



Stable isotope studies in semiarid, karstic environments reveal information for sustainable management of water resources in Damascus, Syria

Paul Königer, Mathias Toll, Thomas Himmelsbach,
Khaled Shalak, Ahmed Hadaya, Refaat Rajab



German Federal Institute
for Geosciences
and Natural Resources

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Outline

- Background / Objectives
- Methods and study site
- Results
 - a) Precipitation input variability
 - b) Mean catchment altitudes
 - c) Variations in groundwater
- Summary and future perspectives

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Background / Objectives

- BRG-TC Project “**Protection of the Fige-h-spring system**”
implement isotope hydrological methods
- High water demand especially during summer months
- Water quality issues - protection zones
in karstic environment

- Implement isotope hydrological methods to:
 - > define catchments: Where does water come from?
 - > explain mechanisms: How fast is the GW transport?
 - > separation of components: How much water?

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Stable isotope methods

- ^2H and ^{18}O environmental tracers for water cycle studies, groundwater recharge, evaporation, component separation, mixing
- Altitude effect in precipitation: heavier isotopes are more abundant in lower altitudes
- Evaporative influence imprints enrichment signal on and cause a shift from meteoric water line (MWL)

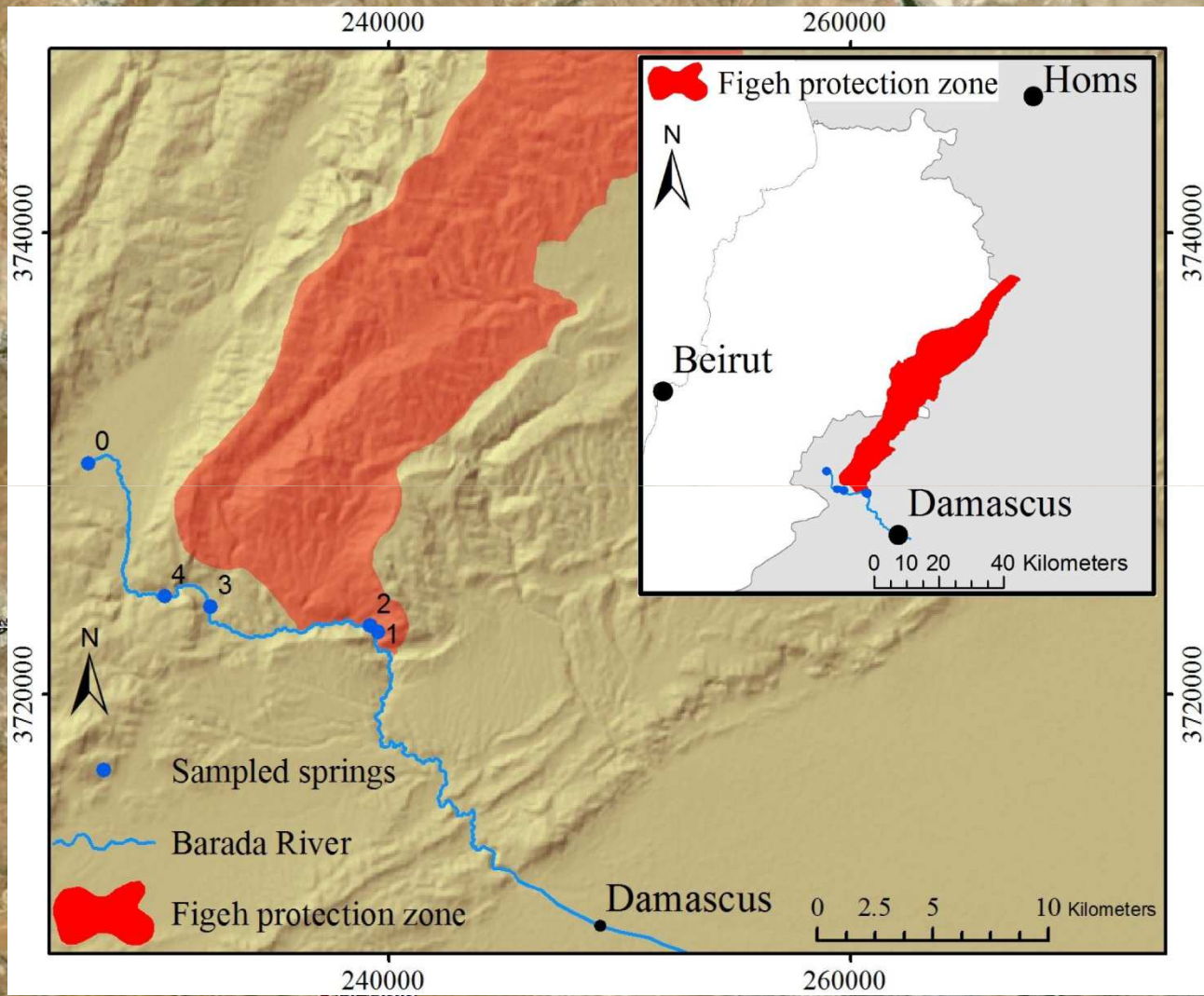
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Study site – Figeih catchment in Syria



