Water Resources Engineering and Management

(CIVIL-466, A.Y. 2024-2025)

5 ETCS, Master course

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Platform of hydraulic constructions

Lecture 1-3: water footprint, virtual water, water bodies and international water associations

Water footprint

The use of water colors it !

PLATEFORME DE CONSTRUCTIONS HYDRAULIQUES

Blue water (rivers, lakes, glaciers, etc.)

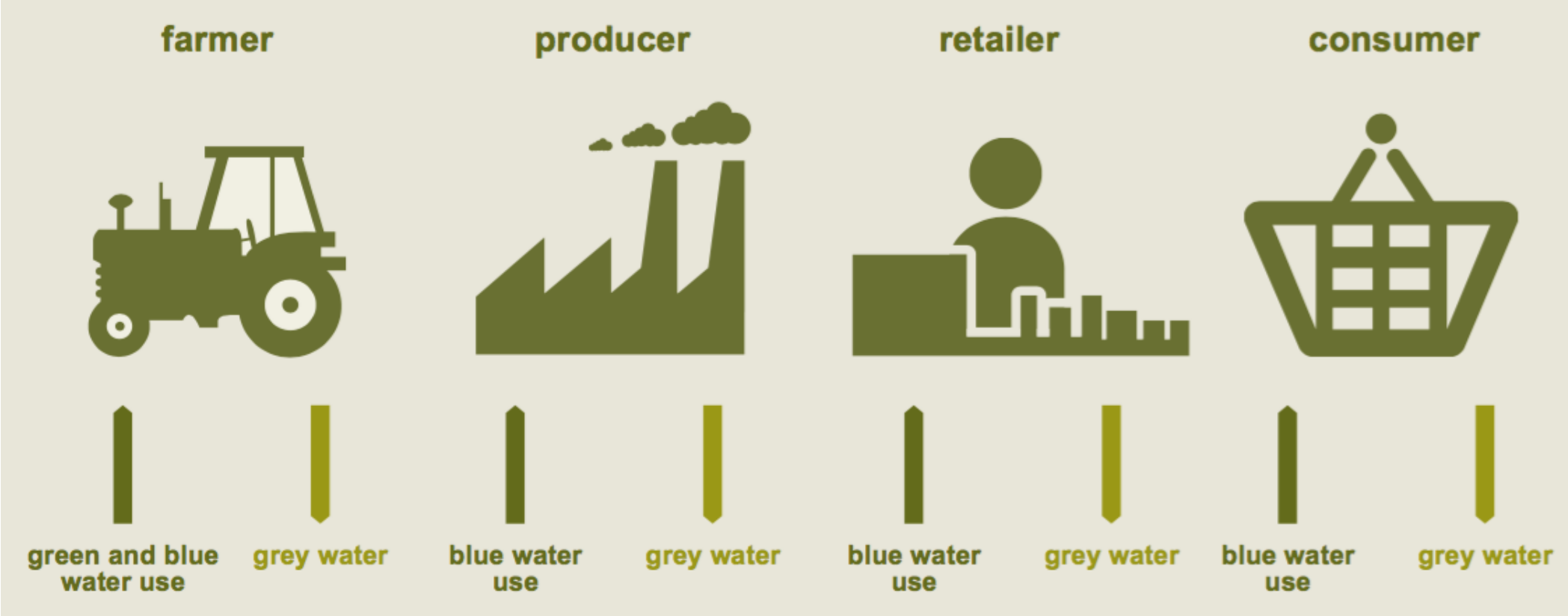
Green water (forests, soil moisture, cultures, etc.)

Gray water(domestic use, commercial, industrial, etc.)

EPFL

Water footprint

Concept proposed by Allen (1980) and later developed by Hoeckstra et al. (1998)



The exist from any process is always gray water!

https://www.eda.admin.ch/deza/fr/home/ddc/publications/alle-deza-publikationen.html/content/publikationen/fr/deza/diverse-publikationen/wasser-fussabdruck-schweiz

Virtual water and water footprint

Virtual water (also called embedded water or shadow water) reflect the fact that the amount of water physically contained in the product is negligible compared to the amount that went into its production

The concept of virtual water allows precise and practical applications since the amounts of water that go into production processes can be quantified.

A country's **water footprint** is the volume of water used to produce goods and services consumed by the inhabitants of a country, including imported goods.

(more in the next lectures…)

"Water footprint of a cup of black coffee: 140 liters: This includes the water used for growing the coffee plant, harvesting, refining, transporting and packaging the coffee beans, selling the coffee, and brewing the final cup."

CHAPAGAIN, A.K. AND HOEKSTRA, A.Y., 2007

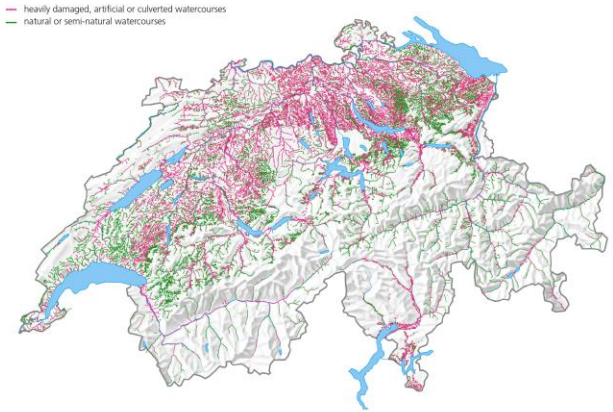
International river basins and water bodies

