Water resources management -Case studies from Greece

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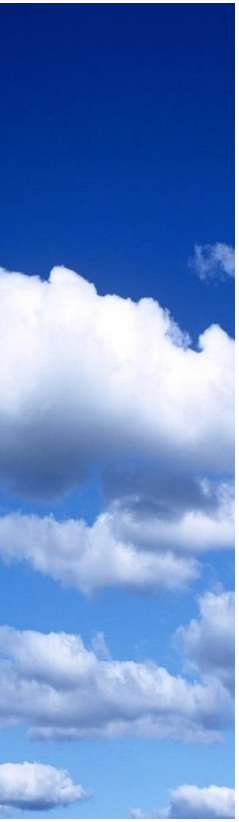
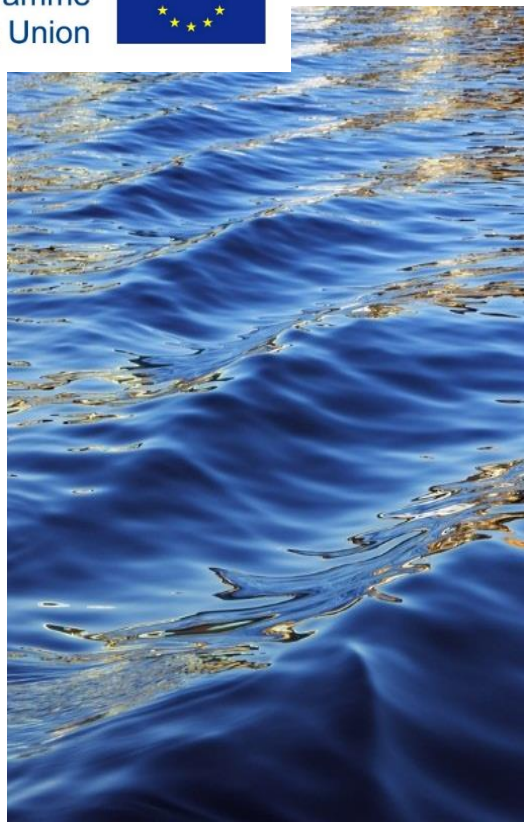


ILHAM-EC

Mobility strand for teachers in Greece

Thessaloniki, 22-26 May 2017



Brief description of Greece's physical characteristics

Greece is a country in South-Eastern Europe, situated on the southern end of the Balkan Peninsula. It is bordered by Bulgaria, the Former Yugoslav Republic of Maced

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About

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf

Climate

Greece's climate consists of three main types that influence well defined regions of its territory. Those are the Mediterranean, the Alpine and the Temperate types.

Mediterranean: 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.

Alpine: is dominant mainly in Western Greece.

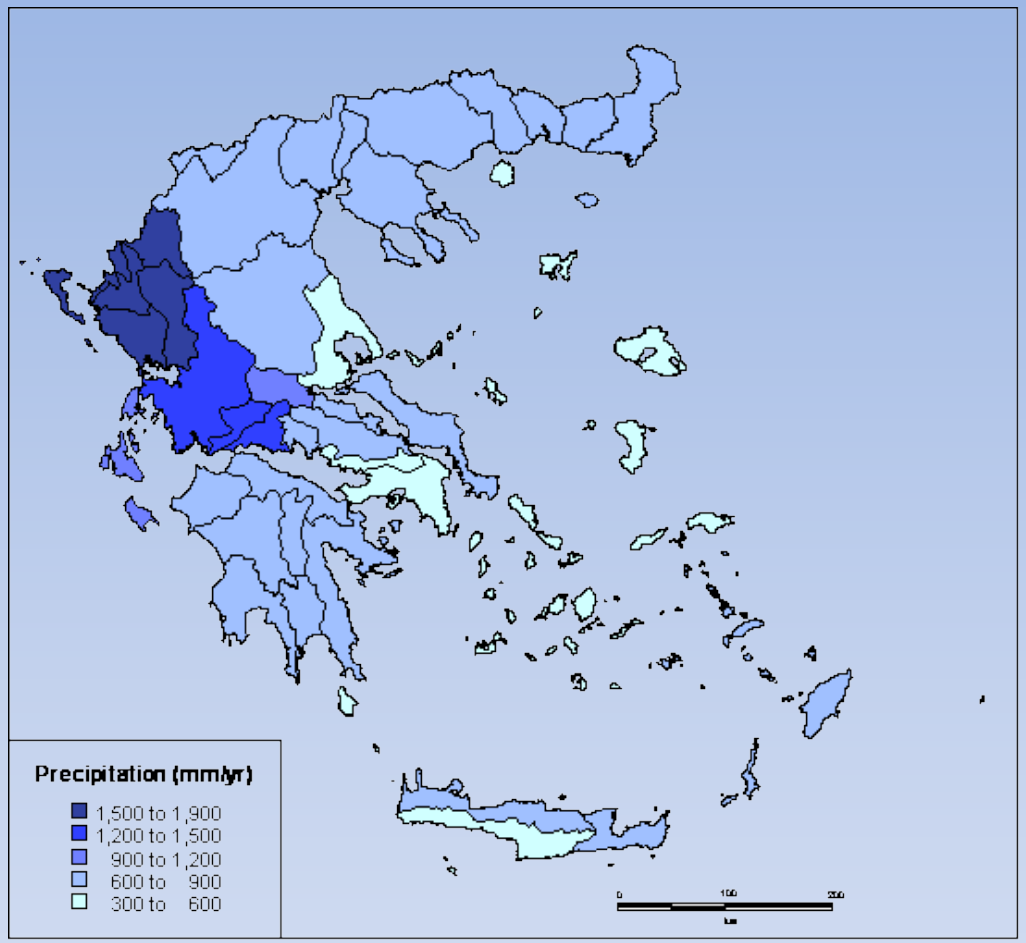
Temperate: affects central and north-eastern part of the country. Athens is located in a transitional area featuring both the Mediterranean and the Alpine types.

The annual precipitation varies from 200 mm in the plains and insular regions, to 2150 mm in the mountainous regions.

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

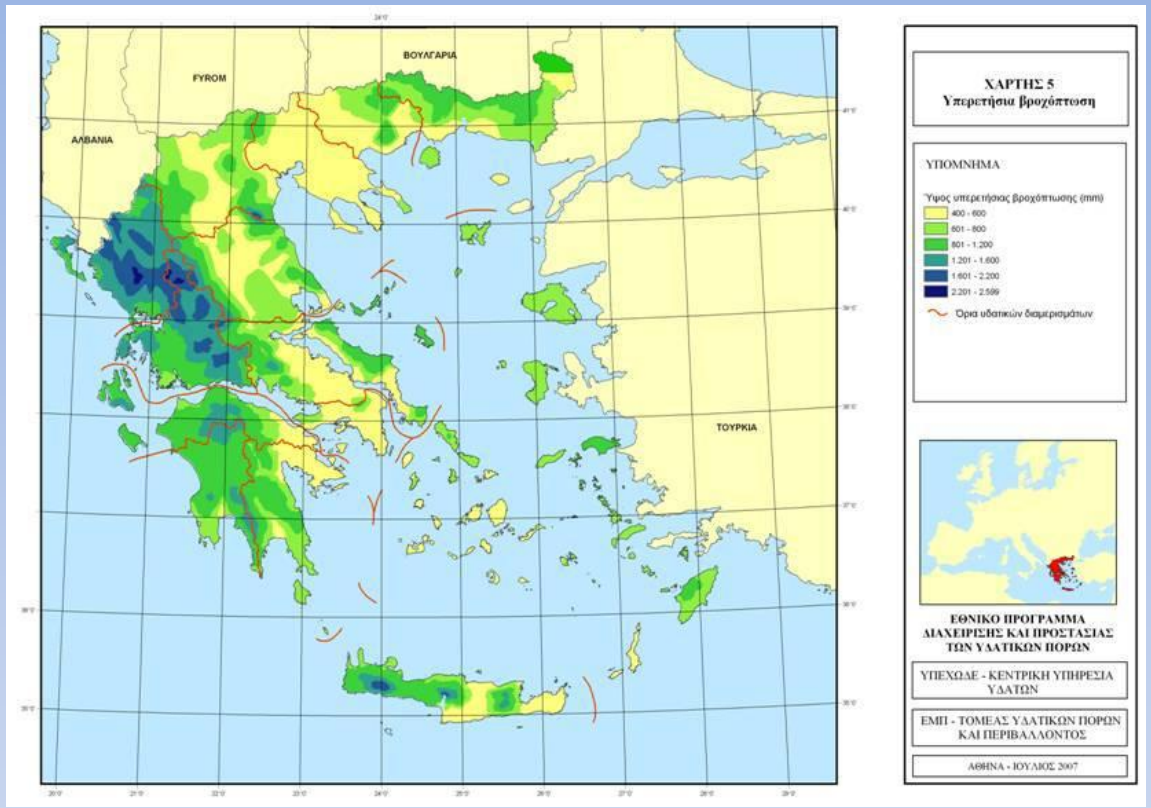
Climate



The maximum precipitation is recorded in the western parts, where the available water resources are consequently plentiful, while in other regions precipitation is much lower and available water resources are insufficient to meet the demand. Due to this inequality in water distribution, areas such as Attica and the Aegean Islands are facing long-term water shortage problems

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Climate



Greece has one of the greatest water resources potentials per capita in the Mediterranean area, and should theoretically have ample water for its population and traditional water uses but water is not evenly distributed in space and time.

Dozens of drought stricken Greek islands in the Aegean are being forced to import greater amounts of water every year (Milos, Nisyros, Amorgos, Koufonisia, Shinoussa, Folegandros, Tinos, Sikinos, Thirasis, Donoussa, Patmos, Symi, Halki and Palionissos)

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm
http://www.lifewateragenda.org/6-5-ii-Mamassis.pdf

Geomorphology-Geology

Greece is a mountainous country. Its main mountainous chain is that of the Pindos Mountains, which run in the N, NW – S, SE forming a continuation of the Alpine folds and upraises.

Another significant mountain chain is Rhodope, which runs along the northern borders of the country.

One of the main characteristics of the country is its extended coastline (exceeds 15,000 km the longest in Europe) and the significant number of islands. (233 islands with an area >0.25km^2, 93>10 inhabitants)

In Greece there are no plains in the geographical sense but only basins formed between mountain chains, broadened due to the corrosive action of rivers.

Formations are mainly comprised of limestone (with many karstic horizons) and sedimentary rocks (flysch, schistones, etc). There are also metamorphic, igneous and volcanic rocks, as well as tertiary and quaternary deposits.

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Groundwater

Greece is dependent on groundwater resources for its water supply (appr. 70%). Water needs are mainly covered by groundwater abstracted from the aquifers via numerous wells and boreholes (approximately 300,000 for the whole of Greece).

