

# The regional differences of wind erosion hazard due to the changing climatic conditions in the Carpathian Basin

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A projekt az Európai Unió támogatásával,  
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társfinanszírozásával valósul meg.

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# Introduction

*One of the greatest natural hazards in the Carpathian Basin is the wind erosion*

*The currently existing potential wind erosion map is estimated the surface sensitivity to wind erosion using only soil texture and the critical wind speed*

*A more complex map could be support the planning purposes*

*Due to climate change wind erosion hazard can change*

*Thus assessing climate change is important*

# Aims

## *Future wind erosion hazard assessment*

- *to predict the location and volume of the hazard, induced by wind erosion*

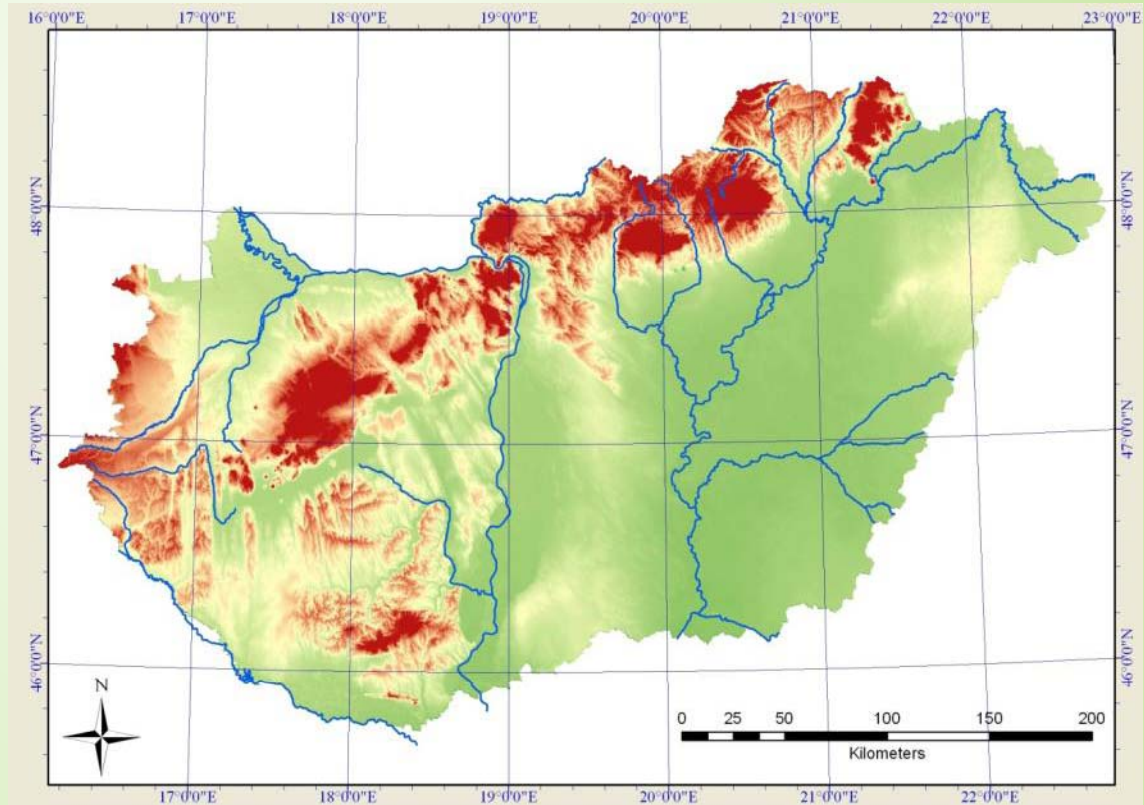
*To generate a new **regional scale** wind erosion sensitivity map based on parameters of*

- *Soil texture,*
- *vegetation cover (%) in March and April and*
- *occurrence of high wind speed (>9)*

# Study area



Hungary  
Located in the Carpathian Basin,  
Central Europe



## **Soil**

unconsolidated sandy and silty sediments, covering about 60% of the Basin

## **Climate**

Highly fluctuating precipitation => frequent water shortage periods

## **Land use**

Most of the lowland areas are arable land

# Methods

In regional scale wind erosion sensitivity 3 factors are important and were used:

Soil texture, vegetation cover and climatic parameters (wind speed)

The **sensitivity against wind erosion** was calculated for each factors separately and finally a summarized map was produced by the average of the factors

