XX CONGRESSO BRASILEIRO DE ÁGUAS SUBTERRÂNEAS
XXI ENCONTRO NACIONAL DE PERFURADORES DE POÇOS
06 a 08 de Novembro de 2018 | Campinas - SP

Fenágua 2018
FEIRA NACIONAL DA ÁGUA

PRECIPITAÇÃO E RECARGA: ISÓTOPOS ESTÁVEIS (δ^2H e $\delta^{18}O$) COMPREENDENDO A MOVIMENTAÇÃO DA ÁGUA

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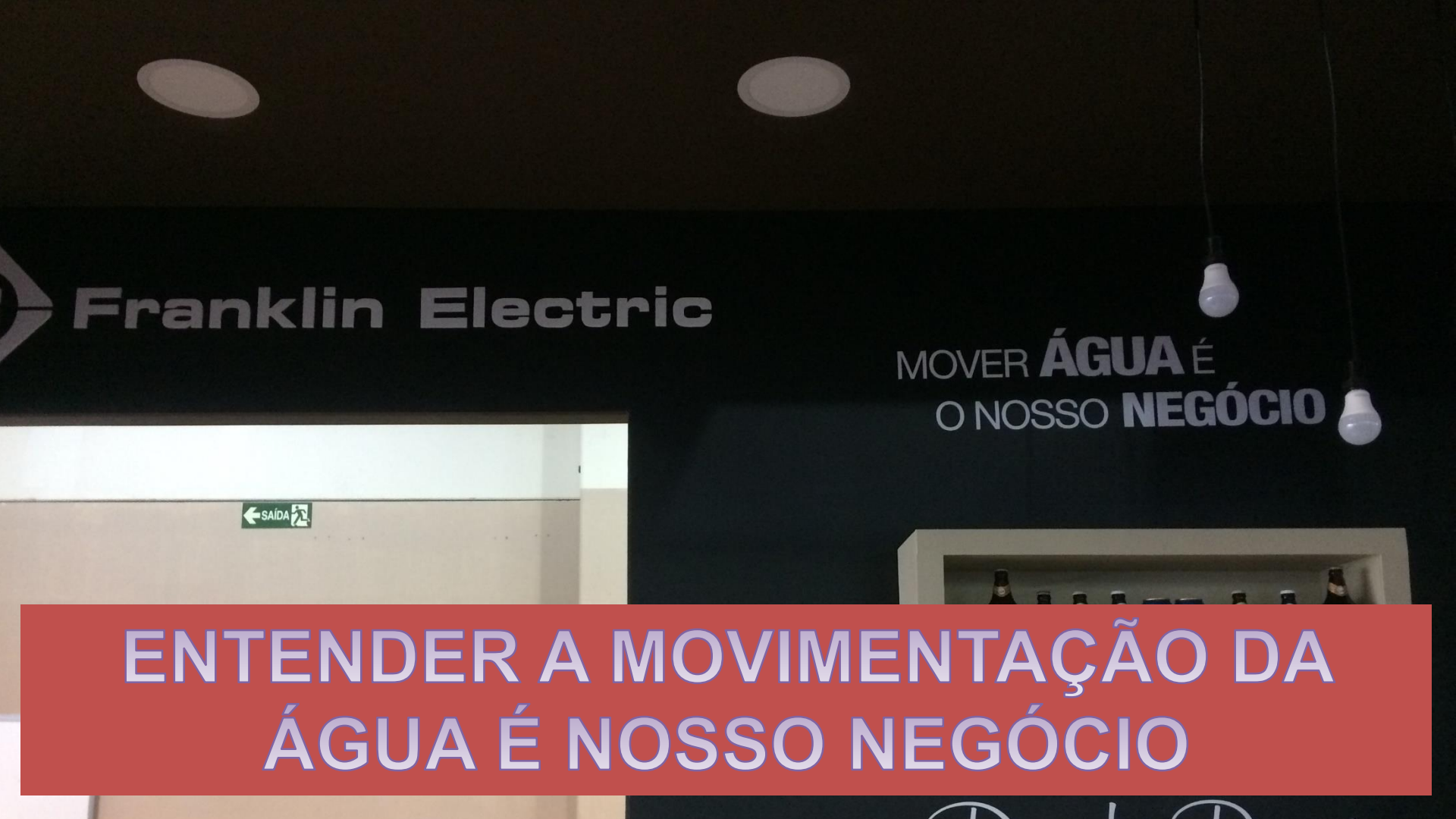
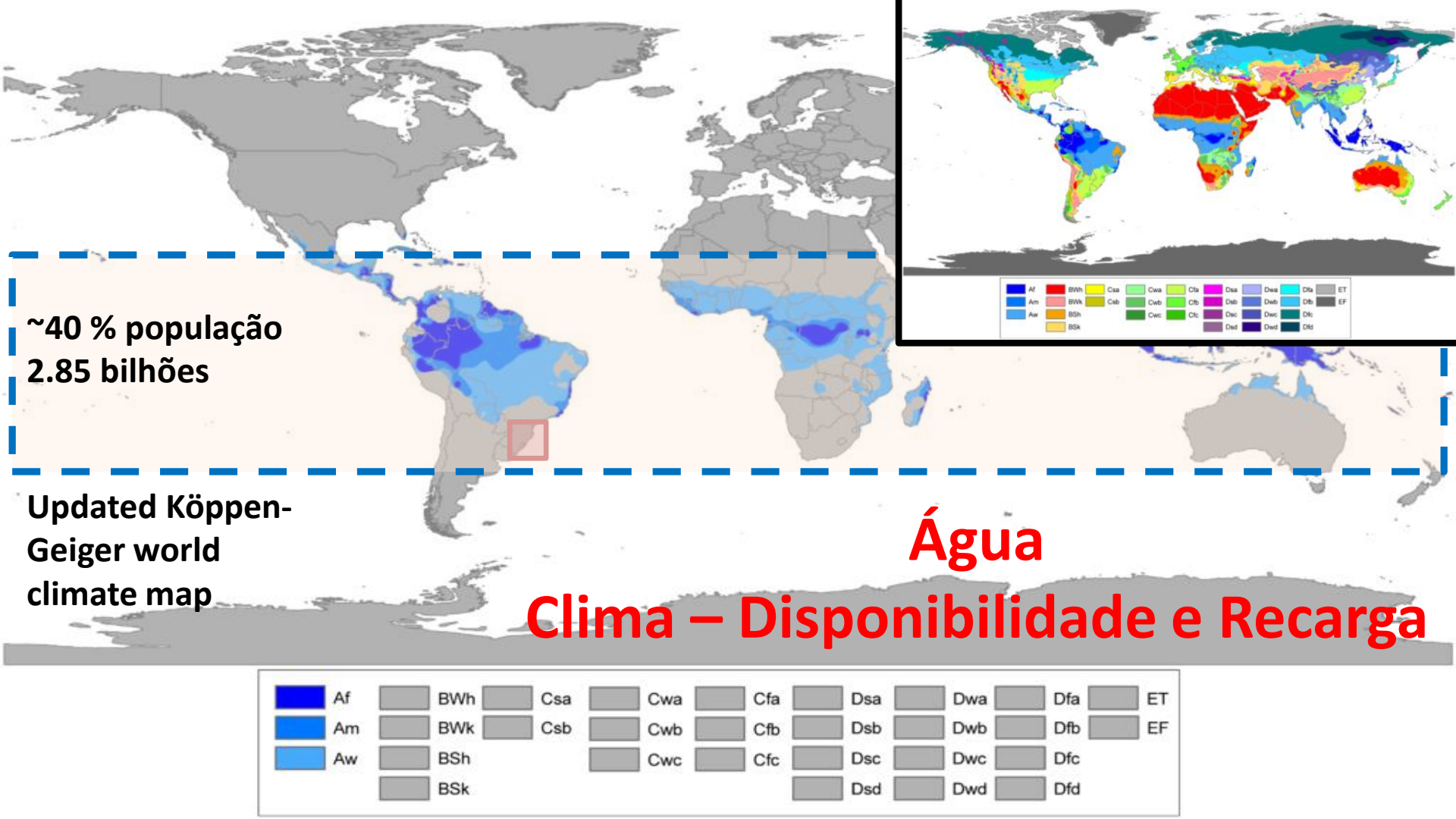
unesp