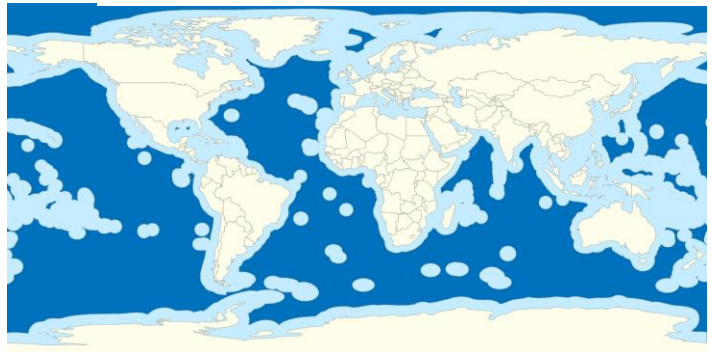
International (national) water bodies

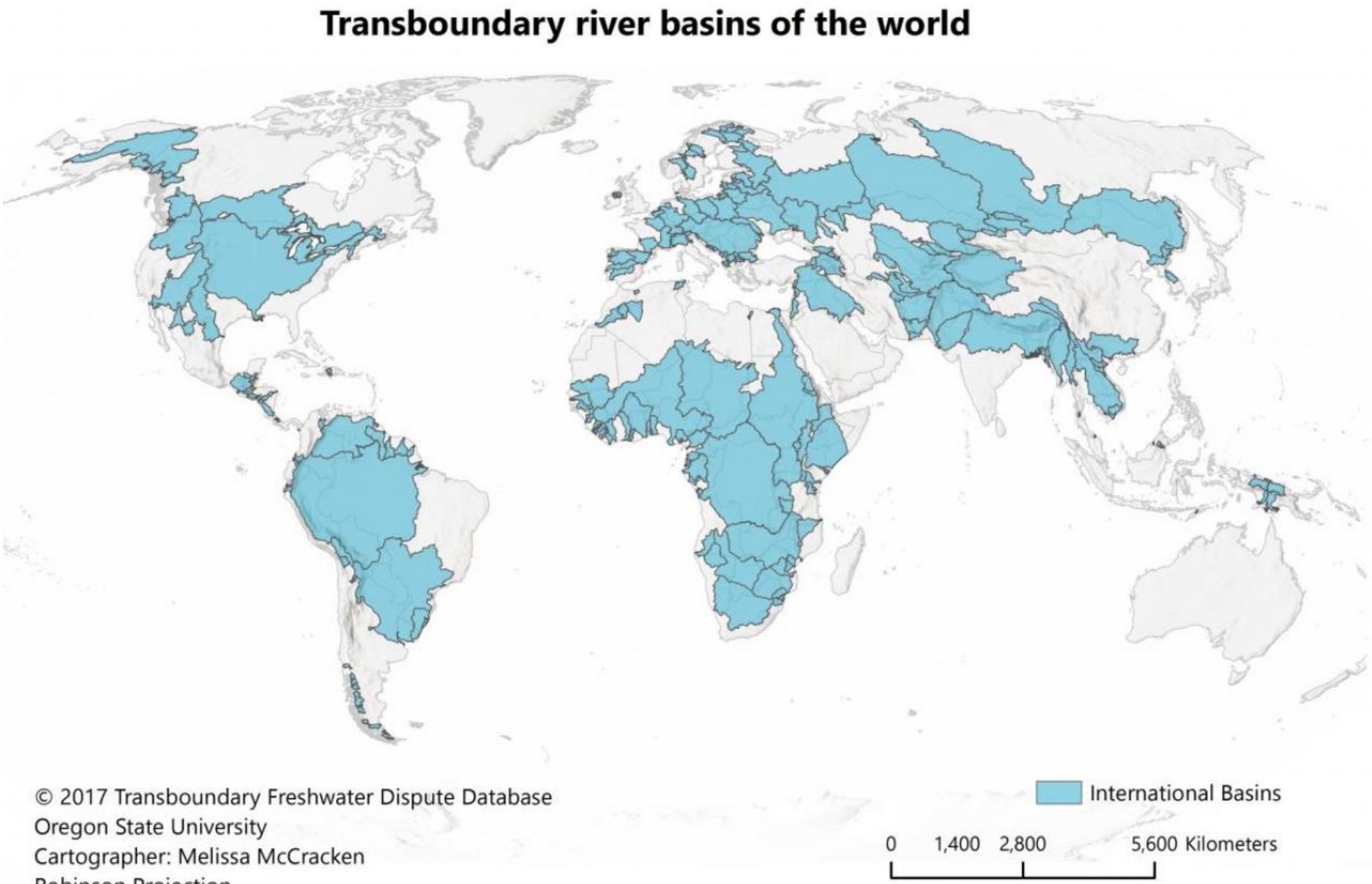
- WHAT IS IT? An international/national water body (basin, lake, reservoir or river) spans over the territories shared by two or more independent States

- WHY ARE THEY GROWING IN NUMBER? More States created due to political changes; improved tools (e.g., GIS) to define their boundaries; Island Nations where ignored up to 1978 (FAO Register)

- WHY IS THEIR STUDY IMPORTANT? <u>Countries that share the same water body may have different levels of access and this could be a source of conflicts</u>







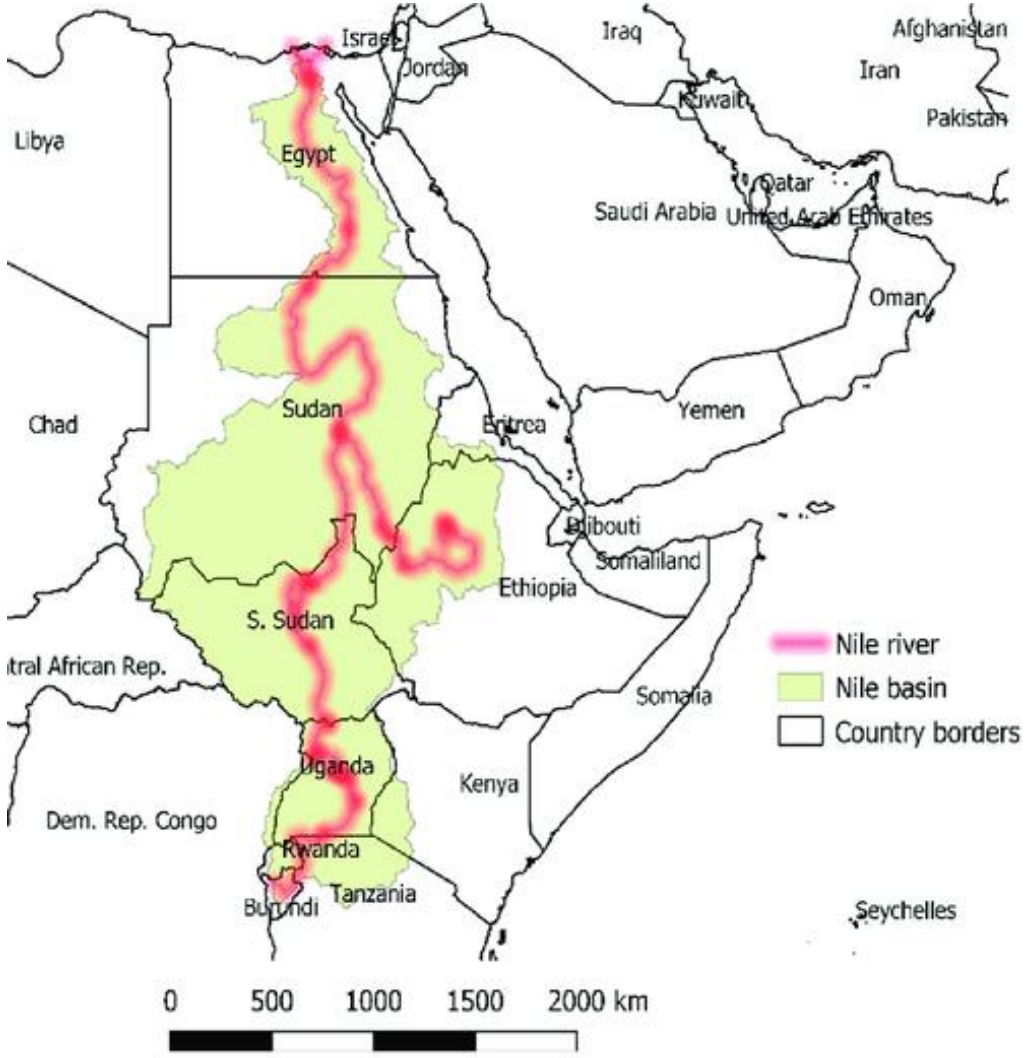
Transboundary waters represent 60% of the world's freshwater flows, with 153 countries sharing at least one of the 286 transboundary river and lake basins or one of the 592 transboundary aquifer systems.

