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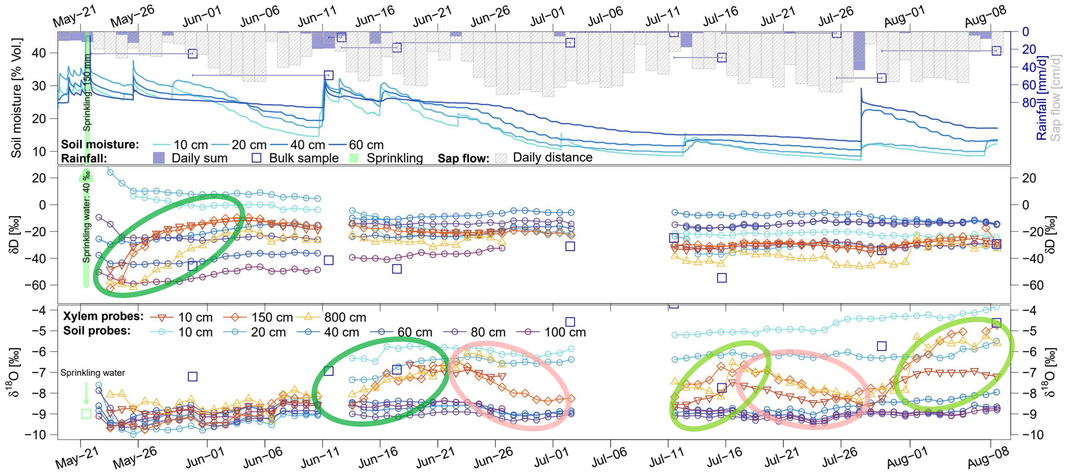
HYDROLOGY

In-situ probes can monitor stable water isotopes within the soil and the xylem of trees. This enables us to observe how trees are changing the source depths of their water uptake depending on water availability.



- Delayed response of xylem isotopic signature to abrupt changes in soil water availability / isotopic signature caused by rainfall events after drying periods
- Changes in xylem isotope signature occur due to:
  - Changes of the soil water isotopic depth profile
  - Downwards shift of the dominant depth of root water uptake due to drying topsoil
  - Upwards shift of the dominant depth of root water uptake after rewetting of topsoil

Inferring plant physiologic parameters for root water uptake modelling from high frequency in-situ isotope measurements

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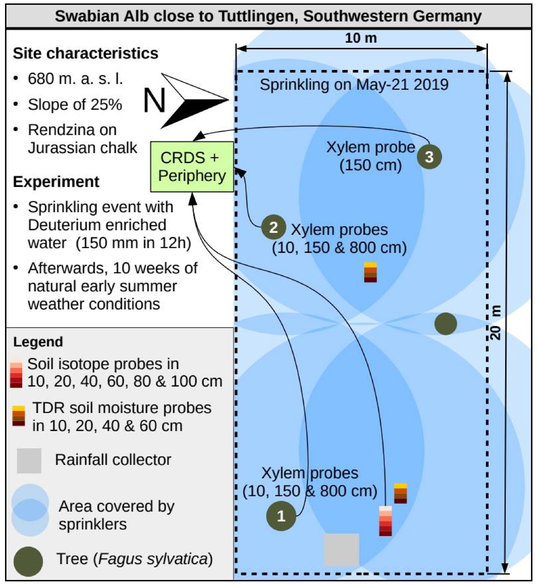
EXPERIMENT



- Sap flow sensors have been installed close to each xylem isotope probe
- Early summer precipitation provided additional ^{18}O-label spike for topsoil

CONCLUSION

In-situ probes allow for subdaily monitoring of isotopic signatures of soil and xylem water.

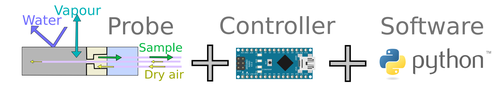
Compared to conventional destructive methods, this method is less invasive and allows repeated measurements at the exact same locations.

Observations of shifting uptake patterns may be used to infer critical matric potentials for root water uptake.

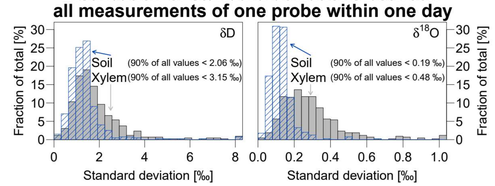
Time delays between changes in soil and xylem isotopic signatures may be used to infer information about root distributions and water transport within the plant.

METHODS

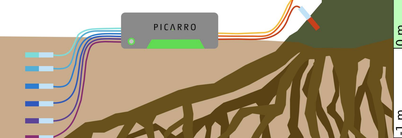
- Continuous sampling of stable water isotopes within a sample gas stream using cavity ring down spectroscopy (**CRDS**)
- In-situ sampling of soil or xylem water via **equilibration** through a **gas permeable membrane** probe head
- One probe at a time is connected to the CRDS
- Total number of measurements ranges from 50 to 150 per day
- **Automated operation** with freely configurable measurement cycle using a **Phython GUI** and an **Arduino** based **valve and gas flow control system**
- **Automated transmission of** pre-processed **measurement results** does not require high bandwidths (~20kB/h) and allows remote monitoring of the measurements



RESULTS



- Small standard deviations between soil isotope measurements within one day
- Slightly higher standard deviations between xylem isotope measurements
  - still accurate enough to detect signature changes under natural conditions
- Dominant depths of root water uptake shift downwards before decrease in sap flow velocities can be observed



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