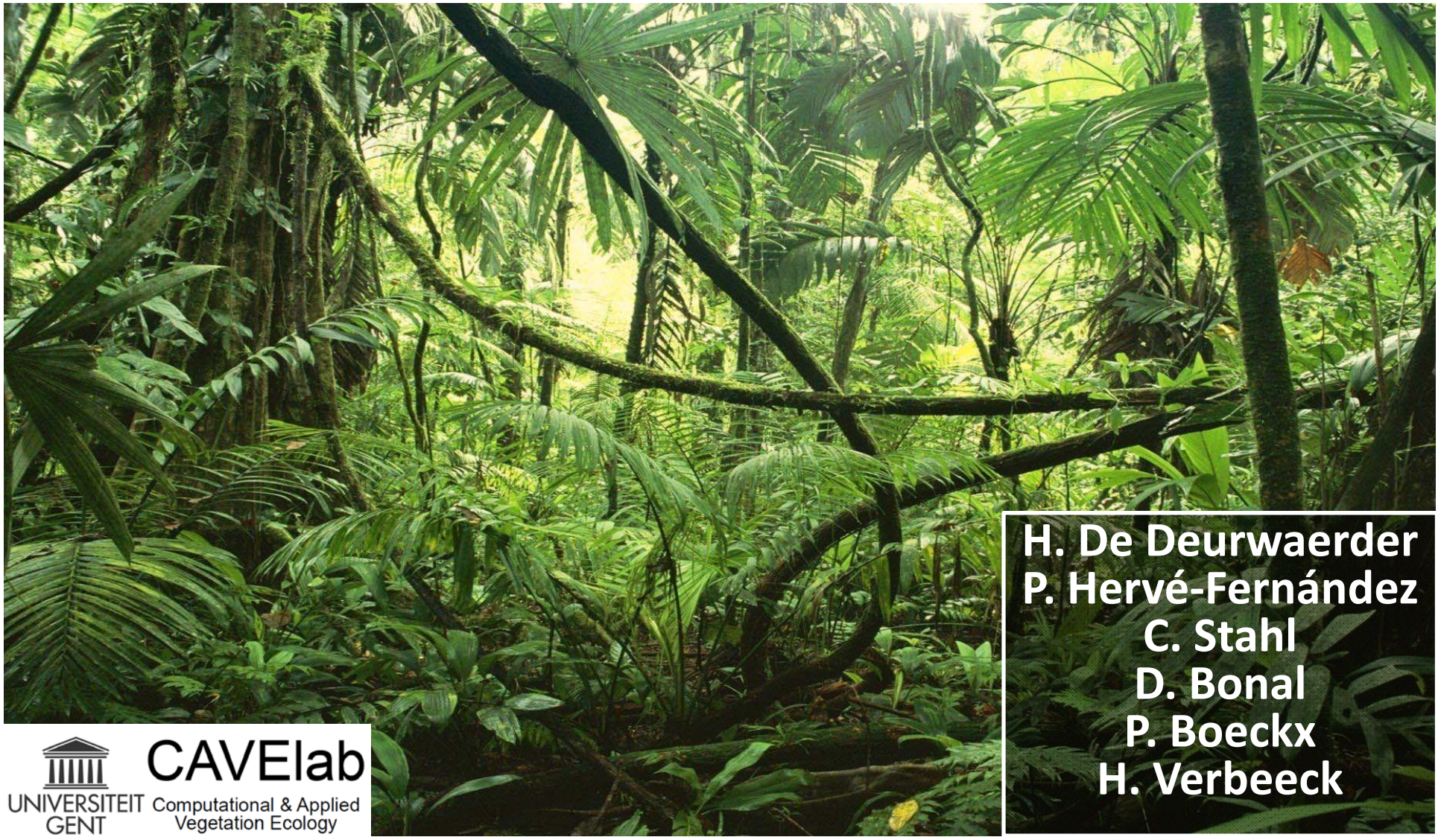
Tapping another water source: below ground competition between lianas and trees

Hannes de Deurwaerder, Pedro Hervé-Fernández, Clement Stahl, Damien Bonal, Pascal Boeckx, Hans Verbeeck

Tapping another source: below ground water competition between lianas & trees



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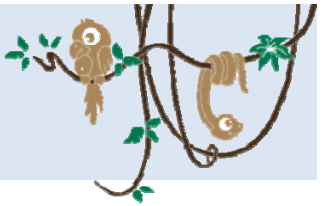

Increasing dominance of large lianas in Amazonian forests

Oliver L. Phillips*, Rodolfo Vásquez Martínez†, Luzmila Arroyo‡§, Timothy R. Baker*, Timothy Killeen‡§‖, Simon L. Lewis*¶, Yadvinder Malhi¶, Abel Monteagudo Mendoza†#, David Neill☆, Percy Núñez Vargas#, Miguel Alexiades††, Carlos Cerón‡‡ Anthony Di Fiore§§, Terry Erwin‖‖, Anthony Jardim§, Walter Palacios☆, Mario Saldias§ & Barbara Vinceti¶**

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‖ Conservation International Washington DC 20036, USA
¶ The School of Earth Environmental and Geographical Sciences, University of Edinburgh EH9 3JU, UK
 # Herbario Vargas, Universidad San Antonio Abad del Cusco, Cusco, Peru
*☆ Fundación Jatun Sacha; ** Missouri Botanical Garden; ‡‡ Herbario QAP, Escuela de Biología de la Universidad Central del Ecuador, Quito, Ecuador*
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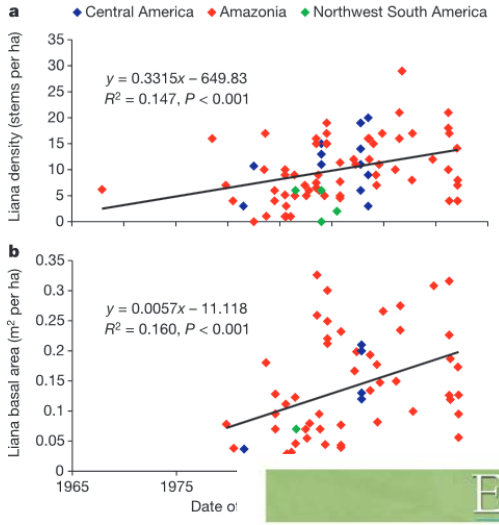
‖‖ Natural History Museum, Smithsonian Institution, Washington DC 20560, USA

densities might be anticipated[19]. Here we assemble several unique,



- Land-cover change
- Forest fragmentation
- Atmospheric CO_2 increase
- Competition for water resource

ECOLOGY LETTERS
Ecology Letters, (2011) doi: 10.1111/j.1461-0248.2011.01590.x

REVIEW AND SYNTHESIS

Increasing liana abundance and biomass in tropical forests: emerging patterns and putative mechanisms

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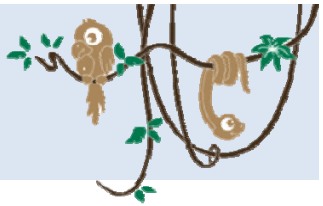
[3]Wageningen University, Centre for Ecosystem Studies, PO Box 47, 6700 AA Wageningen, The Netherlands
**Correspondence: E-mail: schnitzer@uwm.edu*

