GRECPIMA ERANETMED_WATER-13-166

Contact person:
Marion Korres
German Aerospace Center (DLR)
Project Management Agency
European and International Cooperation

Heinrich-Konen-Str.1
53227 Bonn, Germany

GRECPIMA
Groundwater Resilience to Climate Change and High Pressure within an IWRM Approach

Project Acronym
GRECPIMA

Full Project Title
Groundwater Resilience to Climate Change and High Pressure within an IWRM Approach

Call Identifier and Subtheme
Integrated water management from the catchment to coastal zone

Alternative thematic area

Type of activity
Collaborative Research Project
Mobility

Cross cutting Issues
Socio-economics
Governance
Gender

Main Keyword
Climate, Environment, Sustainability -> Coastal Research, Marine Research, Polar Research, Geosciences -> Geosciences in general [FB15]

Keyword 1
groundwater resources management

Keyword 2
global change

Keyword 3
water policy and governance

Keyword 4
agriculture/urban/industrial water demands

Start Date
01-01-2016

End Date
31-12-2018

GRECPIMA ERANETMED_WATER-13-166

Duration

36

Participation

No

Project Summary

In Mediterranean countries, groundwater has become over the past few decades, a fundamental resource for social, economic and environmental sustainability. There is also a need to integrate groundwater and surface water management.

This project aims to develop collaborations allowing (i) to tackle some of the most crucial groundwater issues in the Mediterranean area, i.e. tourism development, urbanization, changes in agricultural practices, seawater intrusion, through three representative sites; (ii) to bring together multiple skills in science and technology in a consistent and promising way regarding groundwater issues, in particular GIS and remote sensing, climate change impacts and flow and transport modeling; and (iii) to deal with social and economic fields by involving stakeholders in Turkey, Algeria and France. The study sites are the region of Mugla in Turkey, the plain of Mitidja in Algeria and the region of Poitou in France.

The project will associate three research teams with various domain expertise, which will allow to implement multiple scientific methods and technologies (hydrology, hydrogeology, climatology, data analysis, modeling, aerospace, IT), yet little used, especially by consulting firms. Mobilities will be provided between the partners to train project participants, including the youngest, to these scientific methods that are not yet included in the academic programs.

Remote sensing will be used out extensively at the satellite scale and a much larger scale (Unmanned Air vehicle of the Turkey team). Soft-computing modeling (e.g. Neural Networks), still very little used, will be applied to long-term forecasts. Mathematical modeling will be also widely used in the project to quantify the flow and recharge, analyze surface water-groundwater interactions and analyze pollution issues.

In addition, every steps of the project will include socio-economic aspects, which will be addressed by involving very closely the stakeholders from 3 countries.

Confirm

I confirm that this proposal is only submitted in this thematic area of the ERANETMED Call

project consortium

Indicate explicitly how the proposals differ:

submitted

Summarize briefly

Financial resources

No

If yes, please specify

confirm

I confirm that the information given in this proposal is correct.

GRECPIMA ERANETMED_WATER-13-166

confirm

I confirm that the proposal is endorsed by all project partners.

Background, Questions and Objectives

Sustainable water resources development and management is recognized worldwide as an ultimate goal of national water strategies. There is extreme variability in the distribution of water resources. Spatial and temporal availability of surface water largely depend on precipitation pattern and regional morphology. Due to buffering and storage capacity of the underground, the groundwater resources are more reliable with respect to the distribution in time. Climate change is likely to impact all water resources, but the response of groundwater will be slower than that of surface water.

In Mediterranean countries, groundwater has become over the past few decades, a fundamental resource for social, economic and environmental sustainability. Human well-being, livelihoods, ecosystems, industries, agriculture and urban development are more and more reliant on groundwater. The development of groundwater therefore should be carefully managed to make full benefit of its potential, to protect its quality and to guard against over-exploitation of the aquifers.

The sustainability of groundwater is on one hand linked to policy issues influencing water and land use, and represents one of the major global challenges in natural resource management. On the other hand groundwater is technically complex. Practical advances in this field are urgently needed, so that the technical expert and the water manager can reach a common understanding.

