Climate Change vulnerabilities & research with regards to forests in Hungary

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HUNGARY

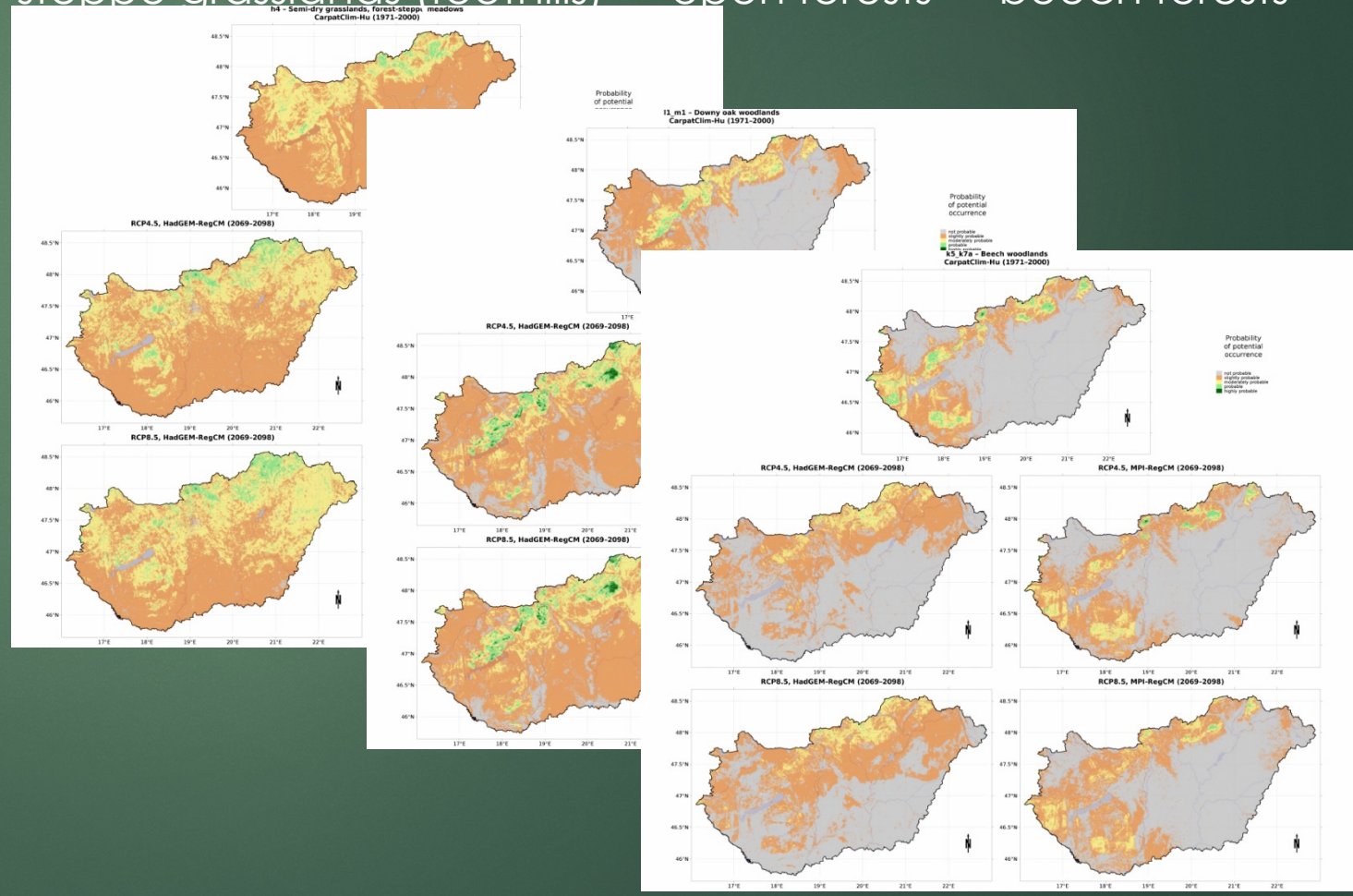
Most pressing vulnerabilities of to climate change in the Carpathians

- Hungarian Medium Mountains
- Climate extremes
  - **Droughts**
  - Other damaging factors: heat waves, frost, wind,
  - Consequences: fire, pests and diseases
- Sustainability of stand forming native tree species – particularly beech
- Sustainability of closed forests
- Sustainability of original habitats in Natura 2000 areas at the edge of the forest biome