The main aquifers are within carbonate rocks (karstic aquifers) and coarse grained Neogene and Quaternary deposits (porous aquifers) and the estimated amount of stored groundwater is 10,300 hm^3/year.

Carbonate rocks cover more than 35% of Greece and many of them are cropping out at the coast.

The use of groundwater resources has become particularly intensive in coastal areas during the last decades with the intense urbanization, touristic development and irrigated land expansion.

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf

Surface Water

There are 765 recorded streams, 45 of which are perennial. There are many seasonal springs that feed into small streams.

The mean annual surface run-off of mainland rivers is 35 $\times 10^9$ m^3. More than 80% of the surface flows originates in eight major river basins: the Acheloos (Central Greece), Axios, Strimonas and Aliakmonas (Macedonia), Evros and Nestos (Thrace) and Arachtos and Kalamas (Epirus).

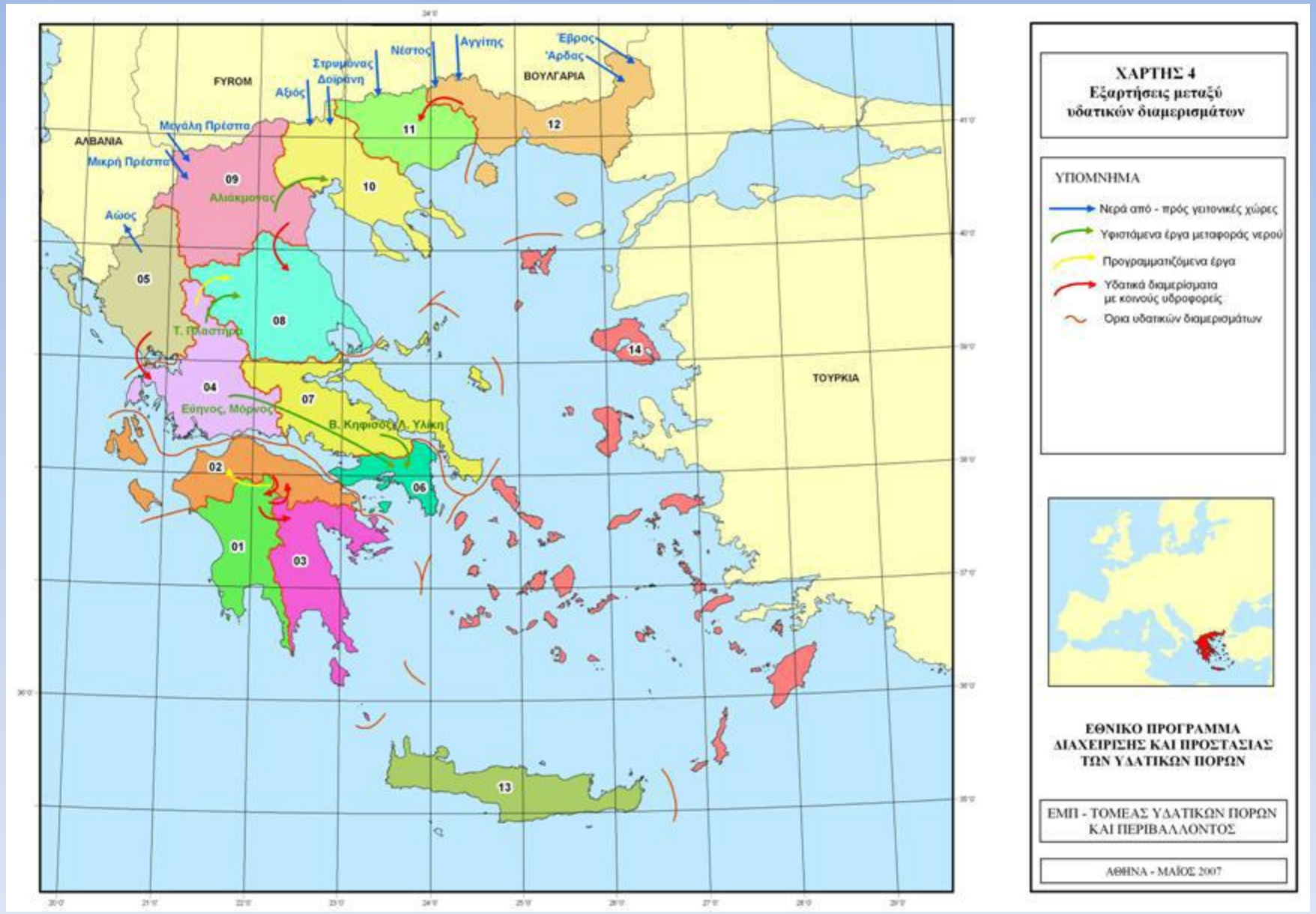
Nine rivers flow over 100 kilometers within Greece.

Four major rivers originate in neighboring countries: Evros (Turkey), Nestos and Strymonas (Bulgaria) and Axios (FYROM).

Total inflow from upstream neighboring countries amounts to 12×10^9 m^3.

41 natural lakes (19 with an area over 5 km^2) occupy more than 600.000 hectares or 0.5% of the country's total area. The largest are lakes Trichonida, Volvi and Vegoritida. Lake Prespa is on the borders with Albania and FYROM.

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf



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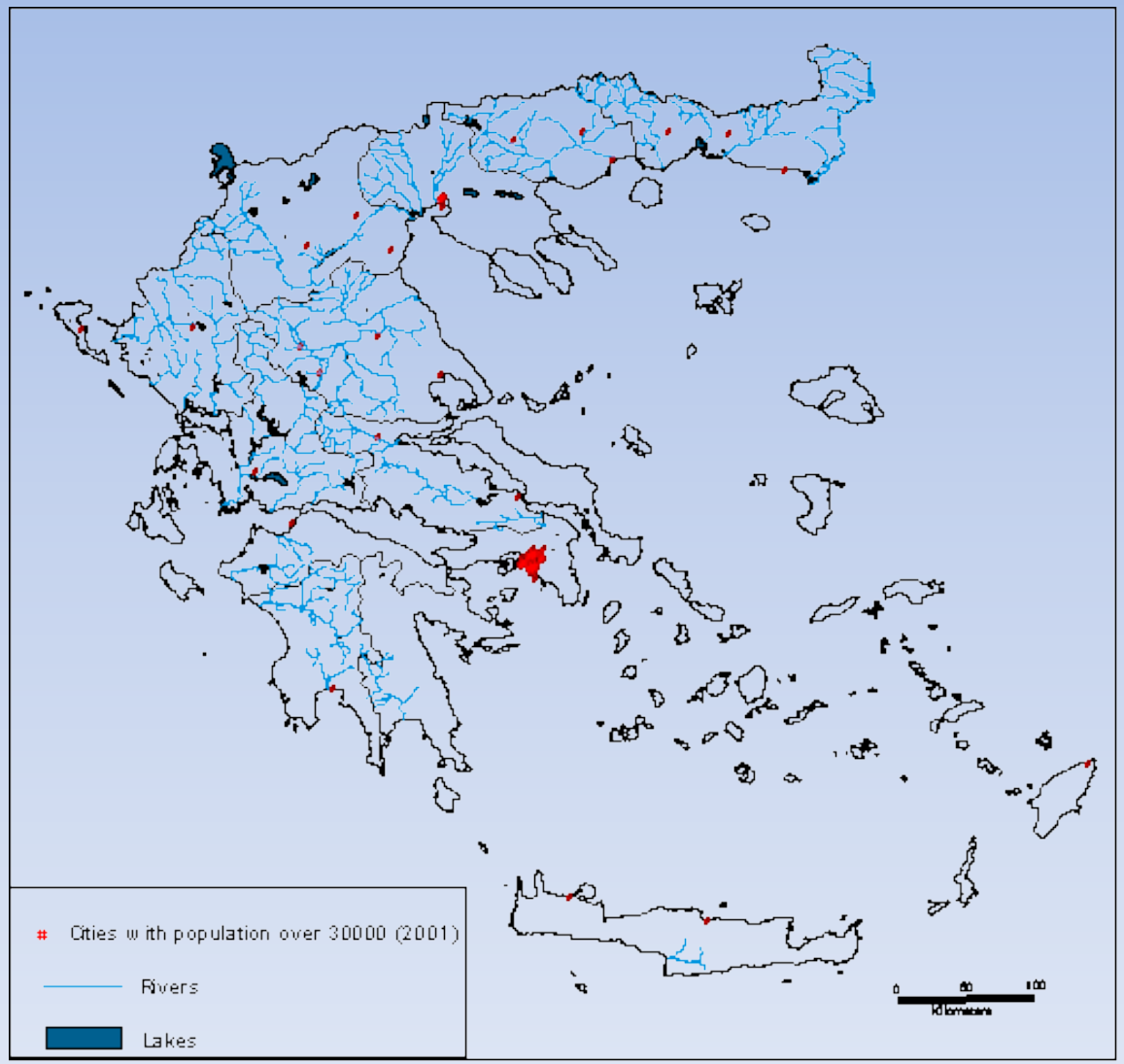
Surface Water



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http://photodentro.edu.gr/photodentro/ged20_gr-lakes_pidx0013256/lakes3.swf

Water demand and supply

Almost 100% of the Greek population is connected to water supply and power utilities, while 76% of the population is connected to sewerage and wastewater treatment networks.

Water demand in Greece peaks in the hot and dry summer months, when water availability is at its lowest, due to the decrease in precipitation. The summer peak is due to the heat that encourages increased water usage, to the influx of visitors to the country during the summer tourist season and to the current irrigation practices and cultivated crop types.

The Aegean Islands have the highest visitor/tourist number compared to permanent population. In August the peak number of visitors to the Aegean Islands is on average ten times greater than the local population, and in certain islands it is even thirty times greater.

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Water demand and supply

Approximately 14 km^3/y of water entering Greece (about 30% of total average annual water resources) originates in neighboring nations.

Thus, conflict arises in cases that the rivers are overabstracted upstream, and where the quality of the water deteriorates to the point that it cannot be used for its intended use downstream.

