WATER SCIENCE for POLICIES

The role of science and technology in projects of peace

IPU ROUNDTABLE ON WATER

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AGENDA

1- Water challenges

- Climate variations and climate change
- Human activities and water pollution

2- Science and technologies for water management

- Wastewater reuse & recycling
- Monitoring quality & quantity
- (De-)centralized drinking water treatments

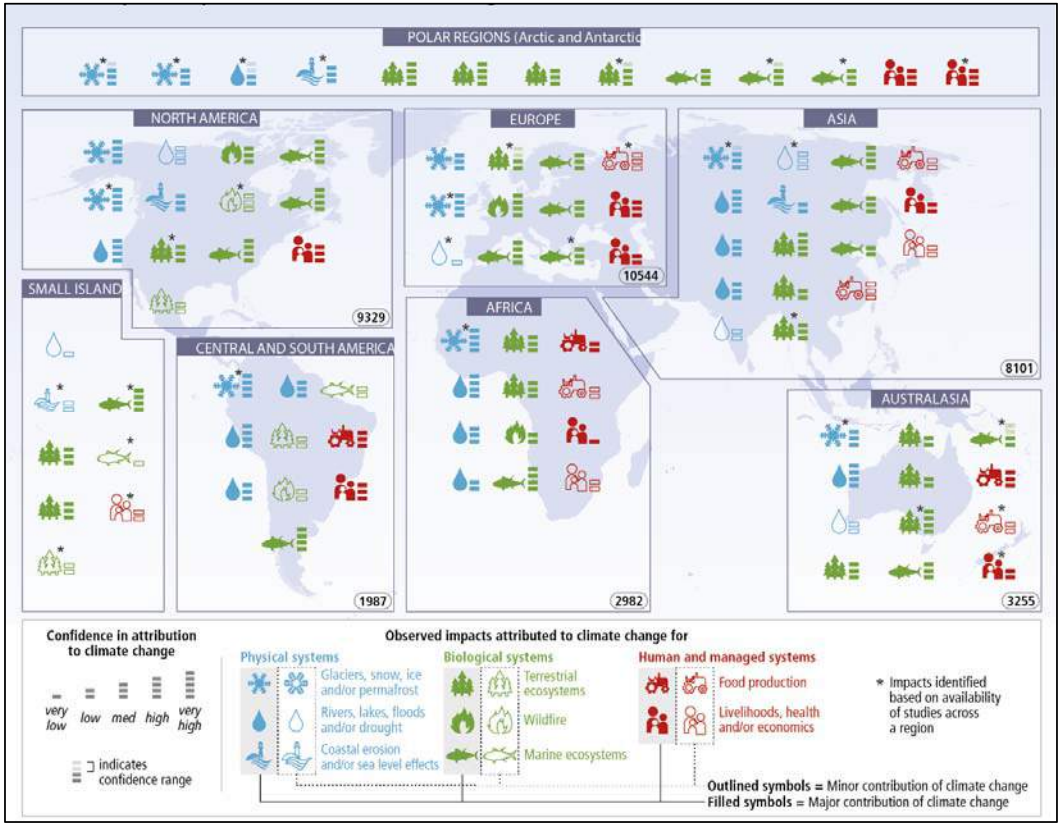
3- Examples of transboundary water cooperation

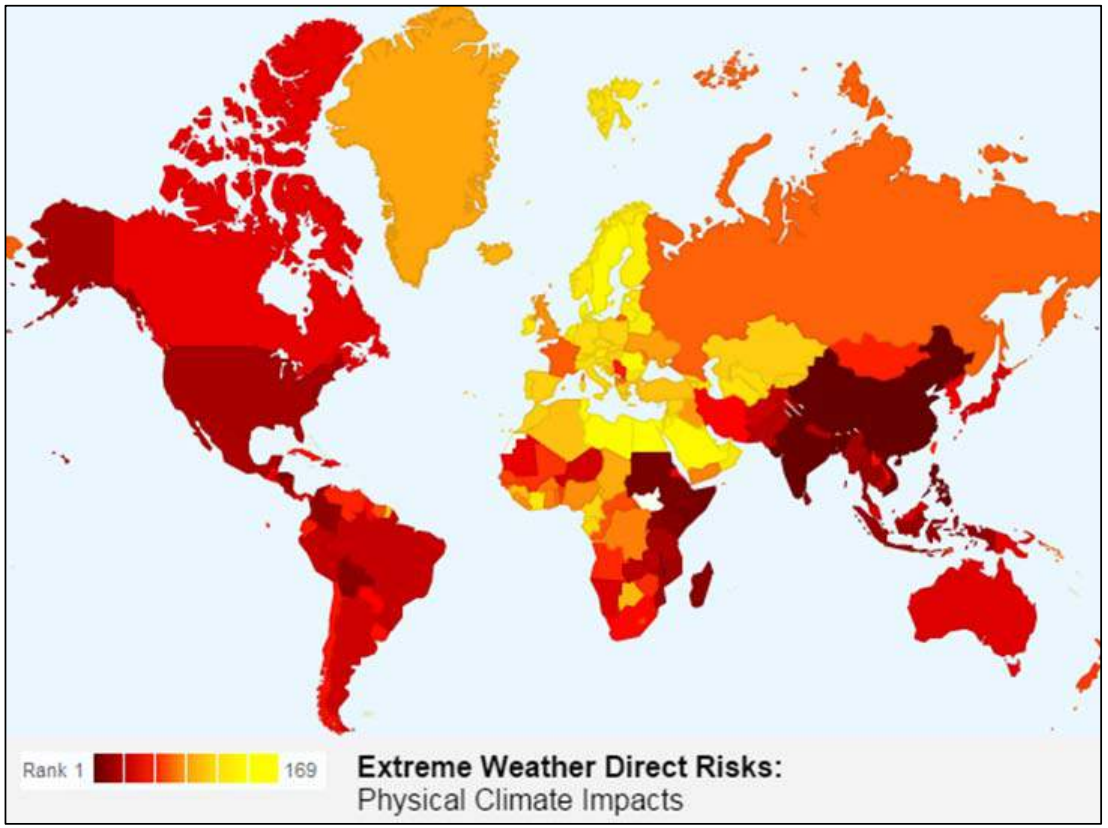
- Lake Geneva transboundary basin
- Middle East challenges & technological adaptation
- Swiss water diplomacy (Blue Peace)

1- Water challenges - Climate variations &climate change

According to the scientific literature, there are substantially **more impacts in recent decades attributed to climate change** (IPCC).

Climate impacts: **Direct** risks (risks **from physical climate impacts alone**) and overall vulnerability for **countries' ability to cope with climate impacts**.





1- Water challenges - Human activities & pollution

Agriculture, mining, flood, domestic/industrial wastewater, inadequate sanitation facilities and open defecation, solid waste are important sources of pollution which affect human health, the environment and ecosystems services (i.e. people's livelihoods).

2- Science and technologies for water management - Wastewater reuse & recycling

Alternatives technologies need to be encouraged over conventional sanitation systems (large sewer systems with centralised high-tech treatment stations) in order:

(i) to save freshwater resources,
(ii) limit the volume of flushing water discharged in the environment, and
(iii) facilitate wastewater collection as well as the possible separation (and eventually the reuse) of human excreta and urine

Wastewater can be reused as irrigation water and fertilizer (nutrient source for food production) in agriculture/aquaculture, and as a source of renewable energy (methane gas / dry organic matter). BUT need formal guidelines for safety and health standards.

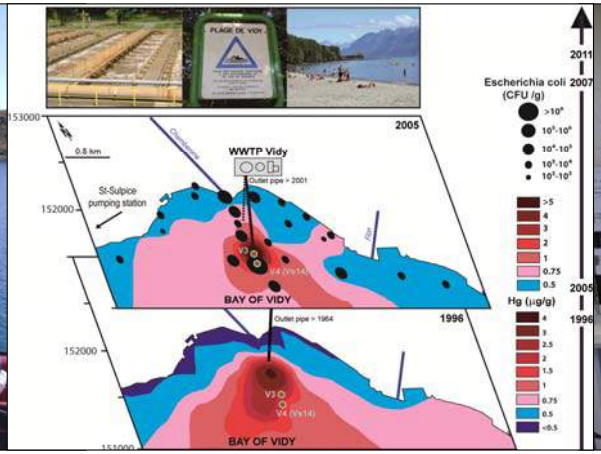
Processing faecal sludge into pellets can be used to increase it's market value as a soil conditioner or for electricity production (gasification).

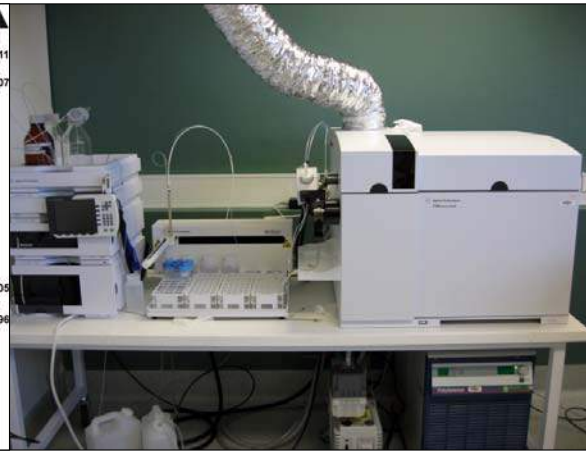
2- Science and technologies for water management - Water quality monitoring

Technologies have to be used to monitor water quality: Drinking, recreational, wastewater, irrigation (and runoff) water.

Water quality parameters (physico-chemical analysis) must be analysed using standardized (comparable) methods

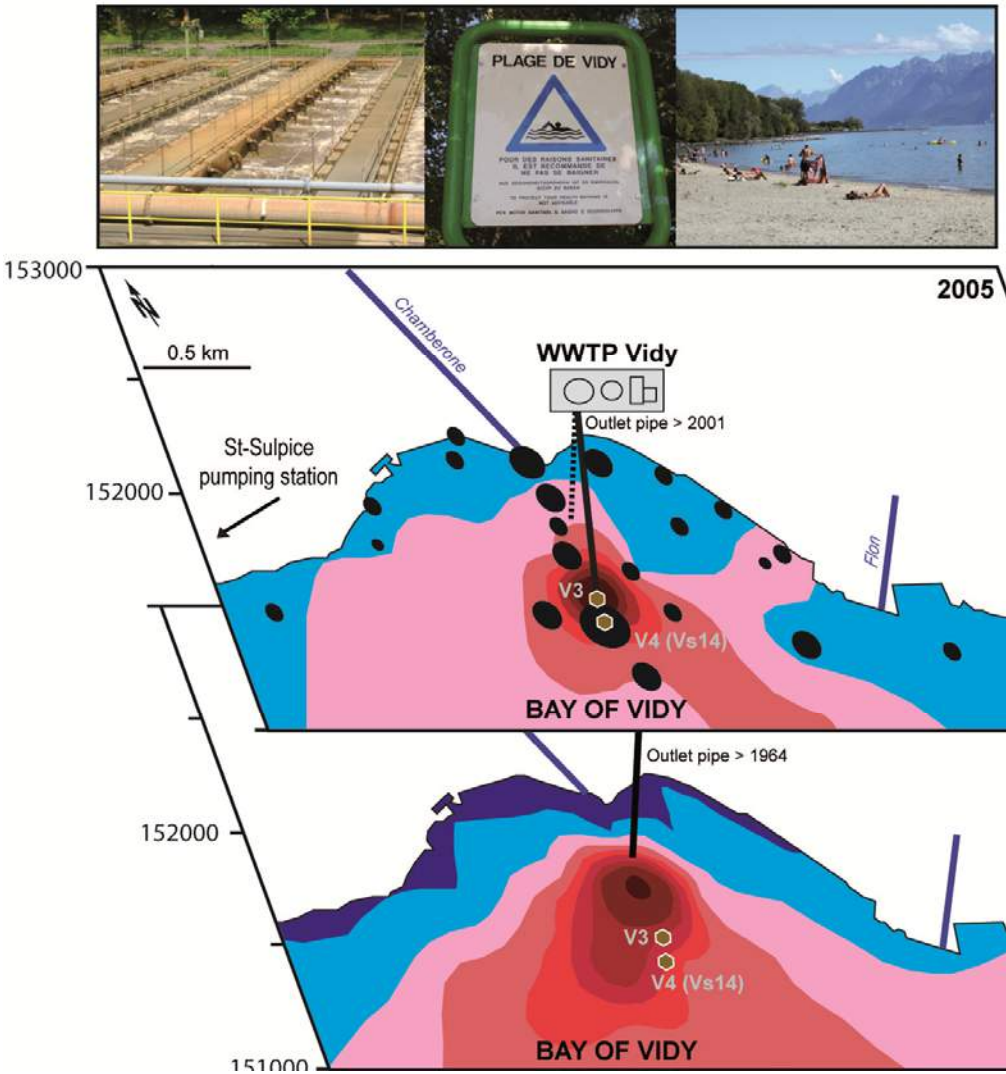
(i) to be compared to regional & international guideline values,
(ii) to provide qualitative information to public authorities & policymakers, and
(iii) to manage, exchange and report data from multiple sources (databases & GIS).

