A satellite image of the Mediterranean Sea, showing the dark blue water of the sea and the surrounding landmasses in shades of brown and green. The curvature of the Earth is visible at the top of the frame.

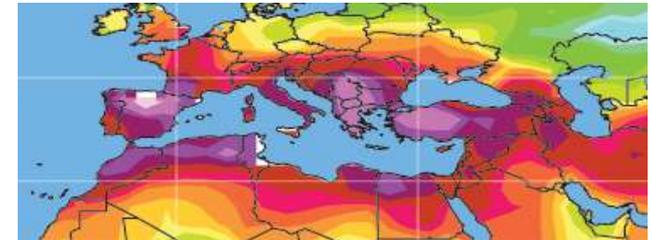
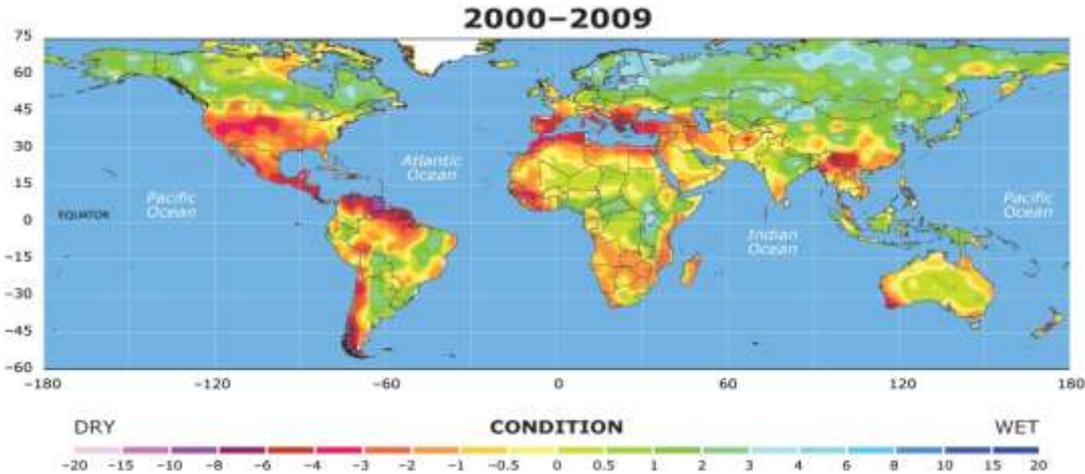
TERENO-MED:

- Adaptation to the Conditions of Water Scarcity -

**TERENO-MED: Terrestrial Environmental Observatories in the
Mediterranean**

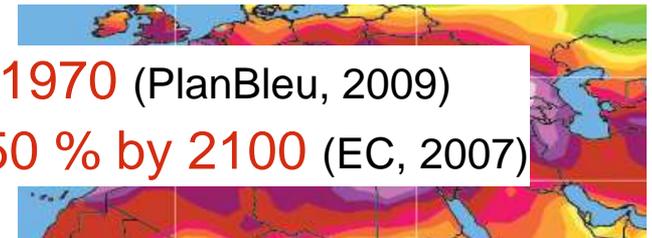
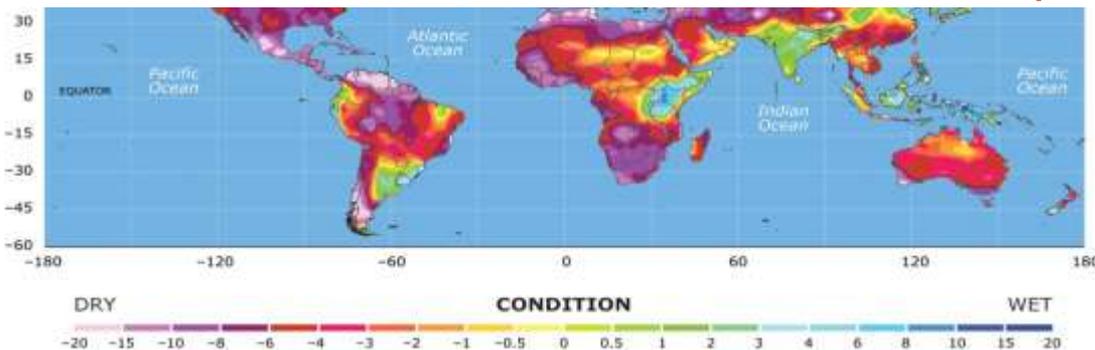
**Team - UFZ: Elisabeth Krueger, Steffen Zacharias, Jan Friesen
FZJ: Harry Vereecken, Heye Bogena**

Increasing number & severity of droughts (Palmer Drought Severity Index*)



2030-2039

Temperature: + 2°C, Precipitation: - 20% since 1970 (PlanBleu, 2009)
Decrease in available water resources: upto 50 % by 2100 (EC, 2007)

