

# Tracing Recent Water Level Changes in a Saudi Arabian Cave by Mining YouTube Videos



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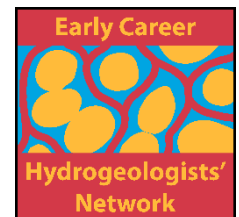
N. Michelsen<sup>1</sup>, H. Dirks<sup>2</sup>, S. Schulz<sup>3</sup>, S. Kempe<sup>1</sup>, M. Al-Saud<sup>4</sup>, C. Schüth<sup>1</sup>

**DORNIER**  
CONSULTING

 **HELMHOLTZ**  
CENTRE FOR  
ENVIRONMENTAL  
RESEARCH – UFZ

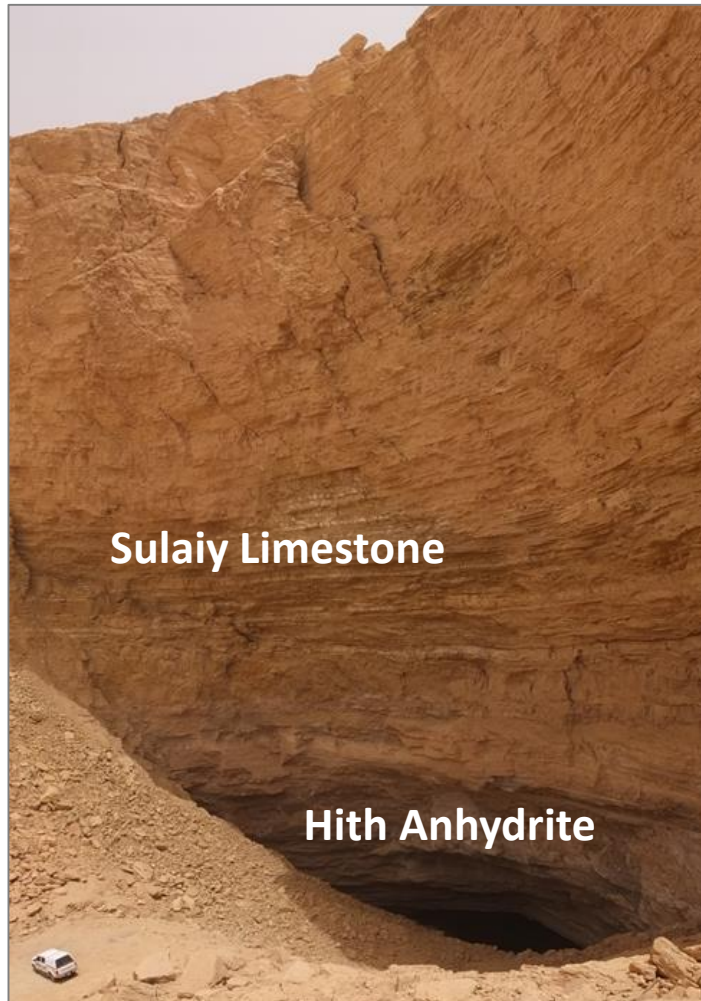


- <sup>1</sup> Technische Universität Darmstadt, Darmstadt, Germany
- <sup>2</sup> Dornier Consulting, Riyadh, Saudi Arabia
- <sup>3</sup> UFZ – Helmholtz Centre for Environmental Research, Halle, Germany
- <sup>4</sup> Ministry of Water & Electricity, Riyadh, Saudi Arabia



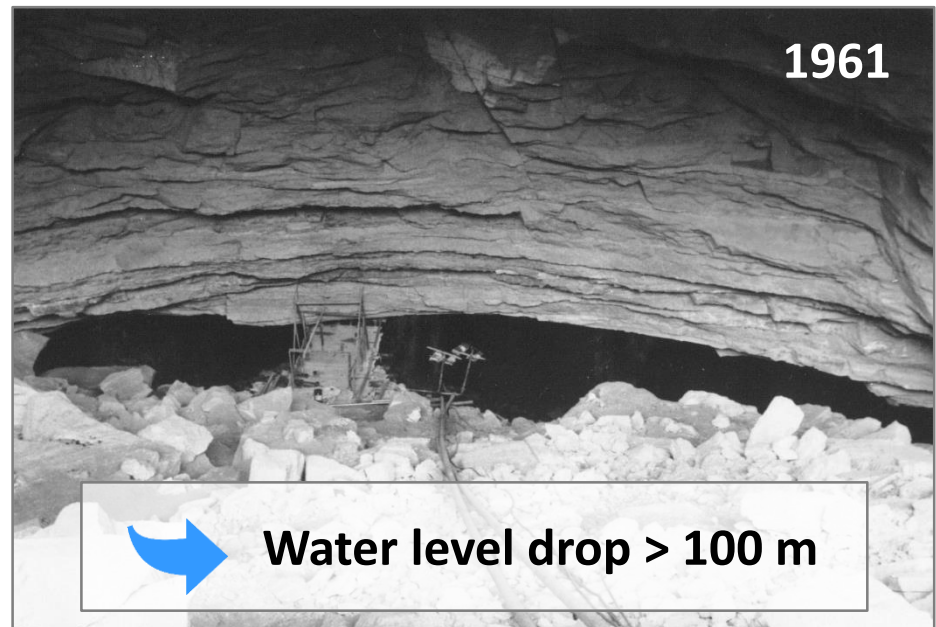
# 1877

# Study Site and Motivation



## Dahl Hith cave:

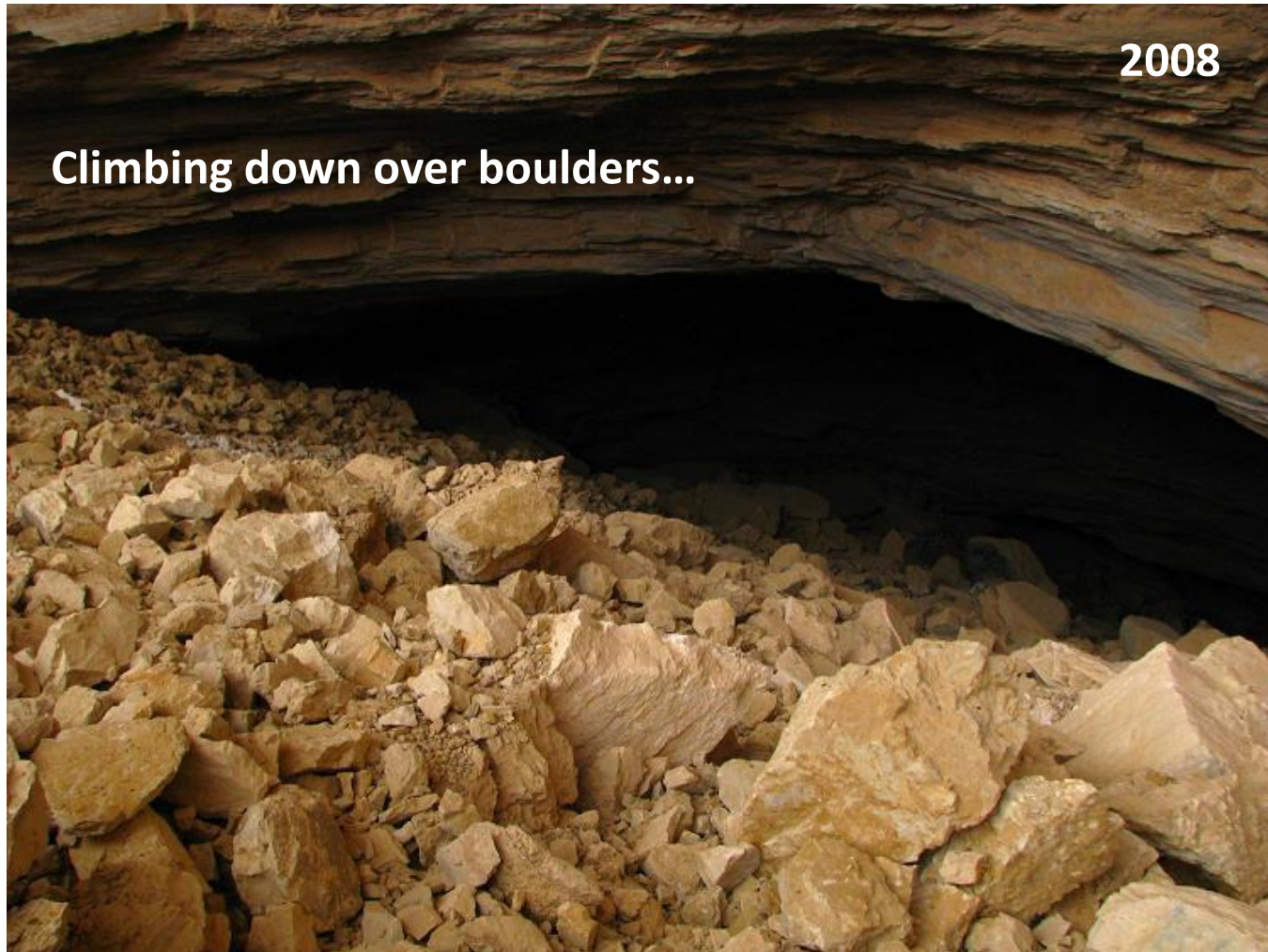
- also known as Ain Hith
- Hith Anhydrite is a major seal rock/aquitard
- used for water supply



