



TU Zvolen



Drought and forest fire danger assessment in changing conditions of climate in Slovakia

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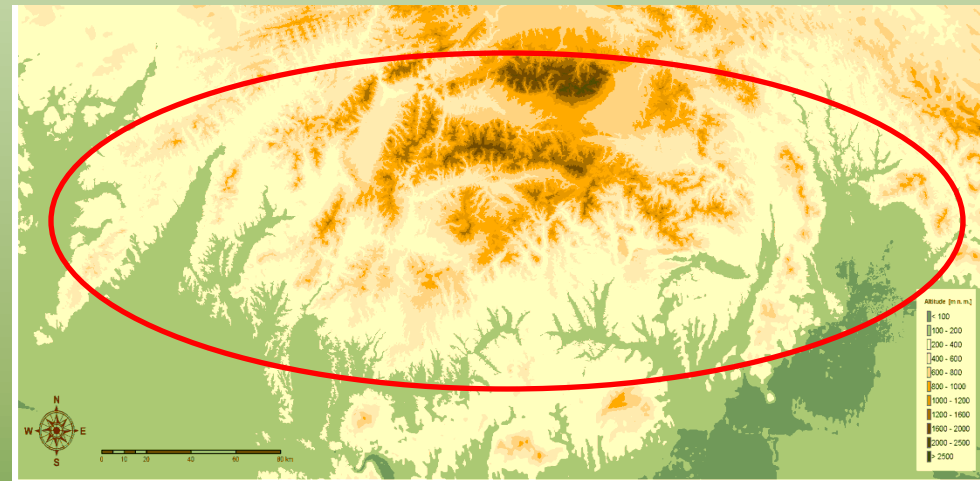
Motivation

- Increasing frequency of warm years in last 2 decades
- Increasing frequency of hot waves and dry spells
- More than 40 percent of northern Carpathians at Slovak territory is covered by forests
- A need for early warning system

Area /Region/



Orography of the region



Elevation: 94 – 2655 m a.s.l.

Mean elevation 450 m a.s.l.

Agricultural production up to 1000 m a.s.l.

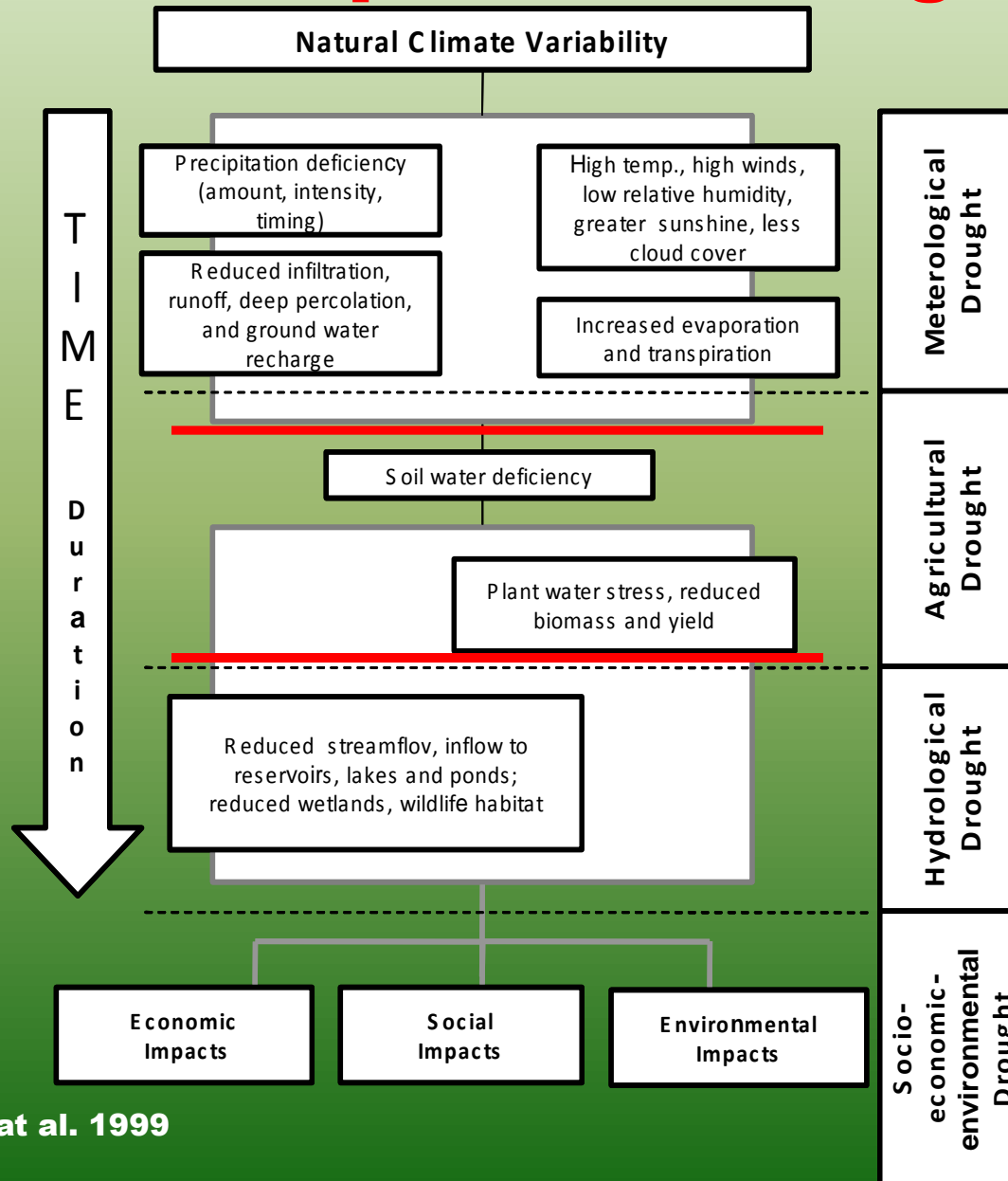
Timber line at cca 1650 m a.s.l.

