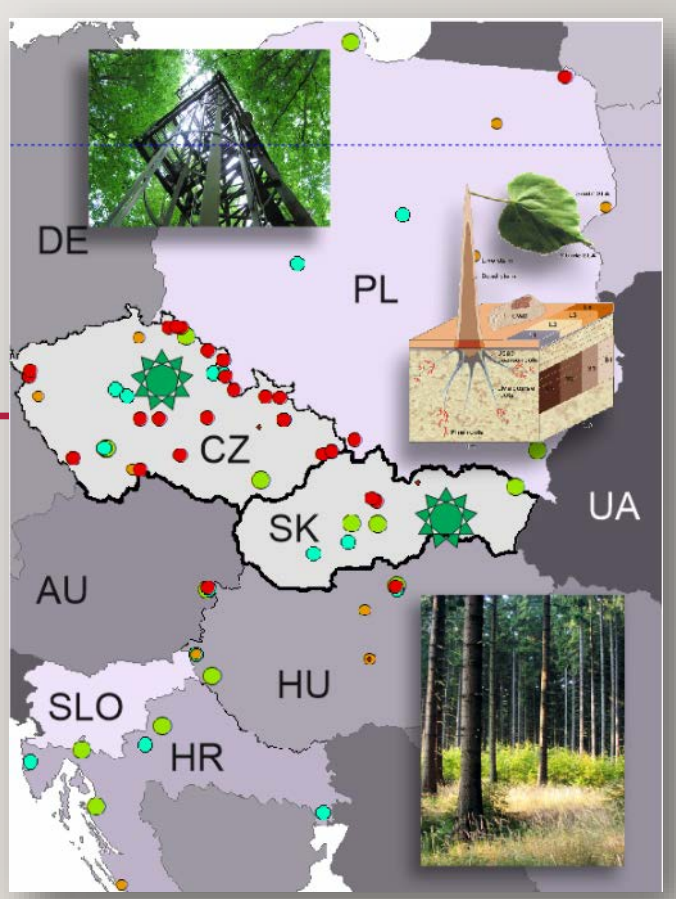
A NEW **MU**LTISCALE **F**RAMEWORK **F**OR ASSESSING **I**MPACTS OF CLIMATE CHA**N**GE ON CENTRAL EUROPEAN FORESTS: MUFFIN

HLÁSNY, T., MERGANIČOVÁ, K., DOBOR, L.

CZECH UNIVERSITY OF LIFE SCIENCES IN PRAGUE,
FACULTY OF FORESTRY AND WOOD SCIENCES

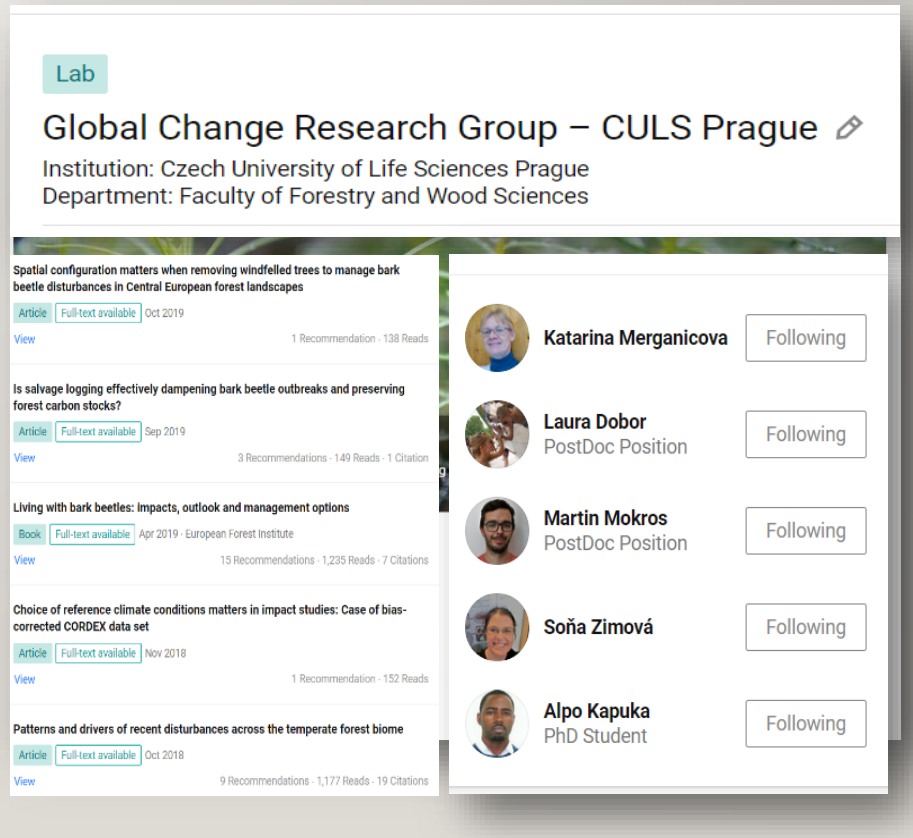


BACKGROUND

- Specific „transient“ conditions of Central Europe with unique disturbance regimes and management history
- Ecosystem dynamics studied using multiple models, such as BiomeBGC, Silva/Sibyla, iLand, EFISCEN, PICUS, etc.
- Efforts and approaches quite fragmented, many aspects understudied
- Good data coverage, ICP Forests, Highly Instrumented Sites, manipulated field experiments, etc.

