# IUFRO Division 4.04.07 Risk analysis

## Socio-ecological conflicts in forest management: risks of (not) adapting?

May 31 - June 2, 2022

**Nancy, France**

**Tuesday, 31st May 2022 – Conference Day 1:**

08:30 – 9:00 **Registration and welcoming coffee** 

09:00 – 9:30 **Welcome speech**

Meriem Fournier (President of INRAE center of Nancy)

Serge Garcia (Director of BETA)

09:30 – 10:00 **Presentation of the seminar and opening session**

Rasoul Yousefpour (Coordinator of the IUFRO Working Group 4.04.07 "Risk Analysis")

Marielle Brunette (Deputy coordinator of the IUFRO Working Group 4.04.07 "Risk Analysis")

10:00 – 11:00 **Keynote speaker – Jose G. Borges** (Forest Research Centre, School of Agriculture, University of Lisbon) (40' presentation + 20' questions)

Addressing wildfire risk and uncertainty by adaptive territorial management.
The FIRE-RES - Innovative Technologies and Socio-Ecological-Economic Solutions for FIRE RESilient Territories in Europe – project approach

11:00 – 11:30 *Coffee break* 

11:30 – 12:30 **Session 1 – Trade-offs in forest management** (20' presentation + 10' questions)

Juan Carlos Zamora-Pereira: Robust drought management strategies promoting ecological resilience and economic efficiency of a mixed conifer-broadleaf forest in Southwestern Germany

Siwar Saadaoui: Spatial analysis of the relationships between wood production and other forest ecosystem services in the territory of the Ballons des Vosges Regional Natural Park

12:30 – 14:00 *Lunch* 

14:00 – 15:30 **Session 2 – Adaptation and ecosystem services** (20’ presentation + 10’ questions)

Marielle Brunette: Financial and natural insurance: an application to forestry

Sandrine Brèteau-Amores: Economic analysis of adaptation options toward drought-induced risk of forest dieback: financial balance and/or carbon balance

Rasoul Yousefpour: Managing forest for water services

15:30 – 15:40 **Egg-timer session 1** (poster) (5’ presentation – 2 slides max)

Félix Bastit: Stability of an unregulated forest bio-economic equilibrium under natural disturbances

Yvonne Brodrechtova: Stakeholders participation in lowering risk associated with wildfire forest management – Slovakia, Podpoanie region

15:40 – 16:10 *Coffee break*

16:10 – 17:10 **Session 3 – Carbon effect** (20’ presentation + 10’ questions)

Ana Flavia Boeni: Carbon stock increase and seedling’s survival in assisted natural regeneration of a tropical landscape

Lukas Baumbach: Climate change opportunity costs for reduced $CO_2$ sequestration and habitat losses in Central American forest

17:10 – 17:20 **Egg-timer session 2** (poster) (5’ presentation – 2 slides max)

Nida Dogan-Ciftci: Effects of climate variability on forest health responses in the Black Sea and Mediterranean regions of Turkey

Lenka Navrátilová: Bioeconomy in Slovakia: what does Slovak society have to say about the needed transformation?

20:00 *Gala dinner at the Café Foy* (1 Place Stanislas, 54000 Nancy)

**Wednesday, 1st June 2022 – Conference Day 2:**

9:00 – 9:40 **Invited speaker – Marco Patacca** (Wageningen University and Research, Wageningen Environmental Research) (30’ presentation – 10’ questions)

Forest disturbances in Europe: trends, risks and opportunities

9:40 – 10:40 **Session 4 – Storm damage** (20’ presentation + 10’ questions)

Barry Gardiner: Modelling wind damage risk to trees along train lines

Robin Bourke: Forest growth and storm damage in German forestry, modelled with 3-PG Mix and Lothar

10:40 – 11:00 *Coffee break*

11:00 – 12:30 **Session 5 – Behaviour** (20’ presentation + 10’ questions)

Sumon San: Importance of farmers’ perception and acceptance in agroforestry-based community forests establishment in encroaching farms: a case study in Taungoo District, Myanmar

Stéphane Couture: How can ambiguity influence the optimal management of a forest? An approach with multi-model markov decision processes

Nathalie Carol: Exploring the distinctive role of spaces in strategic sensemaking – A case study at the Office National des Forêts

12:30 – 14:00 *Lunch*


14:00 – 15:30 **Session 6 – Dealing with uncertainty** (20’ presentation + 10’ questions)

Mar Moure: Agroforestry as a climate change adaptation solution? Cognitive models of uncertainties and risks from farmers transitioning to agroforestry

Dominik Sperlich: Aiming at a moving target – how to implement forest adaptation strategies to climate change under socio-, economic and ecological uncertainties?

Frédéric Bonin: Forest planning facing grand challenges: re-designing routines to tackle uncertainty and blockages insights from a case study at the National Forest Office (ONF)

15:30 – 15:40 **Egg-timer session 3** (poster) (5’ presentation – 2 slides max)

Janko Ljubicic: Development of digital site mapping and estimating future tree species suitability in Serbia

Marko Kazimirovic: Site index curves for pedunculate oak (*Quercus robur* L.) in Srem region of Serbia: mapping the current site productivity as reference point for risk analysis

15:40 – 16:00 *Coffee break*

16:00 – 17:00 **Session 7 – Tools and policy** (20’ presentation + 10’ questions)

Klára Báliková: Compensation payments for legal restrictions in Slovak and Czech Republic: The effective approach for forest ecosystem services support?

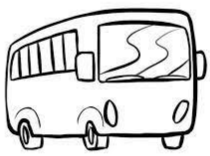
Josiane Kakeu: REDD+ policy integration in land-use sectors: Insights from Cameroon

17:00-17:30 **Conclusions and closing of the conference days and introduction of the field trip**

**Thursday, 2nd June 2022 – Field trip:**

**8:00 – 18:00**

The field trip focuses on abiotic and biotic impacts of climate change in the Vosges region.



