

Do forests care about the past?

Introduction & Objectives

Forest ecosystems are an important sink of atmospheric CO₂ due to their ability to take up large amounts of carbon for wood growth. Yet, it is still unclear how these forest ecosystems will respond to climate change in terms of their net ecosystem exchange (NEE). Therefore, understanding the climatic control on forest NEE and its related role in the terrestrial carbon cycle is of great global interest.

This project is conducted to study climatic drivers of NEE and time lags between microclimatic conditions and the response of forests in terms of carbon exchange as well as tree growth on monthly to annual time scales.

Hypotheses

1. Microclimatic conditions of the previous year will significantly affect current year NEE of both coniferous and deciduous forests (Fig. 1).

2. Expected time lags between microclimatic conditions and NEE are due to a delayed response of carbon uptake and tree growth instead of delayed respiratory processes.

3. Unfavorable climatic anomalies will alter the trees non-structural carbon (NSC) dynamics in such a way, that tree growth will be significantly restricted in the following year.

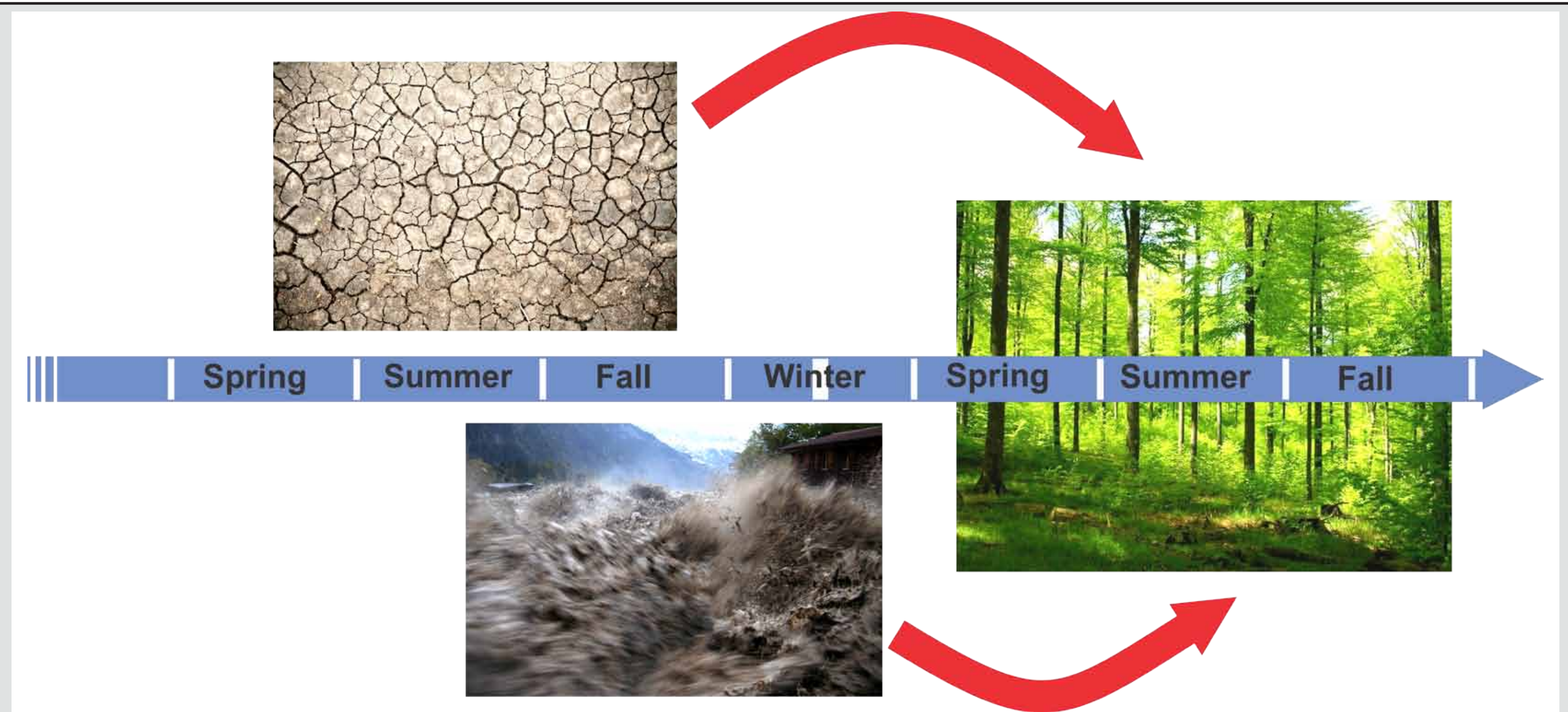


Figure 1: It is expected that especially previous year climatic anomalies will show an influence on current year forest ecosystem NEE and tree growth.

