Impatti dell'inquinamento atmosferico sugli ecosistemi vegetali

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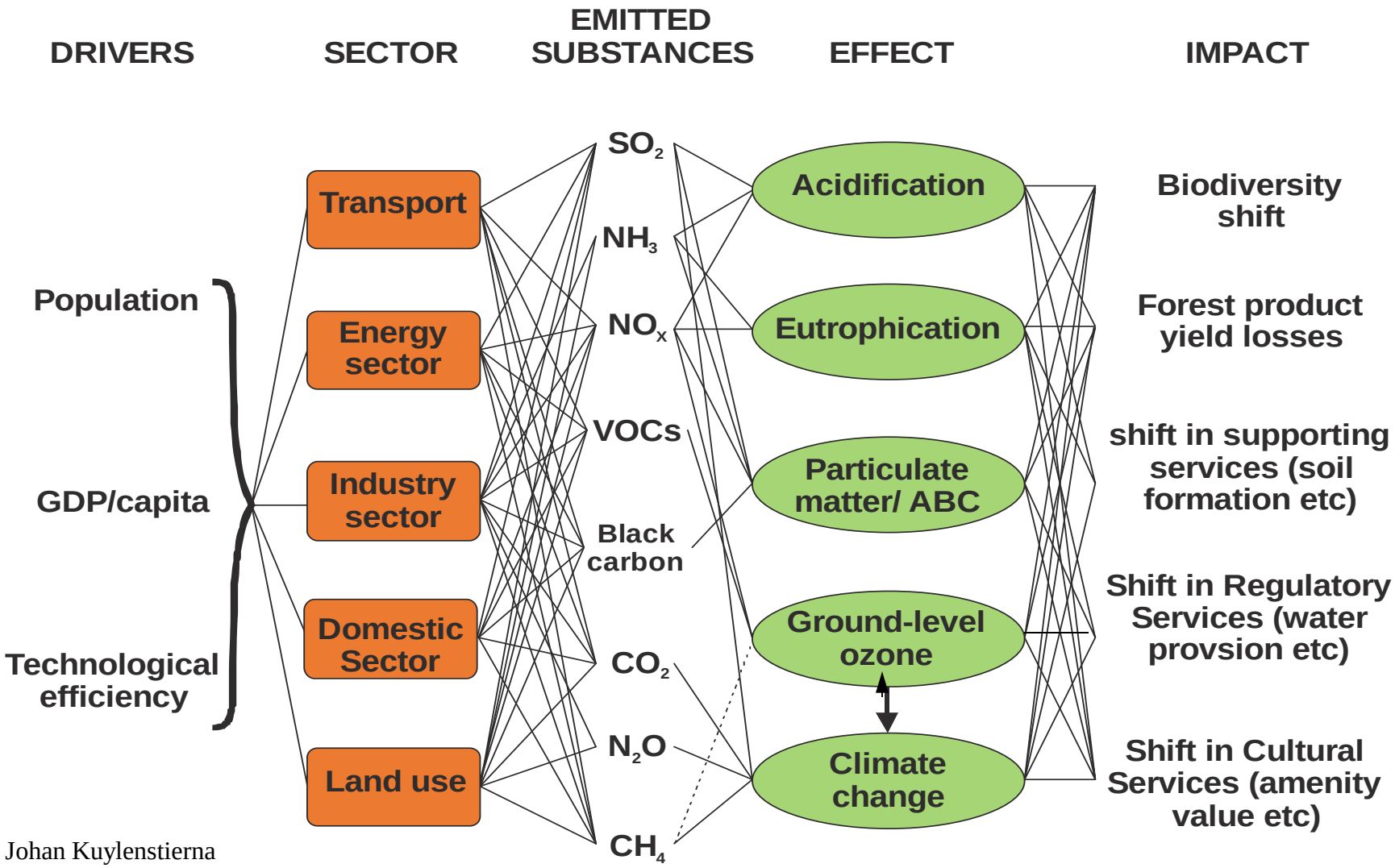
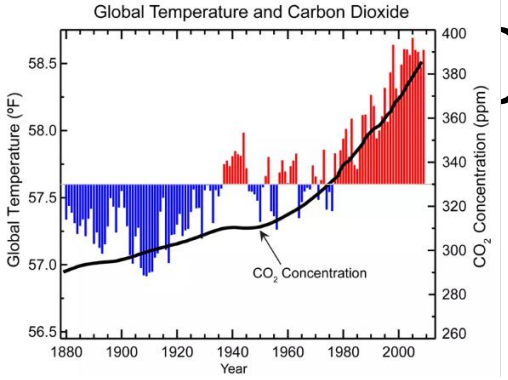
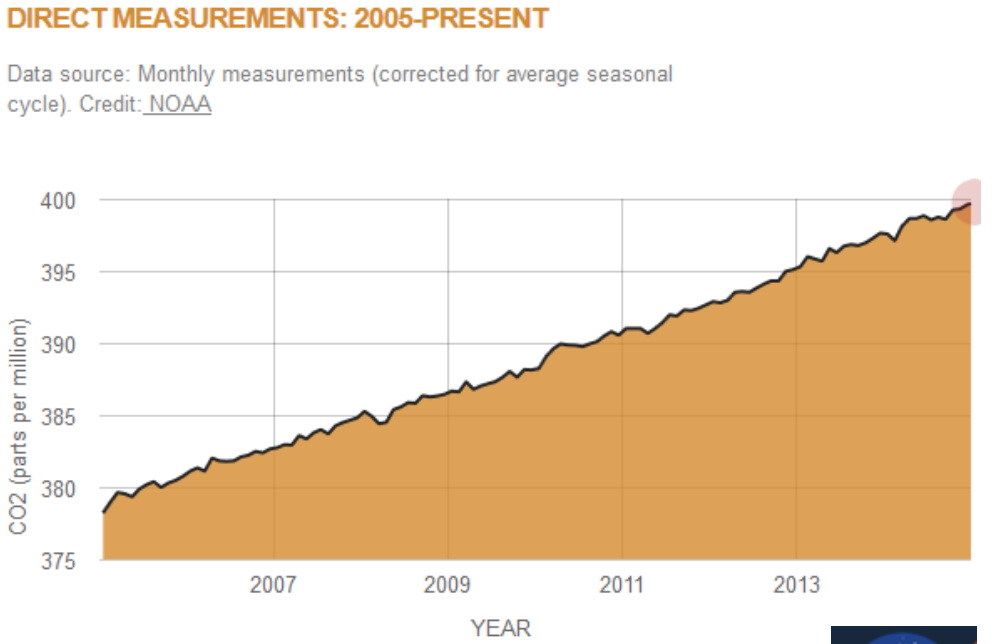
Interrelationships everywhere



