Irrigation and war, the drivers of change in the Orontes River basin

Myriam Saadé-Sbeih*, Ahmed Haj Asaad*, Raoul Gonzalez*, Abdallah Droubi*, Omar Chamali**, François Zwahlen***, Michel Bakalowicz****, Ronald Jaubert*

*IHEID, Geneva **Nada, Turkey ***CHYN, Neuchâtel ****HydroSciences, Montpellier

N°a

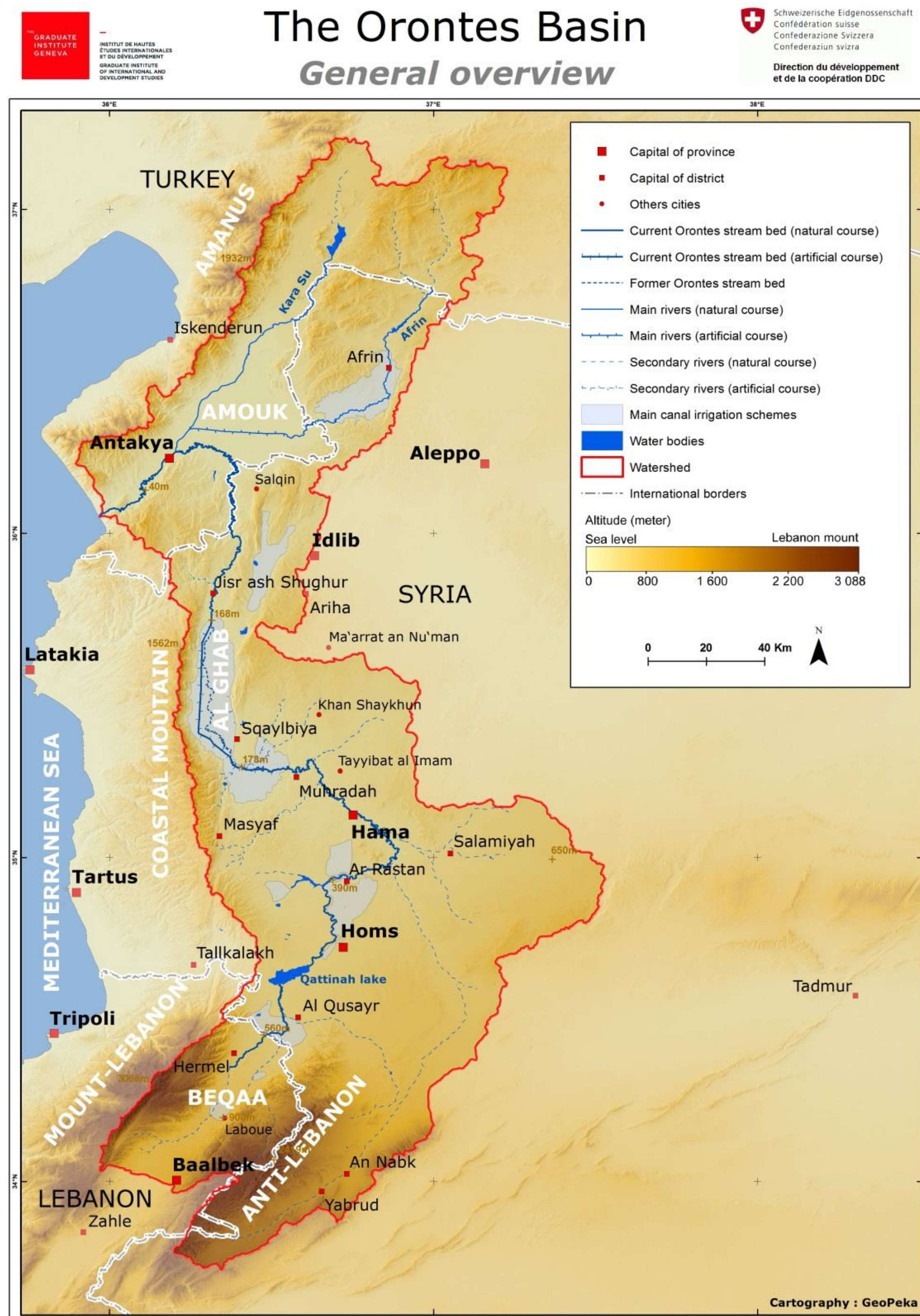
43rd IAH congress

The Orontes River Basin Research Program

Understand the state of surface and ground water resources in the basin to contribute in the longer term to coordinated and sustainable management of the Orontes Basin's water resources

https://www.water-security.org/

Water supply from an irrigation canal, Jabbouleh, Lebanon



Questions

What is the effect of last century agriculture development on groundwater flows and storage?

What about the effects of the Syrian conflict?

Content

Study area: hydrogeological map, cross sections
Data availability and method
Changes in irrigated areas and consequences
Water balance
Conclusions

Main irrigation canal before the conflict (Homs)

Main irrigation canal during the conflict (Homs)

