



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

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HAL Id: hal-02796283

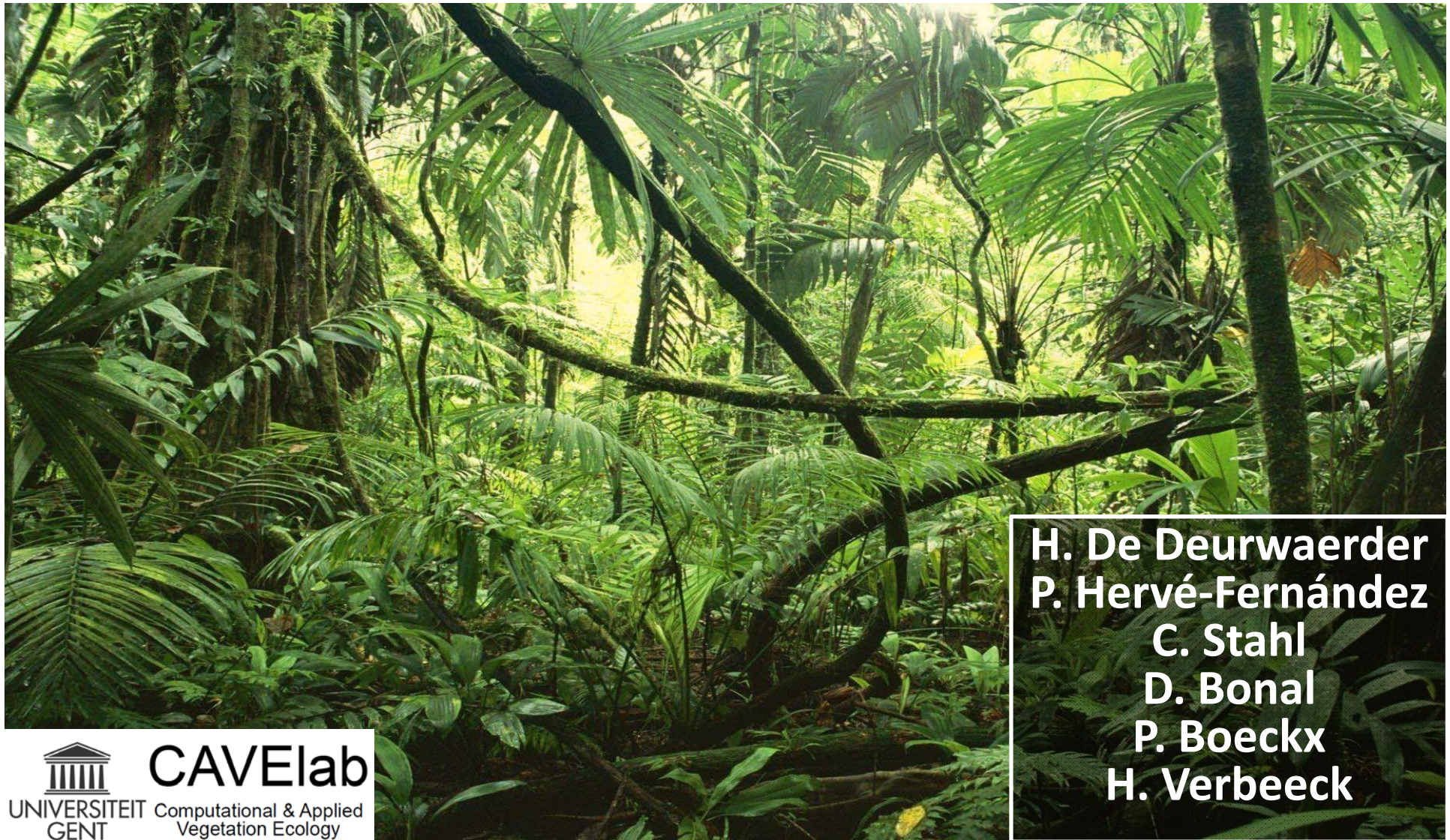
<https://hal.inrae.fr/hal-02796283>

Submitted on 5 Jun 2020

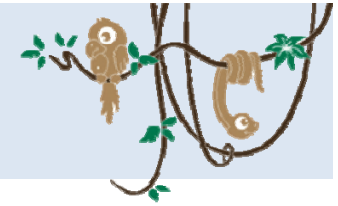
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Tapping another source: below ground water competition between lianas & trees



H. De Deurwaerder
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H. Verbeeck



Increasing dominance of large lianas in Amazonian forests

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† Jardín Botánico de Missouri, Jaén, Peru

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\$ Museo de Historia Natural Noel Kempff Mercado, Santa Cruz, Bolivia

|| 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,

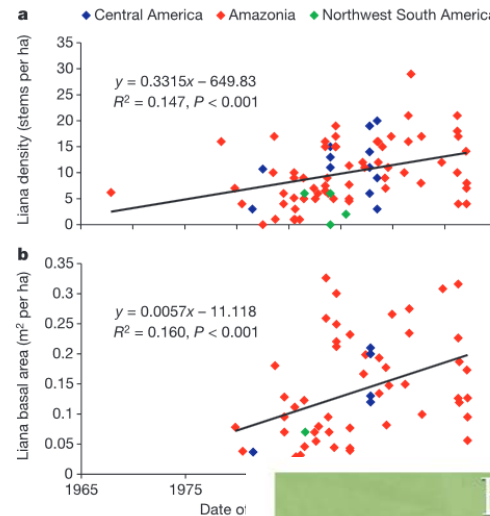
Escuela de Biología de la Universidad Central del Ecuador, Quito, Ecuador

†† New York Botanical Garden, Bronx, New York 10458, USA

§§ Department of Anthropology, New York University, New York 10003, USA

||| Natural History Museum, Smithsonian Institution, Washington DC 20560, USA

There has been concern in the past few decades that increases in liana densities might be anticipated¹⁹. Here we assemble several unique,



- Land-cover change
- Forest fragmentation
- Atmospheric CO₂ 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

Stefan A. Schnitzer^{1,2*} and Frans Bongers³

¹University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, Department of Biological Sciences, PO Box 413, 53201, USA

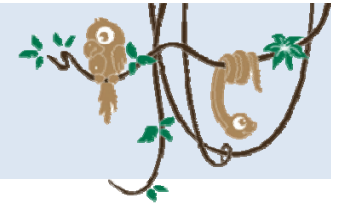
²Smithsonian Tropical Research Institute, Apartado 2072, Balboa, Republic of Panama

³Wageningen University, Centre for Ecosystem Studies, PO Box 47, 6700 AA Wageningen, The Netherlands

*Correspondence: E-mail: schnitzer@uwm.edu

Abstract

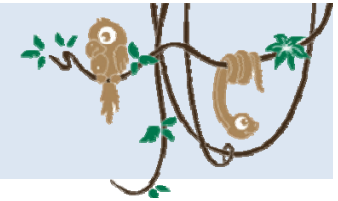
Tropical forests are experiencing large-scale structural changes, the most apparent of which may be the increase in liana (woody vine) abundance and biomass. Lianas permeate most lowland tropical forests, where they can have a huge effect on tree diversity, recruitment, growth and survival, which, in 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 CO₂. 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”





