Long-term human impact on alluvial peatland dynamics in temperate climates.

Ward Swinnen, Nils Broothaerts, Gert Verstraeten

KU Leuven, Belgium

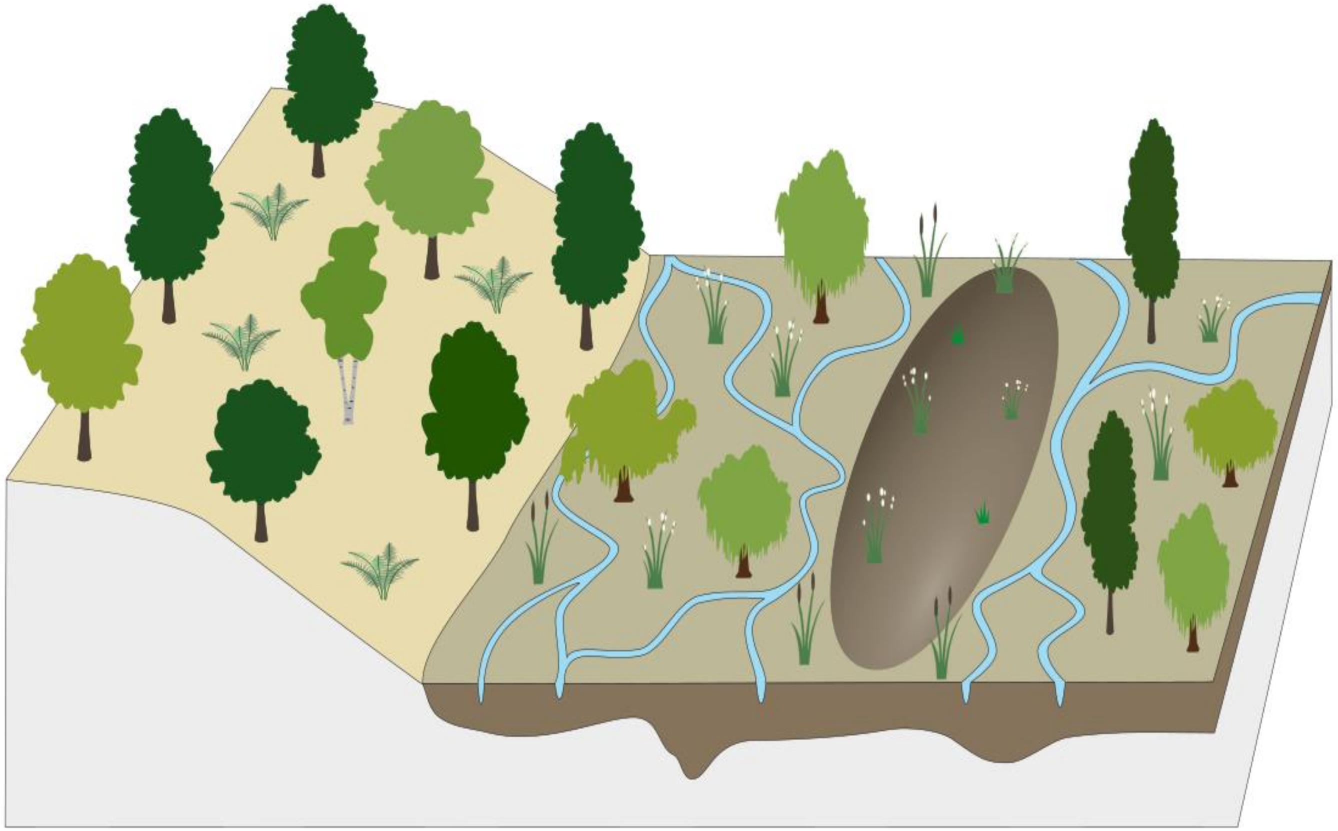
Introduction

- Alluvial peatlands are a common peatland type in temperate climates
- In contrast to other peatland regions, they have a long history of human impact.
- Currently, adequate modelling tools for alluvial peatlands are lacking.
- This study: develop alluvial peatland model & explore effect of past human activities on peatland development

