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Toward spatially variable fire risk indices using weather observations and remote sensing

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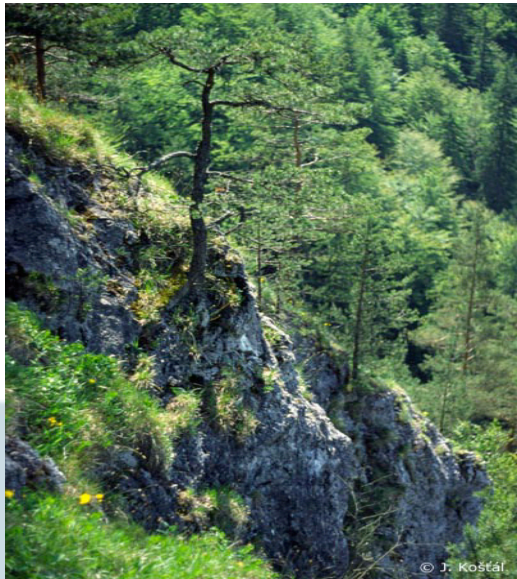

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- Forest fires (wildfires) impose severe economic, environmental and social Issues. > 400 000 ha of burned forests annually (Europe).

- Active suppression of fires is costly and requires deployment of fire fighting resources at remote and inaccesable remote sites

- Monitoring of “new” fires and sites sensible to outbreak of forests is essential for timely response and reduction of resources/costs

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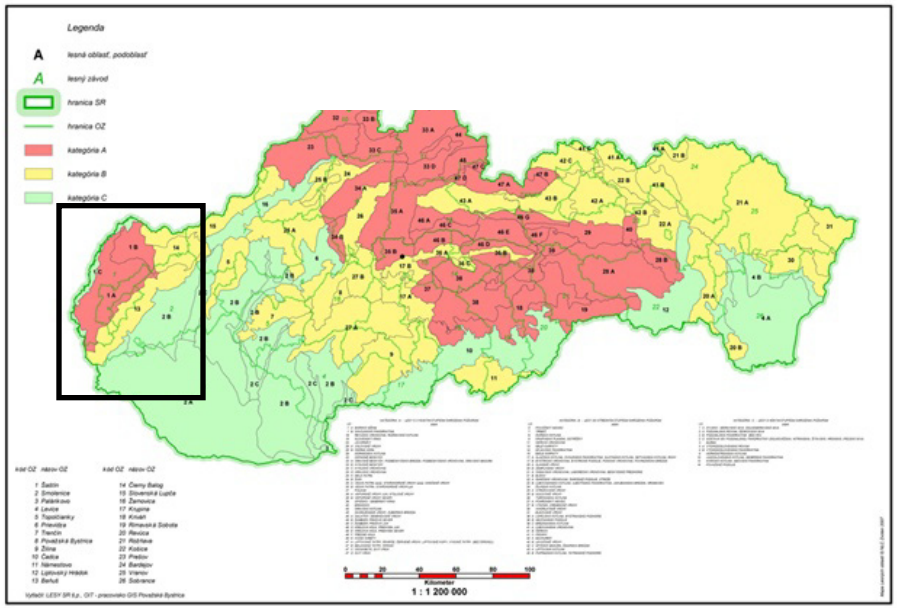
MOTIVATION

- Forest fires destroy vast areas (up to 200 ha/yr; 150 reported forest fires).

In Slovakia, prevention is based on **fire patrolling** and **airborne monitoring systems** (~1000 flight hours).

- Alternative approaches are needed in order to reduce the response time between fire report and deployment of fire fighting resources.



