

The Water-Energy-Food-Ecosystem (WEFE) Nexus Approach and the Water Cycle

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Water-Energy-Food- Ecosystem (WEFE) “Nexus” and the Water Cycle

- The **WEFE Nexus** is often considered as a very “novel” approach in dealing with all four of its crucial for our life and economy components, which are interconnected through human intervention and also with the climate change.
- Few, perhaps, realize readily that all these components were always interconnected closely through the different aspects of the **Water Cycle** in nature.

Water-Energy-Food- Ecosystem (WEFE) “Nexus” and the Water Cycle(s)

1. The “better known” cycle:

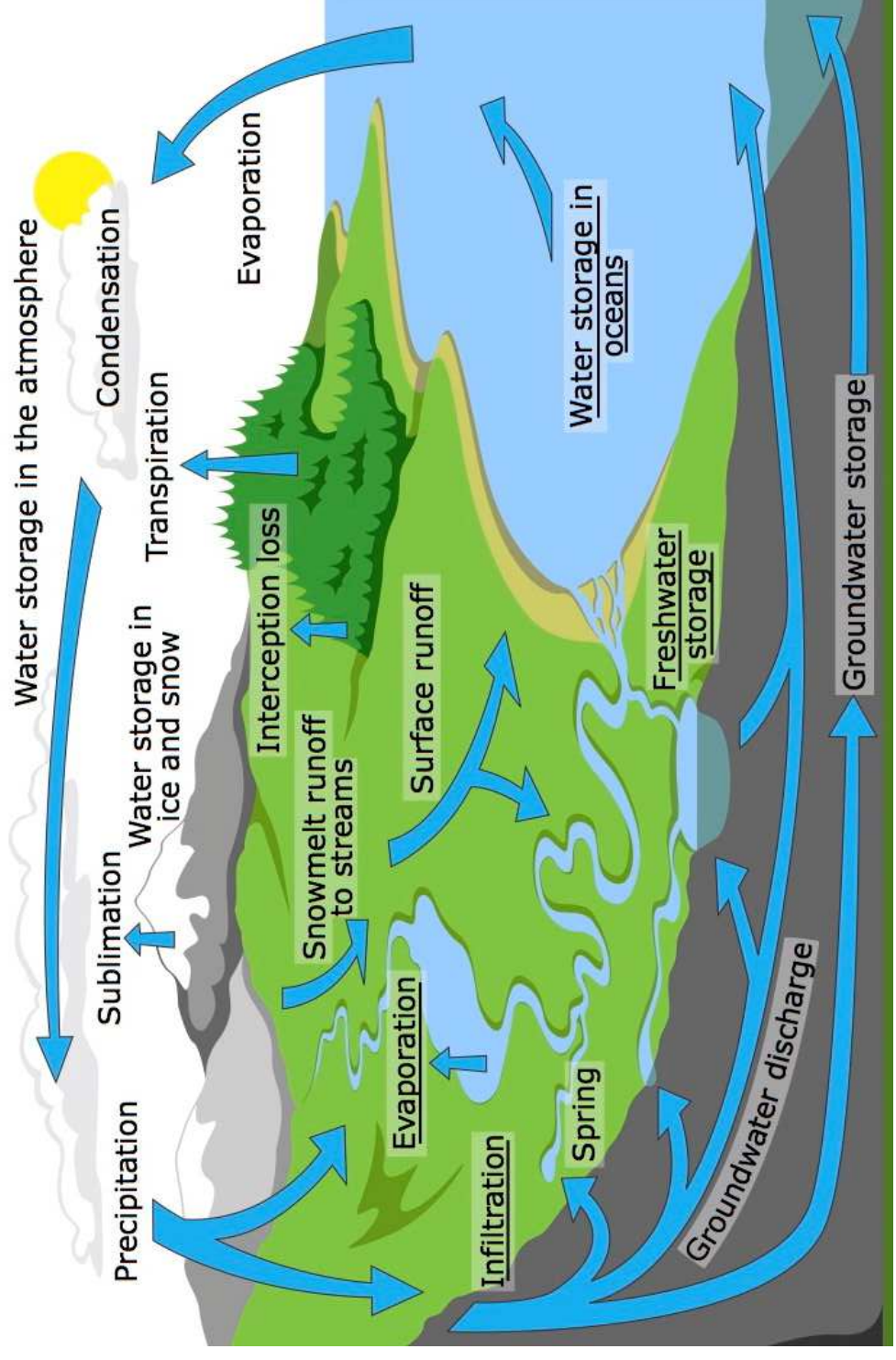
evaporation/evapotranspiration -> condensation

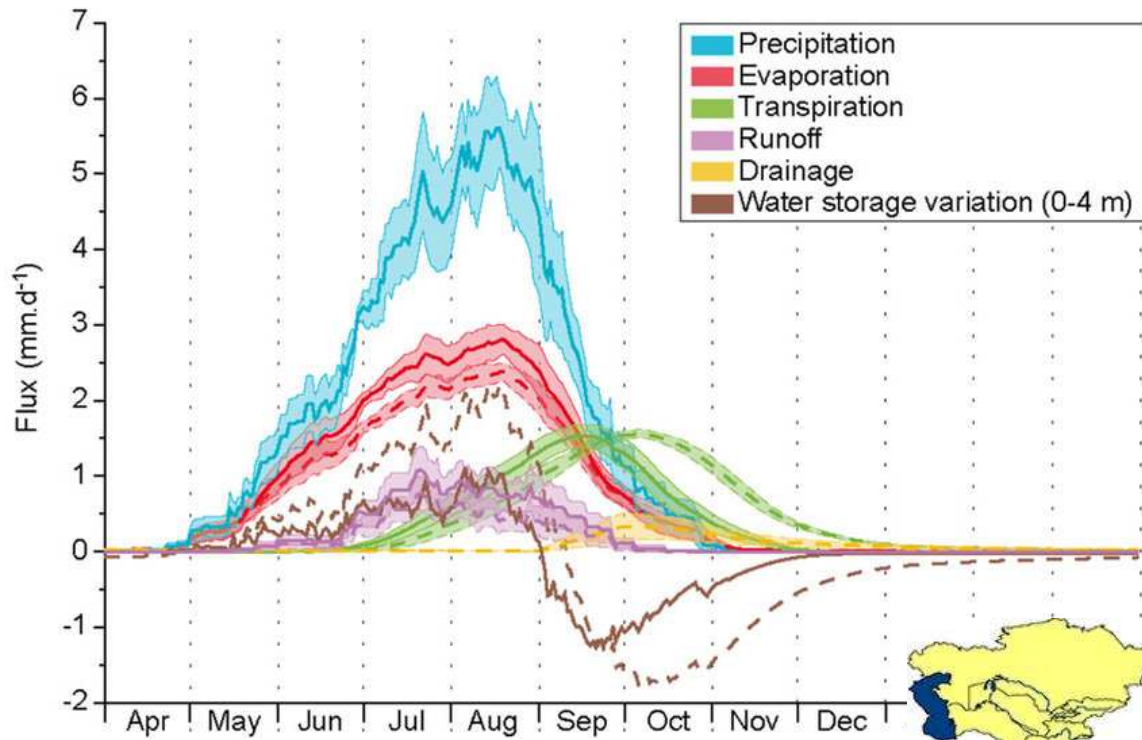
-> precipitation -> runoff -> percolation -> discharge

2. The **seasonal circularity** of the water cycle and each significant variations in the different temperature climatic and geographical zones

