מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

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

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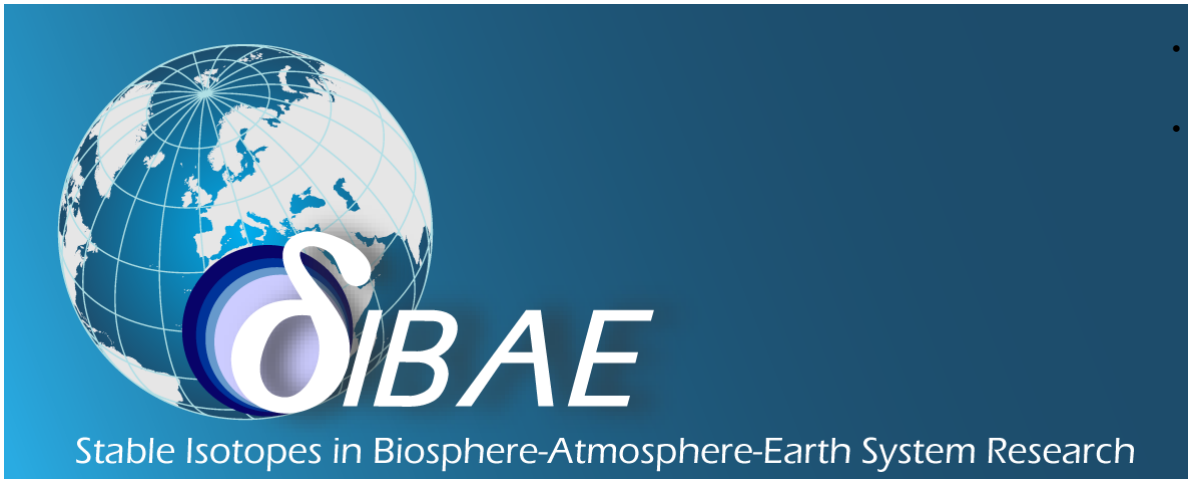
Environmental Sciences & Energy Research

Paris, April 2010

COST Action ES0806 SIBAE



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

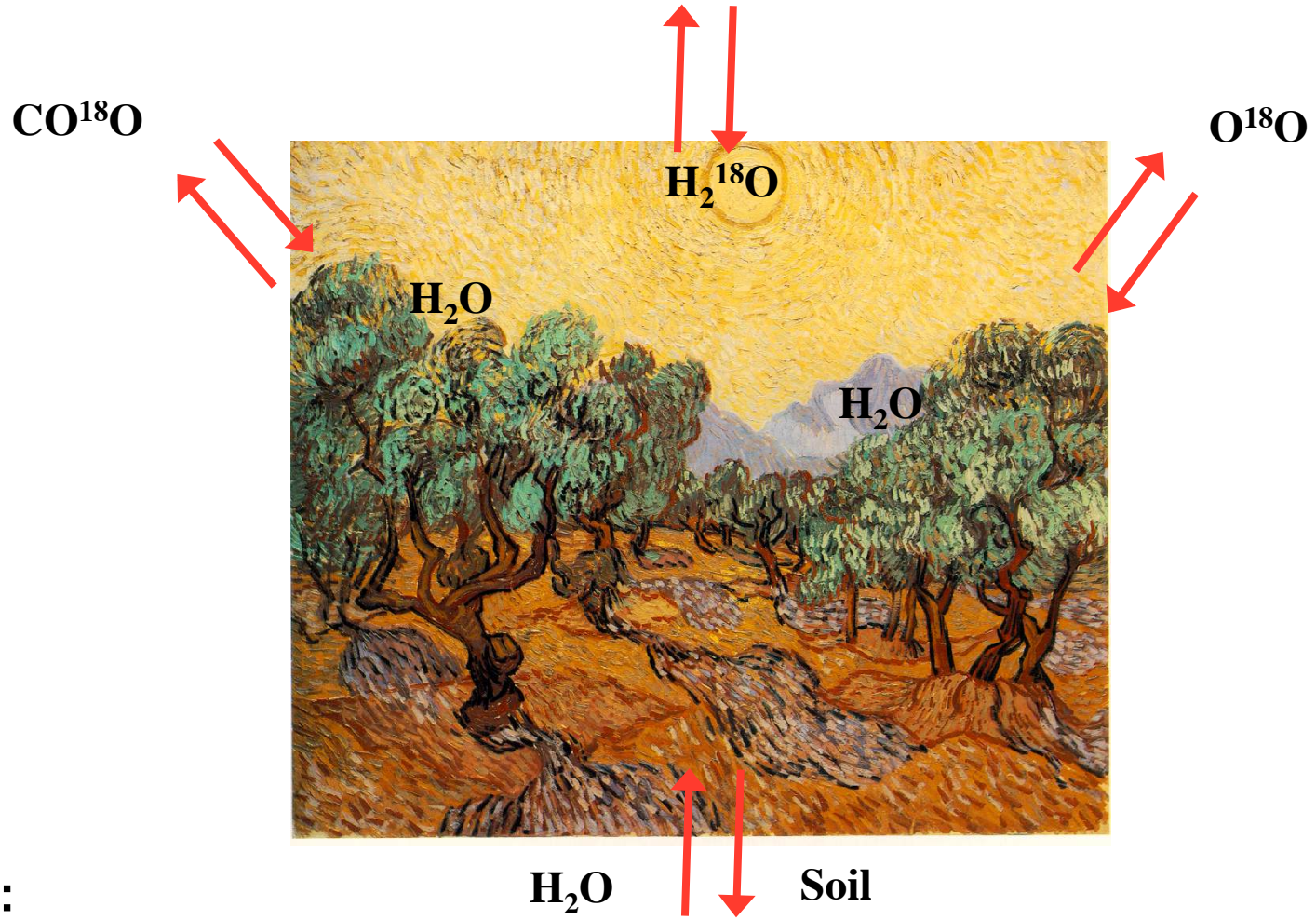
http://www.sibae.ethz.ch/cost-sibae/

Objectives of COST Action SIBAE

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}O links $H_2O/CO_2/O_2$ interactions.



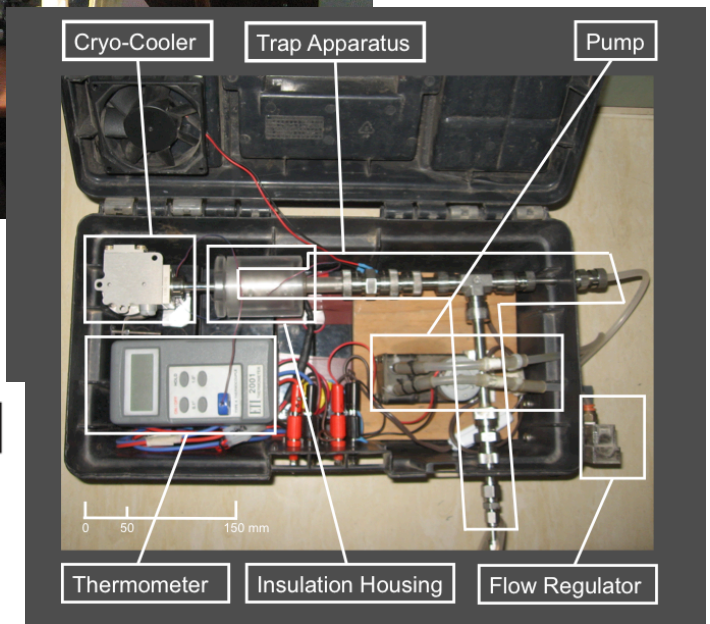
Objectives:

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

Introduction

Methodology

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



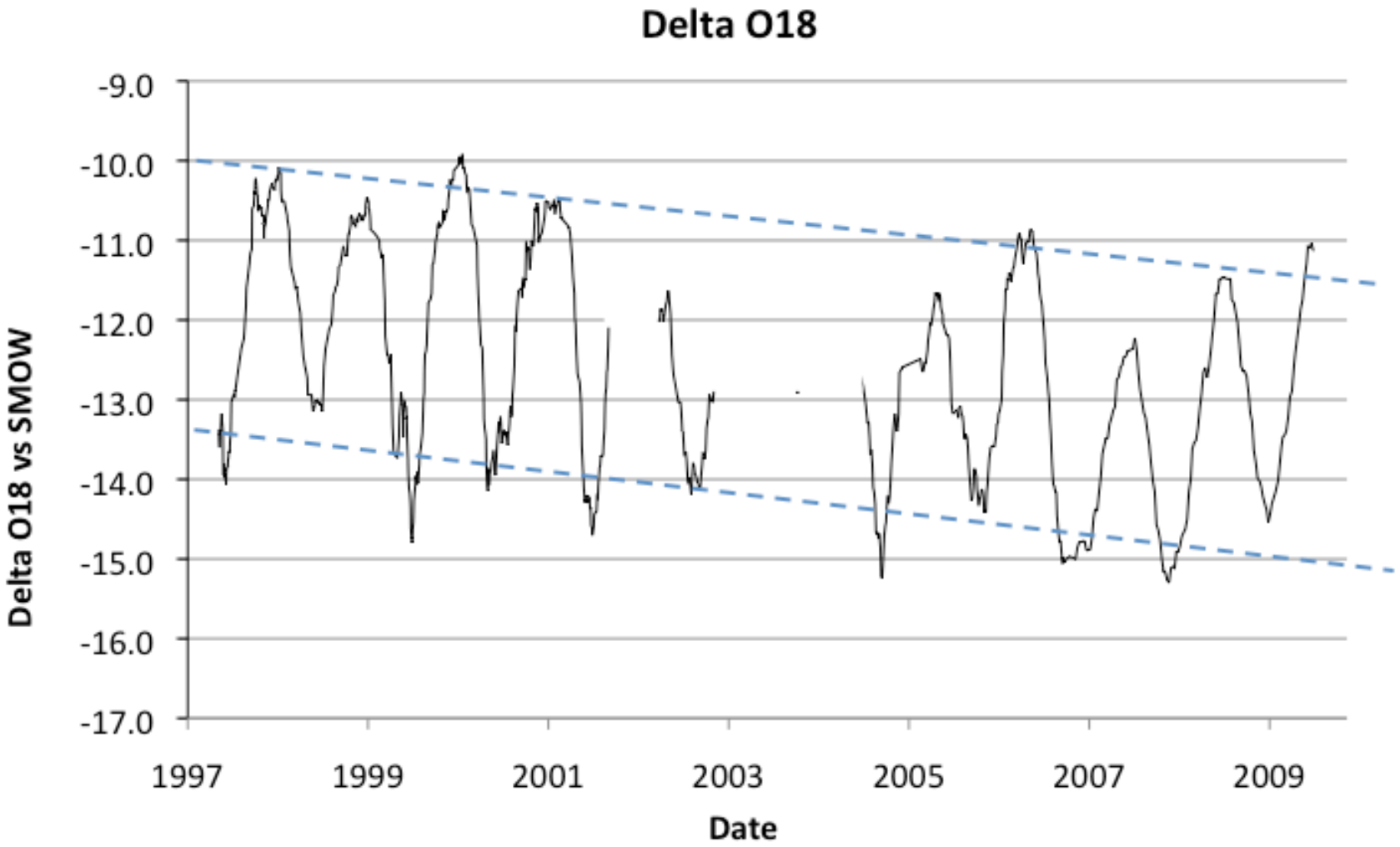
RAPID COMMUNICATIONS IN MASS SPECTROMETRY
Rapid Commun. Mass Spectrom. 2010; **24**: 103–108
Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/rcm.4359

RCM

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

Results

Near surface atmospheric water vapor



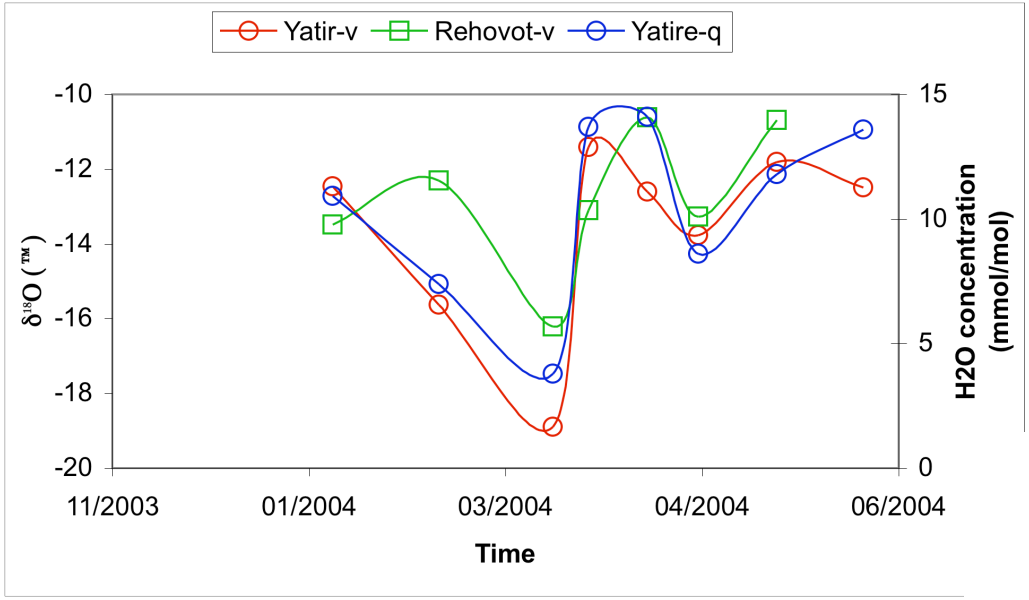
Vapour Collections:

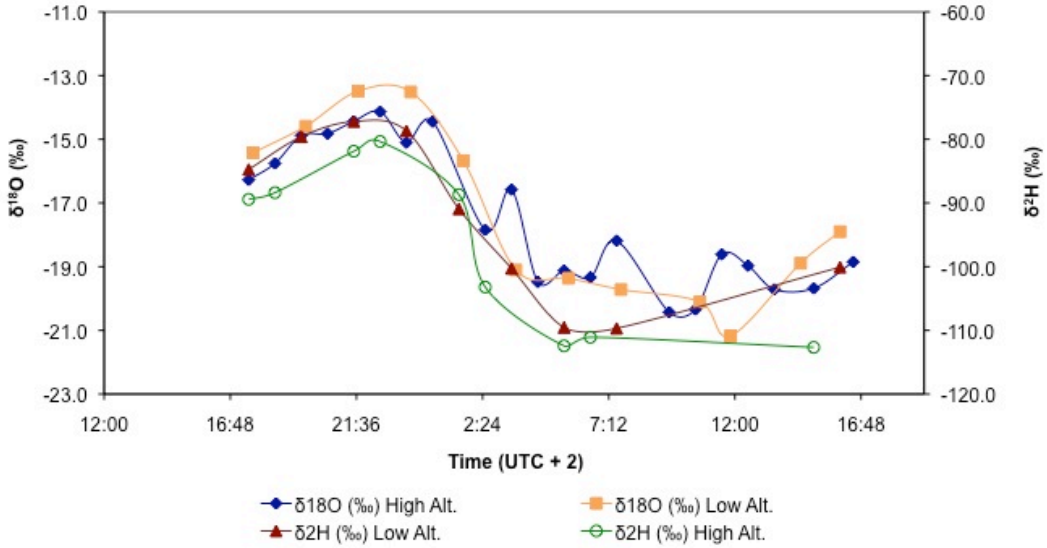
- **WIS Long-term sampling regime:** 1997 – Present, ~2-Weekly collections
- **Is there a long-term trend…**

Results

The local scale:

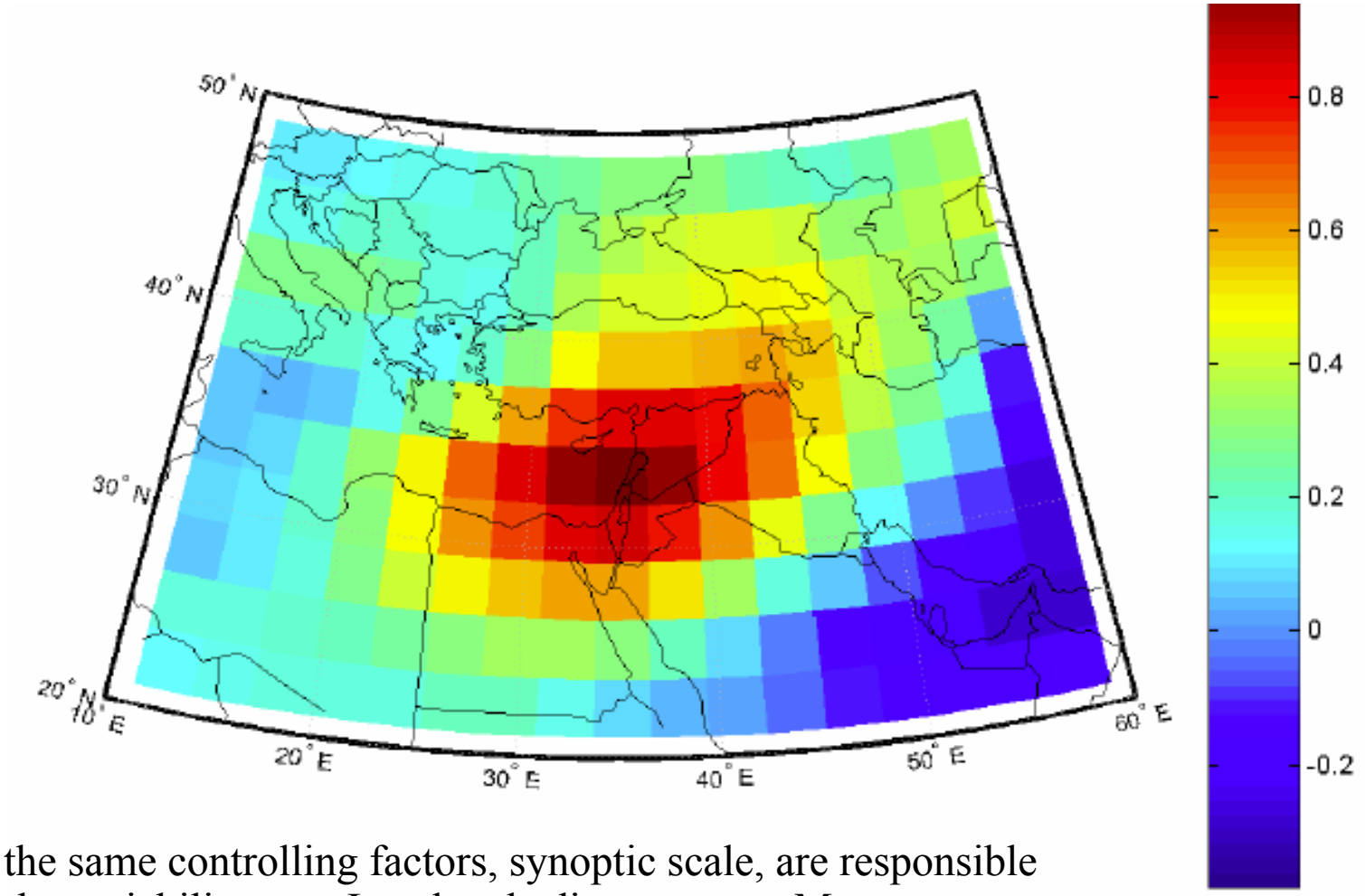
Campus sampling (Weizman Inst.) consistent with rural sampling (Northern Negev). No “altitude” effect





Results

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

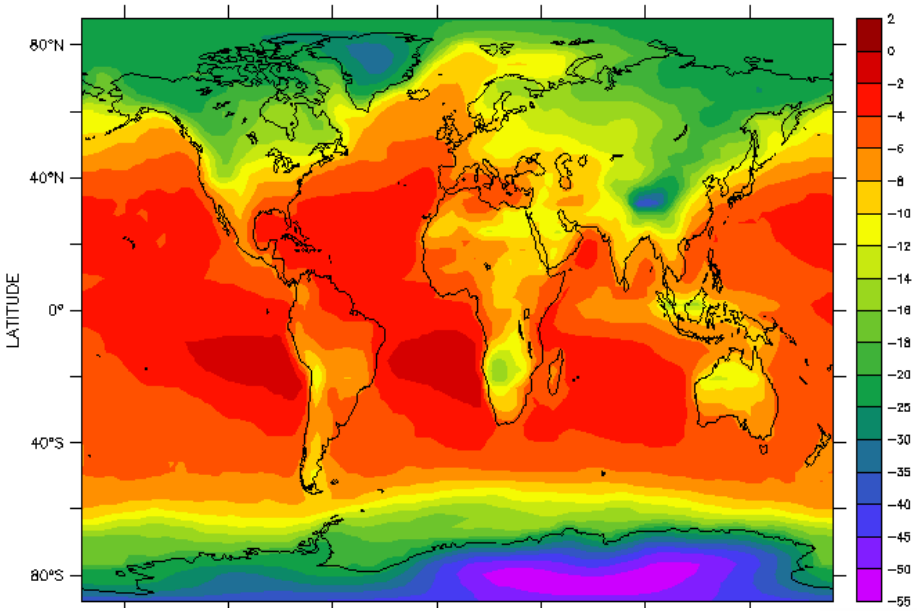


=> the same controlling factors, synoptic scale, are responsible for the variability over Israel and adjacent areas. Measurements in a single location help understand variations over large regions.

