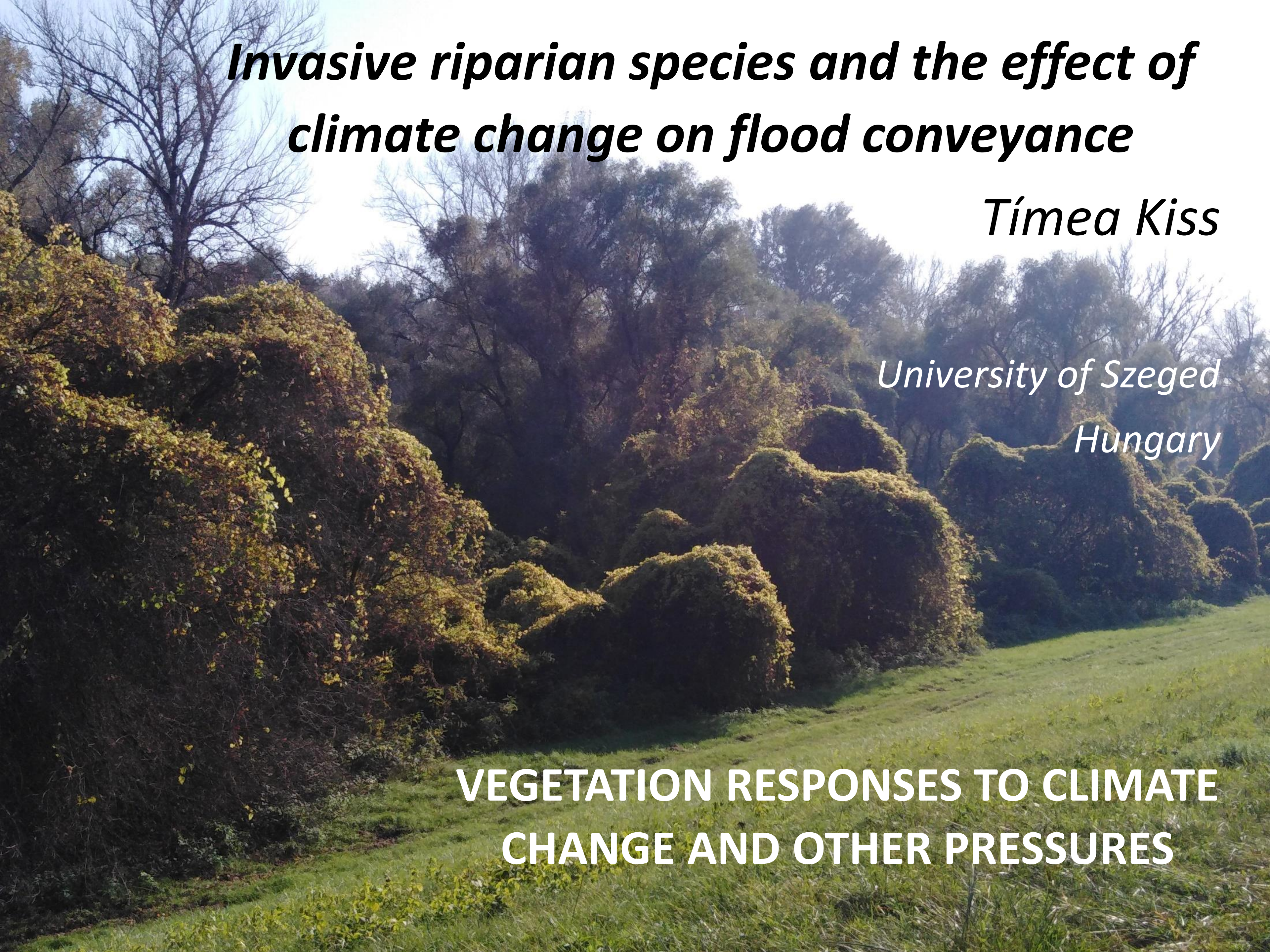


Invasive riparian species and the effect of climate change on flood conveyance

Tímea Kiss

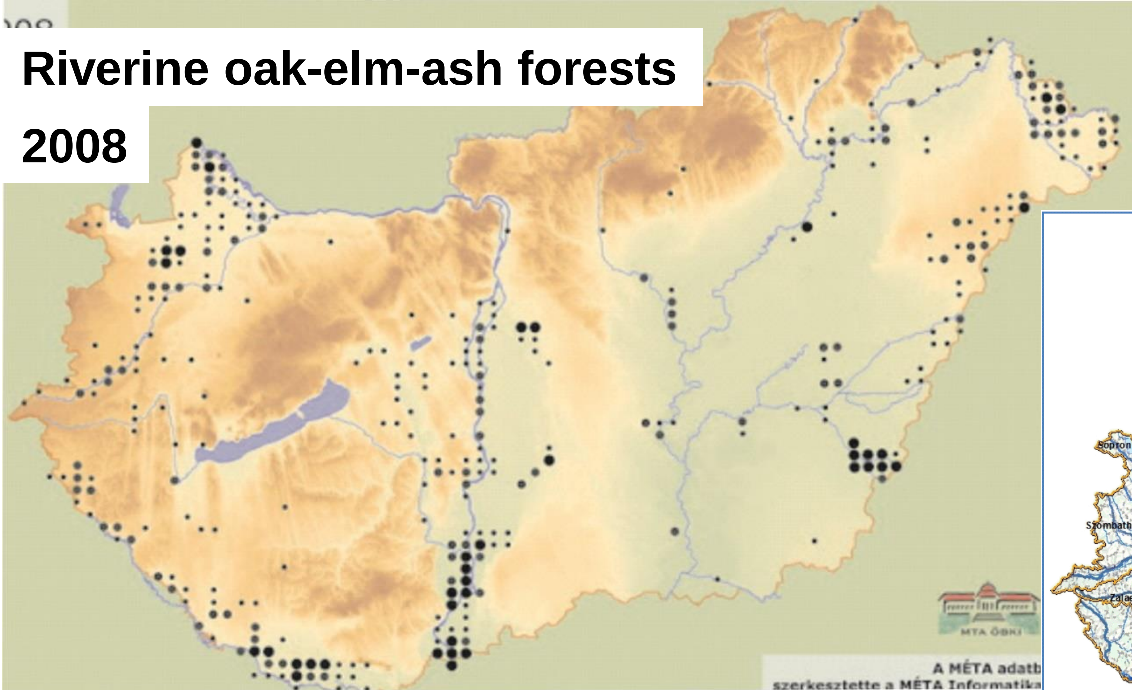
University of Szeged

Hungary

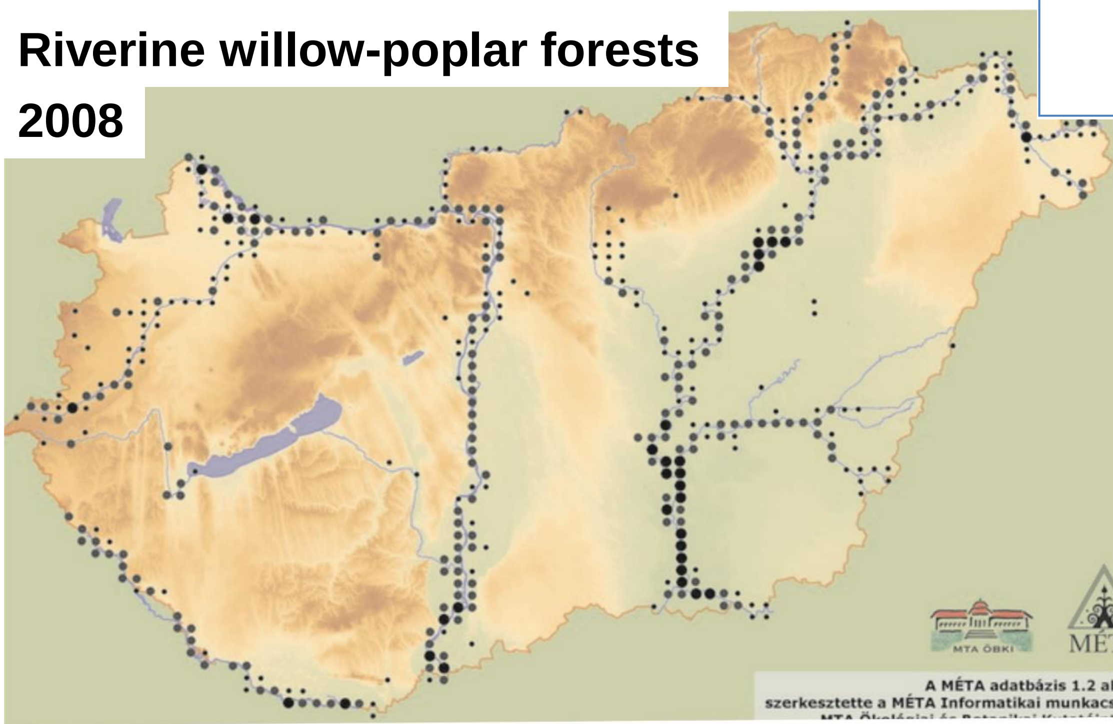
VEGETATION RESPONSES TO CLIMATE CHANGE AND OTHER PRESSURES