3. The **geographical circularity** of water and ocean currents in the planet

DYNAMIC AND COMPLEX: THE GLOBAL WATER CYCLE

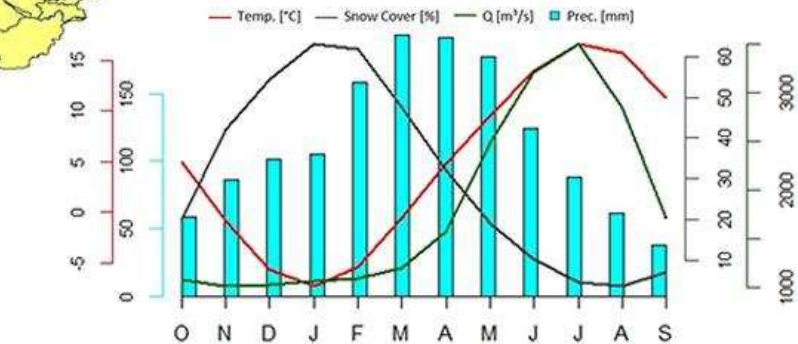




← West Africa



Water Availability



Process Understanding

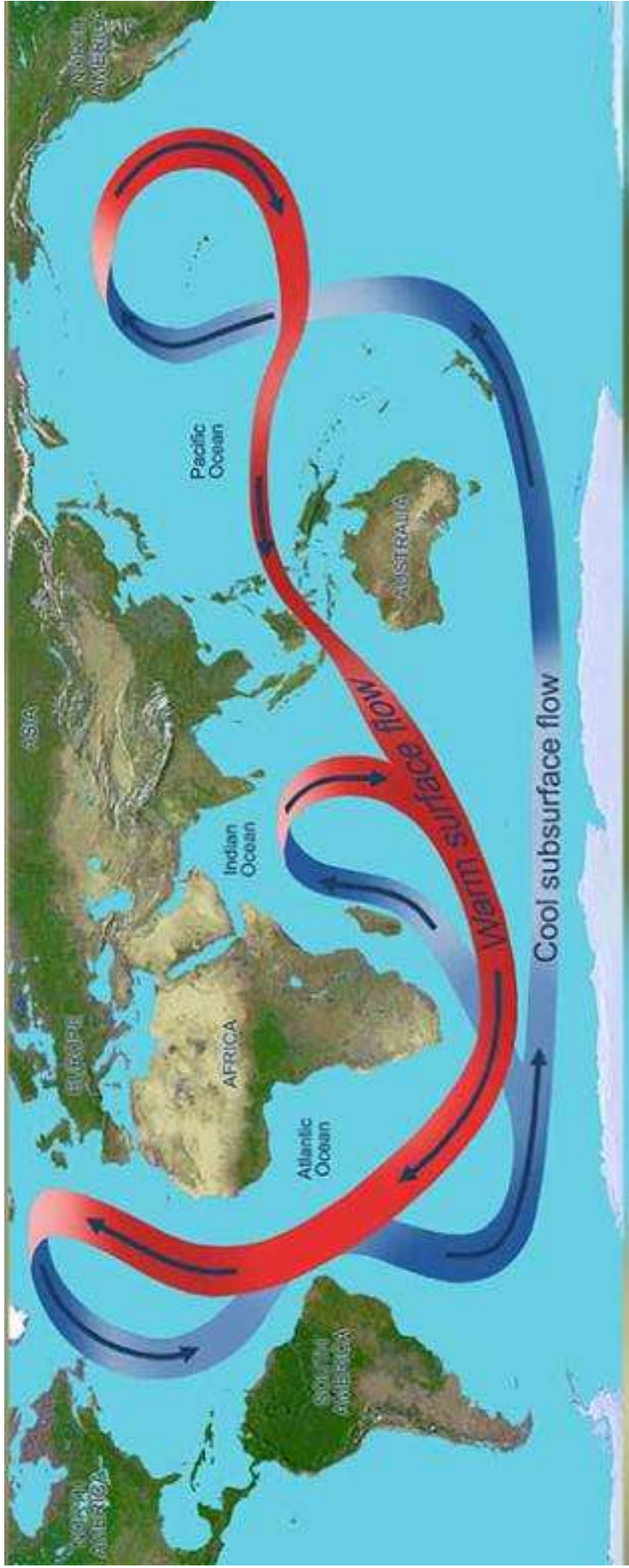
Central Asia →

Decision-Making



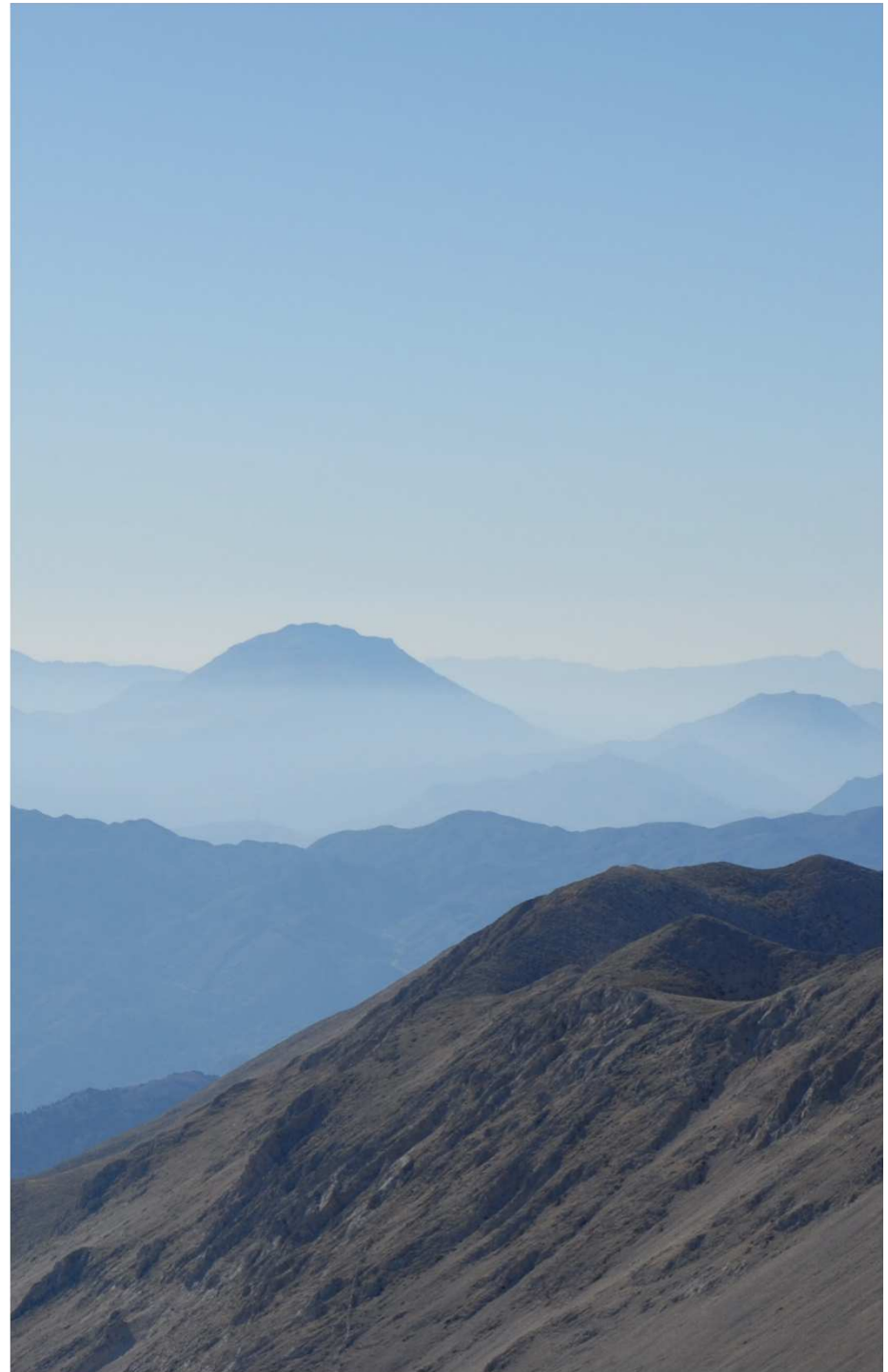
- Seasonal Climate Outlook
Based on ENSO and Northern Hemispheric Snow Cover
→ High Uncertainties
- Seasonal Discharge Forecast
Based on snow cover, previous climate conditions and antecedent discharge
→ High Accuracy

Seasonal Forecasting



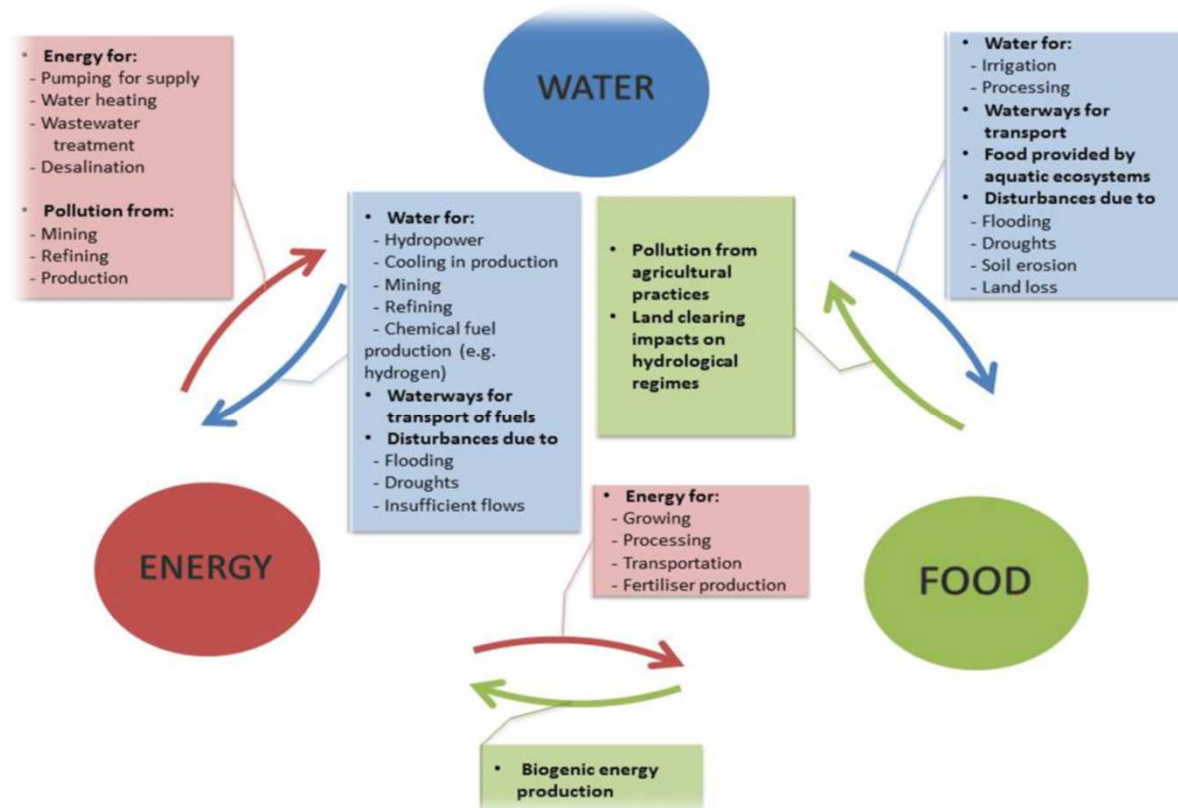
Water-Energy-Food- Ecosystem “Nexus”: an integrated approach

In the water-stressed Mediterranean where desalination, irrigation and water treatment consume considerable amount of energy, the introduction of the concept of **Nexus is important** and facilitates the proper understanding of interrelationships of energy with water, food and ecosystems and the way in which policies and interventions in these sectors could be promoted in a coherent and coordinated way so that development is sustainable and biodiversity is protected.



While the water cycle offers a good introduction to “Nexus”, this concept facilitates innovative and integrated policies

- The concept was introduced in 2011 linking primarily **Water** to **Energy** and soon after **Food**



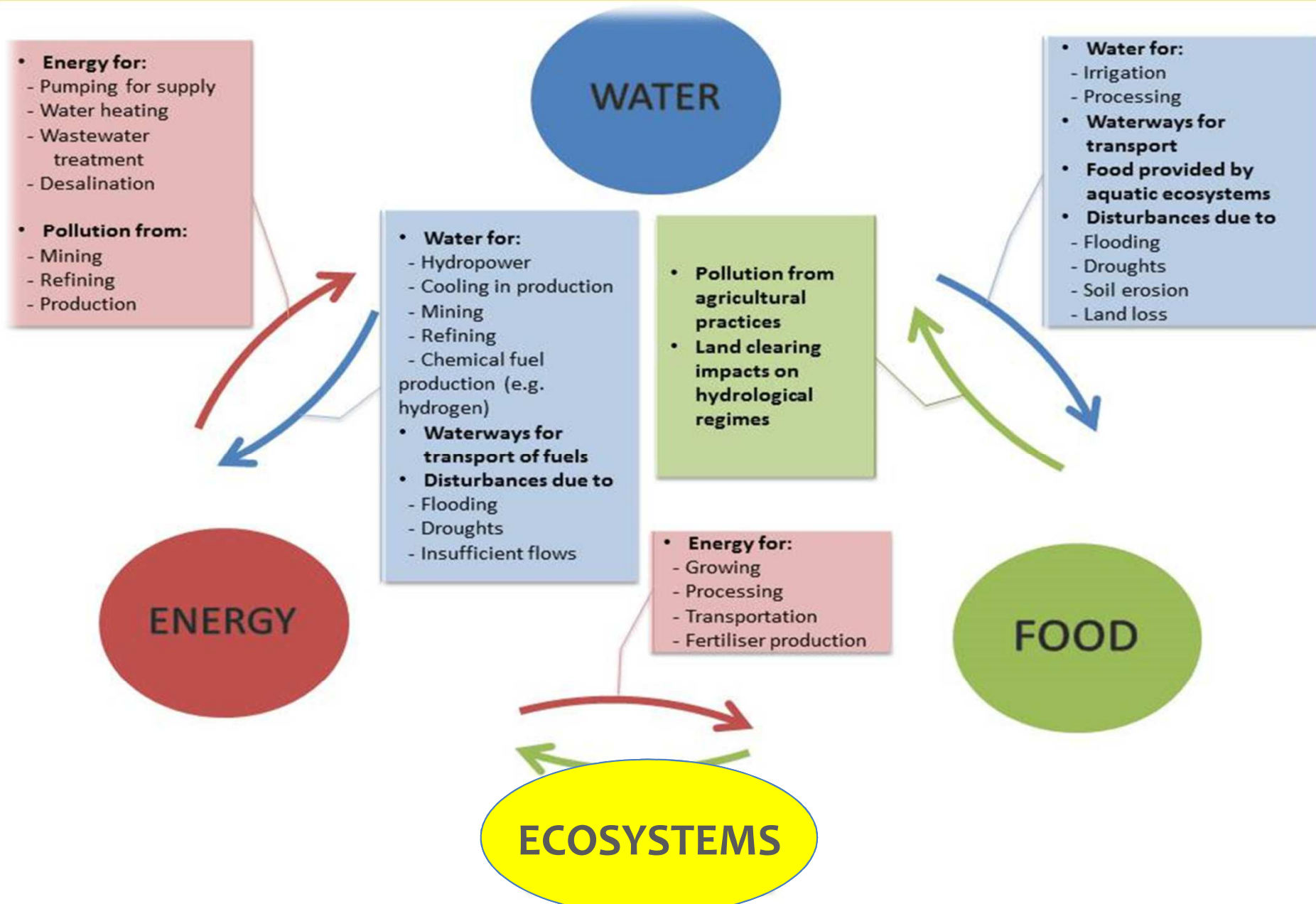
The energy in the Nexus

- The role of energy in the nexus is crucial because of its direct links with both water and food and indirect mainly through climate change with ecosystems.
- **Energy-Water:** Hydropower, cooling water in industries, energy for water extraction and irrigation, for desalination & grey water treatment.
- **Energy-Food:** Agricultural production, harvesting, livestock, transport and treatment of foodstuffs.
- An additional way Energy is linked with the Nexus is through Climate Change