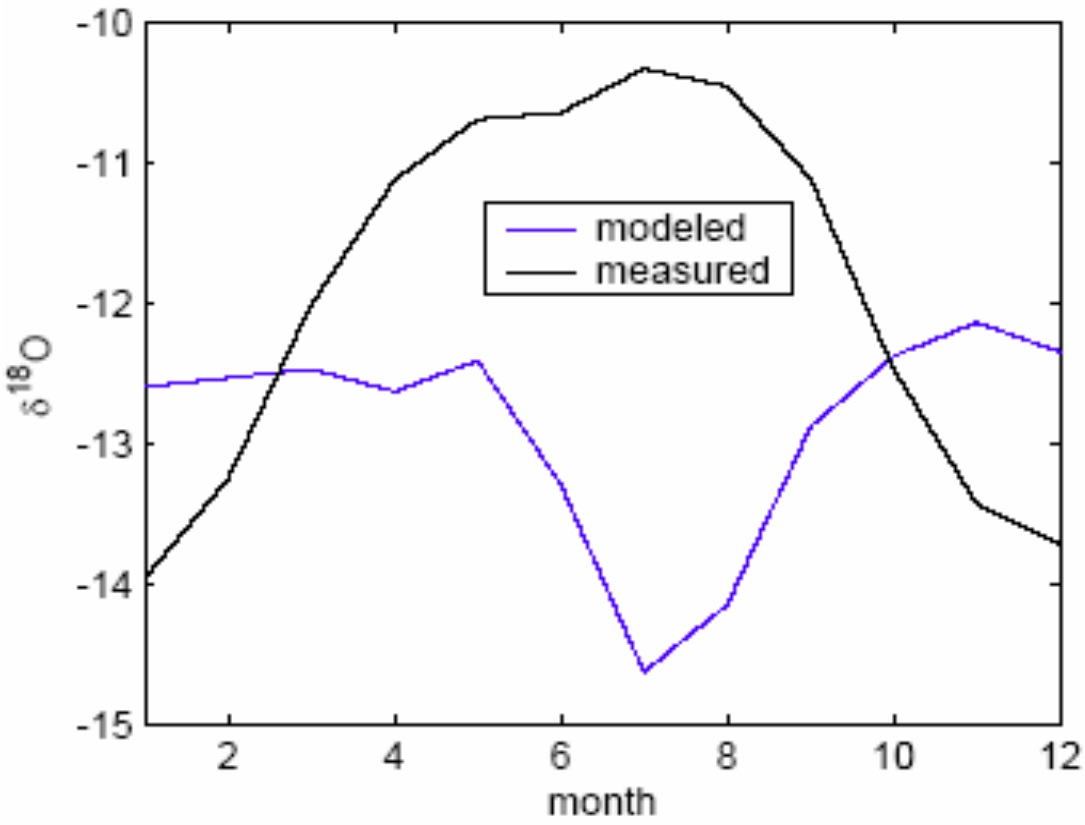
Water-isotope NCAR GCM CAM2,
Jun-Eun Lee & Inez Fung.

Results

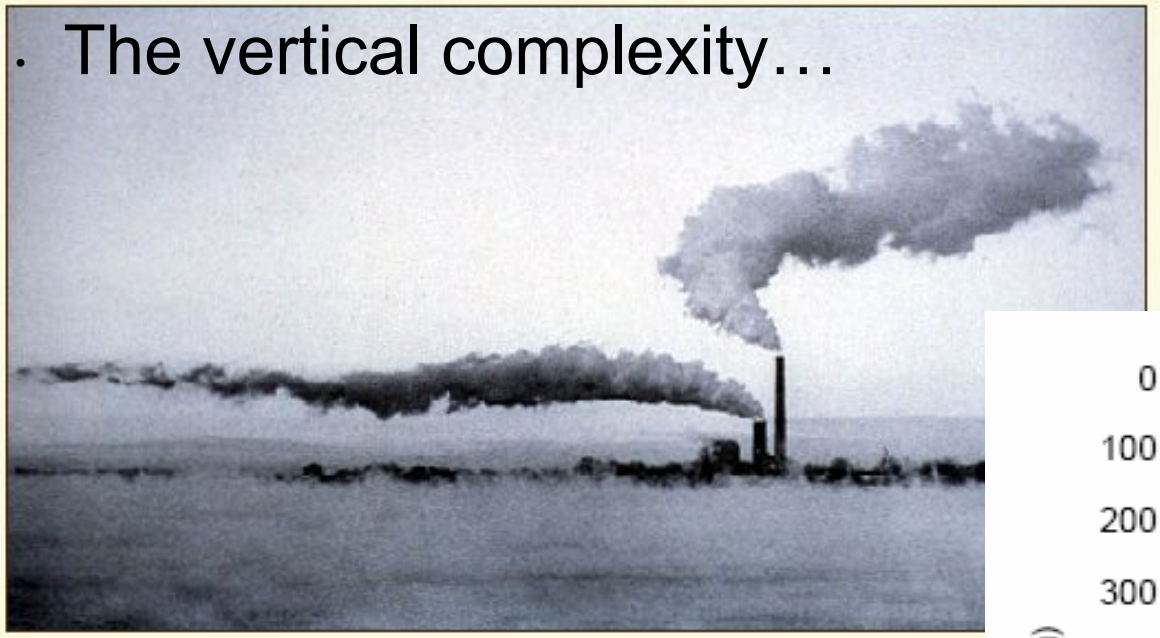
- Model is fine in predicting precipitation patterns (spatial, temporal, altitude trends.
- Model ia wrong in capturing the seasonal cycle…



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

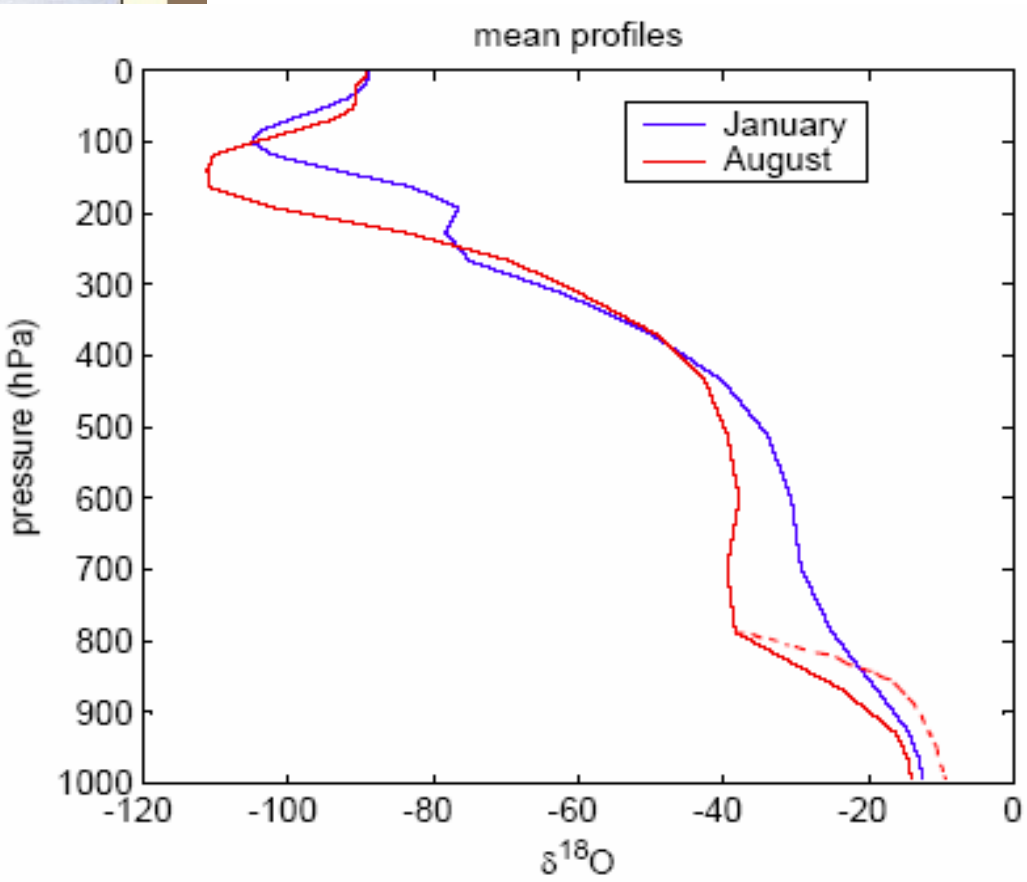


Results



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

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



Tellus (2008)

