# IMPACT OF CLIMATE CHANGE ON FORESTS IN SERBIA - IMPLICATIONS FOR FOREST MANAGEMENT PLANNING

Dejan STOJANOVIĆ

Institute of Lowland Forestry and Environment,

University of Novi Sad,

Antona Cehova 13d, 21000 Novi Sad, Serbia

dejan.stojanovic@uns.ac.rs

# Forest functions and ecosystem services

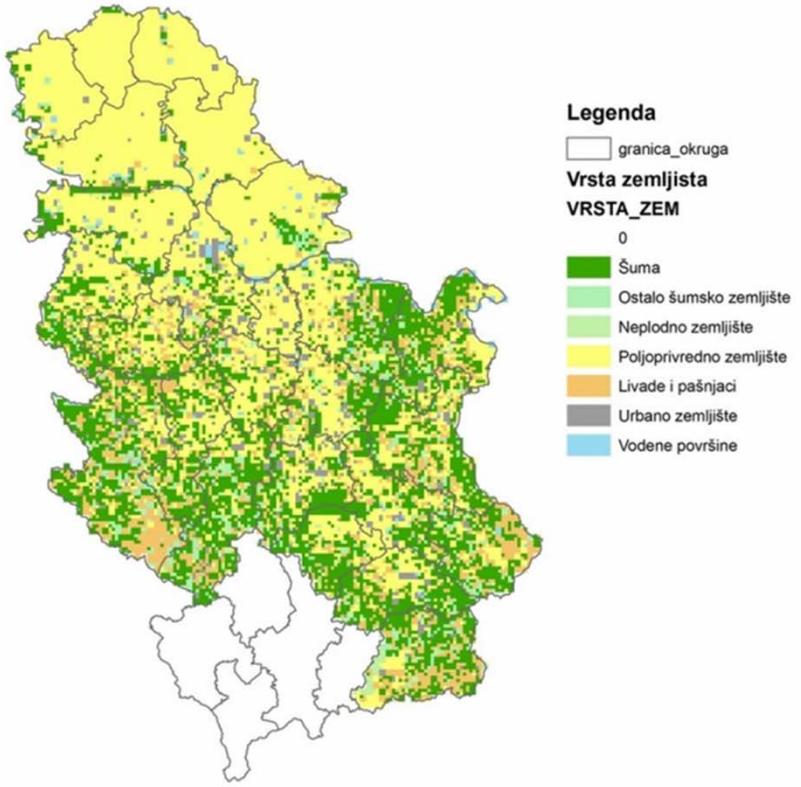
- Every decision made in forestry has and impact to different issues:
  - economical (timber production, livestock, hunting, etc.)
  - environmental (soil erosion, biodiversity conservation, carbon sequestration, etc.) and
  - social (recreational activities, level of employment, population settlement, etc.) (Diaz-Balteiro and Romero, 2008).
- Therefore, forest management planning has great impact to the different sectors and society as a whole.