Definitions

States that are crossed or that share entirely or partially a water course are called Riparian States

Riparian states have uncommensurable responsabilities vs downstream countries

Have you ever thought about responsibilities and consequences of why rivers look murky (local pollution and environment are just one aspect)?



Examples: newly created International river Basins

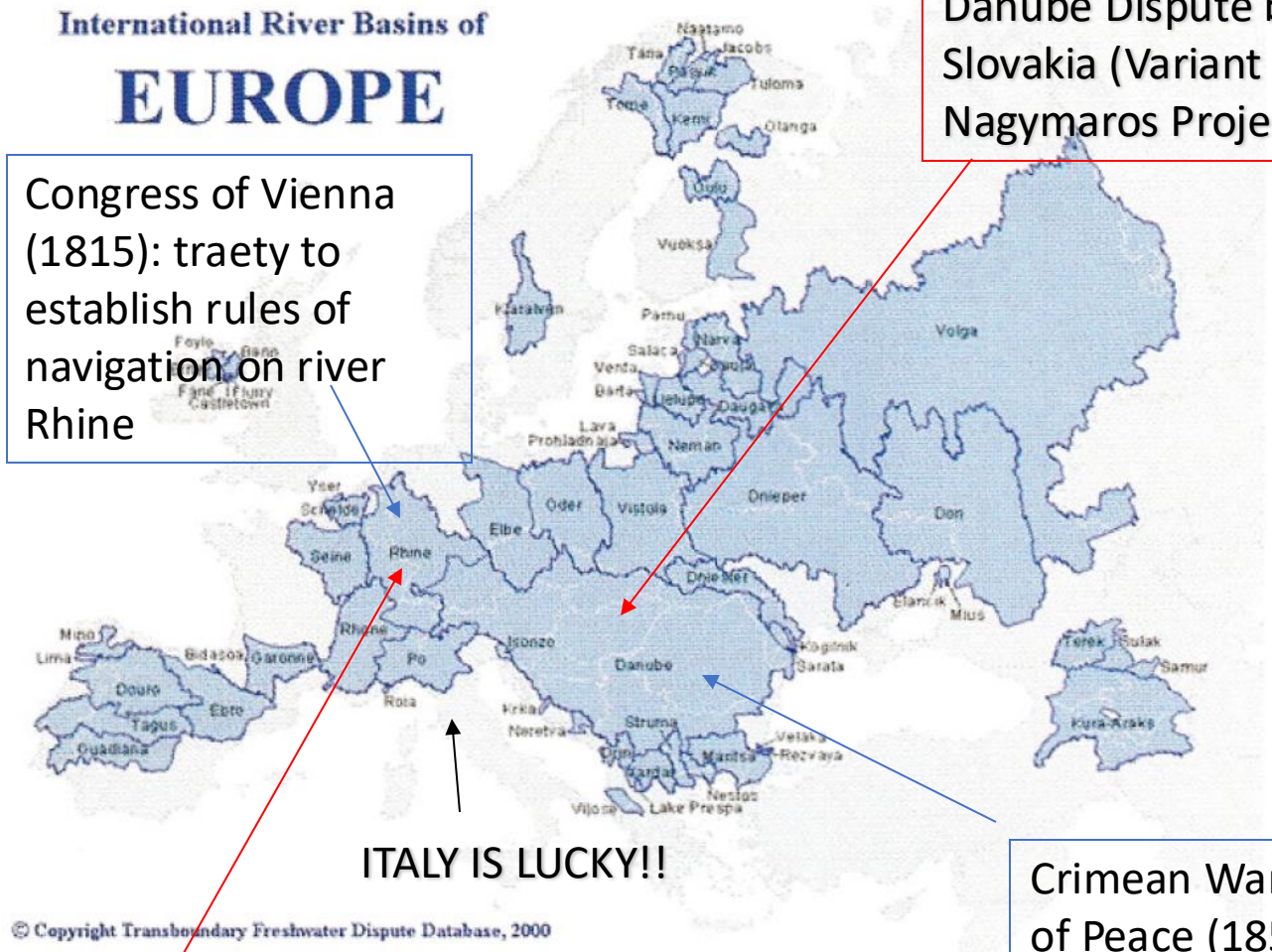
Table 1.2: Number of international river basins by continents and sources of documentation.

Region	Barrett (1994)	1978 Register	Wolf *et al.* (1999)
Africa	55	57	60
Americas	60	69	77
Asia	40	40	53
Europe	45	48	71
Total	200	214	261

Table 1.3: Percentage of land area within international basins.

Continent	1999 Update (%)
Africa	62
Asia	39
Europe	54
North America	35
South America	60
Total	45