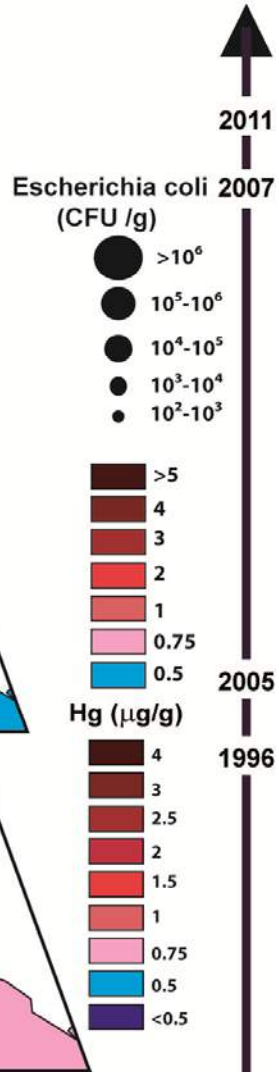


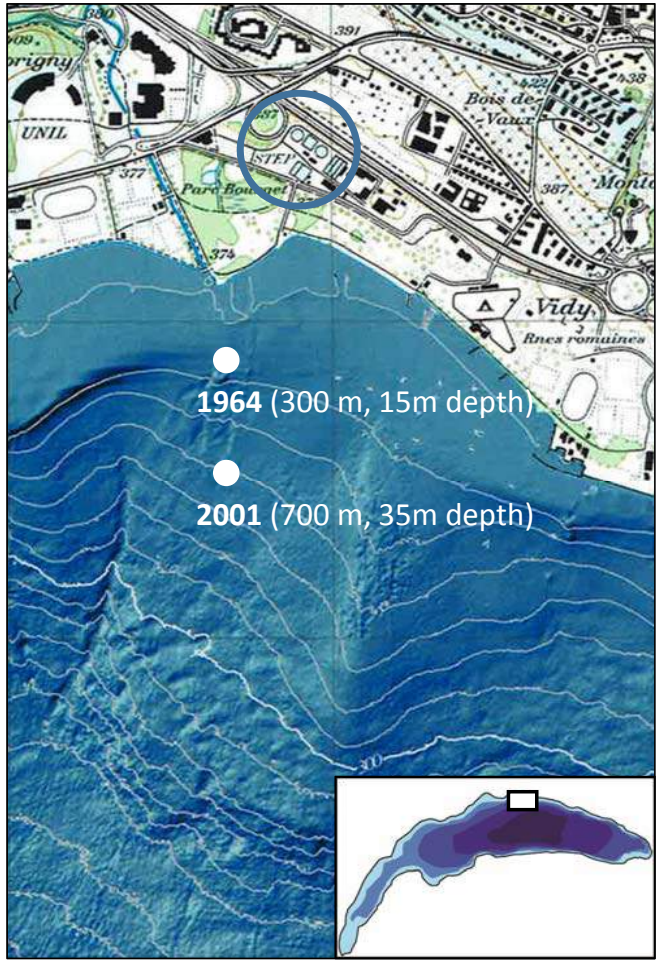


2- Science and technologies for water management - Water quality monitoring

Faecal bacteria (Escherichia coli) and heavy metals (mercury) pollution in Lake Geneva due to treated wastewater discharge

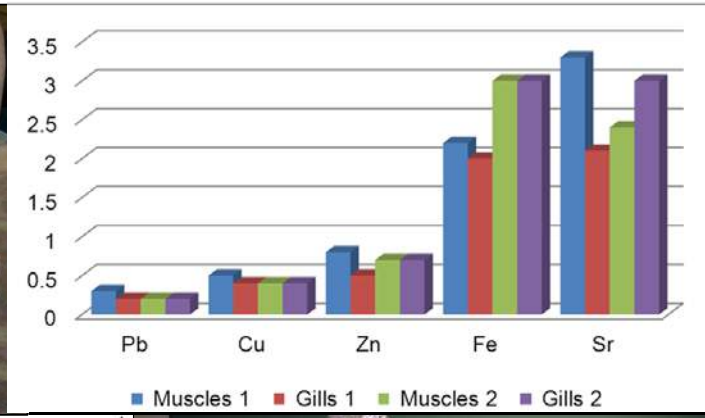


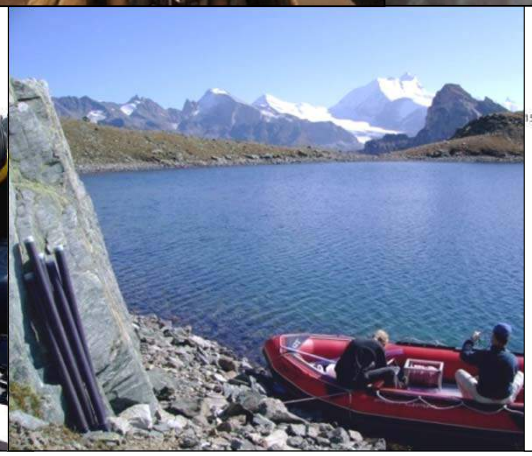


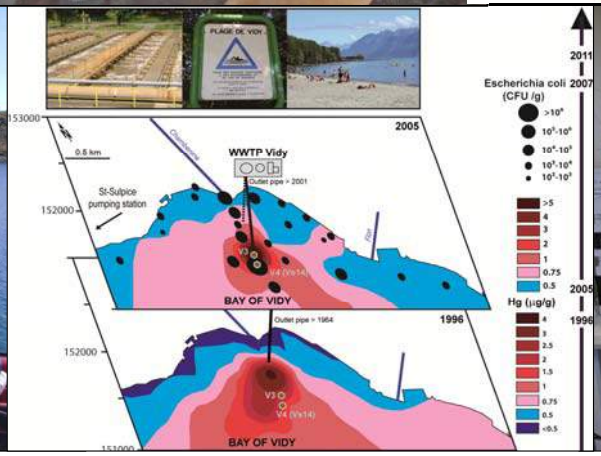


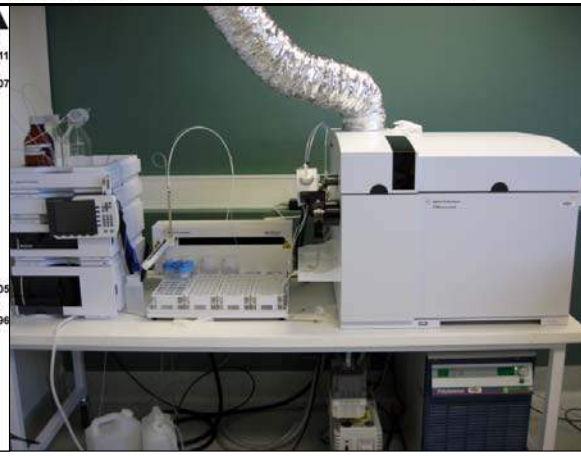
2- Science and technologies for water management - Water quality monitoring

Long–term & continuous measurement of water pollution not easily accessible due to technical and economical issues, but sediments and biological monitoring: Biological indicators (aquatic biota: Fish, molluscs, crustaceans) to monitor environmental pollution. The assessment of human exposure can be performed by examination of suitable human tissue, blood, urine, hair, nails, saliva and teeth.





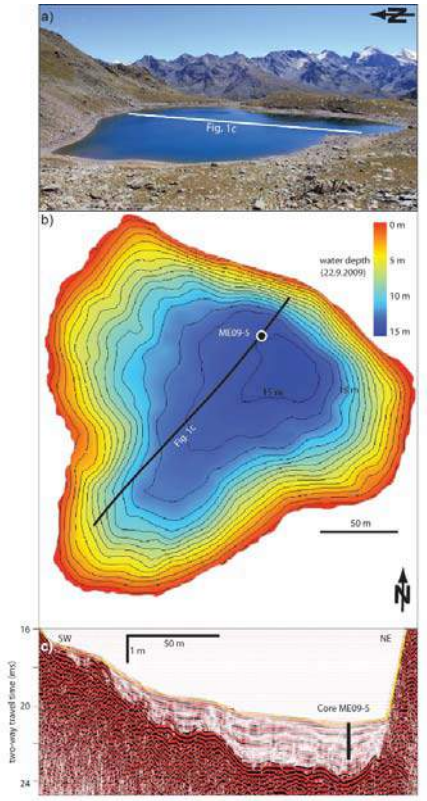




2- Science and technologies for water management - Water <u>quantity</u> monitoring

Need to estimate water quantity/availability (renewable and fossil) and water allocation among states and sectors, such as irrigation (crop water requirements) and hydropower (and transboundary pollution).

Surface water volume (bathymetry)



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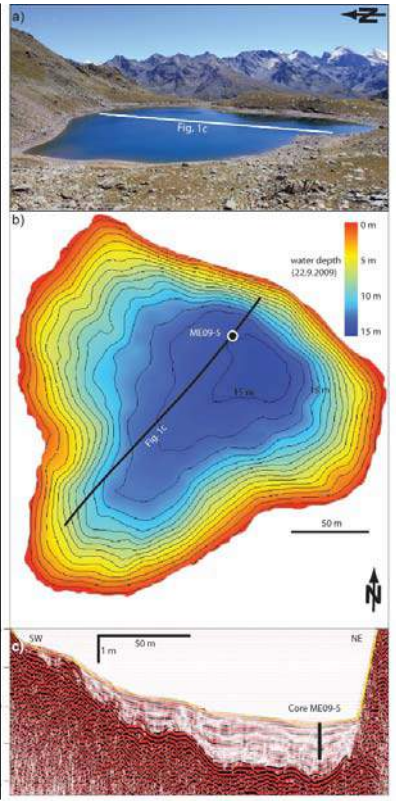

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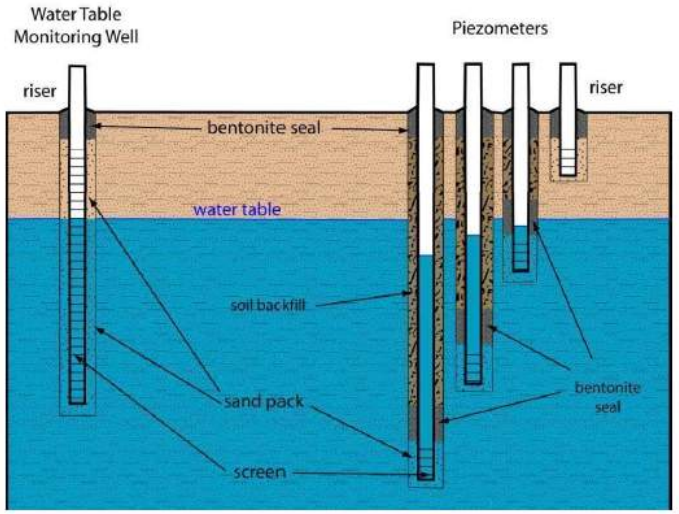
Earth observation satellite for surface water monitoring (e.g. massive irrigation impact on the Aral Sea)

Groundwater volume monitoring (piezometers)