There is also a need to integrate groundwater and surface water management to ensure better overall water management and allocation. Accordingly, groundwater should be addressed in the IWRM (Integrated Water Resources Management).

This project aims to develop collaborations allowing (i) to tackle some of the most crucial groundwater issues in the Mediterranean area, i.e., tourism development, urbanization and changes in agricultural practices, through three representative sites; (ii) to bring together multiple skills inscience and technology in a consistent and promising way regarding groundwater issues, in particular GIS and remote sensing, climate change impacts and flow and transport modeling; and (iii) to deal with social and economic fields by involving stakeholders in Turkey, Algeria and France.

Thus, the project will focus first on the qualitative and quantitative assessment of water resources at three sites, which are facing serious water supply problems to varying degrees. Groundwater is heavily used there. In Turkey, the rate of population and tourism activities has grown considerably during the last 15 years in the Region of Mugla. In summer period specially, the region faces serious water shortage problems due to heavy pressure generated by tourism. The hydrogeological context is constituted by highly kastified limestones. Karstic springs flowing from these aquifers to the Mediterranean sea represent potential natural water resources for Mugla region that are crucial nowadays for water policy/governance due to increase of tourism population and water pollution issues in the lakes and dams reservoirs.

In Algeria,the high population growth and urbanization have led to a significant concentration of population around the capital Alger, and therefore important drinking water needs. The restructuring of agriculture allowed the redeployment of agricultural activity and led to an increased need for irrigation water. Finally the liberation of the commercial activity has allowed an important development of the small and medium industry generating a significant need for industrial water. All these growing trends in water needs combined with a drought phenomenon that occurred during thirty consecutive years, made worse water supply problems to the population, farmers and industrial units.This situation exists in the Mitidja plain, which is the largest sub-coastal plain of Algeria. The growing needs led to overexploitation of groundwater while the natural recharge is limited through rivers. To this overexploitation issue, adds the problem of freshwater-sea water balance changing and sea water intrusion inland. Artificial recharge, from the Oued ElHarrach in its upstream part, could be a way to circumvent this dramatic situation and to propose measures for the sustainable management of this crucial resource.

In France, the study site is located in the Poitou region (West-Center France). The capital of the Region is the historical city of Poitiers.Agriculture is the dominant economic activity in the region. The region is supplied with water primarily from groundwater (86%) and secondly from surface water (14%) for irrigation and drinking purposes. Agriculture uses 70% of the total volumeof water. The development of irrigated agriculture, during the last decades, has led to increased pressure on groundwater, and subsequently to the

degradation of its quality.The main aquifer in the region is the Dogger aquifer. The study will focus on part of this aquifer bounded by the two main regional rivers (Clain and Vienne).
Moreover, the project will associate three research teams with various domain expertise, which will allow to implement multiple scientific methods and technologies (hydrology,hydrogeology, climatology, data analysis, modeling, aerospace, IT), yet little used, especially by consulting firms. Mobilities will be provided between the partners to train project participants, including the youngest, to these scientific methods that are not yet included in the academic programs.
In particular, remote sensing will be used out extensively, at the satellite scale and a much larger scale (Unmanned Air vehicle of the Turkey team). The latter approach, initiated by the Turkish team is quite innovative and original. Soft-computing modeling (e.g. Neural Networks), still very little used but rather promising, will be applied to long-term forecasts. Mathematical modeling will be also widely usedin the project,to quantify theflow of water and recharge of underground systems, analyze surface water -groundwater interactions andanalyze pollution issues.
In addition, every steps of the project will include socio-economic aspects, which will be addressed by involving the stakeholders from 3 countries.
The stakeholder, at Turkey side,will be represented by the Municipality of Mugla, which is responsible for the exploitation and management of water resources in this region. The Municipality of Mugla will be a full partner in this project. Exchanges will beconstant.
At the Algerian side, the stakeholder will be represented by ANRH (National Agency for Water Resources, a public body under the Ministryof Water Resources). ANRH will also be an important partner of this project. ANRH will provide the Algeria team, with their whole measurement network on the plain of Mitidja (piezometers, rain gauges and hydrometric stations). ANRH will be fully involved in this work.
At the French side, the stakeholders will be represented by the ORE (Observatoire Regional des Eaux: regional body responsible for monitoring the water quality and quality), the Syndicats d'Eau (Water distribution authorities) and the Unions of Irrigation water users.
The project intends to build on previous and ongoing achievements related to groundwater management in the 3 countries. The main objectives of the project are:
- Analyze on the3 sites, status and availability of water resources (management rules, quantity, quality, surface/underground resources interactions) with special emphasis on groundwater.
- Analyze how IWRM principles are applied in water resources management in each country, based on recommendations from the Global Water Partnership (GWP) [GWP, 2000. Integrated Water Resources Management. Global Water Partnership Technical Advisory Committee. TAC Background Papers No 4.]
- Analyze aquifers properties which intervene in groundwater resilience (structure, permeability, recharge, storage capacity)
- Analyze on each study site, the effect of climate change (land uses, demography, social and economic activities) and its impact on the availability (quantity and quality) and use of water resources.
- Compare application of the management policy/governance of water resources of the 3 countries, on the study sites, particularly concerning groundwater.
- Develop policy recommendations for assessing how groundwater can support adaptation andbuild resilience to climate change and other stresses.

