Revealing the bark water uptake of isotopically-enriched water by intact branches in the field and its potential contribution (or consequences) to (or for) transpiration estimates

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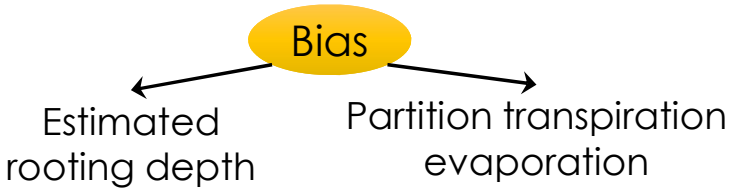
Trees do not only take up water through the roots

Trees xylem water is under tension

- Root water uptake supplies transpiration
- Under excess negative tension:
  - Tall branches
  - Drought
  - Cold

  → Alternative water uptake pathways

    → Uncoupling root water uptake - transpiration

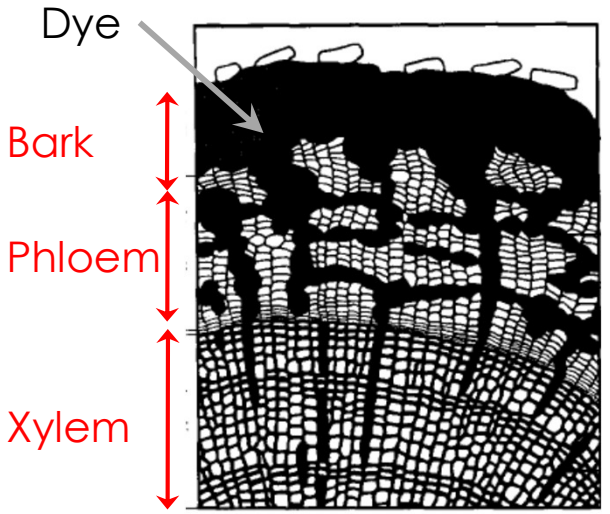


Alternatively water uptake occurs through the BARK

Uptake of water and solutes through twigs of *Picea abies* (L.) Karst

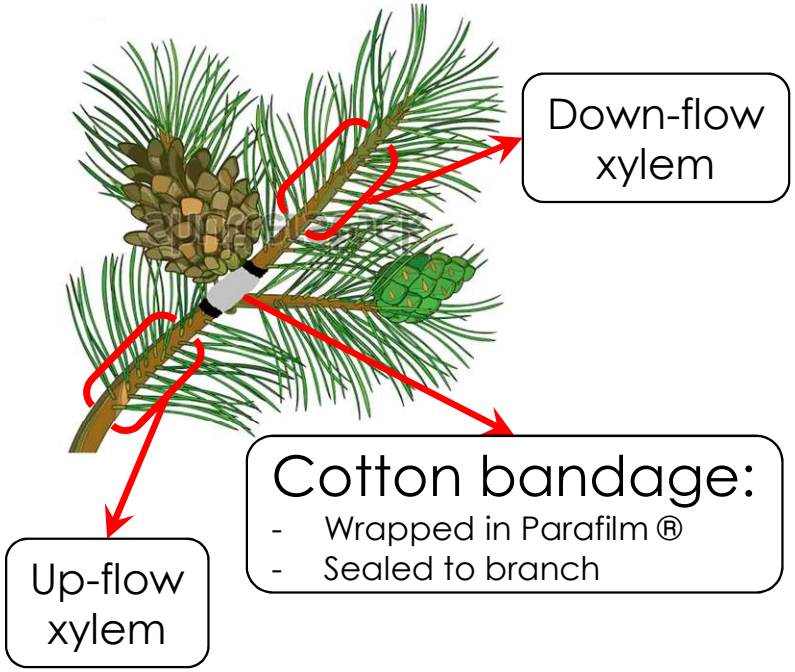
C. Katz, R. Oren*, E.-D. Schulze, and J. A. Milburn**

Structure and Function
Trees
© Springer-Verlag 1989



Using water stable isotopes to demonstrate bark water uptake in intact branches from tall trees

Intact tall branch



Injection of δ^2H-labelled water (~1% ^2H_2O) into the bandage

Water isotopic composition:
- Xylem water (up- and down-flow)
- Transpiration stream down-flow (online)