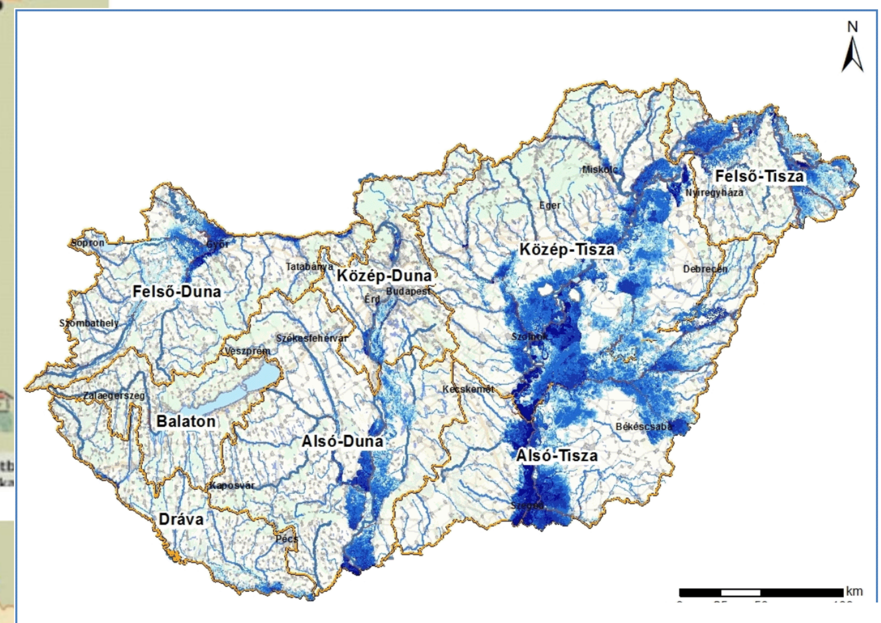
Riparian forests

Riverine oak-elm-ash forests
2008



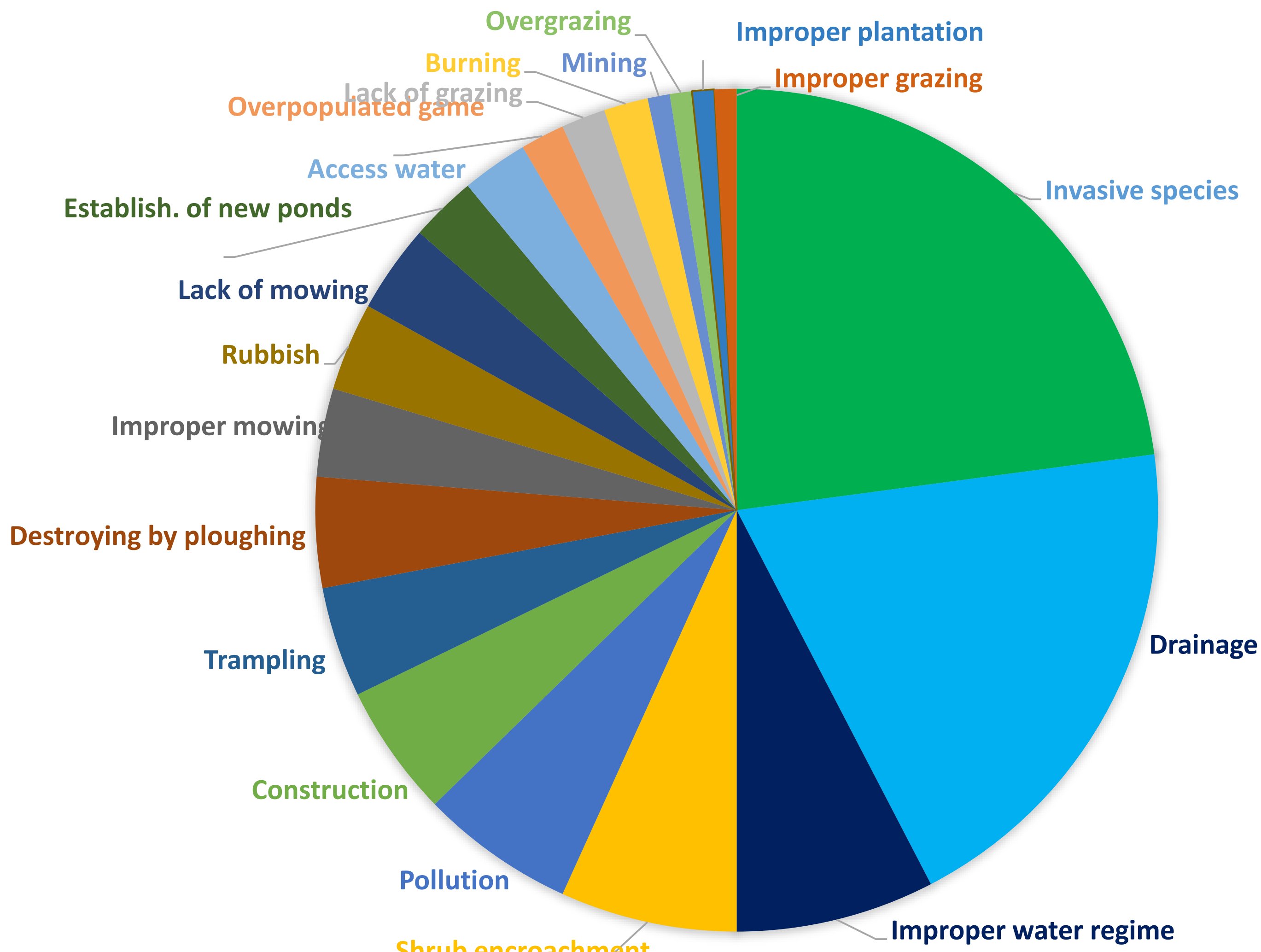
Riverine willow-poplar forests
2008





Pre-regulation riparian areas

Main pressures on wetland vegetation (in Hungary)