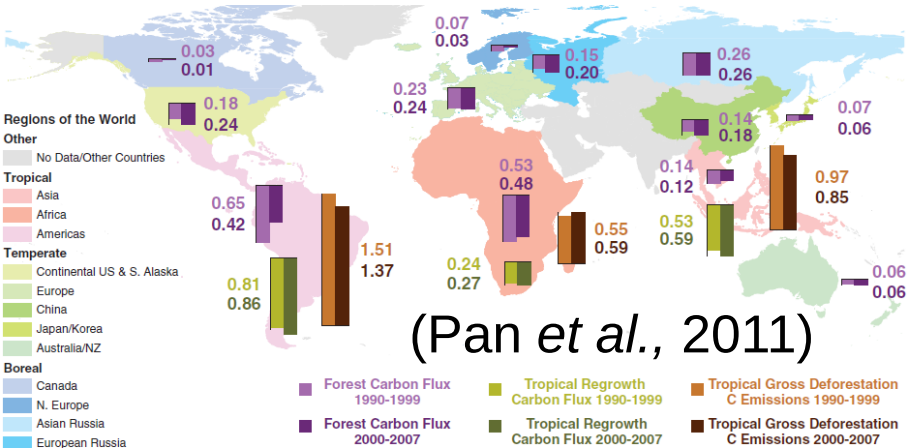
By Johan Kuylenstierna

CO_2

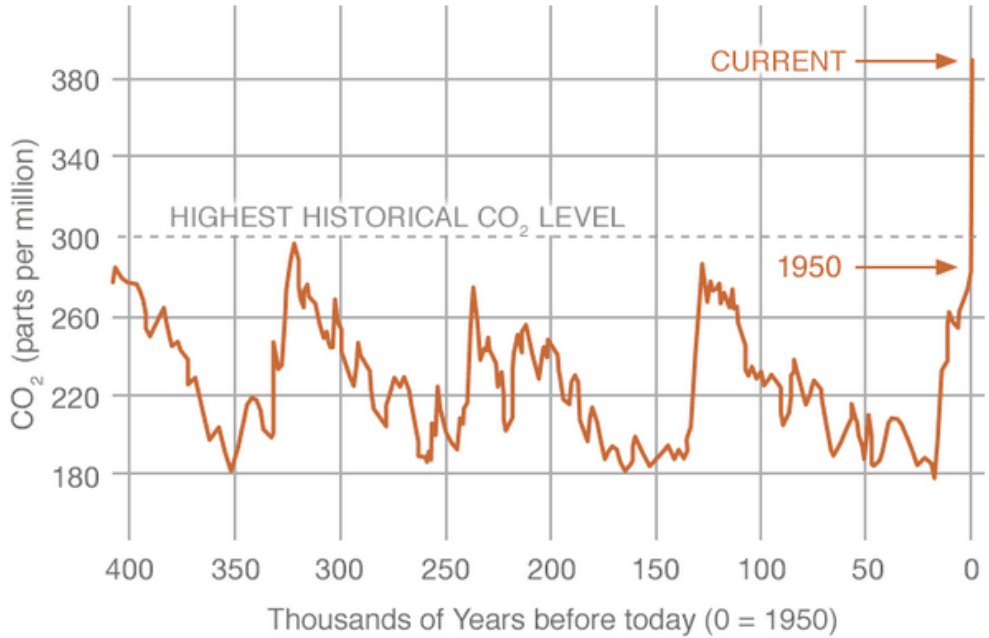




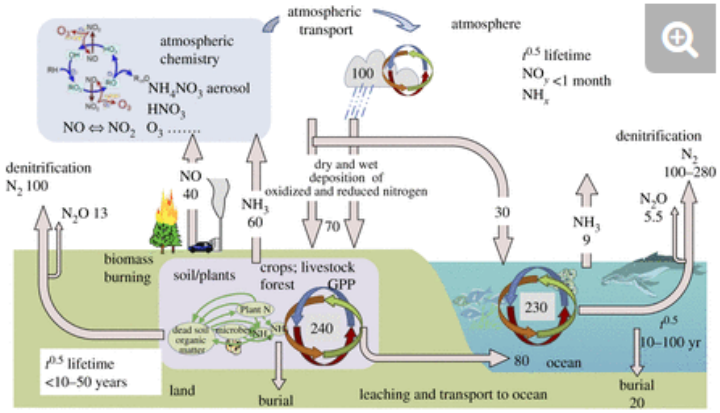
- Concentrations have reached 400 ppm in 2014
- Contribution to present-day total greenhouse effect is estimated in ~20% (Schmidt et al., 2010)
- CO2 is a basic nutrient required for plant growth



(Pan *et al.*, 2011)