The “policy” expansion of Nexus to the ecosystems

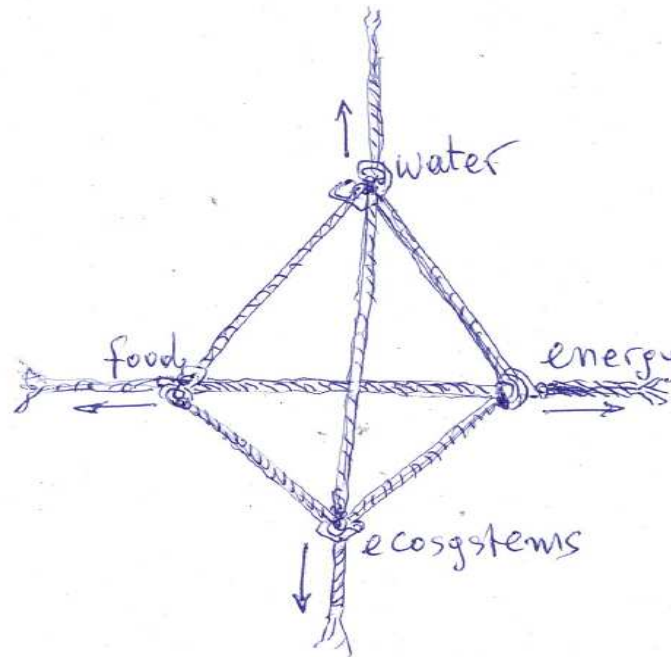
- Through Nexus energy is linked directly and indirectly also to ecosystems and biodiversity.
- Gradually, under the observed rapid deterioration of biodiversity due to agriculture, pollution and climate change, the ecosystems were added to the Nexus.
- The energy production and consumption but, most importantly the source of energy, shifting to concentrated solar power and other renewable energy sources, may change altogether the character and internal balance of the Nexus.

The Nexus: A world of inter-dependencies



Visualization of Nexus

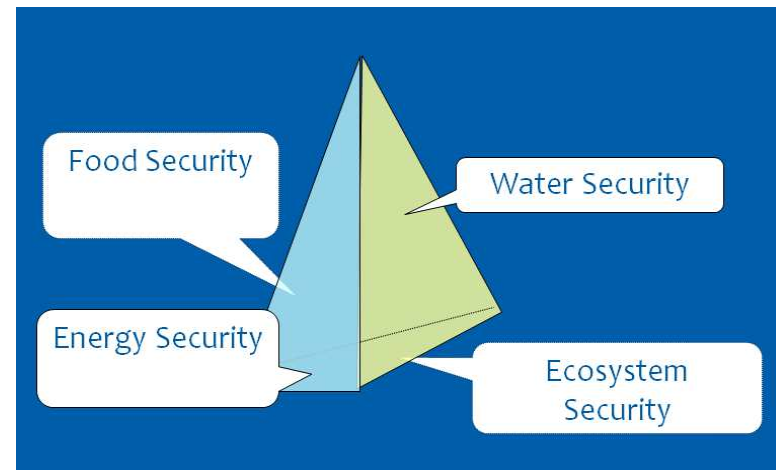
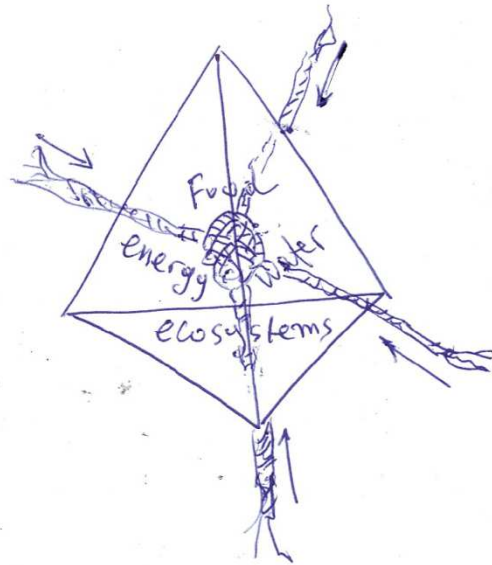
A. As a system of “tensions”:



This visualization indicates that if one pulls too hard, the Nexus will be broken

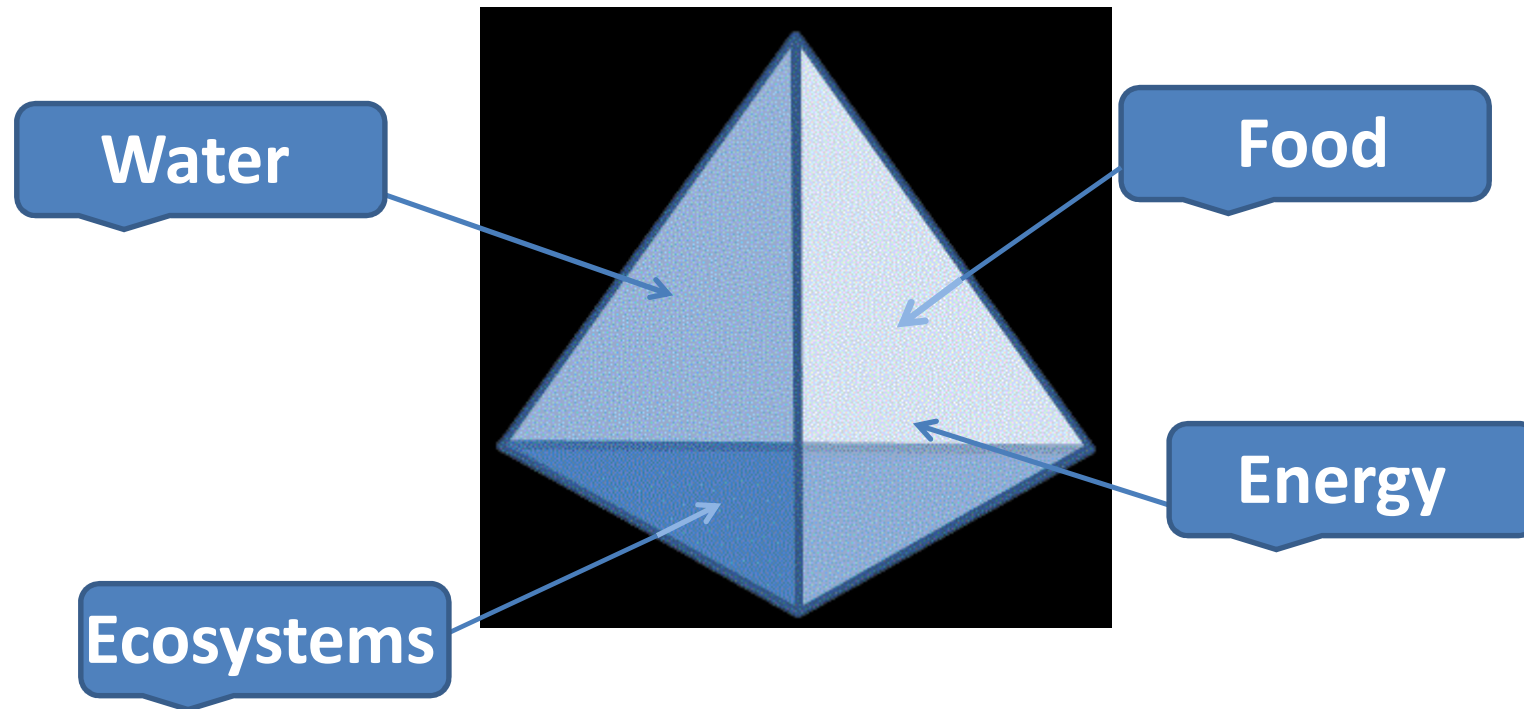
Visualization of Nexus

B. As a system of “convergence”



It provides “equitable” entry points for the major sectors/components of development.

Visualization of Nexus



It provides the “**space**” within which policies and interventions should be closely coordinated and optimized in order to approach SD and achieve the SDGs.

.... provided that the “silos” approach is “abandoned” or rather differentiated by opening connectivity channels



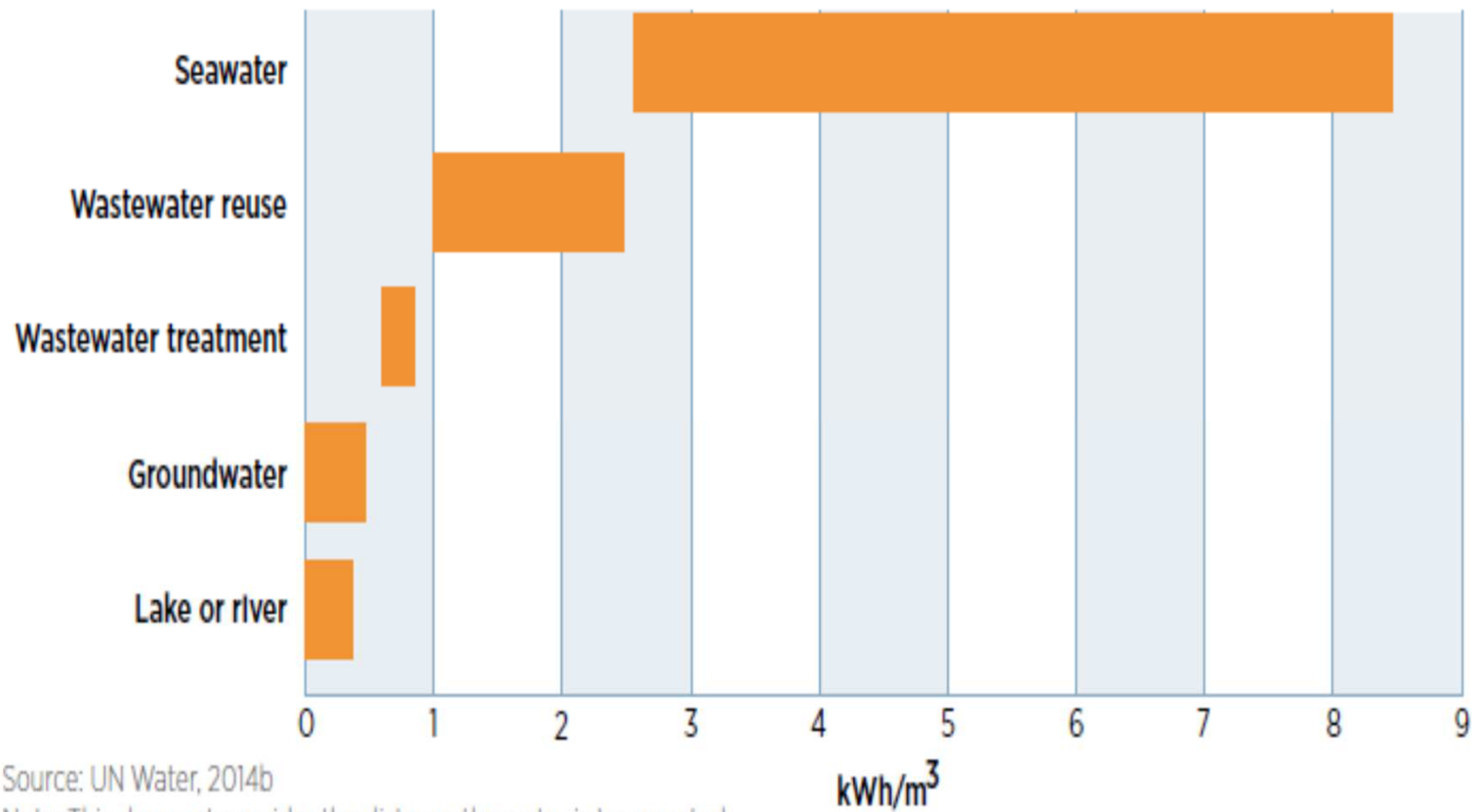
Specificities of the four facets/components of the Nexus

For Sustainable Development, **all four components should be given equal weight** to contribute to shared policies. However, their “character” is different and their “elasticity” too.