Studies on vulnerabilities – any mountain vegetation

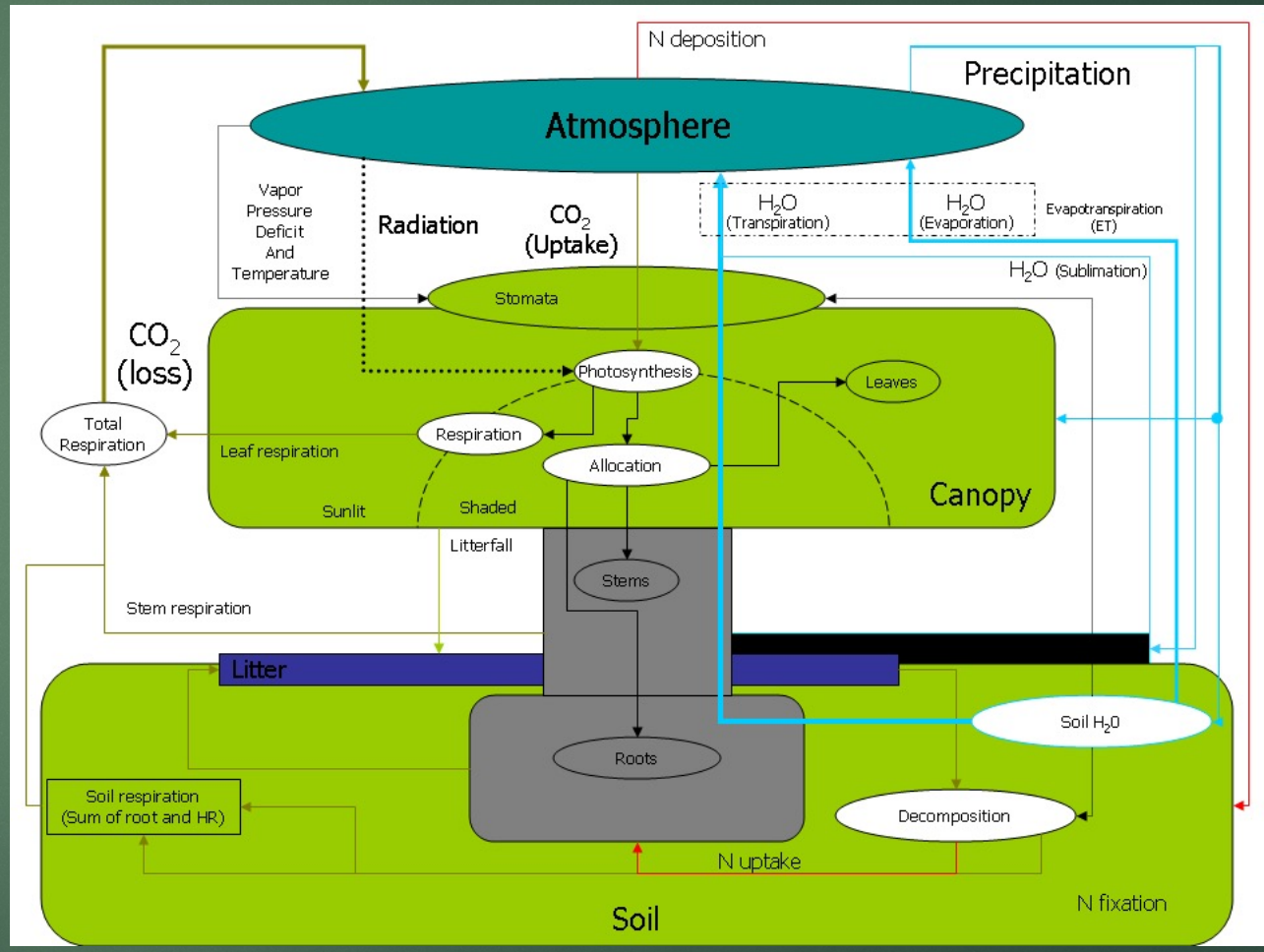
- Centre for Ecological Research
- Multiple potential natural vegetation models
- whole Hungary
- all natural vegetation types
- Expected distributions by 2098, RCP 4.5 and 8.5
- Supports assessment of long-term sustanability