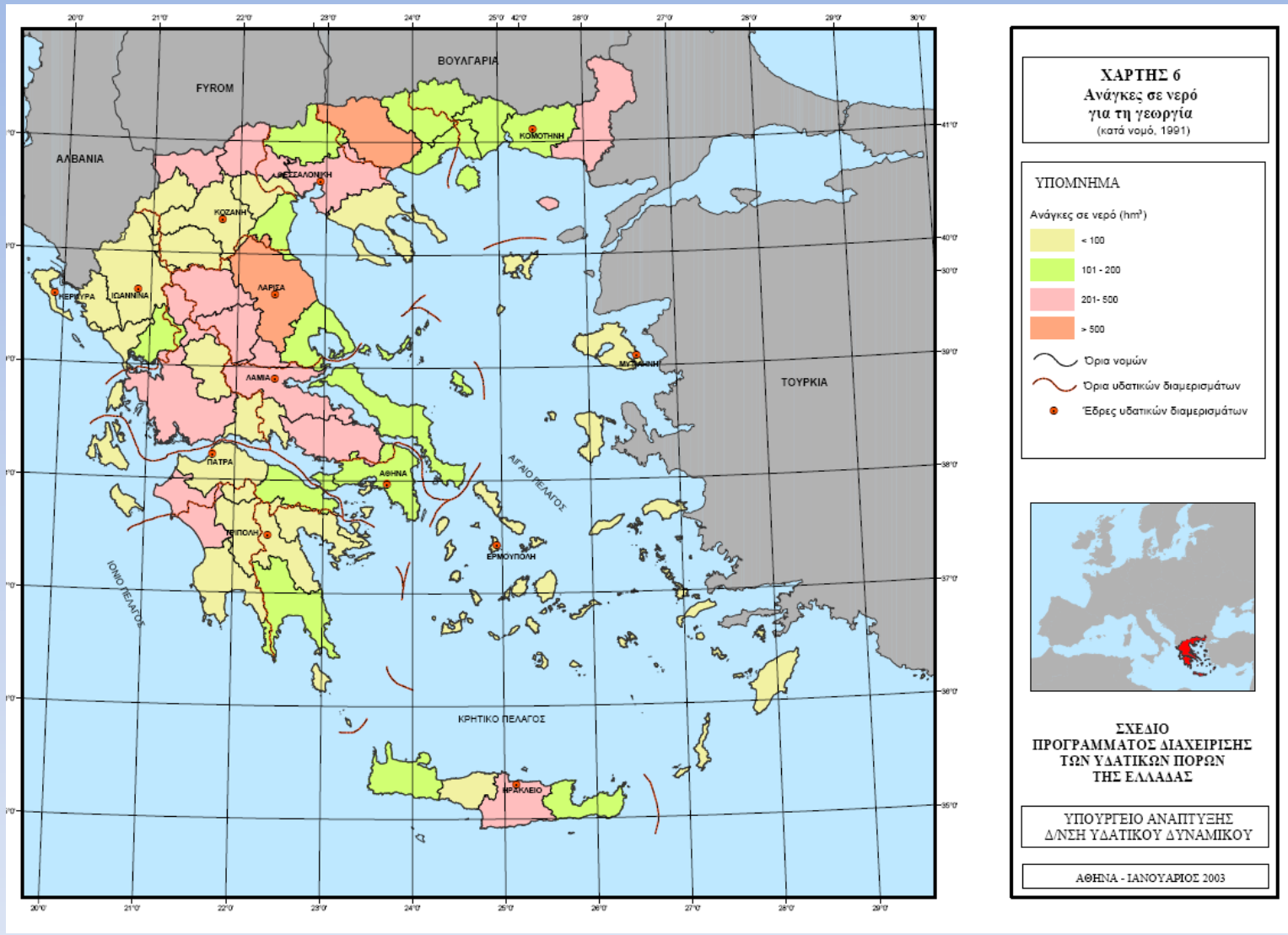
Greece is 31st in top 50 countries with severe water stress.

The major water use is in irrigation for agriculture; 86% of the total consumption. The irrigated land increased greatly in last decades, as indicated by the number of boreholes. (11% is for domestic use, 2% is used in industry and 1% in power production)

Per capita consumption of water is around 830 m^3 with peaks recorded during heat wave days and days of intensive snow fall.

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf

Water demand and supply



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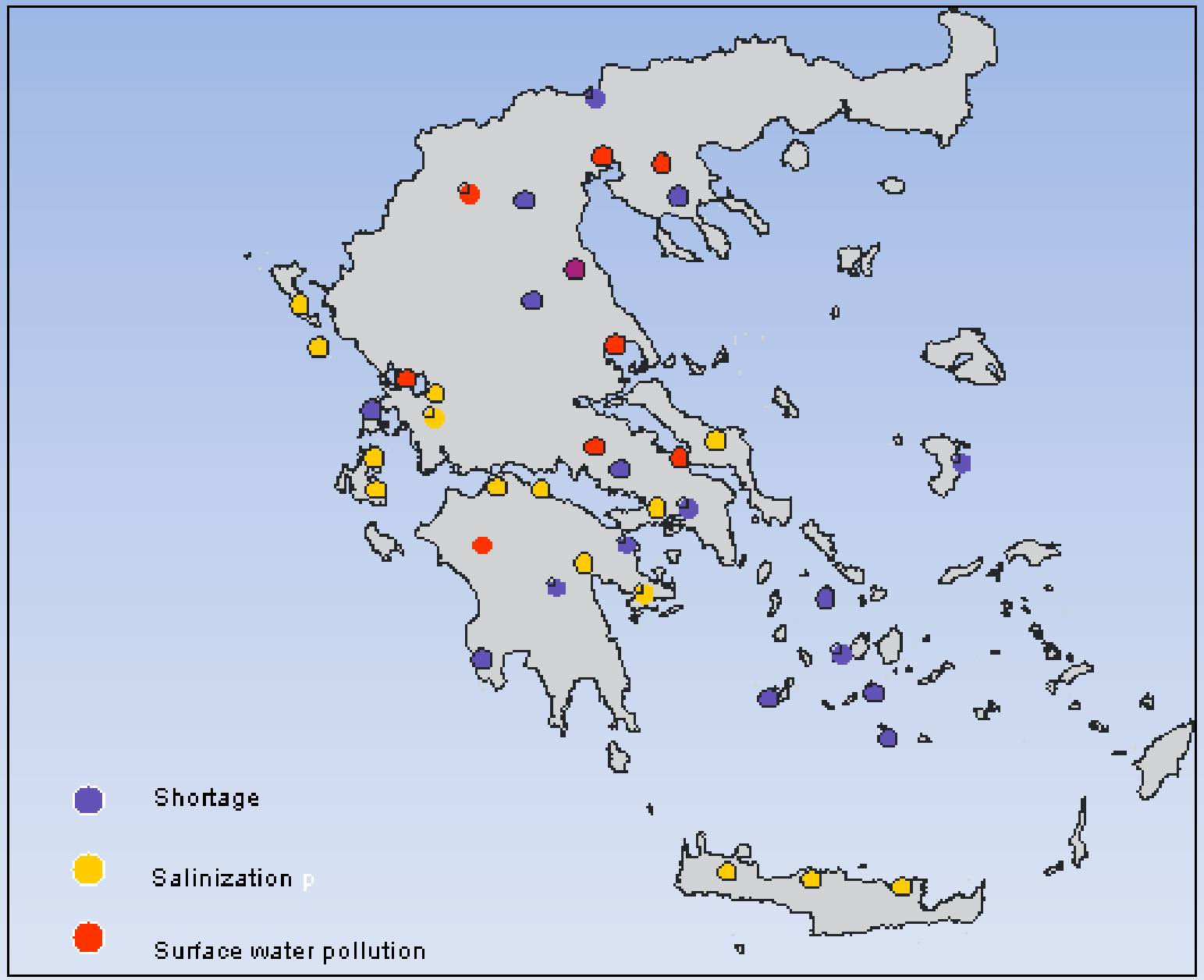

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Environment and protection

Overall, the coastal waters of Greece are of good quality, with the exception of the areas where effluents from the larger cities (Athens, Thessaloniki, Volos) are discharged.

The same cannot however be said for the surface and groundwaters.

Water pollution has been one of the main issues in trans-boundary water resources (disposal of raw domestic, industrial effluents).

High levels of industrial pollutants have been recorded in Greek rivers that pass through the upstream Balkan nations.

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Environment and protection

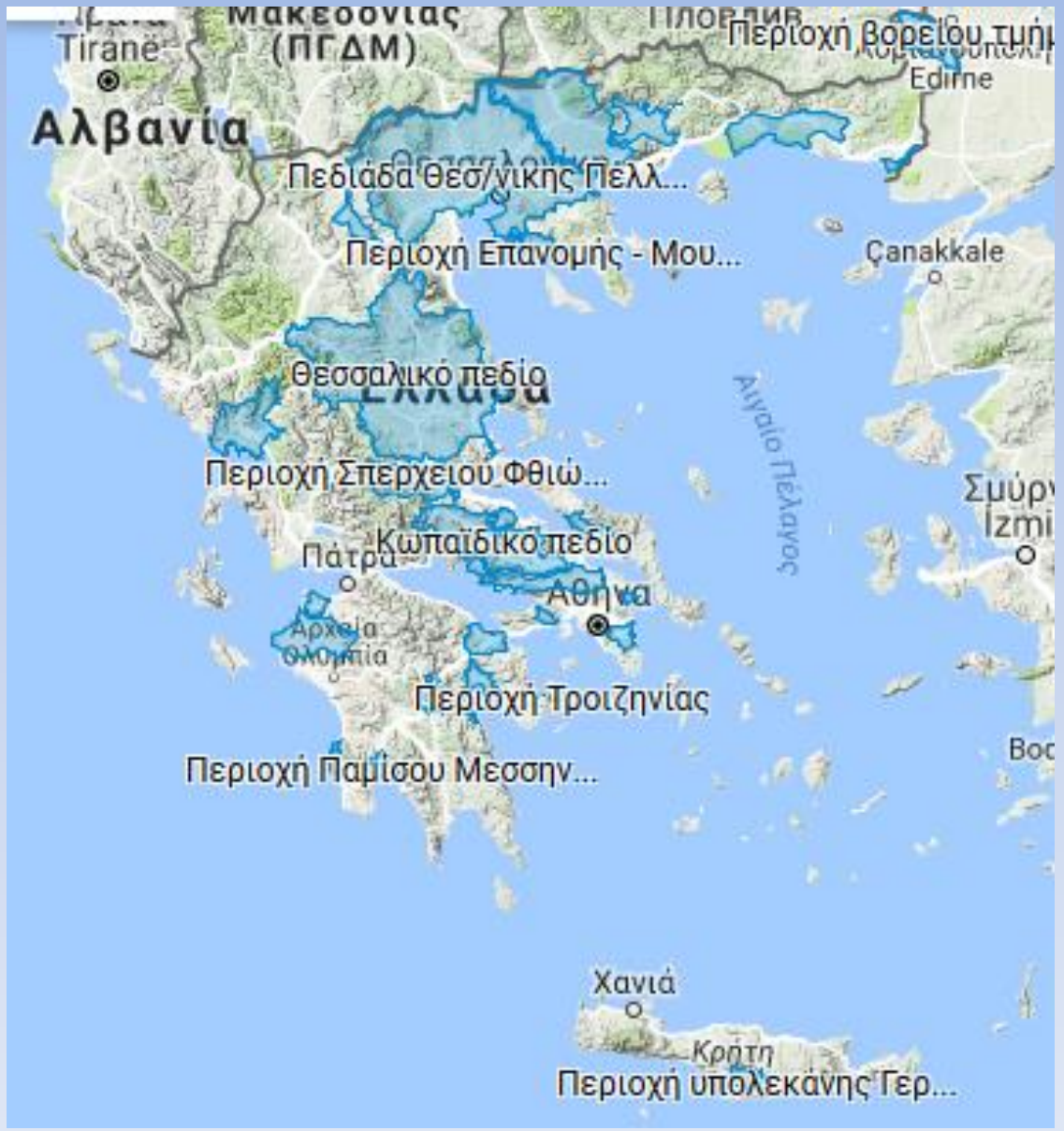
Sources of water resources pollution are:

- the seawater intrusion due to overexploitation of coastal aquifers
- the fertilizers from agricultural activities and
- the disposal of wastewater.