Altitudinal vegetation stages

/characterized by their dominant tree species/

- Dry
wd III-IX
Cca -300 mm
- wd balanced
- humidity
rising
- Humid
wd
Cca 800+ mm
- 1st *Oak - Quercus (Q)*,
 - 2nd *Beech-Oak -Fagus-Quercus (FQ)*,
 - 3rd *Oak-beech - Quercus-Fagus (QF)*,
 - 4th *Beech – Fagus (F)*,
 - 5th *Fir-beech - Abies-Fagus (AF)*,
 - 6th *Spruce- fir-beech - Picea-Abies-Fagus (PAF)*,
 - 7th *Spruce – Picea (P)*,
 - 8th *Mountain pine (M)*,
 - 9th *Alpine (non forest high mountain pastures)*

Drought for different sector activities and time sequence of drought



According to Hayes et al. 1999

Drought and fire indices evaluated

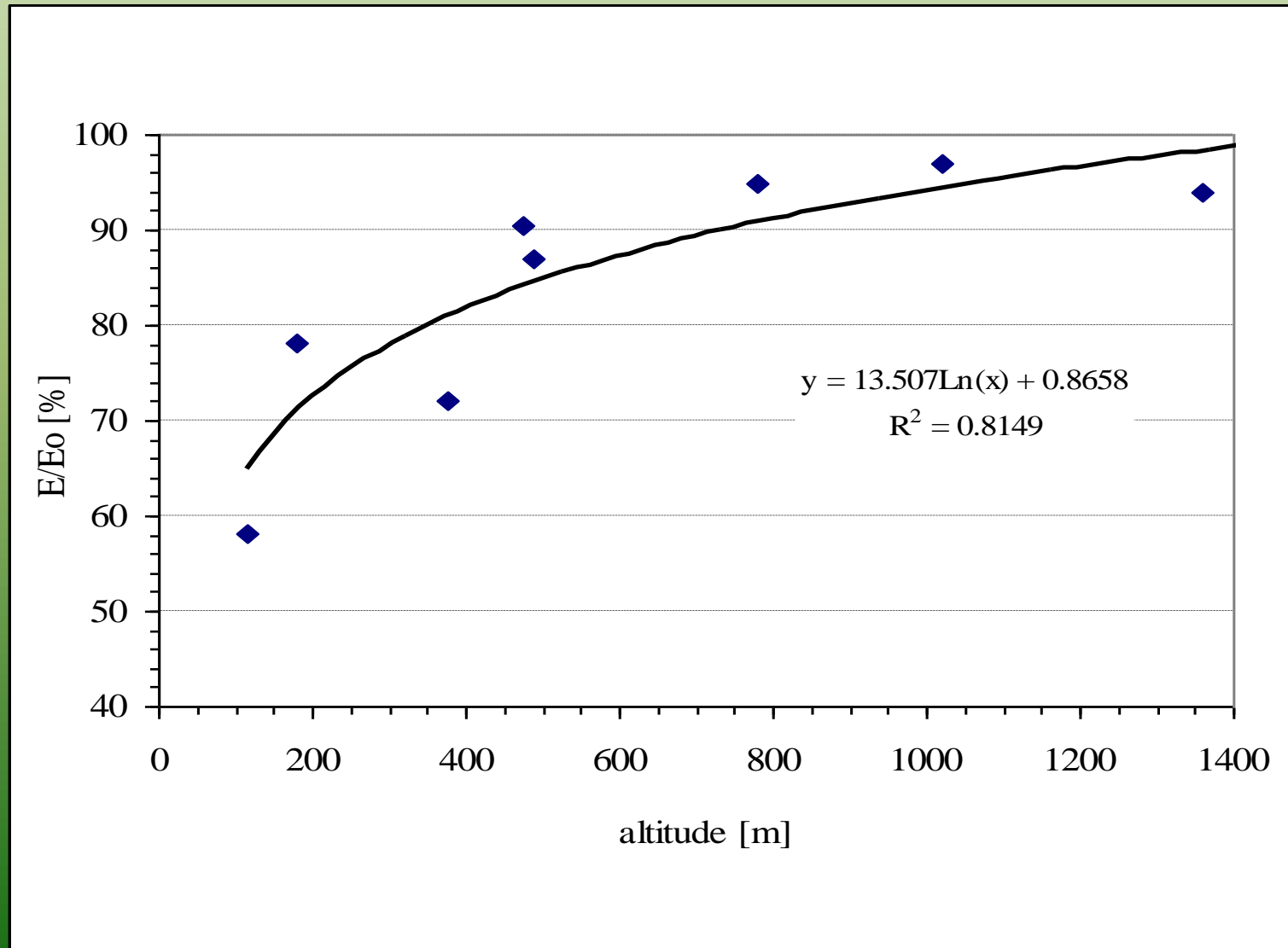
- • *Relative evapotranspiration (E/E_o)*
- • *Budyko`s index of drought (E_o/P),*