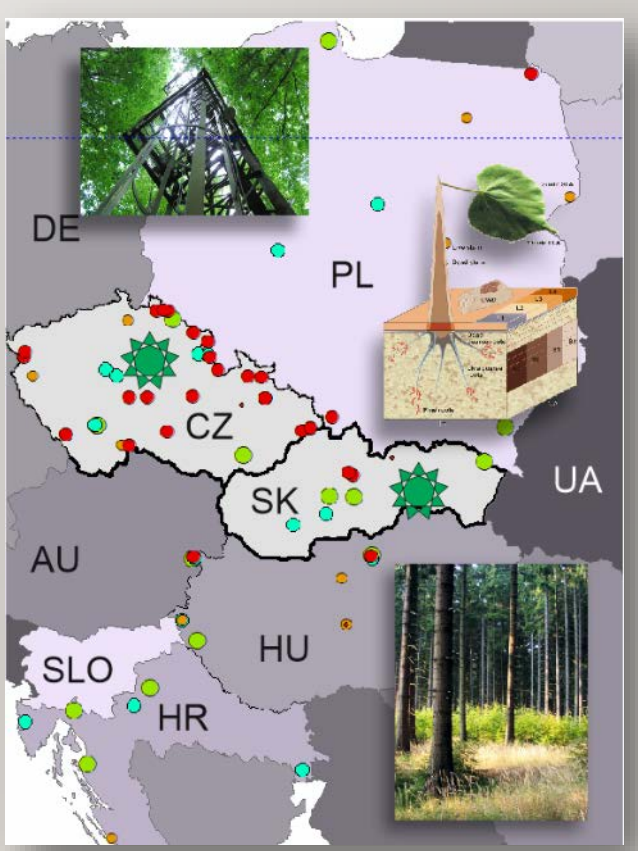
BACKGROUND

- Czech University of Life Sciences, FFWS, received in 2018 a „strategic“ funding to create 9 research teams
- Team no. 6: Global Change Research Group CULS
- Climate change research *sensu lato*, including development, testing and application of ecosystem models



MAJOR OBJECTIVES

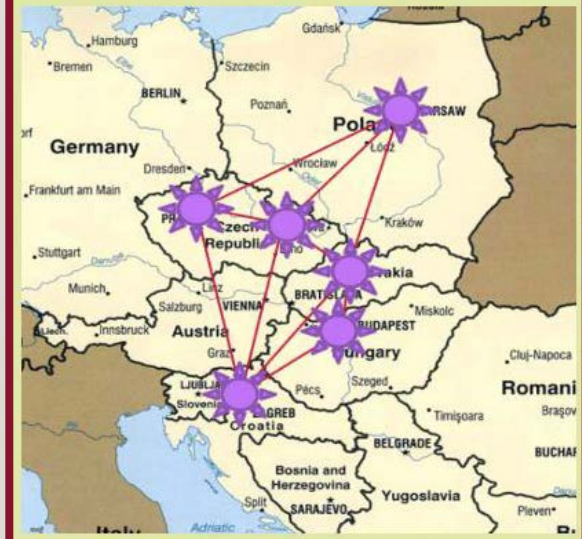
- To create a new platform for climate change research in CE region
- To assimilate diverse data, models and local knowledge
- To address stand- to landscape-scale ecosystem dynamics
- To boost the collaboration within and outside the target region

