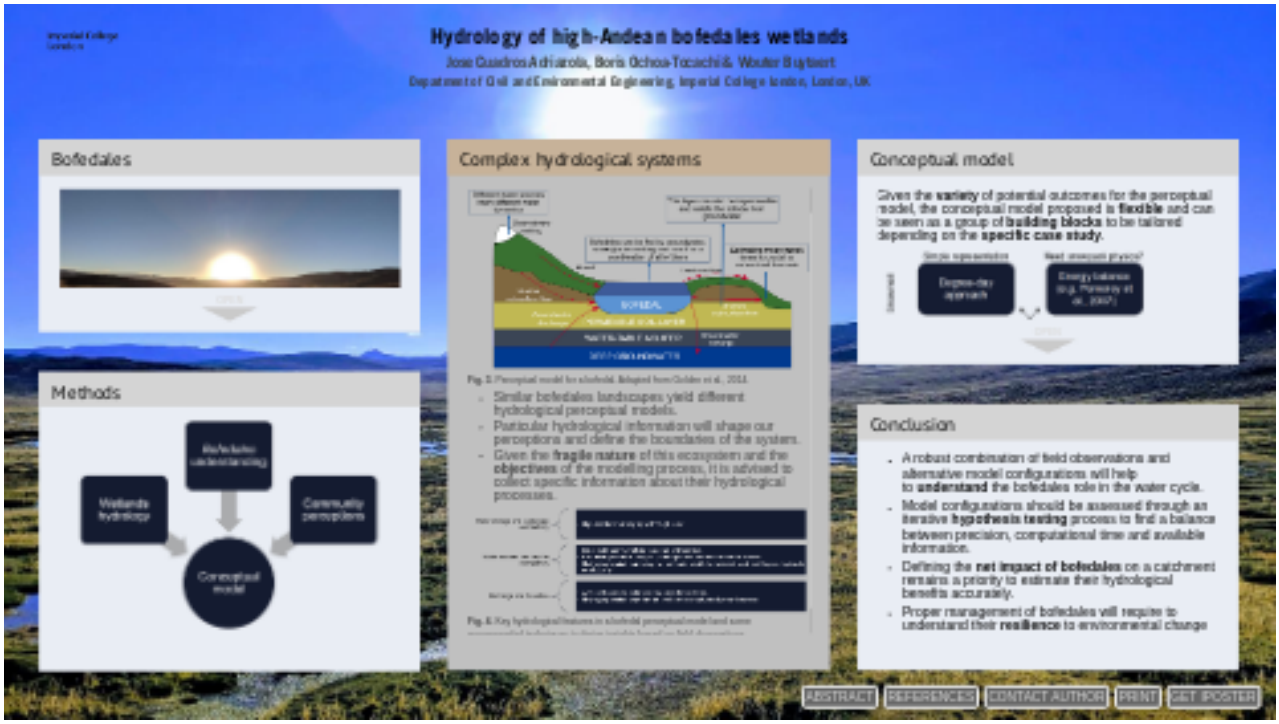
Hydrology of high-Andean bofedales wetlands



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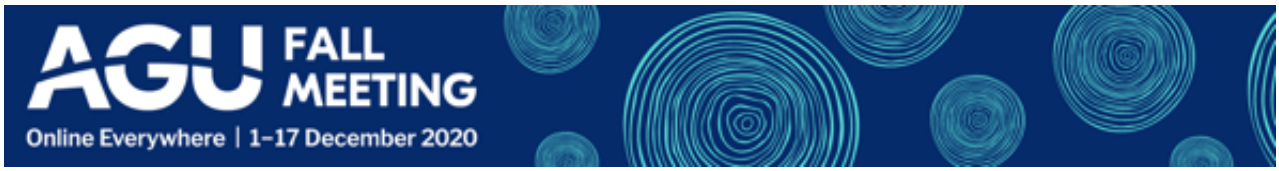

BOFEDALES

Fig. 1. Typical bofedal landscape in Chalhuanca, Peru. Photo courtesy of Boris Ochoa-Tocachi.

- Bofedal (plural bofedales) is a regionally used term to refer to a type of **wetland** developing in the **tropical Andes**.
- They provide various **ecosystem services**, including water-related services such as hydrological regulation.
- Their **role** on the water cycle is crucial but their **net impact** remains **uncertain**. They might reduce peak floods and reduce catchment yield in the same catchment.
- This research proposes a **tailored hydrological model** to represent the bofedales water dynamics.