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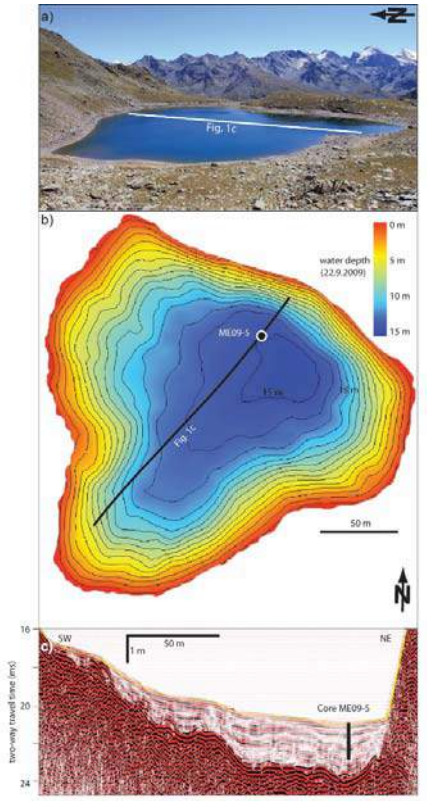
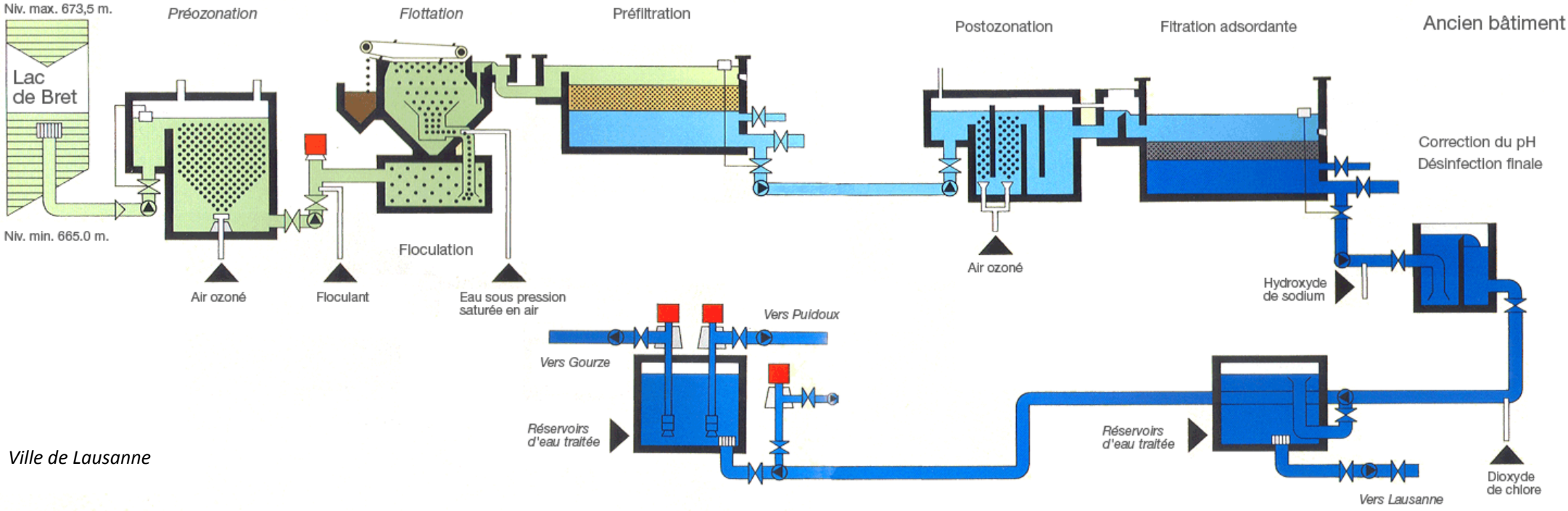


2- Science and technologies for water management

Centralized (large/expensive) drinking water treatment

Taking water from sources of poor quality means much higher operations and maintenance costs (very expensive drinking water of low quality).

New technological challenges due to a wide range of emerging contaminants (e.g. flame retardants, bisphenol, hormones) which cannot be monitored & removed conventional (wastewater/drinking) treatments.



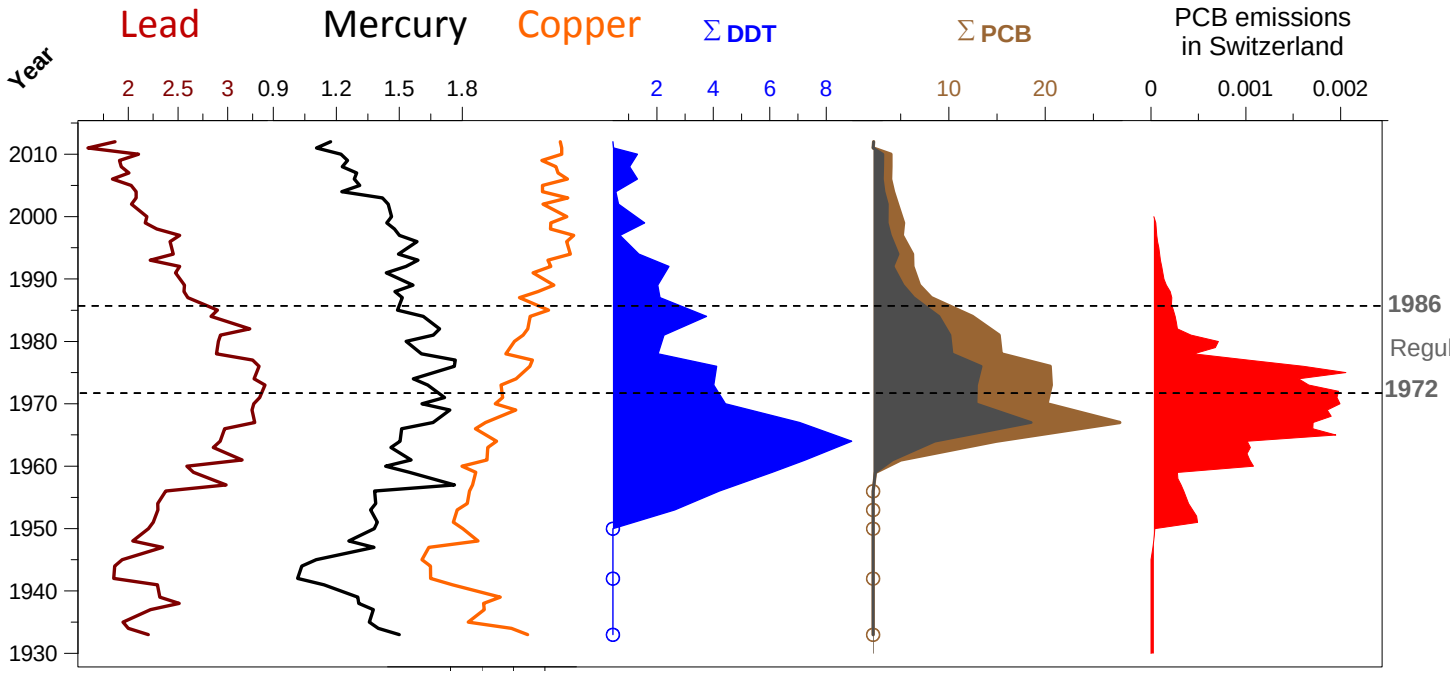
Ville de Lausanne

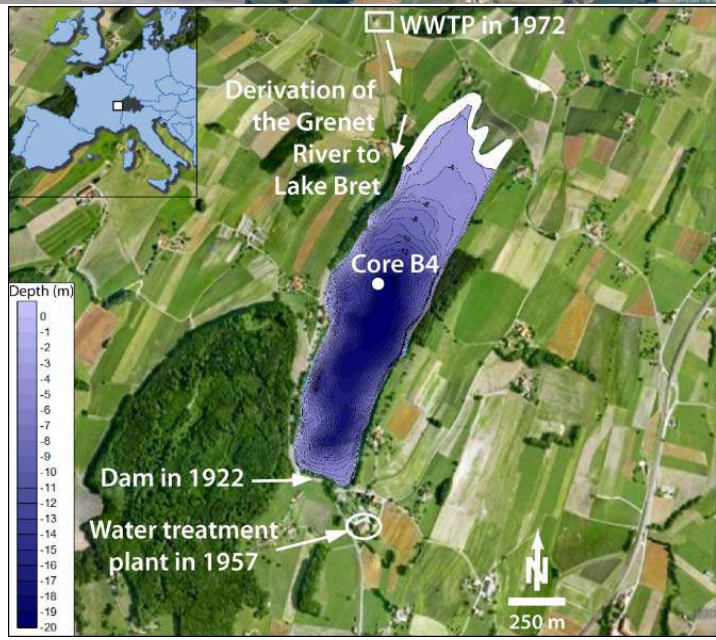
2- Science and technologies for water management

Defining & evaluating the effect of regulatory measures

Environmental assessment for understanding pollutant sources, levels and evolution with time → Defining appropriate environmental policies & for their evaluation.

Local pollution by runoff (due to rain) but also regional atmospheric transport of toxic substances: Heavy metals (lead and mercury, copper as organic fungicide), DDT (pesticide) and PCB (animal & human carcinogens) → (Inter-) national policy





2- Science and technologies for water management

Decentralized (small/low-cost) water-purification systems

Point-of-Use (POU) systems refer to the range of water treatment methods which **treat water at the point of consumption** (rather than at the source). "**Household water management**" is also commonly used, and can encompass **both treatment and storage**.

These water treatment systems have been put forward in recent years as low-cost and effective solutions for providing potable drinking water. BUT need to be regulated to increase the safety of its users: Develop legal-regulatory frameworks, apply national drinking water guidelines, control water quality, accessibility (cost), continuity of the water supply, etc.

Solar Disinfection: Solar energy (UV and temperature) to make biologically-contaminated (e.g. bacteria, viruses) water safe to drink (not for chemicals).

Water kiosk: Outlet through which formal water providers deliver safe water at affordable prices to residents of low-income areas.

New (small/mobile) technologies can produce clean drinking water from freshwater, saltwater and even polluted water.






3- Examples of transboundary water cooperation - Lake Geneva

Inter-governmental Franco-Swiss body (CIPEL since 1963) coordinating the water policy across the Lake Geneva transboundary basin (10,300 km^2), monitoring water quality, recommendations for agricultural practices, etc. Cooperations for wastewater treatment, surface and groundwater, drinking water supply, dams, solid waste management, but also fishing activities, lake transport, etc.