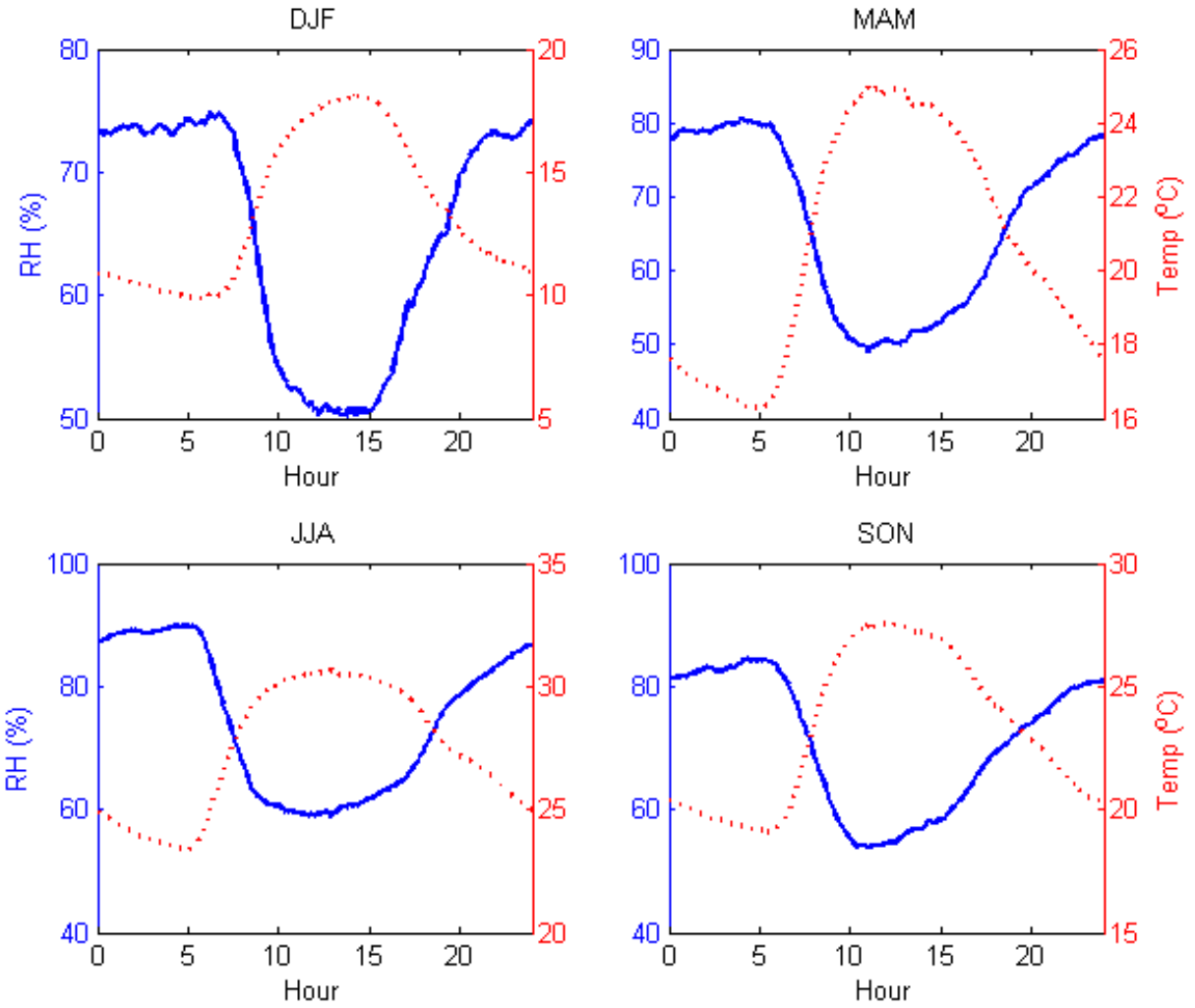
TELLUS

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

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

Results

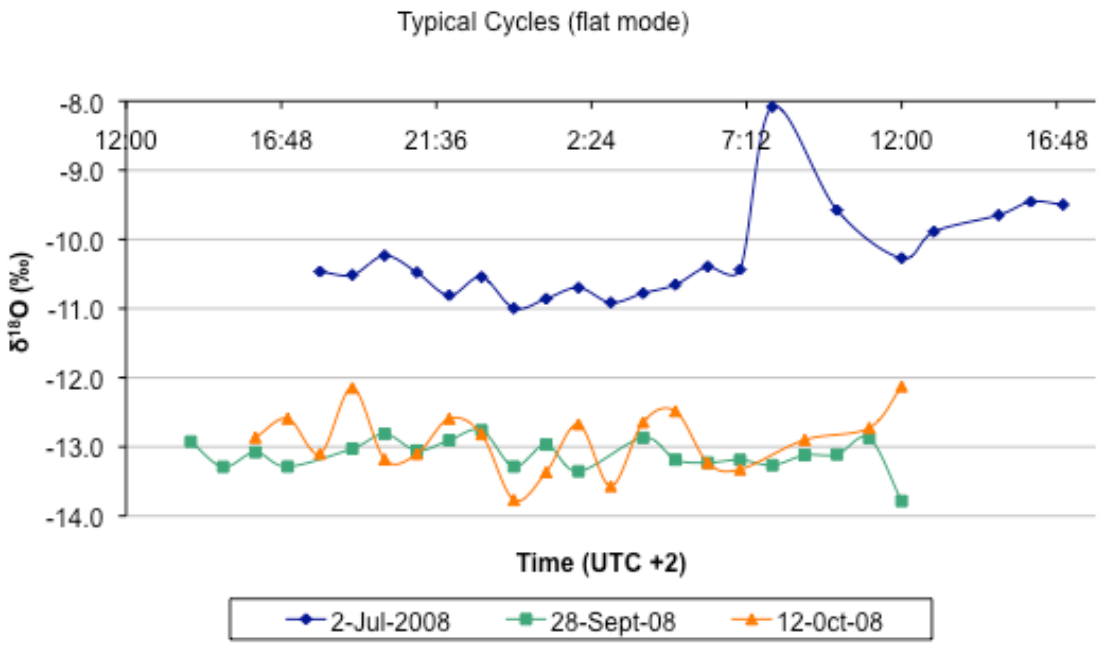
Is the long-term trend artifcat of diurnal cycle?
The “expected” diurnal cycle:

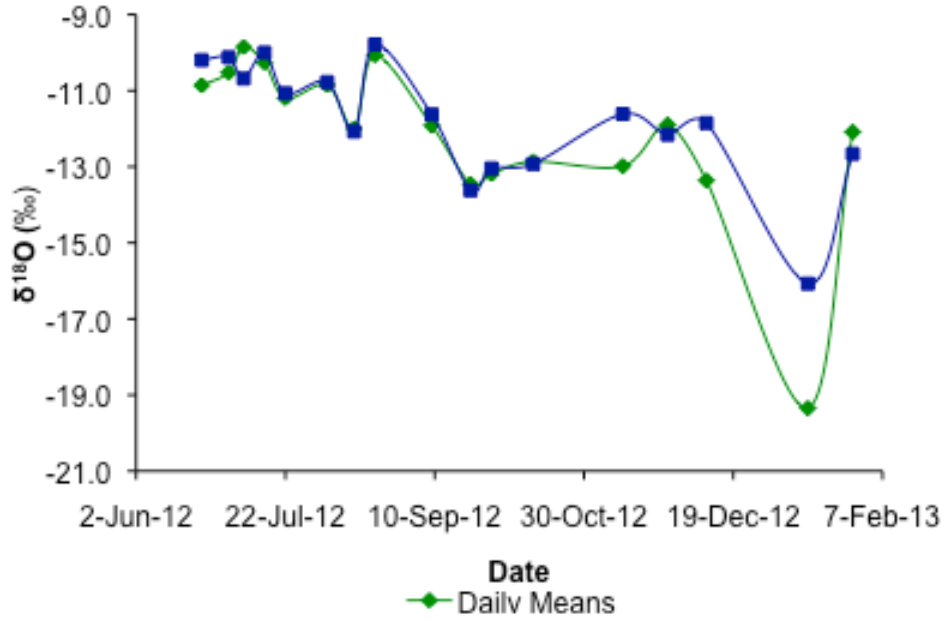


Results

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

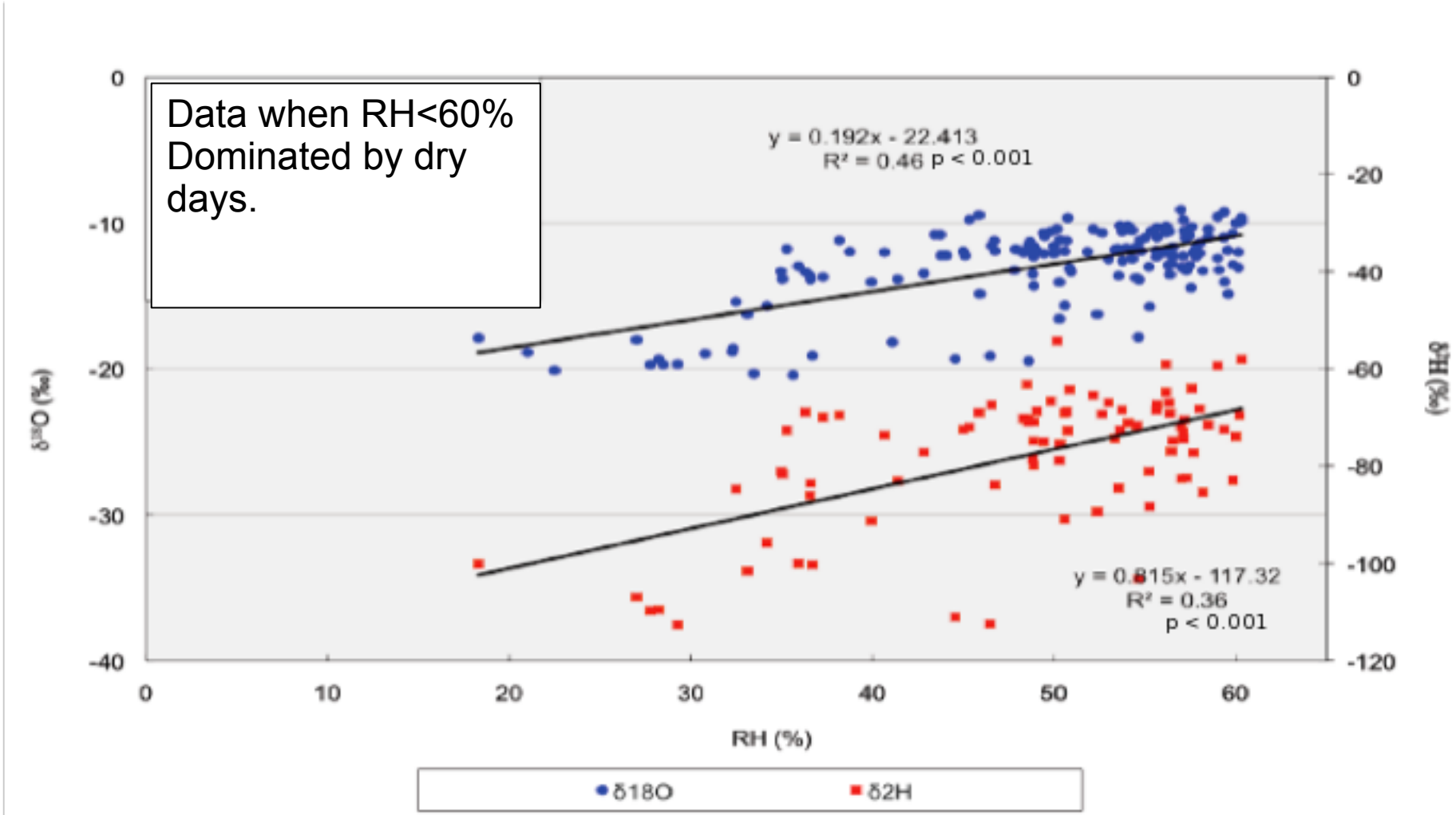
(16 diurnal campaigns
447 samples)