Exemple of transboundary water problems



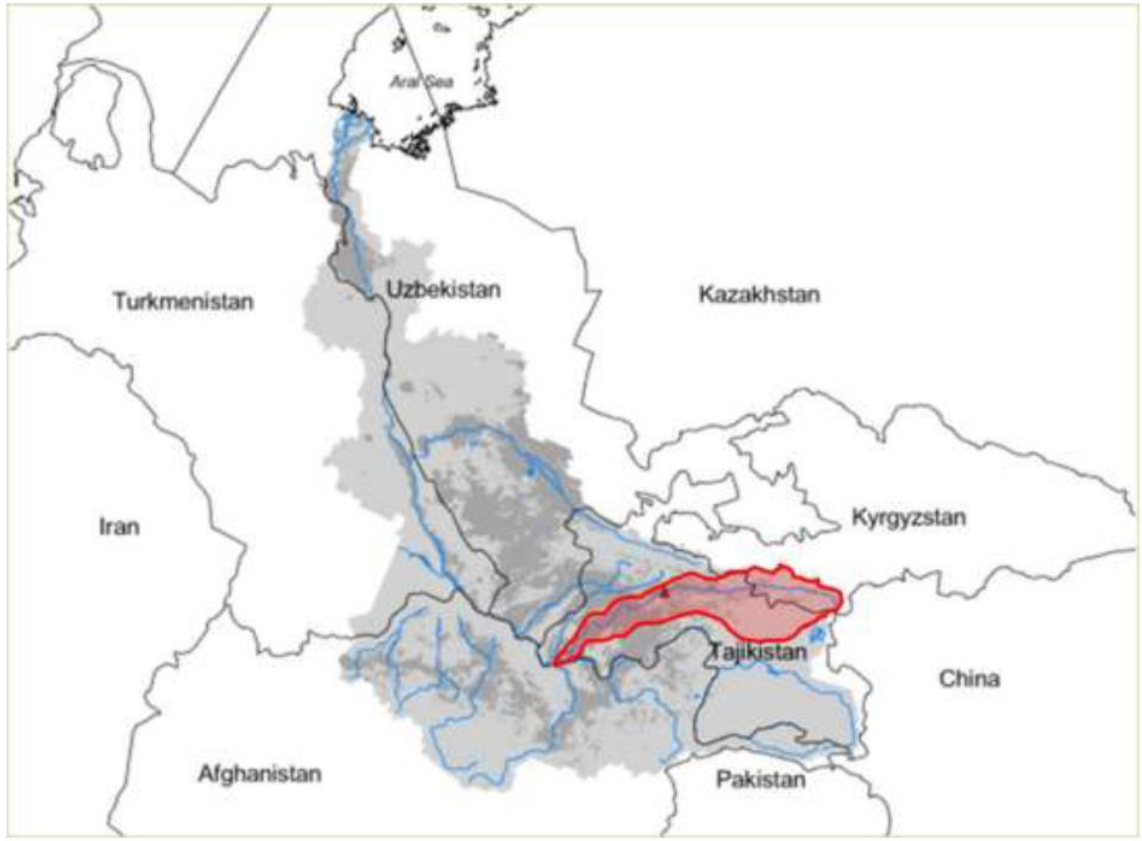
No of Countries	The shared basin
17	Danube
9	Rhine
6	Kura-Arakas
5	Vistula

Rio Grande Dispute between USA and Mexico (since end 1800)

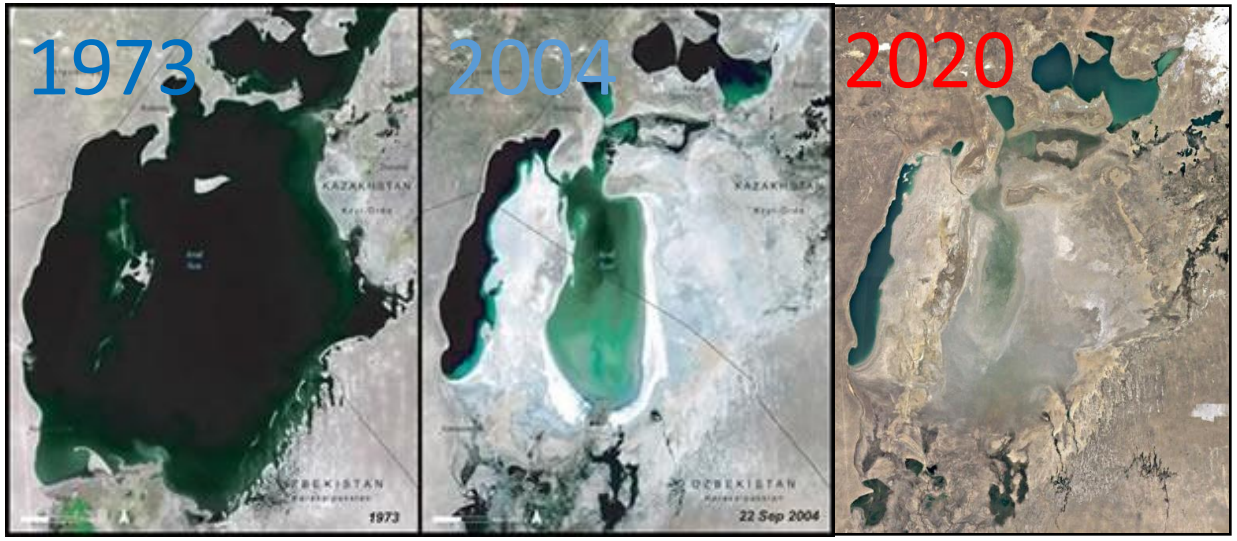
„Harmon doctrine (1895)“: USA enjoy the absolute sovereignty and are free to use all Rio Grande water regardless of consequences for Mexico

No of Countries	The shared basin
8	Amazon
5	La Plata

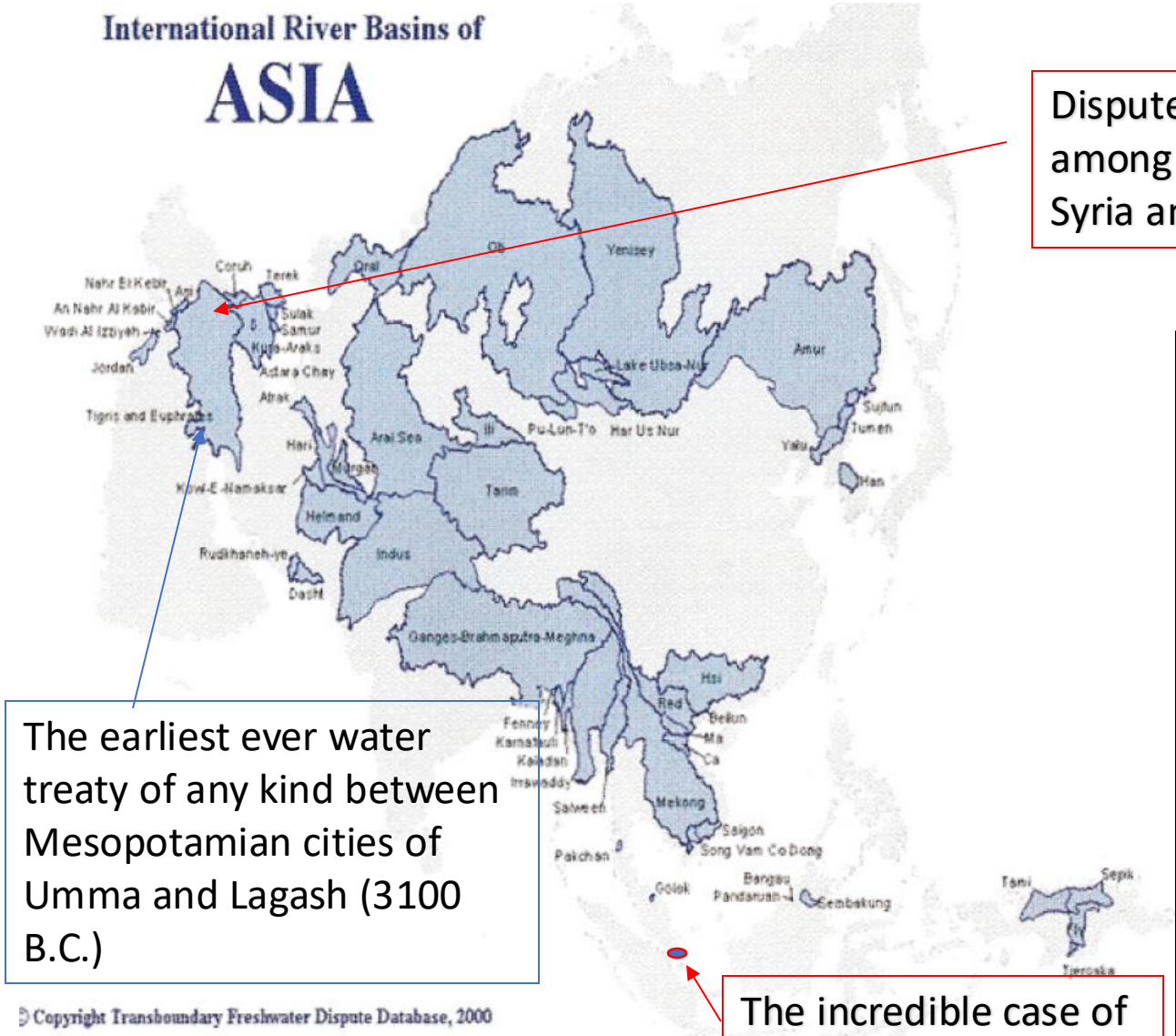
Example: Amu-Darya river basin in central Asia