Framework

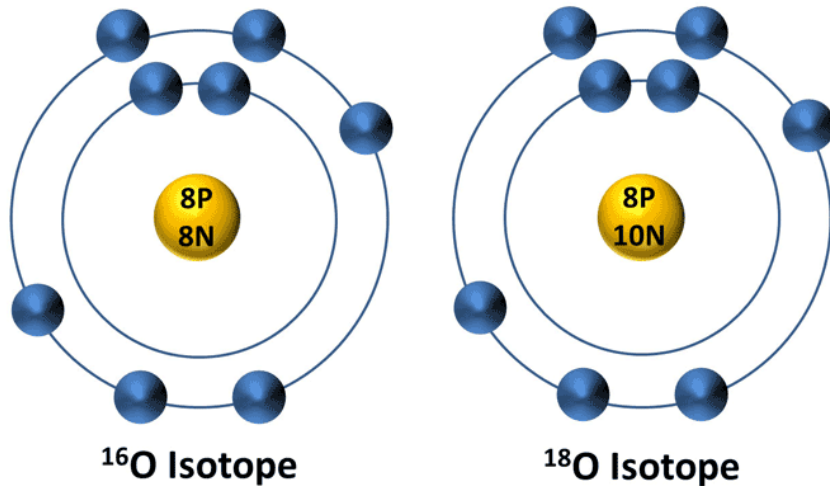
Setup

Results

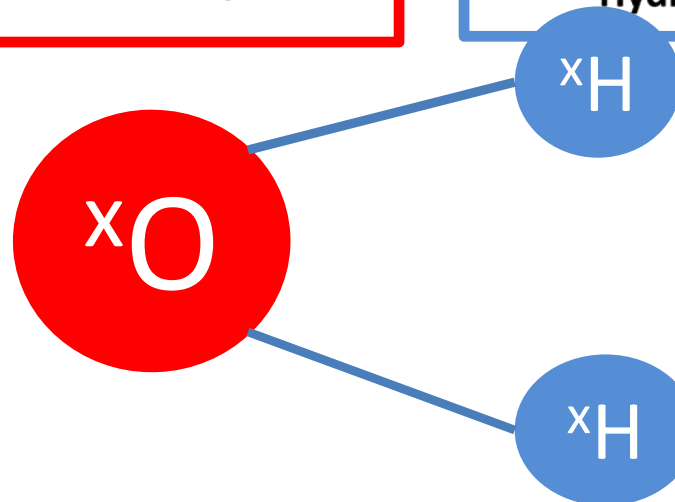
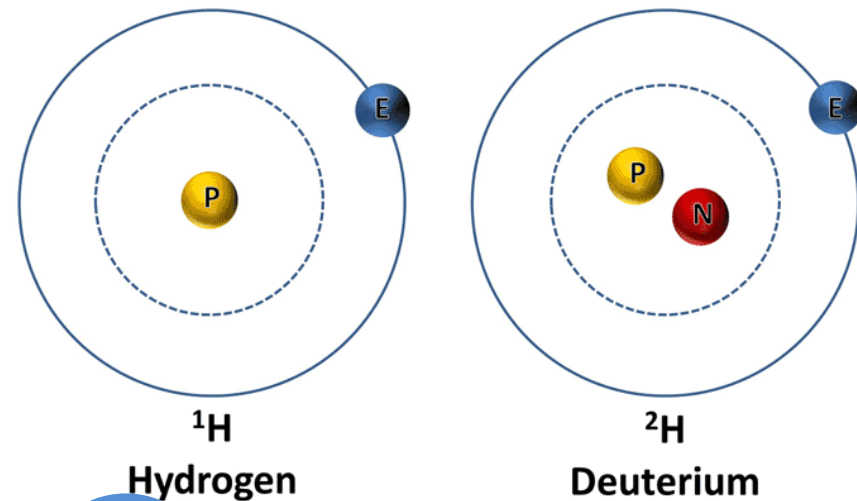
Conclusion

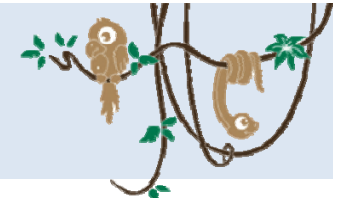
Dual isotope-based studies: $\delta^{18}\text{O}$ & $\delta^2\text{H}$

Oxygen Isotopes



Hydrogen Isotopes





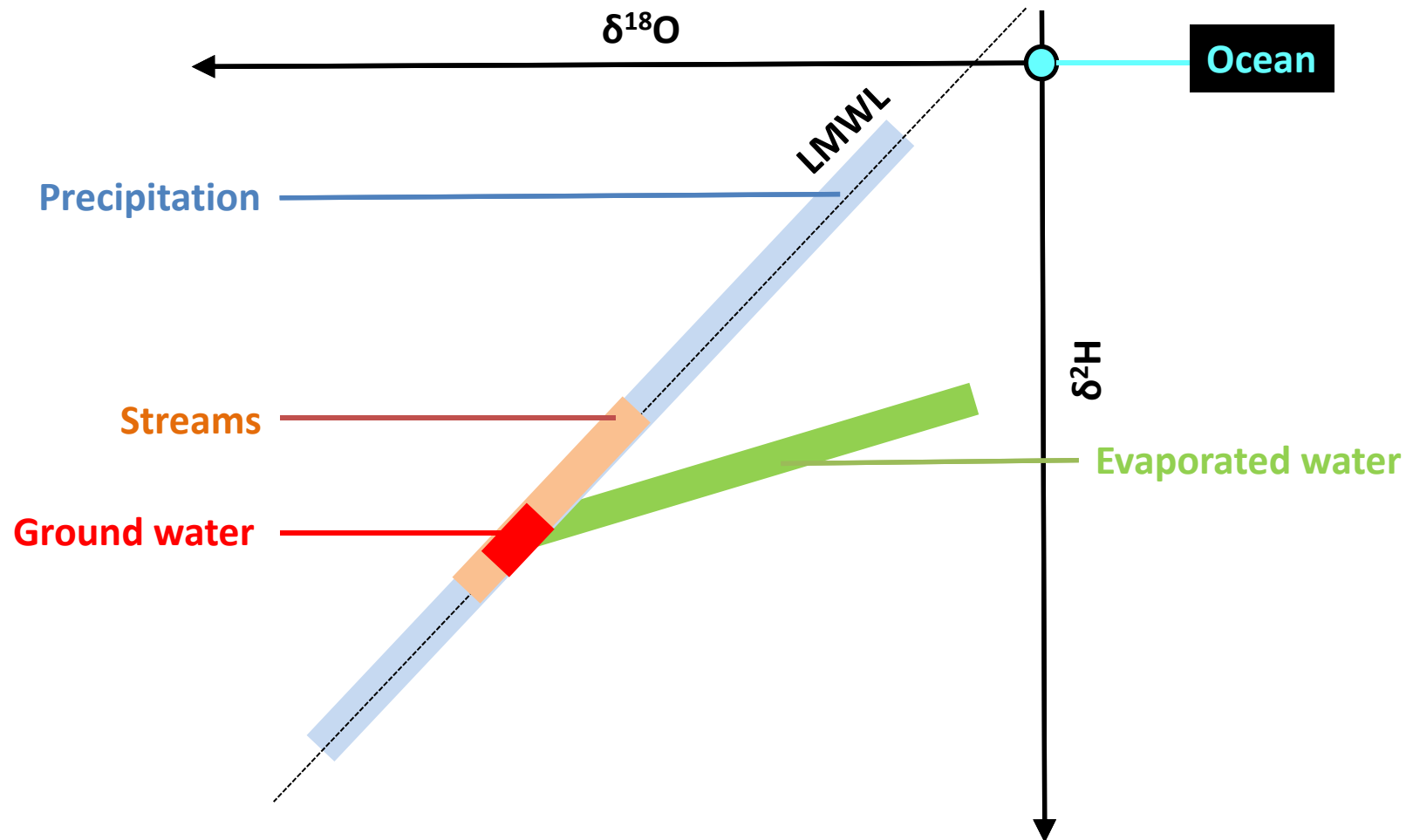
Framework

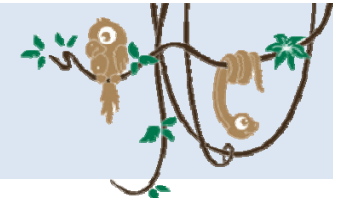
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Results