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# Method



[Alle](#) [Bilder](#) [Videos](#) [Maps](#) [News](#) [Mehr ▾](#) [Suchoptionen](#)


Ungefähr 18.000 Ergebnisse (0,30 Sekunden)

### Ain Heet cave in Riyadh - YouTube



[https://www.youtube.com/watch?v=t1IKZBy9xQc ▾](https://www.youtube.com/watch?v=t1IKZBy9xQc)  
15.06.2013 - Hochgeladen von edavanna dot com babu  
**Ain Heet cave** in Riyadh **Ain Heet cave** or Dahl Heet is one such **with** an underground lake in its interior ...

### Exploring Ain Heet Cave, Riyadh Saudi Arabia (Underground Lake ...



[https://www.youtube.com/watch?v=b5SFuKRdMb8 ▾](https://www.youtube.com/watch?v=b5SFuKRdMb8)  
06.08.2014 - Hochgeladen von Phil Cabria  
DAY 1 - FIRST DESTINATIONS (8:00AM-2:00PM) July 29, 2014 **Ain Heet cave** or Dahl Heet is one ...

### Saudi Caves

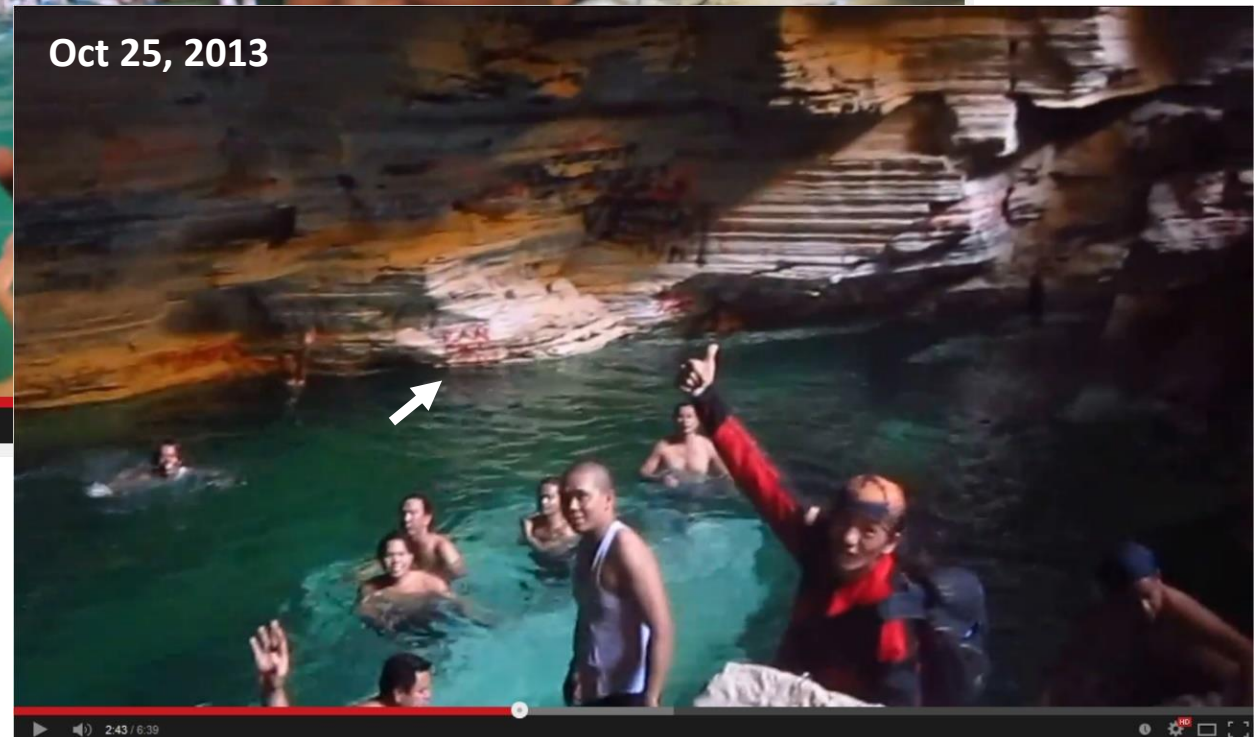
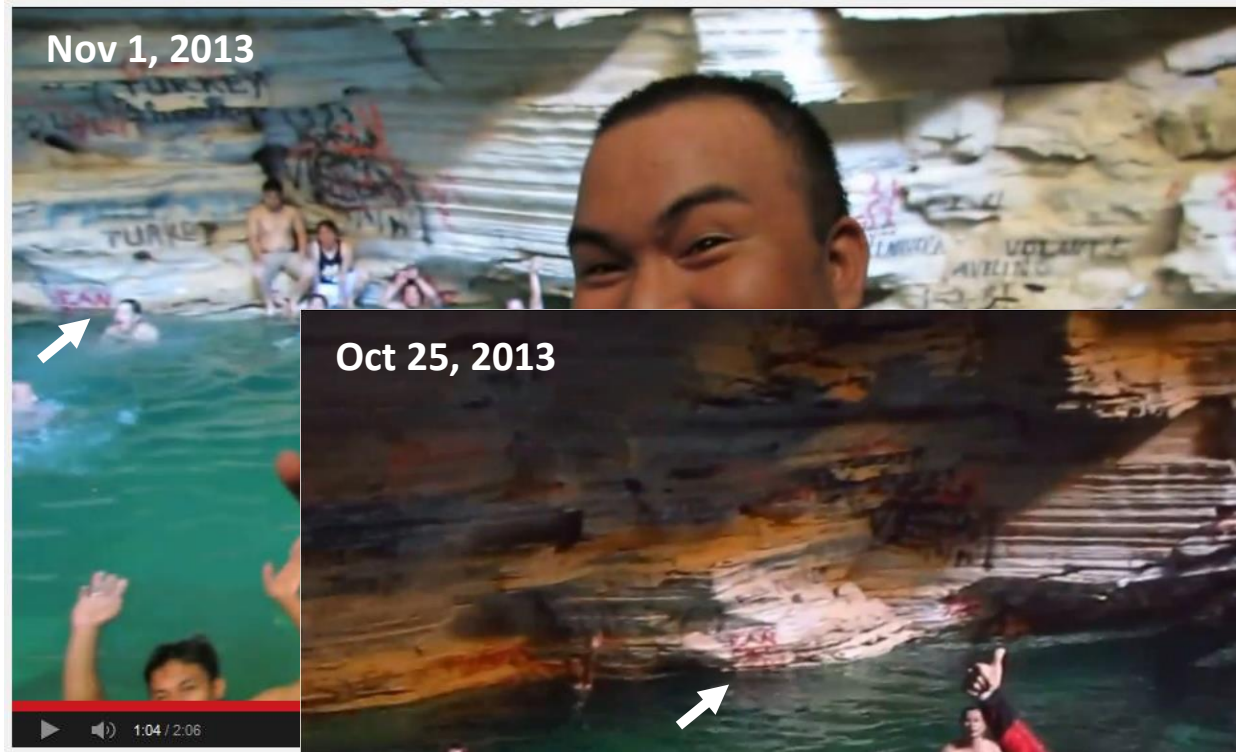
[www.saudicaves.com/cavedive/ ▾](http://www.saudicaves.com/cavedive/) [Diese Seite übersetzen](#)  
I fantasized about a complex underwater **cave** system waiting to be discovered. ... At **Ain Hith** (also spelled **Ain Hit**) in the Sulaib escarpment, the wall of ...