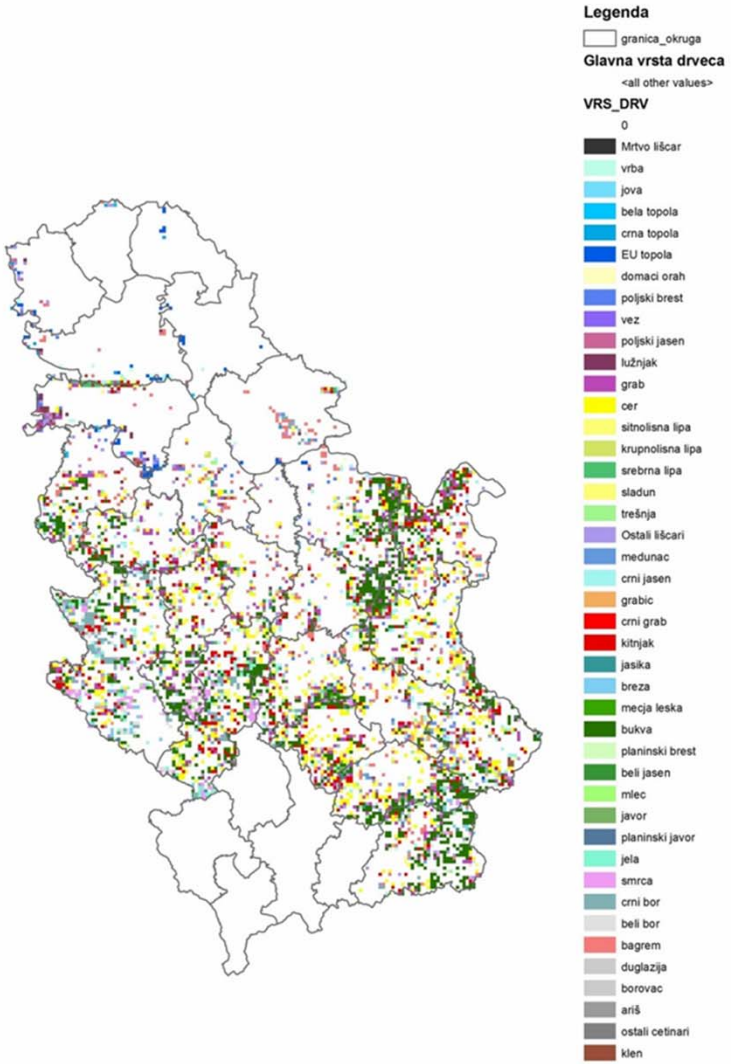
- **Fires in Serbia, 2007**

- **Ice storm in Slovenia, 2014**

- **Wind storm in Slovakia, 2004**

# Forests in Serbia

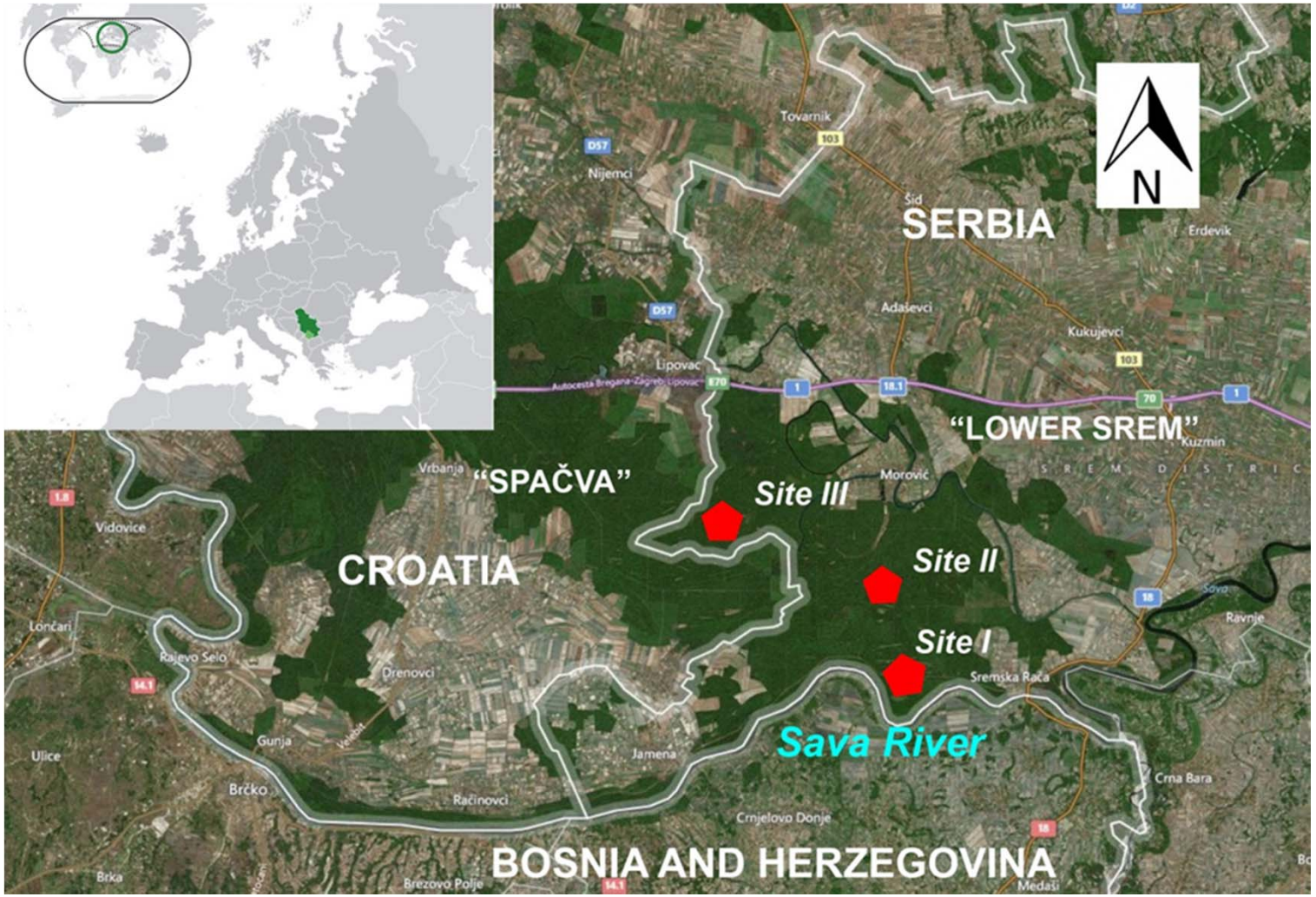


# Case studies

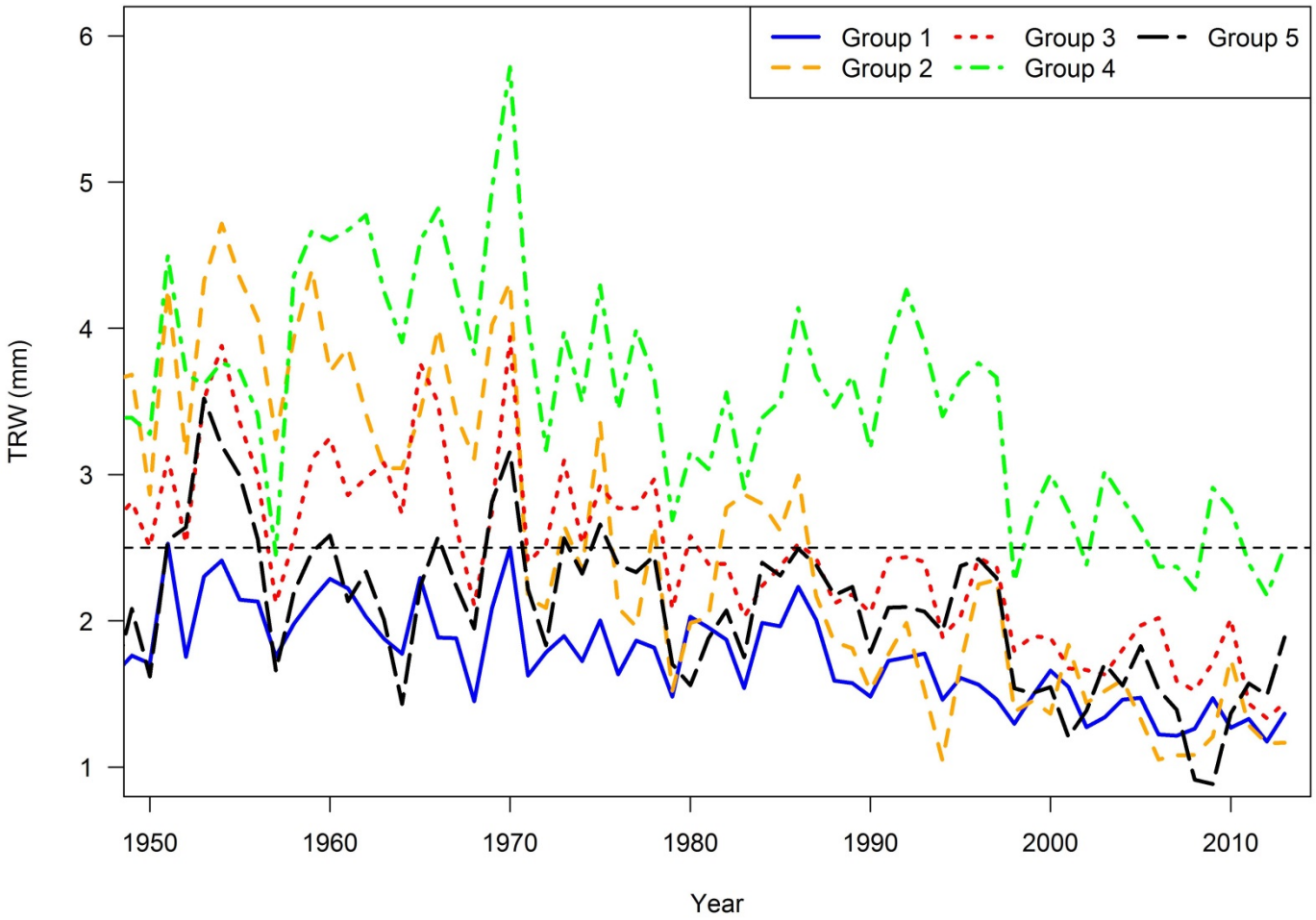
- Pedunculate oak (*Quercus robur*) and European beech (*Fagus sylvatica*)
- Different managemnent regimes
- Different ecology

