Cloud Computing for Hydrologic Modelling and Applications – Background, Challenges, and Opportunities

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Abstract

The water cycle is a complex phenomenon. Technological advancements through computational modelling made it possible for researchers to analyse and visualize this complex process. Nevertheless, problems associated with big data collection, storage, processing, and management activities challenge practitioners. Cloud computing technology provides insights to tackle the above challenge through its ability to store, integrate disparate software architecture, and visualize the outcomes from various perspectives [1]. This offers the hydrological modelling community new opportunities where several scientific breakthroughs have emerged since mid-2000. For instance, data assimilation and optimization framework as a service for water resources management in real-time [2], data integration and analysis system [3], decision support system for urban drainage [4], real-tie environmental modelling to optimize groundwater abstraction [5], and many more. Therefore, it is interesting to review the current findings, limitations, and challenges encountered by hydrologists when attempting a cloud technology-based solution as part of the modelling pipeline.

This paper aims to shed light on the various cloud technology developments in hydrological modelling as well as the applications developed using such models. For this purpose, we adopted a hybrid method that combines a systematic and narrative approach. The systematic literature review-based approach used the PRISMA protocol.

The initial finding revealed the wide spectrum of opportunities offered by Cloud technology to hydrology researcher from various standpoints. This includes the application of IaaS architecture by most of the (about 40% of reviewed literature) research works in this field. Also, from the perspective of cloud deployment model, roughly 65% out of all the reviewed literature have used public cloud for development of their models followed by a considerable number (around 16%) of all the reviewed research publications have adopted specific hydrology related cloud platform. For instance, Cloud-based computing-oriented service or CLAUDE [2]. Furthermore, new categorization of cloud technology framework with respect to hydrology research was established. This consists of development of generalized and centralized web framework that can provide means to develop customized artificial intelligence (AI) solutions through Platform-as-a-Service (PaaS) systems. This study also aims to narrow the gap between cloud computing research and hydrology research to promote the emergence of tailored cloud computing techniques for dedicated hydrological modelling aspects and applications.

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