Study sites and methodology

Boreal forest: Rosinedal (Sweden), July & September 2018

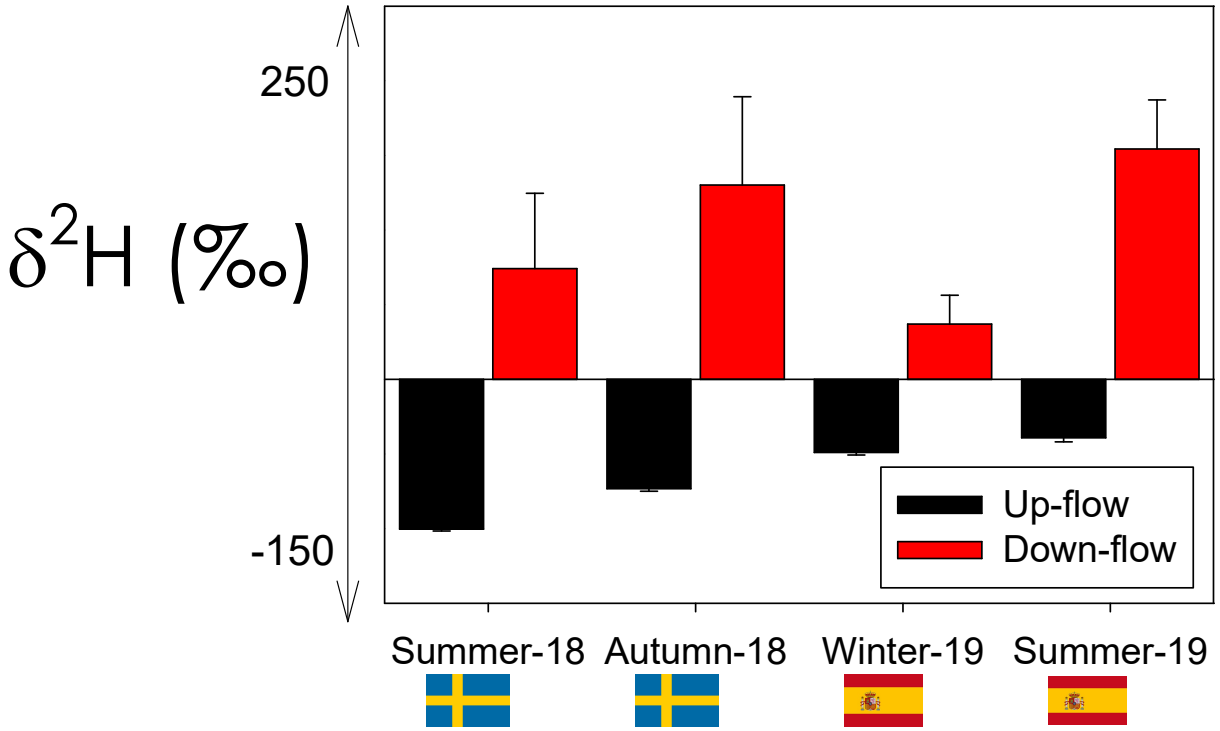
Top canopy branch chambers:
- Gas exchange (CO_2 & H_2O)
- Online δ^2H and $\delta^{18}O$ of water vapour in and out (CRDS)

