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EROWIN part study: Linking regional modeling with field measurements to evaluate effectiveness of living windbreaks as measures against wind erosion

Questions

- Where are areas highly susceptible to wind erosion?

- How will the wind erosion potential in the Pannonian region respond under changing climate conditions?

- Where to concentrate actions for installation or maintenance of windbreak network?

Regional modeling

- detection of areas with high risk for wind erosion using the model SoLoWind

- intersection of soil water regime, soil physical characteristics and windbreak network to assign priority areas for authorities

- testing approaches to down-scale regional model linked to measurements

- including climate change scenarios for wind energy and soil moisture

- sensitivity study based on stochastic input variations

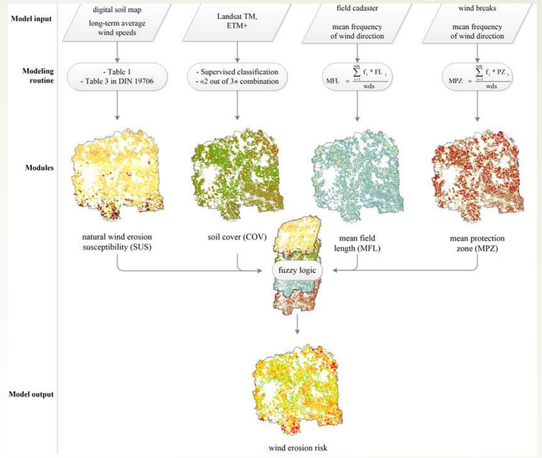


Fig.1. Model framework of SoLoWind, Schmidt et al., 2017

Ecological inventory of windbreaks

- Field determination of vitality and resilience of windbreaks classified by soil texture and field capacity

- assessment of recent and future potential of windbreak species and structural types to fulfill protective function against erosion and drought

- statistical analyses of establishment success of subsidized windbreak installations from the last seven centuries

Fig. 2. exemplary windbreak in the study region

(Expected) outcomes

- Assessment and evaluation of the wind erosion potential in the Pannonian region

- wind erosion risk maps

- maps showing site conditions for growth of effective living windbreaks

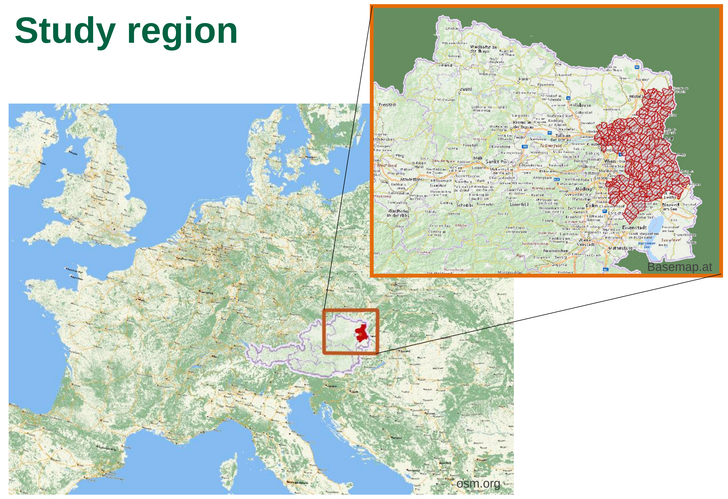
- evaluation of effectiveness of living windbreaks as wind erosion mitigation measure

- relation of windbreak functionality to site conditions

The story

Soil erosion and unproductive water losses in arable cultures are major threats to landscape functionality and agricultural production. Living windbreaks are established mitigation measures and fulfill numerous valuable ecosystem services. Nevertheless, they are often endangered for agro-economical reasons. Land reform authorities and other institutions devote considerable energy to maintain and extend the existing windbreak networks experiencing variable success. Regional modeling should help to evaluate former efforts and to rise effectiveness of future investments. Therefore, several types of data from remote sensing and field measurements are merged in course of a comprehensive modeling study.

Study region



References:
Schmidt, S., et al. (2017): Modelling Hot Spots of Soil Loss by Wind Erosion (SoLoWind) in Western Saxony, Germany. Land Degrad. Develop. 28: 1100-1112.

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Project EROWIN

General Concept Introduction 2019-2022

Wind erosion in the Pannonian region

A major threat to arable soils under current and future climate conditions?