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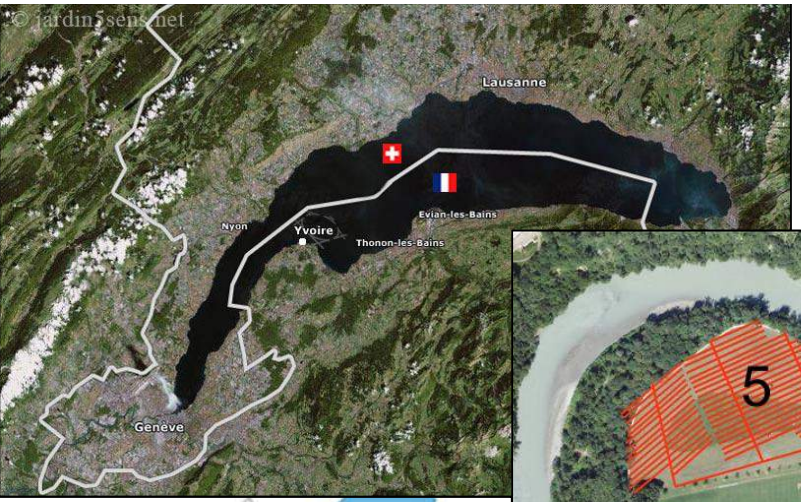
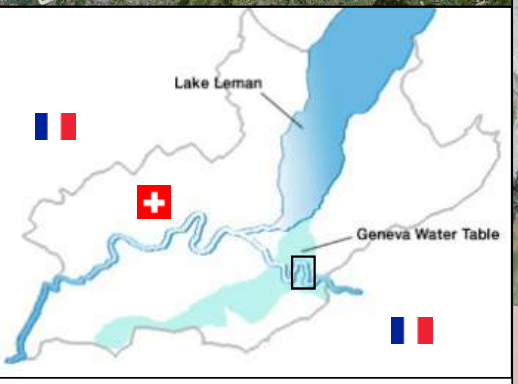
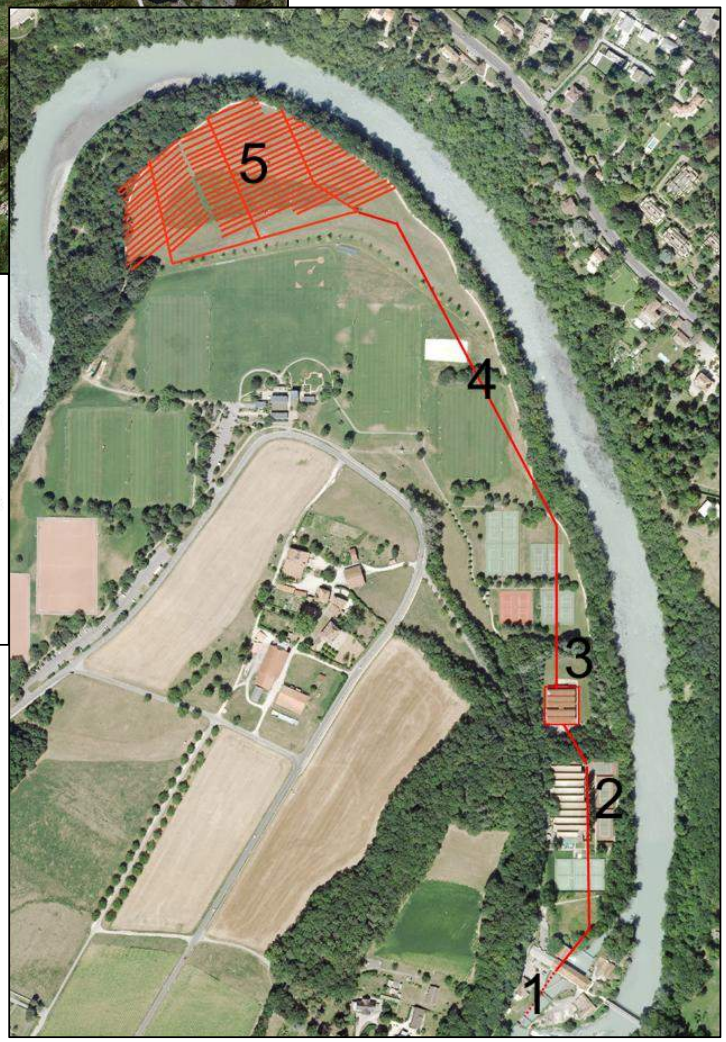
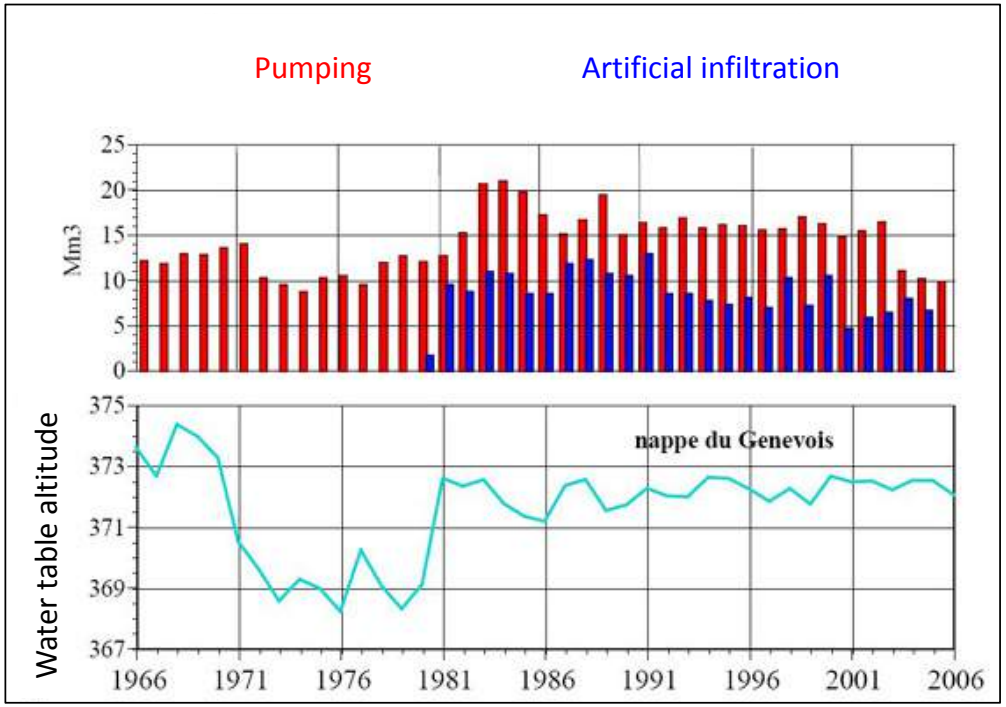
Transboundary water cooperation - Lake Geneva water table









1. Water from the Arve River is pumped
2. Pipeline to the station (340 m)
3. Basic treatment
4. Pipeline to the recharge area (700 m)
5. Recharge area (subdrains, 5000 m)

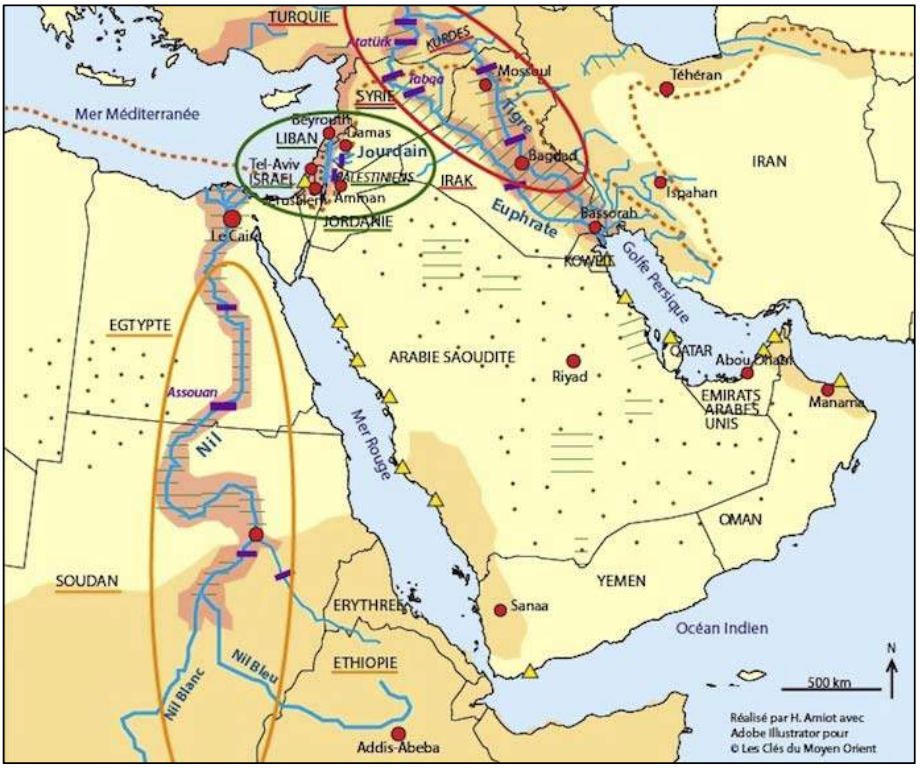
The Geneva water table (Switzerland) is mainly fed by the infiltration of water from the Arve river (France): 225 millions m^3 of water in 25 years

3- Examples of transboundary water cooperation - Water challenges in the Middle East

▶ Most of the countries of the region are semiarid or arid, and the majority of the water resources are shared among several riparian parties.

▶ An absence of "all inclusive" agreements on the international water basins in the region that lack the inclusion of other riparian States & water quality component (tend to focus on quantity measures).

▶ Absence of riparian agreements on the management of transboundary groundwater aquifers which could be renewable or non-renewable = fossil water (e.g. between Jordan and Saudi Arabia or between Egypt, Sudan, Libya and Chad).



Tree Major River basins: Nil River, Jordan Basin, Tigris and Euphrates Rivers

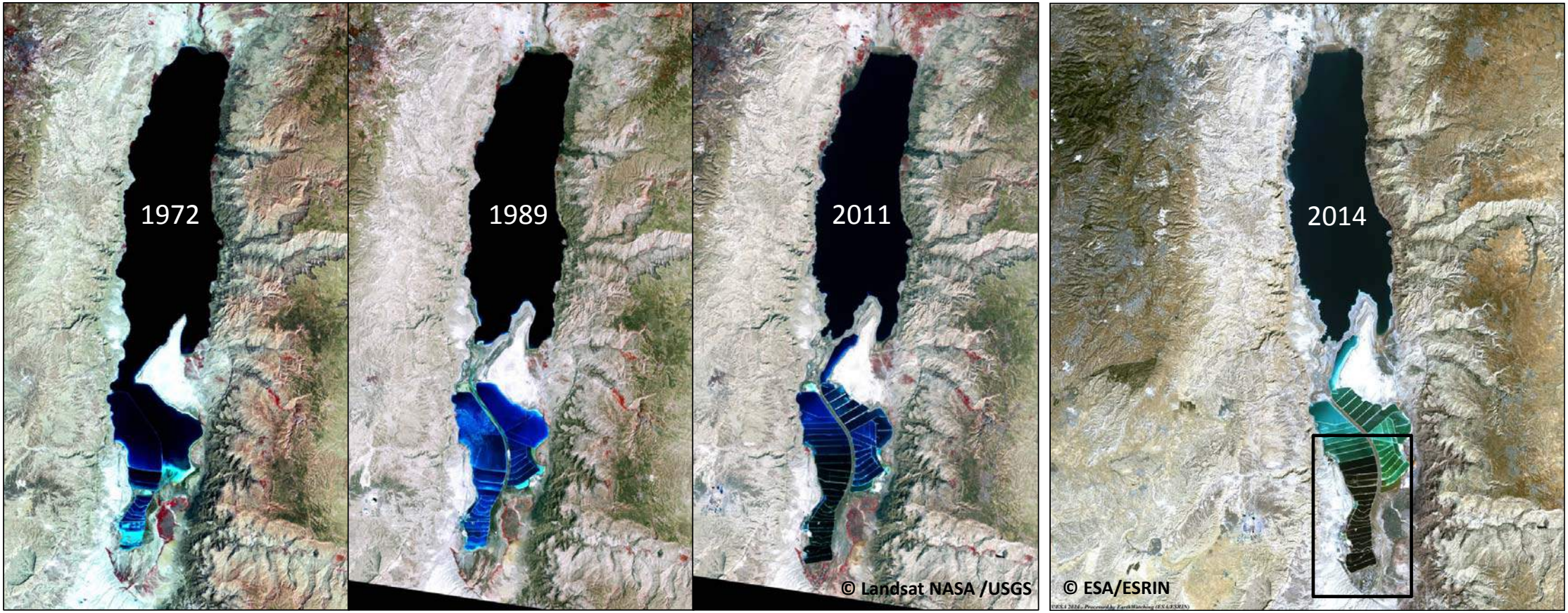
High population density
Middle population density
Low population density
Large cities