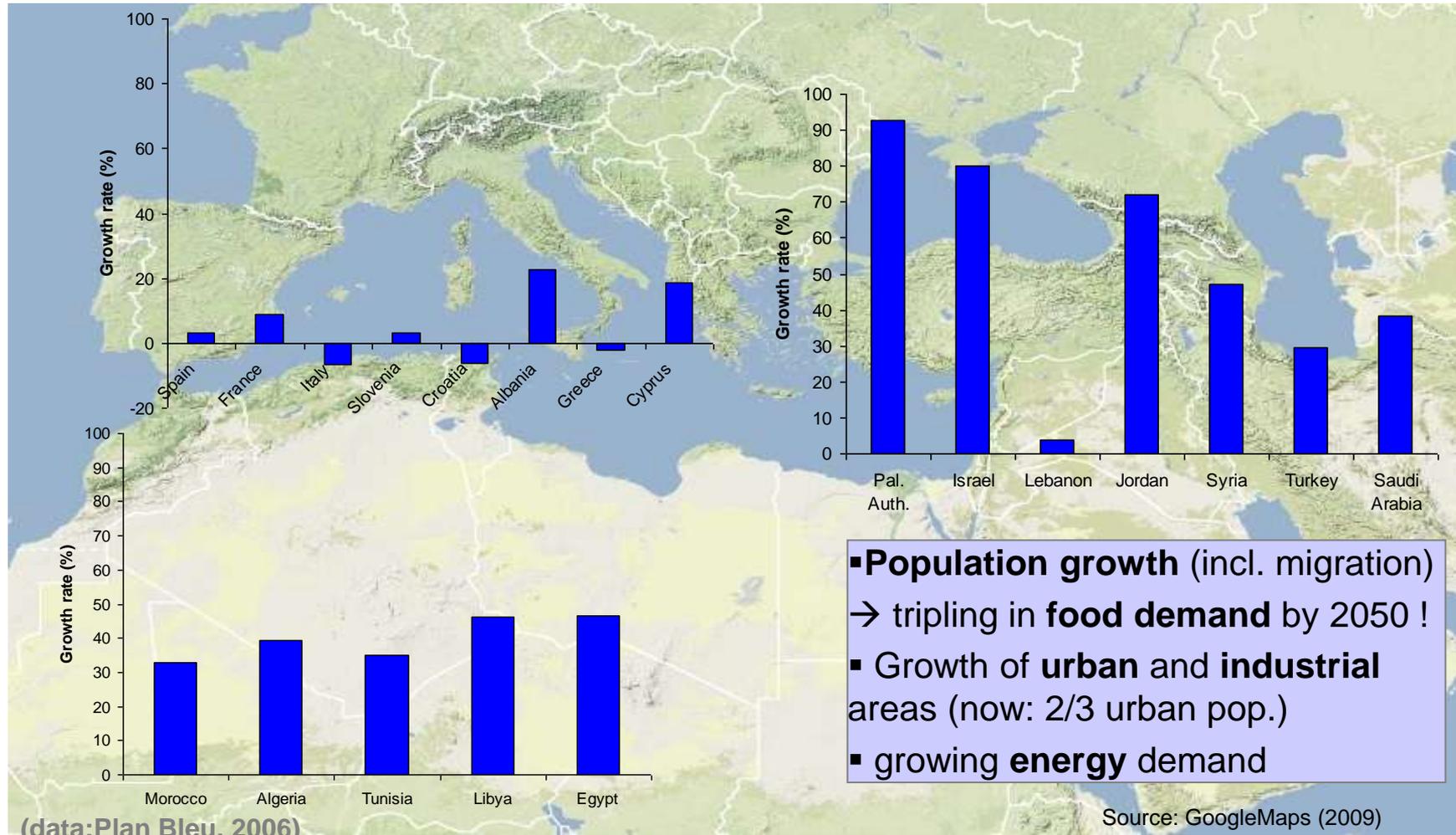


2060-2069

* Determines aridity through precipitation and temperature information (part. for long-term prognoses; < -4 = extreme drought)

