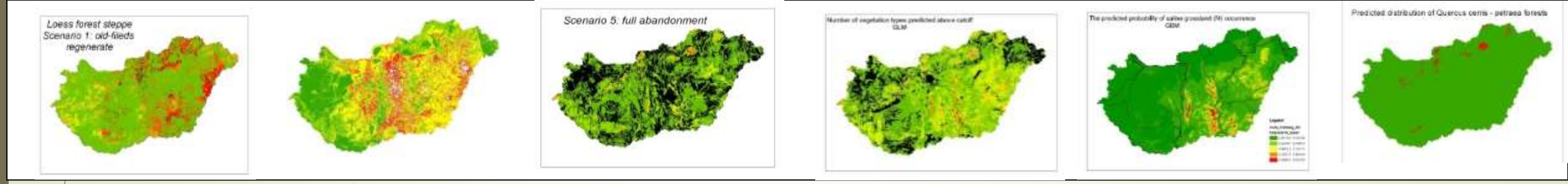

Expected future potential natural vegetation of Hungary under climate change scenarios

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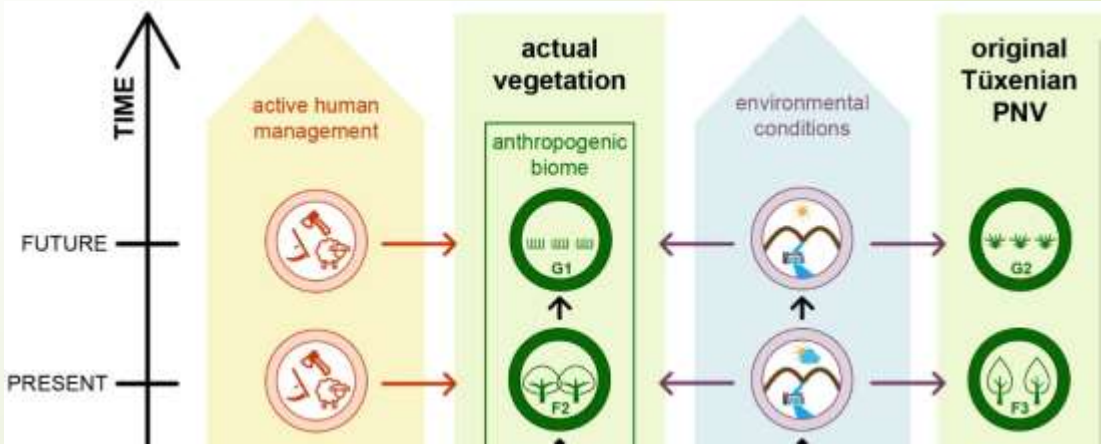
CENTRE FOR ECOLOGICAL RESEARCH

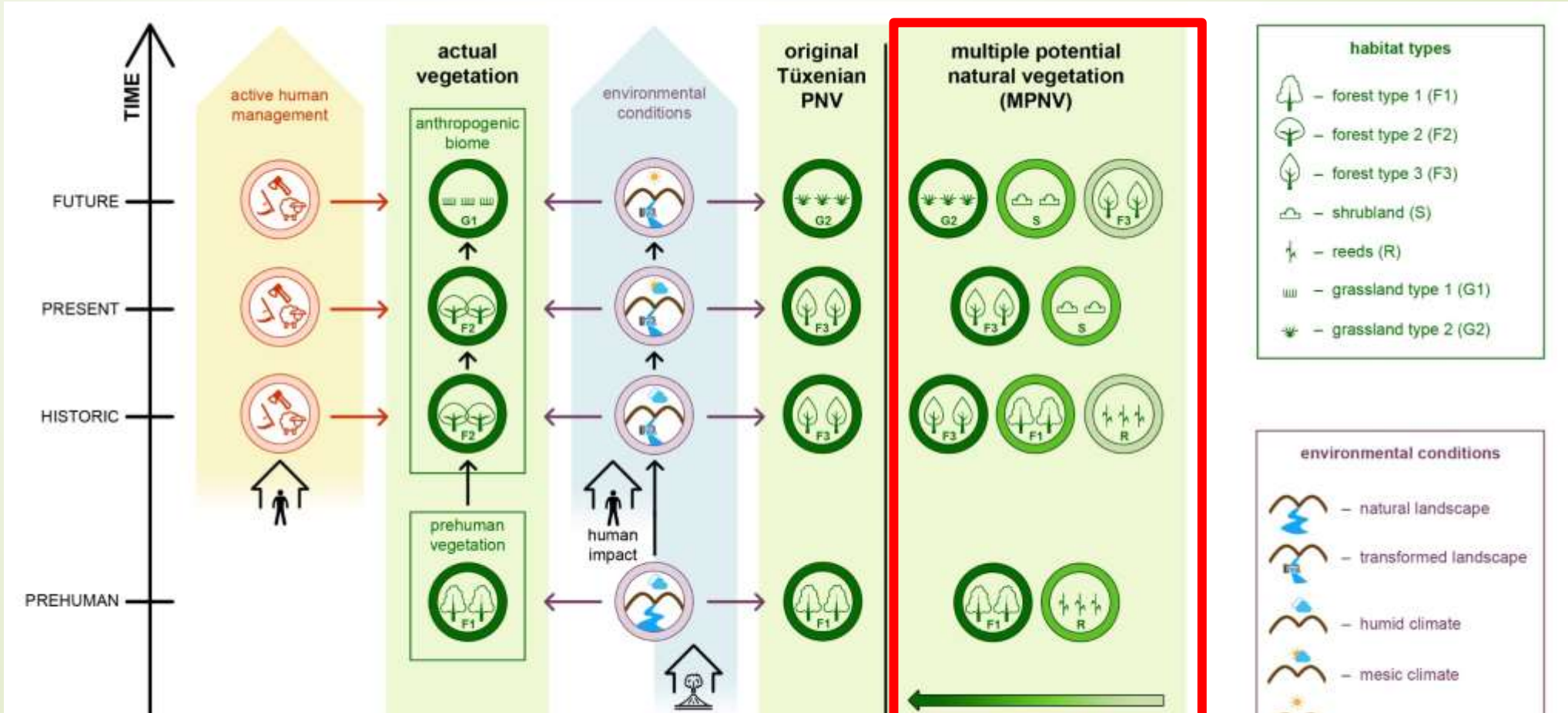
Potential Natural Vegetation

- The potential natural vegetation (PNV, as defined by Tüxen) embodies the vegetation that is
  - capable to survive (not necessarily develop)
  - under the current environmental conditions (not prehuman)
  - without continuous human management (mowing, grazing livestock)
- I.e. PNV characterises the site potential
- If estimated through models site characteristics can be updated for scenarios
  - Assessment of expected impact
  - Longterm sustainability estimate
  - Vulnerability assessment