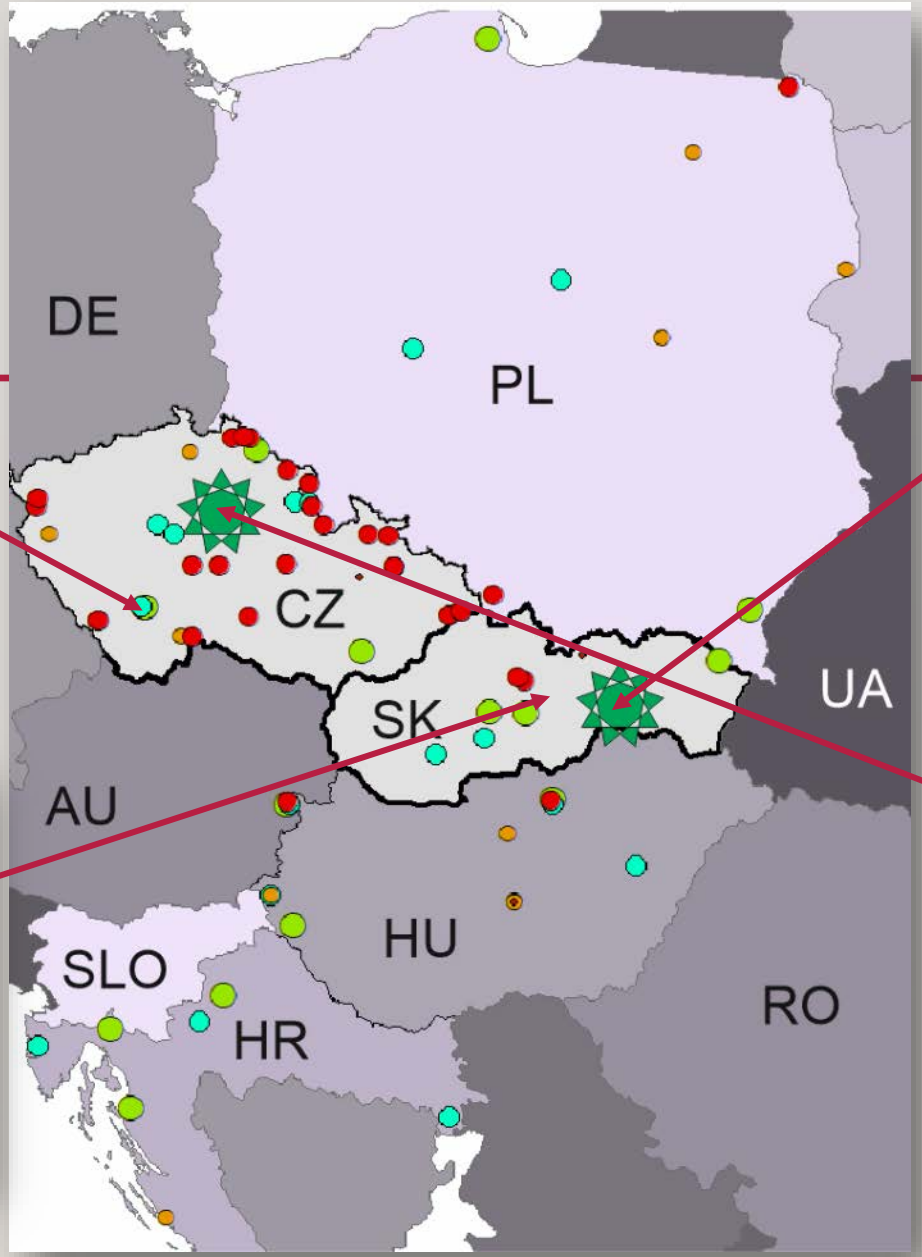


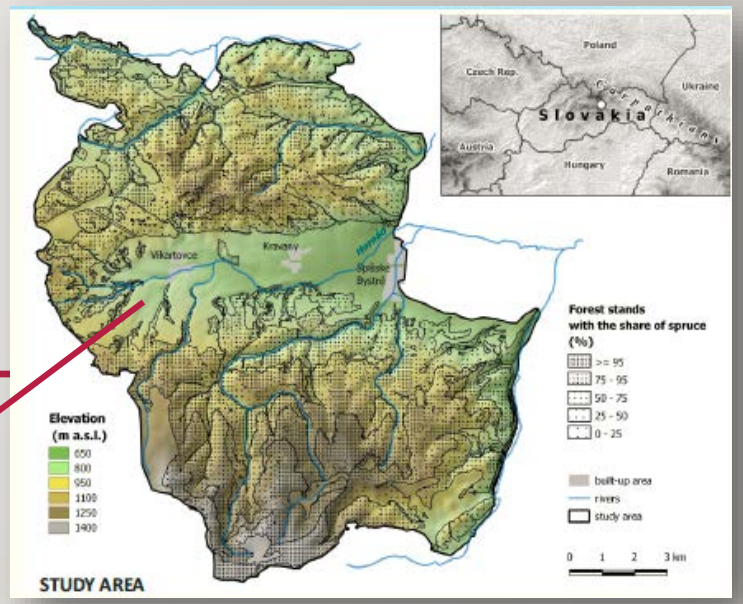
Field data

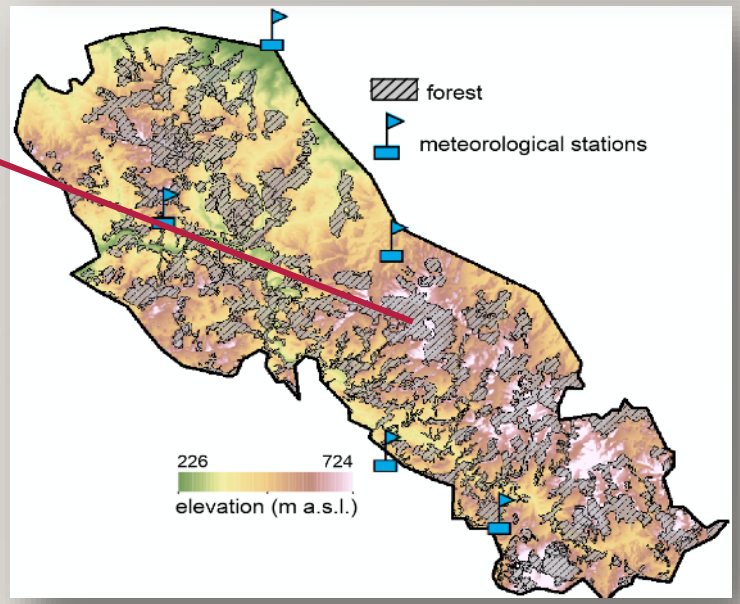
Stand	Landscape
ICP Forests *Highly Instrumented Sites* *Manipulated field experiments*	*Forest management plans* *National Forest Inventories* *Soil, meteorology, etc.*

Collaborating institutions
data, local knowledge ...