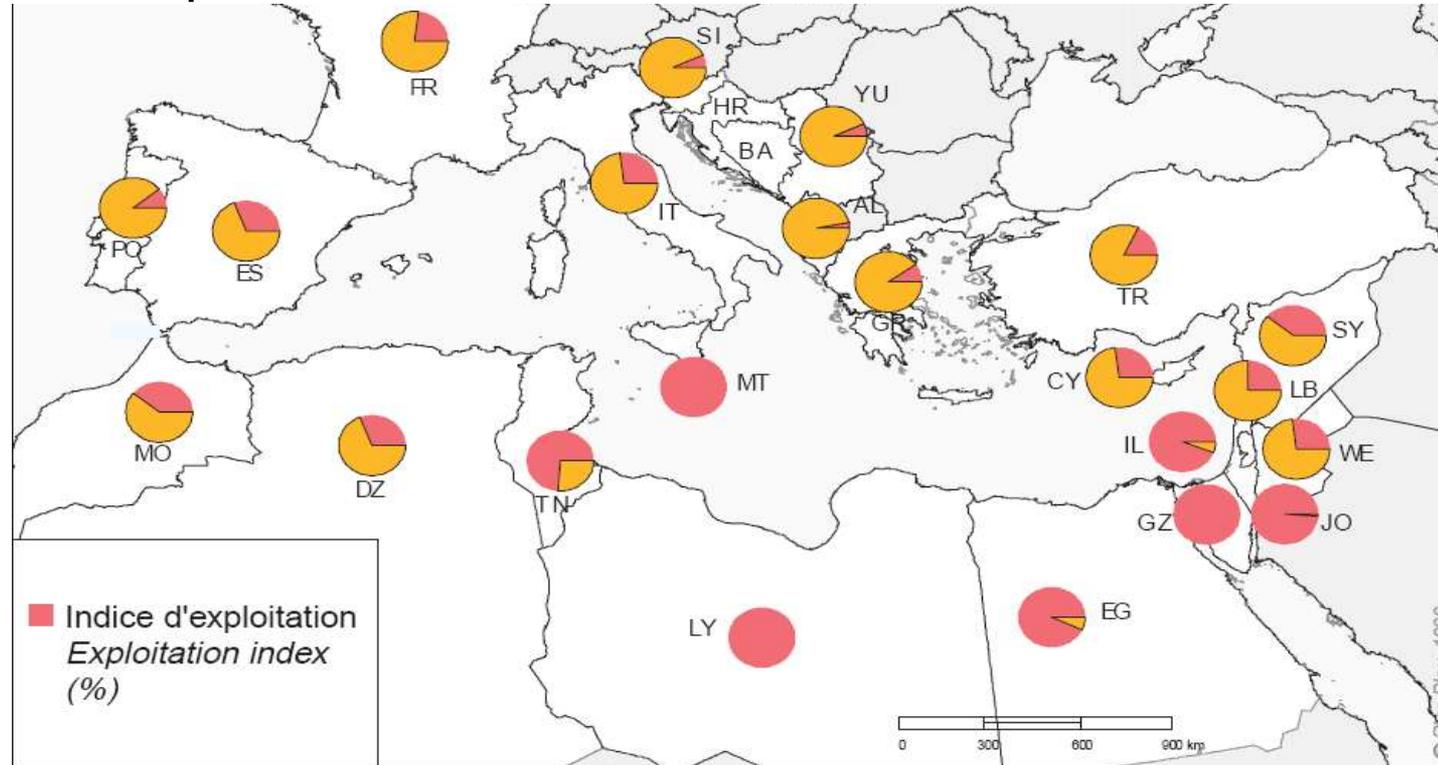
source: NCAR images, 2010

The challenge: Distribution of Expected Population Growth in the Mediterranean by 2050



The challenge: Exploitation of available resources

Current exploitation of renewable natural water resources



Overall goal

- Develop solutions to overcome/adapt to water scarcity
- Improve water quality, supply and sanitation systems
- Improve water efficiency, in particular in agriculture
- Develop „intelligent“ solutions for a sustainable resources management

Water Science Alliance: Priority research fields

Solutions to generic water problems of global dimension

1. The impact of global change on water resources (development of scenarios)
2. Innovations for a sustainable water resources management



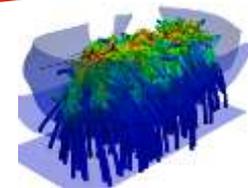
Strengthening of methodological key competences

3. Quantification of water and matter fluxes at catchment scale
4. Integrated concepts for observation and exploration
5. Development of complex system models and data integration



Complex water management in a priority region

6. Management of scarce water resources in the Circum-Mediterranean region



Research needs (Water Science Alliance – Mediterranean Research Case)

Precise water resources assessment at catchment scale, including:

- lakes & reservoirs
- groundwater resources
- desalinated water
- wastewater and irrigation return

Development of reliable scenarios for resources development over the next 50-100 years, considering:

- feedbacks of available resources with changes in temperature, precipitation, water use
- population growth
- economic changes
- landuse and water management changes
- changes in population patterns (growth of megacities, migration)
- technological innovations
- water transfers (regional/cross-border, virtual water trade)

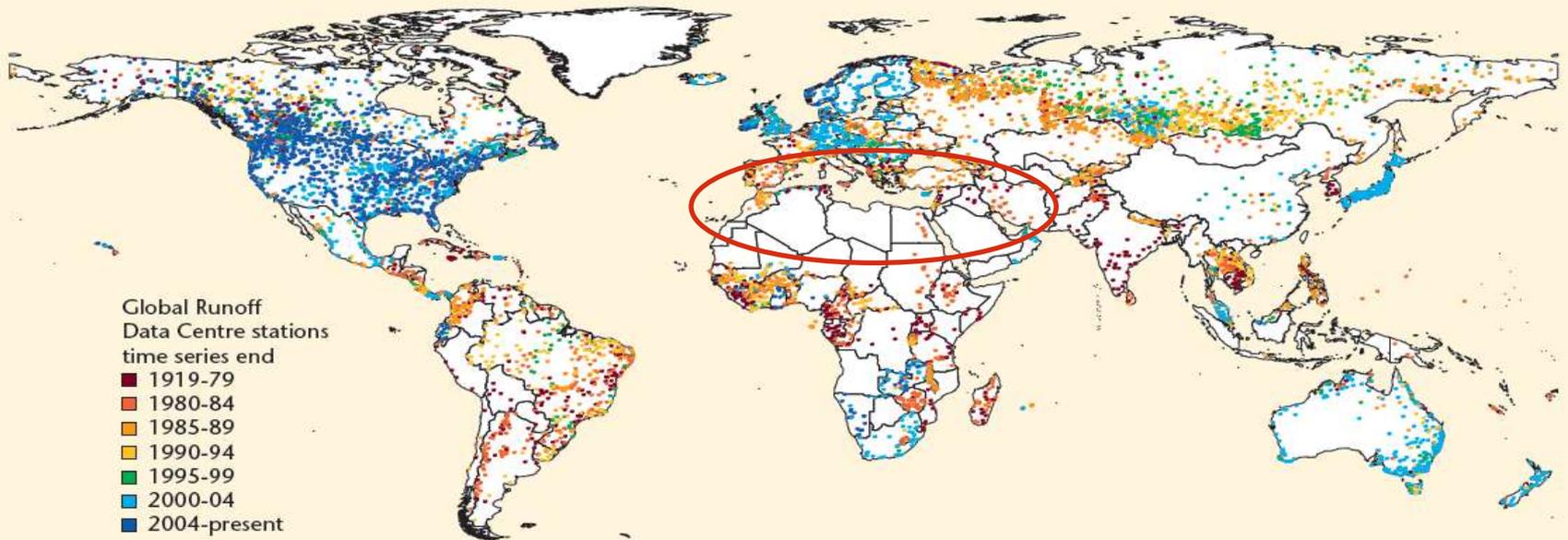
Development of adequate concepts and tools for an integrated management of water and land resources coupled with renewable energy production and water purification (sustainable regional planning)