Project Description

The project focuses on the resiliency of groundwater resources facing increasingly high pressure exerted by the socio-economic world and facing the climate variability and change, within the principles of IWRM. The project brings together three different climatic, water resources and socio-economic contexts. In all these three environments, groundwater is the mainwater resource.
The main stages of the project are described hereunder (see also Timeframe table).
1. Reviews of literature (unpublished reports, journal articles, conferences) on the study sites in each country (water resources status, human activities, socio-economic status, demographic evolution, etc.).
2. Data inventory/availability on hydrology, climatology, water demands and uses on each study site. This includes, (but is not limited to):
- rivers discharges/quality
data; - springs discharges;

- precipitation/evapotranspiration;
- water demands.

3. Data Inventory and identification of hydrogeological units in each study site. This includes, (but is not limited to):
- soils/geology/watersheds/piezometric
maps; - water well record data;
- observation well data;
- pumping test data;
- geophysical data;
- groundwater quality data and contaminant sources (domestic, industrial waste waters, fertlisers, etc.); - groundwater level data;
- groundwater abstractions; -
groundwater recharge data; -
aquifers structure;
- aquifers properties (permeability, transmissivity, storage capacity).

4. A summary will be made on the above data inventories in order to specify the state of knowledge on each of the study site. A report will be prepared by each team leader. Each report should include, whenever feasible, the following:
- overview of available data;
- general description of the study site setting (geography, topography, drainage, geomorphologic conditions, etc.);
- general description of geologic setting (geologic materials; vertical and lateral extent of individual geologic units; stratigraphy and structural features, etc.);
- descriptions of aquifers (confined, unconfined, unconsolidated, bedrock); aerial extent and thickness; - aquifer properties (transmissivity, storage, etc.);
- evaluation of the global water balance, including precipitation, evapotranspiration, infiltration and runoff conditions;
- assessment of current aquifer budget, including amount and sources of recharge; aquifer storage; current ground water extraction; ground water discharge;
- seawater intrusion (This feature relates only to the Mitidja aquifer in Algeria);
- description of local and regional ground water flow systems and rates of
movement; - evaluation of surface water / ground water interaction;
- evaluation of ground water quality conditions.