MPNV

- PNV: one vegetation type fits one location
- Extension: Multiple PNV (MPNV): probability distribution of potentially surviving vegetation types

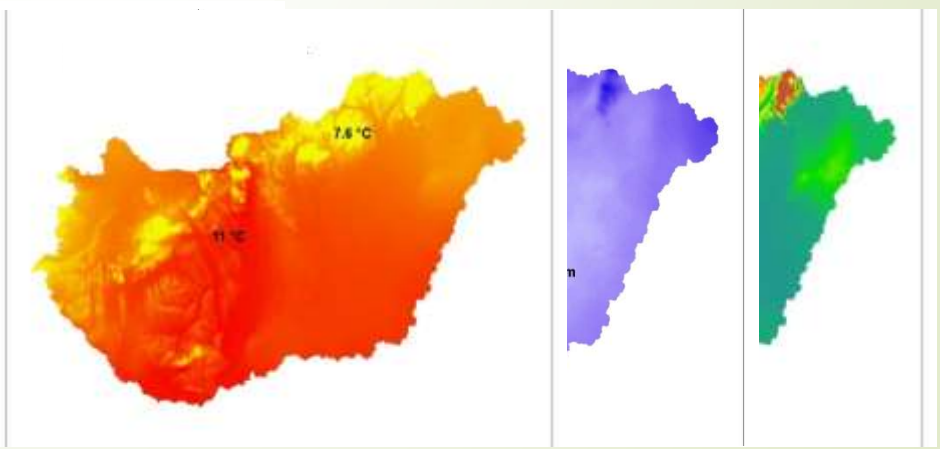


Methods: our MPNV models for Hungary

Habitat distribution models

- formalisation of abiotic requirements of natural habitats
- Vegetation data = f (x_1*climate + x_2*hydrology + x_3*soil …)
- Gradient Boosting Models in R

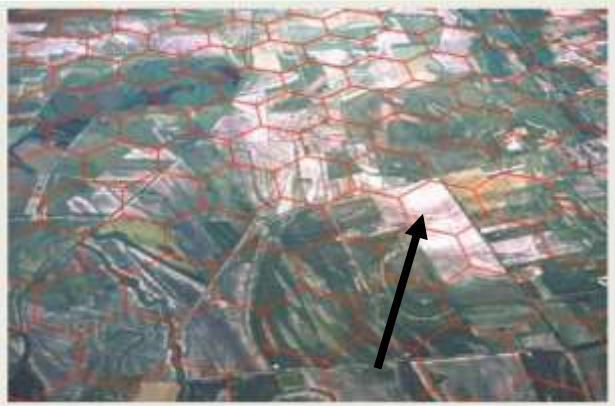
= f (



)

Vegetation data

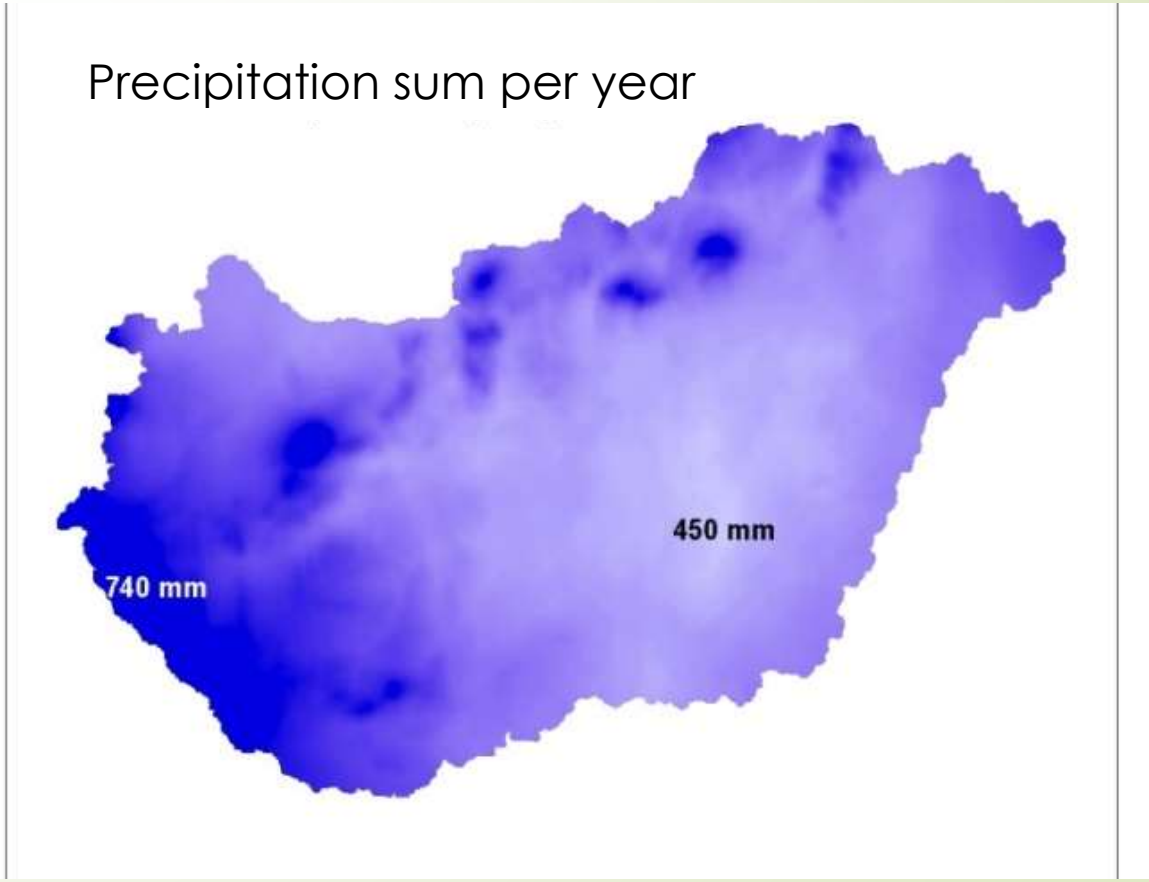
- Landscape Ecological Vegetation Database & Map of Hungary (MÉTA)
- 267813 hexagons covering the full country
- Each hexagon with natural vegetation was visited by experts
- Observed presence/absence of mature vegetation types -> 40 habitat models



