

Evaluation of the Wind Erosion Risks in GIS

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1. Résumé

L'article décrit des possibilités d'évaluation des risques de l'érosion éolienne au moyen du modèle créé au milieu GIS. Ce modèle utilise la base de données pédologique pour indiquer le danger potentiel d'érosion de sols. Comme d'autres fondements, on utilise des bases de données de types de terrains sur les terres agricoles, des informations et des données météorologiques pour déterminer des directions du vent et des conditions climatiques.

Au moyen de ces données mises en présentation graphique, il est possible de créer un modèle digital de terrain et régionaliser les données météorologiques. Par la suite, on localise des éléments végétaux de ligne en paysage et selon leurs caractéristiques d'altitude et de densité, il est possible de générer une zone effective autour de chaque élément qui protège le terrain contre les effets de l'érosion éolienne.

2. Introduction

Wind erosion is a serious problem in Czech Republic especially in southern parts (Southern Moravia,) where are conditions inclinable to its development : sandy soils, warm and dry weather in comparison with other parts of the country, windy areas, large areas of arable land.

Most problems started to come out after the World War II, when the properties of small farms were collectivised. Instead of short plots with rich diversification of vegetation set in the large areas of monocultures. Almost all natural wind barriers were destructed (balks, field roads with tree and shrub lines, game refuges etc.), which enabled to increasing wind erosion risks and damages.

This serious problem was partially solved in 50ties by planting out some protective shelter – belts. However since this time no other care for them has occurred, so the situation of their conditions, age, and efficiency is not very positive.

Although our literature offers several methods for estimating the risks caused by wind erosion, these techniques are hardly applied in designing works through the land use planning and land consolidation process.

So as to evaluate the wind erosion risks in certain area with including the efficiency of wind shelter – belts and other vegetation wind barriers was developed a model, that can take into account the meteorological and soil conditions with combination of condition of vegetation wind barriers (height, width, age, gaps, density of network). This model, developed in ARCINFO software, can be useful tool for designers, landscape planners and other experts. It enables to estimate risks of wind erosion on each plot, to design new barriers on endangered places and to design the reconstruction of existing vegetation barriers.

3. Material and method

3.1. Potential erosion risks from the wind erosion

For the analysis of wind erosion risks are necessary following materials:

- Pedological maps
- Orthophoto maps
- Digital maps of tracts of land
- Digital maps of vegetation wind barriers
- Data of predominant wind direction and velocity

The first step is to evaluate the potential erosion risks from the wind erosion according to the pedologic characteristics of the treated area. This process is based on the fact, that the Czech Republic has pedologic information system in digital maps. This system is created by complex information about the ecological and production characteristics of agricultural soil, i.e. soil structure, texture, depth, slope, exposition, and climatic region. These characteristics are expressed by five number numerical code, respective to each soil-ecological unit, and localized in geographical information system.

The potential erosion risks are evaluated by combination the value of climatic region and the value of soil factor, given by the soil type.

The **climatic region** is given by the sum of daily temperatures upper than 10°C, probability of occurrence of dry vegetation seasons, average consumptive water stability in vegetation period, average annual temperatures and annual sum of precipitations.

The **soil factor** is identified by soil texture, genetic soil type, hydromorphic level, matrix and skeletal conditions.

It is assumed, that the areas in dry and warm weather are inclinable to wind erosion, also the sandy and light-textured soils inclines to the wind erosion.

By combination of these two factors was obtained the coefficient of risk, which is categorised to the six levels of danger:

category	Level of risk
1	without risks
2	inclinable
3	slightly endangered
4	endangered
5	heavily endangered
6	most endangered

As it is assumed that only the arable land is endangered, there were chosen only the fields with arable land from the map of land trucks. Connection of the two levels – level of endangered soils and level of land trucks in GIS led in creating the map of areas, endangered by wind erosion.

3.2. Evaluation of efficiency of vegetation wind barriers

This process consists from the three steps. First the map of predominating directions of wind erosion affecting winds must be created. In the Czech Republic is considered wind

velocity $3\text{m}\cdot\text{s}^{-1}$ as the erosion affecting wind. Using the digital model of the treated areas it was obtained the map of regionalised directions of wind erosion affecting winds.

The second step is to assess the tolerable length of field according to the soil characteristics. Only the plots with categories 4-6 are considered:

Category of potential w.e.risk	Tolerable length of field (m)
4	< 850
5	< 600
6	< 350

The model in GIS identifies all the plots with exceeded tolerable length.

By the third step were created the protective zones around the vegetation wind barriers in predominant direction of wind. This protection zones represent the area, protected by the wind barrier from the wind. The spread of the zone was defined according to the criteria:

Type of barrier	Leeward side (m)	Windward side (m)
shelterbelts	300	100
other line vegetation	150	50

The model performs the evaluation of the efficiency of wind barriers by defining the percentage representation of protected area of arable land.

4. Results and discussion

The model performed in this paper was used for the evaluation of wind erosion risks in the region of South Moravia, the warm and dry part of the Czech Republic. (see the map 1 and 2) By this method there were localised areas endangered by wind erosion. The results enable to focus to the problematical areas and to make the designs of establishing the new shelter -belts. The model can help with optimal placement the barriers in certain fields and with evaluating the new state in the area. The model can be used for analyses in large areas as well as in land adjustment projects in certain parts (cadastres).

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