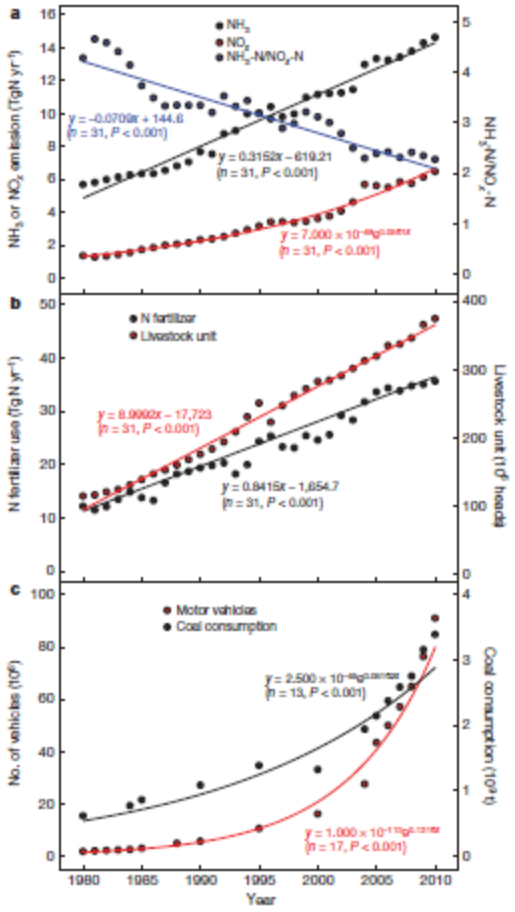
Reactive Nitrogen

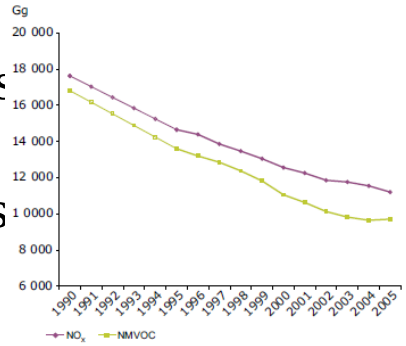


(Fowler *et al.*, 2013)

- N in the atmosphere has increased globally since the 1940s as a result of anthropogenic activities
- Nitrogen is a basic nutrient required for growth, and most natural plant systems are N-limited
- Increased N deposition in the last 70 years has caused negative effects e.g. eutrophication and acidification as well as positive effects e.g. increasing forest growth
- Due to successful control measures, N emissions have declined by 25% since 1990 in Europe while N deposition has increased by 60% by 1980 in China

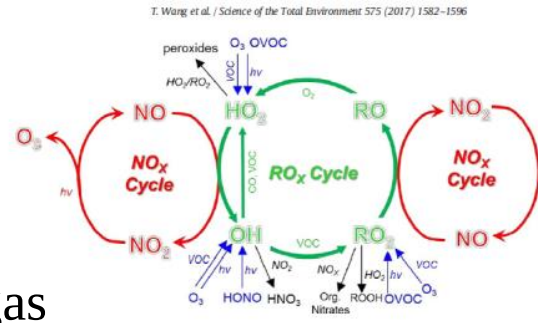
Emission of NOx and NH3 in China since 1980 and main sources (Liu et al. 2013)

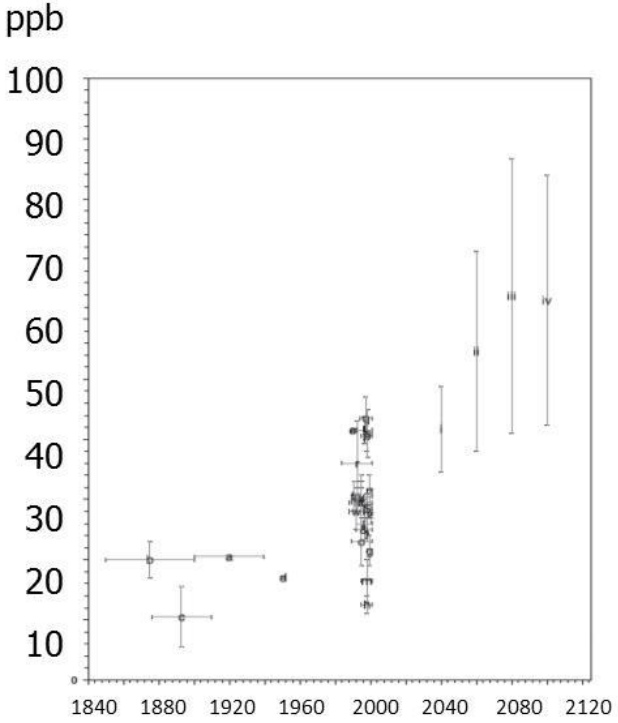




Emission of NOx and NMVOC in Europe since 1990 (EMEP 2008)