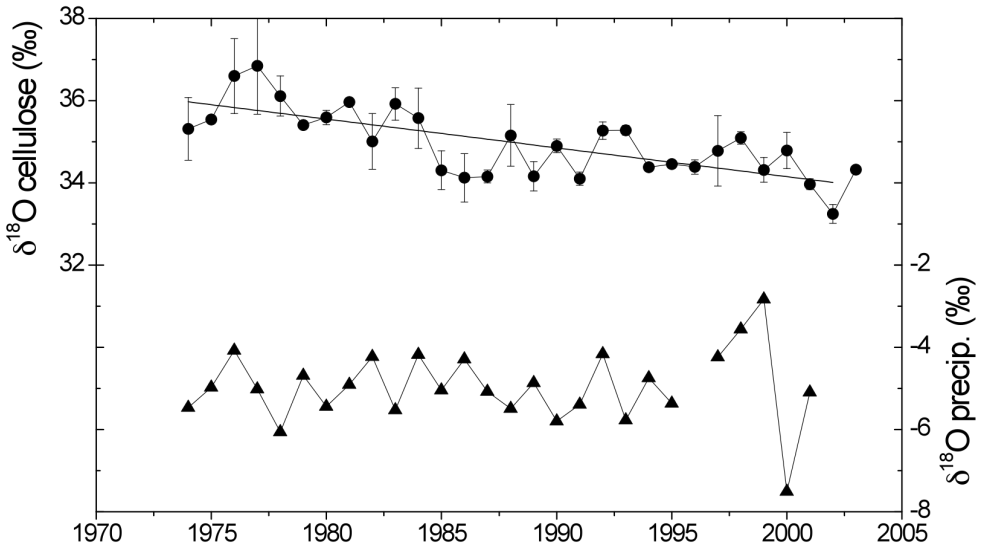


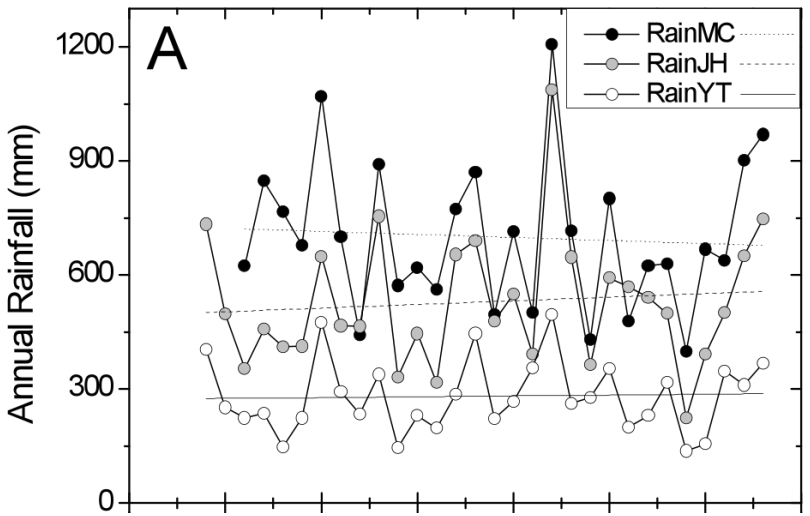
Results:

An underlying effect of humidity emerges in low humidity conditions.

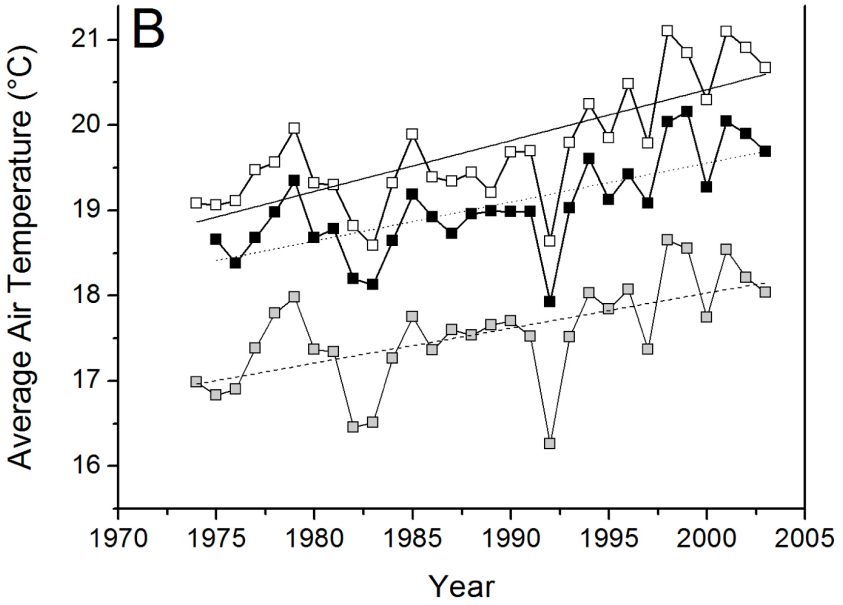


Discussion





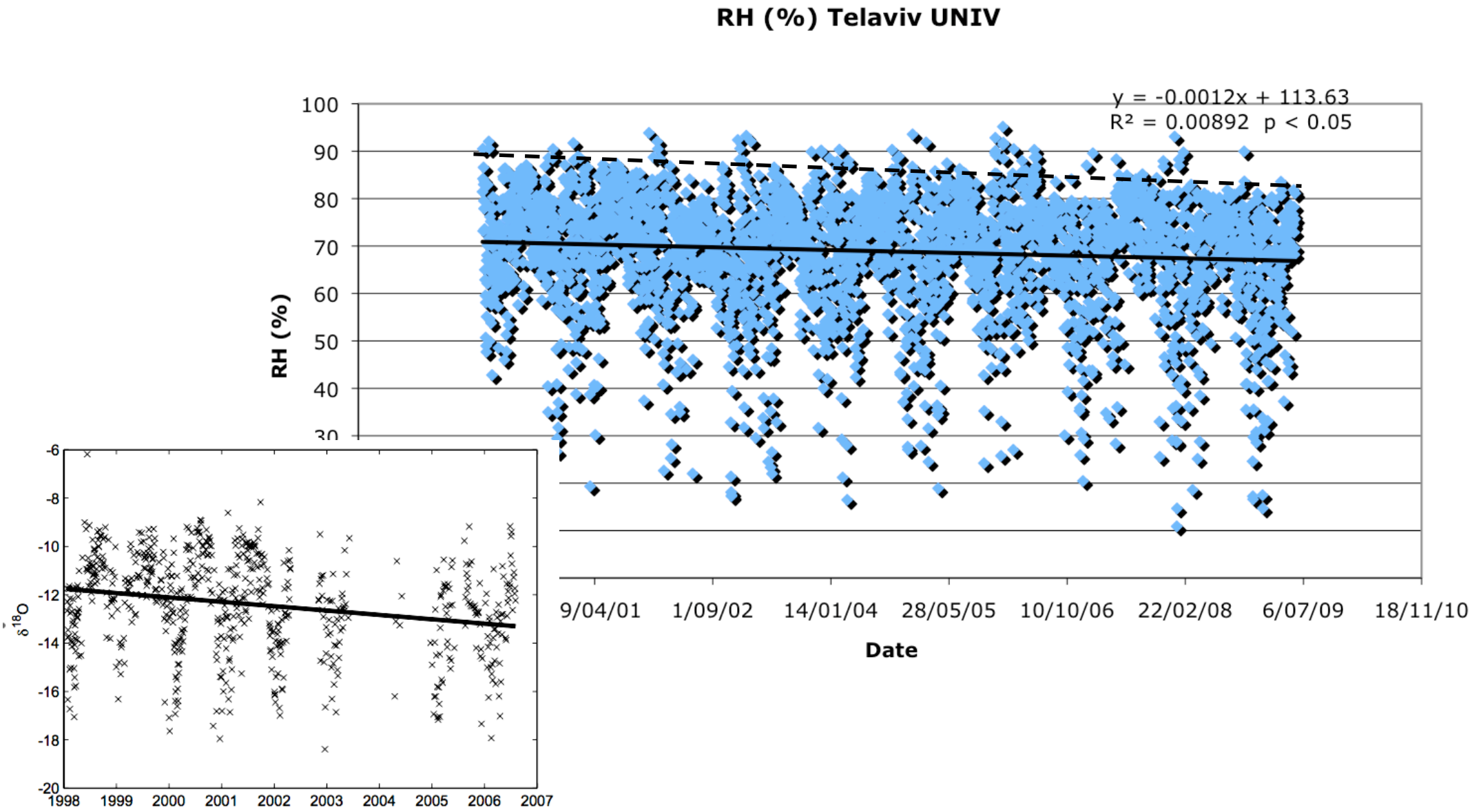
Climate change indicators in the Eastern Med



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

Discussion

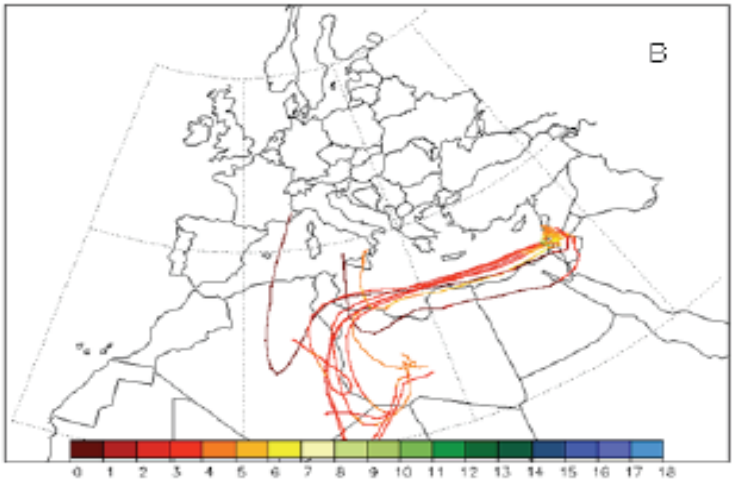
- Some indications for a drying trend exist…
- Does this reflect change in circulation patterns?