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Greece_Groundwater_country_report.pdf

Environment and protection

Vulnerable areas in nitrate pollution



http://www.ypeka.gr/Default.aspx?tabid=250&language=en-US

Water laws and regulations

The administration and management of water Greek legislation has been harmonized with respect to the European Water Framework Directive.

According to Article 24 of the Greek Constitution, the protection of the natural environment is not only a responsibility of the state, but also of the citizens. The state is under obligation to take preventive and corrective measures for the protection of the natural environment in the framework of sustainability. These measures should be taken both on the legislative and the administrative level.

The protection of water resources is also regulated by a number of international agreements and legislation, such as the Ramsar international agreement on the protection of internationally important wetlands or NATURA 2000ETC.

Several EU directives on the protection of waters and public health have been adapted by the Greek legislation (98/83/EC, 91/767/ EC, 87/217/ EC, 86/280/ EC, 84/491/ EC, 83/513/ EC, 82/176/ EC, 80/68/ EC).

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Water laws and regulations

The Special Secretariat for Water is responsible for the development and implementation of all programs related to the protection and management of the water resources of Greece and the coordination of all competent authorities dealing with the aquatic environment. The implementation of the Water Framework and the Marine Strategy Directives as well of the related daughter Directives fall within the scope of the activities of the Secretariat.

The Secretariat, in collaboration with the Regional Water Authorities, formulates and, upon approval by the National Council for Water, implements the River Basin Management Plans and the national monitoring program.

More specifically the Secretariat is responsible for:

- the coordination of all agencies and state institutions, related to water issues and the regional Water Directorates
- the implementation of the Water Framework Directive
- the implementation of the Marine Strategy Directive
- the implementation of the national monitoring program
- the implementation of the Floods Directive
- the implementation of the Urban Wastewater Directive and reuse programs
- the implementation of the Nitrates Directive
- the implementation of the Bathing Waters Directive
- Transboundary and international water issues

http://www.ypeka.gr/Default.aspx?tabid=246&language=en-US

Natural Institutional and Policy options

The local authorities are responsible for water use (with the exception of protected water bodies and areas) therefore the management of water resources is often found to be poor and disorganized.

Maintenance of infrastructure in the more remote areas tends to be poor, while long term contingency planning is almost non-existent. Financial constraints are the main reason behind the poor management and lack of planning.

Responses to water shortages vary depending on the area and the conditions and tend to be short-term responses.

In cases of water shortage demand reduction management principles have been used in the past.

The means used to confront water shortages have depended mainly on the cost of the method. Hence, the first response to water shortages invariably involves new drilling of the aquifers.

Groundwater is extensively used both for domestic and irrigation water supply throughout the country.

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Natural Institutional and Policy options

In cases where the quality or quantity of groundwater does not meet the required standards, an alternative way of ensuring water supply is importing water from neighboring, richer in water resources areas (water hauling by ships, underwater pipes etc).

Dams and reservoirs are used where there are funds available and locations

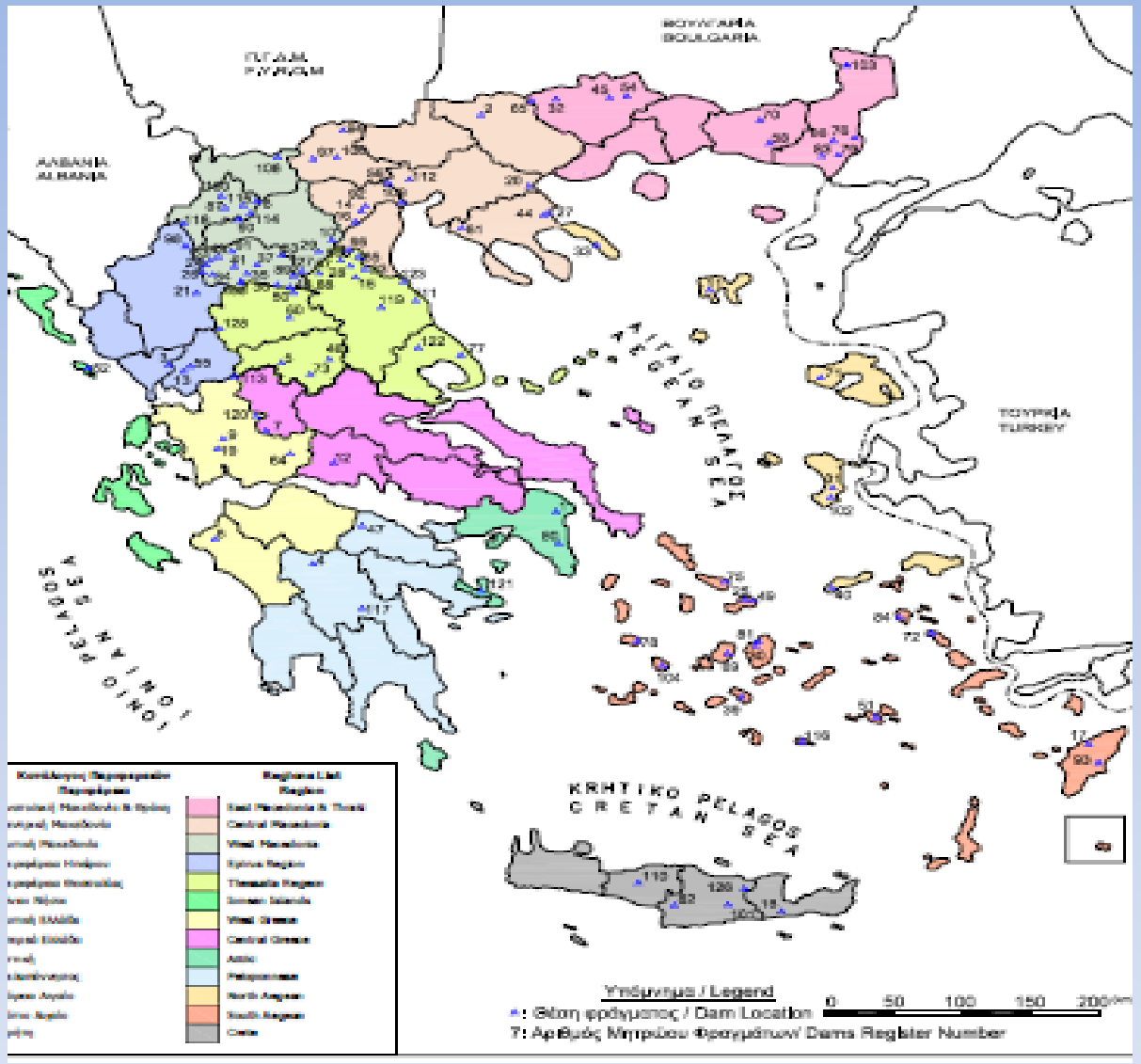
Alternatively, desalination plants are also used in cases of more limited funds or lack of suitable locations.

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Dams

In Greece 165 with height more than 15m have been constructed until now.

http://www.eeft.gr/Fragmata_Elladas_201311.pdf



http://www.eeft.gr/Fragmata_Elladas_201311.pdf

Constraints facing the water sector

Natural:

- Uneven water resource distribution
- Uneven precipitation distribution, spatially and temporally
- Dependence on transboundary waters

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Constraints facing the water sector

Human:

- Uneven population distribution
- Tourist influx is uneven in space and time
- Excessive water consumption for irrigation
- Demand peaks in the dry season
- Groundwater is contaminated by pollutants
- Overexploitation of underground aquifers causes salinization and irreversible damage
- Lack of environmental awareness

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Constraints facing the water sector

Technical:

- Local authorities lack the technology, know how and specialised personnel needed for long term management and for the construction and particularly maintenance of water infrastructure
- Old distribution networks with high losses
- Some areas very deficient in resources require new technologies (e.g. the islands) or the transfer of water from remote areas (e.g. Athens)
- Lack of proper irrigation techniques that would save water Illegal connections to the networks

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Constraints facing the water sector

Financial:

- Lack of well defined, long-term water policy
- Focus on short-term development policies
- Lack of coordination among responsible authorities
- Inadequate setup of water authorities with overlapping responsibilities
- Distribution of responsibility to local authorities with limited resources
- Management units are defined politically rather than basin-wide
- Lack of reliable data on supply and demand, particularly for irrigation
- Lack of public awareness on water issues, and of public participation in decision making

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Constraints facing the water sector

Financial:

- Deficient allocation of funds to the remote regions, exacerbated by the multitude of responsible authorities
- Water pricing is politically influenced and not based on water cost, leading to inadequate finances for the funding of further infrastructure

http://environ.chemeng.ntua.gr/wsm/Newsletters/Issue2/CircumstancesInGreece.htm

Water supply in Athens

The Marathon Dam is considered unique because it is entirely paneled externally with Pentelikon white marble. The Boyati Tunnel (13,4 km) was constructed to transport water from the Marathon impounding reservoir to a new water treatment plant in Athens.

Yliki Lake in the nearby prefecture had a significant amount of available waterbut is situated on a lower altitude compared to Athens. It required the construction of pumping facilities (the biggest in Europe) in order to transport the raw water to Athens.

