

Workshop on
Developing regional cooperation for shared karst aquifer management in SE E
Thessaloniki, Hellas 27-28 June 2008

Hellenic data and characteristics Monitoring data and existing information

George Stournaras

**Professor of Hydrogeology and Engineering Geology
University of Athens**

President of the Hellenic Committee of Hydrogeology



**University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology**



HELLAS: GEOGRAPHICAL DATA AND CHARACTERISTICS

The surface area of Greece is 130.100 km² of which 20% is distributed to its 3.000 islands, whereas, two thirds of the Greek territory is mountainous, making the country one of the most mountainous in Europe. Greece has the longest coastline in Europe with a total length exceeding 15.000 km of which 5% belongs to areas of unique ecological value.

Hellenic climate is consisted of three types that influence well defined regions of the territory. Those are the **Mediterranean**, the **Alpine** and the **Temperate** types. The first one features mild, wet winters and hot, dry summers. The Aegean Islands and the south-eastern part of mainland Greece are mostly affected by this particular type. The Alpine type is dominant mainly in Western Greece. Finally the Temperate type affects central and north-eastern part of the country. Athens is located in a transitional area featuring both the Mediterranean and the Alpine types.



Water resources situation

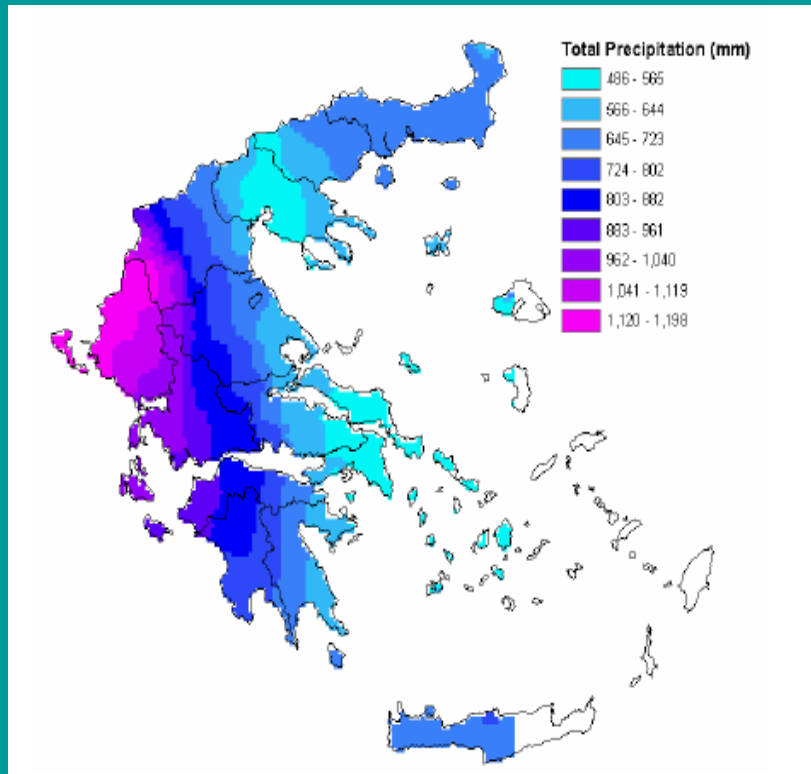
The mean annual surface run-off of mainland **rivers** is 35 billion m³. More than 80% of the surface flows originates in eight major river basins: the Acheloos (Central Greece), Axios, Strymonas and Aliakmonas (Macedonia), Evros and Nestos (Thrace) and Arachtos and Kalamas (Epirus). Nine rivers flow over 100 Kms within Greece. Four major rivers originate in neighbouring countries: Evros, Nestos and Strymonas (Bulgaria) and Axios (FYROM). Total inflow from upstream neighbouring countries amounts to 12 billion m³. One river originated from Greece discharge in Albania (Aoos)

41 natural **lakes** occupy more than 600.000 hectares or 0.5% of the country's total area. The largest are Trichonida, Volvi and Vegoritida. Lake Prespa is on the borders with Albania and FYROM.

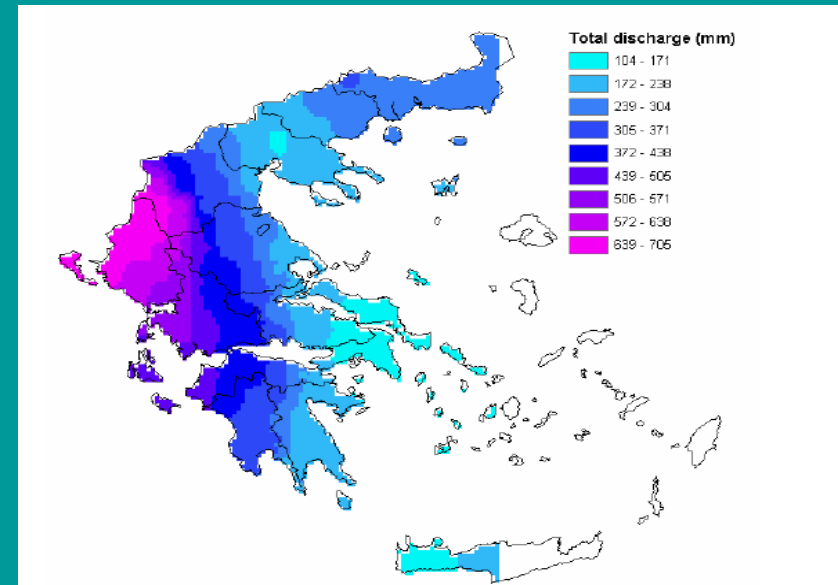
The number of Greek **wetlands** rises to about 400 with 10 of them designated as Ramsar wetlands.

The 14 **artificial lakes** (ten with an area over 5 km²) occupy 26.000 hectares.





Distribution of total precipitation in Greece
(the crucial role of the Pindos mountain chain)



The shortage of water is also apparent from the distribution of runoff in Greece, which presents an uneven distribution proportional to the rainfall, as shown in the figure

