

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/236335182>

Delineation of the Groundwater Catchment for Jeita Spring using Tracer Tests, Mapping of GW Vulnerability and Delineation of GW Protection Zones

Conference Paper · February 2013

CITATIONS

0

READS

133

1 author:



Armin Margane

Deutsche Gesellschaft für Internationale Zusammenarbeit GIZ

78 PUBLICATIONS 267 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Characterization of groundwater flow and vulnerability assessment of karstic aquifers-Development of a process-oriented vulnerability concept for water travel time in karst aquifers- "Tanour and Rasoun karst springs catchment area (NW-Jordan)" [View project](#)



Protection of Jeita Spring [View project](#)



Council for Development and Reconstruction (CDR)
Ministry of Energy and Water (MoEW)
Water Establishment Beirut and Mount Lebanon (WEBML)



Federal Institute for Geosciences
and Natural Resources (BGR),
Hannover, Germany

German-Lebanese Technical Cooperation Project Protection of Jeita Spring

Delineation of the Groundwater Catchment for Jeita Spring using Tracer Tests, Mapping of GW Vulnerability and Delineation of GW Protection Zones

4th Beirut Water Week

February 20, 2013

Dr. Armin Margane, BGR



Protection of Jeita Spring



- Project - Tasks
- Description of Project Area
- Project Activities related to Protection Zones
 - Delineation of GW Catchment
 - GW Vulnerability Map
 - GW Protection Zones



Project Setup

Duration

1st phase	2 years	July 2010 – June 2012
extension	1.5 years	July 2012 – December 2013

Partners

- Council for Development and Reconstruction (CDR)
- Water Establishment of Beirut and Mount Lebanon (WEBML)
- Ministry of Energy and Water (MoEW)

Cooperation between two German Development Aid Projects

- KfW Development Bank > Jeita wastewater project (GITEC)



Planned Project Activities

1. Integration of water resources protection aspects into the investment planning and implementation process in the wastewater sector

- Geoscientific advice for wastewater projects (site selection, EIA, WW best practice guidelines, standard for wastewater reuse, EIA guideline WW)

2. Integration of water resources protection aspects into landuse planning

- Preparation of GW vulnerability maps;
- Inventory of GW hazards, risk assessment;
- Delineation of GW protection zones
- Support of implementation



Planned Project Activities

3. Collection and use of monitoring data concerning quality and quantity of water resources

- Monitoring network
- Water balance
- WEAP model
- Advice to WEBML (optimal usage and protection)

4. Support of the partner institutions concerning the implementation of urgent protective measures

Proposal for an

- improved capture of Jeita Spring;
- improved water conveyance system from the Jeita Spring to the Dbaye treatment plant.



- Insufficient and inadequate meteorological stations/data (not heated > no snow data)
- No groundwater monitoring > no water levels > no GW model
- Spring discharge monitoring stations not adequately designed, maintained and monitored
- Surface water gauging stations not adequately designed and maintained
 - ▶ lack of funds and staff

Water resources assessment needs monitoring system for all water balance components

- rainfall / snow
- spring discharge
- runoff (surface water)
- groundwater abstraction
- irrigation water use (return flow)
- domestic water use / losses (return flow)

- ▶ no data > no correct water resources assessment
- ▶ wrong water resources assessment leads to wrong planning !
- ▶ failed investments in the water sector



Spring Monitoring

- multiparameter probes
- gauging stations (weir, ADCPs)
- direct discharge measurement (> 300 dilution tests)



Labbane spring

Jeita spring



Daraya tunnel

Multiparameter probes parameters:
Water level
Temperature
EC
pH
ORP
DO
(ammonium)
(ISE)

Telemetric data transfer

Leita



Kashkoush spring

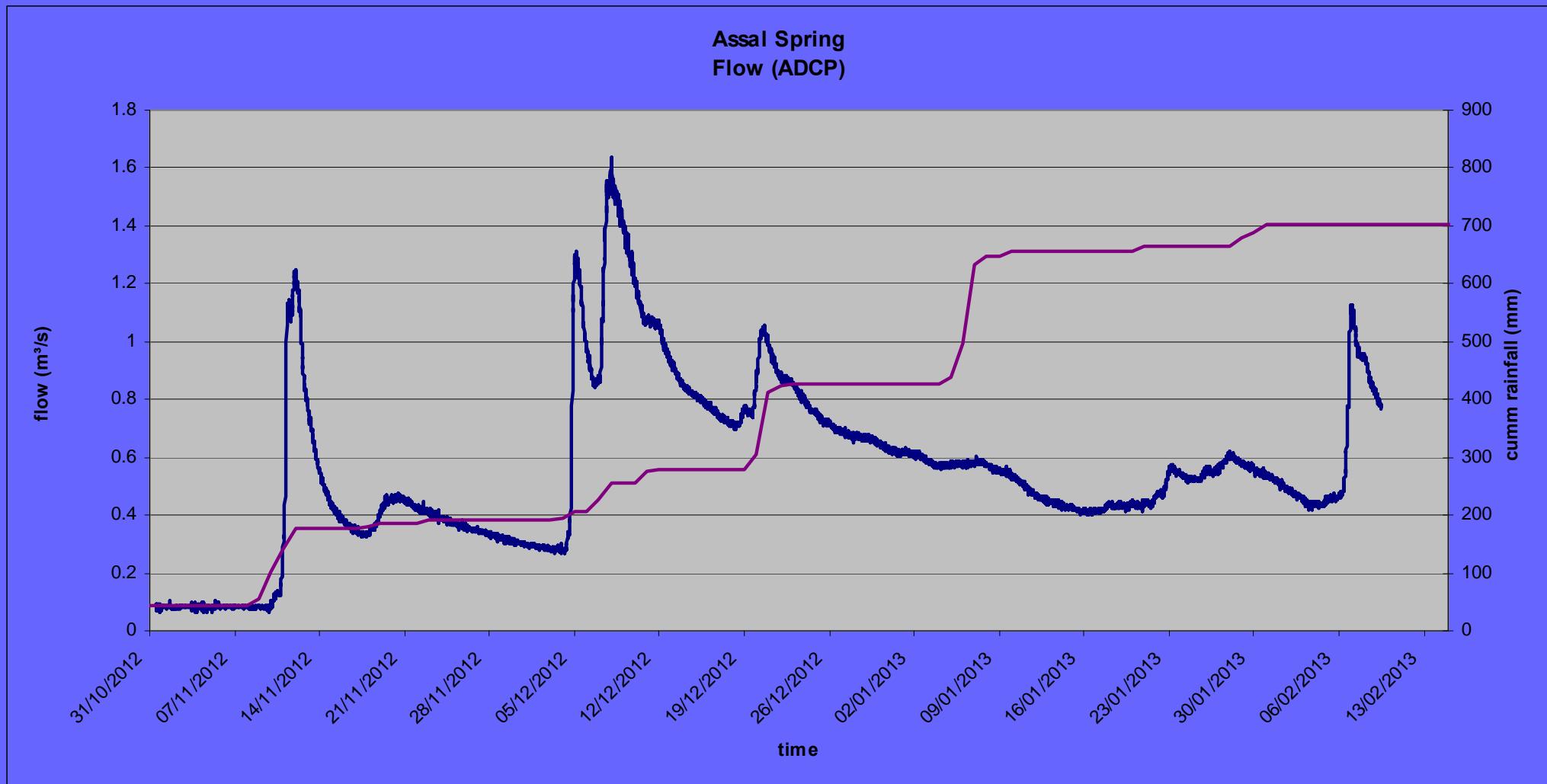


+ADCP

Assal spring

Spring Monitoring

Assal – Monitoring by ADCP & multiparameter probe



ADCP : every **15 min**

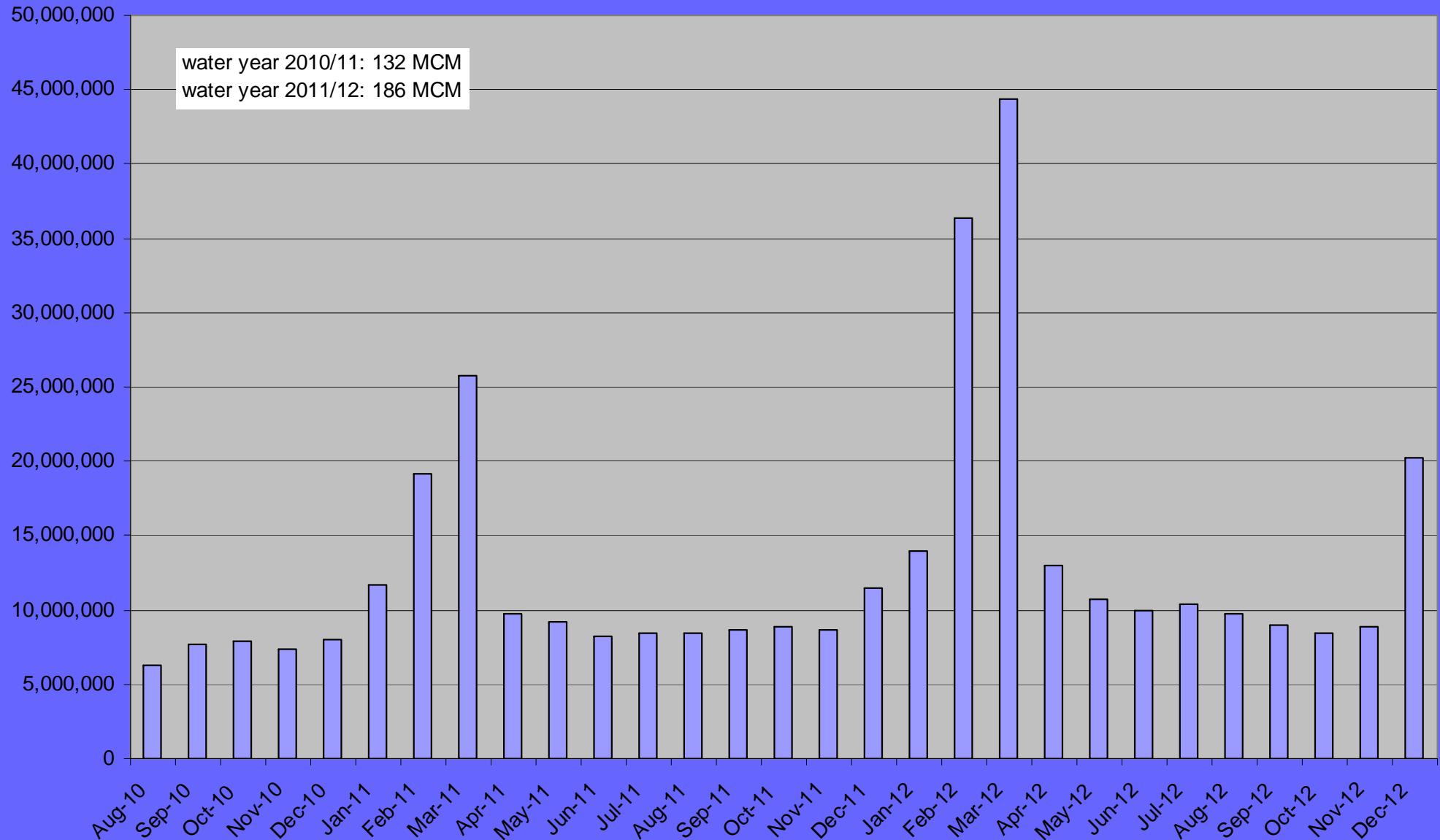
multiparameter probe: every **20 min**



Protection of Jeita Spring



Monthly Discharge Jeita Spring



Climate data

Installation of meteorological stations at

- Sheile
- Aajaltoun
- Kfar Debbiane
- Bakeesh
- Chabrouh dam



Surface water data

Proposal for installation of streamflow gauging stations at

- Daraya (Nahr es Salib)
- Daraya (Nahr es Zirghaya)
- Jeita/Kashkoush (Nahr el Kalb)