Damascus

Google earth

US Dept of State Geographer
Image © 2012 DigitalGlobe
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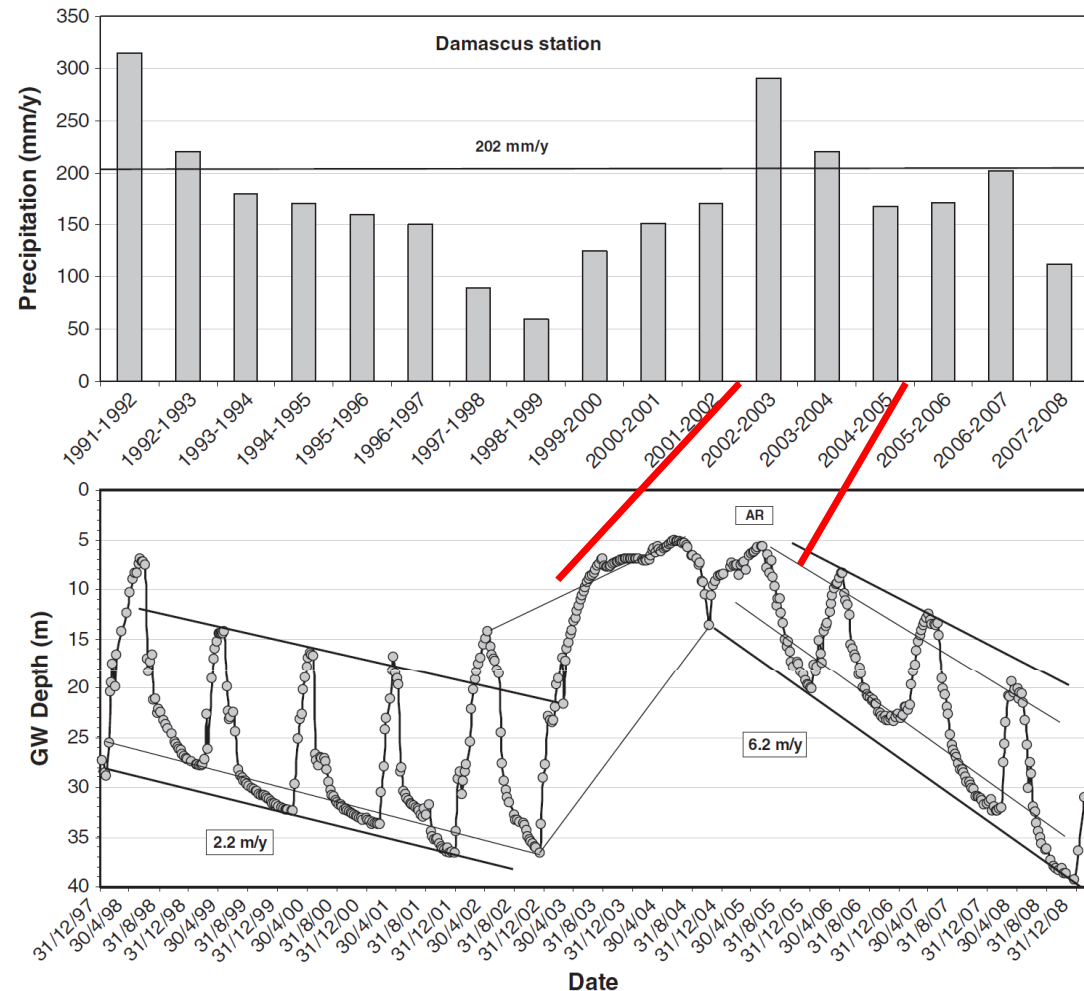
Ras Al-Ain