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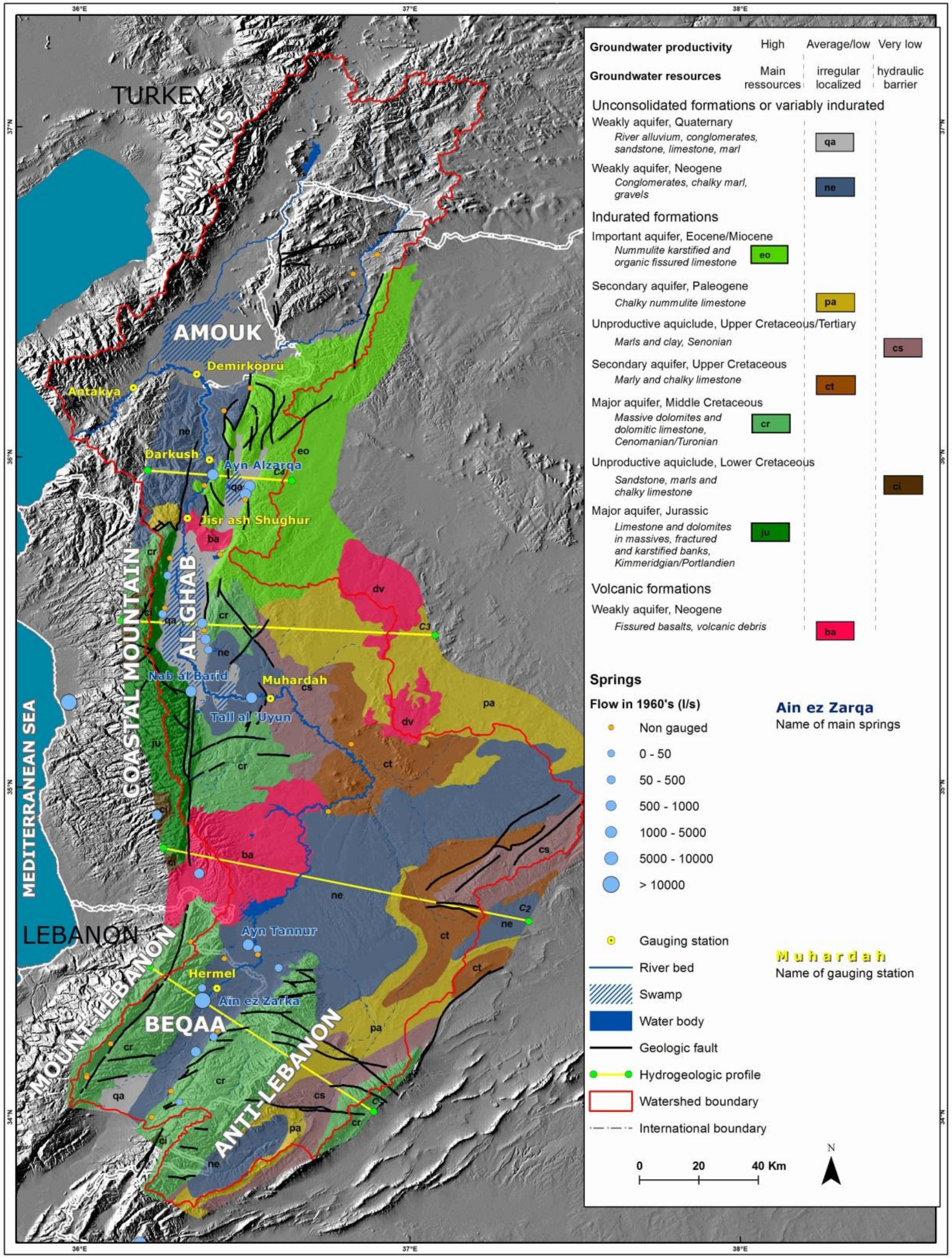
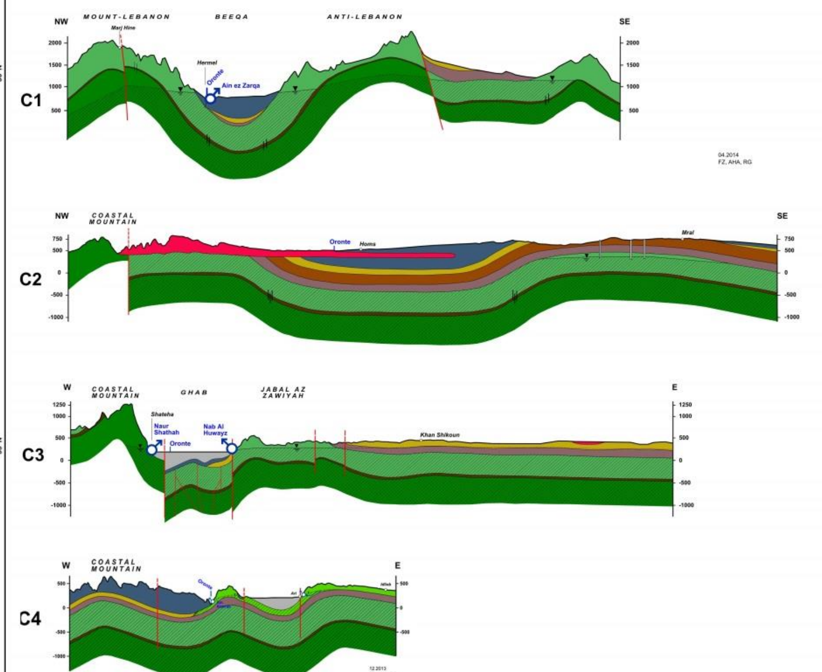
Study area: the Lebanese and Syrian parts of the Orontes River basin





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Groundwater sampling, Salamiyah area

Data availability

Scarce, discontinuous and heterogeneous datasets…

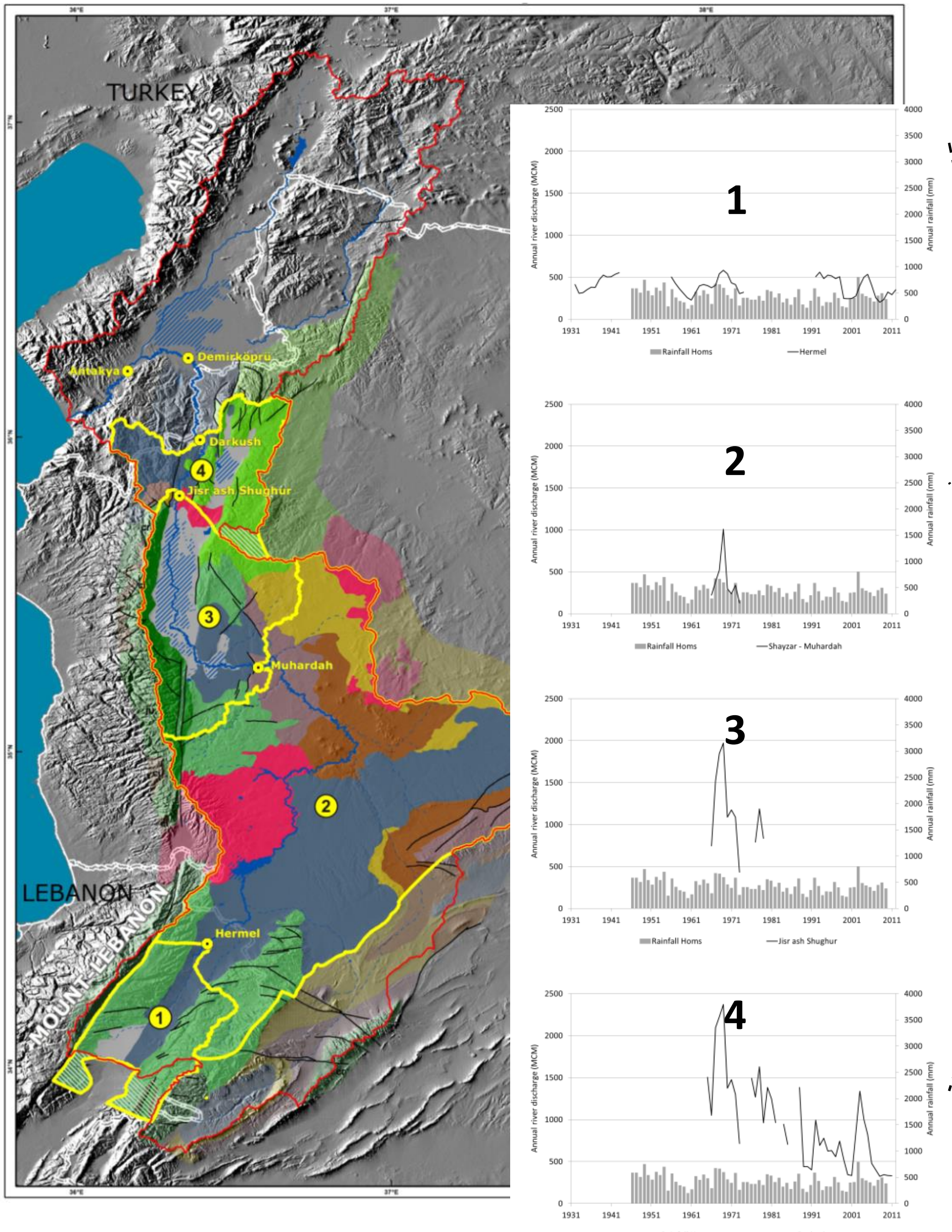
… sometimes contradictory according to national sources

Method

Calculation of surface and ground water balances to confront the different datasets and build a consistent conceptual model of the Orontes River Basin.