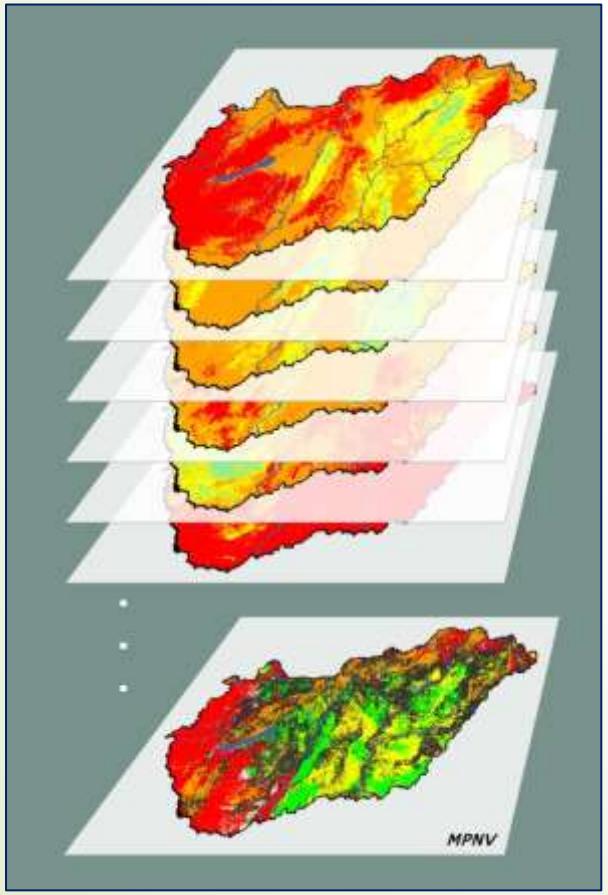
35 ha hexagons

Explanatory variables

- Climate – bioclimatic variables derived from
  - precipitation
  - temperature
- Soil characteristics
  - sand vs. clay fractions,
  - pH
  - rooting depth
  - organic matter content
- Hydrology
  - distance to water bodies
  - ground water levels
- Topographic position index



The MPNV estimate



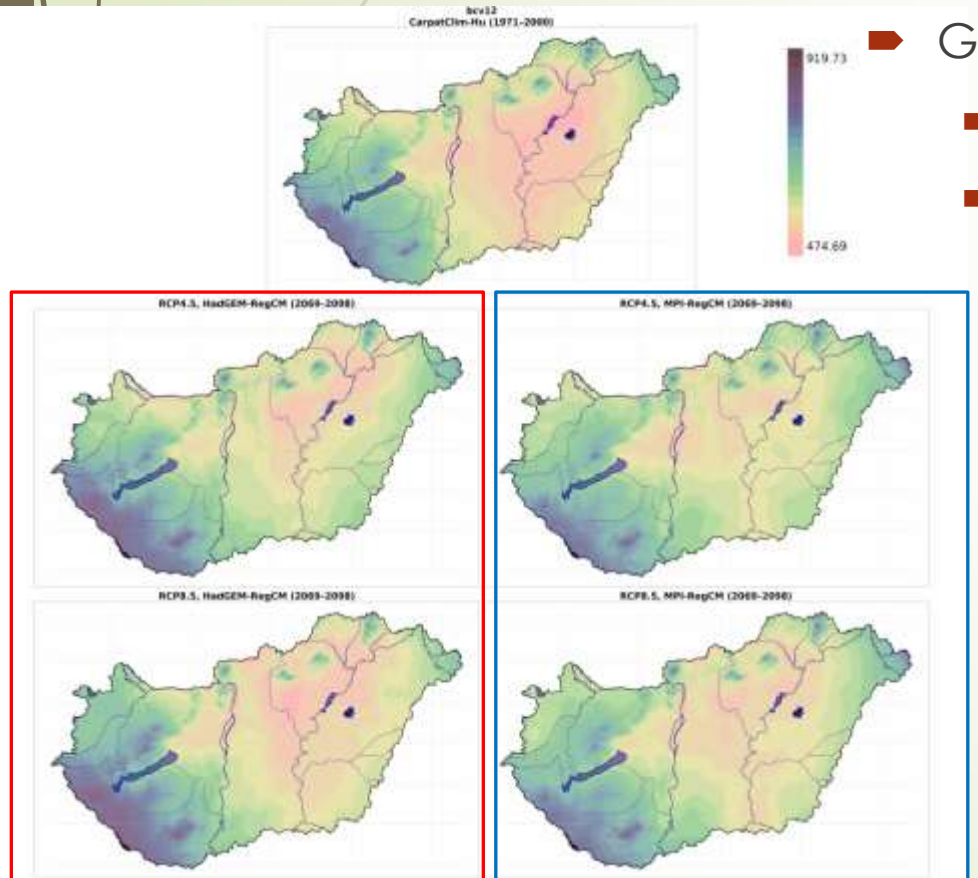
- Probabilistic maps per vegetation type (habitat)
- https://www.novenyzetiterkep.hu/english/node/potveg_en - jpg
- Accessible as a database upon request – free for research

Imelda Somodi, Zsolt Molnár, Bálint Czúcz, Ákos Bede-Fazekas, János Bölöni, László Pásztor, Annamária Laborczi, Niklaus E. Zimmermann (2017): Implementation and application of Multiple Potential Natural Vegetation models – a case study of Hungary. Journal of Vegetation Science.

