Food and Agriculture Organization of the United Nations

WATER VULNERABILITY IN THE EUPHRATES-TIGRIS BASIN

LESSONS FROM THE WORK OF FAO

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19 MAY 2021

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

OUTLINE

1. Context of the Tigris-Euphrates river basin
2. The FAO project: objectives and challenges
3. Vulnerability of transboundary flows
4. Basin-wide vulnerability on the Euphrates side
5. Conclusions and recommendations

OUTLINE

1. Context of the Tigris-Euphrates river basin

THE TIGRIS-EUPHRATES

Image credits: Google maps

TIGRIS-EUPHRATES CONTEXT

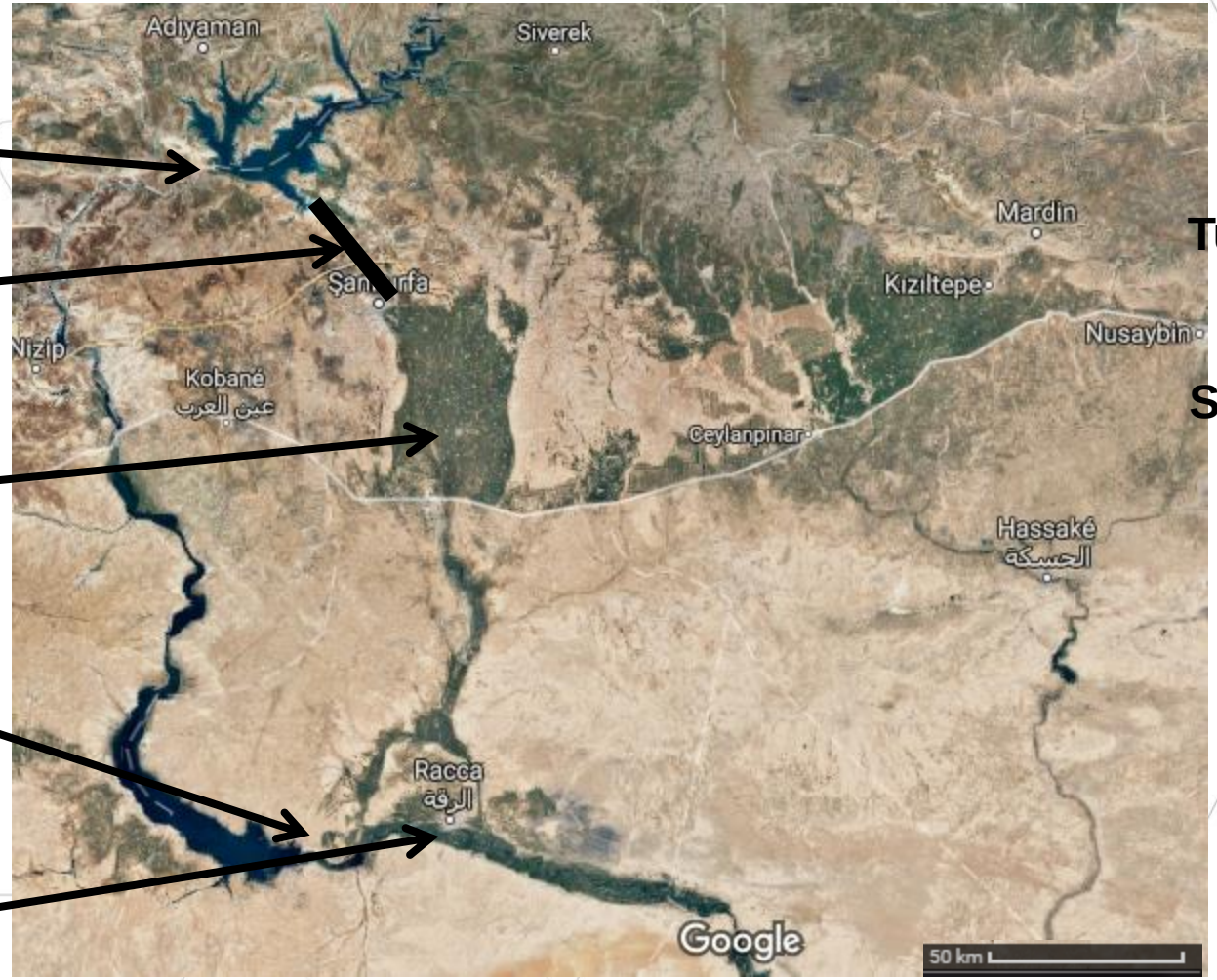
Ataturk dam

Sanliurfa tunnel

Harran plain
(150k ha)

Tabqa dam

Raqqa
(ISIS ex-capital)



Turkey

Syria

Image credits: Google maps

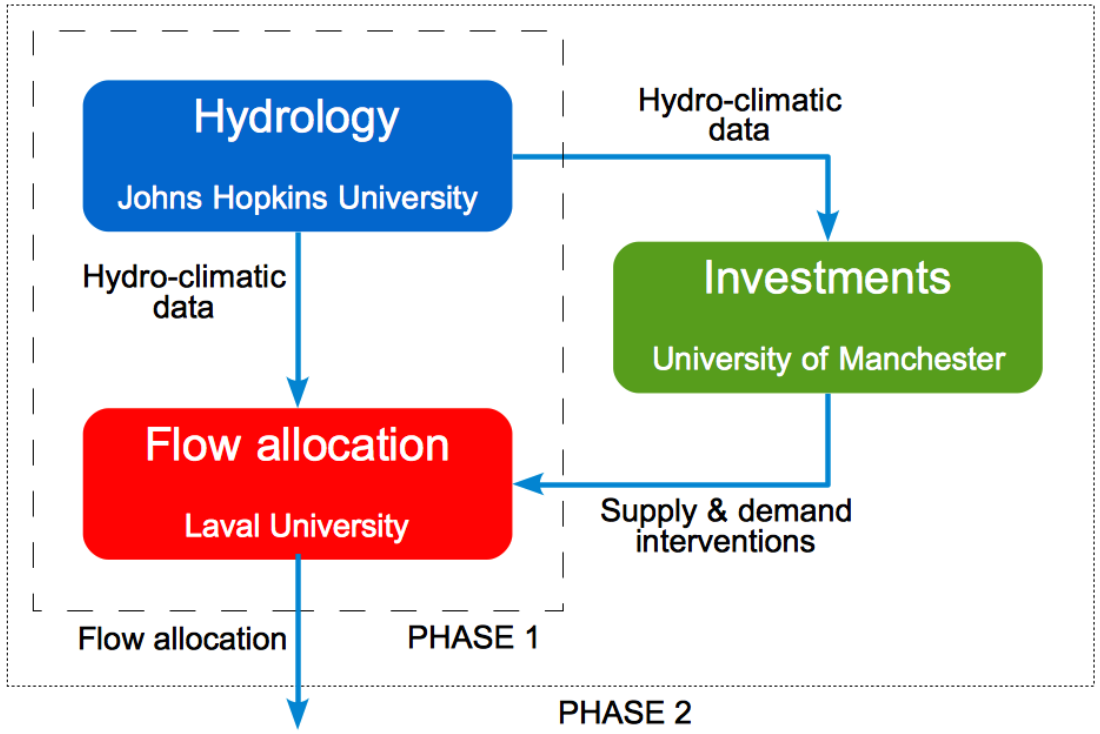
OUTLINE

1. Context of the Tigris-Euphrates river basin
2. The FAO project: objectives and challenges

THE FAO PROJECT

- The project has several phases and components including the development of a detailed hydro-economic model of the basin

- Phase 1 = current situation in the basin in terms of supplies and demands



Phase 2 = scenarios of future demands and supplies

Climate change
Irrigation projects
Hydropower projects

BUT: ISIS-related conflicts!

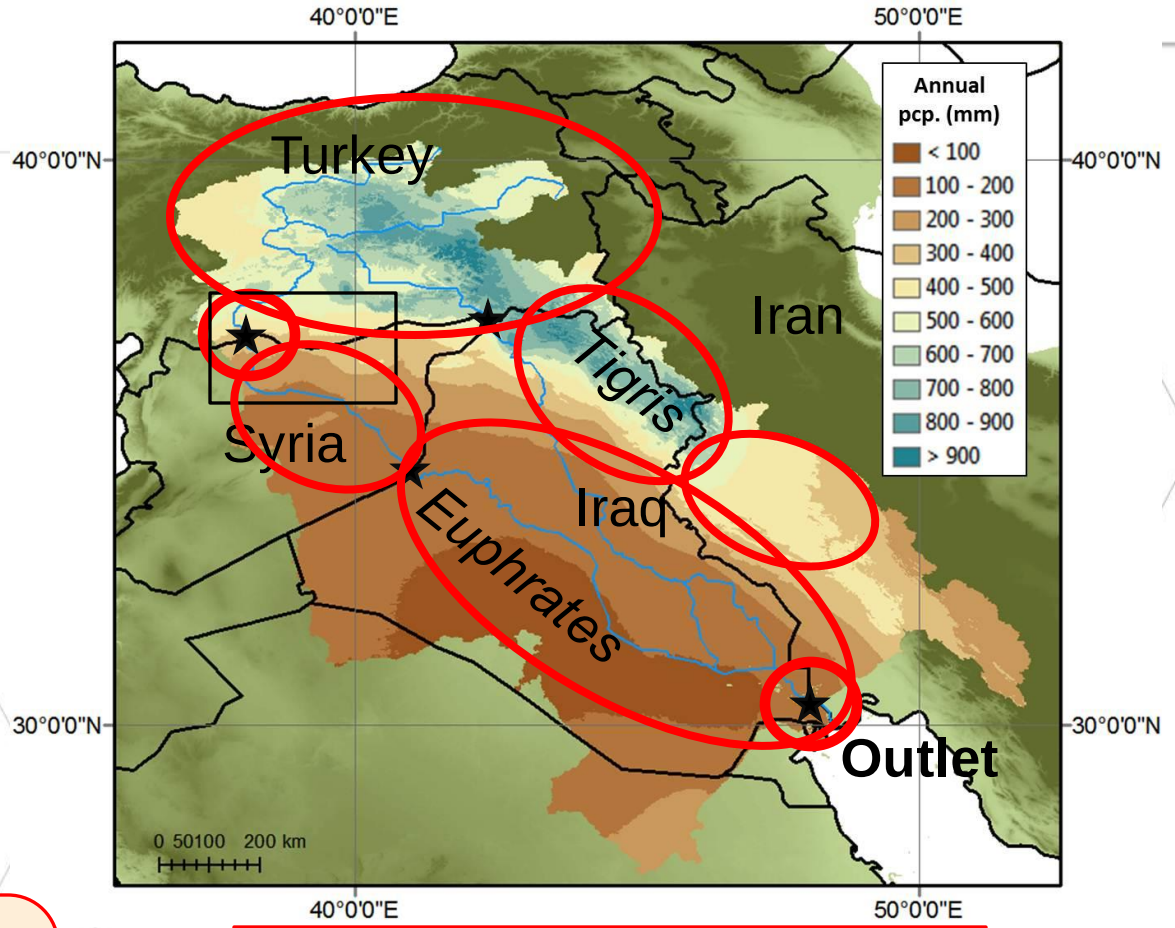
PROJECT GOALS: PHASE 1

Current situation?