LARHIA

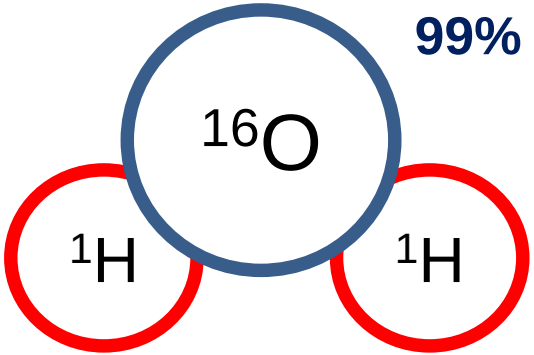


ENTENDER A MOVIMENTAÇÃO DA ÁGUA É NOSSO NEGÓCIO

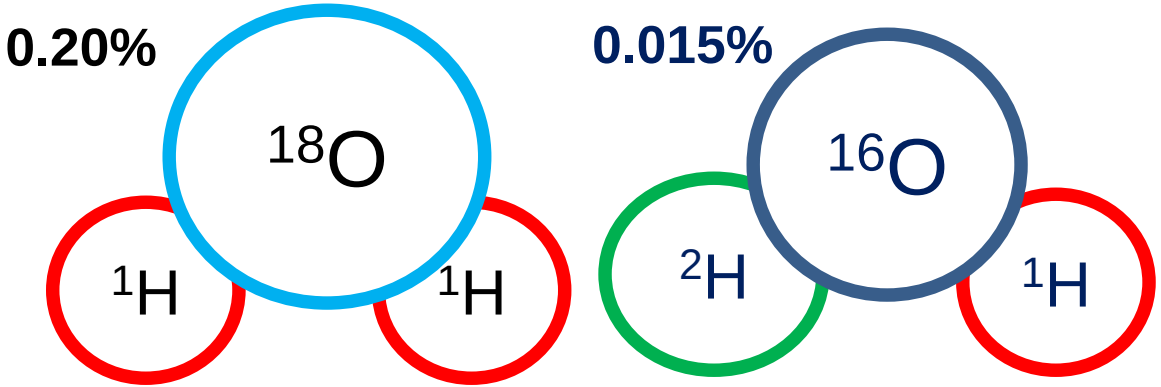

~40 % população
2.85 bilhões
Updated Köppen-Geiger world climate map
Água
Clima – Disponibilidade e Recarga
Af
Am
Aw
BWh
BWk
BSh
BSk
Csa
Csb
Cwa
Cwb
Cwc
Cfa
Cfb
Cfc
Dsa
Dsb
Dsc
Dsd
Dwa
Dwb
Dwc
Dwd
Dfa
Dfb
Dfc
Dfd
ET
EF

Por que isótopos estáveis?

História da Água – Mudanças de fase da água ao longo do ciclo hidrológico ficam registradas



'Água Leve'
Evaporação favorecida



'Água Pesada'
Condensação favorecida

Por que isótopos estáveis?

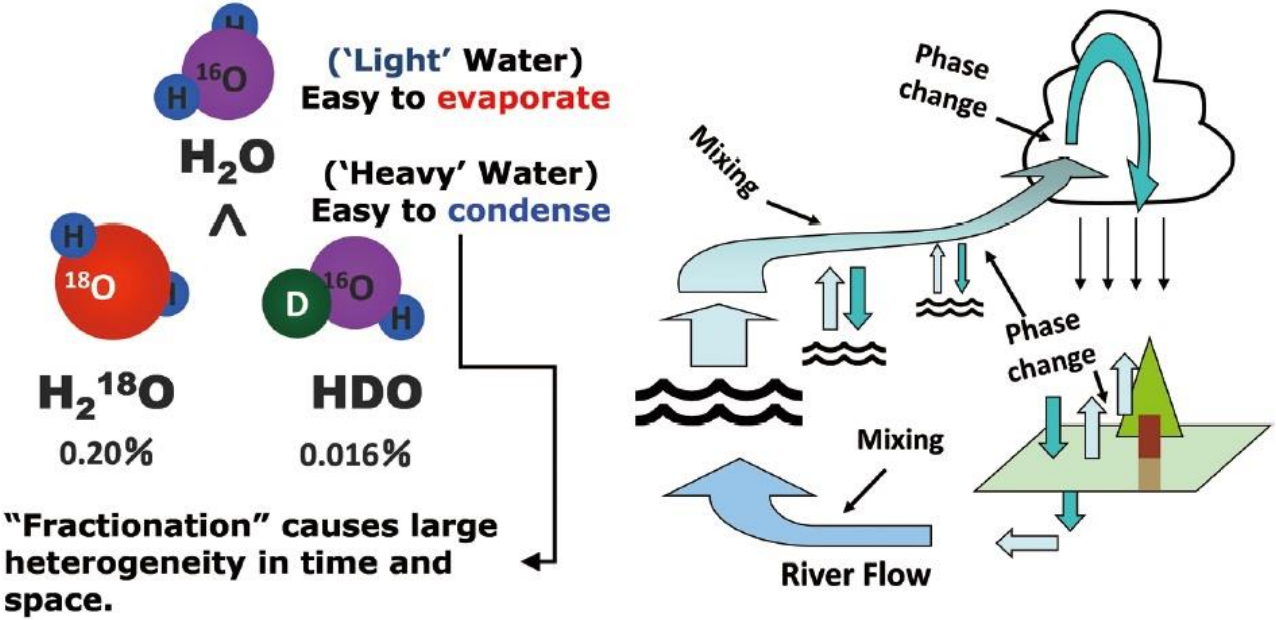
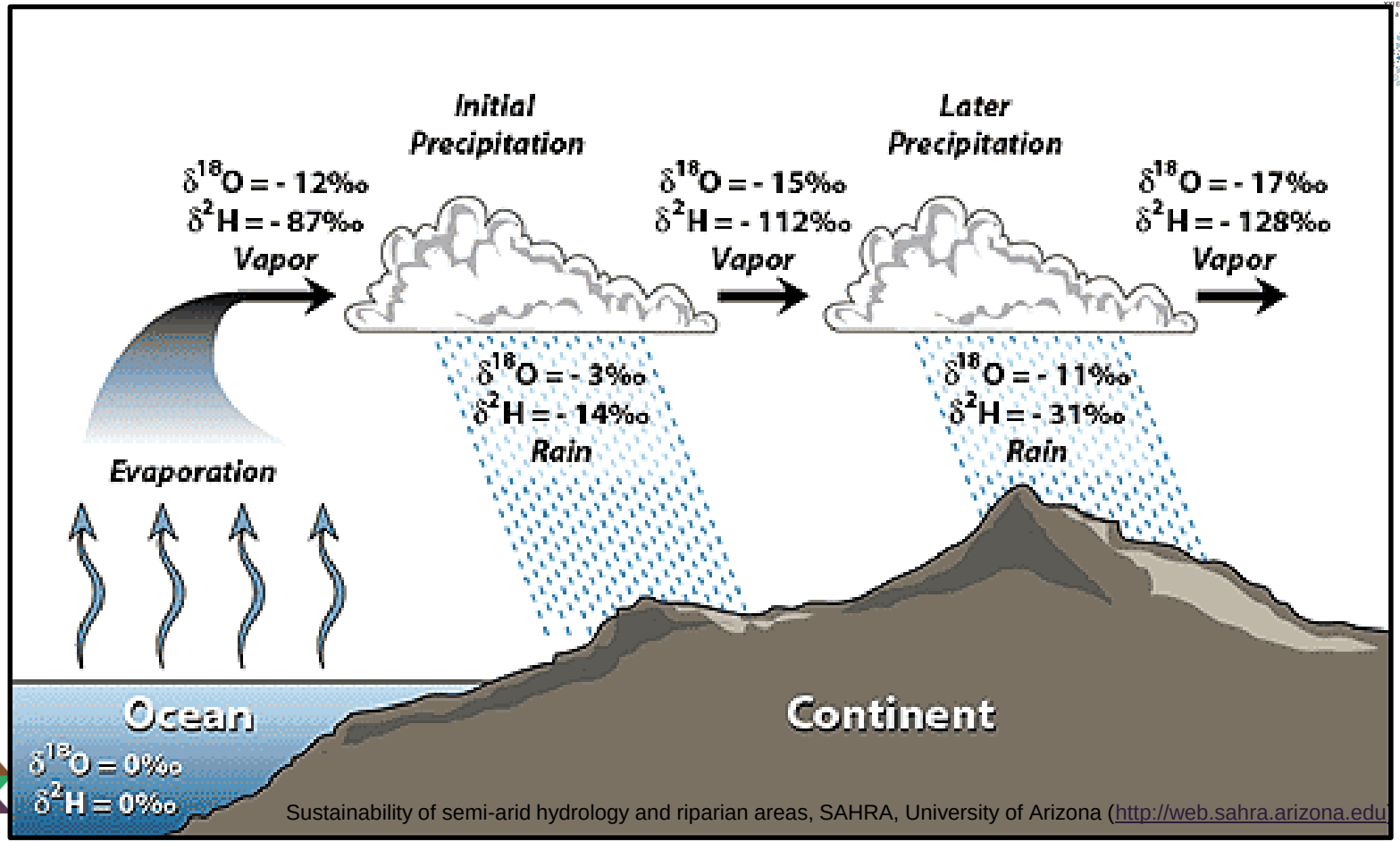