- *Canadian Forest Fire Weather Index – complex method*
- *Angstrom index*
- *Baumgatrner index*
- *Waldbrandgefahre nindex (M-68) – modified method of water balance*

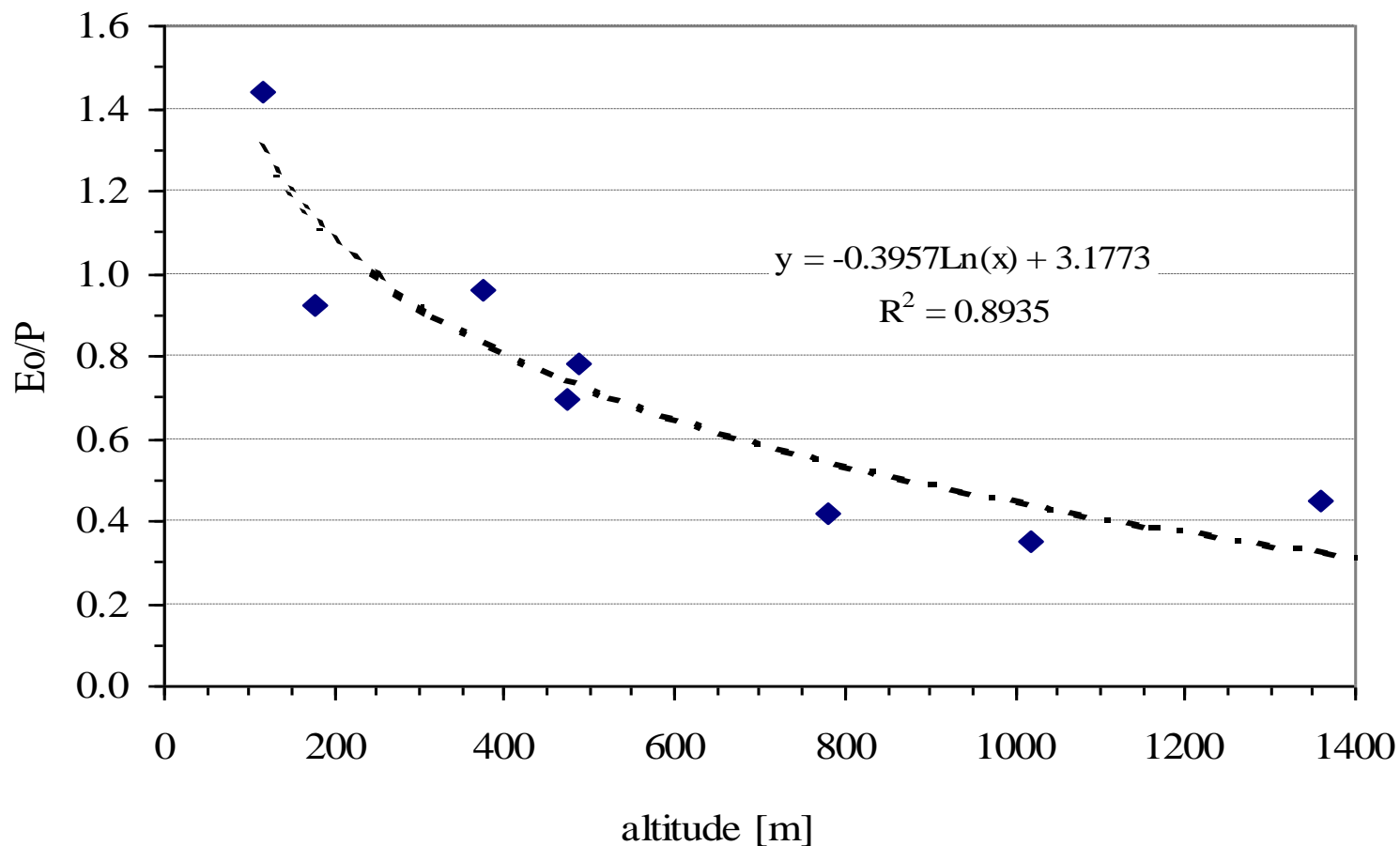
Yearly values of humidity characteristics /1951-2005/