# Development of digital site mapping and estimating future tree species suitability in Serbia

Janko Ljubicic[1], Olivera Kosanin[1], Dominik Sperlich[4], Marko Kazimirovic[2], Branko Stajic[2], Nenad Petrovic[2], Ivana Vasic[3], Jelena Nedeljkovic[3], Dragan Nonic[3], Marc Hanewinkel[4], Axel Weinreich[5], Dejan Bakovic[5]

1- Chair of Forest Ecology, Faculty of Forestry, University of Belgrade
2- Chair of Forest Management Planning, Faculty of Forestry, University of Belgrade
3- Chair of Forest Organization and Economics, Faculty of Forestry, University of Belgrade
4- Chair of Forest Economics and Forest Planning, University of Freiburg
5- UNIQUE Landuse Gmbh

## Introduction

- Digital site mapping is a rather new concept which has not been done in Serbia, and can serve as a basis for modern forest management
- **The division of forest area into site types, which represent homogeneous spatial units in terms of vegetation, soil, climate and position (terrain, slope and exposure) is not only ecologically relevant, but essential for forest planning and management**
- The selection of site types can be based on the synthesis of site data, i.e. on the basis of combining soil water balance level (WBL) and soil nutrient regime (NR) of a certain area
- This study presents results of WBL and NR in the area of the Boranja mountain massif (MU "Istocna Boranja") (Fig. 1), on phyllite (Fig. 2) , in beech forests- the most common forest type in Serbia

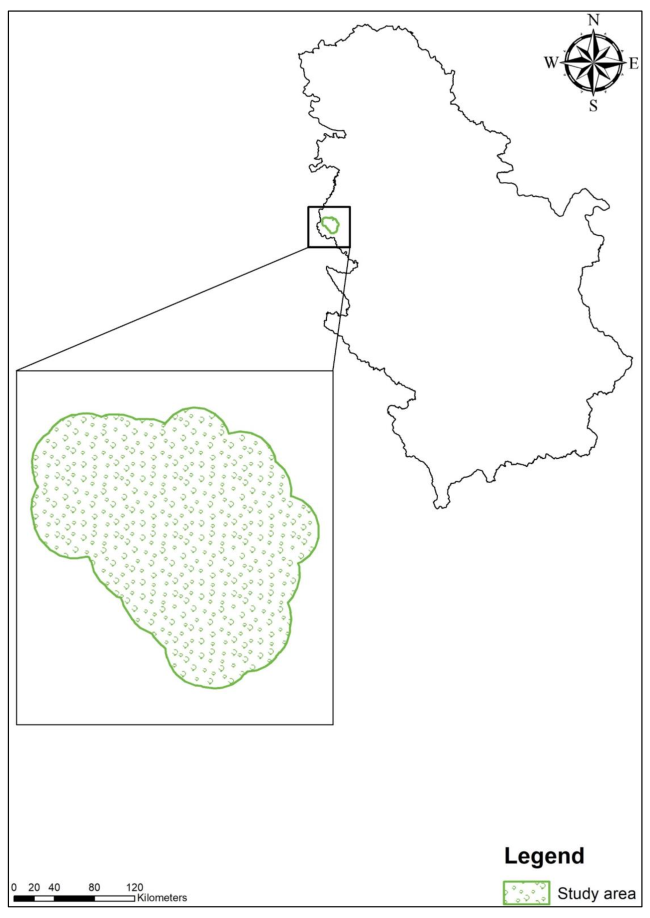


Fig. 1

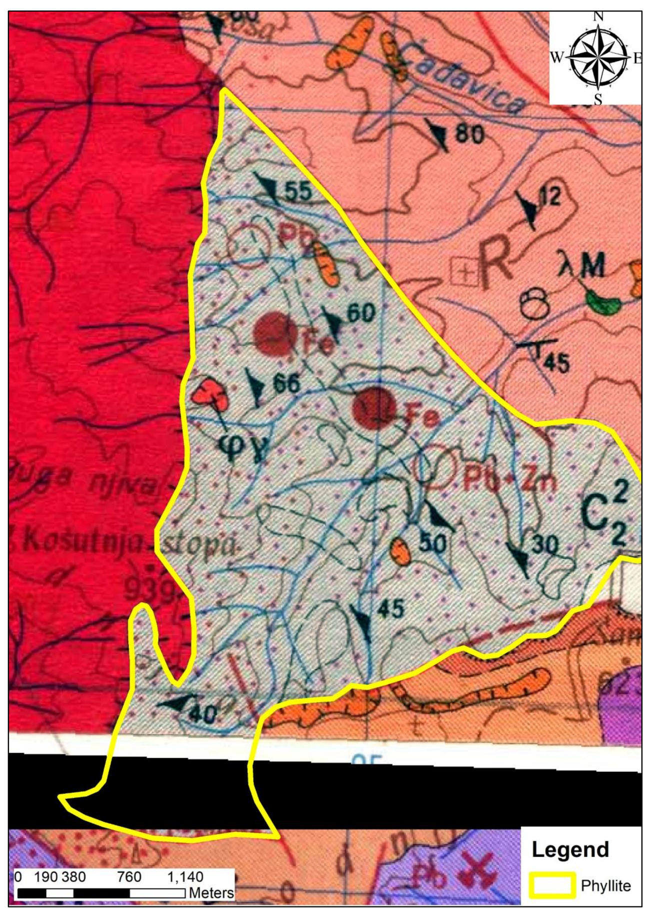


Fig 2.

## Material and methods

- Dominant landforms (geomorphons) were extracted in GIS (Fig. 3), and 46 soil profiles were opened on them (19 were analysed in laboratory) + 46 Vegetation relevés were collected
- Slopes <30° and >30° and warm (S, SW, SE, W), cold (N, NE, NW, E) and neutral aspects (slope up to 12.5°) were taken into account
- The available water capacity (AWC) is determined for each horizon based on: texture, skeletal content, soil density and humus content

$$AWC_{horizon} = (AWC_{tab} * (1- \text{skeletal content } (\%)/100) * \text{depth (mm/dm)}$$

- The obtained AWC values are supplemented by tabular corrections for humus content calculated on horizon capacity, and finally, the obtained AWC values by horizons are summed and the AWC profile is obtained

$$AWC_{profile} = AWC_{horizon\_n1} + AWC_{horizon\_n2} + \ldots AWC_{horizon\_n} \text{ (mm/profile)}$$

- Based on the obtained AWC values (mm), soils are classified into 7 classes (Tab. 1)