1) Establishment of a baseline for 1930s conditions and estimation of hydrogeological parameters

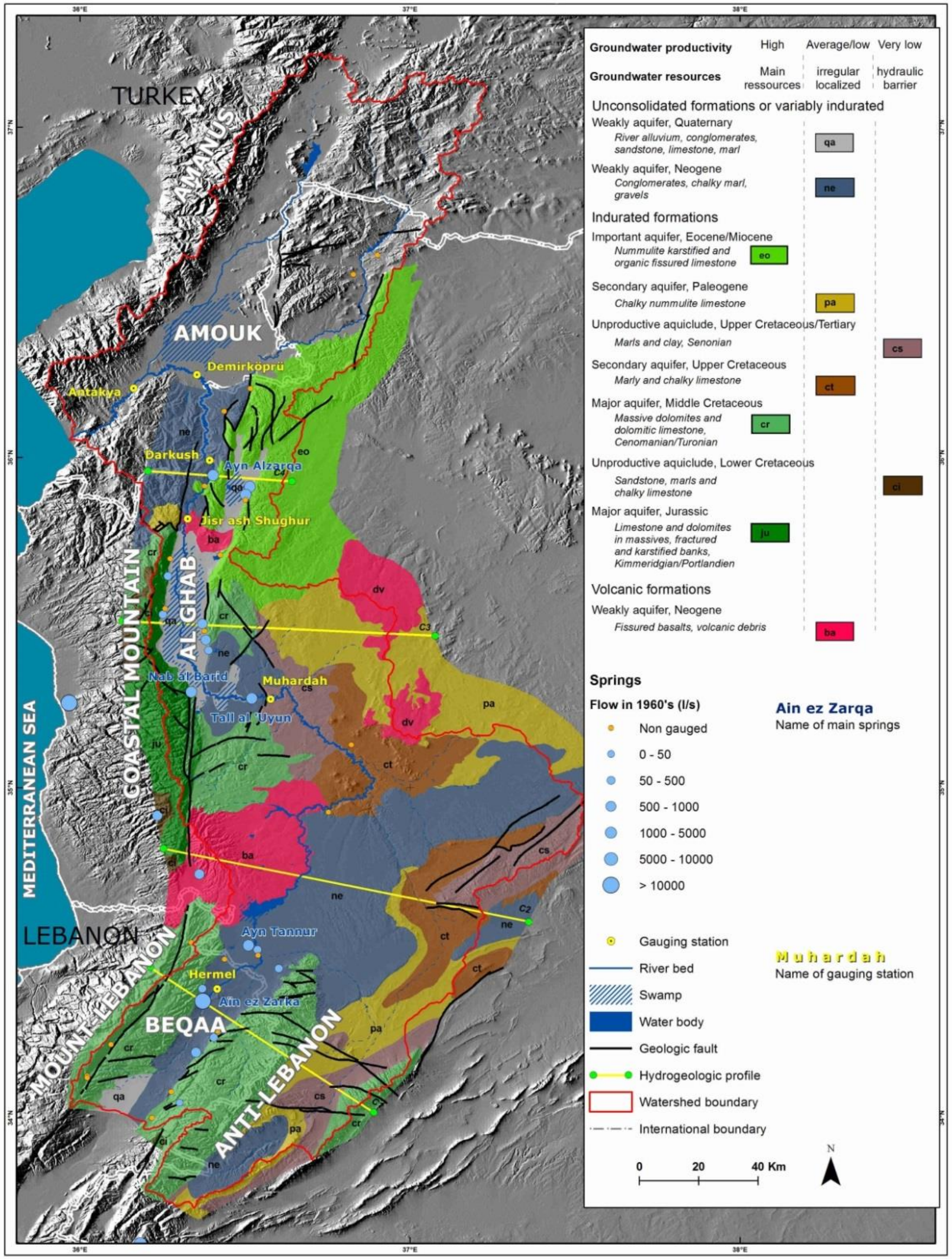
2) Reconstitution of historical water balances (1930s; 1970s; 2000s and post-2011)



(10^6/y)	1930s	1970s	2000s	Post-2011
Hermel	400	400	400	400
Shayzar / Muhardah	770	400	215	430
Jisr ash Shughur	1470	920	340	870
Darkush	1850	1250	600	1200

Reconstitution of Orontes River average annual discharge for different gauging stations

ESCWA (2013), Kerbe (1987), DSI (2014)



Estimation of hydrogeological parameters

Hydrogeological formation/ Aquifer	Id	Thick (m)	ei_f	r_f		et_f	
				1	2	1	2
Quaternary *Weakly aquifer*	qa	~ 150	0.05	0.15	0.35	0.80	0.60
Neogene *Weakly aquifer*	ne	~ 150	0.05	0.15	0.35	0.80	0.60
Neogene *Weakly basalts aquifer*	ba	~ 150	0.05	0.15	0.35	0.80	0.60
Important Eocene aquifer	eo	200 - 300	0.50	0.10	0.10	0.40	0.40
Paleogene *Secondary aquifer*	pa	150 - 250	0.10	0.10	0.30	0.80	0.60
Upper Cretaceous / Tertiary *Unproductive aquiclude*	ct	100 - 200	0.02	0.18	0.38	0.80	0.60
Upper Cretaceous *Secondary aquifer*	cs	150 - 250	0.10	0.10	0.30	0.80	0.60
Major Cretaceous aquifer	cr	400 - 900	0.60	0.05	0.05	0.35	0.35
Lower Cretaceous *Improductive aquiclude*	ci	100 - 200	0.02	0.18	0.38	0.80	0.60
Major Jurassic aquifer	ju	~ 900	0.65	0.05	0.05	0.30	0.30
Primary *Weakly ignous aquifer*	ig	> 1000	-	-	-	-	-

Effective infiltration ei_f, Direct runoff r_f and Evapotranspiration et_f coefficients

