Quantifying water security using hyper-resolution hydrological modelling on top of an Open Data Cube (ODC)

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1 Context

Given the current and forecast pressures over regional and global water systems as a result of population growth and human activities, water security has been recognised as one of the most significant challenges of the 21st century (Srinivasan et al. (2017)). Therefore, rigorous quantification of the impacts of climate change on water security have a key role informing water management and policy, and to support the progress in the implementation of the Sustainable Development Goals (SDGs) (Eekhout et al. (2018)).

2 Aim

To evaluate water security at a regional scale as part of the collaborative laboratories (collaboratories) that form part of the Water Security & Sustainable Development Hub by implementing a hyper-resolution hydrological modelling approach to quantify water scarcity and vulnerability.

3 The Research

This research will be at the junction of three areas: hydrological physical modelling, satellite Earth observation data and cloud computing technology. During the past two decades the development of hydrological predictions at spatial resolution on the order of 1 km or less has been recognised as a grand challenge in hydrology. The advances in satellite and sensor technology, coupled with the development of cloud computing, have enabled the advancement of hydrology as a data-intensive science. As a result, there is a considerable impetus and interest in future research and approaches in the use of these emerging technologies to develop new insights that contribute to fundamental aspects of the hydrological sciences.

Advancement in hydrological sciences as a data-intensive science needs to explore effective approaches for the use and analysis of the petabytes of existing Earth Observation data.

GEOSPATIAL SYSTEMS

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4 The Know How

4.1 Computational Framework

Open Data Cube (ODC)

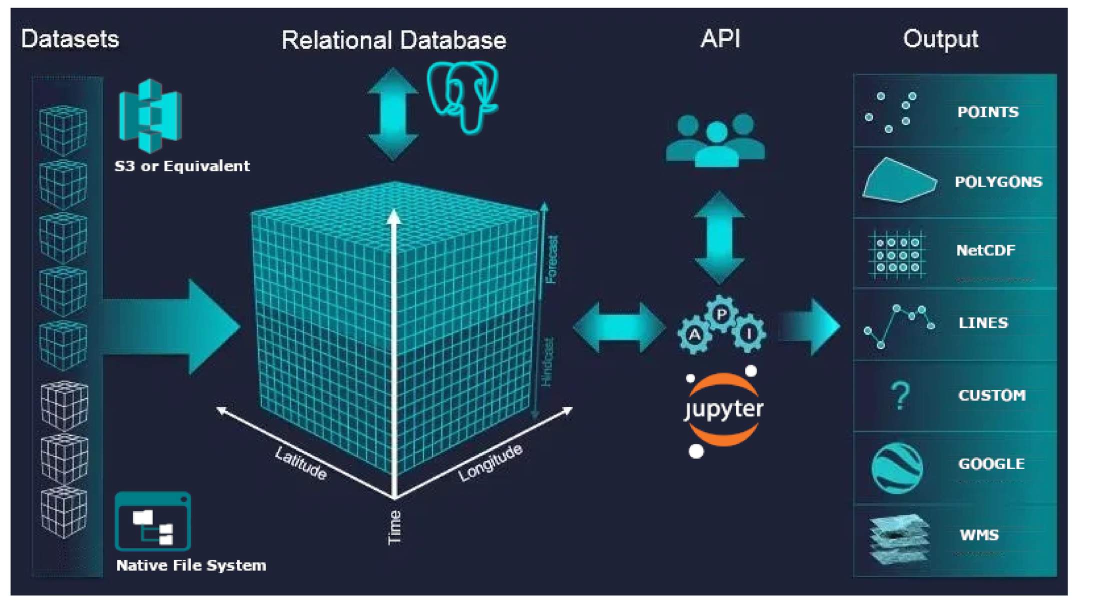

Figure 4.1: ODC storing, sharing and publishing of the data architecture (image modified from https://www.cursoseledeteccion.com/la-iniciativa-global-open-data-cube/ accessed 2022-05-03)

4.2 Water Security Assessment

PBSD - SHETRAN

Simulation of hydrological processes related to blue and green water cycles such as rainfall interception by vegetation, evaporation and transpiration, variably saturated subsurface flow, and river/aquifer interactions.

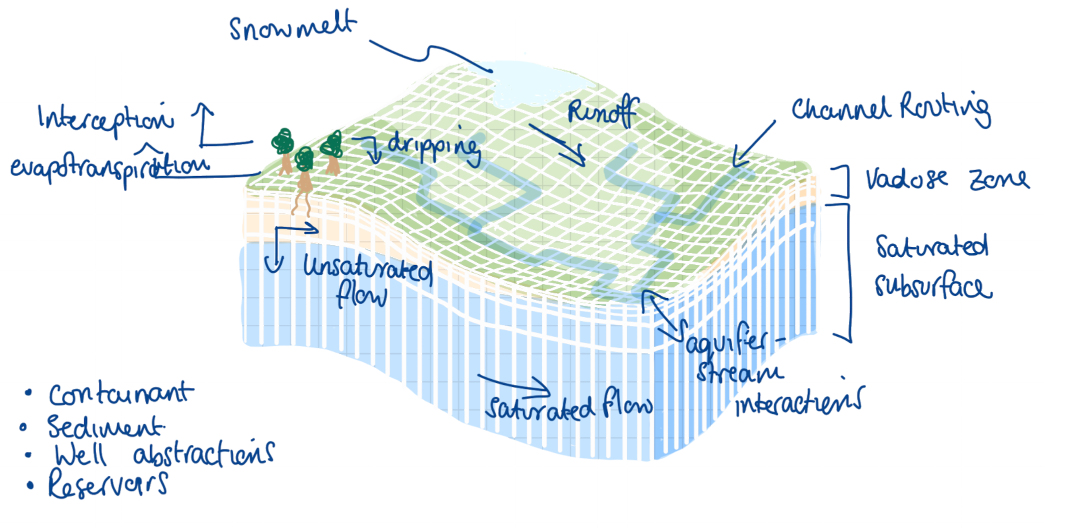

Figure 4.2: Conceptualisation of catchment hydrology in SHETRAN (image designed by Dr. E. Lewis)

Water security analysis

The impact of climate change on water security will consider the distribution of green water (e.g. soil moisture as a result of infiltration) and blue water (e.g. waterflows through the land surface) storage.

WATER SECURITY & SUSTAINABLE DEVELOPMENT HUB

References

Eekhout, J. P., Hunink, J. E., Terink, W., & Vente, J. de. (2018). Why increased extreme precipitation under climate change negatively affects water security. *Hydrology and Earth System Sciences*, *22*(11), 5935–5946.
Srinivasan, V., Konar, M., & Sivapalan, M. (2017). A dynamic framework for water security. *Water Security*, *1*, 12–20.