~40 % forested

Current Practice in Slovakia

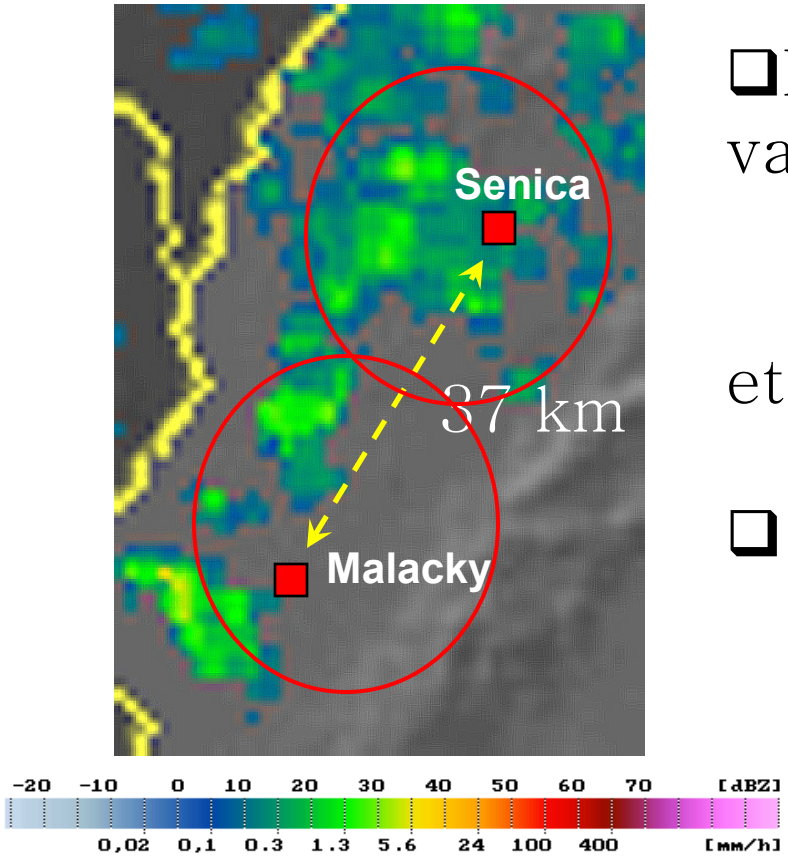
Calculation of Soil-Climatic Coefficient of Dryness

