WAMA-WADIT

Water management and adapation based on watershed digital twins

Water4All
Water security for the planet

Abstract

In this proposal, we aim to study and understand the effect that climate extremes (droughts and floods, under current and climate change conditions) have on the behaviour of water management systems, to develop optimized management strategies and operation rules that minimize the effects of climate extreme and of climate change, and that maximize water security. The knowledge and understanding gained will be used to create a watershed digital twin, that may be applied to different watersheds with different conflictual water-related problems. A guide detailing the process required to build digital twins for specific watershed and problems will also be published.

Our proposal, thus, pursues three main objectives: one related to the generation of knowledge, the scientific objective, whose main aim is to advance the knowledge in the climate, hydrological and water management fields; another one focused on technological transfer, the practical objective, whose main aim is to translate the most up-to-date scientific knowledge to the terms used by decision makers, practitioners and managers; and a third objective aiming at developing a tool, the product objective, that provides an easy application of the methodology developed.

Our main scientific objective is to improve the understanding of the effects that drought and floods have on the operation of water management systems (specifically on single and multi-reservoir systems), and how optimal management strategies may mitigate the effect of such extremes. This objective will require that we tackle more specific objectives related to the characterization of climate, hydrology, and reservoirs, the most relevant of which are:

- 1. Analyzing systematic errors on climate and hydrologic predictions
- 2. Including more complete groundwater dynamics models, coupled to the surface hydrology ones
- 3. Incorporate more complex snow dynamics into hydrological modeling, especially over complex systems, as the Mediterranean mountain areas
- 4. Assess the effect that long-term forecasts and projections of extreme events may have on the operation of reservoir management, and how operation rules may be used as anticipatory and adaptation measures to reduce natural hazard and climate change impacts on water management, with a focus on extreme events.

Our proposal tackles issues in topics 1 and 2 of the call.

In topic 1, resilience, adaptation and mitigation to hydroclimatic extreme events, this proposal addresses the three subtopics. We aim at providing answers for knowledge gaps, like including a better error treatment for generating hydrological projections, as well as to better incorporate uncertainty. We also will explore better ways to capture the interaction between surface and groundwater hydrological flows, and to better incorporate snow dynamics. We will consider how to incorporate climate change projections in all these topics (point 1.1). We also aim to develop a methodology that will help end-users to design digital twins where adaptation scenarios, as well as short-term and seasonal forecasts, can be tested and quantified to select optimal strategies (point 1.2). The tool that we will develop will serve to improve the resilience and adaptation capacity of water infrastructure (point 1.3).

In topic 2, tools for water management - in the context of hydroclimatic extreme events, we are proposing to create a methodology and a free and open-source software tool to quantify and evaluate risk, short-term operational decision making and long-term adaptation actions, including hydroclimatic extreme events (point 2.1). The methodology and software tool would also allow to analyze scarcely monitored areas, complementing the lack of information with plausible scenarios, and communicating uncertainties in a robust way (point 2.2).

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FUNDACIÓN INSTITUTO DE HIDRÁULICA AMBIENTAL DE CANTABRIA / UNIVERSIDAD DE CANTABRIA- SPAIN

Project partners

- ANTEA FRANCE - FRANCE
- BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES - FRANCE
- INSTITUT POLYTECHNIQUE DE GRENOBLE - FRANCE
- UNIVERSIDAD DE CÓRDOBA - SPAIN
- UNIVERSITY OF BRISTOL - UNITED KINGDOM
- UNIVERSITÀ' DEGLI STUDI DI TRENTO - ITALY

Funding organisations

AEI (SPAIN) / ANR (FRANCE) /
EPSRC UKRI (UNITED KINGDOM) / MUR (ITALY)

Duration

3 years

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KEYWORDS

Hydrology (Water science),
Water system modelling,
Integrated management of water,
Climatology and climate change,
Open Source Software