Forest steppe grasslands (foothills) -> open forests -> beech forests



Forests – Biome-BGC-MuSo

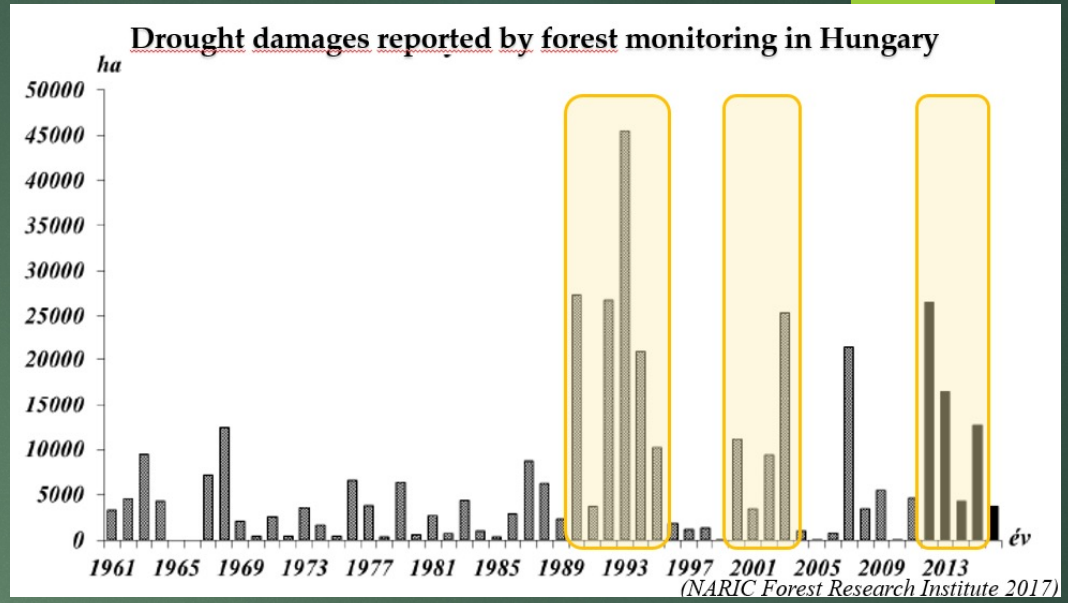
- Joint research of
  - Eötvös Loránd University – Zoltán Barcza
  - Centre for Agricultural Research – Nándor Fodor
- Simulates Biome-Biogeochemical cycles
- Inlcuding carbon fluxes -> significance for climate change mitigation
- Specifically parametrised for Hungarian forest stands based on field data from Eddy covariance towers

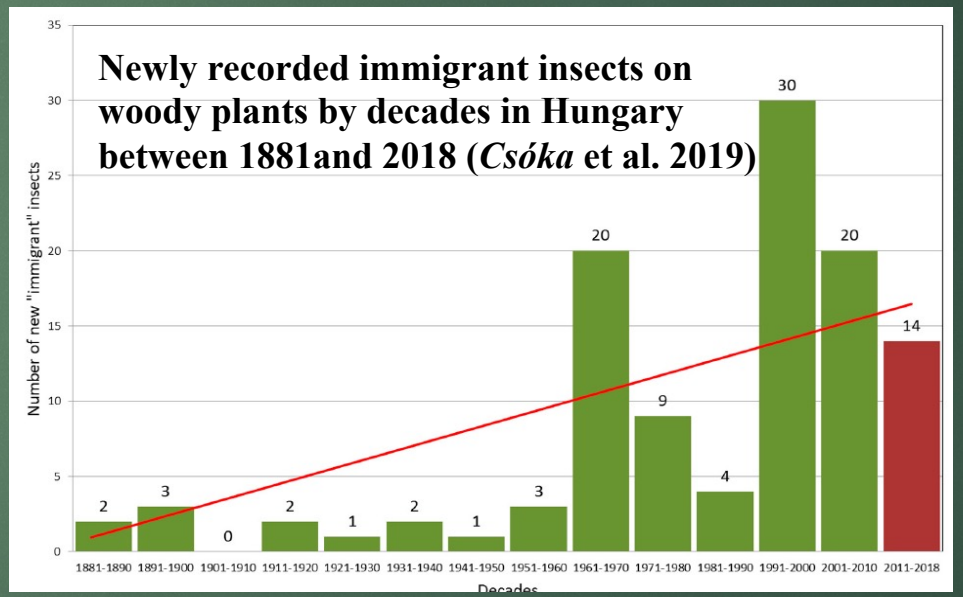


Reserach on vulnerability -Forests

- University of Sopron
- Forest/steppe limits are particularly threatened by climate change (*Mátyás* et al. 2018)
- **Drought-induced damage symptoms** are already observed in forests (first of all: beech):
  - declining growth and vitality
  - health status decline
  - simultaneously growing virulence and invasion of pests and diseases