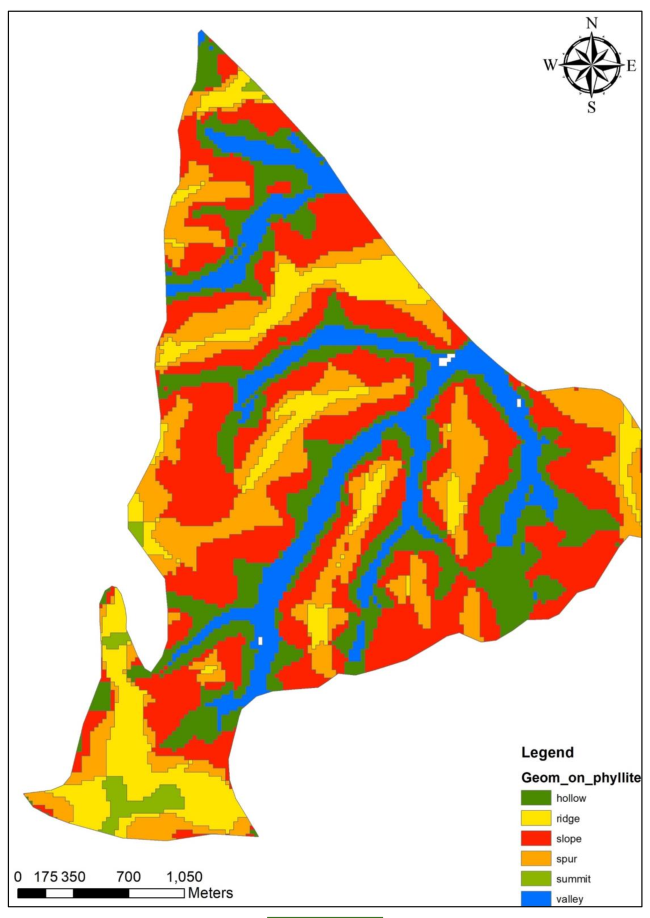


Fig. 3

| AWC [mm] | AWC classes |
|---|---|
| 1 – 10 | 1 |
| 10 - 25 | 2 |
| 25 - 45 | 3 |
| 45 - 65 | 4 |
| 65 - 95 | 5 |
| 95 - 130 | 6 |
| > 130 | 7 |

Tab. 1

## Acknowledgments

The present study is part of the project „Entwicklung und Implementierung von Anpassungsstrategien an den Klima-wandel bei der Waldbewirtschaftung (Adaptive Waldbewirtschaftung – Deutschland - Serbien): (ANKLIWA-DS)

## Material and methods

- The obtained values for AWC, which are determined in field conditions, must be corrected by applying the appropriate transformation tables: frequency table, median transfer table and WBL transfer table from which we derived WBL classes and classified sites according to the water deficit (Tab. 2)
- The most common parameter used to determine the NR is the degree of base saturation or pH value in water
- Based on the pH value and the degree of saturation of the bases, which are determined by laboratory testing or estimated on the basis of a geological map, the NR is assessed through the classification scheme (Tab. 3)

| WBL | Class | Water deficit |
|---|---|---|
| 1 | Extremely dry | Very long periods of water deficit |
| 2 | Very dry | Long periods of water deficit |
| 3 | Dry | Longer periods of water deficit |
| 4 | Medium dry | Occasionally in longer periods of water deficit |
| 5 | A little wet | In shorter periods of water deficit |
| 6 | Moderately humid | Occasionally in short periods of water deficit |
| 7 | Wet | Rarely water deficit |
| 8 | Very humid | Water deficiency is very rare |
| 9 | Extremely humid | Extremely rare water deficiency |

Tab. 2

| Coarse fraction | < 50 % | > 50 % | | |
|---|---|---|---|---|
| | | alkalinity of bedrock | | |
| pH class | | high | medium | less |
| 1 | rich | rich | rich-medium | rich-medium |
| 2 | rich-medium | rich-medium | rich-medium | medium |
| 3 | medium | rich-medium | medium | medium |
| 4 | medium | medium | medium | medium-poor |
| 5 | medium-poor | medium | medium-poor | medium-poor |
| 6 | poor | medium-poor | medium-poor | poor |

Tab. 3

## Results and conclusions

- The obtained results were used for the production of digital maps of WBL and NR
- Landforms (geomorphons) on which the data for the sites were collected are: hollow, ridge, slope (<30° and >30°), spur, summit and valey
- **WBL values range from 4 to 7 (Fig. 4): 4-medium dry; 5-a little wet (slightly moist); 6-moderately humid and 7- wet (humid)**
- **NR occurs from poor to medium (base saturation is used as a parameter) (Fig. 5)**
- By overlapping these maps, site types are obtained in digital form (Fig. 6)
- In further research we will apply multifactor spatially explicit models that include climate data (temperature, precipitation) combined with WBL and NR
- Based on this bioclimatic complex, we will assess occurrence, distribution and suitability of beech under current and future climate conditions