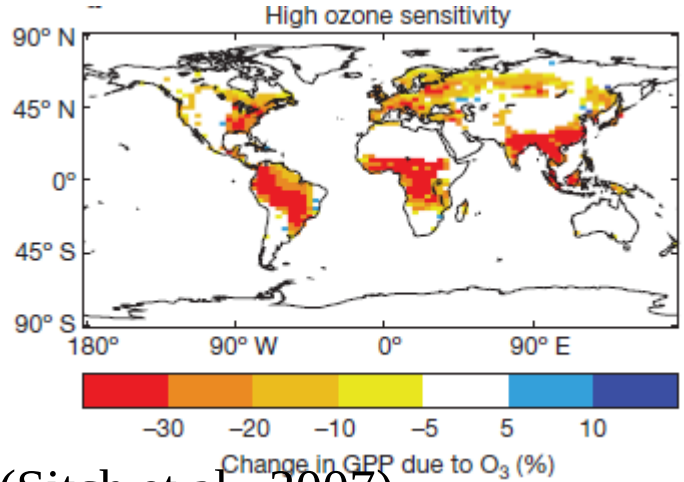
Surface ozone



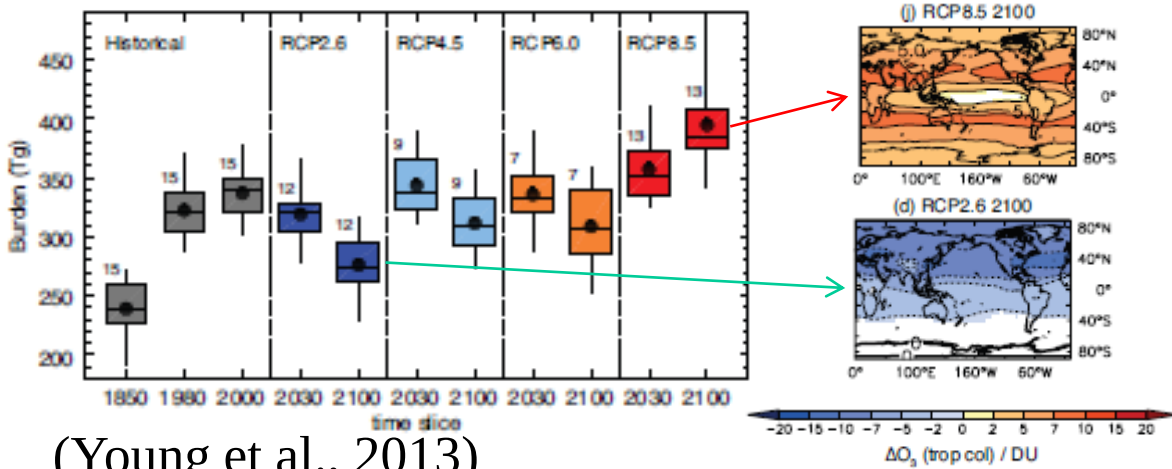


- Powerful phytotoxic gas
- Doubled since the pre-industrial age
- Current rise 0.5-2% a year
- Uncertainty in future scenarios depends on efficiency of control measures over precursors

(Paoletti, 2007)



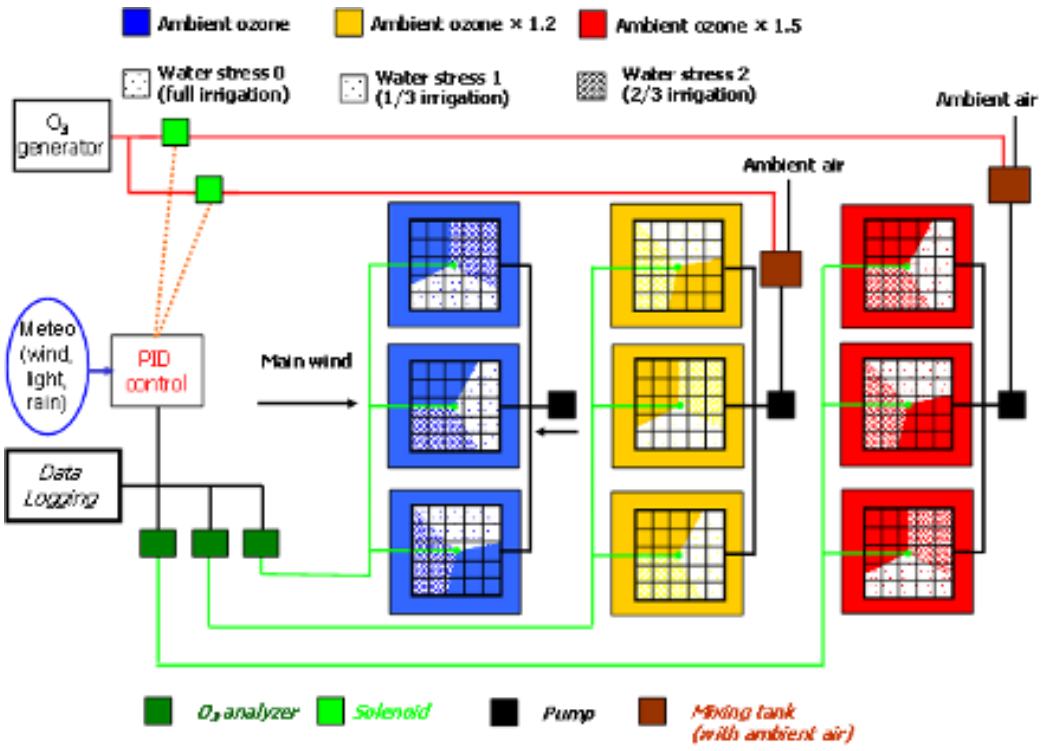
(Sitch et al., 2007)



(Young et al., 2013)

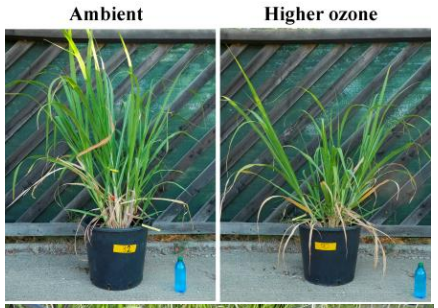
Simulating the effects of ozone on vegetation

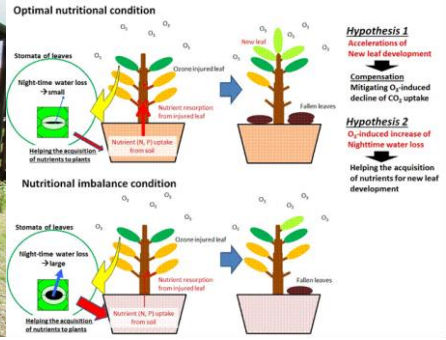
F O_3 X
F r e e-a i r O_3 e X p o s u r e



MOTTLES Life

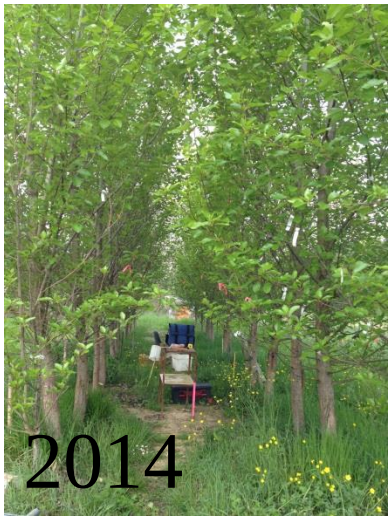
Simulating the effects of ozone on vegetation