$$KS_i = \frac{Bi}{VVK} \qquad B_i = \sum_{i=1}^{n} Kz_i$$

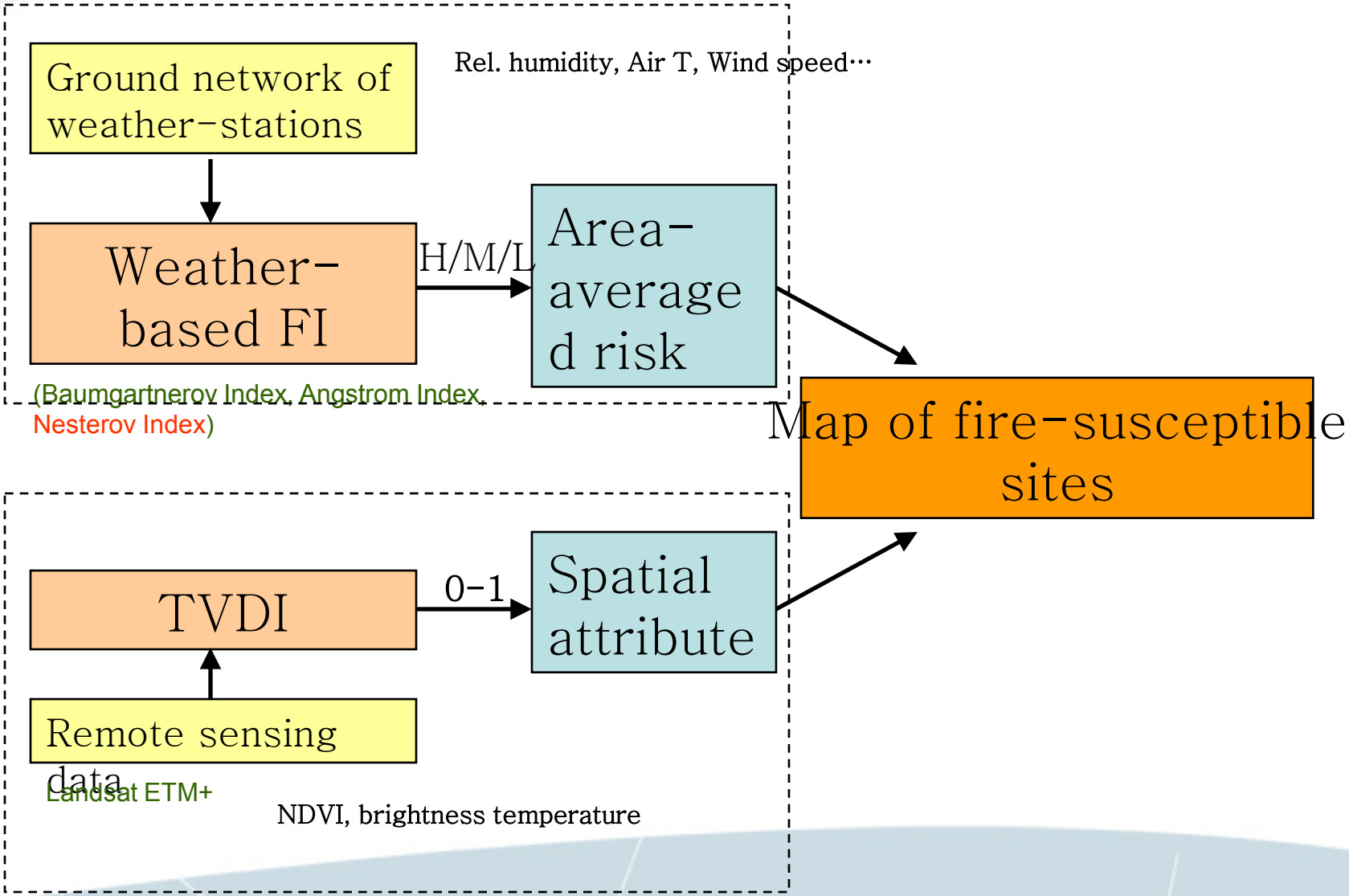
SWC – soil water content ← Spatially variable

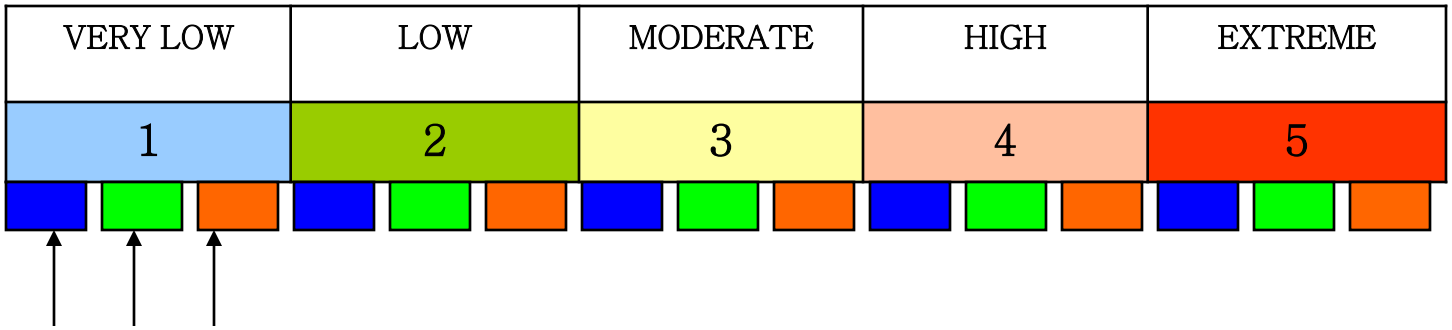
$Kz = ET0 - P$ *ET0* is potential evapotranpiration [mm] *and P is precipitation* [mm]

	VERY LOW	LOW	MODERATE	HIGH	EXTREME
Risk level	1	2	3	4	5
KS_i	≤ 0	0 – 0.5	0.5 – 1	1 – 2	> 2

