

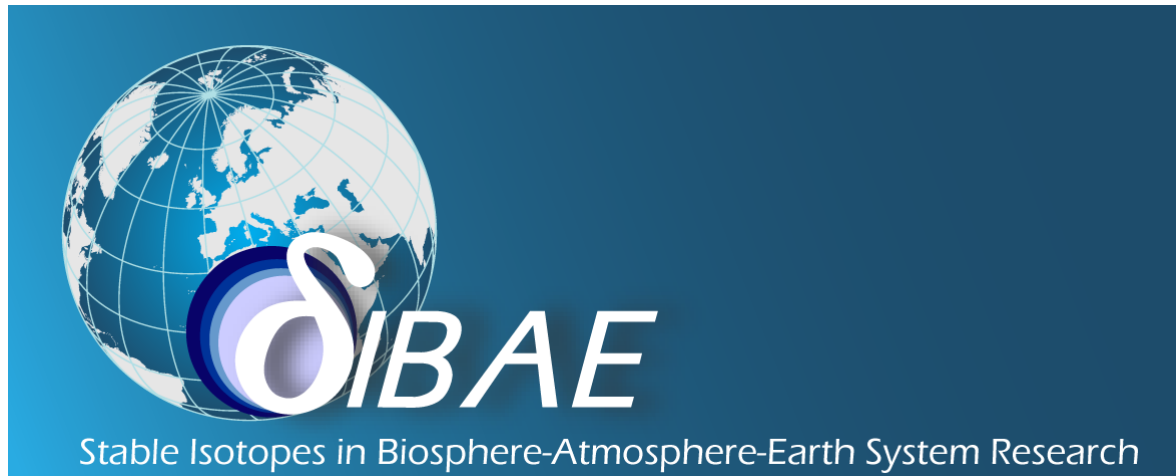
## Insights to the daily and seasonal variation in near surface water vapor in the Eastern Mediterranean

**Dan Yakir**, Leon Peters, Alon Angert, Joel Gat  
Environmental Sciences & Energy Research



# COST Action ES0806 SIBAE

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- Runs 2009 - 2013, 22 countries
- Four working groups, STSMs, conferences, workshops

<http://www.sibae.ethz.ch/cost-sibae/>

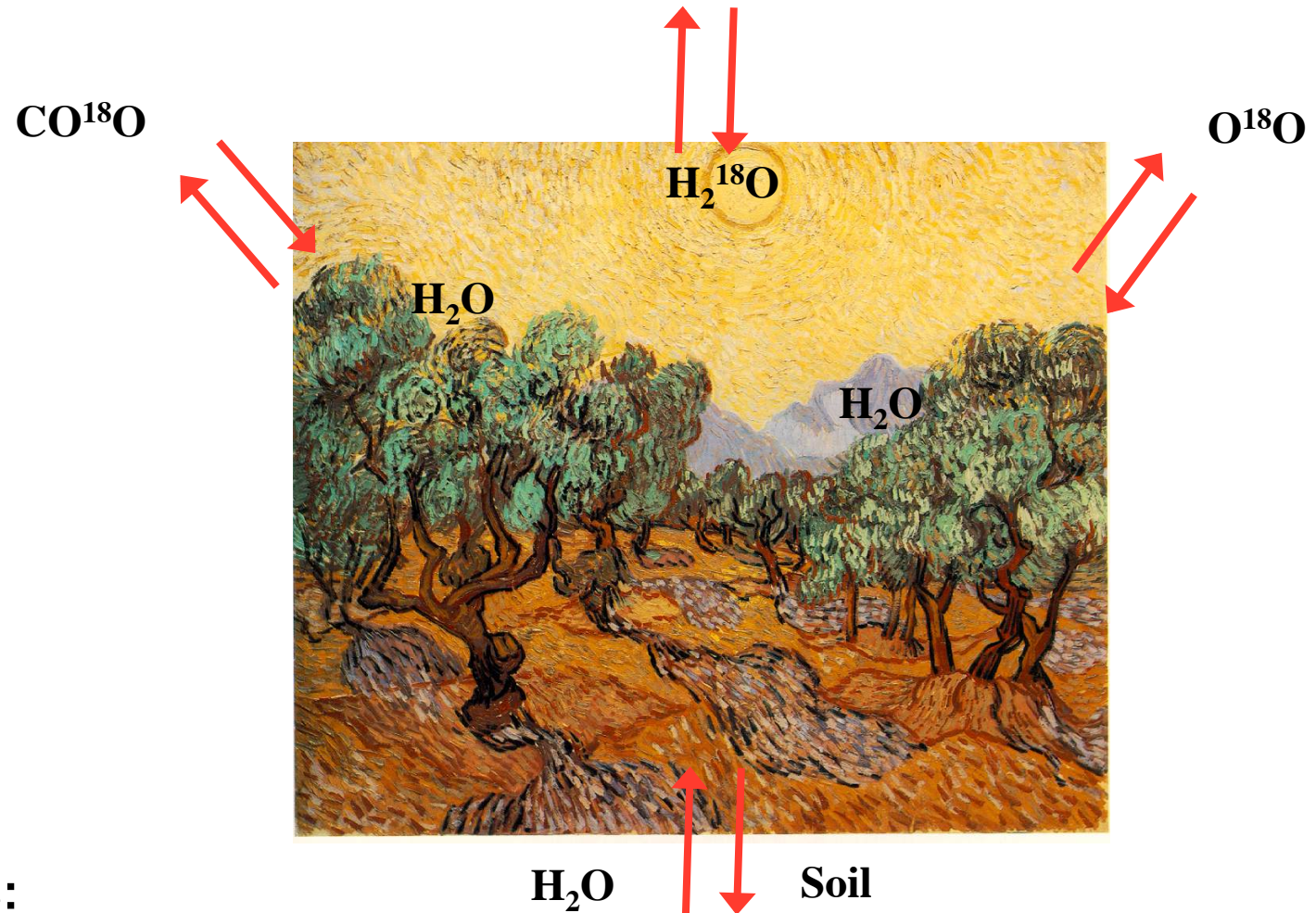
## Objectives of COST Action SIBAE

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**Main objective:** To integrate and coordinate research using stable isotopes as a critical tool in biosphere-atmosphere-Earth system science across scales and across disciplines in Europe

# Introduction

Near surface water vapor isotopes are key elements for:  
ET & ecohydrology, atmospheric circulation, paleoclimate, d-excess, going  
beyond precip  $^{18}\text{O}$  links  $\text{H}_2\text{O}/\text{CO}_2/\text{O}_2$  interactions.



**Objectives:**

**Investigate the controls over the diurnal, seasonal and  
long-term variations in near surface vapor isotopes**



# Introduction

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International Atomic Energy Agency

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**IAEA - MIBA**  
MOISTURE ISOTOPES IN THE BIOSPHERE AND ATMOSPHERE  


**Resources**  
Moisture Isotopes in the Biosphere and Atmosphere  
**Background and Justification**  
The International Atomic Energy Agency (IAEA), in cooperation with the WMO, has long been operating the Global Network of Isotopes in Precipitation (GNIP), which has provided global data to understand and simulate the water cycle under present and past climates. Recently, the IAEA initiated efforts to improve the availability of isotope data on other water cycle components in an effort to supplement GNIP data and integrate isotope applications in hydrological cycle, carbon cycle, and climate research. The group for Moisture Isotopes in the Biosphere and Atmosphere (IAEA-MIBA) was constituted and includes a group of scientists with diverse research interests ranging from local ecosystems to global scales. [read more »](#)  
**Initial Meetings and Protocol Development**  
The initial consultants' meetings held in November 2003 and May 2004 resulted in the development of the basic network design and sampling concepts. It was decided that for this network that regular sampling of the isotopic composition of water in plant leaves, stems, soil and atmospheric