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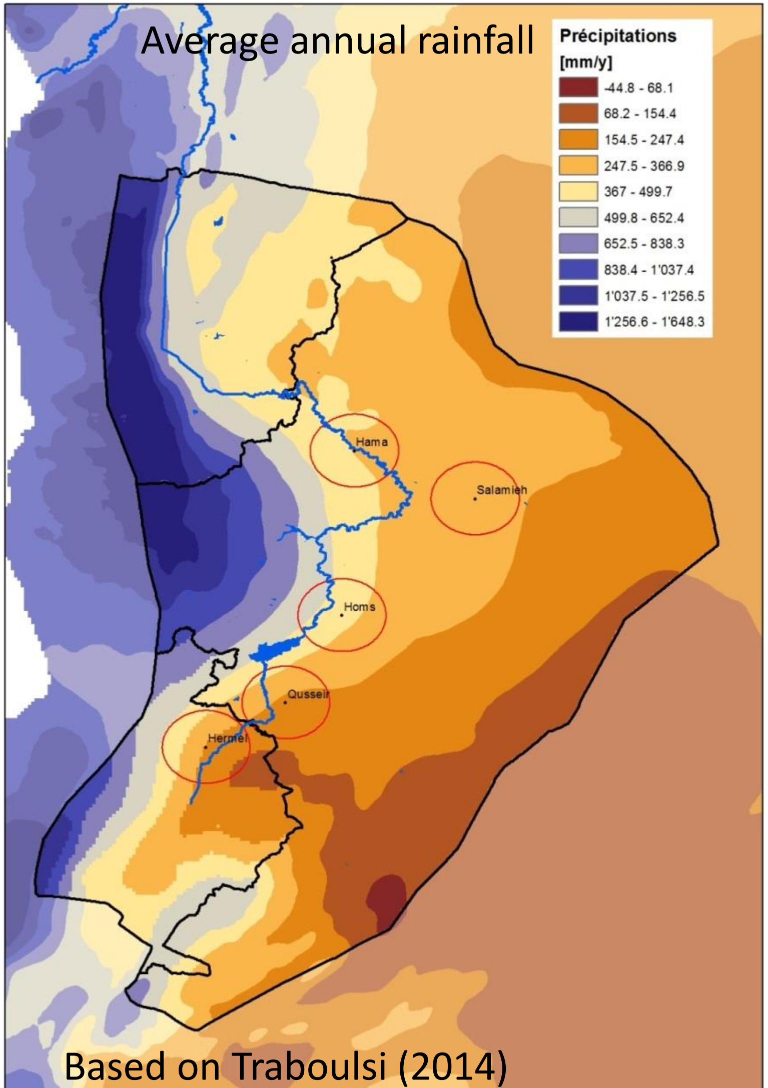
Calculation of average annual effective infiltration and direct runoff



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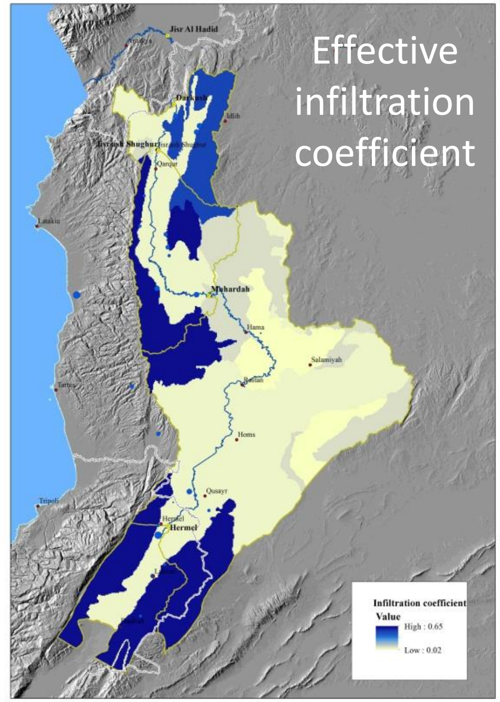

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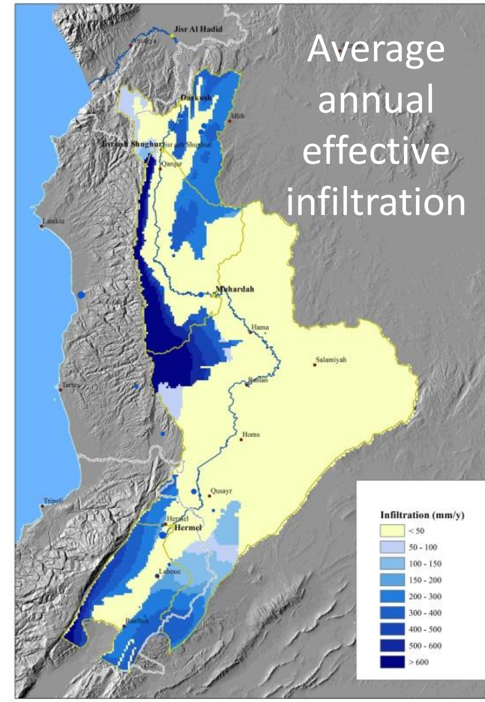

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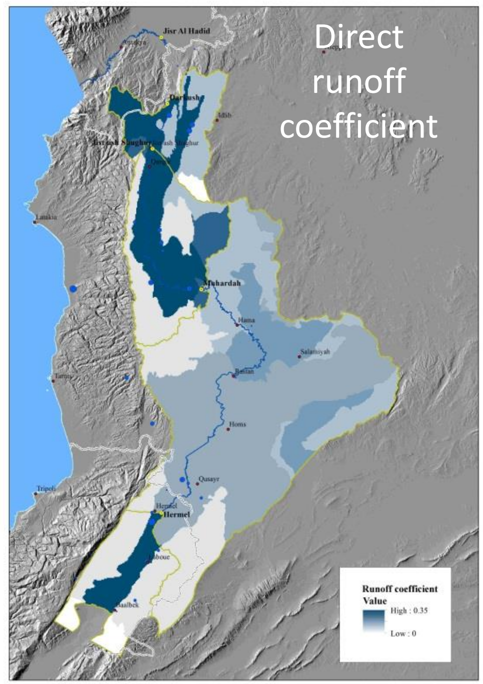