International transboundary water conflict conflict for hydropower, agriculture, industrial and domestic water uses…at the expenses of the environment



ARAL SEE



No of Countries	The shared basin
6	Ganges-Brahmaputra-Meghna
6	Aral Sea
6	Tigris and Euphrates
6	Tarim
6	Kura and Araks
6	Mekong

Well-known conflict and cooperation problem between Ethiopia and Egipt due to the blue-white Nile confluence

(voice comments)

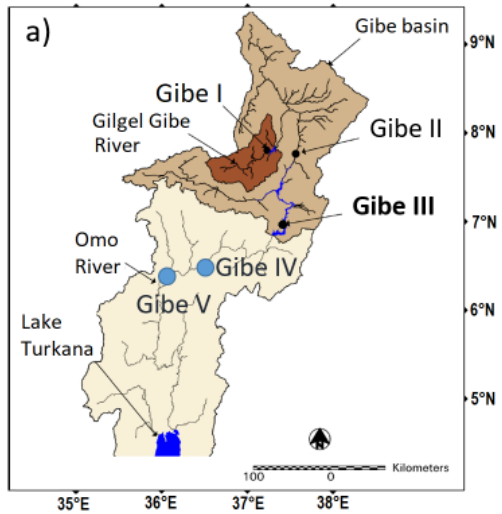
Transboundary water conflict between Ethiopia and Kenya due to the impoundment of River Omo

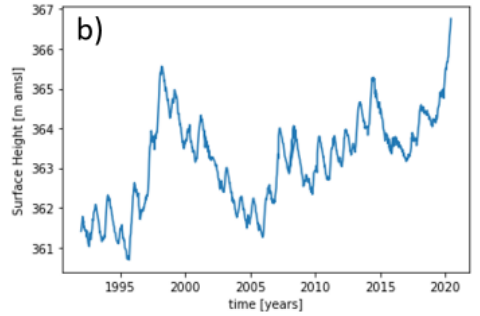
(see later example)

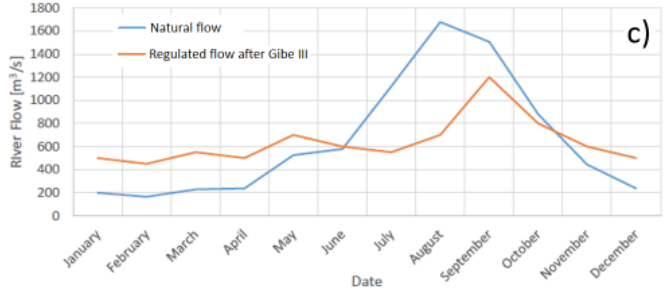
Map 1.2: Africa map of transboundary river basins.

No of Countries	The shared basin
11	Congo, Niger
10	Nile
9	Zambesi
8	Lake Chad
6	Volta
3	Orange

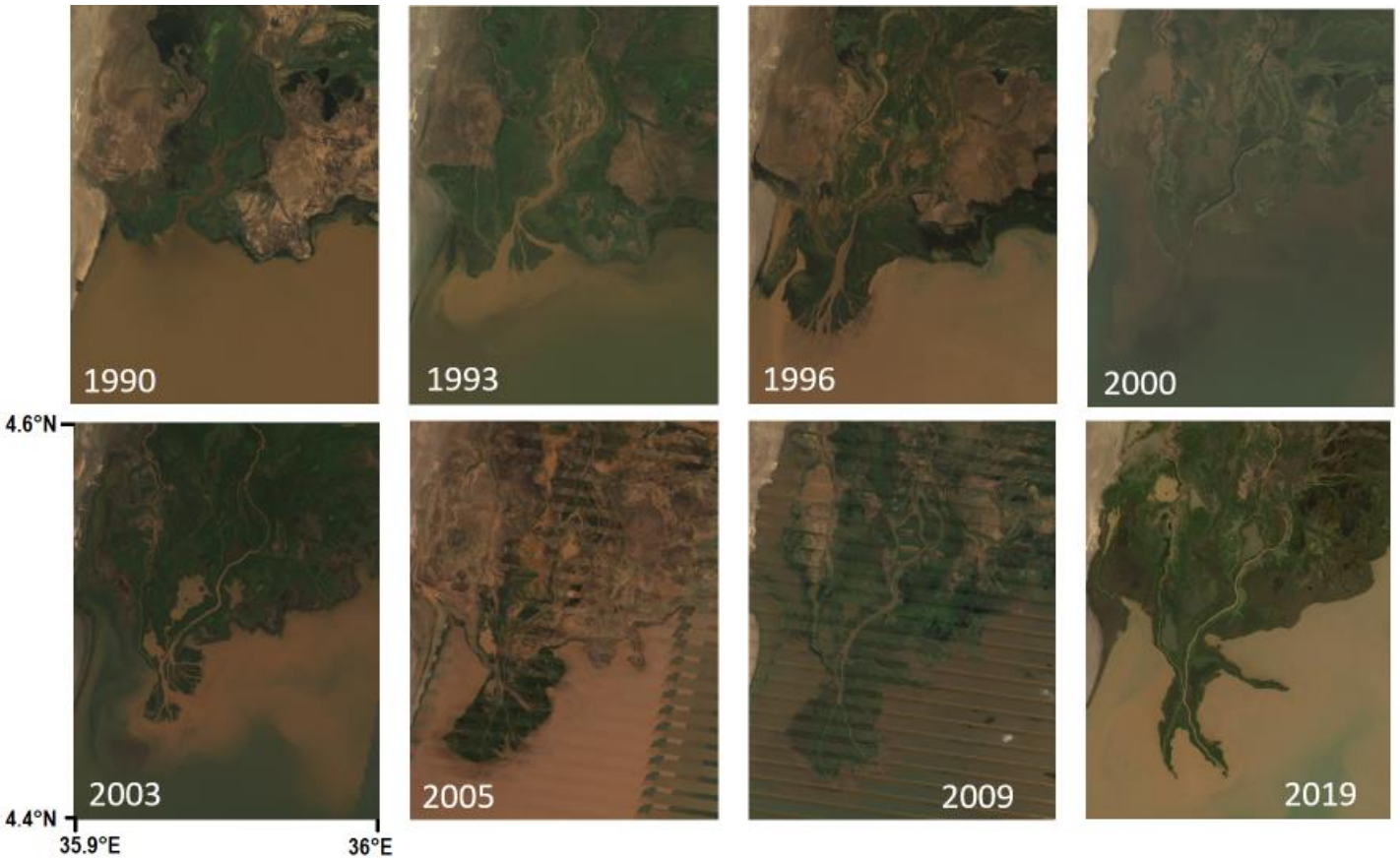
Example: Lake Turkana transboundary water conflict

