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# Measuring dissolved gases in trees

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In contrast to surface water, soil and groundwater contain higher (noble) gas concentrations exceeding those in air saturated water (excess air, [1]). As trees use soil water as their main water source, questions arise regarding the presence in trees of gases and excess air derived from soil water. We developed an experimental method to measure dissolved gases *in-situ* in real time in tree sap with the aim to track the flow of gases from the soil, through trees and other plants, into the atmosphere.

Several semipermeable membrane probes (adapted from [2]) were installed at different heights in a fir tree and were connected to a portable gas equilibrium membrane-inlet mass spectrometer (GE-MIMS [3]) to continuously analyze gases (He, Ar, Kr, $N_2$, $O_2$, $CO_2$, $CH_4$) in the sap and the soil over weeks. Additionally, we irrigated the tree with He or Ar enriched water to carry out tracer experiments in the tree. We observed diurnal dynamics that could be linked to the tree physiological activities. We will discuss these experiments as well as the developed experimental techniques that allow separating physical transport and exchange of gases derived from the soil or the atmosphere from $CO_2$ and $O_2$ produced by physiological processes in the tree.

[1] Kipfer et al. (2002), *Reviews in Mineralogy and Geochemistry*, ***47****, 615–700*; [2] Volkmann et al. (2014), *Hydrology and earth System Sciences,* ***18****, 1819-1833;* [3] Brennwald et al. (2016), *ES&T,* ***50****, 13455-13463*