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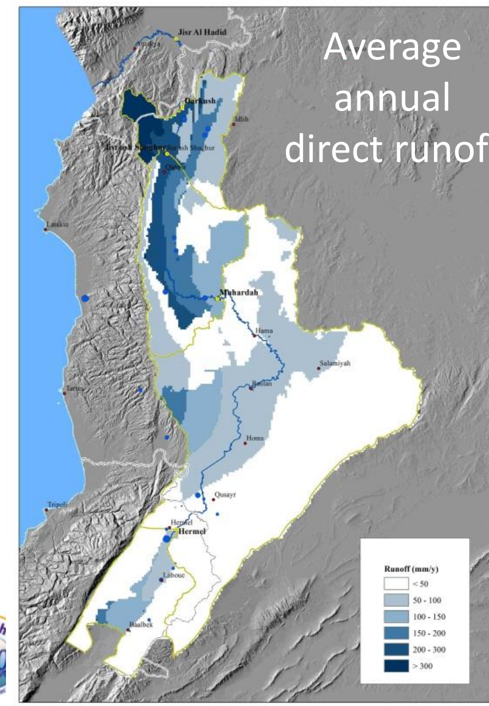
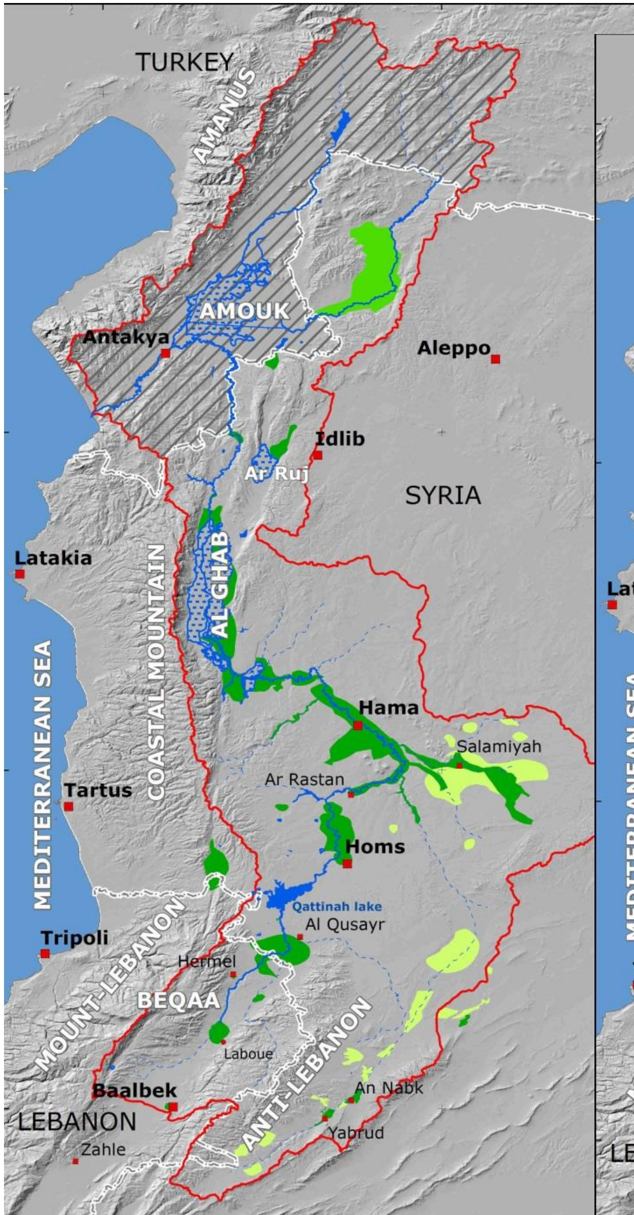
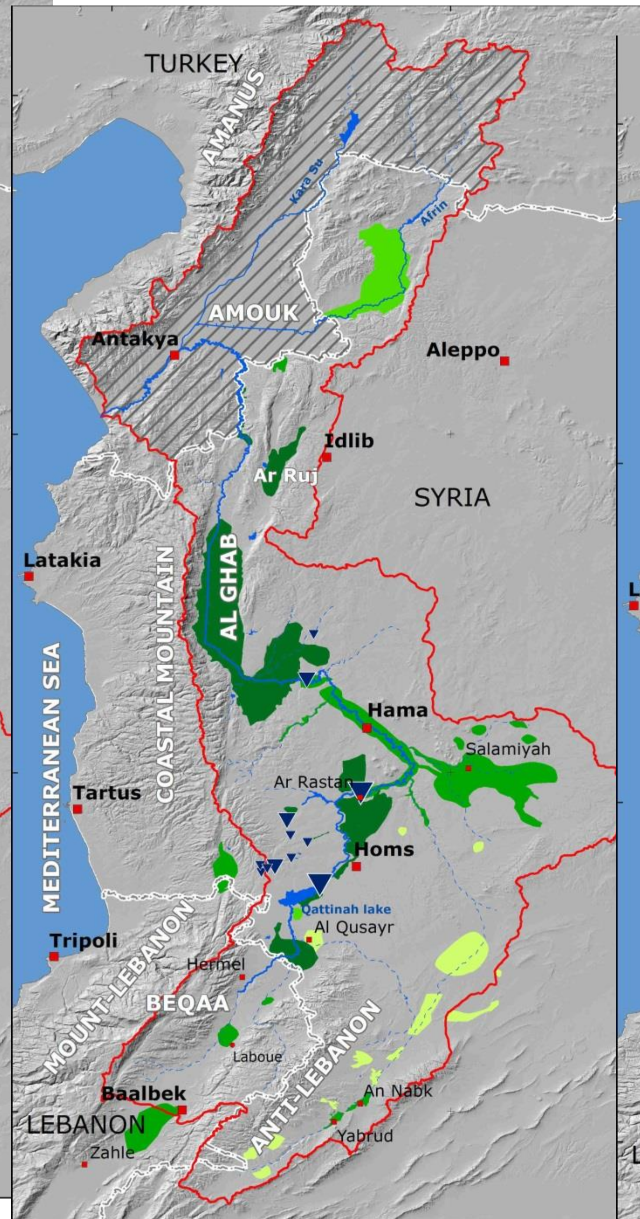