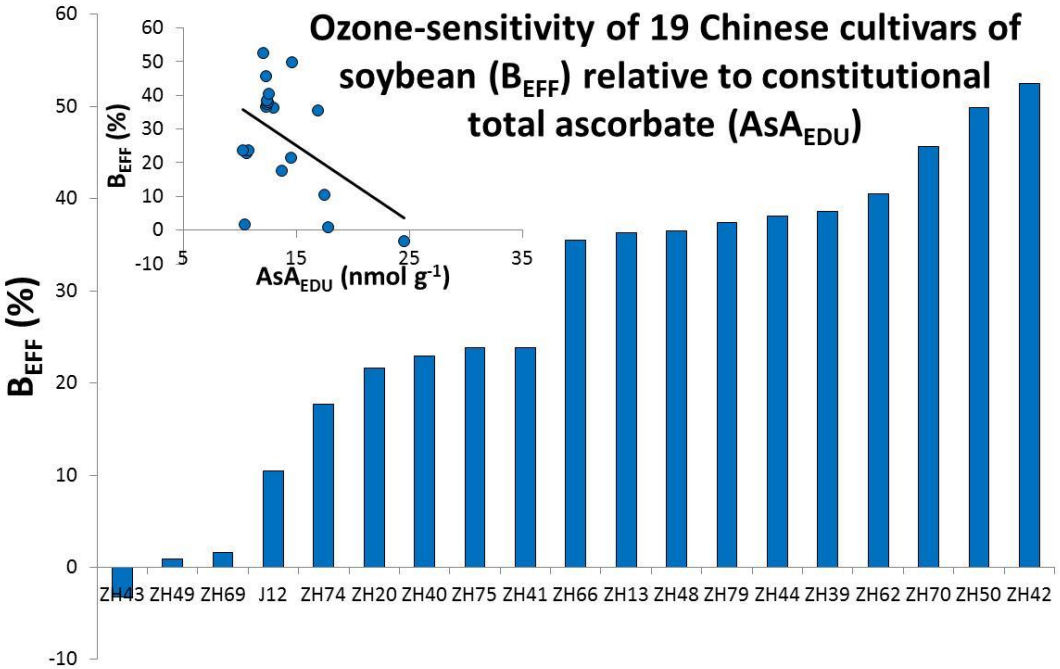


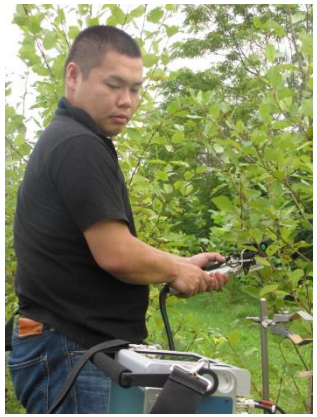


MOTTLES Life

Use of the antiozonant etylenediurea







Ozone impacts on GPP

Reduction in carbon assimilation was more related to stomatal ozone flux than to ozone concentration.

The negative effects of ozone occurred within a day of exposure/uptake

O3 concentration

Stomatal O3 flux

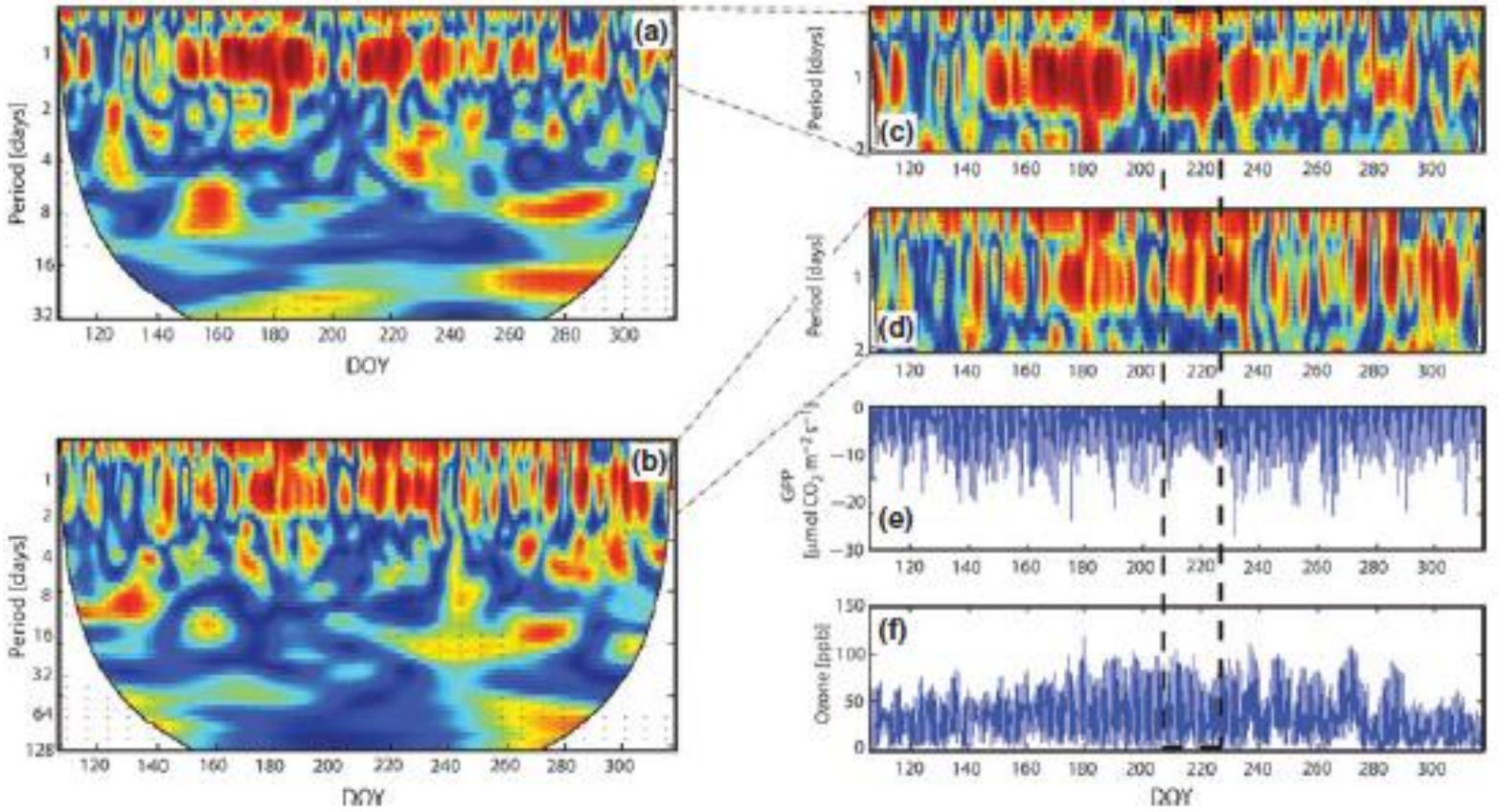
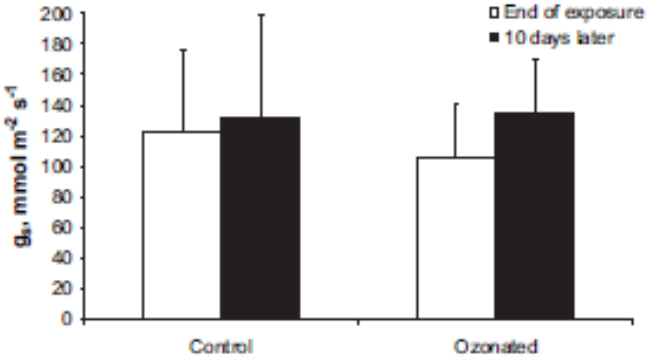