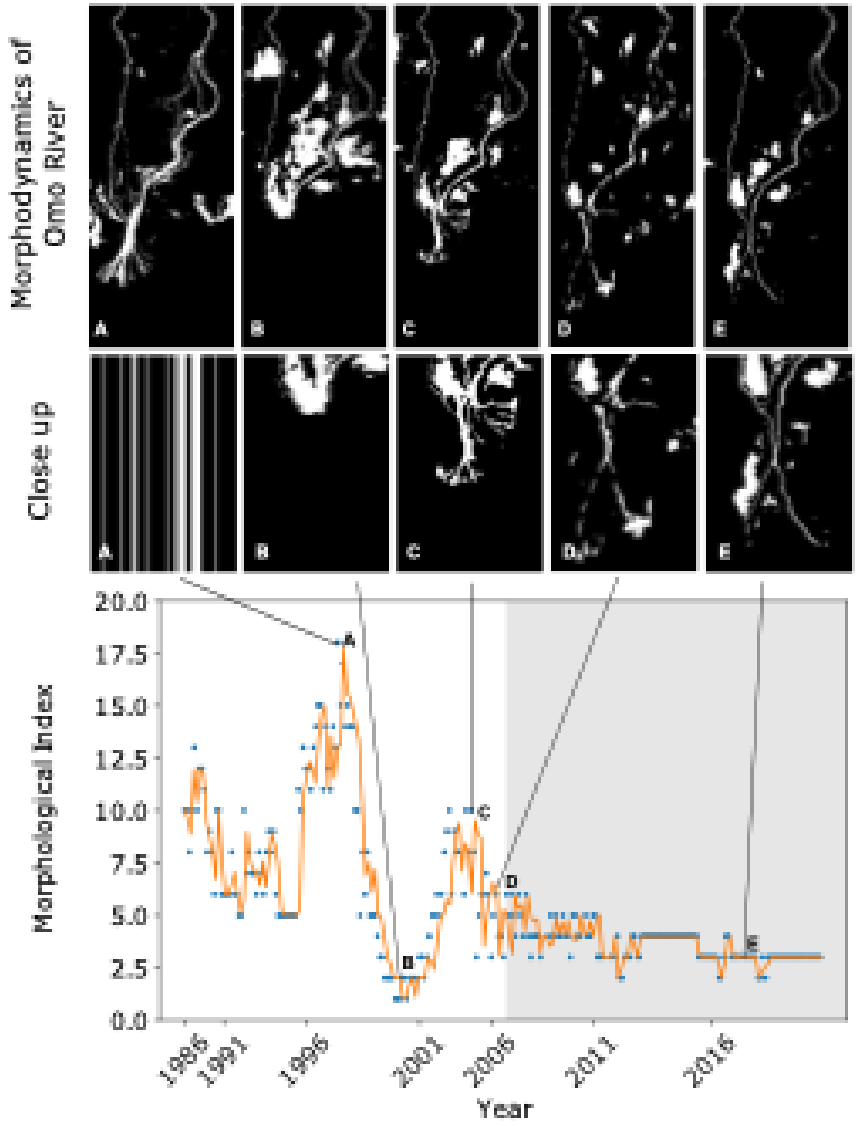






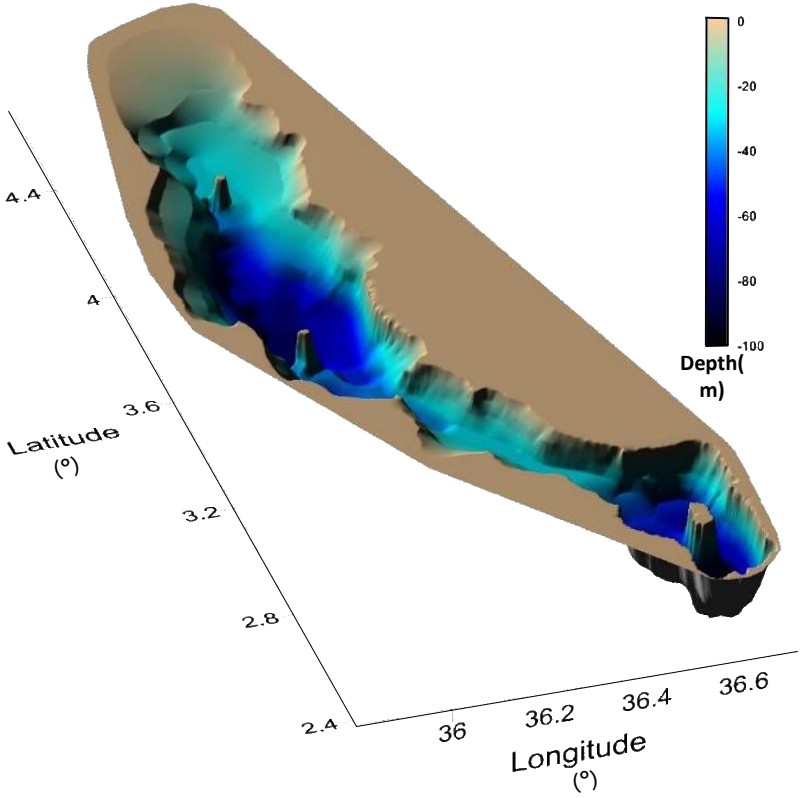
Sediment impondment causes reduced delta activity