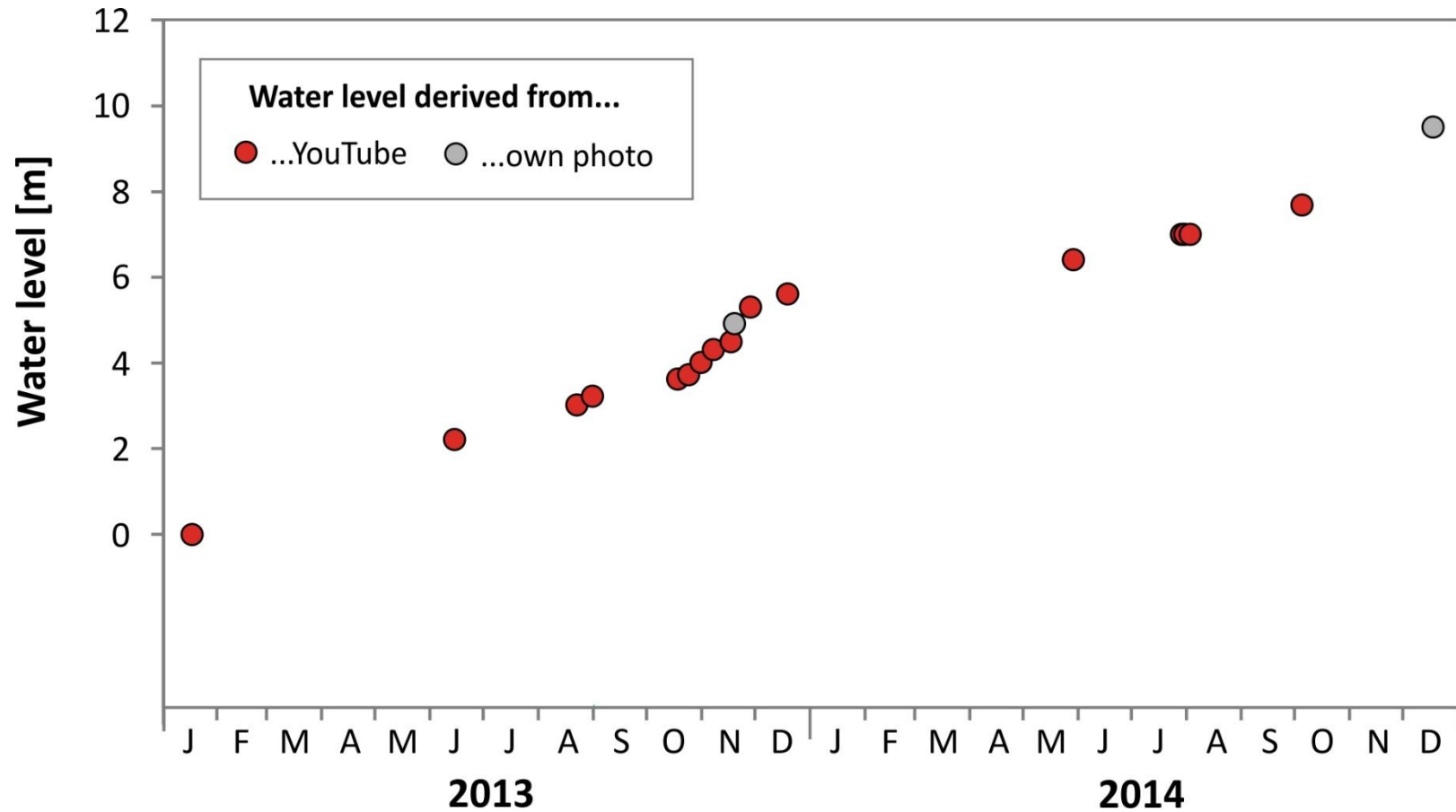
# Method: The YouTube Approach



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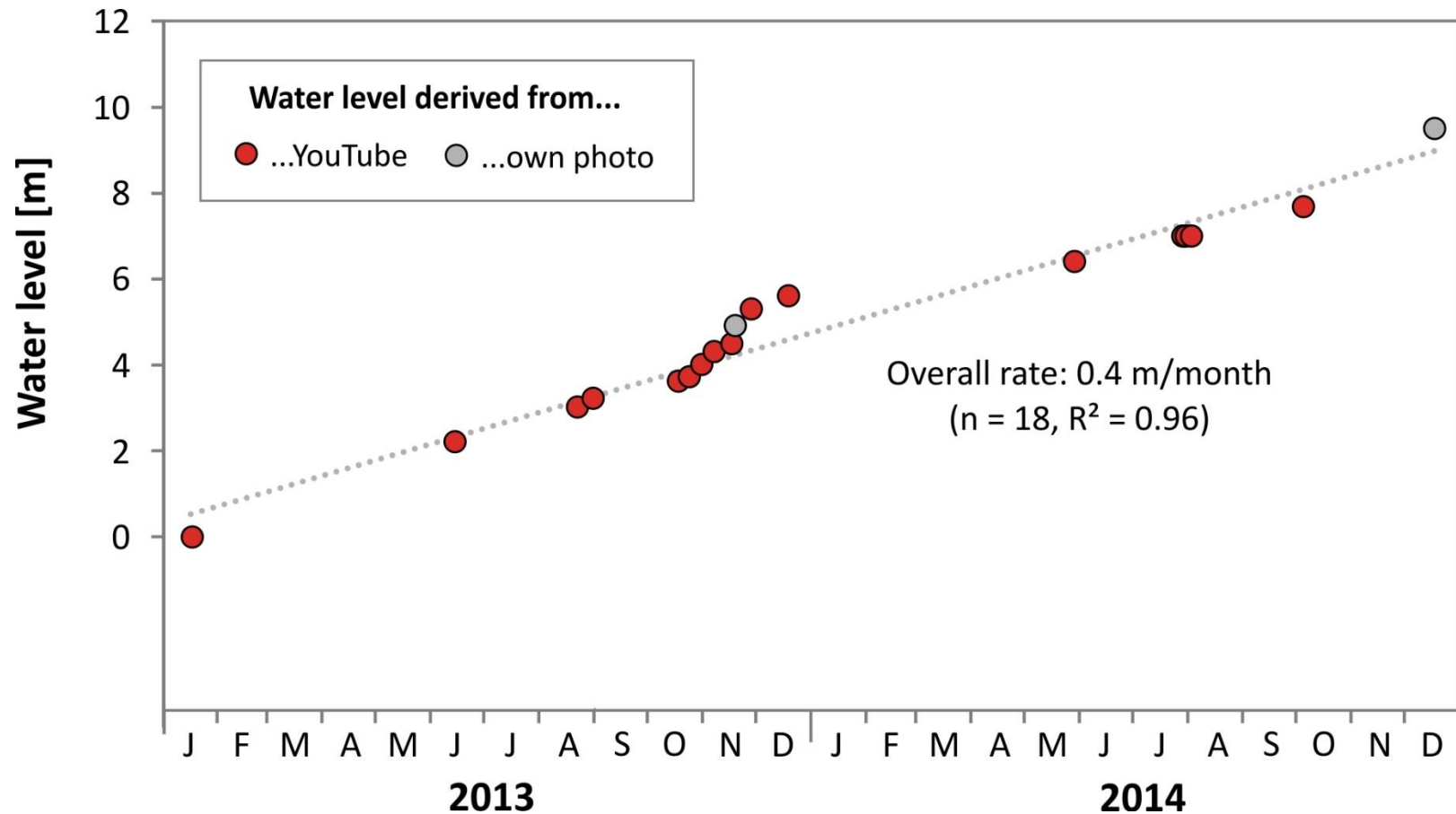