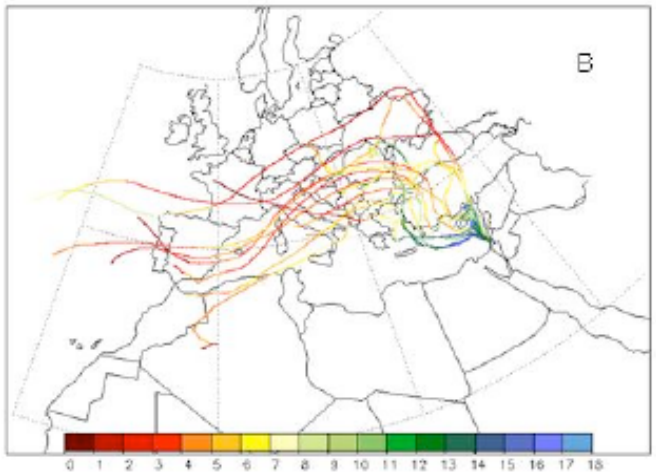
Discussion

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

"Dry day"; δ_V ~-12



"Wet day"; δ_V ~-10



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

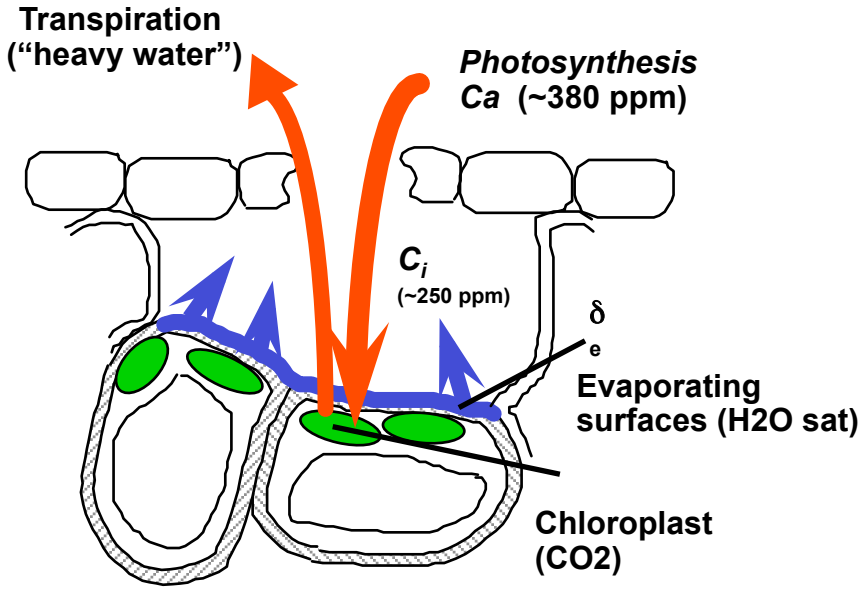
Heini Wernli and Stephan Pfahl, Mainz/ETH

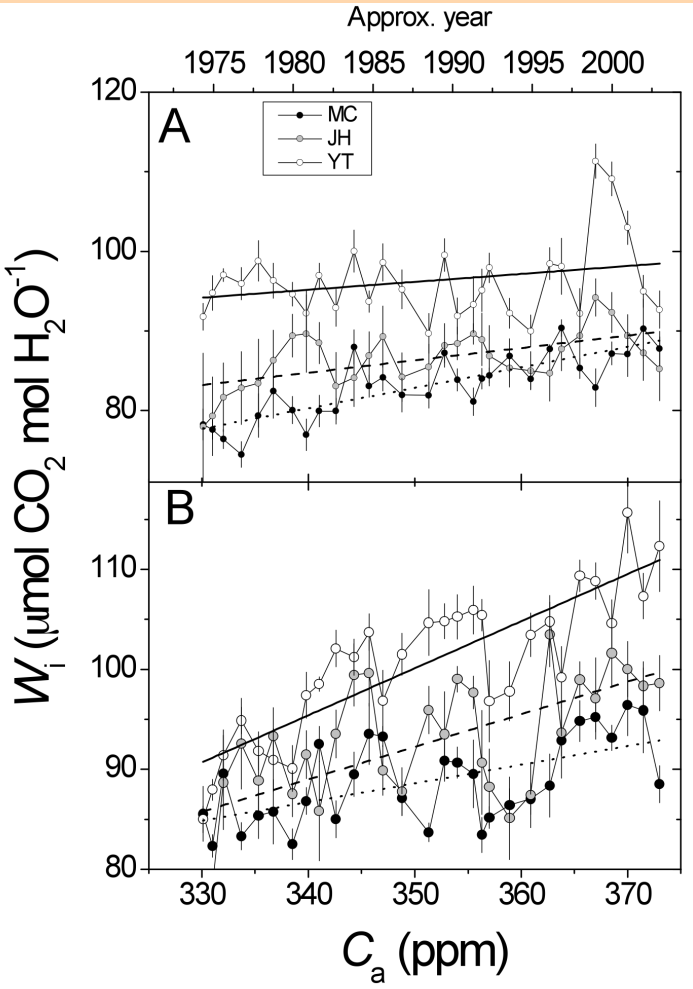
Discussion

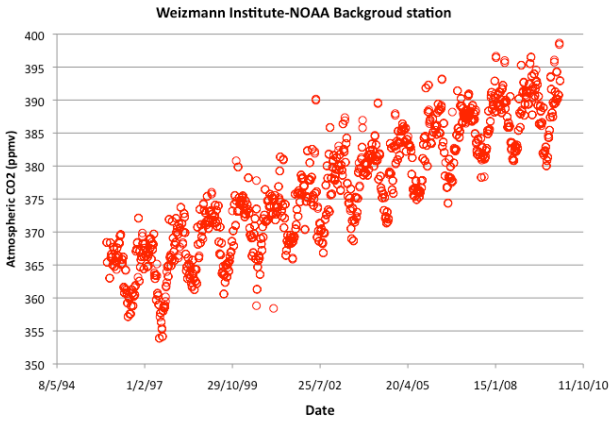
Effects of land suface processes: ET decline with increasing WUE, associated with CO2?

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

Reduced T ("heavy" water) reduces δ_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 δ_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 δ_V is associated with increase in water use efficiency (CO2 effect?) that reflect reduced ET.

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

סוף