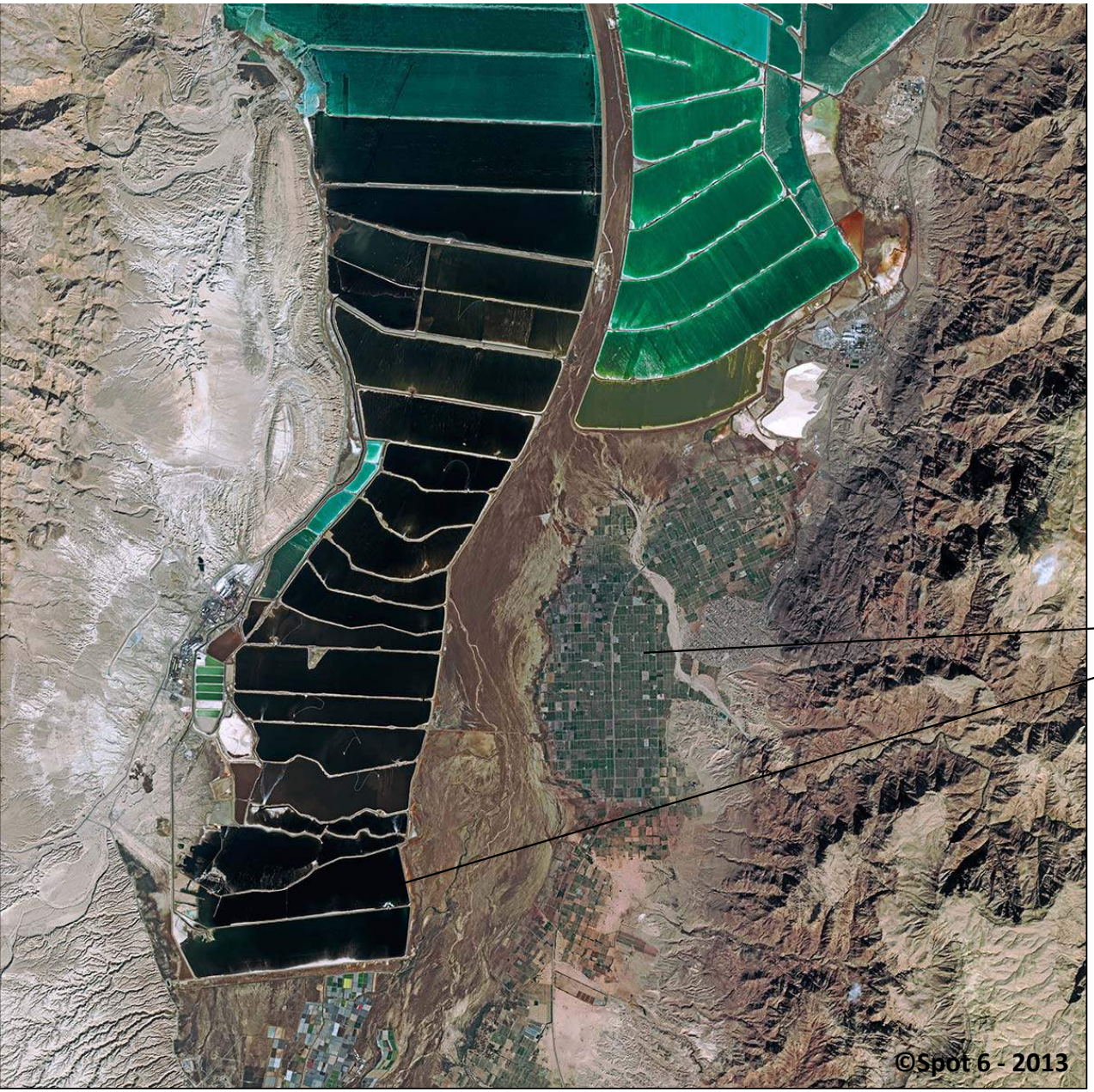
Main rivers
Tributaries
Major aquifers
Isohyet 300 mm

Large dams
Desalination plants
Irrigated agricultural area

The evolution of the Dead Sea over the last decades

During the last fifty years, the Dead Sea lost the third of its area (from 950 km^2 to 637 km^2).
Dead Sea receives today 260 million m^3 of water per year, against 1.25 billion in 1950.
Its level has dropped about 30 meters (now 422 meters below sea level and at 394 meters in the sixties).

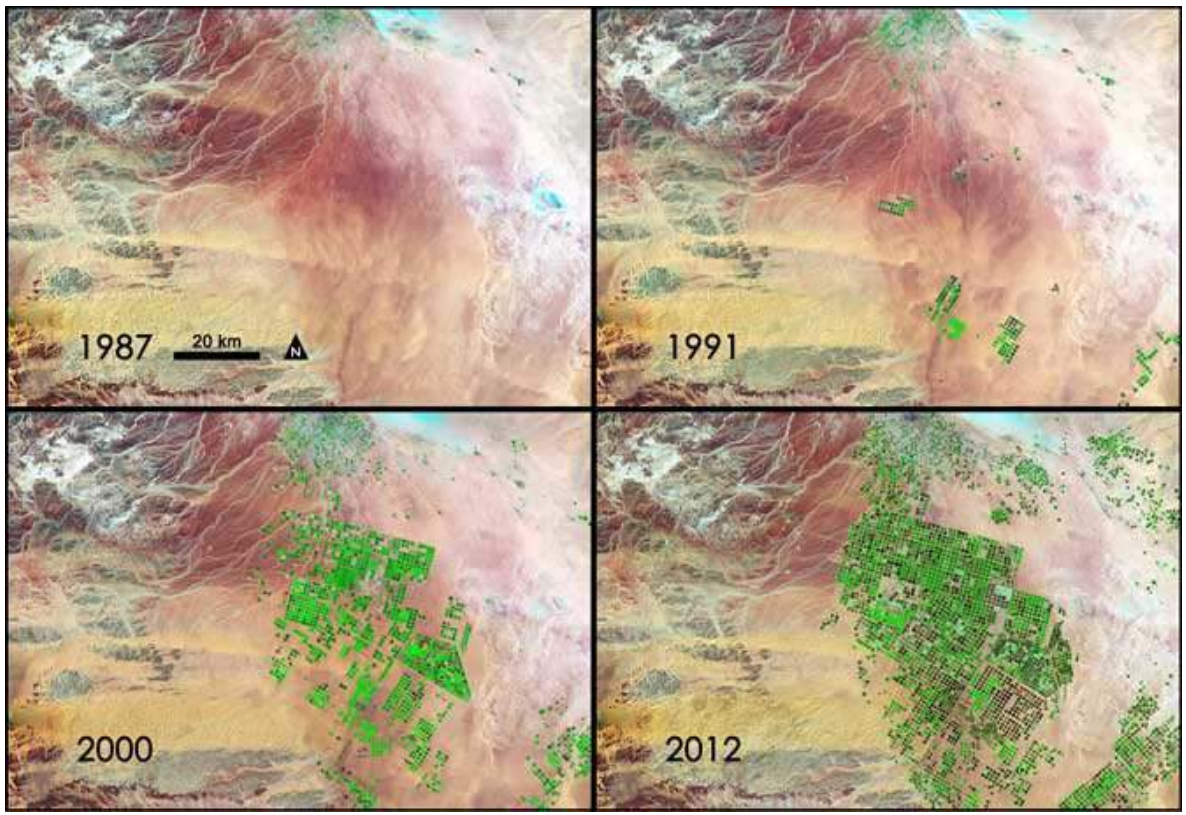




Irrigation of agricultural lands and industrial production of salts and minerals (evaporation ponds) (Israel and Jordan).

Technological adaptation: Saudi Arabia drilling groundwater resources

Non renewable fossil water (accumulated between 10,000 and 2 million years ago) is mined from depths as great as 1 km, pumped to the surface, and distributed via large centre pivot irrigation feeds. Some hydrologists estimate it will only be economical to pump water for about 50 years (**before oil?**)



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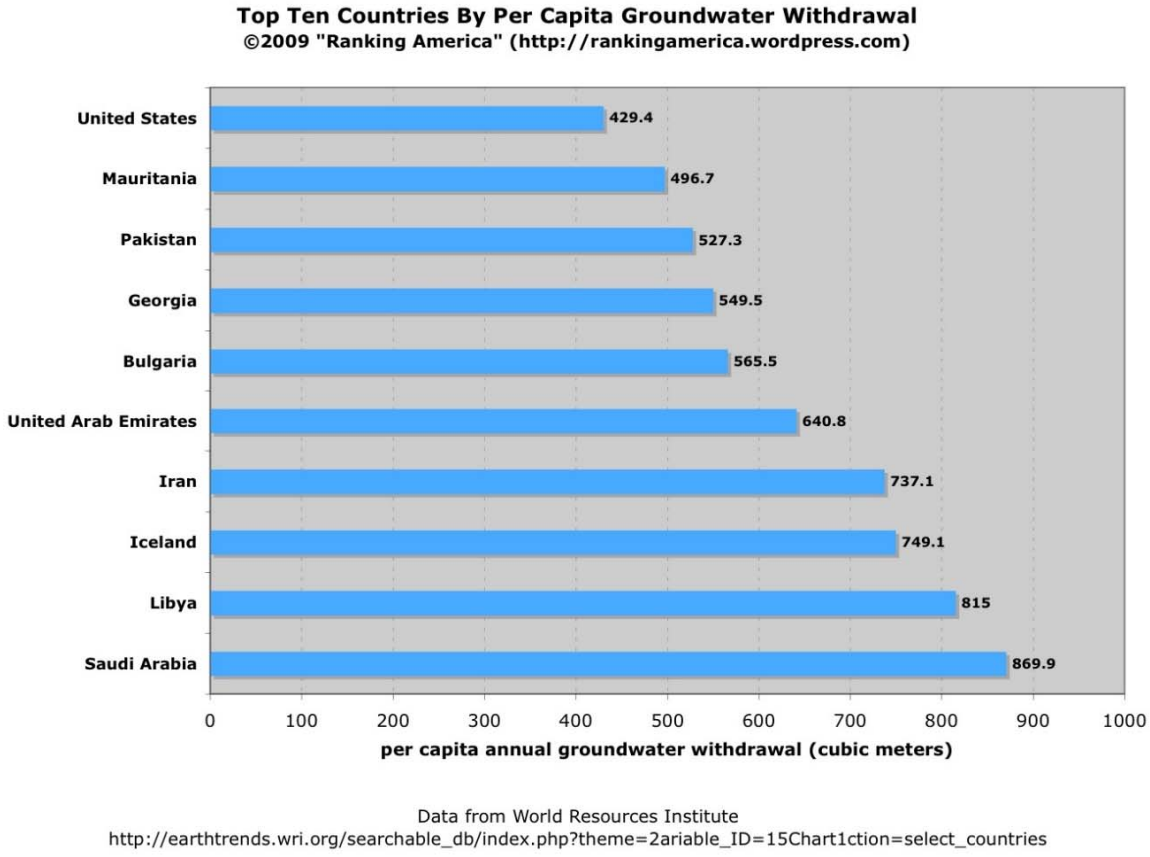


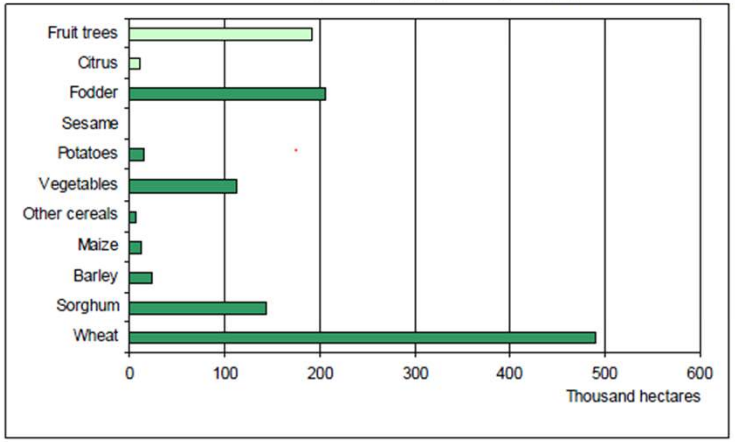
Data from World Resources Institute
http://earthtrends.wri.org/searchable_db/index.php?theme=2ariable_ID=15Chart1ction=select_countries

© Landsat NASA /USGS

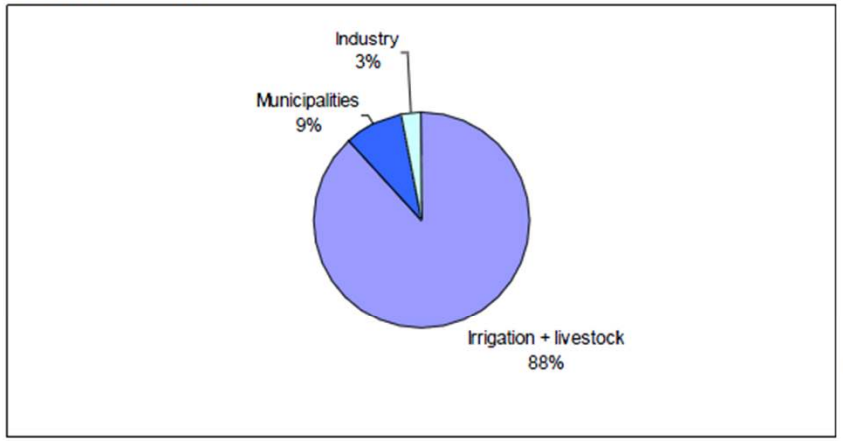
Food and Agriculture Organization of the United Nations