- reliable infrastructure planning
- innovative technology development
- new storage concepts
- adapted political and economic instruments



Lack of basis for future scenarios: scarce data/long-term monitoring sites

Map 13.1 Distribution of Global Runoff Data Centre streamflow gauges

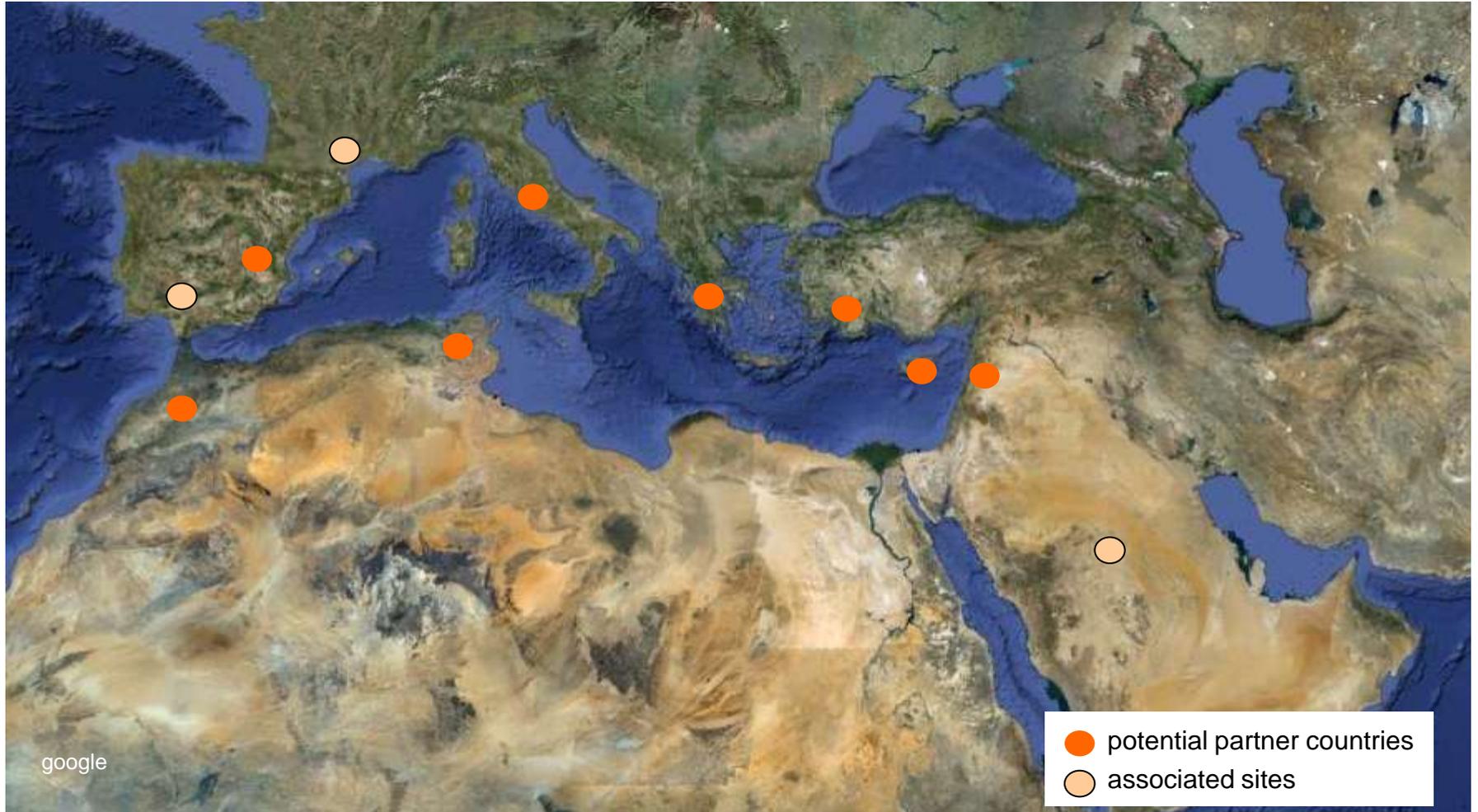


Source: Global Runoff Data Centre (<http://grdc.bafg.de/>).