As'Saboura

Mezzeh

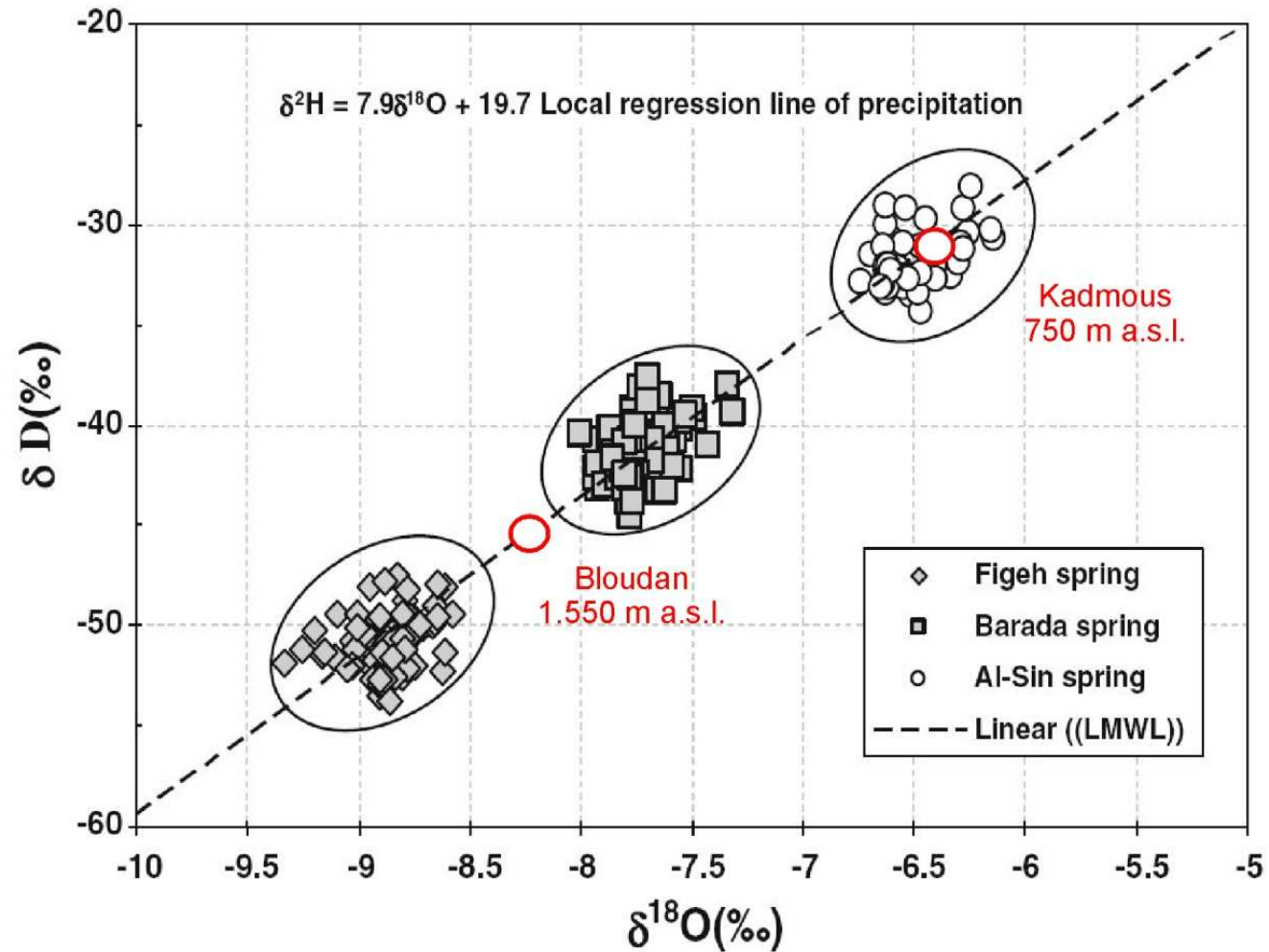
Precipitation, and groundwater patterns for Damascus, Syria