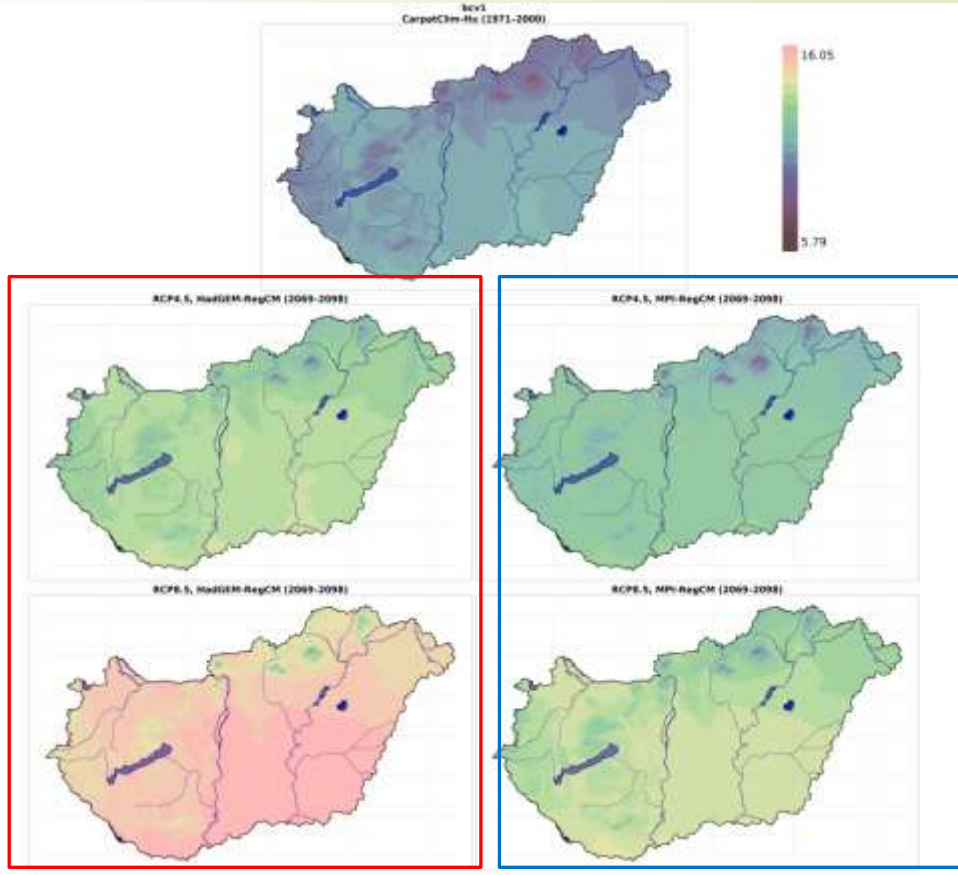
Climate change scenarios

- CMIP5
- 2069-2098
- Regional Climate Model: RegCM 4.3 – optimised for Hungary (a courtesy of ELTE)
- Global Climate Models:
  - HadGEM
  - MPI