Fig. 1. Schematic illustration of stable water isotopes and their relation to the Earth's water cycl

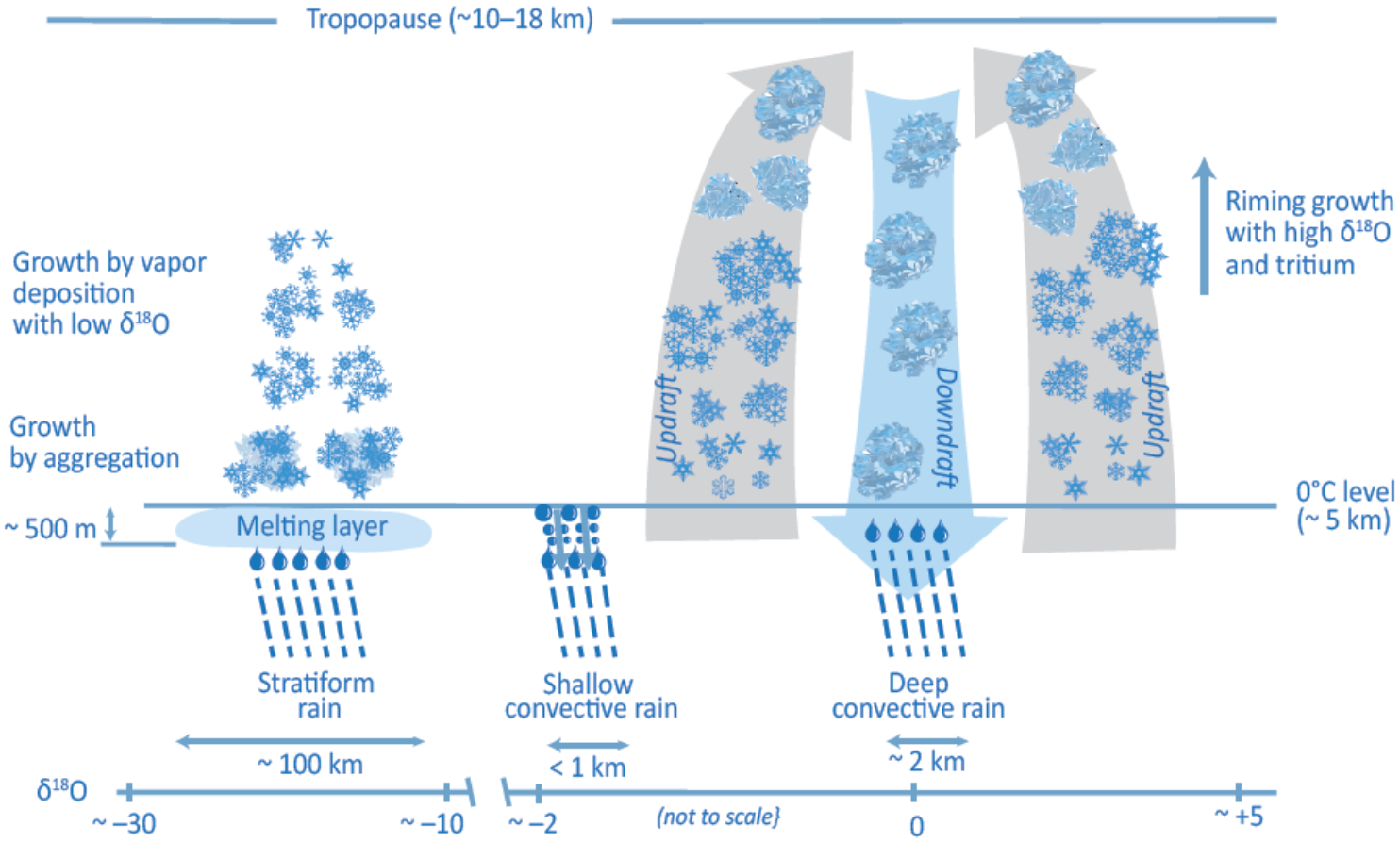
Fracionamento – Sinal Isotópico Único
Variabilidade Isotópica – Temporal e Espacial

