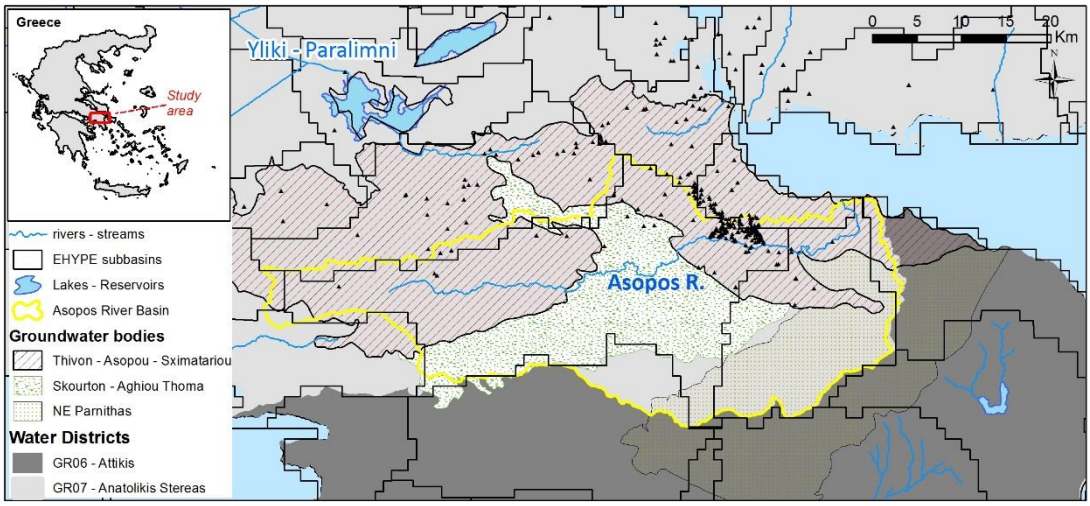
# *Environmental Flows and Point Source Emissions*

***EMVIS Consultant Engineers (http://emvis.gr/)***

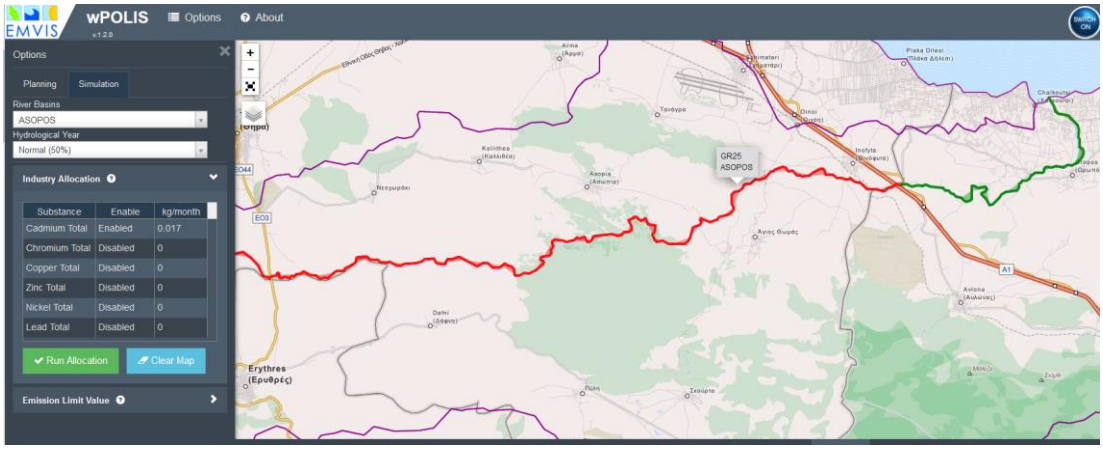
***Special Secretariat for Water - Ministry of Environment, Energy and Climate Change (http://www.ypeka.gr/Default.aspx?tabid=347&language=en-US)***