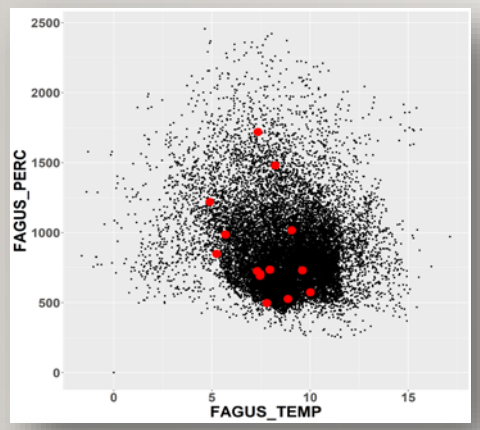


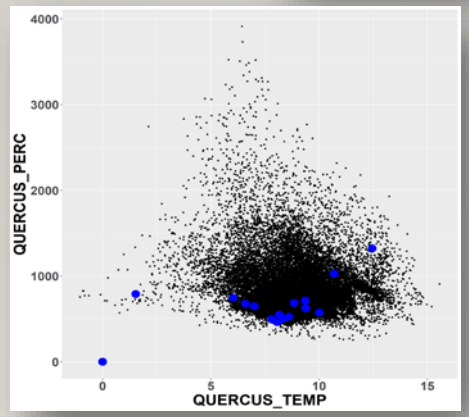

DE
PL
CZ
SK
UA
AU
HU
SLO
HR
RO

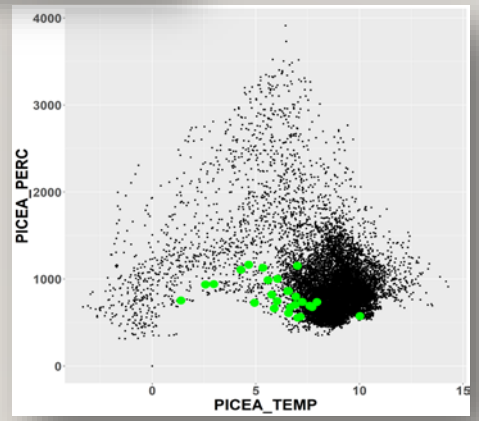

Poland
Czech Rep.
Ukraine
Slovakia
Austria
Hungary
Romania
Elevation
(m a.s.l.)
650
800
950
1100
1250
1400
Forest stands
with the share of spruce
(%)
>= 95
75 - 95
50 - 75
25 - 50
0 - 25
built-up area
rivers
study area
0 1 2 3 km
STUDY AREA


forest
meteorological stations
226
724
elevation (m a.s.l.)

STAND-SCALE COMPONENT

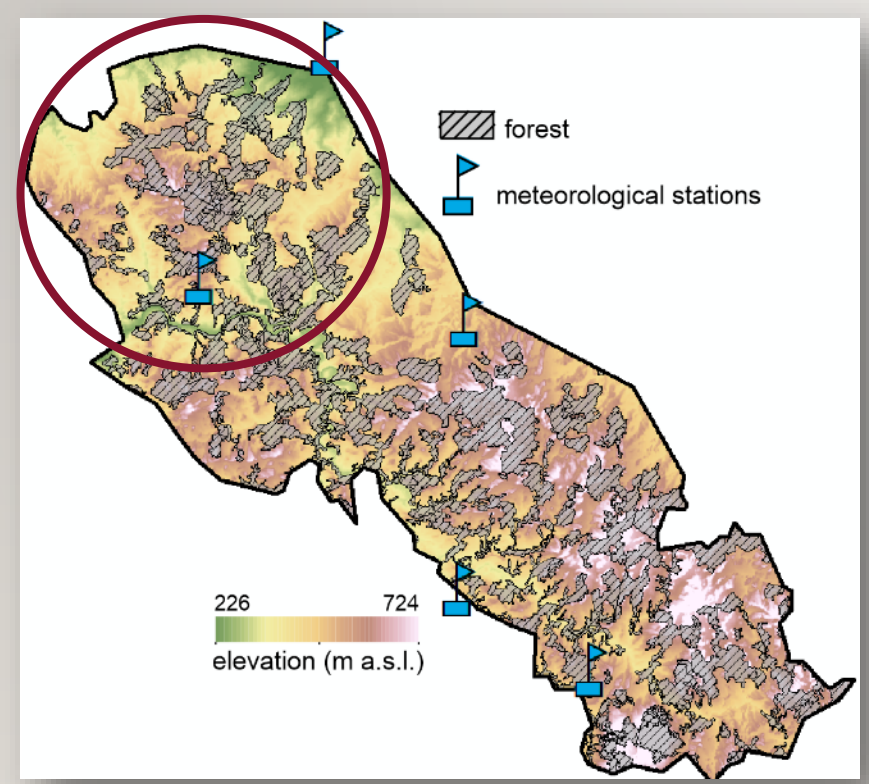


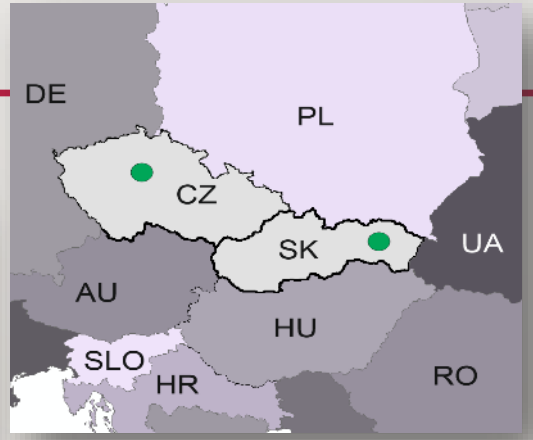




Data source	Country	Number of plots per tree species			Available data						Number of plots
		Norway spruce	European beech	Oak	Stand volume	Site description	Soil description	Climate	Management	Physiological meas.	
Highly Instrumented Sites	Czech R.	1			yes	yes	yes	yes		yes	1
	Slovakia	1	1		yes	yes	yes	yes		yes	2
	Croatia			1	yes	yes	yes	yes		yes	1
ICP Forests	Czech R.	8	3	1	yes	yes	yes	yes	yes		12
	Slovakia	5	3	2	yes	yes	yes	yes	yes		10
	Croatia	1	3	1	yes	yes	yes	yes	yes		5
	Hungary	2	3	5	yes	yes	yes	yes	yes		10
	Poland	3	3	2	yes	yes	yes	yes			8
Thinning experiments	Czech R.	15	3	2	yes	yes	yes		yes		20
All		36	19	14							69