1) Hydropower, irrigation benefits (per country)

2) Vulnerabilities, risks.

- Irrigation shortages?
- Border flows?
- Outlet flows?



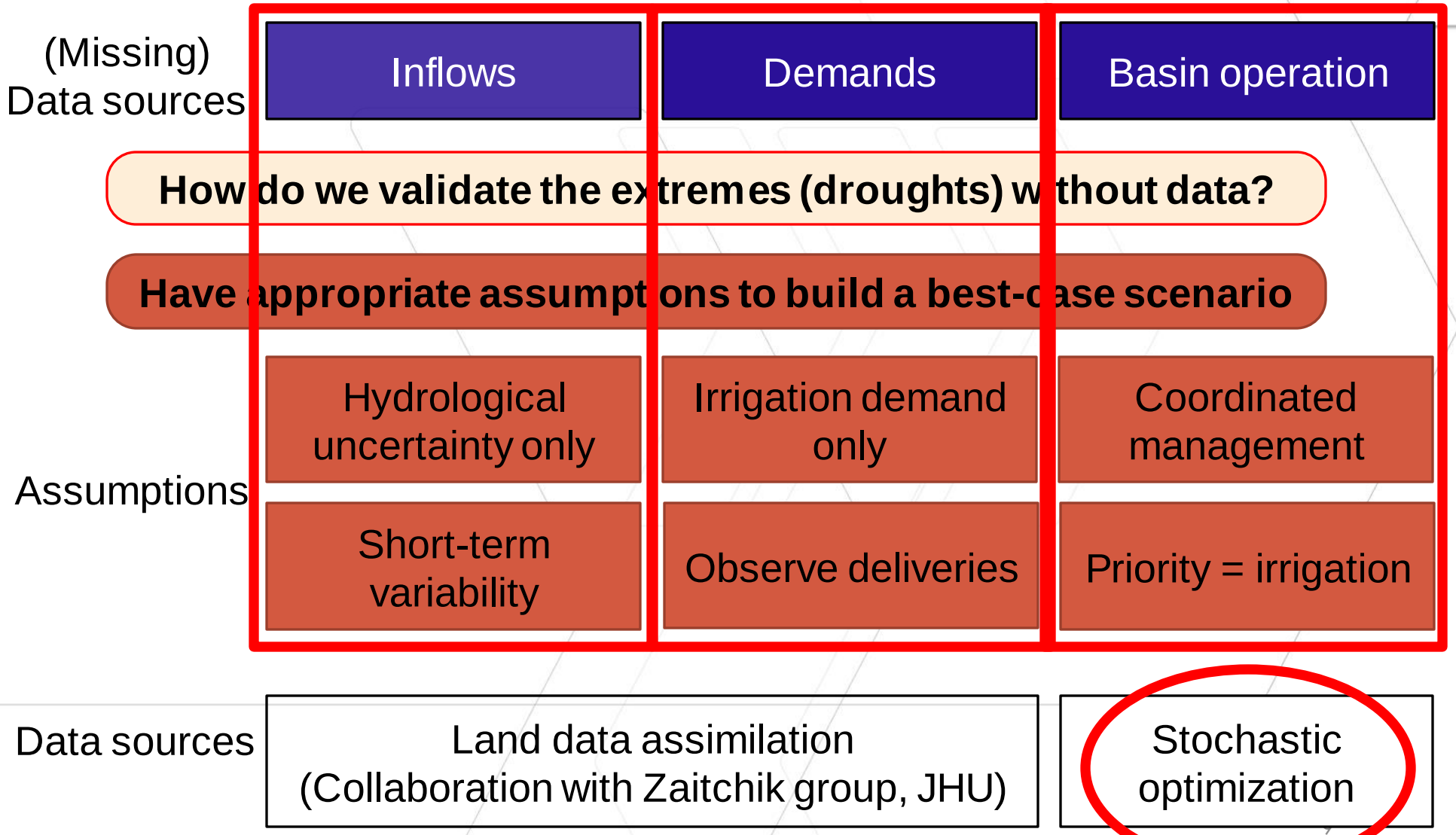
Uncoordinated development (+ conflict)

- **Limited data availability**

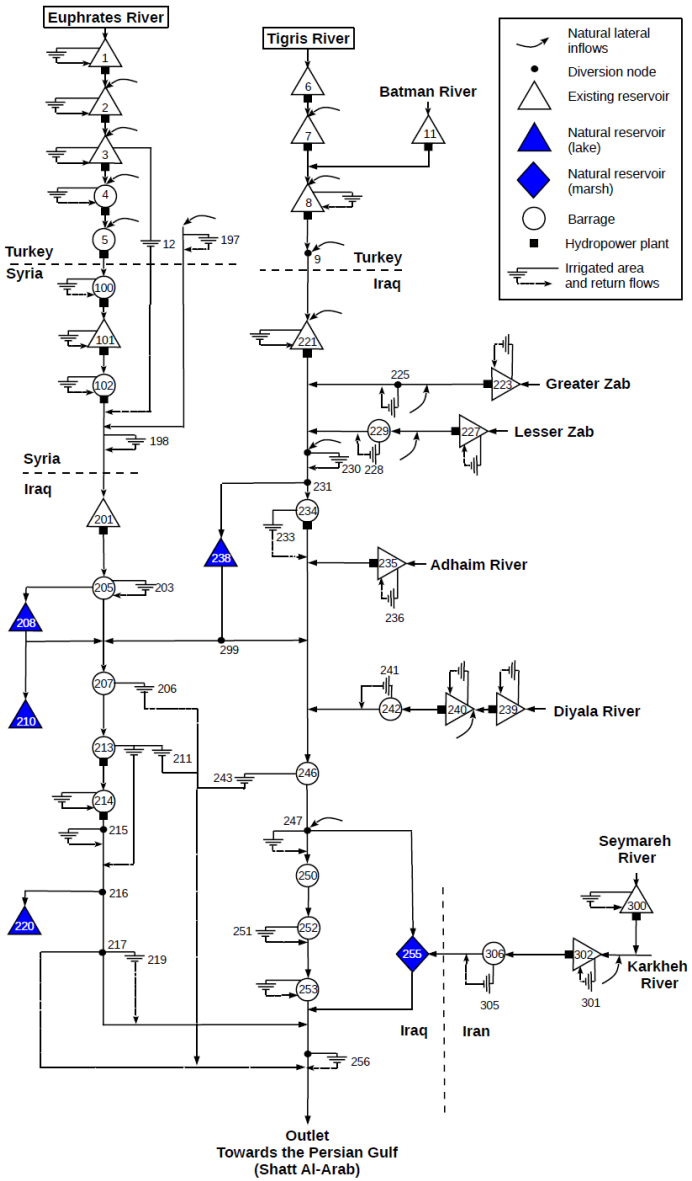
Monthly flow allocation

Represent variability

THE MODELLING CHALLENGE



A LARGE MULTI-RESERVOIR SYSTEM



Inflows at 28 nodes

Irrigation demands at 51 sites

Operation of 17 reservoirs

How do we solve this?