LRA station 226 Daraya
(Nahr es Salib + Nahr es Zirghaya)



Parshall flume weir Daraya (Nahr es Salib)

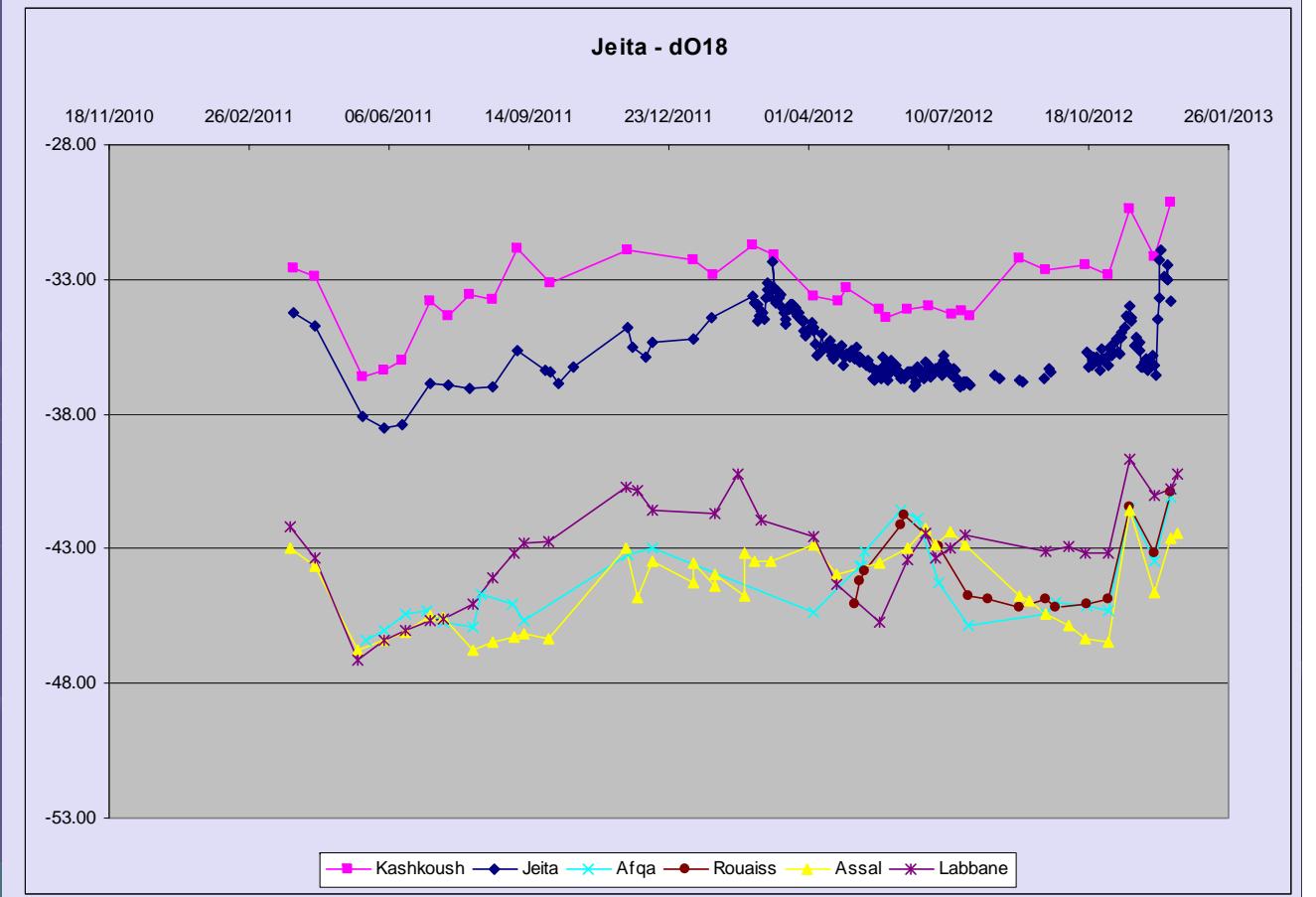
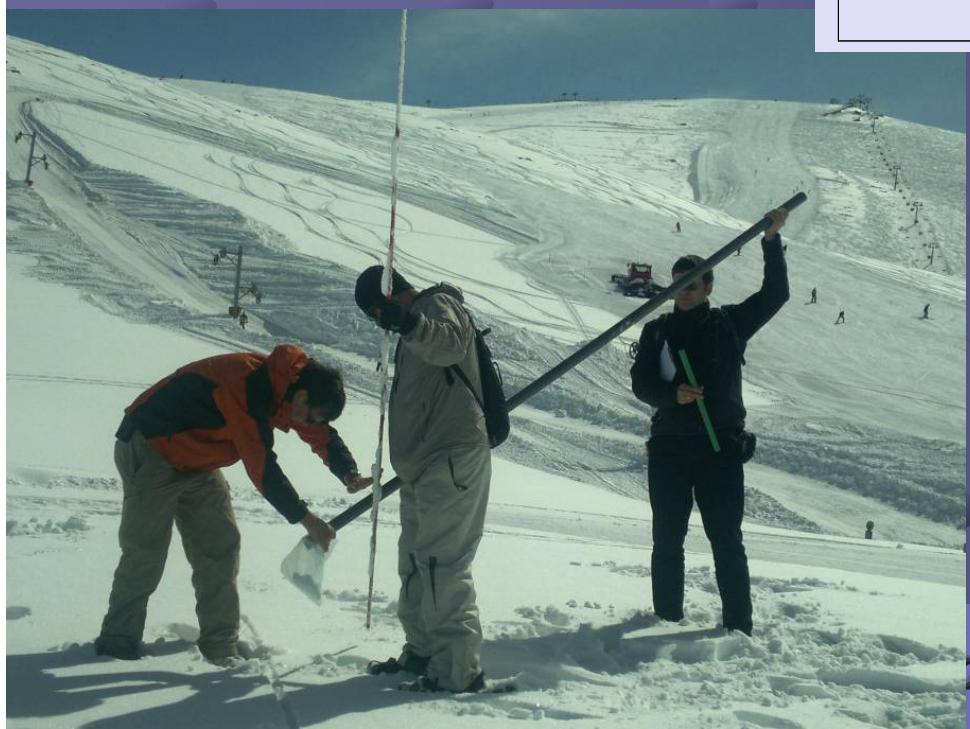


Isotope data

- deuterium/oxygen-18
- tritium/helium
- CFC (chlorofluorocarbon)