Annual precipitation



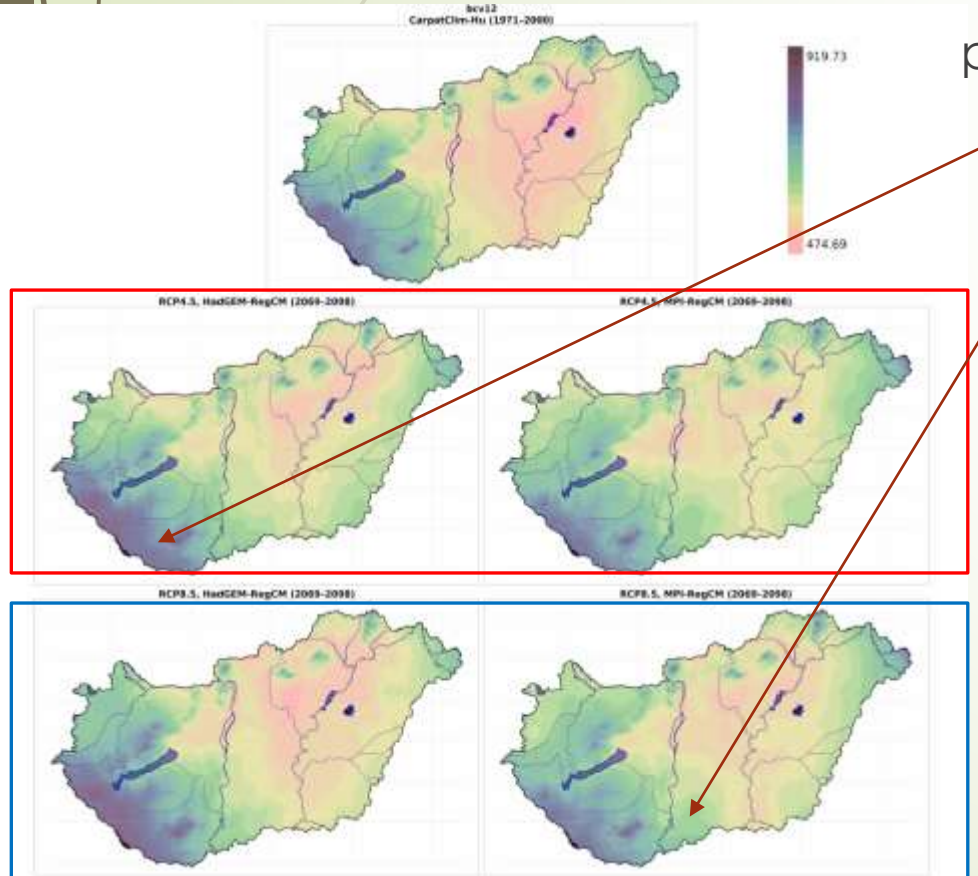
Annual mean temperature



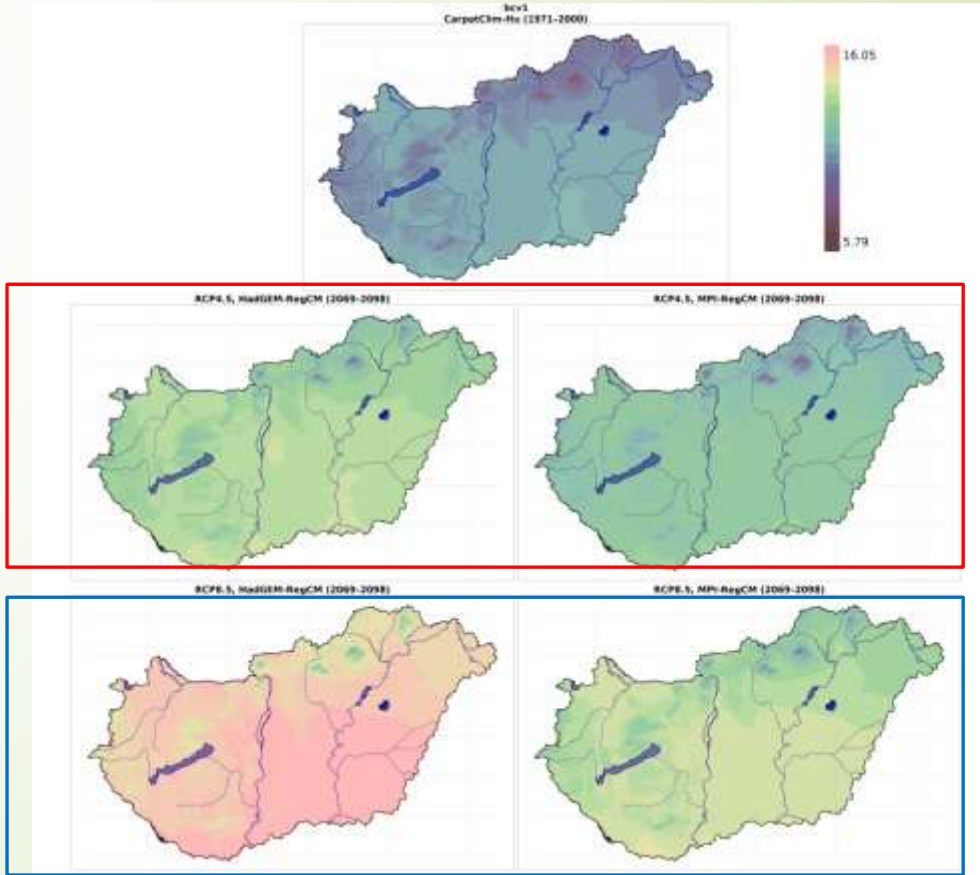
Climate change scenarios

- Representative Concentration Pathways
  - RCP4.5
  - RCP8.5
- Note the projected increase in precipitation

Annual precipitation



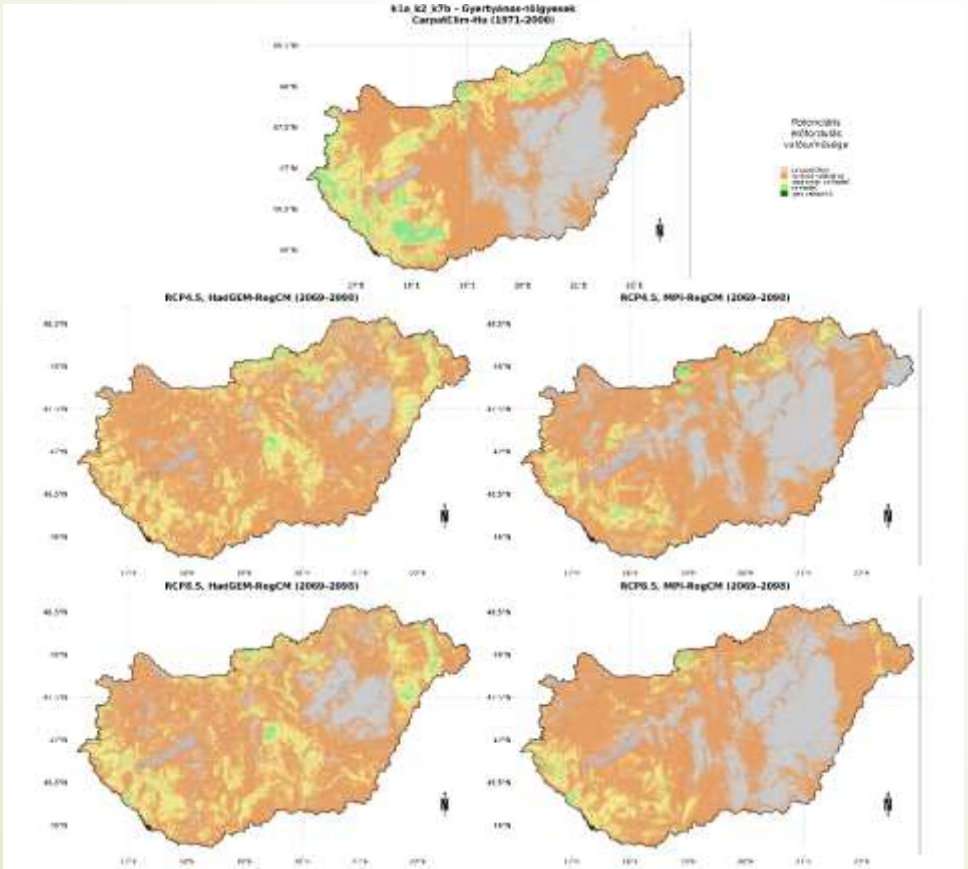
Annual mean temperature



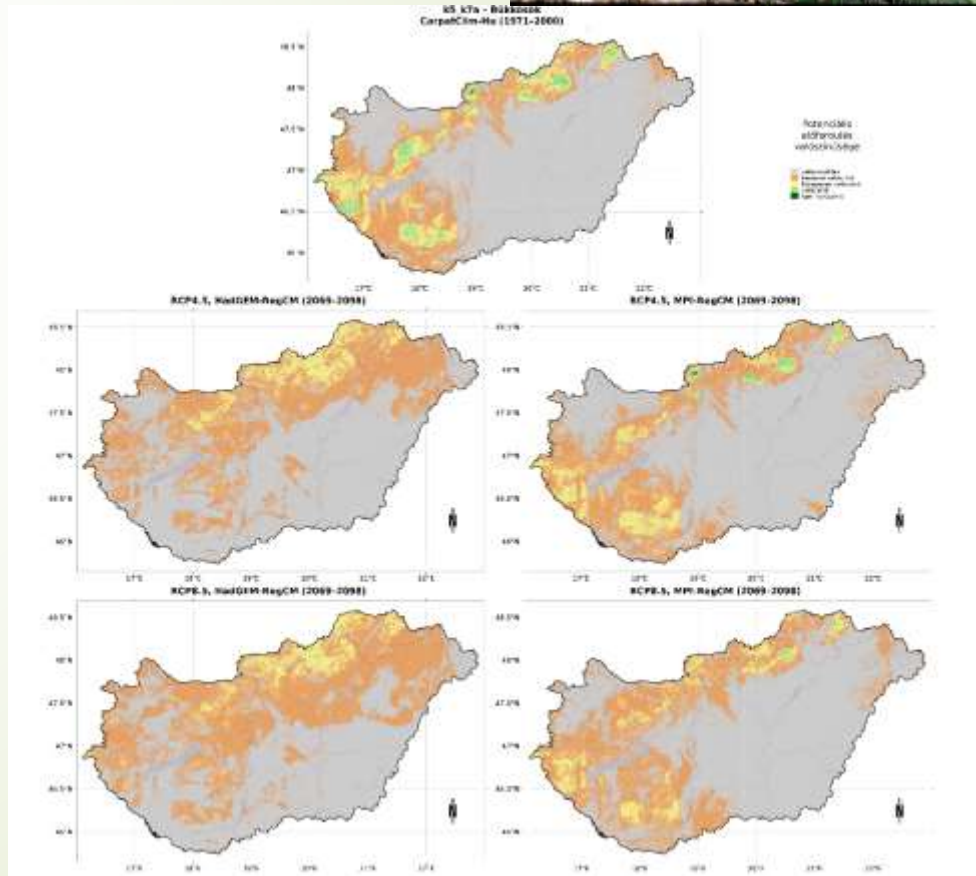
Results – expected climate change impacts

