



# **The detection of windfall and windbreaks in the Norway spruce stands using GEOBIA, LiDAR and aerial photo based 3D point clouds – a case study in Koscieliska Valley (Tatra National Park, Poland)**

**Adria Descals, Paweł Hawryło, Piotr Węzyk**

Laboratory of Geomatics, Institute of Forest Resources Management  
Faculty of Forestry, University of Agriculture in Krakow, Poland



# The detection of windfall and windbreak in Norway spruce stands using GEOBIA, LiDAR and aerial photo based 3D point clouds – a case study in Koscieliska Valley (Tatra National Park, Poland)



**The detection of windfall and windbreak in Norway spruce stands using OBIA, LiDAR and aerial photo based 3D point clouds – a case study in Koscieliska Valley (Tatra National Park, Poland)**

Adria Decoals, Paweł Hawyło, Piotr Wężyk  
 Laboratory of Geomatics, Department of Forest Management, Geomatics and Forest Economics  
 Institute of Forest Resources Management, Faculty of Forestry, University of Agriculture in Kraków

### Introduction

- The upper heights (95% of the Norway spruce stands) derived automatically from ALS point clouds become very important information in studies on mountain vegetation.
- The digital photogrammetry is offering nowadays 3D point clouds derived with the so called stereo-matching approach. The role of ALS is still important as information about DTM helping with DSM modeling.

### Study area

Lower part of Koscieliska Valley (Tatra National Park, Poland) in 2013 is approximately 1.64 ha of spruce forest, meadows (Polana Koscieliska) and wetland-urban interface.

### Stereo-matching

- DSM was generated from stereo-matched of high resolution digital aerial photos (0.07 m; 2016) and DTM from ALS (ISOK project, 2012) and stereo-matching (2016). Based on DTM the nDSM (DSM) was created.

### WIND DAMAGE CLASSIFICATION

Land Cover map of Koscieliska Valley based on nDSM classification

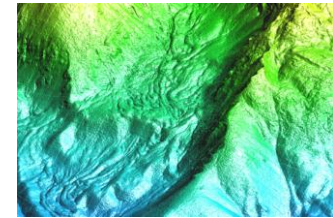
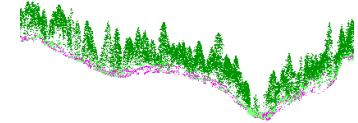
### Stem detection

- Lying Norway spruce stems with roots systems were detected on the 7 cm orthophoto using Object-Based Image Analysis (OBIA). The characteristics of the windbreak were analyzed.

### Results

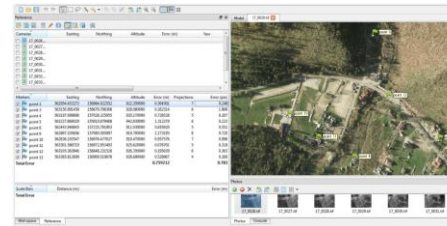
- The wind storm December 25, 2013 destroyed 47.0% of 110.52 ha analyzed Norway spruce forest stands.
- The total area of the gaps located among Norway spruce stands was 17.6 ha, which represents the 15% of the forest area. The orthophoto from 2009 suggested that these gaps were previously created also by natural damage.
- Automatically detected tree snags or stumps (16.3% in total) were distributed primarily to the North (mean azimuth 259°) in an area of 66.6 ha – without any clear evidence DTM surface.

Aspect	Classified by	Surface area (ha)
N	1195	-3.1
NE	1189	7.9
E	1110	-1.1
SE	151	-3.3
S	107	0.3
SW	202	10.1
W	224	0.7

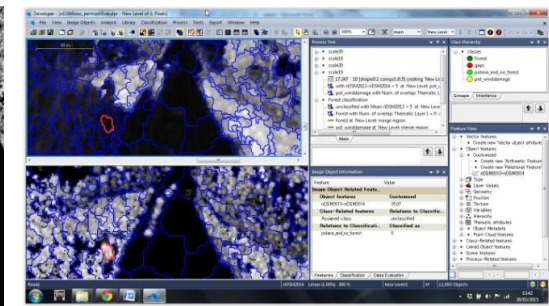
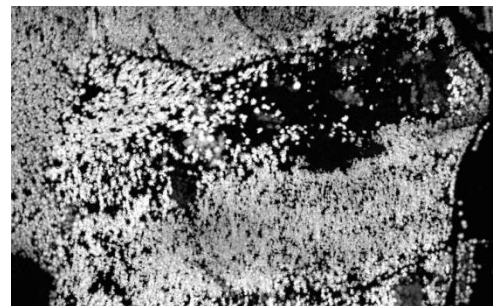