Station	H [m] (a.s.l.)	P [mm]	E ₀ [mm]	E [mm]	E/E ₀ [%]	E ₀ /P	Vegetation stage
Hurbanovo	115	537	748	432	58	1,44	1. oak
Myjava	375	671	627	450	72	0,96	2. beach-oak
Kamenica n. C.	178	722	644	501	78	0,92	3. oak-beech
Plaveč	488	693	522	451	87	0,78	4. beech
Červený Kláštor	474	755	507	457	90	0,69	5. fir-beech
Oravská Lesná	780	1114	456	432	95	0,42	6. spruce-fir-beech
Tatranská Javorina	1020	1253	422	412	97	0,35	7. spruce
Štrbské Pleso	1360	995	435	407	94	0,45	7. spruce 8. mountain pine

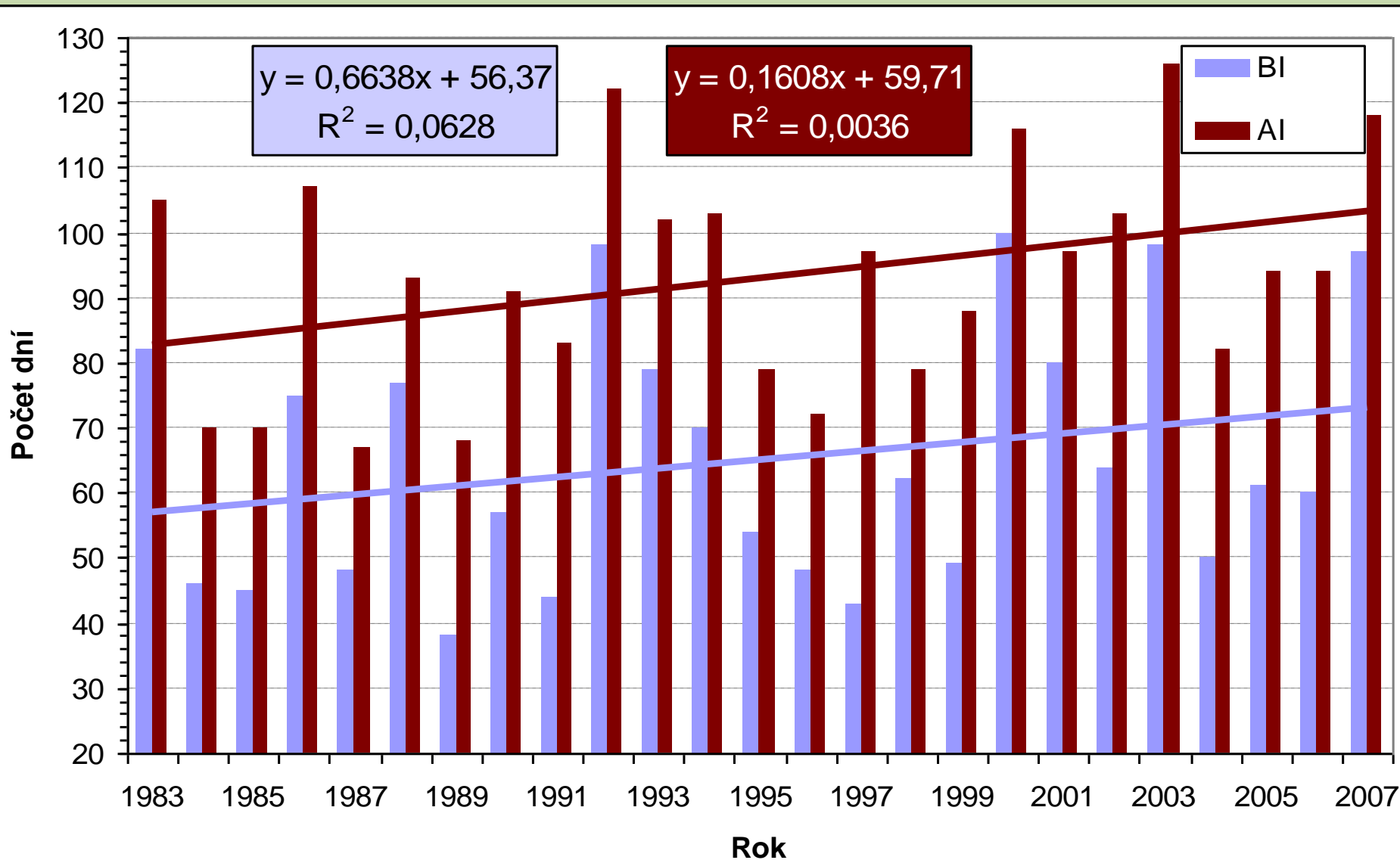
Logarithmic regression dependence of relative evapotranspiration annual values (E/Eo) on altitude [m a.s.l.] for the period 1951-2005