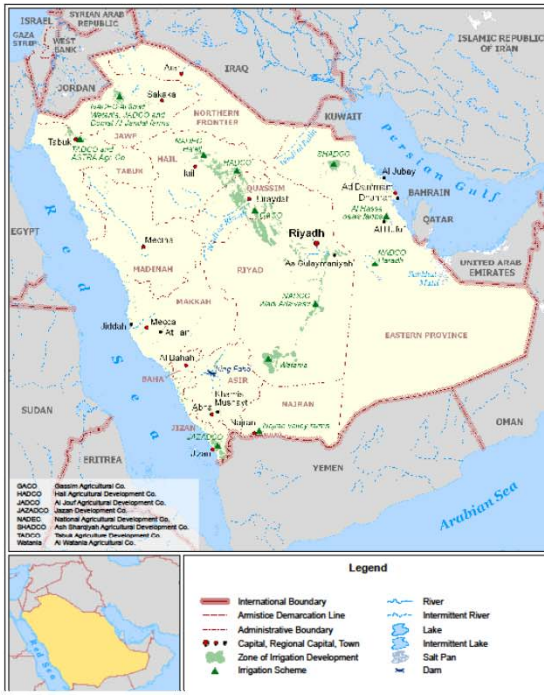
FAO's global water information system for Saudi Arabia (AQUASTAT)

Irrigated crops
Total harvested area 1 213 587 ha in 2006 (In 1999, cropping intensity on equipped area actually irrigated: 101%)

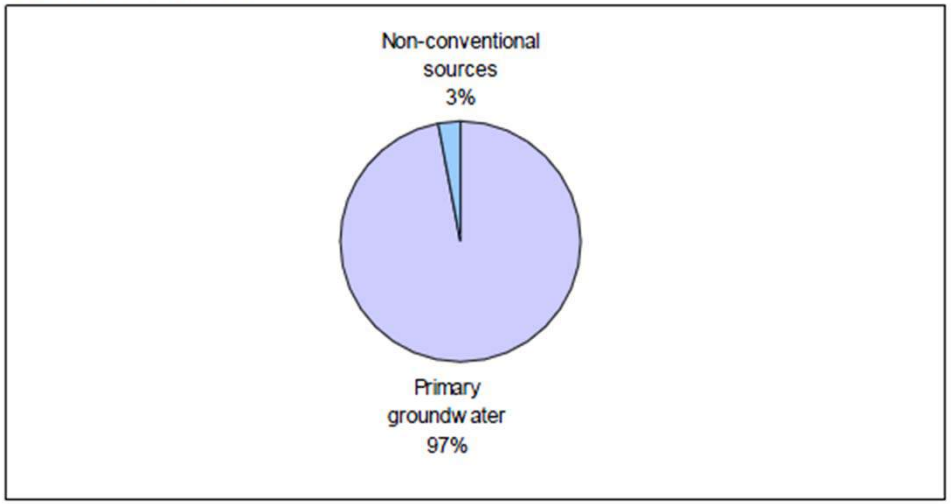


Water withdrawal by sector
Total 23 666 km^3 in 2006

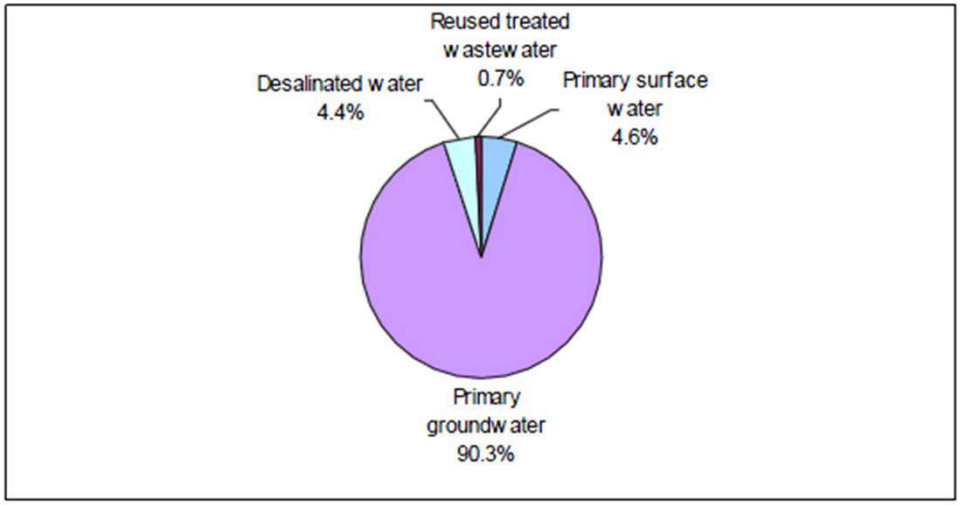




Source of irrigation water
Total 1 730 767 ha in 2000



Water withdrawal by source
Total 23 666 km^3 in 2006

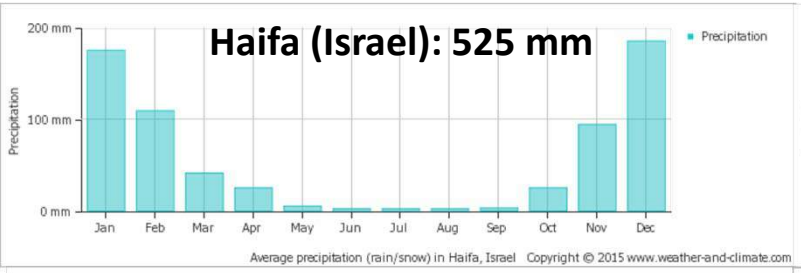


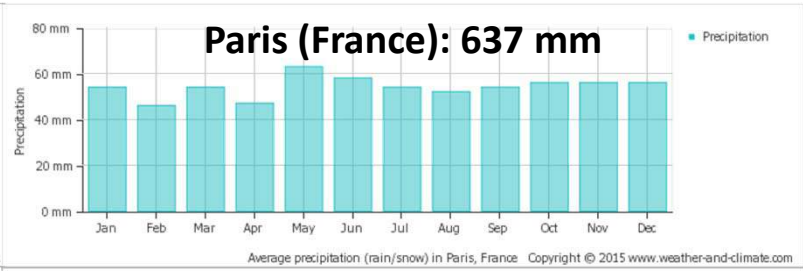
Challenges: Rainfall distribution in the Middle East

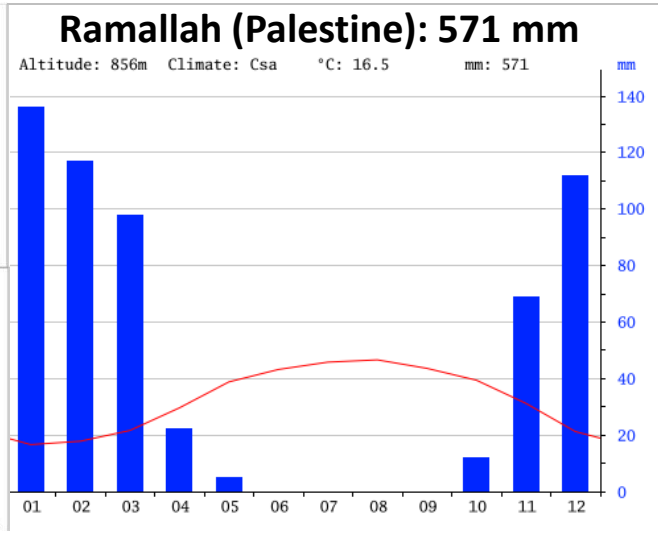
Some areas have high rainfall (around 500-700 mm/year), for example the mountains of Lebanon, Palestine and Yemen, some are rich in water resources, such as river valleys, and some are even swampy areas (e.g. delta formed by the confluence of the Tigris and the Euphrates in Iraq) (<u>problem of quantity distribution</u>).

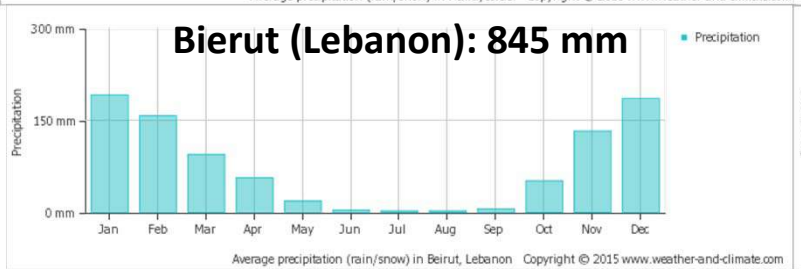
Moreover, rainfall has limited effect because of its concentration in the winter season (October-February). Therefore, the flow and the water during the floods are irregular throughout the year, in addition to being irregular between years (<u>problem of water conservation</u>, need to store water).

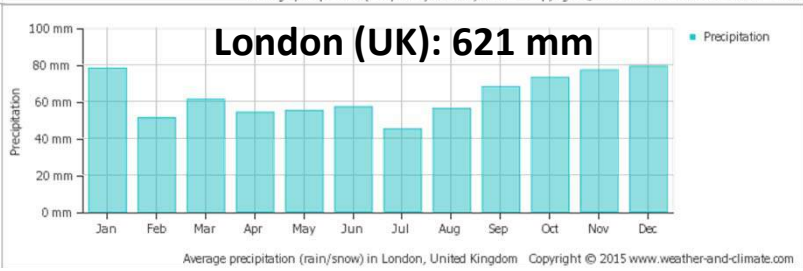
Finally, heavy concentrations of people are not situated where it rains more, but along the rivers that allow permanent irrigation for agriculture and urban water supply (<u>problem of spatial distribution</u>).







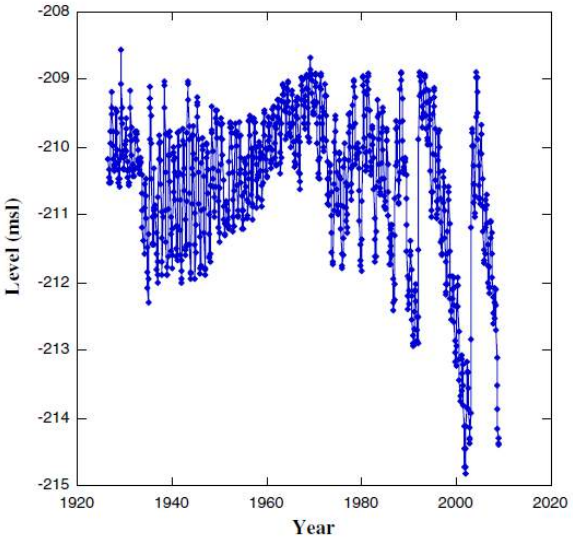




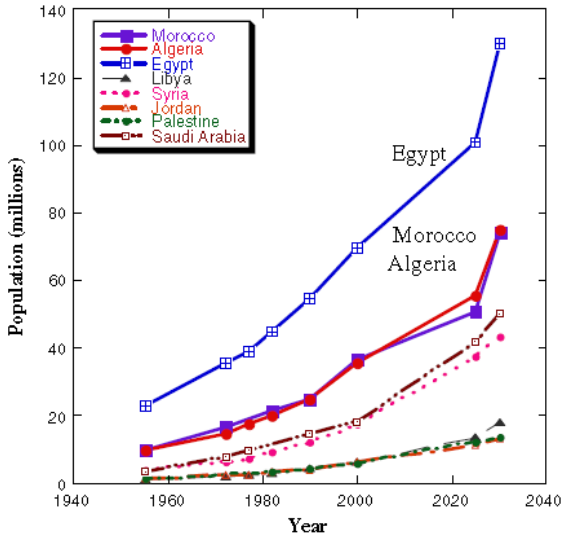
Challenges: Demographic growth in the Middle East

Demographic growth and human activities are affecting the availability and quality of water resources in the ME region:

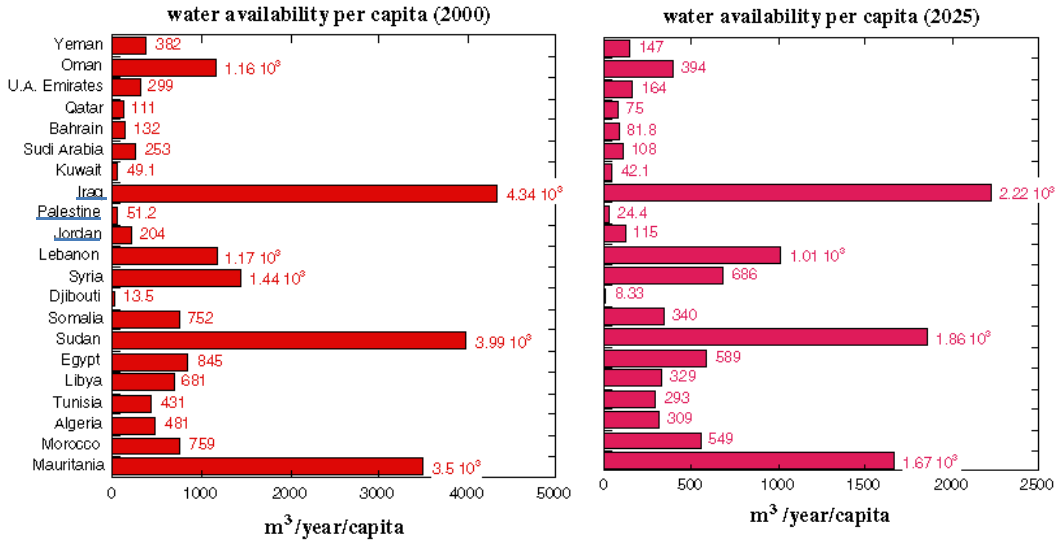
Changes of water levels in the Sea of Galilee (Israel)