METHODS

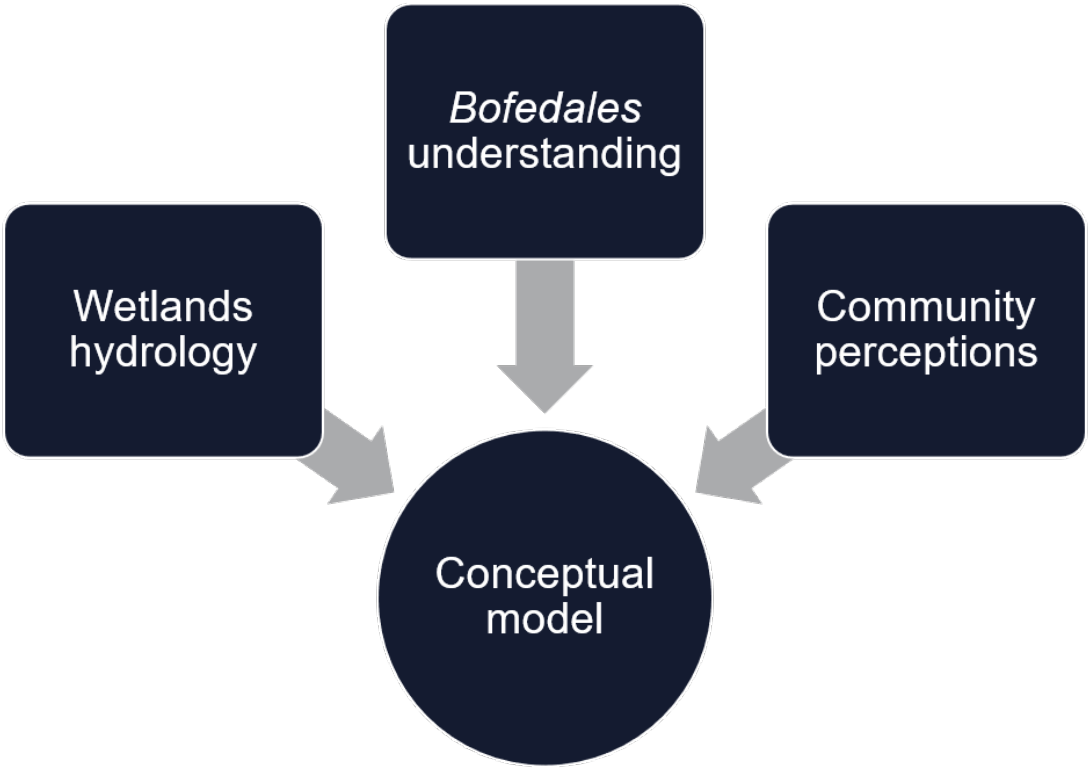

Fig. 2. Data sources to be analysed via critical analysis

COMPLEX HYDROLOGICAL SYSTEMS

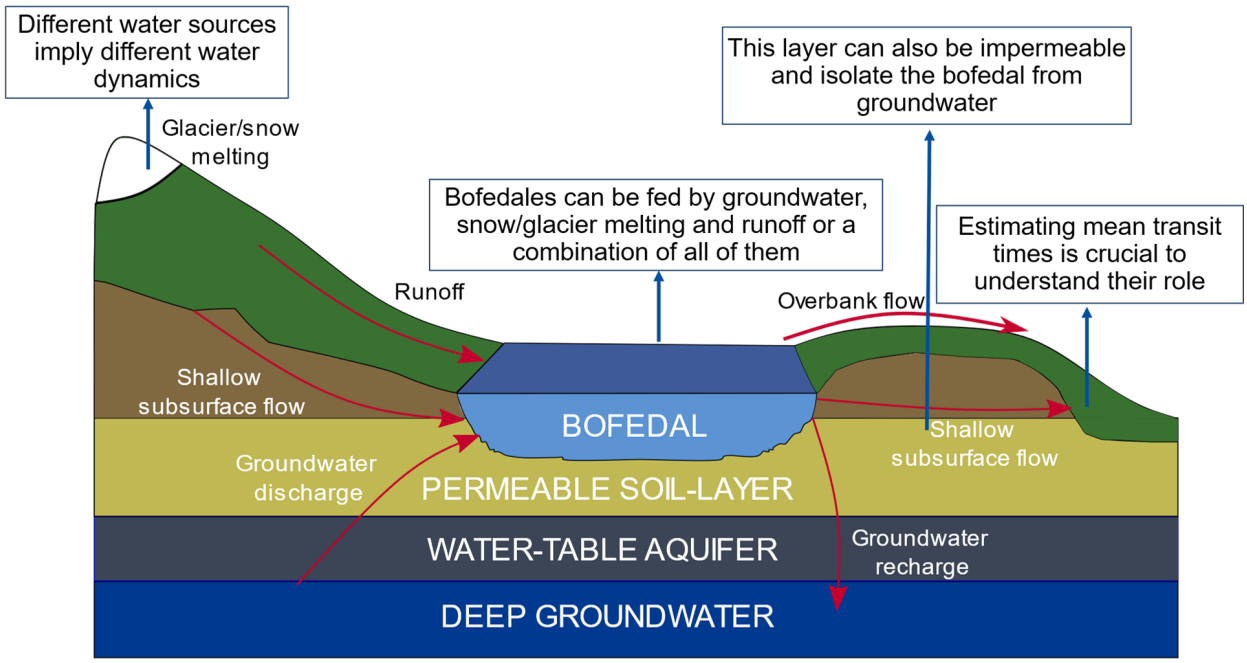

Fig. 3. Perceptual model for a bofedal. Adapted from Golden et al., 2014.

- Similar bofedales landscapes yield different hydrological perceptual models.
- Particular hydrological information will shape our perceptions and define the boundaries of the system.
- Given the **fragile nature** of this ecosystem and the **objectives** of the