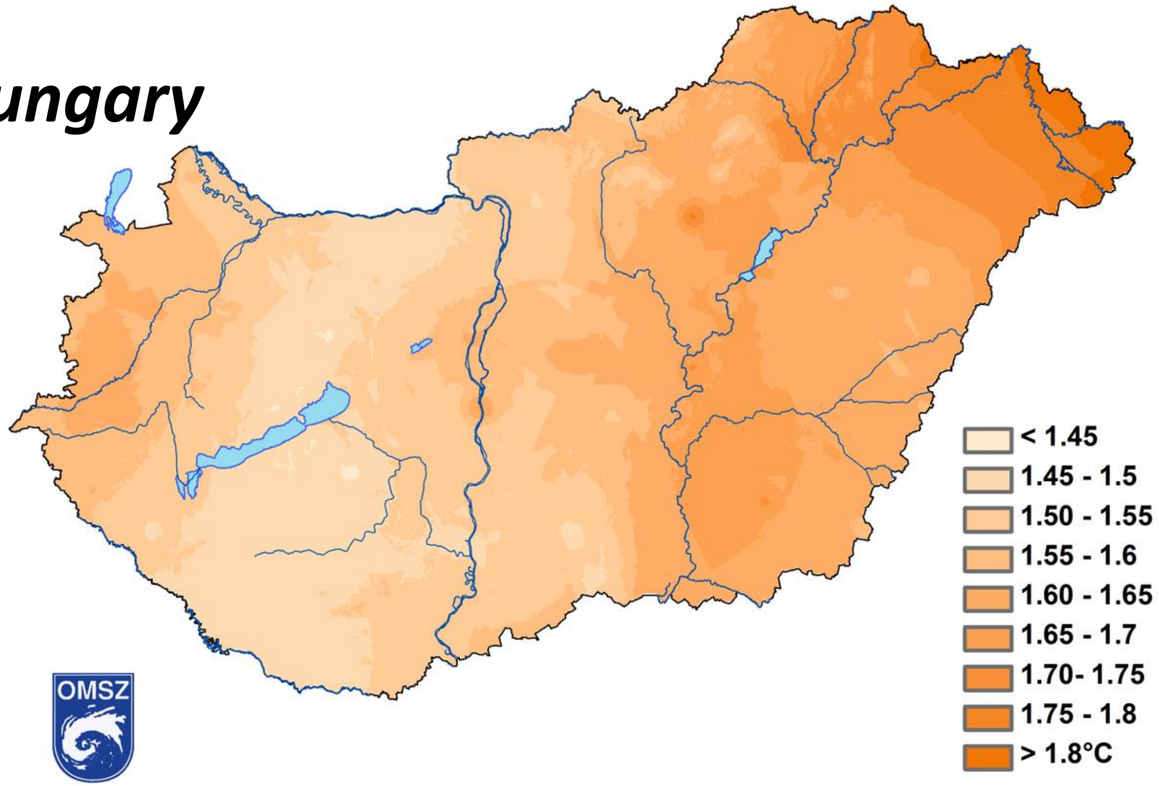


Climate change is not mentioned!

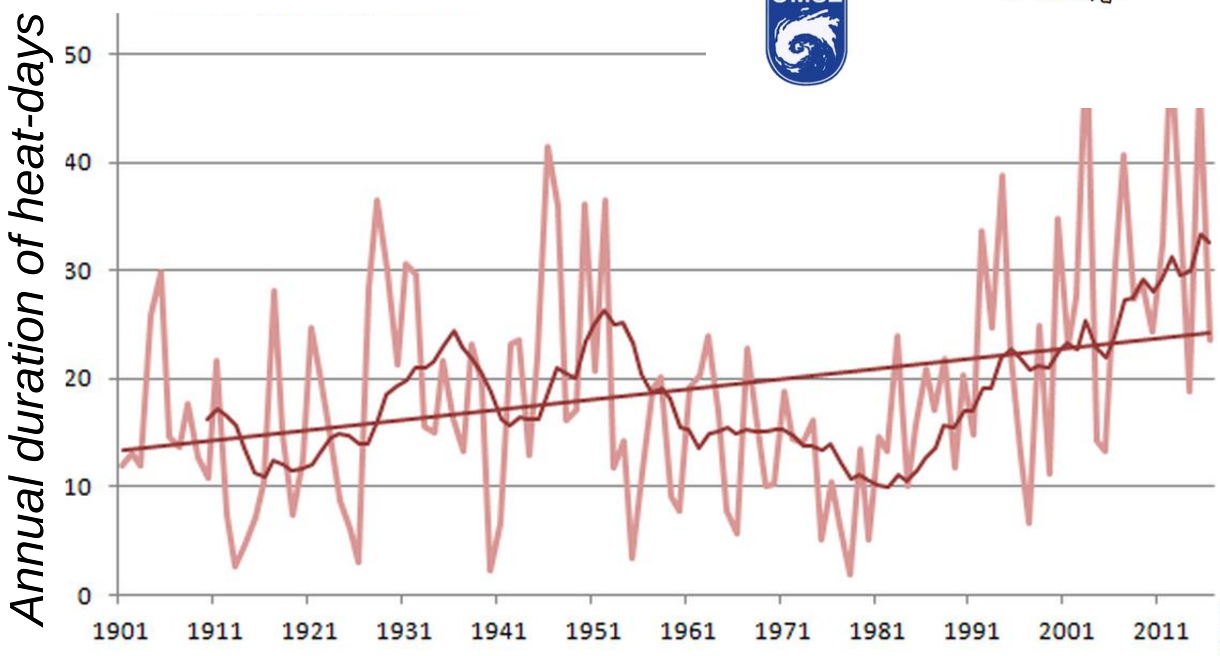
Molnár et al. (2008): Threatening factors encountered: Actual endangerment of the Hungarian (semi-) natural habitats. Acta Botanica Hungarica

Climate change in Hungary

Annual mean temperature change (1981–2016)



Annual duration of heat-days (1901-2016)

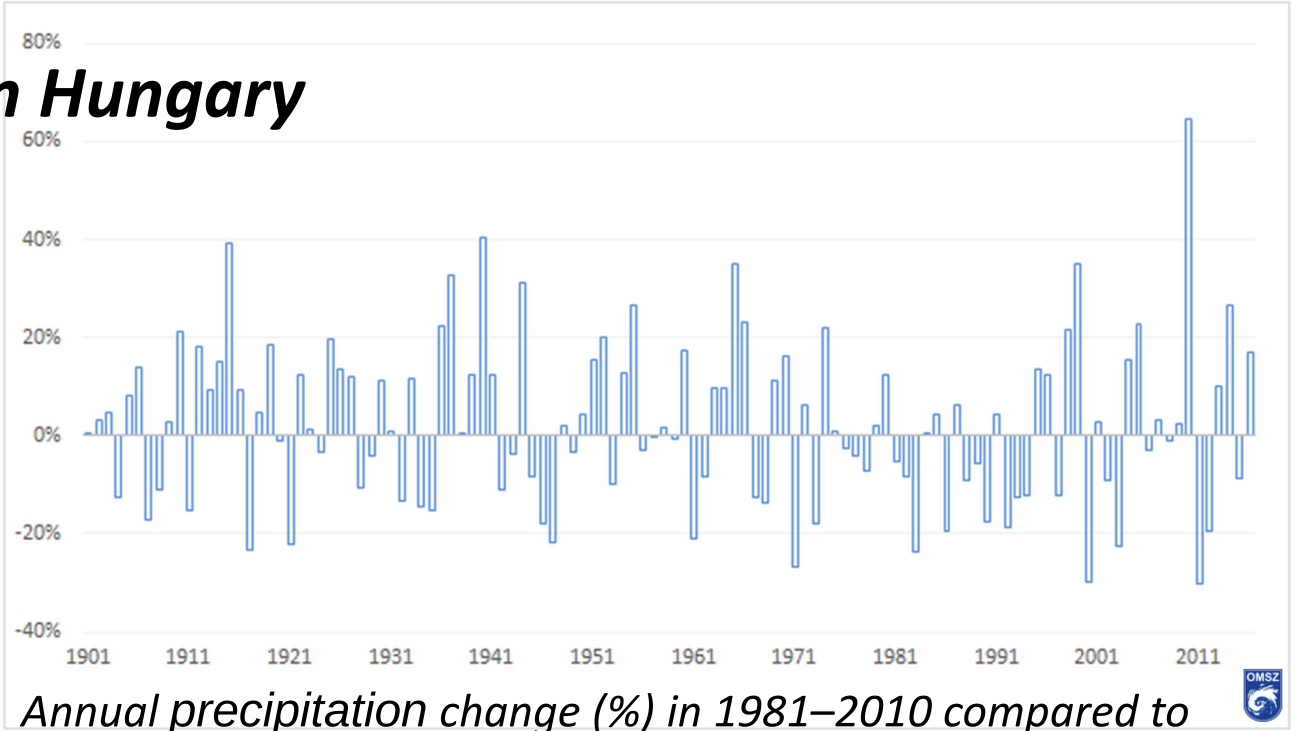


Until 2050 +2-3°C
(scenarios: A2, B2)

https://www.met.hu/eghajlat/eghajlatvaltozas/megfigyelt_valtozasok/Magyarorszag/
IPCC 2001, 2007