Population growth in countries in the MENA region



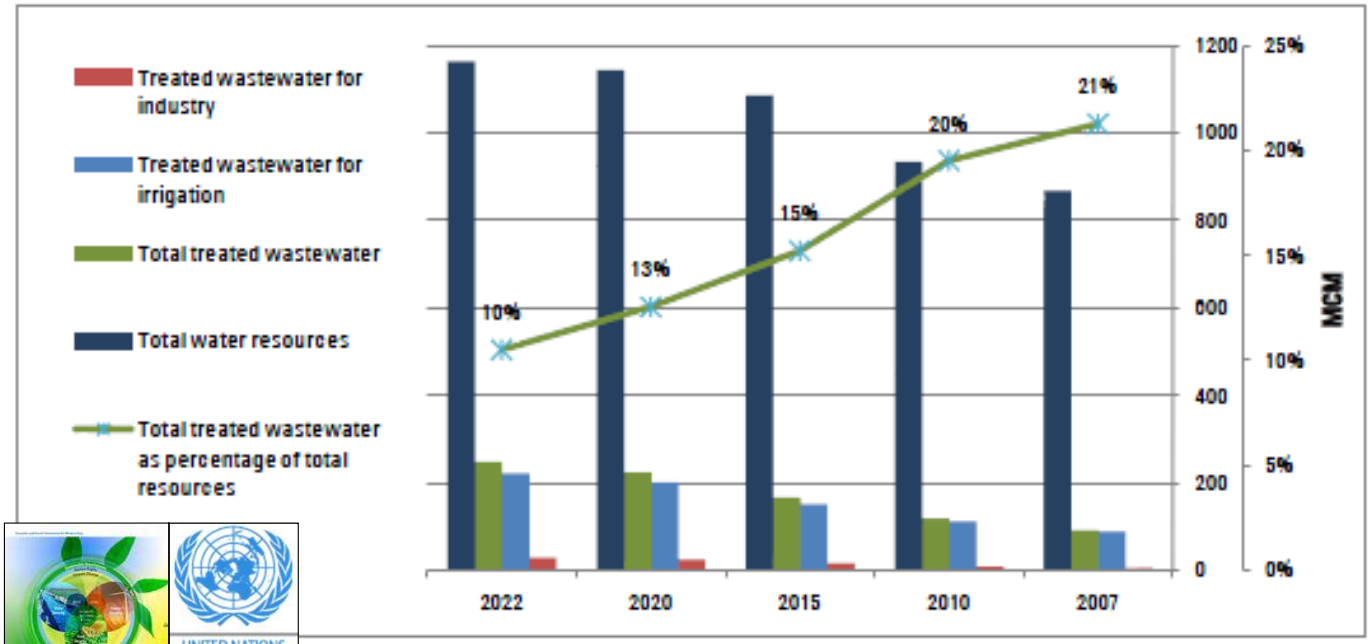
Water availability per capita (cubic meter/year/person) in some countries in the MENA region



Technological adaptation: Wastewater reuse and recycling in Jordan

Wastewater treatment **and reuse** has been introduced to the region since the late 1960. The practice has been expanded ever since and as much as 55 million m^3 of treated municipal wastewater were being reused in 2002 in Jordan.

Figure 12. Current and projected treated wastewater usage as per Jordan's National Water Strategy, 2008-2022



→ Creation of many jobs (circular economy)
→ Environmental law, policy & regulation (jobs)

Faecal sludge drying beds - The Wadi el-Shueib Waste Water Treatment Facility- Jordan

UNITED NATIONS
الاسكوا
ESCWA

Technological adaptation: Seawater desalinization in Israel

Israel: The Sorek seawater reverse osmosis plant – the largest in the world (~ $500 million)

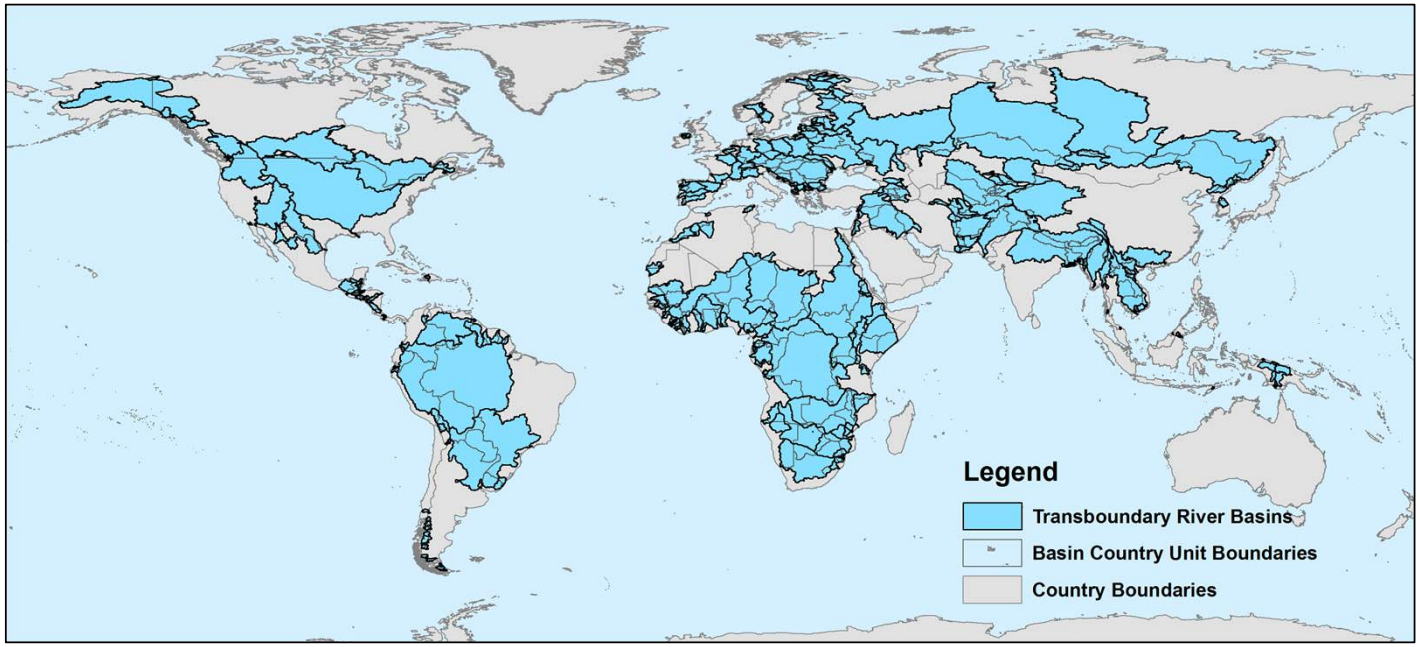
Limit: The running cost, transport, distribution, and maintenance (> $1 /$m^3$ of desalinated water ($77 for 70$m^3$/yr). If this cost is not to exceed 2% of the disposable income, the disposable income of the individual should average $3850/yr (Israel and oil-enriched countries).

Water diplomacy (Blue Peace)

The world's **263 transboundary** lake and river basins cover **nearly half** of the Earth's land surface.

The water systems of the world support the socioeconomic development and wellbeing of humanity. Many of these systems are shared by two or more nations, and these transboundary resources are linked by a complex web of environmental, political, economic and security interdependencies.

While ecosystem services provided by these systems support the socioeconomic development and wellbeing of much of the world's population, these basins continue to be impacted and degraded by multiple and complex human-induced and natural stresses.



TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

GROUNDWATER
LAKES & RESERVOIRS
RIVER BASINS
LARGE MARINE ECOSYSTEMS
OPEN OCEAN

The Global Programme Water Initiative goal is ***to influence the global policy dialogue, fostering water cooperation focusing on environmental services and on promoting equitable and balanced socio-economic development***

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The **Water Diplomacy** cluster looks at involving Switzerland in addressing the challenges of water security through the hydro-diplomacy approach which combines the creation of an enabling framework for policy dialogue at the government level with projects on data and knowledge management to foster evidenced-based dialogue, building trust and promoting sound decision-making and creating new opportunities for resolving water related conflicts.

The Global Programme Water Initiatives supports the following programs, projects and initiatives:

- Blue Peace Global
- Blue Peace in the Middle East
  - √ Blue Peace in the Middle East - Cooperation Council
  - √ Strategic Management of Hydrological and Meteorological Data in the Middle East
  - √ Challenges and Opportunities for Concerted Water Management in the Orontes River Basin
- Blue Peace Central Asia
- Water Diplomacy & Governance in Key Transboundary Hot Spots
  - √ BRIDGE (Building River Dialogue and Governance)
  - Support to the UNECE Water Convention activities
  - √ Groundwater Resources Governance in Trans-Boundary Aquifers
  - Capacity Building Development in International Water Law

Water Governance and Water Diplomacy – Blue Peace in the Middle East

Cooperation Council

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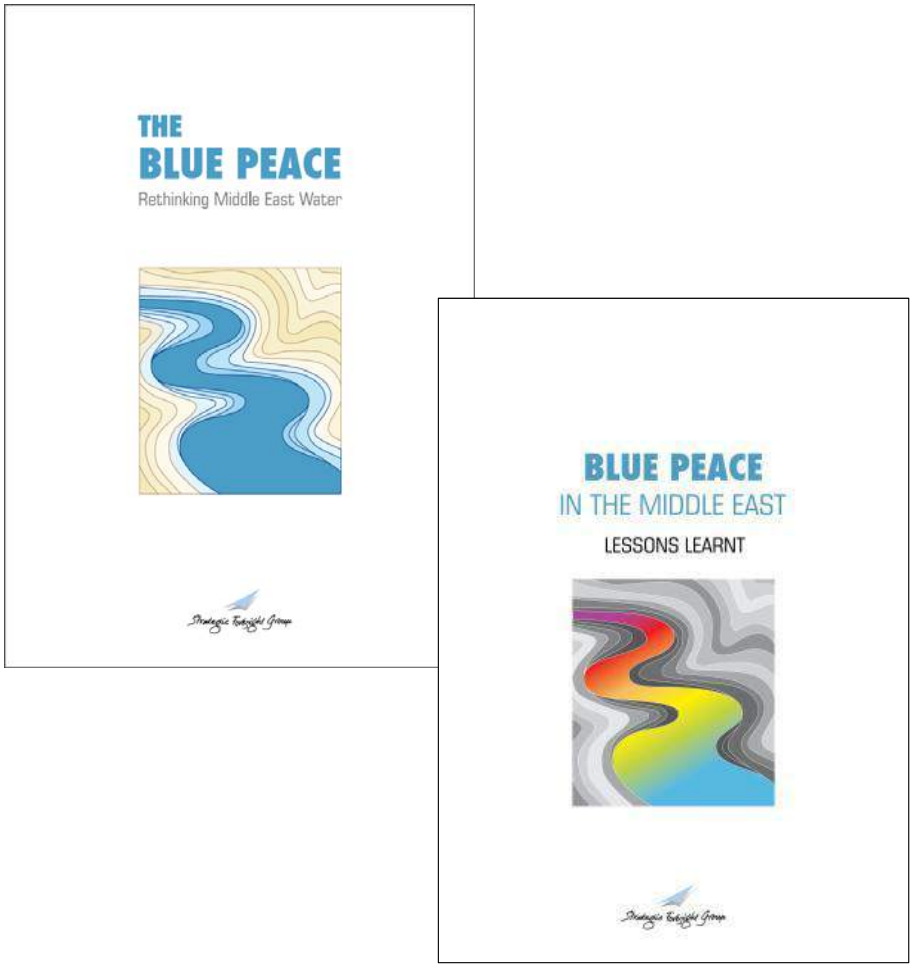
Middle East Water Initiative Based on European Model

Switzerland, Germany, France, Luxembourg, the Netherlands, Austria, Liechtenstein, Belgium and Italy are 9 European countries that closely and productively cooperate to protect the Rhine River from pollution, and monitor the quality and the density of its water flow to ensure its optimal utilization.