- For instance: water resources, food and traditional energy production from fossil fuel have limited elasticity as their production is linked to a particular place but there is high elasticity in their use. For example, an area which has low agricultural production may import food (importing simultaneously “virtual” water). Energy may be transferred through networks and water could be stored and transported within some limits.
- From the four, ecosystems are the least “elastic”. We cannot transfer or store them and the changes/degradation of ecosystems is the least “reversible”.

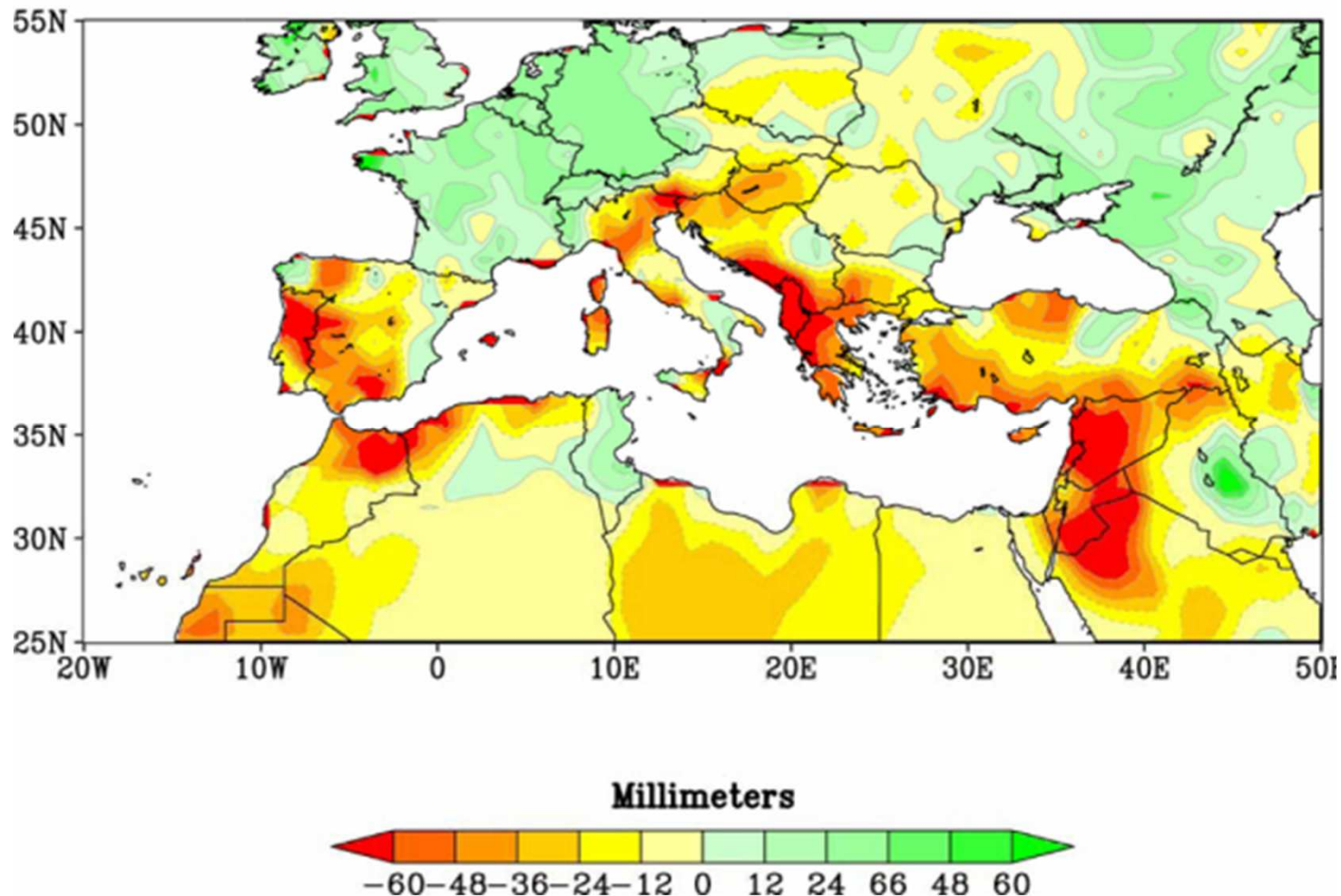
Water & Energy in Nexus: making the right choices

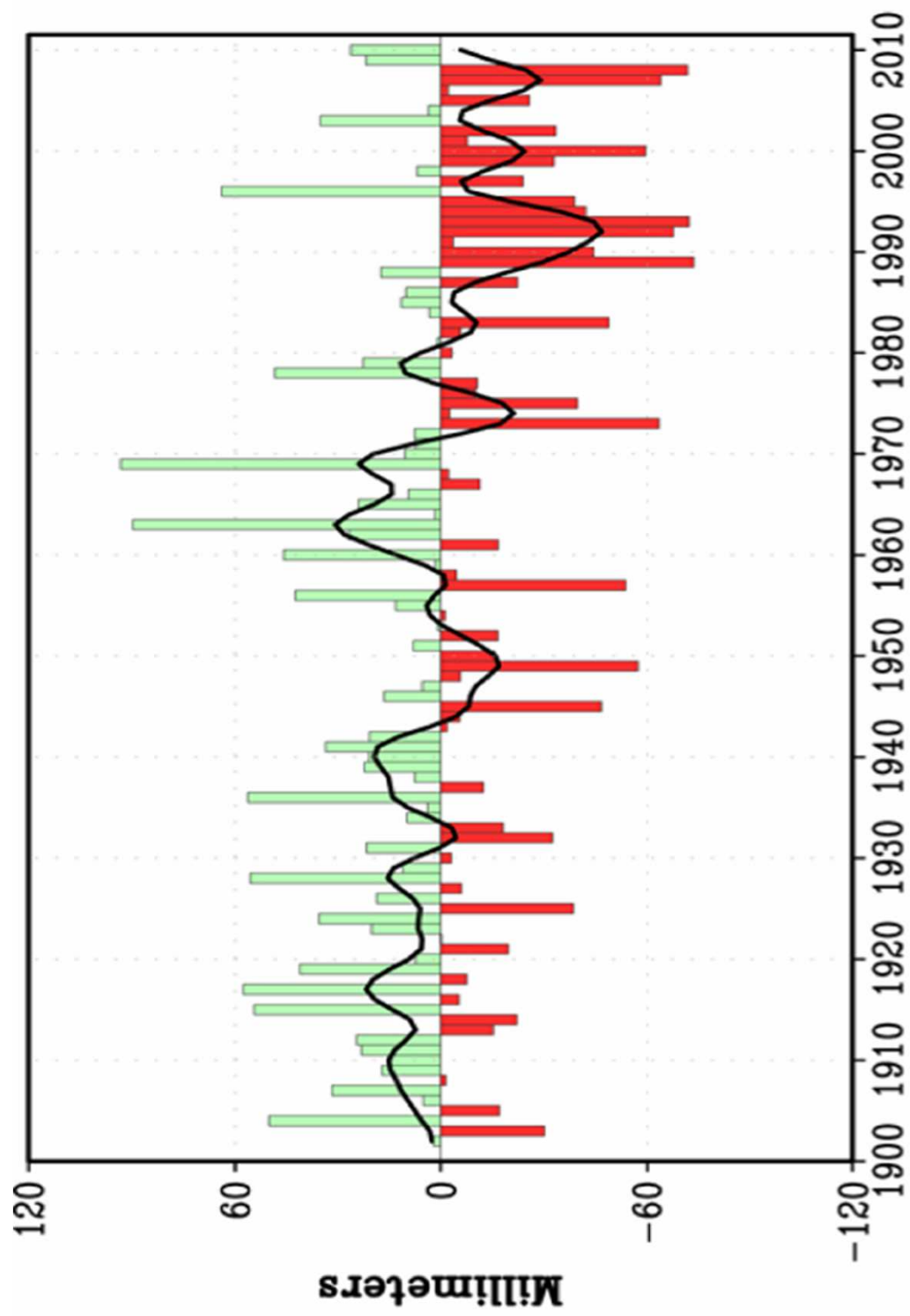
Amount of Energy required to provide 1 m³ of water that is safe for human consumption