## Summary

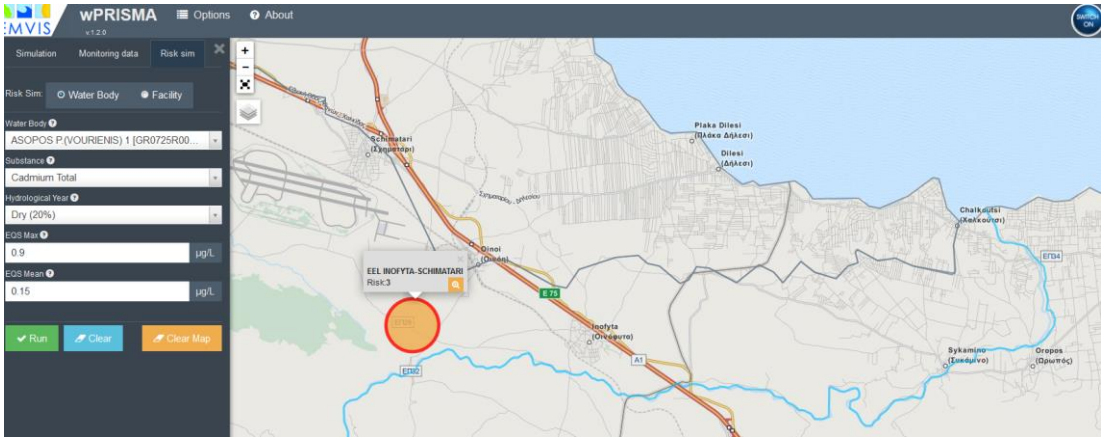
***The Special Secretariat for Water, being responsible for the implementation of the WFD in Greece, needs to know to what extend the quality of Asopos River, located 35km northern of Athens in a basin where there is significant industrial activity, is likely to be affected by climate change. Indicators of low flow characteristics (discharge, mean annual duration etc), of most prevailing flow conditions and future predictions of discharge time series will be used to assess the effectiveness of appointed Emission Limit Values and evaluate current climate change adaptation measures.***




*Study Area – The Asopos River basin*




*Testing of Emission Limit Values with wPolis developed under SWITCH-ON project*




*Testing risk of violating Environmental Quality Standards using wPrisma developed under SWITCH-ON project*

# 1 Case Study Description

## 1.1 Water-management issue to be addressed

*The Asopos River basin is located in central Greece, at the River Basin District of Eastern Sterea Ellada, covering an area of approximately 720 km$^2$. Its water bodies receive significant pressures both in terms of quantity and quality, mainly attributed to water abstraction for irrigation and to the significant industrial activity in the area, respectively. It is noted that the industrial sector in the greater area reflects approximately 20% of the total national industrial production. Under this aspect, the Special Secretariat for Water, being responsible for the implementation of the WFD in Greece, needs to assess the climate change impact on water quality of Asopos river, evaluate the efficacy of relative National Management Plans and climate-proof the quality of this important waterbody as wells as the economic growth and industrial sustainability.*

## 1.2 Decision support to client

*The client wants to evaluate the efficacy of regulatory measures imposed on local industry for environmental protection of Asopos River, under future conditions, and examine possible modification of permits if necessary.*

## 1.3 Temporal and spatial Scale

*The client is interested in evaluating (1) environmental impacts of climate change and (2) protective/adaptive measures effectiveness for a period of maximum 20 years ahead.*

*The abovementioned goals concern the Asopos River basin (regional scale), extending in an area of about 720 km$^2$.*

## 1.4 Knowledge Brokering

*The communication with the client takes place via meetings in person, phone calls and e-mails.*

*Meetings with the client are arranged whenever something must be presented in order to be explained and discussed. Presentations of the concept of the project and our planed workflow, combined with discussions over the presented material have led to a first level of understanding: The client begins to realize the information that can be made available and the level of service that can be offered and we (the knowledge purveyors) better understand the client's needs and are aware of clients problems that can arise and need to be solved. Meetings are followed by phonecalls or e-mails in order to (1) clarify matters that came up during the evaluation of meeting results, (2) request data required for the assessment, (3) inform over the progress of the project and (4) arrange a new meeting. Intermediate results of the assessment will be presented to the client via meetings in person in order ensure that: (i) results are useful for the client, (ii) it is clear to the client what can and what cannot be expected from the certain assessment and (iii) to re-asses the client's needs based on discussions over (i) and (ii) presented above.*

## 1.5 Climate Indicators

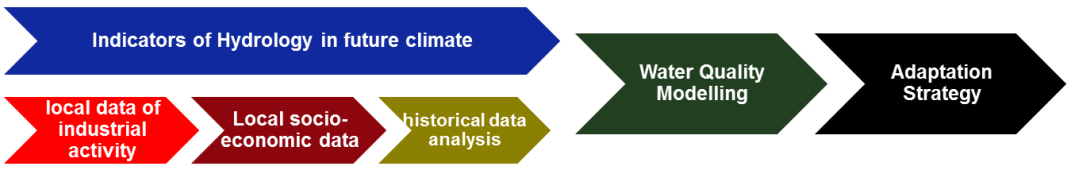
### 1.5.1 Pan-European Indicators

*Hydrological data (Pan-European indicators), under climate change scenarios, including low flow characteristics (discharge, mean annual duration etc), indicators on most prevailing flow conditions and discharge time series will be necessary for the evaluation of future quality status of Asopos River.*