These European countries constitute a model for peaceful and civilized cooperation, despite their ethnic diversity and linguistic differences as well as a long history of political disputes. This is the message that the Strategic Foresight Group's (FSG) "Blue Peace in the Middle East" initiative seeks to convey to the countries of the Middle East.



Water Governance and Water Diplomacy – Blue Peace in the Middle East

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Trip organized to the Rhine between Germany and Switzerland, in which politicians, experts and reporters took part (from Turkey, Iraq, Lebanon, Jordan, Syria, Egypt and Saudi Arabia).

KEY LEARNINGS AND MESSAGES

- Political commitment and willingness at the highest level is extremely important
- Time and patience is needed, especially when the political climate might not be favourable
- Trust is a necessary factor in joint management at all levels. The media is a good tool to correctly inform the public and dispel myths about neighbours
- Joint monitoring can be achieved in many different ways, through a joint international monitoring station at national borders, or through sharing of data from national monitoring stations
- While it is not necessary to have the same monitoring equipment at different monitoring stations, exchange of data is very imperative
- Frequent exchange and interaction between relevant government departments and the scientific and technical community is essential to inform policy decisions
- Building small monitoring stations for quality control is not expensive and can be a step towards building cooperation
- Local community involvement to build ownership is an important parallel track

Water Governance and Water Diplomacy – Blue Peace in the Middle East

Strategic Management of Hydrological and Meteorological Data in the Middle East

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Theme/Cluster
Water Diplomacy

Region
Middle East; Lebanon, Jordan and League of Arab States

Partners
World Meteorological Organisation (lead); National Hydromet Services, Royal Scientific Society, League of Arab States, UN-ESCWA

Background information
It is not possible to manage what is not measured: this is a most basic part of water resources management.

Project objectives
Strengthen the delivery of hydro-meteorological services in Middle East countries to improve water resources management and support economic development.

Beneficiaries
Users of hydro-meteorological services in public and private sectors.

Water Governance and Water Diplomacy – Blue Peace in the Middle East

Challenges and Opportunities for Concerted Water Management in the Orontes River Basin

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Swiss Agency for Development and Cooperation SDC

Theme/Cluster

Water Diplomacy

Region

Middle East Region; Lebanon, Syria and Turkey

Partners

Graduate Institute of Geneva (lead), Lebanese and Turkish water organizations and academia, Syrian experts

Background information

The 2011 Middle East Blue Peace report recommended IWRM in cross border rivers.

Project objectives

Strengthen capacities for IWRM at local and national level to foster water cooperation in the Orontes river basin, post-conflict.

Beneficiaries

Water users in the Orontes basin at all levels (irrigation, water supply, ecosystems).

The Orontes river basin is highly significant from strategic, political and socio-economic standpoints and comprises some of the most conflict-affected areas in Syria.

Water Diplomacy and Governance in Key Trans-boundary Hot Spots

Groundwater Resources Governance in Trans-Boundary Aquifers

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Swiss Agency for Development and Cooperation SDC

Theme/Cluster

Water Diplomacy

Region

Central Asia, Southern Africa, Central America

Partners

UNESCO IHP, IUCN

Background information

Two-step approach to build recognition of the shared nature of the resource and to reach consensus on trans-boundary governance mechanisms.

Project target

- **To improve knowledge and recognition of the importance and vulnerability of trans-boundary groundwater resources.**
- **To enhance cooperation on water security, reduce trans-boundary and water-use conflicts, and improve overall environmental sustainability.**

Beneficiaries

National Governments, Major user groups, International organisations

BRIDGE - Building River Dialogue and Governance

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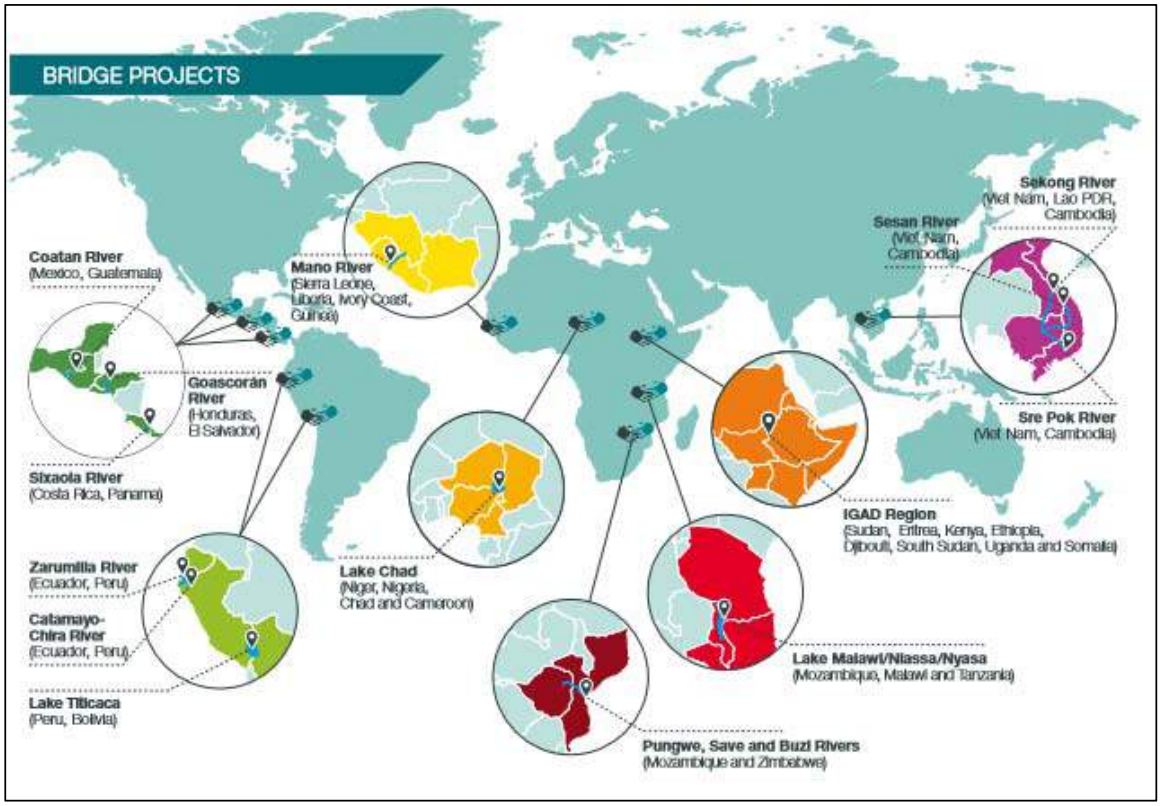
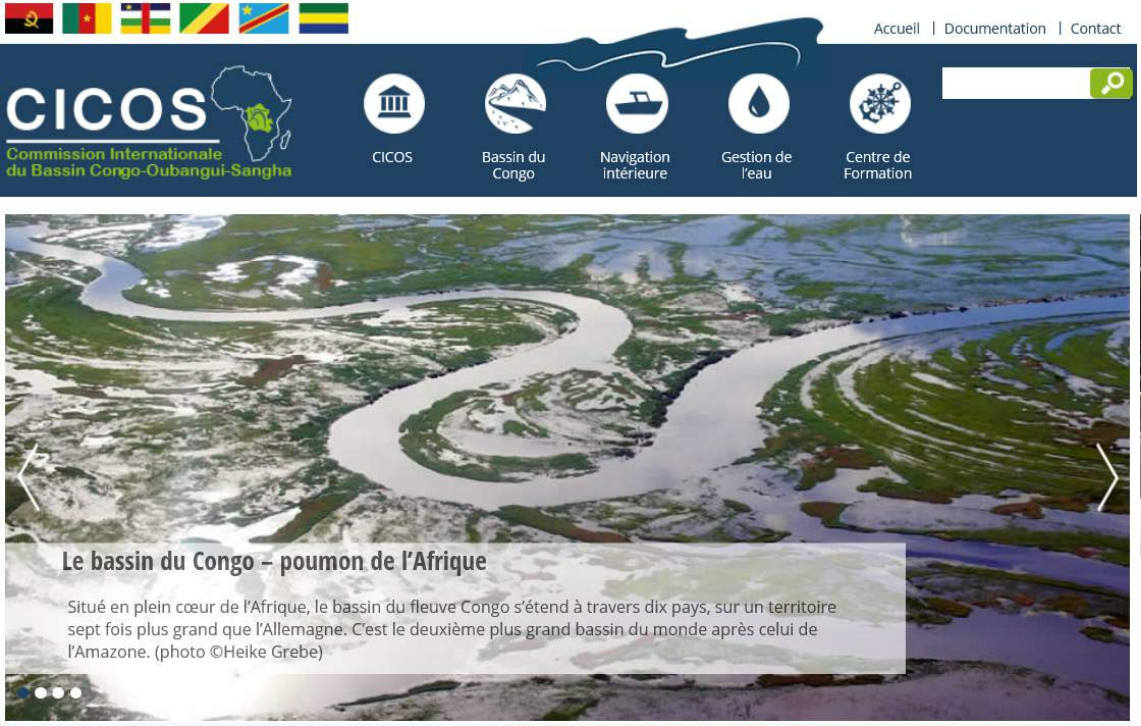
BRIDGE supports the capacities of countries sharing river or lake basins to implement effective water management arrangements through a shared vision, benefit-sharing principles and transparent and coherent institutional frameworks. Its goal is to enhance cooperation among riparian countries by applying water diplomacy at multiple levels.

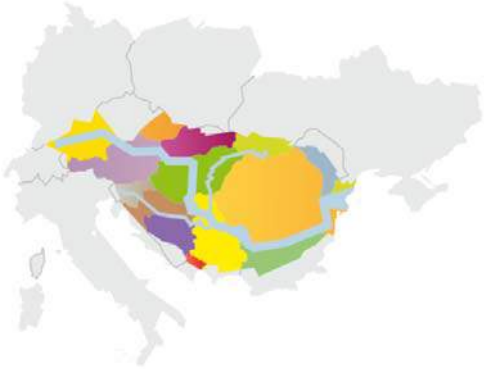


Water Law & Governance Support Platform

The Water Law and Governance Support Platform (WLGSP) offers legal expertise and ad hoc technical support on water governance issues in transboundary basins.

Examples of transboundary water cooperation





The Danube river is the one that flows through the most nations (travels within the territory of 18 nations)

Conclusions

- Need to develop national strategies for monitoring and assessment of rivers, lakes and groundwaters – tailored to the specificities of the river basin
- Need to promote riparian agreements on transboundary rivers and groundwater aquifers (e.g. UNECE Convention)
- National water strategies should form the basis of legislation and should spell out institutional arrangements (regional water management culture)
- Policies need to address the various aspects of the water sectors (e.g. irrigation, municipal/industry) and its components, including the “informal” sectors
- Harmonized (comparable) quality data collected and reported to the target groups (public authorities, joint bodies, public)
- International partners and agencies can provide assistance to restructure the water sectors by extending capital assistance and technical support, promoting high-level dialogue on the sector reforms
- A common platform for water monitoring can foster a strong cooperation among all the involved parties/countries (i.e. scientific-based approach with international coordination mechanisms)

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http://www.cicos.int/

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Additional sources

WATER DIPLOMACY CONSORTIUM

UNITED NATIONS
ESCWA

United Nations Economic and Social Commission for Western Asia

Klingbeil, R., 2012. Groundwater and Water Management Issues in the Middle East. Presentation as part of the Water Resources Management Program / Desert and Arid Zones Sciences Program / Environmental Management Program.

How has this session given ideas for improvements in water management or new business ideas?

Please write your answer on the post-it notes – answers will be collated into a slide to share later in the day

e.g.

- Is there a laboratory with capacity for water analysis and monitoring?
- Are there any new technologies for water supply or sanitation that would work in your region?
- Is there any collaboration with overseas University or Research Centres on environmental assessment and monitoring?
- Is the reporting of water quality analysis accessible?