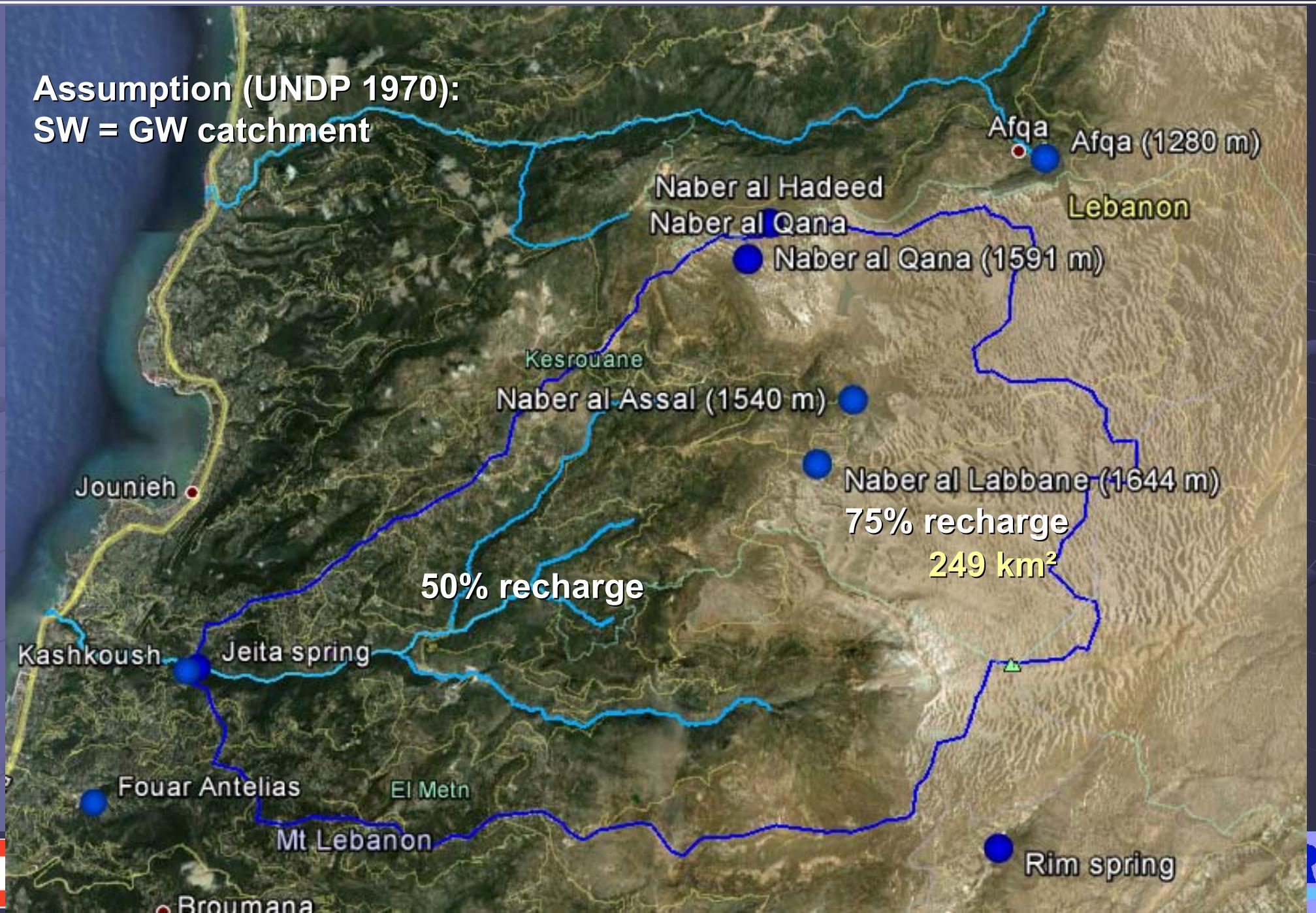
D/¹⁸O > 500 analyses

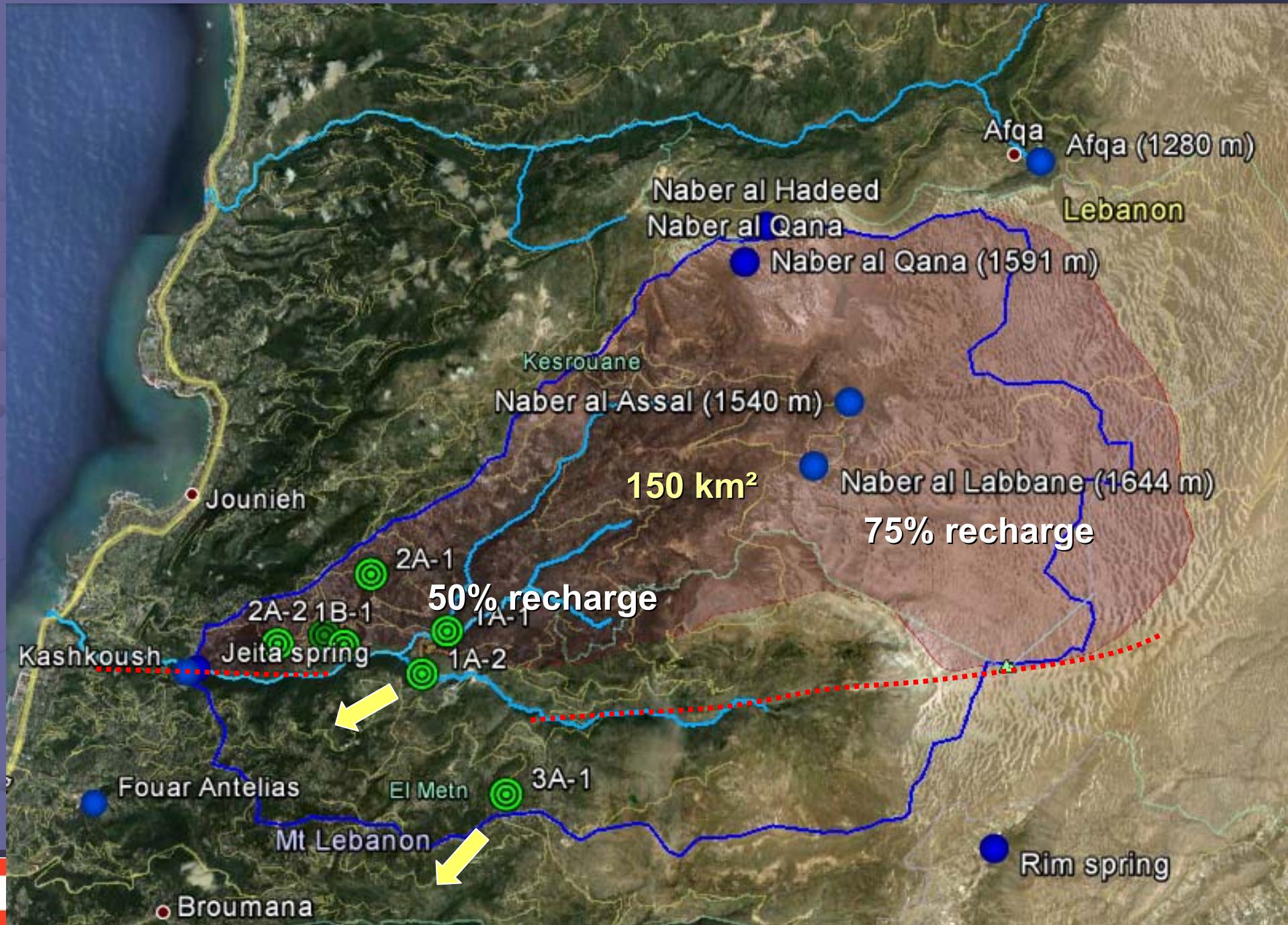
- 6 springs
- rainfall – 6 stations @ diff elev.
- snow sampling campaigns

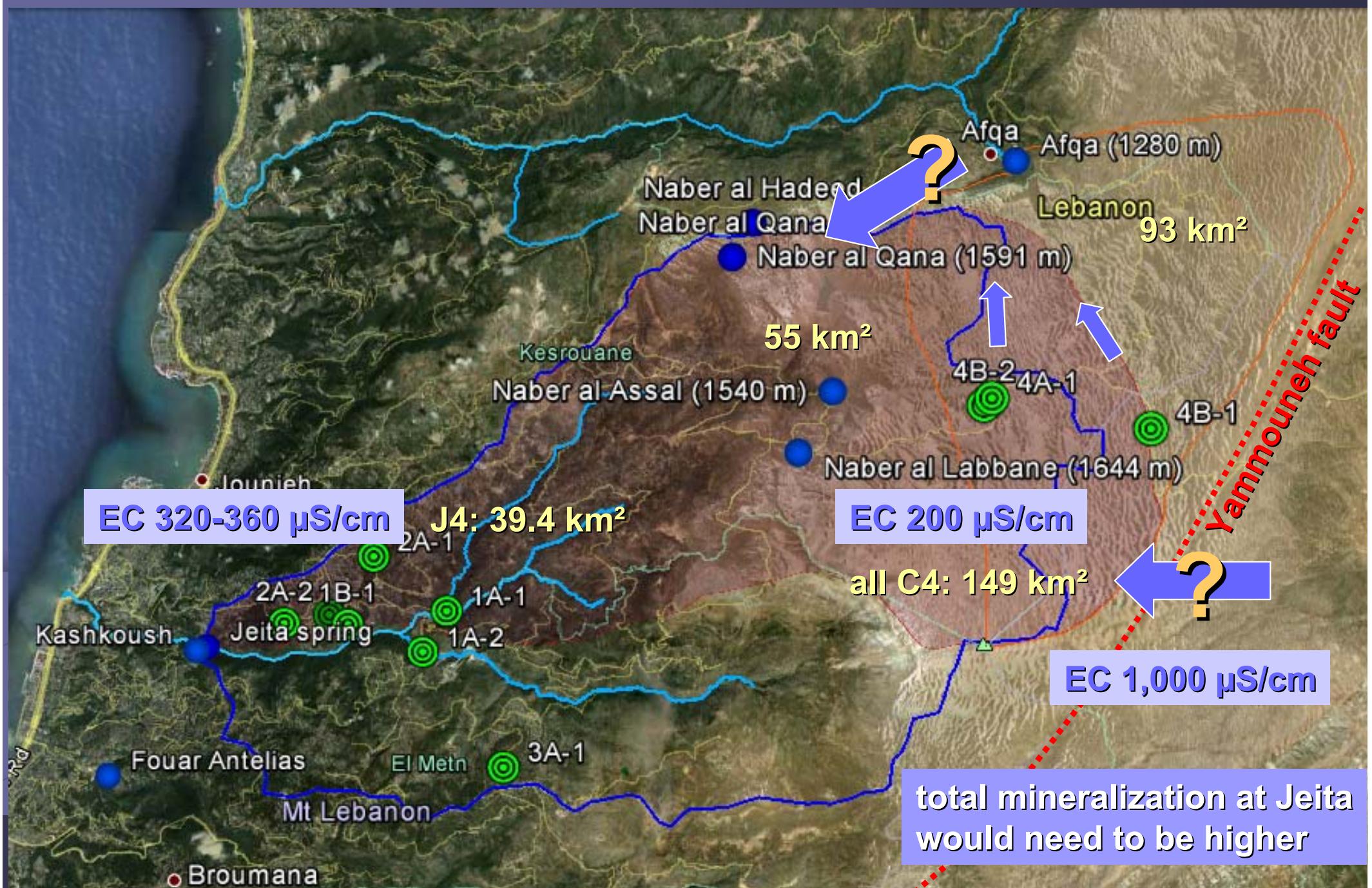


D/¹⁸O
Springs Jurassic Aq (J4) :
- Jeita : daily
- Kashkoush : every 15 days
Springs Upper Creataceous Aq (C4) :
- Assal, Labbane, Afqa, Rouaiss : 15 days
Rainfall: Jeita, Sheile, Aajaltoun, Raifoun,
Kfar Debbiane, Chabrouh : every 15 days
Snow: integral & 10 cm depth intervals, 2 winter seas.