TERENO MED – Goals & concept (first step towards joint Mediterranean research network)

- **Helmholtz funding:** € 6.8 million (2012-2014; UFZ, FZJ)
- **International Network of Global Change Observatories** (8-10 observatory sites) → investigation of the impacts of global warming and human influence (e.g. irrigation, land use change, input of pollutants) on Circum-Mediterranean water resources and ecosystems
- **Concept** based on national **TERENO** initiative

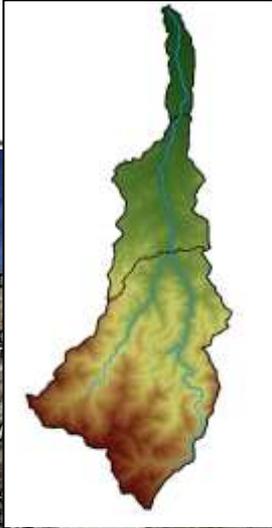
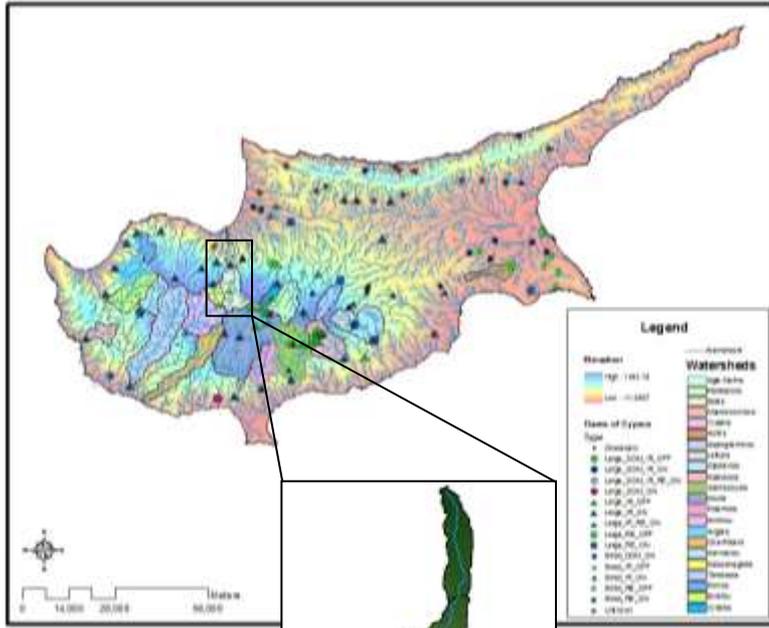
TERENO-MED – Circum-Mediterranean Network



Criteria for Observatory Sites

- **Relevance** of the site/catchment for regional water supply (municipal, agricultural, industrial) & production (e.g. food production)
- **Representativity** in the context of the regional aspects of the Mediterranean
 - Water balance (precipitation, abstraction, outflow to the sea, etc.)
 - Ecosystem services and landuse
- The observatory site should correspond to or include a **river catchment**
- Representativity with regard to typical gradients in land use and/or climate
- **Gradients** in water quality / limitations for use
- Accessibility and maintainability, (security from vandalism?)
- **Sensitivity/Vulnerability to external effects** (global change impacts)
- Adequate size (< approx. 1.000 km², nested catchment approach)
- **Existing monitoring network**
- Availability of historical data (discharge, climate, land use), quality of existing data and information
- Availability of **long-term technical support**
- Water infrastructure (dams, water supply/sanitation infrastructure, etc.)
- **Water problem !**

TERENO-MED – potential partners



Peristerona catchment

Catchment size: 76 km² (+35 km² up to Massari dam in Turkish occupied territory)

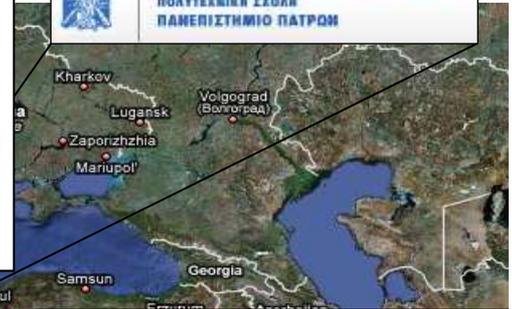
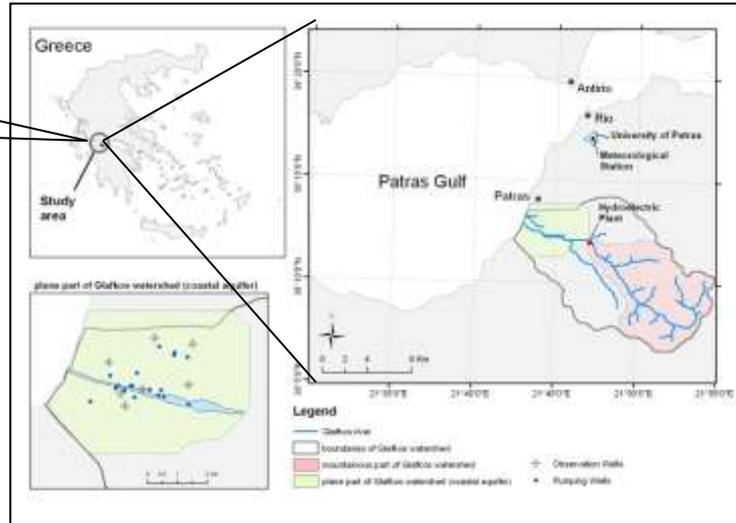
Altitude: 440-1560 masl