**Data Bank**  
Isotope Hydrology Information System (ISOHIS)  
Global Network of Isotopes in Precipitation (GNIP)  
Moisture Isotopes in the Biosphere and Atmosphere (MIBA)  
Global Network of Isotopes in Rivers (GNIR)

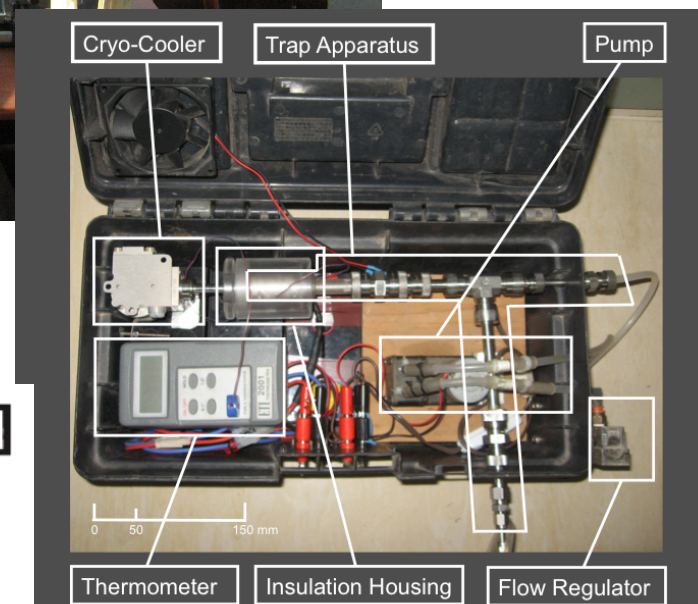
**On-Line Resources**  
GIS-Global Mapping Tool for ISOHIS(ISOHIS-MAP)

**Water Sites**  
  
**UN-Water**  
Water for Life  
2005–2015  
**IAH**  
International Association of Hydrogeologist  
**IAHS**  
International Association of Hydrological Sciences



# Methodology

## Sampling at two heights above ground (5 & 40 m)



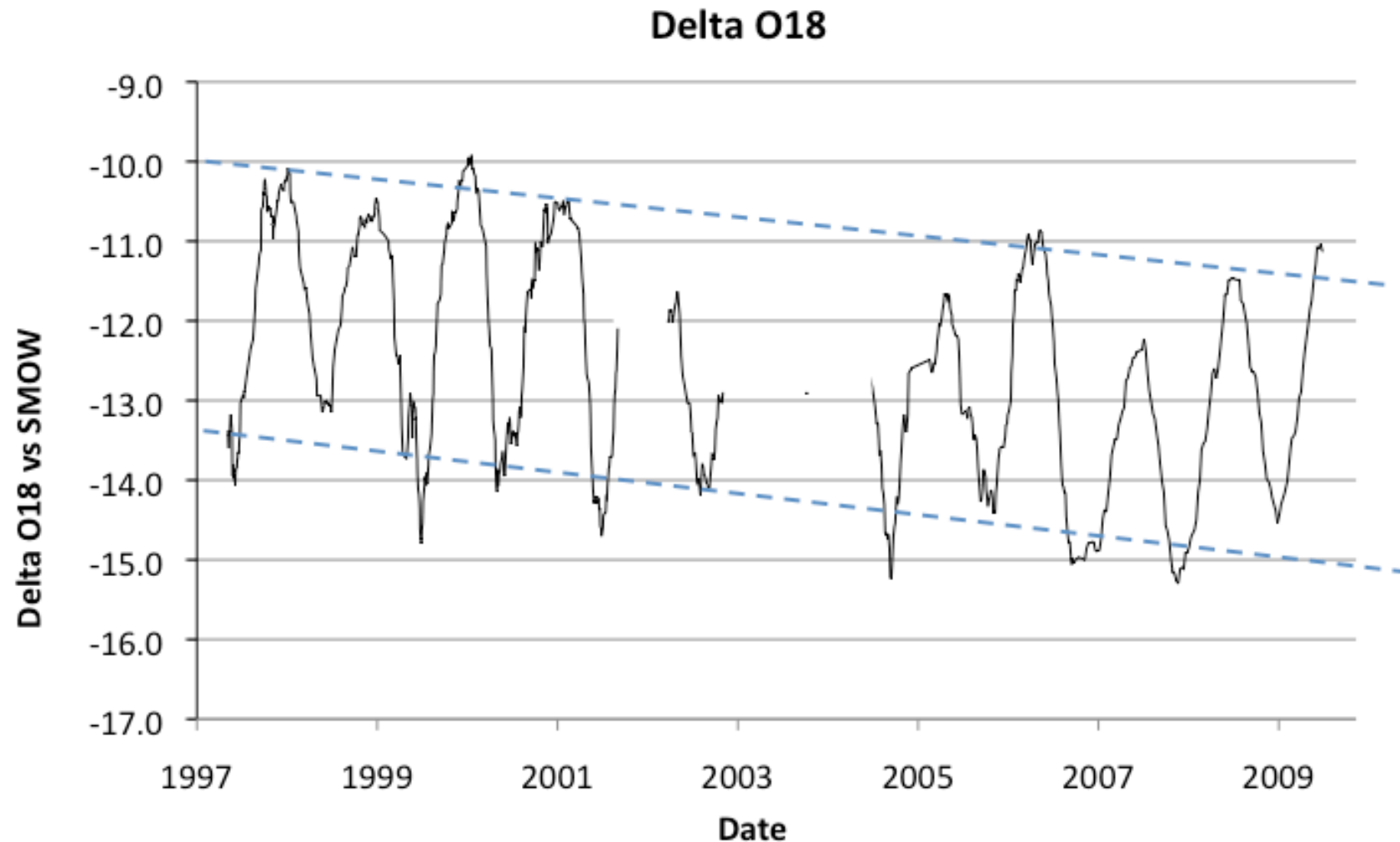
RAPID COMMUNICATIONS IN MASS SPECTROMETRY  
*Rapid Commun. Mass Spectrom.* 2010; **24**: 103–108  
Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/rcm.4359