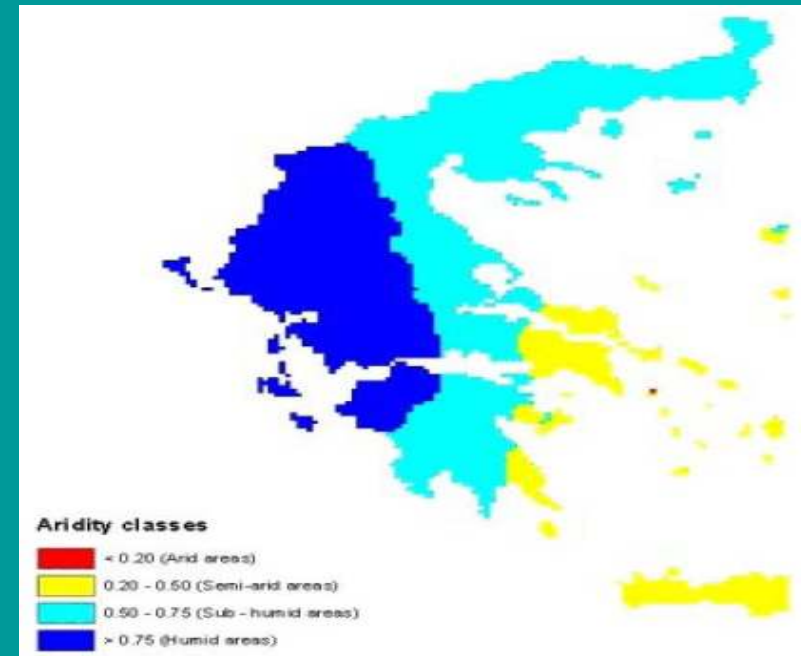
Runoff distribution in Greece
(crucial role of the mountainous relief)



The **evapotranspiration** is an important hydrological loss that takes place both from the surface and the upper soil layers. The value of evapotranspiration is quite high, especially in the dry eastern regions of the country.

A widely used indicator for the climatic characterization of a region is the **UNESCO's indicator of dryness**, defined as the ratio of the mean annual precipitation to the corresponding potential evapotranspiration.

The figure shows the distribution of the given indicator in Greece, indicating the severity of drought that affects south-eastern Greece and the islands of Aegean



*Indicator of dryness for Greece
(Values below 0.20 characterize dry regions, between 0.20 and 0.49 almost dry, between 0.50 and 0.74 almost humid, over 0.75 characterize humid regions)*

(Humid and sub-humid areas in transboundary regions)





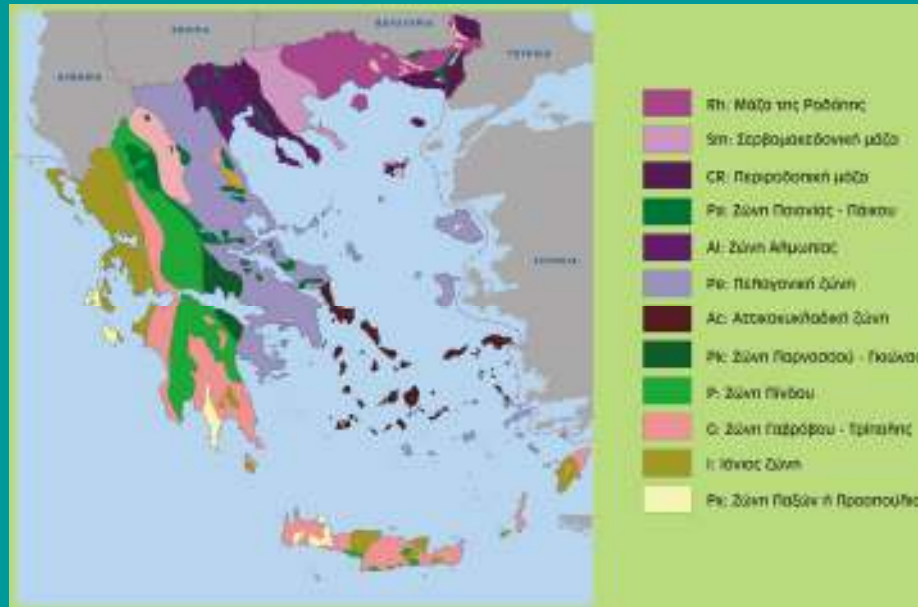
**Areas where over-exploitation of coastal groundwater resources
has been registered**



**University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology**



HELLAS: GEOLOGICAL AND HYDROGEOLOGICAL DATA



The Hellenic geotectonic zones (Hellenides)

