RESEARCH CASE STUDY

UK Centre for Ecology & Hydrology

Improving wetland flood predictions in Earth System models

Toby Marthews, Simon Dadson, Douglas Clark (UKCEH)

Hydro-JULES

Why it matters

As climate change increasingly impacts the water cycle, the changing occurrence and extent of floods around the world are of ever greater concern. This is especially true for wetlands and other inundated areas, which have always been integral to society for the range of ecosystem services they provide and for the biodiversity they sustain. However, they are also known to be major sources of methane, a potent greenhouse gas that accounts for almost 80% of natural emissions[1].

Predicting the size and frequency of floods at a global level is challenging. Surface water is the product of several finely-balanced water cycle processes, and slight changes in rainfall, evaporation rate or soil infiltration can greatly affect inundation extent and, in some locations, even move the local environment from wetland to dryland, or vice versa[2].

Adding to the difficulties, satellite-based observation of inundation is also challenging. In some landscapes, the local water balance (i.e. whether precipitation and other water inputs outweigh evaporation and other water outputs) is controlled by water courses like streams and wadis that are either too small or too ephemeral to be picked up by satellites.

We are leading the way in producing reliable, high resolution predictions of inundations around the globe

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
t: @HydroJules

What we are doing

How can we improve predictions of flood extent across the globe and, through this, improve our understanding of wetlands, methane and the carbon cycle in Earth system models? In Hydro-JULES we address this challenge head-on. Using some of the latest and most sophisticated inundation simulators, and comparing them to the best observational data on inundation and wetland areas, we are producing robust and reliable predictions of inundation across the world, at a resolution fine enough to be used in Earth system models. For example, national or regional governments may use these predictions to identify regions and areas at risk of flooding, while researchers may use them to improve estimates of continental or global methane budgets.

Satellite image of a river delta wetland system

Impacts and benefits

These predictions can be used by a wide range of individuals and organisations, including land owners, policy makers, researchers and international groups, to quantify and predict the dynamics of wetlands and other inundated areas around the world. In this way, Hydro-JULES research is providing a means to better understand and manage wetland environments into the future.

> *"Being able to model this level of complex hydrological behaviour is vital in realistically representing wetland extent and ultimately means that we can more accurately simulate wetland methane emissions. This is key to understanding the historic and future trends in methane and, most importantly, how such processes may respond to a changing climate."*
>
> Dr Robert Parker, National Centre for Earth Observation (NCEO), University of Leicester

[1] Global Methane Budget (2020). The Global Methane Budget. https://www.globalcarbonproject.org/methanebudget/

[2] Marthews, T.R., Dadson, S.J., Clark, D.B., Blyth, E.M., Hayman, G., Yamazaki, D., Becher, O.R.E., Martínez-de la Torre, A., Prigent, C. & Jiménez, C. (2021). Inundation prediction in tropical wetlands from JULES-CaMa-Flood global land surface simulations. Hydrology and Earth System Sciences Discussions.

UK Centre for Ecology & Hydrology

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS British Geological Survey

UKRI Natural Environment Research Council