RESEARCH CASE STUDY

UK Centre for Ecology & Hydrology

A modular modelling framework for the terrestrial water cycle

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Hydro-JULES

Why it matters

The Earth's atmosphere and land surface are deeply interconnected systems. Given this, hydrological knowledge of water above and below the ground is as critical to atmospheric scientists as meteorological knowledge of atmospheric water is to hydrologists. In the context of a changing climate, both communities of researchers need to work together so that we can model how changes in atmospheric and hydrological conditions impact each other. This is crucial to answering key societal questions regarding the future availability of water resources and the intensity of extreme events such as floods and droughts.

Land system models have historically been developed to link the atmosphere and the land. However, these models originated as a subset of atmospheric models, which often present an overly simplified view of the land and its hydrology. For example, while atmospheric models will take into account different types of land cover, such as ice, vegetation and urban areas, they fail to consider the movement of water below these various surfaces. Moreover, the resolution of the Earth's surface in these models is often too low to be of much use to hydrologists.

Hydro-JULES is developing an improved modelling framework for land system models for hydrologists

Hydro-JULES, is a research programme funded by the UK's Natural Environment Research Council (NERC), in order to advance our ability to predict the future availability of water resources and the risk of water related disasters under a changing climate.

The Hydro-JULES programme is building a three-dimensional, open source, community model of the terrestrial water cycle to support and enable collaborative work across the research and academic communities in hydrology and land-surface science. This five-year programme is delivered by the UK Centre for Ecology & Hydrology (UKCEH) in partnership with the British Geological Survey (BGS) and National Centre for Atmospheric Science (NCAS).

w: hydro-jules.org
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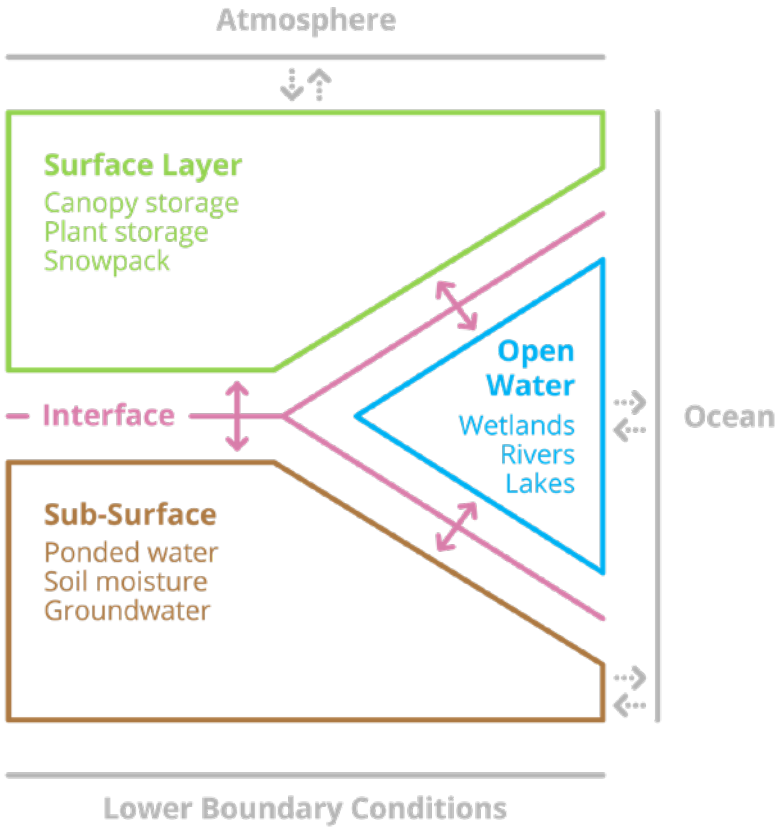

Blueprint for a modular representation of the terrestrial water cycle

What we are doing

To overcome these limitations, Hydro-JULES is developing a new framework for land system models. In order to provide hydrologists with a more flexible representation of the terrestrial water cycle, this framework represents land-based hydrological processes as three interconnected components: surface layer, subsurface and open water.

This modular approach has several benefits. First, it enables hydrologists to consider the horizontal movement of water and water-borne contaminants, such as nutrients and sediment, through an entire landscape, from ice to lakes to underground channels. Second, it allows researchers to adapt the resolution of the components to suit their needs. Third, the interconnected nature of the framework also allows the hydrological modelling community to contribute improved versions of the three components. In this way, a broad range of hydrological expertise – as well as latest scientific thinking – can be incorporated into the framework and the models made using it.

Impacts and benefits

This new framework is set to have positive and far-reaching impacts on our understanding of the water cycle. In collaboration with the UK Met Office, the Joint UK Land Environment Simulator (JULES) – the land component currently used by the Met Office – will be modified so it can take advantage of the new framework. This means that advances in the representation of hydrological processes in JULES will not only benefit the hydrological community but will also benefit atmospheric modellers. Additionally, the framework's ability to model the movement of water through an entire landscape will benefit ocean and Earth system modellers tracking the flow of water-borne contaminants as they are drained from the land into the oceans.

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BGS British Geological Survey
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