PROJECT INFORMATION

Project title: LPJ-MLC: In-canopy ozone processes

Project ID: 26

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PROJECT DESCRIPTION

Scientific question to address:
Do bVOCs protect plant cells from oxidative damage caused by the deposition and uptake of atmospheric (ground-level) ozone?

Hypothesis:
High bVOC-emitting species have a competitive advantage over co-located low bVOC-emitting species in a world of increasing atmospheric ozone concentrations.

Project plan:
1. Couple LPJ-GUESS and MLC-CHEM box model

2. Evaluate the performance of the model using data from selected ICP Forest sites:
   - Initialise the model with site-specific soil data and vegetation type and characteristics;
   - Use site-specific meteorological data to drive the coupled model;
   - Compare model output growth characteristics data (e.g. LAI, height gain, ...) against site observations;
   - Compare model output flux data (C and N) against site measurements.

Evaluation conducted at a maximum of 6 sites (preferably “paired”) covering a range of tree species, climate conditions and atmospheric ozone concentrations.

3. Evaluate the performance of the model using data from ECLAIRE flux measurement sites (shorter-term measurement data but includes emissions and deposition of reactive species):
   - Initialise the model with site-specific soil data and vegetation type and characteristics;
   - Use site-specific meteorological data to drive the coupled model;
   - Compare model output LAI against site measurements;
   - Compare model output flux data (C and N) against site measurements;
   - Compare model output bVOC and soil NOx emissions fluxes against site measurements;
   - Compare model output ozone deposition fluxes against site measurements.

Evaluation conducted at a maximum of 2 sites of different climatic conditions.

4. Use the coupled model to simulate growth, emissions, deposition and canopy chemistry at previously selected ICP Forest sites. Compare output from simulations at "paired" sites (see below) and evaluate simulated ozone fluxes, uptake and impacts against observations of damage, growth, ...

"Paired" sites to include:

- the same tree species (high emitting) under different atmospheric ozone concentrations;
- the same tree species (low emitting) under different atmospheric ozone concentrations;
- different tree species under similar atmospheric ozone concentrations.

5. Parameterise different ozone responses and sensitivities under various "strategies" of bVOC synthesis and emission:

- odd oxygen quenching in the canopy;
- odd oxygen quenching on leaf surfaces;
- odd oxygen quenching in the stomata;
- odd oxygen quenching within the leaf or other plant structure.

6. Use the developed model to perform simulations for other ICP Forest Level II sites and ECLAIRE flux sites not used for either the initial evaluation or model development stages. Evaluate model performance against growth, C and N fluxes and fluxes of reactive species as previously.

7. Conduct regional simulations with LPJ-MLC under current climate conditions (using GCM model output climate data) and under future scenarios.

Data-mining techniques for model evaluation and development of parameterisations:

- multivariate and non-linear regression analysis
- hypothesis testing
- testing for trends
- Empirical Orthogonal Function analysis
- neural network approach