on of Jeita Spring

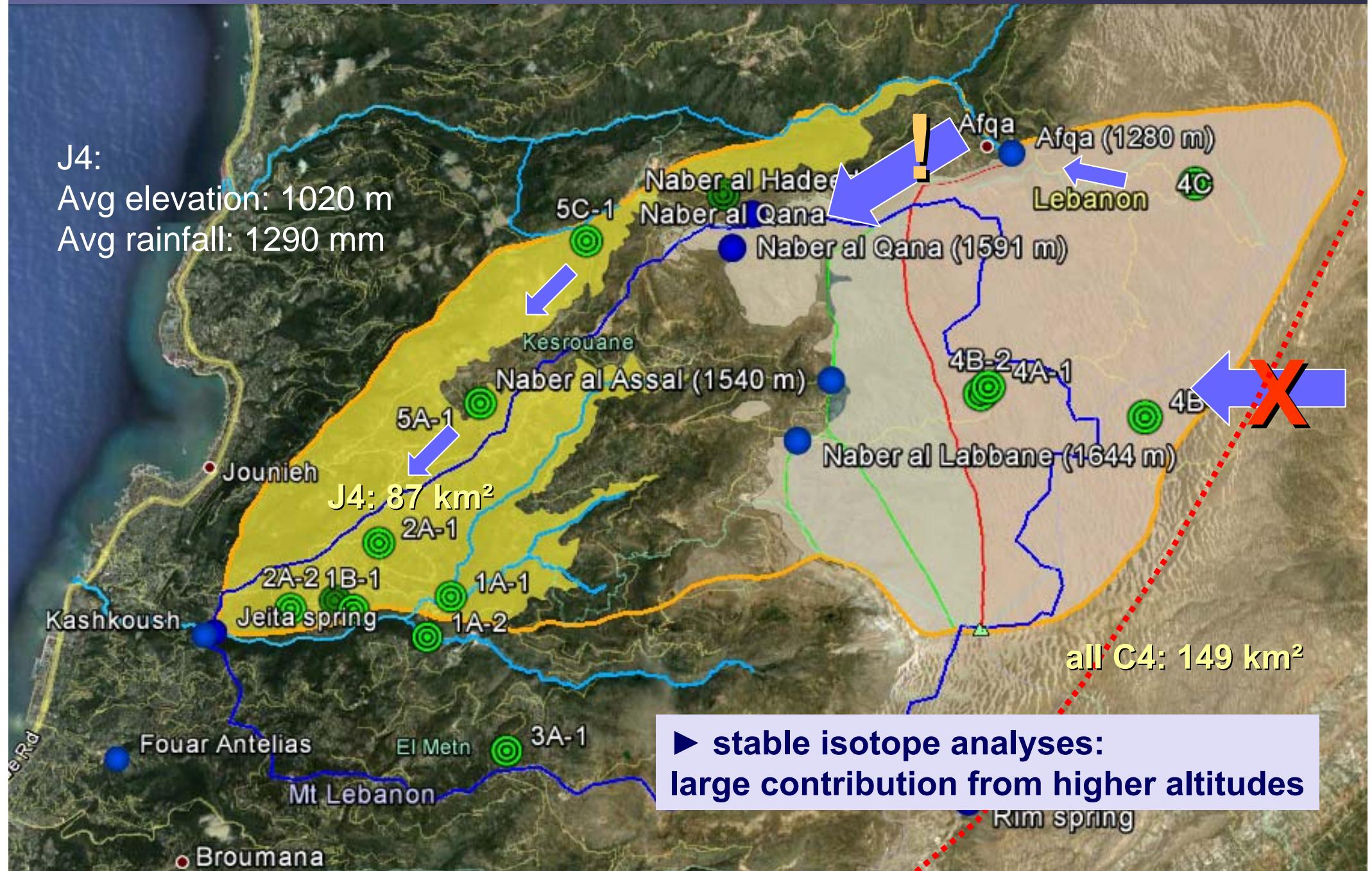


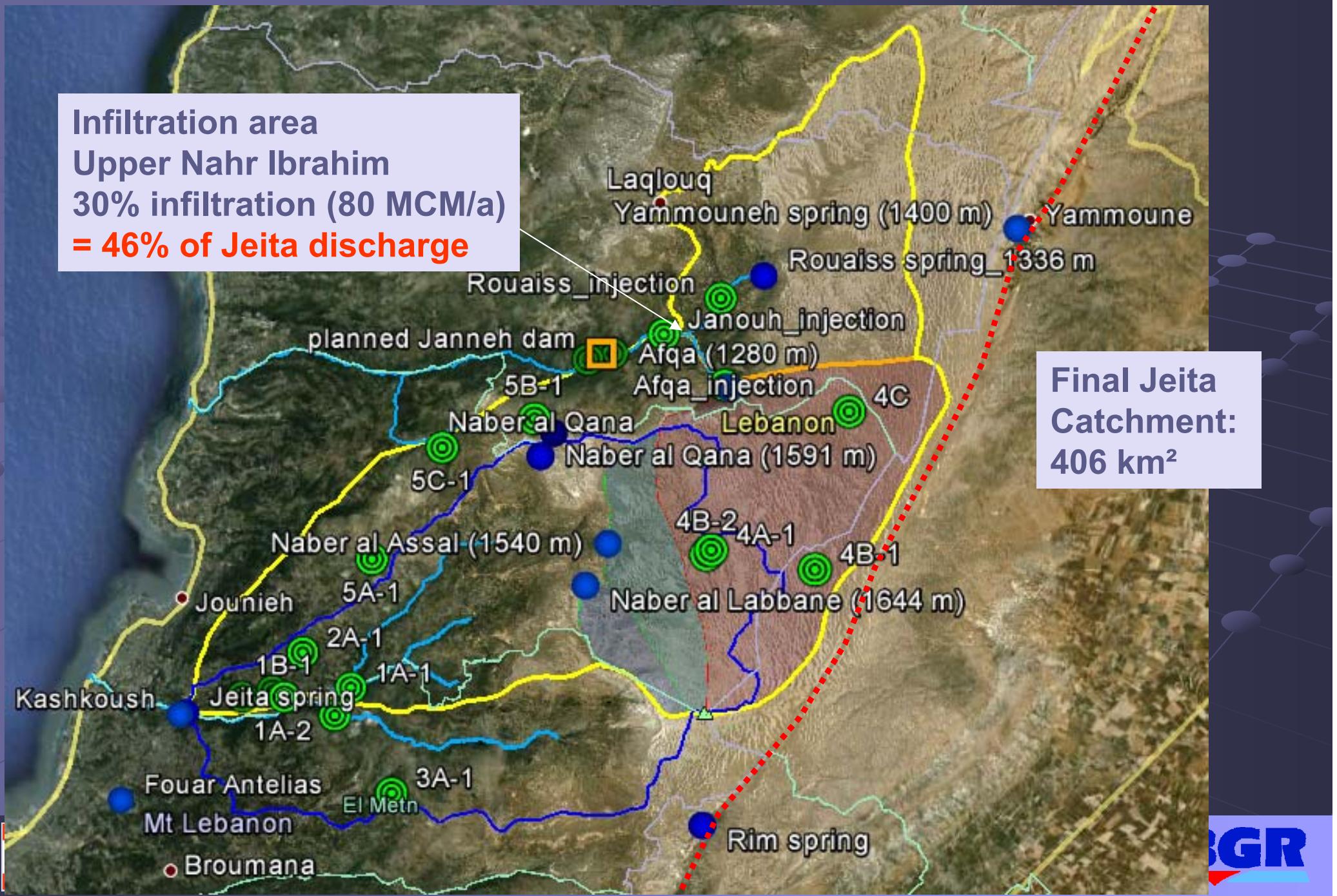




Project Area

September 2011 / April 2012





Groundwater recharge

Importance of Snow

Cretaceous plateau (1,800 – 3,000 m asl):
2-4 m snow (2012: up to 10 m and more)
November – May

Very important for GW recharge (~ 86%)
Snow is the lifeline of Lebanon

Climate change may lead to a significantly lower groundwater resources availability

Regional climatic scenarios predict less rainfall (15-30%), higher summer and winter temperatures (up to 5°C+) and thus less snow and runoff, more evaporation

Groundwater recharge

10/26/2007

- no major surface water runoff
- rapid infiltration into Cretaceous aquifer
- high GW recharge from snow melt



C4 limestone
(upper aquifer)



