation and crops in Asia?

(i.e. Ndep; acidification; ozone; and diffusive radiation change, etc)

What are the vegetation types most sensitive to atmospheric pollution- and what qualitative and quantitative information is available on impacts?

What are impacts of climate on vegetation and vegetation on climate in Asia?

What methods are used to assess the impacts of atmospheric pollutants in Asia coming from local regional and global scales?

What experience is there from the extrapolation of methods developed in Europe and North America to tropical, subtropical and temperate regions in Asia?

'Ozone and Plants' to be held in China in May 18-21 2014 (II)
(<http://www.bj-ozone.com/index.html>).

HTAP session questions:

What type of impact assessment could be performed with the model simulations coming available from HTAP and MICS- on global and regional scales?

Which research groups, organisations would engage in joint analysis of HTAP/MICS model outputs on impacts on vegetation?