WP1: Measurements

- innovative sampling approach to capture full view to sediment transport patterns
- monitoring of meteorological conditions, soil moisture

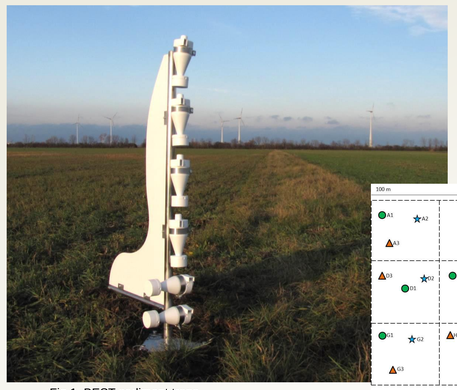

Fig.1. BEST sediment traps

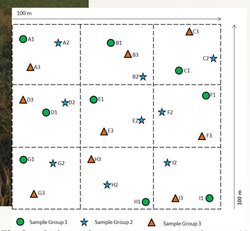

Fig.2. wind erosion measurement scheme, US National Wind Erosion Research Network (Webb et al., 2015)

WP2: Ecological inventory of windbreaks

- vitality and resilience of species regarding future climate conditions
- update for installation and maintenance guidelines of the Authority of Land Reform, Lower Austria

Fig.3: exemplary windbreak in the study region

WP3: Physical modeling

- wind tunnel experiments, varying soil conditions, density of hedges, etc.

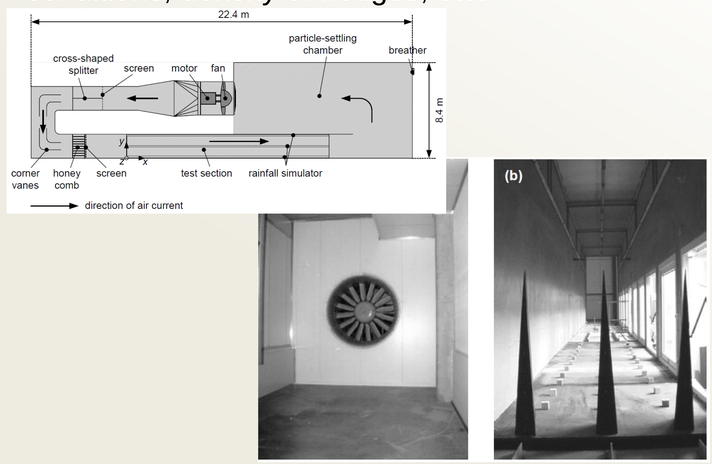

Fig.4: setup and impressions of wind tunnel physical modeling (Cornelis et al., 2004)

WP4: Regional modeling

- detection of areas with high risk for wind erosion.
- model SoLoWind

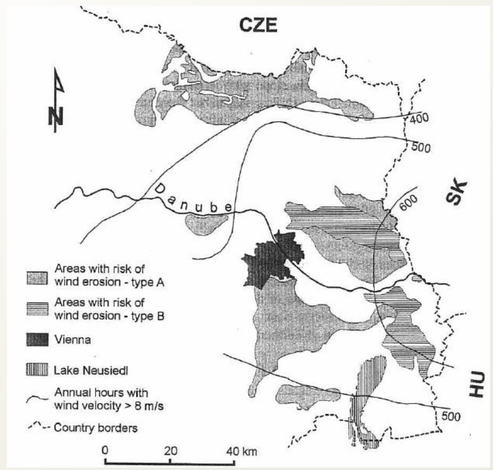

Fig.5: wind erosion susceptibility map of Eastern Austria (Nowak, 1972, modified)

Project Idea

The degrading impacts of wind on plant production are observed frequently, including soil erosion and unproductive water losses. Nevertheless, wind erosion on agricultural soils has not yet been scientifically investigated in Austria. Hence, there is no robust information available about the relevance of wind degradation and subsequently the effectiveness of protection measures like vegetative wind shelter belts. Predicted future climate conditions will likely strengthen the threat.

Outlook

- quantitative information about relevance of wind erosion in the region
- characteristics of effective and stable vegetative wind shelters
- extension of regional modeling including water balance components

References:

- Cornelis, W., Erpu., G., Gabriels, D. (2004). The I.C.E. Wind Tunnel for Wind and Water Interaction Research. In: Visser, S., Cornelis, W.M. (eds). 2004. Wind and rain interaction in erosion. Tropical Resource Management Paper 50, Wageningen, NED, 232pp.
- Nowak (1972) modified in: Strauss P., E. Klaghofer (2006): Status of soil erosion in Austria. In: Soil Erosion in Europe (Eds.: J. Boardman, J. Poesen), John Wiley, London, New York, 205-212.
- Webb N.P., et al. (2015). Standard Methods for Wind Erosion Research and Model Development: Protocol for the National Wind Erosion Research Network. USDA-ARS Jornada Experimental Range, Las Cruces, USA.

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