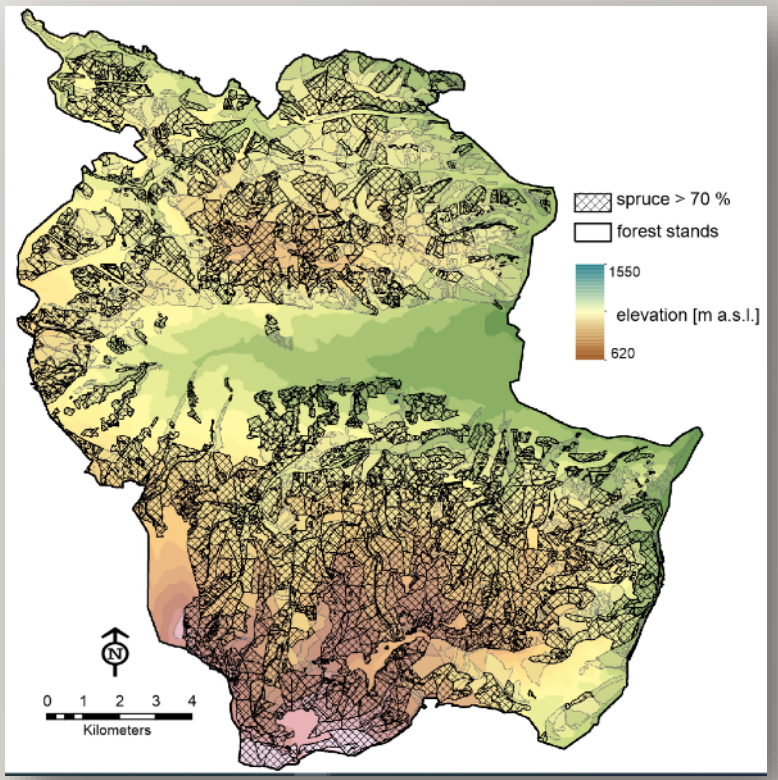
LANDSCAPE SCALE COMPONENT





near Prague, 35 000 ha, spruce-pine-oak-larch, 200-700 m a.s.l.

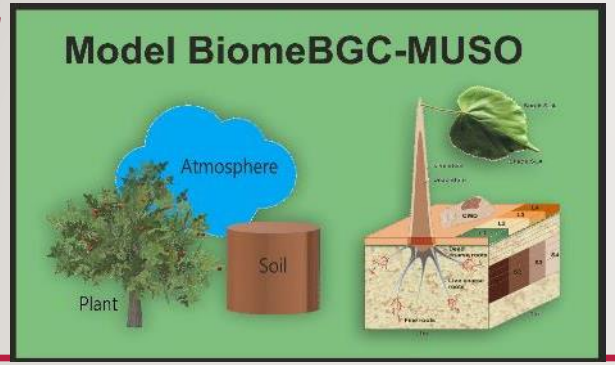
Low Tatras (SK), 16 000 ha, spruce-pine-beech, 600-1600 m a.s.l.

