Fluxes from Flooded Vegetation

Toby Marthews

UKCEH, 12th October 2021

Mississippi, Missouri & Illinois rivers in flood, St Louis, USA (NASA)

Hydro-JULES

UK Centre for Ecology & Hydrology

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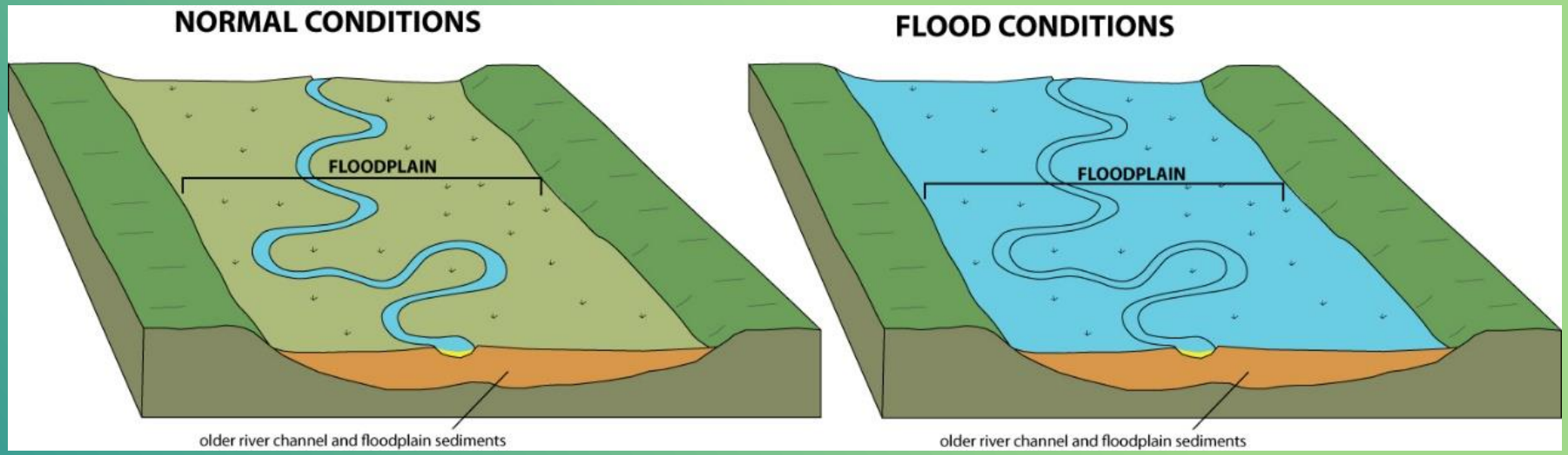
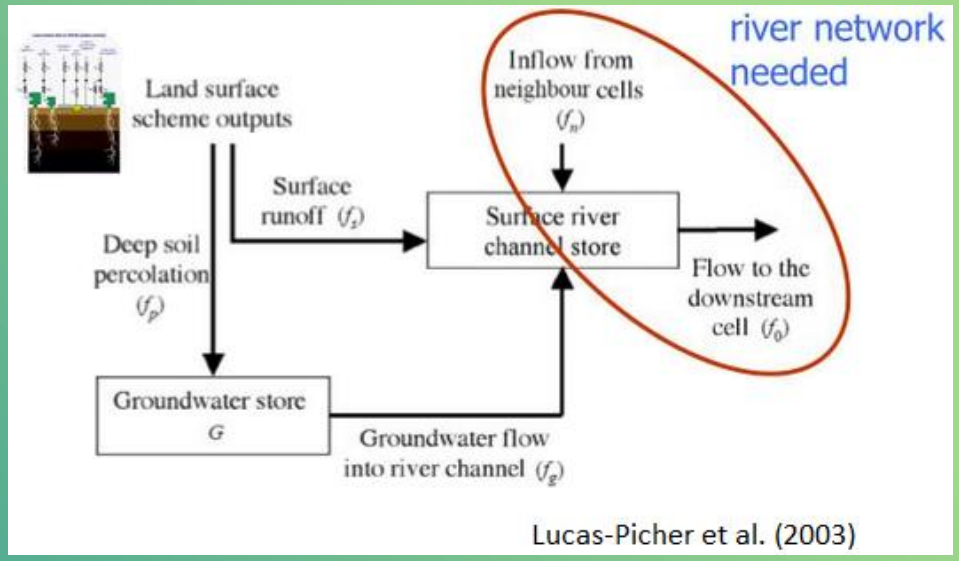
River overbank inundation



