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Editorial: Hydro-informatics for sustainable water management in agrosystems, volume II

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Editorial on the Research Topic
Hydro-informatics for sustainable water management in agrosystems, volume II

This second volume of the Research Topic entitled "*Hydro-informatics for Sustainable Water Management in Agrosystems*" marks the induction of the theme as a periodical topic in the Frontiers in Water journal. This is an important step in a journey aiming at exploring appropriate or opportune application of Hydroinformatics in the agricultural domain. As part of the first volume, the field of Agricultural Hydroinformatics (Celicourt et al., 2020) was proposed as a holistic approach leveraging information and communication technologies to sustainably transform the socio-natural assemblage, i.e., farmers, lands, crops, pipes, pumps, livestock, rivers (Bakker, 2012; Barnes, 2012), that shapes, and is shaped by water. Initially, this vision was materialized through a diverse range of: (a) technical studies focusing on the performance of subsurface drainage and irrigation systems, and (b) phenomenological ones aiming at designing software tools for farmers empowerment in a context of raising water saving awareness. The papers that make up this volume highlight a new set of topics (water data gaps filling, drought impacts management, soil compaction and hydrodynamic properties, irrigation systems efficiency, and sediment concentrations and loads modeling) that further extend the scope and horizon of the application of Hydroinformatics in agriculture.

Zeynoddin et al. address a critical challenge that often pervades agricultural systems datasets, that of missing data or data gaps resulting from a variety of technical and environmental issues (Teh et al., 2020). The paper proposes a filtering and imputation algorithm that implements three prominent predictive models (Extreme Learning Machine, k-Nearest Neighbors, and Evolutionary Optimized Inverse Distance Method) to estimate missing values in soil matric potential measurements from potato fields in northern Quebec (Canada) based on meteorological data. In the context of their application, the results demonstrate that the Extreme Learning Machine model proved to be the most effective amongst the models evaluated. The authors acknowledge the computational demand of the models and suggest a pre-filtering strategy to circumnavigate this Research Topic.

Dahlmann et al. delve into the upstream-downstream asymmetry of drought impacts in four major river basins of the European Alps - Rhine, Rhone, Po and Danube, over a 20-year time frame. The intra-basin upstream-downstream segmentation lies on two classification techniques: (a) the distance between each sub basin outlet and the river basin most-downstream sink and (b) human footprint on the land surface based on socio-economic variables. The investigation highlights that the agricultural sector, specially crop and livestock farming, as the most affected among the economic sectors across the study region, where beef and dairy production is located in the higher elevation areas and crop production in the foothills and foreland areas.

Mbarki et al. examined five soil compaction thresholds and the impacts on the hydrodynamic properties of loamy sand soil sampled from a potato field in the agricultural regions of northern Quebec (Canada). Laboratory experiments were conducted to assess the soil hydraulic characteristics (saturated and unsaturated hydraulic conductivity, soil water retention capacity) using the constant head method, a HYPROP device, and a WP4C dew point potentiometer. Sixteen hydraulic models available in the HYPROP-FIT software were fitted to the soil water retention curve data. The following main results were obtained: (a) the saturated and unsaturated conductivity decreases with increasing soil compaction, (b) the Peters-Durner-Iden model, labeled VGm-b-PDI, was selected as the optimal model owing to its superior performance. As an extension of the laboratory results to a practical context, the VGm-b-PDI model was implemented in the HYDRUS-1D modeling software to evaluate the amount of irrigation for each compaction level. The study concludes that soil compaction influences soil hydraulic properties and irrigation water requirements asymmetrically, with the amount of irrigation water being optimal at a moderate level of soil compaction.

Mortel and Madramootoo propose a set of seven irrigation water thresholds in terms of the total available soil water (TAW) in the root zone in the form of scenarios to compare between yield and water use efficiency in sugarcane (*S. officinarum*) production in Guyana. Their continuous open-furrow irrigation simulation implemented using the AquaCrop model was supported by field measurements including climate and soil data, as well as local crop parameters. They conclude that: (a) an irrigation scenario of 70% TAW provides high yields and optimal water use, and (b) a soil-water content above the 70% TAW threshold ought to use more irrigation water, with marginal or no increase in yield.

Bée et al. focus on the detrimental consequences of soil degradation on aquatic environments in the province of Prince Edward Island (Canada). They compare flow, suspended sediment concentrations (SSC), and loads in two agricultural watersheds, Tuplin Creek and Spring Valley, of the province. The data fluxes used for the hydrological and suspended sediment models development include water level and turbidity, suspended sediments, and flow. Then, the model is applied to simulate future daily flows and suspended sediment concentrations based on a relatively pessimistic climate change scenario (RCP 8.5) until year 2,100 using the Soil and Water Assessment Tool. The results indicate a slight increase in the average suspended sediment concentrations. Furthermore, for the Tuplin Creek watershed, more frequently high sediment peaks are anticipated with potentially significant implications on ecosystem disturbances.

Altogether, the articles summarized above contribute to demonstrate the relevance of the proposed Research Topic, and hence, the spectrum of farming systems challenges that the field of Hydroinformatics is positioned to address. The article by Bée et al. further confirms the intricate and intertwined nature of these complex challenges that our societies must develop mitigation and adaptation strategies to address. Again, a socio-technical view of farming systems management and transformation is a viable pathway toward unlocking the sustainability transitions of the agricultural sector.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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