The karst distribution in Hellas



University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology

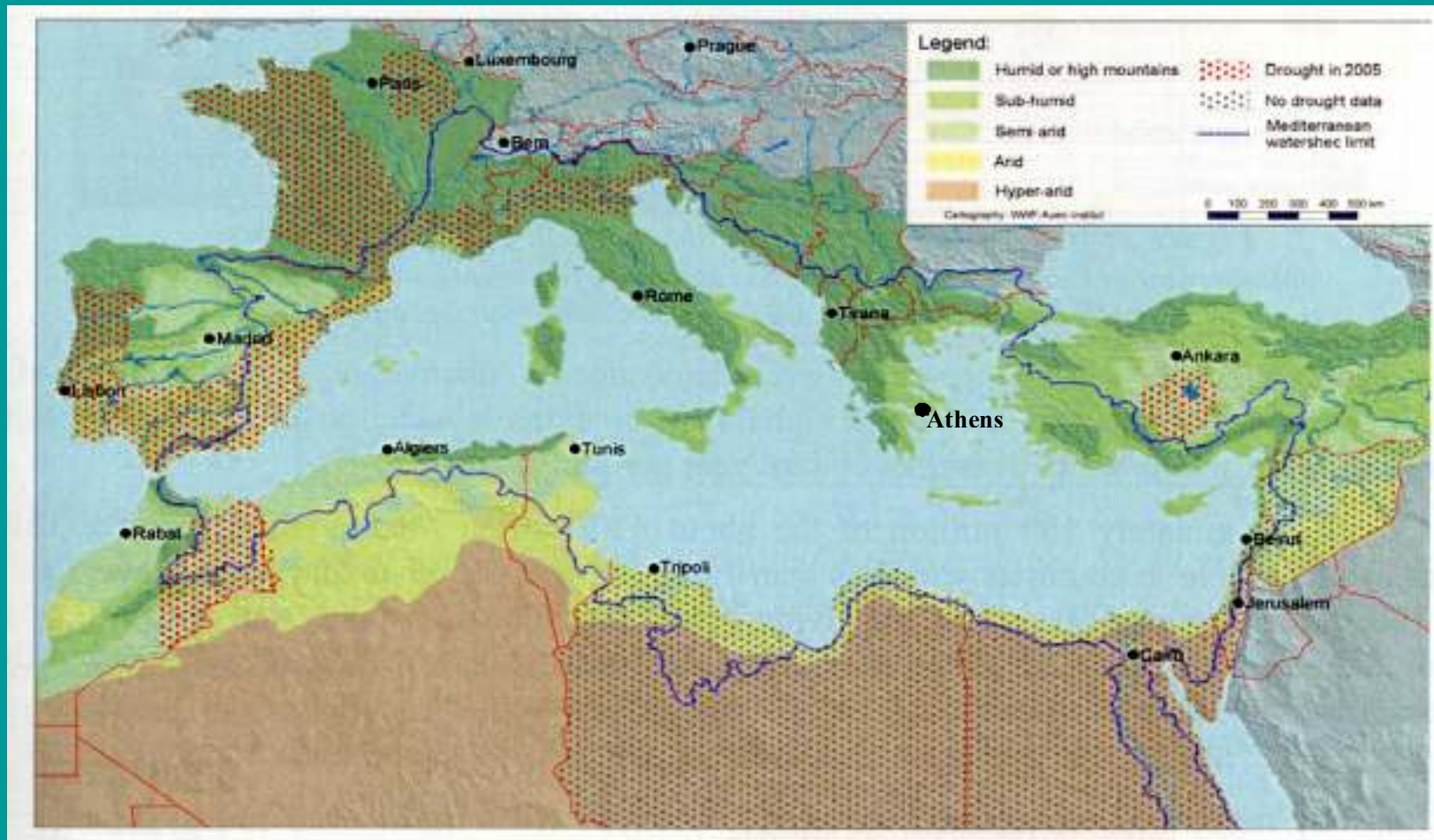


STARTING FROM MEDITERRANEAN

Mediterranean countries present many common features and, at the same time, a considerable variability in terms of **climate, water and land resources and development issues**. All these characters include arid and semi-arid climate, limited water resources, agricultural development related to the water availability and high economic and social value of water. From geological and hydrogeological point of view the common features include:

- The **Mediterranean type of karst configuration**, related to the paleogeography of the Mediterranean basin (karstic media)
- The **extended deltaic formations** and thus the porous media important aquifers (homogeneous and continuous media)
- The **extended igneous and metamorphic rocks**, forming an important field of fissured rocks aquifers (homogeneous and discontinuous media)
- The **common problem of the salinization of the coastal aquifers**, mainly due to the overexploitation, which is the result of the intense social, economic, industrial and agricultural activity during a period of more than 25 centuries
- The fact that **Mediterranean basin is the world's first tourist destination**





University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



Water resources by inhabitant

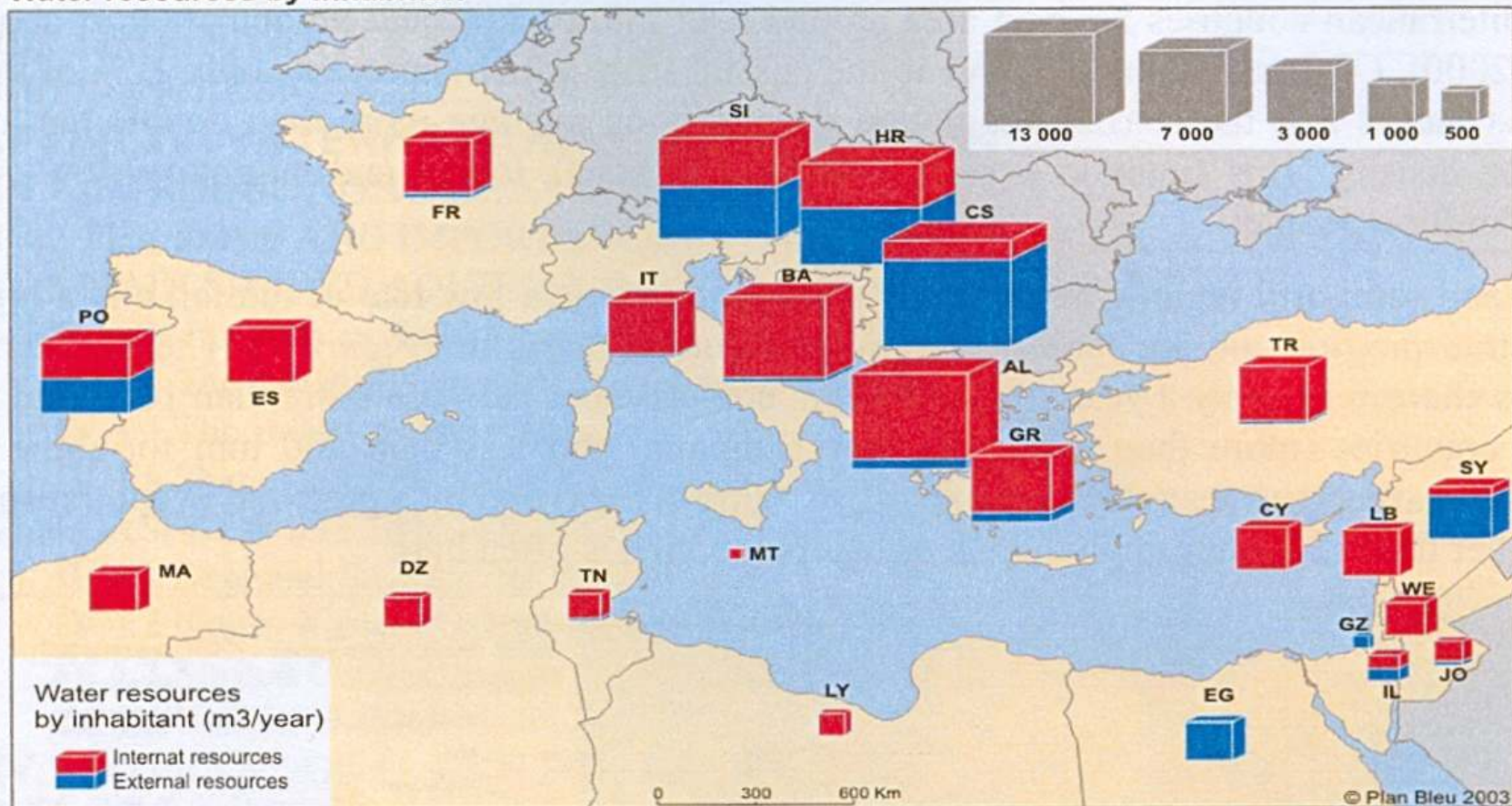


Figure 2: Water resources per capita in Mediterranean countries
 (Mediterranean Vision on water, population and the environment for the XXIst century
 by Jean Margat and Domitille Vallee MEDTAC/Blue Plan December 1999)



University of Athens – Faculty of Geology and Geoenvironment
 Hellenic Committee of Hydrogeology



The Mediterranean Basin is seriously affected by:

- **Reduced replenishment of the water** (mainly through Gibraltar, additionally through Suez)
- **Pollution and Contamination** originated not only from coastal human activities (domestic waste, industrial sewage, residues of the chemical support of the intensive agriculture, hydrocarbons from land installations and shipping etc), but also originated from the inland activities through the rivers estuaries
- **Global Climatic Changes**, since Mediterranean basin seems to be especially sensitive and vulnerable to the given changes
- The **differentiation of organization, degree of progress etc of the implementation of the WFD** among EU countries and the Middle East and African countries
- The **same differentiation among the EU countries** themselves
- The each time functions of public participation (Goal \Rightarrow Democratic Process, Efficiency, Better Policy ... Metric \Rightarrow Citizens satisfied engaged in the decision-making process, Reduction of transaction and compliance costs, Comparison of similar policies with public participation with policies through non-participative proceedings)