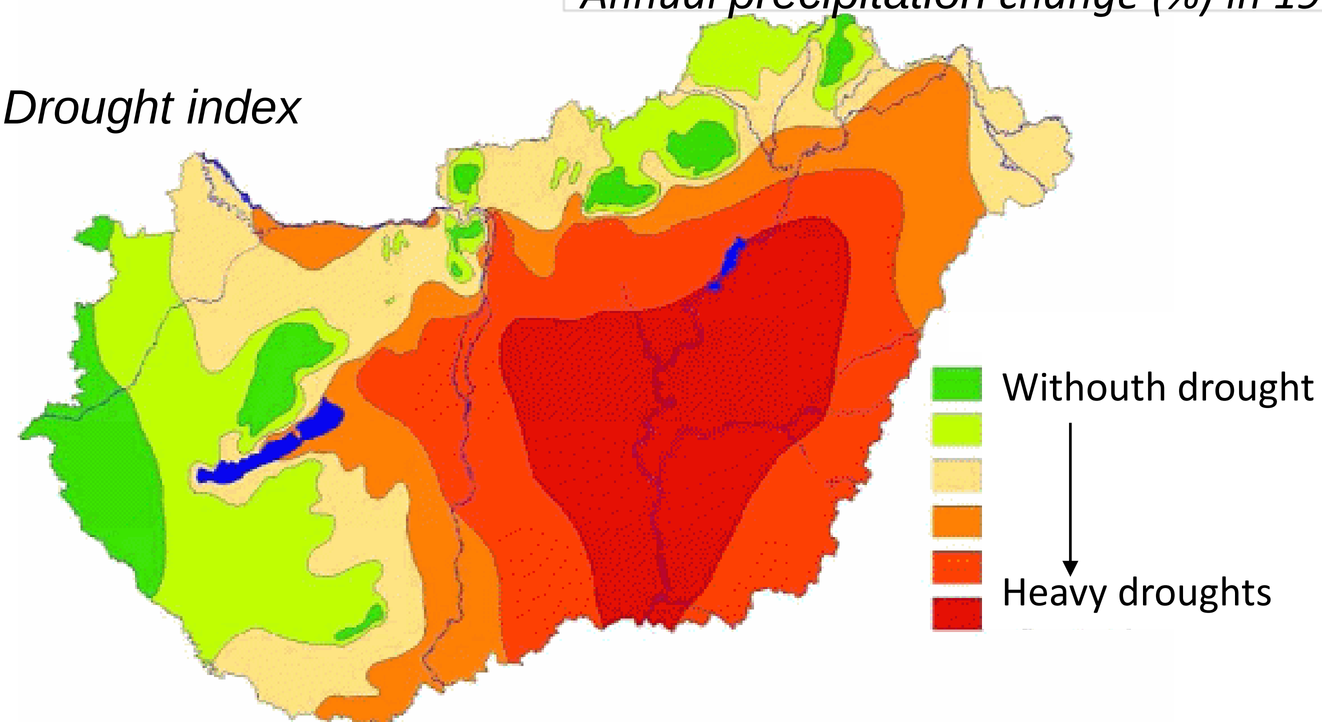
Climate change in Hungary

Until 2050 precipitation: -13-15% (drier summers, wetter winters).



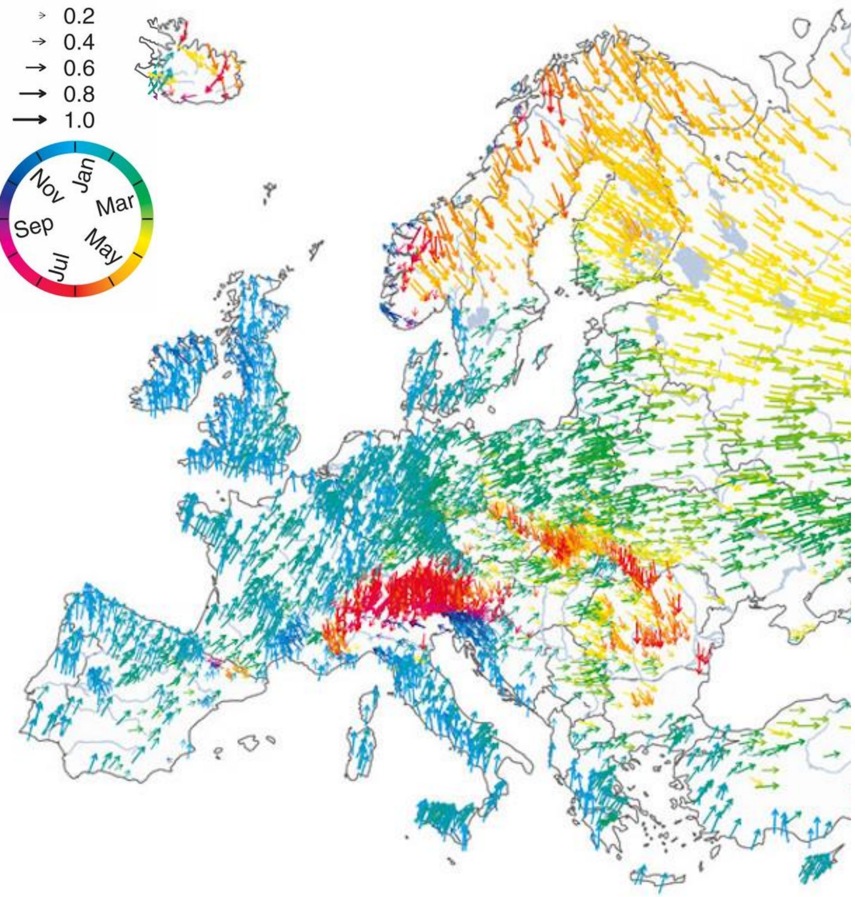
Annual precipitation change (%) in 1981–2010 compared to 1901–2016 period

Drought index

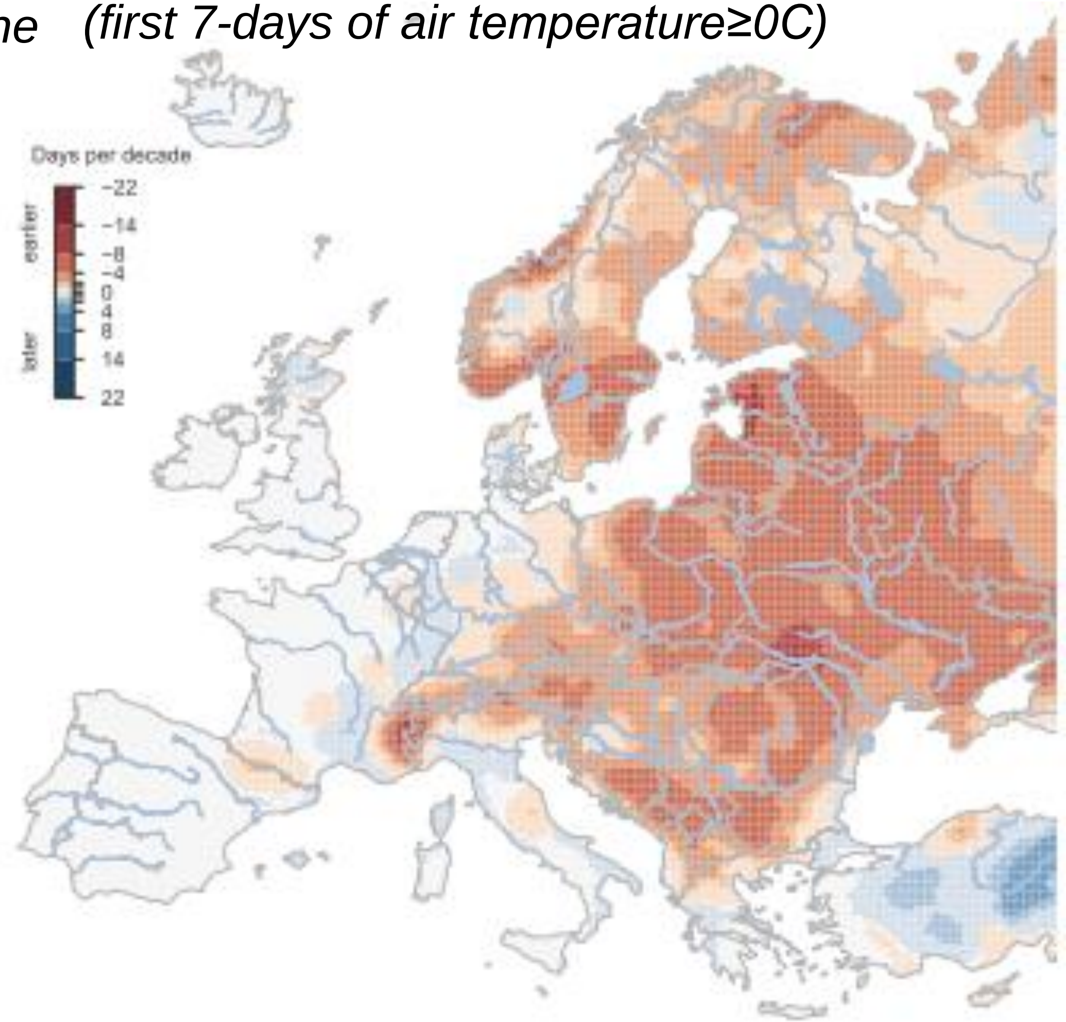


Climate change related hydrological changes

Average time of floodings over the year:
winter floods - summer floods
The arrows indicate the distribution of the floods