In case of each parameters sensitivity was defined by applying the fuzzy logic

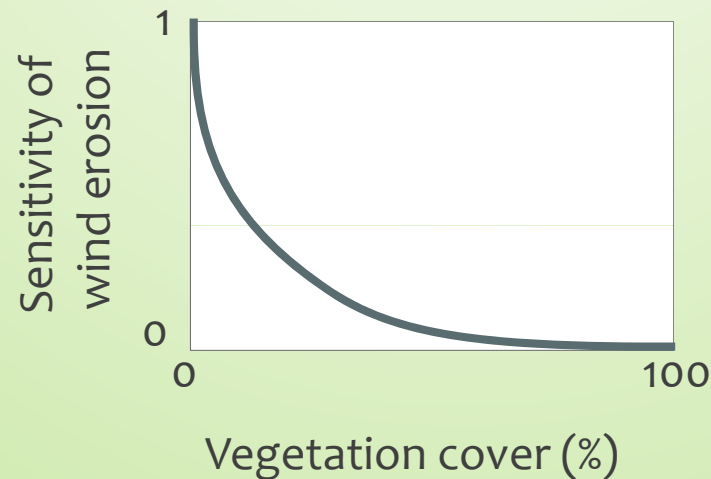
Different fuzzy membership functions was applied for the factors

# Calculating the sensitivity of vegetation cover

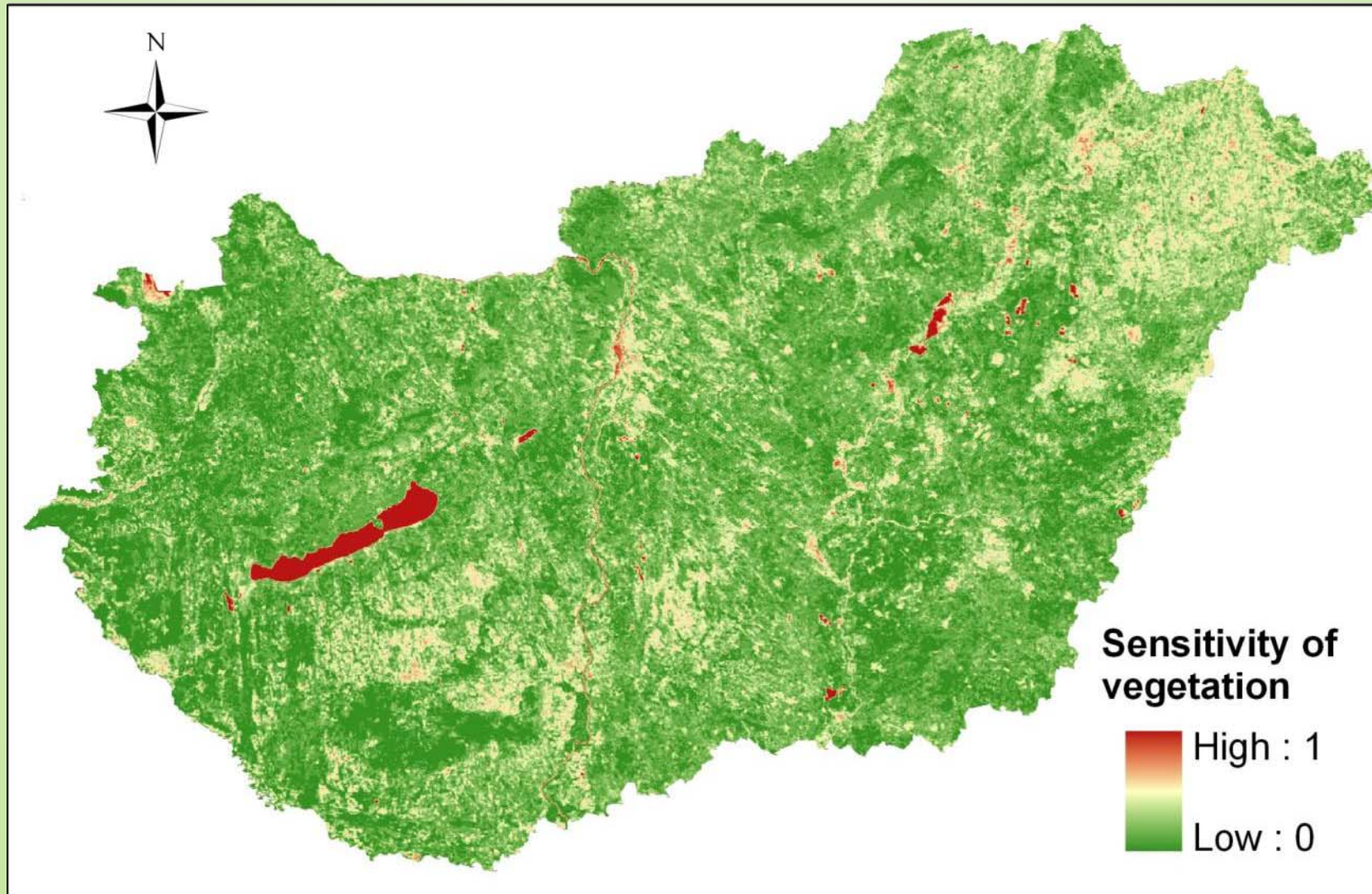
Average **MODIS NDVI** was calculated for the two most relevant months (March and April) for the period of 2000-2010