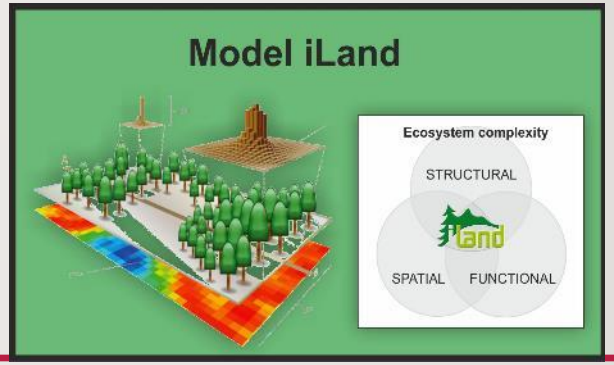


Refined parameters

Improved model architecture

Improved representation of processes

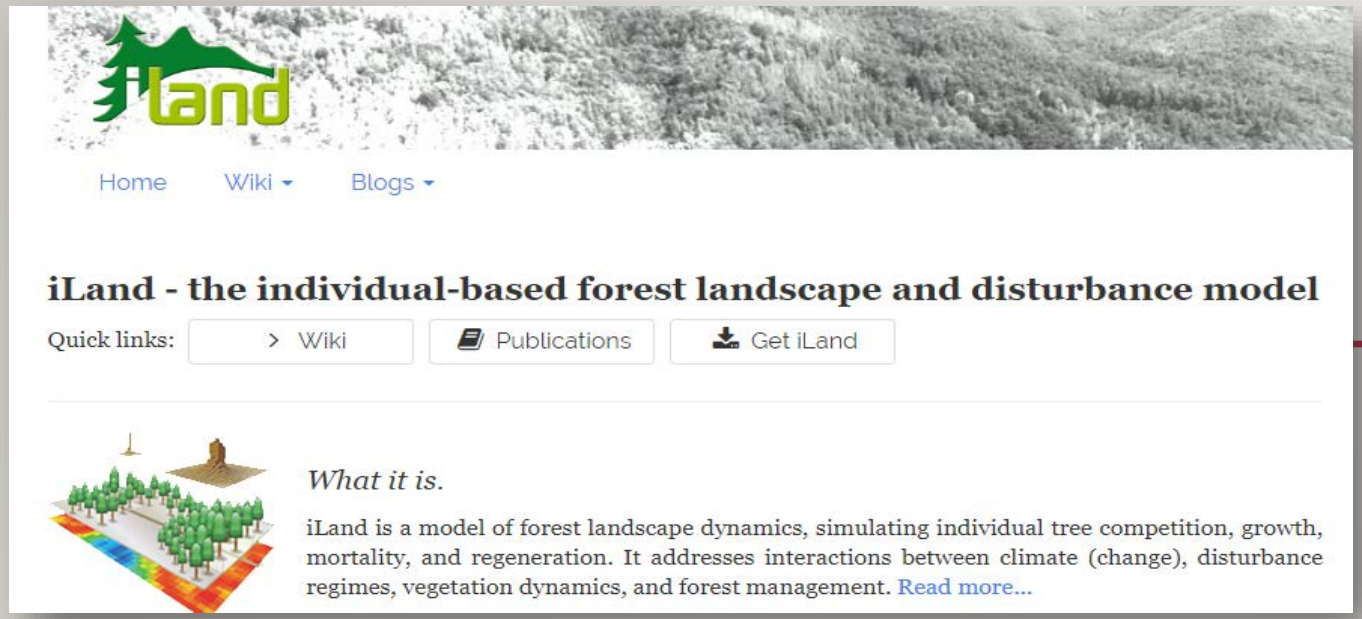


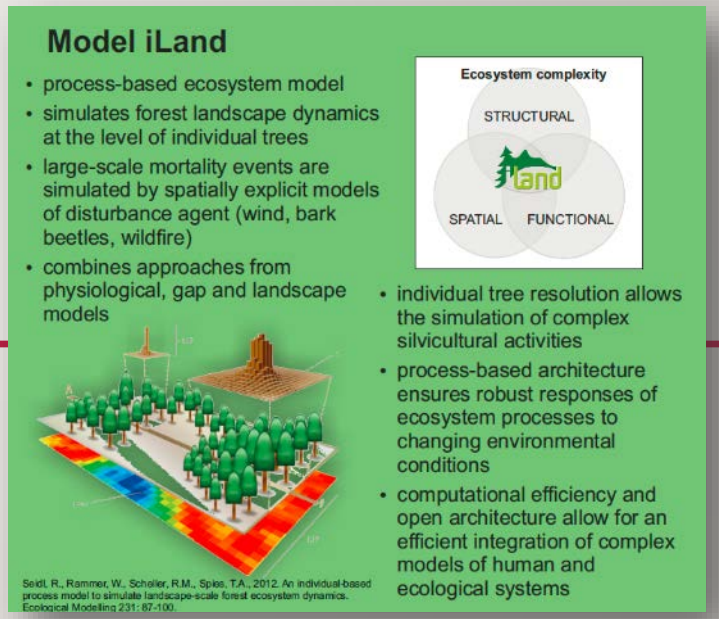


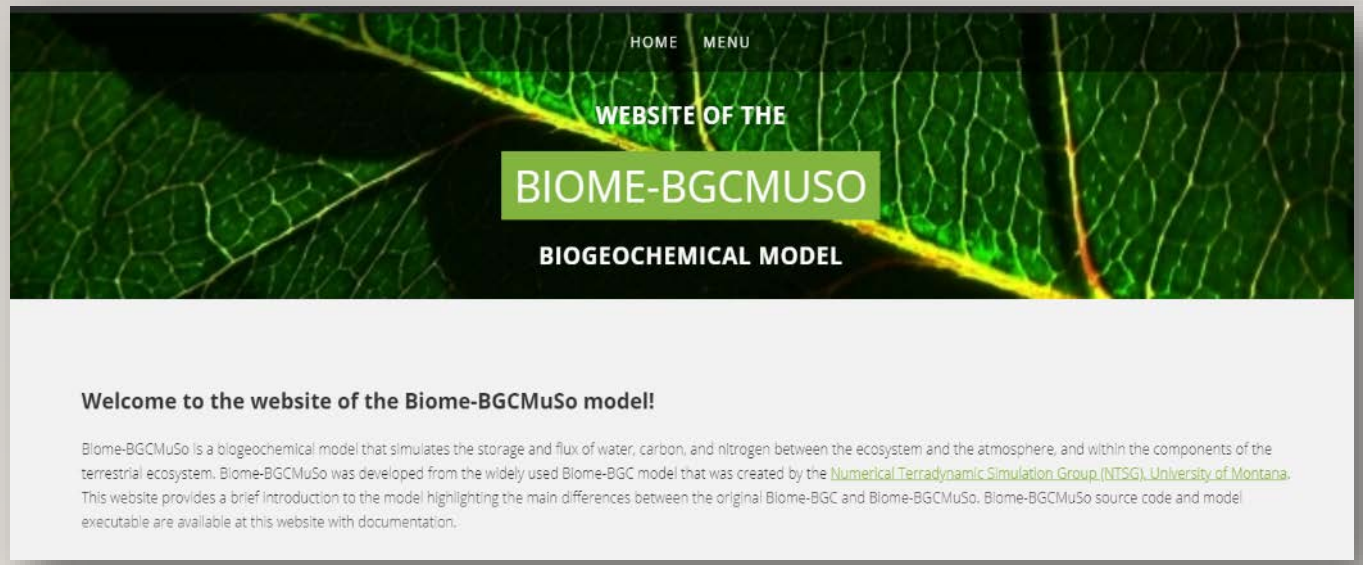
Stands and landscape initialized for modelling purposes