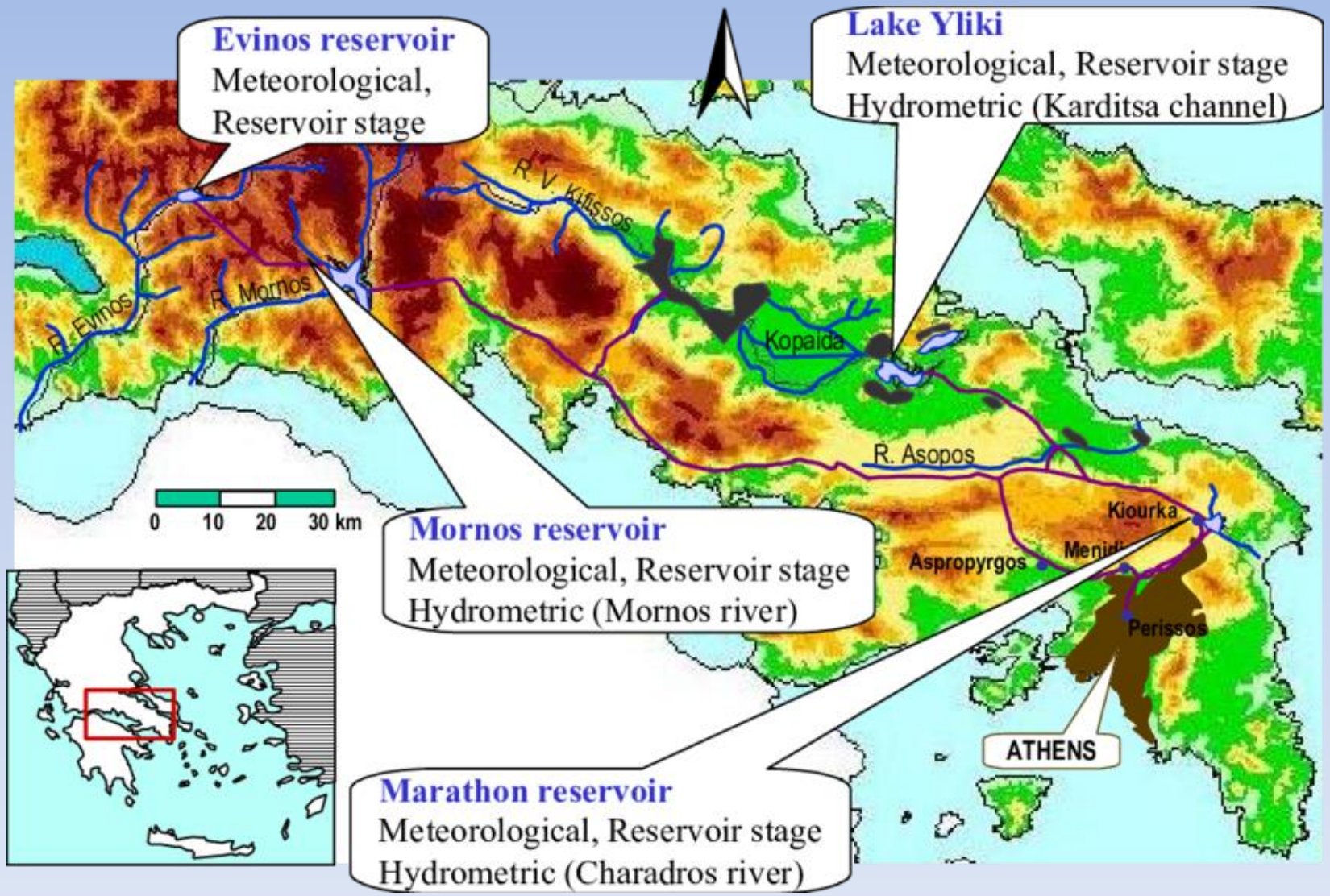
The Mornos dam is one of the highest earth gravity dams in Europe with a height of 126 m. The Mornos aqueduct that transports water from the Mornos reservoir to Athens is the second longest aqueduct in Europe.

The Evinos river diversion has provided Athens with additional water. The project consists of the Evinos Dam and a diversion tunnel (29,4 km long).

Raw water is transported from various sources to the four water treatment plants in the Athens area.

https://www.eydap.gr/en/TheCompany/Water/HistoricalTrackBack/

Water supply in Athens



https://www.researchgate.net/figure/222521991_fig1_Figure-1-The-Athens-Water-Supply-System

Marathonas Dam

ΦΡΑΓΜΑ ΜΑΡΑΘΩΝΑ

38°10' 1.99" N
23°54' 20.64"E

Νομός: **Αττικής**
Prefecture: **Attiki**

Ποταμός: **Χάραδρος**
River: **Charadros**

Χαρακτηριστικά Φράγματος			Dam data
Κύριος του έργου	ΕΥΔΑΠ ΠΑΓΙΩΝ	EYDAP ASSETS	Dam owner
Τύπος φράγματος	Βαρύτητας Λιθοδέματος	Masonry Gravity	Dam type
Ύψος φράγματος	54 m		Dam height
Μήκος στέψης	285 m		Crest length
Όγκος φράγματος	$179x10^3$ m^3		Dam volume
Χωρητικότητα ταμ.	$41x10^6$ m^3		Reservoir capacity
Επιφάνεια ταμειυτήρα	2,45 km^2		Reservoir area
Εμβαδόν λεκάνης απορροής	118 km^2		Catchment area
Παροχή σχεδιασμού υπερχειλιστή	100 m^3/sec		Spillway Capacity
Περάτωση	1929		Completion

Σκοπός	Purpose
Ύδρευση.	Water Supply.

http://www.eeft.gr/Fragmata_Elladas_201311.pdf

Mornos Dam

ΦΡΑΓΜΑ ΜΟΡΝΟΥ

38°31'29.03" N
22°07'17.39" E

Νομός: **Φωκίδας**
Prefecture: **Fokida**

Ποταμός: **Μόρνος**
River: **Mornos**

Χαρακτηριστικά Φράγματος			Dam data
Κύριος του έργου	Ε.Υ.Δ.ΑΠ ΠΑΓΙΩΝ	EYDAP ASSETS	Dam owner
Τύπος φράγματος	Χωμάτινο με κεντρικό πυρήνα	Earthfill with central core	Dam type
Ύψος φράγματος	139 m		Dam height
Μήκος στέψης	815 m		Crest length
Όγκος φράγματος	$17x10^6$ m^3		Dam volume
Χωρητικότητα ταμ.	$764x10^6$ m^3		Reservoir capacity
Επιφάνεια ταμιευτήρα	19,9 km^2		Reservoir area
Εμβαδόν λεκάνης απορροής	588 km^2		Catchment area
Παροχή σχεδιασμού υπερχειλιστή	1.135 m^3/sec		Spillway Capacity
Περάτωση	1979		Completion

Σκοπός	Purpose
Ύδρευση	Water Supply

http://www.eeft.gr/Fragmata_Elladas_201311.pdf

Water supply of Thessaloniki

EYATH S.A. uses the Karst system of aquifers in the Paiko Mountain. Water is abstracted from the Aravissos springs from two natural supply shafts, a spring fitted with a pump and 11 water boreholes which pump water via connecting pipes to the Aravissos aqueduct.

The quantity of water obtained from the Aravissos springs ranges from 65,000 to 130,000 m^3 a day, depending to a large degree on snowfall and rainfall recorded every year.

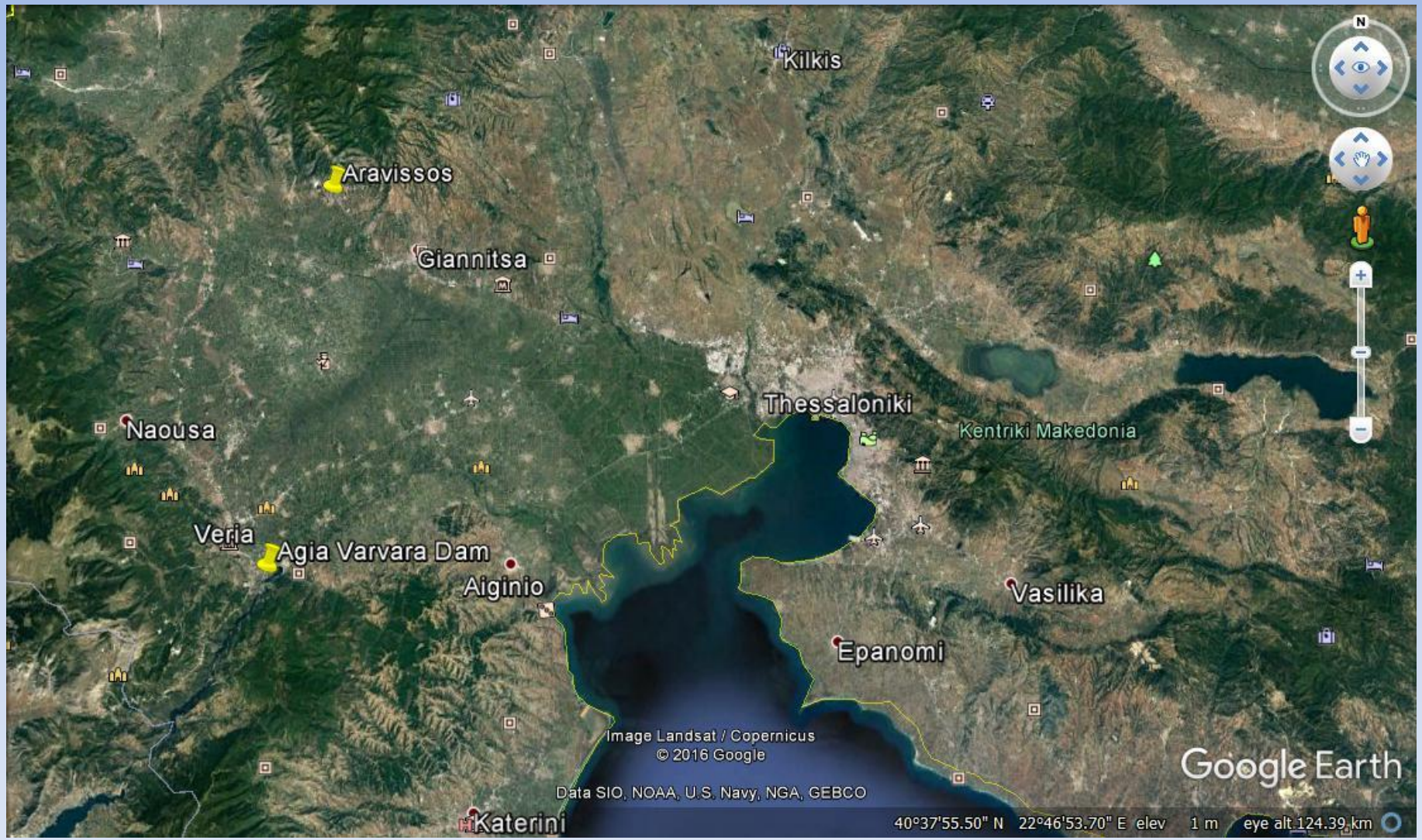
Water is abstracted from the Aliakmonas River in the area known as Varvares around 40 km from the river delta. Water is diverted via a 50 km long free-flowing channel to the Axios River where it reaches the water treatment plant (known as the refinery).

Clean drinking water is then directed to 75,000 m^3 storage tanks and distributed via a network of pipes 36 km long to existing water supply tanks.

At present the refinery facilities can treat 150,000 m^3 a day. When fully deployed the refinery will be able to treat 600,000 m^3 a day.

http://www.eyath.gr/index.jsp?extLang=LG

Water supply of Thessaloniki



Axios river basin

Axios River Basin is located in the central Balkan Peninsula and drains more than 80% of FYROM as well as parts of Bulgaria and Greece (Hellas).

The total drainage basin covers an area of approximately 23,700 km^2.