RCM

**A rapid method for the sampling of atmospheric water vapour for isotopic analysis**

# Results

Near surface atmospheric water vapor



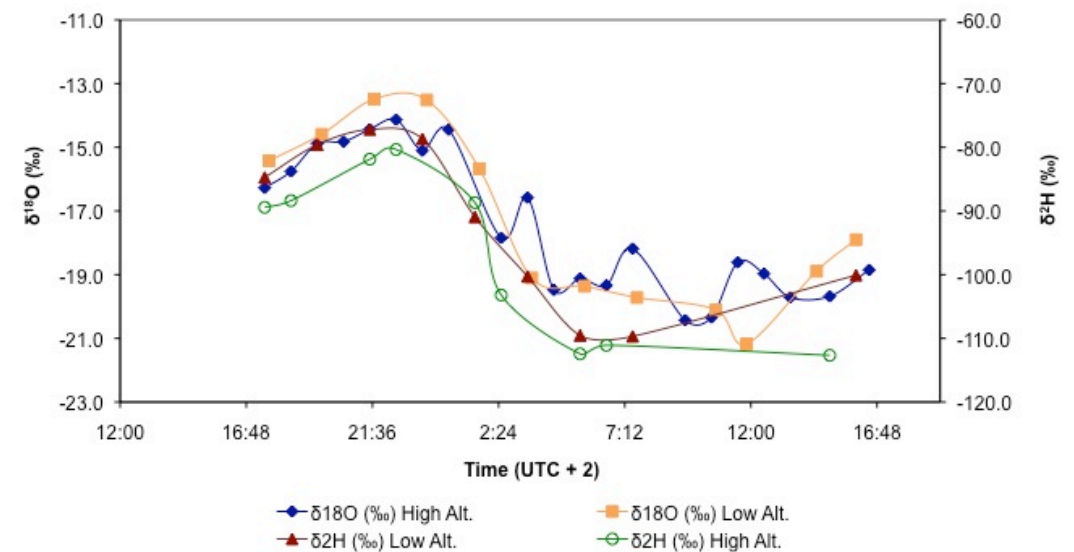
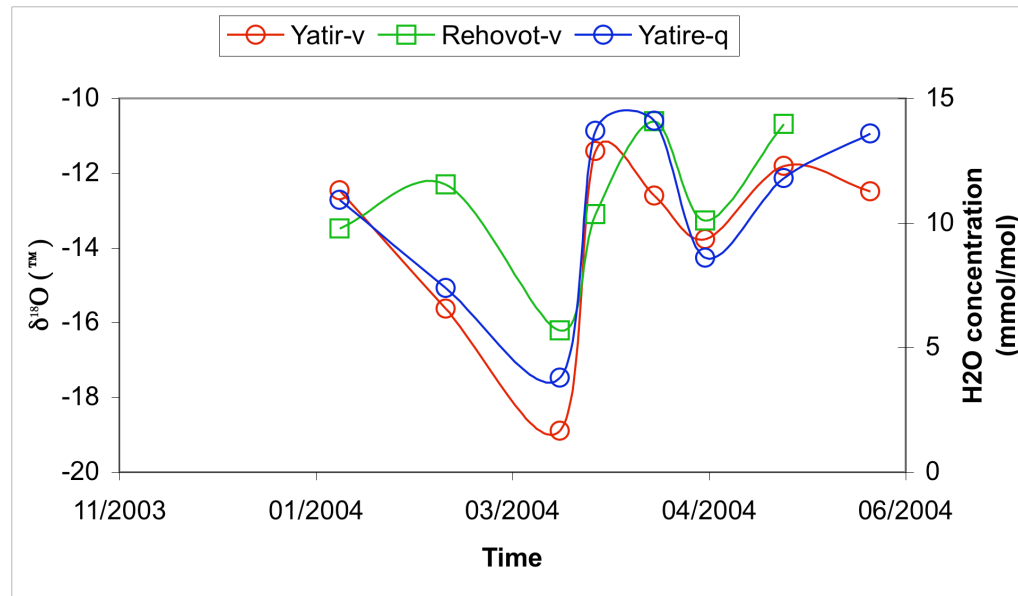
## Vapour Collections:

- **WIS Long-term sampling regime:** 1997 – Present, ~2-Weekly collections
- **Is there a long-term trend...**

# Results

The local scale:

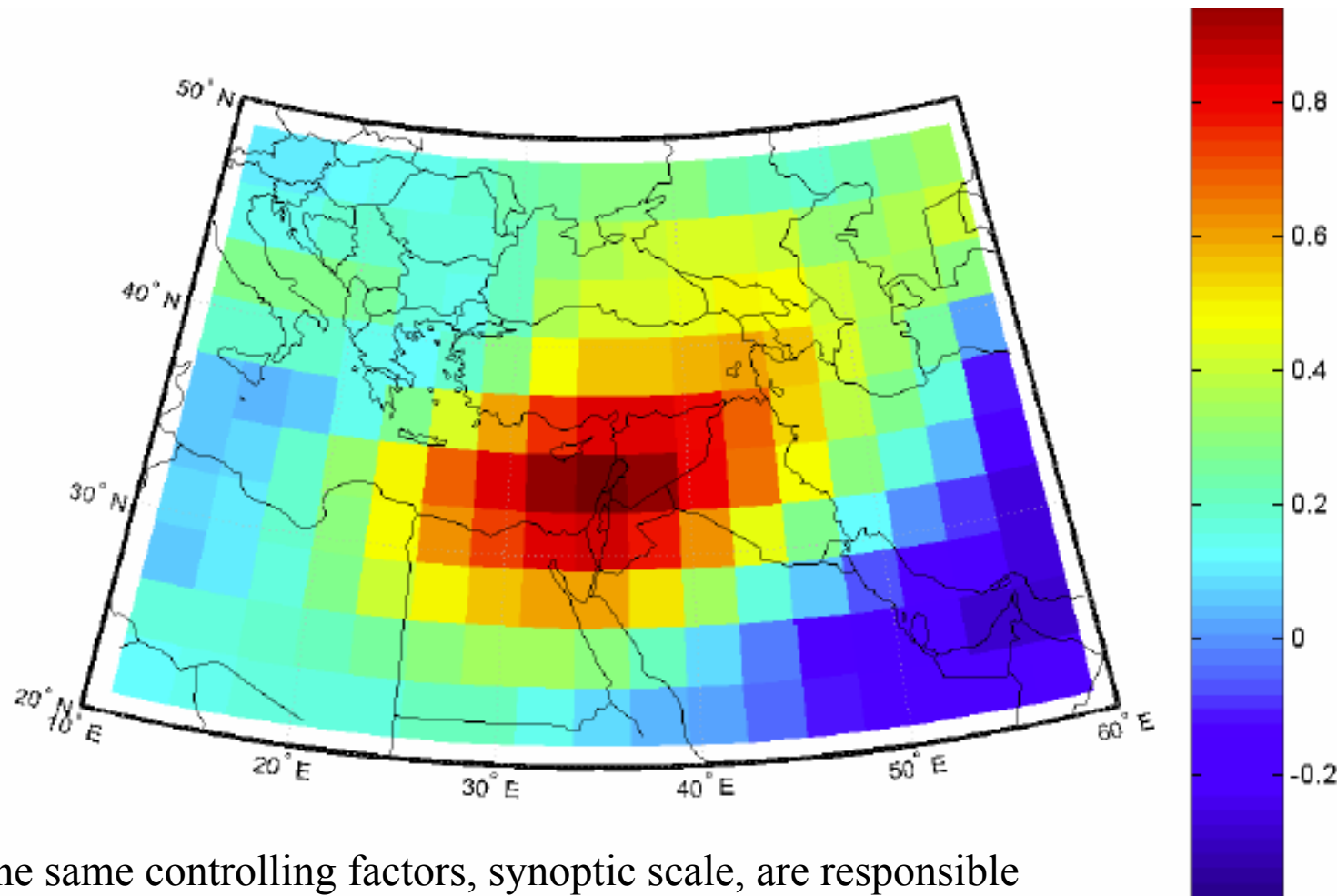
Campus sampling (Weizman Inst.) consistent with rural sampling (Northern Negev). No “altitude” effect





# Results

Correlation between Israel and the region:  
Seasonal ( $r=0.8$ ); inter-annual ( $r=0.7$  to  $r=0.5$ )

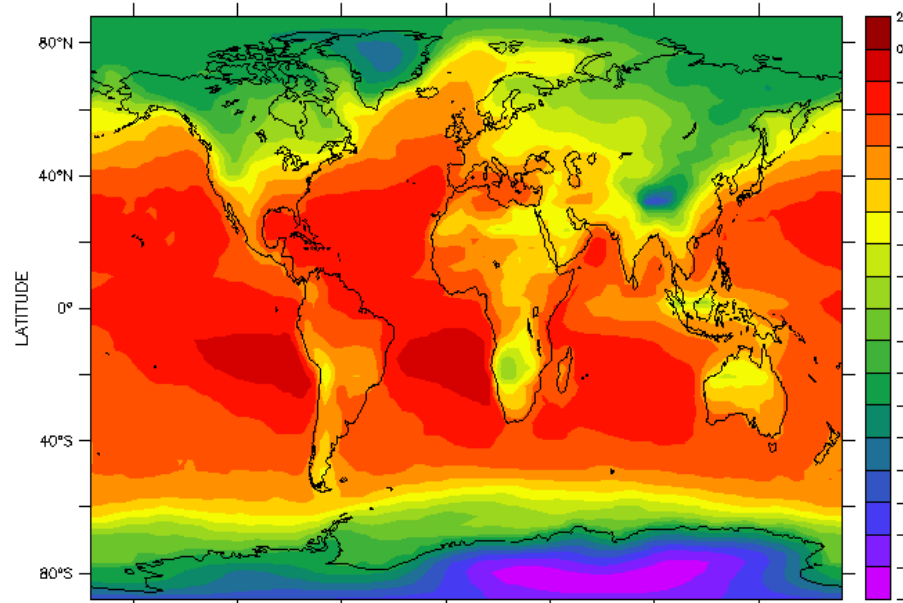


=> the same controlling factors, synoptic scale, are responsible for the variability over Israel and adjacent areas. Measurements in a single location help understand variations over large regions.