- Adversely affected: closed mesic forests

Oak-Hornbeam forests



Beech forests

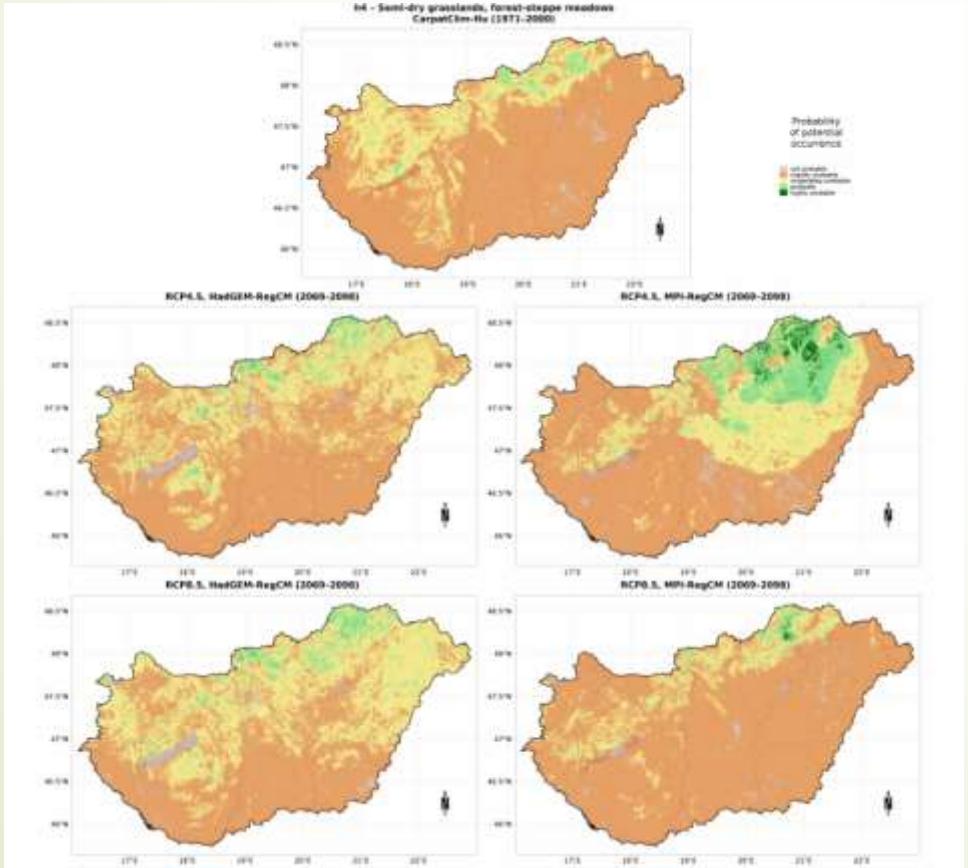


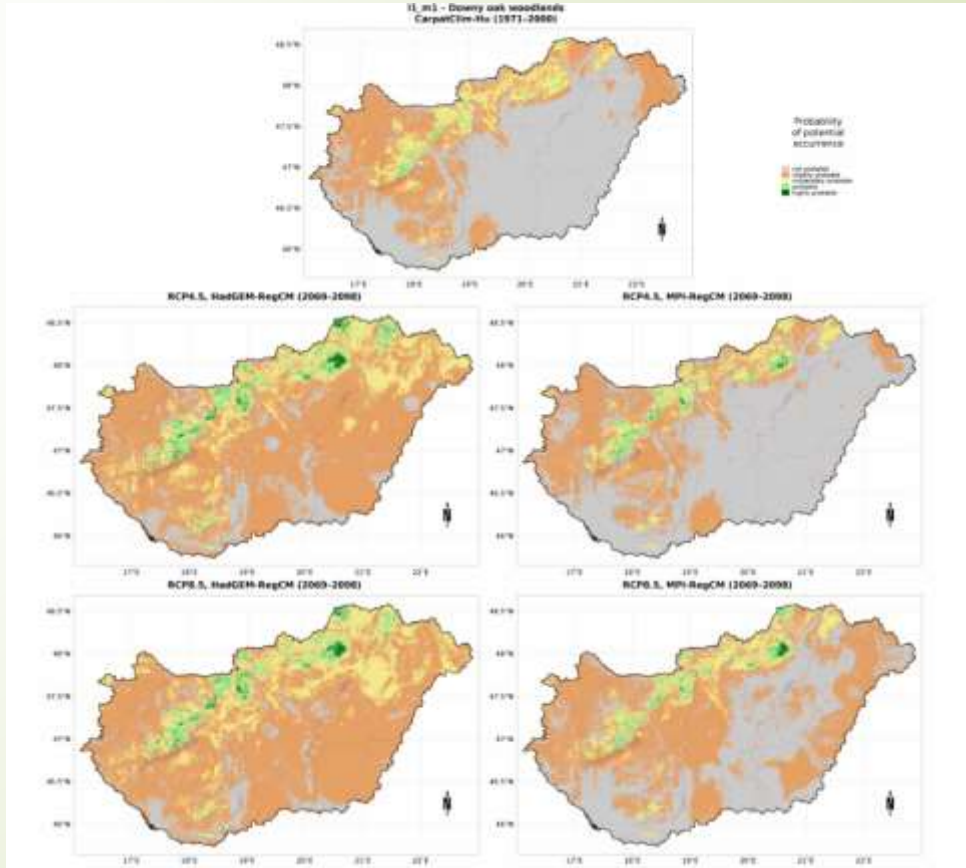
Results – expected climate change impacts