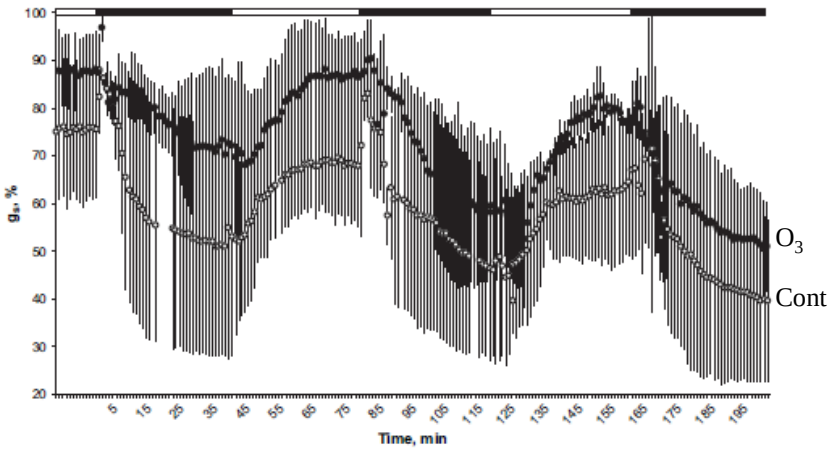
Fig. 2 Wavelet coherence analysis to look the temporal correlations between the residuals of gross primary productivity (GPP) and ozone concentration (a, c) or stomatal ozone deposition (b, d) for the Lindcove site. The colors for power values are from blue (low temporal correlations with GPP) to red (high temporal correlations with GPP). The thick black line in a and b indicates the cone of influence that delimits the region not influenced by edge effects. Black broken boxes show examples of strong correlation (denoted by red color in c, d) between low GPP values and high ozone concentrations. Days of the year (DOY), days after January 20th of year 2010.

Fares et al (2013) GCB

Ozone impacts on water loss from stomata

***Arbutus unedo*, 3-yr-old potted seedlings, 90 d, 5 h/d, 110 ppb, closed chambers**





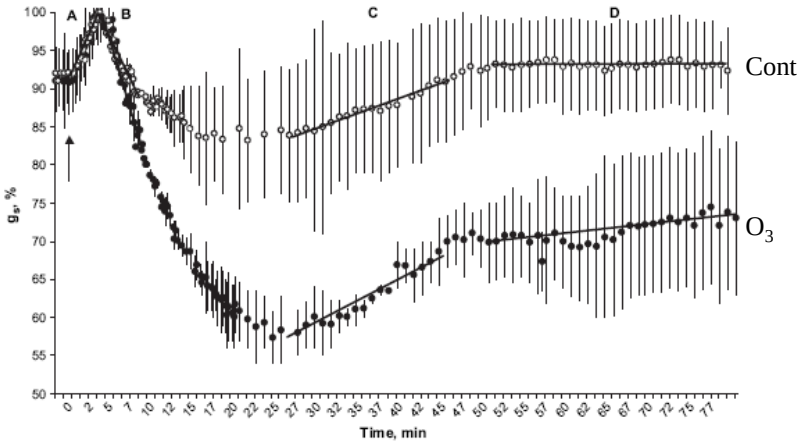
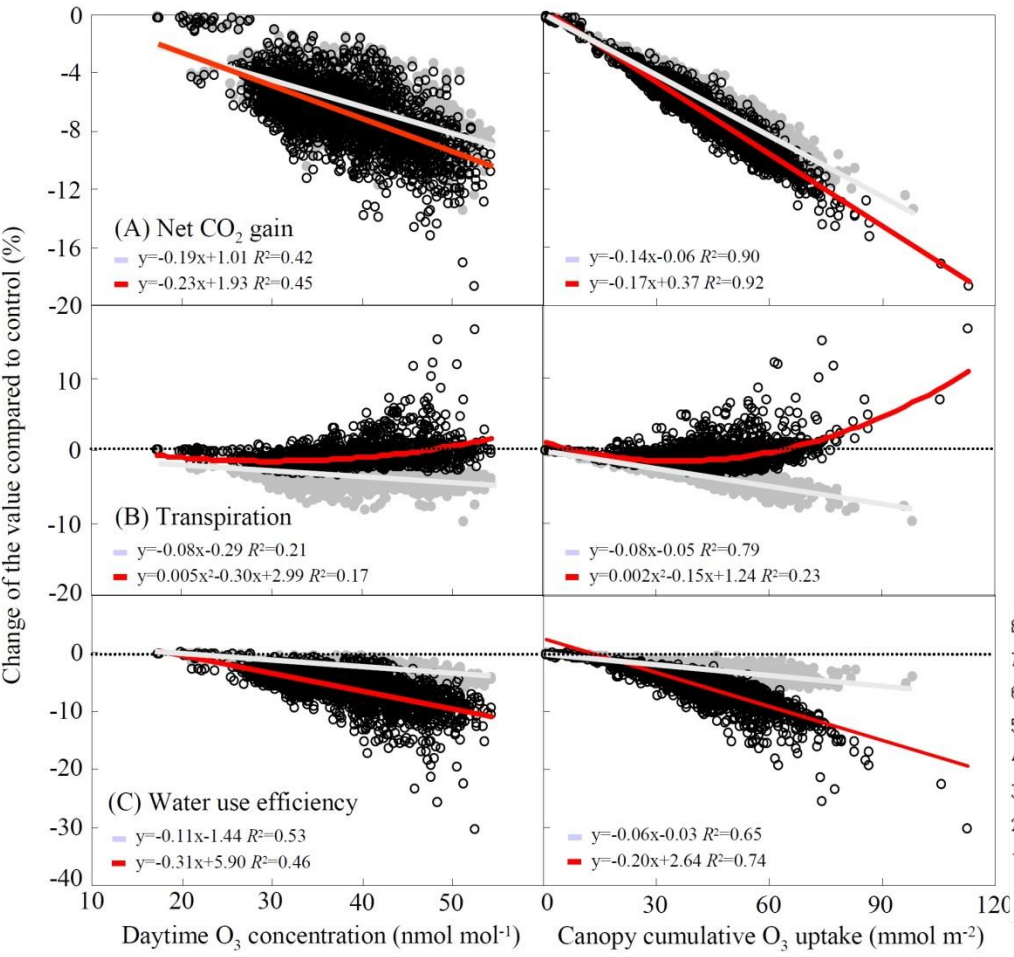