Setting

- Alluvial peatlands with elongated peat bodies between small streams.
- Case-study: lowland Belgium

Picture: Jelle Van den Berghe



Model development

- Adapted version of the Digibog model (Morris et al., 2015)

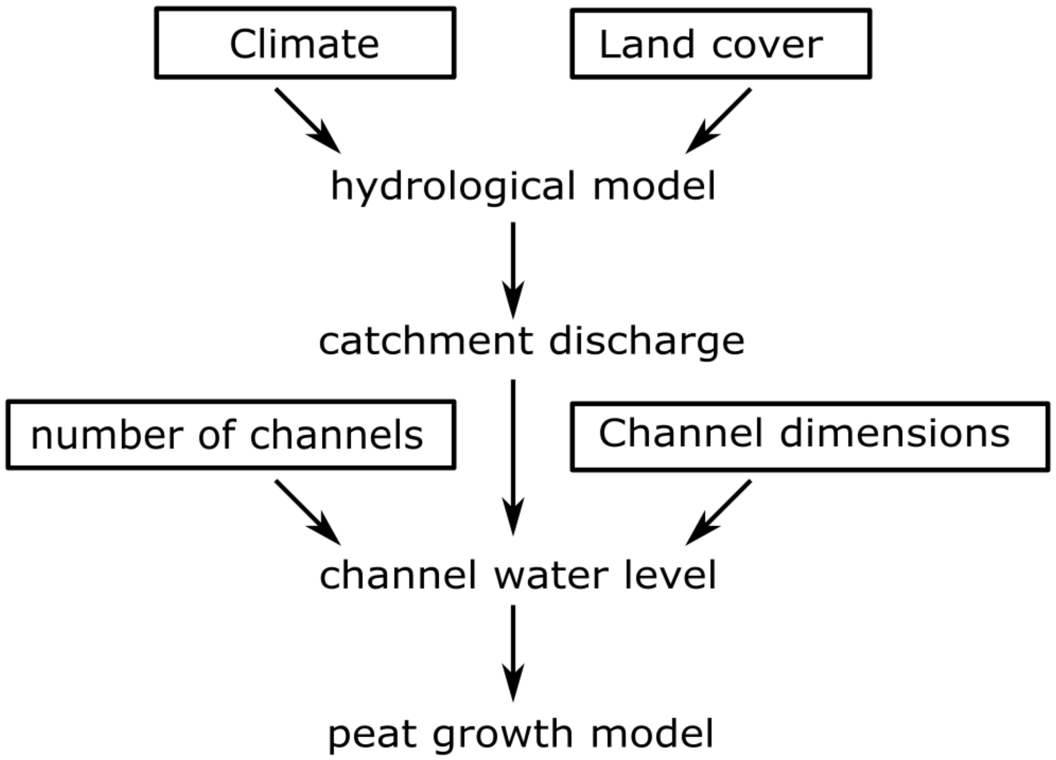
- Changes to the original model:

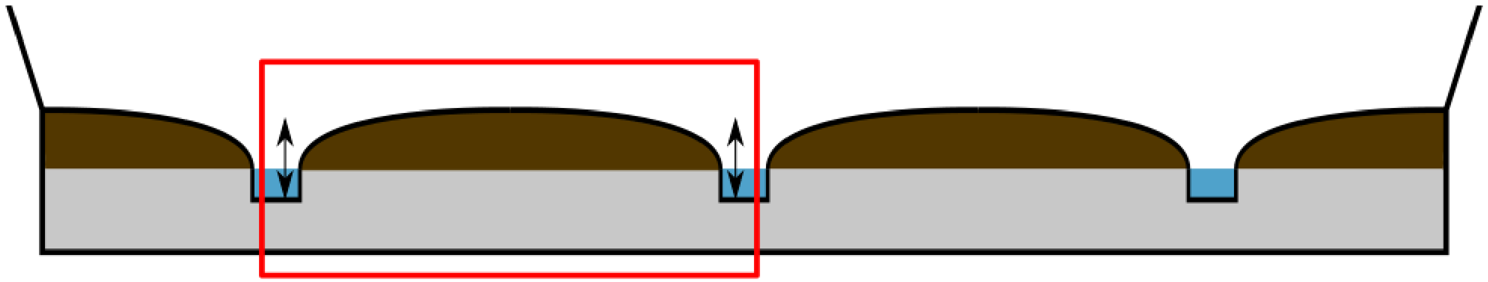
  - Include wider range of vegetation types (carr forest and sedge meadows)

  - Coupled with the STREAM catchment hydrology model (Aerts et al. 1999) to provide streamflow as a lateral boundary condition

Model setting

- Catchment hydrology model determines water level in the floodplain channel.
- Peat growth model simulates long-term peatland development for a bog between two parallel streams.