(Abou Zakhem et al. 2012, HP)



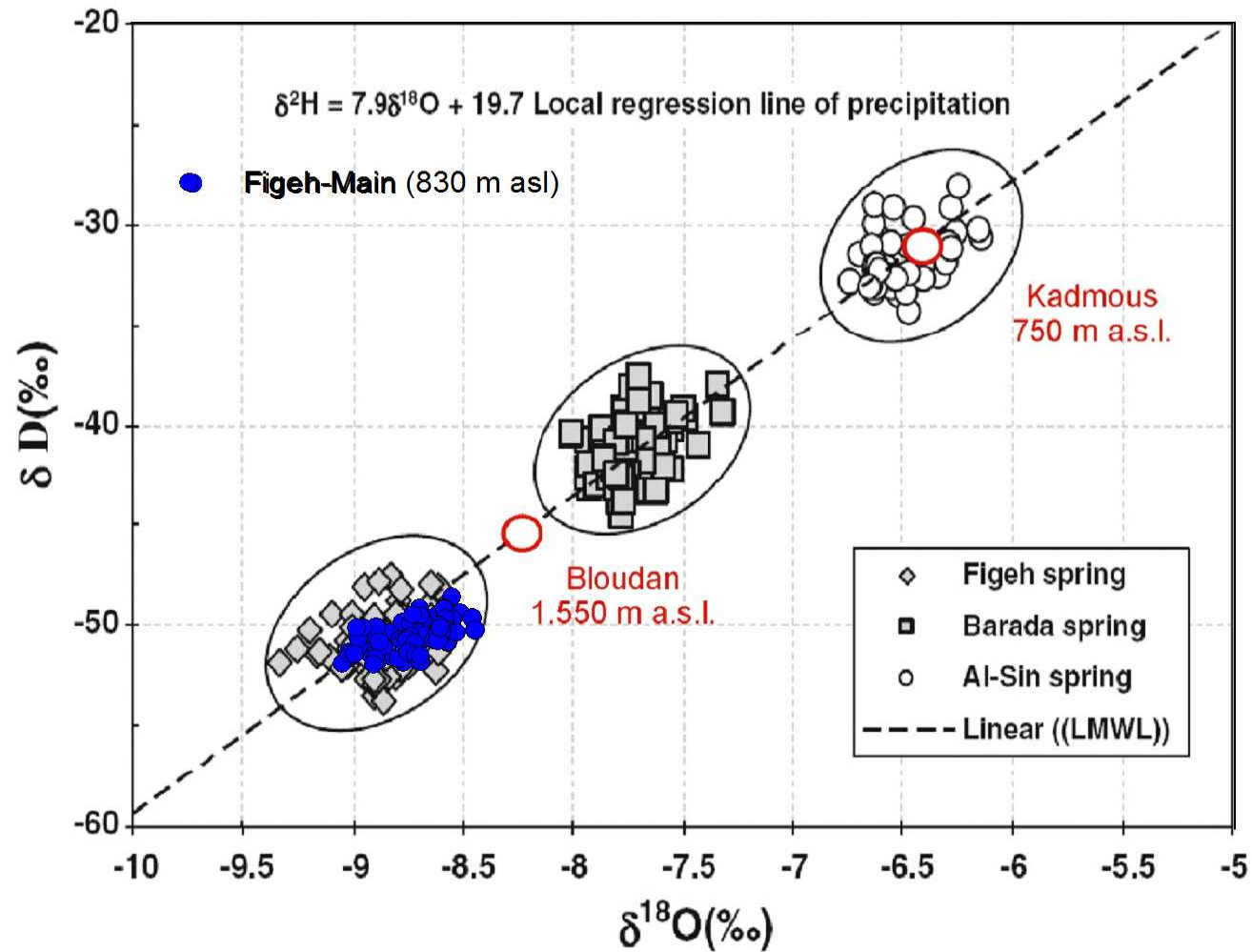
- > Large inter-annual and seasonal variability of precipitation input
- > Water resources mainly rely on mountainous areas
- > In Mountains precipitation mainly as snow / snow storage at higher altitudes
- > Monitoring at higher altitudes / mountainous areas is more complicated