# Results





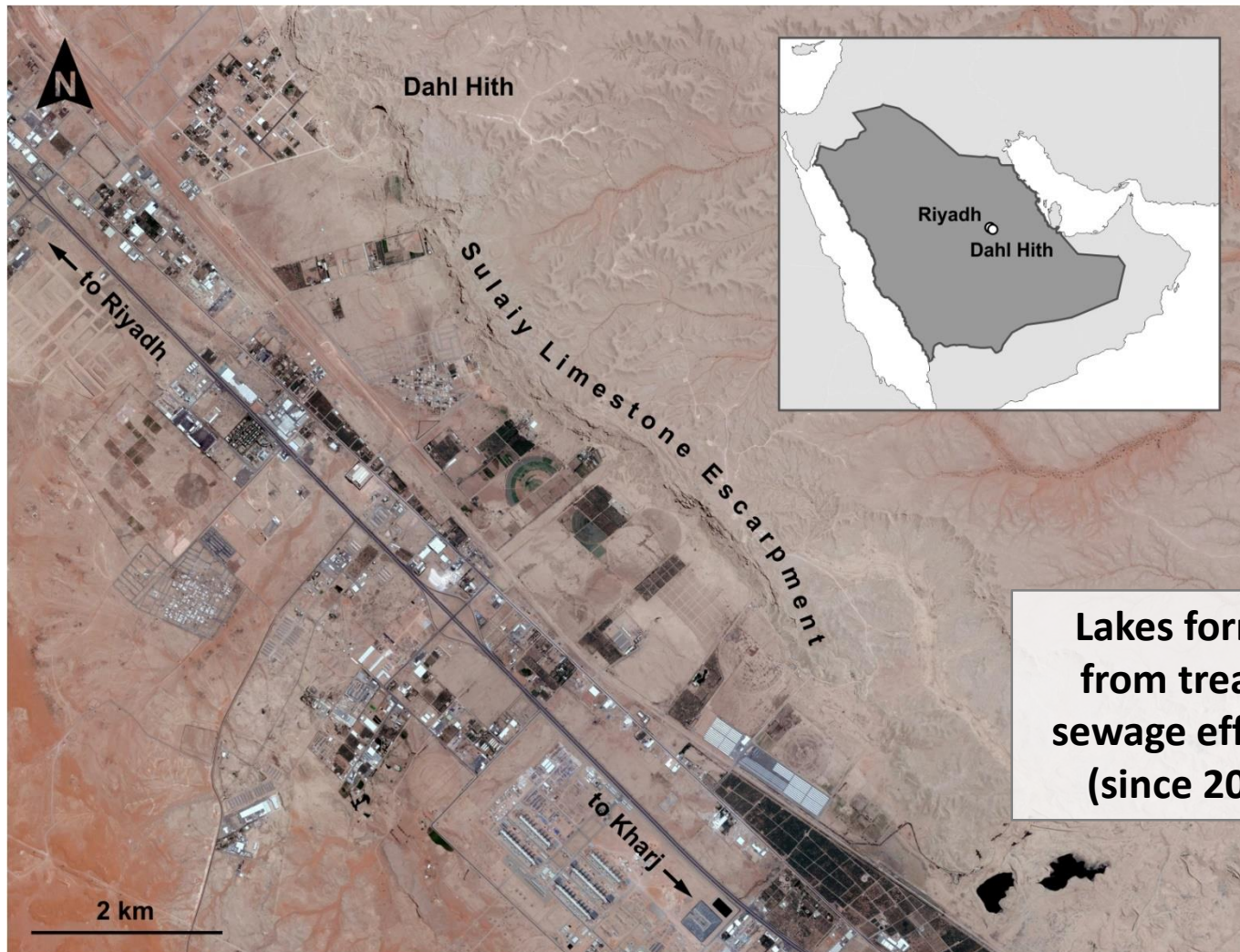
# Results



# Results



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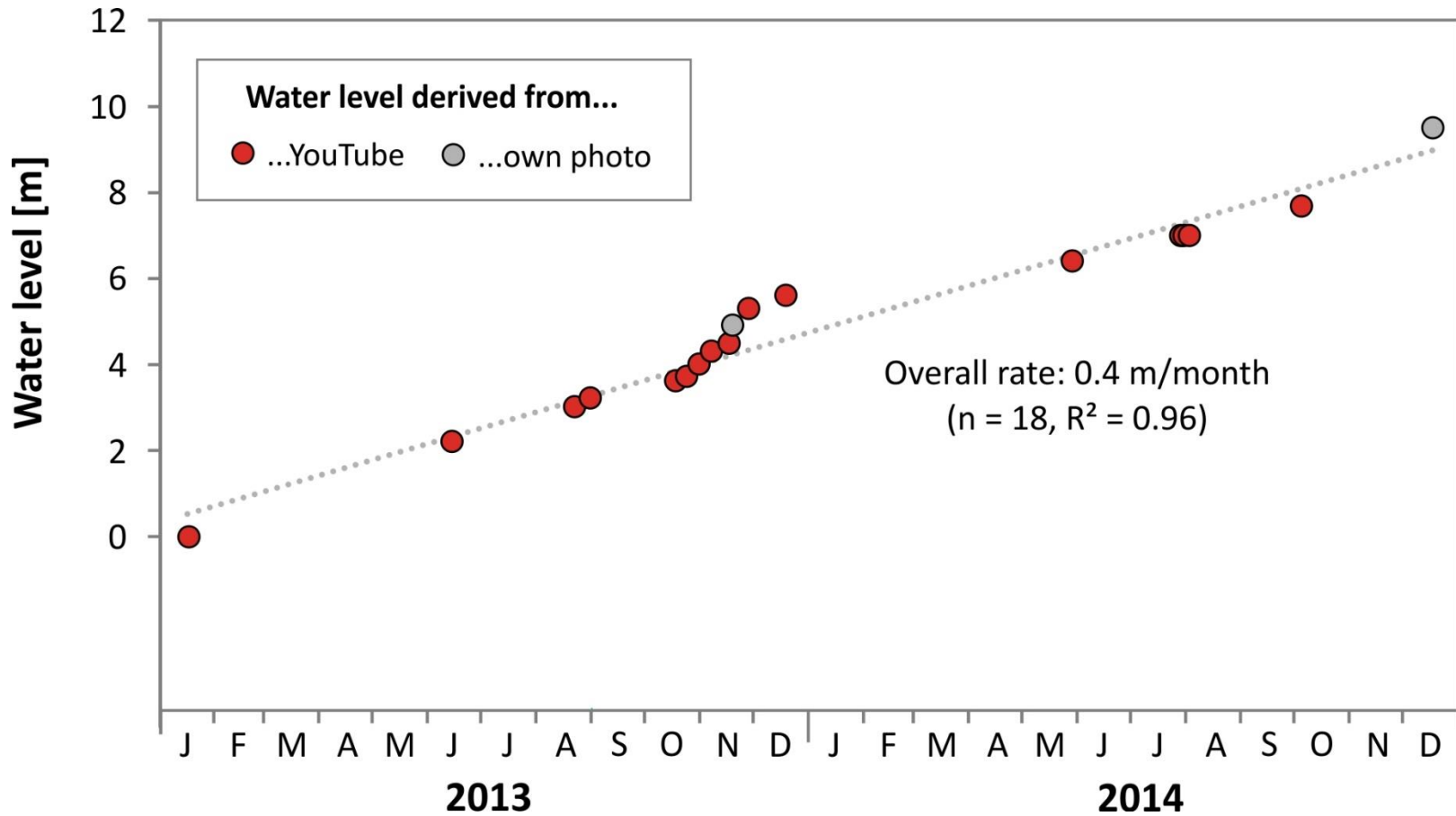
# Results

## View to SSE



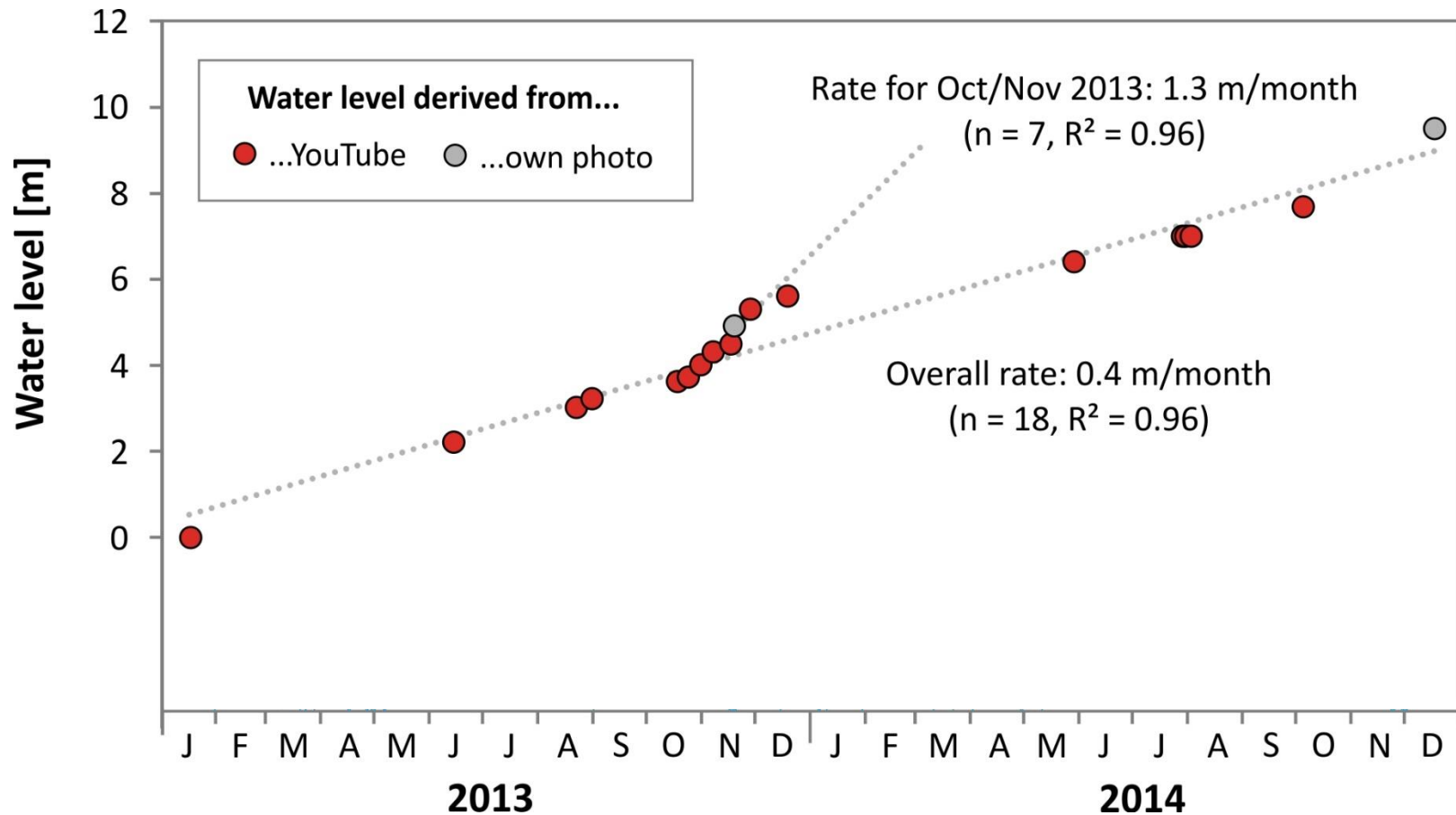
**“...nearly hopeless jumble of low hills representing complexly settled rocks” (Steineke et al. 1958)**