Axios River is the largest river that crosses Macedonia (North Greece) and the second largest in Balkans. The total length of the river is 380 km, app. 80 km of which belong to Greece

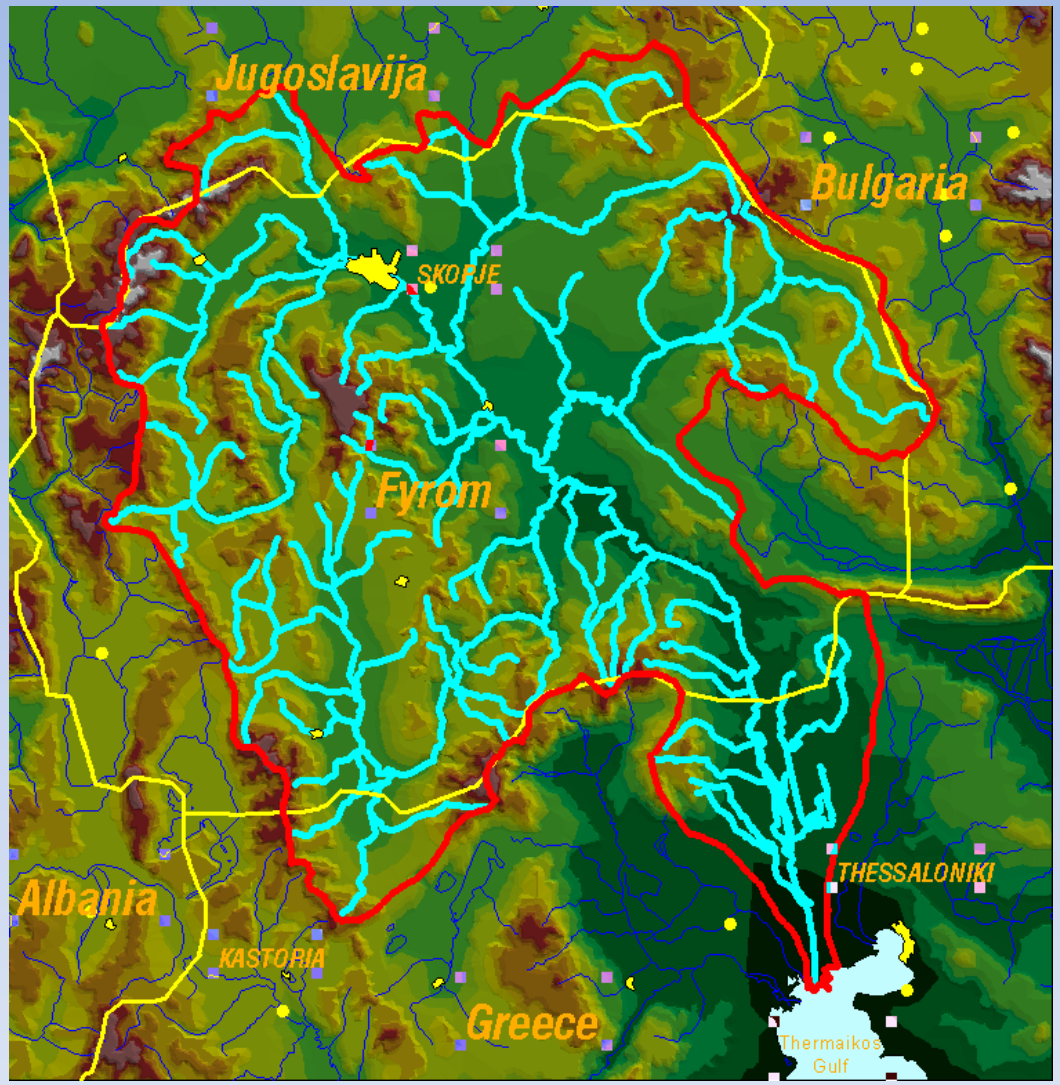
The river originates from a mountainous area (Shara massif) in the borders between Albania and Former Yugoslav Republic of Macedonia and discharges in Thermaikos Gulf (Greece), where one of the most important European Deltas is created.

Axios Delta is part of a larger complex of wetlands and is environmentally protected by many international conventions.

Papadopoulou-Mourkidou, E. (2004): Pollution of Axios river and impacts from agriculture and to agriculture: brief report of INTEREEG I&II project (in Greek).

Papadopoulou-Mourkidou, E., Karpouzas, G., Patsias, J., Kotopoulou, A., Milothridou, A., Kintzikoglou, K. and Vlachou, P. (2004): Sci. Total Environemnet 321, 127-146.

Axios river basin



Elevation range (m)

- 0 - 250
- 250 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1250
- 1250 - 1500
- 1500 - 1750
- 1750 - 2000
- 2000 - 2250
- 2250 - 2500

Eurocat-Axcat project (2001): General description of the Axios River catchment and theGulf of Thermaikos.Fundedby: European Commission, DG Research 5th Framework Programme.

Axios river basin

River Axios is separated in three parts according to the water usage:

The first part (0-20km) is used only for urban water supply.

The second part (20-60km) where the Eleousa dam is located (the only dam in the catchment located in the Greece) is used for irrigation. Two parallel artificial routes on the left and right hand side of the dam have been constructed in order to distribute the water to the whole valley. The main problem from the functioning of the dam is the intense decrease of the water flow in the summer period.

The third part of the river (60-80km), located from the Eleousa dam up to its estuaries, is almost exclusively used for industrial use. It has to be noted that there are many illegal water pumps in this part across its banks, but they cannot be officially accounted due unavailability of reliable data.

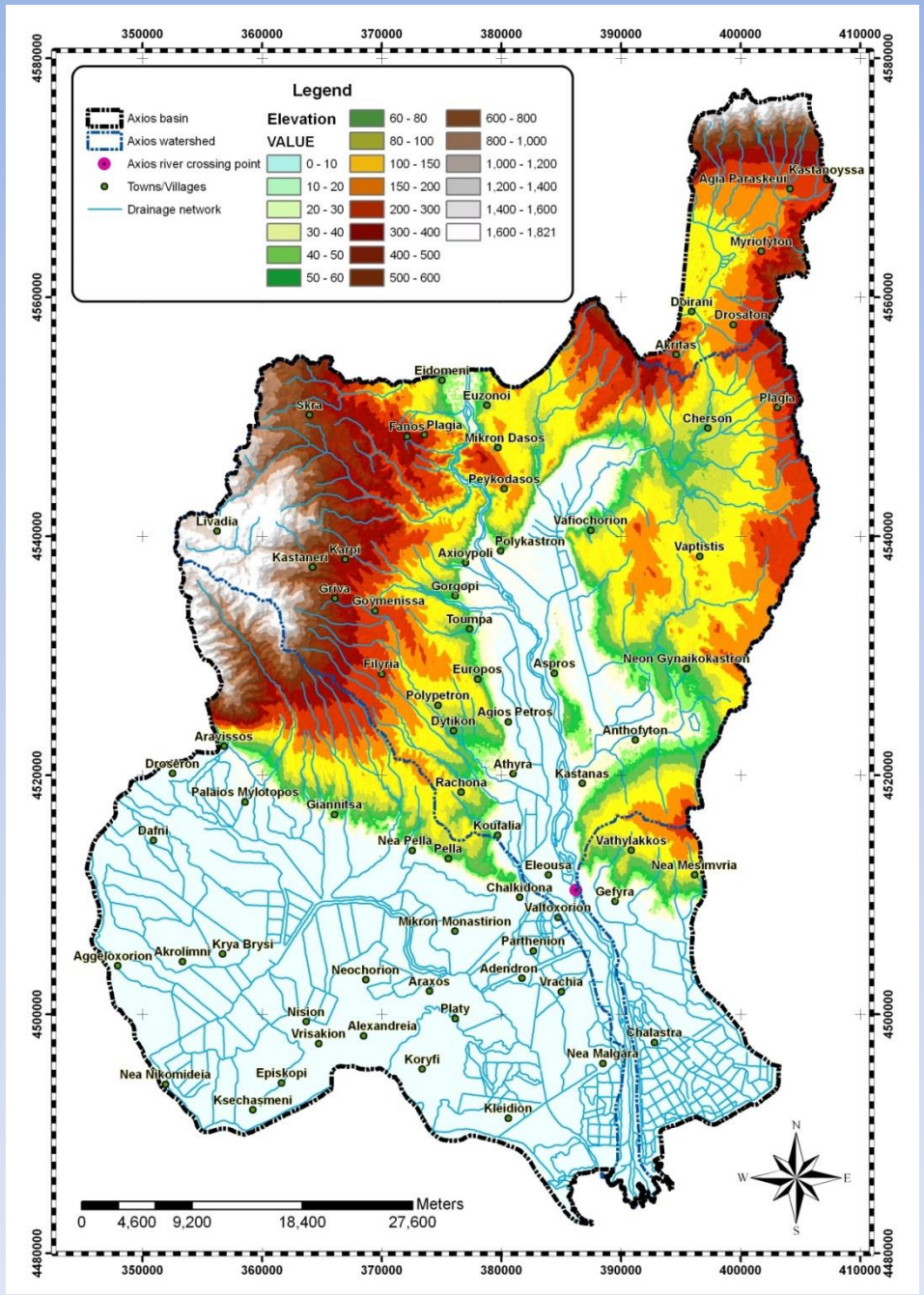
Eurocat-Axcat project (2001): General description of the Axios River catchment and theGulf of Thermaikos.Fundedby: European Commission, DG Research 5th Framework Programme.

Axios river basin

During the 1950's, the "Elli's" dam was constructed 28 km away from the Axios river mouth, to cover the increased water demands for irrigation. The dam irrigates, through a system of channels, an area of about 350,000 stremmas.

Eurocat-Axcat project (2001): General description of the Axios River catchment and theGulf of Thermaikos.Fundedby: European Commission, DG Research 5th Framework Programme.