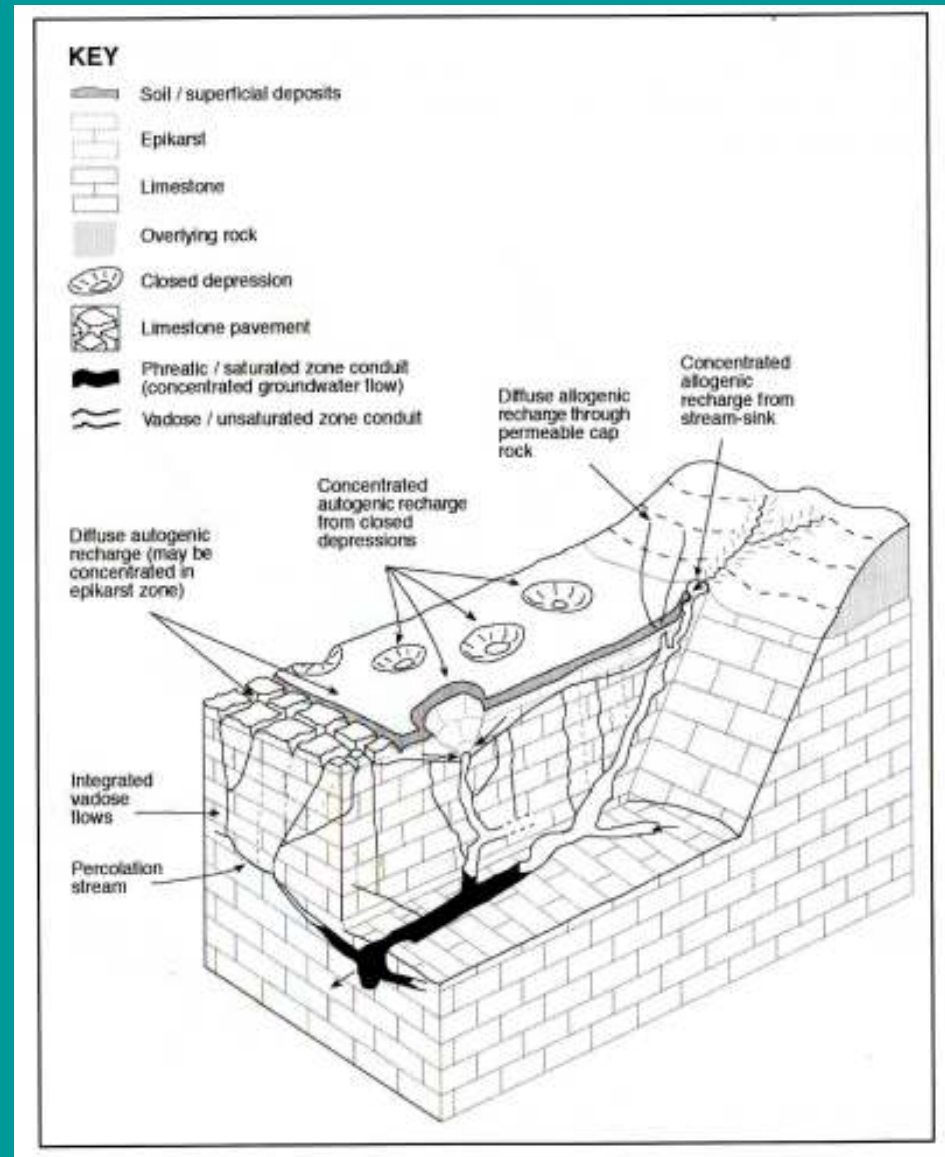


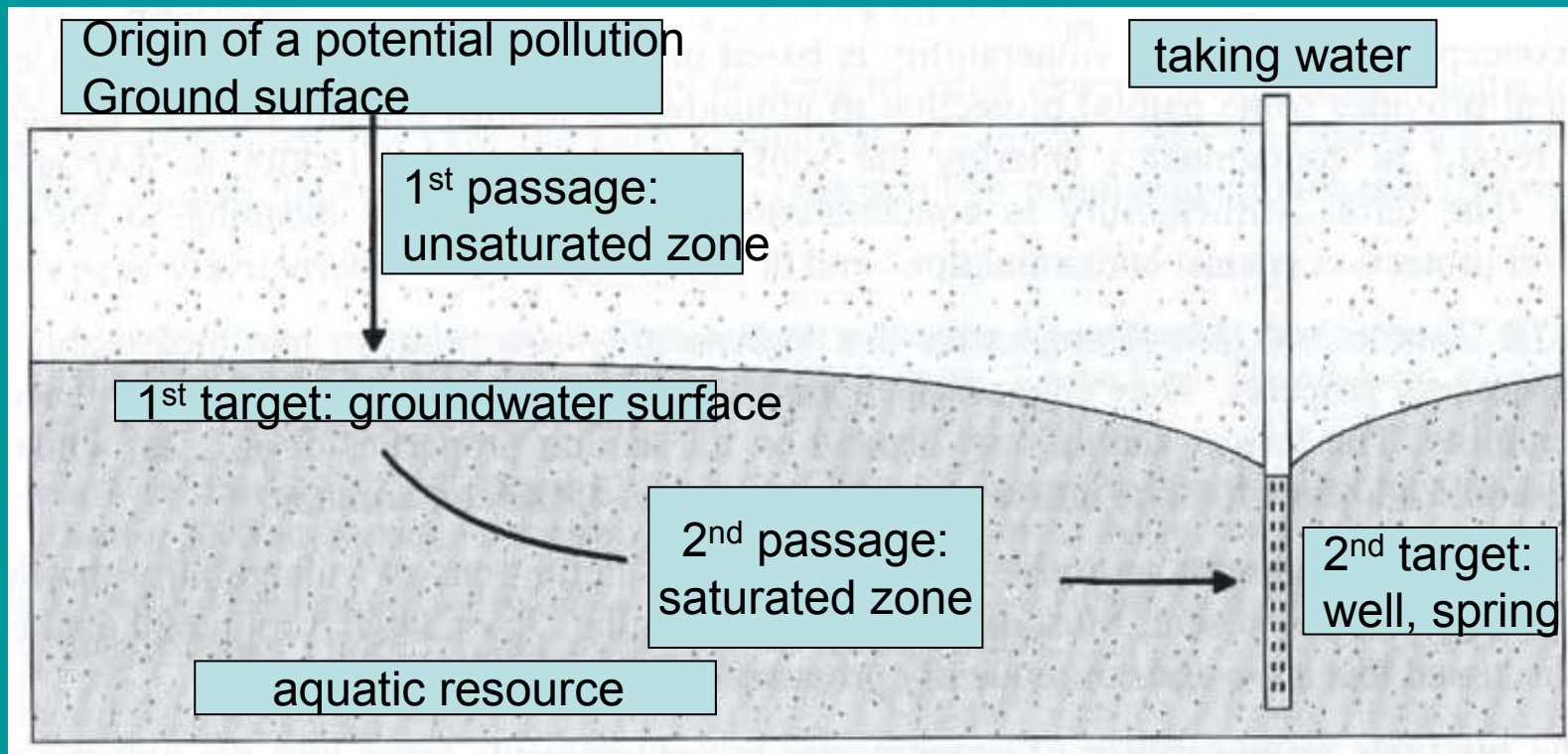
CONTINUING TO KARST

Particularities in vulnerability of karst aquatic systems

Karst is the most vulnerable formation since:

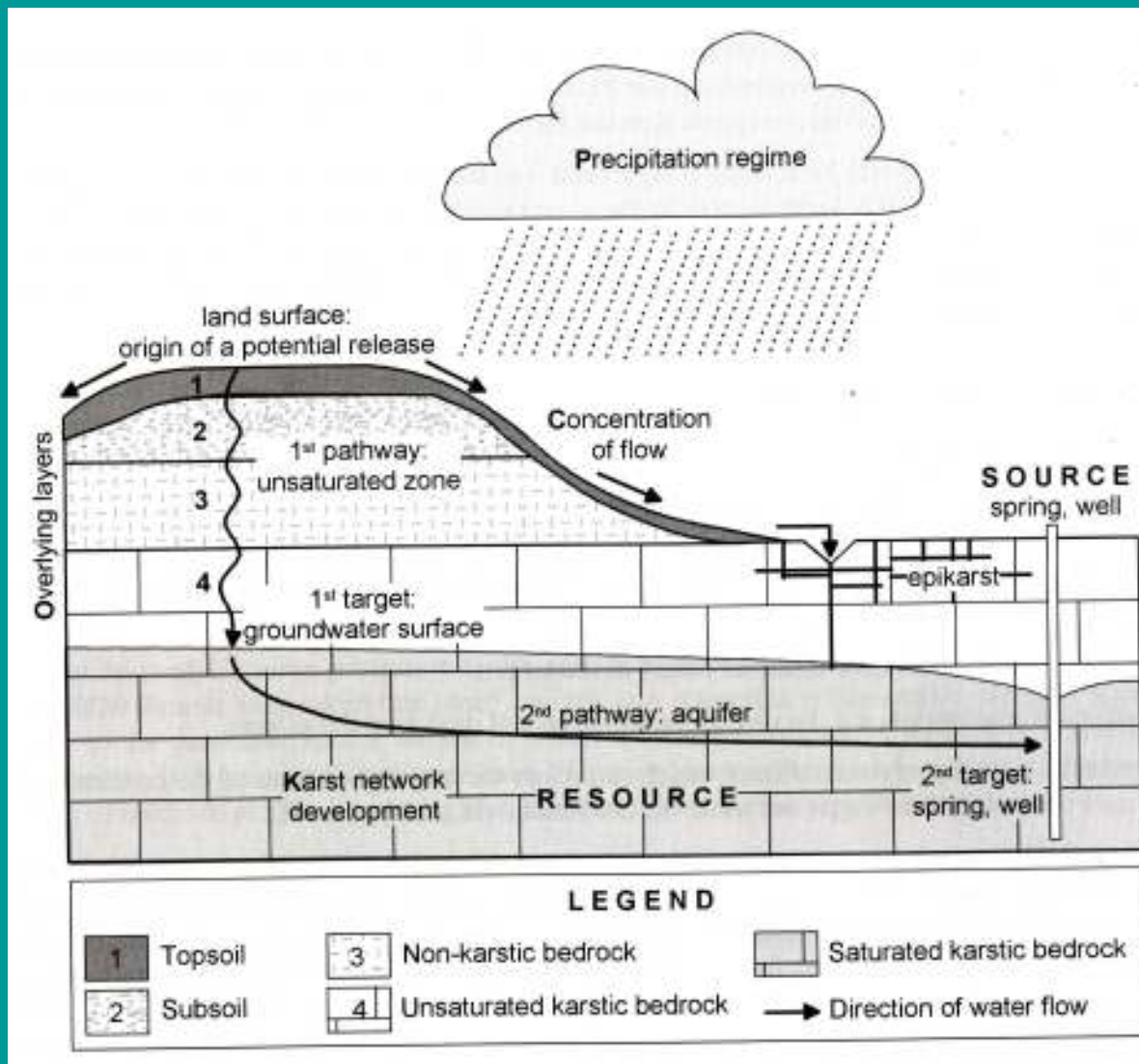
1. It is open at the surface (environment of the pollutants disposal) at least at their alimentation zone
2. Important mechanisms of the pollutants confrontation do not appear or appear typically (filtration, retention, absorption, capillarity)
3. They transport the pollutants quickly (with distinct and considerable dilution phenomena) compared to the porous (continuous) media





However, it is necessary to underline a principle of the Environmental Hydrology *“...there is a difference between the entry of the pollutant within the aquatic system (resource pollution and vulnerability) and the arrival of the pollutant to the water supply structure, such as a well or a spring (source pollution and vulnerability)...”*