## Results





# Results



# Results





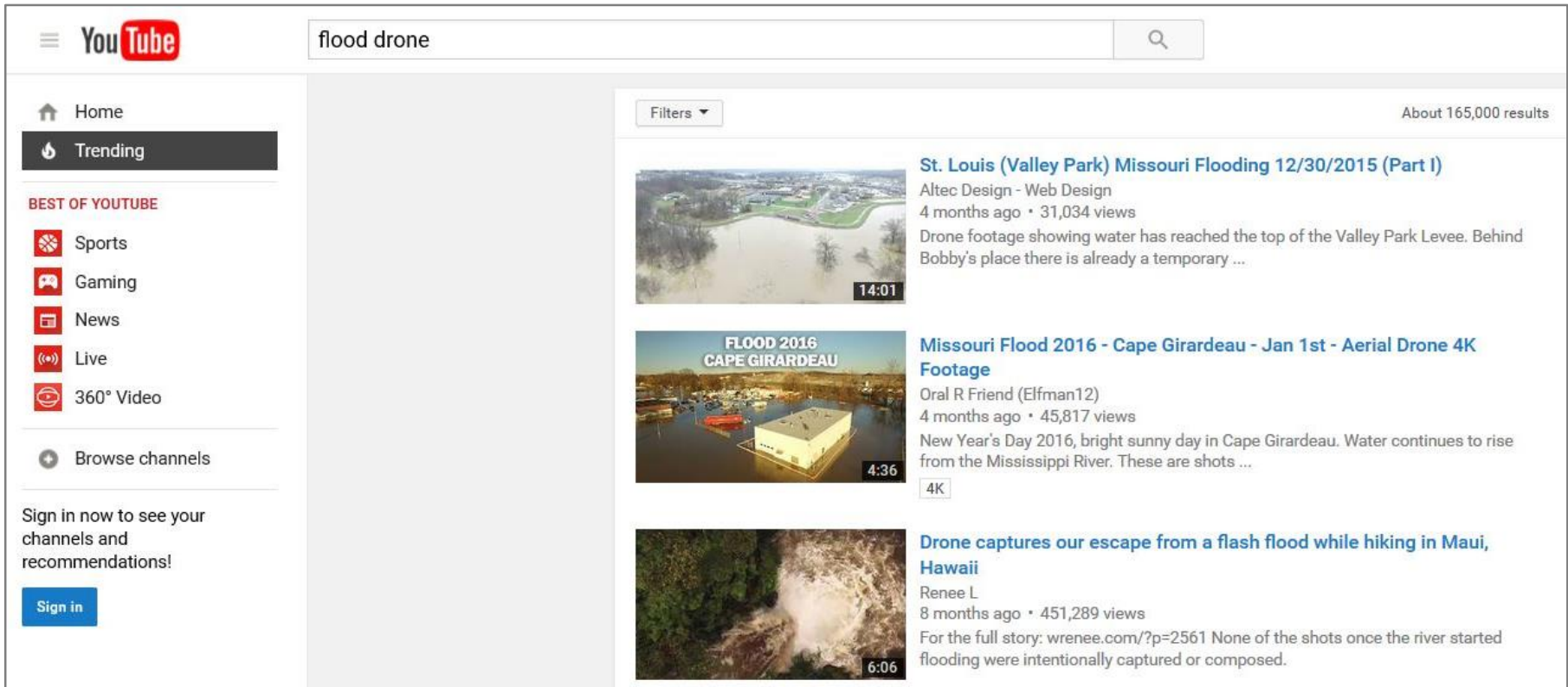
# Discussion

- Approach provides ESTIMATES only (complementary data source)
- Quantification of error and error propagation difficult
- *In principle* possible, e.g. by physically measuring previously estimated distances
- ...would currently require diving (dangerous, water quality, etc.)



# So what?

Approach could be adapted to other settings: Spring discharge, stream stage, etc.



The screenshot shows a YouTube search results page for the query "flood drone". The search bar at the top contains the text "flood drone" and a magnifying glass icon. Below the search bar, the left sidebar displays navigation options: Home, Trending, and a section titled "BEST OF YOUTUBE" with icons for Sports, Gaming, News, Live, and 360° Video. A "Browse channels" button is also visible. The main content area shows three video results. The first video is titled "St. Louis (Valley Park) Missouri Flooding 12/30/2015 (Part I)" by Altec Design - Web Design, with 31,034 views and a duration of 14:01. The second video is titled "Missouri Flood 2016 - Cape Girardeau - Jan 1st - Aerial Drone 4K Footage" by Oral R Friend (Elfman12), with 45,817 views and a duration of 4:36. The third video is titled "Drone captures our escape from a flash flood while hiking in Maui, Hawaii" by Renee L, with 451,289 views and a duration of 6:06. The search results indicate "About 165,000 results".

YouTube

flood drone

Home

Trending

BEST OF YOUTUBE

Sports

Gaming

News

Live

360° Video

Browse channels

Sign in now to see your channels and recommendations!

Sign in

Filters

About 165,000 results

**St. Louis (Valley Park) Missouri Flooding 12/30/2015 (Part I)**

Altec Design - Web Design

4 months ago • 31,034 views

Drone footage showing water has reached the top of the Valley Park Levee. Behind Bobby's place there is already a temporary ...

14:01

**FLOOD 2016 CAPE GIRARDEAU**

**Missouri Flood 2016 - Cape Girardeau - Jan 1st - Aerial Drone 4K Footage**

Oral R Friend (Elfman12)

4 months ago • 45,817 views

New Year's Day 2016, bright sunny day in Cape Girardeau. Water continues to rise from the Mississippi River. These are shots ...

4:36

4K

**Drone captures our escape from a flash flood while hiking in Maui, Hawaii**

Renee L

8 months ago • 451,289 views

For the full story: [wrenee.com/?p=2561](http://wrenee.com/?p=2561) None of the shots once the river started flooding were intentionally captured or composed.

6:06

# Summary and Conclusions

- Social media mining (citizen science, crowd-sourcing in a broader sense)
- Precedent of using multiple YouTube videos to reconstruct historical water levels over an extended time period
- Approach yields estimates, but probably viable in data-scarce settings
- Method is transferable (spring discharge, stream stage, flood extents, etc.)
- Outreach component

## More details:

Michelsen et al. (2016) YouTube as a crowd-generated water level archive  
Sci. Tot. Environ., 568, 189-195

## Contact:

Nils Michelsen, Institute for Applied Geosciences, TU Darmstadt, Germany  
michelsen@geo.tu-darmstadt.de





The screenshot shows the BBC News homepage. At the top, there is a navigation bar with the BBC logo, a 'Sign in' button, and links to News, Sport, Weather, Shop, Earth, Travel, and More. Below this is a red banner with the word 'NEWS' in white. Underneath the banner is another navigation bar with links to Home, Video, World, UK, Business, Tech, Science, Magazine, and Entertainment & Arts. The 'Science' link is highlighted. The main content area features the section 'Science & Environment' with a red underline. The headline is 'YouTube graffiti videos track cave water'. Below the headline, it says 'By Jonathan Amos, BBC Science Correspondent, Vienna'. At the bottom left of the article preview, it shows a clock icon, the date '15 April 2015', and the category 'Science & Environment'. At the bottom right, there is a green 'Share' button with a share icon.