Axios river basin



Axios river basin

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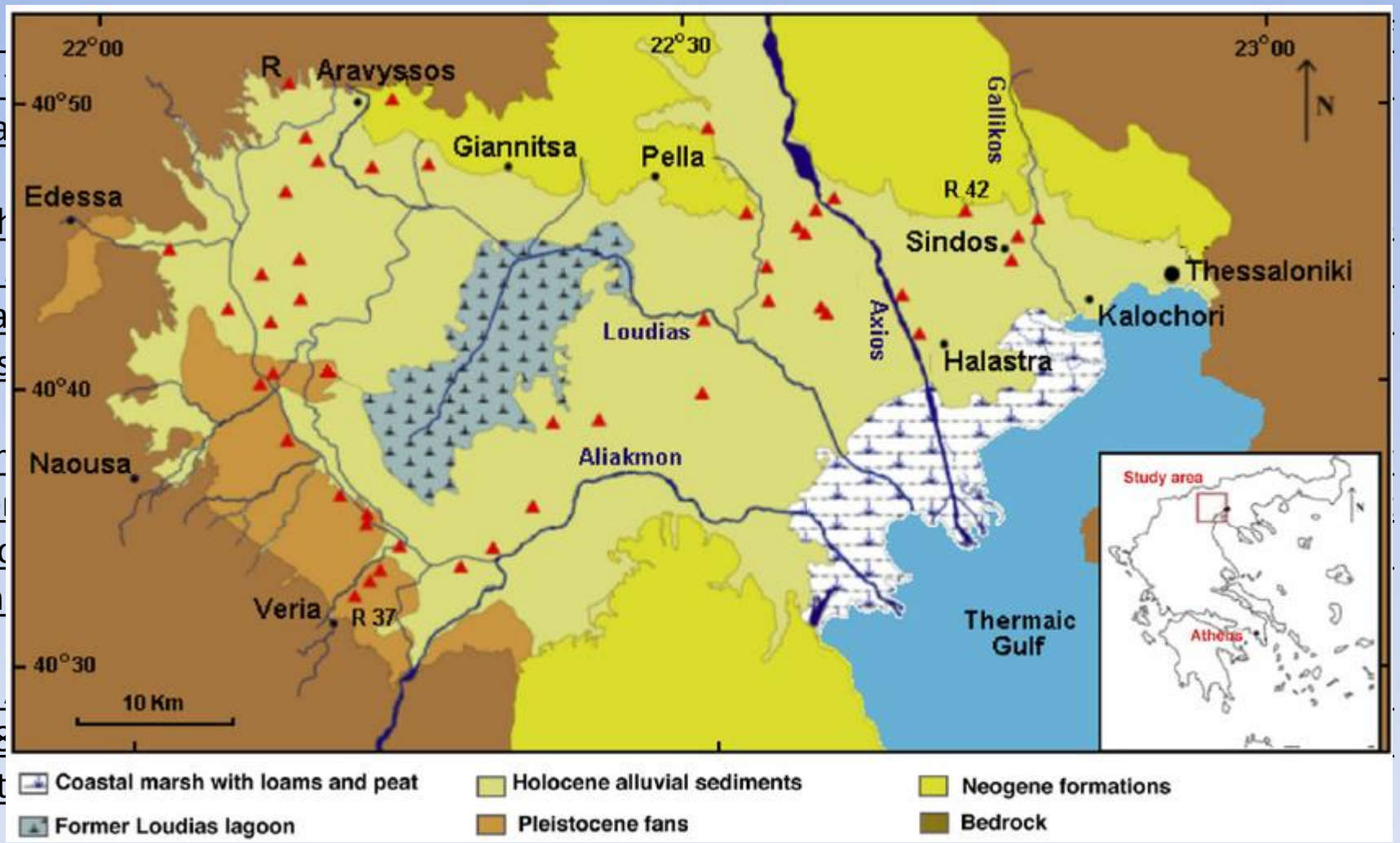
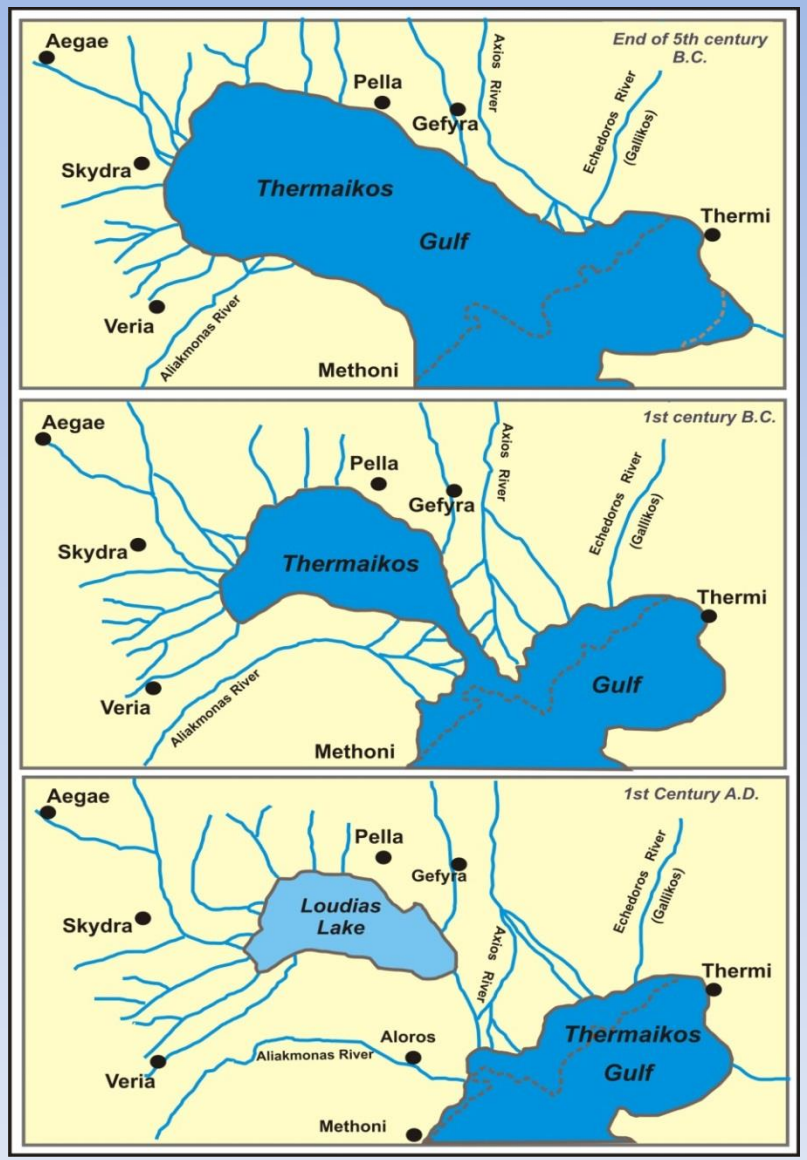


Smardon, (2009): The Axios River Delta – Mediterranean Wetland Under Siege, Sustaining the World's Wetlands, Springer, New York, pp. 57-92.

www.researchgate.net/figure/238378542_fig1_Fig-1-Location-map-and-geology-of-the-Thessaloniki-plain-Red-triangles-indicate-the

Axios river basin



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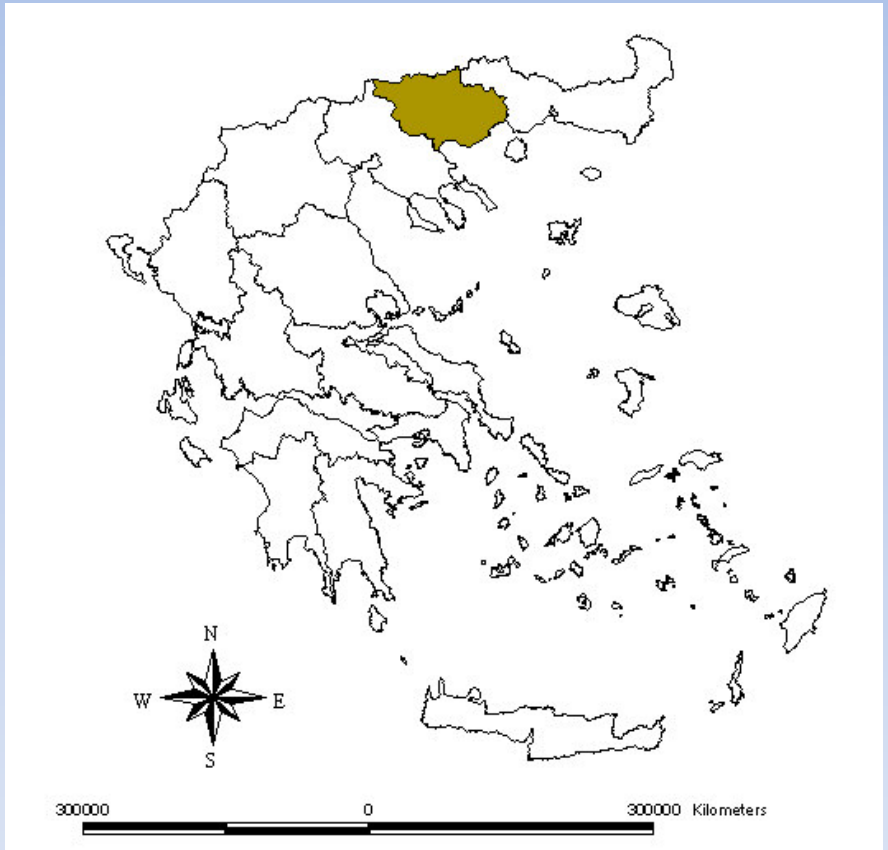
Strymonas river basin

Strimonas River basin is a transboundary basin shared by, Greece (36,5%), FYROM (9,5%), Serbia (4%) and Bulgaria (50%). The Greek part of the basin covers an area of 6.472 km^2



Chalkidis I., Seferlis M. and Sakellariou-Makrantonaki M. (2016), evaluation of the environmental impact of an irrigation network in a Ramsar area of the Greek part of the Strymonas river basin using a coupled MIKE SHE/MIKE 11 modelling system, Global NEST Journal, 18(X), XX-XX.

Strymonas river basin

Strymonas River and Lake Kerkini (an artificial lake fed by Strymonas) are the main surface water bodies in the basin which in turn support the natural enrichment of the basin with groundwater

Lake Kerkini was constructed during 1933-36 mainly for protection against floods caused by Strymonas River. Soon after it was used as a reservoir for irrigation water. During recent decades a unique wetland ecosystem has been developed in its shores, which is protected by the Ramsar Convention and EU legislation.

Strymonas River outflows to Strymonikos Gulf whose coastal ecosystems are very important for fisheries, biodiversity and tourism. Agricultural activities, which constitute the main threat to surface waters and groundwater in the basin, take place in its lower part which covers an area of 100.000 ha. From the entire arable land 84.500 ha are irrigated. An amount of 54.500 ha (64.5% of the total irrigated area) meet their irrigation needs directly from Strymonas River and Lake Kerkini while the remaining 30.000 ha from streams and pumping wells (ground water)

The irrigation and drainage of this area is been elaborated through a dense network of irrigation canals and drainage ditches. The Land Reclamation Service of Serres – Greece (DEB-S) is responsible for the water resources management in the agricultural area

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Strymonas river basin

The water level in the lake is controlled by four gates that also control the downstream discharge to avoid floods at the lowest area of the basin.

The west part of the mountainous area downstream of Lake Kerkini, drains through a number of torrents that outflow directly into Strimonas River. At the east the main drainage canal Belitsa receives almost all surface runoff from both the plain and mountainous areas and finally outflows into Strymonas River.