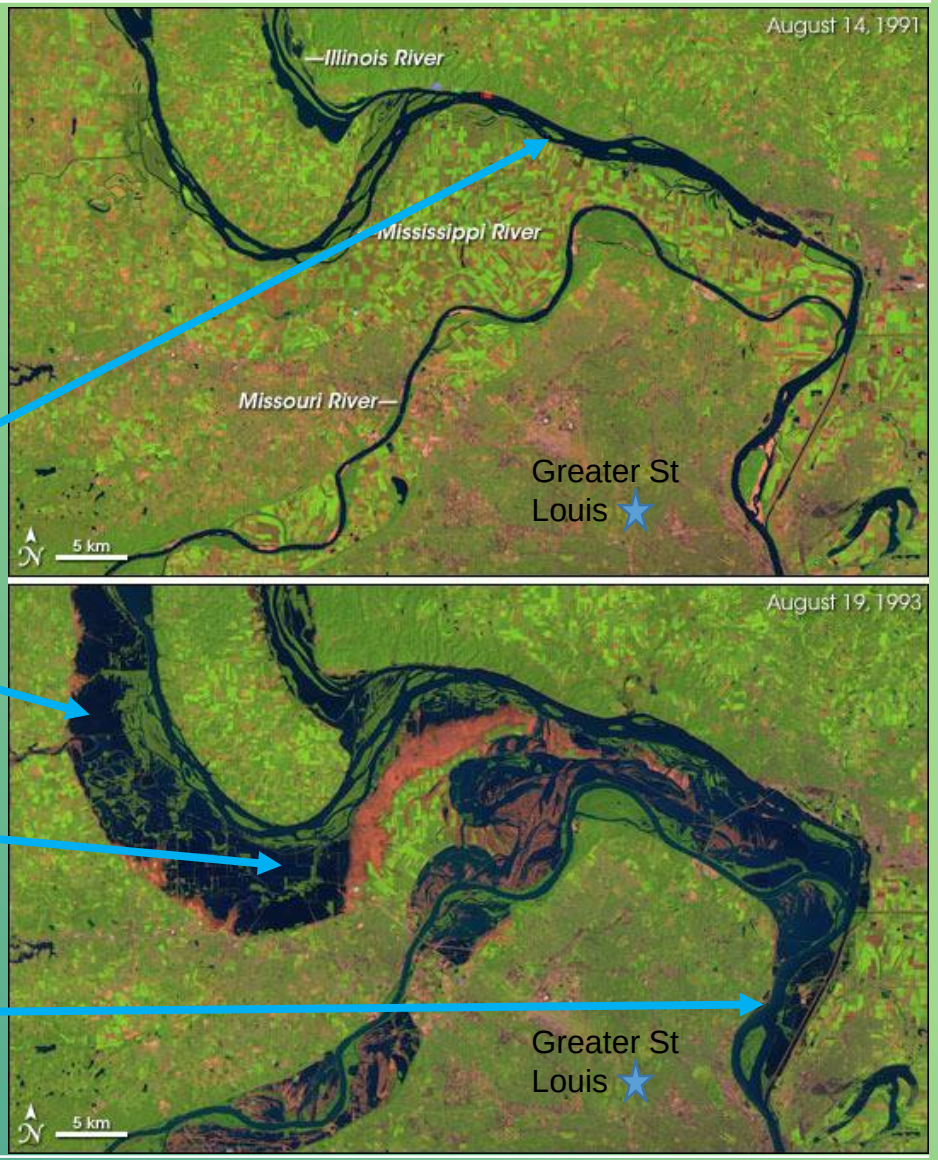
Cartoon from https://www.wired.com/2011/05/flooding-creates-floodplains/

- ***Overbank inundation*** is exactly what it says: it is the familiar process by which rivers burst their banks and expand temporarily to inundate part of their floodplain.