Ephemeral stream

TERENO-MED – potential partners




ΤΜΗΜΑ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
 ΠΟΛΥΤΕΧΝΙΚΗ ΣΧΟΛΗ
 ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ



Glafkos catchment

Catchment size: 146 km²

Altitude: 0-1880 masl

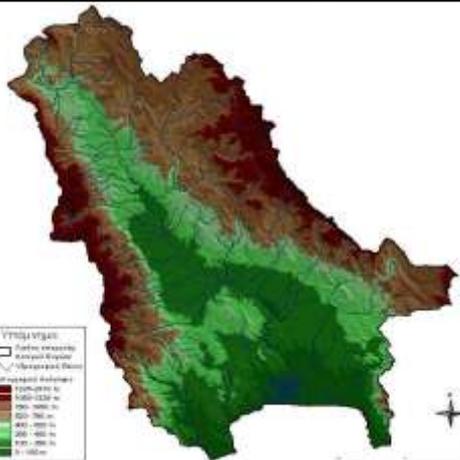
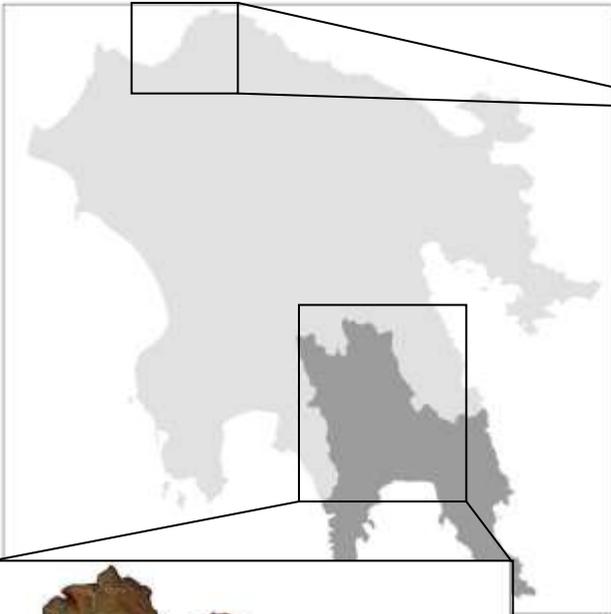
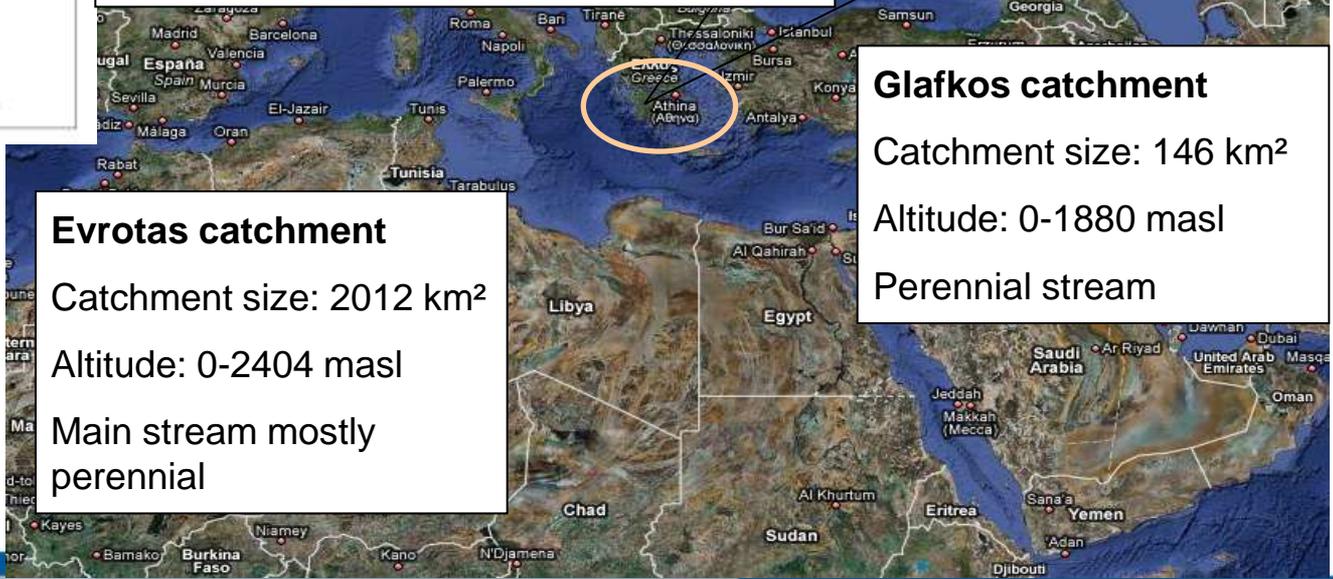
Perennial stream