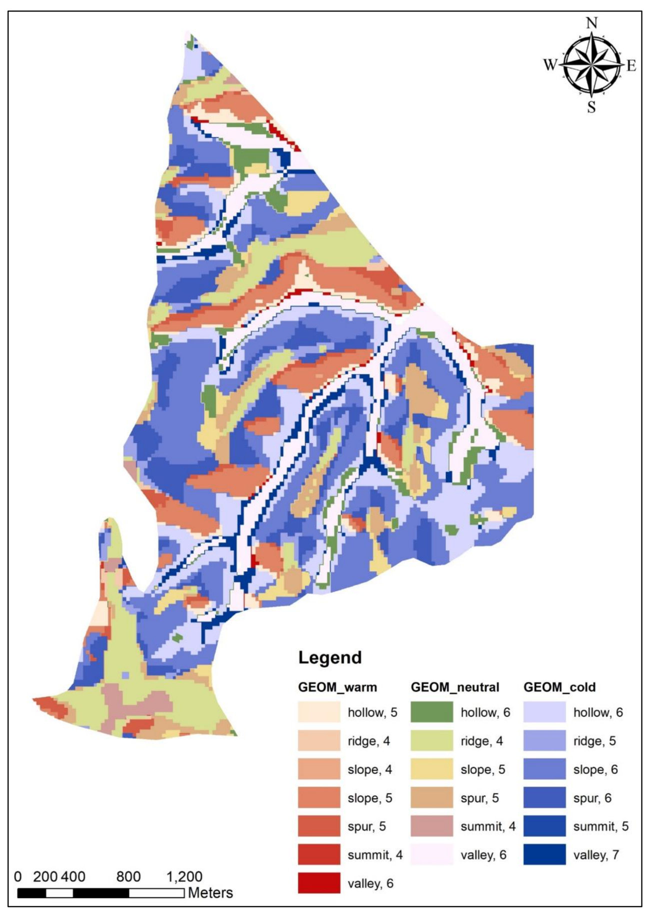


Fig. 4

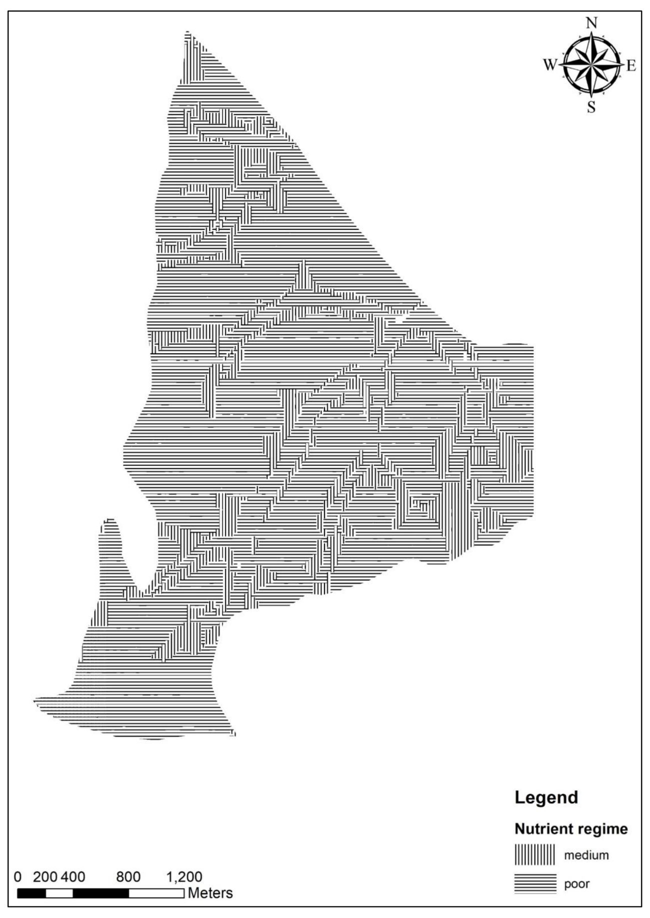


Fig. 5

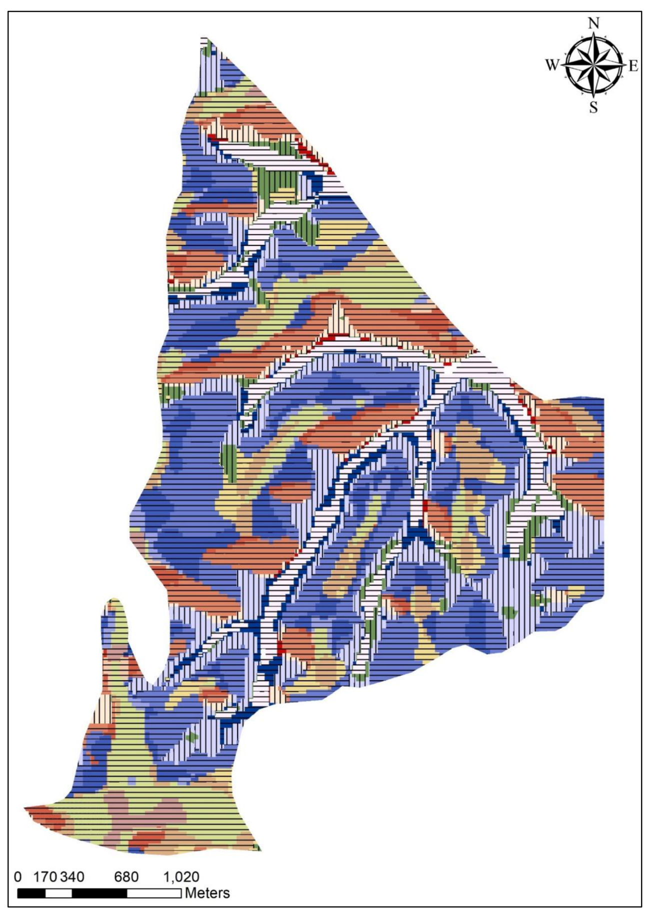


Fig. 6

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**Socio-ecological conflicts in forest management: risks of (not) adapting?**
**May 31 - June 2, 2022**
**Nancy, FRANCE**

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# Site index curves for pedunculate oak (*Quercus robur* L.) in Srem region of Serbia: mapping the current site productivity as reference point for risk analysis

**Marko Kazimirović**[1], Branko Stajić[1], Dominik Sperlich[2], Janko Ljubicić[1], Nenad Petrović[1], Olivera Košanin[1], Axel Weinreich[3], Dejan Baković[3], Marc Hanewinkel[2]

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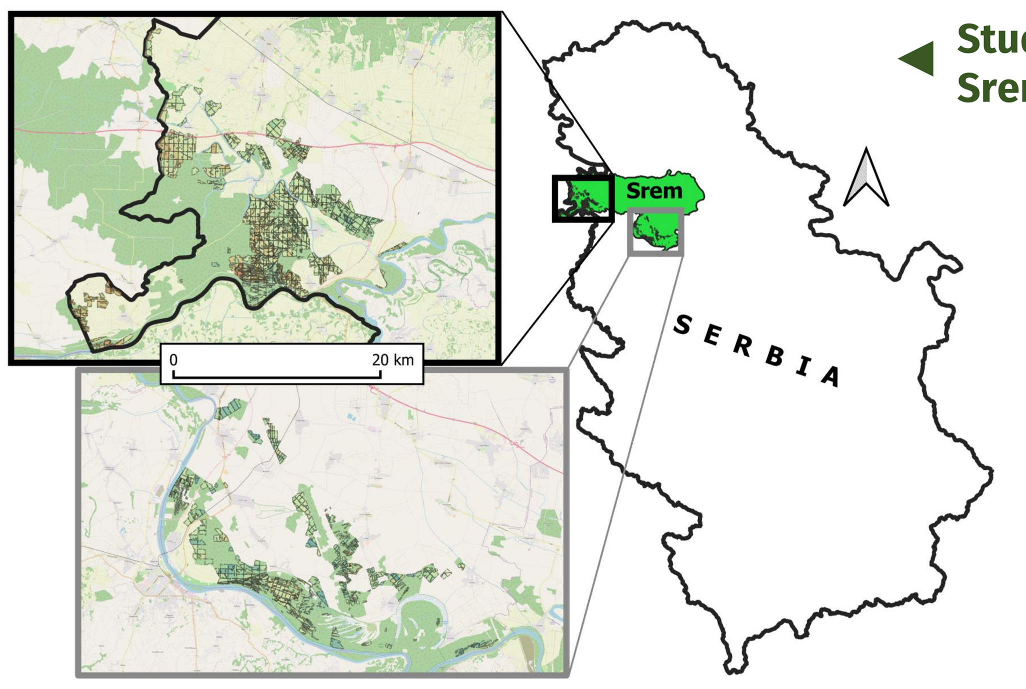
## 1. INTRODUCTION