# Pedunculate oak

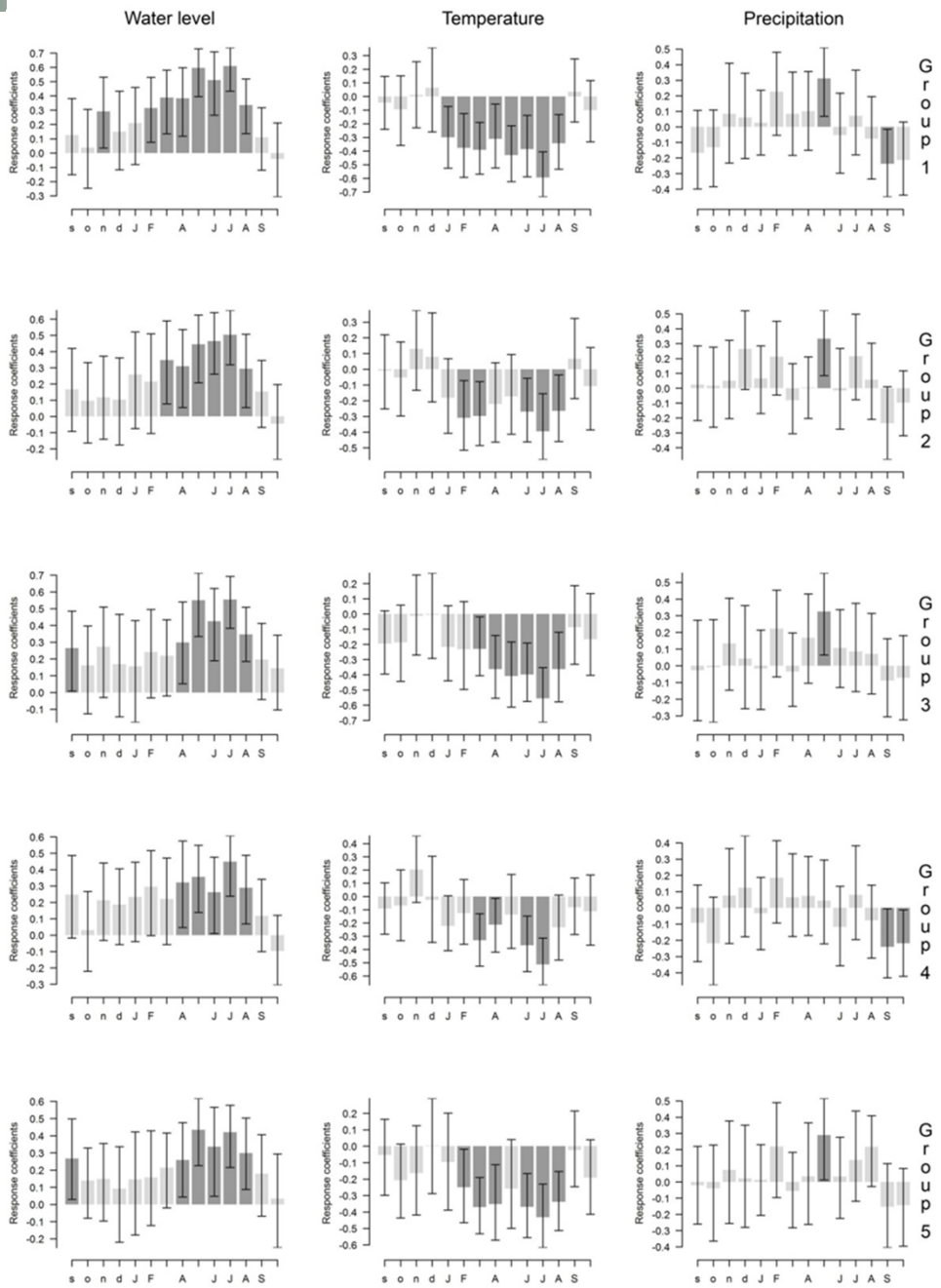


Strict nature reserve “Stara Vratična“, I category

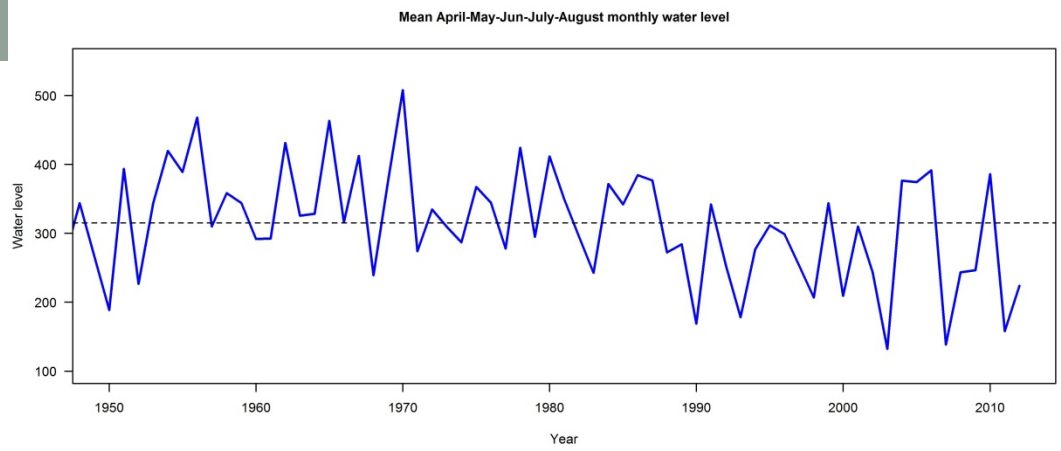
Old tree with diameter of 210cm at breast height (Smogva)