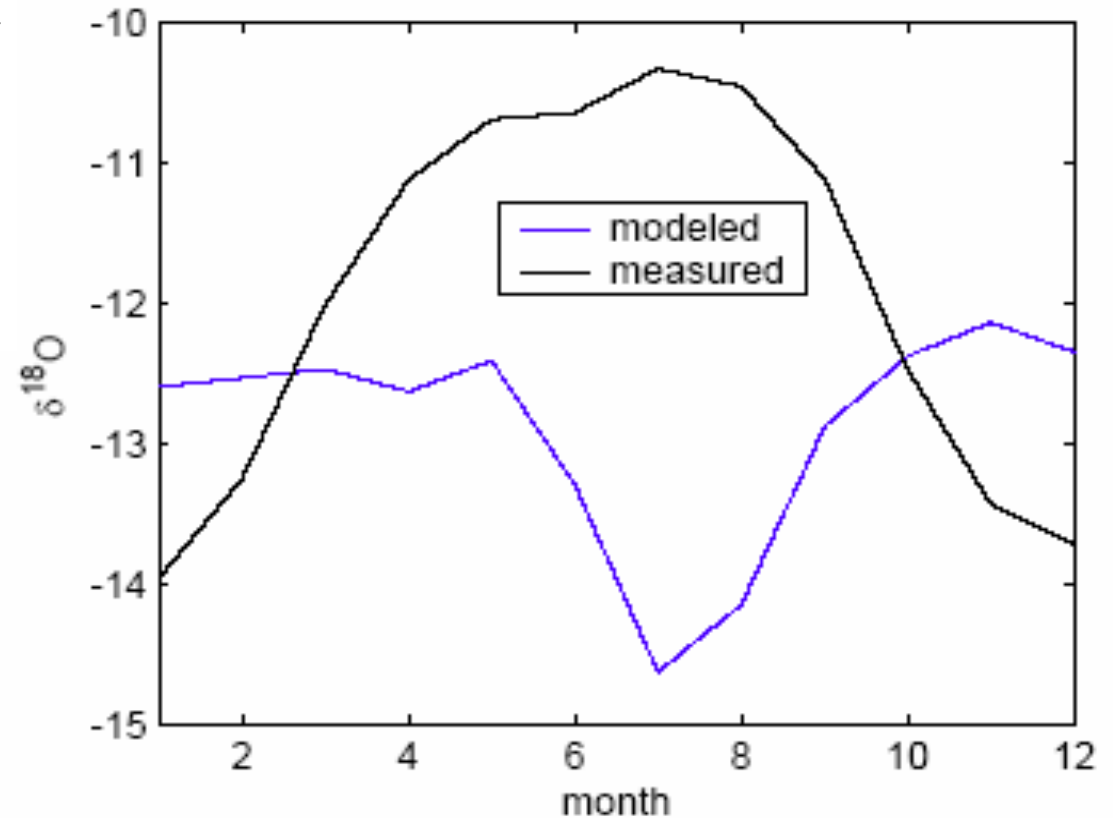
Water-isotope NCAR GCM CAM2,  
Jun-Eun Lee & Inez Fung.

# Results

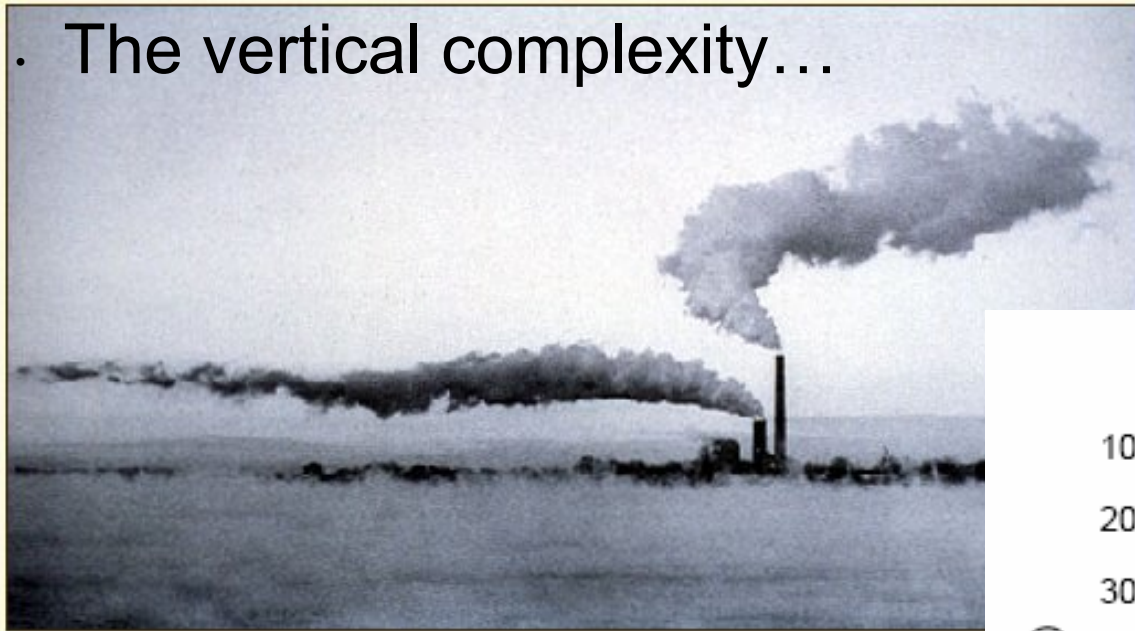
- Model is fine in predicting precipitation patterns (spatial, temporal, altitude trends).
- Model is wrong in capturing the seasonal cycle...



Water-isotope NCAR GCM CAM2,  
Jun-Eun Lee & Inez Fung.