→ **increasing mortality**



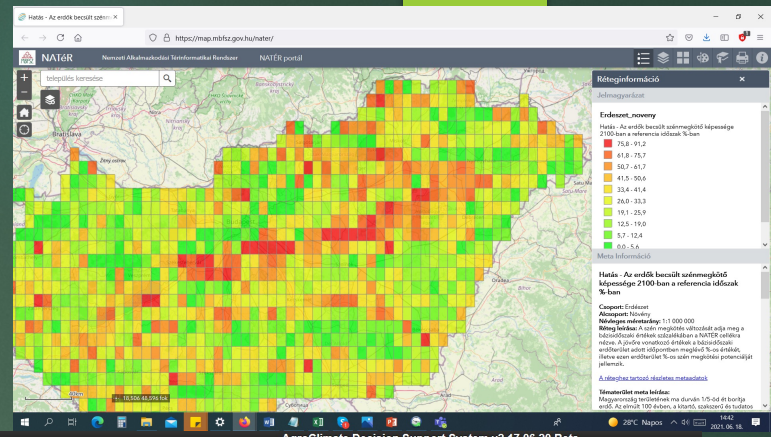


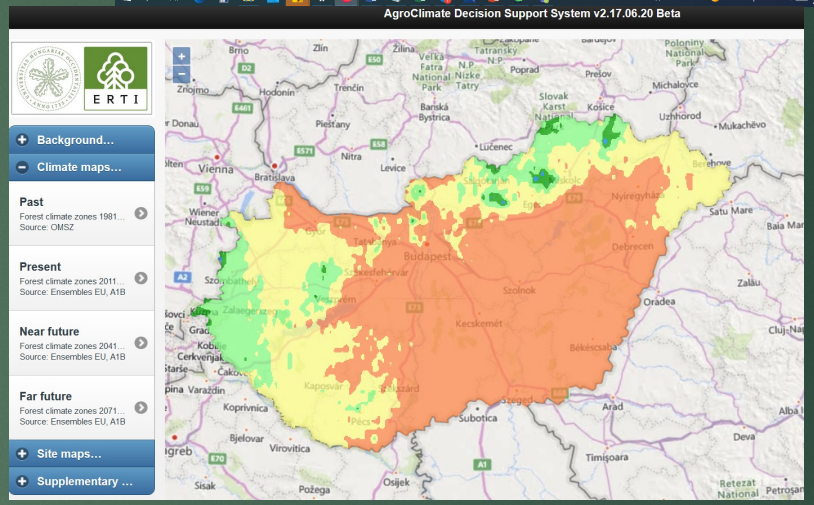
- By 2100, more frequent extreme drought years → not suitable for the native tree species
- Urgent needs for rethink of the tree species selection in order to support adaptation in the forestry sector

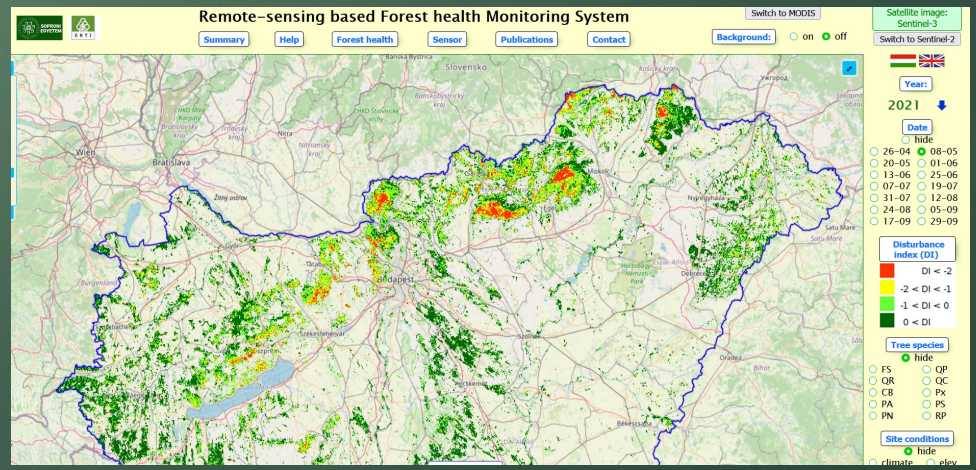
Response to impacts & policies

- Decision support systems:
  - Cross-sectoral
    - National Adaptation Geo-information System (NAGiS): https://nater.mbfsz.gov.hu/en
    - Forestry, soil, agriculture, ecology layers
  - Forestry
    - AgroClimate Decision Support System http://agrarklima2.nyme.hu/dtr/index-eng.html

      adaptive species choice & yield estimates
    - NARIC FRI GeoPortal http://www.ertigis.hu/index.php/en/
- Remote-sensing based Forest health Monitoring System http://193.224.22.151/TEMRE.php
- Official strategies
  - 2nd National Climate Change Strategy
  - Renewable Energy Action Plan