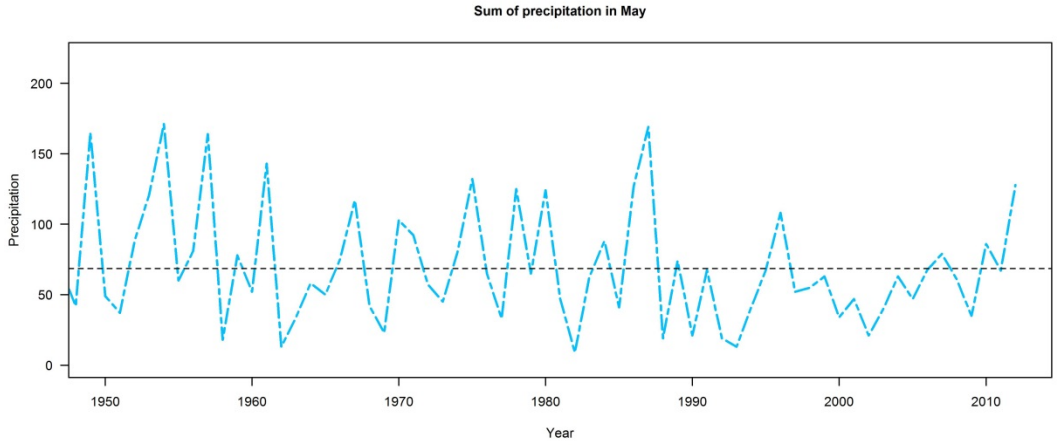


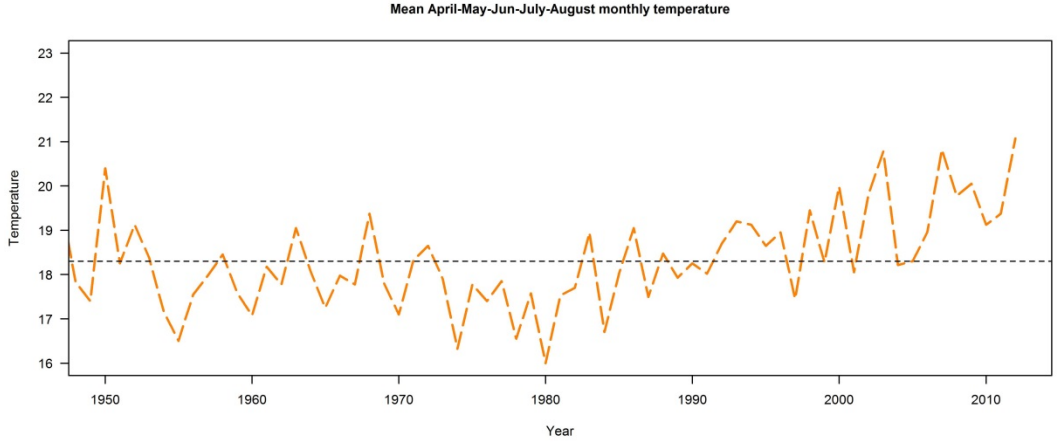

Tree-ring widths of five tree groups for the period 1951-2012

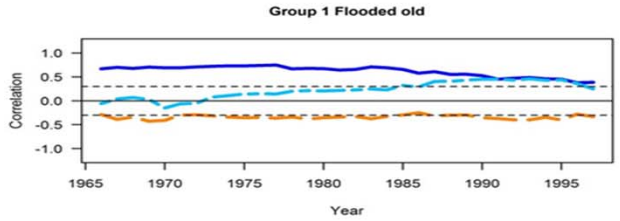


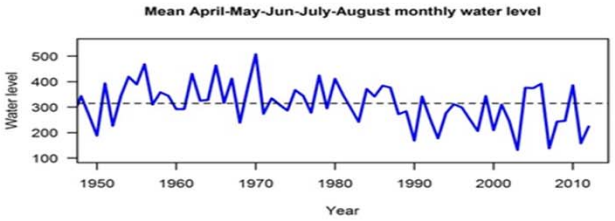

- Simple Pearson's correlation between TRW (std.) and water level, temperature and precipitation (left to right) for five tree categories (up to down) for the period 1951-2012 (small letters represent the previous year and capital the year of the growth). Dark colour represents bootstrapped correlations significant at $p<0.05$ ($n=62$).

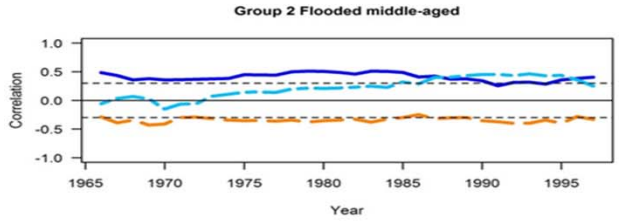

Mean April-May-Jun-July-August monthly water level
Water level
500
400
300
200
100
1950
1960
1970
1980
1990
2000
2010
Year

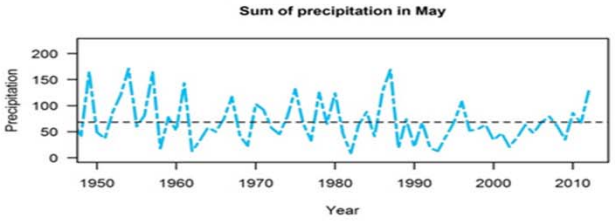

Sum of precipitation in May
Precipitation
200
150
100
50
0
1950
1960
1970
1980
1990
2000
2010
Year

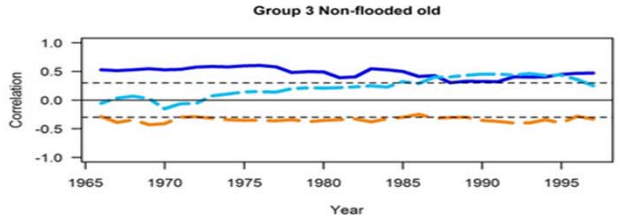

Mean April-May-Jun-July-August monthly temperature
Temperature
23
22
21
20
19
18
17
16
1950
1960
1970
1980
1990
2000
2010
Year

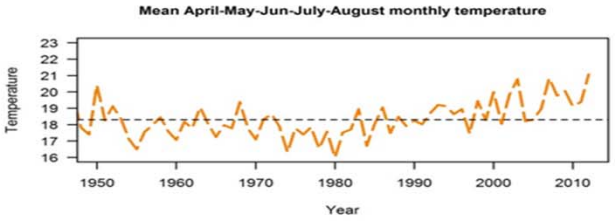

Group 1 Flooded old
Correlation
1.0
0.5
0.0
-0.5
-1.0
1965
1970
1975
1980
1985
1990
1995
Year

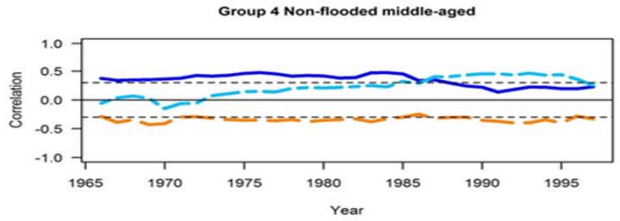

Mean April-May-Jun-July-August monthly water level
Water level
500
400
300
200
100
1950
1960
1970
1980
1990
2000
2010
Year

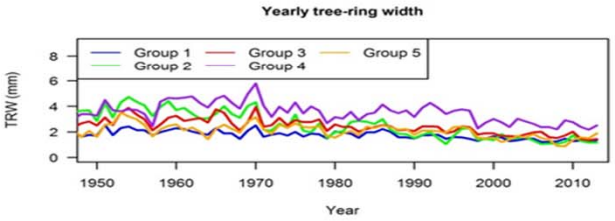

Group 2 Flooded middle-aged
Correlation
1.0
0.5
0.0
-0.5
-1.0
1965
1970
1975
1980
1985
1990
1995
Year

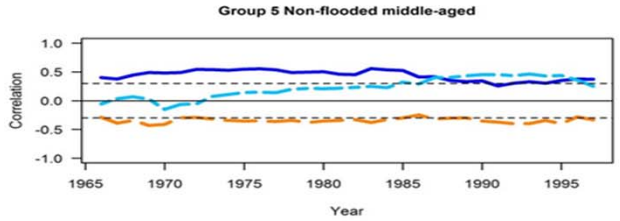

Sum of precipitation in May
Precipitation
200
150
100
50
0
1950
1960
1970
1980
1990
2000
2010
Year