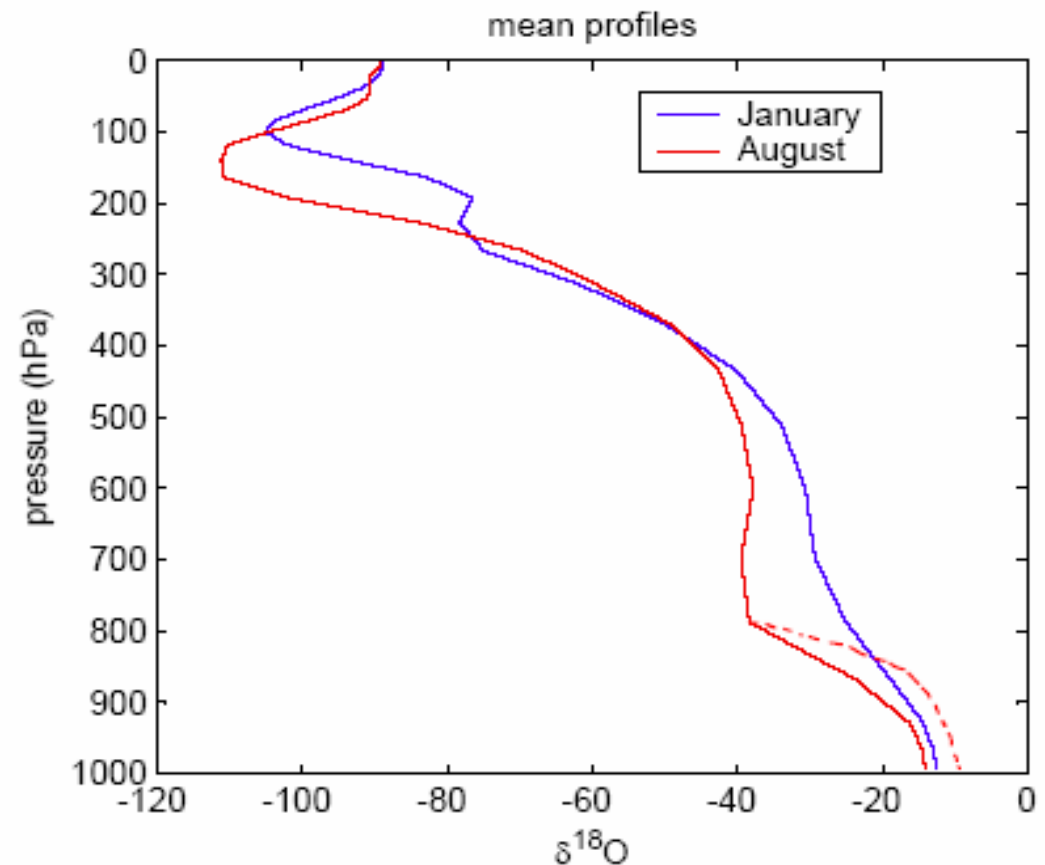


## . The vertical complexity...



Our hypothesis: the vertical mixing is significantly influenced by subsidence and the PBL characteristic.

During summer, mixing between surface and free trop' is inefficient...



## Seasonal variations in the isotopic composition of near-surface water vapour in the eastern Mediterranean

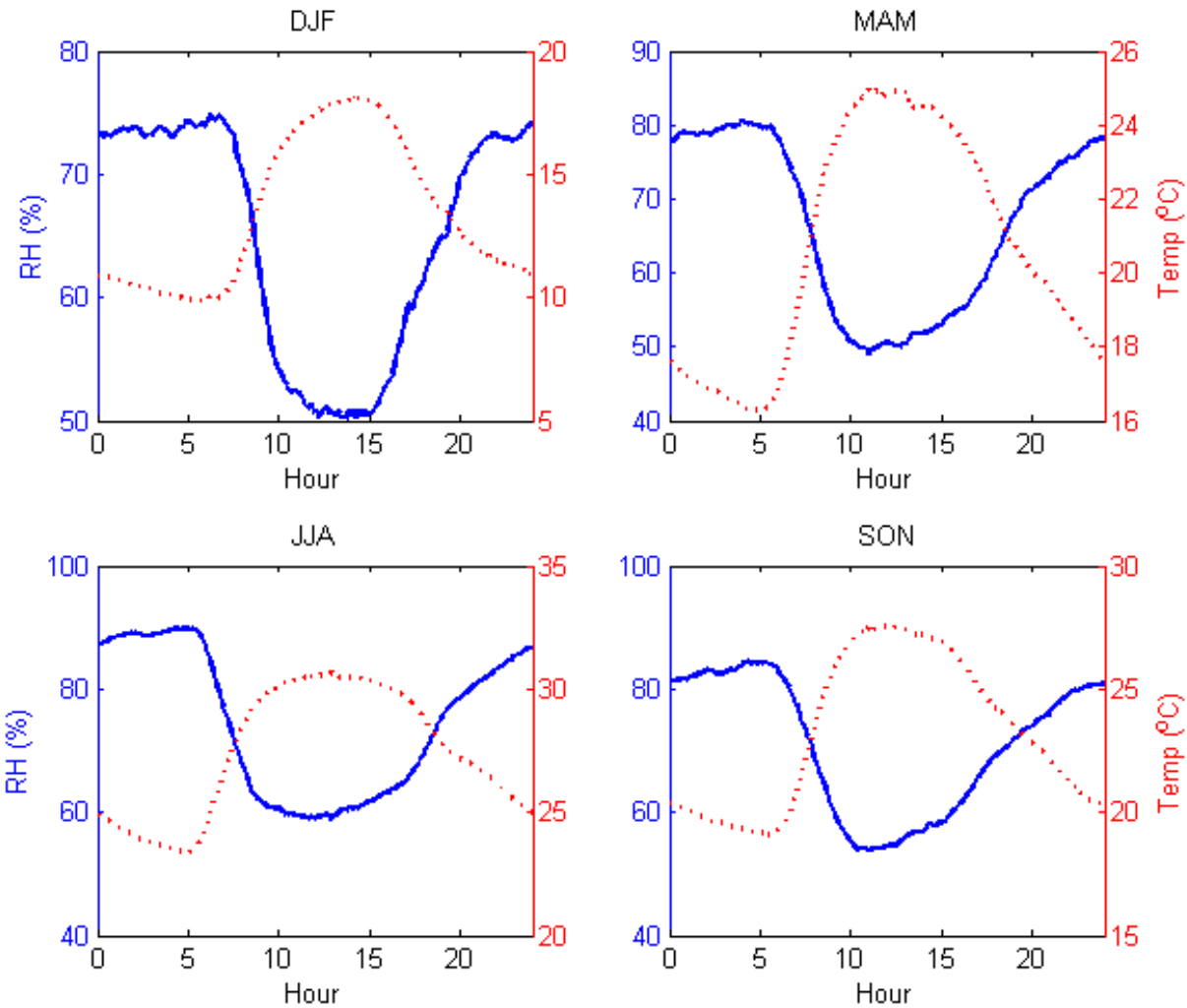
By ALON ANGERT<sup>1</sup>, JUNG-EUN LEE<sup>2</sup> and DAN YAKIR<sup>1\*</sup>, <sup>1</sup>Department of Environmental Sciences and Energy Research, The Weizmann Institute of Science, Rehovot 76100, Israel; <sup>2</sup>Berkeley Atmospheric Sciences Center, University of California, Berkeley, CA 94720-4767, USA



# Results

Is the long-term trend artifact of diurnal cycle?

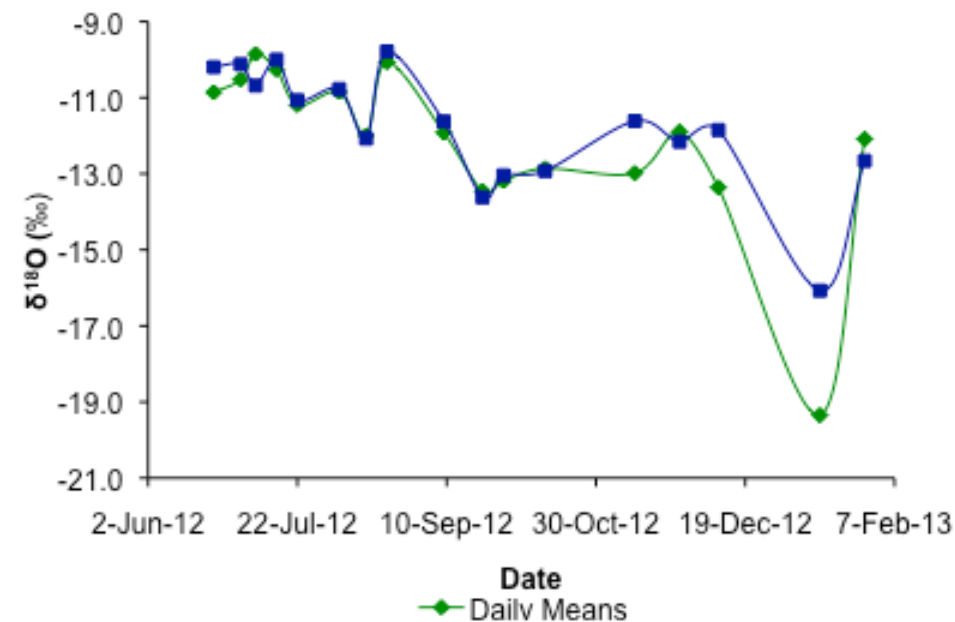
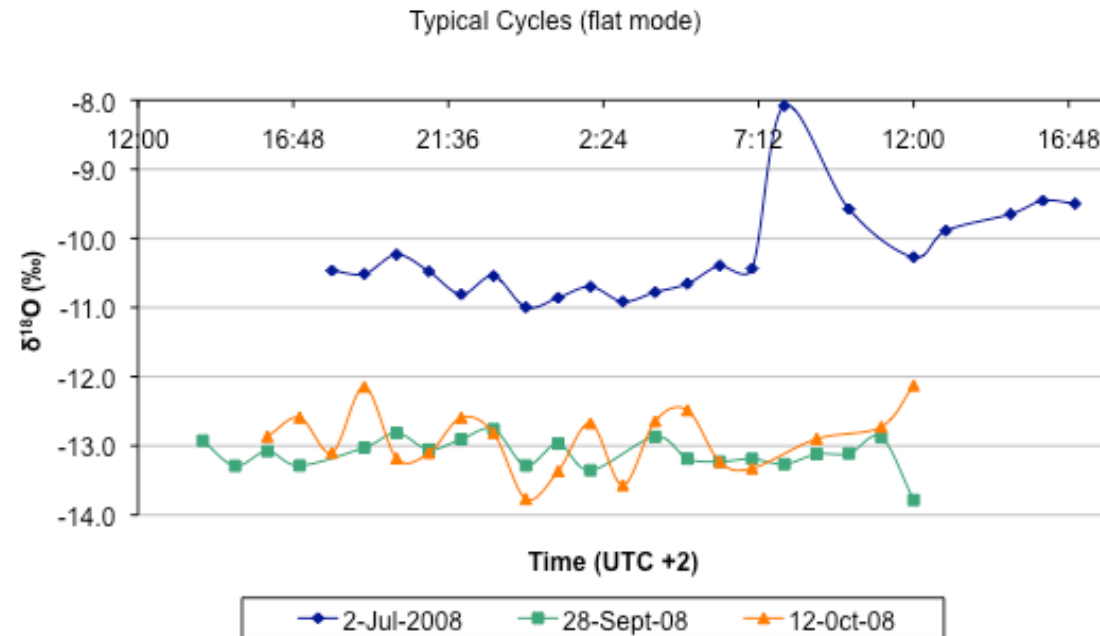
The “expected” diurnal cycle:



# Results

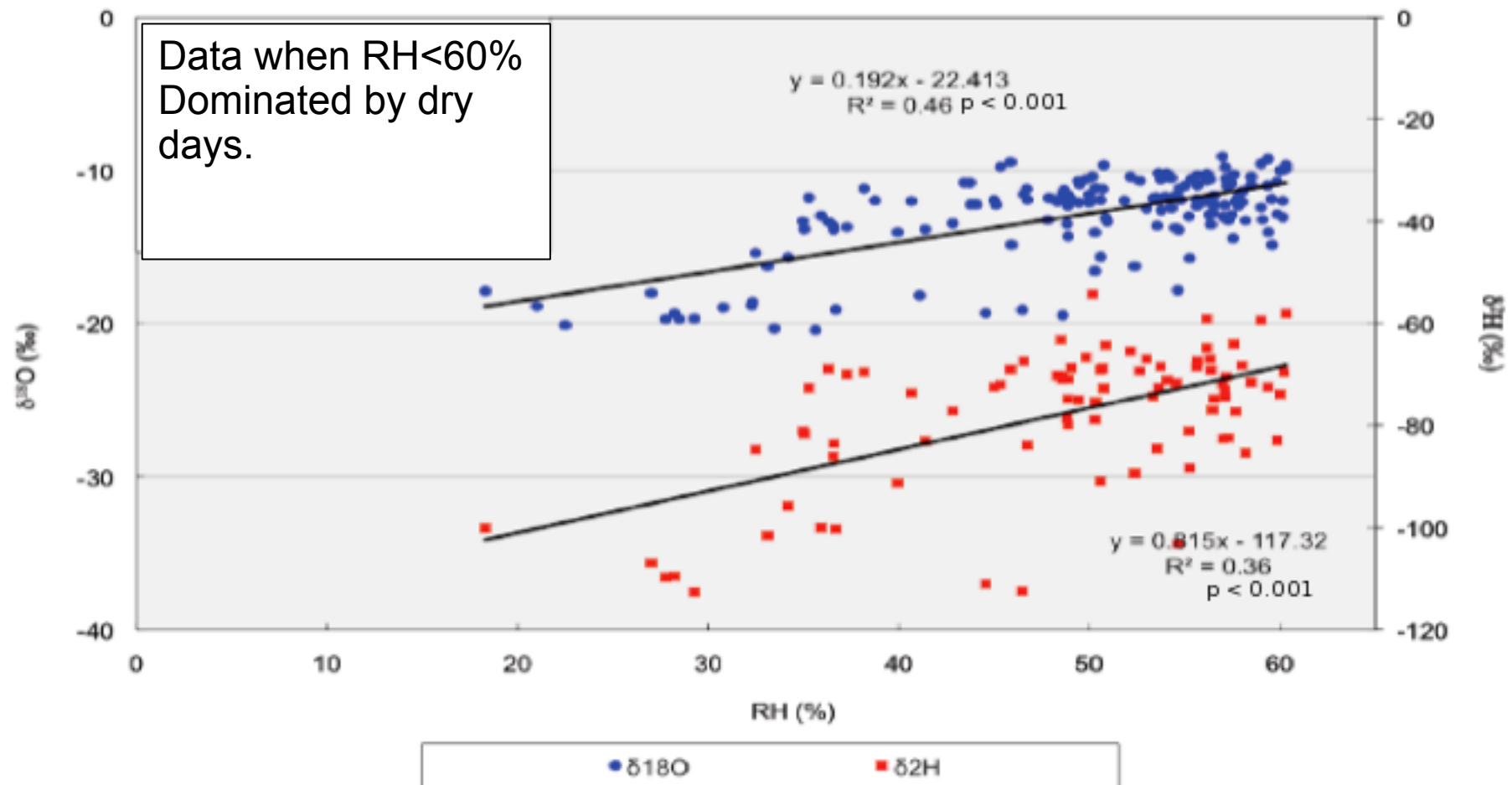
No clear diurnal cycle  
No day/night effect  
No “altitude” effect

(16 diurnal campaigns  
447 samples)



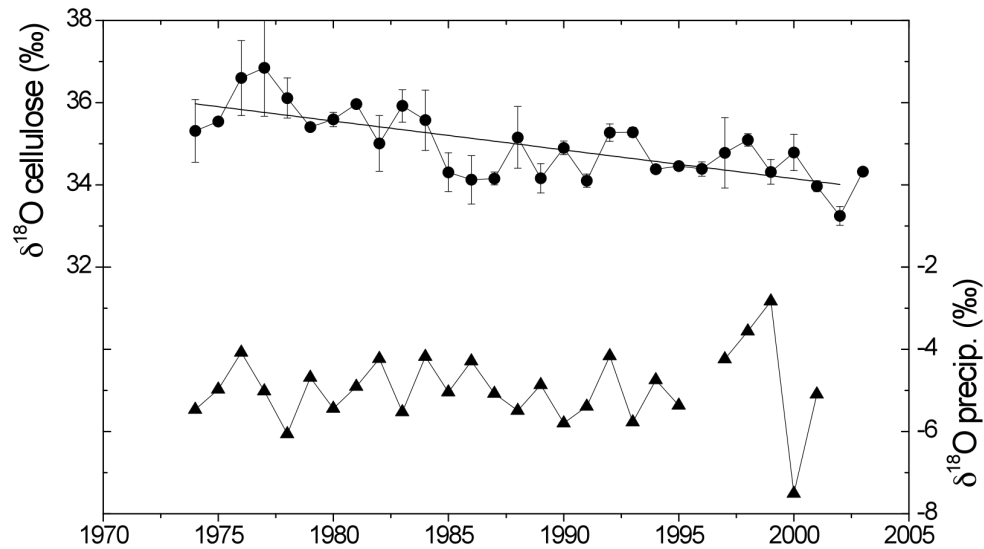
# Results:

An underlying effect of humidity emerges in low humidity conditions.