- Benefitting in hills/low mountains: xeric forests & the forest steppe

Quercus pubescens woodlands

Forest steppe grasslands

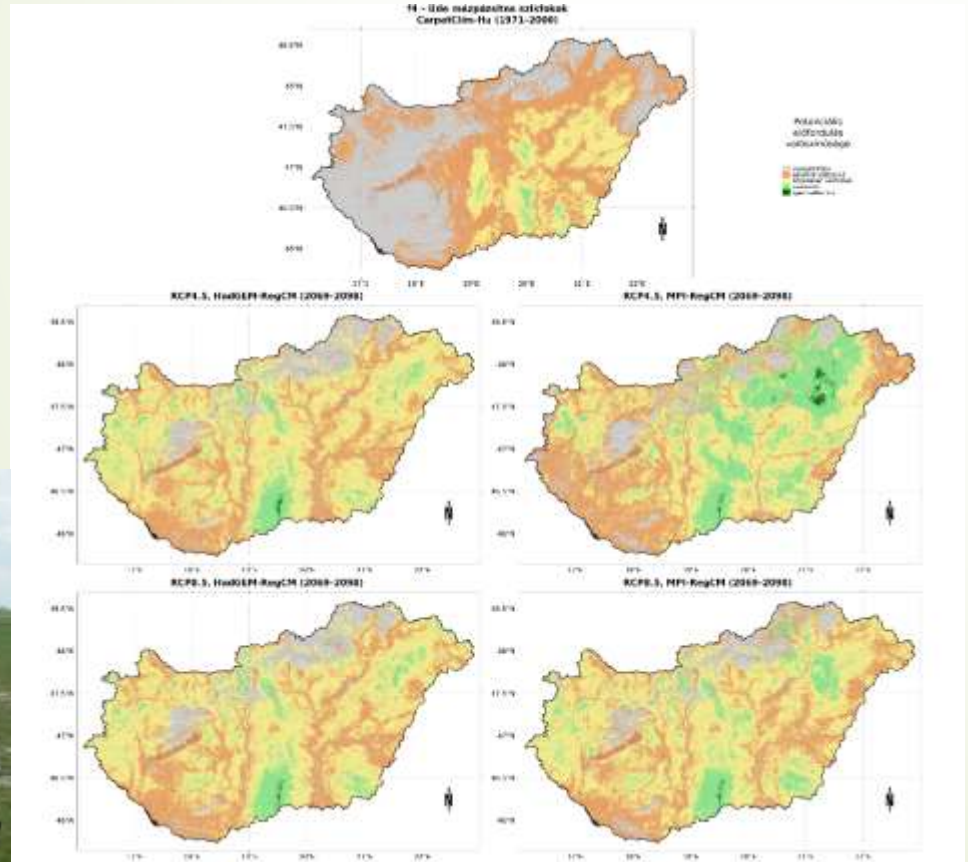




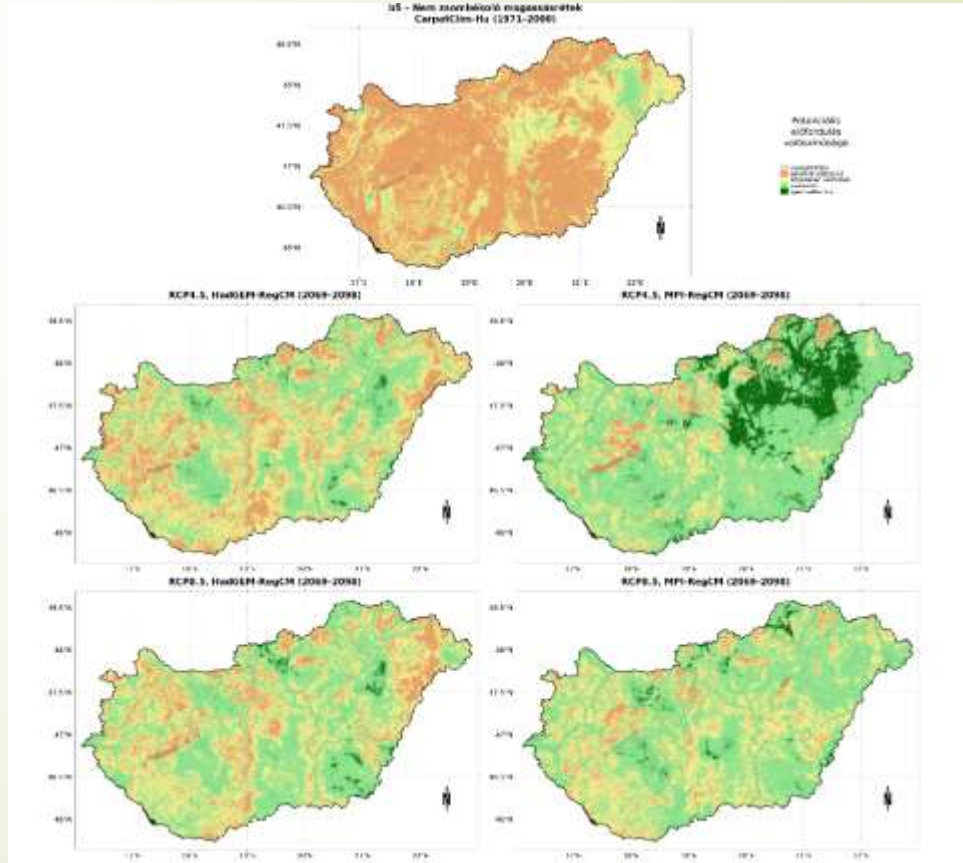
Results – expected climate change impacts