**BBC** Sign in News Sport Weather Shop Earth Travel More

## NEWS

Home Video World UK Business Tech Science Magazine Entertainment & Arts

Science & Environment

### YouTube graffiti videos track cave water

By Jonathan Amos  
BBC Science Correspondent, Vienna

🕒 15 April 2015 | Science & Environment

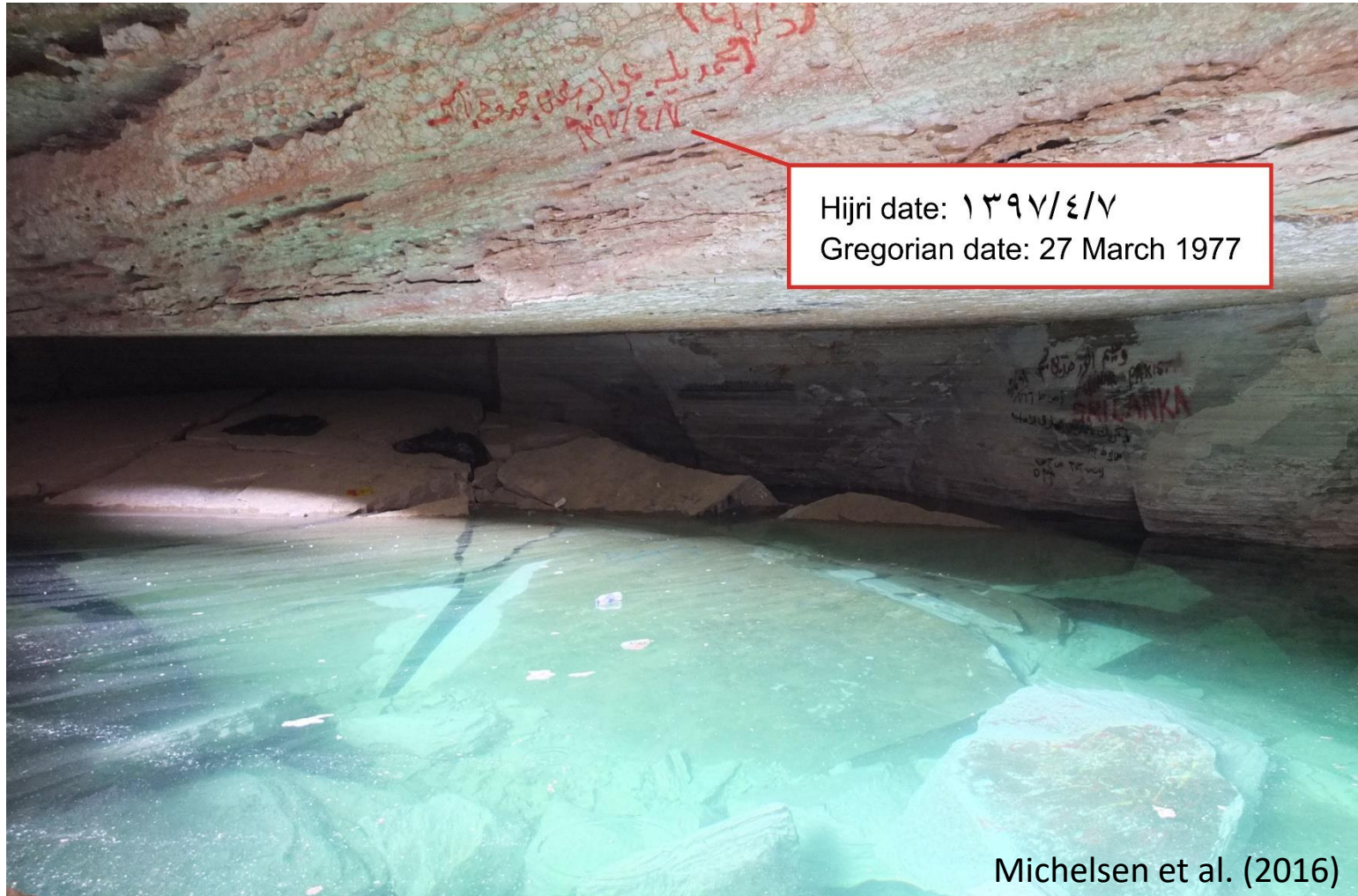
🔗 Share

<http://www.bbc.co.uk/news/science-environment-32324232>

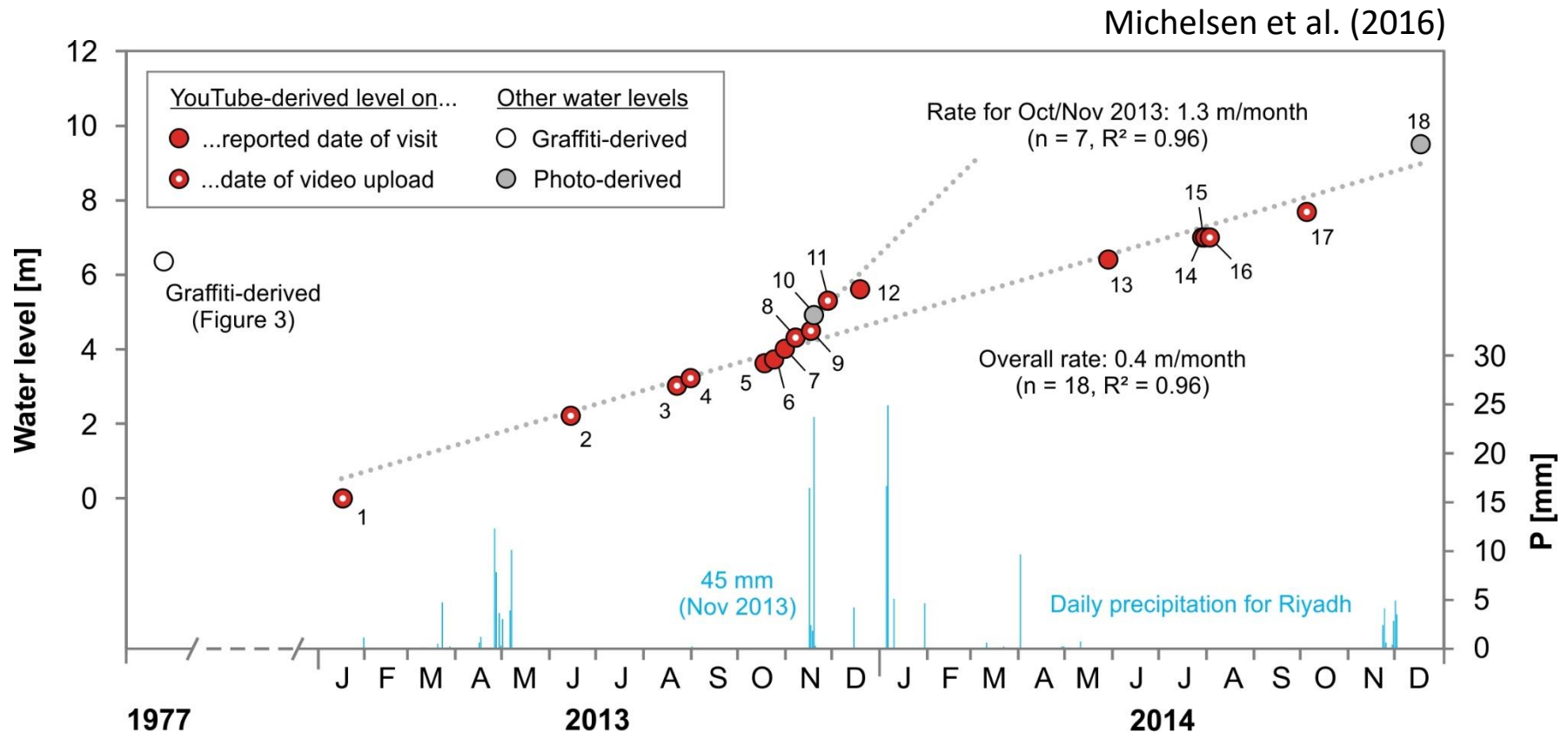
## More genuine water level data hidden in the graffiti...



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# More genuine water level data hidden in the graffiti...







