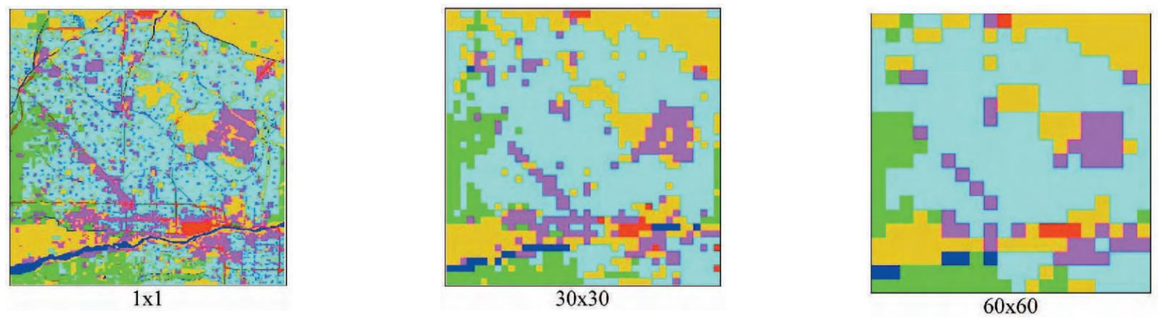
Wavelet-based techniques and GIS tools for identifying fine scale landscape patterns

Master thesis by Pleșoianu Alin-Ionuț, under the supervision of dr. Stupariu Mihai-Sorin, dr. Pătru-Stupariu Ileana, also in collaboration with PhD student Stoicescu Ioana

Introduction

Problem: Landscape structure, function and ultimately pattern are scale-dependent (Turner, 1989; Wu, 2004), and fine-scale ecological information is lost with traditional pattern analyses (Wu & Hobbs, 2002). Trees and bushes are elements of fine-scale landscape pattern.

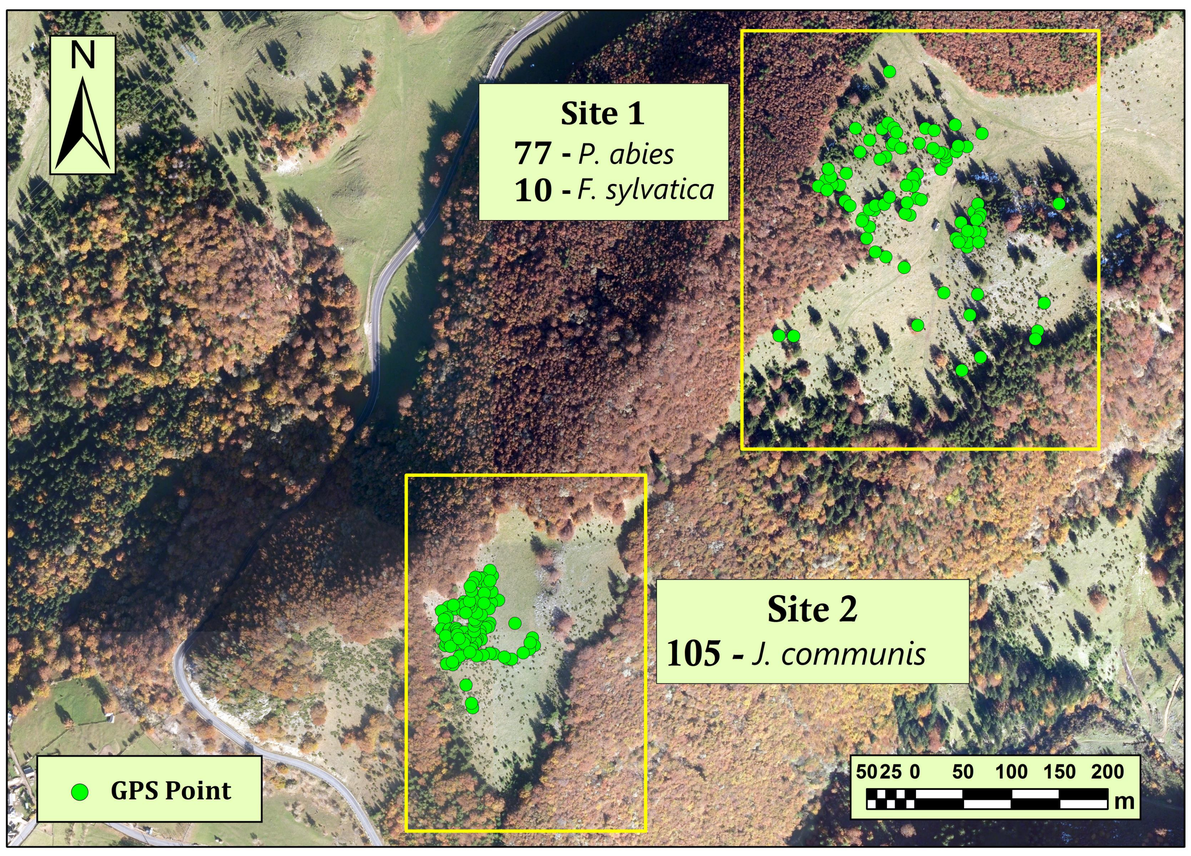
Pattern change due to grain size change (Wu & Hobbs, 2002)



Study objective: implement a technique for automatic ecological feature detection (trees and bushes) from a high-resolution LiDAR Canopy Height Model.