### 1.5.2 Local indicators

*The investigation of possible connections between hydrological forcing data (from pan-European models) and historical water quality problems may reveal useful, local indicators.*

## 1.6 Pan-European data to local scale




**Indicators of Hydrology and future climate** – Identification of future discharge characteristics for Asopos River Basin. Relative indicators: (1) future change of low-flow discharges, low flow characteristics (discharge, mean annual duration etc) but also indicators on most prevailing flow conditions and (2) future predictions of discharge time series to be directly evaluated. Indicators result from Pan-European hydrological models, which were based on Pan-European climate change predictions from an ensemble of climate models.

**Local data of industrial activity** – Collect local data concerning industrial activity in Asopos River Basin which is related directly to the river (e.g. effluent receiver or water source). Collect local discharge data and identify major pollutants loading of river.

**Local socio-economic data** – Investigate connections between population, local economic growth, present ecological status and official regulatory permits.

**Historical data analysis** – Evaluate population and sectoral economy growth potential, based on local historical data, in order to estimate future industrial activity and future pollution loads in Asopos River.

**Water Quality Modelling** – Use hydrological data (Pan-European indicators) and estimated pollution loads (River Basin Assessment), to model water quality of Asopos River under present and future conditions. Evaluate different climate change scenarios to investigate the effect of hydrological changes in the assimilative capacity of the river. Examine the seasonal variations in the assimilative capacity to identify periods of time that surface water quality is likely to be compromised by specific pollutants. Investigate connection of hydrological forcing data (from pan-European models) with water quality problems and identify possible useful indicators.

**Adaptation Strategy** – If climate change impact to the river's assimilative ability and quality is significant, depending on the future scenario evaluated, strategic adaptation measures will be investigated to ensure sustainable and environmental-friendly economic growth of the study area. Reevaluation of Emission Limit Values for the industry or measures to be incorporated in River Basin Management Plans will be discussed. Uncertainties of the assessment, related to the uncertainties of the climate change indicators, can be crucial and should be estimated if necessary and significant changes should be imposed on local economy.

## 1.7 Lessons learnt

*The present assessment aims to shed light to the efficacy of existing management strategies of Asopos River against future change in climate conditions. It is expected that the climate service will provide, through an organised, easy-to-access and clear way, a number of different scenarios of future hydrologic conditions. This alone will contribute in making a more thorough assessment based on current scientific data from various sources and will raise the quality of the analysis and the usefulness of the outcome.*

## 1.8 Importance and Relevance of Adaptation

*Asopos River Basin extends over 720 km$^2$, it is located only 35 km away from Greek capital, Athens, and hosts a large industrial sector (20% of the total national industrial production). Ensuring environmental sustainability along with economic growth of local industry is a key goal and closely depends on the ability to adapt to future climate conditions. Estimations on future hydrologic conditions and incorporation in environmental assessments would often include rough estimations, or even assumptions, of expected change in some of the problems variables. The Climate Service is expected to provide a series of different climate impact indicators and variables, which are based on current scientific knowledge, which can be easily accessible and will be available for different scenarios. As a result, the effect of climate impact on hydrology and therefore on the environmental status can be assessed thoroughly, increasing the climate adaptation abilities.*

## 1.9 Pros and Cons or Cost-Benefit analysis of climate adaptation

*Environmental and policy reasons (e.g. WFD) impose the need to protect the quality of Asopos River and therefore, establish regulations for water uses. However, it is also very important for the local economy that the significant industrial sector continue to be viable and not "strangled" by hard-to-comply-with regulations. The above "boundary conditions" define a fragile relationship between sustainable economy and environment. This fragile balance could be easily overthrown by climate change impacts. The cost of changing the abovementioned balance would be hard to estimate, however it is self-evident that armoring*

*the industry-river relation against climate change impacts is of great environmental and economic importance.*

## 1.10 Policy aspects

*The present case study is exactly targeting policy changes and implementation. Restrictions imposed on effluent characteristics of industry (Emission Limit Values) will be evaluated against future predictions of river discharge conditions. Results and conclusions will be used by the client, Special Secretariat for Water (Ministry of Environment, Energy and Climate Change), to re-evaluate existing regulations and environmental permits procedures.*

## 1.11 Contact

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