

How did the “Great Karst Spring of Mesopotamia” dry up: Impacts of climate change or groundwater over-exploitation

Context and objectives

Located along the Syria-Turkey border between the Euphrates and Tigris rivers, Ras el Ain was renowned as one of the globe's largest karst springs, recording mean annual flows of $\sim 40 \text{ m}^3/\text{s}$. Starting from the mid-1980s, the spring's discharge steadily declined, ultimately leading to its complete drying up after 2008. This decline has been attributed to two main factors: (1) changing precipitation patterns due to climate change, and (2) the expansion of groundwater-irrigated croplands on both sides of the border. However, quantitative studies of the relative anthropogenic and climatic impacts are still lacking.

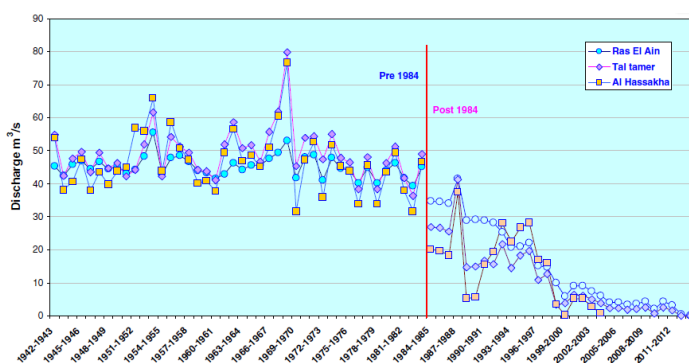
The goal of this project is to provide a quantitative analysis on the impact of climate change and groundwater over-exploitation on the spring discharge – an issue which is especially problematic in semi-arid areas, and more importantly, in a transboundary aquifer separating two water stressed countries.

Methodology

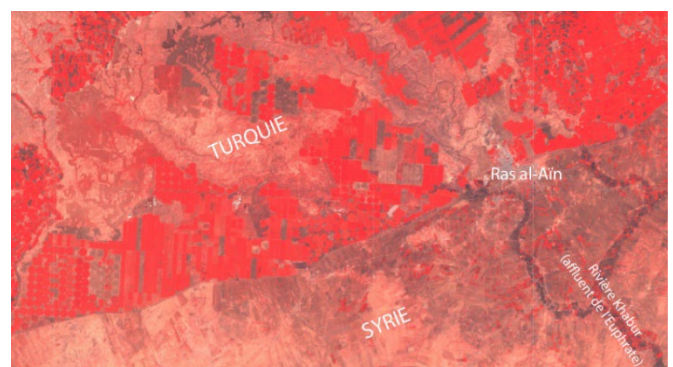
In this project, remote sensing and hydrogeological modelling will be utilized. First, we aim at classifying land use/land cover (LULC) in Google Earth Engine by applying machine learning algorithms on the LANDSAT archive that provide a continuous record of optical imagery since 1972.

Second, by Leveraging the extended precipitation/discharge data available for this spring, a hydrogeological model will be developed and calibrated against the natural flow conditions (prevalent before the 1980s). For the 1984-2011 period, LULC changes will be integrated into the model to analyze how groundwater recharge and storage varies with respect to groundwater pumping, and how it is correlated with the spring discharge.

Supervision and collaboration



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The project will be supervised by Dr. Landon Halloran, Saeed Mhanna and Prof. Philip Brunner.

We are also in contact with Boulos Abou Zakhem – an expert on the hydrogeology of Ras el Ain spring. Given satisfactory results, eventual publication of a journal article, co-authored by the student, is possible.