Precipitação e Clima

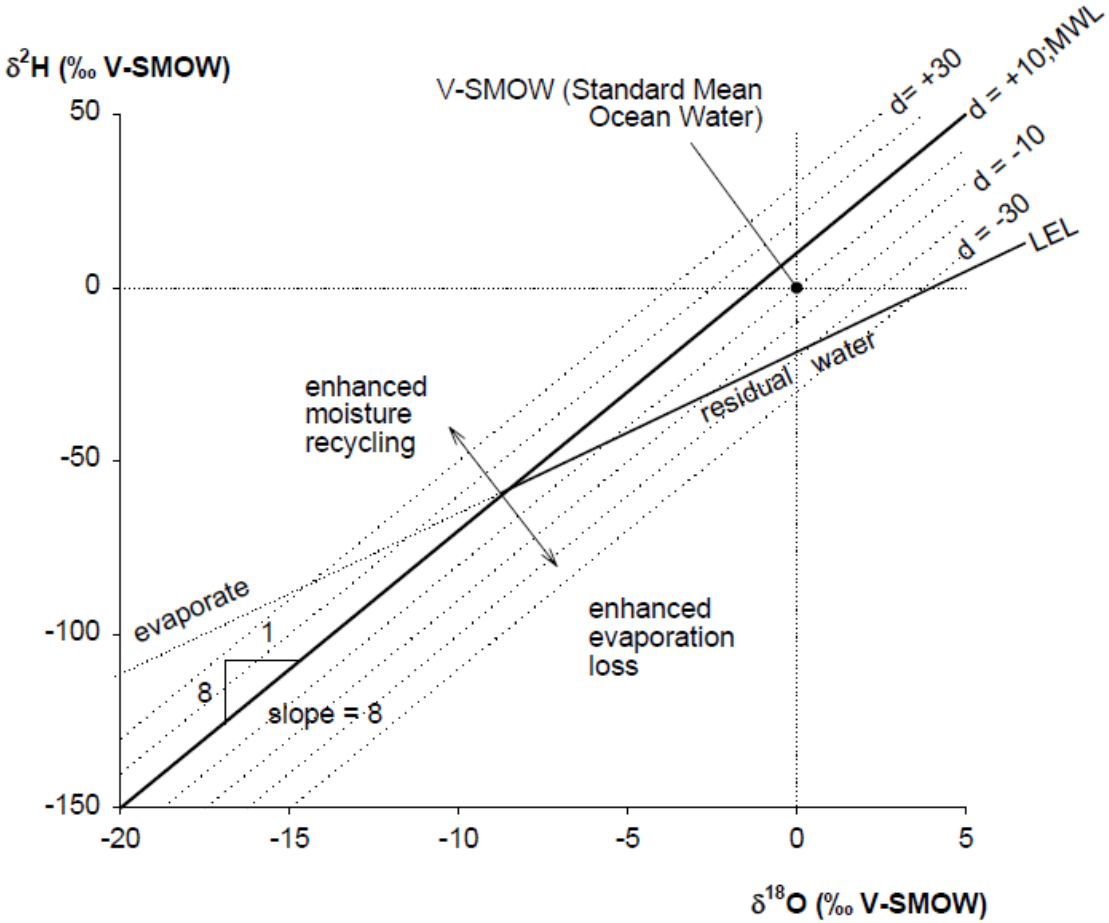


Sustainability of semi-arid hydrology and riparian areas, SAHRA, University of Arizona (http://web.sahra.arizona.edu)