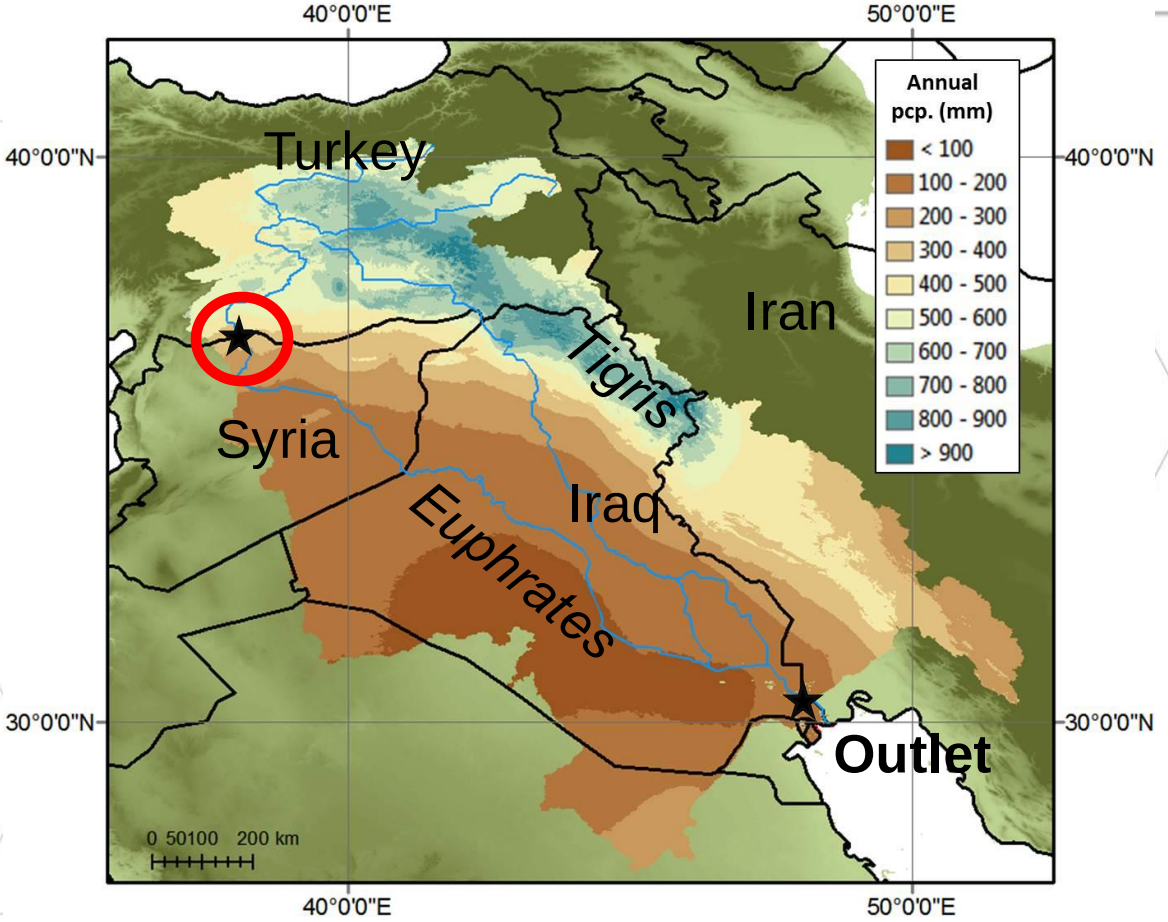
SDDP-YPRE

- SDDP invented in 1980s (Brazil) for stochastic multireservoir optimisation.
- YPRE: extension for data-limited cases (Rouge & Tilmant, 2016)

RESULTS FROM 1,000 SIMULATIONS

1,000 data points
✓ for all 12 months
✓ anywhere

“Best-case” scenario:
Optimisation satisfies irrigation demand BUT…



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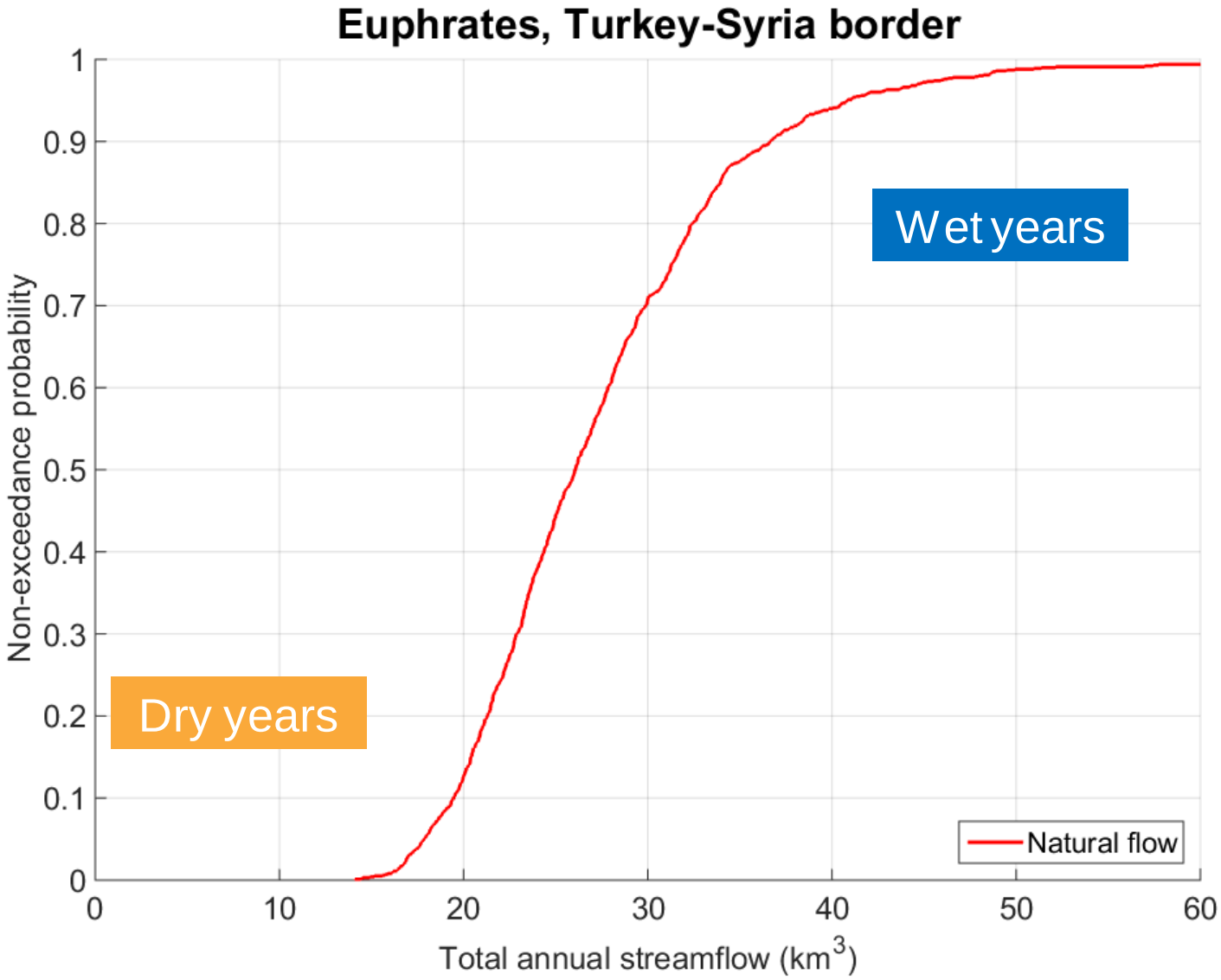
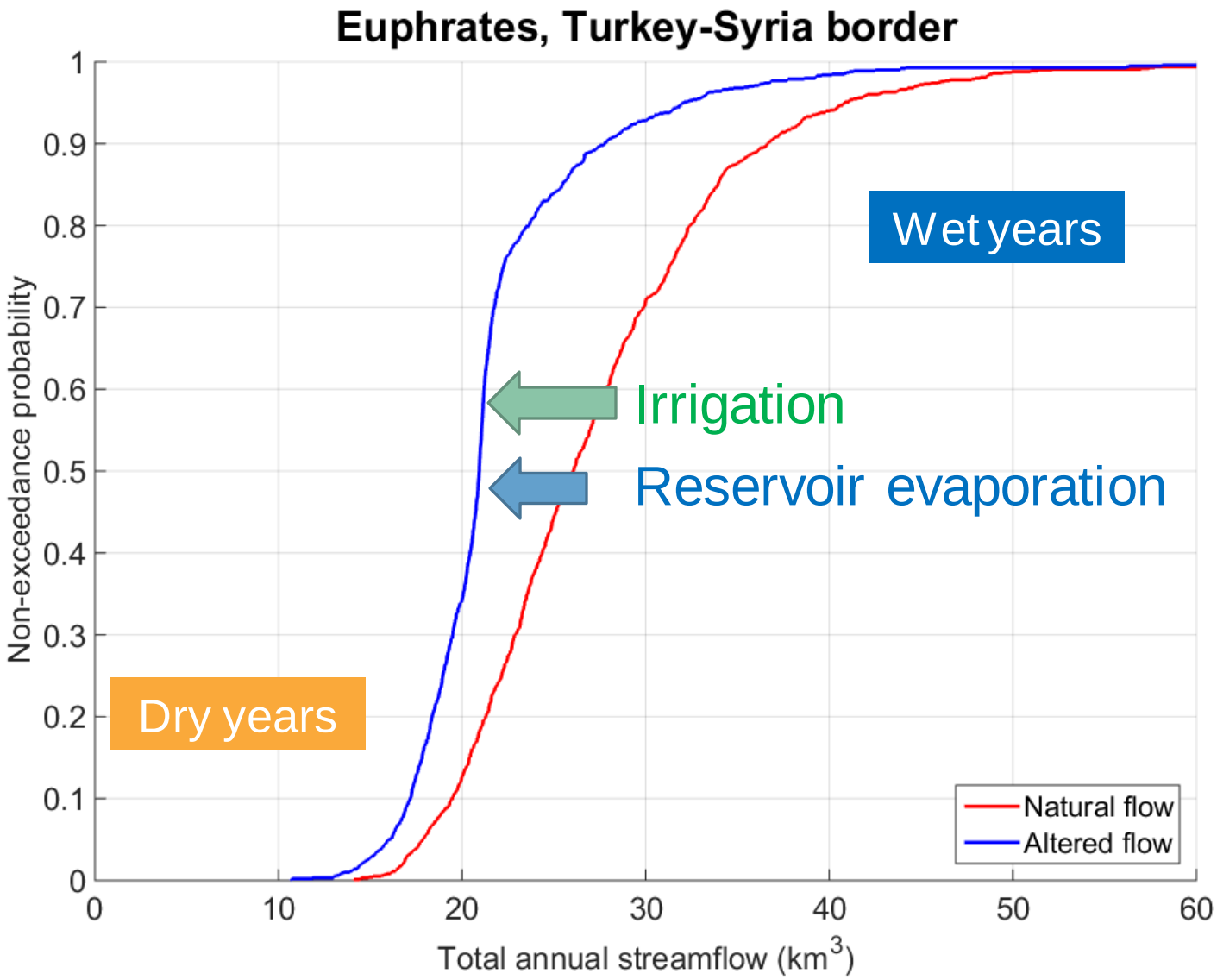
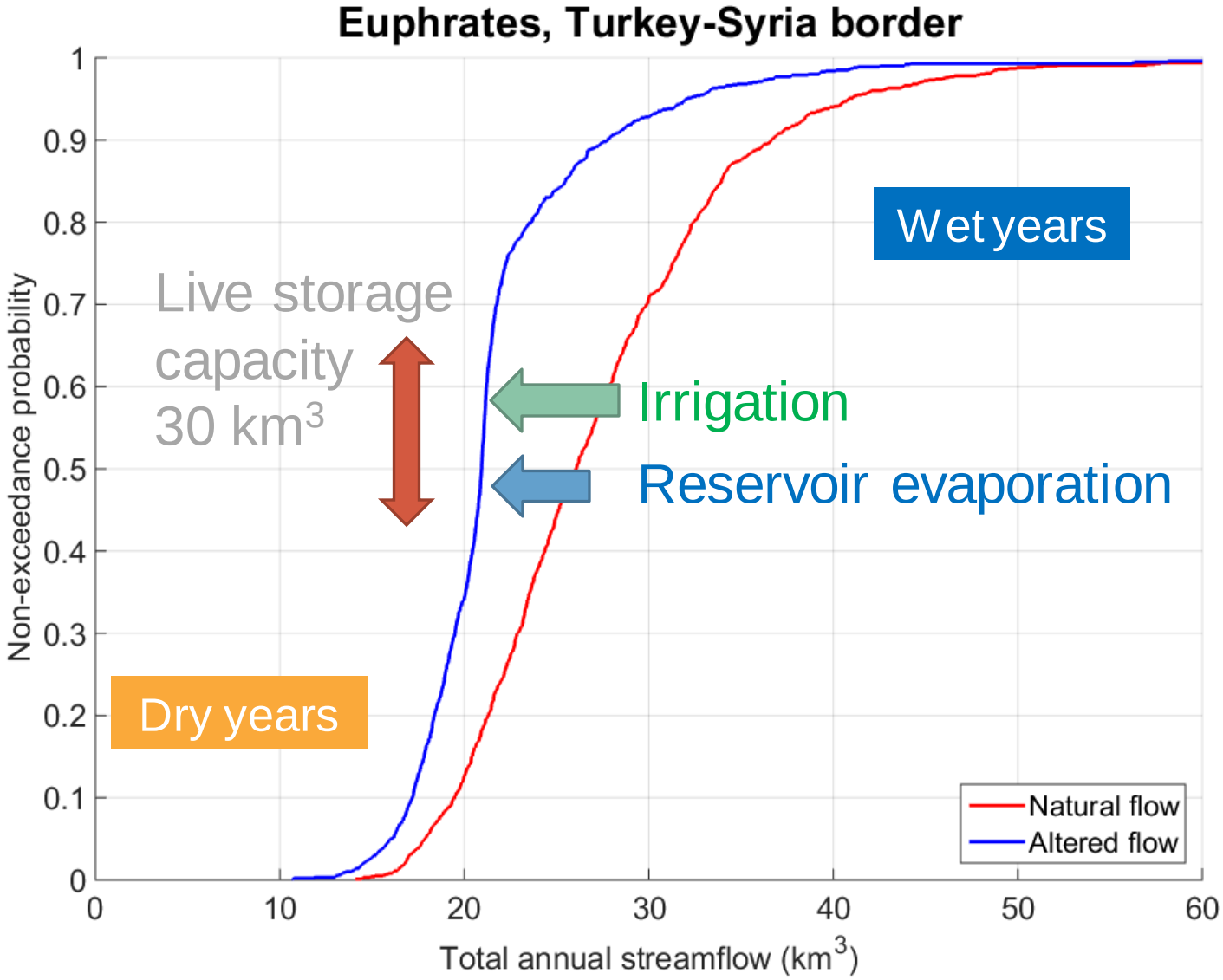
FROM NATURAL FLOWS...