**Predicting the possible environmental and socio-economic consequences of climate change depends on a reliable comparison of the current and future productivity. Although sustainable forest management should rely on forest site productivity figures, tools for the productivity stratification of highly valuable pedunculate oak stands in the Srem region of Serbia are currently lacking. The most commonly used scale for site quality classification is obtained by sectioning the height-age oscillation range with the desired number of the expected site index curves. The ideal data source for height growth modelling is forest inventory surveys since they contain the complete variation heights along a spatial and ecological gradient. Yet, the usage of those datasets in natural stands is usually restricted due to the unknown age structure. However, fact that light-demanding species are naturally preconditioned to even-aged structure, together with huge commercial interest for pedunculate oak wood, have affected the management plans to contain useful records of stand's age.**

- **Development of the first dynamic site index curves (SI) for the pedunculate oak in the Srem region of Serbia.**
- **Creating the spatially continuous productivity map covering a total of 22 management units**

## 2. MATERIAL & METHODS

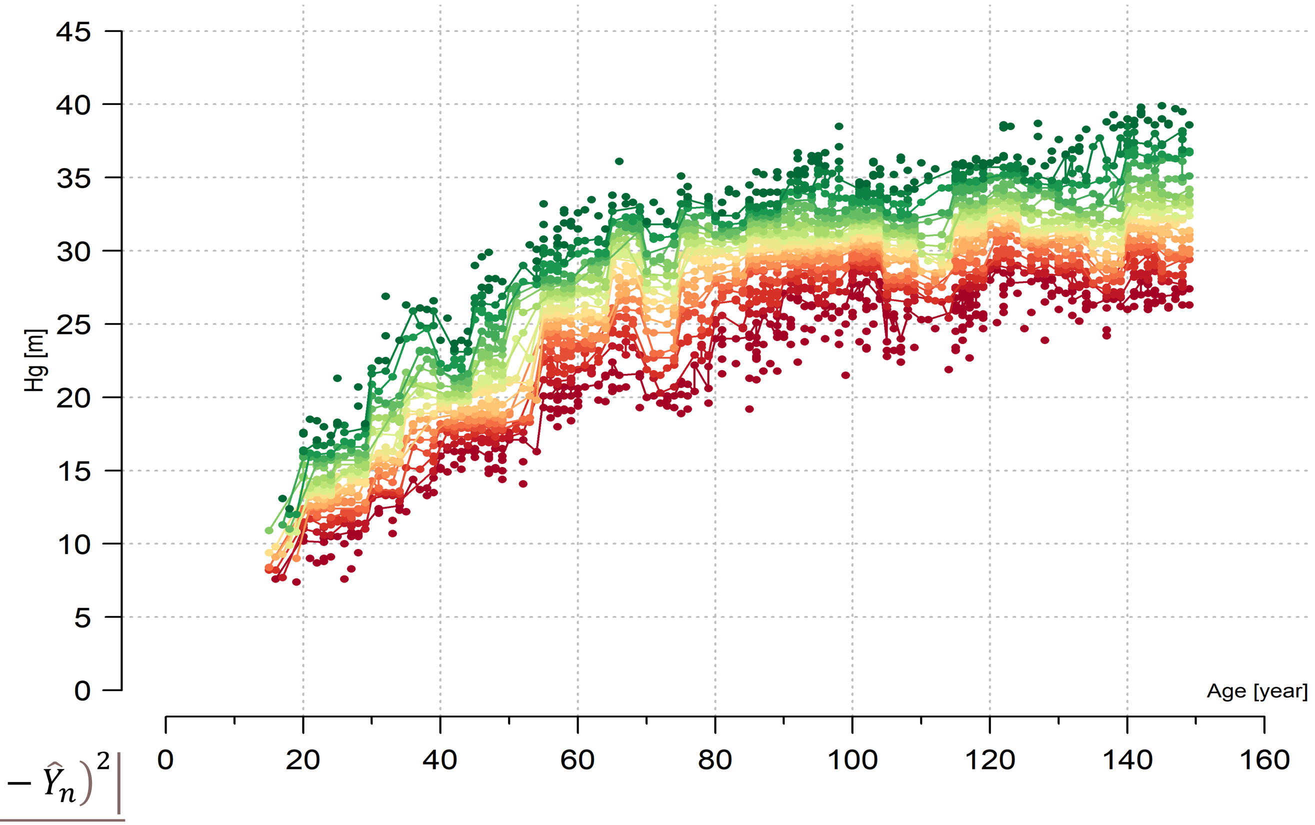



**Study of height growth of pedunculate oak are collected in Srem region located in north-western part of Serbia.**

**Models were calibrated & verified by using the network of 3636 detailed temporary sample plots (TSP).**

| | Parametrisation | | | | | Verification | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | N | $\bar{X}(SD)$ | | min | max | N | $\bar{X}(SD)$ | | min | max |
| 20 | 153 | 24 | 3.91 | 15 | 30 | 93 | 24.81 | 3.25 | 19 | 30 |
| 40 | 251 | 41.2 | 5.68 | 31 | 50 | 155 | 43.77 | 4.68 | 31 | 50 |
| 60 | 252 | 61.03 | 5.43 | 51 | 70 | 226 | 59.81 | 4.59 | 51 | 70 |
| 80 | 257 | 81.18 | 5.77 | 71 | 90 | 244 | 83.35 | 5.2 | 71 | 90 |
| 100 | 301 | 100.05 | 5.62 | 91 | 110 | 366 | 99.81 | 5.27 | 91 | 109 |
| 120 | 258 | 121.11 | 5.28 | 111 | 130 | 262 | 120.81 | 4.78 | 112 | 130 |
| 140 | 261 | 140.11 | 5.44 | 131 | 149 | 206 | 140.95 | 4.98 | 131 | 149 |