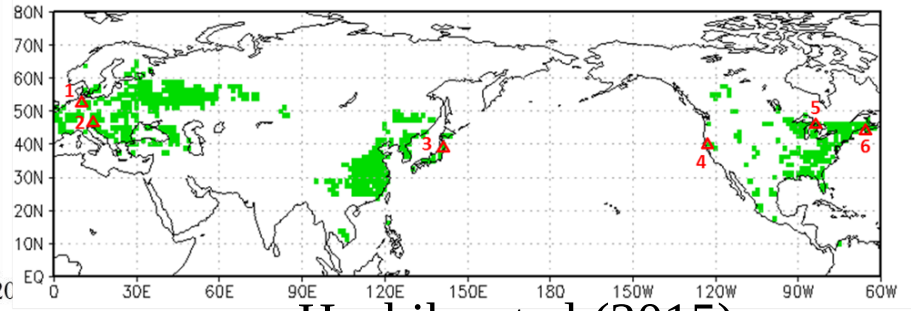
Fig. 4. Time course of stomatal conductance, expressed as percentage (±SD) of the maximum recorded in control (open symbols, 0 nmol mol^{-1} O_3) and ozonated (full symbols, 110 nmol mol^{-1} O_3) leaves of *Arbutus unedo* seedlings, after dissection of the main leaf vein at time 0 (arrow). Measurements were performed at day 10 after the end of a 90-d fumigation. Capital letters and thick lines indicate phases of linear variation, whose slopes are compared in Table 1.

(Paoletti 2005)

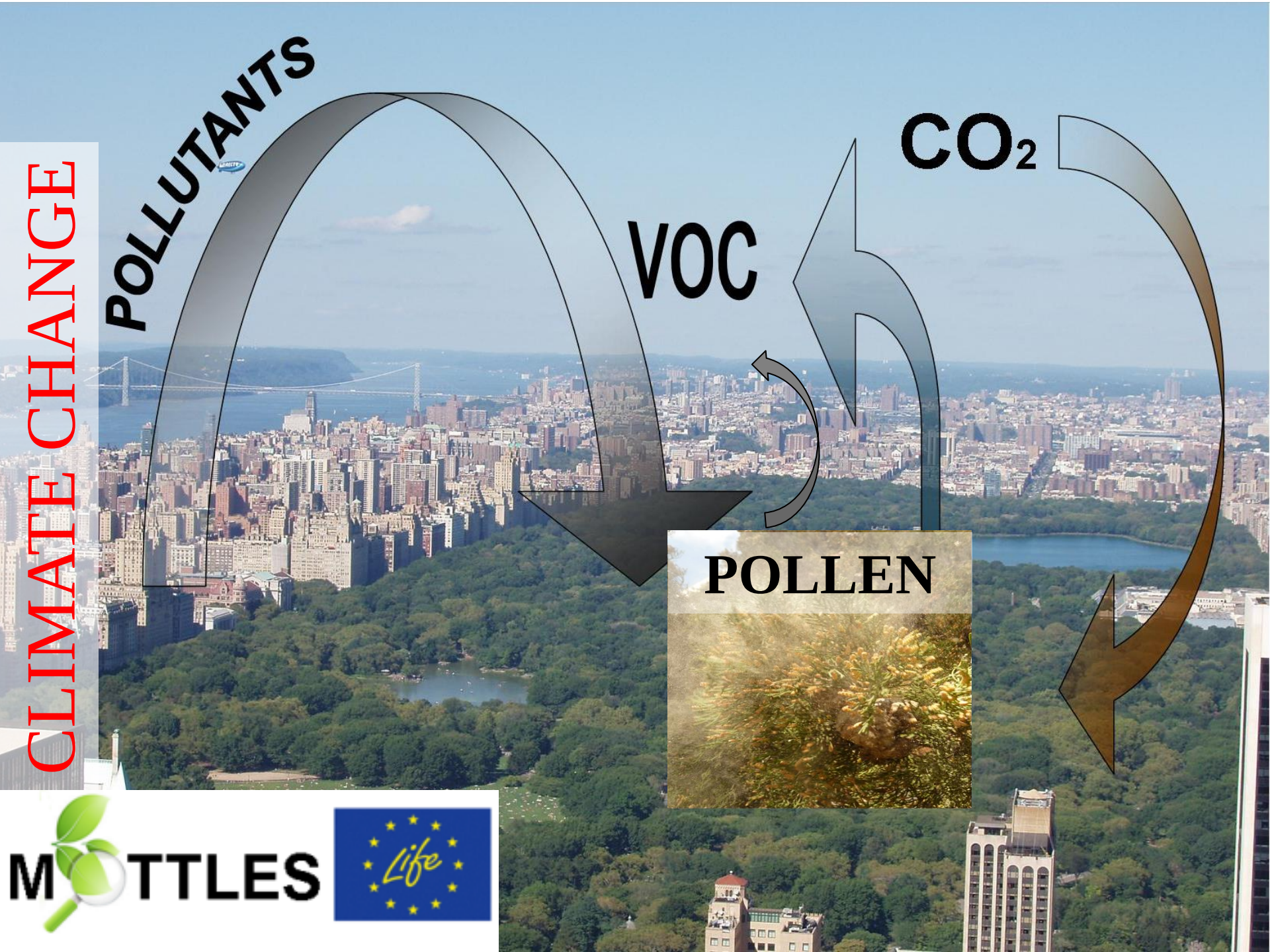
Ozone impacts on the carbon/water balance of global temperate deciduous broadleaf forests