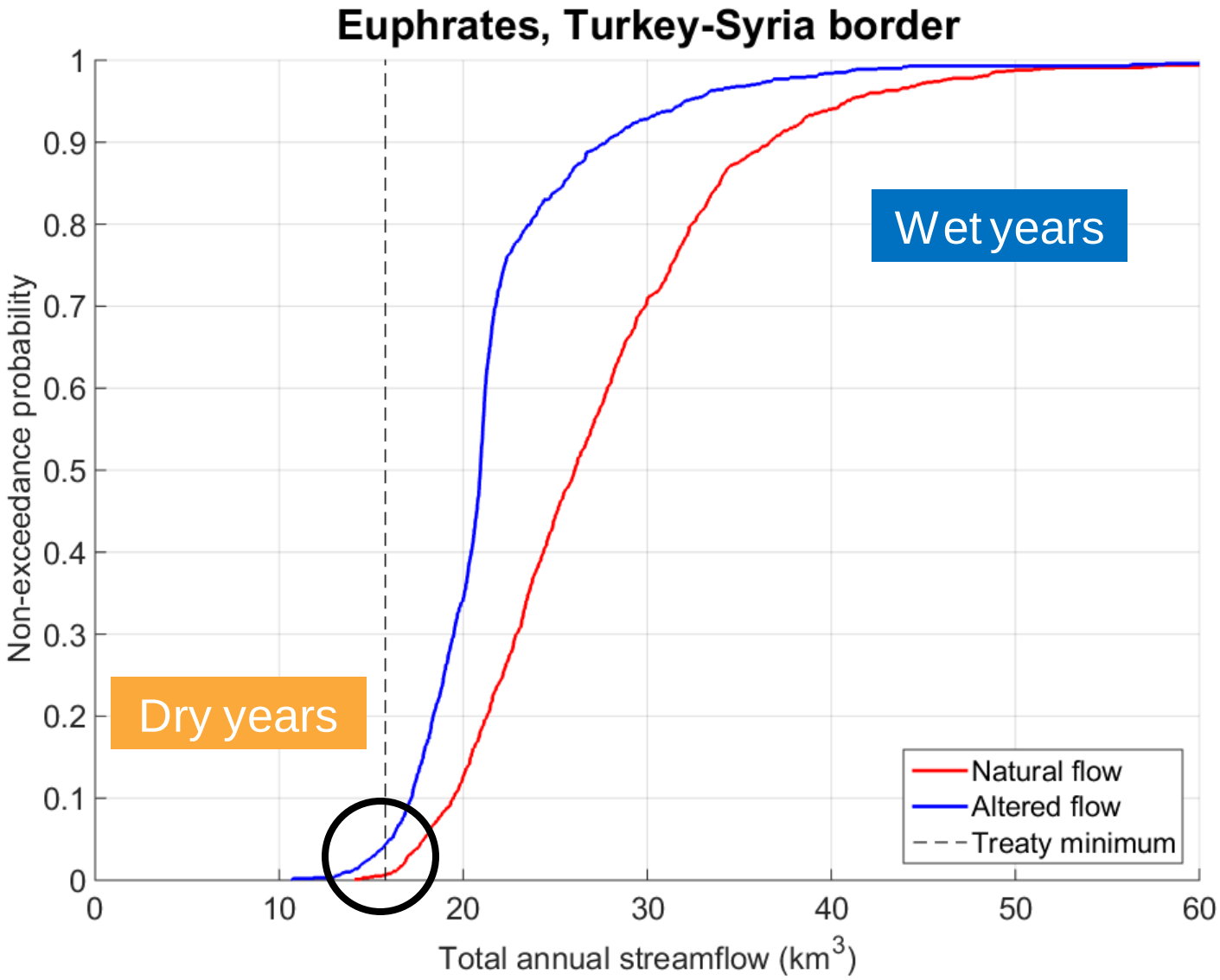
… TO ALTERED FLOWS



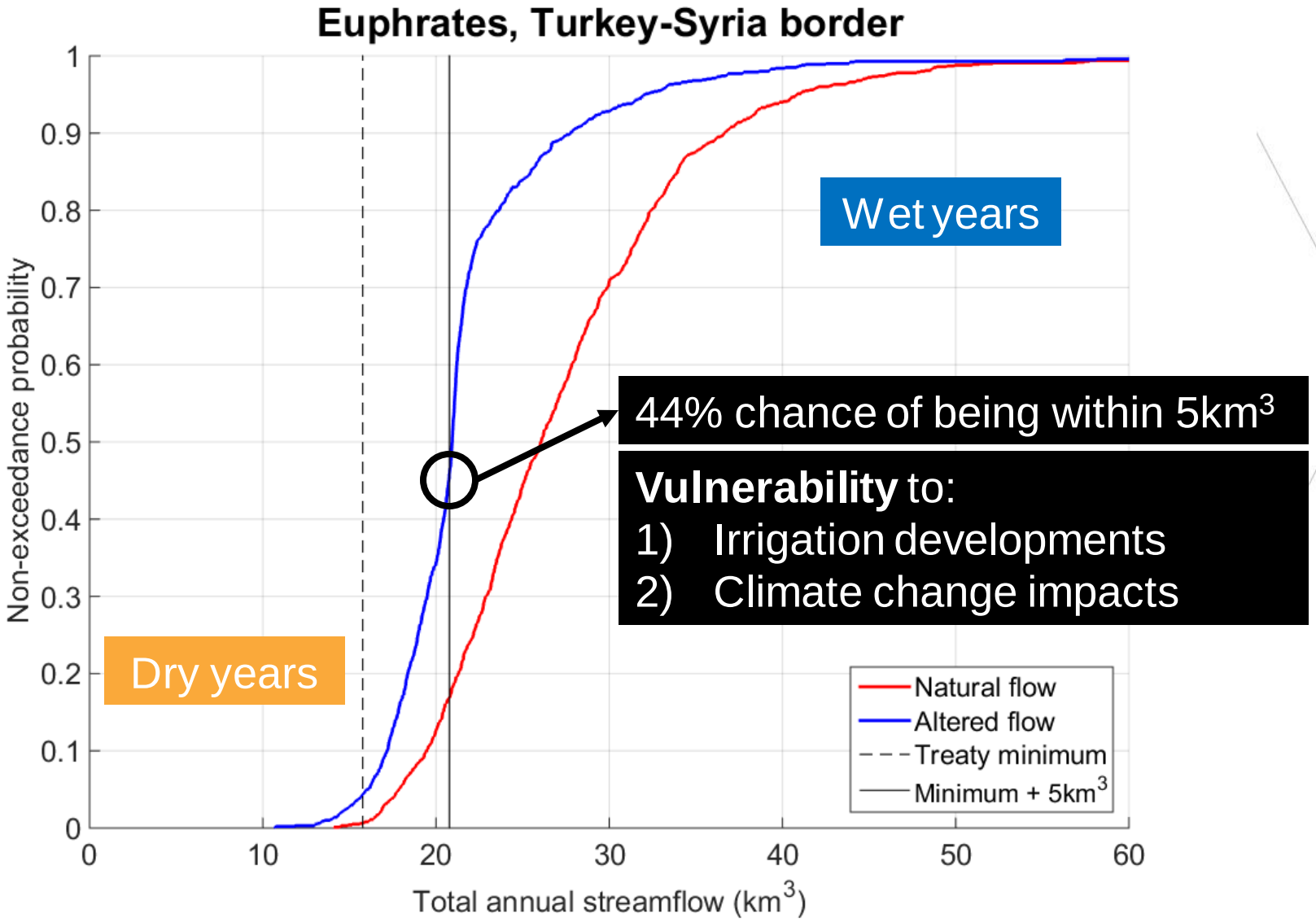
INFRASTRUCTURE IMPACTS ON FLOW?