Vegetation cover (FVC) was calculated from NDVI value  
(*Carlson & Ripley 1997*)

Type of the Fuzzy membership function was half-hyperbolic



# Sensitivity of vegetation cover



# Methods

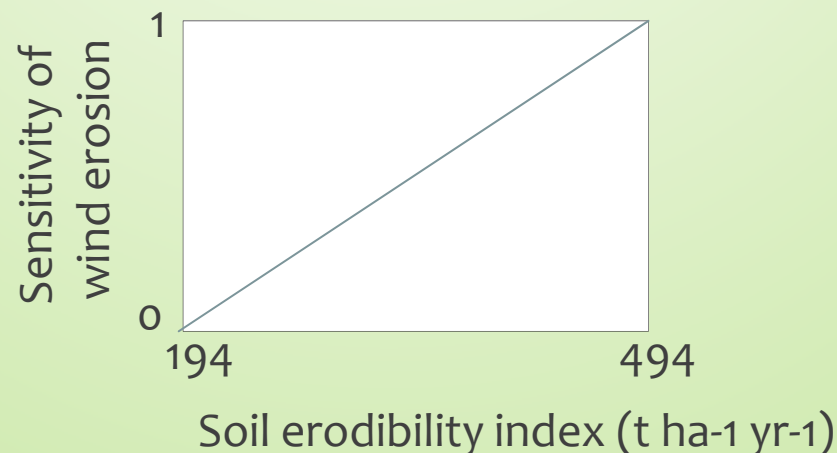
## Calculating the sensitivity of soil texture

Dominant soil texture was defined on the basis of the Agrotopographical Map (1:25.000) (70 years old, based on measured data)