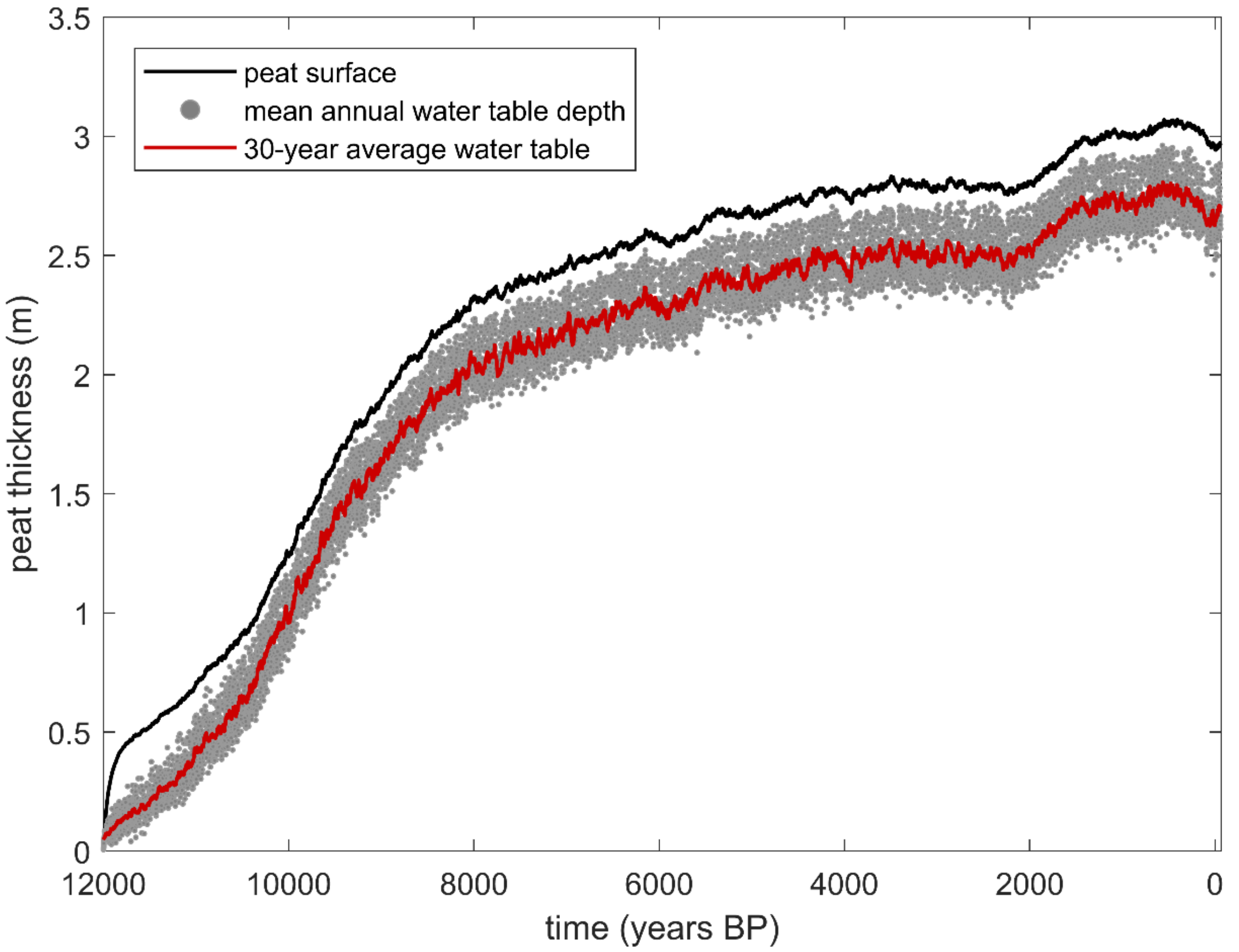




Standard model run

- Early-Holocene peatland development
  - Stabilisation after 8 ka BP

- Modelled development matches well with ^{14}C-dates and geomorphic reconstructions