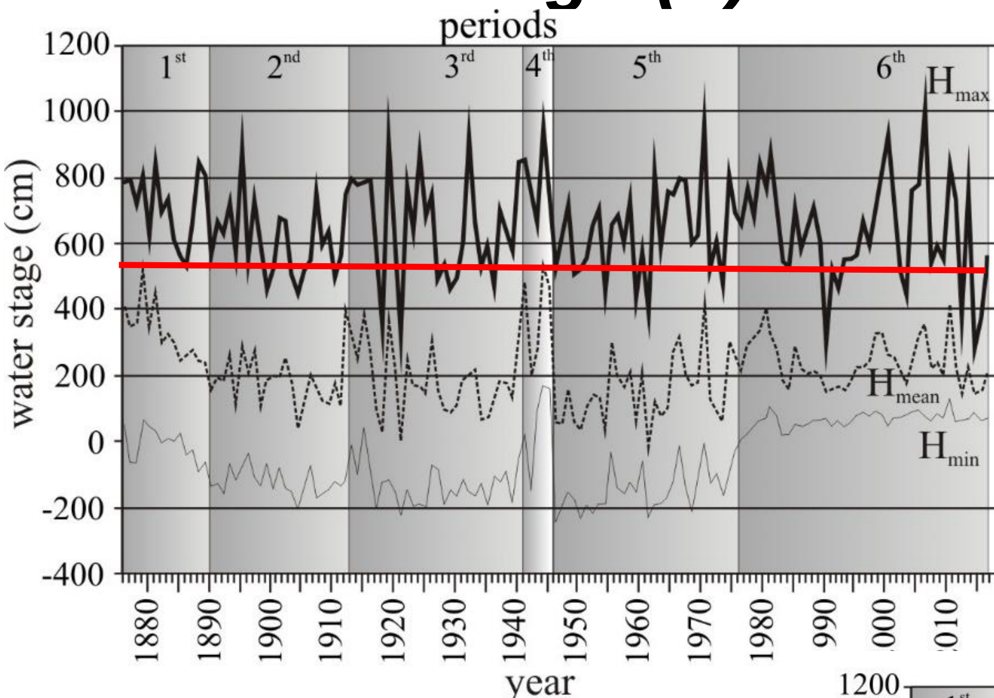


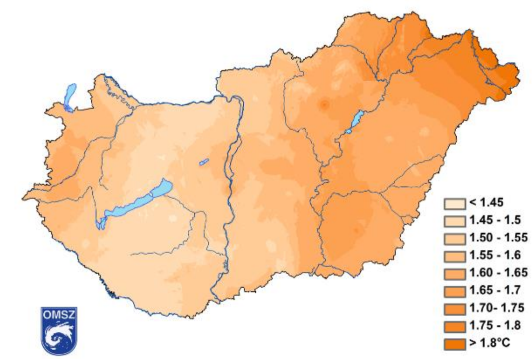
Snowmelt index
(first 7-days of air temperature≥0C)



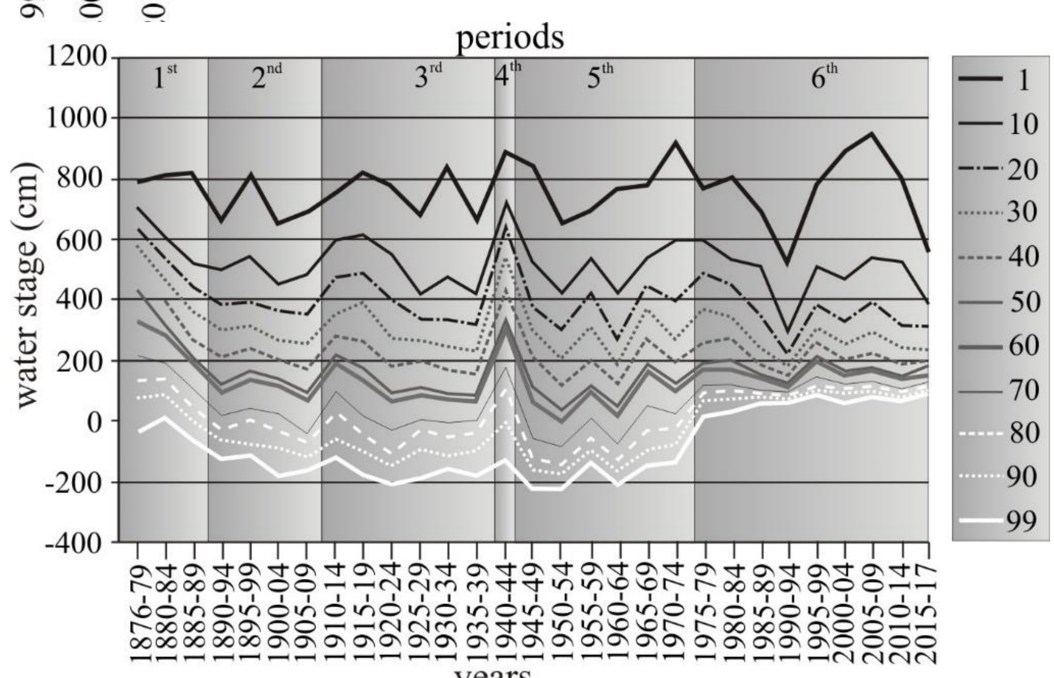
Blöschl et al. 2017: Changing climate shifts timing of European floods," *Science* 357

Climate change (?) related hydrological changes





Annual stages of the Tisza River at Szeged (1876 and 2017)



Stage probability curves at Szeged gauge station (1876-2017)

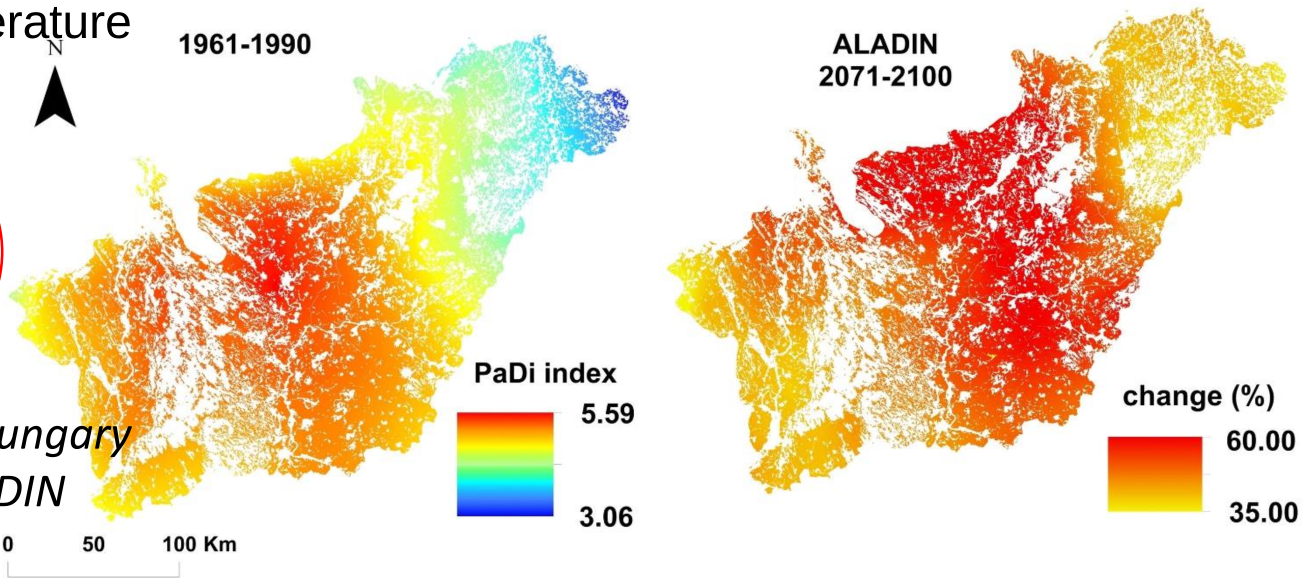
Climate change (?) related hydrological changes

Forecast:

Rivers:

Decreasing run-off
Summer: long-lasting low stages
Winter: earlier floods, increasing stages
Small streams: frequent flash-floods

Lakes: negative water household (summer: drying up)
Ground-water: dropping level
Droughts: larger areas, greater frequency
Increasing water temperature



Drought vulnerability of SE Hungary and its change based on ALADIN regional climate model

Nováky B. (2005): Az éghajlatváltozás hatása a felszíni és felszín alatti vizekre (VAHAVA alapozó tanulmány, kézirat). Gödöllő. 36 p.