Earlier studies - Karst springs in Anti-Lebanon, Syria



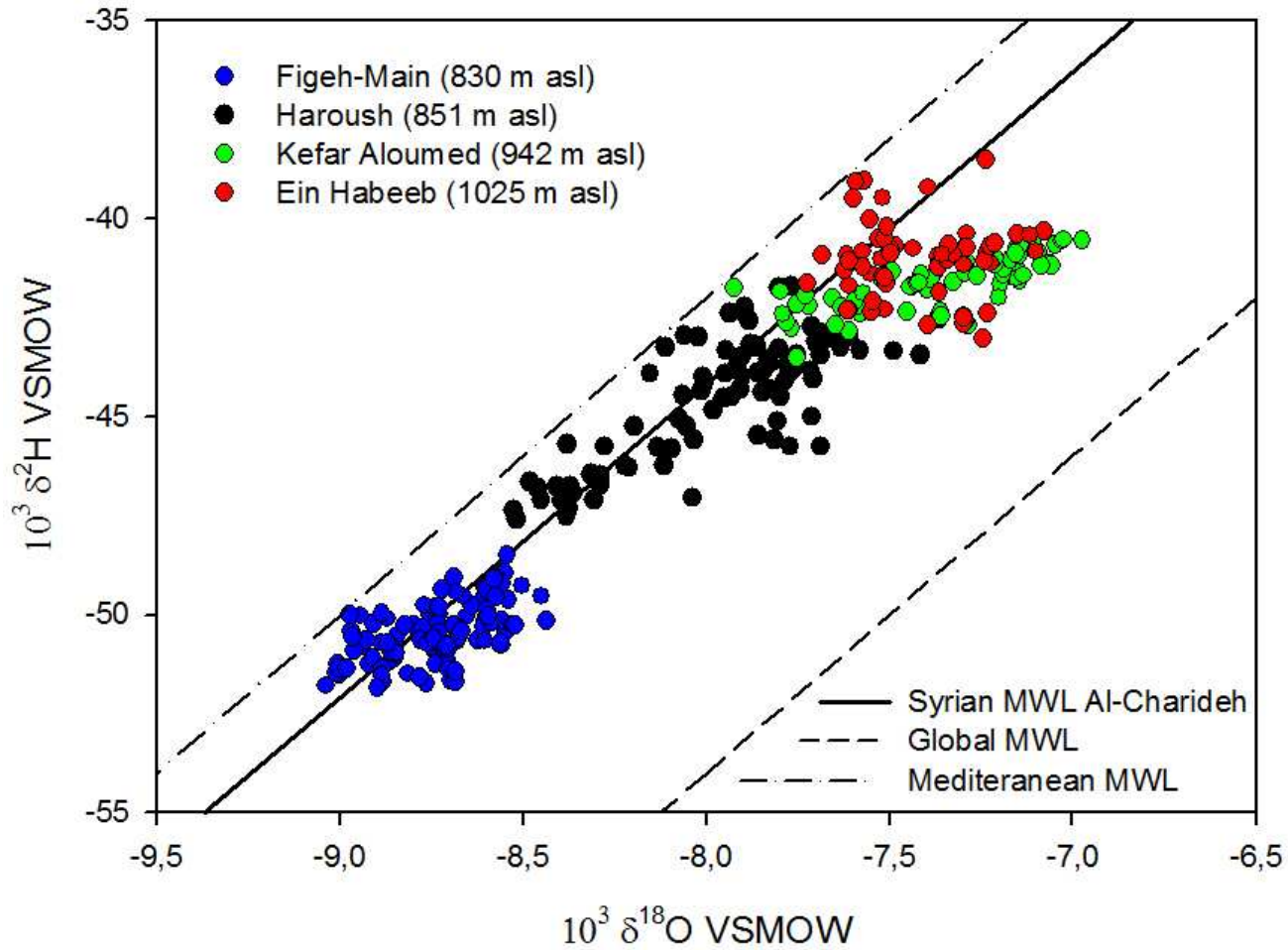
Relationship between δD and $\delta^{18}O$ values for spring samples and precipitation collected in the karst system in Western Syria (Al-Charideh, 2011)