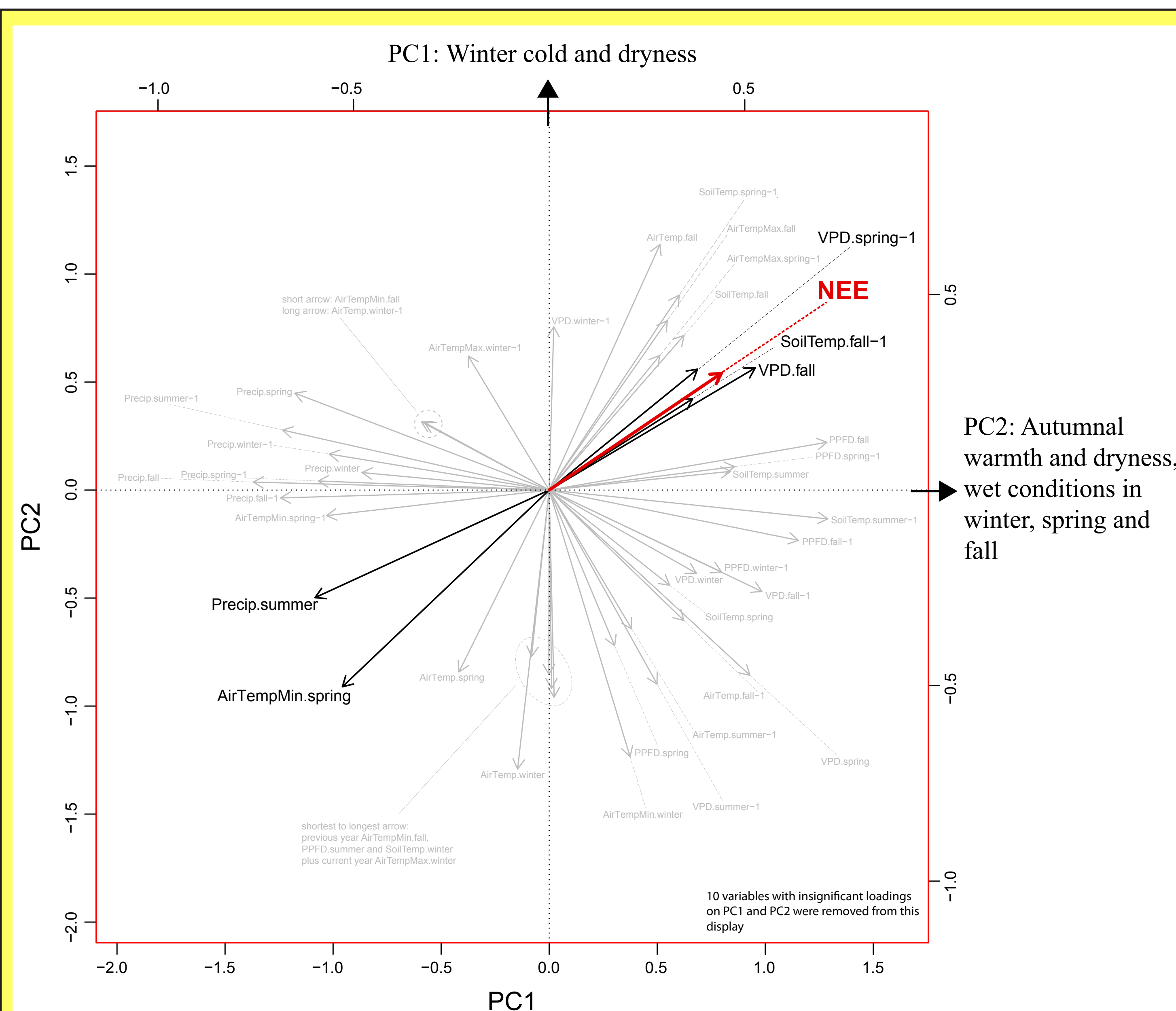


Figure 2: Principal component analysis of annual NEE sums and seasonal means/sums of climatic variables for the period 1997-2010 at Davos site. Variable-1 denotes the respective variable measured in the previous (not the current) year.

First Results

The annual NEE for the Davos coniferous forest is represented by both the first and the second principal component (Fig. 2). Current year NEE is driven by the current year (spring temperature, summer precipitation, autumnal VPD) and the previous year (spring VPD, autumnal soil temperature) microclimate.