ID	Date	Link	Screenshot time	Comment	Water level [m]
1	18 Jan. 2013 (U)	<a href="http://www.youtube.com/watch?v=JBIXGCFOc0">www.youtube.com/watch?v=JBIXGCFOc0</a>	0:12	Reference	0.0
2	15 Jun. 2013 (U)	<a href="http://www.youtube.com/watch?v=t1IKZBy9xQc">www.youtube.com/watch?v=t1IKZBy9xQc</a>	0:18, 0:35, 0:39	2.2 m higher than ID 1	2.2
3	23 Aug. 2013 (U)	<a href="http://www.youtube.com/watch?v=fh_mtgMdHjM">www.youtube.com/watch?v=fh_mtgMdHjM</a>	3:51, 5:09	0.8 m higher than ID 2	3.0
4	1 Sep. 2013 (U)	<a href="http://www.youtube.com/watch?v=6nze81liXQ">www.youtube.com/watch?v=6nze81liXQ</a>	0:01	0.2 m higher than ID 3	3.2
5	19 Oct. 2013 (V)	<a href="http://www.youtube.com/watch?v=fGwDoLX9FdA">www.youtube.com/watch?v=fGwDoLX9FdA</a>	0:11, 0:52	0.1 m lower than ID 6	3.6
6	25 Oct. 2013 (V)	<a href="http://www.youtube.com/watch?v=OqQuVPi1YwI">www.youtube.com/watch?v=OqQuVPi1YwI</a>	2:43, 3:41	1.5 m higher than ID 2	3.7
7	1 Nov. 2013 (V)	<a href="http://www.youtube.com/watch?v=hlzpBjYdTD8">www.youtube.com/watch?v=hlzpBjYdTD8</a>	0:54, 1:05	0.3 m higher than ID 6	4.0
8	8 Nov. 2013 (U)	<a href="http://www.youtube.com/watch?v=FXyNf_qNskA">www.youtube.com/watch?v=FXyNf_qNskA</a>	0:07	0.3 m higher than ID 7	4.3
9	18 Nov. 2013 (U)	<a href="http://www.youtube.com/watch?v=sQodFaGMILQ">www.youtube.com/watch?v=sQodFaGMILQ</a>	9:36	0.5 m higher than ID 7	4.5
10	20 Nov. 2013 (V)	Own photo	n.a.	0.4 m higher than ID 9	4.9
11	29 Nov. 2013 (U)	<a href="http://www.youtube.com/watch?v=IhqNlrOg0_4">www.youtube.com/watch?v=IhqNlrOg0_4</a>	0:03	0.4 m higher than ID 10	5.3
12	20 Dec. 2013 (V)	<a href="http://www.youtube.com/watch?v=HdQ7-cNDyNI">www.youtube.com/watch?v=HdQ7-cNDyNI</a>	0:37	0.7 m higher than ID 10	5.6
13	30 May 2014 (V)	<a href="http://www.youtube.com/watch?v=JSf1s9CrP1U">www.youtube.com/watch?v=JSf1s9CrP1U</a>	0:30, 1:47	1.5 m higher than ID 10	6.4
14	30 Jul. 2014 (U)	<a href="http://www.youtube.com/watch?v=Y69kL-K8Y-k">www.youtube.com/watch?v=Y69kL-K8Y-k</a>	0:32	0.6 m higher than ID 13	7.0
15	1 Aug. 2014 (U)	<a href="http://www.youtube.com/watch?v=urPHGT340dw">www.youtube.com/watch?v=urPHGT340dw</a>	0:14, 2:09	Same as ID 14	7.0
16	4 Aug. 2014 (U)	<a href="http://www.youtube.com/watch?v=mkITdMehbGk">www.youtube.com/watch?v=mkITdMehbGk</a>	0:05, 0:12	Same as ID 14 and ID 15	7.0
17	6 Oct. 2014 (U)	<a href="http://www.youtube.com/watch?v=rKcNLxLH6xQ">www.youtube.com/watch?v=rKcNLxLH6xQ</a>	1:16, 1:40	0.7 m higher than ID 16	7.7
18	19 Dec. 2014 (V)	Own photo	n.a.	1.8 m higher than ID 17	9.5

Michelsen et al. (2016)

# Method

- Each line represents a Youtube video or own site visit (1-3 screenshots/photographs)
- Multiple reference points
- Reference points were frequently changed due to drowning

Jan 2013

Dec 2014





HYDROLOGICAL PROCESSES

*Hydrol. Process.* **30**, 90–105 (2016)

Published online 29 July 2015 in Wiley Online Library  
(wileyonlinelibrary.com) DOI: 10.1002/hyp.10532

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# Gauging extreme floods on YouTube: application of LSPIV to home movies for the post-event determination of stream discharges

Raphaël Le Boursicaud,<sup>1</sup> Lionel Pénard,<sup>1</sup> Alexandre Hauet,<sup>2</sup> Fabien Thollet<sup>1</sup> and Jérôme Le Coz<sup>1\*</sup>

<sup>1</sup> *Irstea, UR HHLY, Hydrology–Hydraulics, 5 rue de la Doua CS70077, 69626 cedex, Villeurbanne, France*

<sup>2</sup> *EDF-DTG, 21 avenue de l'Europe BP41, 38040 cedex 09, Grenoble, France*





## **Survey by CITC & KFUPM (2014) about smartphone/social media use**

- 3000 interviews in Saudi Arabia; age range: 12-65 years
- remarkable smartphone penetration: 67% of the respondents owned a smartphone and 72% used a smartphone
- 91% of the respondents used social media
- Use of social media in the preceding six months (multiple choice):
  - YouTube: 70%
  - Facebook: 59%
  - Twitter: 53%
  - Instagram: 41%
  - etc.

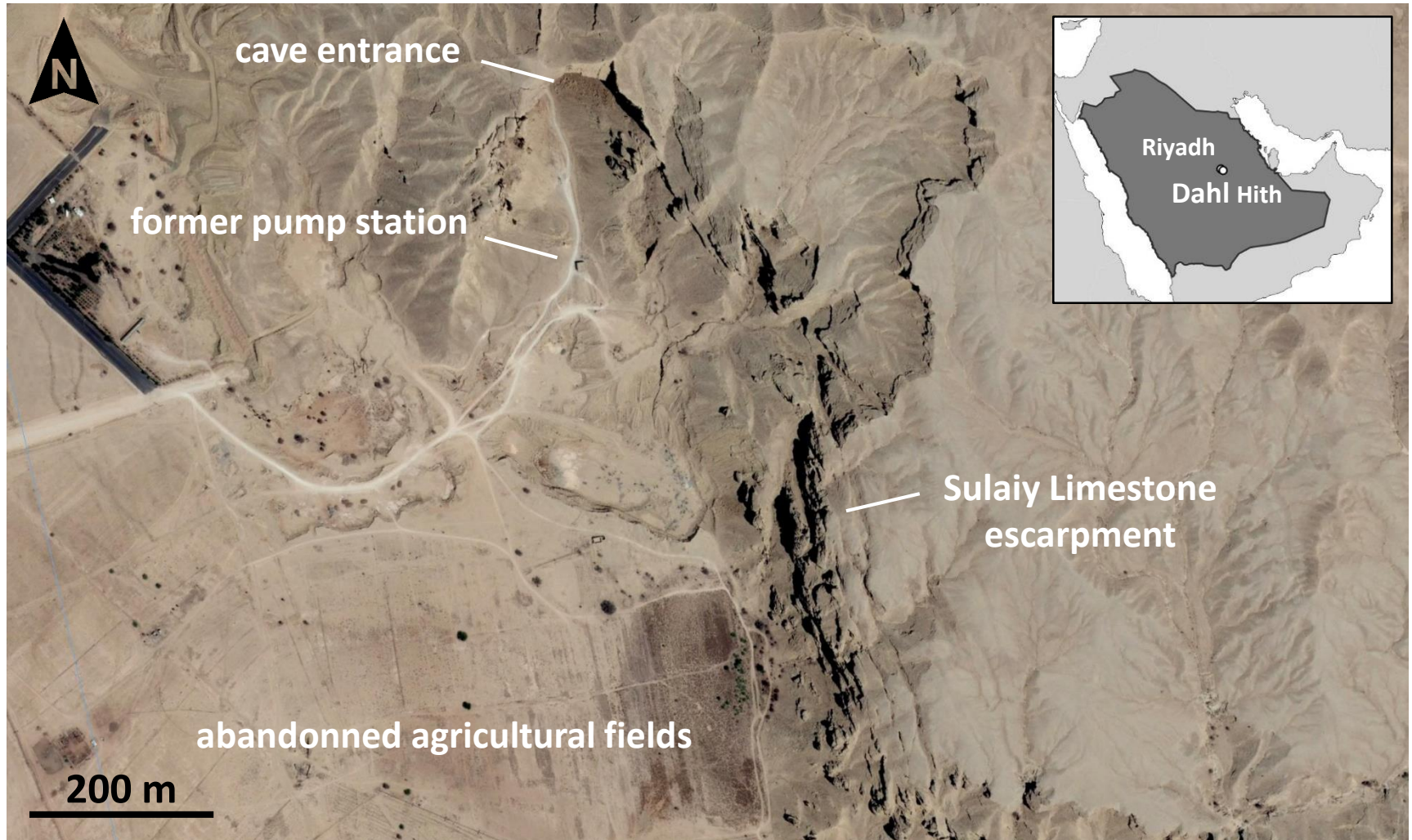
[www.citc.gov.sa/English/Reportsandstudies/Studies/Pages/default.aspx](http://www.citc.gov.sa/English/Reportsandstudies/Studies/Pages/default.aspx)