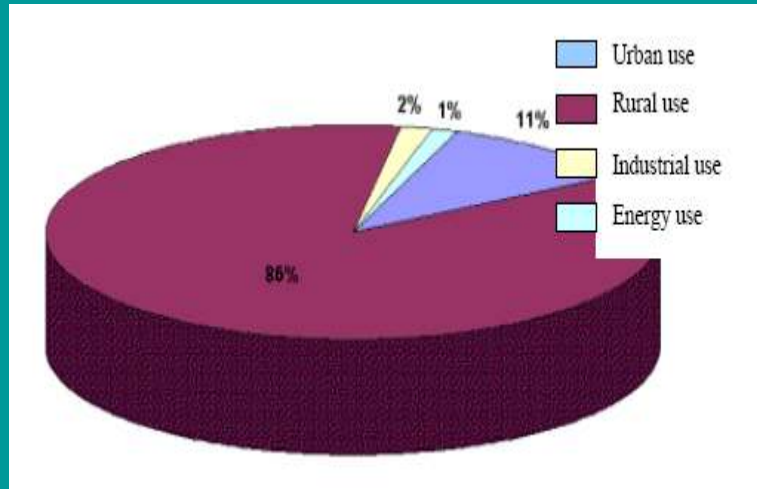




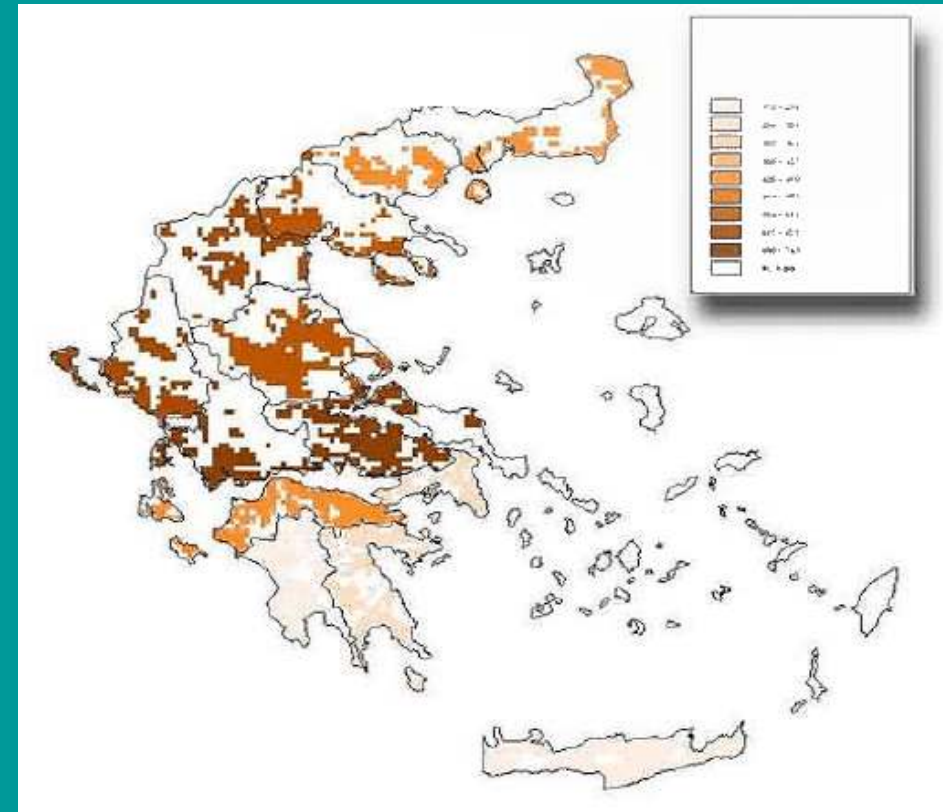
University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



SOME SIDES OF THE ACTUALITY OF THE WATER MANAGEMENT



*Water use in Greece
(additionally wrong irrigation systems)*



THE MONITORING

The Institute of Geology and Mineral Exploration (IGME), among different researchers, has established a national network for monitoring qualitative and quantitative properties of groundwater, collecting systematically hydrological, hydrochemical and other data (heavy metals, pollutants).

The National Surface and Groundwater Quality Monitoring Networks are currently under revision and readjustment, according to the requirements of the WFD. Through this activity, a coherent and comprehensive overview of the chemical and ecological status within each River Basin District will be provided. This overview will enable, after assessment of the reference conditions, the classification of the surface waters into five classes, on the basis of specific quality elements and the development of national classification.



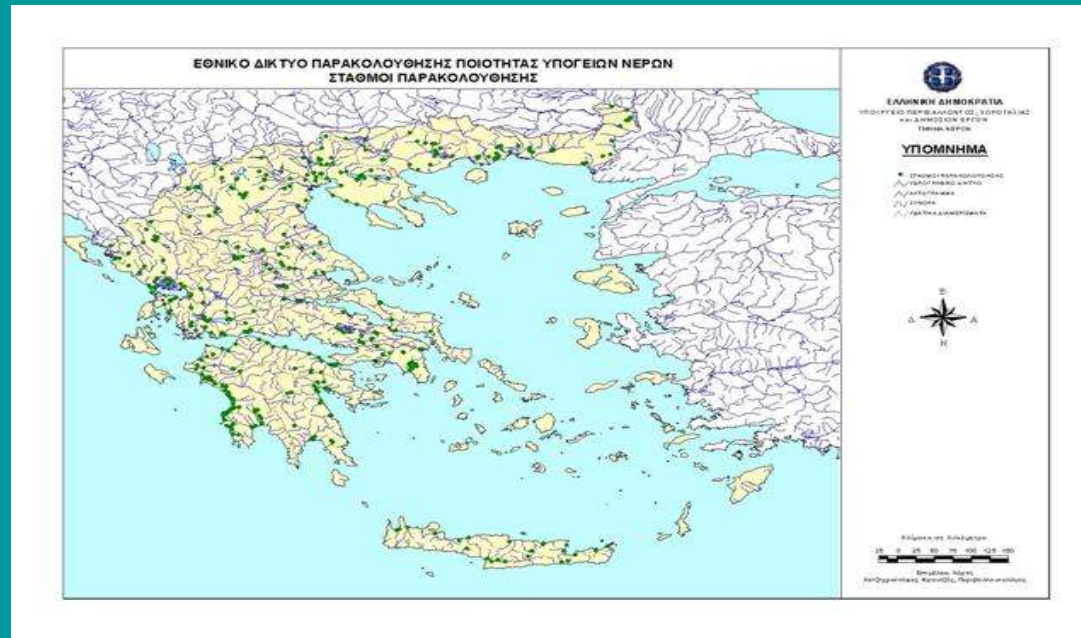


The surface water monitoring system



**University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology**





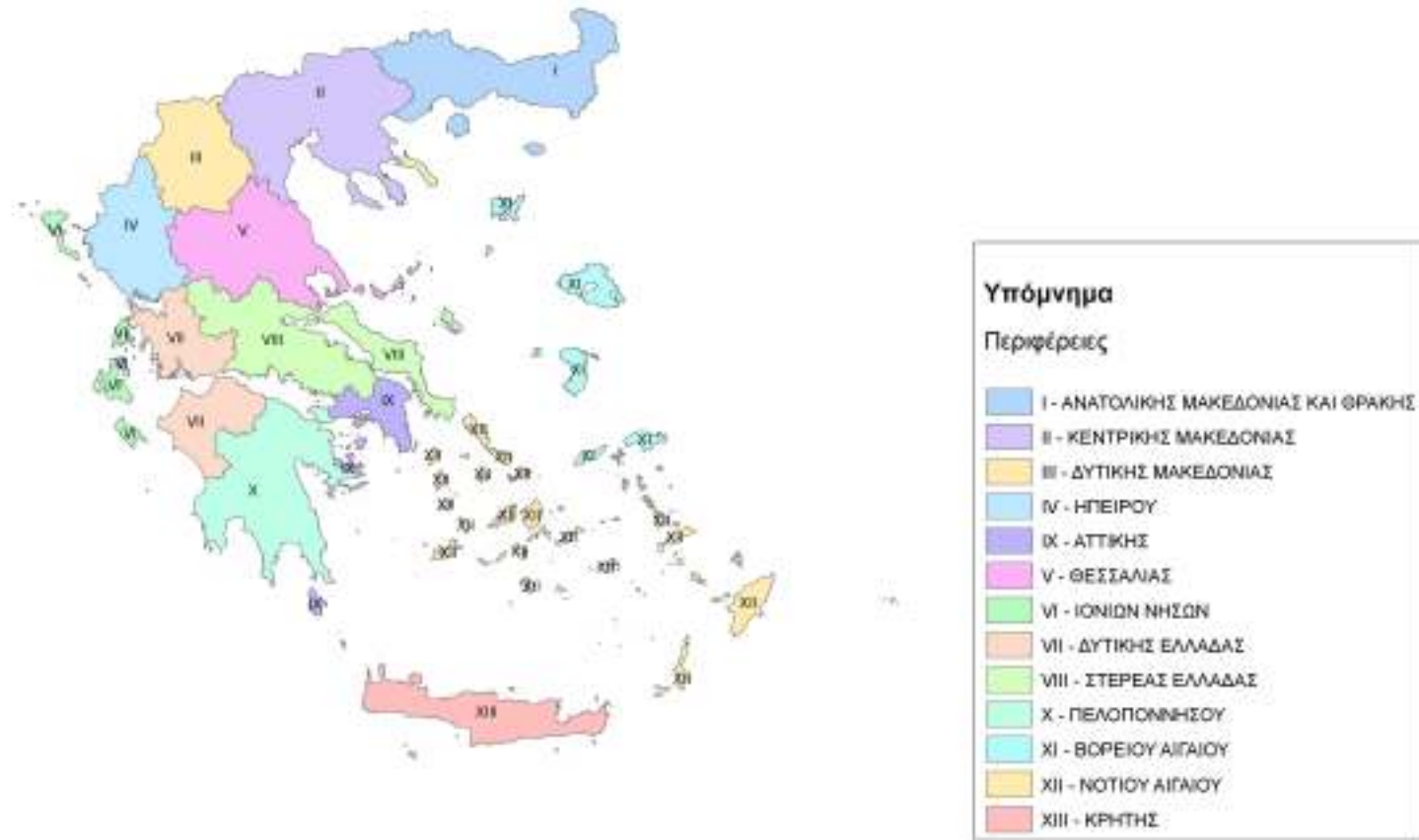
Groundwater monitoring is carried out at approximately 400 sampling points covering the whole country except for the Aegean islands. Sample analyses focus on nitrates of agricultural origin.