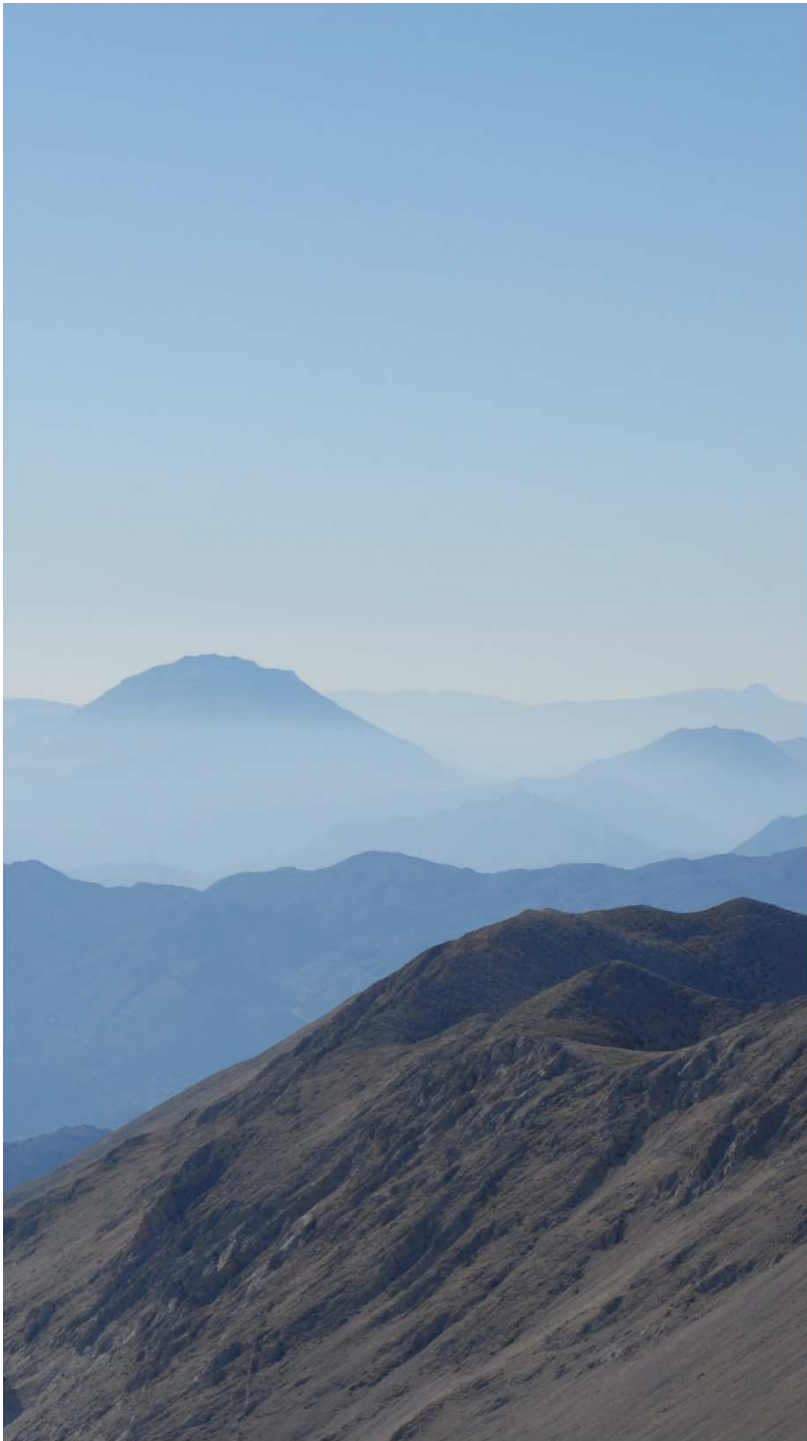


Climate Change in the Mediterranean

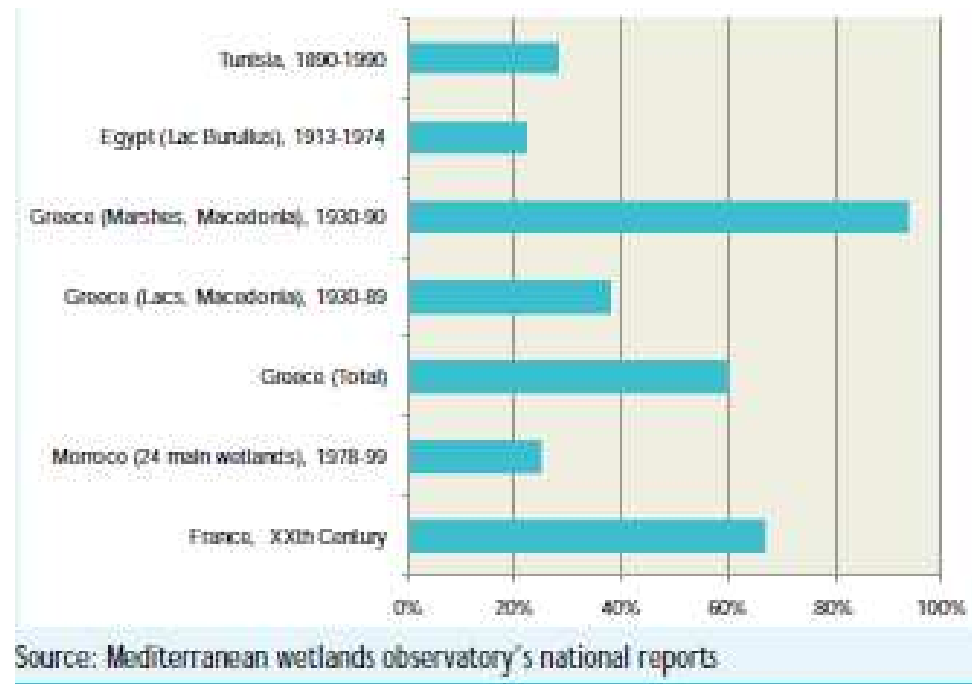
The red areas are the ones most affected by water scarcity recently due to a reduced precipitation in winter periods.



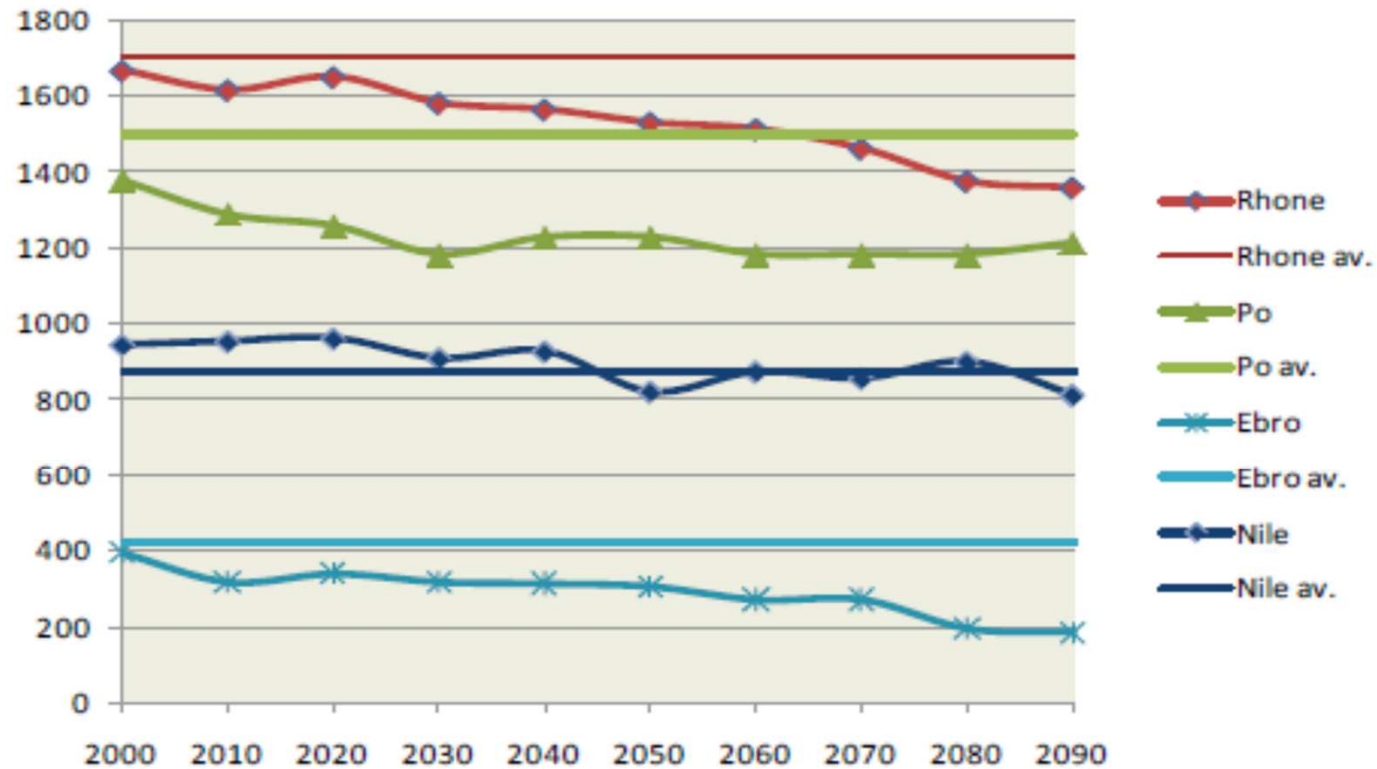




Examples of loses of wetlands in various Mediterranean countries (or part of countries)



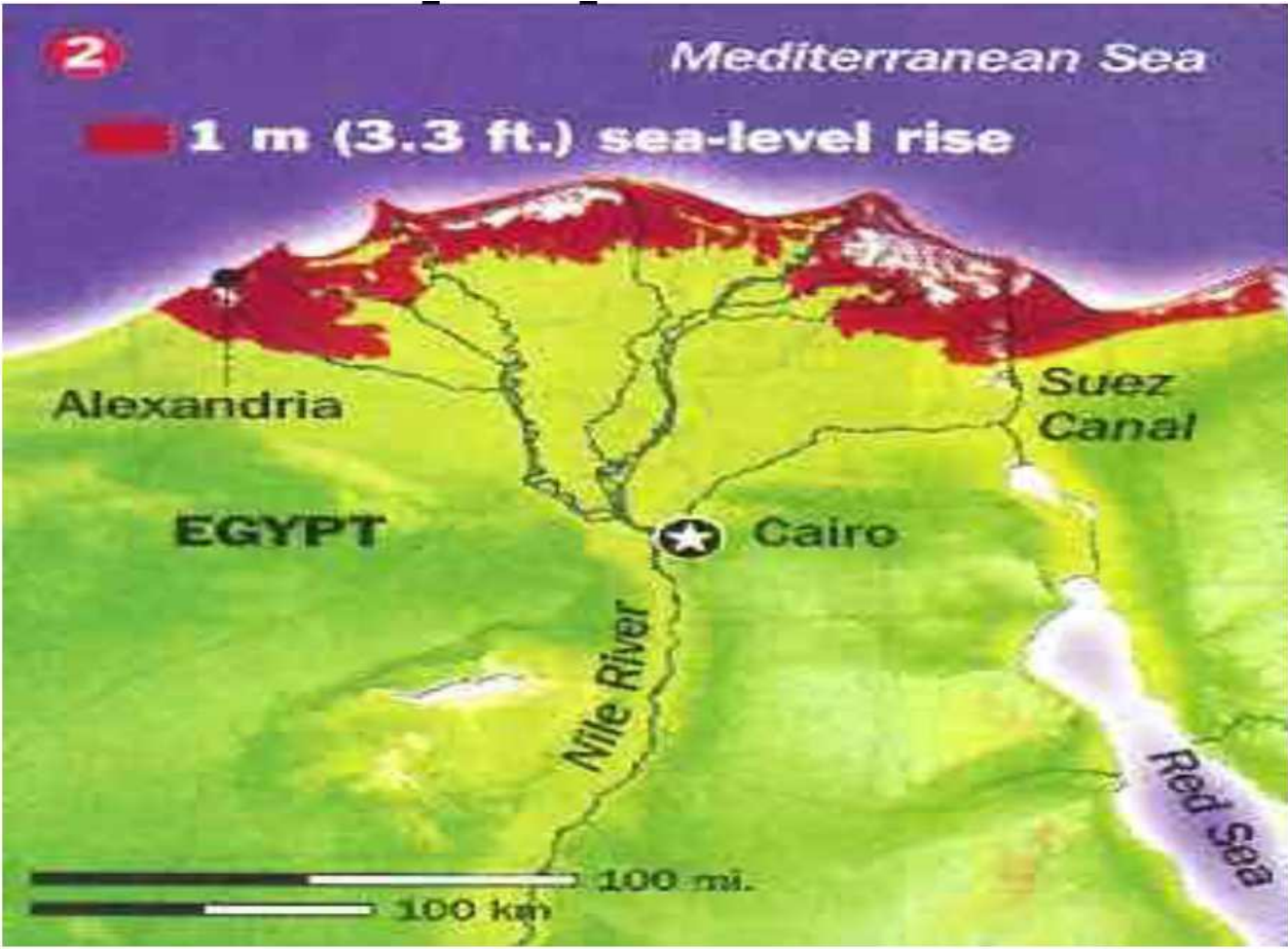
Annual average flow of the main rivers, 2000-2090 (m³/s)