Challenges

- Climate change mitigation – CO_2 sequestrations - > afforestations
  - Hungary at the edge of the forest biome, rather forest steppe
  - Might move towards steppe → Potential cover of closed forests decrease – afforestation might not be sustainable → loss of the ecosystem services of forests
  - Growing tree mortality → Forests can turn into net carbon emitters
  - Carbon sequestration does occur in grasslands/wetlands as well
- Adaptation
  - Increasing aridity – adaptive selection of species/target habitat for planting/restoration
  - Speed of climate change faster than the speed of the adaptation capacity of forests → Estimating the future of current forests
  - Adapting management to more open forests
  - Supporting natural dynamics rather than conserving the current situation in protected/Natura 2000 areas

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Related projects/GIS-based systems

- NAGiS https://nater.mbfsz.gov.hu/en
- AgroClimate Decision Support System http://agrarklima2.nyme.hu/dtr/index-eng.html
- NARIC FRI GeoPortal http://www.ertigis.hu/index.php/en/
- Remote-sensing based Forest health Monitoring System http://193.224.22.151/TEMRE.php
- Multiple Potential Natural Vegetation estimations https://www.novenyzetiterkep.hu/english/node/potveg_en

Related publications

- Bede-Fazekas Á, Czúcz B, Somodi I. 2017 Vulnerability of natural landscapes to climate change – a case study of Hungary Időjárás / Quarterly J Hun Met Service 121: 4 393-414.
- *Czimber K. & Gálos B. 2016: A new decision support system to analyse the impacts of climate change on the Hungarian forestry and agricultural sectors. Scandinavian Journal of Forest Research DOI:10.1080/02827581.2016.1212088*
- *Csóka G. & Hirka A.* 2011: Alien and invasive forest insects in Hungary (A review). Biotic Risks and Climate Changes in Forest. *Berichte Freiburger Forstliche Forschung 89:* 54–60.
- *Führer E., Horváth L., Jagodics A., Machon A. & Szabados I. 2011: Application of a new aridity index in Hungarian forestry practice. Időjárás 115: 205–216*
- *Gálos B., Führer E., Czimber K., Gulyás K., Bidló A., Hänsler A., Jacob D. & Mátyás Cs. 2015.* Climatic threats determining future adaptive forest management – a case study of Zala County. Időjárás 119(4): 425-441
- Lepesi N, Bede-Fazekas Á, Czúcz B, Somodi I. 2017 Adaptive capacity of climate sensitive habitats to climate change in Hungary. Időjárás / Quarterly J Hun Met Service 121: 415-436.
- Mátyás C., Berki I., Bidló A., Csóka G., Czimber K., Führer E., Gálos B., Gribovszki Z., Illés G., Hirka A., Somogyi Z. 2018. Sustainability of Forest Cover under Climate Change on the Temperate-Continental Xeric Limits. *Forests*, 9(8):489; doi: 10.3390/f9080489
- Móricz N., Garamszegi B., Rasztovits E., Bidló A., Horváth A., Jagicza A., Illés G., Vekerdy Z., Somogyi Z. and Gálos B. 2018. Recent Drought-Induced Vitality Decline of Black Pine (*Pinus nigra* Arn.) in South-West Hungary – Is This Drought-Resistant Species under Threat by Climate Change? Forests, 9(7):414; doi:10.3390/f9070414
- Rasztovits, E., Berki, I., Mátyás, Cs., Czimber, K., Pötzelsberger, E., and Móricz, N., 2014: The incorporation of extreme drought events improves models for beech persistence at its distribution limit. Annals For. Sci. 71, 201–210
- Somodi I, Molnár Zs Czúcz B, Bede-Fazekas Á, Bölöni J, Pásztor L, Laborczi A, Zimmermann NE. 2017 Implementation and application of multiple potential natural vegetation models – a case study of Hungary. J Veg Sci 28: 1260-1269.
- *Somogyi Z.* 2016: Projected effects of climate change on the carbon stocks of European beech (*Fagus sylvatica* L.) forests in Zala County, Hungary. *Lesnícky časopis - Forestry Journal* 62: 3-14