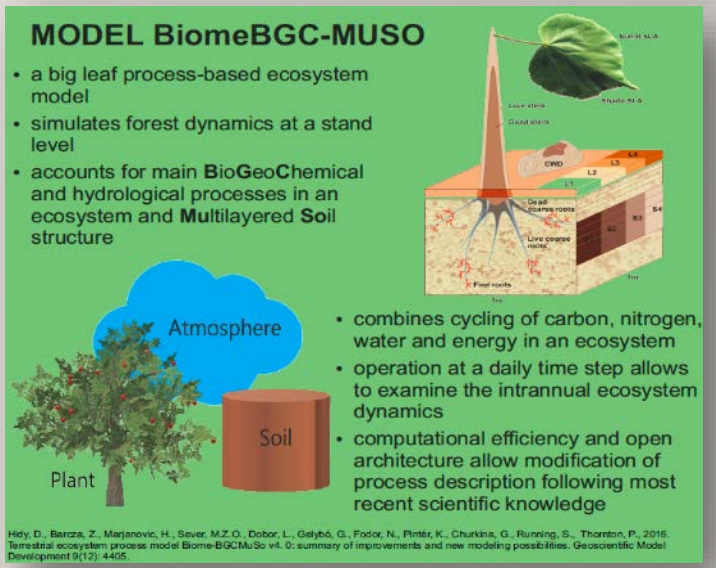
Stand	Landscape
ICP Forests *Highly Instrumented Sites* *Manipulated field experiments*	*Forest management plans* *National Forest Inventories* *Soil, meteorology, etc.*

Collaborating institutions
data, local knowledge ...


iLand
Home
Wiki
Blogs
iLand - the individual-based forest landscape and disturbance model
Quick links:
Wiki
Publications
Get iLand
What it is.
iLand is a model of forest landscape dynamics, simulating individual tree competition, growth, mortality, and regeneration. It addresses interactions between climate (change), disturbance regimes, vegetation dynamics, and forest management. Read more...

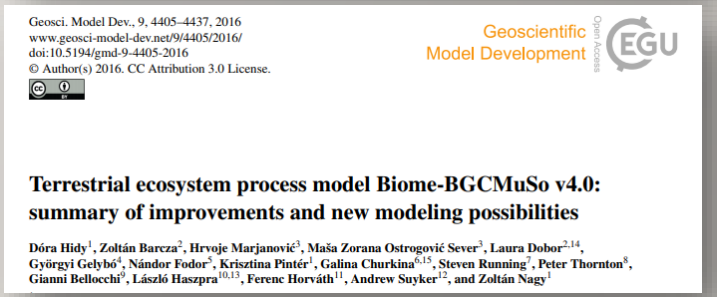

Model iLand
process-based ecosystem model
simulates forest landscape dynamics at the level of individual trees
large-scale mortality events are simulated by spatially explicit models of disturbance agent (wind, bark beetles, wildfire)
combines approaches from physiological, gap and landscape models
Ecosystem complexity
STRUCTURAL
SPATIAL
FUNCTIONAL
individual tree resolution allows the simulation of complex silvicultural activities
process-based architecture ensures robust responses of ecosystem processes to changing environmental conditions
computational efficiency and open architecture allow for an efficient integration of complex models of human and ecological systems
Seidl, R., Rammer, W., Scheller, R.M., Spies, T.A., 2012. An individual-based process model to simulate landscape-scale forest ecosystem dynamics. Ecological Modelling 231: 87-100.


HOME
MENU
WEBSITE OF THE
BIOME-BGCMUSO
BIOGEOCHEMICAL MODEL
Welcome to the website of the Biome-BGCMuSo model!
Biome-BGCMuSo is a biogeochemical model that simulates the storage and flux of water, carbon, and nitrogen between the ecosystem and the atmosphere, and within the components of the terrestrial ecosystem. Biome-BGCMuSo was developed from the widely used Biome-BGC model that was created by the Numerical Terradynamic Simulation Group (NTSG), University of Montana. This website provides a brief introduction to the model highlighting the main differences between the original Biome-BGC and Biome-BGCMuSo. Biome-BGCMuSo source code and model executable are available at this website with documentation.


MODEL BiomeBGC-MUSO
a big leaf process-based ecosystem model
simulates forest dynamics at a stand level
accounts for main BioGeoChemical and hydrological processes in an ecosystem and Multilayered Soil structure
Atmosphere
Soil
Plant
combines cycling of carbon, nitrogen, water and energy in an ecosystem
operation at a daily time step allows to examine the intrannual ecosystem dynamics
computational efficiency and open architecture allow modification of process description following most recent scientific knowledge
Hidy, D., Barcza, Z., Marjanovic, H., Sever, M.Z.O., Dobor, L., Gelybó, G., Fodor, N., Pintér, K., Churkina, G., Running, S., Thornton, P., 2016. Terrestrial ecosystem process model Biome-BGCMuSo v4. 0: summary of improvements and new modeling possibilities. Geoscientific Model Development 9(12): 4405.

BIOME-BGC MUSO

- An advanced version of the BiomeBGC model (Thornton et al. 1998, 2000, 2002) developed at ELTE Budapest (Hidy et al. 2016)
- Multiple soil layers, more detailed soil hydrology
- Drought related plant senescence
- Management modules: thinning, harvesting, sowing, irrigation, mowing, grazing, ploughing
- Seven phenophases with specific carbon allocation



Refined parameters

Improved model architecture

Improved representation of processes

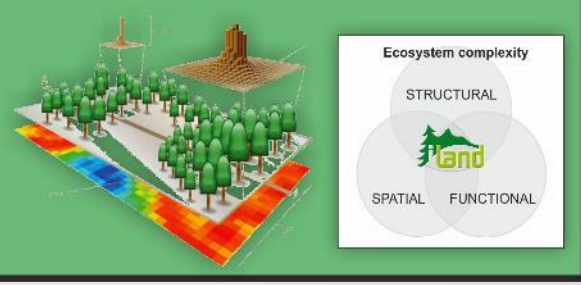
Margins identified based on literature review

Sensitivity analysis

Bayesian estimation (GLUE)