University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



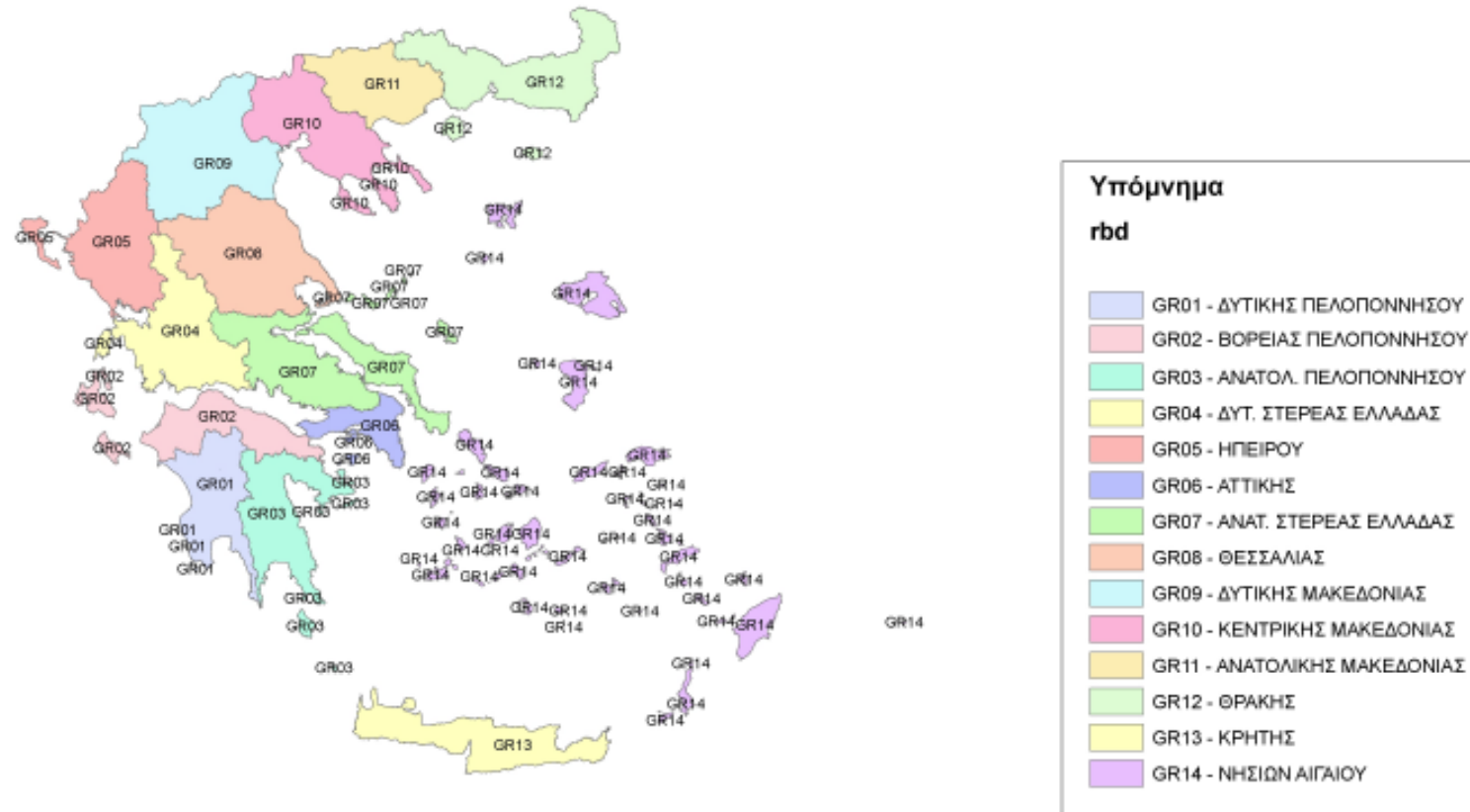
Αρμόδιες Αρχές (Competent Authorities)



University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



Περιοχές Λεκανών Απορροής Ποταμών (River Basin Districts)



University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



In Greece, the supply of clean and sanitarly appropriate water, from ground and surface waters, to every citizen in the country, consists one of the main responsibilities of Public Administration. The state is responsible for providing water and wastewater services to Athens and Thessaloniki and has effectively entrusted water services to two large companies: to EYDAP (Athens Water Supply and Sewage Company) in Athens, which legally has private status but is supervised by the Ministry for the Environment, Physical Planning and Public Works and to DEYATH in Thessaloniki, a public sector company. In cities, over 10000 municipal companies manage water and wastewater services. In smaller towns and rural areas, communities are directly responsible.



Legal situation

Since December 2003, a new legislative and institutional framework has been put into force in the country. It consists of Law 3199/9-12-2003 on water protection and the sustainable management of the water resources, with which the EU Water Framework Directive (WFD) (2000/60/EC) is transposed into the national legislation. It lays emphasis on the management of water on the basis of **river basins** as well as on the water pricing so that it reflects its **full costs**. In more detail, the main objectives of the new Law include: the long-term protection of water resources, the prevention of deterioration and the protection and restoration/remediation of degraded water resources and wetlands, the reduction and, in cases, the phase out of harmful and polluting discharges, the reduction of groundwater pollution and the prevention of its further deterioration as well as the mitigation of the effects of floods and droughts.