Evrotas catchment

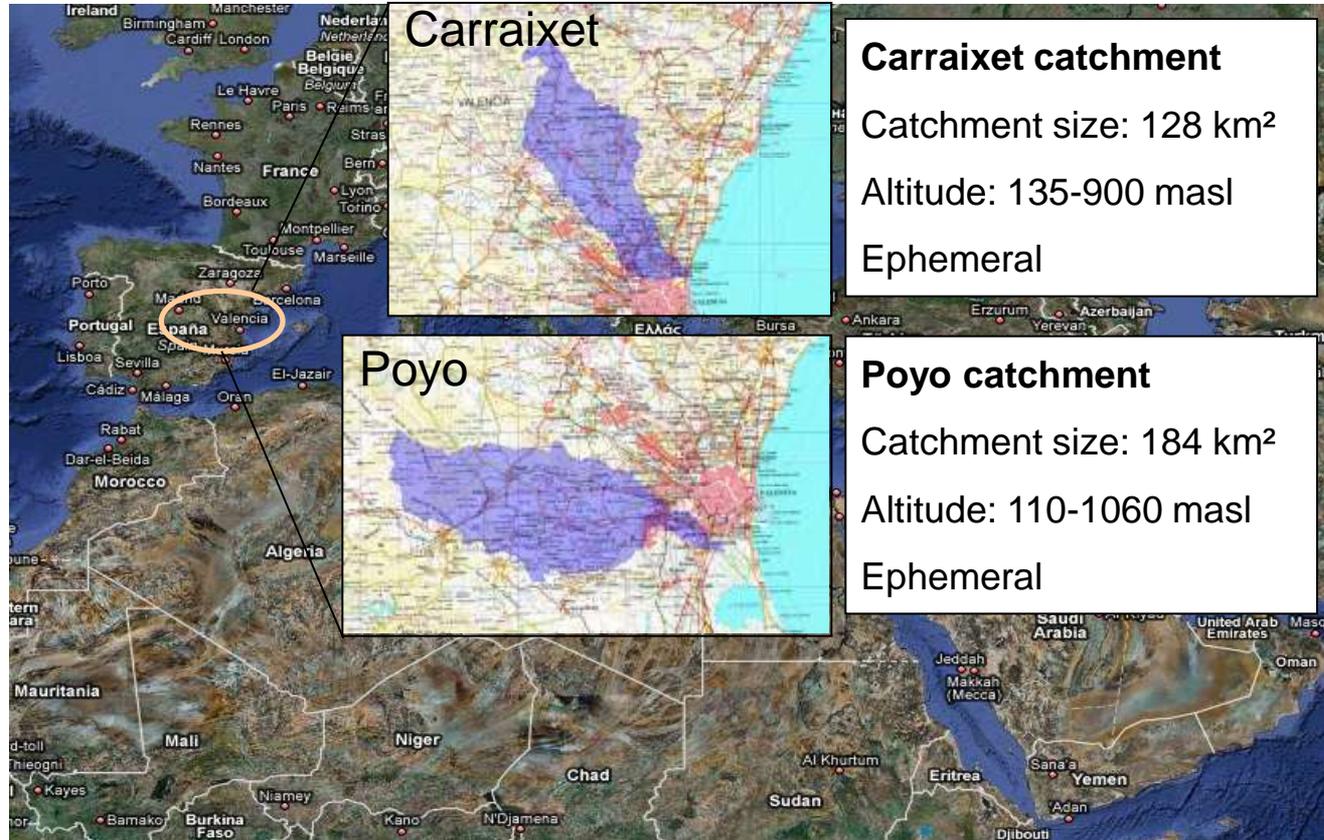
Catchment size: 2012 km²

Altitude: 0-2404 masl

Main stream mostly perennial



TERENO-MED – potential partners



TERENO-MED – potential partners



Associate site in France:
Héroux catchment
(near Montpellier)



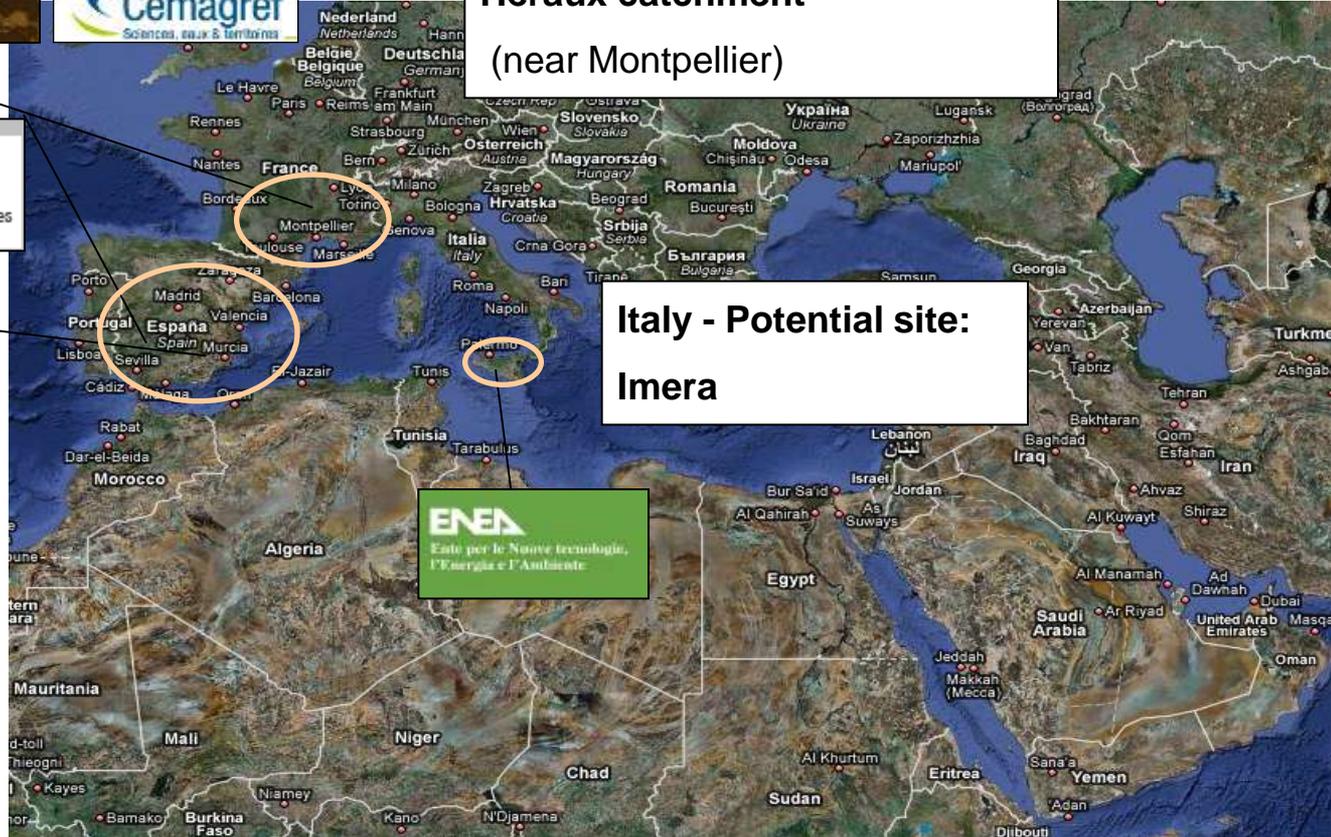
Spain (several options)