- Benefitting in the lowlands: wetlands, steppe and forest steppe

Alkaline steppe



Non-tussock sedge meadows



Explanation

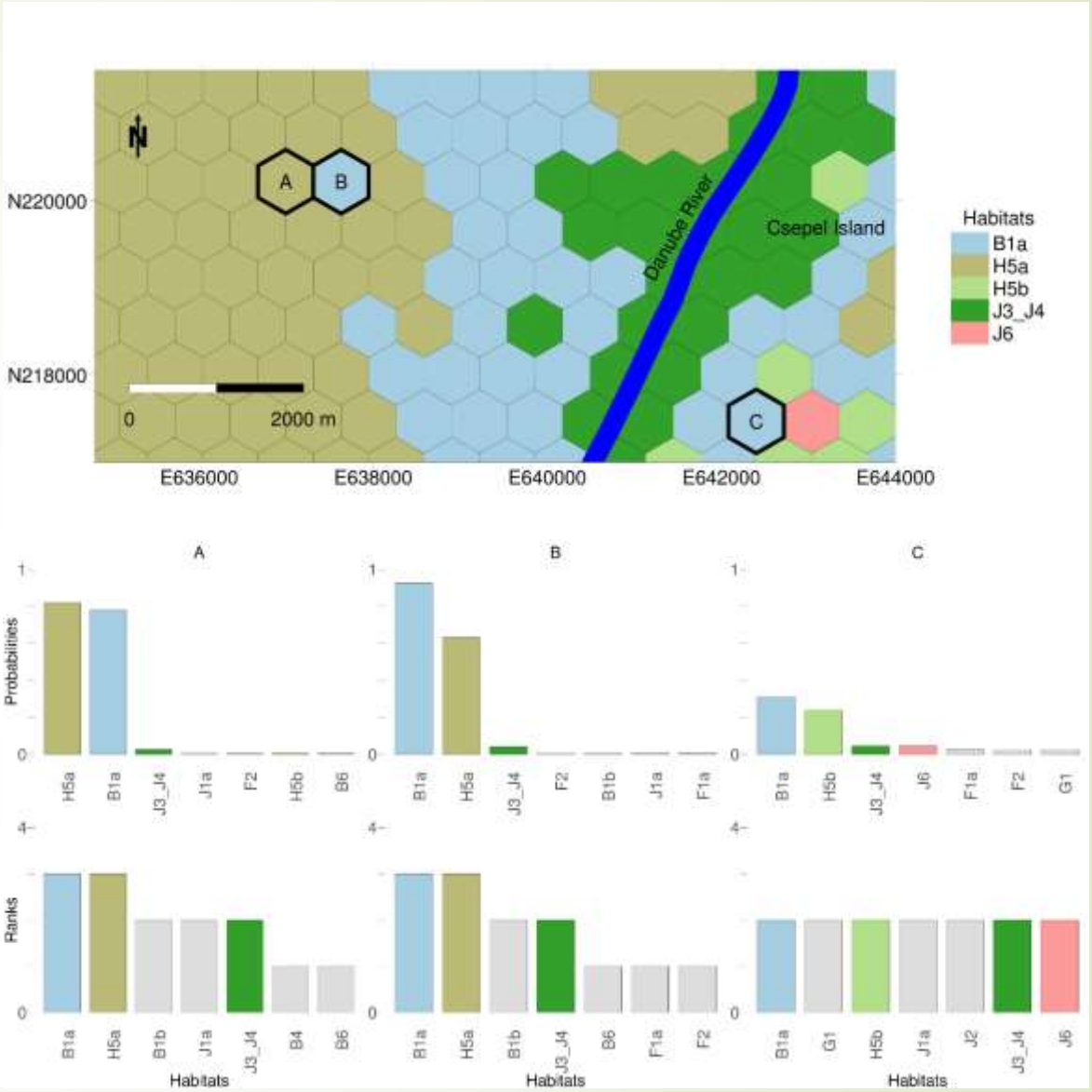
- Expected decline
  - Mesic forests in the hills
- Expected benefit
  - Xeric forests in the hills
  - Steppe – though the benefit of alkaline steppes particularly pronounced
- Unexpected benefits
  - Closed mesic (forest steppe) forests in the lowlands
  - Wetlands in the lowlands
- Reasons
  - Projected increase in annual precipitation
    - Timing might affect agriculture more than natural communities, where vegetation cover can store water
    - Particularly in wetlands
  - Pattern of precipiations increase (in the winter, with hot and dry summer) favours salinisation -> benefit of alkaline vegetation

Conclusion

- CMIP5 scenarios differ from CMIP4 -> surprises in predictions regarding vegetation
- Under the current projections even closed forests are possible, but more likely in the lowlands – likely due to better water retention potential
- wetlands are predicted to be widely potential on flat terrain
- Precipiation projections greatly influence vegetation outcome -> particularly important for us to be as precise as possible

Thank you for your attention!

MPNV

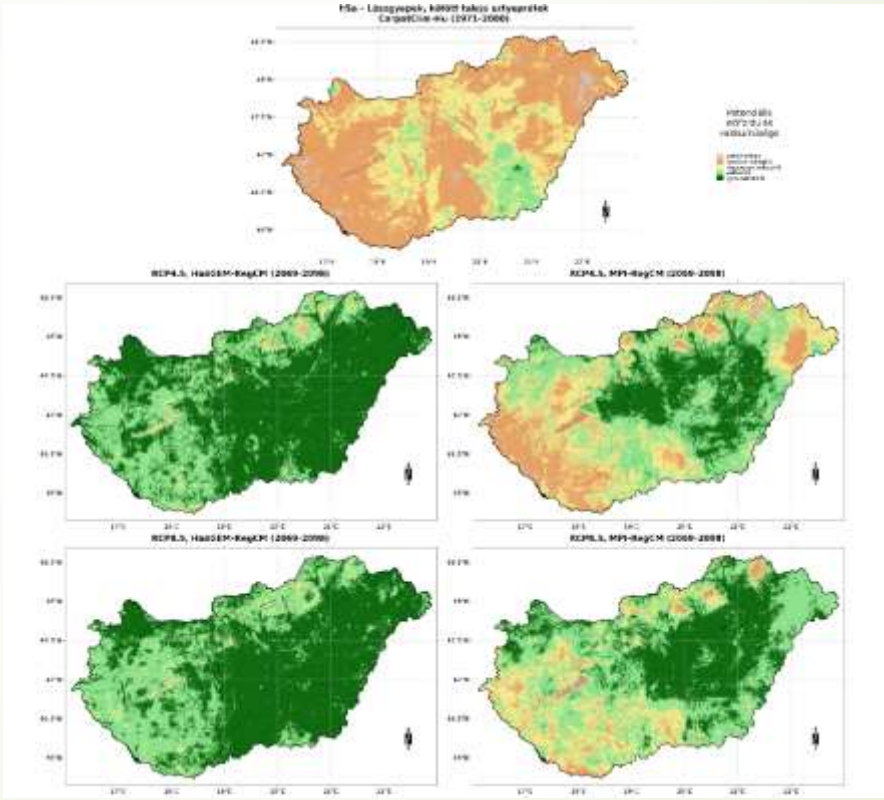


Ranks: 0 1 2 3 4

Probs.: 0 Pres_min Abs_mean Pres_mean Abs_max 1

where Probs. stands for probabilities;

Steppe on solid substrate (loess)



Forest steppe forests