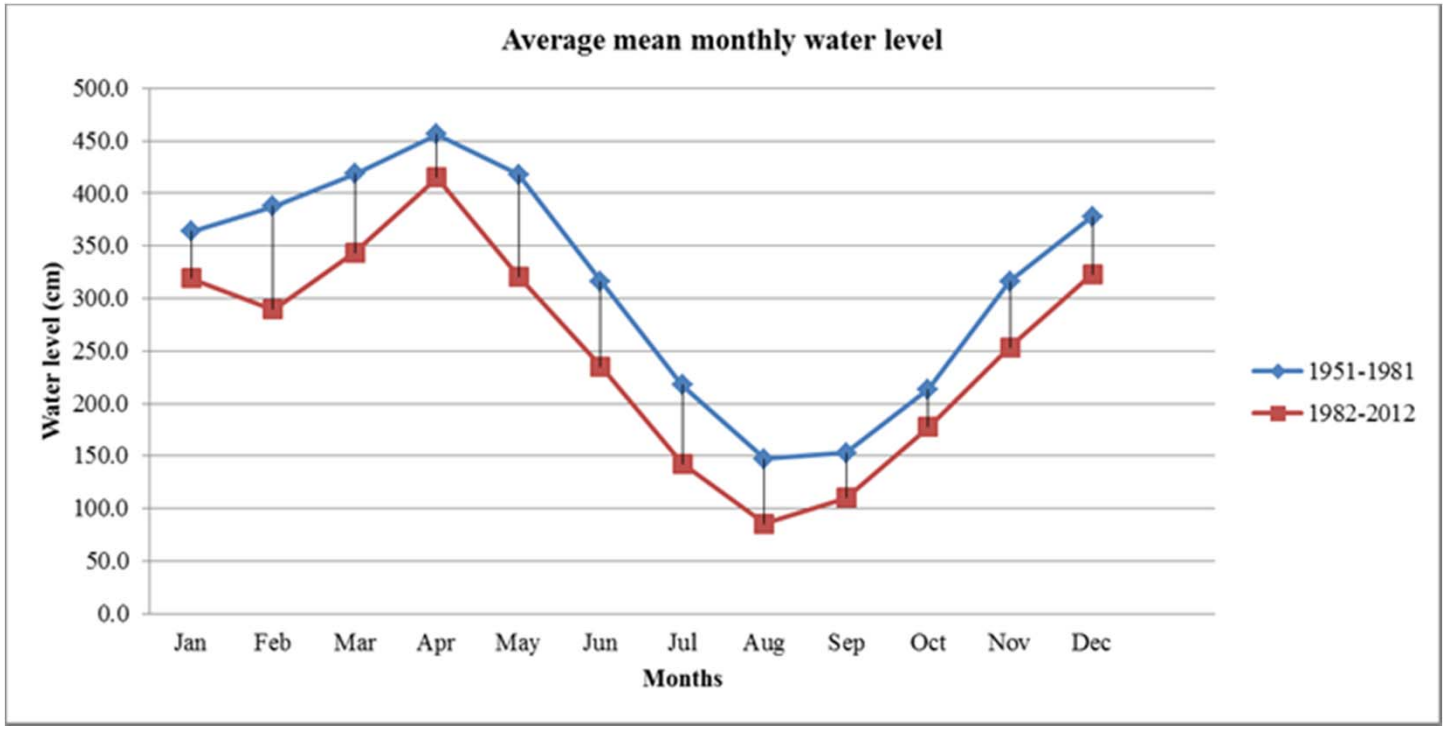

Group 3 Non-flooded old
Correlation
1.0
0.5
0.0
-0.5
-1.0
1965
1970
1975
1980
1985
1990
1995
Year


Mean April-May-Jun-July-August monthly temperature
Temperature
23
22
21
20
19
18
17
16
1950
1960
1970
1980
1990
2000
2010
Year

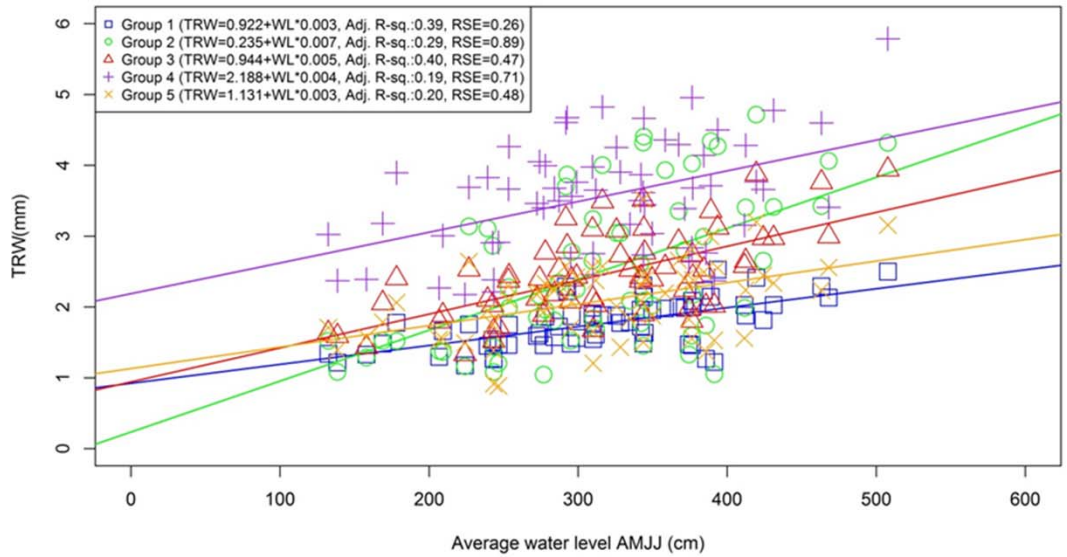

Group 4 Non-flooded middle-aged
Correlation
1.0
0.5
0.0
-0.5
-1.0
1965
1970
1975
1980
1985
1990
1995
Year

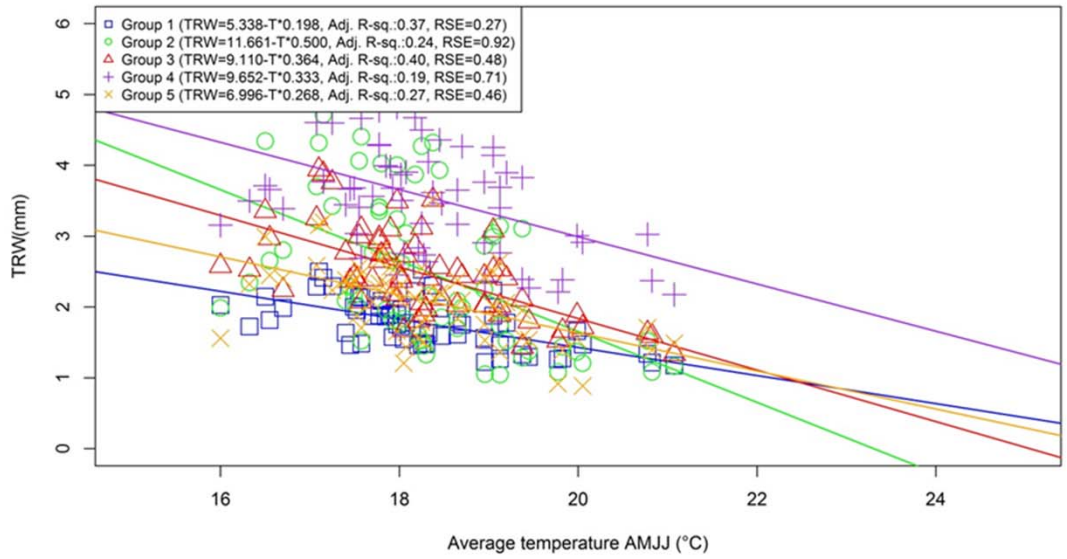

Yearly tree-ring width
Group 1
Group 2
Group 3
Group 4
Group 5
TRW (mm)
8
6
4
2
0
1950
1960
1970
1980
1990
2000
2010
Year