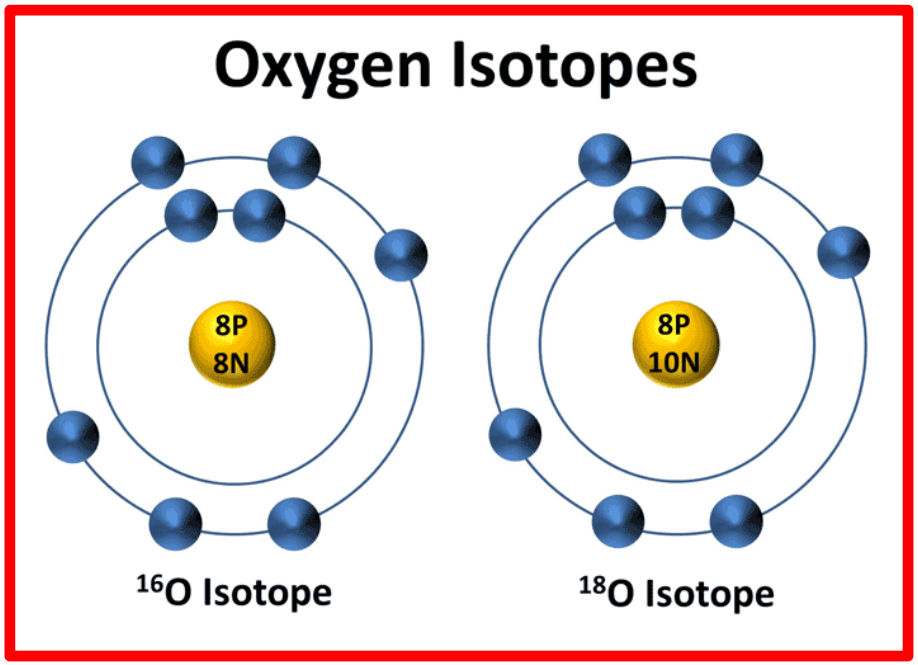
Abstract
Tropical forests are experiencing large-scale structural changes, the most apparent of which may be the increase in liana (woody vine) abundance and biomass. Lianas permeate most lowland tropical forests, where they can have a huge effect on tree diversity, recruitment, growth and survival, which, in turn, can alter tree community composition, carbon storage and carbon, nutrient and water fluxes. Consequently, increasing liana abundance and biomass have potentially profound ramifications for tropical forest composition and functioning. Currently, eight studies support the pattern of increasing liana abundance and biomass in American tropical and subtropical forests, whereas two studies, both from Africa, do not. The putative mechanisms to explain increasing lianas include increasing evapotranspirative demand, increasing forest disturbance and turnover, changes in land use and fragmentation and elevated atmospheric CO_2. Each of these mechanisms probably contributes to the observed patterns of increasing liana abundance and biomass, and the mechanisms are likely to be interrelated and synergistic. To determine whether liana increases are occurring throughout the tropics and to determine the mechanisms responsible for the observed patterns, a widespread network of large-scale, long-term monitoring plots combined with observational and manipulative studies that more directly investigate the putative mechanisms are essential.

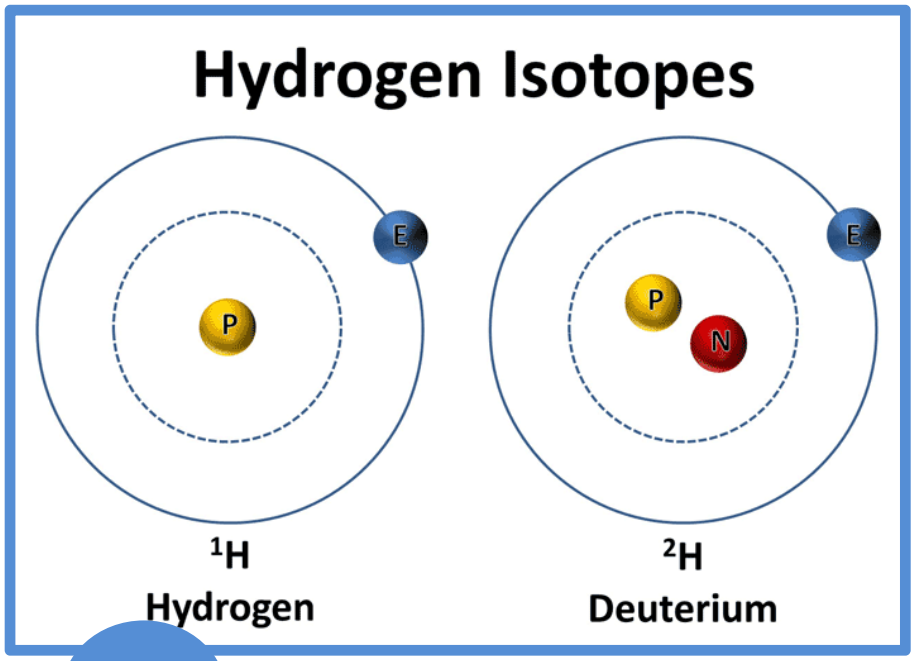


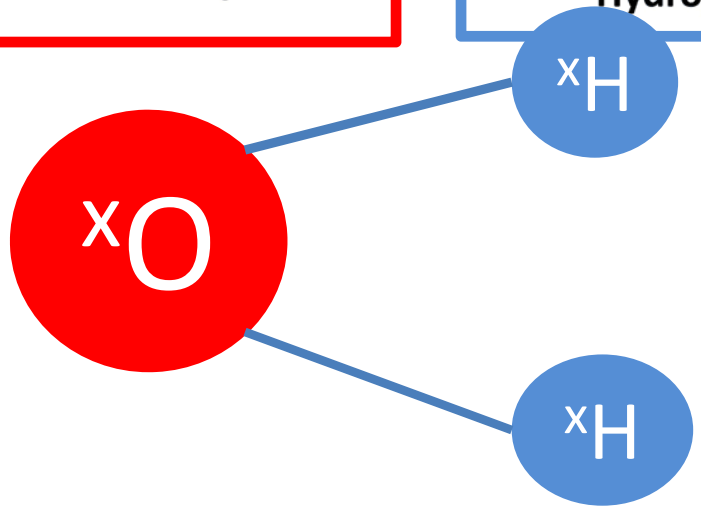
HYPOTHESIS:

"There is strong below ground competition for the same water resources between lianas and trees"

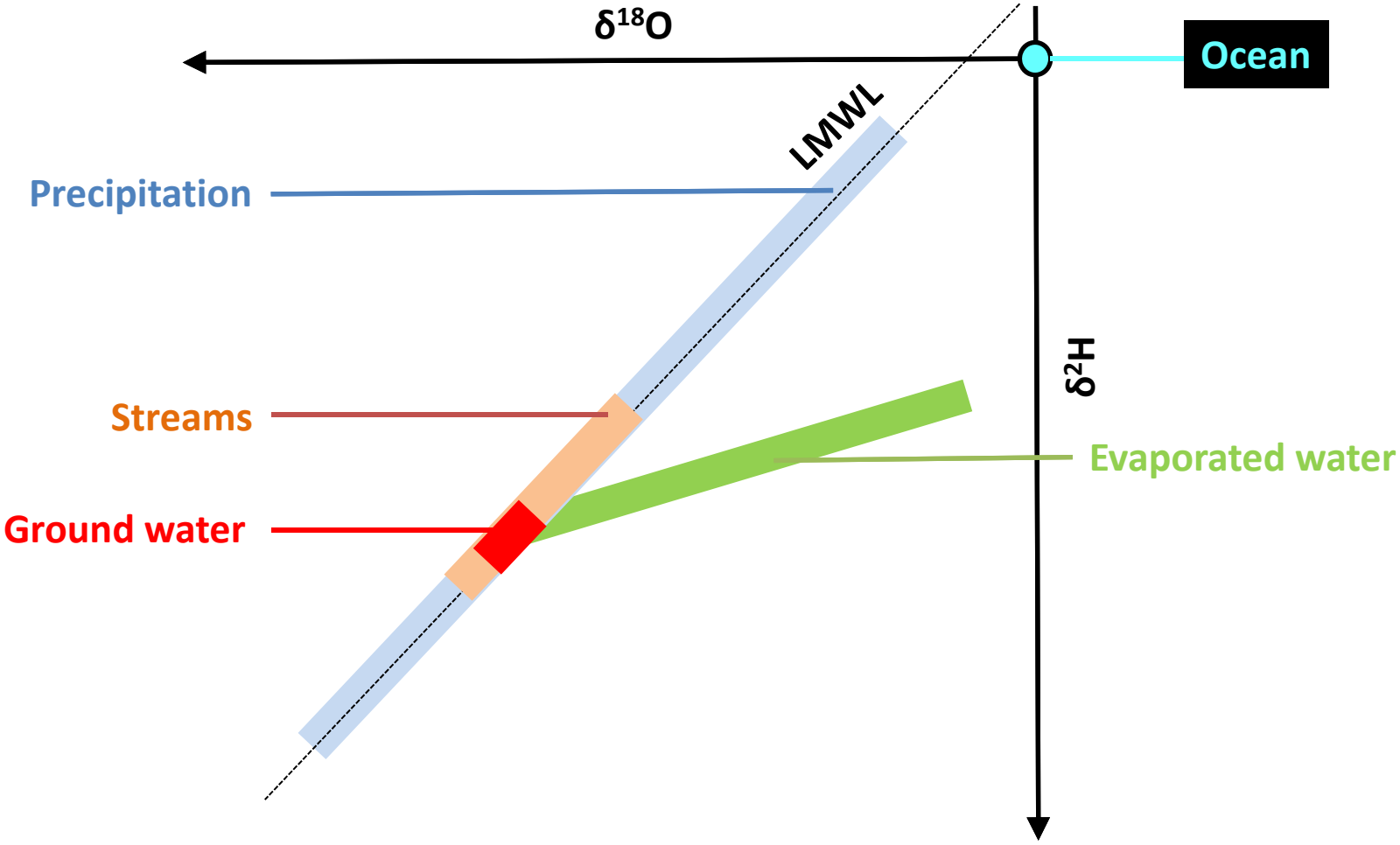
Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$