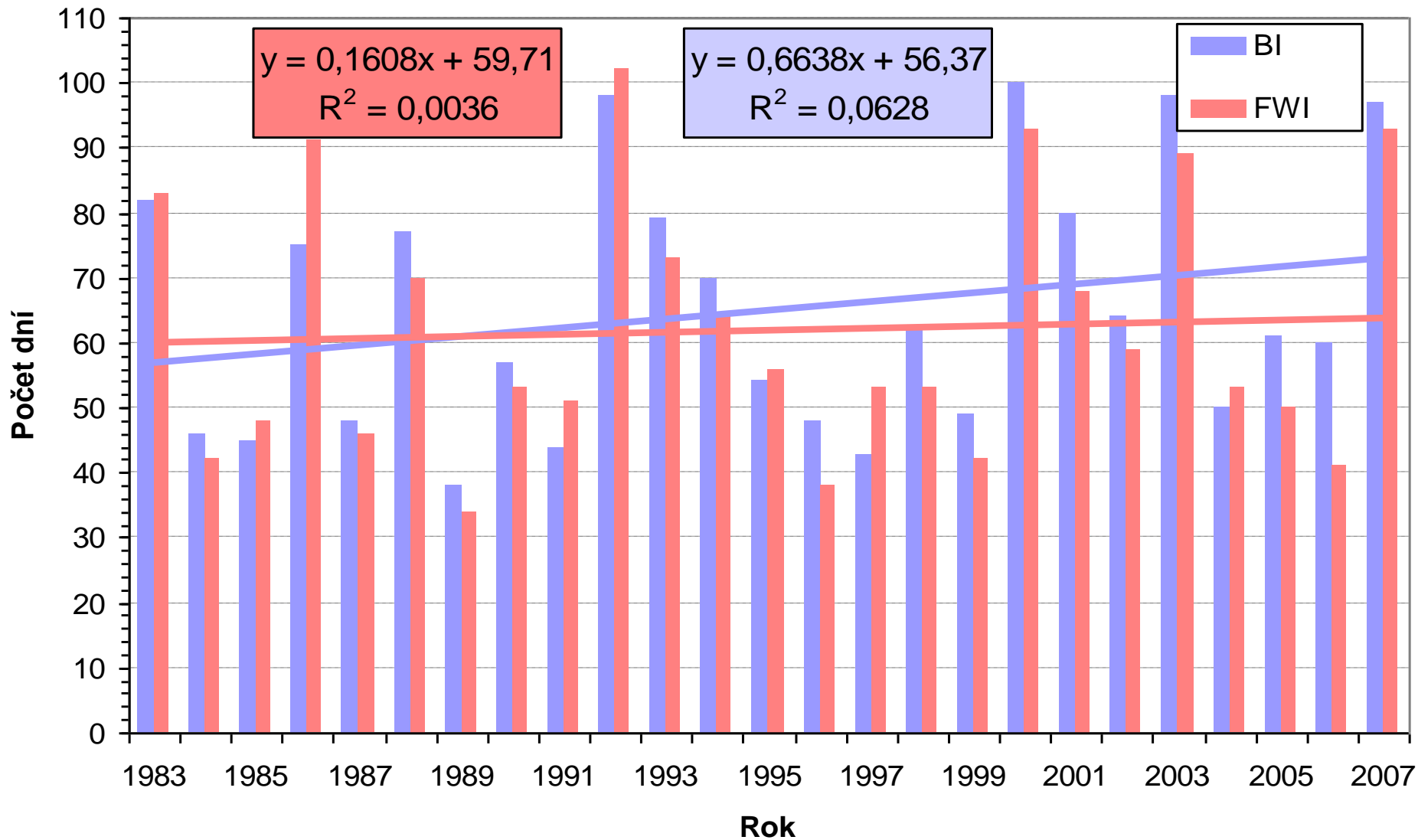
Logarithmic regression dependence of Budykos drought index annual values (Eo/P) on altitude [m a.s.l.] for the period 1951-2005