RESPECT OF 1987 AGREEMENT?



VULNERABILITY OF TREATY RESPECT!



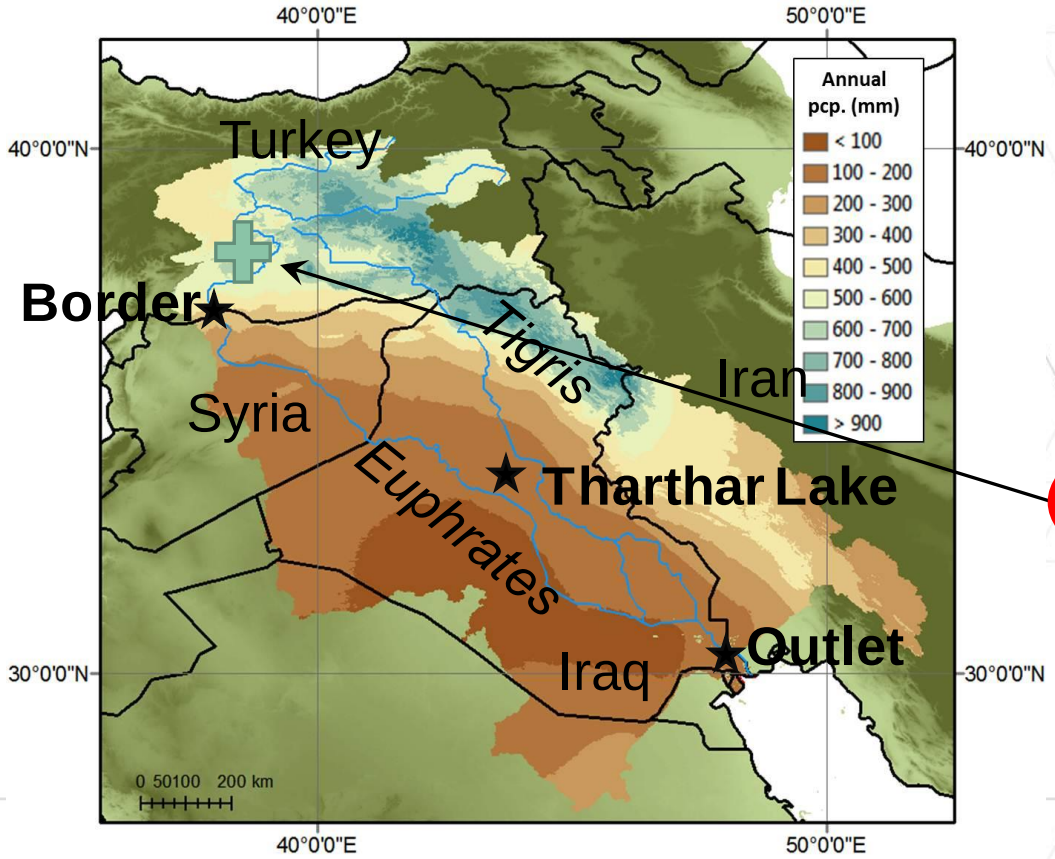
Wet years

44% chance of being within 5km^3

Vulnerability to:
1) Irrigation developments
2) Climate change impacts

Dry years

KEY VULNERABILITIES & SCENARIOS

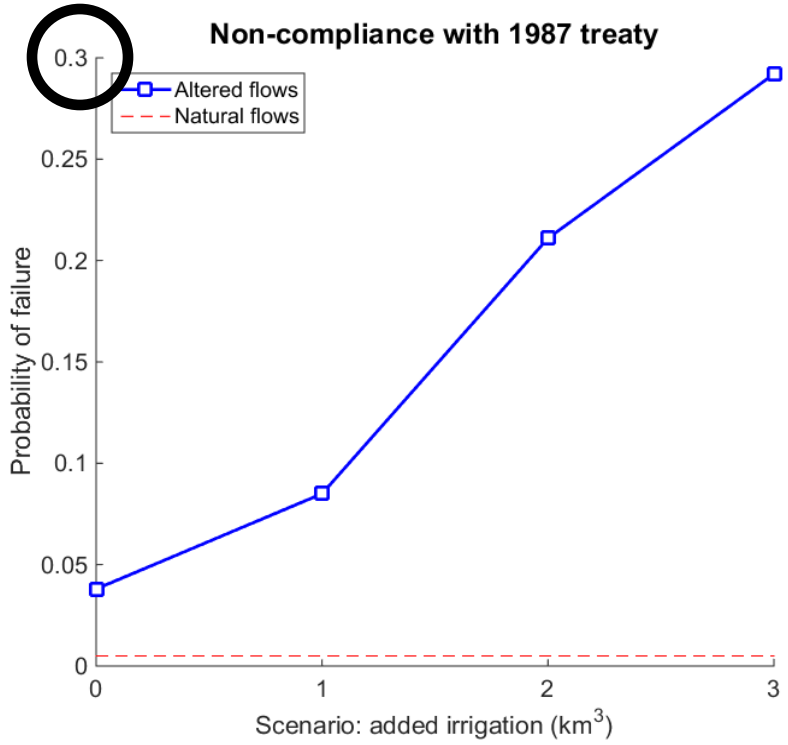


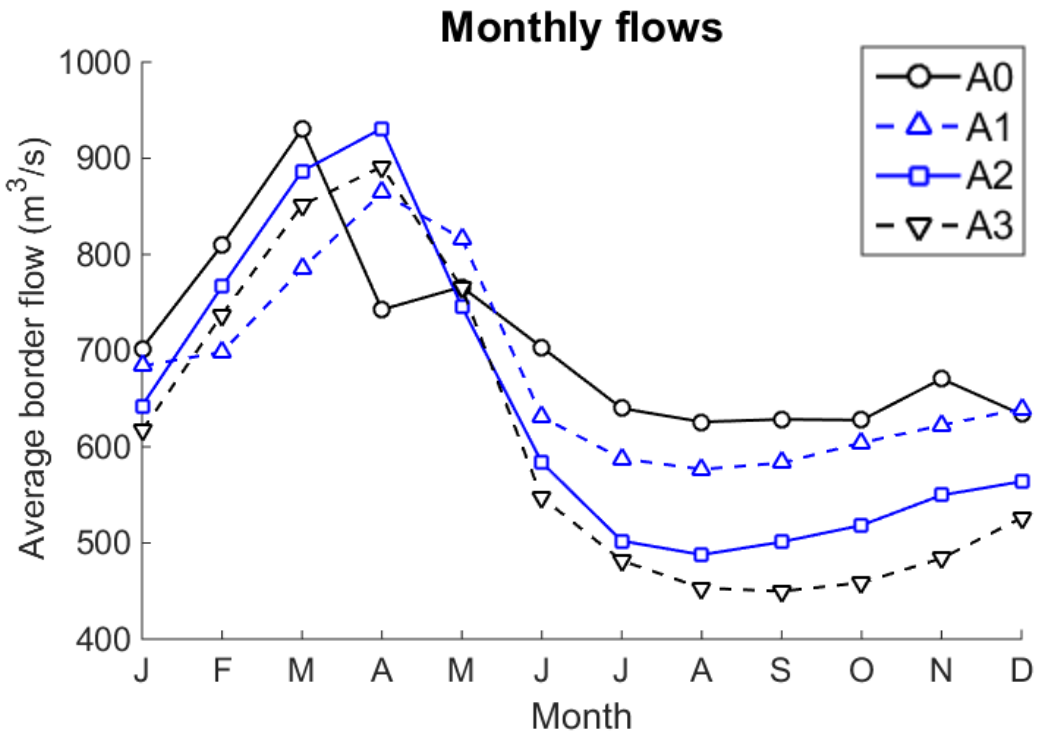
➢ Scenarios

	Baseline network
Baseline irr.	A0
Irr. +1 km^3	A1
Irr. +2 km^3	A2
Irr. +3 km^3	A3

1) Vulnerability of border flows to supply-demand change?