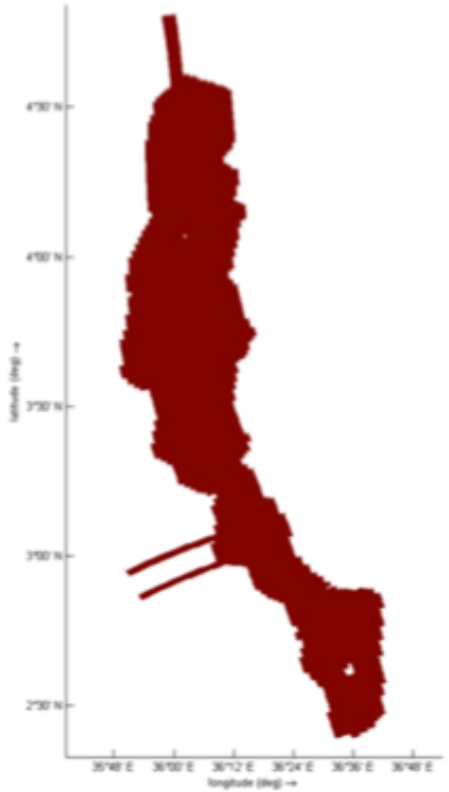


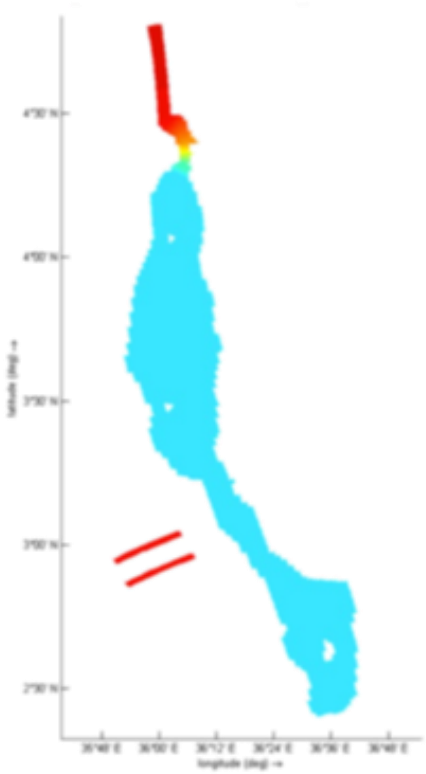


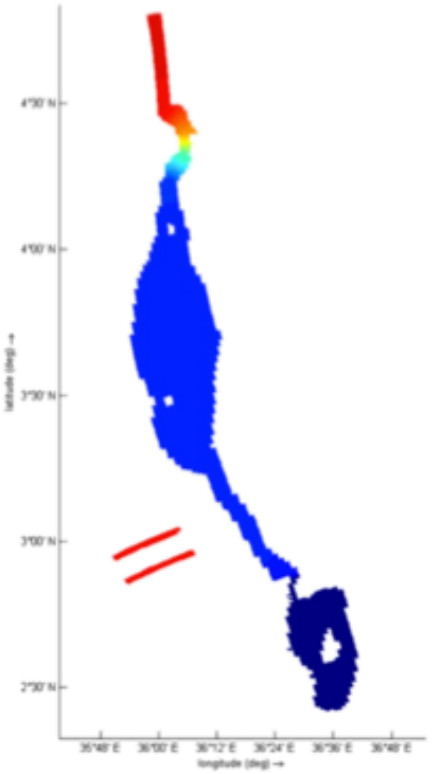
Zen, Perona, Medina-Lopez (Geomorphology, 2023)

Further use for irrigation might threaten lake's existence









Water associations and frameworks

International water associations (examples)

Based in London, founded in 1999, it is a non-profit association bringing together more than 10000 professionals in water engineering and management situated in 140 countries
https://iwa-network.org

Based in Germany, founded in 1981 (EWPCA), is an independent, non governemental and non-profit associaiton dealing with management and improvement of water resources
https://www.ewa-online.eu/home.html

Based in Colombo (Sri-Lanka), founded in 1985, it is a non-profit WM association and operates through his offices situated in Africa and Asia
https://www.iwmi.cgiar.org

Based in Geneve, founded in 2014, was established by the Swiss confederation and the University of Geneva, with a focus on waper policy and security
https://www.genevawaterhub.org

International water associations, framework directives and acts

PLATEFORME DE CONSTRUCTIONS HYDRAULIQUES

SWISS WATER PARTNERSHIP

The Swiss Water Partnership (SWP) is a multi-stakeholder platform launched in 2012 bringing together around 70 Swiss organisations from academia, civil society, public and private sectors who contribute to solving global water challenges.
https://www.swisswaterpartnership.ch

WISE FRESHWATER
FRESHWATER INFORMATION SYSTEM FOR EUROPE

The Water Framework Directive (2000/60/EC) requires EU Member States to achieve good status in all bodies of surface water and groundwater by 2027. Good status is comprised of four assessments:

> Ecological status of surface waters
> Chemical status of surface waters
> Chemical status of groundwaters
> Quantitative status of groundwaters

https://water.europa.eu/freshwater/europe-freshwater/water-framework-directive

GlobalWaters.org

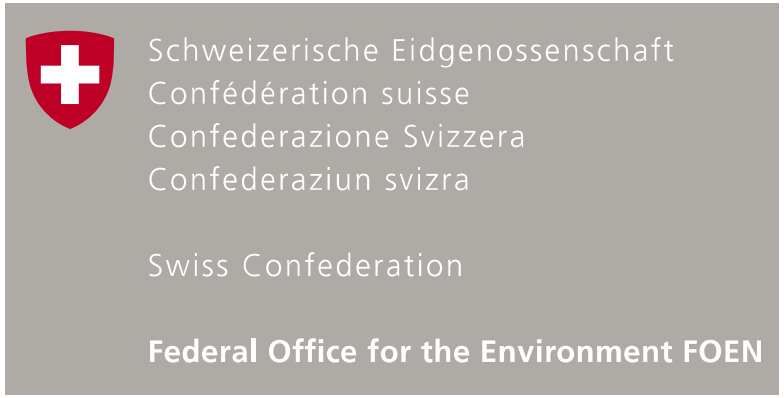
A global water security, sanitation, and hygiene knowledge portal
https://www.globalwaters.org/what-we-do/wrm

OECD
BETTER POLICIES FOR BETTER LIVES

The Organisation for Economic Co-operation and Development (OECD) is an international organisation that works to build better policies for **better lives**. They developed the Water governance Indicator Framework
https://www.oecd.org/regional/OECD-Water-Governance-Indicator-Framework.pdf

National enagement and laws

The swiss water footprint report, which gives a global vision about Swiss water dependance on other countries (surprise!)
https://www.eda.admin.ch/publikationen/en/deza/diverse-publikationen/wasser-fussabdruck-schweiz.html



Federal laws about environmental protection
https://www.bafu.admin.ch/bafu/en/home/topics/law/publications-studies/publications/swiss-environmental-law.html

Report about the effect of climate change on Swiss water bodies
https://www.bafu.admin.ch/bafu/en/home/topics/water/water--publications/publications-water/effects-of-climate-change-on-swiss-water-bodies.html

Strengthening global water initiatives (GWIs)

Proficient at their best and weak and corrupt at their worst, the systems that govern the planning and management of water resources need attention

Water problems are a global issue, but does this require the globalization of water management (intended as GWIs)?