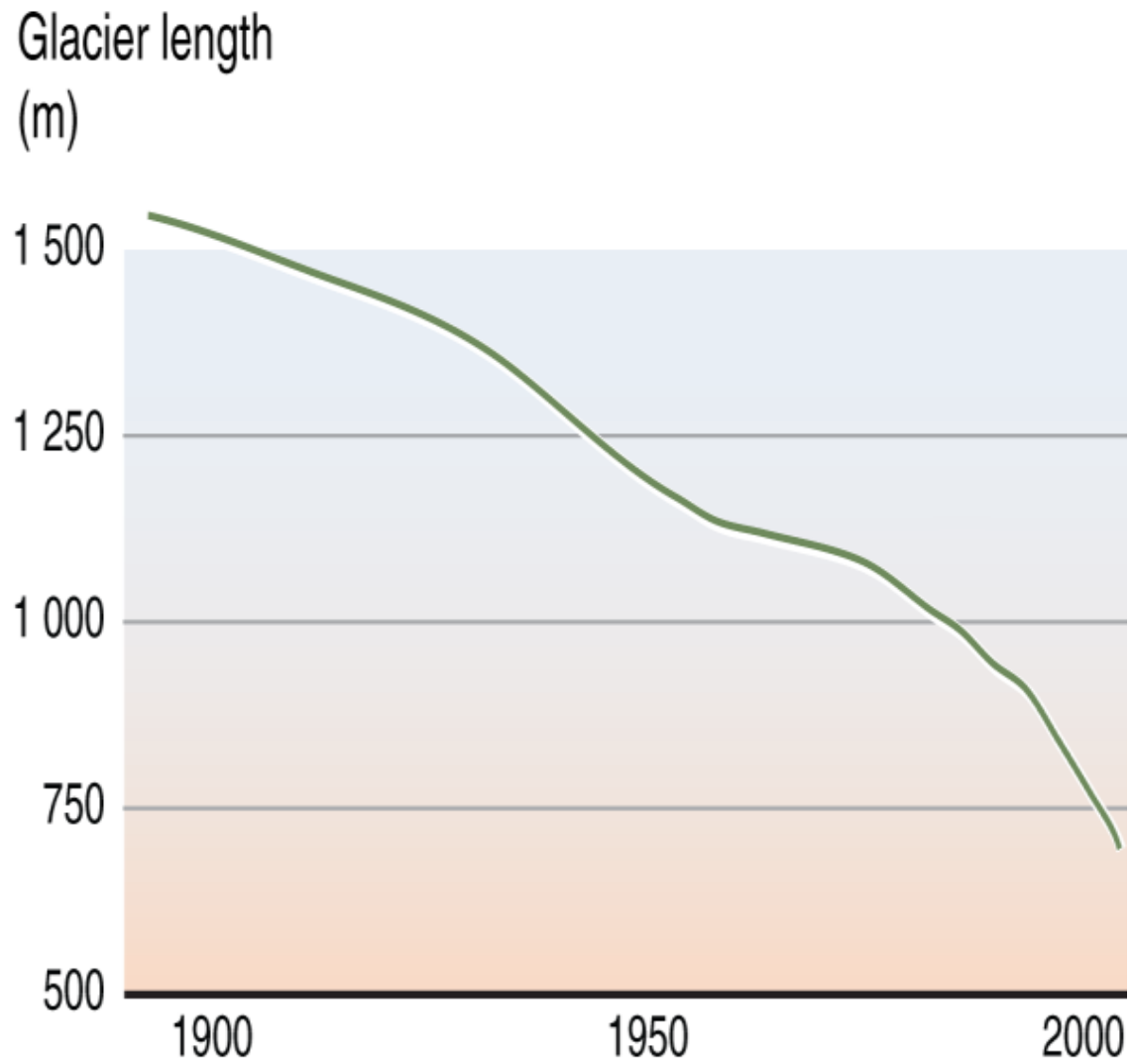


Note: av. = average over the 20th century.

Source: Somot S. (2005)

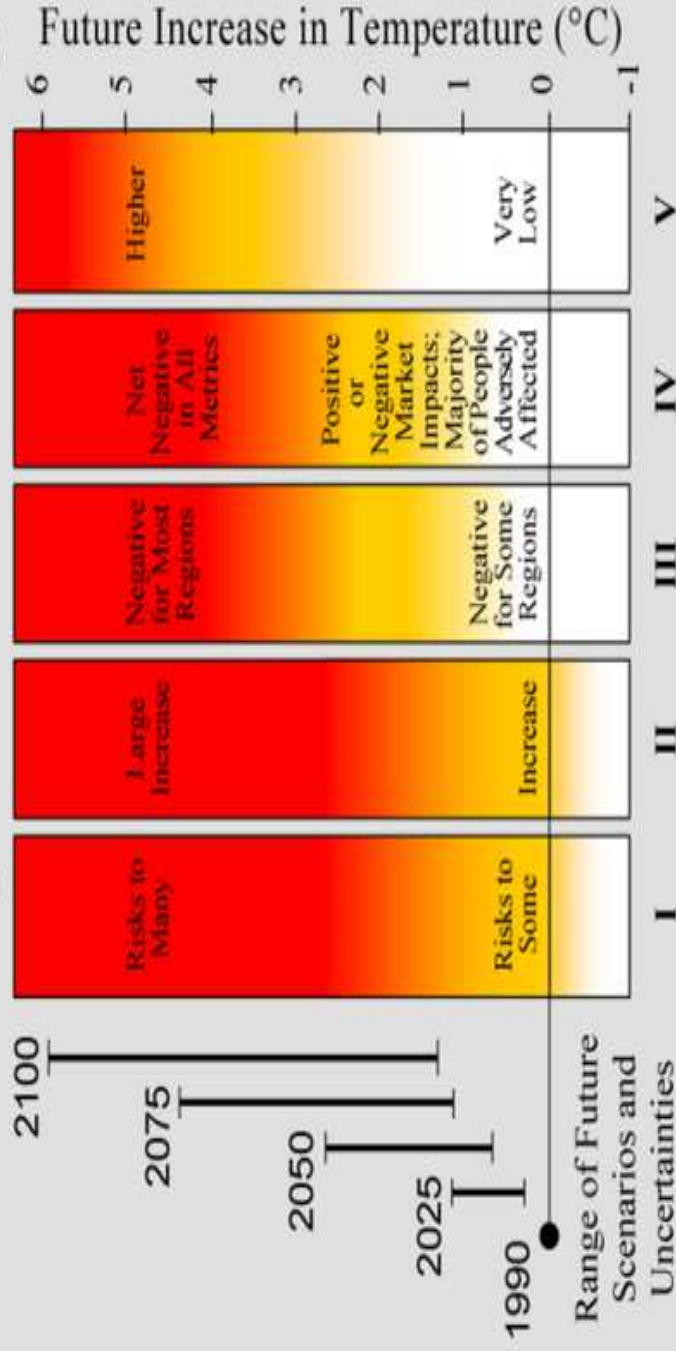
Risk of immersion; Nile Delta: red zone = less than 1 m above sea level, 10 M people in 2000





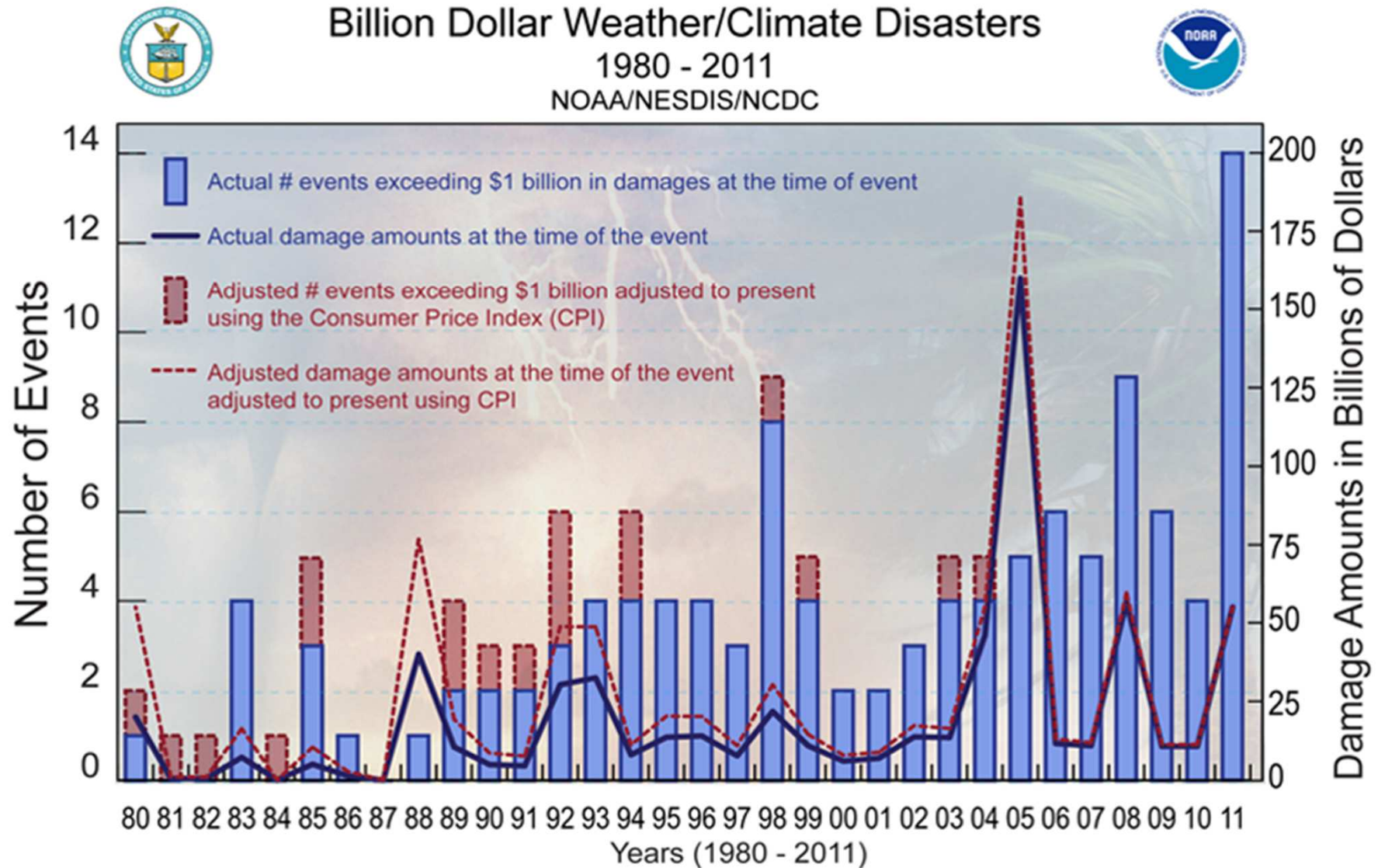
Ice loss on Lewis Glacier (Mount Kenya), 1900s to 2000s.
Source: (UNEP 2007)

Risks and Impacts of Global Warming



- I** Risks to Unique and Threatened Systems
- II** Frequency and Severity of Extreme Climate Events
- III** Global Distribution and Balance of Impacts
- IV** Total Economic and Ecological Impact
- V** Risk of Irreversible Large-Scale and Abrupt Transitions

Unabated weather phenomena are represented by disasters, the cost of which is enormous and increasing during the last three decades