SCENARIOS A: BORDER FLOWS





Less water for downstream irrigation…

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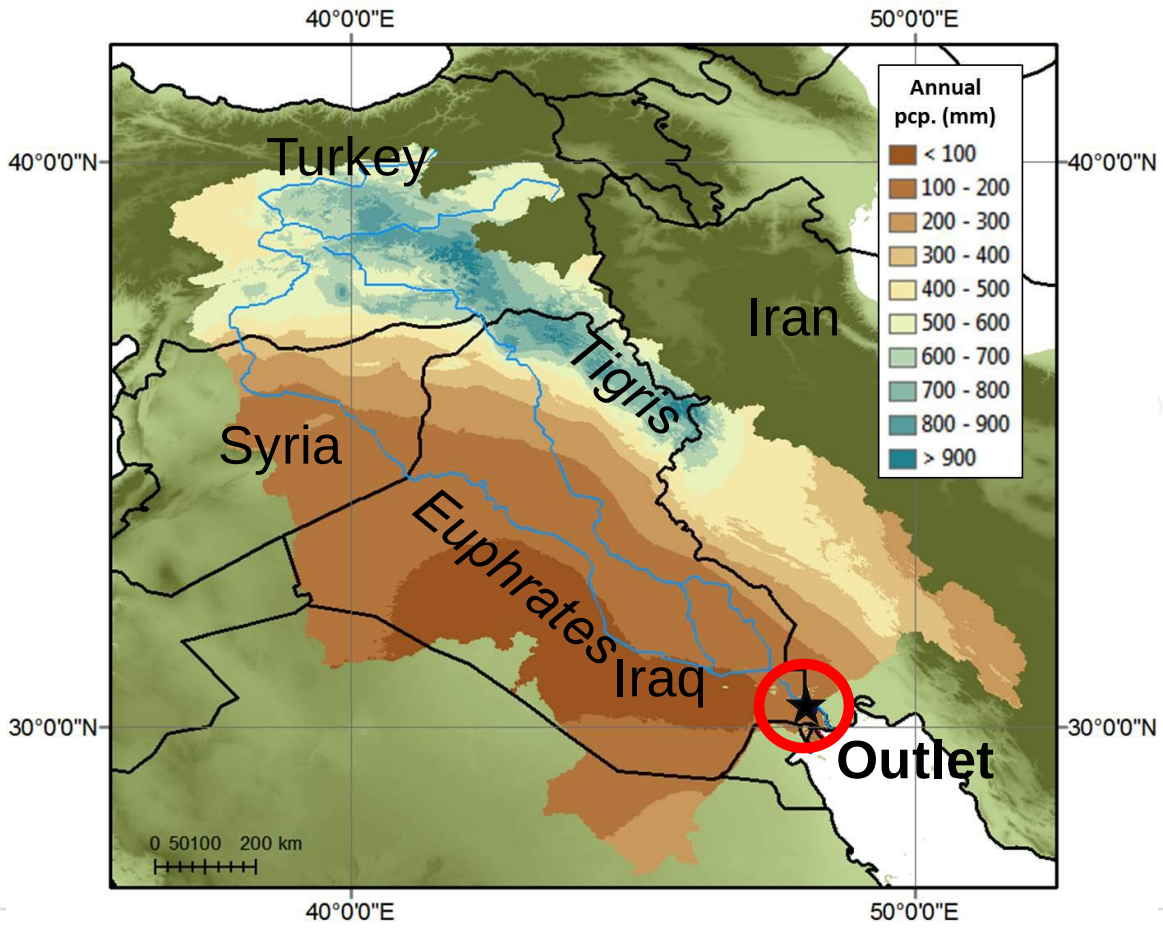
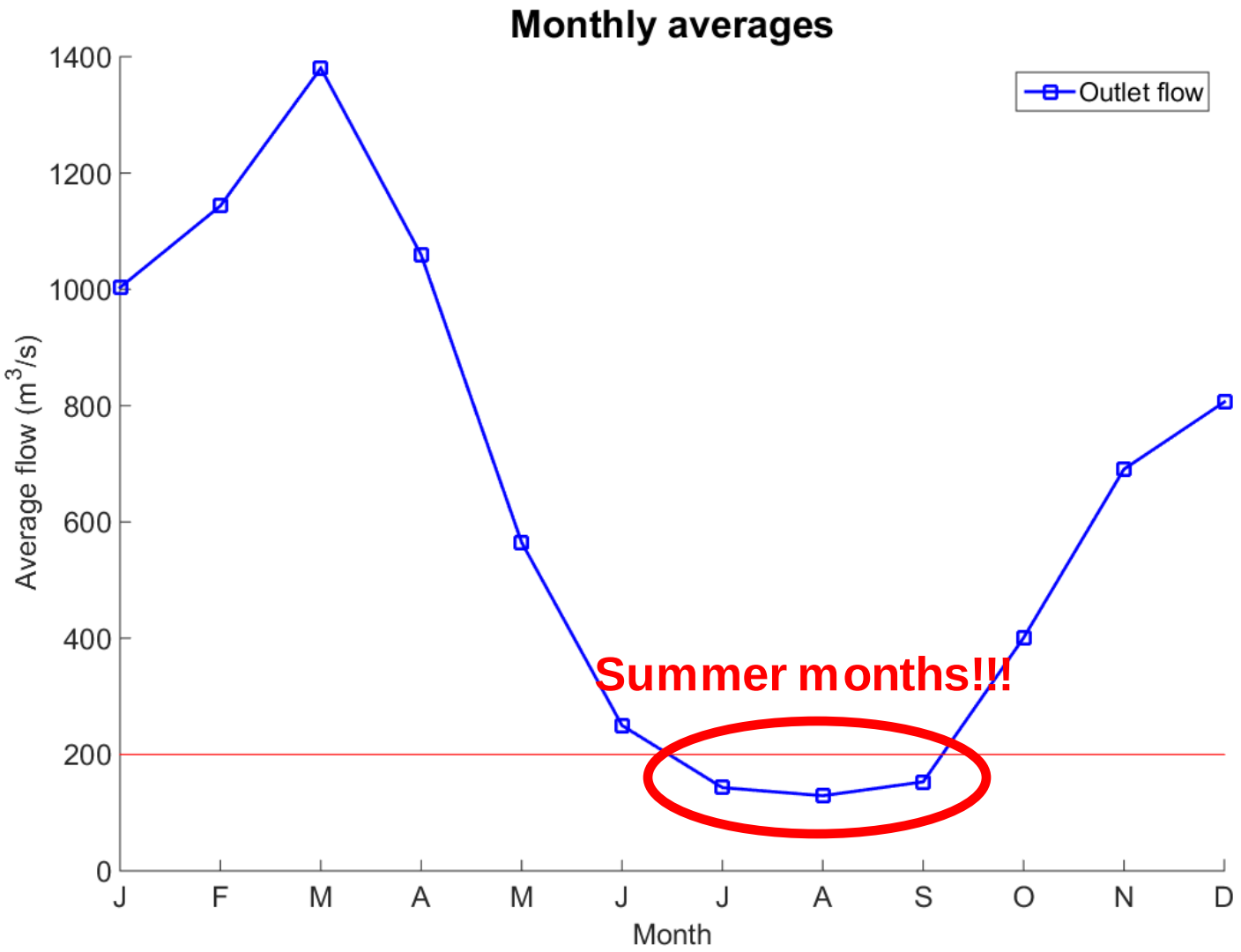
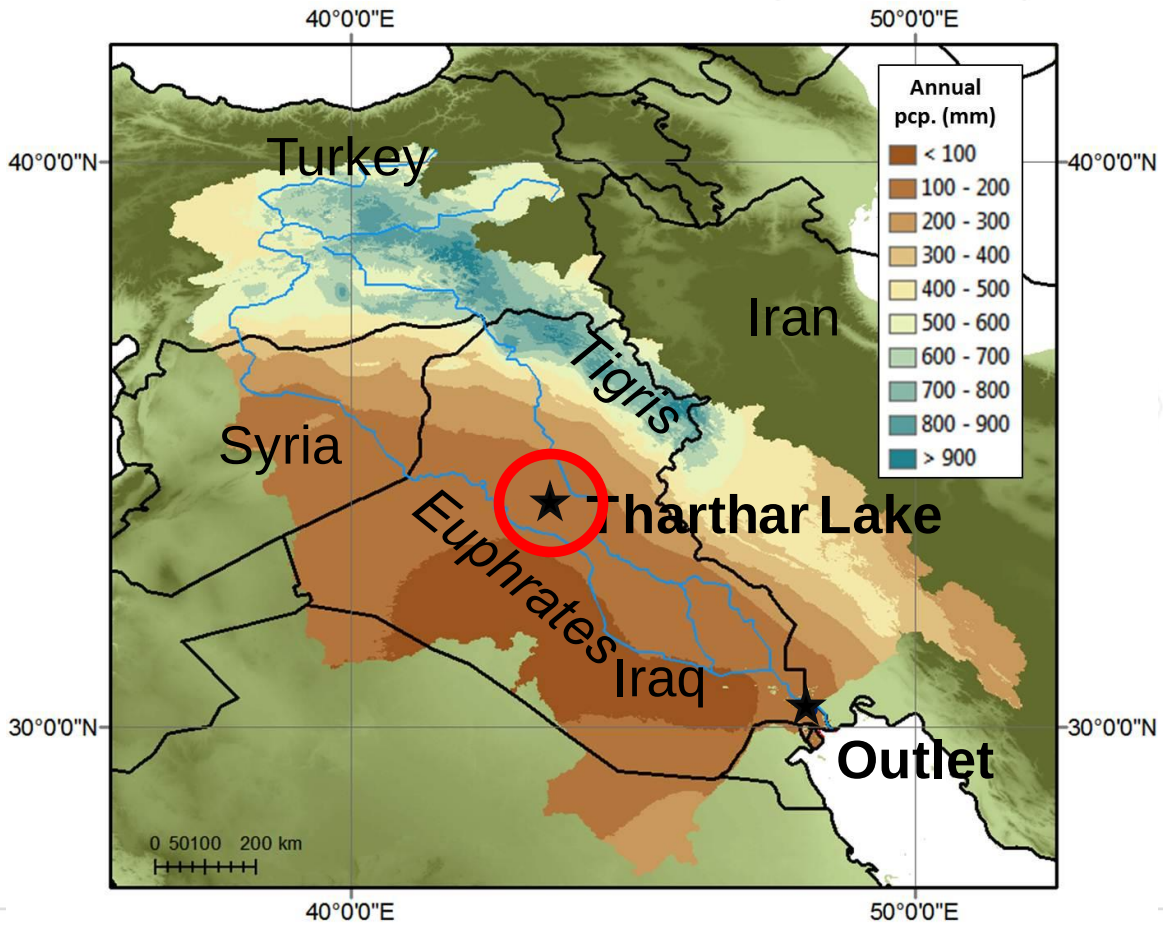
OUTLET FLOWS