River overbank inundation

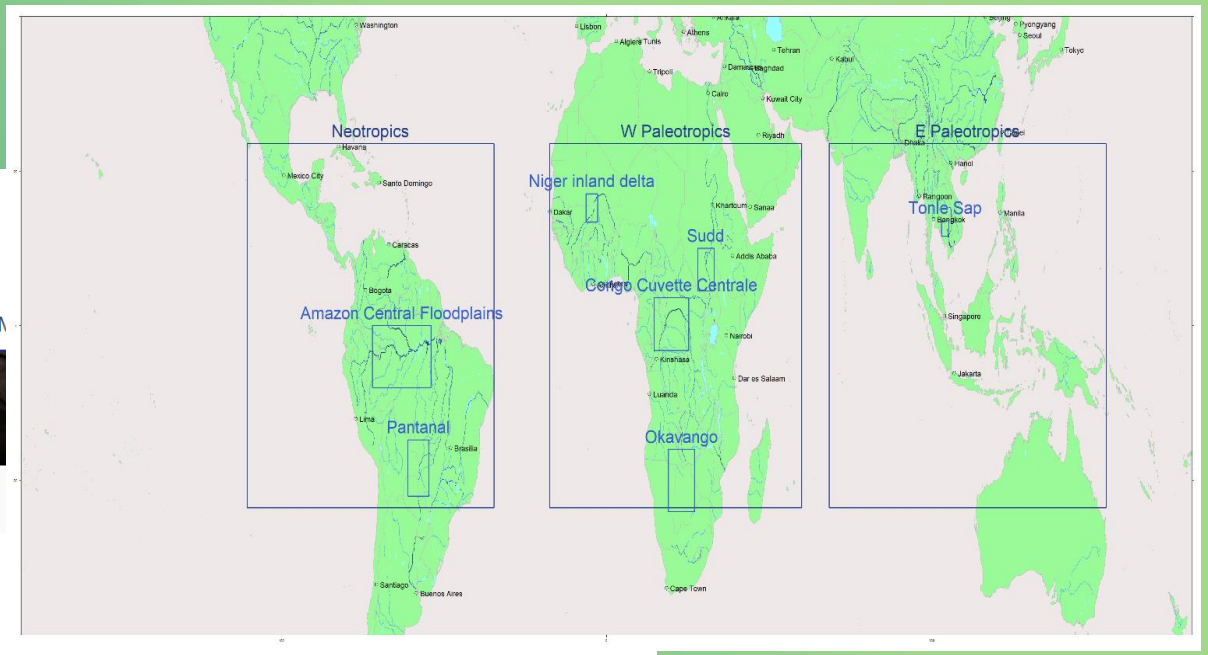
- Take the example of the August 1993 “Great Flood of the Mississippi River” in St Louis, USA.
- How much of this event can we simulate?
  - River flow regime (Are we getting flood events when and where we should? Does the inundation stay as long as it should?)
  - Evaporation from the inundated area
  - Influence on vegetation (e.g. grasslands become flooded grasslands: how does this affect productivity?)
  - Methane flux from semi-permanent inundated areas such as wetlands



NASA Earth Observatory

Inundation

I've been working on wetland prediction from land surface models in a paper in *HESS*:



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Inundation prediction in tropical wetlands from *JULES-CaMa-Flood* global land surface simulations