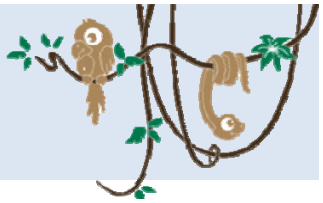




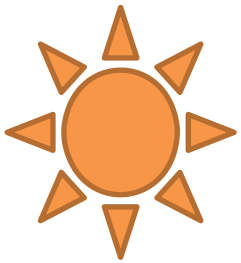


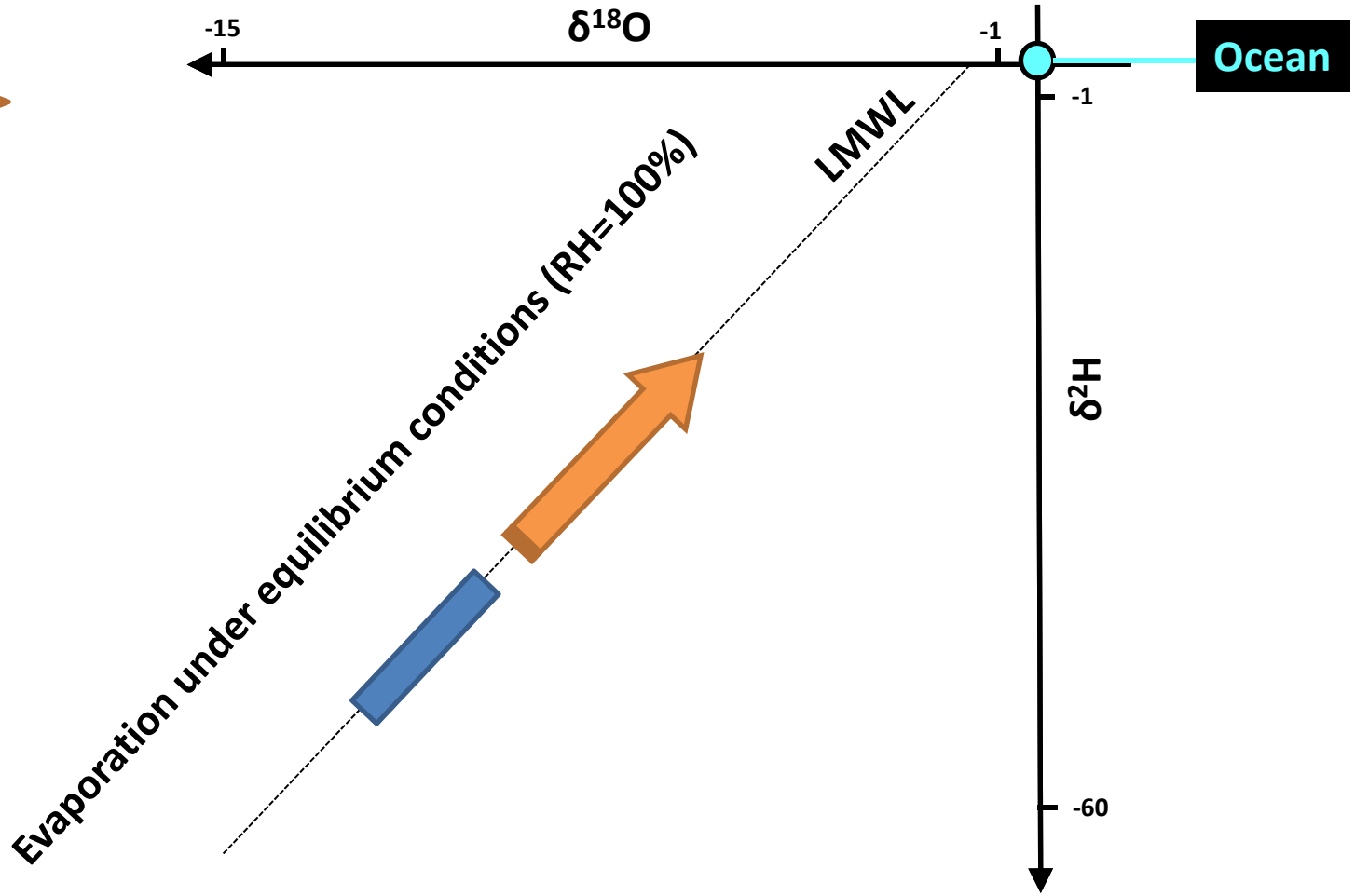
Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$