Climate change related changes in invasive species

New species, new invasions:

1930s 4% of the flora was invasive, now 12% (Borhidi 2009)

Redistribution of species:

Disappearance: *Fallopia japonica* (Beerling et al. 1995)

Increasing territory: *Solidago gigantea* (increasing summer temperature)

Extreme hydrology:

accelerating spread (*Amorpha fruticosa, Solidago gigantea, Impatiens glandulifera*)

Warmer winters and hot summers: creepers (*Echinocystis lobata*)

(Borhidi 2009; Kovács-Láng et al. 2008; Czúcz et al. 2007)

Spreading of Amorpha fruticosa on floodplains

History in floodplains:

Introduced in 18th c: to support bank stabilisation

1970s- in forest plantations

1990s- on abandoned plough-fields and orchards

2000s- supported by large and frequent floods

Habitat conditions:

High temperature needs + frost-sensitive (←climate change)

Heliophil: in artificial plantations, fallow lands

Flood tolerant

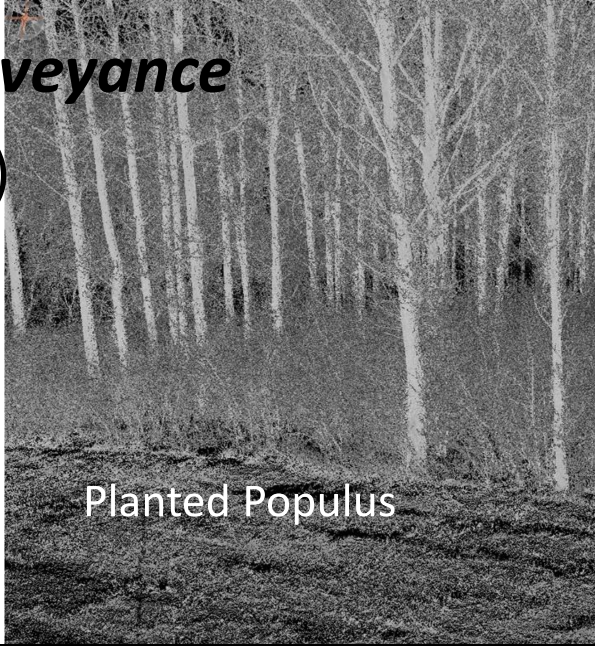
The effect of Amorpha fruticosa on flood conveyance

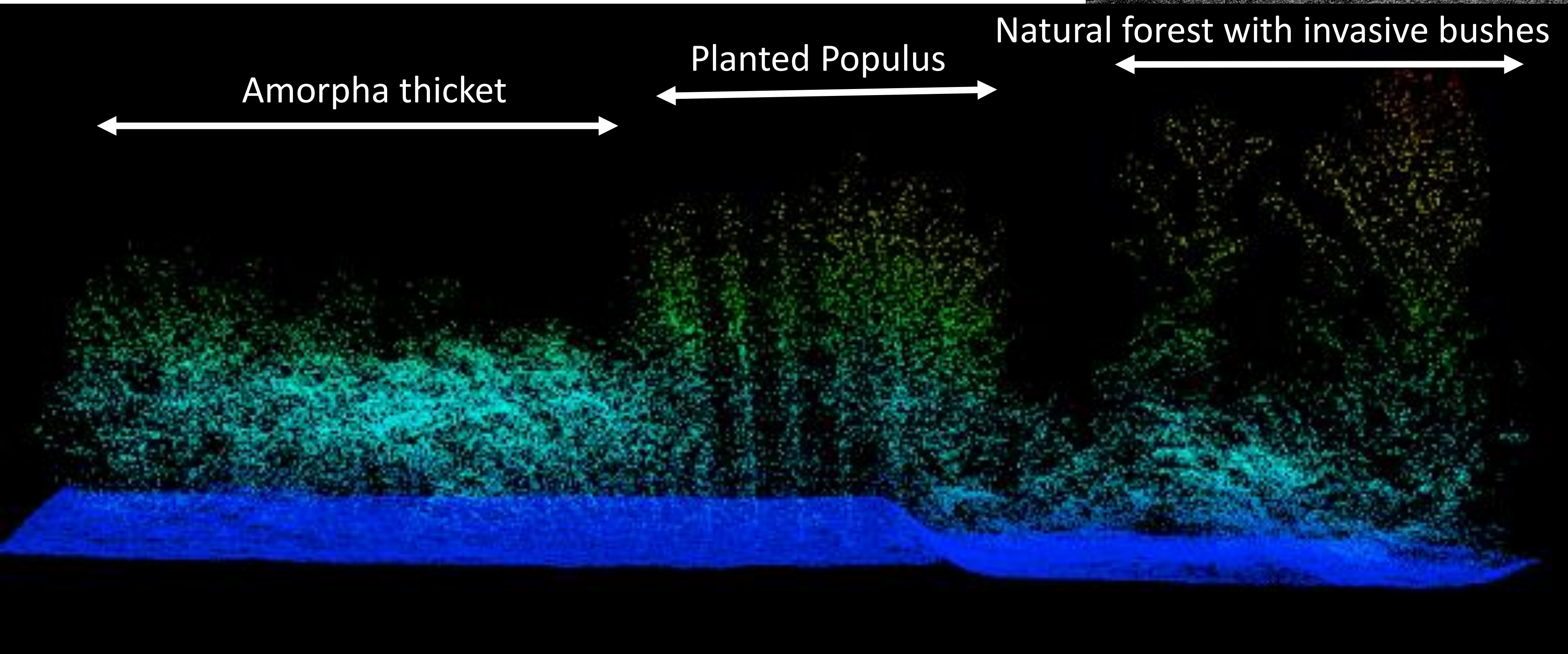
1. Vegetation density increase (Based on 60 plots)

Natural forests: + 3%

Forest (*Populus*) plantations: +23%

Former meadows, pastures and plough fields: +76% (-100%)