5. Planning/realization of additional investigations to fill data gaps.
6. Evaluation of the vulnerability of aquifers to surface contaminants. This work will be focused mainly on agricultural contaminants including nitrates. The vulnerability will be characterized using weighted index methods'. Many methods exist in the literature. A test will be performed with the DRASTIC method, the most used (Aller et al, 1987). The method is well known and takes into account the following parameters (Depth, Recharge, Aquifer lithology, Soil, Topography, Impact of Unsaturated zone hydraulic Conductivity) and assigns weights. Drastic index is made up of a sum of product of the rating and weights for these parameters. RS and GIS are adapted tools to run this method. The UAV (Unmanned Air Vehicle) of the Turkey team will be implemented on Mugla site for this purpose.
On the 3 sites, the vulnerability maps will be compared with the state of groundwater contamination, especially by nitrates.
7. 1st year Full Report. The report should also contain an analysis of management methods applied in each of the study areas and describe the extent to which these terms integrate the principles of IWRM, as presented in the Global Water Partnership (2000). This will be done in close collaboration with the stakeholders in each country. Efforts will be made to define how the specific conditions of each country (environmental and socioeconomic circumstances in regional context) can be adapted to the concept of IWRM.

8. Land uses analysis and evolution during the last decades, using RS and GIS. Theland use/land cover and its evolutionwill be analyzedover the last2-3decades(deforestation,agricultureexpansion/reduction, Irrigatedagricultureexpansion/reduction, urbanization,etc.).
Impacts of changing climate and land use on water availability and hydrologic regimes (and hydrologic extremes, e.g. droughts) will be evaluated. Impacts on ecosystems and coastal responses will also be considered.
9. Analysis of the climate variability impact on available time series data (precipitation, groundwater level, soil temperature, rivers discharges, etc) using statistical tests (Mann–Kendall test, Pettitt test) and/or frequential analysis. Identification of trends and change points in hydrological factors. The following questions should be addressed, by each team, whenever possible, given its specific regional context:
- susceptibility of groundwater to climate variability and change; - climate variability impact on groundwater recharge and storage;
- climate variability impact on surface runoff;
- climate variability impact on interactions between groundwater and surface waters;
- climate variability impact on seawater intrusion in the Mitidja aquifer (Algeria team).

10. Writing a synthesis report on activities 8 and 9, in close association with stakeholders in each country.
11. 2nd year full report
12. Modeling tasks.
Depending on the available data, the modeling approaches will be of empirical type (e.g.neural networks) or deterministic type, or a combination of both types of approach. The modelswill be developedtaking into account themajor issueof uncertaintyaffecting theclimatological parameters.
On the plain of Mitidja, modeling work will include: deterministic hydrogeological modeling of the aquifer in steady and transient states; simulation with the previous model, of artificial recharge tests of the groundwater; evaluation of artificial recharge impacts on the storage capacity of the aquifer; simulation of seawater intrusion; analysis of stabilization solutions of the fresh water seawater interface.
Int he Mugla region, rainfall-water table, water table–springs discharges and rainfall-spring discharges relationships will be established using soft computing models such as neural network. These models will then be used to establish springs discharges predictions taking into account the impact of climate variability. Inthe region of Poitou, a deterministic model of the aquifer of the Dogger between rivers Clain and Vienne will be developed in steady and transient states. This model will then be used to analyze the impact of climate variability on water resources of this region.
13. Writing a synthesis report on the modeling work undertaken for 6 months.
14. Writing the final report of the project.

Project management

3 main meetings will be held on the project management:
- A first meeting to launch the project, to be held in Poitiers. The purpose of the meeting is to remind the participants with the rules of operation of the project.
- A mid-term meeting, to be held in Mugla (Turkey). The results obtained to date will be presented and discussed.
- A final project closure meeting, to be held in Algiers. This meeting will be held as part of a symposium organized by the team of Algeria, where the achievements of this project will be presented to an international audience.

Videoconferences will be held regularly at the rate of one every two months, to provide an update on the progress of each team. These regular videoconferences will be supplemented by videoconferences organized at the request of one of the partners when needed.

The project coordinator is planning a coordination mission to each partner each year.
The other 2 team-leaders also plan trips to other partners. Therefore, the meetings between the 3 team leaders will be sufficiently regular, to ensure continuous monitoring and rigorous management of project

work.

Each partner also foresees the exchange of permanent researchers with other partners, in order to promote the sharing of skills.