Past human activities in lowland Europe impacting alluvial peatlands

- Upstream catchment land cover change (since Neolithic period)
- Changes in channel geometry and number of channels (since the Middle Ages)
- Peat cutting (since the Middle Ages)

- Here: simulations of these activities under stable climate conditions for 10,000 years.

Upstream land cover change

- Model simulations for a set of land cover scenarios, ranging from fully forested to fully deforested.

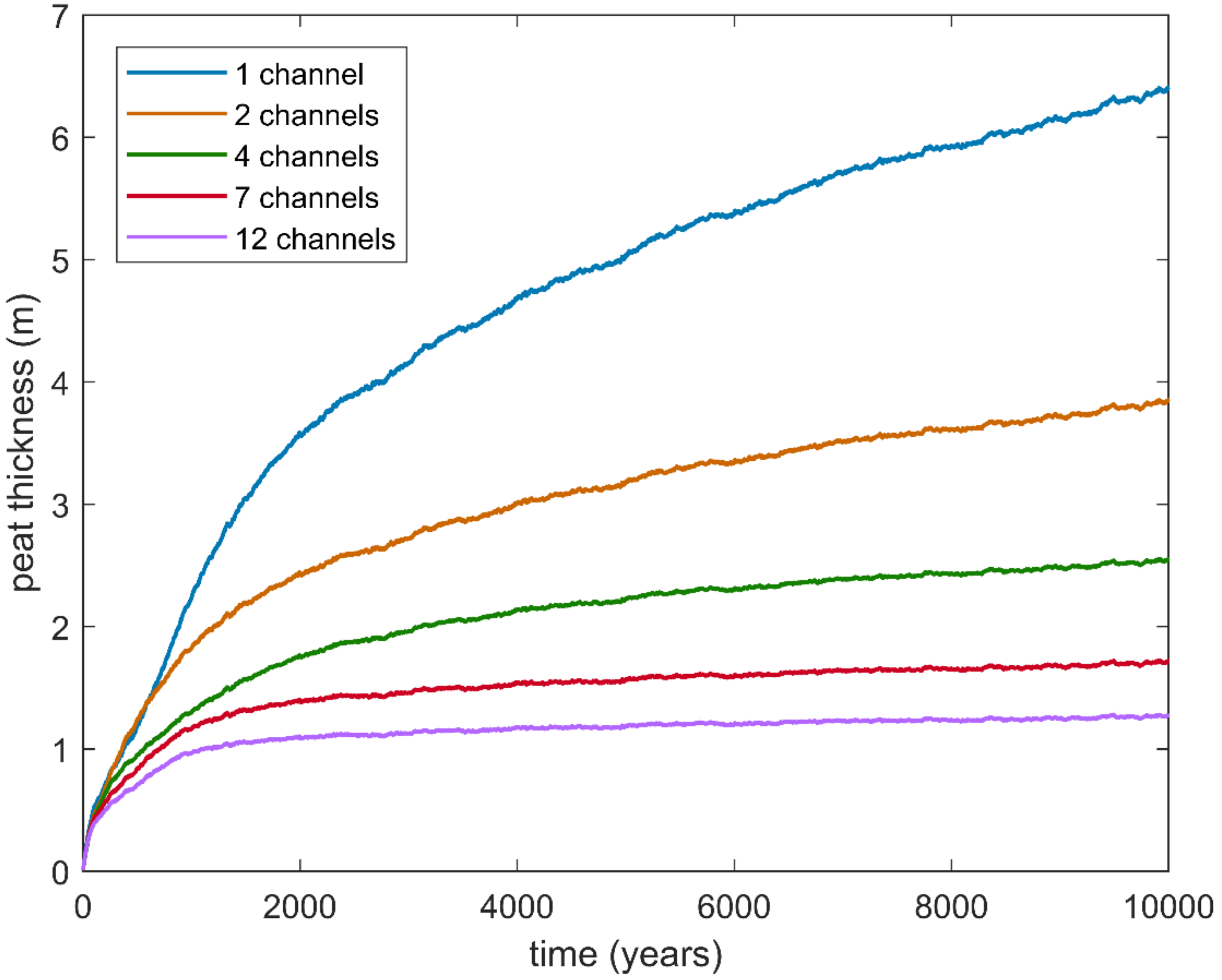
- Upstream land cover affects water level in floodplain streams mostly during peak flow events.