Protection of Jeita Spring

BGR

Groundwater recharge

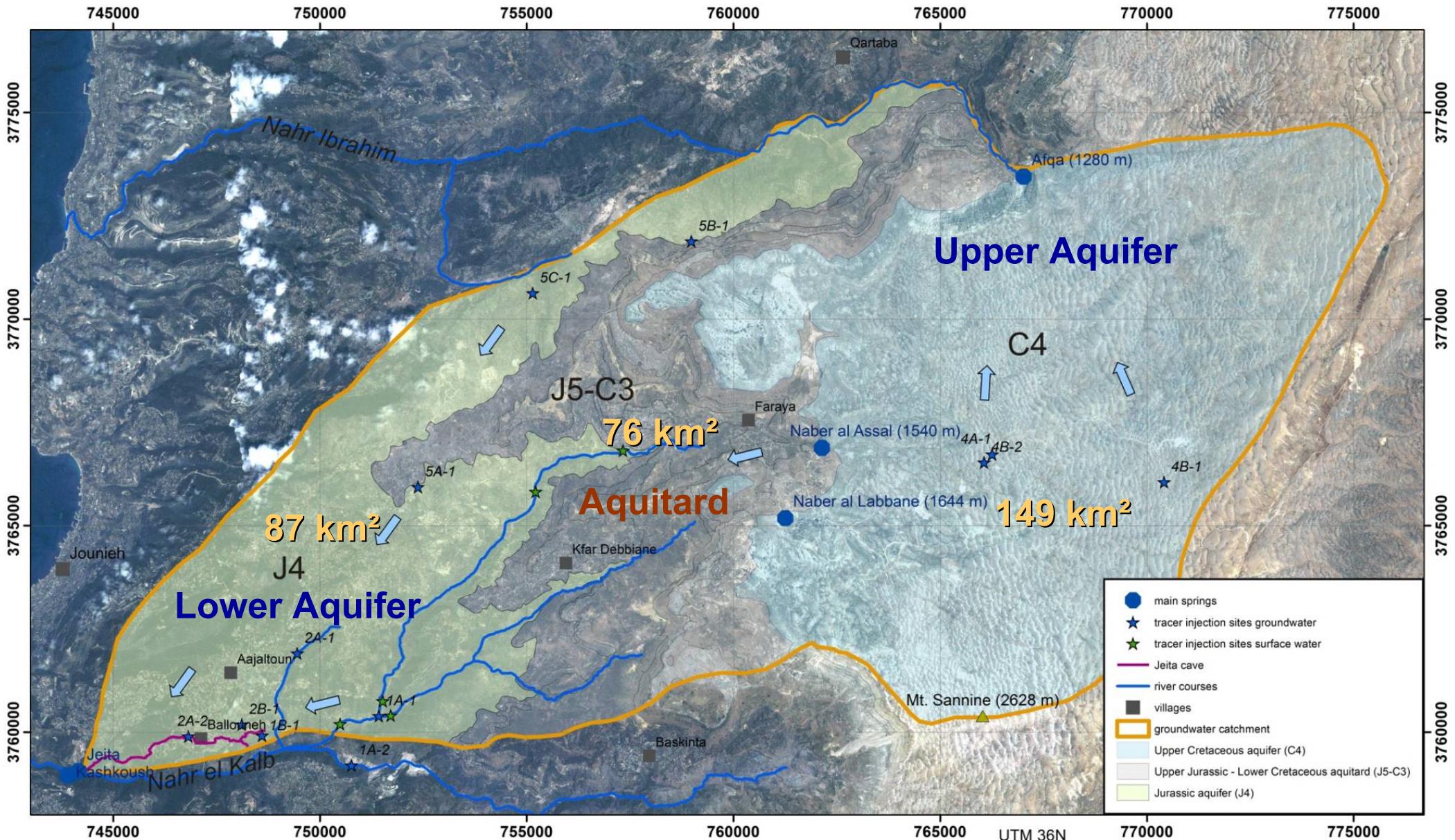


GW recharge via dolines

assumed GW recharge 86% in C4

Groundwater System

New geological map prepared by BGR

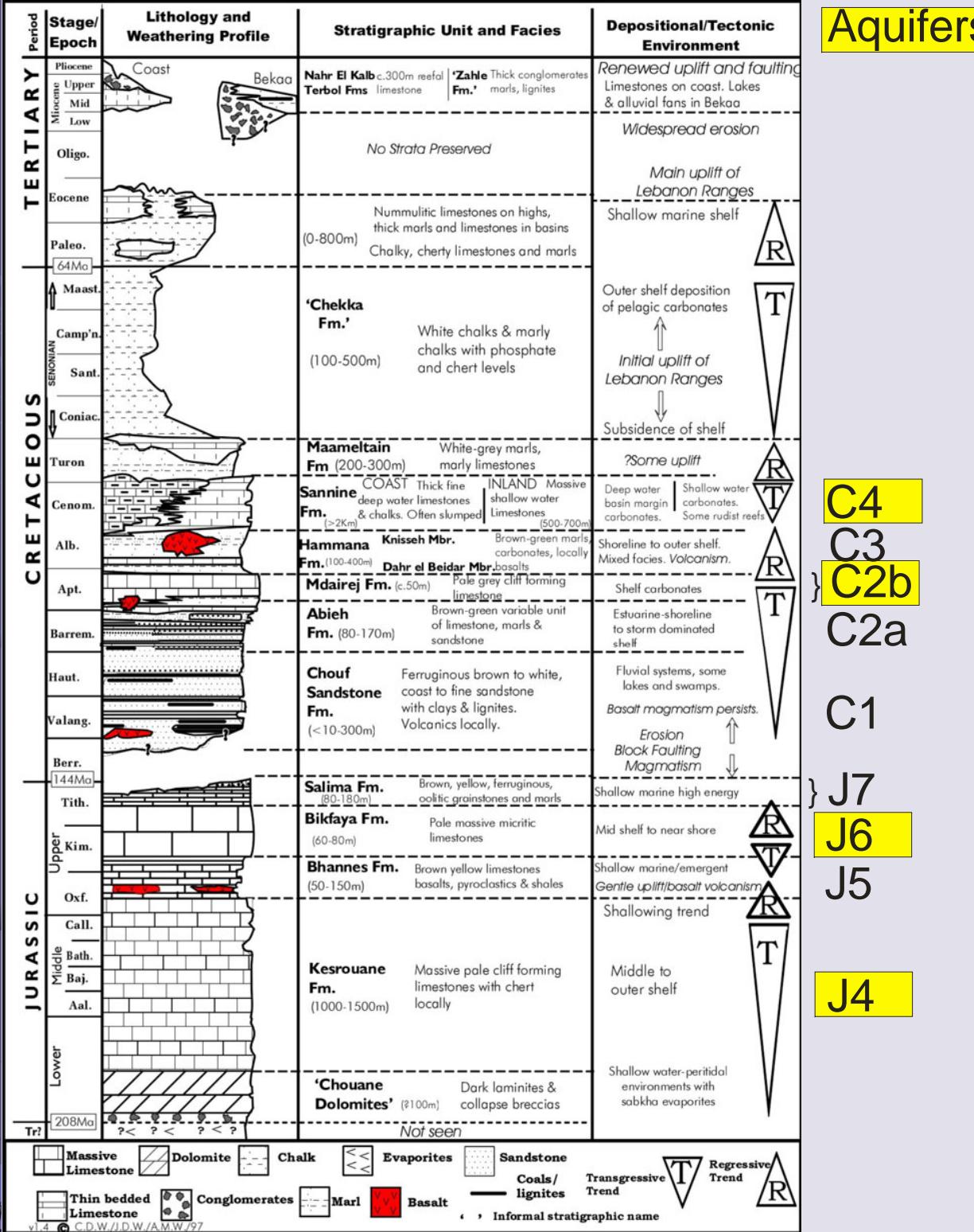
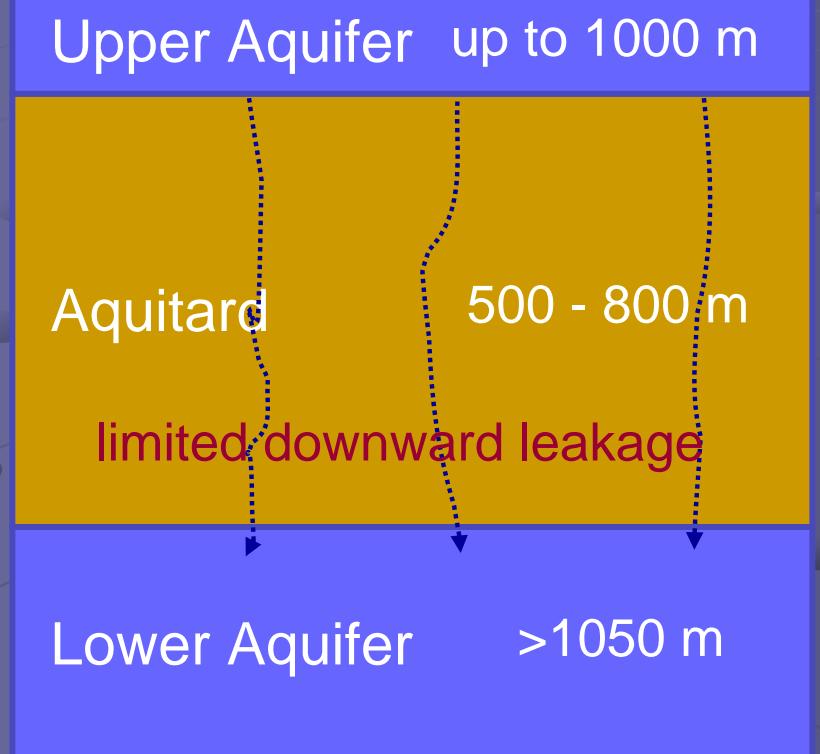