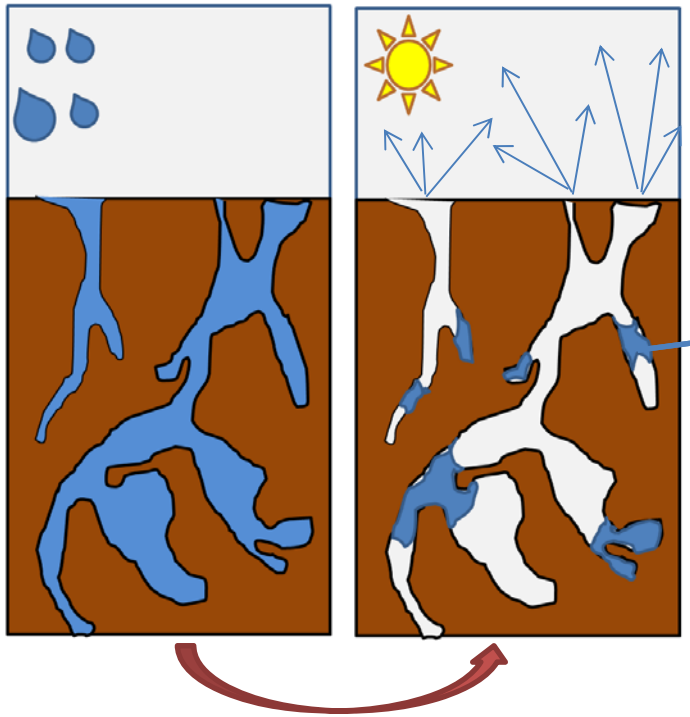


Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$



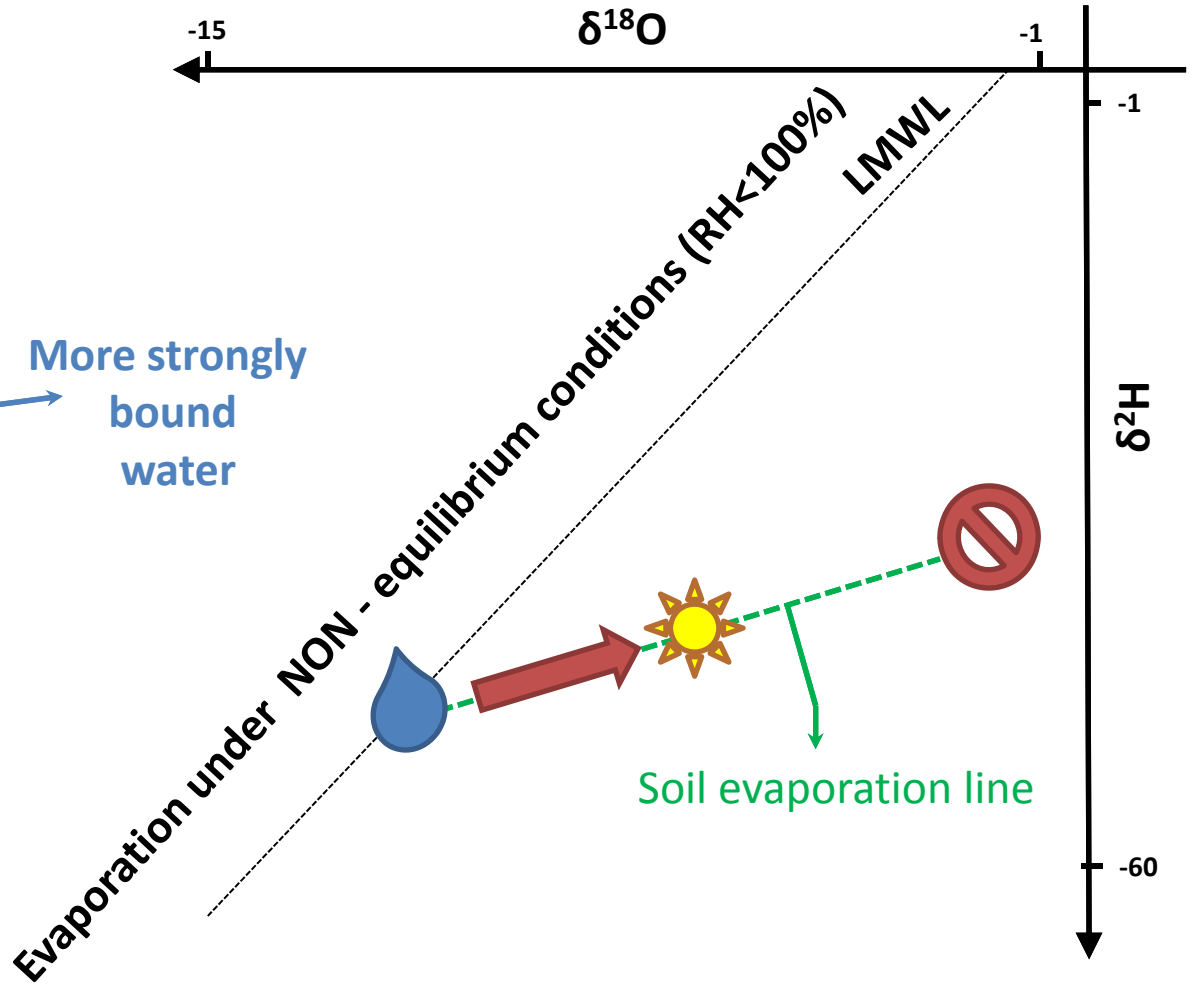


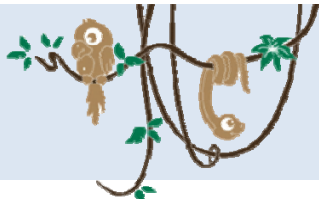
Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$



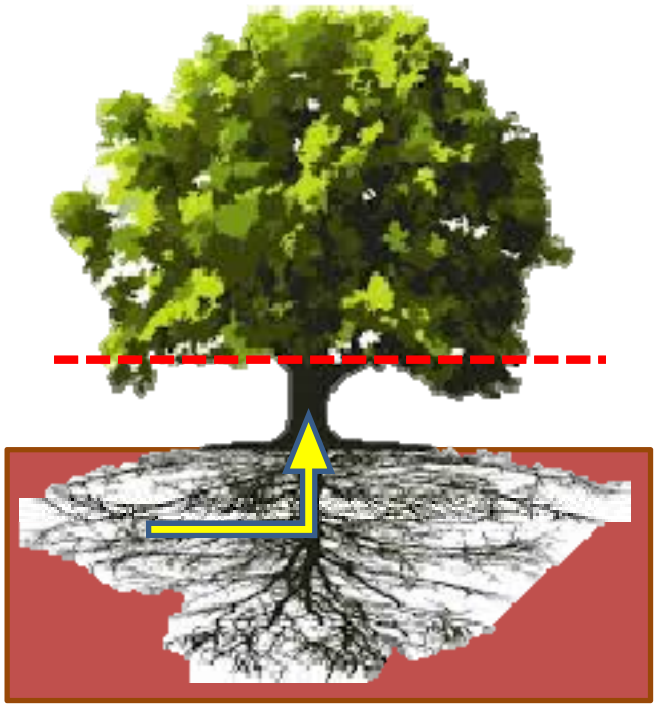
More strongly bound water

Enrichment of heavier water molecules
($^{1,1}H_2{}^{18}0$, $^{1,2}H_2{}^{18}0$)





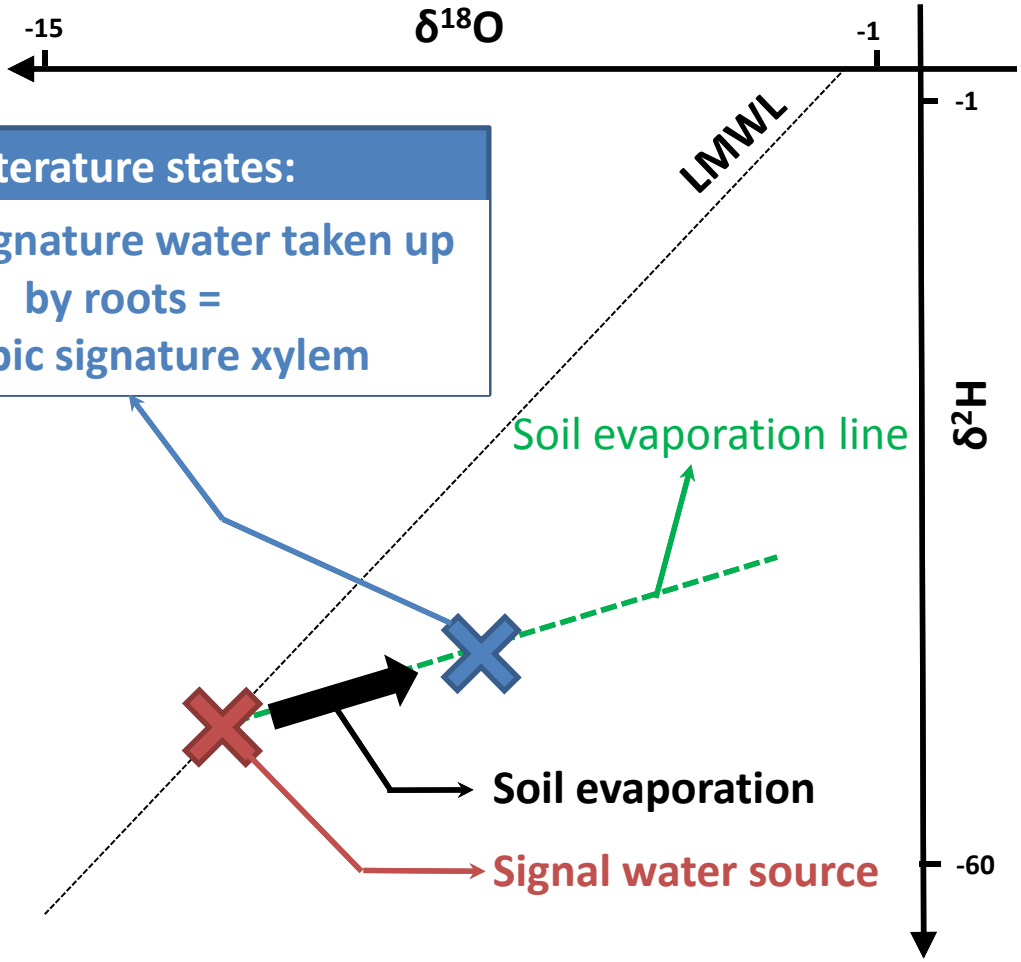
Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$



No fractionation

Literature states:

Isotopic signature water taken up by roots = Isotopic signature xylem



Diapositive 8

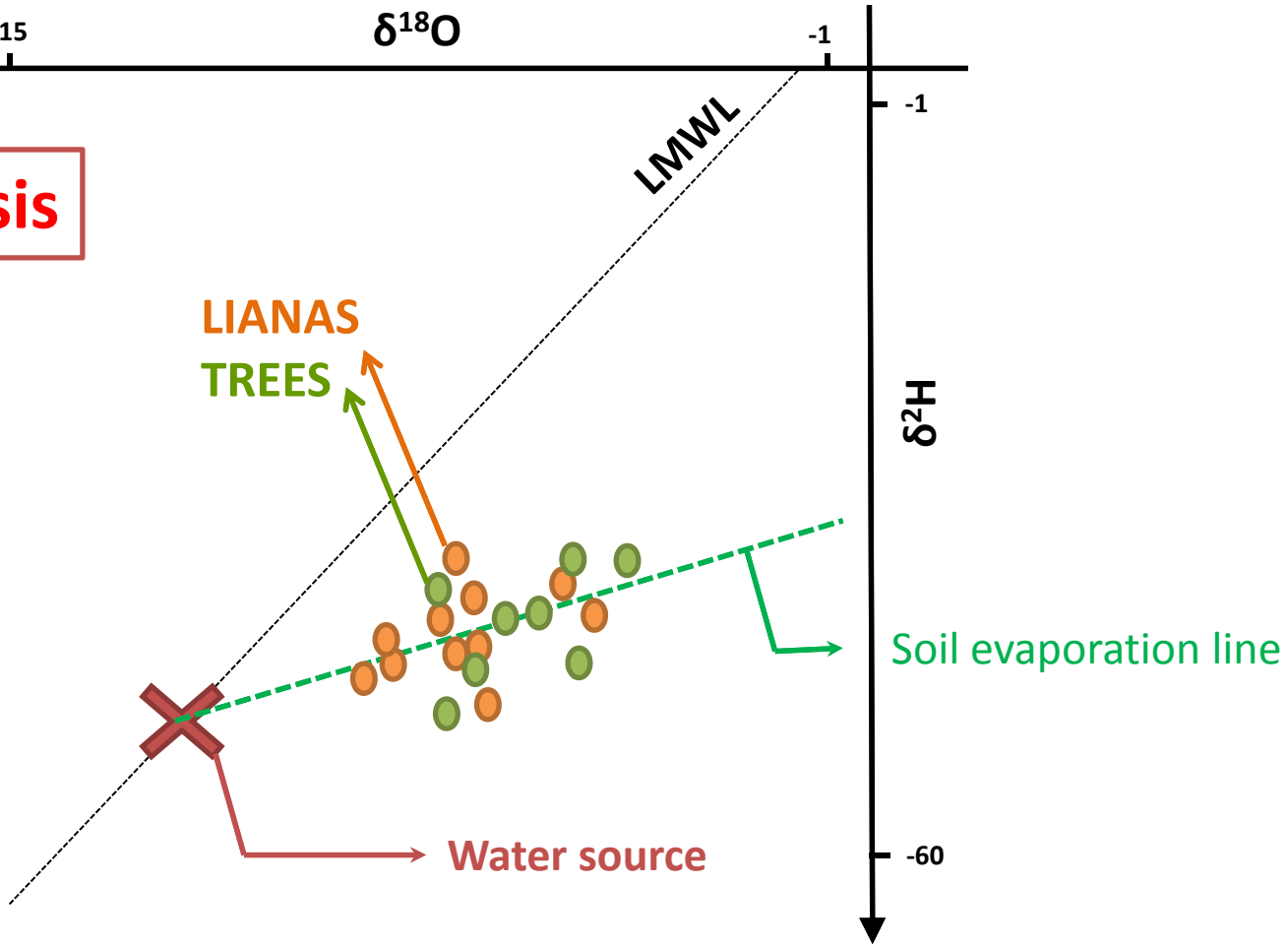
H7

Sxw#vrlo#zdwhu#iljxuhv/#pruh#dqg

Kdqqhv>#4923925349

Dual isotope-based studies: $\delta^{18}O$ & $\delta^{2}H$

Our hypothesis



Period:

- Oct. 2015

Catchments:

- White Sand (**Sand**)
- Oxysol (**Clay**)

Soil samples:

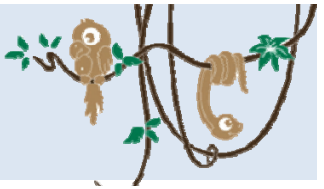
- 6 soil cores per catchment
- 0.1-0.2-0.3-0.45-0.6-0.9-1.2-1.8m

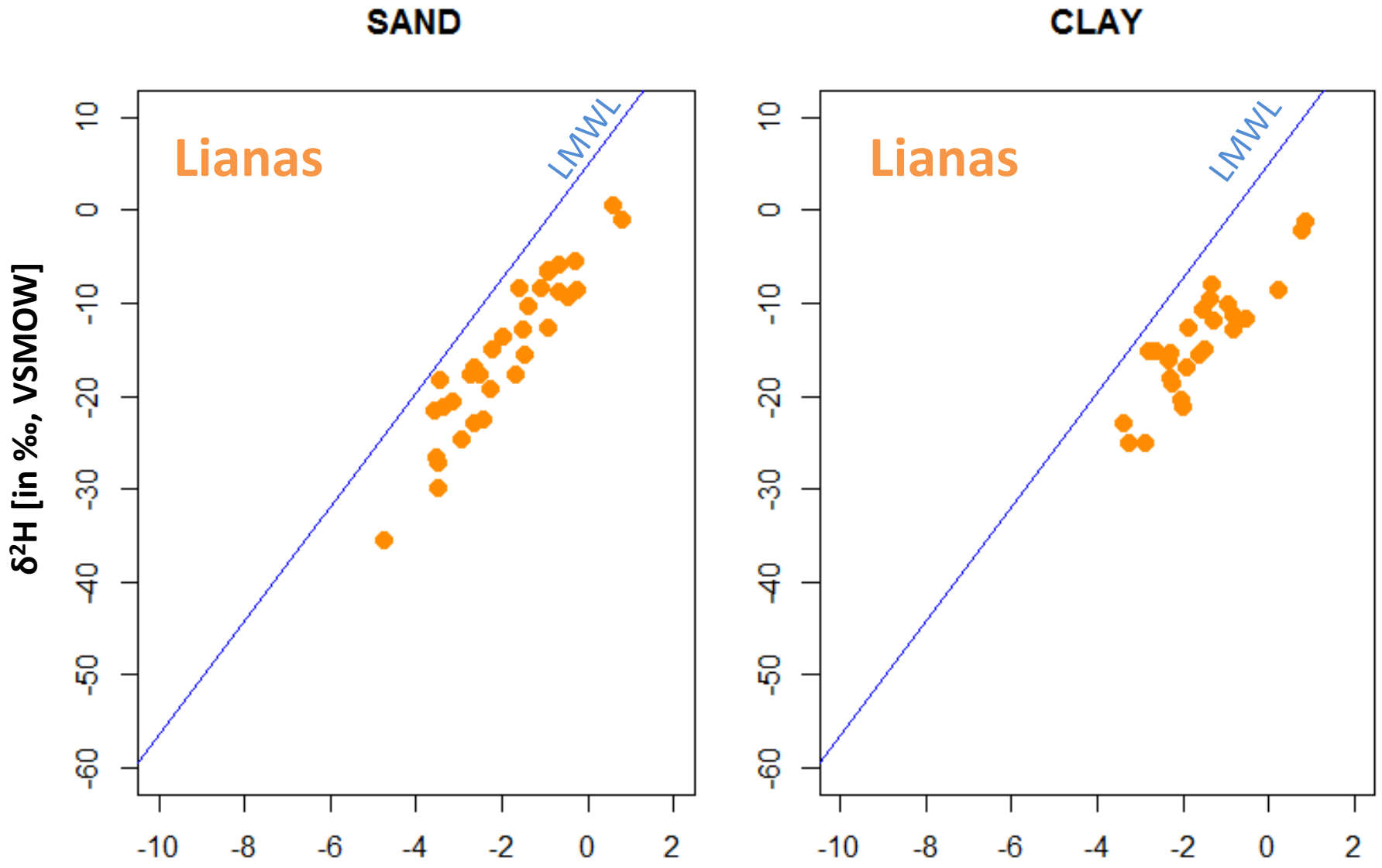
Tree samples:

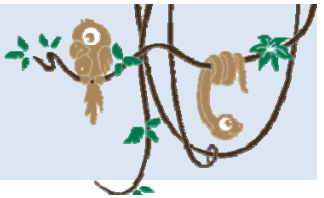
- cored xylem samples

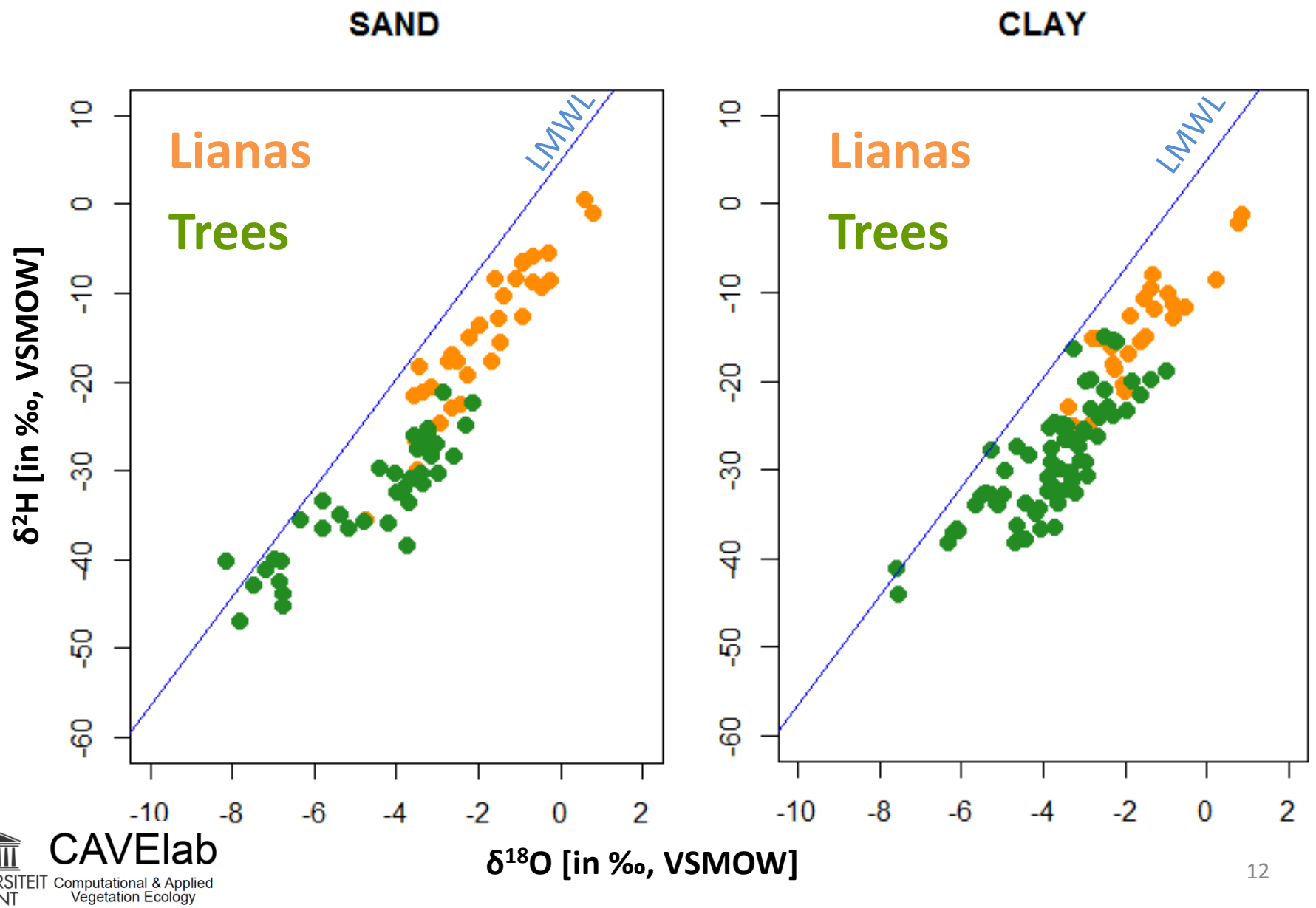
Liana samples:

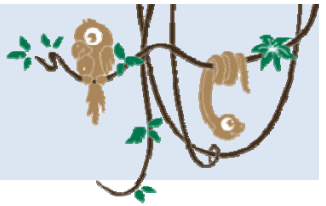
- in situ branch collection



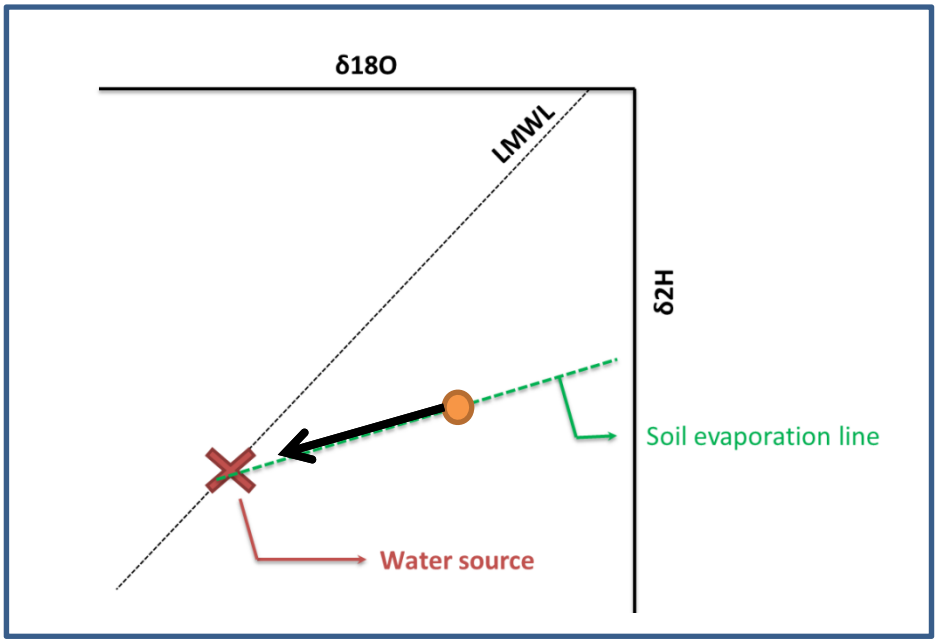

SAND
CLAY
Lianas
LMWL
Lianas
LMWL
δ²H [in ‰, VSMOW]
δ¹⁸O [in ‰, VSMOW]
10
0
-10
-20
-30
-40
-50
-60
-10
-8
-6
-4
-2
0
2




SAND
CLAY
Lianas
Trees
LMWL
δ²H [in ‰, VSMOW]
δ¹⁸O [in ‰, VSMOW]
10
0
-10
-20
-30
-40
-50
-60
-10
-8
-6
-4
-2
0
2



Backtracking the source



Global prediction of δ_A and δ^2H-$\delta^{18}O$ evaporation slopes for lakes and soil water accounting for seasonality

J. J. Gibson,[1,2] S. J. Birks,[3,4] and T. W. D. Edwards[4]

Received 19 April 2007; revised 21 January 2008; accepted 7 February 2008; published 28 June 2008.

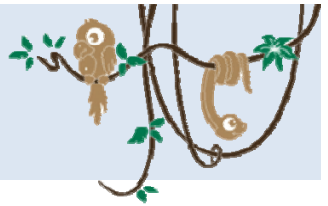
$$S_{LEL} = \frac{\left[\frac{h(\delta_A - \delta_P) + (1+\delta_P)(\varepsilon_K + \varepsilon^+/\alpha^+)}{h - \varepsilon_K - \varepsilon^+/\alpha^+}\right]_2}{\left[\frac{h(\delta_A - \delta_P) + (1+\delta_P)(\varepsilon_K + \varepsilon^+/\alpha^+)}{h - \varepsilon_K - \varepsilon^+/\alpha^+}\right]_{18}}$$