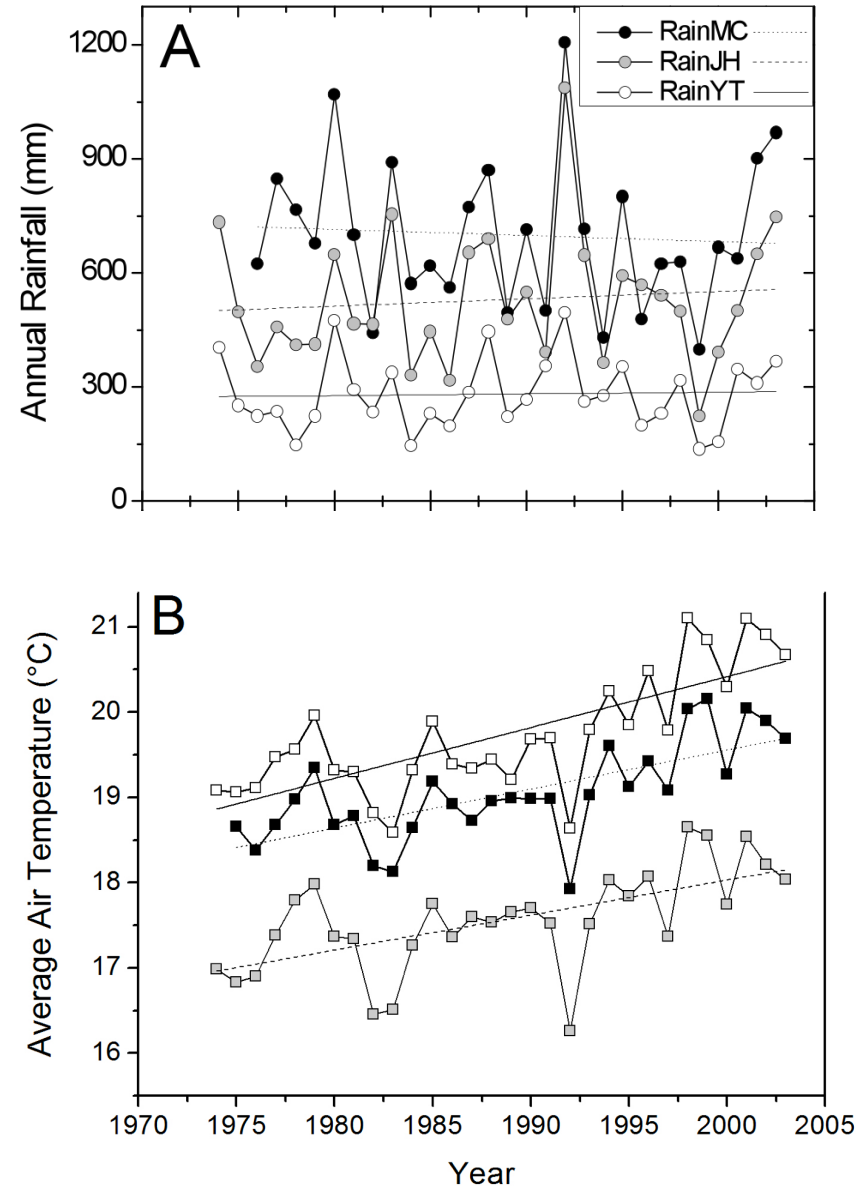


# Discussion



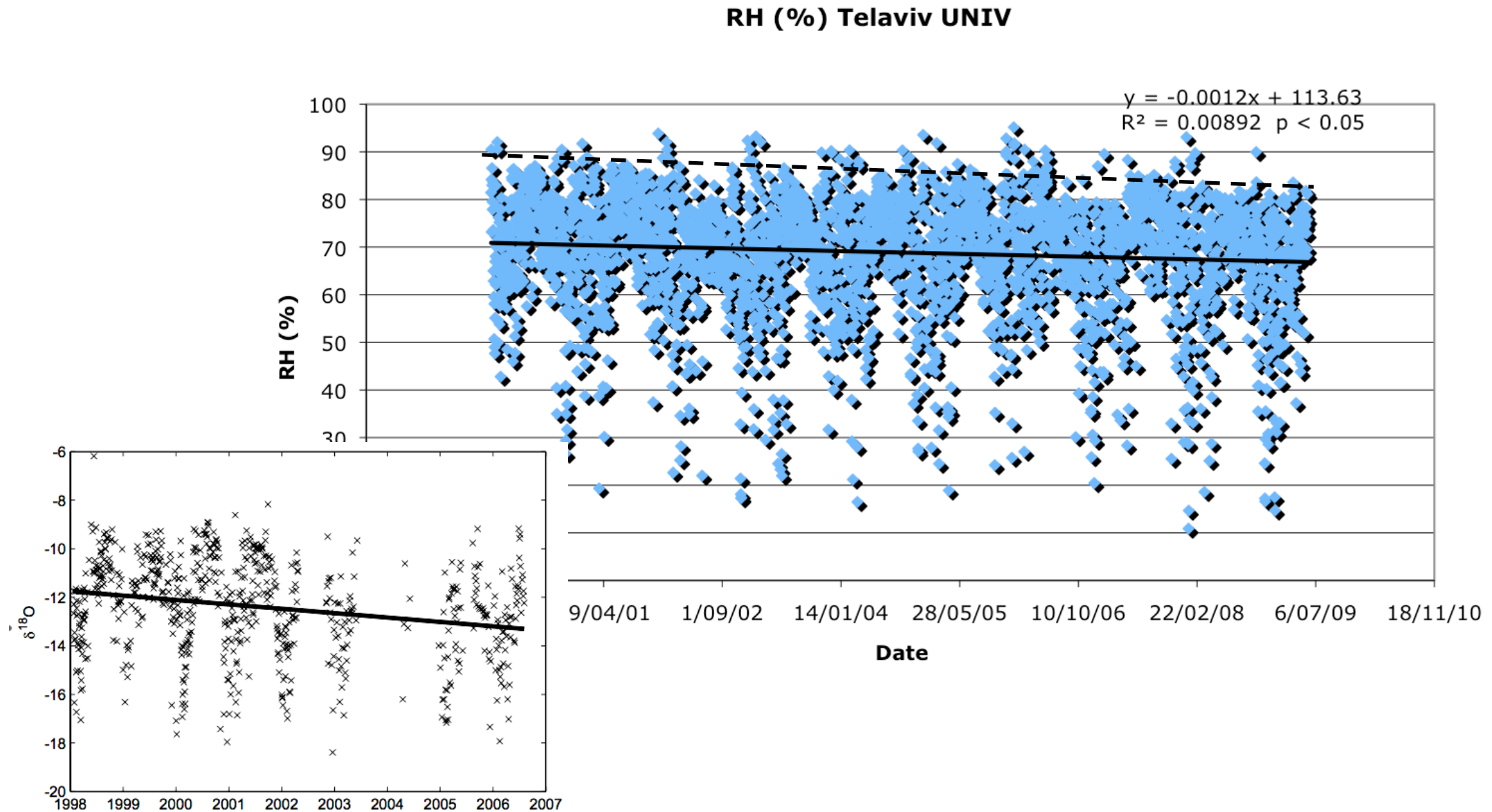
## Climate change indicators in the Eastern Med

$^{18}\text{O}$  of cellulose is influenced by leaf water and in turn by atmospheric vapor



# Discussion

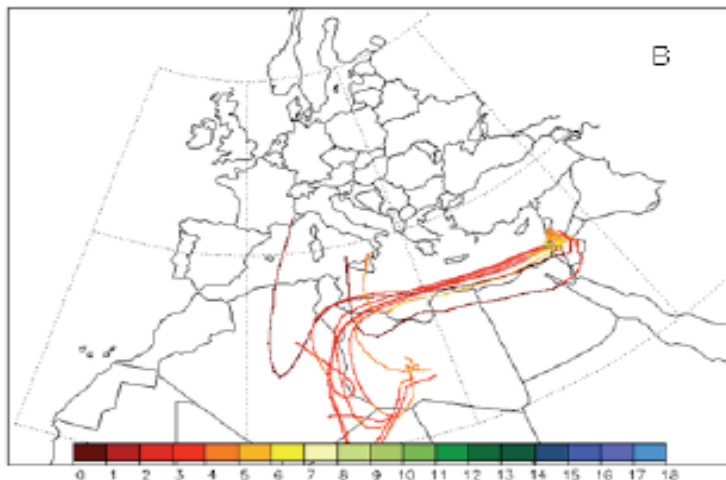
- Some indications for a drying trend exist...
- Does this reflect change in circulation patterns?



