Understanding patterns of secondary forest succession on abandoned agricultural land in the Polish Carpathians using airborne laser scanning data

Natalia Kolecka*, Jacek Kozak*, Urs Gimmi**

*Institute of Geography and Spatial Management, Jagiellonian University
**Swiss Federal Research Institute for Forest, Snow and Landscape Research WSL

Project supported by a grant from Switzerland through the Swiss contribution to the enlarged European Union
How agricultural decline contributed to forest cover increase over the past 150 years, and how this trend will continue in future?
The past forest cover change

Austro-Hungarian military maps (1860s)
Polish topographic maps (1930s)
Polish topographic maps (1970s)
contemporary topographic data (2010s)
The past forest cover change

- georeferencing
- manual / automated vectorisation of forest cover
I. 1860s – 1930s

II. 1930s – 1970s

III. 1970s – 2010s

The past forest cover change
The past forest cover change

I. 1860s – 1930s
II. 1930s – 1970s
III. 1970s – 2010s

The past forest cover change
The past forest cover change
Future: modelling

Land use scenarios and climate change
- land abandonment
- urban sprawl

DynaCLUE modelling

Future land use maps

Land cover maps

1970s
2010s

Land use suitability analysis

Variables

Future: modelling

DynaCLUE modelling

Future land use maps

Land cover maps

1970s
2010s
Future: mapping forest succession with aerial photos

1997 landcover
- Forest: 54.71%
- Succession: 1.39%
- Other: 43.90%

2009 landcover
- Forest: 44.37%
- Succession: 10.21%
- Other: 45.42%

Forest in 1997
- F-F: 97.70%
- F-O: 1.13%
- F-S: 1.17%

F. succession in 1997
- S-S: 35.40%
- S-F: 52.52%
- F-O: 12.08%

Arable land in 1997
- O-O: 79.86%
- O-F: 16.86%
- O-S: 3.28%
Future: mapping forest succession with airborne laser scanning (ALS) data

- ALS point cloud data from the national database, mostly 2012, classes defined according to the ASPRS standards
- segmentation based on vegetation height and vegetation cover

- overlayed with national topographic data
- tested overall accuracy 95%
Future: mapping forest succession with airborne laser scanning (ALS) data

- sampling the entire Polish Carpathians, 230 ALS tiles 2 x 2 km
Future: mapping forest succession with airborne laser scanning (ALS) data

- average rate of fs on agricultural land: 14%, up to 38%; mostly occurred on grasslands, mostly medium high vegetation
Future: mapping forest succession with airborne laser scanning (ALS) data
Future: mapping forest succession with airborne laser scanning (ALS) data
Concluding remarks

- forest cover increase in the Polish Carpathians was a 'sprawl' type process; distance to forests was the most important factor, except for periods with abrupt socio-economic changes.
- most likely, forest cover increase will continue in future with similar spatial patterns.
- forest cover increase had, and will have, important implications for biodiversity loss, cultural landscapes and traditional agricultural activities.
“Carpathians Unite - mechanism of consultation and cooperation for implementation of the Carpathian Convention” is a project supported by a grant from Switzerland in the years 2012-2015 through the Swiss Contribution to the enlarged European Union.

http://karpatylacza.pl/
Thank you