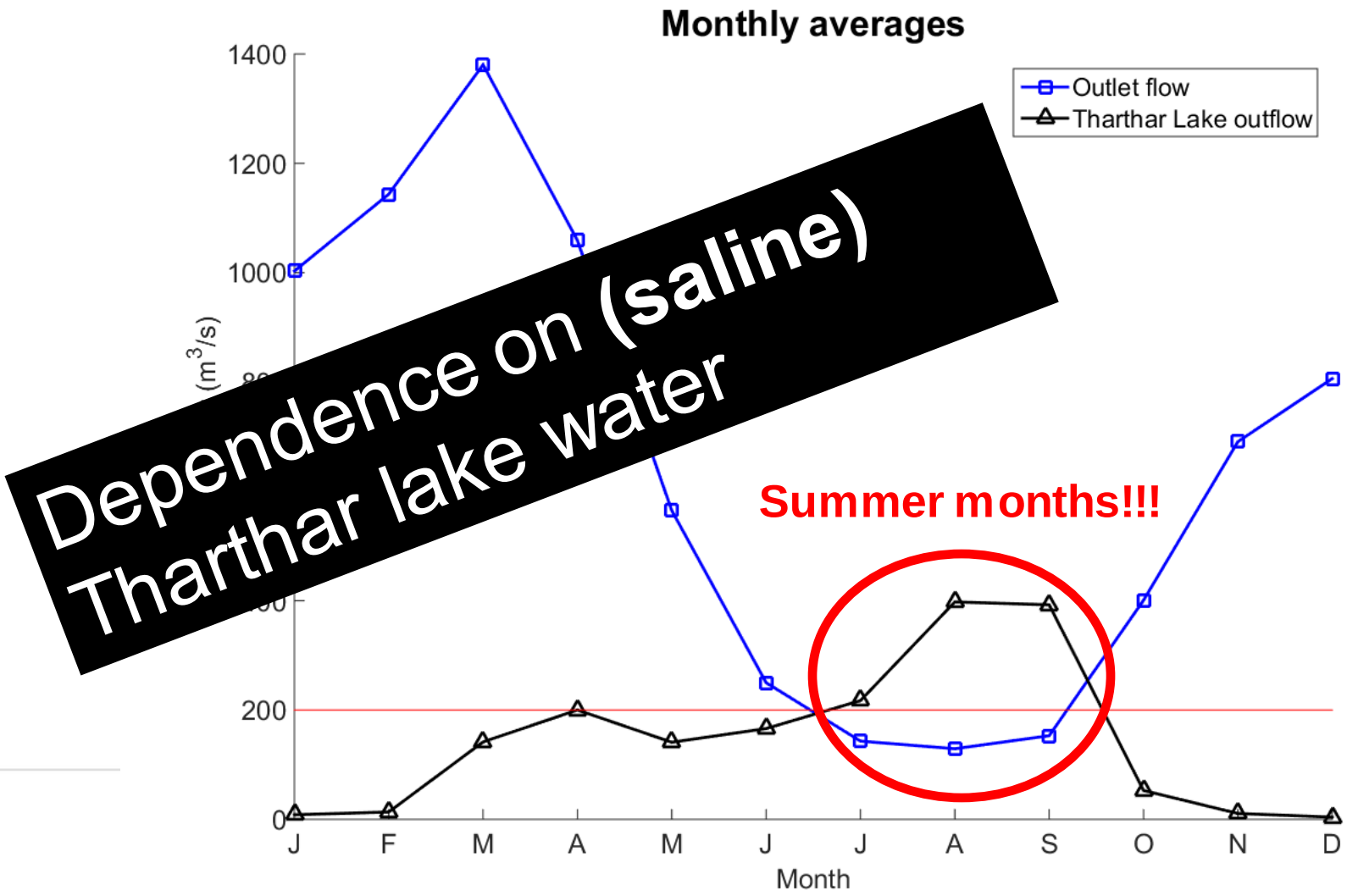
OUTLET FLOWS



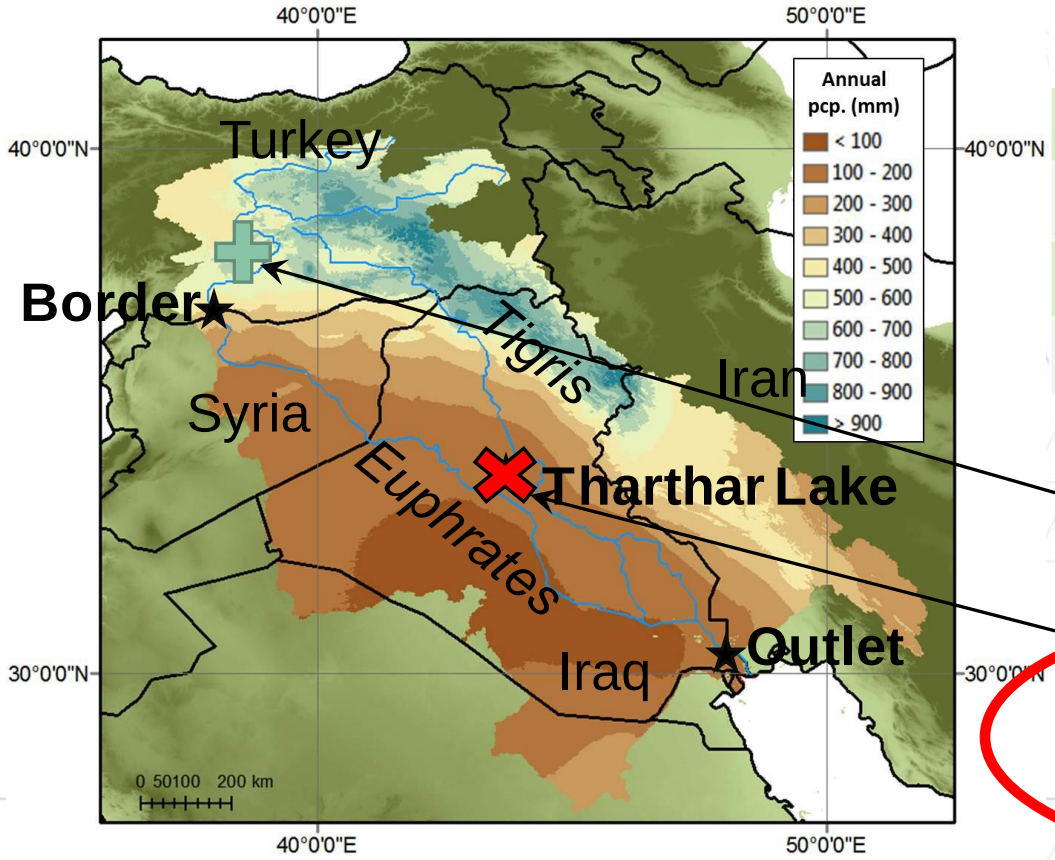
A COMPARISON



OUTLET VS. THARTHAR LAKE FLOWS



KEY VULNERABILITIES & SCENARIOS



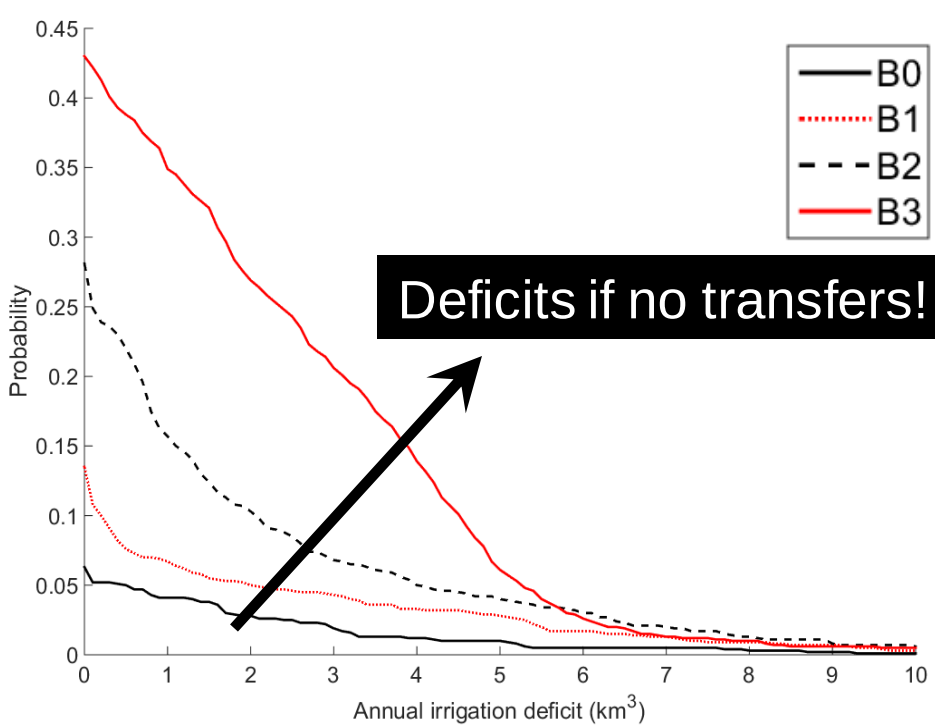
- Scenarios

	Baseline network	No Tharthar outlet
Baseline irr.	A0	B0
Irr. +1 km^3	A1	B1
Irr. +2 km^3	A2	B2
Irr. +3 km^3	A3	B3