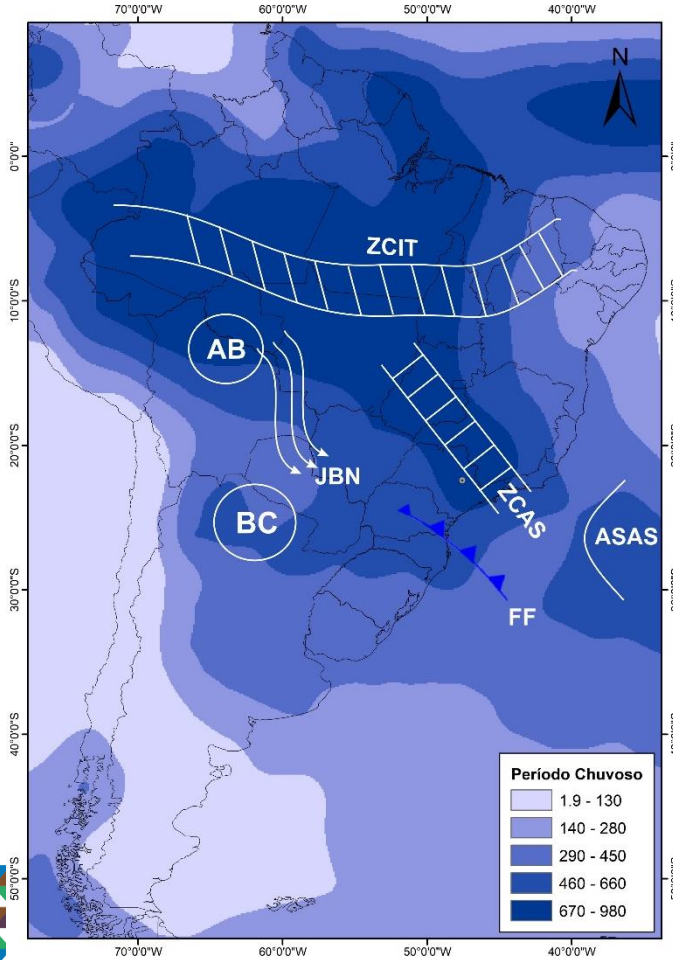
Precipitação e Clima

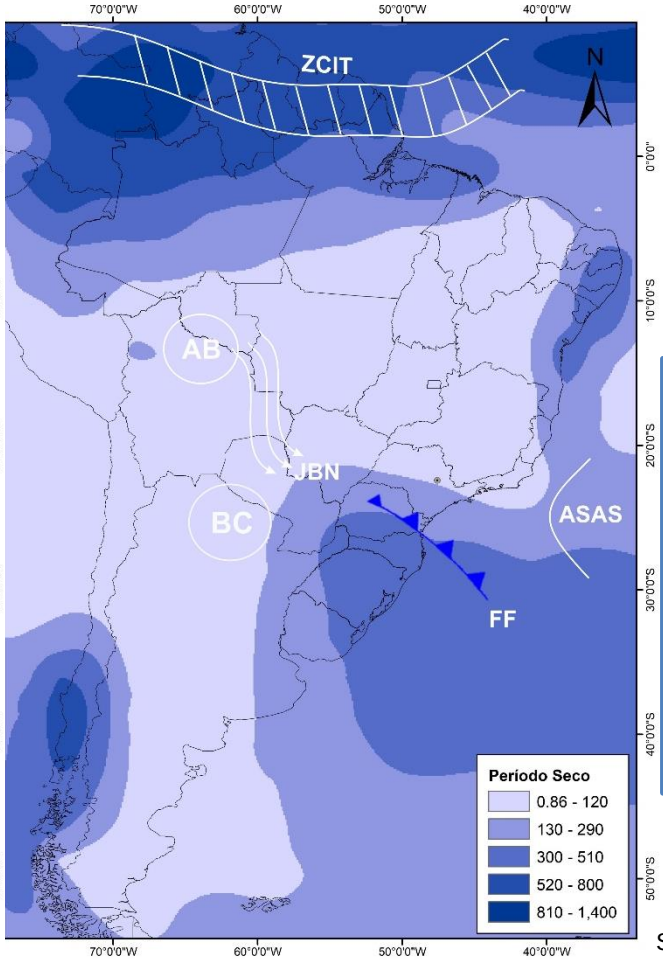


Reta Meteórica



Clima





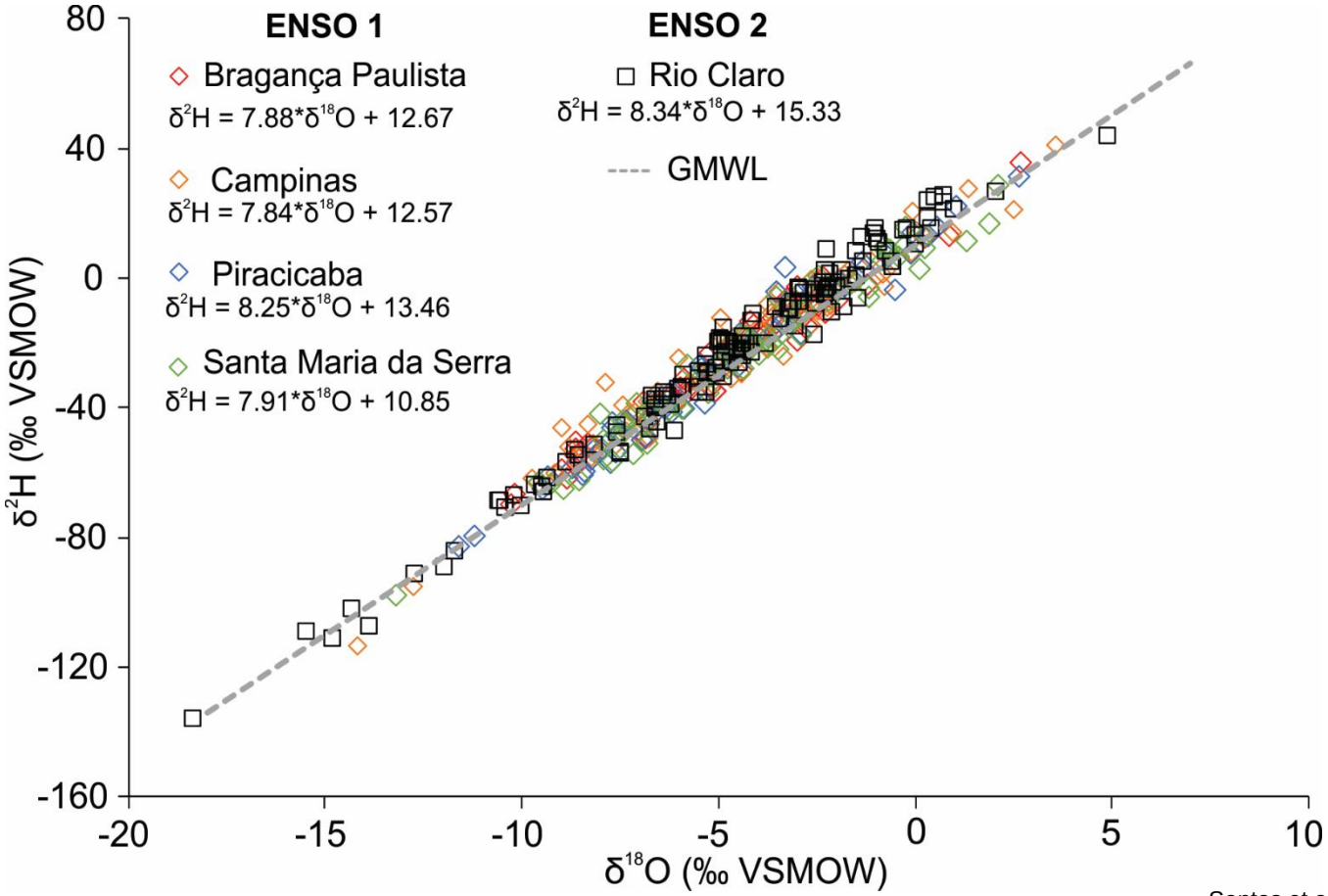
Período seco: abril-setembro

Período chuvoso: outubro-março

Precipitação anual em torno de 1400mm
17° e 24°C

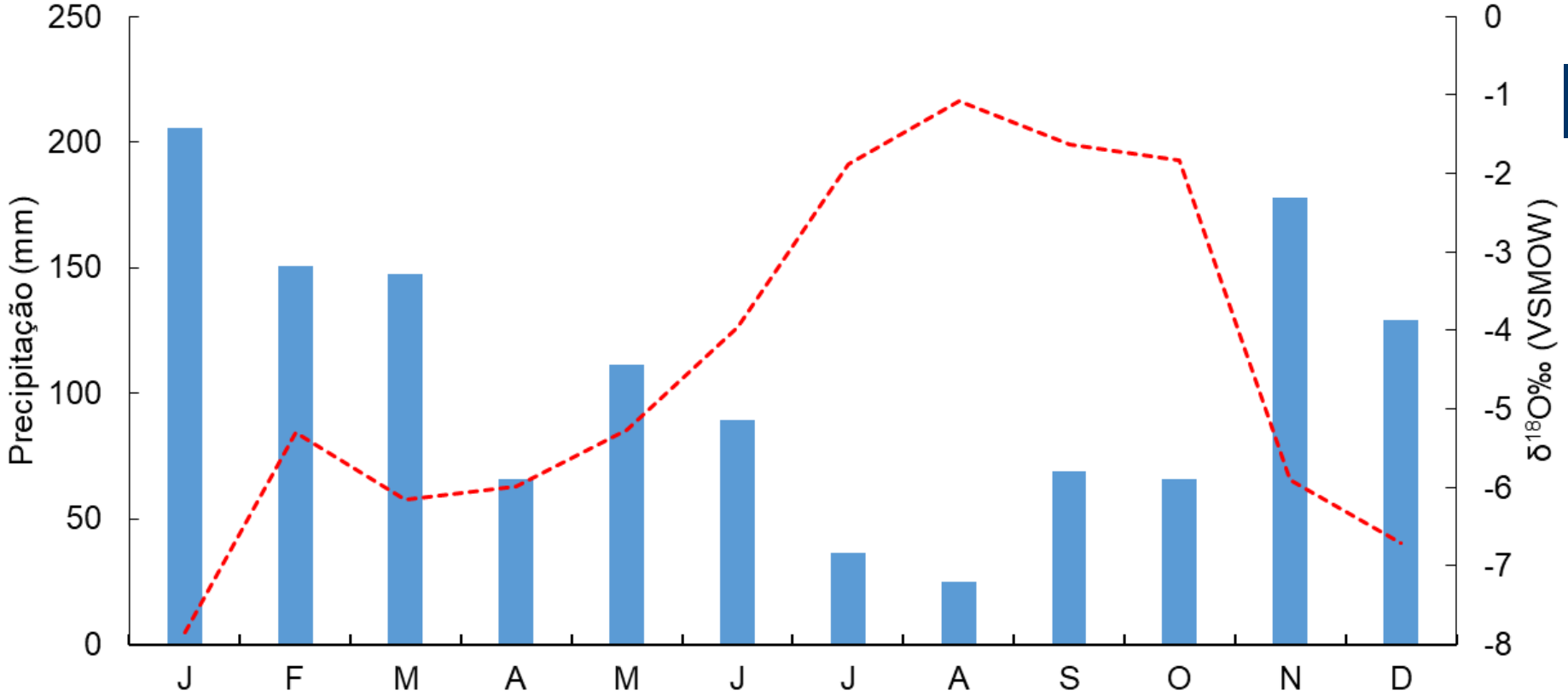
Santos et al. (2018) *em revisão* – HYP

Sazonalidade Precipitação