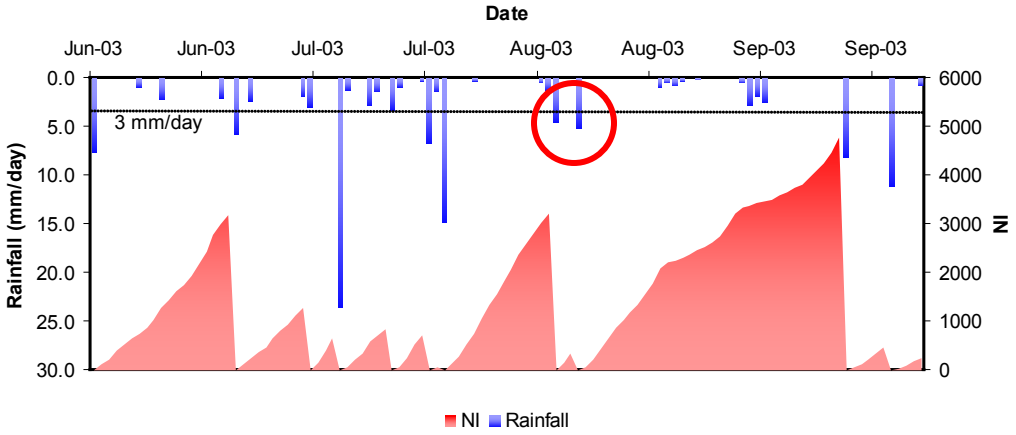


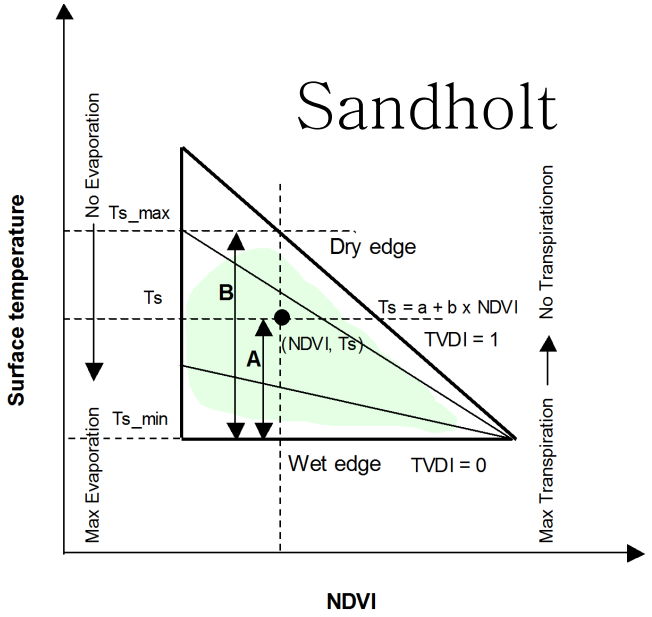
- Rainfall is a highly spatially variable phenomenon (summer storms, topography, etc.)
- Relying merely on weather-data (point measurements) produces only area-average fire risk
- Synergy with NDVI and temperature retrieved from RS can fill in


Ground network of weather-stations
Rel. humidity, Air T, Wind speed…
Weather-based FI
H/M/L
Area-averaged risk
(Baumgartnerov Index, Angstrom Index, Nesterov Index)
Map of fire-susceptible sites
TVDI
0-1
Spatial attribute
Remote sensing data
Landsat ETM+
NDVI, brightness temperature