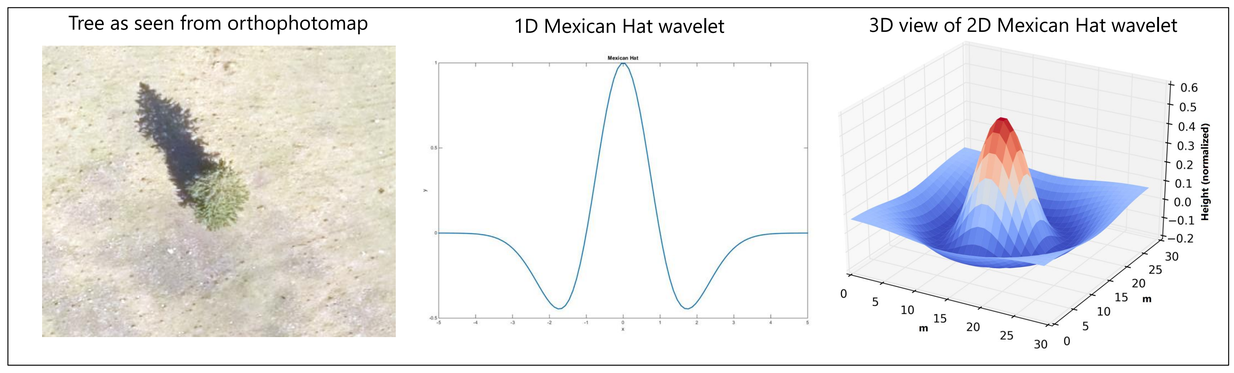
Study area and field campaign

- Two study sites (wooded pastures) in Fundata, Brasov, Romania
- Tree and bush locations were recorded with a portable GPS, with an error of ±3m
- Trees belong to different height classes, and are of *P. abies* and *F. sylvatica* species
- Bushes belong to *J. communis* species and have same height class

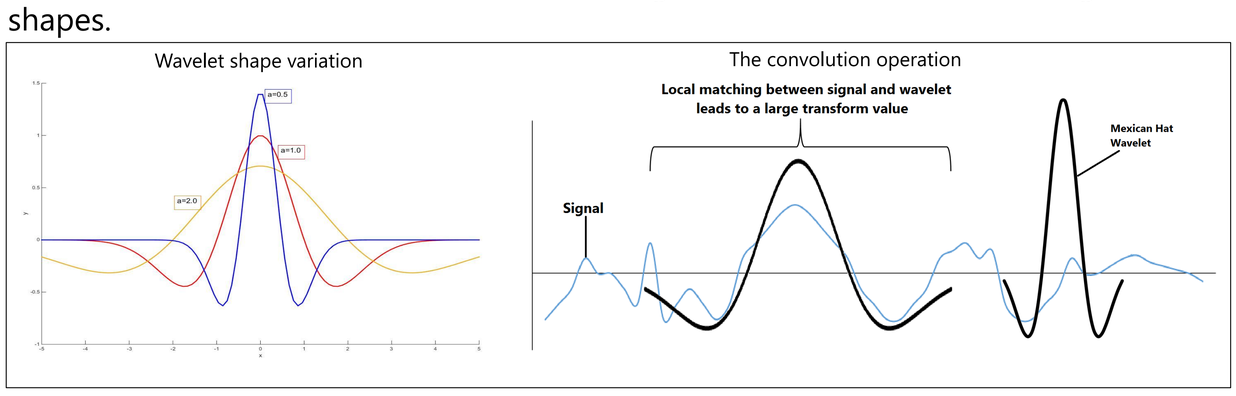


Wavelet methods

Wavelet: function described by certain mathematical properties (Addison, 2002). The wavelet shape corresponds to features searched in the data. Mexican Hat (Ricker wavelet) was chosen due to the similar shape to that of a tree.