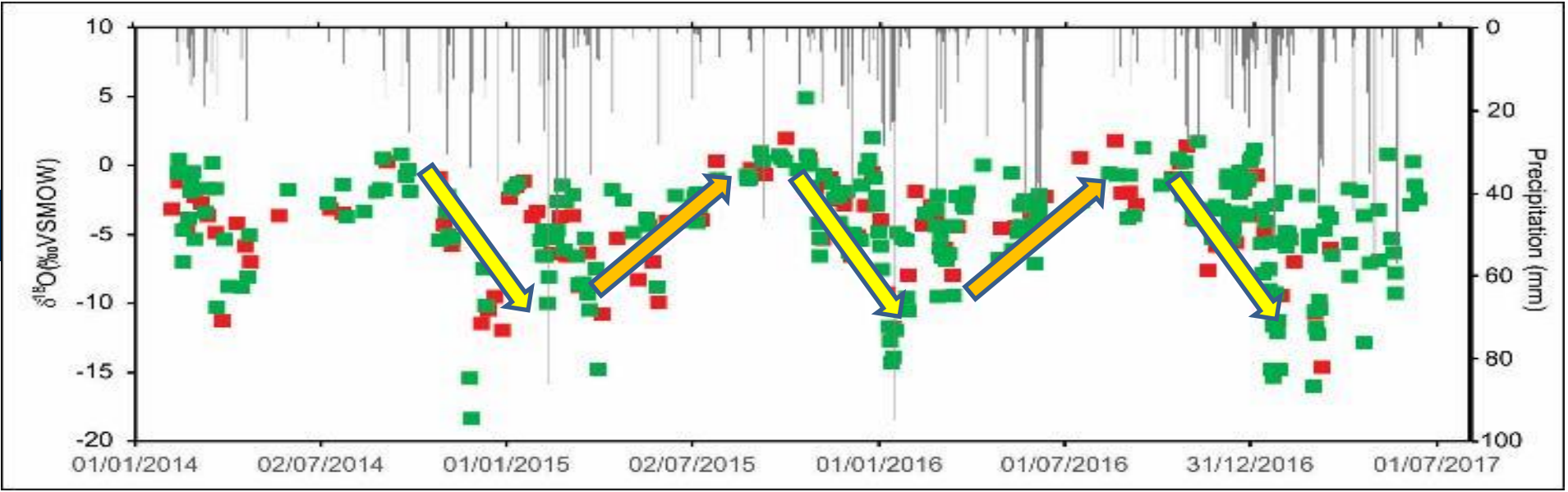
Santos et al. (2018) *em revisão* – HYP

Sazonalidade Precipitação



Santos et al. (2018) *em revisão* – HYP

Sazonalidade Precipitação

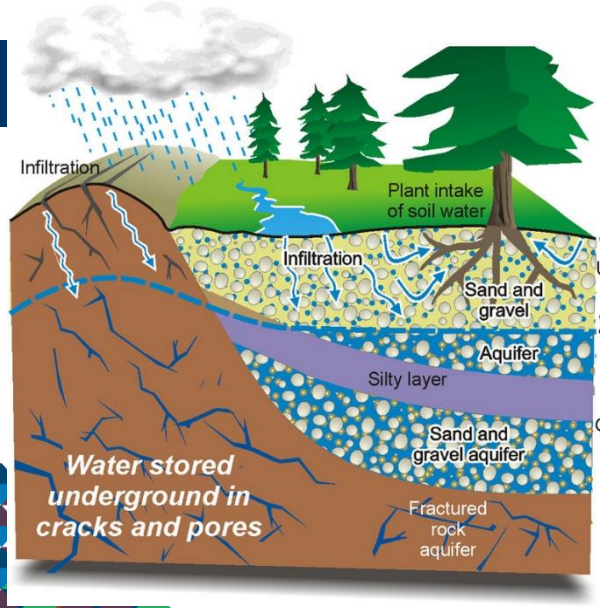


Ação da ZCAS

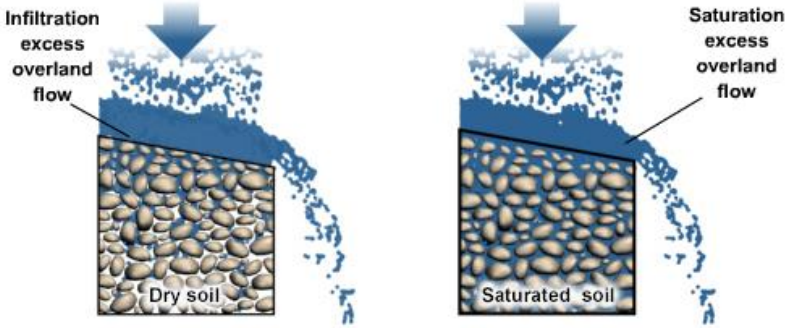
Santos et al. (2018) *em revisão* – HYP

Recarga Águas Subterrâneas

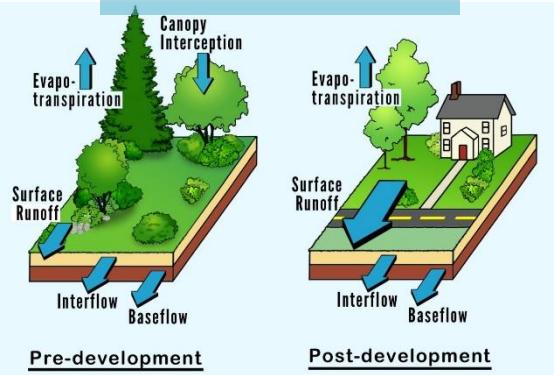
Infiltração



Capacidade de infiltração