Five key aspects of “nexus” security

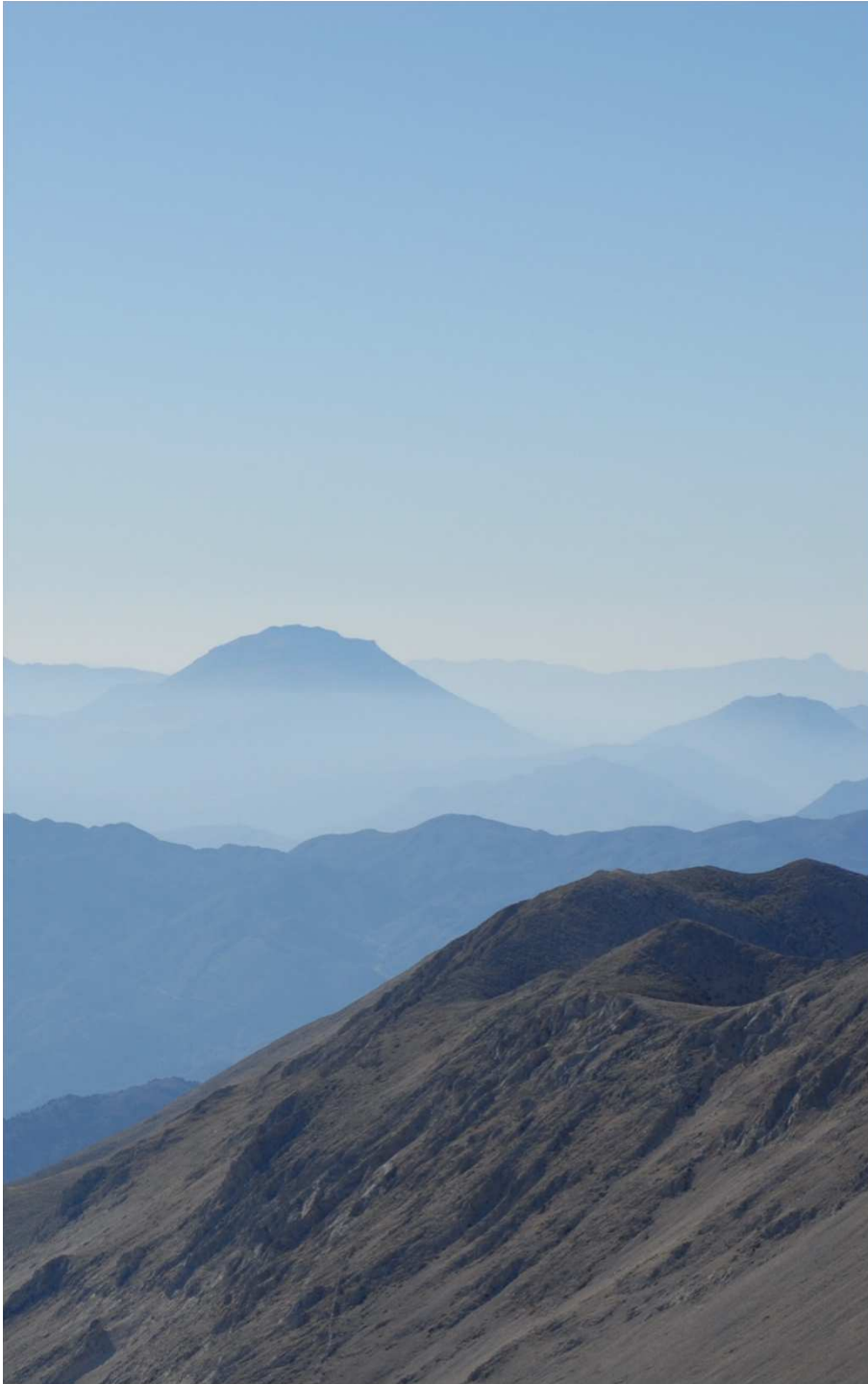
“Nexus” security:

- **goes beyond physical availability** due to complex interactions between natural and socioeconomic systems
- **demands addressing variability and risk**
- **should focus on the needs of individuals**, especially the poor and vulnerable
- **should urgently shift to decarbonization of energy sources**
- **should meet environmental/ecosystem needs**, over time, in terms of quantity and quality (**Ecosystems based approach**)
- **requires management of competition and/or conflict between users & uses**, preferably through rules-based systems (**IWRM**)

The Nexus approach should

- **Facilitate enhancement of water, energy and food security, while preserving ecosystems and their functions, by:**
 - *increasing* efficiency and productivity of resources,
 - *shifting* towards more sustainable consumption and production patterns and improving demand management,
 - *building* synergies and improving governance across sectors, through policy mainstreaming and cross-fertilization
- **Move fast to decarbonisation of energy production.**
- **Enhance IWRM application**, assisting in the water sector policies and strategies to harmonize with these of water-using sectors

It is emphasized that solutions need to be tailor-made and localized: one-size does not fit all



Nexus anticipated outcomes

- Energy security with parallel decrease of energy bills particularly attractive for islands through decentralised systems.
- Water security and food security fostered
- Protection of inland, coastal and marine habitats and biodiversity assisted
- Climate change resilience fostered

- **Substantial economic benefits gained through improved natural resources management**
- **New green/blue jobs created and/or existing jobs preserved**

The “nexus” security & resilience

Addressing security of the **system** requires both:

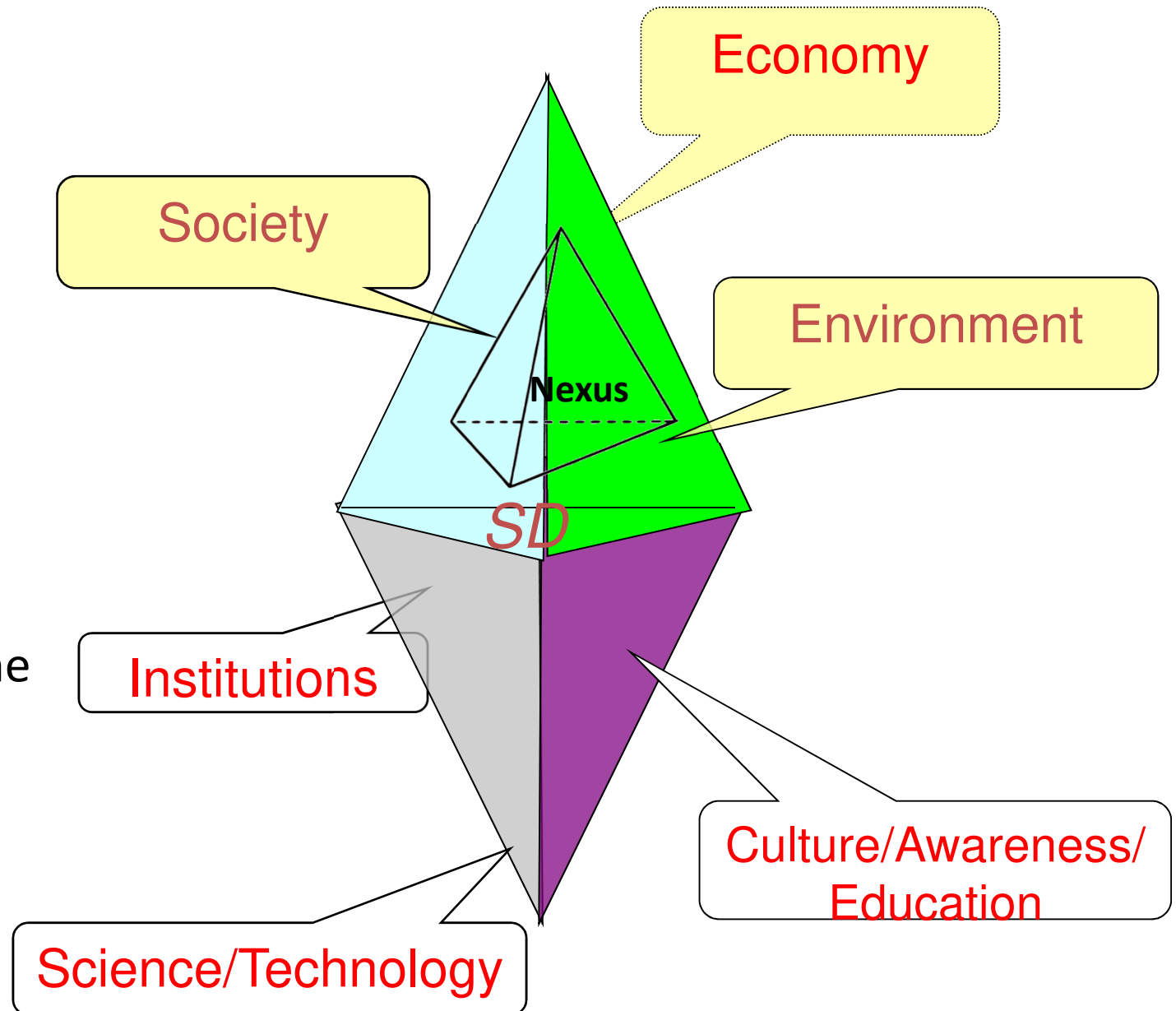
- **Reducing the conditions, pressures and root causes of its vulnerability**
- **Enhancing its resilience** (*the ability of a system to return to equilibrium after a perturbation or disturbance*)

To implement the above, measures are needed by employing all 3 tools for Sustainable Development:

- **technological**
- **institutional**
- **educational/information/cultural**

The nexus sits within the SD tetrahedron

For effectively addressing both **SD** and **nexus**, effective good **governance** is needed and proper use of the available tools.




Tools to be used in a coordinated way for enhancing “nexus” security




Institutional and Legal Frameworks and Regulations

Financial and other incentives (green taxes, levies, charges, etc), indication on products about their energy, water and material footprint, designation of protected areas and biosphere reserves.



Appropriate, clean technology, de-carbonization of energy and energy saving (building insulation, sun heaters), water saving systems, modern rainwater harvesting systems, material recycling, nature based solutions.



Awareness raising and education (clean consumption and production, value of biodiversity and ecosystem services, intrinsic value of nature).

Examples of Nexus policy interventions in the pipeline

At regional level:

- UfM Water Agenda, WEG Priority Work on Nexus;
- GIZ 'Nexus Regional Dialogues' Programme (EC+Germany);
- GWP-Med 'Nexus in Southeastern Europe' Project (ADA, Germany, GEF);
- GWP-Med 'Matchmaker' Project, also for North Western Sahara Aquifer (Sida);
- Nexus 'Child Project' of the GEF MAP UNEP MedProgramme (GEF)
- EU funded Water Energy Support (WES) for the Mediterranean;
- More! But not very much more yet.

Demonstrating Nexus locally:

- Local projects popping up, including RAED's project on Water & Energy

Nexus suggested fields of policies

Aimed outputs	Main types of interventions
Nexus-related challenges and solutions identified and prioritized, at different geographical scales, through multi-stakeholder consultation based on Nexus analysis and assessments	Build background for policy interventions and investment identification and prioritization
Nexus governance settings strengthened, at different geographical scales	Provide tools for introducing and operationalising Nexus approach in governance systems
Planning and implementation of Nexus solutions enabled, at different geographical scales	Coordinate, leverage and facilitate financing for Nexus interventions
Knowledge shared and capacity built on Nexus methodologies, policies and technologies	Generate and disseminate Nexus knowledge
Demonstration applications implemented as means for knowledge sharing	Design and implement pilot interventions with replication potential at local level