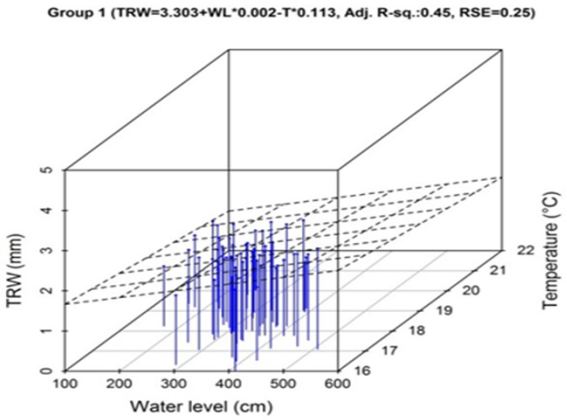

Group 5 Non-flooded middle-aged
Correlation
1.0
0.5
0.0
-0.5
-1.0
1965
1970
1975
1980
1985
1990
1995
Year

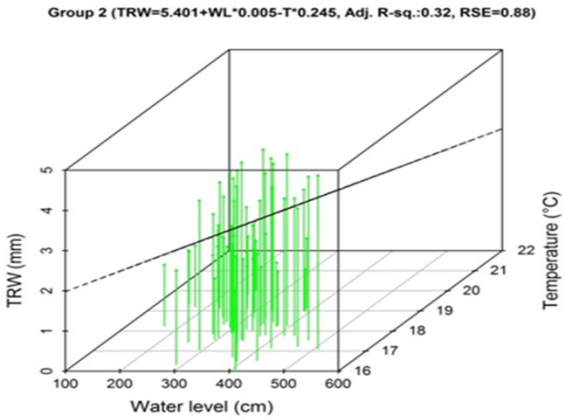


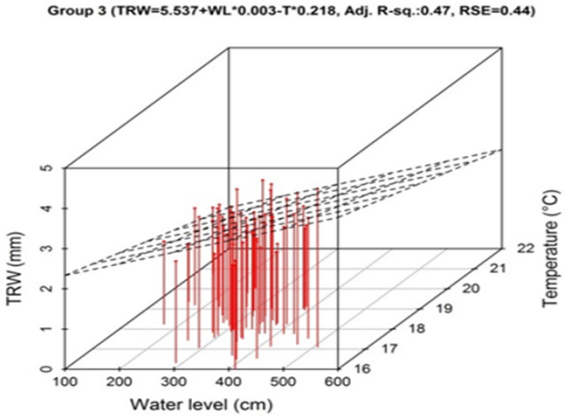

Changes in average monthly water levels for two time periods (1951-1981 and 1982-2012)

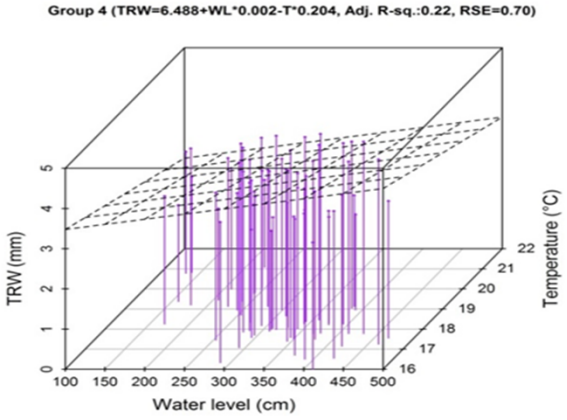

Group 1 (TRW=0.922+WL*0.003, Adj. R-sq.:0.39, RSE=0.26)
Group 2 (TRW=0.235+WL*0.007, Adj. R-sq.:0.29, RSE=0.89)
Group 3 (TRW=0.944+WL*0.005, Adj. R-sq.:0.40, RSE=0.47)
Group 4 (TRW=2.188+WL*0.004, Adj. R-sq.:0.19, RSE=0.71)
Group 5 (TRW=1.131+WL*0.003, Adj. R-sq.:0.20, RSE=0.48)
TRW(mm)
0
1
2
3
4
5
6
0
100
200
300
400
500
600
Average water level AMJJ (cm)

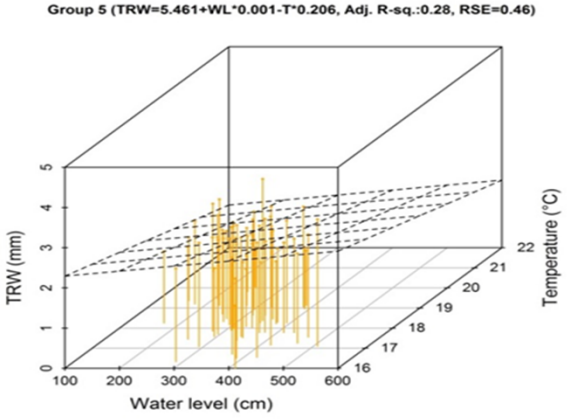

Group 1 (TRW=5.338-T*0.198, Adj. R-sq.:0.37, RSE=0.27)
Group 2 (TRW=11.661-T*0.500, Adj. R-sq.:0.24, RSE=0.92)
Group 3 (TRW=9.110-T*0.364, Adj. R-sq.:0.40, RSE=0.48)
Group 4 (TRW=9.652-T*0.333, Adj. R-sq.:0.19, RSE=0.71)
Group 5 (TRW=6.996-T*0.268, Adj. R-sq.:0.27, RSE=0.46)
TRW(mm)
0
1
2
3
4
5
6
16
18
20
22
24
Average temperature AMJJ (°C)


Group 1 (TRW=3.303+WL*0.002-T*0.113, Adj. R-sq.:0.45, RSE=0.25)
TRW (mm)
Water level (cm)
Temperature (°C)


Group 2 (TRW=5.401+WL*0.005-T*0.245, Adj. R-sq.:0.32, RSE=0.88)
TRW (mm)
Water level (cm)
Temperature (°C)


Group 3 (TRW=5.537+WL*0.003-T*0.218, Adj. R-sq.:0.47, RSE=0.44)
TRW (mm)
Water level (cm)
Temperature (°C)


Group 4 (TRW=6.488+WL*0.002-T*0.204, Adj. R-sq.:0.22, RSE=0.70)
TRW (mm)
Water level (cm)
Temperature (°C)


Group 5 (TRW=5.461+WL*0.001-T*0.206, Adj. R-sq.:0.28, RSE=0.46)
TRW (mm)
Water level (cm)
Temperature (°C)

# European beech

# European beech

- Current forests, as well as those that are planted today, will be exposed to drastically different climate conditions.

