Effects of landscape elements on spatial differences of microclimatic variables – comparison between measurements and modelling approaches

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Landscape elements play an important role in preventing wind erosion and protecting arable land outside of tillage and crop management practices. The wind reducing effect of any landscape element may influence leeward distances up to the 40-fold of its height. In addition, when the sun is shining, areas close to the landscape elements are shaded. Wind velocity and solar radiation are the primary affected parameter, which again have impact on temperature, dew formation, evaporation and soil moisture in the zones influenced by landscape elements (Veste et al., 2020). Therefore, not only the wind erosion susceptibility of a soil but also plant growth factors can vary considerably within short distances.

The combination of large fields and dry climatic conditions are favoring factors for wind erosion in the Federal State of Brandenburg. On the other hand, Brandenburg has a very diverse landscape structure, including forests, alley trees, hedges, small groves and many other habitats. Within the framework of the Cross Compliance regulations ((EC) No 73/2009) for direct support schemes for farmers a method has been developed, to include the influence of landscape structure in the assessment of wind erosion susceptibility of soils (DIN 19706; Funk et al., 2004). This method has been continuously developed and now uses the Digital Surface Model (DSM) from the laser scanning survey of Brandenburg to determine the location and height of any landscape element with a horizontal resolution of 1 x 1 m and a vertical resolution in the centimeter range. The height of each landscape element can be used to calculate the shading effects of the wind or the sun in a GIS. These calculations were compared with detailed measurements of meteorological parameter in and around shelter belts in an orchard.

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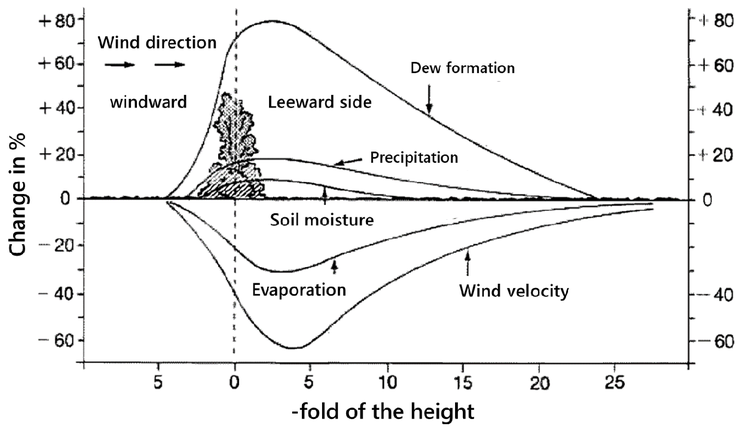
Problem

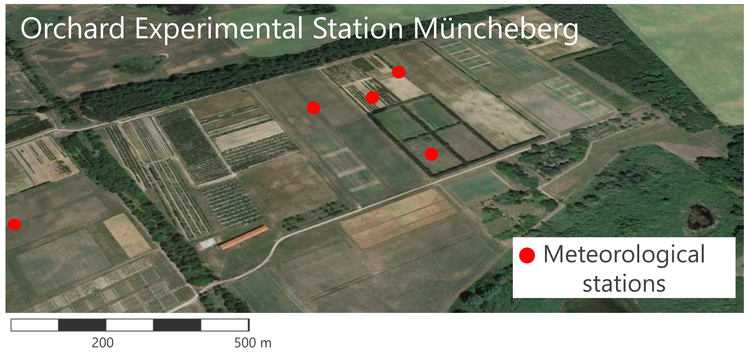
- Landscape elements influence primary directional meteorological parameter as *wind velocity* and *solar radiation*
- This results in further spatial differences of temperature, humidity, evaporation or dew formation,
- Finally: different growth conditions for crops at short distances

How can this be mapped in a GIS or made available for modeling?

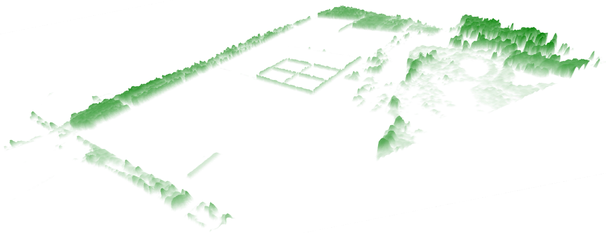
Effects of a shelter belt on meteorological parameter



Material and Methods

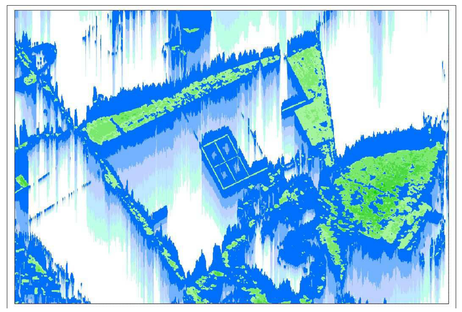


Laser scan of landscape structure (height of landscape elements in 1 x 1 m raster, 10 cm height accuracy)

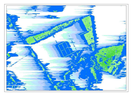


Wind velocity reduction

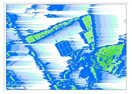
Calculated for 8 directions N, NE, E, ...
Wind from north,..



...east,



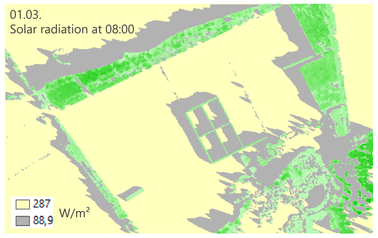
...south,



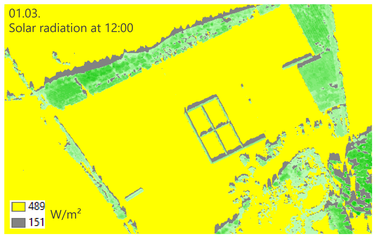
Spatial distributed reduction of wind velocity, distance dependend

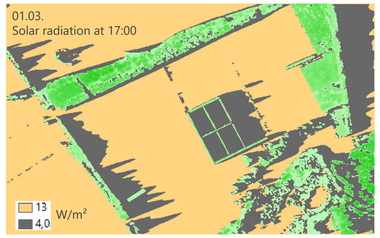
Solar radiation distribution

Calculated for each hour from 01.03. – 31.10. from sunrise to sunset

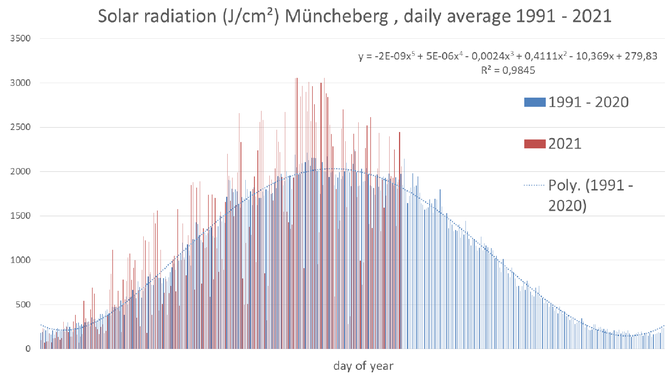


Solar radiation and shadowing at 08:00, 12:00 and 17:00, Radiation in the shadowed zones is 30 % of the full sun exposition





Depending on demands matching with current data of different temporal resolution (hourly, daily, ...)



Tasks for the next period:

Comparison between modelled and measured data

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