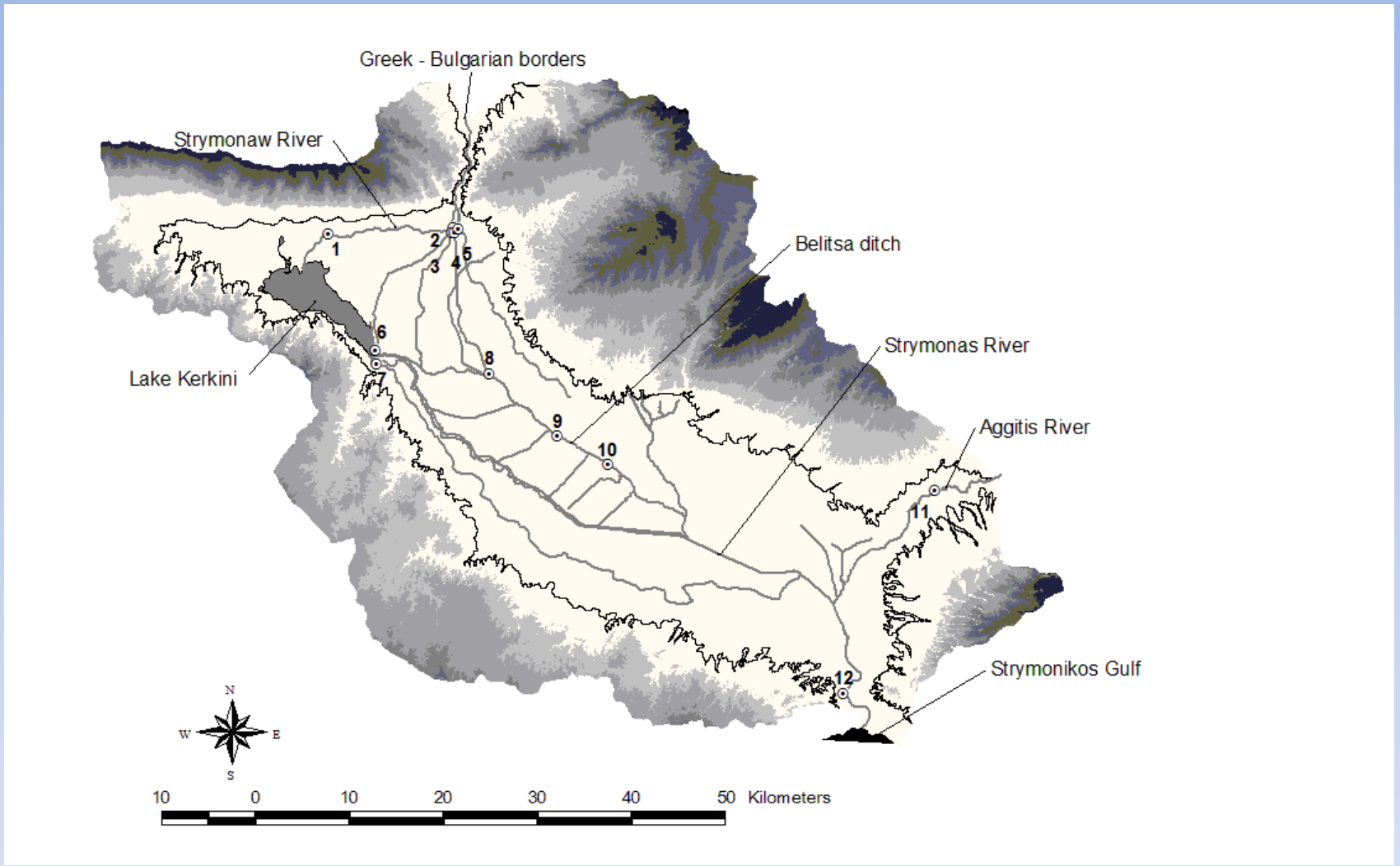
During summer 11 km after Strymonas crosses the Greek-Bulgarian borders part of its discharge diverts into three irrigation networks while the remaining discharge outflows into the lake Kerkini.

Three more irrigation networks receive water directly from the Lake.

Belitsa drainage ditch receives the drainage water from all the above irrigation networks (almost all the networks located at the east of Strymonas River) and supplies with water three more irrigation networks. The excess water of Belitsa outflows again into Strymonas river which in turn is used from the remaining irrigation networks downstream the lake Kerkini

Chalkidis I., Seferlis M. and Sakellariou-Makrantonaki M. (2016), evaluation of the environmental impact of an irrigation network in a Ramsar area of the Greek part of the Strymonas river basin using a coupled MIKE SHE/MIKE 11 modelling system, Global NEST Journal, 18(X), XX-XX.

Strymonas river basin



Water source for the irrigation networks in Strymonas basin

Chalkidis I., Seferlis M. and Sakellariou-Makrantonaki M. (2016), evaluation of the environmental impact of an irrigation network in a Ramsar area of the Greek part of the Strymonas river basin using a coupled MIKE SHE/MIKE 11 modelling system, Global NEST Journal, 18(X), XX-XX.

Strymonas river basin

The plain of Serres is probably one of the richest ones in Greece in terms of surface water availability. In many cases soil studies has shown that the crops could meet their irrigation needs directly from the capillary zone.

Due to the above together with the early constructions of the Lake Kerkini and the accompanied land reclamation works the use of ground water constitutes only a small percentage compared to surface water use in Strymonas basin.

It is estimated that 25% of the agricultural land is irrigated by pumping wells (21250 ha) and springs (8750).

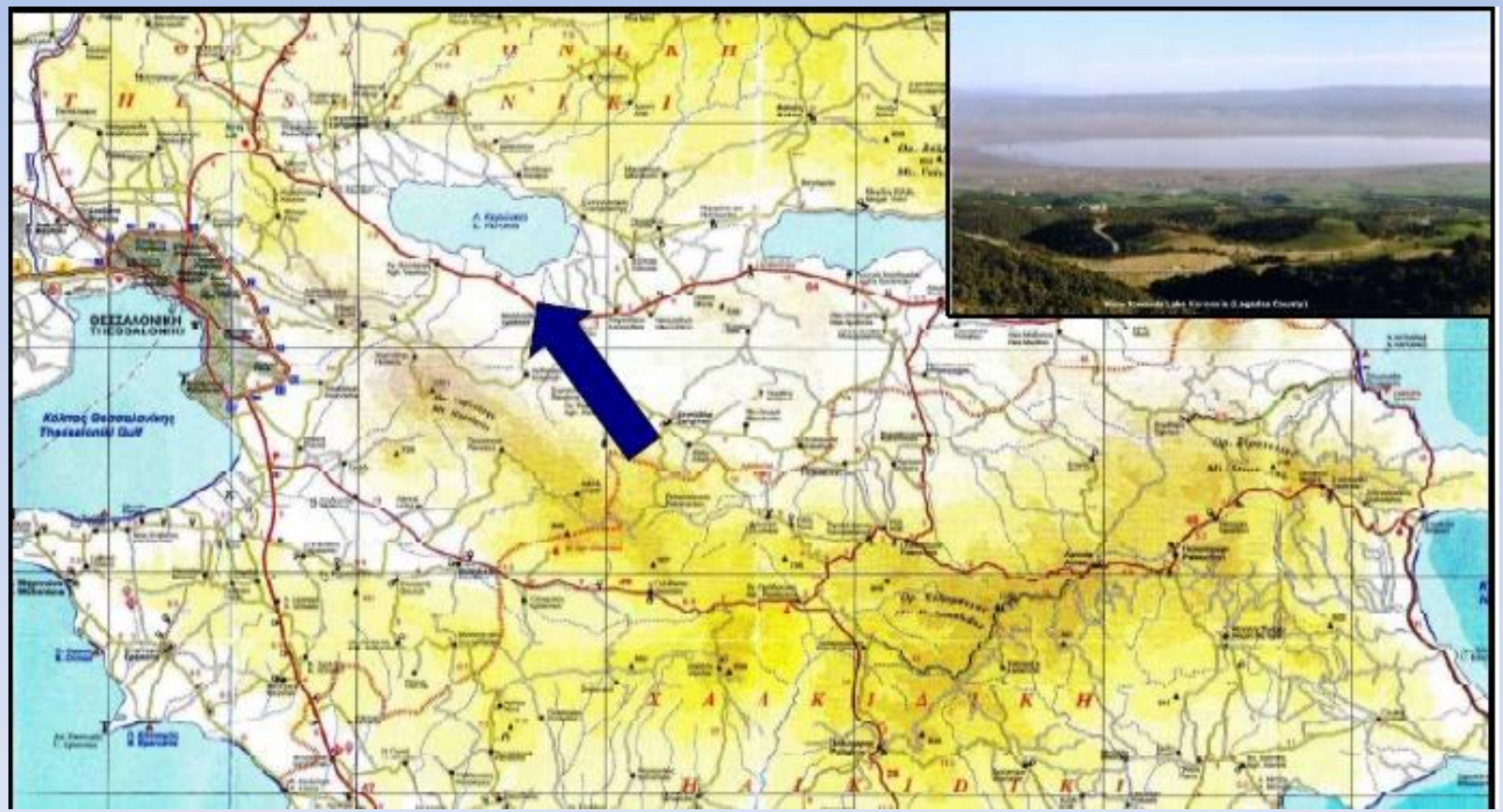
Nowadays, a 5 MW Hydroelectric station operates at lake Kerkini's dam. The effect of the hydroelectric station does not lead to water management changes and the way it works is compatible with the ecological functioning of the lake (high and stable water level without major fluctuations).

Chalkidis I., Seferlis M. and Sakellariou-Makrantonaki M. (2016), evaluation of the environmental impact of an irrigation network in a Ramsar area of the Greek part of the Strymonas river basin using a coupled MIKE SHE/MIKE 11 modelling system, Global NEST Journal, 18(X), XX-XX.

Lake Koronia

Site Description- General Characteristics

Lake Koronia is located approximately 12 Km to the E-NE of Thessaloniki city, North Greece (altitude 74 m above sea level).



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Lake Koronia

The area of the lake was reduced from 45 Km^2 in 1985 to 30 Km^2 in 2005.

The water reserves were reduced from $200x10^6$ m^3 to $20x10^6$ respectively, as a result of lowering of lake level from >4 m to <1 m.

The water balance of Koronia sub-basin was surplus until 1985 but since then the regime was reversed.

There is a hydraulic communication between the lake and the phreatic aquifer. The direct water abstraction from the lake and the groundwater pumping from the phreatic aquifer resulted to the degradation of the lake.

The recent years the lake was completely dry especially during the summer period.

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Lake Koronia

Satellite image of Koronia lake in the year 2003

Satellite image of Koronia lake in the year 2013

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Lake Koronia

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Lake Koronia

The lake has experienced a progressive increase in trophic state.

Point (urban effluent, industry) and non point sources (agricultural activities) of water pollution have led to a quality degradation of the water resources.

Lake Koronia area is protected by the RAMSAR Convention.

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Lake Koronia

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We need to promote sustainable water resources management so that we will not undermine the future of the next generations