Irrigation extension 1930s – 2000s

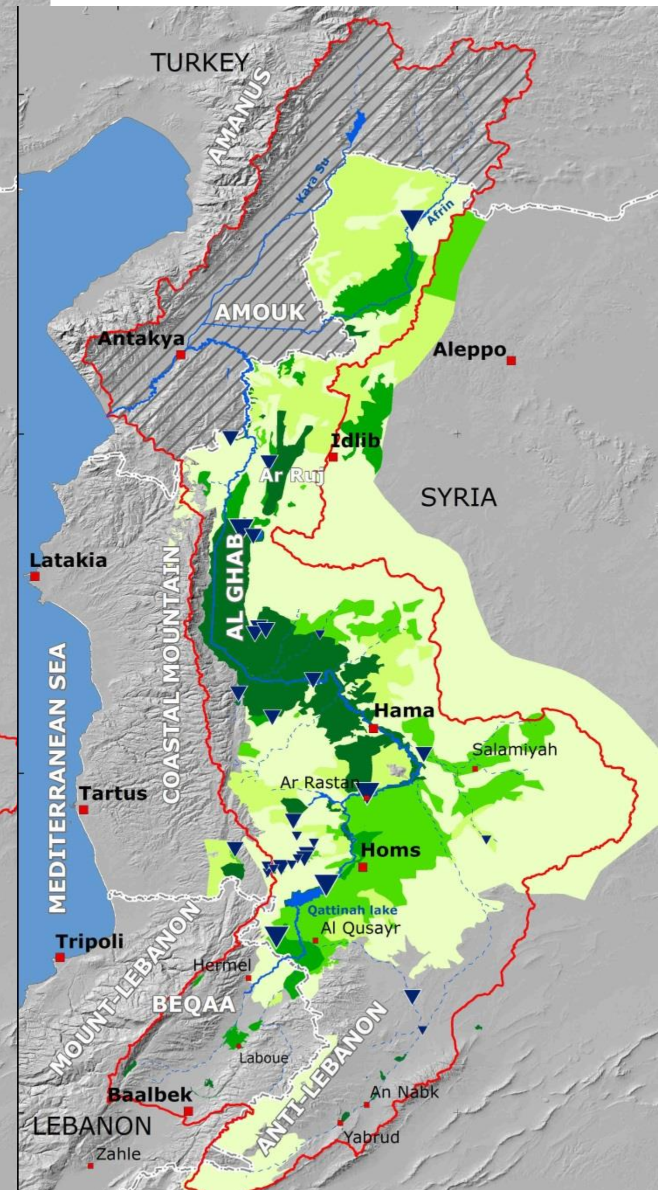
1930s



1970s

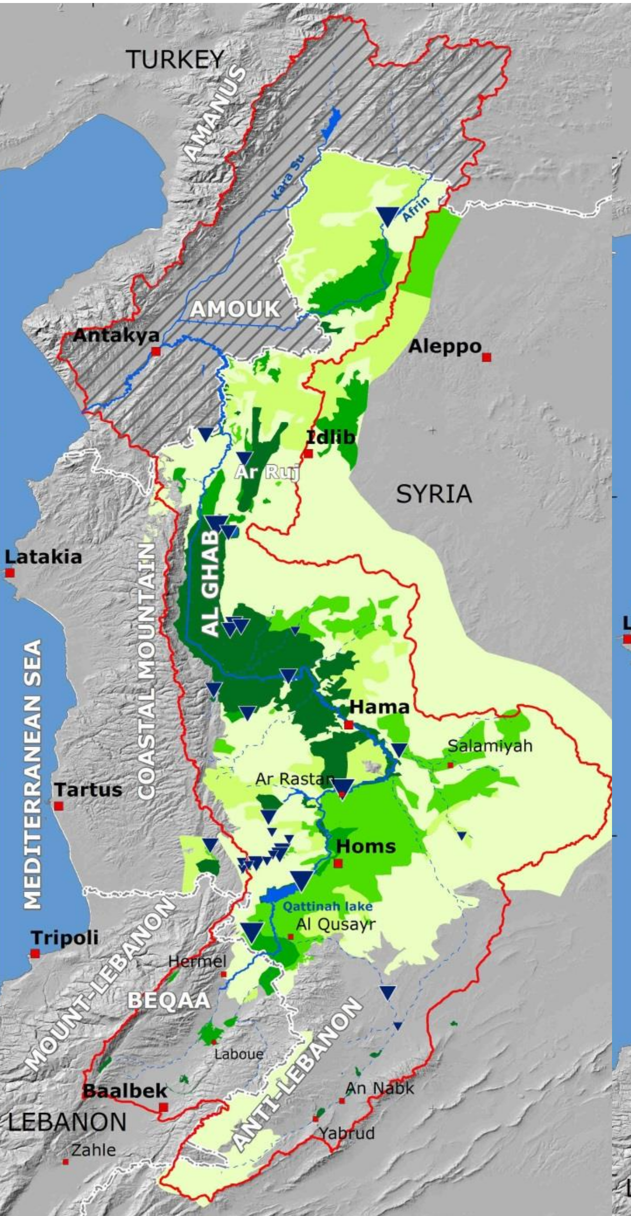


2000s

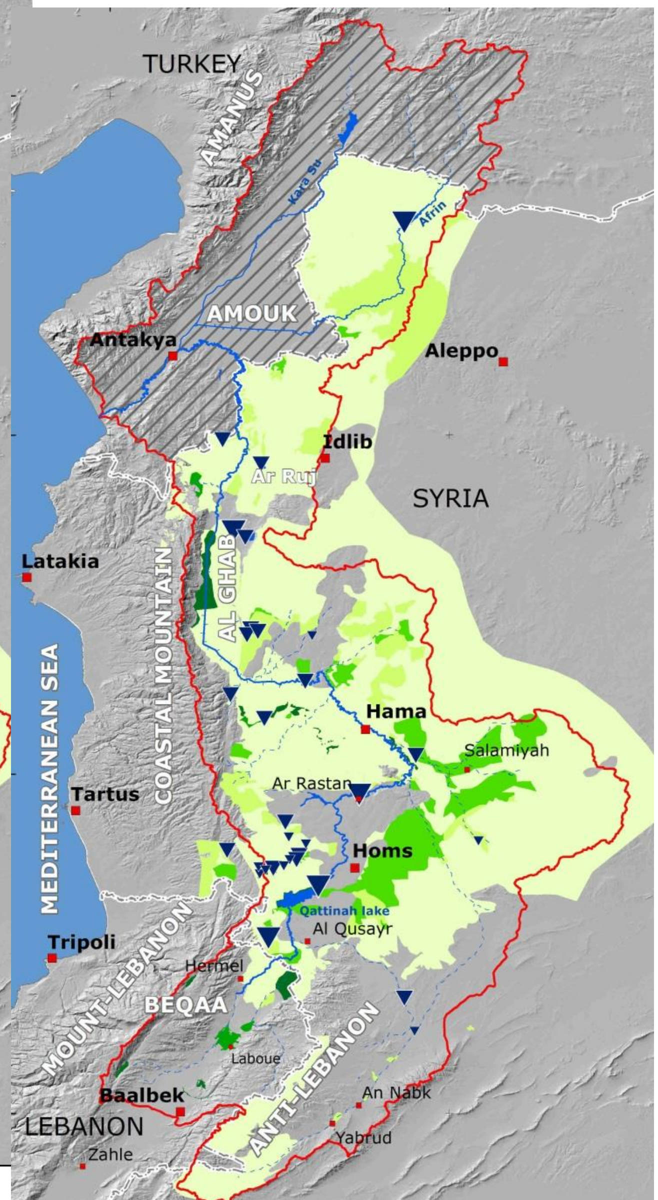


Decrease in irrigated areas after 2011

2000s



2014



Irrigated area (% of arable land)

- 85 - 95 %
- 65 - 85 %
- 35 - 65 %
- 15 - 35 %
- Less than 15 %

Dam storage capacity (in million cubic meter)

- < 1
- 1 - 50
- > 50

Stream bed (natural course)

Stream bed (artificial course)