Model BiomeBGC-MUSO

Model iLand



Regionally adopted species-specific parameters

Stands and landscape initialized for modelling purposes

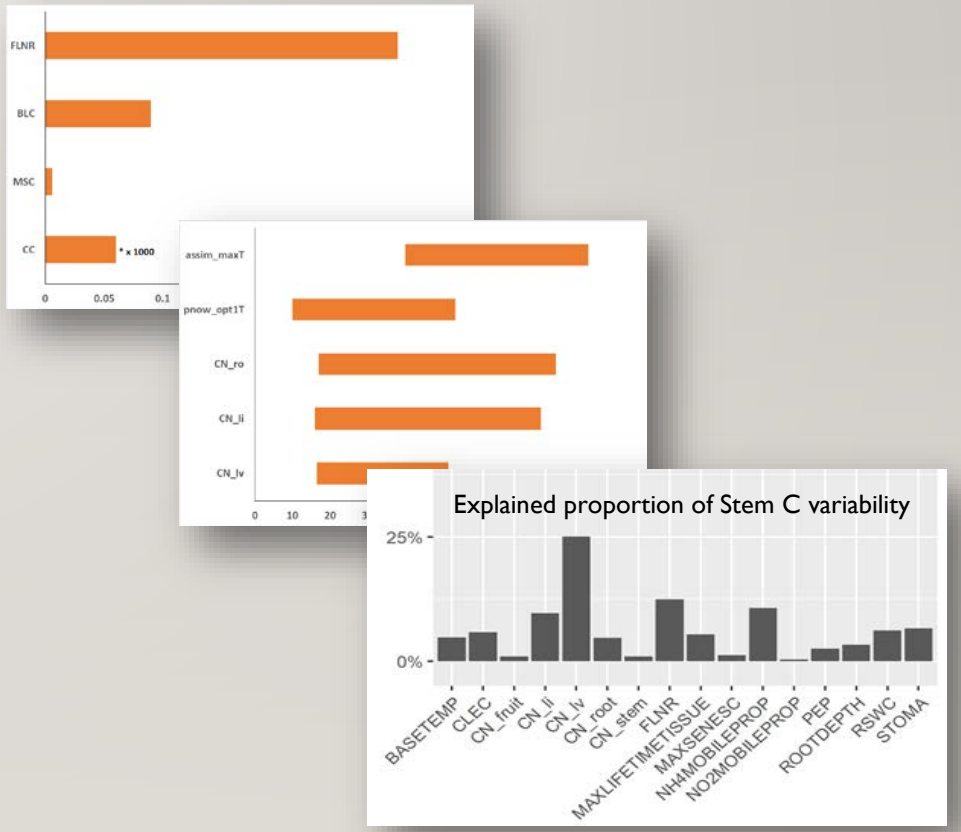
Field data

Stand	Landscape
ICP Forests *Highly Instrumented Sites* *Manipulated field experiments*	*Forest management plans* *National Forest Inventories* *Soil, meteorology, etc.*

Collaborating institutions
data, local knowledge ...

PARAMETER ESTIMATION, BBGC MUSO CASE

- Approximately 160 ecophysiological parameters
- New parameters on allocation, CH4, phenology, senescence, etc.
- Plausible range of each parameter for temperate tree species identified based of literature review
- Most influential parameters identified using the Monte Carlo-based sensitivity analysis
- Statistical calibration using the GLUE procedure



Refined parameters

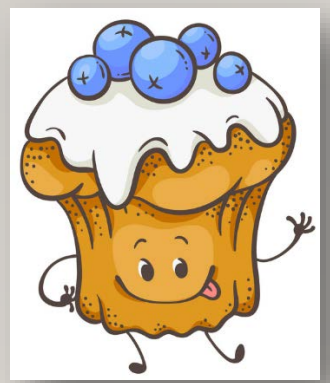
Improved model architecture

Improved representation of processes

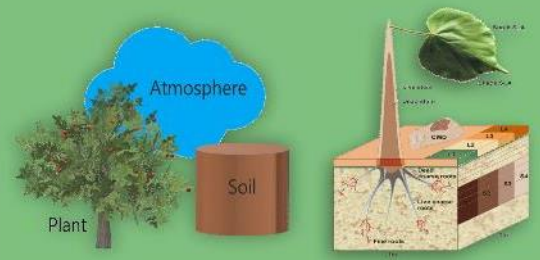
Margins identified based on literature review

Sensitivity analysis

Bayesian estimation (GLUE)



Model BiomeBGC-MUSO



Model iLand

Regionally adopted species-specific parameters

Stands and landscape initialized for modelling purposes

Field data

Stand	Landscape
ICP Forests *Highly Instrumented Sites* *Manipulated field experiments*	*Forest management plans* *National Forest Inventories* *Soil, meteorology, etc.*

Collaborating institutions
data, local knowledge ...

ACKNOWLEDGEMENTS

Model developers:

Model iLand: Rupert Seidl, Werner Rammer, BOKU / TUM,

Model BiomeBGC-MuSo: Zoltán Barcza, Dóra Hidy, et al., ELTE Budapest

Data & local knowledge contributors:

Jiří Novák et al., VÚLHM, CZ

Ladislav Sigut, Czechglobe, CZ

Daniel Kurjak, Peter Fleischer, Katarína Střelcová, et al., TUZVO, SK

Zuzana Sitková, Pavol Pavlenda et al. NFC-FRI Zvolen, SK

Hrvoje Marjanovič, et al. CFRI, HR

ICP Forests, CarboEuroFlux, CarboEuropeIP (EU-FP6)

and others.

Thank you for your attention