Exchanges of young participants are sufficient in number each year to ensure permanent contact between the teams:
- Poitiers to Mugla and Algiers: 1 MSc student / year, 3 months each year
- Algiers to Poitiers: 2 PhD students, 2 months 1st year and 3 months 2nd year, each
- Algiers to Mugla 2 PhD Students, 1st year 2 months each
- Mugla to Poitiers 1 PhD Student, 3 months / year

The exchange of permanent researchers also contribute to maintaining a high level of communication between partners:
- Poitiers to Mugla and Algiers: 1 Assoc.Prof 1 week / year
- Algiers to Poitiers: 2 Assist.Prof, 2 weeks 1st year and 2nd year, each
- Algiers to Mugla: 2 Assist.Prof, 2 weeks 1st year each

During the project, each partner is bound to issue the following reports:
- 1 progress report six months after the start of the project (June 2016)
- 1 complete report after the first year of the project (December 2016)
- 1 Progress Report halfway through the project (June 2017)
- 1 complete report after the second year of the project (December 2017)
- 1 progress report halfway through the 3rd year (June 2018)
- The final report of each partner (December 2018)

A Gantt chart is given in the appendix.

Impact of Project results

The project results will allow to better undersantd the problems that exist around water resources in these three countries. The comparison of the results between the three countries will identify the strengths and weaknesses regarding water resource management procedures in each country. The dialogue will be constant throughout the duration of the project with managers and stakeholders.
In fact, one of the expected significant impacts of this project is the awareness of managers for a sustainable and integrated management of water resources and making available to them appropriate means to strive for such management.
The three countries involved in this project, are suffering from water-related problems to varying degrees. In Algeria, a major impact of this project will be significant improvement in the groundwater of Mitidja in quantity and quality. The impact on the socio-economic development of the plain will be significant.
In Turkey, the tourist pressure is high in the Mugla region. Reaching in this context, an integrated water resource management can contribute greatly to tourism and economic development of this region.
In France, the quality problem of water resources is a major issue. The expected impact of the project is to show managers the opportunities to improve this situation.
The project will also have a high impact in capacity building, training, and mobility. Young researchers from three countries are involved in this project. This will help to train them in methods of integrated water resources management. Mobilities between the three countries are planned. This will help to raise awareness of the situations in the host country. A 2nd year planned workshop will train participants in the RS-GIS methods, increasingly used in the study of water resources.
The project will establish a strong synergy between the partners. The project results will be jointly published in high-impact journals and joint presentations at international conferences.

Ethics, gender, young researchers

The project includes a significant participation of female researchers.

GRECPIMA ERANETMED_WATER-13-166

Project Coordinator

Academic Title	Professeur
First name	Moumtaz
Family name	Razack
Name of institution	University of Poitiers
Organisation/ Division	UMR 7285 IC2MP
Street, No. / Post Box	5 rue Albert Turpain B8 TSA 51106
Postal code	86073
Town	Poitiers cedex 09
Country	France
Phone	+33/549453681
Fax	+33/549454241
E-mail	moumtaz.razack@univ-poitiers.fr
Website	
Total Cost	75,909
Requested Funding	75,909

GRECPIMA ERANETMED_WATER-13-166

Project Partner 1

Academic Title	Assistant Professor
First name	Bedri
Family name	Kurtulus
Name of institution	MuglaSitkiKocman University
Organisation/ Division	Remote Sensing and Geographic Information System Center (RS-GIS Center)
Street, No. / Post Box	Kotekli Campus
Postal code	48000
Town	Mugla
Country	Turkey
Phone	+90/2522111824
Fax	+90/2522111911
E-mail	kurtulusbedri@gmail.com
Website	http://cbs.mu.edu.tr/
Total Cost	89,540
Requested Funding	89,540

GRECPIMA ERANETMED_WATER-13-166

Project Partner 2

Academic Title	Professor
First name	Mohamed
Family name	Meddi
Name of institution	Ecole Nationale Supérieure de l''Hydraulique
Organisation/ Division	Hydrologie
Street, No. / Post Box	BP 31
Postal code	09000
Town	Blida
Country	Algeria
Phone	+213/71638760
Fax	+213/25399446
E-mail	mmeddi@yahoo.fr
Website	www.ensh.dz

Total Cost	74,250
Requested Funding	74,250