Universität Basel

# Research Project

# CANOPY – NCCR Climate Phase 2

### Third-party funded project

**Project title** CANOPY – NCCR Climate Phase 2
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**Project start** 01.04.2005
**Probable end** 31.03.2009
**Status** Completed

Beyond its direct effect on the climate system, the enrichment of the atmosphere with CO2 has indirect implications on the water cycle through its influence on leaf stomata (K$^{\prime}$orner 2000). 70% of total evaporative loss of water in Europe passes through these leaf pores, which commonly open less widely if exposed to elevated CO2. A reduced moistening of the atmosphere and increased soil moisture are, thus, common observations in CO2 enrichment experiments.

Given that no place on earth can escape these CO2-induced changes of the water cycle, they need to become implemented into climate models. Currently they are not. One of the reasons is a lack of trustworthy field data until very recently. The worldwide three existing, free air CO2 enrichment (FACE) experiments in tall stature forests, provide first insights into the involved processes. Surprisingly, the expected CO2 signal was not found in a 15 m tall pine monoculture in North Carolina, and there is also no clear signal seen in a 10 m tall sweetgum plantation in Tennessee. The **Swiss Canopy Crane project**, the first CO2 enrichment experiment in a mature natural forest (Pepin and K$^{\prime}$orner 2002), now in its fourth year of operation, offers an explanation. The project sofar revealed a species specificity of adult forest tree water savings in a CO2-enriched atmosphere (some species respond, others don't). It, thus, depends on the presence of species (e.g. in a catchment) whether water savings and perhaps increased runoff will occur or not. Sap flux responses and soil feedback are still poorly understood and there is the possibility that periodically wetter soils permit even higher rates of transpiration and, thus, reduce the net "water saving" CO2 signal. The greatest limitation of experimental findings is the lack of atmospheric feedback. Reduced forest tree transpiration may also reduce atmospheric humidity at a landscape scale. How will these changes feed back on tree transpiration?

Our proposed contribution to the NCCR Climate WP3 aims at closing these gaps of evidence for forests, will provide realistic input variables for model parameterization, and test atmospheric feedback on forest vegetation for a year 2080 CO2 scenario.

(1) To establish – *in situ* – firm evidence on the effects of elevated CO2 on mature forest tree water relations (stomatal responses, sap flux reductions, soil moisture consequences).

(2) To develop algorhythms which permit predicting these responses from atmospheric and soil moisture data.

(3) To provide best estimates of species-specific and, thus, community-based water savings for catchment models (link to H. Bugmann) and climate models (link to Ch. Sch$^{\prime}$ar).

(4) To simulate *in situ* (experimentally), driving forces derived from climate models which account for CO2 effects on vegetation.

(5) Based on (2) and (4) a final objective is to establish a real time link between a climate model (Ch. Schʹar group) and computer controlled air conditions around forest leaves, aiming at a realistic picture of the hydrological consequences of plant responses to elevated CO2.

**Financed by**
Swiss National Science Foundation (SNSF)

**Add publication**

**Add documents**

**Specify cooperation partners**