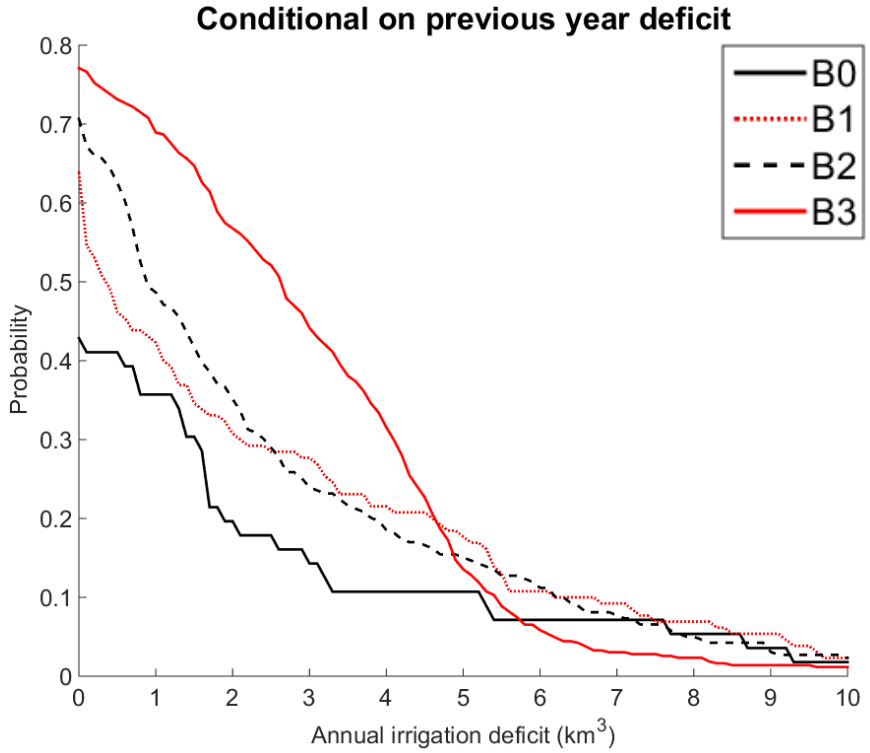
1) Vulnerability of border flows to supply-demand change?

2) Dependence of (Euphrates) flow on outside transfers of saline water?

SCENARIOS B: EUPHRATES IRRIGATION



Deficits if no transfers!



Large storage capacity means risks are correlated over multiple years!

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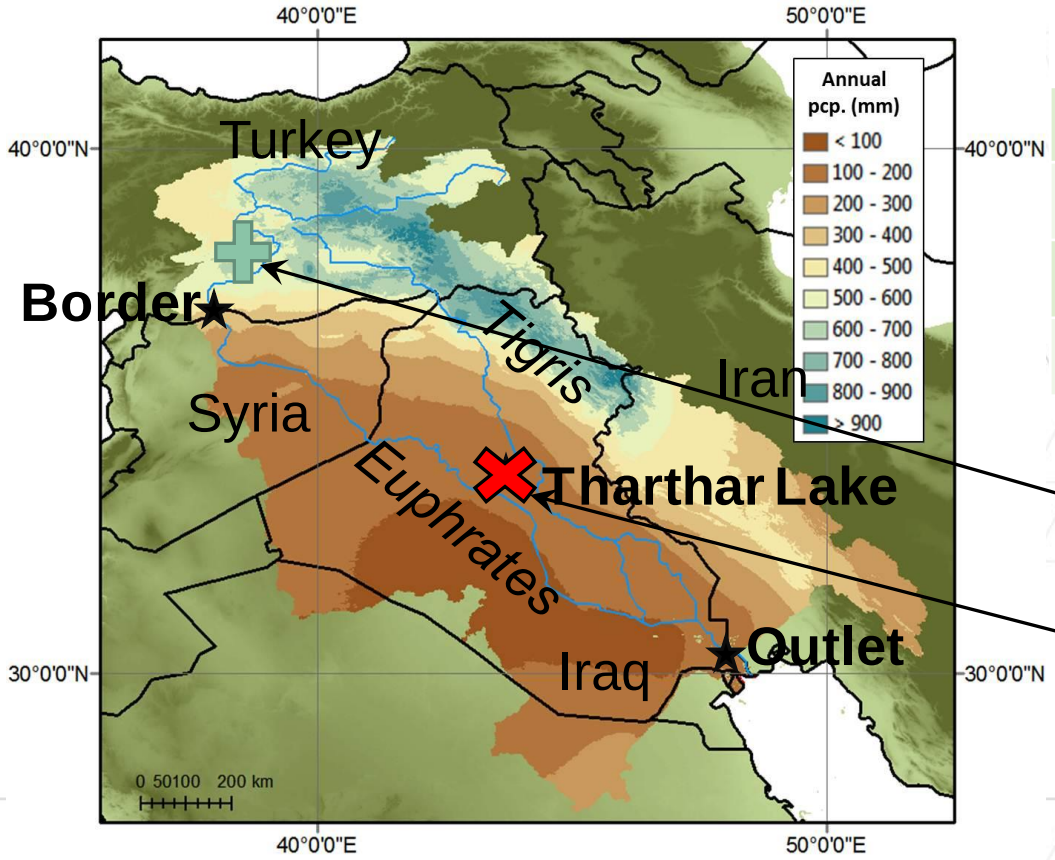

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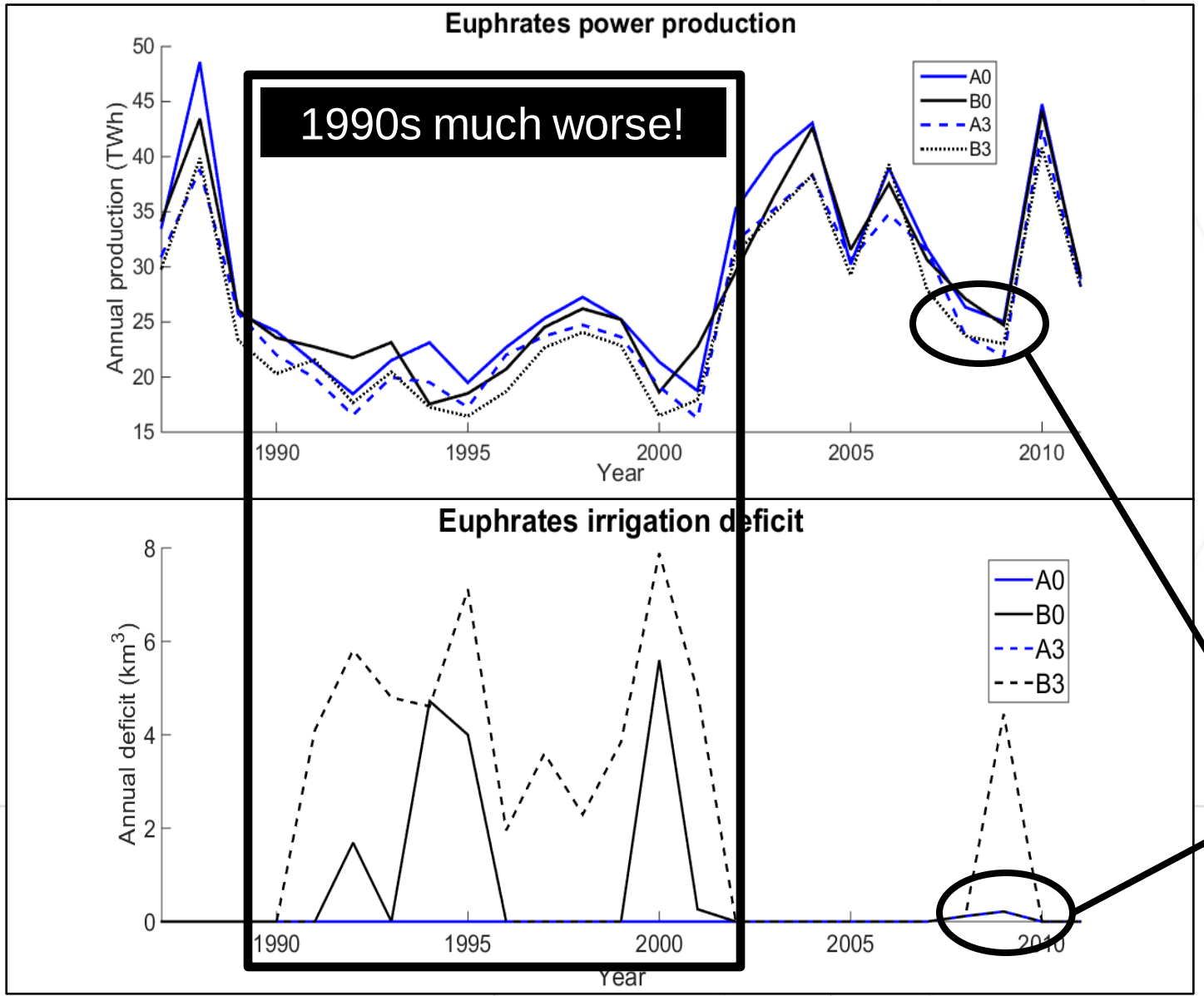
APPLICATION TO HISTORIC FLOWS



Inter-annual Variability

2007-2009 Syria drought

KEY TAKEAWAYS

- **Best-case scenario built to overcome lack of data**
  - ➢ Monthly time-step, accounts for variability.
  - ➢ Drought vulnerability assessment

Unsustainable development :

- ➢ Iraq dependence on saline water
- ➢ Sensitivity to additional (planned) irrigation developments

- **Quantitative evaluation of competing claims**
  - ➢ Vulnerabilities likely to be present in practice
  - ➢ Approach translatable to other transboundary basins

SPEAKER NOTES

Dr Charles Rougé has been a lecturer (equivalent to Assistant Professor) at the University of Sheffield since September 2018. He has 10+ years of experience dealing with complex real-world water engineering problems. He specialises in understanding how to adapt and transform the infrastructure that enables us to use water, under the triple challenge of climate change, population growth, and the energy transition.

His current projects include: hydropower systems design and operation, forecast-based resilience of the water supply sector, vulnerability assessment in the Indus basin in a changing world.

His expertise spans hydro-economic modelling and analysis, using multi-criteria optimisation to understand complex trade-offs between water users, vulnerability analysis, and using complex models from multiple sectors to uncover opportunities for adaptation.

The University Of Sheffield.