**The candidate models were fitted to artificially established growth trajectories.**




**Five flexible polymorphic equations with variable asymptotes, derived by the generalized algebraic difference approach (GADA).**

| Base equation | Site-related parameters | Solution for X with initial conditions $(H_0, T_0)$ | Dynamic form | |
|---|---|---|---|---|
| Hossfeld IV $H = \frac{b \cdot T^c}{T^c + a}$ | $a = \beta_1 R_0^{-1}$; $b = \beta_2 + R_0$ | $X_0 = H_0 - \beta_1 + \sqrt{(H_0 - \beta_1)^2 + \frac{2H_0 e^{\beta_2}}{T_0^c}}$ | $H = H_0 \cdot \frac{T^c(T_0^c X_0 + e^{\beta 2})}{T_0^c(T^c X_0 + e^{\beta 2})}$ | M1 |
| Chapman-Richards: $H = a \cdot (1 - e^{-c \cdot T})^b$ | $a = e^{X_0}$; $b = \beta_1 + \frac{\beta_2}{X_0}$ | $X_o = \frac{(\ln H_0 - \beta_1 L_0) + \sqrt{(\ln H_0 - \beta_1 L_0)^2 - 4\beta_2 L_0}}{2}$; $L_0 = \ln(1 - e^{-cT_0})$ | $H = H_0 \cdot \left(\frac{1 - e^{-cT}}{1 - e^{-cT_0}}\right)^{\beta_1 + \frac{\beta_2}{X_0}}$ | M2 |
| | $a = e^{X_0}$; $b = \beta_1 + \frac{\beta_2}{X_0}$ | $X_o = \frac{(\ln H_0 - \beta_1 \ln(1 - e^{-cT_0}))}{1 + \beta_2 \ln(1 - e^{-cT_0})}$ | $H = H_0 \cdot \left(\frac{1 - e^{-cT}}{1 - e^{-cT_0}}\right)^{\beta_1 + \beta_2 \cdot X_0}$ | M3 |
| Lundqvist: $H = a \cdot e^{-b \cdot T^{-c}}$ | $a = e^{X_0}$; $b = \beta_1 + \frac{\beta_2}{X_0}$ | $X_o = \frac{\beta_1 \cdot T^{-c} + \ln H_0 + L_0}{2}$; $L_0 = \sqrt{(\beta_1 \cdot T_0^{-c} + \ln H_0)^2 + 4\beta_2 \cdot T_0^{-c}}$ | $H = e^{X_0} \cdot e^{-(\beta_1 + \frac{\beta_2}{X_0}) \cdot T^{-c}}$ | M4 |
| Weibull: $H = a \cdot (1 - e^{-b \cdot T^c})$ | $a = X_0$; $b = \beta_1 + \beta_2 X_0$ | $X_0 = \frac{\ln H_0 - \beta_1 \cdot \ln(1 - e^{-T^c})}{1 + \beta_2 \cdot \ln(1 - e^{-T^c})}$ | $H = e^{X_0 + (\beta_1 + \beta_2 X_0) \cdot \ln(1 - e^{-T^c})}$ | M5 |

**The best model is selected using:**

- **quantitative measures of goodness of fit**

$$\bar{e} = \frac{\sum_{n=1}^{N}(Y_n - \widehat{Y}_n)}{N} \qquad RMSE = \sqrt{\frac{\sum_{n=1}^{N}\left(Y_n - \hat{Y}_n\right)^2}{N - p}}$$

$$MEF = 1 - \frac{\sum_{n=1}^{N}\left(Y_n - \hat{Y}_n\right)^2}{\sum_{n=1}^{N}(Y_n - \bar{Y})^2} \qquad MAD = \frac{\sum_{n=1}^{N}\left|\left(Y_n - \hat{Y}_n\right)^2\right|}{N}$$