⇒ 5 categories could be differentiated

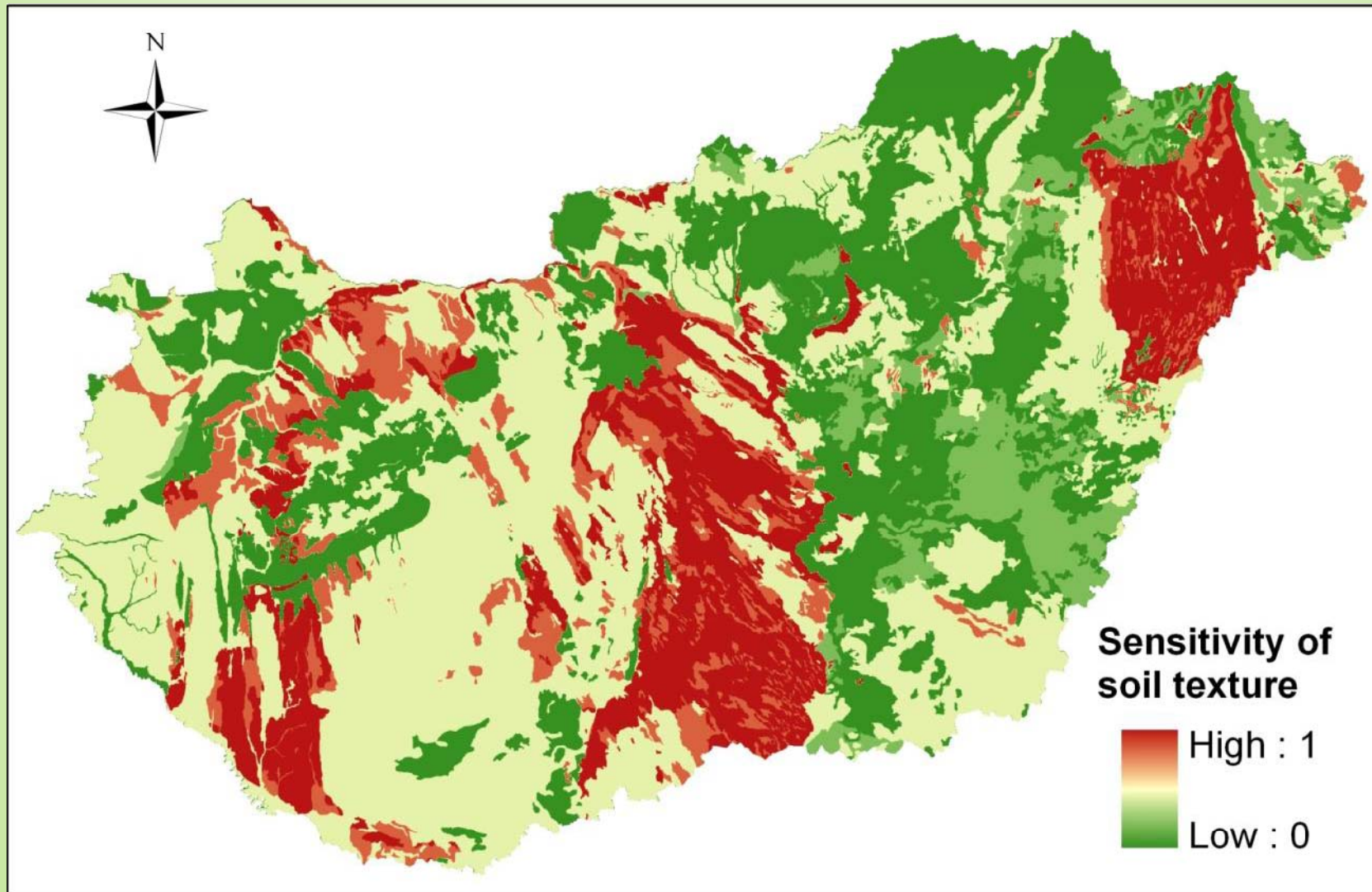
Sensitivity was estimated with Soil erodibility index ( $\text{t ha}^{-1} \text{yr}^{-1}$ ), using the Wind Erodibility Groups from National Agronomy Manual (2002)