Windstorms in Polish Tatra at Dec. 25, 2013

ALS LiDAR data from 2012



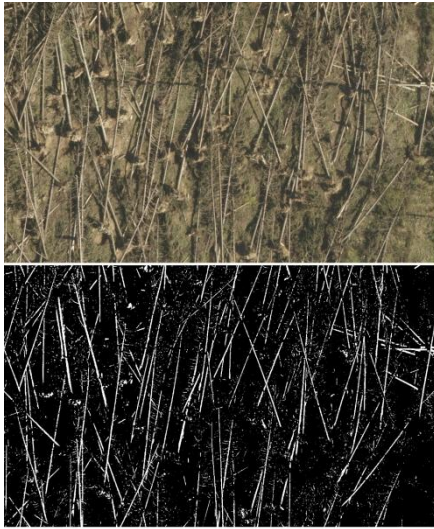
AGISOFT PhotoScan software – 3D point clouds - DSM



nDSM based on stereo-matching and GEOBIA approach



# The detection of windfall and windbreak in Norway spruce stands using GEOBIA, LiDAR and aerial photo based 3D point clouds – a case study in Koscieliska Valley (Tatra National Park, Poland)



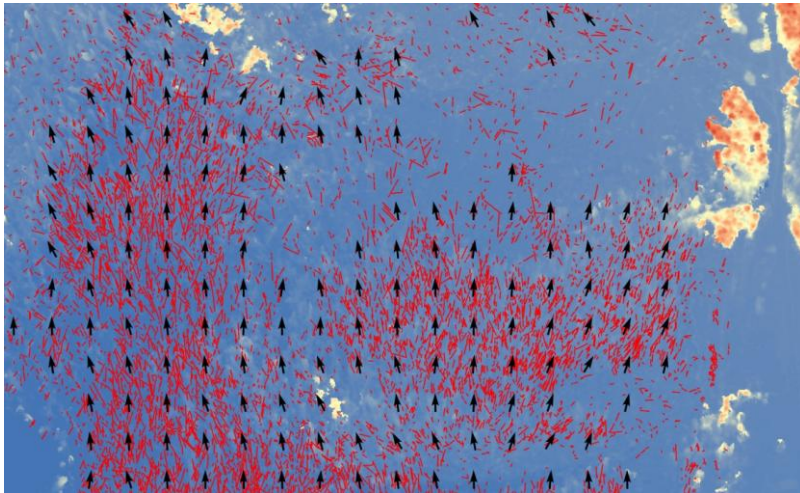
Enhancing of the 7 cm aerial orthophoto.



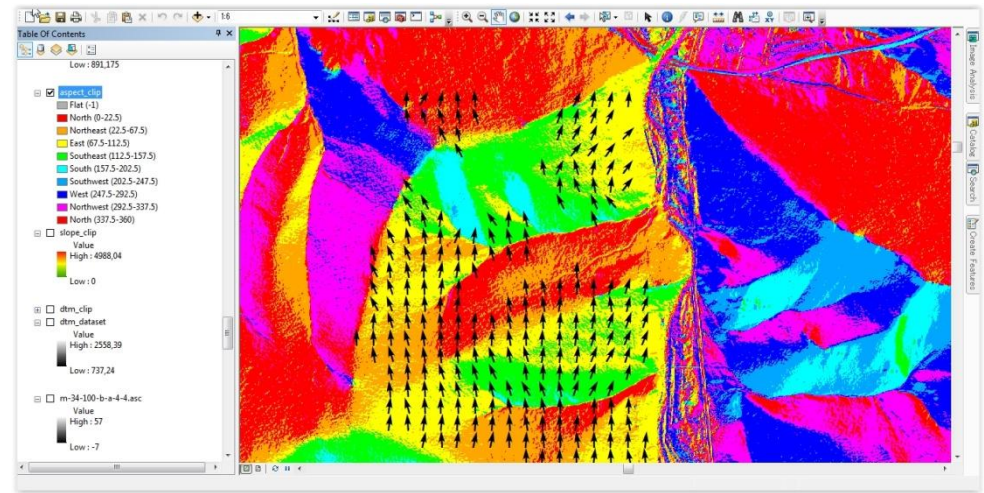
Automatically vectorized stems



Image enlargement



Results: Red - stems / black arrows - wind directions



wind direction over the aspect map