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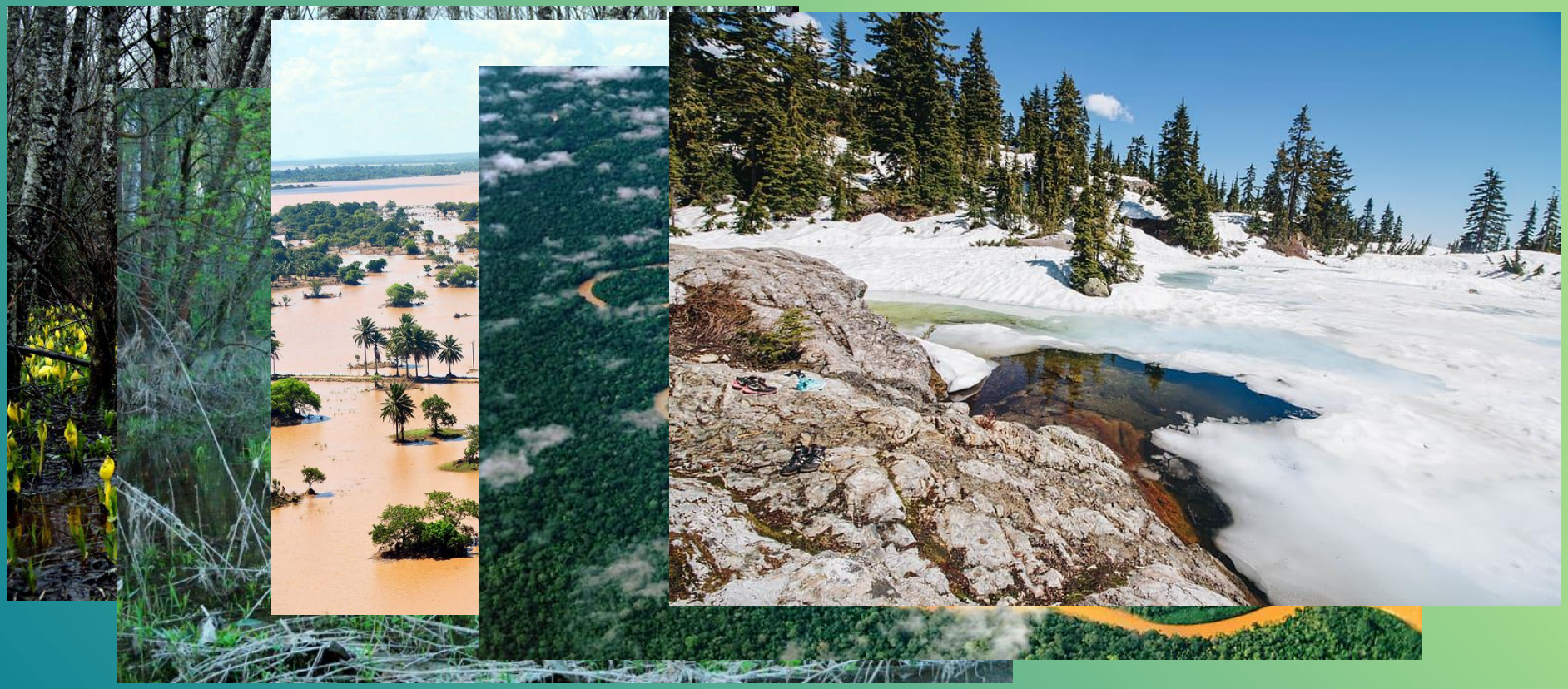
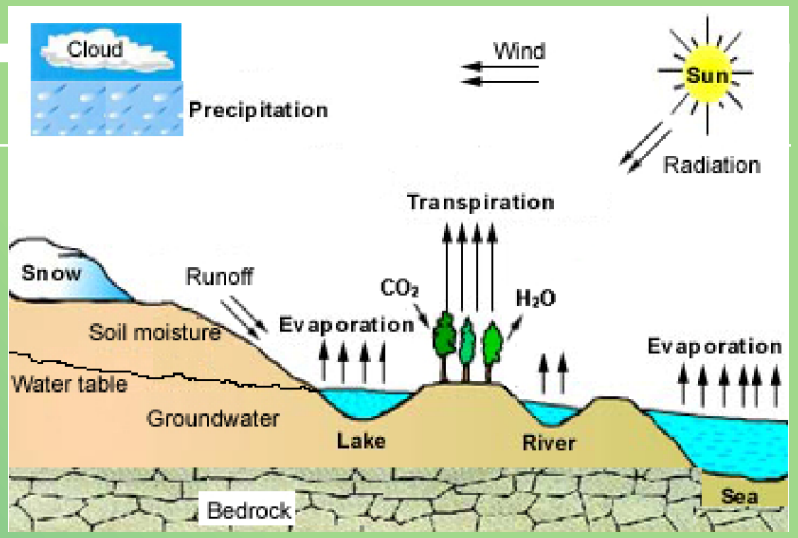
Flooded vegetation

- Flooded vegetation is not generally treated explicitly in land surface models. In the JULES code, for example, ice and lake areas on land are assumed to have zero vegetation (and rivers have no width).
- Partly this is about perception: If you say “forest”, “grassland” or “lake” then people generally know what you are talking about, but across a landscape - arctic, temperate or tropical - there is huge gradation between dry and wet environments. Which of the following is the wettest environment?



Flooded vegetation



- Current land surface models do their very best, but I believe suffer from an artificial distinction between ‘dry land’ and ‘wet land’. Look at this illustration of the water cycle (from Yang 2004). See how the land-surface fluxes only come from either water surfaces or dry vegetation with nothing in between?

Another example: is this landscape:

- A floodplain?
- A forest riparian ecotone?
- A wetland complex with associated water courses?
- A ‘gridcell with ~5% open water surface’?

It depends who you talk to!

Flooded vegetation

The terrestrial land surface is approximately divided into 41% drylands, 10% ice (mostly in Antarctica), 1% urban, 31% forests, 6% wetlands (half permanent, half seasonal), 3% lakes and 8% other biomes (inc. grasslands, shrublands).

This sounds clear, but I am suspicious: do swamp/riparian forests go in “wetland” or “forest”? Ramsar have drawn the line here, but they admit themselves it’s a bit of an arbitrary one: every forest is part of a water catchment, so inundation really grades seamlessly from mountain top to river course. That 6% wetland figure includes 13% of Canada’s land area, for example, but you could argue a case that most of Canada is pretty damp: perhaps a better ‘hydrological model’ would be to consider almost all forests and other biomes as ‘very seasonal wetlands’ ....?

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