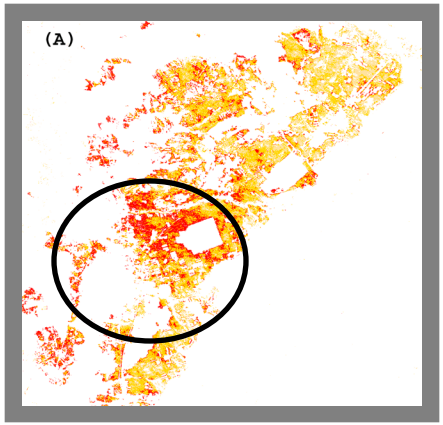


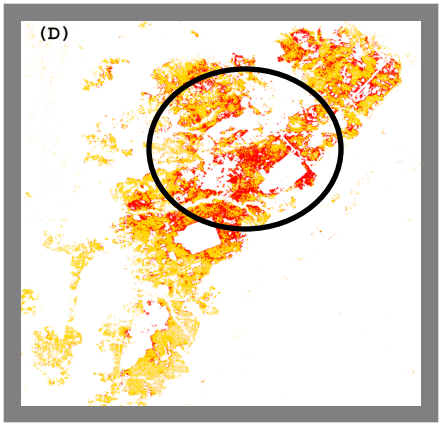
Spatial attribute

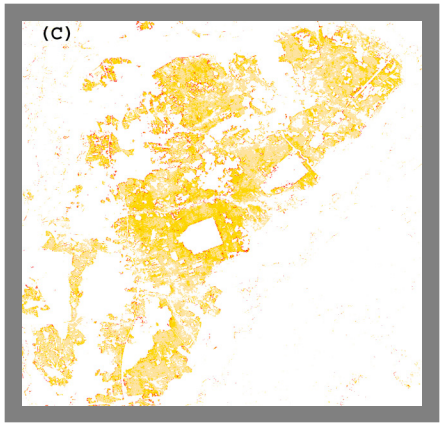


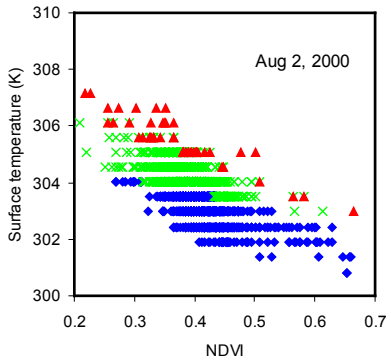


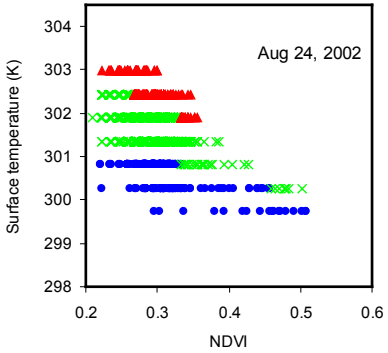
Water stress, dryness, density

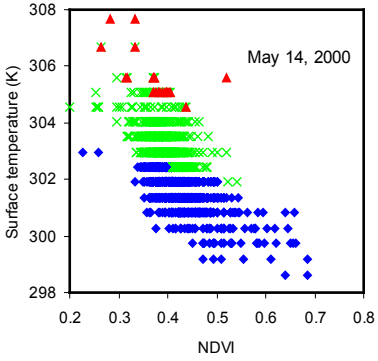












TVDI

● 0-0.33 × 0.33-0.66 ▲ 0.66-1

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Summary

TVDI maps → spatial distribution of weather-based fire risk rating indices (**synoptic view, near-real time**)

→**Timely allocation of fire-fighting resources** to areas with higher risk of fire outbreak

→**Targeting forest management** to fire-susceptible areas

→ RS provides better spatial coverage compared to ground surveys….reduction of cost and human resources

Remote sensing = detection of active fires + **early warning**

Density of weather-stations is **declining** worldwide

- *Integrating **remote sensing** is perceived as difficult and costly by potential data users.* RS imagery may be a low-cost source of information,
- *Exploitation of the **benefits** of space-based **remote sensing** in forestry is slowed by institutional barriers.* Remote sensing is the most efficient and economical means of monitoring active forest fires over large areas on a routine basis.

Validation against ground measure

Publication:

Onderka, Melicherčík: Spatial discretization of the Nesterov index using multispectral satellite imagery, submitted to Meteorological Journal

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Thank you for your attention……

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