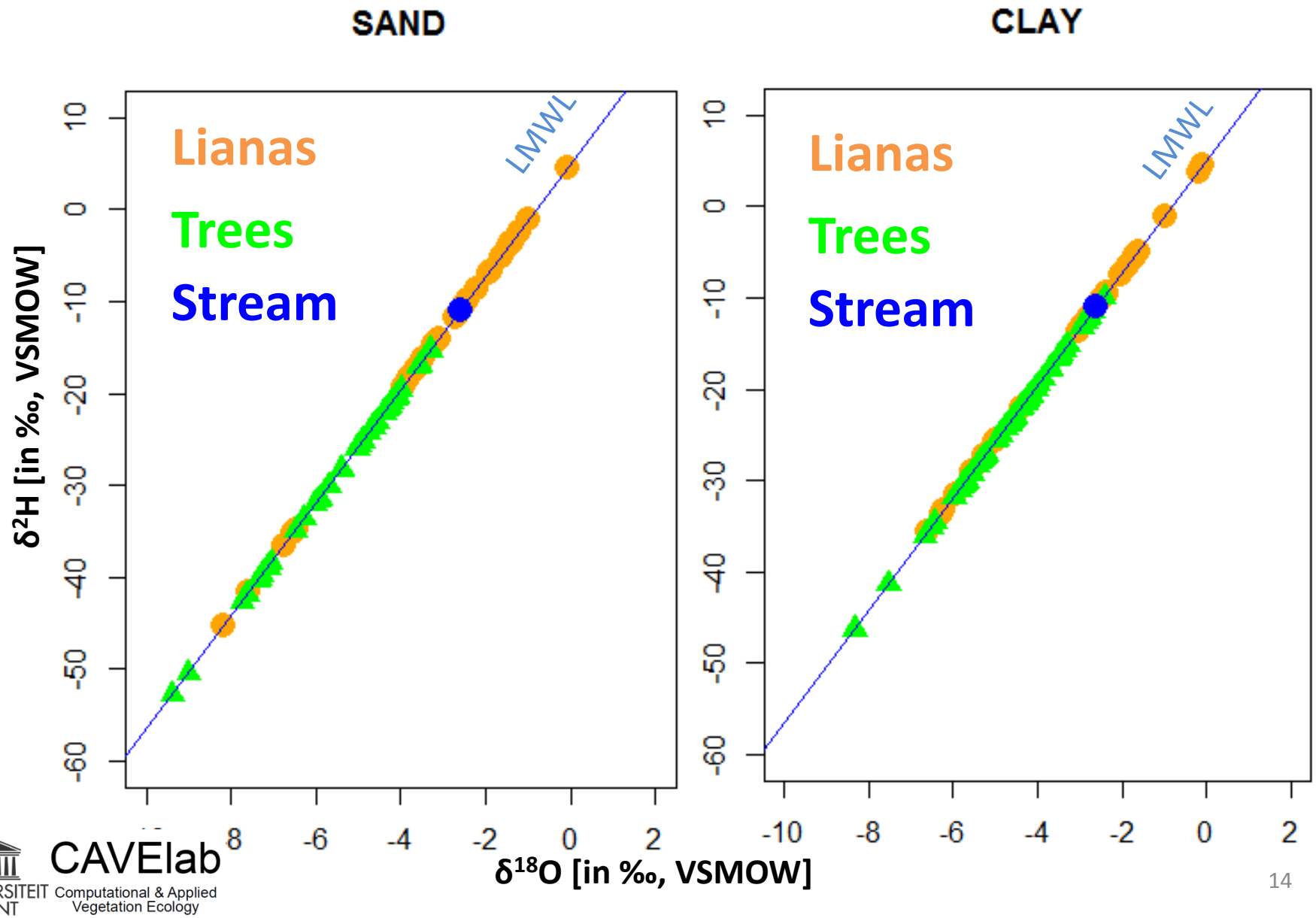
➡ S_{LEL} = 2.8

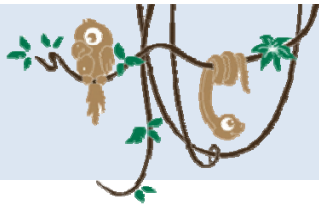
Diapositive 13

H5 U#ydoxhv#elm#olmqhq#

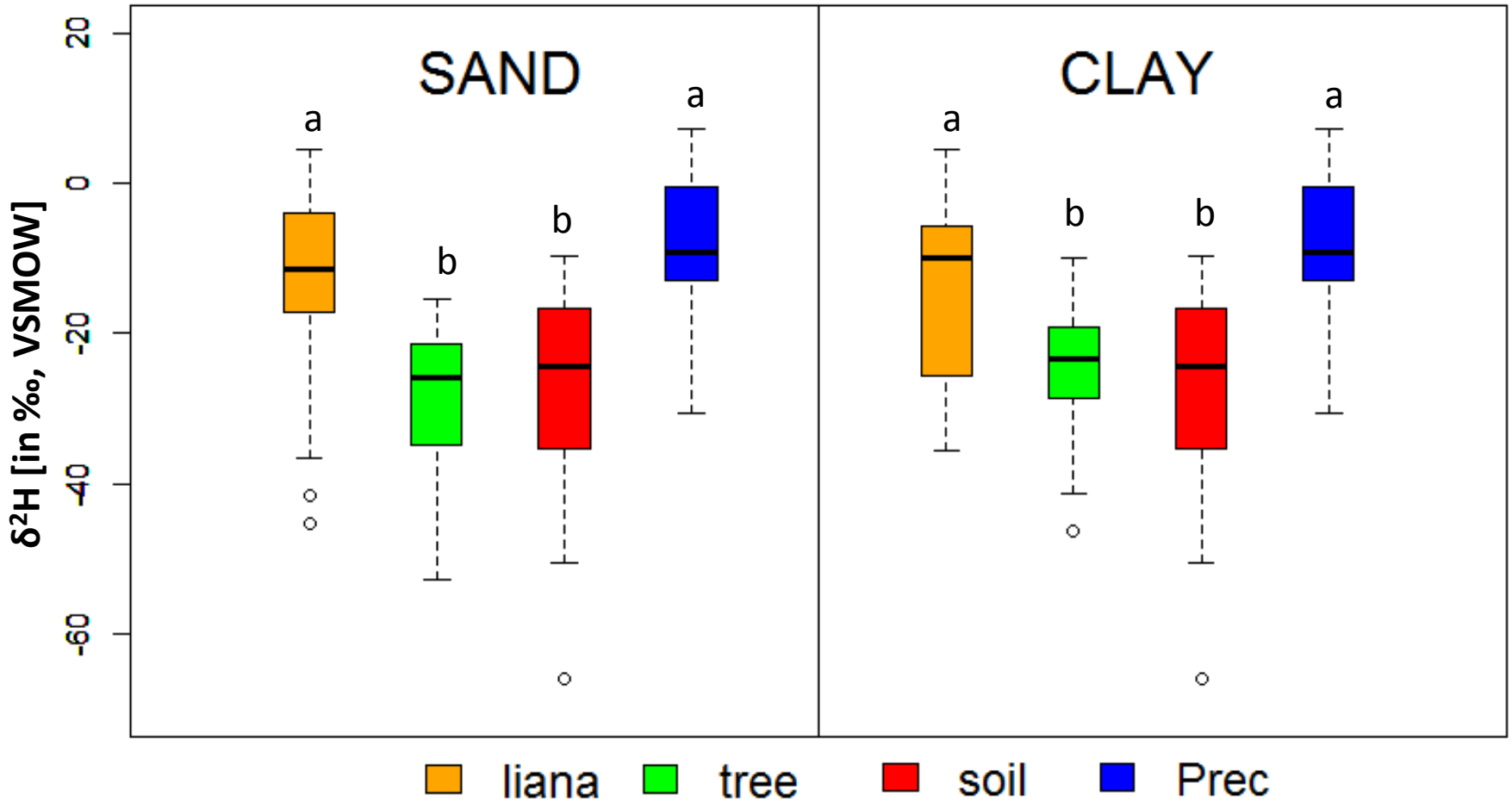
Kdqqhv>#4623925349

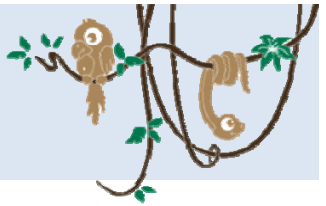



SAND
CLAY
Lianas
Trees
Stream
LMWL
δ²H [in ‰, VSMOW]
δ¹⁸O [in ‰, VSMOW]
10
0
-10
-20
-30
-40
-50
-60
-10
-8
-6
-4
-2
0
2