The development of days reached 3+ values of Baumgartner (BI) and Angström (AI) index at Bratislava meteorological station for the fire season (April-September) of the years 1983-2007



The development of days reached 3+ values of Baumgartner (BI) and Canadian (FWI) index at Bratislava-Koliba meteorological station for the fire season (April-September) of the years 1983-2007



Practical application of fire index: soil-climatic drought index

Waldbrandgefahren index (M-68) – modified method of water balance

Method - water balance method respecting different soil types

Practical calculation => soil – climatic drought index:

$$KS_i = \frac{Bi}{VVK}$$

$$Bi = \sum_{i=1}^n Kz_i$$

Bi – balance to the date of calculation n ,
 VVK – field water capacity of the soil

$$K_z = ET_0 - Z$$

ET_0 - potential evapotranspiration [mm]

Z - precipitation [mm]

Kz - climatic index of watering?
/effective humidity/

Technological line

- Input data – daily temperatures and precipitation from 60 stations
- Interpolation of data to 5x5 km grid
- Modification towards heavy rain and vegetation stage /phenology/
- Calculation for today from yesterday data
- Calculation for next 2 days from NWP model
- GIS technology used for map interpretation
- Web based system for public use

Scale

	Very low	Low	Medium	High	Very high
Intensity	1	2	3	4	5
KS_i	≤ 0	0 – 0,5	0,5 – 1	1 – 2	> 2

