



EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

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**COST STSM Reference Number: COST-STSM-TU1206-27377**

**STSM Applicant: Alejandro García-Gil, IDÆA (ESP)**

**STSM Topic: Development of concepts for the management of thermal resources in urban areas**

**Host: Prof. Peter Huggenberger. Applied and Environmental Geology; Department of Environmental Sciences; University of Basel, Basel, Switzerland**

Dear Hans,

Please find below my report of the Short-term Scientific Mission (STSM) I made from 1. To 5.06.2015 to the Applied and Environmental Geology Department of Environmental Sciences, University of Basel, Switzerland. The objective of the cooperation partners is to develop concepts and methods for the management of thermal resources in urban areas.

Our collaboration already started with Jannis Epting's visit to Barcelona during a STSM from 5. to 10. January and now was continued by my STSM to Basel in June 2015. Our intention is to advance our collaboration and publication intentions by further STSM to the individual collaboration partners and to directly implement our results in the reporting of the different work tasks of the WG2 Subgroup "City-scale groundwater and geothermal data and modelling – a review of best practice". This report reiterates the original plan, summarises the activities and the attached document compiles the relevant information for the two selected case study cities in Basel (CH) and Zaragoza (S).

### ***Rationale***

In urban areas the shallow subsurface often is used as a heat resource (so-called shallow geothermal energy), i.e. for the installation and operation of a broad variety of geothermal systems. At the same time, groundwater is increasingly used as a cheap cooling medium, e.g. for buildings. Further impacts like the so-called urban heat island effect also influence the thermal regime in the subsurface. As a result, significantly increased groundwater temperatures have been observed in many urban areas.

For the two selected case study cities in Basel (CH) and Zaragoza (S) already comprehensive monitoring networks (hydraulics and temperature) as well as calibrated high-resolution numerical heat-transport models have been developed by the individual collaboration partners (Epting et al. 2013; Epting and Huggenberger 2013; Garcia Gil et al. 2014). This previous work showed that an understanding of the variable influences of hydraulic and thermal boundary conditions due to specific geological and hydrogeological conditions in urban settings is crucial. It also could be shown that good quality data are necessary to appropriately define and investigate thermal boundary conditions and the temperature development in urban systems.

### ***Objectives***

These existing datasets and models will allow compiling and comparing the different hydraulic and thermal boundary conditions for both groundwater bodies, including: (1) River boundaries (River Rhine and Ebro); (2) Regional hydraulic and thermal settings; (3) Interaction with the atmosphere under consideration of urbanization; (4) Anthropogenic quantitative and thermal groundwater use.

For both groundwater bodies potential natural states will be investigated for different urban settings and varying processes concerning groundwater flow and thermal regimes.

From the experience of both case study cities concepts for the management of thermal resources in urban areas will be derived and the transferability of the applied methods to other urban areas discussed. The methods should allow an appropriate selection of parameters (spatiotemporal resolution) that have to be measured for representative interpretations of groundwater flow and thermal regimes of specific water bodies (settings and boundary conditions).

### ***Description of the work carried out during the STSM***

- General agreement on the work plan and time schedule
- Normalization of results obtained from heat transport modelling in order to compare the non stationary groundwater and energy budgets obtained from the selected case study cities: Basel (CH) and Zaragoza (S).
- Advance of scientific publications and elements to be implemented into the reports of the different work tasks of the WG2 Subgroup “City-scale groundwater and geothermal data and modelling – a review of best practice”

### ***Description of the main results obtained***

- Groundwater and heat transport numerical model of Zaragoza city have been adapted to the settings existing in the one in Basel city.
- A normalization approach of the different scale numerical model results have been discussed and adopted.

- Compilation of temperature data from both case studies monitoring network have allowed to compare to develop and compare an IRF indicator (García-Gil et al. 2015, ISSN 0375-6505) for the estimation of the resources available for shallow geothermal exploitation.

***Future collaboration and work plan with the host institution***

- STSM to at Institute of Environmental Assessment and Water Research (IDÆ); UPC, Barcelona, Spain  
June 2015  
  
This follow-up STSM will again involve several meetings and final discussions of the publications at the host institute in Barcelona.
- English Publication, summer 2015 paper submission.

***Foreseen publications/articles resulting from the STSM***

- Development of concepts for the management of thermal resources in urban areas – Transferable concepts on the basis of the experience gained from the Basel and Zaragoza case studies.
- The monitoring network policies of shallow geothermal exploitation systems and its optimal design in urban areas - Experiences gained from the Basel and Zaragoza case studies.