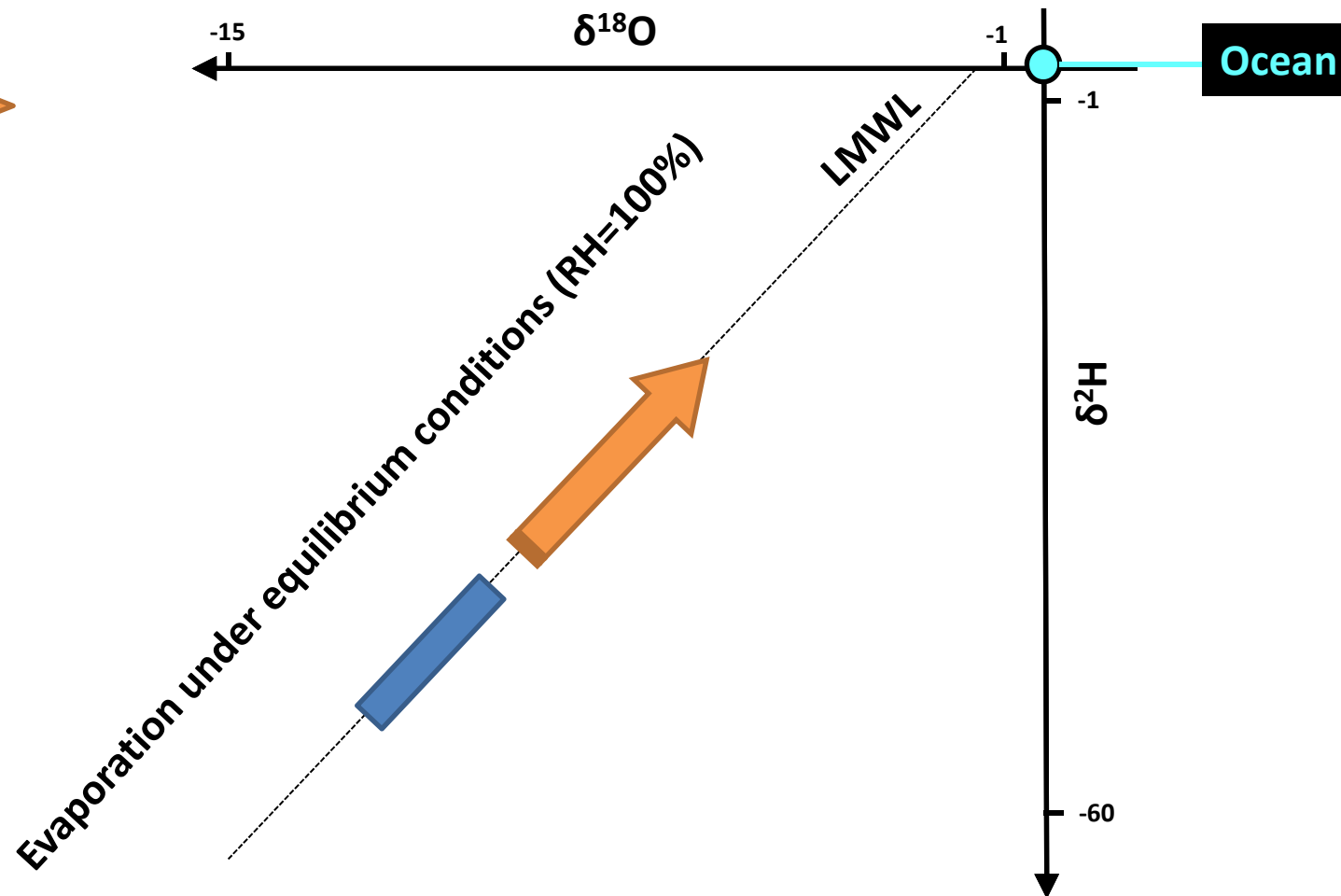
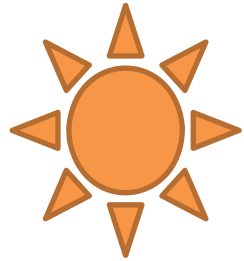
Conclusion