Earlier studies - Karst springs in Anti-Lebanon, Syria

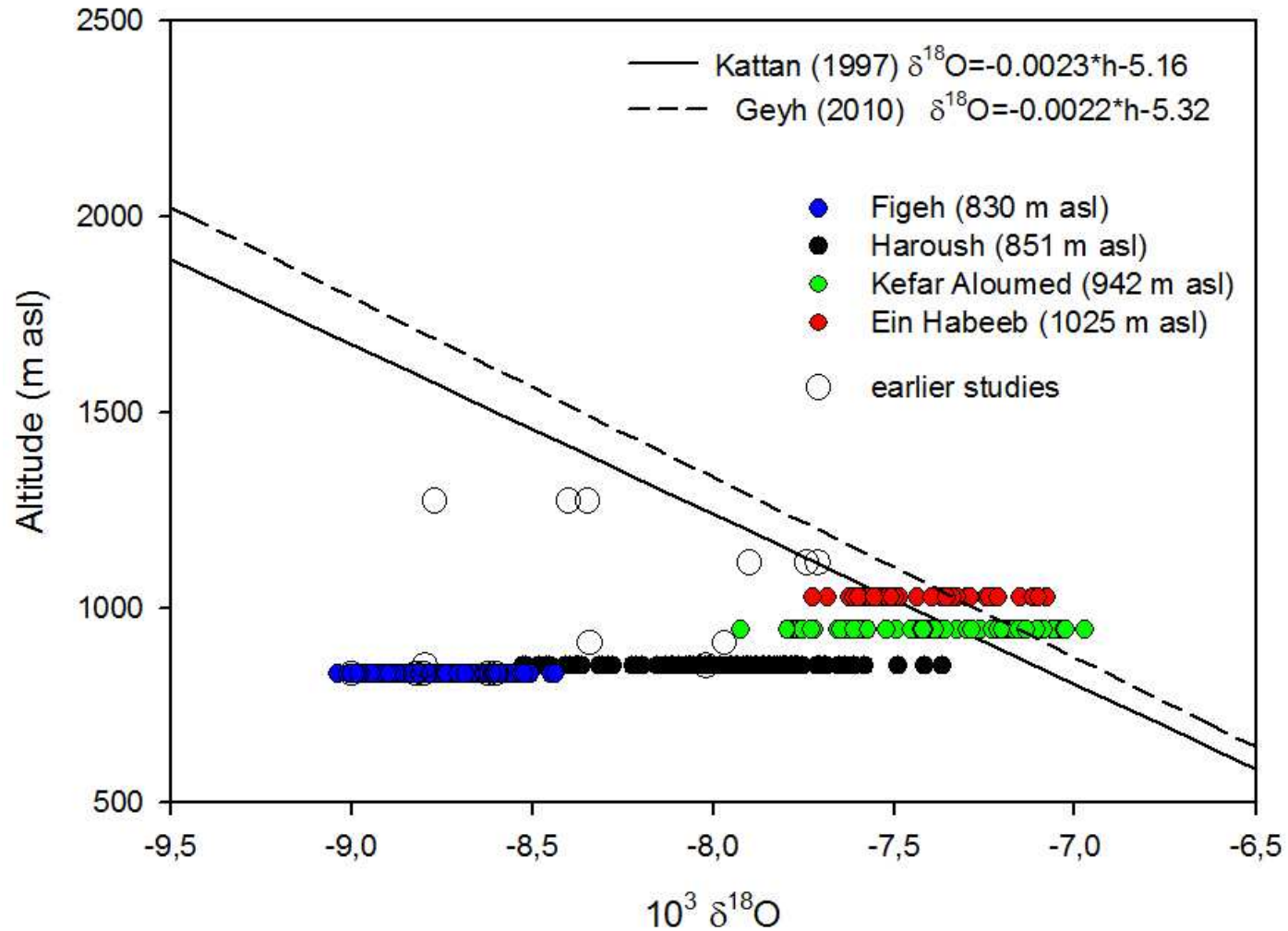


Relationship between δD and $\delta^{18}O$ values for spring samples and precipitation collected in the karst system in Western Syria (Al-Charideh, 2011)