(open to discussion)

Table 1. Key moments in global water history since 1965

Event	Date(s)	Venue
International Hydrological Decade	1965–1974	Worldwide
UN Conference on the Human Environment	1972	Stockholm, Sweden
UN Conference on Water	1977	Mar del Plata, Argentina
International Drinking Water Supply and Sanitation Decade	1981–1990	Worldwide
International Conference on Water and the Environment	1992	Dublin, Ireland
UN Conference on Environment and Development (Earth Summit)	1992	Rio de Janeiro, Brazil
First World Water Forum	1997	Marrakech, Morocco
International Conference on Water and Sustainable Development	1998	Paris, France
Second World Water Forum	2000	The Hague, Netherlands
UN Millennium Summit	2000	New York City, USA
International Conference on Freshwater	2001	Bonn, Germany
World Summit on Sustainable Development	2002	Johannesburg, South Africa
International Year of Freshwater	2003	Worldwide
Third World Water Forum	2003	Kyoto, Japan
Commission on Sustainable Development, Sessions 12 and 13	2004, 2005	New York City, USA
International Water for Life Decade	2005–2015	Worldwide
Fourth World Water Forum	2006	Mexico City, Mexico
World Water Week[a]	2007	Stockholm, Sweden

[a]World Water Week has been an annual event held in Stockholm each summer (though under different names) since 1991. In this table, only the most recent event is listed.

(from Varady et al., Env. Sci and Policy sust. Dev. (2017)

Evolution of global WM framewors

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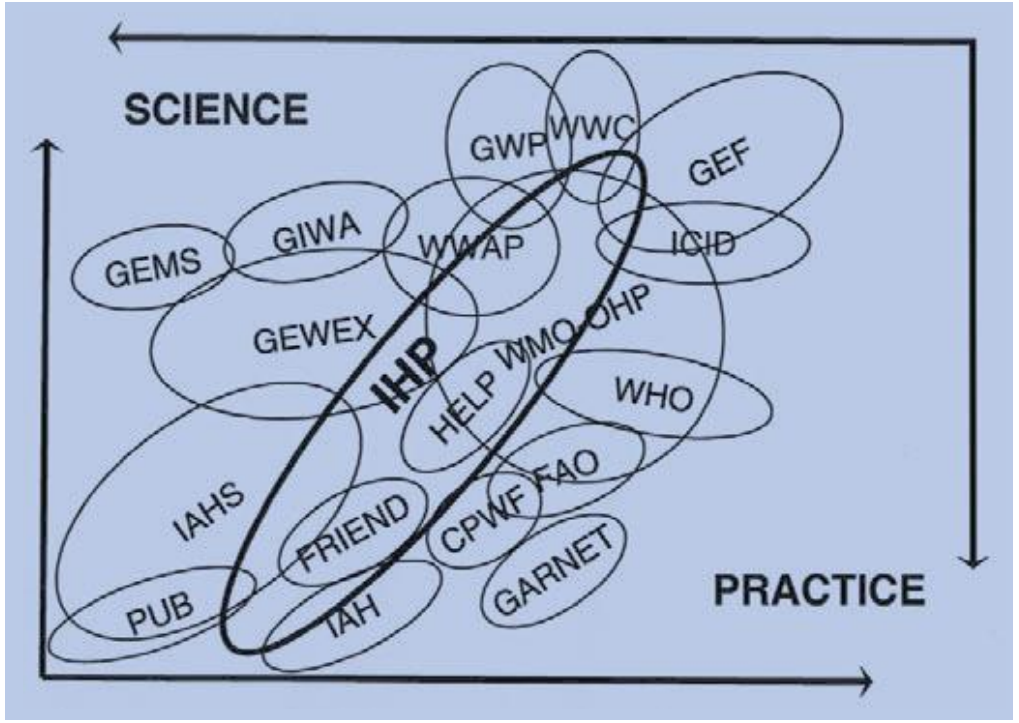

From Varady et al. (2017)

Strategies for sustaining global water initiatives

Tasks	Options
Transform overlap into a resource	
Characterize overlap	• Use inventory and institutional mapping to assess overlap • Incorporate policy and program evaluation techniques in water governance
Manage overlap	• Seek examples from GWI programmatic evaluations to identify "productive" overlap opportunities and possible incentives structures
Use nontraditional settings	• Use Internet-based portals, listservs, search engines, other modes–especially drawing on examples from global initiative networks • With assistance from key GWIs and donors, develop GWI portal; include budgets, reports, events schedules, news summaries, interactive elements
Address proliferation by strengthening networks	
Devise collaboration strategies	• Leverage financial resources to promote cooperation • Compile online database of programmatic and organizational gaps • Add "GWI Assessment" chapter to future World Water Development Reports • Strengthen information flows that encourage collaboration within and across specialties
Mitigate conflict	• Attempt to involve potential adversaries on joint projects or initiatives
Support donor decisionmaking	• Use institutional overlap repository to help donors screen, select, and fund programs
Seek multiple ways to assess and influence outcomes	
Involve participants	• Hold GWI forum with assessment goals
Seek examples	• Survey models by successful GWIs and other global initiatives • Consider available tools for measuring impact, contributions, and shortcomings of GWIs
Develop tools	• Assess impacts via qualitative/quantitative, historical/prospective, and process/outcome approaches • Identify most/least successful GWIs: indicators, benchmarks, milestones, criteria, reviews, and investment levels • Quantify GWI accomplishments, such as number of sites, training programs, and participants • Assess degree of GWI impact on regional/national policies and global investment in water
Create incentives	• Develop incentives for GWIs to merge or dissolve when they no longer meet objectives
Engage donors	• Encourage donors to support GWIs whose impacts are most significant and effective

From Varady et al. (2017)

The paradox of bringing innovation

« Sur le plan

technique, c’est une

réussite, sur le plan

humain, c’est un

génocide »

K. Zammiti, Sociologie d’un barrage (Sidi Salem)

Take home messages from these three lectures

- L1.1 I can describe the evolution of water management policies across the history and see how multidisciplinary it has become and which disciplines involves today

- L1.2 I can describe (but not need to remember by hearth) the water problem interdependencies
- L1.2 I can explain the differences between water scarcity, shortage and stress
- L1.2 I can illustrate the link between planetary boundaries and sustainable water management

- L1.3 I can remember which colour of water is associated to which use/source
- L1.3 I can qualitatively explain the concept of water footprint and virtual water
- L1.3 I understand what riparian states are and why transboundary water conflicts originate (but do not need to remember the list of ripar. States)
- L1.3 I can qualitatively describe one of the examples of water conflicts
- L1.3 I can explain the concept behind the strategies of global water initiatives (GWIs)