Type of Fuzzy membership function was linear





# Sensitivity of soil texture



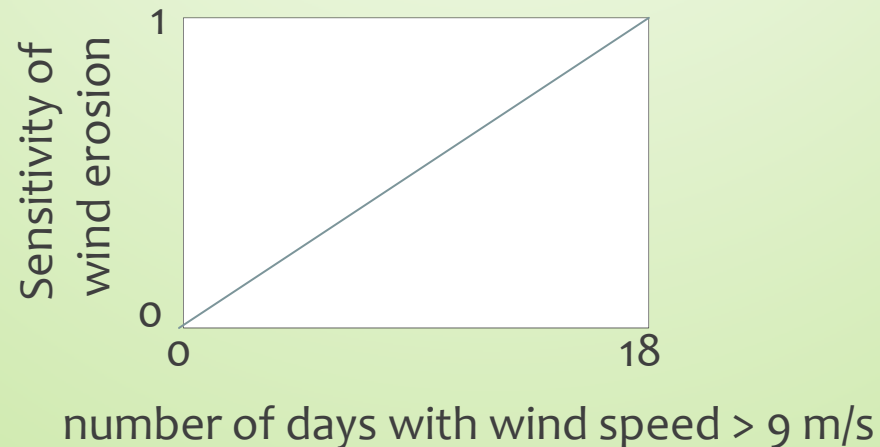
# Methods

## Sensitivity against wind

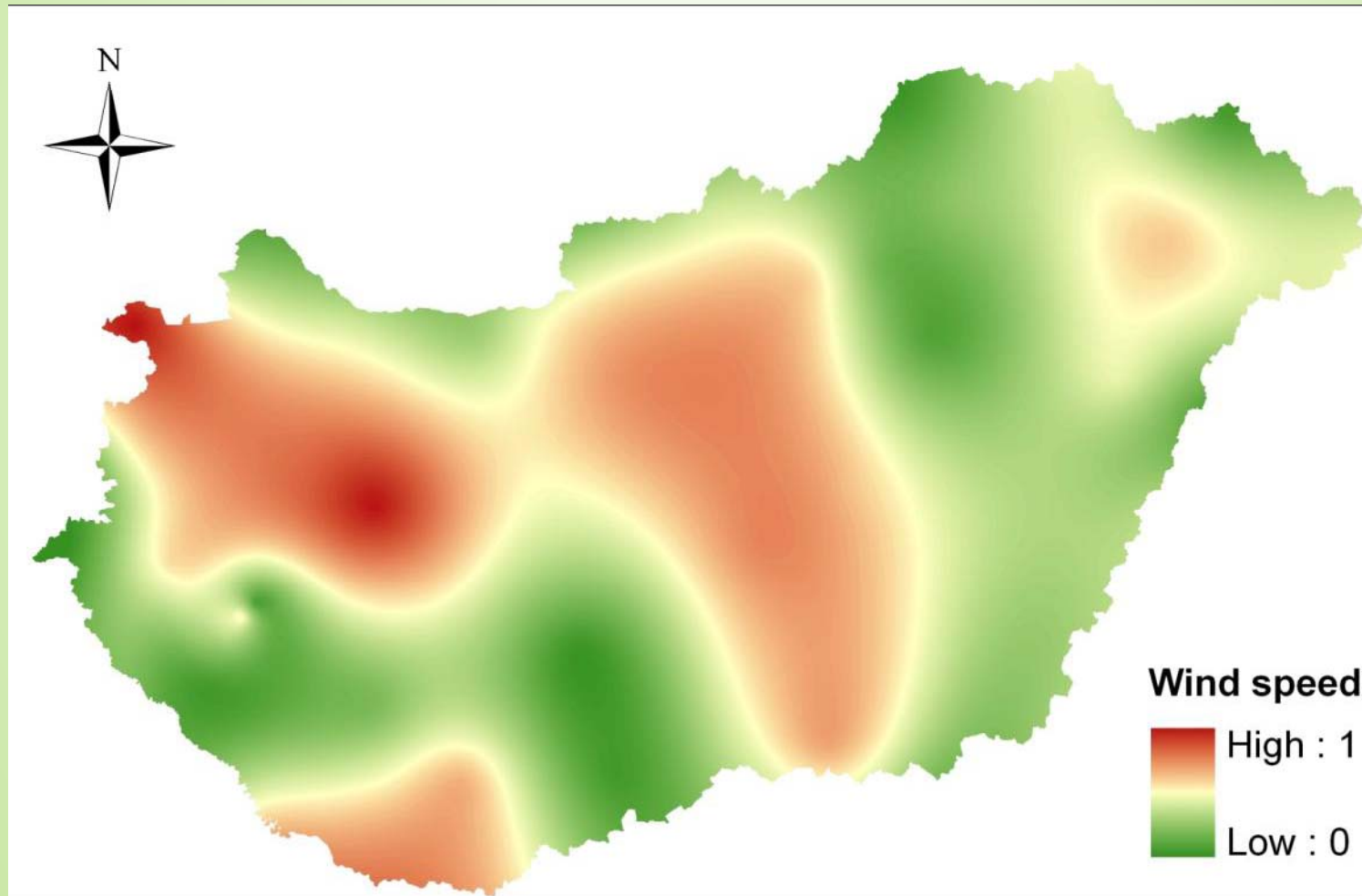
Sensitivity was calculated by using incidence of high wind speed (average number of days with wind speed  $> 9$  m/s in March and April for the period of 2000-2010)

Source: Point data of 52 meteorological stations  
[gis.ncdc.noaa.gov/map/cdo/](http://gis.ncdc.noaa.gov/map/cdo/)