Swamp

Water body

Watershed boundary

Province capital

District capital

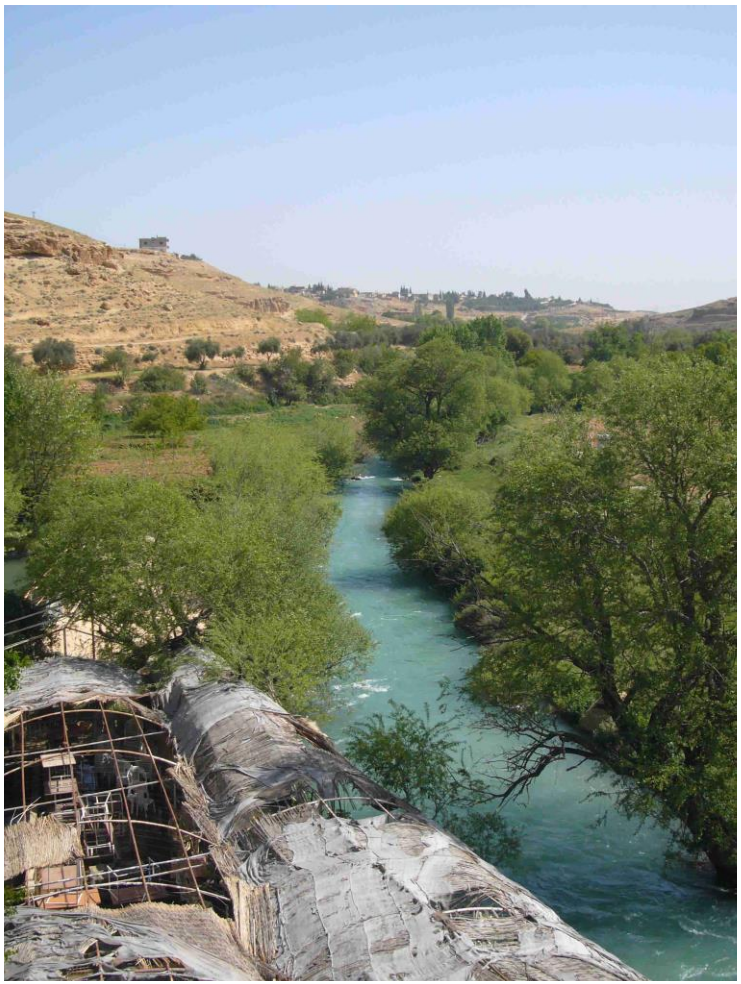
Others cities

International boundary

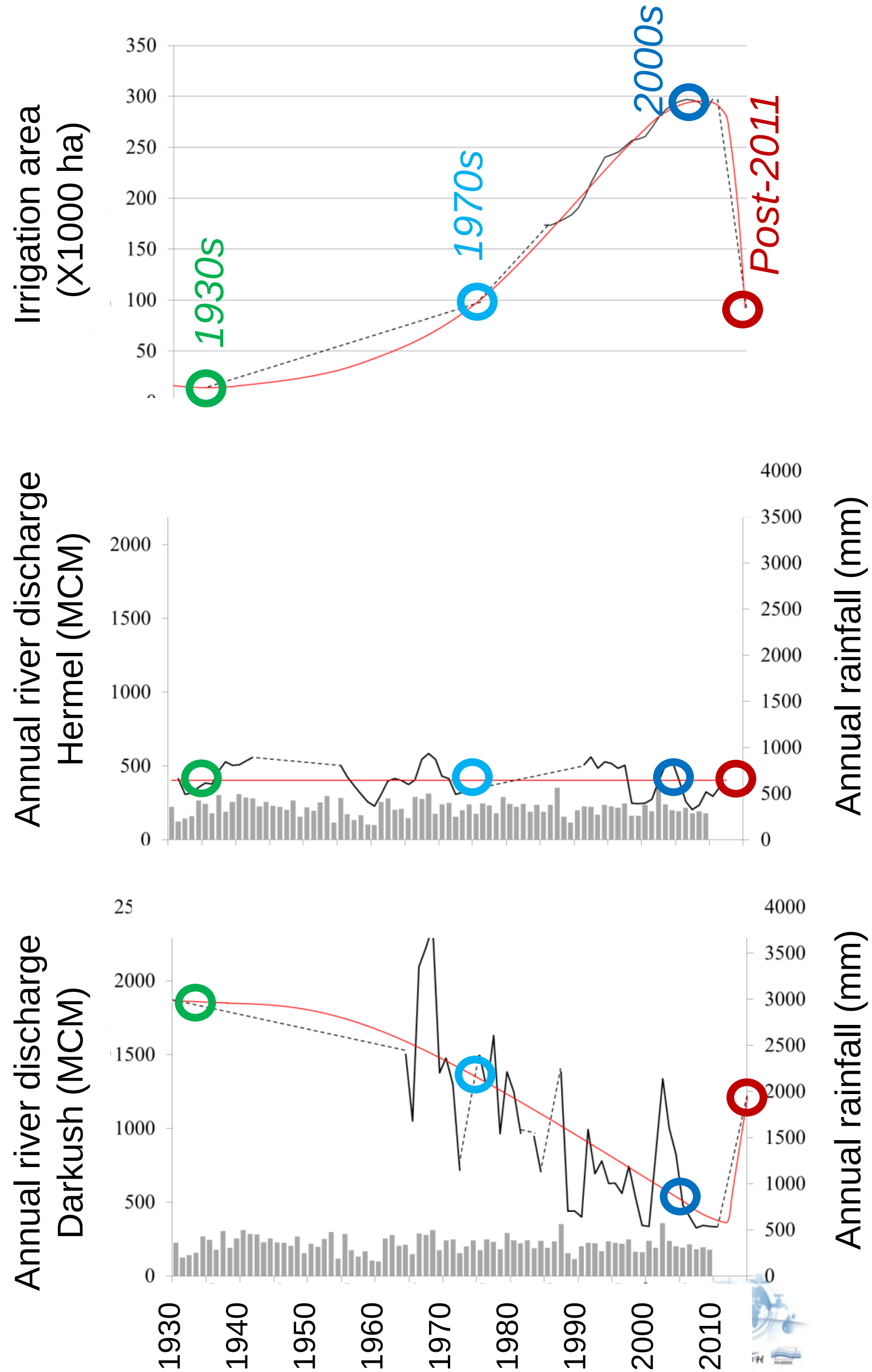
0 20 40 Km

N

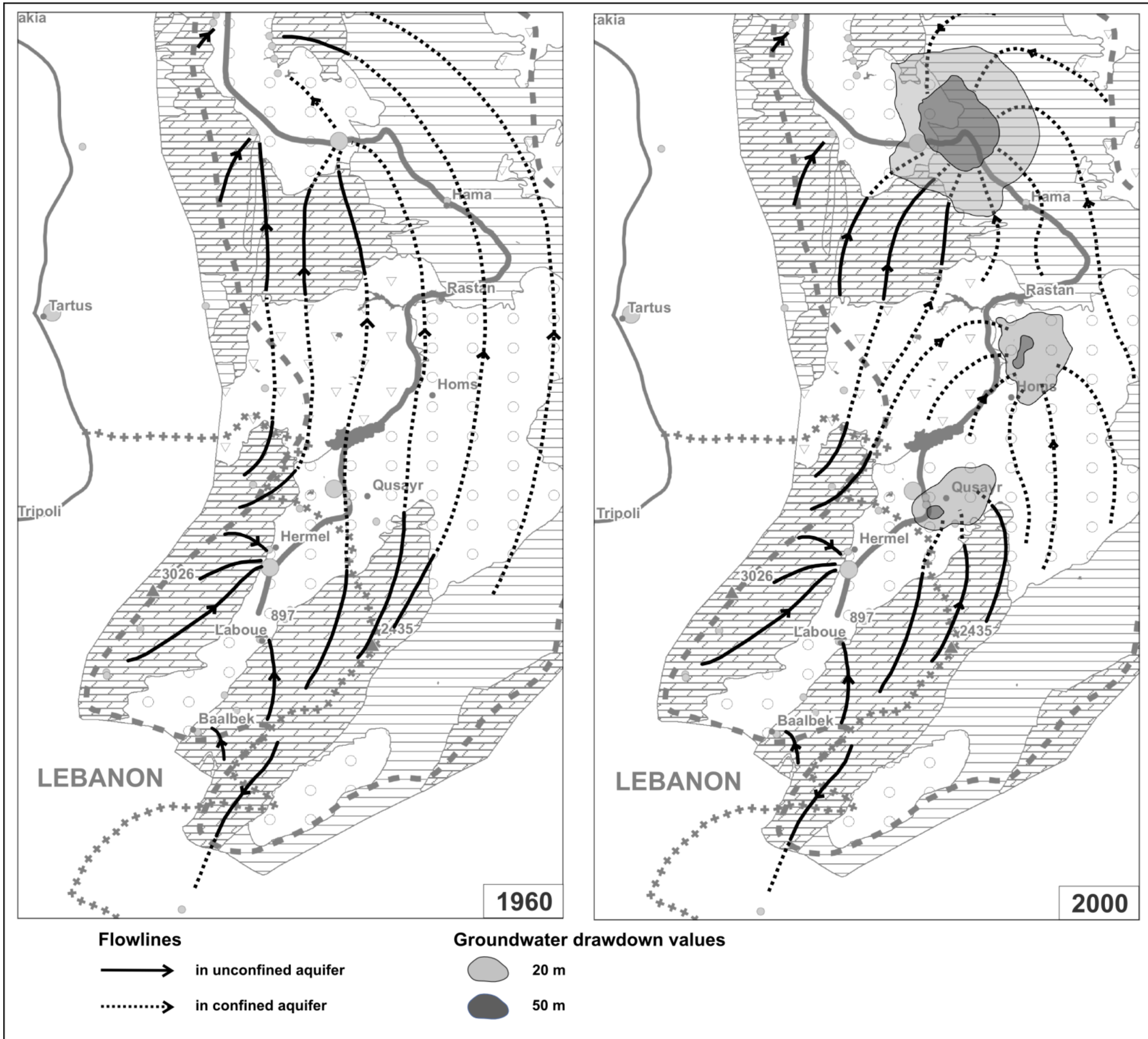
Changes in irrigated areas and river discharge, 1930/31 – 2013/14



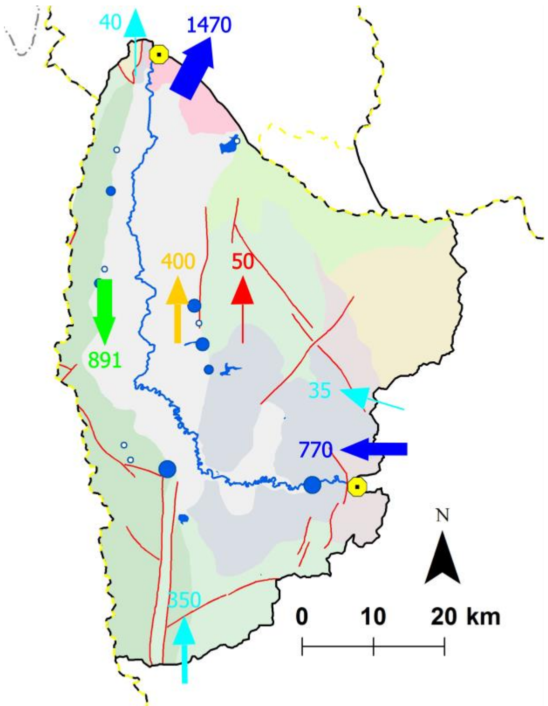
Orontes River, Hermel



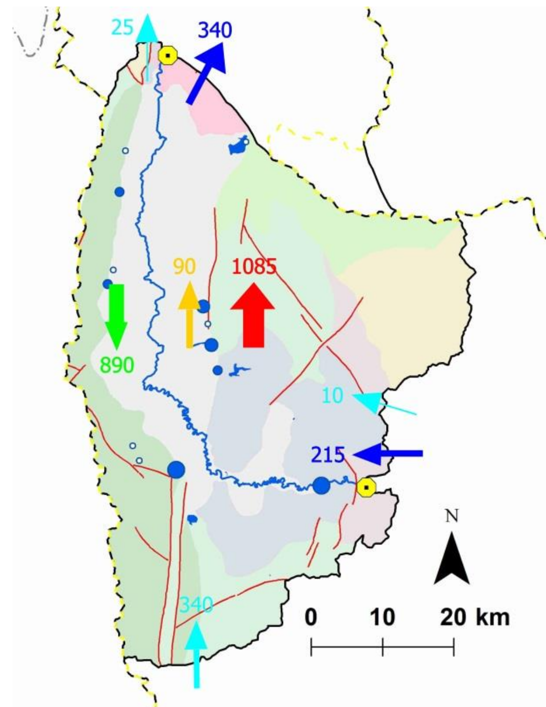
Effect on subsurface fow



Water balance
Sub-catchment: Jisr ash Shughur



1930s



2000s

ΔS = -85 MCM/y

Water balance, global catchment

	1930s	1970s	2000s	After 2011
IN				
EP_{IN}	2802	2802	2802	2802
D_{IN}	0	0	0	0
F_{IN}	0	0	0	0
IR	5	66	102	46
Total IN	2807	2867	2904	2848
OUT				
D_{OUT}	1850	1250	600	1200
F_{OUT}	50	50	40	55
E	490	131	175	175
C	416	1441	2243	619
Total OUT	2806	2873	3058	2049
ΔS	*0*	*-5*	*-155*	*798*

EP Effective precipitation; D_{IN} River discharge (inflow); F_{IN} Ground water or surface water inflow; *IR* Irrigation return; D_{OUT} River discharge (outflow); F_{OUT} Ground water or surface water outflow; *E* Water surface evaporation; *C* Anthropic evapotranspiration; ΔS change in groundwater storage.

Conclusions

Irrigation was the main driver of changes in the Orontes River Basin between the 1930s and 2000s, involving different dynamics and evolution trends in each sub-catchment

Sharp reverse of trend after the start of the Syrian conflict, with consequences for the downstream part (including the Turkish part), in terms of flood control and risks of dam failure.

For present and future interventions → take into account both the protection of springs and the risks related to the increased water flows

Important to restart agriculture in the basin, to sustain livelihood of farmers who are still in the area, but also to ensure secure conditions for the rest of the population living downstream.

Flood, Antakya airport