Protection of Jeita Spring

BGR

Aquifers

Lithostratigraphy



Source: C. D. Walley

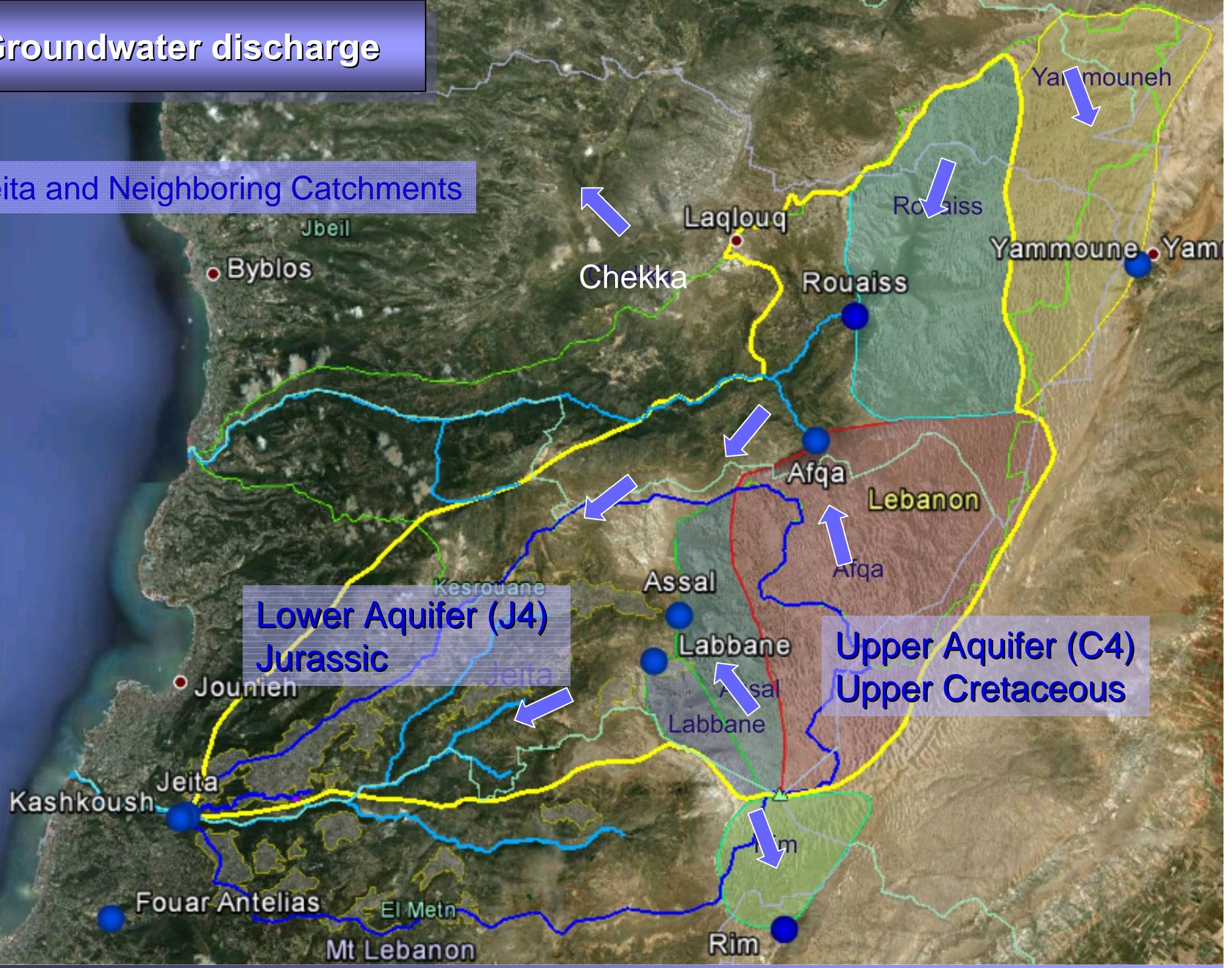


Proto

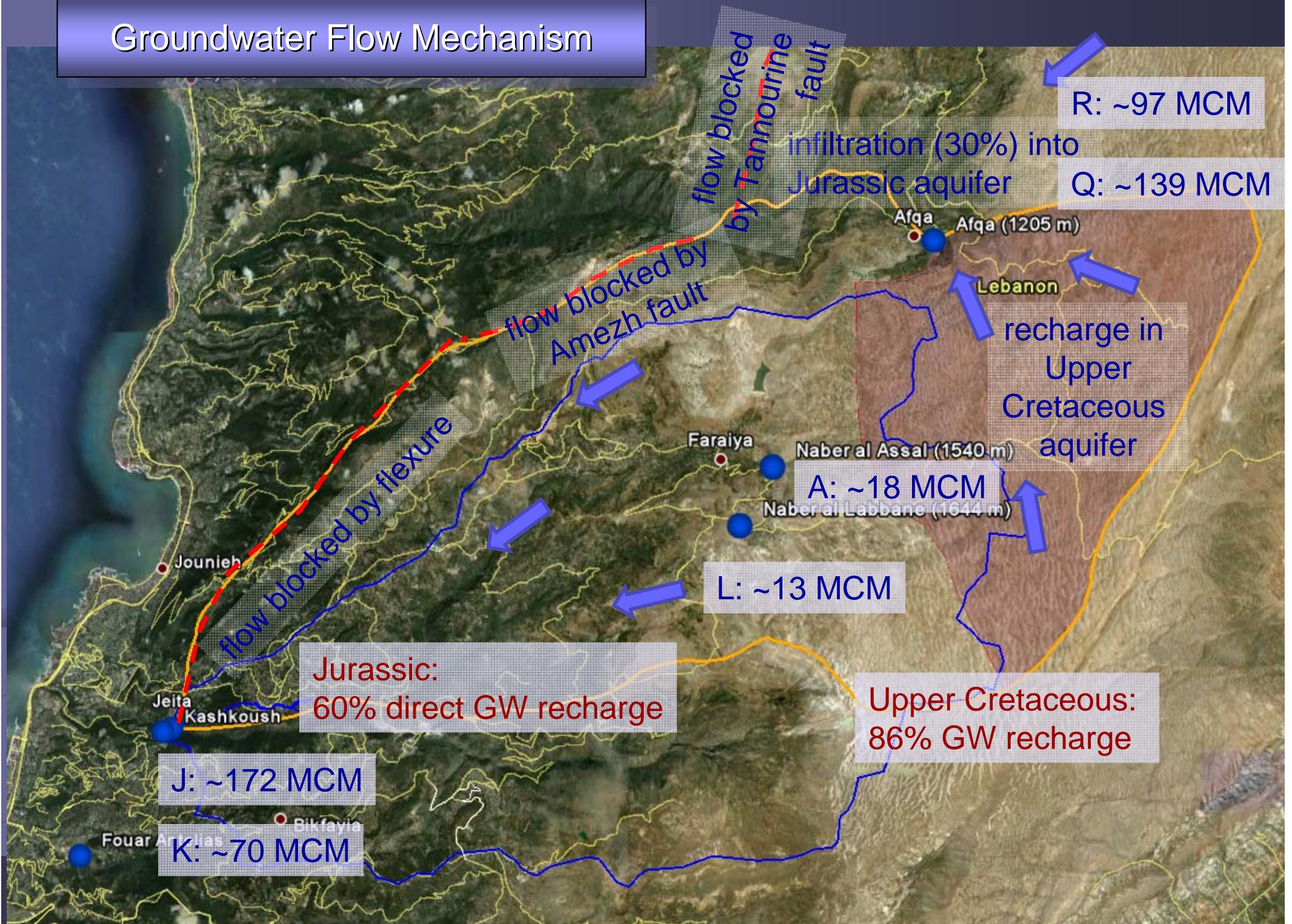
v1.4 C.D.W./J.D.W./A.M.W./97

Groundwater discharge

Jeita and Neighboring Catchments



Groundwater Flow Mechanism

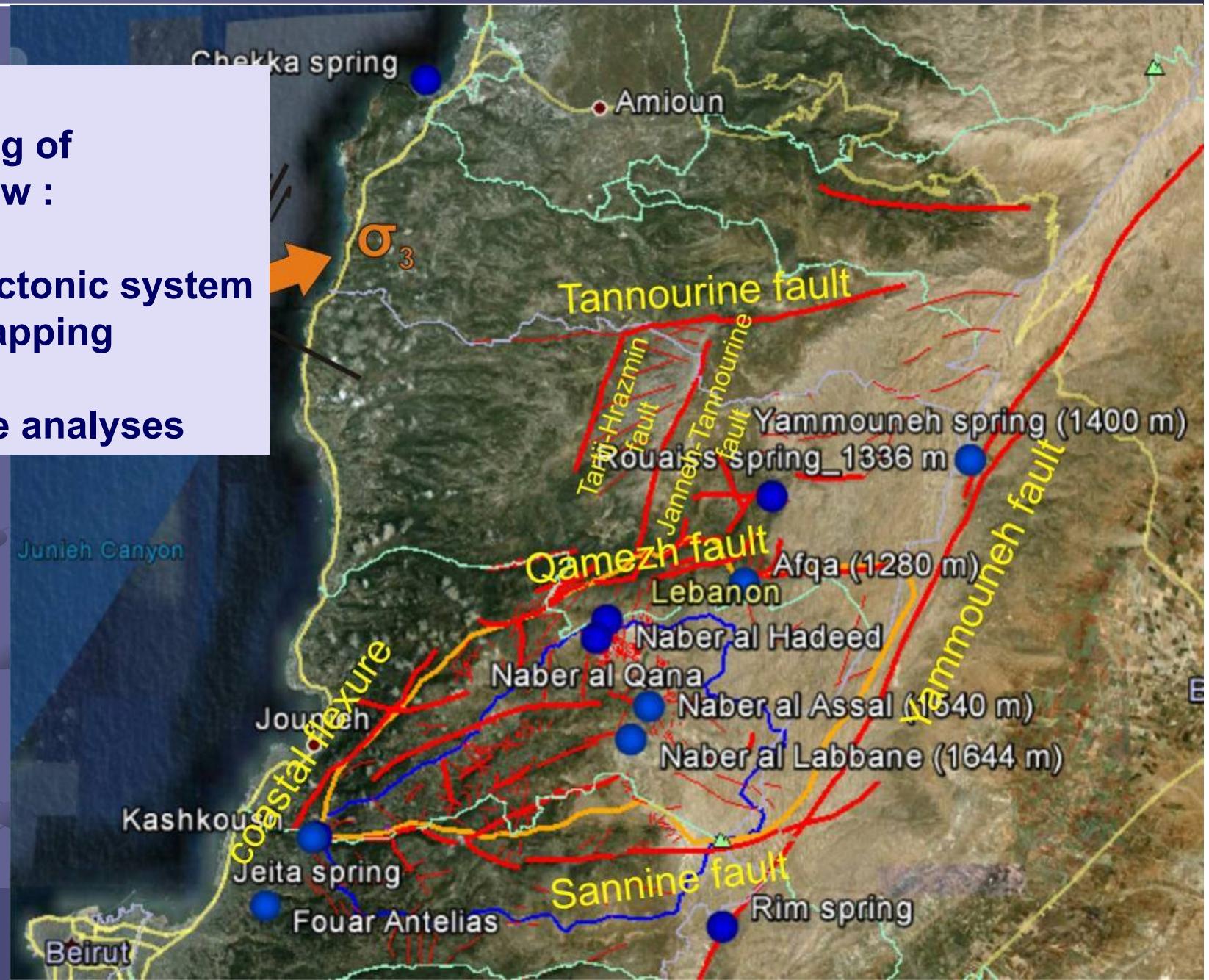


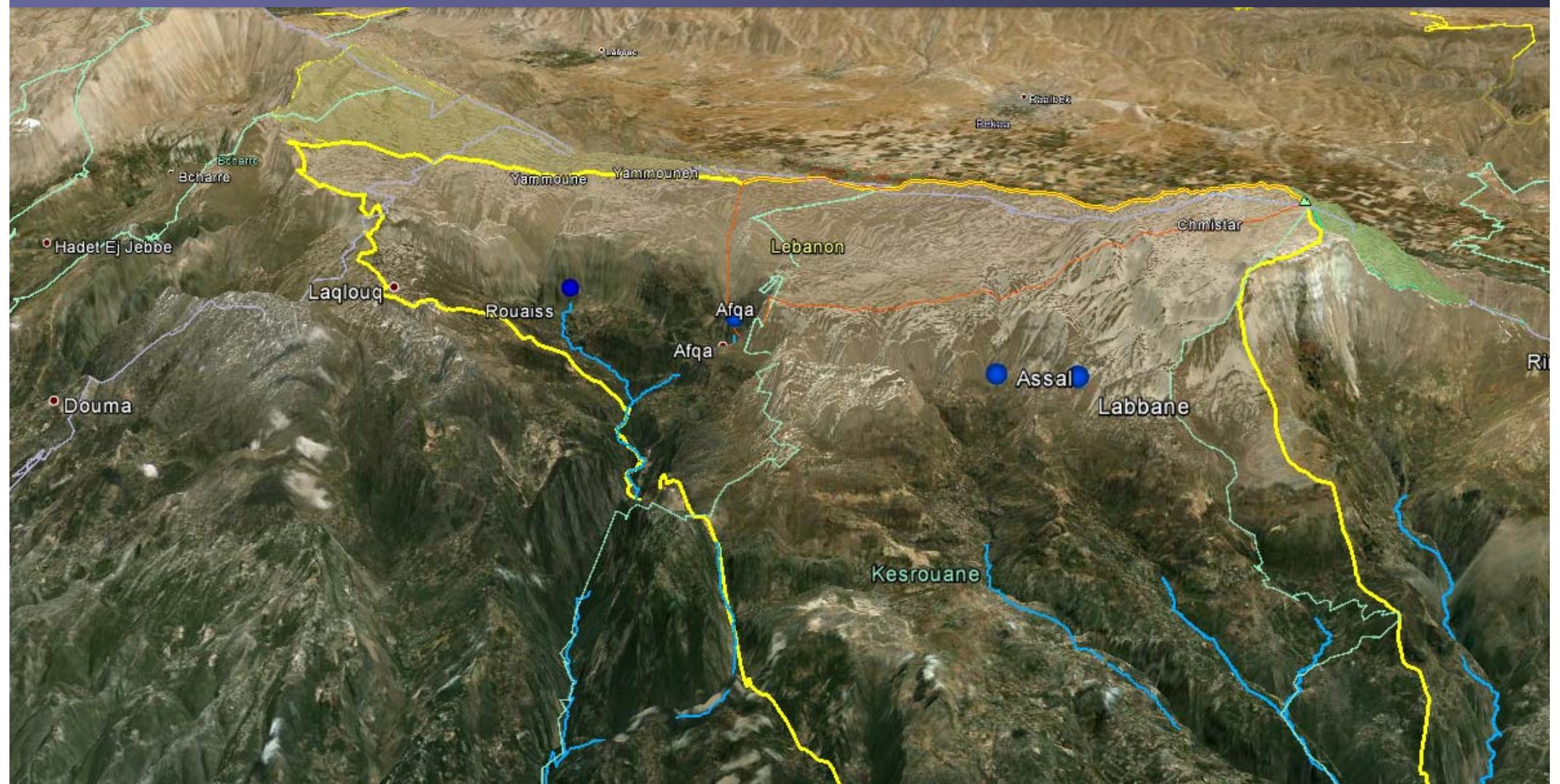
Groundwater Flow

controlled by
- structure (base) and
- tectonics

key elements
to understanding of
groundwater flow :