Interpolated map was created from the stations data

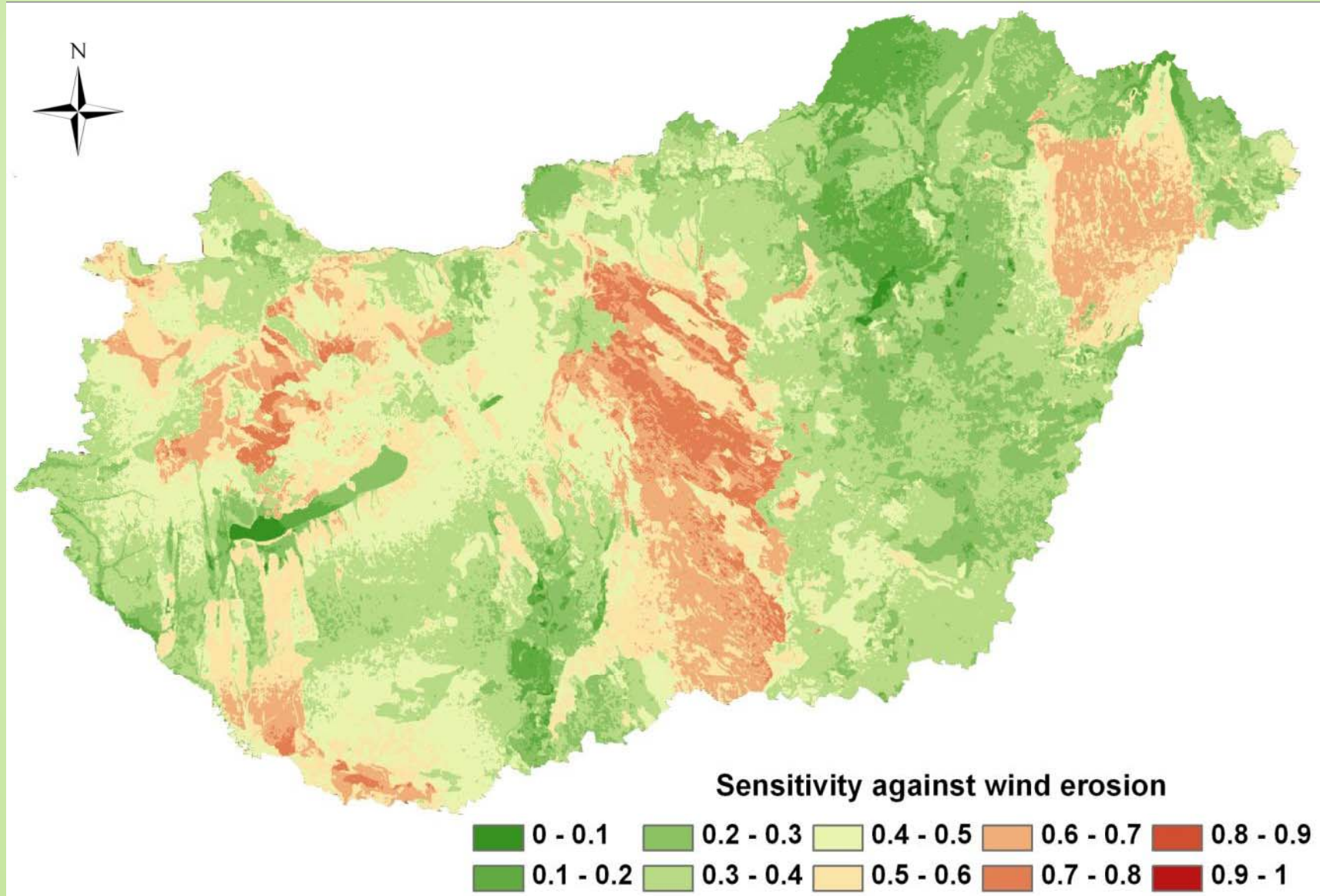


## Sensitivity against wind



sensitivity was calculated by using incidence of high wind speed (average number of days with wind speed  $> 9$  m/s for period 2000-2010)

# Summarised sensitivity



# Estimation of the future wind erosion hazard

Estimation of the future wind erosion hazard was carry out by using two regional climate models: ALADIN and REMO

- *The spatial resolution of data is 22' (~ 25 km)*
- *data for two periods (2021-2050 and 2071-2100)*
- *Used data: 30 years average monthly precipitation sum; 30 years average monthly temperature; 30 years average monthly wind speed*

Calculating average future climate erosivity for the two periods on the basis of RWEQ :