- These events are relatively rare and do not influence the simulated peat thickness.

The effect of the number of channels

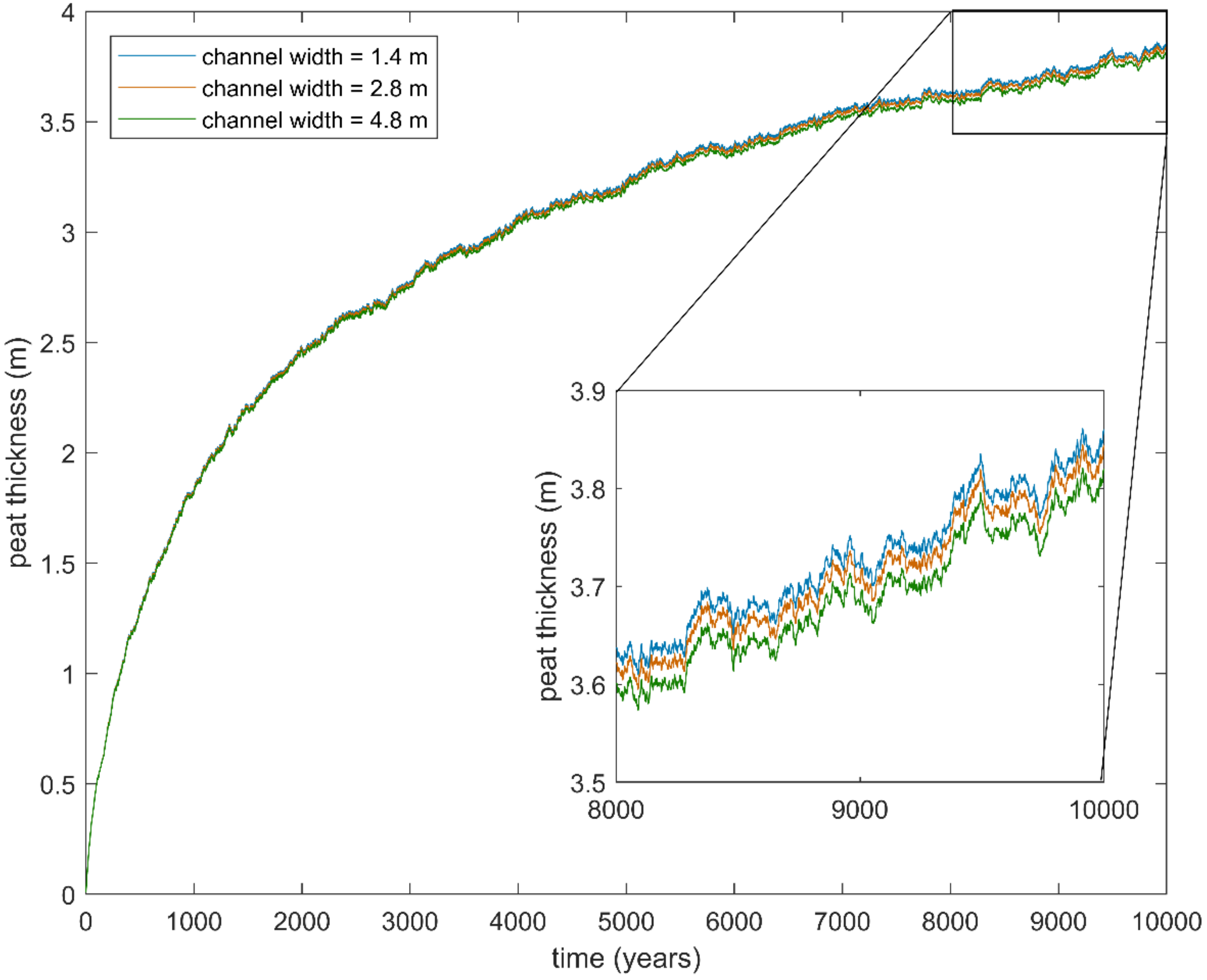
- The number of channels in a floodplain have a strong effect on the resulting peat thickness.