# Selection of own phtographs





# Study Site



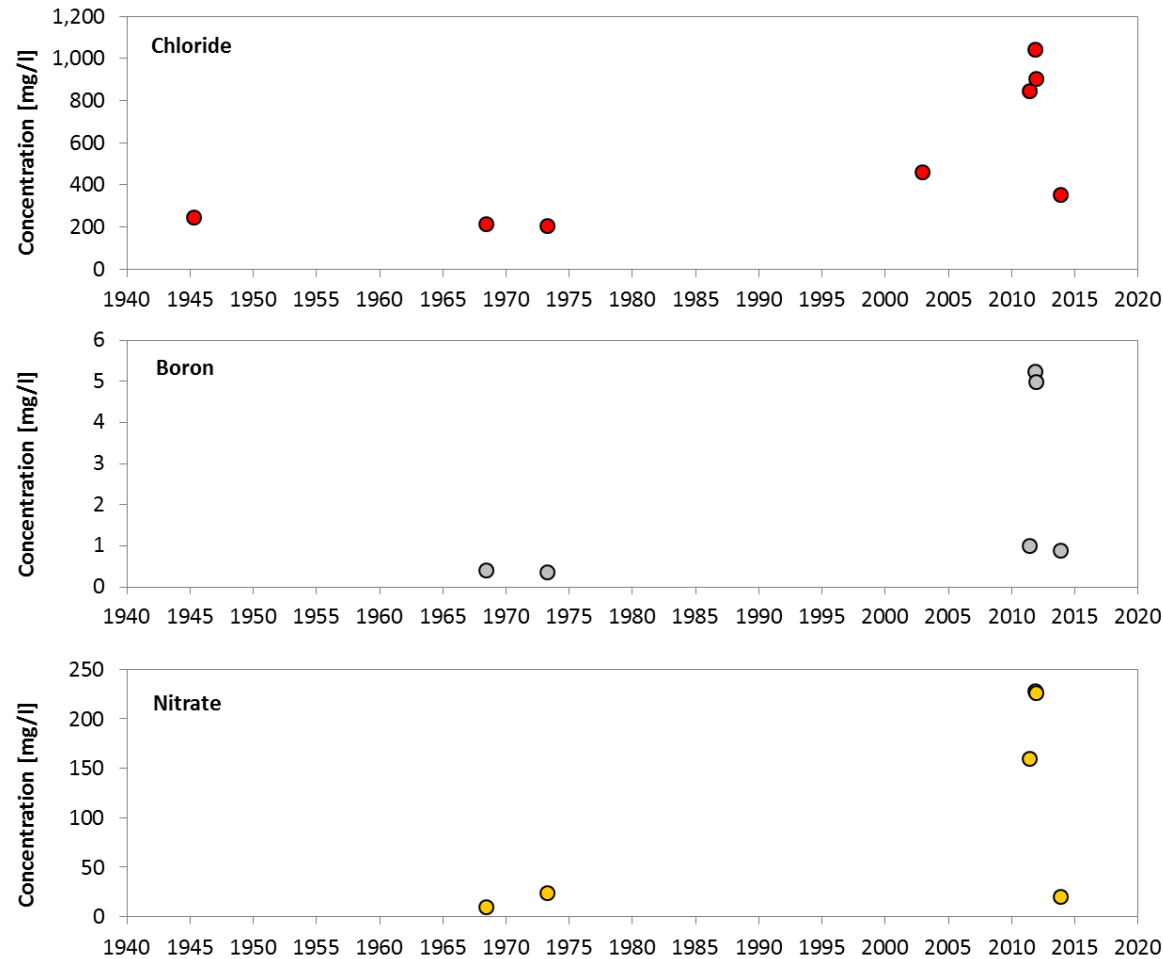


# Study Site

## Dahl Hith (Ain Hith)



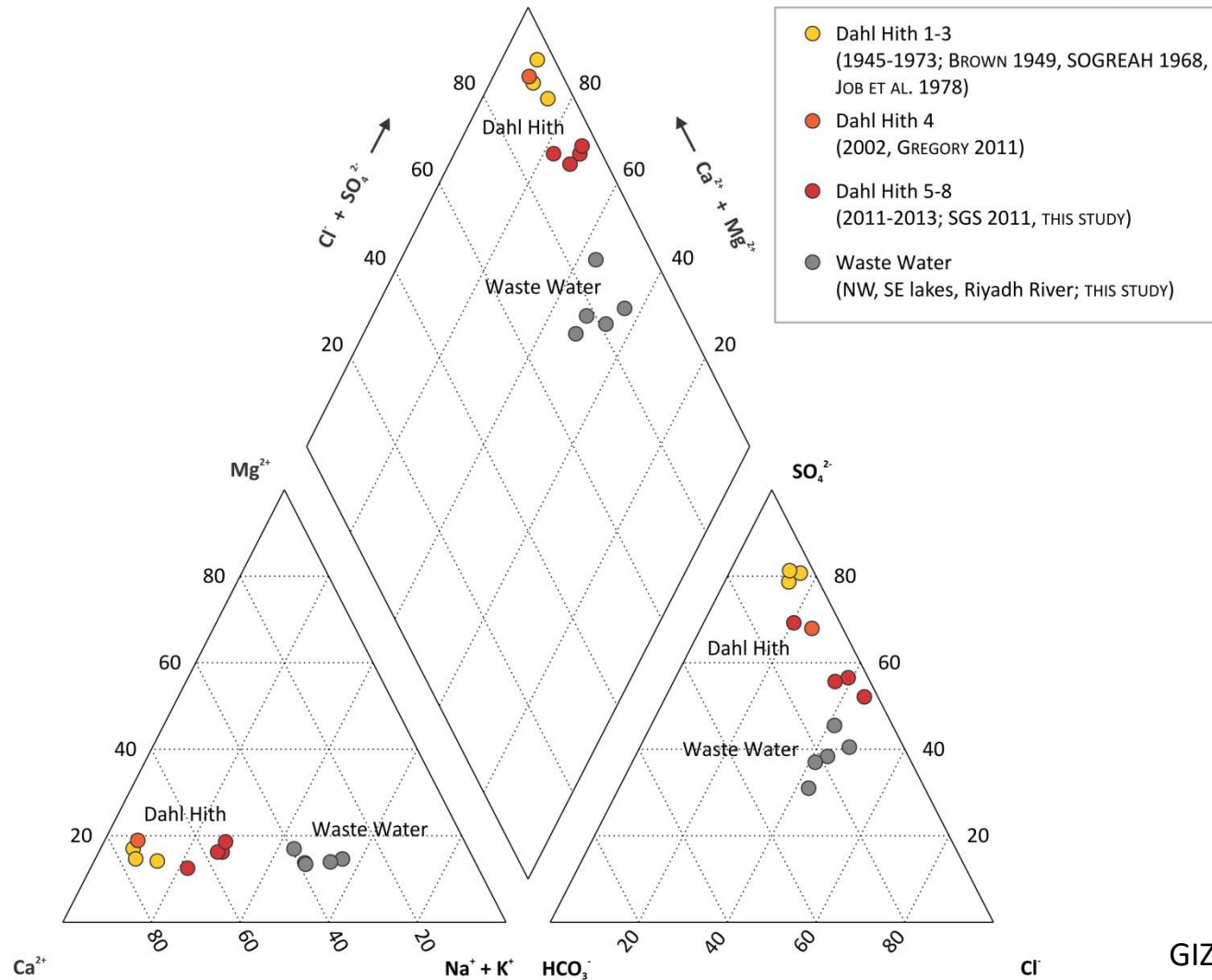
# Hydrochemistry – Time Series



# Hydrochemistry – Piper plot



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GIZ/DCo (2015)



Dec 28, 2006

500 m

GOOGLEEARTH (2015)

LANDSATLOOK VIEWER (2015)



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May 15, 2011

Aug 17, 2013

June 6, 2014

Feb 22, 2008

Mar 25, 2008

Dec 28, 2010

Mar 2, 2011

# Waste water discharge





# Infiltration of waste water





1994



Bjurström (2005)

2002



Killey et al. (2002)