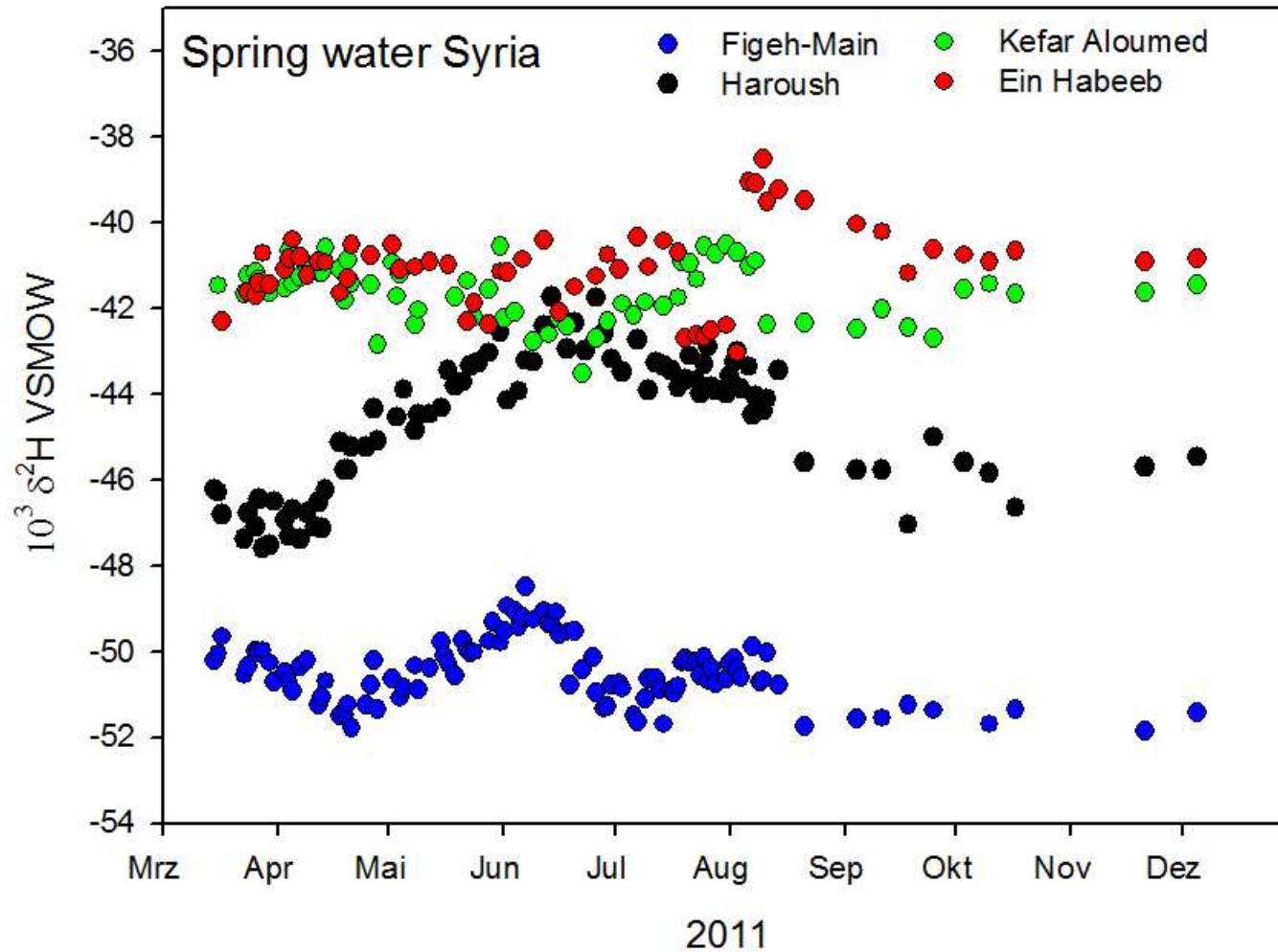
$\delta^{18}\text{O}$ vs. $\delta^2\text{H}$ for springs in the Figeih catchment