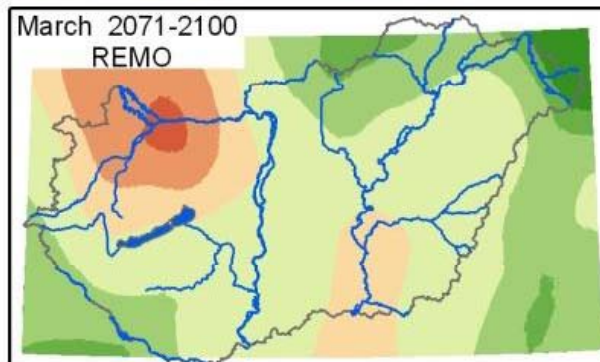
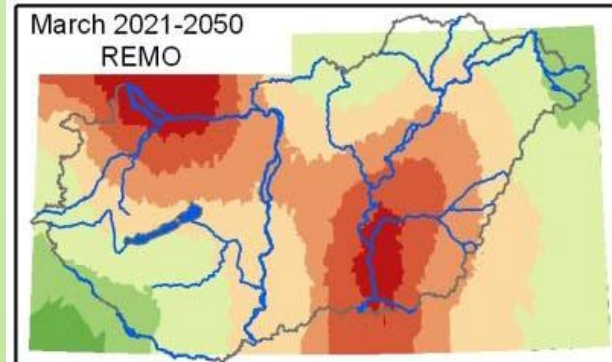
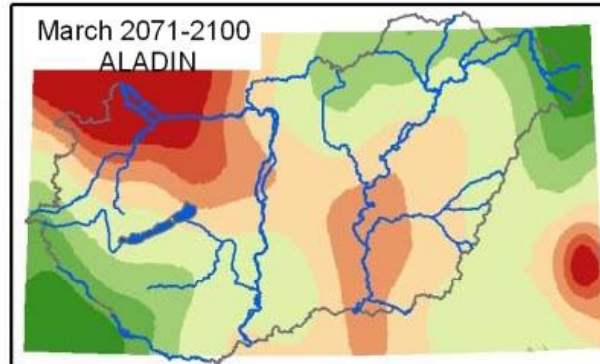
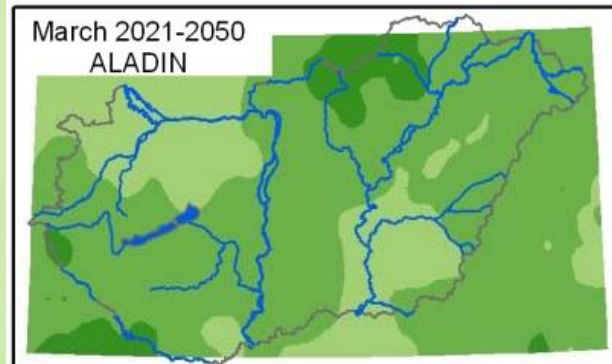
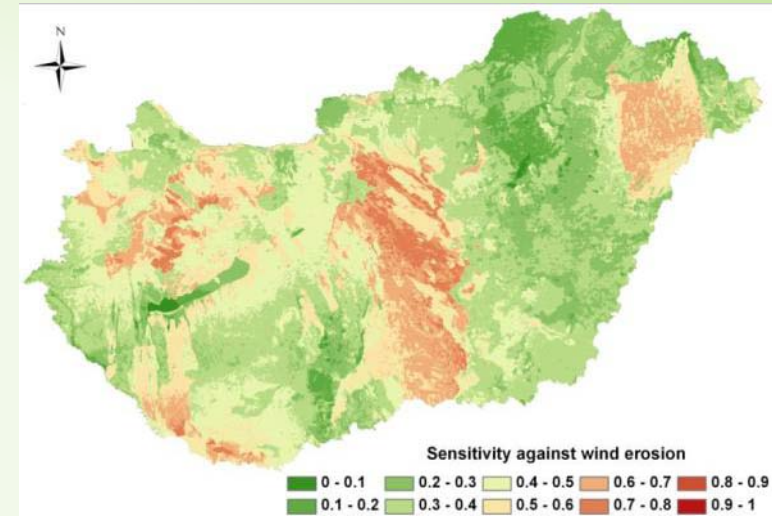
$$C = 386 * u^3 / (PE)^2$$

*where u: monthly average wind speed; PE: precipitation-effectiveness index of Thornthwaite*

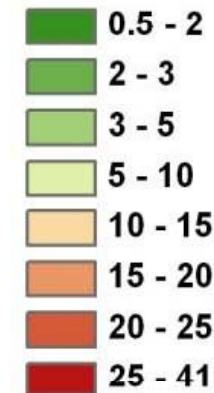
$$PE = 3.16 * Pi / (1.8 Ti + 22)^{10/9}$$

*where Pi: monthly precipitation in mm; Ti: average monthly air temperature in °C*