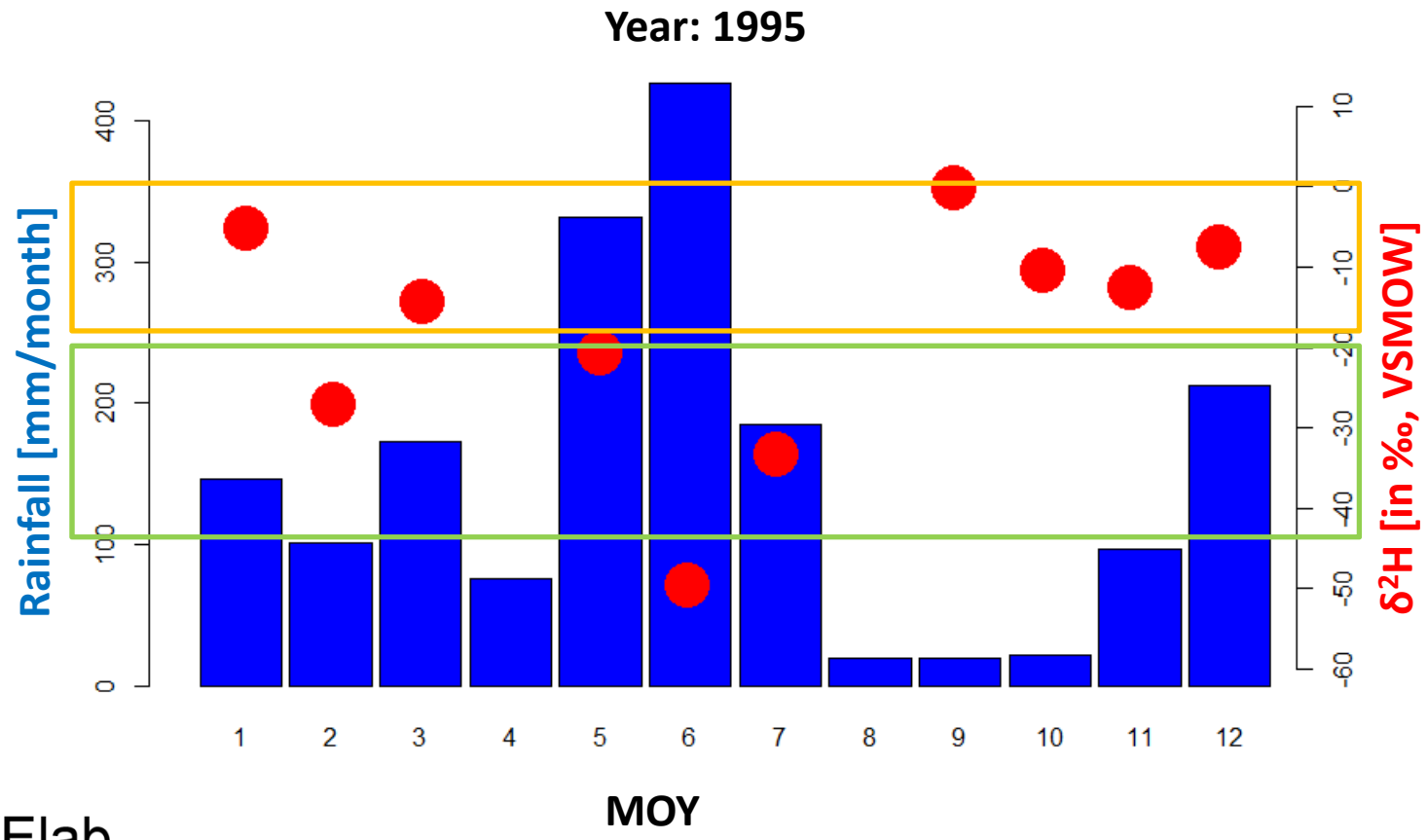
Projected δ^2H





Plausible explanation lies in seasonal replenishment of water compartments

Suzini data



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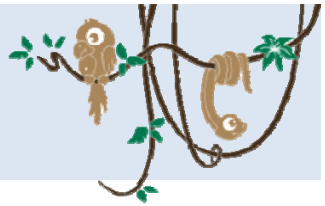
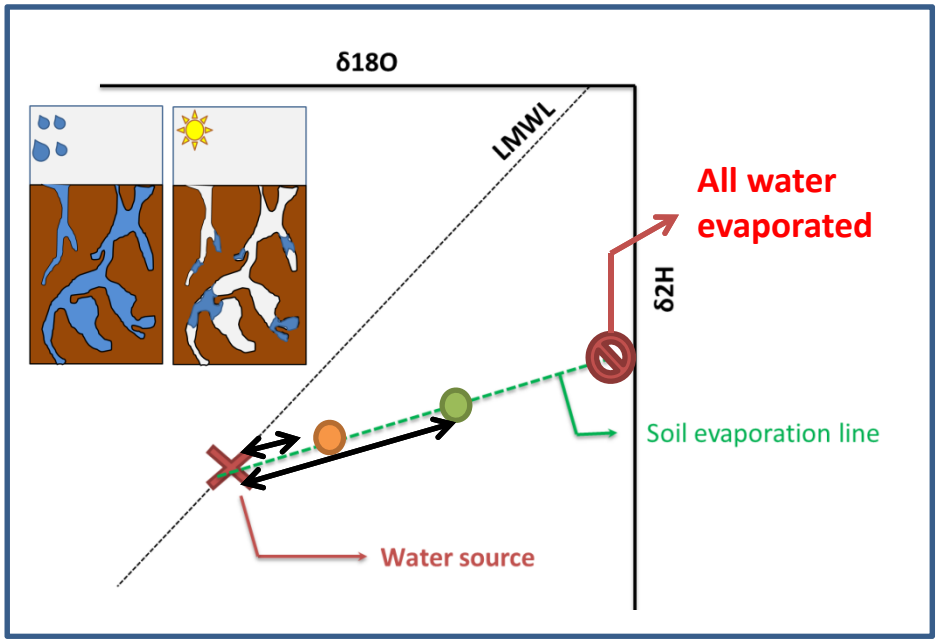
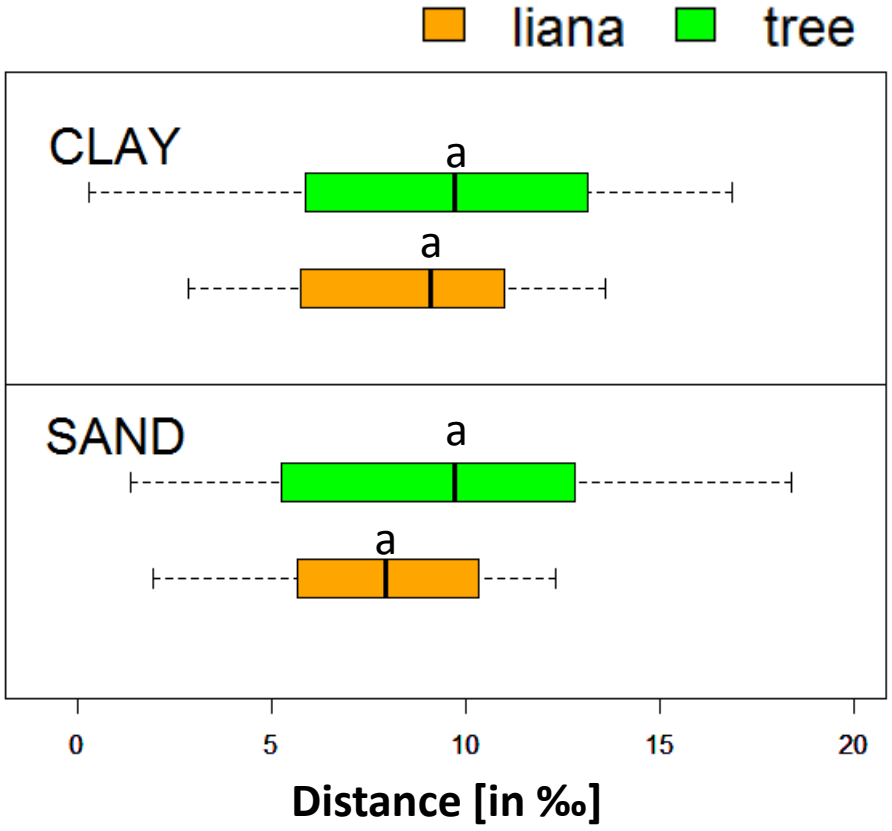


Backtracking extractable range





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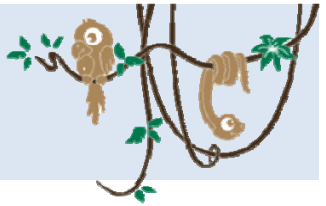

Plausible explanation in the difference in mycorrhizal colonization

Oecologia (2016) 180:1037–1047
DOI 10.1007/s00442-015-3410-7

CrossMark

HIGHLIGHTED STUDENT RESEARCH

Root and leaf traits reflect distinct resource acquisition strategies in tropical lianas and trees

Courtney G. Collins[1] · S. Joseph Wright[2] · Nina Wurzburger[1]

Compared to trees, lianas possessed higher specific leaf area, specific root length, root branching intensity, and root nitrogen (N) and phosphorus (P) concentrations, and lower leaf and root tissue density, leaf and root carbon (C), root diameter, root C:P and N:P, and mycorrhizal colonization. Our study provides new evidence that liana leaf and

Conclusion

- Lianas and trees **tap different precipitation water source**, with lianas tapping heavier water
- Different isotopic singature in lianas and trees might be linked to **seasonaly replenishment of specific water compartments**
- Trees seem to have a **broader extractable range** (mobile-static water)
  → probably linked to the interaction with mycorrhizae
- Dual isotope study is a **usefull and easy practice** in ecohydrology studies and understanding


Thanks for your attention,
any questions?
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