modelling process, it is advised to collect specific information about their hydrological processes.

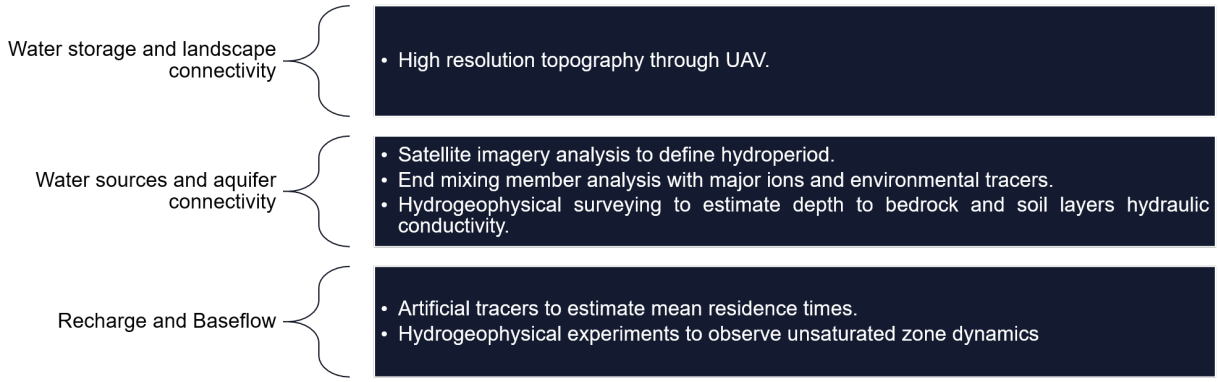

Fig. 4. Key hydrological features in a bofedal perceptual model and some recommended techniques to derive insights based on field observations

CONCEPTUAL MODEL

Given the **variety** of potential outcomes for the perceptual model, the conceptual model proposed is **flexible** and can be seen as a group of **building blocks** to be tailored depending on the **specific case study**.