- **the analysis of residual scattering and**
- **the biological plausibility**

**Expected $SI_{100}$ for oak was first determined and then subsequently mapped for pure and mixed stands.**

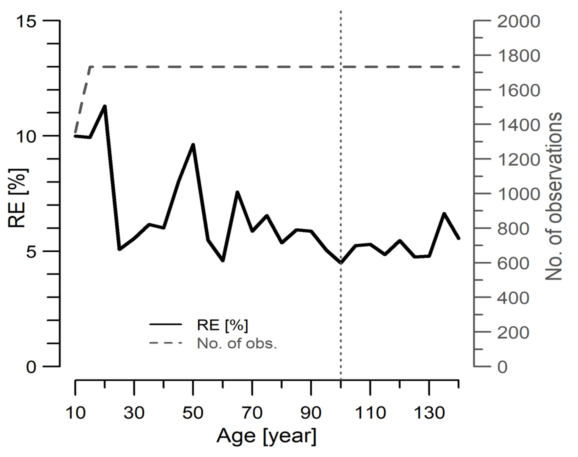
## 3. RESULTS & DISCUSSION

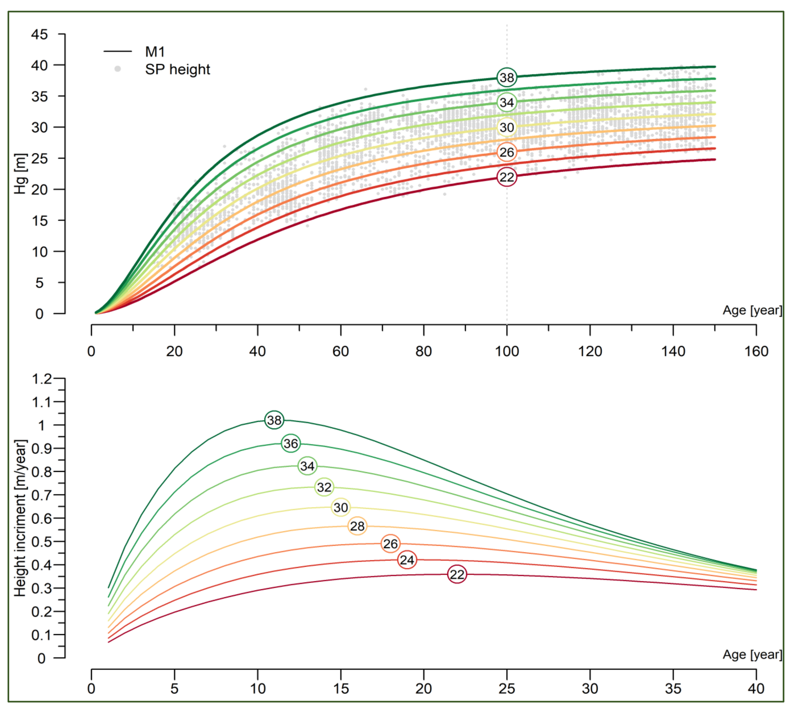
| Model | Par. | Estimate | Standard error | *t-value* | *p* |
|---|---|---|---|---|---|
| M1 | $\beta_1$ | 22.21846 | 2.640614 | 8.414127 | *** |
| | $\beta_2$ | 9.105472 | 0.2967 | 30.689166 | *** |
| | $c$ | 1.690559 | 0.061311 | 27.573571 | *** |
| | $\rho_1$ | 0.804632 | | | |
| M2 | $\beta_1$ | -4.819214 | 0.959261 | -5.023882 | *** |
| | $\beta_2$ | 21.198305 | 3.387182 | 6.25839 | *** |
| | $c$ | 0.028152 | 0.001047 | 26.876751 | *** |
| | $\rho_1$ | 0.788599 | | | |
| M3 | $\beta_1$ | 7.347052 | 0.988377 | 7.43345 | *** |
| | $\beta_2$ | -1.7448 | 0.279239 | -6.248406 | *** |
| | $c$ | 0.028154 | 0.001047 | 26.884978 | *** |
| | $\rho_1$ | 0.788547 | | | |
| M4 | $\beta_1$ | -99.295894 | 34.830912 | -2.850798 | ** |
| | $\beta_2$ | 434.709643 | 130.822338 | 3.322901 | *** |
| | $c$ | 0.886917 | 0.045135 | 19.65043 | *** |
| | $\rho_1$ | 0.83759 | | | |
| M5 | $\beta_1$ | 104.147915 | 18.576513 | 5.60643 | *** |
| | $\beta_2$ | -24.54002 | 5.157348 | -4.758264 | *** |
| | $c$ | 0.333087 | 0.005972 | 55.771999 | *** |
| | $\rho_1$ | 0.81869 | 2.305662 | 2.305662 | |

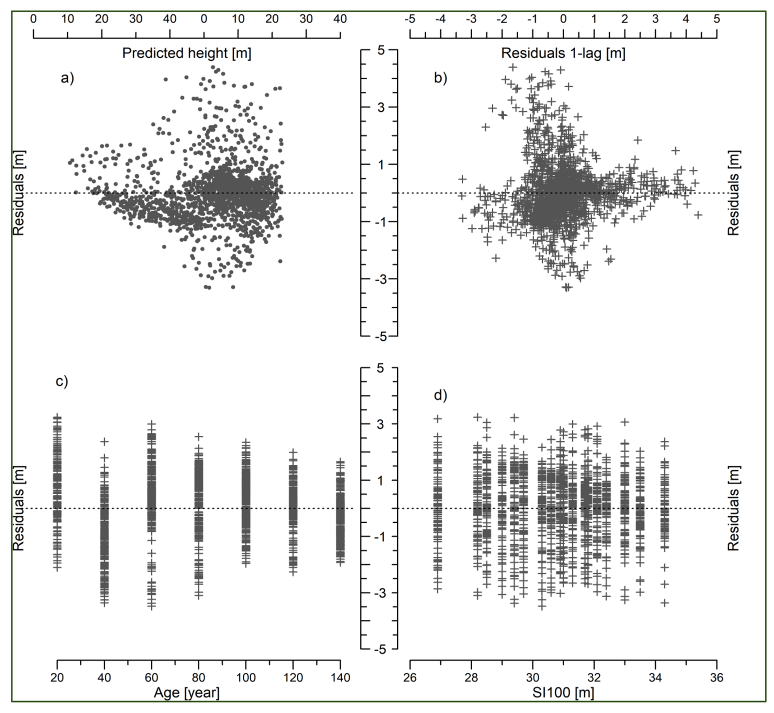
| Model | Fitting statistics | | | | | Validation statistics | | | Growth | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{e}$ | *RMSE* | $R^2$ | *d-w* | *AIC* | Bias | *MAD* | *MEF* | Asy. | Culm. | Age |
| M1 | 0.0631 | 1.1195 | 0.9676 | 1.98 | 3793.96 | -0.0099 | 0.2439 | 0.9975 | 43.4 | 1.13 | 11 |
| M2 | 0.0388 | 1.0973 | 0.9707 | 1.98 | 3898.04 | 0.0076 | 0.2457 | 0.9975 | 42.1 | 1.69 | 1 |
| M3 | 0.0387 | 1.0972 | 0.9707 | 1.98 | 3897.97 | 0.0064 | 0.2460 | 0.9975 | 42.0 | 1.79 | 1 |
| M4 | 0.0592 | 1.2588 | 0.9614 | 2.01 | 3970.89 | 0.0100 | 0.2440 | 0.9975 | 47.8 | 1.53 | 7 |
| M5 | 0.0481 | 1.1879 | 0.9656 | 1.99 | 3942.91 | 0.0008 | 0.2474 | 0.9975 | 44.5 | 1.37 | 5 |