Cobertura do solo



Recarga de Águas Subterrâneas

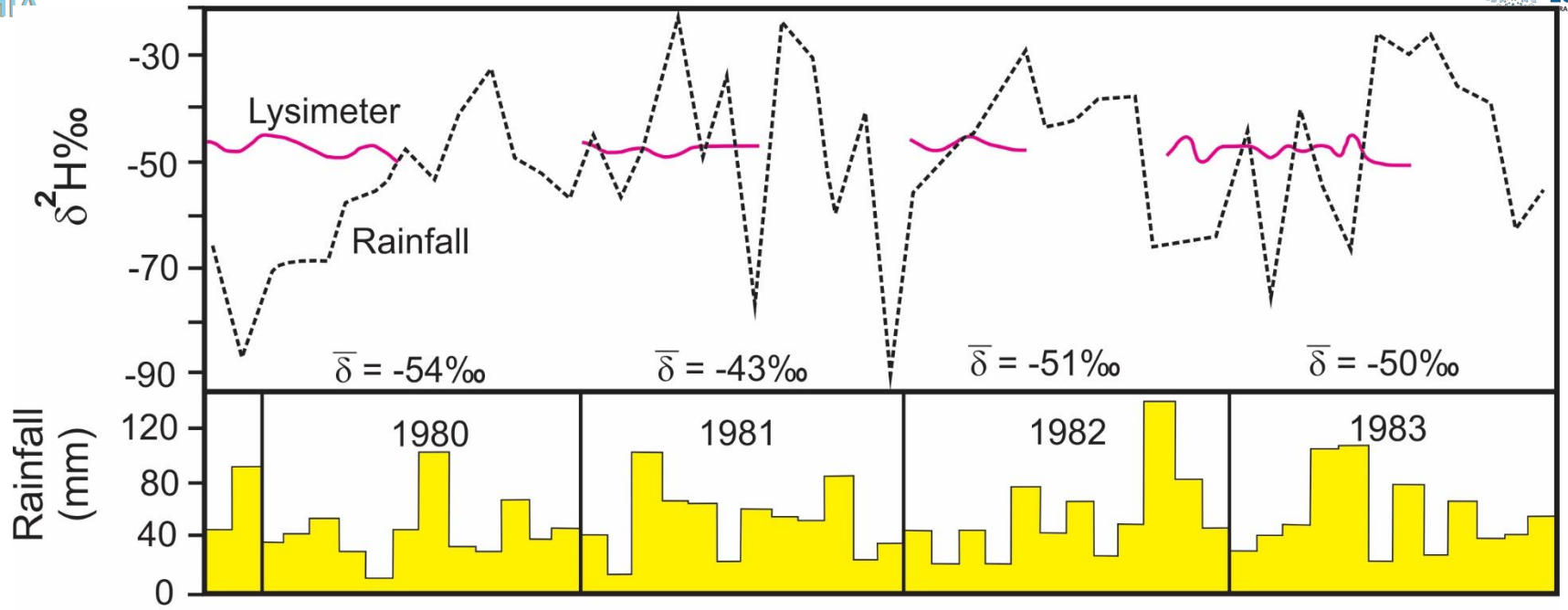


Fig. 4-1 Seasonal variations for deuterium in precipitation and attenuation during movment to 5m depth in unsatured chalk, at Fleam Dyke, eastern England (modified from Darling and Bath, 1988)

Recarga de Águas Subterrâneas

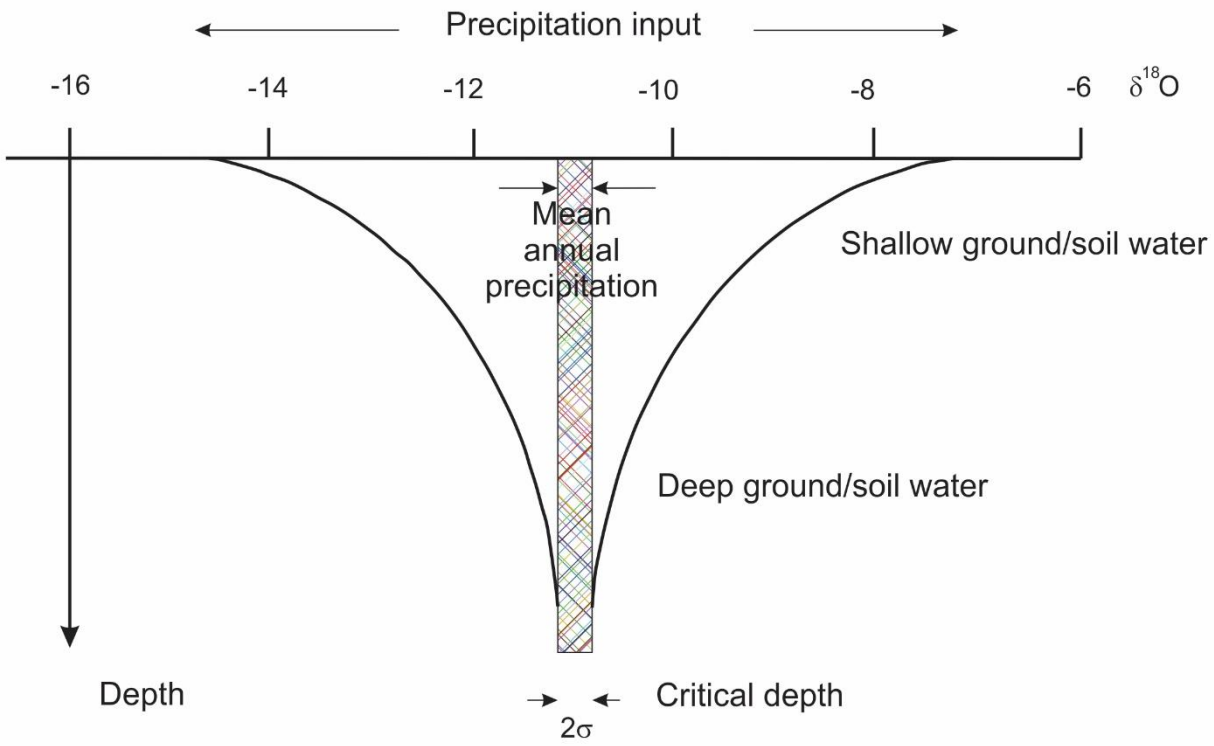
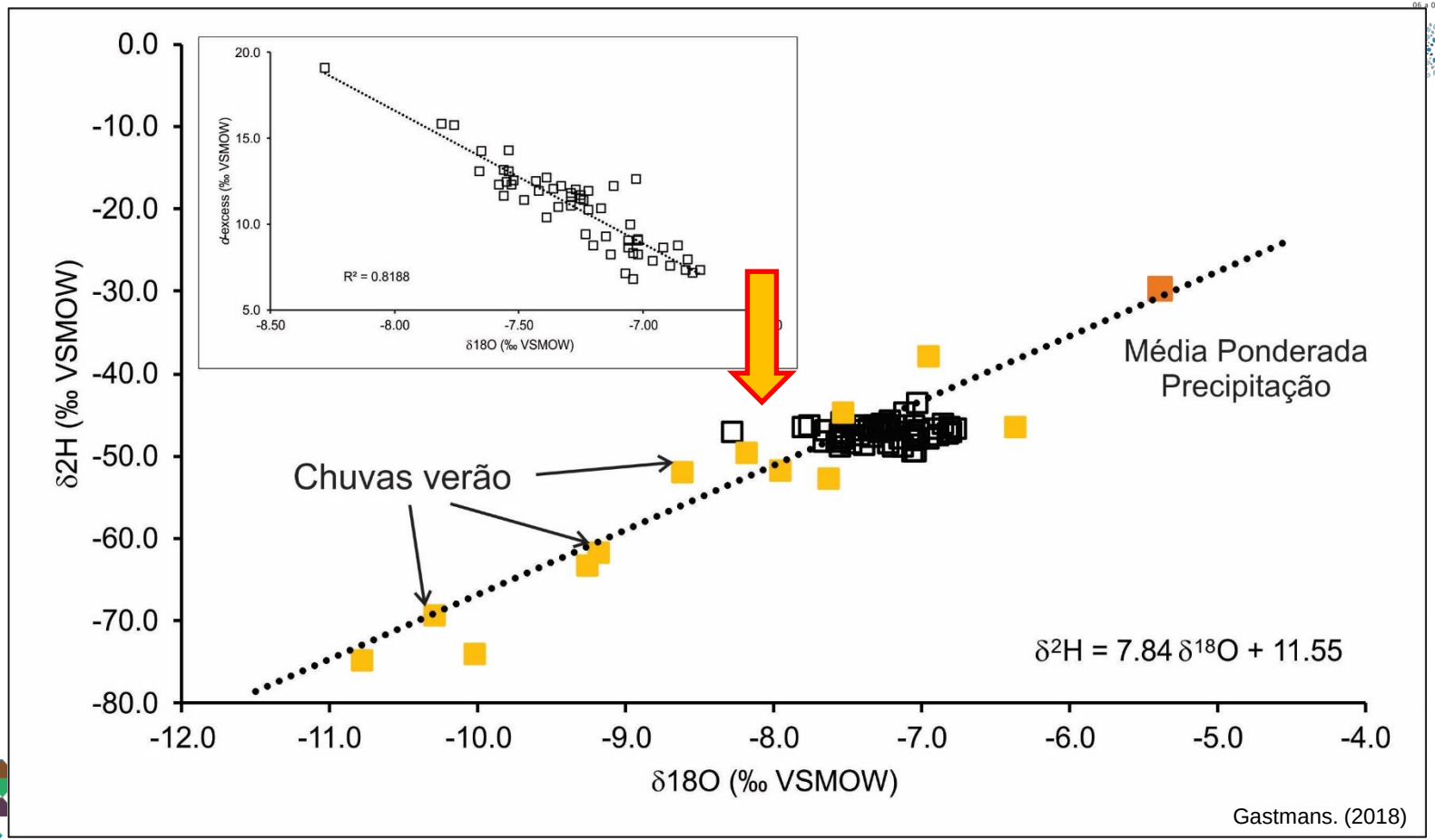