- More channels lead to a more effective drainage of the floodplain and thus a lower peat thickness.



Channel width

- Channel width has a limited effect on the peat thickness.
- Narrow channels lead to higher water levels for the same discharge, resulting in a slightly higher peat thickness

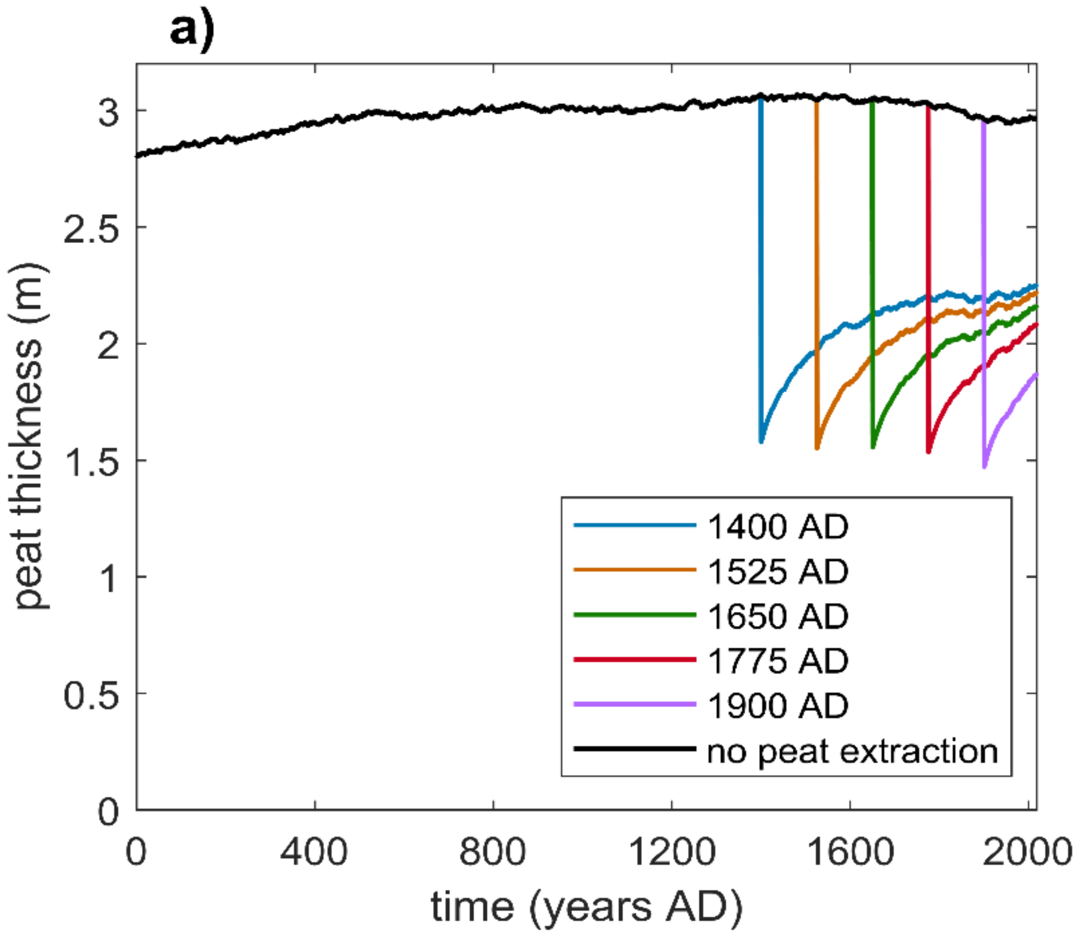


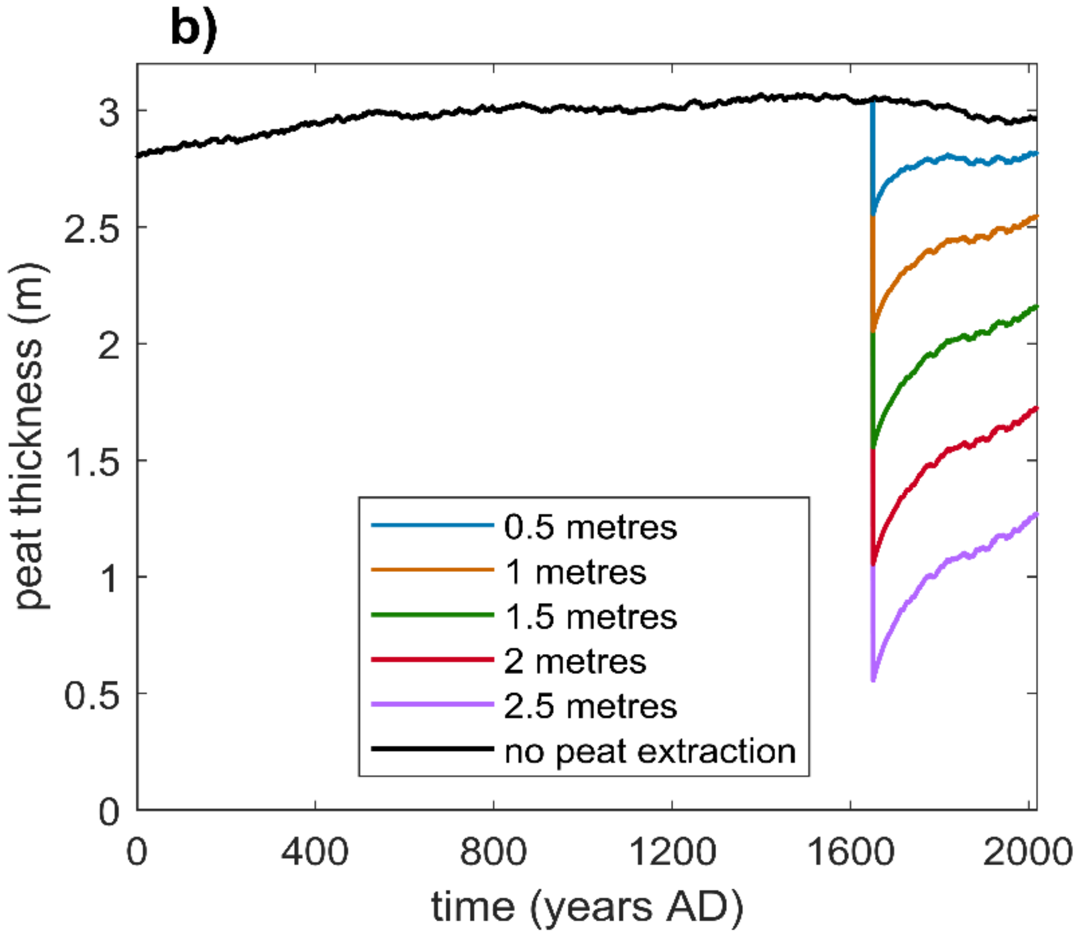
Peat cutting

- Widespread since the Late Middle Ages
- Simulations with different dates of peat cutting (1400 AD – 1900 AD) and cutting depth (0.5 m – 2.5 m)

Peat cutting

- Peatlands need long time periods to recover, even from thin cuttings (0.5 m).





Conclusion

- Developed modelling framework allows to simulate alluvial peatland development on Holocene timescales. The effect of different human activities can be tested.
- Peat cutting and changing the number of floodplain channels have strong and long-lasting effects on the peatland development.
- Upstream land cover does not influence peatland hydrology but can have other effects which are not considered here (sediment deposition, nutrient input, …).