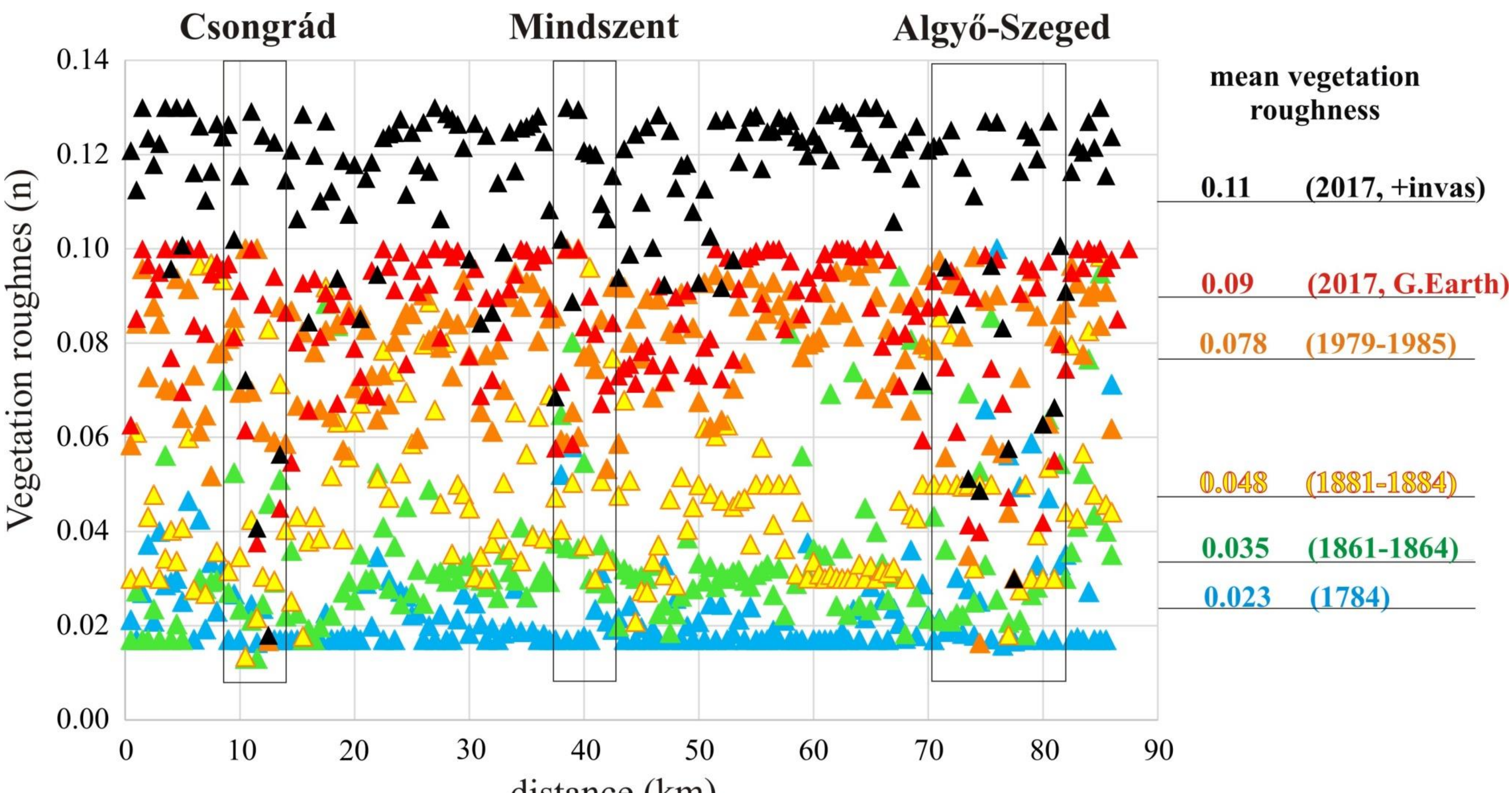




The effect of Amorpha fruticosa on flood conveyance
2. Vegetation roughness calculation

Based on:

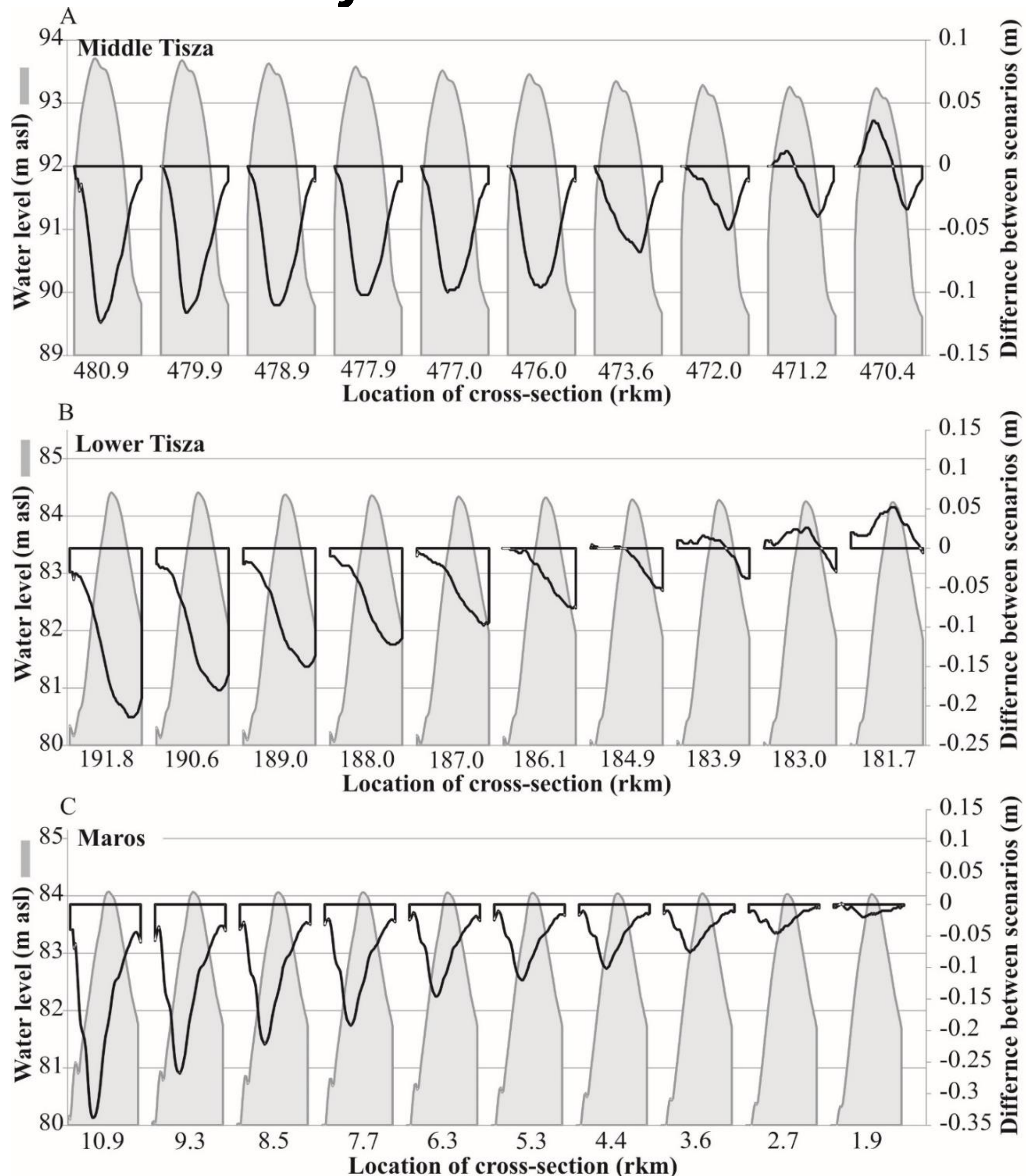
1. Land-use categories combined with vegetation roughness values (Chow 1959)
2. Vegetation density calculations (2017 photographs)



3. Modelled flood

Hec-RAS modelling:
Scenario 1: actual floodplain roughness

Scenario 2: Managed floodplain (*Amorpha* clearance along 10 km-long floodplain)



