FOREST FIRE OCCURRENCE PROBABILITY MODEL IN THE KARST FOREST MANAGEMENT AREA SLOVENIA

dr. Tomaž Šturm
Slovenia Forest Service
www.zgs.gov.si
SLOVENIA
KARST FOREST MANAGEMENT UNIT

- 152,476 ha, 57 % forest cover.
- Broadleaves forests prevail (73 %), pine trees dominate on 21 % of the region. The largest shares of tree species in wood stock are black pine (*Pinus nigra*, 23 %) and beech (*Fagus sylvatica*, 18 %). Other dominant tree species are hardwoods (sessile oak, turkey oak, downy oak, hop hornbeam).
- The Karst forest management area concentrates 55 % of all fires in Slovenia and the burnt area represents 95 % of all burnt areas.
- The period between 1995 and 2009 contains 871 forest fires and an affected forest area of 6,047 ha.
KARST FOREST MANAGEMENT UNIT
FOREST FIRE OCCURRENCE PROBABILITY MODEL

Slovenia forest service:
- data of forest management plans – forest stands,
- data of fire activity – past, present.

ArcGIS 10.0 → Spatial statistics tools:
- Ordinary Least Squares,
- Geographically Weighted Regression.

The purpose is to estimate the probability that a forest fire will happen during a period of time in a certain place (forest stands).
FOREST FIRE OCCURRENCE PROBABILITY MODEL
FOREST FIRE OCCURRENCE PROBABILITY MODEL

Dependent variables:
- information on the development phase,
- canopy closure,
- main tree species regarding to growing stock,
- growing stock per hectare,
- the share of hardwoods trees with regard to growing stock,
- Shannon-Wiener index tree species composition,
- Shannon-Wiener index size class distribution,
- elevation of forest stand.

Independent variable:
- information on the past fire activity in the forest stand.
ORDINARY LEAST SQUARES

AICc   -12310,219
R²       0,01
Adjusted R²   0,01

GWR WITH FIXED KERNEL TYPE

Dependent variables:
- main tree species regarding to growing stock,
- growing stock per hectare,
- the share of hardwoods trees with regard to growing stock,
- Shannon-Wiener index tree species composition,
- elevation of forest stand.

Independent variable:
- information on the past fire activity in the forest stands.
GWR WITH FIXED KERNEL TYPE

Residuals map showing the distribution of residuals for the forest fire occurrence probability model. The map uses a color scale to represent different ranges of residuals:
- Blue for residuals less than -2.5 standard deviations
- Dark blue for residuals between -2.5 and -1.5 standard deviations
- Dark gray for residuals between -1.5 and -0.5 standard deviations
- Light gray for residuals between -0.5 and 0.5 standard deviations
- Yellow for residuals between 0.5 and 1.5 standard deviations
- Orange for residuals between 1.5 and 2.5 standard deviations
- Red for residuals greater than 2.5 standard deviations

The map also indicates the presence of a railway network.
GWR WITH FIXED KERNEL TYPE

FOREST FIRE OCCURRENCE PROBABILITY IN FOREST STANDS
- very high
- high
- moderate
- low

km
FIRE OCCURRENCE PROBABILITY BY FOREST STANDS CHARACTERISTICS

- **Altitude (m):**
  - Fire occurrence probability
  - Variations depending on altitude

- **Share of hardwood (%):**
  - Fire occurrence probability
  - Variations depending on share of hardwood

- **Tree species:**
  - Fire occurrence probability
  - Variations for different tree species

- **Shannon-Wiener index tree species composition:**
  - Fire occurrence probability
  - Variations depending on tree species composition

- **Wood stock (m²/ha):**
  - Fire occurrence probability
  - Variations depending on wood stock
GWR WITH ADAPTIVE KERNEL TYPE
GWR WITH ADAPTIVE KERNEL TYPE

Very high forest fire occurrence probability:
- 991 forest stands,
- 9.887,44 ha (12 %) forests.

Verification:
- 118 forest fires in 2010 and 2011,
- 55 (47 %) started in forests,
- 62 % in forests stands with very high forest fire occurrence probability.
CONCLUSIONS

A combination of spatial statistical methods (OLS, GWR) on the characteristics of forest stands has allowed detailed insight into forest fire occurrence and its characteristics.

The presented model gives us a clue about the endogenous stand factors that affect fire probability, and how the probability can be modified by varying these factors through forest management.

We established that usefulness of forest stand maps overcome their original purpose of collecting and preparing for forest management.
Thank you for your attention

dr. Tomaž Šturm