Fig. 4-3 Schematic of the attenuation of seasonal isotope variation (2H or 18O) in recharge waters during infiltration through the unsatured zone and movement within the saturated zone, and the critical depth bellow which isotopic variability is less than the analytical precision (2σ)

Recarga de Águas Subterrâneas



Gastmans. (2018)

Recarga de Águas Subterrâneas

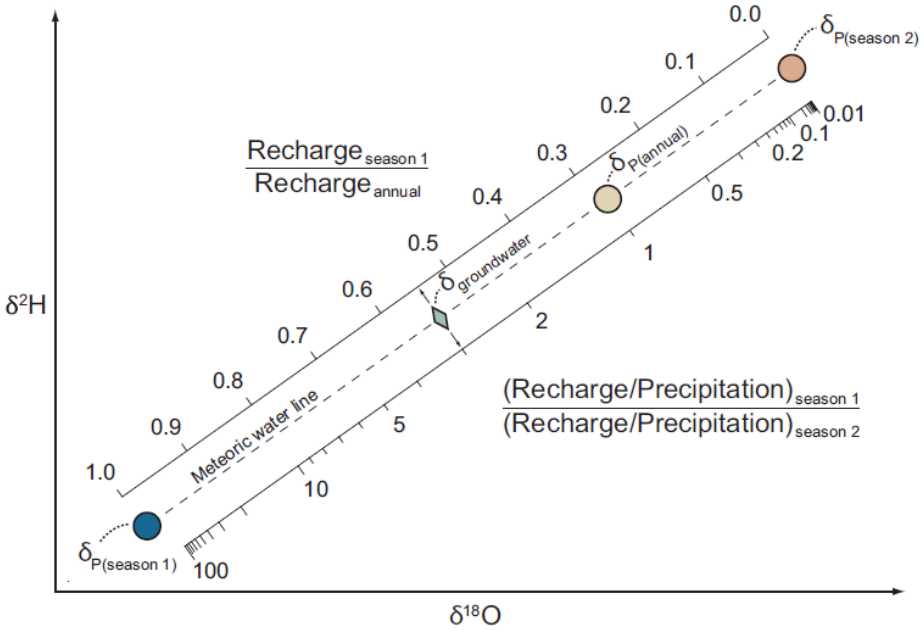
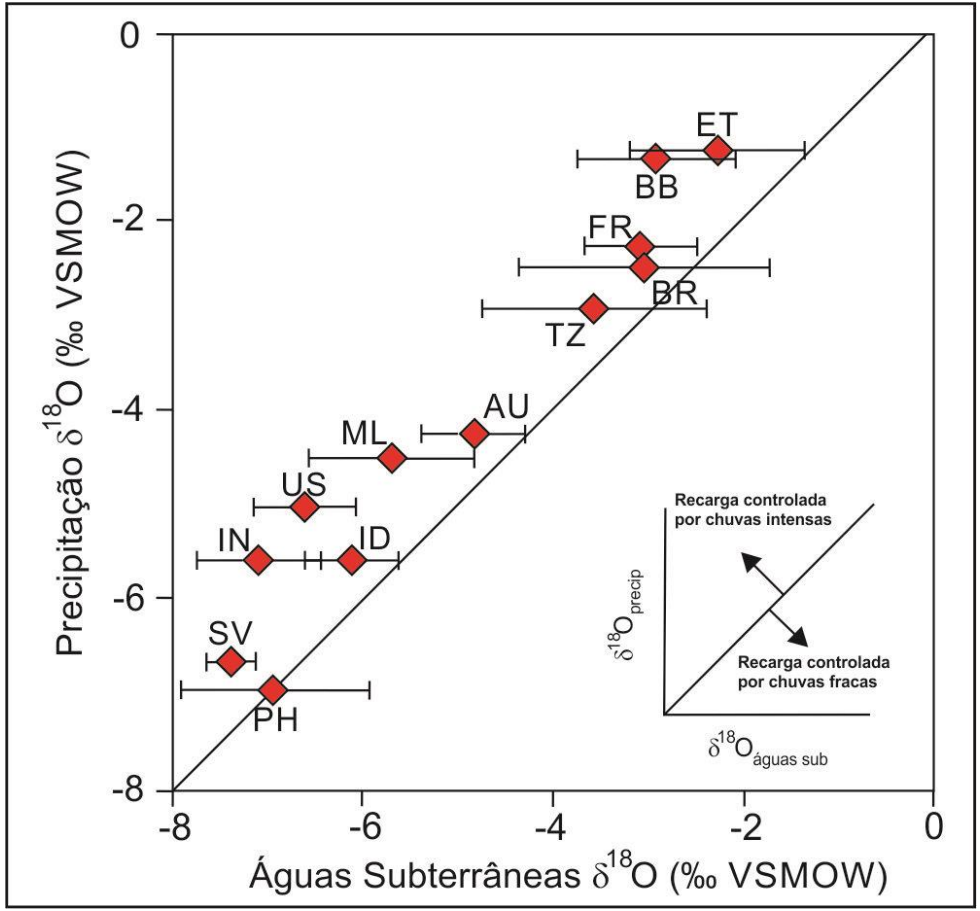


Figure 2. Schematic showing an isotope-based derivation of the seasonality of the groundwater recharge ratio (recharge as a proportion of precipitation: *R/P*). The upper axis marks the contribution of season 1 to the total annual recharge flux. The lower axis shows how a comparison of the isotopic composition of annual precipitation ($\delta_{P(annual)}$) and groundwater ($\delta_{Groundwater}$) can be used to compare the groundwater recharge ratios of season 1 (i.e., $(R/P)_{season\ 1}$) to season 2 (i.e., $(R/P)_{season\ 2}$). The example shown above (i) has 30% of the annual precipitation flux during season 2 ($\delta_{P(annual)}$ matched to upper axis), (ii) has 54% of the annual groundwater recharge during season 2 ($\delta_{Groundwater}$ matched to upper axis), and (ii) has a higher groundwater recharge ratio (i.e., *R/P*) during season 1 compared to season 2, with the $(R/P)_{season\ 1}/(R/P)_{season\ 2}$ value of 3 ($\delta_{Groundwater}$ matched to lower axis). The dashed line marks a hypothetical regression of meteoric waters for this specific location.

Jashecko et al. (2014) doi:*10.1002/2014WR015809*

Recarga de Águas Subterrâneas



Jashecko et al. (2015) doi:10.1088/1748-9326/10/12/124015

Considerações Finais

- Compreensão da movimentação da água ao longo do ciclo hidrológico – caminhos e disponibilidade;

- Monitoramento – precipitação (sinal de entrada) – variações sazonais e interanuais

- Recarga não é constante e homogênea ao longo do ano – controle físico do solo (??)

- Associação entre clima e precipitação – importante aspecto para reconstituição paleoclimáticas – águas subterrâneas como registro climas pretéritos

OBRIGADO!!!

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