Conclusion & Outlook

The previous year microclimate plays an important role in controlling current year CO₂ fluxes of the Davos forest. Therefore, such time lags cannot be neglected, e.g. in annual carbon budget models.

Next steps:

- Quantifying influence of time lags on annual NEE
- Identifying origins of time lags on ecosystem scale
- Exploring underlying plant physiological mechanisms on tree scale

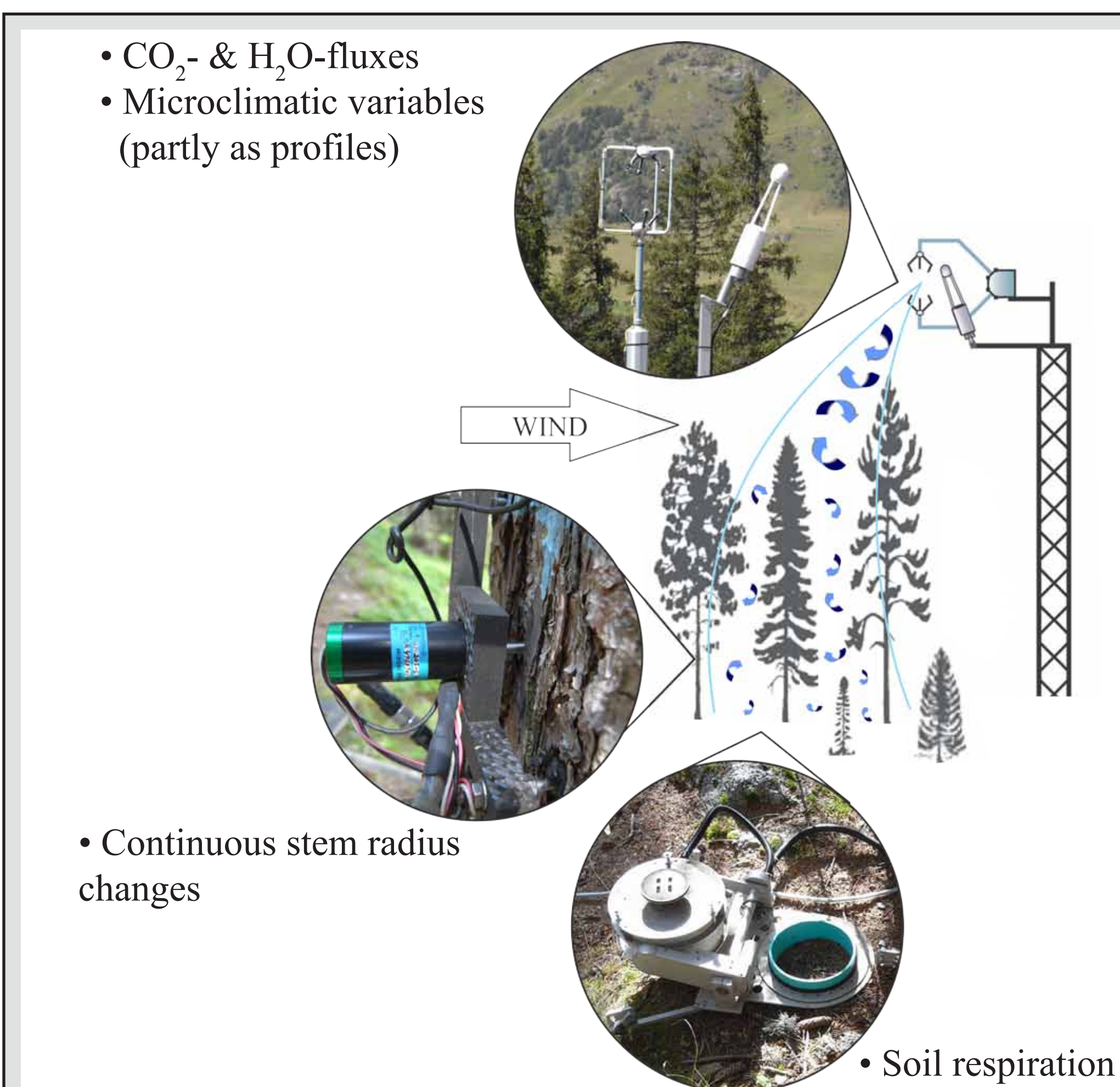


Figure 3: Instrumental set-up at the Davos research site.

Methods

- Long-term measurements (see Fig. 3)
- Research sites (Fig. 4):
 - Davos, subalpine coniferous forest (1639 m a.s.l.)
 - Laegeren, mixed deciduous forest (800 m a.s.l.)



Figure 4: Location of the two Swiss research sites.

Contact & Acknowledgements

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