Isabena subcatchment
(tributary to Ebro river)

Subcatchment of
Andarax, near Almería

Júcar sub-catchments
(near Valencia)

Associate site: Donana



Italy - Potential site:
Imera

Criteria for Partners

TERENO-MED minimum run-time: 15 years,
current funding: infrastructure investment only

Scientific

- Specific scientific and technical **competence** (track record)
- Own scientific topic related to the observation **agenda** (covered by own resources)
- Guarantee to **maintain and operate** the TERENO-MED catchments in their proximity
- **Data archiving**, raw data **processing**, quality assurance, open-source accessibility of data and information

Ministerial

- **Involvement of respective** research/science and environment **ministry**
- **Support** of the initiative with respect to the involvement in research project activities (e.g. EU)

Facing the challenges in the Mediterranean: TERENO - MED

- Set-up of environmental / hydrological **observatories** in selected areas (→ **start: 2012**) with Mediterranean partners who:
 - Are interested and able to contribute to a long-term (15 years!) observation network
 - Who have or are willing to invest their capacities into a strong Euro-Mediterranean partnership on integrated environmental observation and research → joint efforts for acquiring European and national research funding
 - Political support for a Mediterranean Research Network
 - **Preparation of Mediterranean science case for national & EU-funding**
 - Linking up with **existing activities** within the area (e.g.: joint TERENO-MED – SICMED sites, LTER Europe, ICOS, ...)
- TERENO-MED: start-up initiative for a Circum-Mediterranean integrated observation and research initiative (long-term, large-scale, integrated environmental research initiative)

Vision: Sustainable Water Resources Management in the Circum-Mediterranean linked to Energy Production & Distribution

Link to the Helmholtz Desert Alliance (Wüsten-Allianz) ?



TERENO-MED – potential partners

The map shows the Mediterranean basin with callouts to various partner organizations. The callouts include:

- INRA**: Institut National de la Recherche Agronomique (France)
- CNRS**: Centre National de la Recherche Scientifique (France)
- IRDA**: Institut de Recherche pour le Développement (France)
- Cemagref**: Centre de coopération internationale en recherche agronomique pour le développement (France)
- HELMHOLTZ ASSOCIATION**: Helmholtz Association (Germany)
- ENEA**: Ente per le Nuove tecnologie, l'Energia e l'Ambiente (Italy)
- SAPIENZA UNIVERSITÀ DI ROMA**: Sapienza University of Rome (Italy)
- THE CYPRUS INSTITUTE**: The Cyprus Institute (Cyprus)
- ΤΜΗΜΑ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ ΠΟΛΥΤΕΧΝΙΚΗΣ ΣΧΟΛΗΣ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΠΑΤΡΩΝ**: Department of Civil Engineering, Patras University of Applied Sciences (Greece)
- TÜBİTAK**: The Scientific and Technological Research Council of Turkey (Turkey)
- Ciemat**: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (Spain)
- IRD**: Institut de Recherche pour le Développement (France)
- OSS**: Organization for Science and Society (Libya)
- TEL AVIV UNIVERSITY**: Tel Aviv University (Israel)
- MEKOROT**: Israel National Water Co. (Israel)
- Other partners ?**: A box with a question mark and the text "Other partners ?" (Libya)
- Other partners ?**: A box with a question mark and the text "Other partners ?" (Morocco)
- Other partners ?**: A box with a question mark and the text "Other partners ?" (Egypt)
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- Other partners ?**: A box with a question mark and the text "Other partners ?" (Burkina Faso)
- Other partners ?**: A box with a question mark and the text "Other partners ?" (N'Djamena)
- Other partners ?**: A box with a question mark and the text "Other partners ?" (Djibouti)



**Coming soon:
www.tereno-med.net**

Thank you for your attention !

“Energy is never lost”

Hermann von Helmholtz



HELMHOLTZ
GEMEINSCHAFT