- Ozone-induced stomatal sluggishness, i.e., a delay in stomatal responses to fluctuating stimuli, can change the carbon and water balance of forests
- Ozone can decrease water use efficiency, i.e., the ratio of net CO_2 gain to transpiration, of temperate deciduous forests up to 20% when ozone-induced stomatal sluggishness is considered, and up to only 5% when the stomatal sluggishness is neglected



Hoshika et al (2015)


CLIMATE CHANGE
POLLUTANTS
VOC
CO_2
POLLEN
MOTTLES
Life

COST FP1204
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Functional traits of urban trees in relation to their air pollution mitigation potential

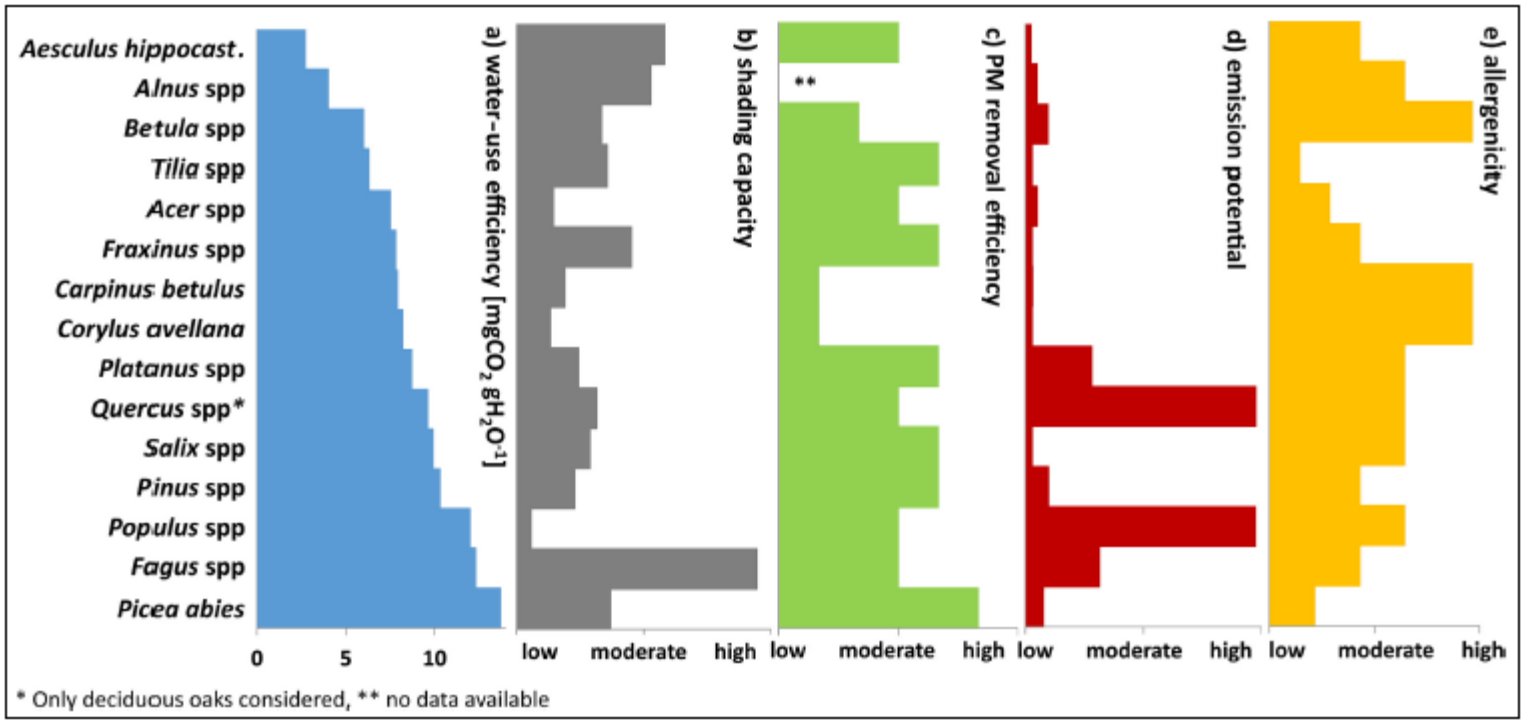

Figure 3. *Selection criteria listed for the most common urban tree species. (a) Water-use efficiency (WUE) taken from Wang* et al. *(2013) and other sources; (b) shading capacity calculated as leaf area index × relative leaf abundance throughout the year (based on Tiwary* et al. *2016) × crown width/tree height (based on https://www.horticopia.com/hortpip/index.shtml); (c) PM removal efficiency based on relative numbers given by Yang* et al. *(2015) as described in the text; (d) lumped isoprene and monoterpene emission potentials under standard conditions (based on units of micrograms per grams dry weight per hour; Karl* et al. *2009); and (e) allergenicity calculated as pollination duration × intensity × toxicity (Cariñanos* et al. *2016). All values except WUE are scaled between lowest and highest values obtained in the dataset.*

Grote et al. Frontiers in Ecology and the Environment, 2016

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3rd Asian Air Pollution Workshop (AAPW-3) will be hold at the same venue (afternoon 20 - morning 22 October)

Thanks!

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