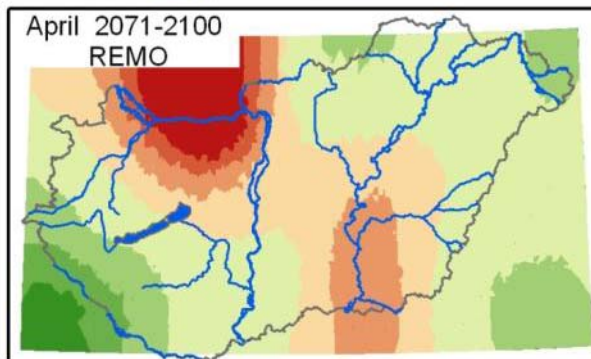
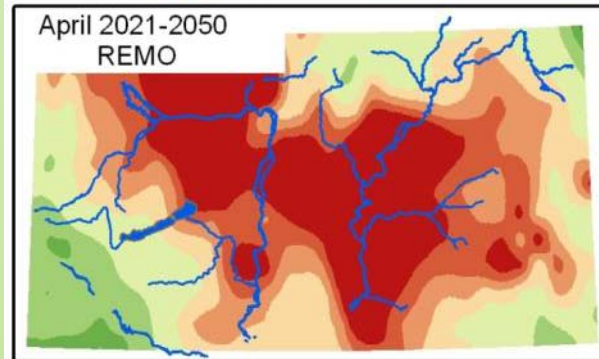
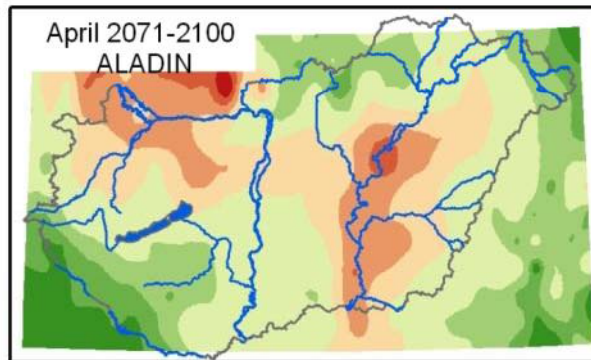
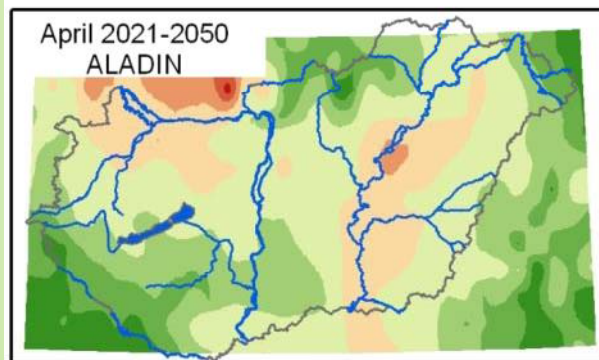
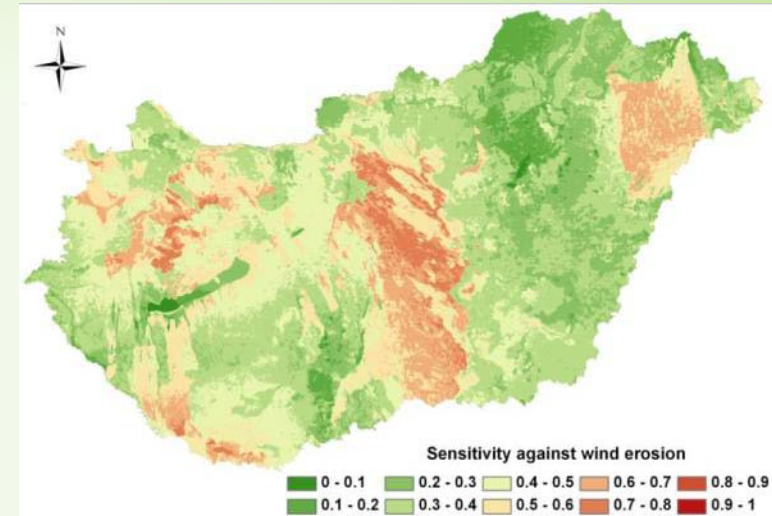
# Spatial distribution of the climatic factor in March based on REMO and ALADIN models



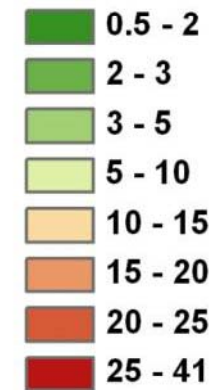
## Climatic factor



# Spatial distribution of the climatic factor in April based on REMO and ALADIN models



## Climatic factor



# Conclusion

- The regional scale wind erosion sensitivity analysis and the created map can assist in outlining areas with different rate of sensitive
- More detailed analysis is needed in the regions, where the wind erosion sensitivity is high to define whether the local environmental parameters enhance or reduce the rate of erosion
- The model based analysis of the future changes of climatic factor in wind erosion indicates, that the climate models have high uncertainty in the projection of wind speed
- Thus future prediction of wind erosion rate is very problematic, even in regional scale





**MAGYARORSZÁG MEGÚJUL**



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