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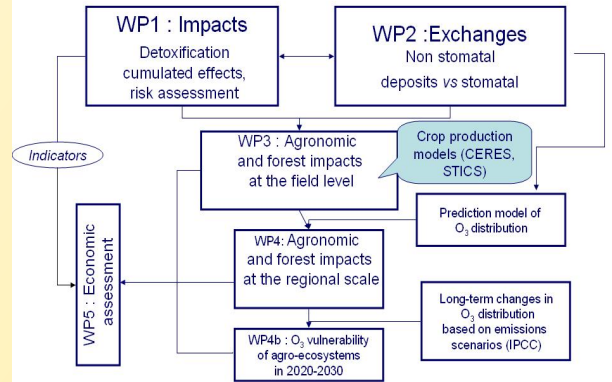
Vulnerability to ozone in anthropized ecosystems. Which risks for 2020-2030? (« VULNOZ » ANR project)

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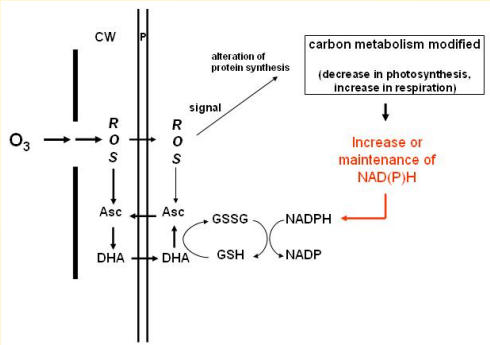
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Context : In industrialized countries, ozone (O₃) is an important gaseous air pollutant with phytotoxic effects due to strong oxidizing properties. Model projections using IPCC scenarios for the 21st century indicate that concentrations of ozone will exceed internationally accepted critical levels. An increased vulnerability of agroecosystems could occur. Over the past decades, the risk assessment for O₃ effects on European vegetation has driven the development of thresholds primarily based on the AOT40 exposure index. There is now accumulating evidence that the responses of vegetation to ozone are better related to the absorbed dose (Cumulative Ozone Uptake = CUO) through stomata than to external concentrations. The absorbed dose is defined as the balance between the O₃ taken up and the detoxification capacity. However, until now, the detoxification capacity of plants remains poorly quantified, and detoxification functions to be included in photosynthesis models are needed. Moreover, the O₃ taken up is often assimilated as the canopy O₃ flux, neglecting the non-stomatal flux. The VULNOZ project aims to improve the European risk indicators development through a re-evaluation of ozone-impact models

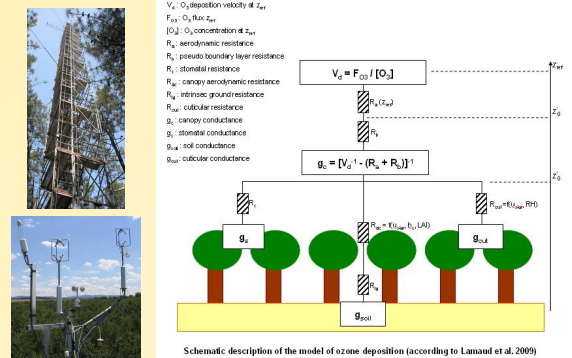
integrated in photosynthesis and plant growth models .



O₃ physiological impact and detoxifying functions

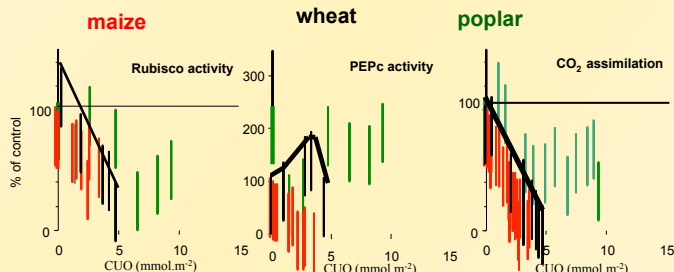


General diagram of the VULNOZ project



Summary of the detoxifying processes to be tested by biochemical and molecular analyses. After validation, the resulting detoxifying functions will be included in photosynthesis models.

O₃ face system and phytotron chambers

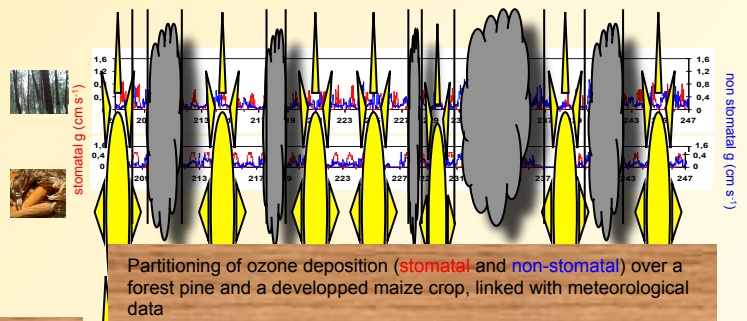


Relative to CUO, the Rubisco activity and CO₂ assimilation were decreased. By contrast, higher PEPc activities were shown for C3 plants (poplar and wheat) but not for C4 plants (maize). Based on these results maize appears to be a less resistant species than wheat and poplar.

Dizengremel P., Le Thiec D., Bagard M., Jolivet Y., 2008 - Ozone risk assessment for plants: central role of metabolism-dependent changes in reducing power. *Environmental Pollution*, 156, 11-15.

Partitioning stomatal and non-stomatal fluxes

The improvement of the parameterisation of ozone deposition requires to quantify O₃ fluxes and stomatal conductances over various ecosystems with a unified and comparable experimental method.



Partitioning of ozone deposition (stomatal and non-stomatal) over a forest pine and a developed maize crop, linked with meteorological data

Lamaud E., Loubet B., Irvine M., Stella P., Personne E., Cellier P. - 2009 - Partitioning of ozone deposition over a developed maize crop between stomatal and non-stomatal uptake. *Journal of Agricultural Science*, 143, 1365-1366.
Lamaud E., Tuzet A., Cellier P., Noctor G., Repellin A., Dizengremel P., Bethenod O., Castell J-F., Roche R., Jolivet Y., 2009 - Metabolic-dependent changes in plant cell redox power after ozone exposure. *Plant Biology*, 11, 35-42.

Conclusion : Additional investigations are currently performed to validate the occurrence of redox power to sustain the detoxification processes. A first outcome of this work will be the issuing of a sub-model for plant functioning under ozone constraint. The strength of this project is the integration of this sub-model into several, more global models to: (i) predict the impact on crop growth (STICS and CERES models), and (ii) on the functioning of ecosystems (CHIMERE, ORCHIDEE models) and (iii) to estimate the economical consequences (AROPaj model).