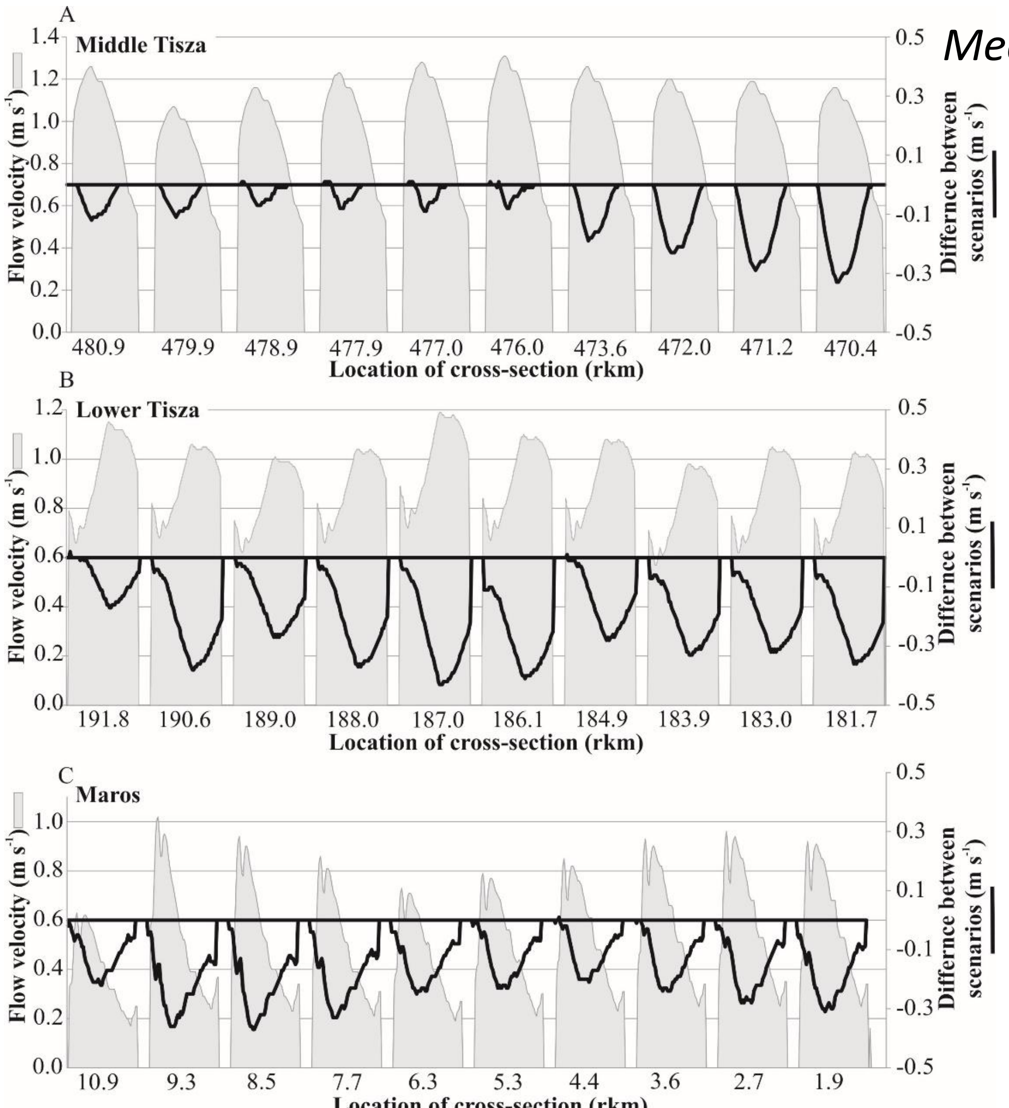
3. Modelled flood

Hec-RAS modelling:

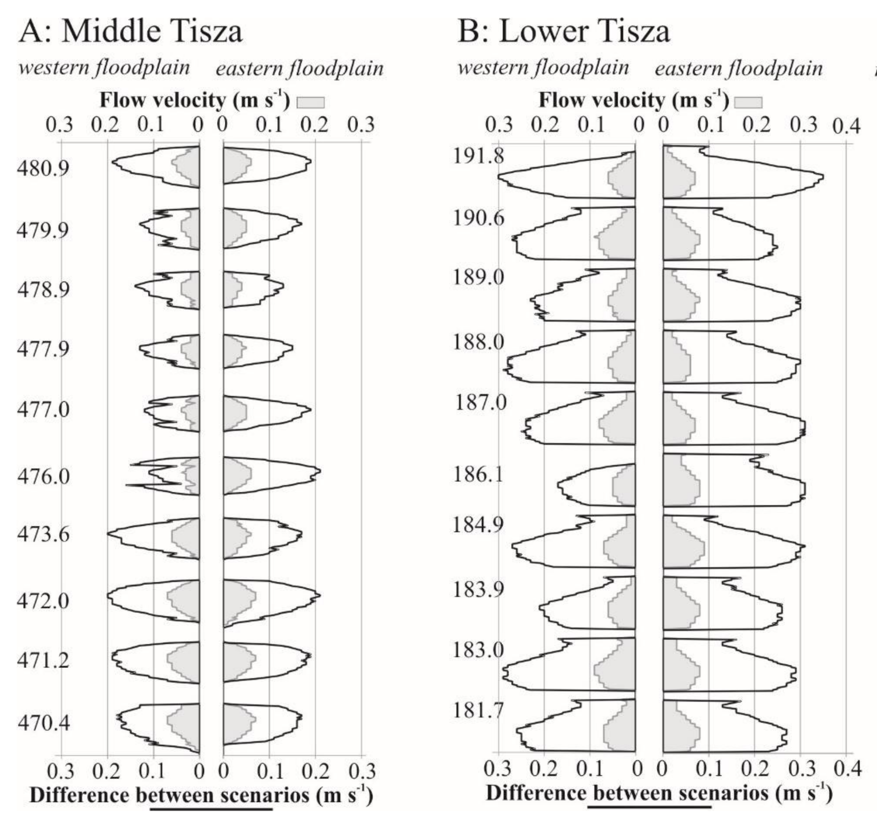
Scenario 1: actual floodplain roughness

Scenario 2: Managed floodplain (*Amorpha* clearance)

Mean in-channel flood velocity



Mean overbank flood velocity



Conclusions

Riparian forest are disturbed by
climate change driven hydrological
changes + invasive species

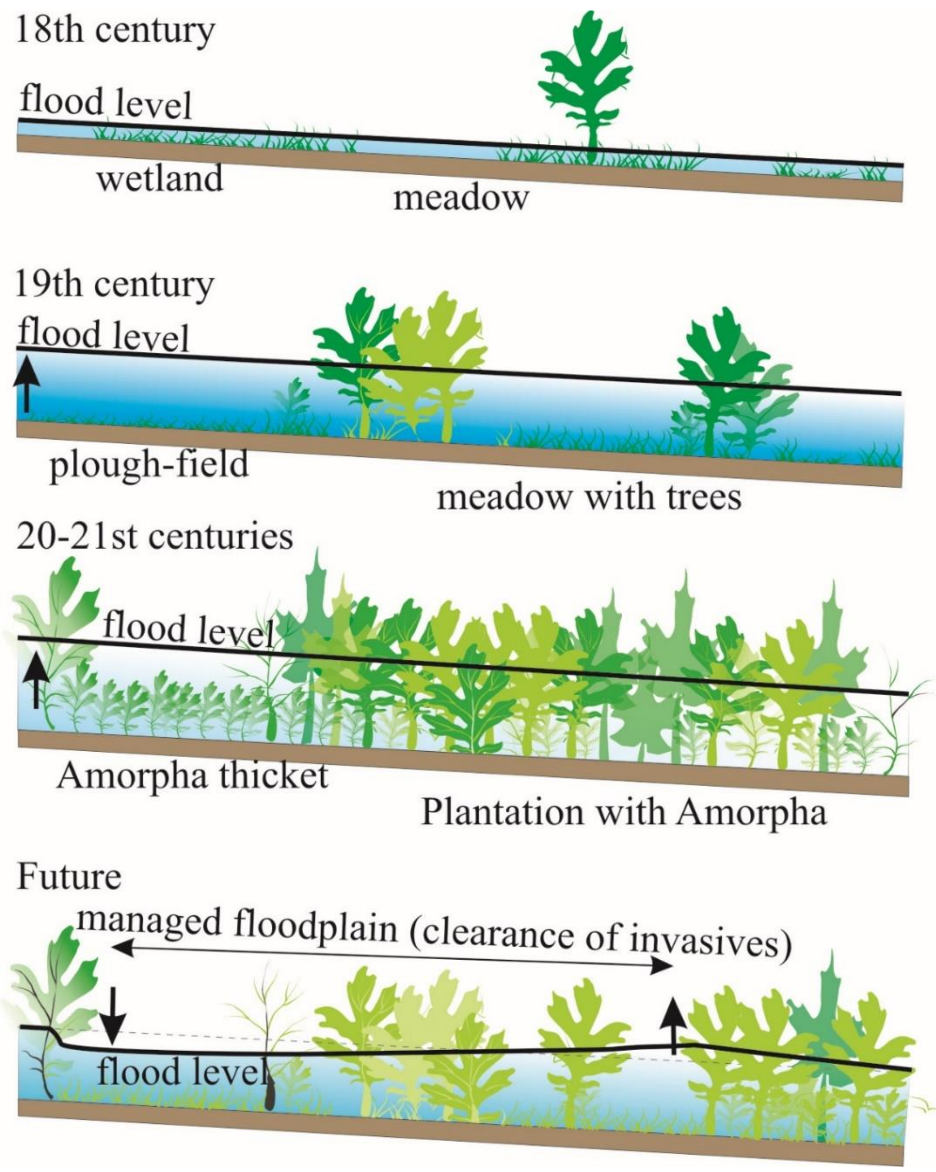
The ***land-use in floodplains has fundamentally changed***

→ vegetation roughness (0.023 →0.09)
→ invasive *Amorpha* (→ 0.11)
especially in Poplar plantations and
abandoned lands (density: +23-100%).

In case of ***invasive species control***

flood level: - 10-35 cm
channel flow velocity: - 30%
overbank flow velocity: + 100-200%

→ ***fluvial processes***



Thank you!