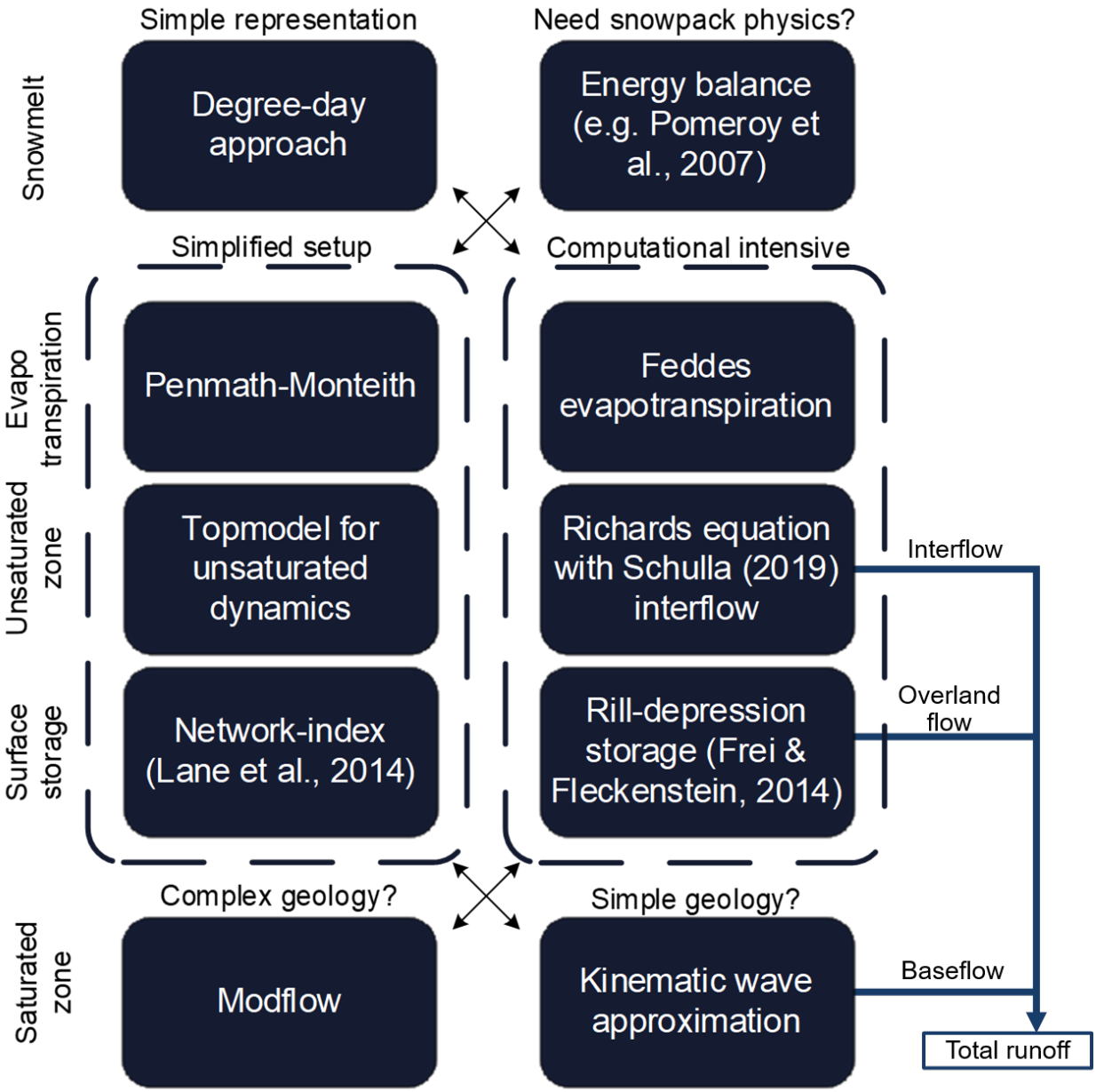

Fig. 5. A flexible conceptual model depending on the understanding of a bofedal, objectives of the study and computational resources available.

CONCLUSION

- A robust combination of field observations and alternative model configurations will help to **understand** the bofedales role in the water cycle.
- Model configurations should be assessed through an iterative **hypothesis testing** process to find a balance between precision, computational time and available information.
- Defining the **net impact of bofedales** on a catchment remains a priority to estimate their hydrological benefits accurately.
- Proper management of bofedales will require to understand their **resilience** to environmental change such as **climate change** and **anthropogenic impacts**.

ABSTRACT

Bofedales is a regionally-used term to refer to peatlands and wet meadows ecosystems developed in the Puna biome in the Andes. These ecosystems are characterised by the presence of hydrophilic vegetation in a seasonal or perennially saturated soil. Like other types of wetlands, the bofedales provide various ecosystem services, including water-related services such as hydrological regulation. In the context of climate change and a potential increase in water scarcity, the creation of artificial bofedales is gaining interest as a potential nature-based solution. However, integrating this solution to improve local water security requires quantitative hydrological understanding, yet very few research results on the hydrology of bofedales have been published and data required to build hydrological models are scarce. Here we present an overview of the current state of scientific understanding about hydrological processes in bofedales. We then identify key processes that might be overlooked by widely-used hydrological models and introduce a roadmap to incorporate them. Lastly, we elaborate on the type of measurements that are needed to increase insights about hydrological regulation of bofedales. These are necessary steps to scale future research into practical knowledge to assess bofedales as a natural infrastructure for water security.

REFERENCES

Frei & Fleckenstein. (2014) Representing effects of micro-topography on runoff generation and sub-surface flow patterns by using superficial rill/depression storage height variations. Environmental Modelling and Software. 52, 5-18.

Golden, H. E., Lane, C. R., Amatya, D. M., Bandilla, K. W., Raanan Kiperwas, H., Knightes, C. D. & Ssegane, H. (2014) Hydrologic connectivity between geographically isolated wetlands and surface water systems: A review of select modeling methods. Environmental Modelling and Software. 53, 190-206.

Lane, S. N., Brookes, C. J., Kirkby, M. J. & Holden, J. (2004) A network-index-based version of TOPMODEL for use with high-resolution digital topographic data. Hydrological Processes. 18 (1), 191-201.

Pomeroy, J. W., Gray, D. M., Brown, T., Hedstrom, N. R., Quinton, W. L., Granger, R. J. & Carey, S. K. (2007) The cold regions hydrological model: a platform for basing process representation and model structure on physical evidence. Hydrological Processes. 21 (19), 2650-2667.