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





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





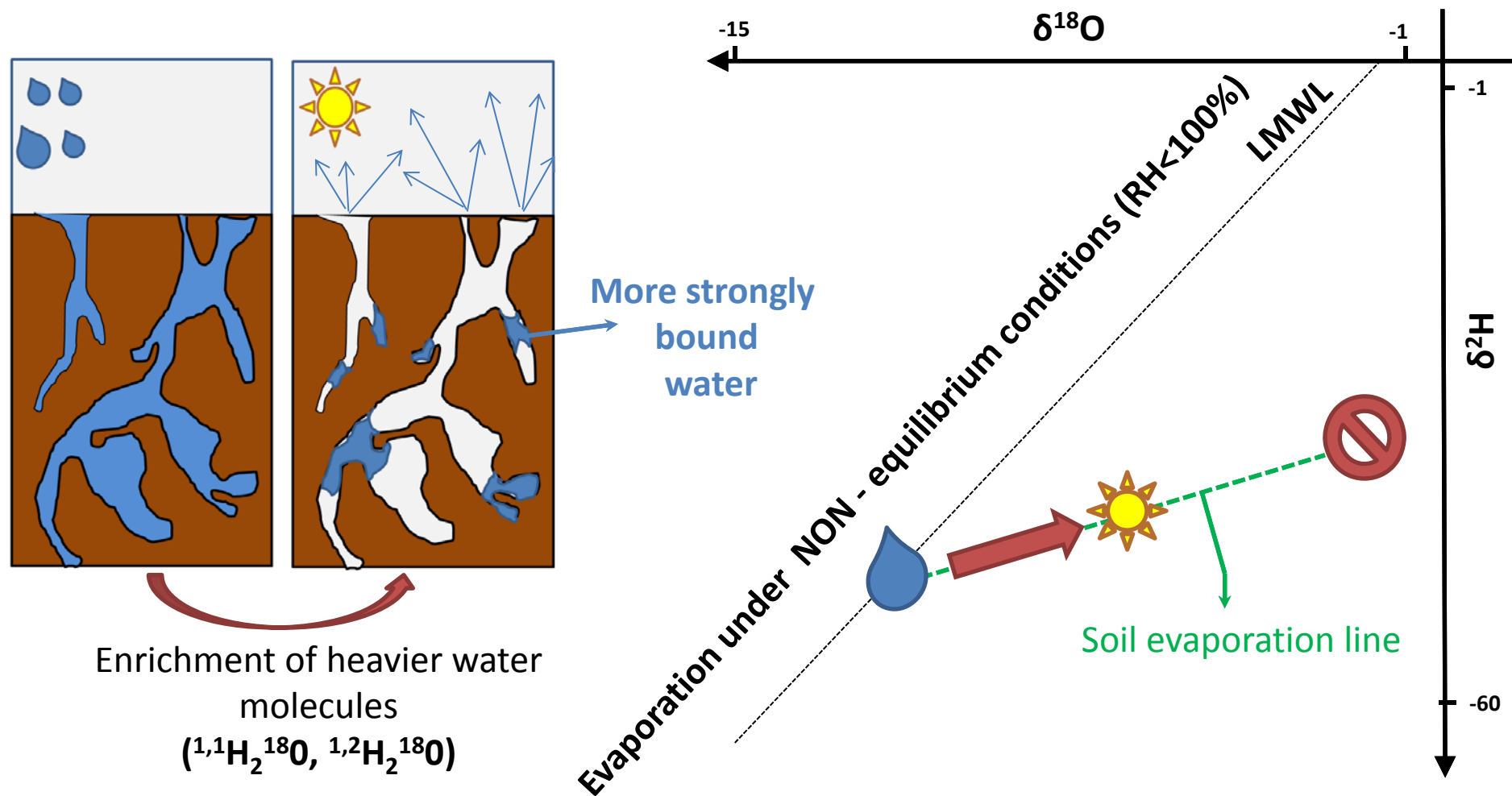
Framework

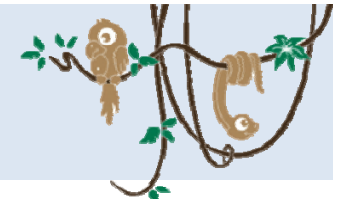
Setup

Results

Conclusion

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





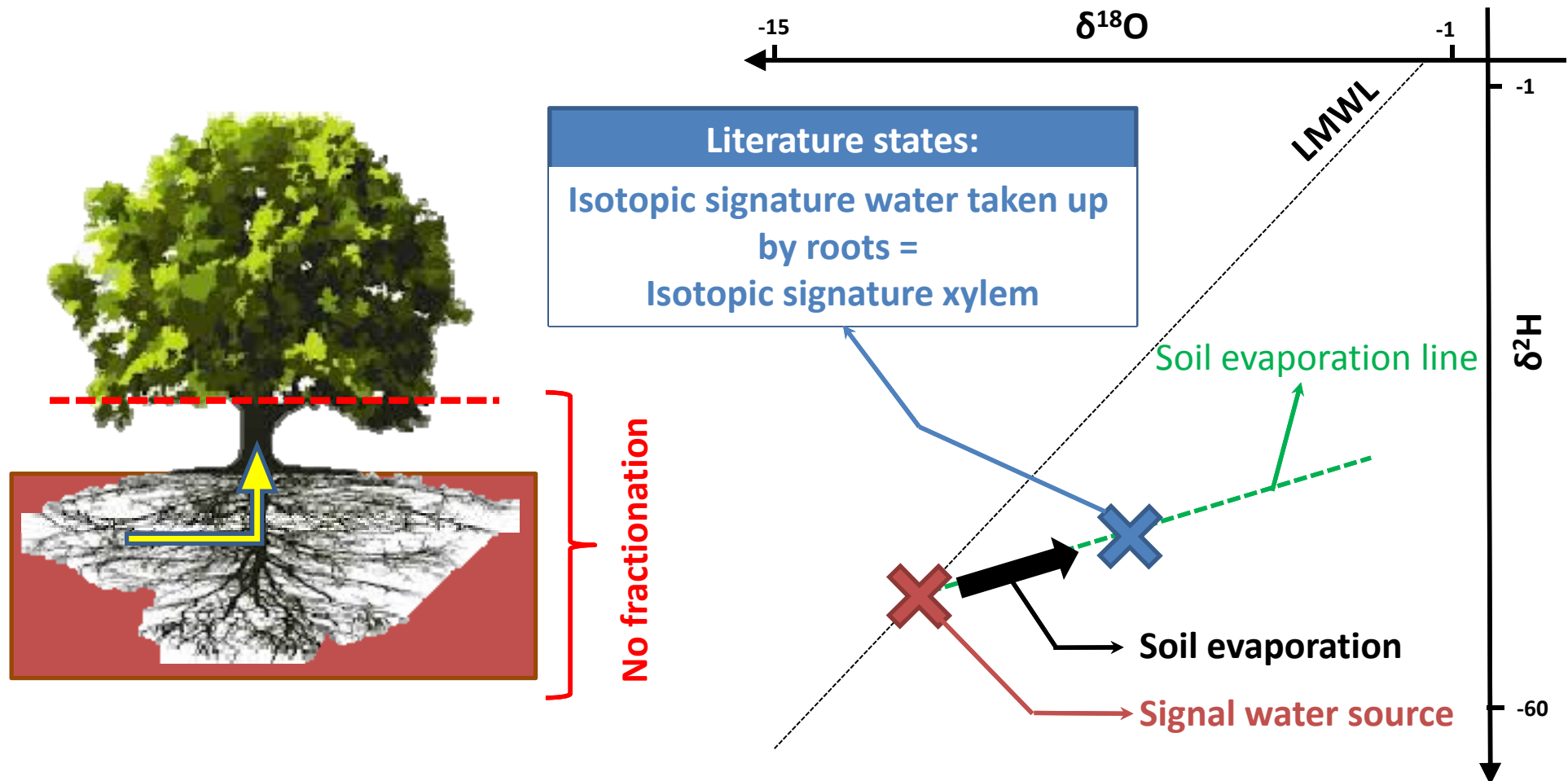
Framework

Setup

Results

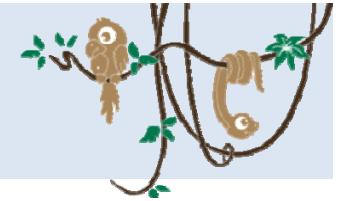
Conclusion

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



Diapositive 8

H7 Sxw#vrlo#zdwhu#iljxuhv/#pruh#dgg
Kdqqhv>#4923925349



Framework

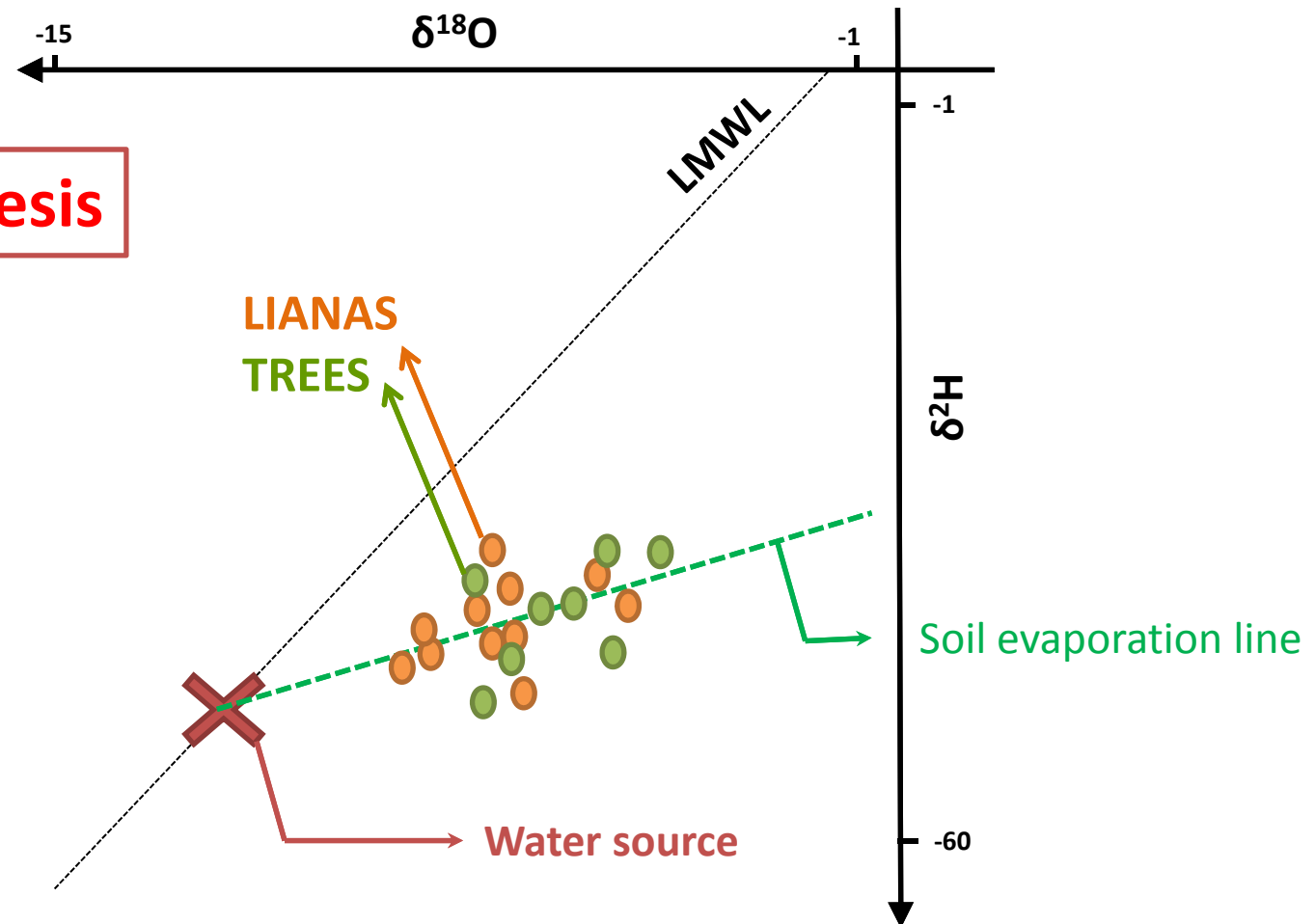
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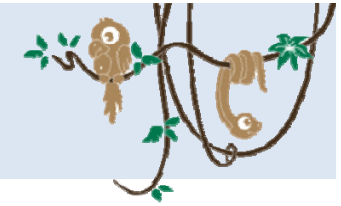
Results

Conclusion

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

Our hypothesis





Framework

Setup

Results

Conclusion



Period:

- Oct. 2015

Catchments:

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

Soil samples:

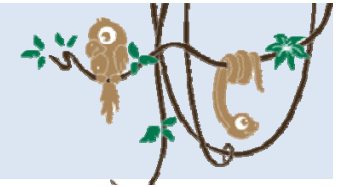
- 6 soil cores per catchment
- 0.1-0.2-0.3-0.45-0.6-0.9-1.2-1.8m

Tree samples:

- cored xylem samples

Liana samples:

- in situ branch collection



Framework

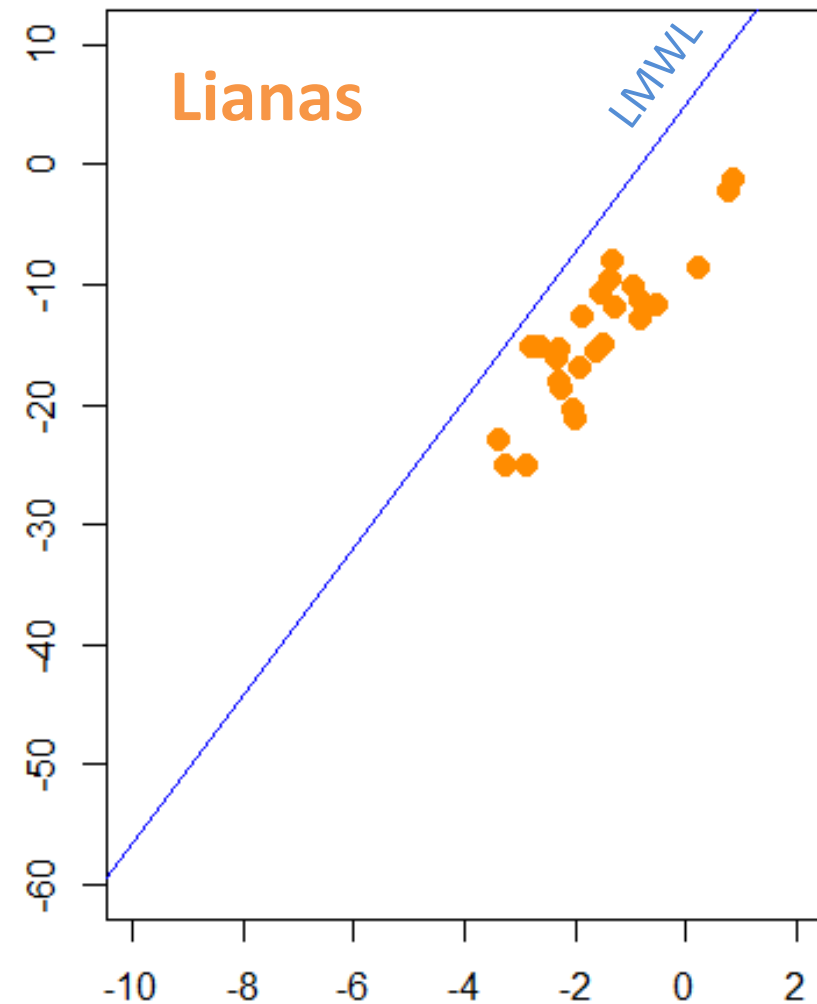
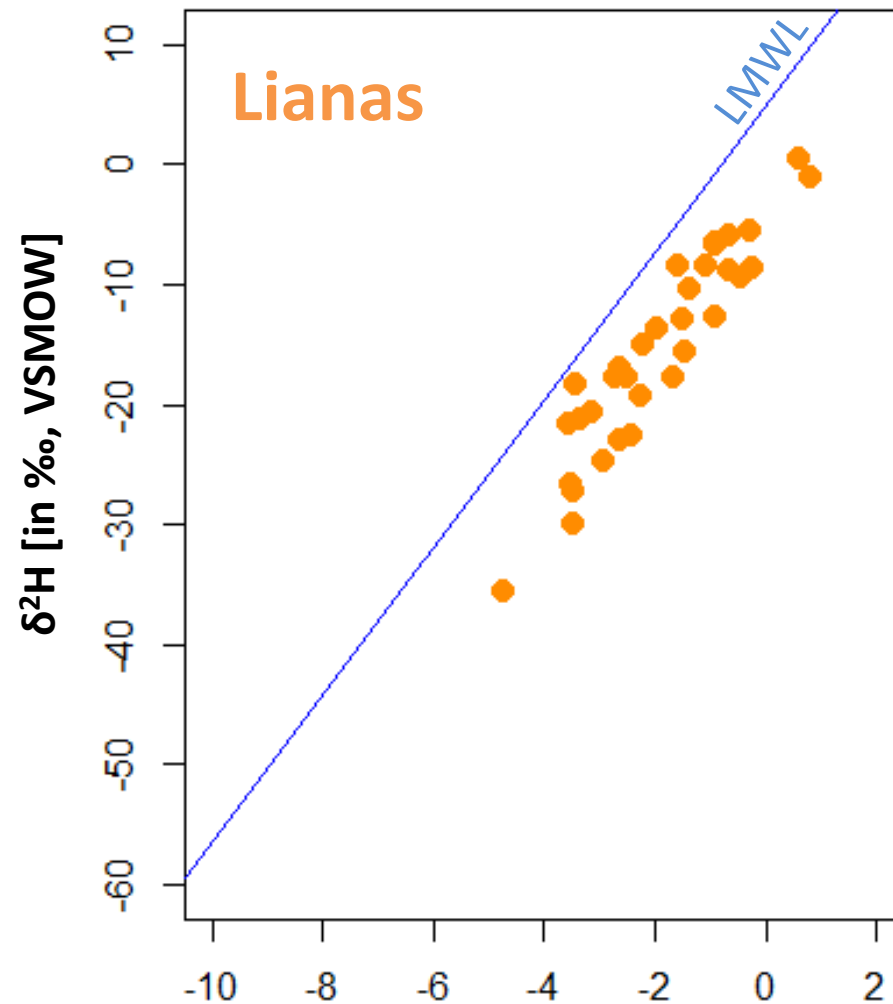
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Results

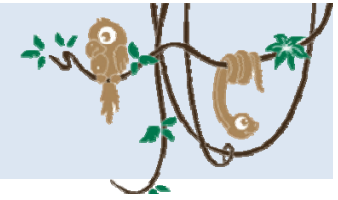
Conclusion

SAND

CLAY



$\delta^{18}\text{O}$ [in ‰, VSMOW]



Framework

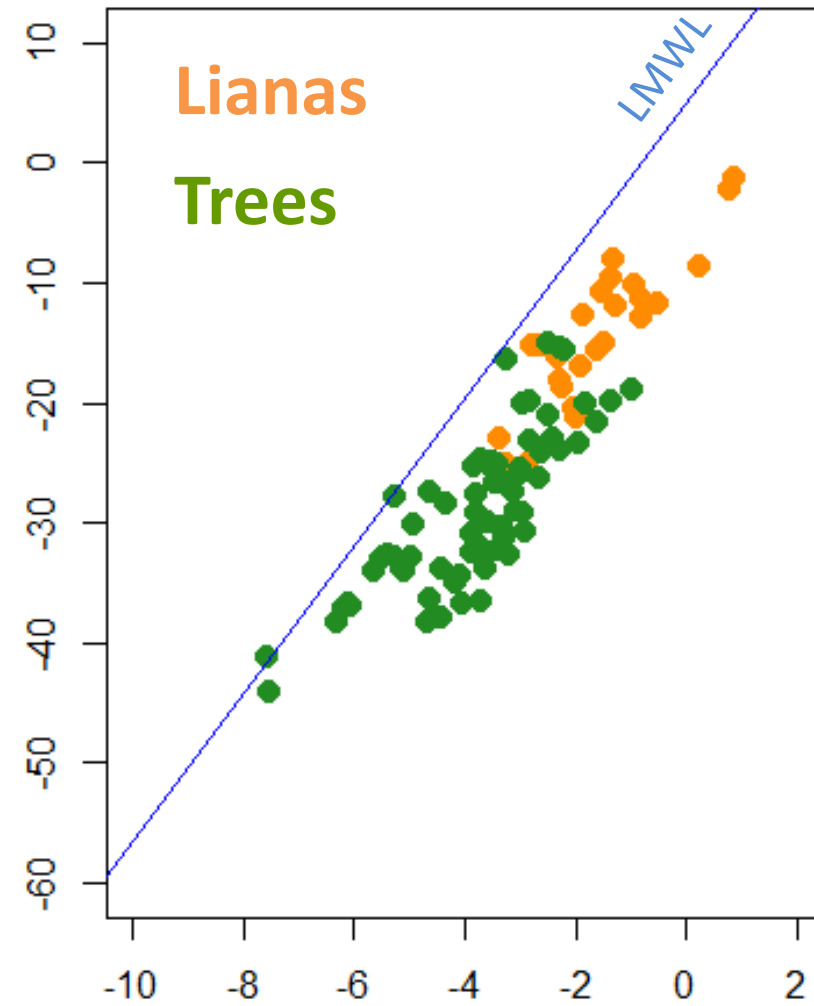
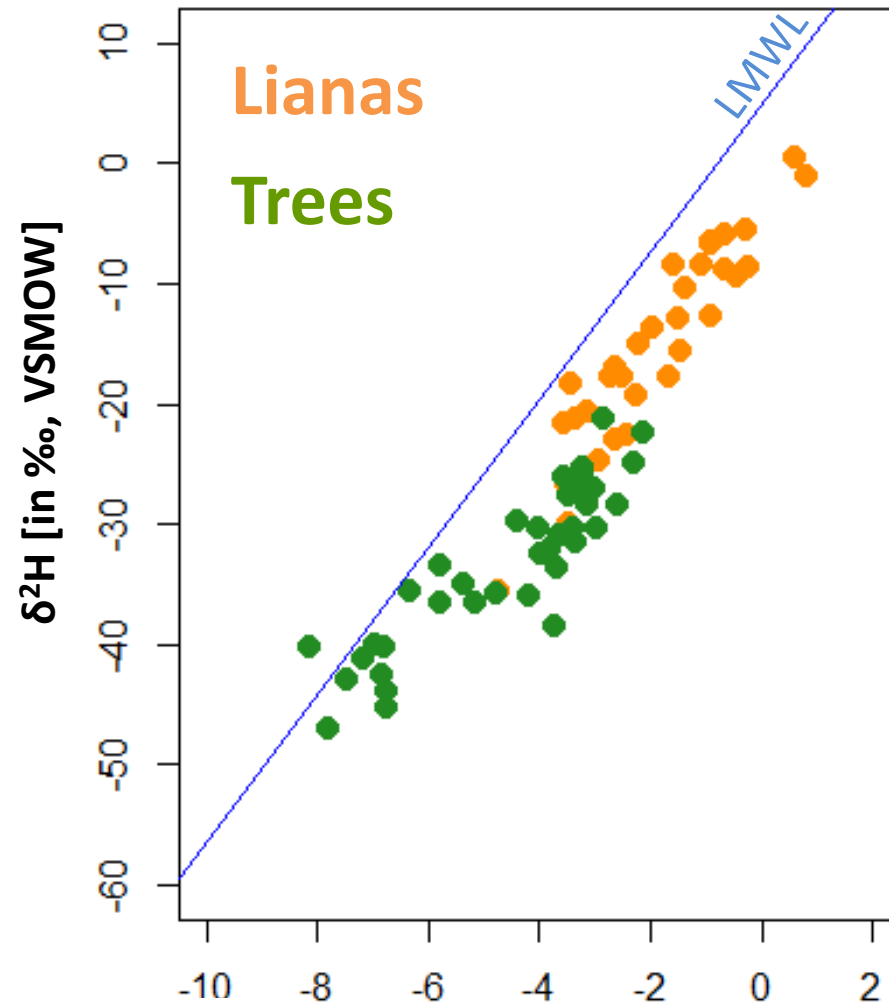
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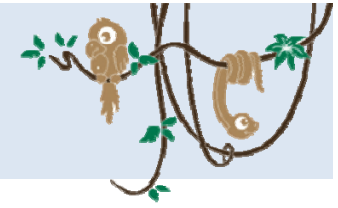
Results