Agricultural and Forest Meteorology 176 (2013) 94–103

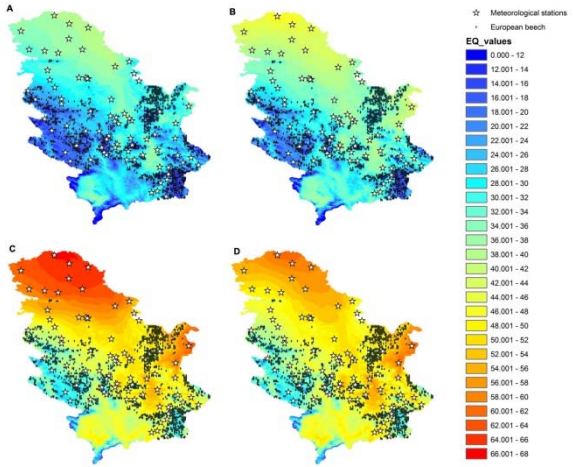
Contents lists available at SciVerse ScienceDirect

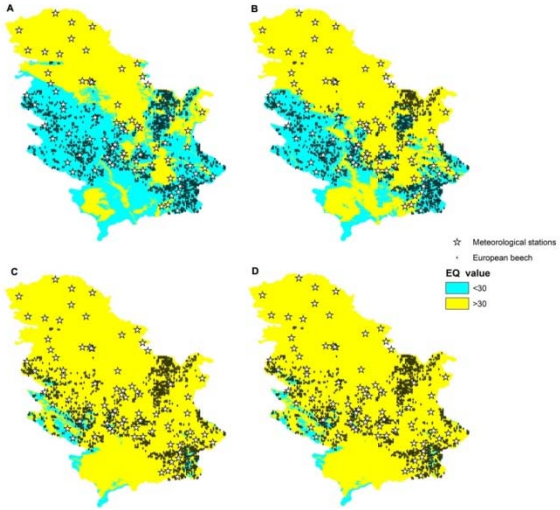
Agricultural and Forest Meteorology

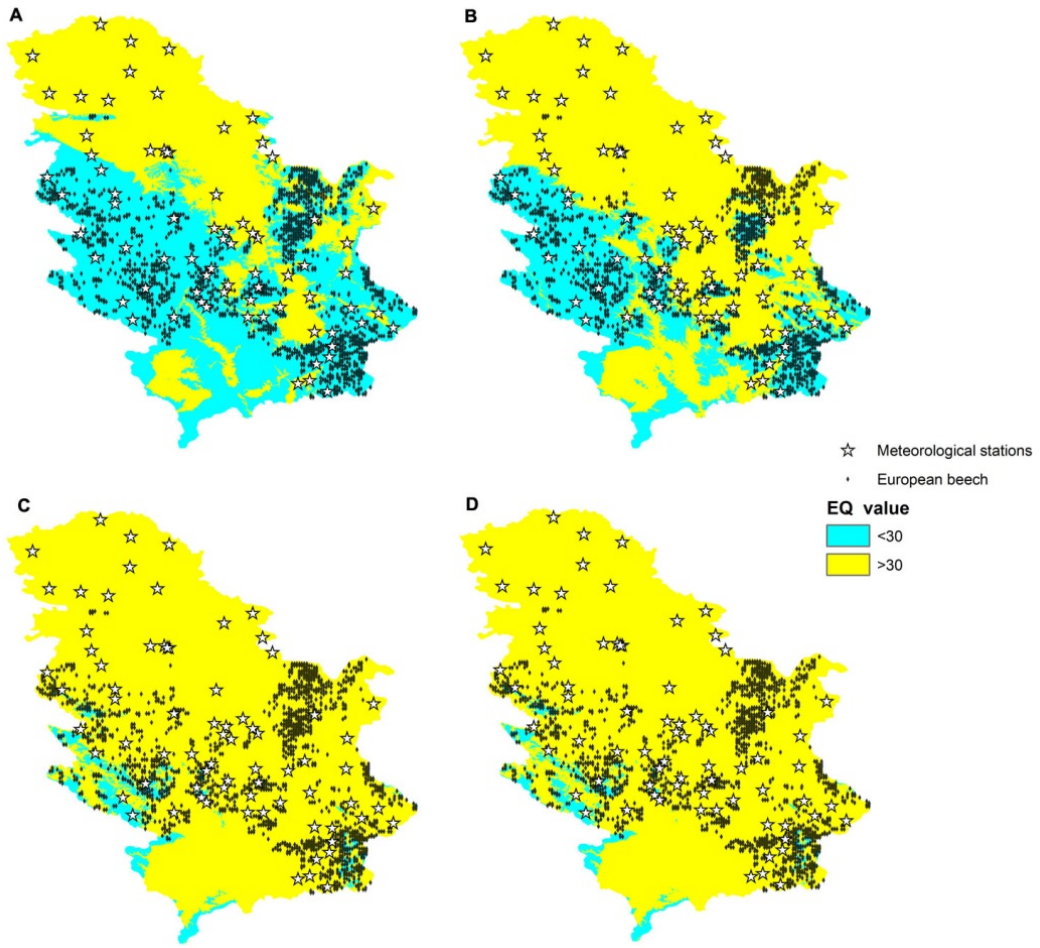
journal homepage: www.elsevier.com/locate/agrformet

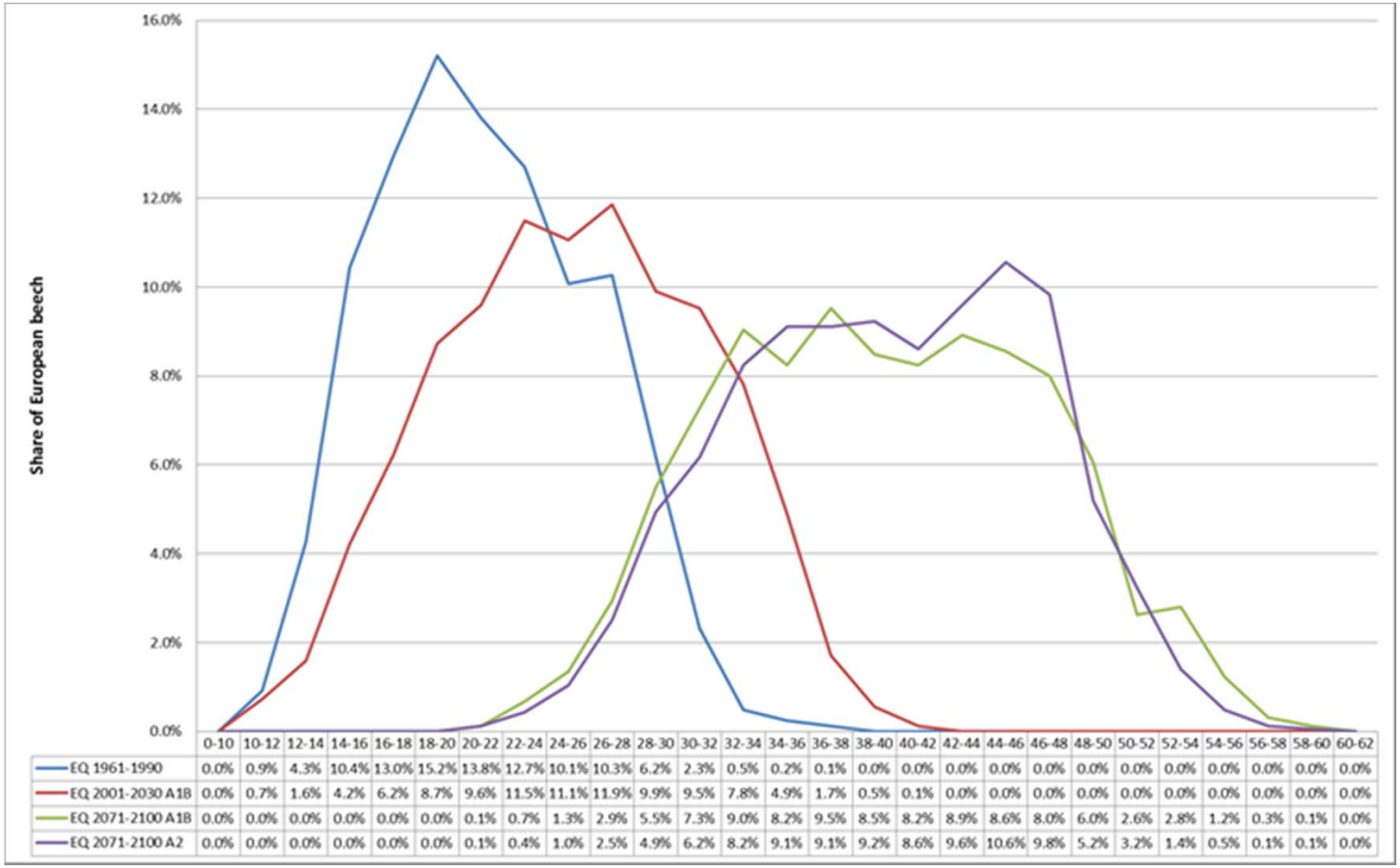
Prediction of the European beech (*Fagus sylvatica* L.) xeric limit using a regional climate model: An example from southeast Europe