Temperate mixed forest: Monte Santiago (Spain): February & July 2019

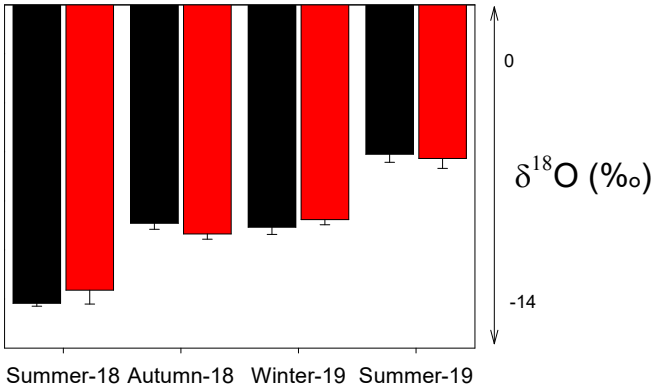
Cryogenic extraction xylem water

Isotopic analyses

Bandages: significant δ^2H enrichment of xylem water in the down-flow segments

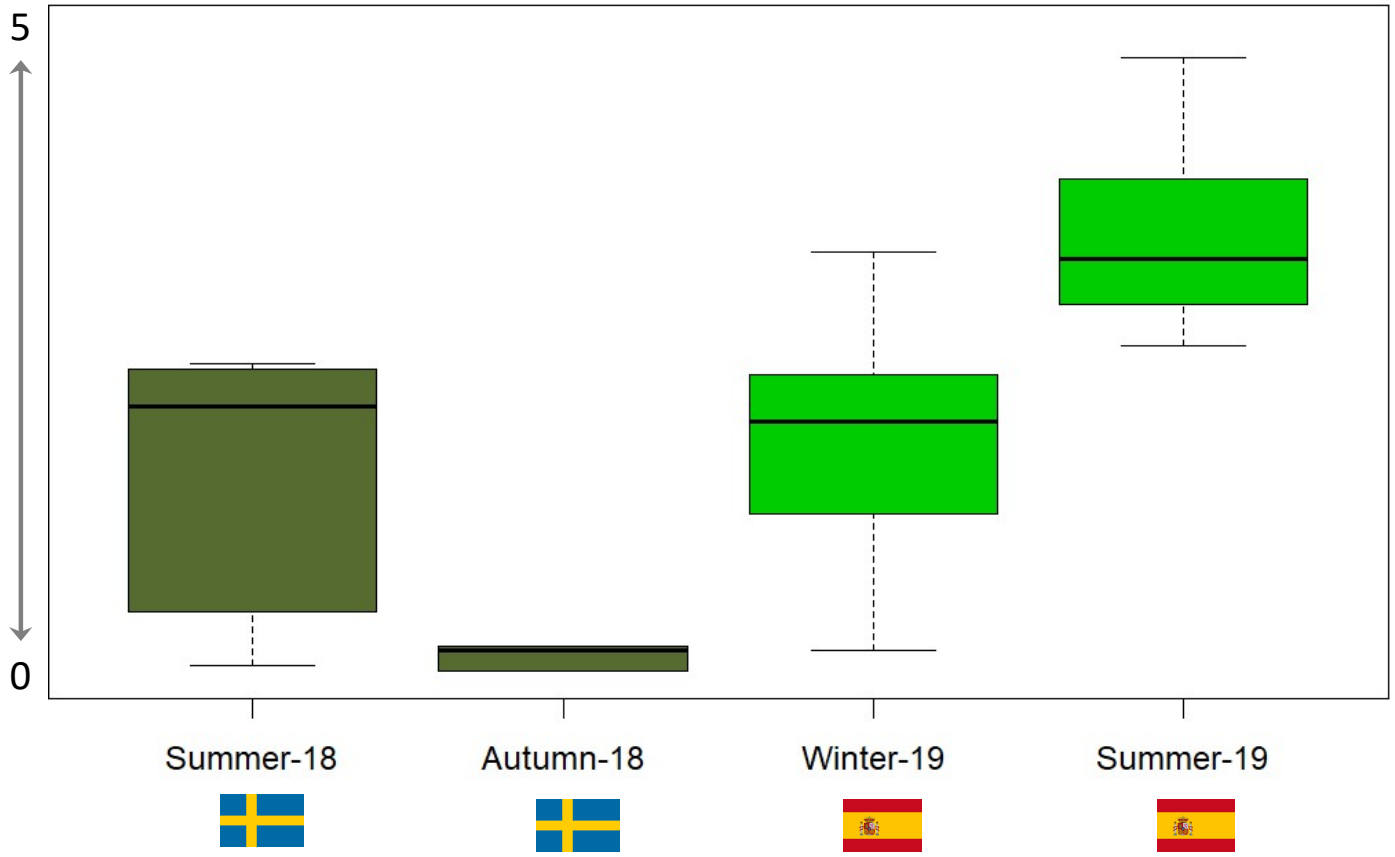


No significant effect on $\delta^{18}O$



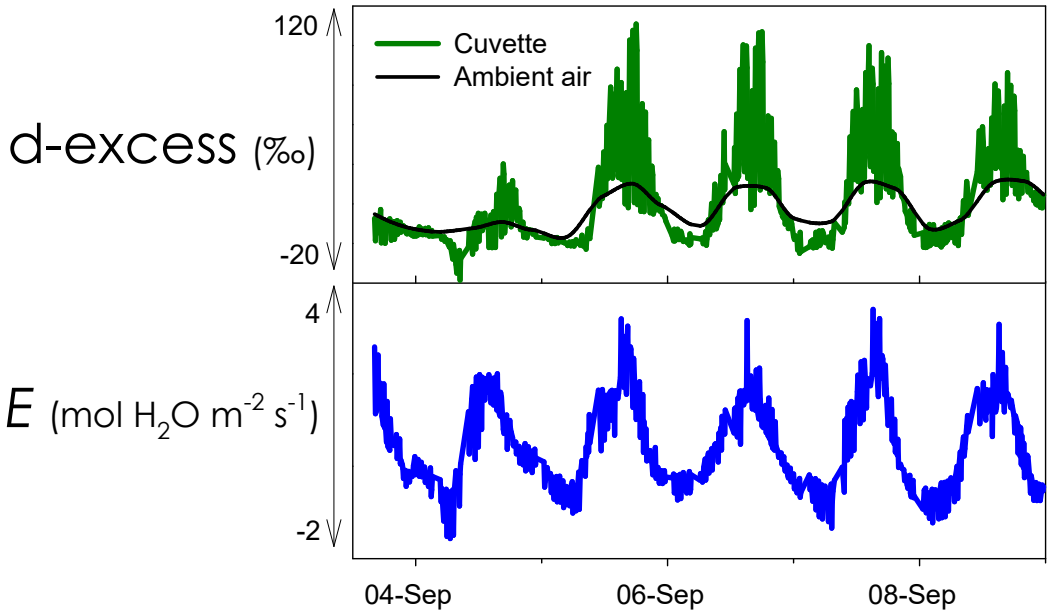
Bark water absorption rate is greater in the warmer site and in summer

Bark water absorption rate
Ln(mmol m^{-2} day^{-1})



Water absorbed through the bark contributes to maintain transpiration

Transpiration d-excess increases as δ^2H-labelled water is absorbed through the bark



Deuterium excess (d-excess) and transpiration (*E*) from cuvette measurements, Sweden, 2018

- Bark water uptake was:
  - ✓Ubiquitous, significant and detectable in all seasons
  - ✓Related to transpiration

Methodologies relying on measurements of stem water transport or changes in soil water storage could underestimate transpiration

Do you want to know more?

- Get in touch with me:

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- See you (hopefully) in July ~~2020~~ 2021 at the 2nd workshop on water partitioning and plant-soil interactions (Hannover, Germany, EGU, Galileo conference)

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