The Law 3199/03 also incorporates the **polluter pays principle** and the objective of maintaining or reaching a good ecological status for all water resources through the control of pollution by use of threshold levels and standards. It also introduces innovative approaches concerning the protection of water quantity and **the transnational cooperation for the protection of transboundary water courses and lakes**.



The new legislation for the protection and the sustainable management of the water resources in Greece provides a detailed identification of 13 Regional Water Directorates, which have the responsibility for organising and co-ordinating water policy activities and specific Water Programmes and Action Plans with specific measures for the River Basin Districts (RBDs) of the country. They are in charge for implementing the WFD in the RBDs and they are supervised by the Central Water Agency, a governmental authority with the overall responsibility for establishing the national water policy.

The 3199/03 Law also integrates the public participation requirements of the WFD. The active involvement of the interested parties is ensured by their representation at the National and Regional Water Councils that will be developed as a part of the new administrative framework. In order to complete the transposition of the WFD, besides this new law, further instruments, e.g. Presidential Decrees and Joint Ministerial Decisions, have been prepared, for the incorporation of the technical provisions of the Directive



Management of protected areas including wetlands, was defined in 1999 (Law 2742/99) through the establishment of administrative units (Management Bodies) and the competence of **NATURA 2000** Committee, whereas in 2002, through Law 3044/02, 25 Management Bodies were established, additionally to the existing two ones.

Management of the most important protected wetland sites in Greece, designated as Ramsar wetlands of international importance, is attained through the establishment of these Bodies (which are financially supported, for the time being, from the state), that will collaborate with the respective regional services to be established according to Law 3199/03, with the mandate to develop and implement regional water management plans.



Recapitulative editions present the water regime of the Mediterranean basin and Greece

Regarding the hydrogeological conditions and water uses:

“Mediterranean groundwater report”, Technical report on groundwater management in the Mediterranean and the Water Framework Directive, *European Commission, Environment, Technical Report 2007/001*

Regarding the implementation of the EU Water Framework Directive

“Implementing the EU water framework directive towards integrated water management in Europe” *Elli Louka (ed.), Proceedings of International Conference, Athens, May 12, 2006*

Regarding the implementation of the EU Water Framework Directive in Greece

J. Sympetheros: COUNTRY REPORT: GREECE, Conference of the water directors of the Euro-Mediterranean and Southeastern European countries, 6 & 7 November 2006, Athens

Regarding the karst groundwater vulnerability

- COST action 620 “Vulnerability and risk mapping for the protection of carbonate (karst) aquifers”
- COST action 621 “Groundwater management of coastal karstic aquifers”

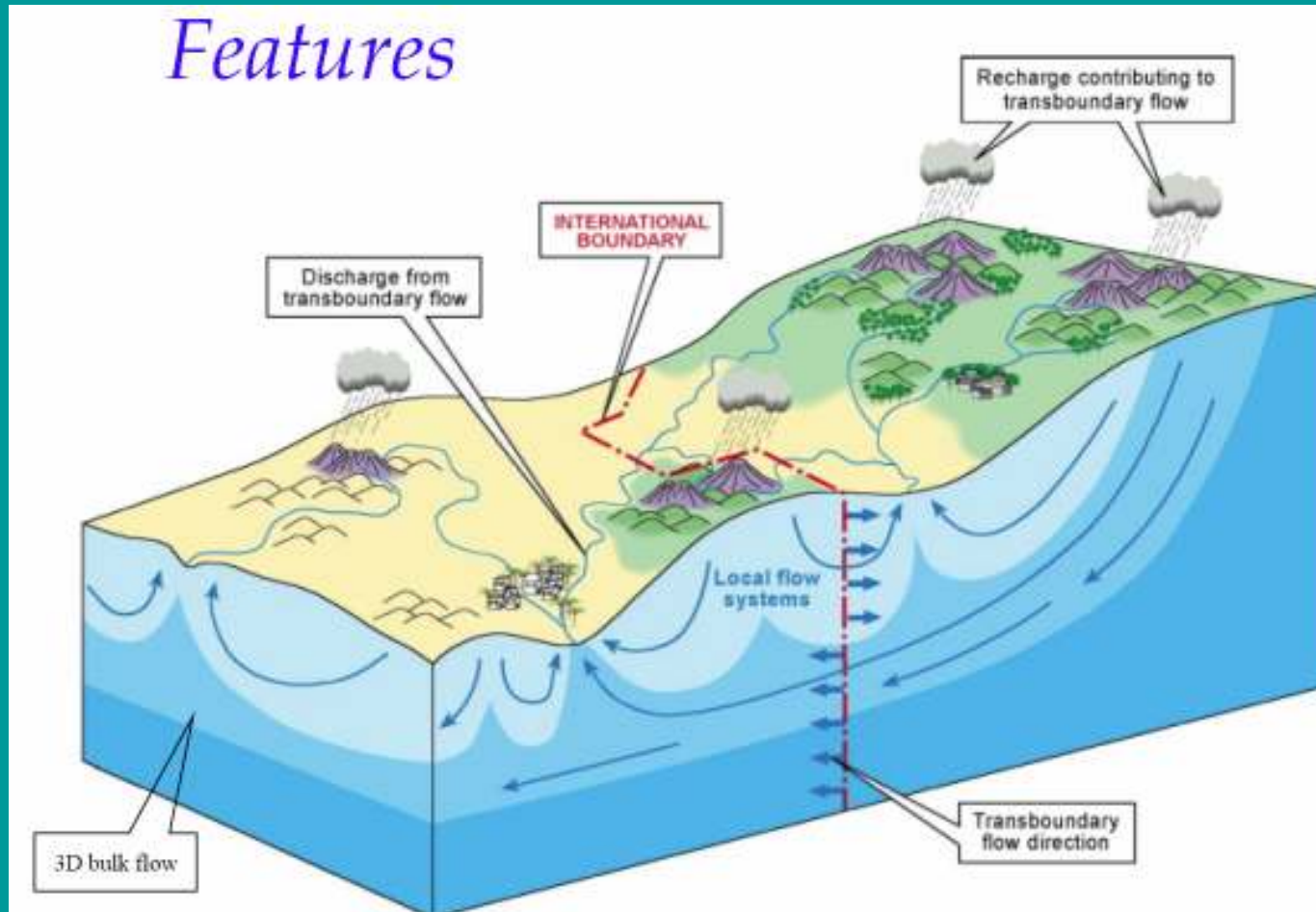


University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology



Thank you for your attention!

Features



Puri, Arnold (2002)



University of Athens – Faculty of Geology and Geoenvironment
Hellenic Committee of Hydrogeology