“Nexus” & investment

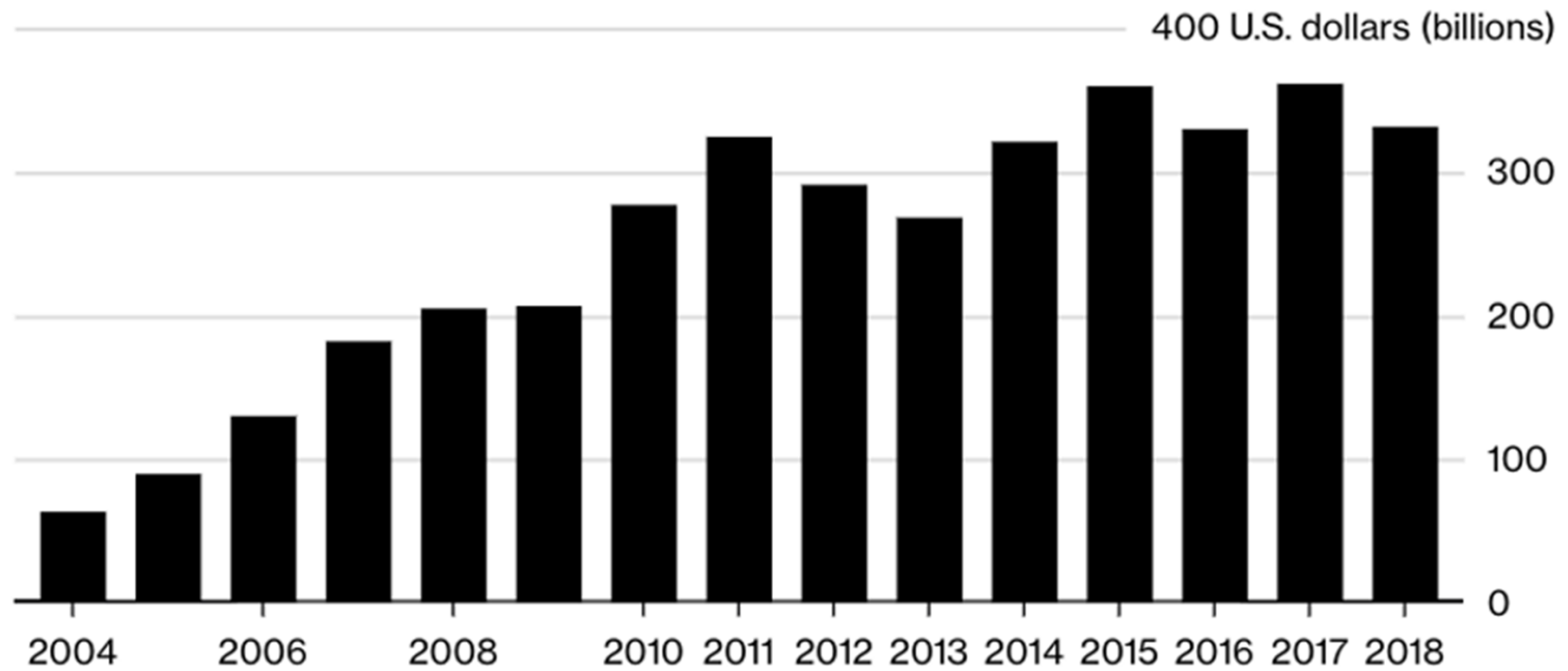
- To achieve nexus security, against global warming, water scarcity and loss of biodiversity, considerable **investment** is needed for **‘hard’** and **‘soft’ infrastructures**

e.g. for de-carbonization of energy, non-conventional water resources, sustainable food production but also for large scale education, awareness and training.

- Such blending of investments should be promoted to provide benefits for **society** and **ecosystems** allowing **adaptation** to long-term climate changes and climate variability and shocks. The world’s poorest people and countries will benefit more, while economic development will be boosted.

Power in numbers

Global green energy investment tops \$300 billion in 2018



Water focused investment (hard)

- Multipurpose dams (hydro, irrigation, securing ecological flows, flood mitigation)
- Energy/flow co-optimization in cascades of dams in transboundary basins
- De-carbonized energy solutions for:
 - water abstraction
 - desalination
 - irrigation
 - waste water treatment
- Irrigation systems optimizing non-conventional water resources
- Green/Blue urban interventions involving non-Conventional Water Resources
- Nature based infrastructure enhancing ecosystem services (related to wastewater management / floods and extreme events management)

Examples of good practice by local and regional authorities within Europe:

Canary Islands: Combining Wind with Hydro-Electricity

- The project was funded by loans from the Spanish government and other banks, implemented in El Hierro Island with a population of 10,700 people.
- 5 wind turbines were expected to generate up to **11.5MW** of power for domestic consumption.
- Part of the energy produced with wind is used to pump water to a reservoir upstream driving 6 hydraulic turbines capable of generating up to **11.3MW** of electricity.
- The combined hydro-wind power station overcomes therefore the problem of the intermittency of wind.
- In 2019, renewable energy has covered **53.8%** of the demand for electricity on the island of El Hierro.

Examples of good practice by local and regional authorities within Europe:

The Covenant of Mayors initiative

- Launched in 2008 by the European Commission with the ambition to gather local governments voluntarily committed to achieving and exceeding the EU climate and energy targets.
- It is a significant example of collective action between local and regional actors which can have a major impact on meeting renewable energies targets.
- The initiative now gathers 9,000+ local and regional authorities across 57 countries.

Smart Grids



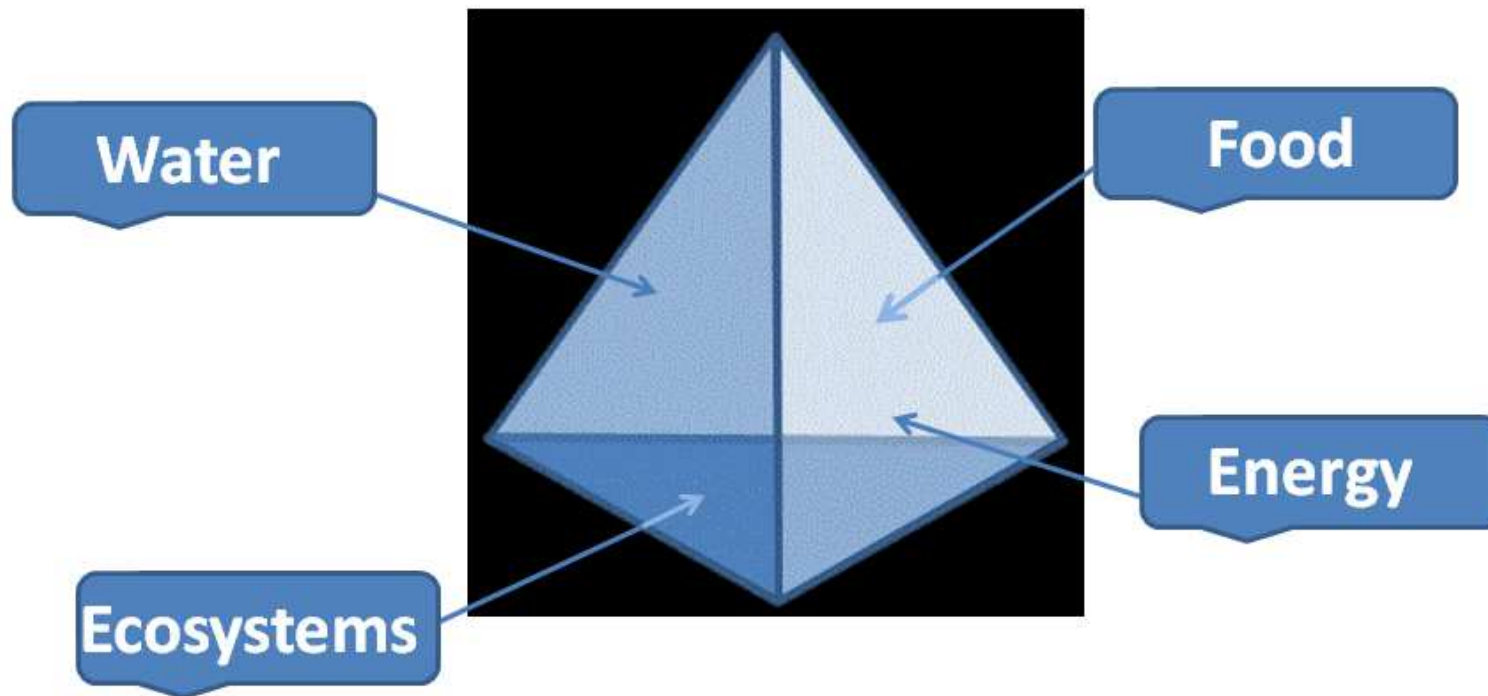
Efficient smart grid solutions can enable the implementation of advanced monitoring, control, and automation functions, and apply cutting-edge communication technology for local and remote operations. So, power blackouts are minimized, grid performance is optimized and operating costs are reduced.

“Nexus” & investment (soft)

- education
- training
- management
- Supporting institutions to become robust
- information sharing
- capacity building

.... to monitor, predict, plan for and cope with climate variability and all aspects of the nexus.

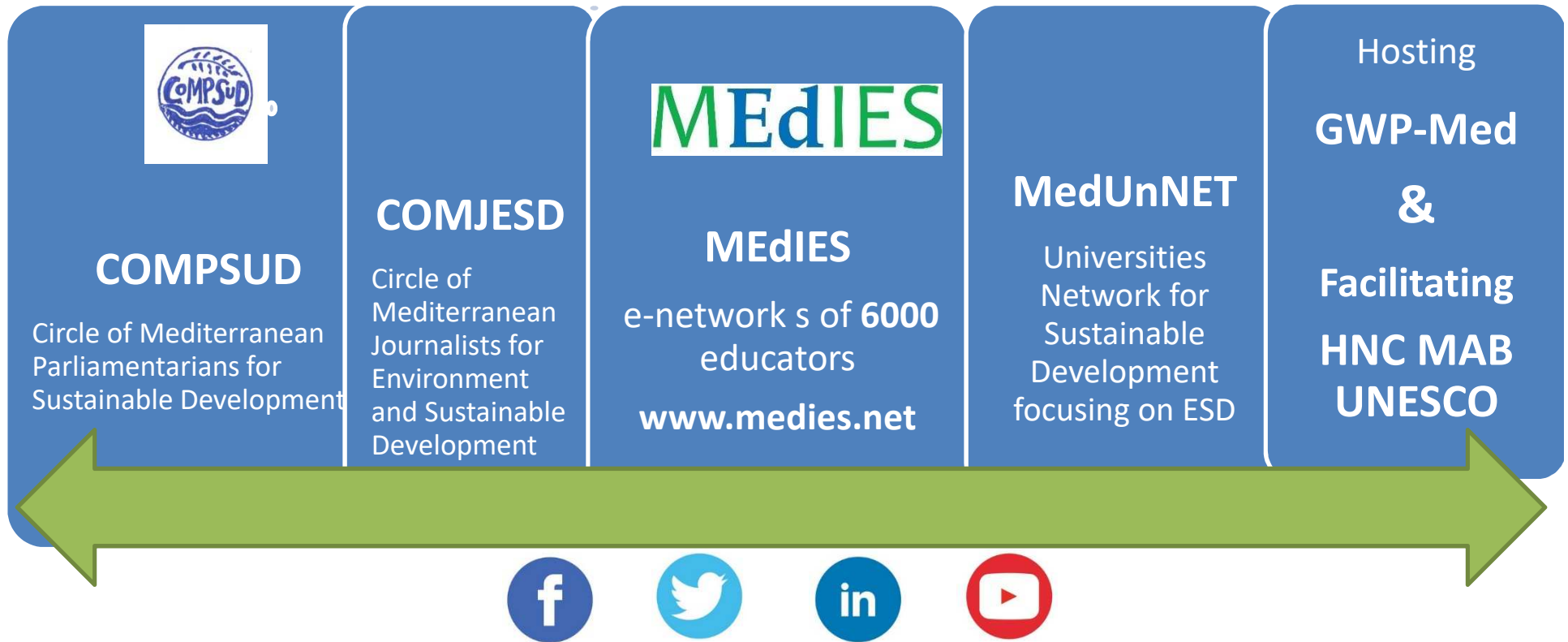
The nexus space is large enough and appropriate to allow for win-win solutions



... provided that the “silos” approach is abandoned.

MIO-ECSDE channels promoting WEFE Nexus

MIO-ECSDE is a Federation of 130 NGOs from 28 countries around the Mediterranean reaching to thousands of citizens. It facilitates 4 other networks of major Mediterranean stakeholders playing a key role in addressing the region's sustainable development challenges:



Thank you!

Secretariat of the HYBRID UNIVERSITY of ASTEROUSIA

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