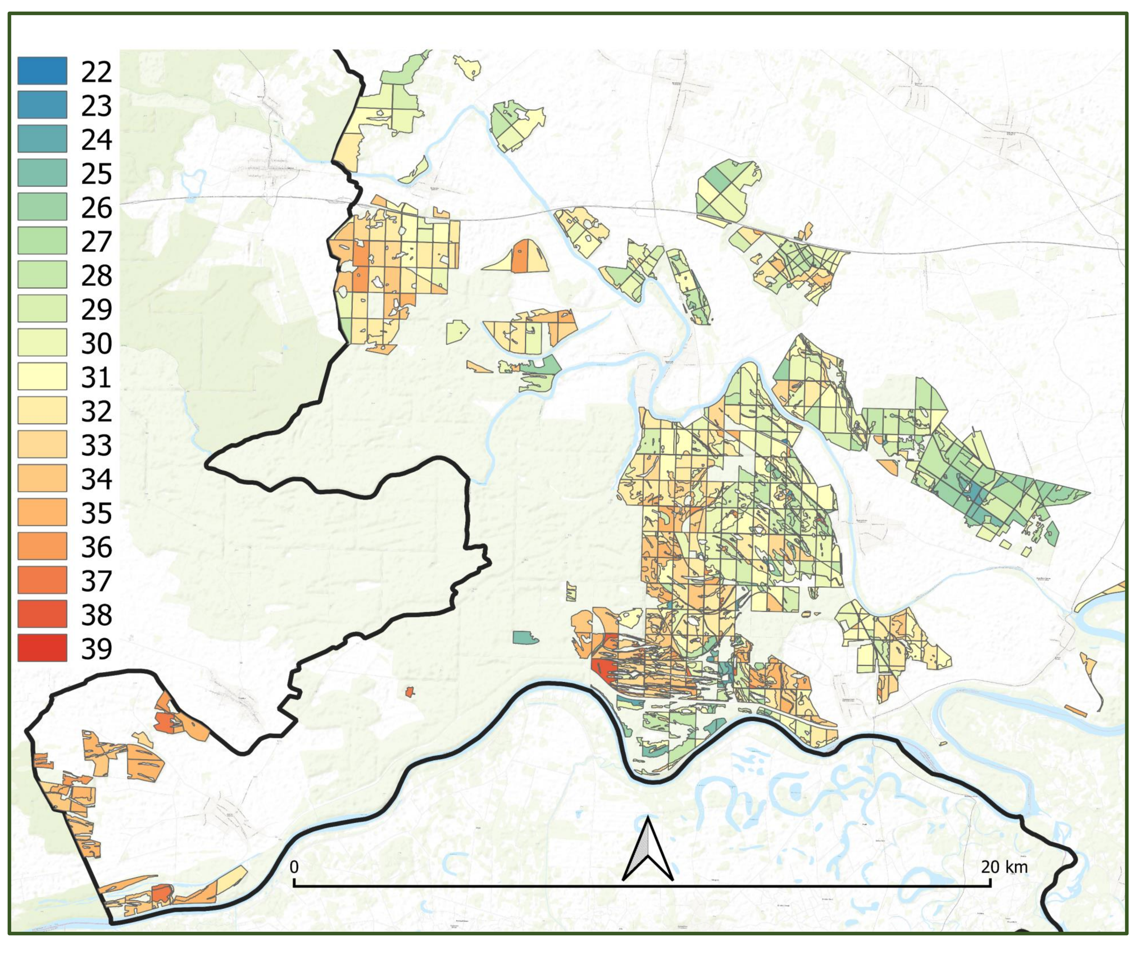
$$H = H_0 \cdot \frac{T^{1.690559}\left(T_0^{1.690559}\ X_0 + e^{9.105472}\right)}{T_0^{1.690559}\left(T^{1.690559} X_0 + e^{9.105472}\right)}$$

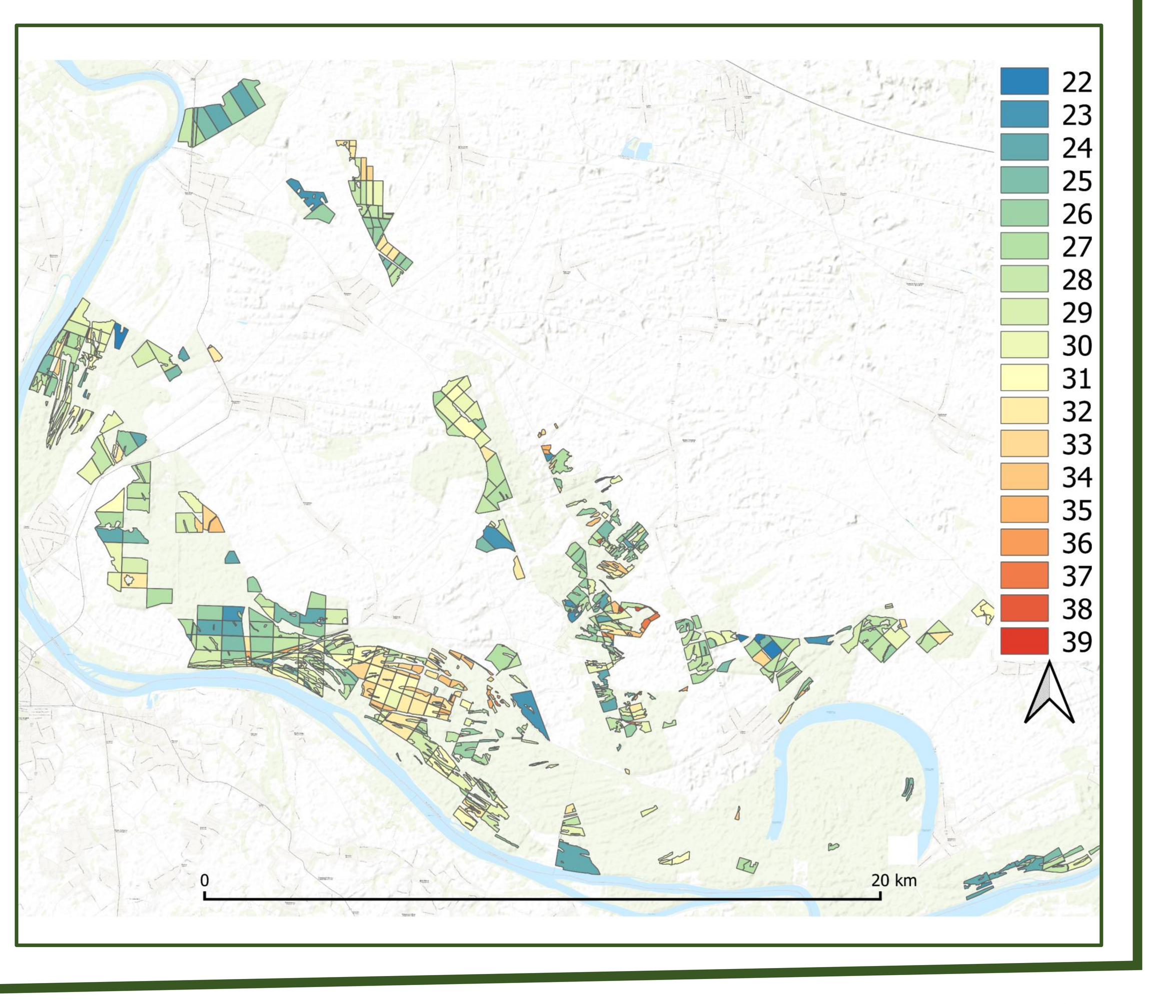
$$X_0 = H_0 - 22.21846 + \sqrt{(H_0 - 22.21846)^2 + \frac{2H_0 \cdot e^{9.105472}}{T_0^{1.690559}}}$$




## 4. REFERENCES

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