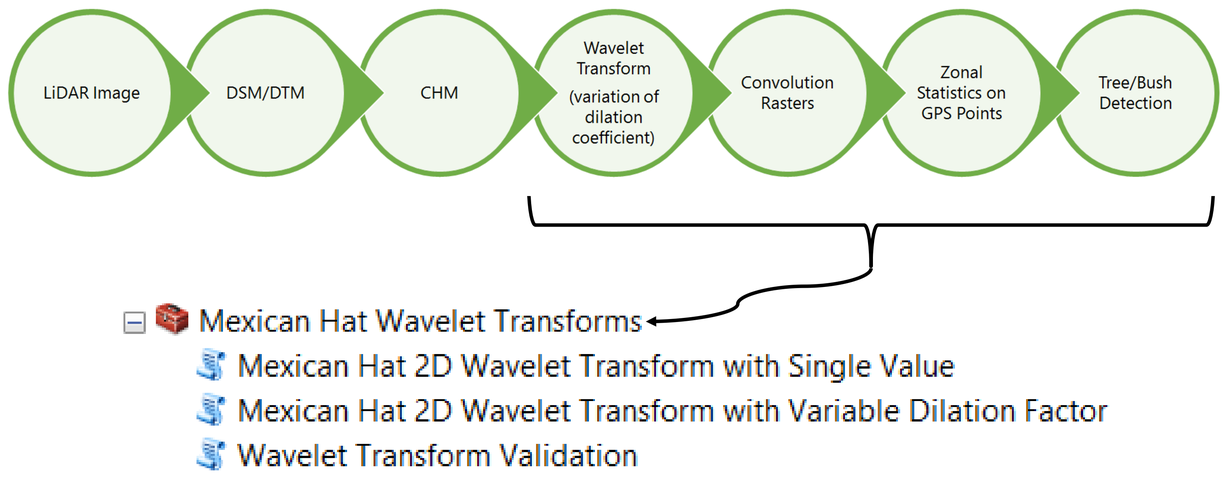


Dilation factor: the shape of the Mexican Hat wavelet depends on the dilation factor, which needs to be varied in order to detect vegetation features in a wide range of shapes.

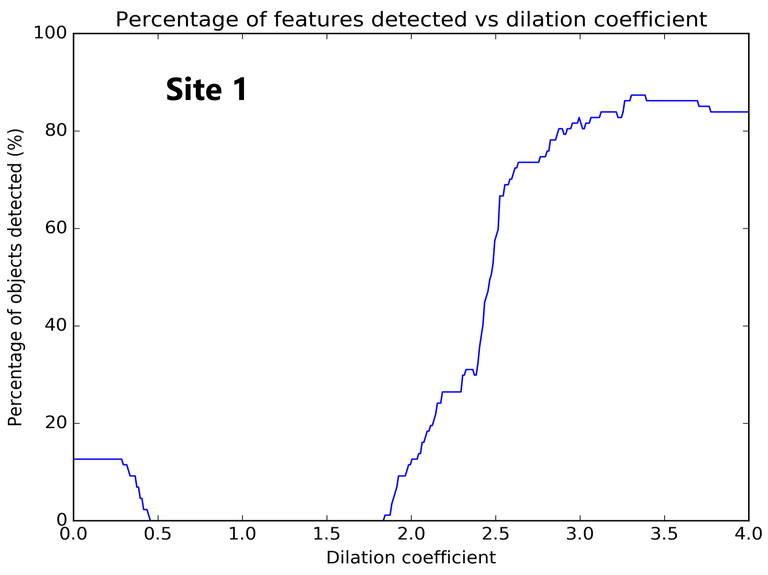


Method implementation

We used Python scripting for ArcGIS with the aim to create a toolbox for the wavelet transform operation. The CHM is regarded as a 2D discrete signal, the wavelet is discretized and the convolution operation is applied.



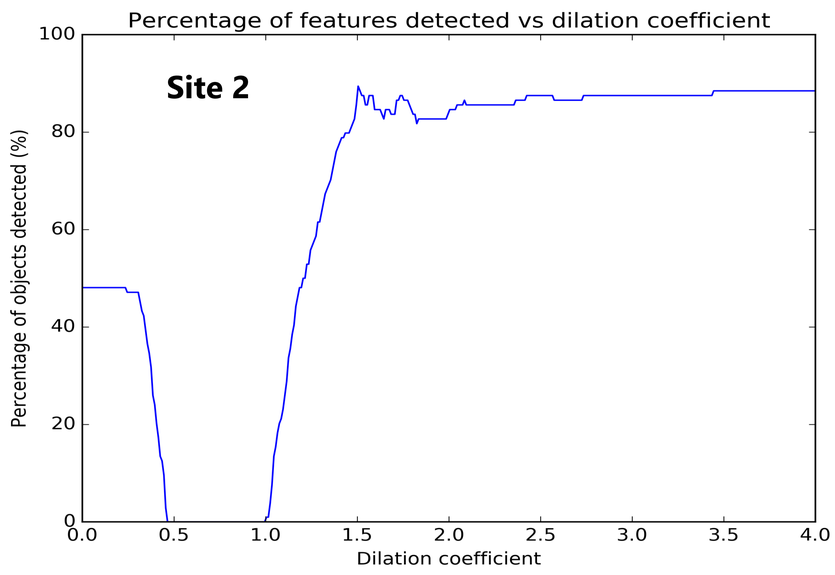
Results



The results show the possibility to detect trees of various traits, with a high detection percentage (>80 %), under variable ecological attributes (coniferous – deciduous species).

The tool also shows very high detection values (90%) for bushes features.

This technique provides a procedure to detect fine-scale ecological features, such as trees and bushes, from a high-resolution CHM.



Acknowledgements

This study was partially financed by the Romania - Switzerland Research Programme, WindLand project, codes IZERZO 142168/1 and 22 RO-CH/RSRP, project director Mihai-Sorin Stupariu
We are also very greateful to dr. Ionuț Șandric for helping in the ArcGIS toolbox construction.

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