Forest fire index on 3.5.2011

Predpoved Indexu požarného nebezpečenstva v lesoch na

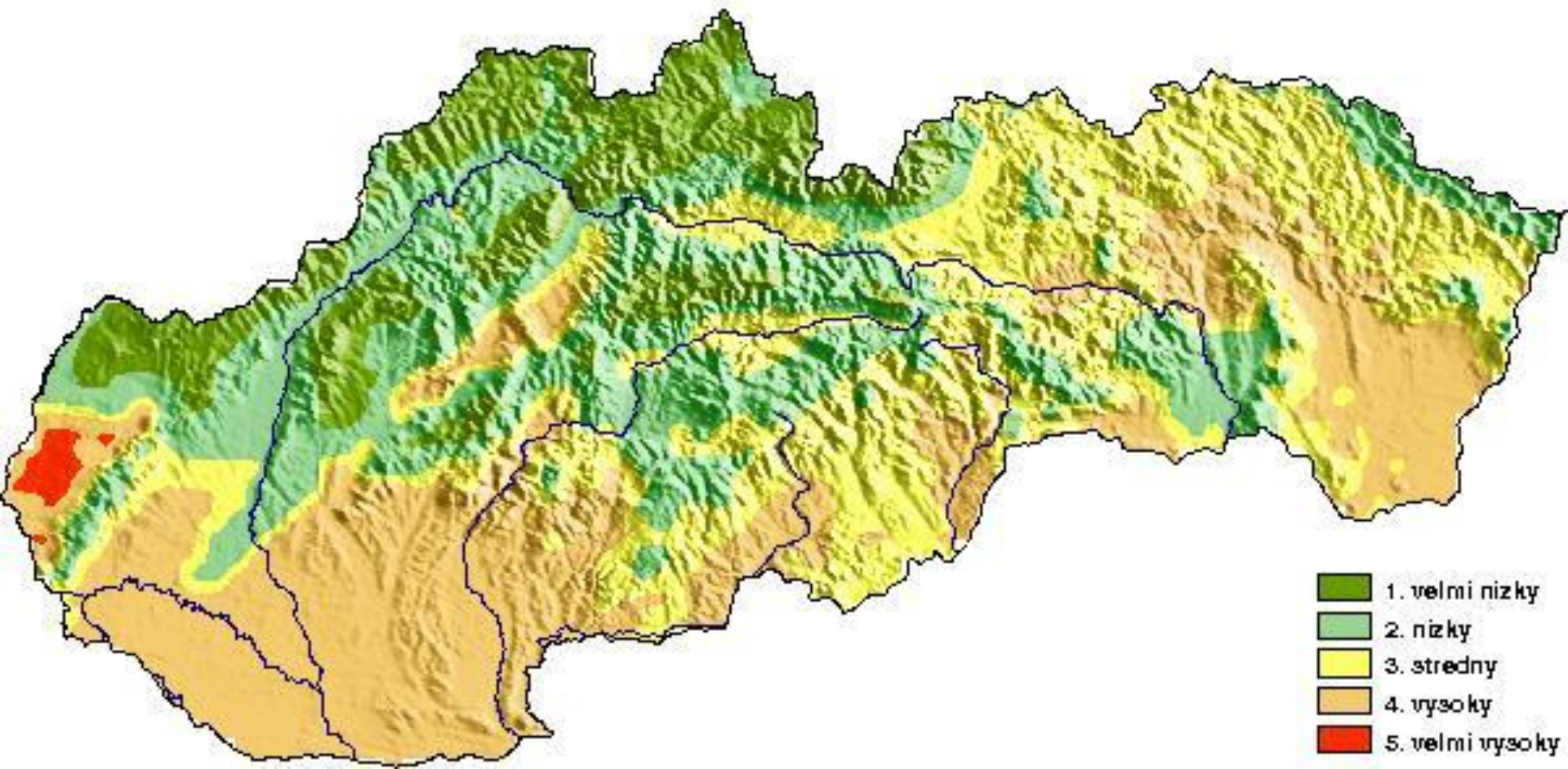
03.05.2011



Forest fire index on 4.5.2011

Predpoved Indexu požiarneho nebezpečenstva v lesoch na

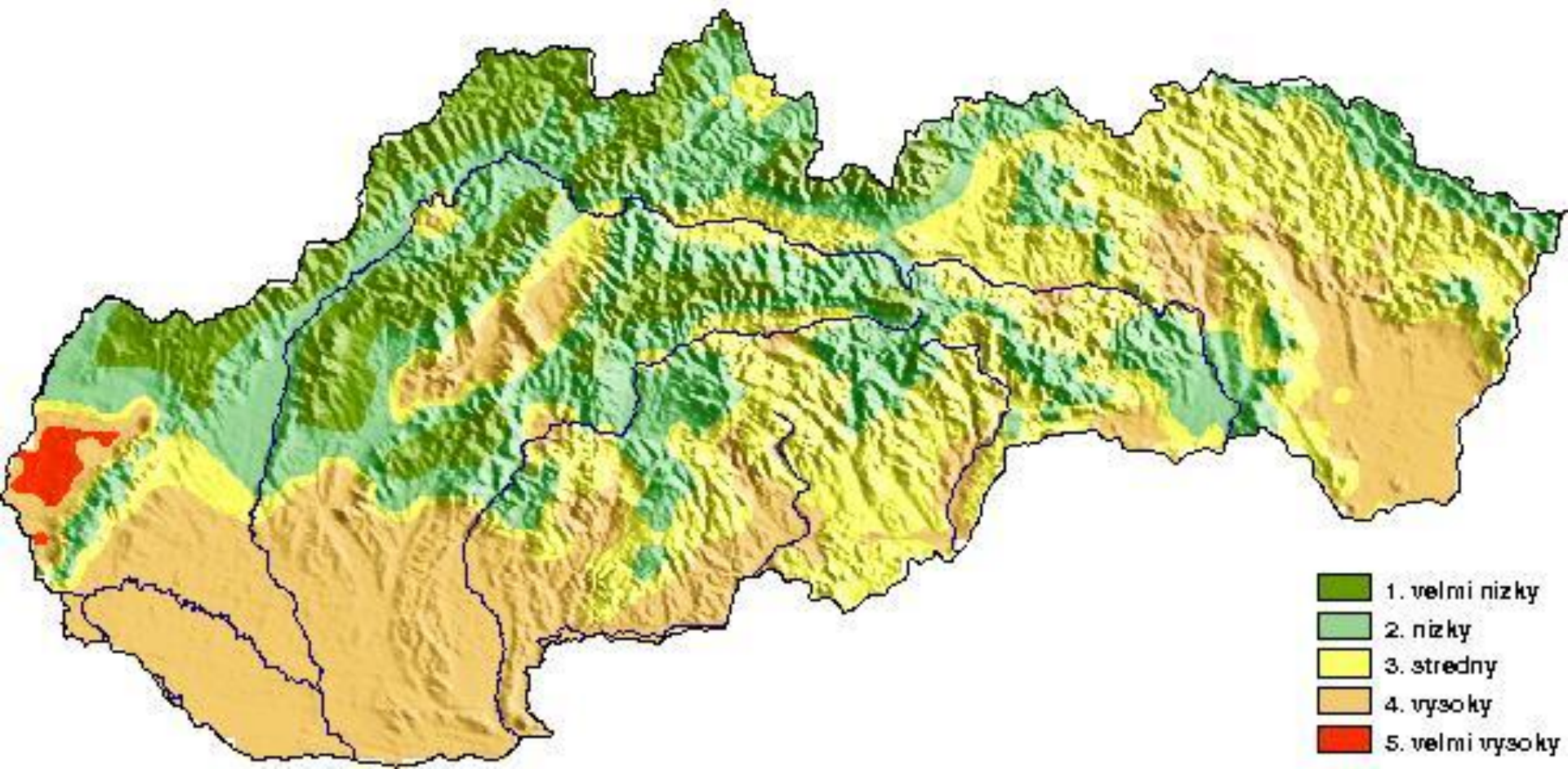
04.05.2011



Forest fire index on 5.5.2011

Predpoved Indexu požiarneho nebezpečenstva v lesoch na

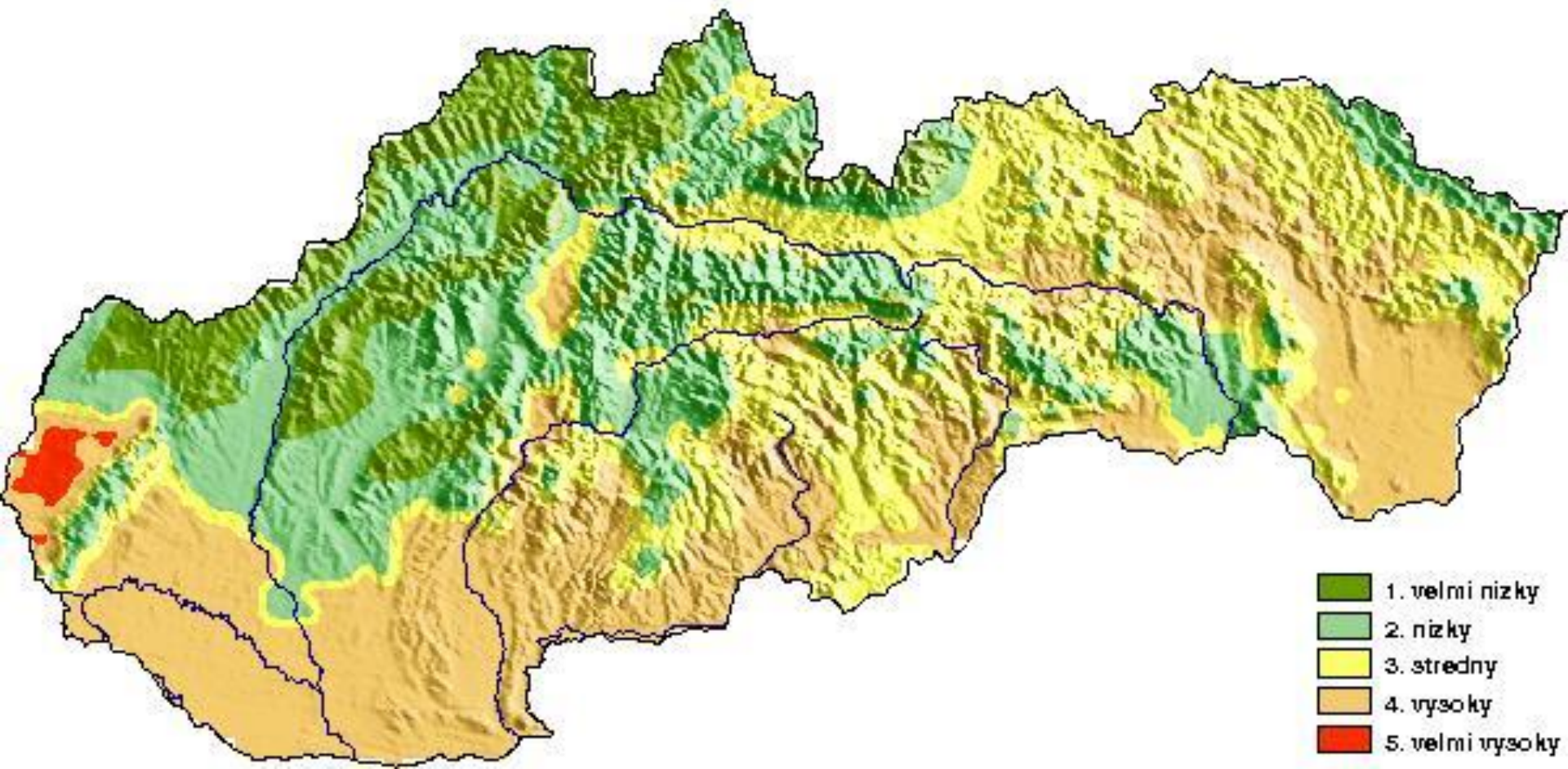
05.05.2011



Forest fire index on 6.5.2011

Predpoved Indexu požiarneho nebezpečenstva v lesoch na

06.05.2011



Further needs

- Missing comparison with forest fire data

Inputs:

Biological

- More accurate and updated phenological data
- To include the forest floor characteristics

Meteorological

- ~~Better characteristics of further meteorological elements expressing atmospheric stage~~
- More accurate interpolation methods respecting the orography

Thank you



Structure of the Canadian forest fire weather index