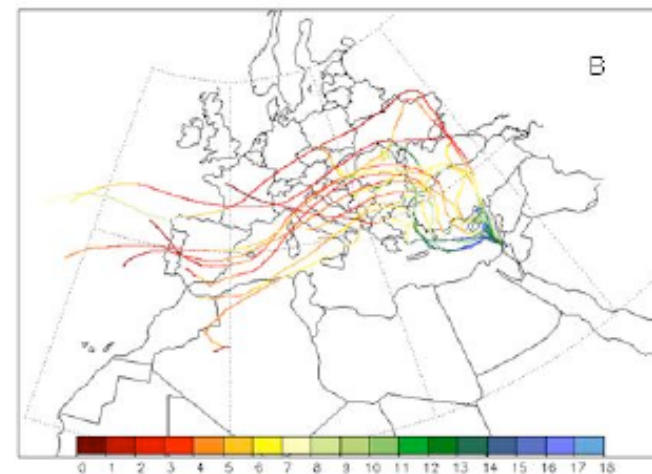
# Discussion

Change in atmospheric Circulation? Atmospheric circulation: dry days from N. Africa, wetter days from the Balkan

“Dry day”;  $\delta_v \sim -12$



“Wet day”;  $\delta_v \sim -10$



Clear variations in the source and dynamics in the moisture levels. Is this reflected in observed variation in our  $\delta_v$  values?

Heini Wernli and Stephan Pfahl, Mainz/ETH

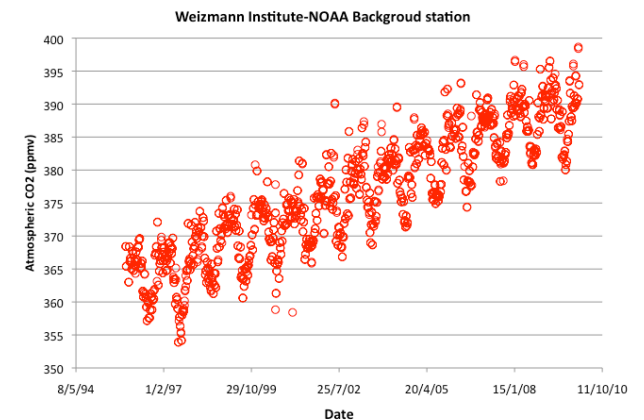
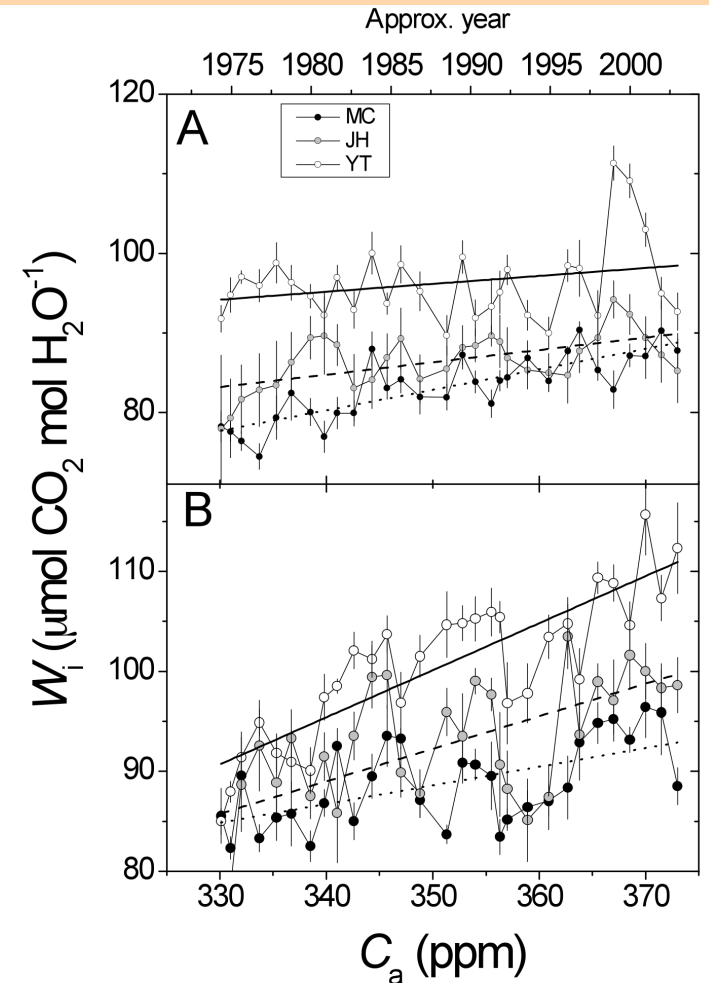
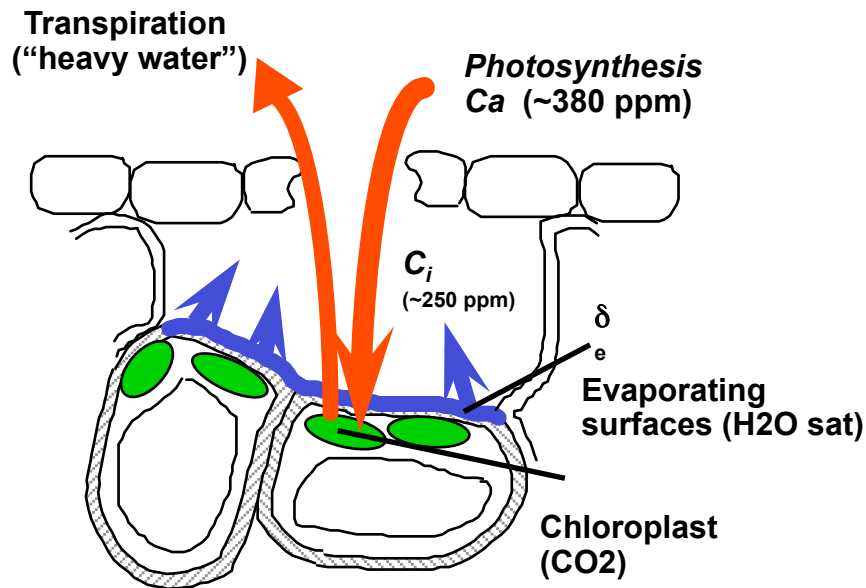


# Discussion

Effects of land surface processes: ET decline with increasing WUE, associated with CO<sub>2</sub>?

Water Use Efficiency (W):  
Ratio of Carbon uptake / Water loss (T)  
Derived from <sup>13</sup>C in tree rings

Reduced T ("heavy" water) reduces  $\delta_v$



# Summary

Seasonal cycle can only be explained by accounting for changes in vertical mixing

Long-term trend cannot be explained by effects of diurnal cycle

Relative humidity is linked to diurnal  $\delta_v$  dynamics (apparent when  $RH < 60 \%$ )

Drying trends could be associated with changes in circulation patterns (to more southerly; also effected by wind speed and  $q$ ).

Long-term trend in  $\delta_v$  is associated with increase in water use efficiency (CO2 effect?) that reflect reduced ET.

$\delta_v$  could become a useful indicator for regional change (climate, circulation patterns, etc.)