- analysis of tectonic system
- geological mapping
- tracer tests
- stable isotope analyses



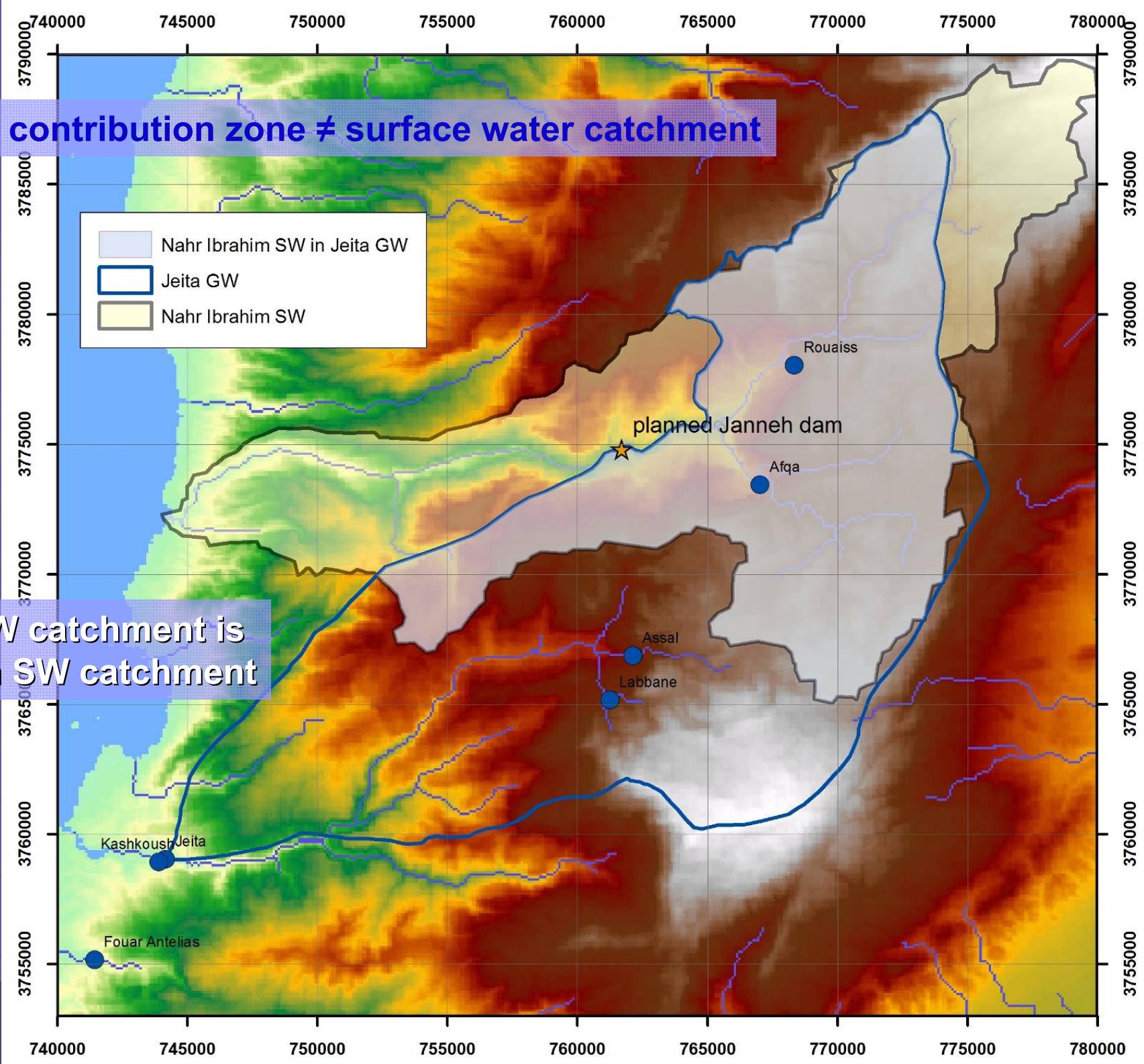


Protection of Jeita Spring



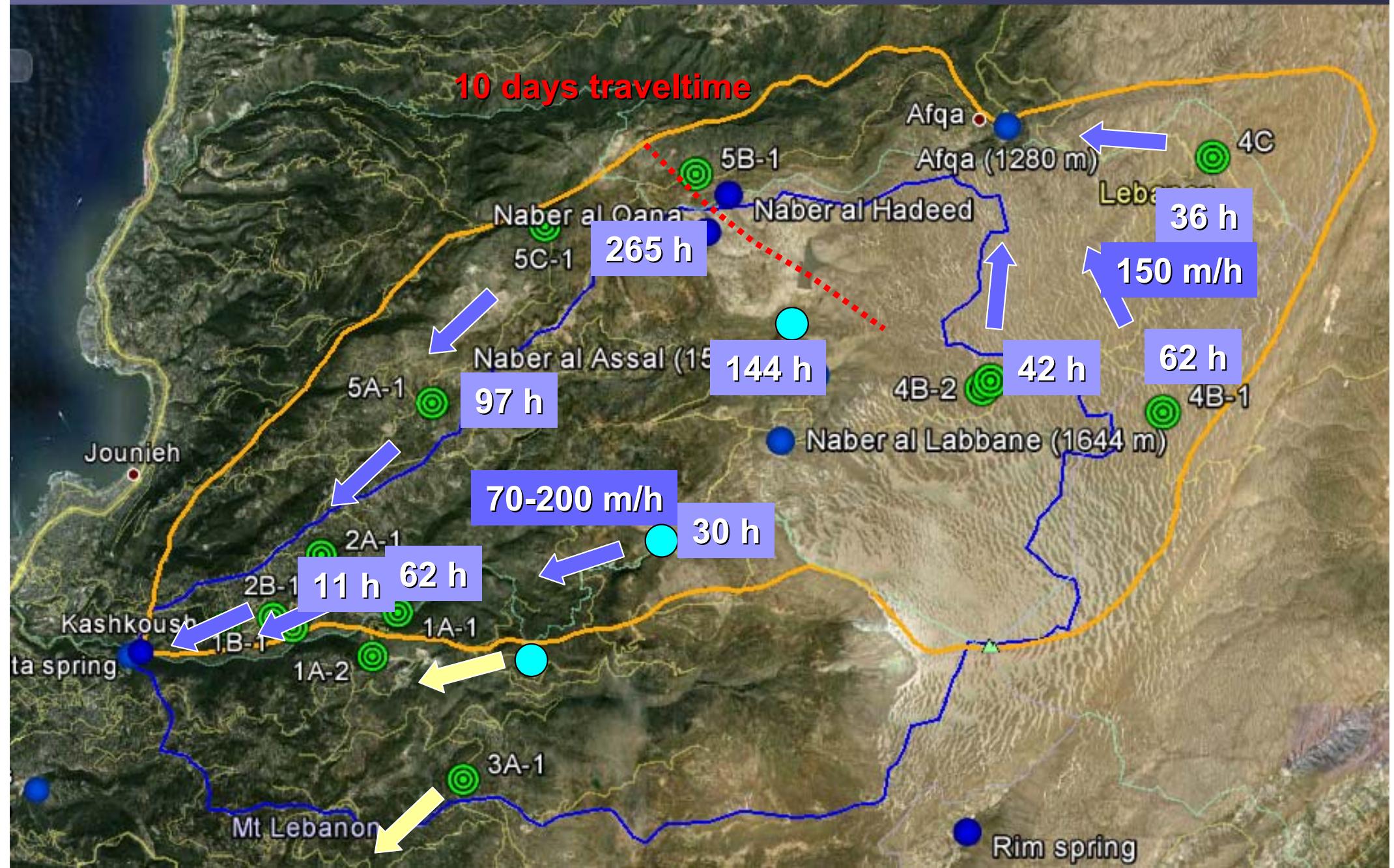
Groundwater contribution zone ≠ surface water catchment