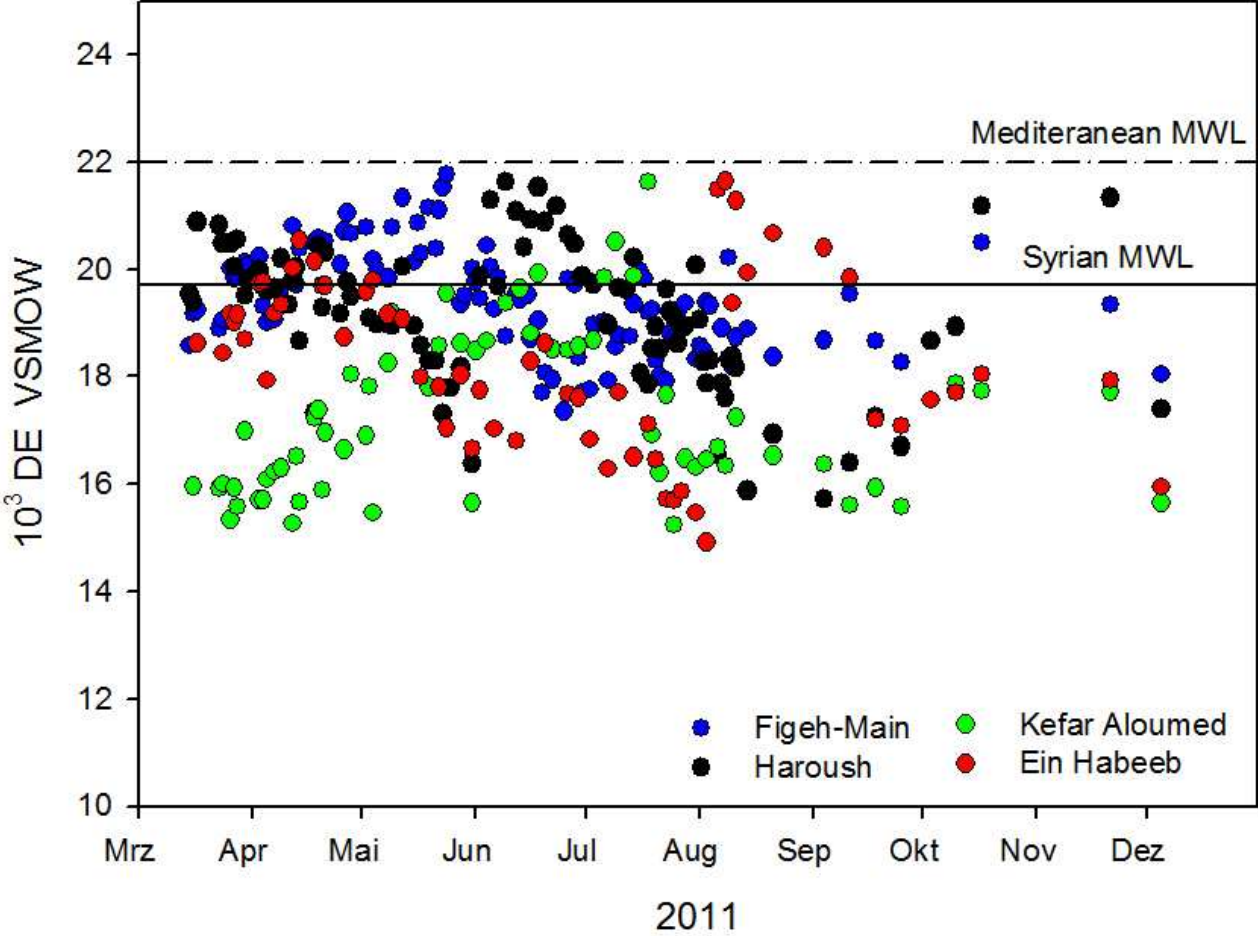
Altitude effect for springs in the Figeih catchment



Time series for springs in the Figeih catchment



Deuterium Excess for springs in the Figeih catchment



Summary

- Stable isotope methods add valuable information for water resources management in semiarid regions
- Altitude effect lead to reasonable mean recharge elevations for 4 wells in the Figehe spring catchment
- Deuterium excess values in GW reflect precipitation input and evaporative influence.
- High resolution time series indicate additional dynamics (snowmelt) – high throughput measurements are possible with new laser instruments

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Future perspectives

- Better understanding of short time variability - extended measurements during snowmelt 2012
- More precise input characterization - snow / rain
- Comparison with ongoing isotope studies in Lebanon (Jeita catchment)
- Combination / establish a transect Antilebanon Mt. Lebanon

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Thanks for your attention

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