Conclusion

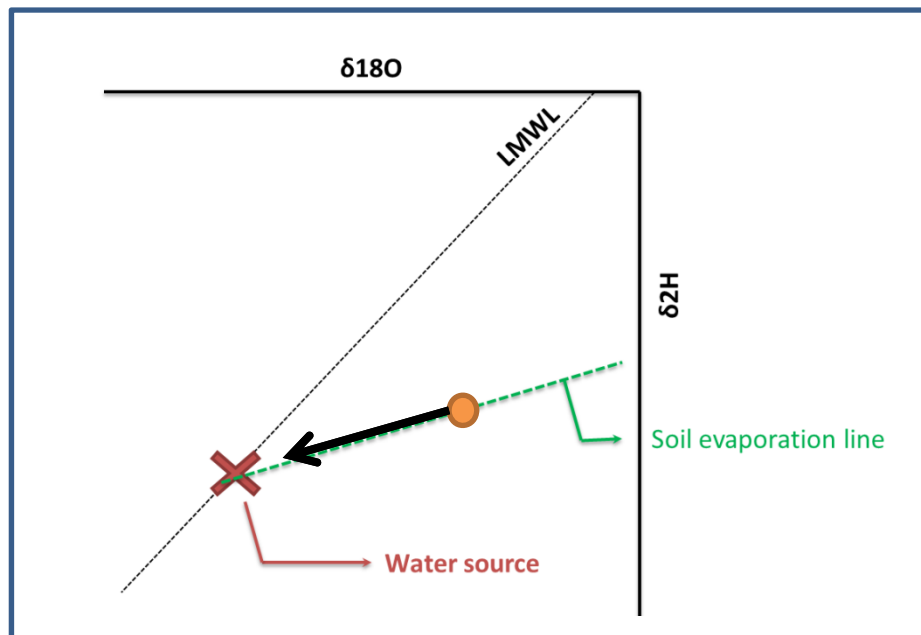
SAND

CLAY





Backtracking the source



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

J. J. Gibson,^{1,2} S. J. Birks,^{3,4} and T. W. D. Edwards⁴

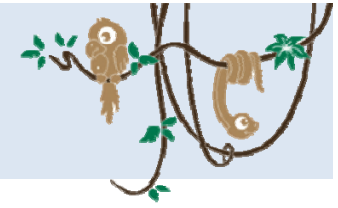
Received 19 April 2007; revised 21 January 2008; accepted 7 February 2008; published 28 June 2008.

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

$$\Rightarrow S_{LEL} = 2.8$$

Diapositive 13

H5 U#ydoxhv#elm#olmqhg#
Kdqghv>#4623925349



Framework

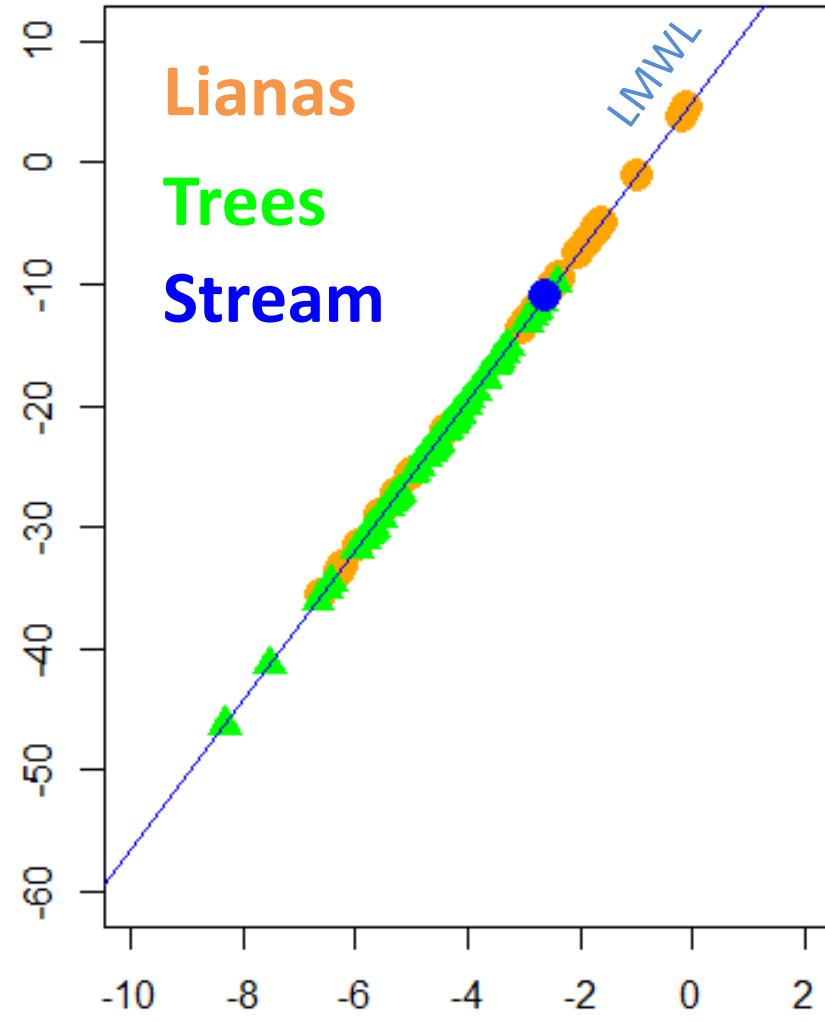
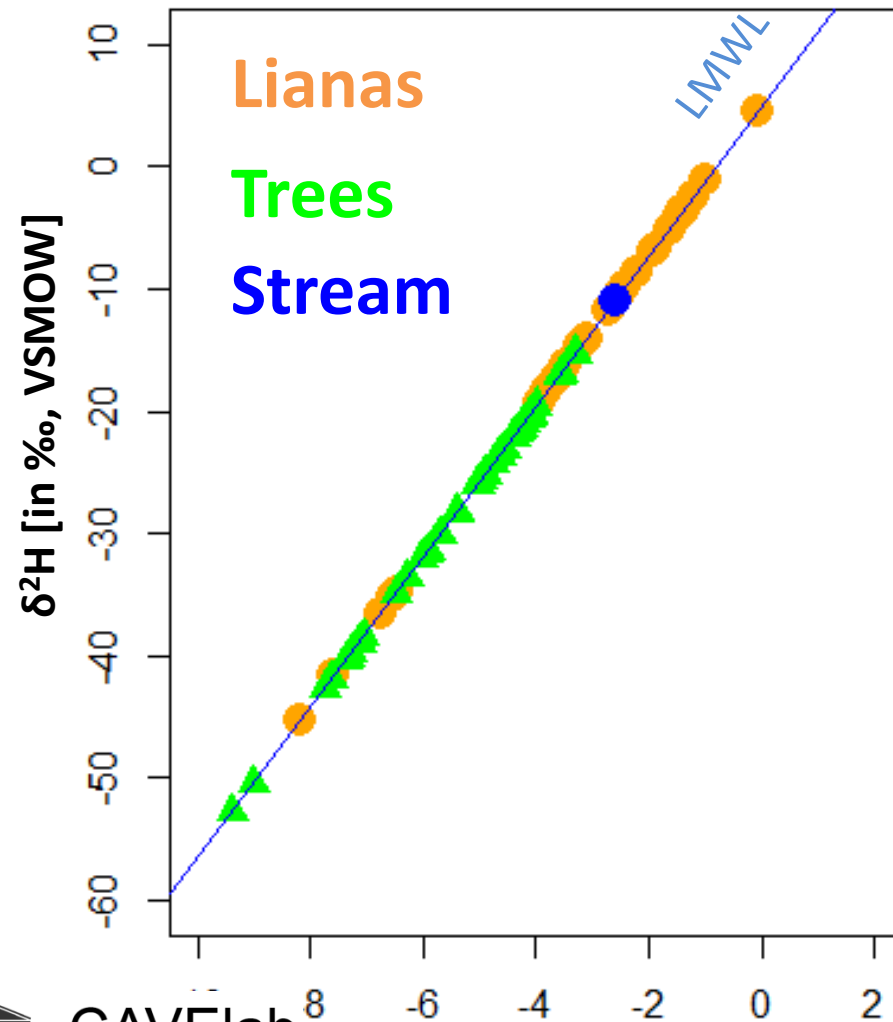
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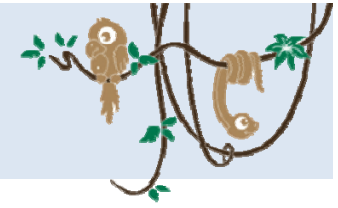
Results