**50% of Jeita GW catchment is
in Nahr Ibrahim SW catchment**



Groundwater Flow

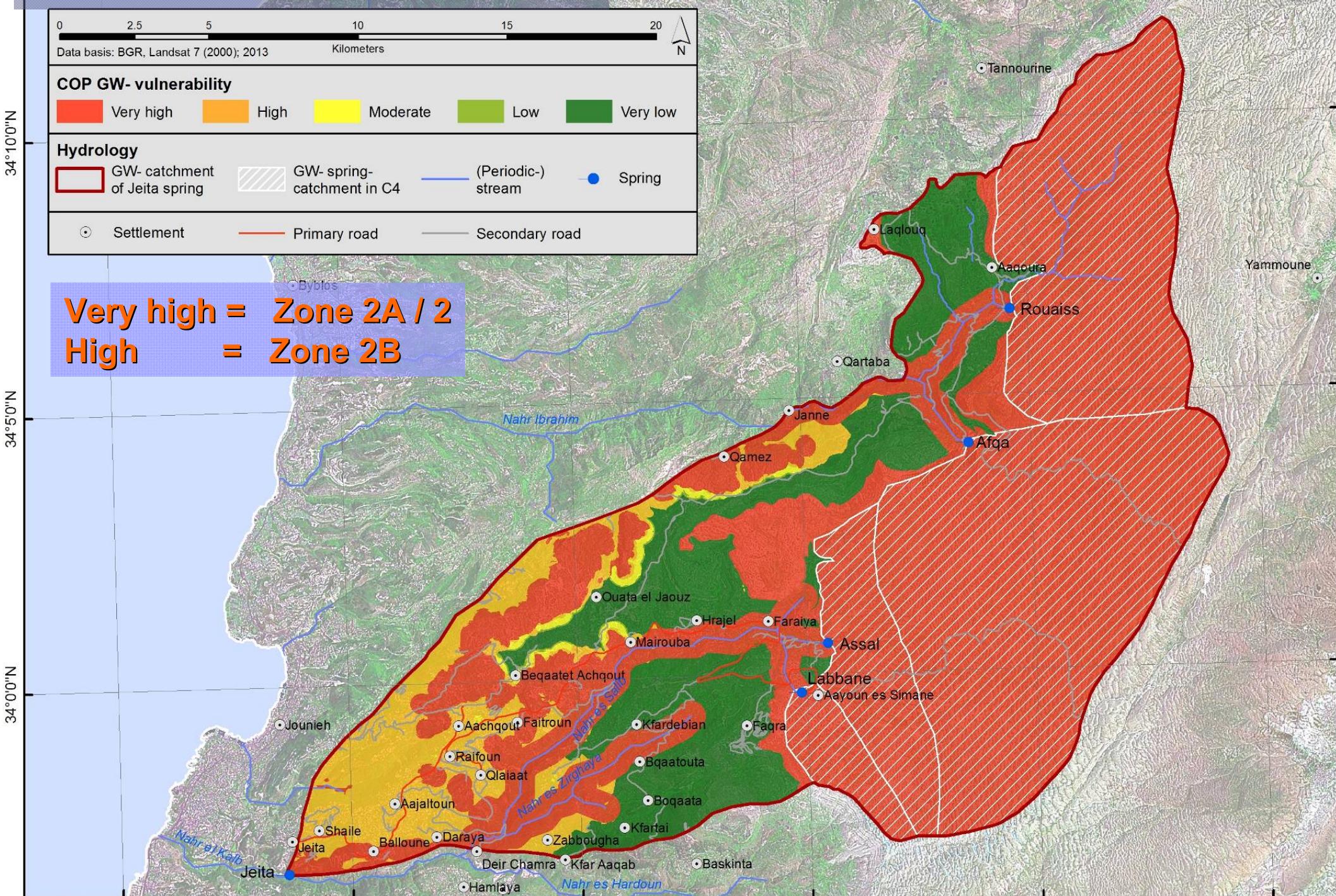
Mean travel times



Groundwater Protection Zones

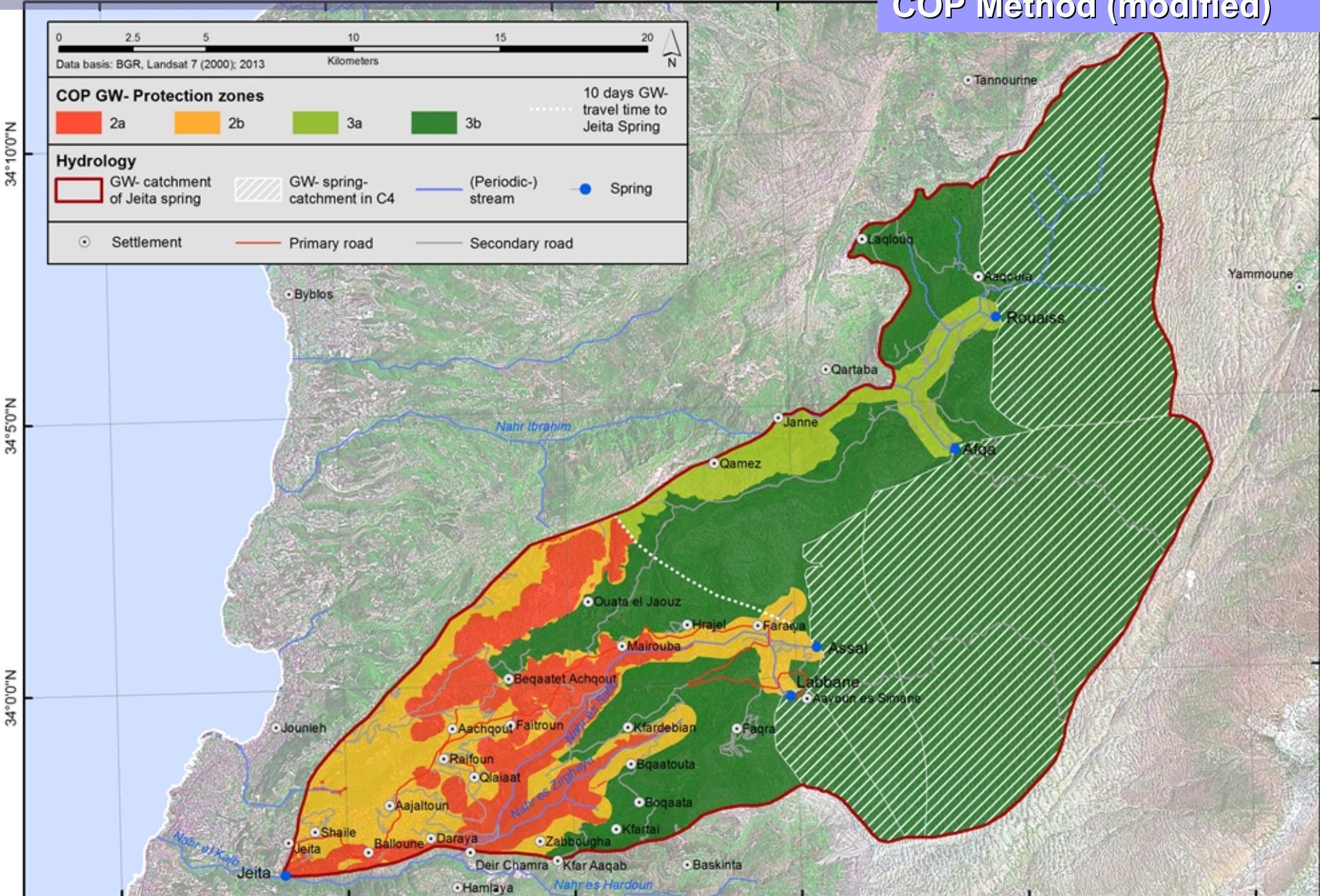
Groundwater Vulnerability COP Method (modified)

35°50'0"E



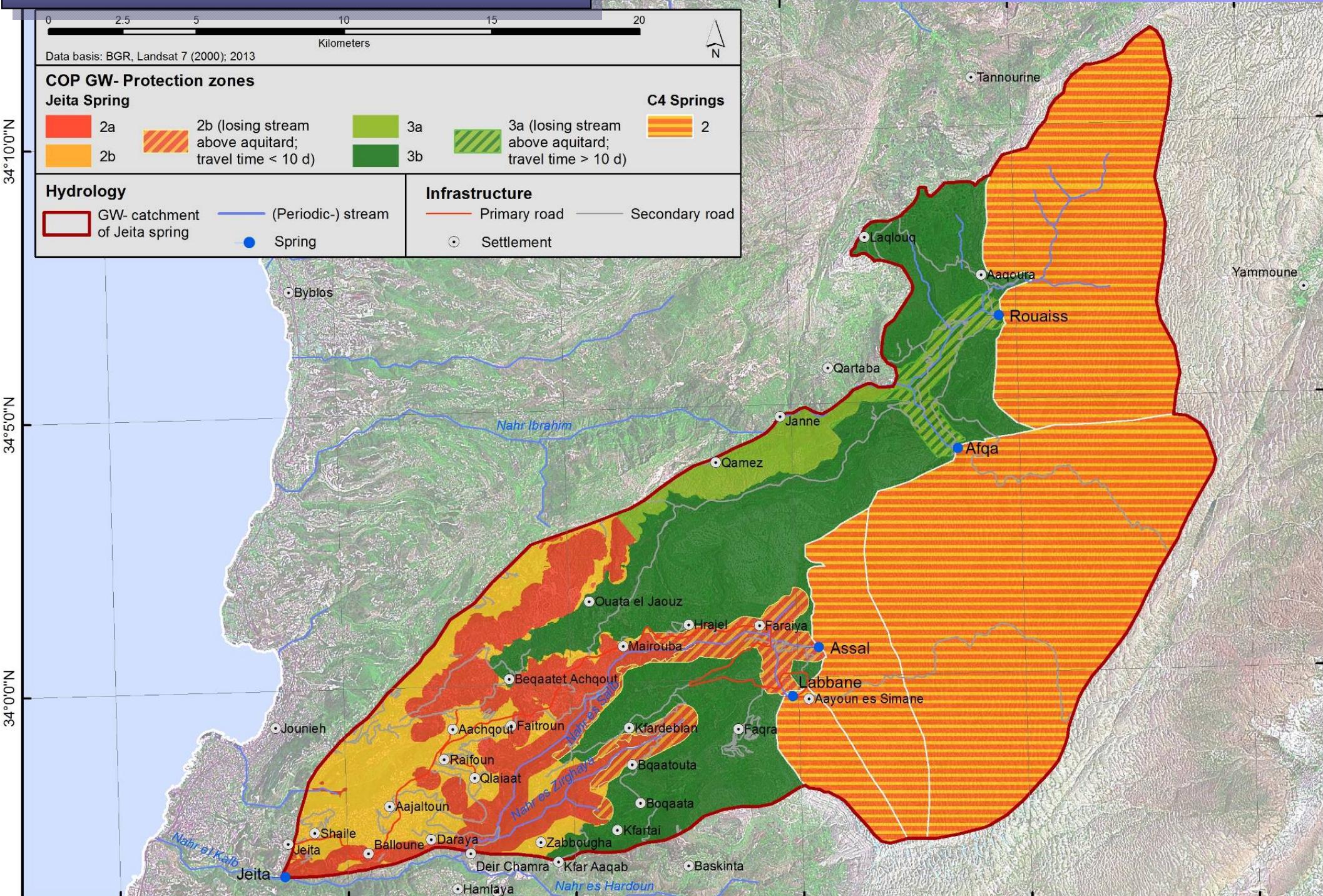
Groundwater Protection Zones

for Jeita Spring based on
Groundwater Vulnerability
COP Method (modified)



Groundwater Protection Zones

for Jeita, Afqa, Rouaiss,
Assal and Labbane springs



*Thank you for your
kind attention*

www.bgr.bund.de/jeita

Dr. Armin Margane – Project Team Leader
Raifoun, Saint Roche Street
armin.margane@bgr.de +961 70 398027



Protection of Jeita Spring

BGR