Dejan B. Stojanović[a,*], Aleksandra Kržič[b], Bratislav Matović[a], Saša Orlović[a], Anne Duputie[c], Vladimir Djurdjević[b,d], Zoran Galić[a], Srdjan Stojnić[a]




A
B
C
D
Meteorological stations
European beech
EQ value
<30
>30

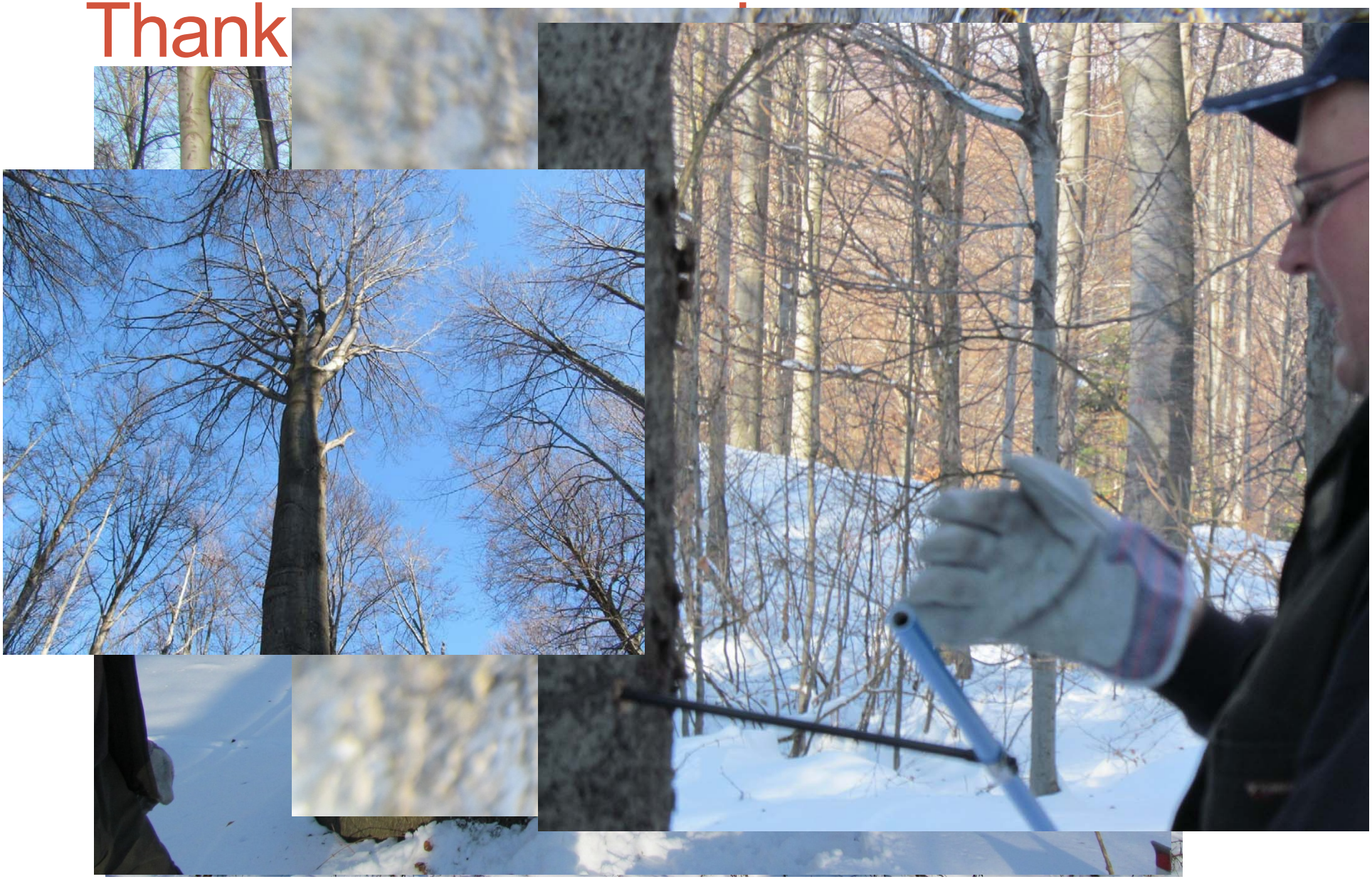



| | 0-10 | 10-12 | 12-14 | 14-16 | 16-18 | 18-20 | 20-22 | 22-24 | 24-26 | 26-28 | 28-30 | 30-32 | 32-34 | 34-36 | 36-38 | 38-40 | 40-42 | 42-44 | 44-46 | 46-48 | 48-50 | 50-52 | 52-54 | 54-56 | 56-58 | 58-60 | 60-62 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EQ 1961-1990 | 0.0% | 0.9% | 4.3% | 10.4% | 13.0% | 15.2% | 13.8% | 12.7% | 10.1% | 10.3% | 6.2% | 2.3% | 0.5% | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| EQ 2001-2030 A1B | 0.0% | 0.7% | 1.6% | 4.2% | 6.2% | 8.7% | 9.6% | 11.5% | 11.1% | 11.9% | 9.9% | 9.5% | 7.8% | 4.9% | 1.7% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| EQ 2071-2100 A1B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.7% | 1.3% | 2.9% | 5.5% | 7.3% | 9.0% | 8.2% | 9.5% | 8.5% | 8.2% | 8.9% | 8.6% | 8.0% | 6.0% | 2.6% | 2.8% | 1.2% | 0.3% | 0.1% | 0.0% |
| EQ 2071-2100 A2 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.4% | 1.0% | 2.5% | 4.9% | 6.2% | 8.2% | 9.1% | 9.1% | 9.2% | 8.6% | 9.6% | 10.6% | 9.8% | 5.2% | 3.2% | 1.4% | 0.5% | 0.1% | 0.1% | 0.0% |

# CONCLUSIONS - RECOMMANDATIONS

- Improve management of public enterprises and provide adequate institutional (legal) framework

- Pedunculate oak forests
  - Increase the groundwater level in ecosystem if possible
  - Promote regeneration which is closer to nature
  - Promote mixed forests
  - Change of tree species at unsuitable habitats

- Beech forests:
  - Promote continious cover forestry
  - Promote mixing in the future

# Thank