Hyperspectral data as a tool for assessment of temporal changes in Norway spruce forest conditions in a historically heavily polluted mountainous region of Czech Republic affected by long-term acidic deposition.

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The Krušné Hory Mts. located in the western part of the Czech Republic suffered since the 1950’s till the 1990’s heavy atmospheric pollution due to the mining activities and coal combustion adjacent to the mountain range. Acidic deposition in combination with harsh climatic conditions led there to forest decline. Although the load of SO2 has significantly decreased since 1991, tree damage was still visible in 1998 in terms of high defoliation or dead trees. Nowadays Norway spruce trees do not exhibit visible symptoms of damage but we suppose that the full recovery of Norway spruce forests is not complete yet due to persisting adverse soil conditions.

The main goal of the present project is to assess the temporal changes in the physiological status of Norway spruce forests in the Krušné Hory Mts. using two hyperspectral data sets acquired in 1998 (ASAS sensor) and in 2013 (APEX sensor) and ground truth data (LAI, tree crown status, photosynthetic pigment contents, leaf spectral properties measured by spectroradiometer, soil properties – pH, contents of basic cations, heavy metals, etc.). Ground truth data were evaluated by unconstrained and constrained multivariate analyses using Canoco 5.

Total carotenoids to chlorophyll ratio – in 1998 the stands exhibited different physiological status corresponding to the pollution gradient with healthier trees at the western part of the mountains. Analysis of the foliar chemistry in 2013 show a slight improvement of the Norway spruce physiological status in the eastern part of the mountains while a status of the western-located stands slightly worsened. We also studied the differences in soil geochemical conditions, which appeared to be less favorable in the western part of the mountains characterized by a low base cation contents in the top organic horizon and a very low pH (pH<3).

The next step of the project is to design the predictive models for pigments and other biochemical stress indicators based on laboratory spectroscopy and upscale the models to the canopy level. The final complex conclusion about the temporal change in Norway spruce physiological status after processing the hyperspectral data will provide the information on a larger spatial scale for the local forest management.

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