Conclusion

SAND

CLAY





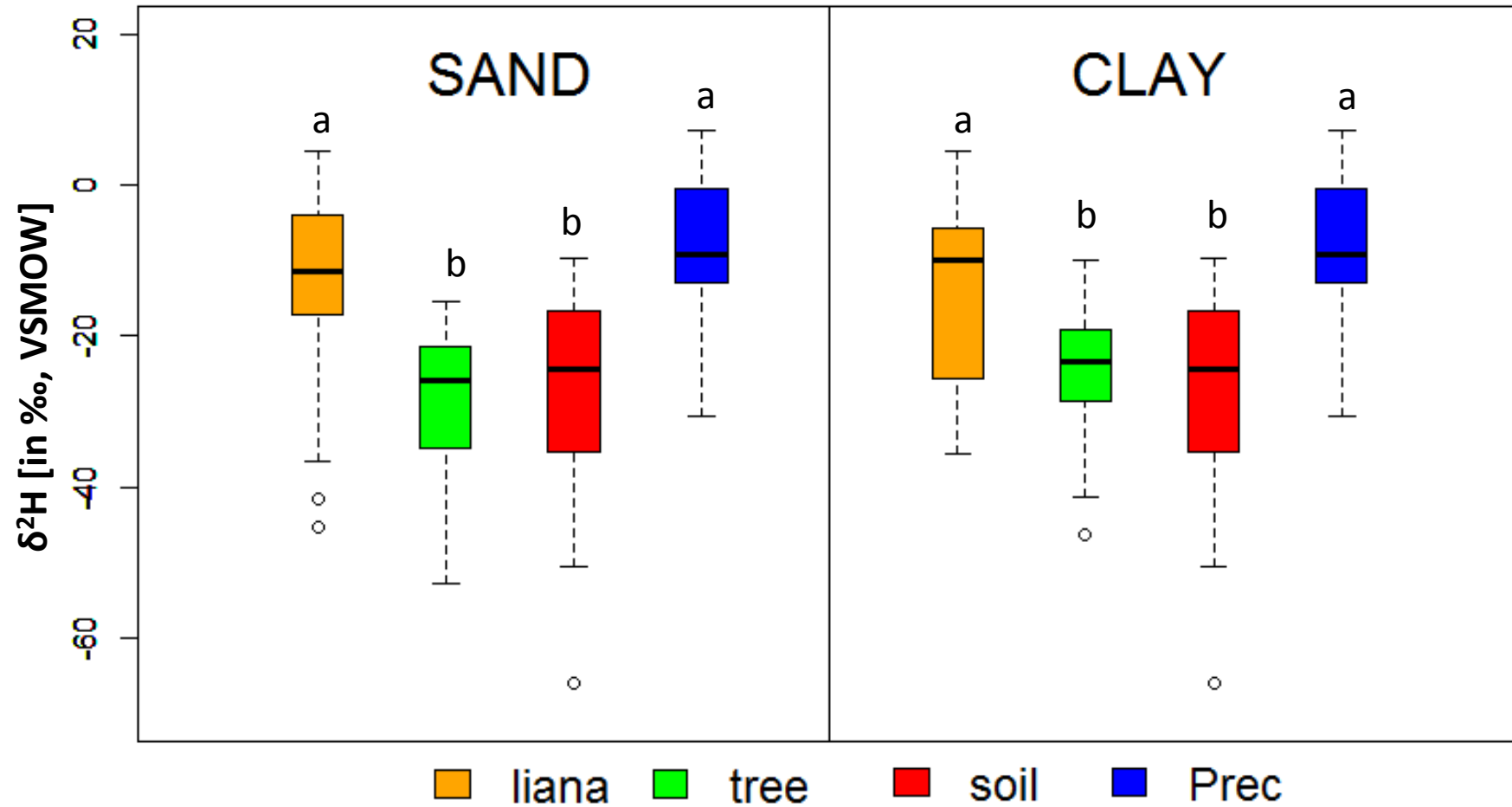
Framework

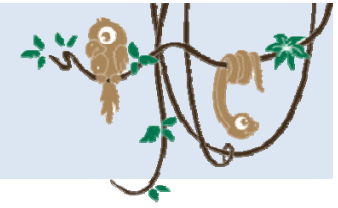
Setup

Results

Conclusion

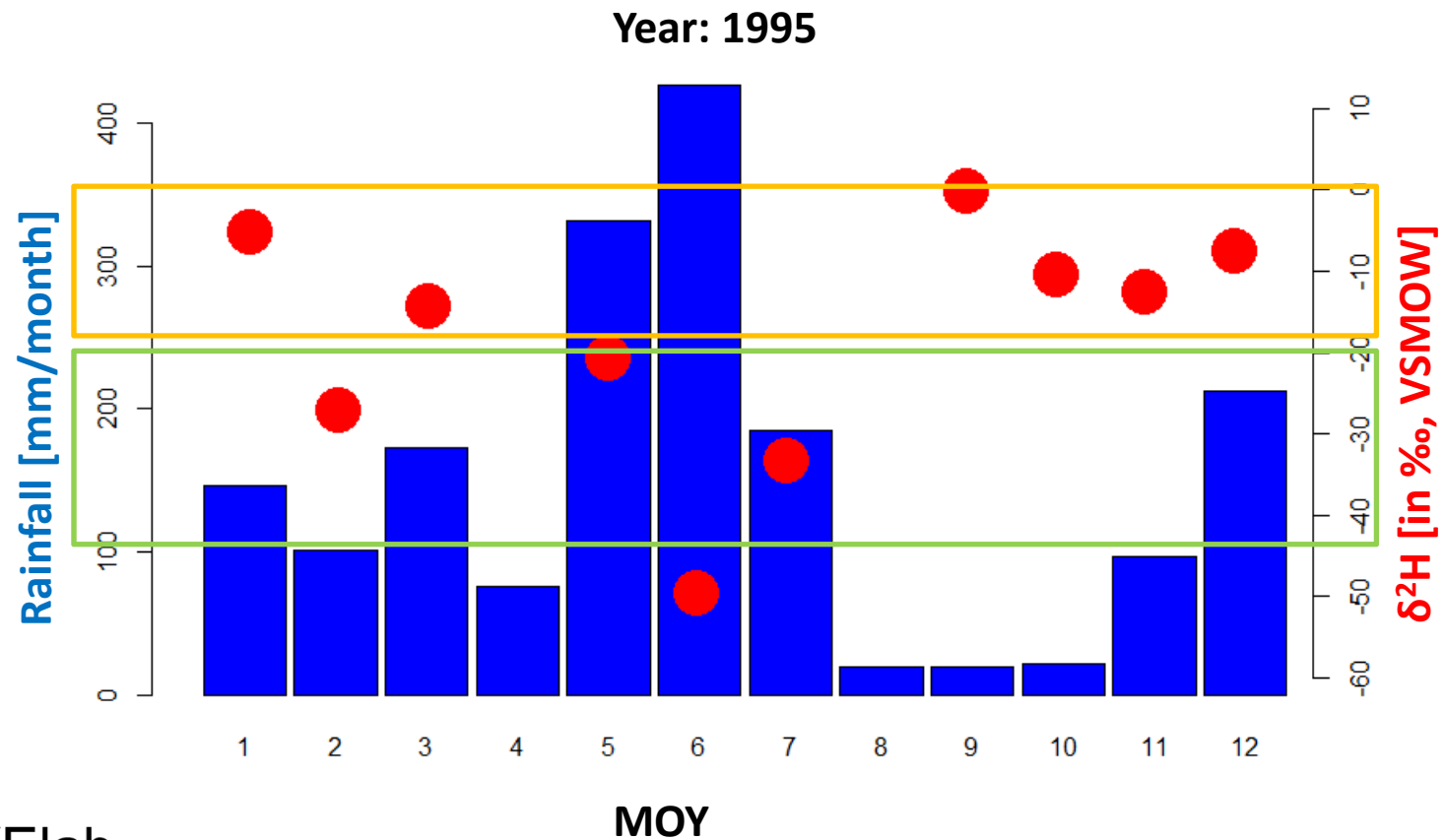
Projected $\delta^2\text{H}$

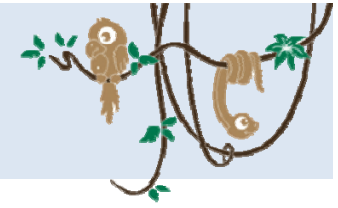




Plausible explanation lies in seasonal replenishment of water compartments

Suzini data





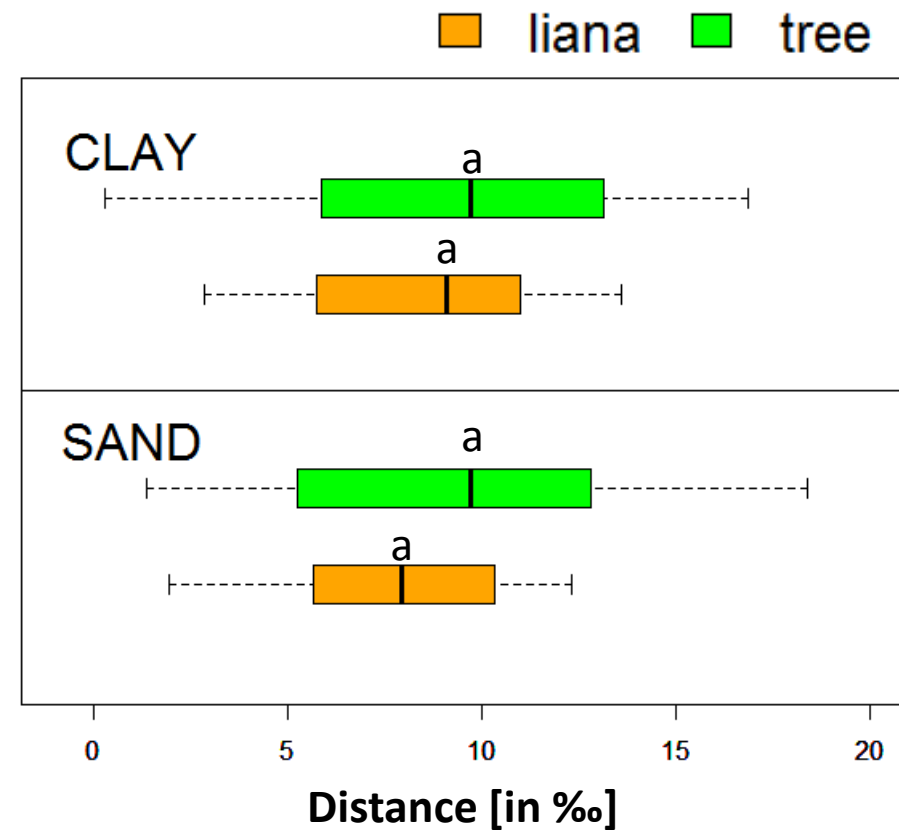
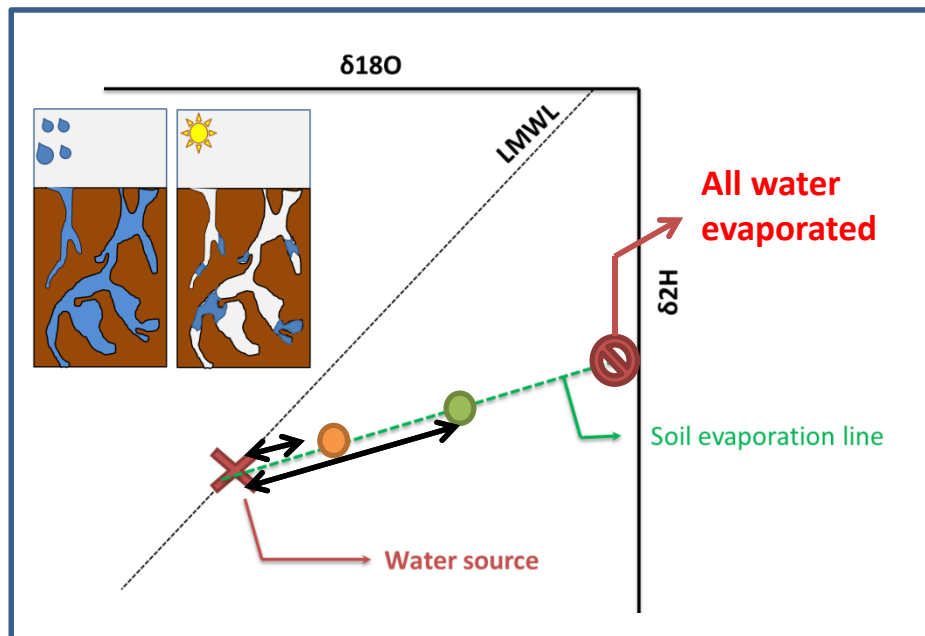
Framework

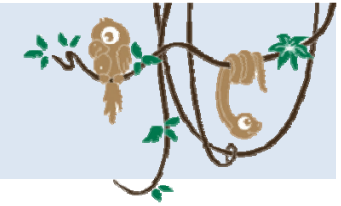
Setup

Results

Conclusion

Backtracking extractable range





Plausible explanation in the difference in mycorrhizal colonization

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



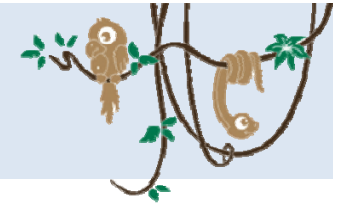
HIGHLIGHTED STUDENT RESEARCH

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

Courtney G. Collins¹ · S. Joseph Wright² · Nina Wurzburger¹



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



- Lianas and trees **tap different precipitation water source**, with lianas tapping heavier water
- Different isotopic signature in lianas and trees might be linked to **seasonally 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



Framework

Setup

Results

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Thanks for your attention,
any questions?