Impacts of extreme wind speeds and other factors on vegetation disturbances in the German railway network

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Winter windstorms are among the most dangerous and costly natural hazards in Central Europe. Their ability to cause tree and branch fall leads to disruptions and damages along railway systems. Along the German railway network the Deutsche Bahn is preventively removing about 30.000 trees per year. Still, each year a multiplicity of disturbances occur which may lead to delays, economic damages or even train collisions.

A data set with vegetation disturbance events between 2017 and 2020 along the German railway system is provided by the Deutsche Bahn. The aim of this study is to use exploratory statistics as well as machine learning methods like regression techniques or decision trees to explore the relationship between vegetation damages and meteorological parameters like wind gusts, precipitation or temperature. Additionally, tree related factors and surrounding conditions like ground frost and soil moisture will be taken into account. Finally, we want to derive critical thresholds and combinations of weather parameters leading to significant damage risk.

We find a positive relationship between vegetation disturbance and wind speeds. Especially strong winter storms leave a very clear signal in the disturbance time series. For example, the highest numbers of vegetation disturbances occurred during the winter storms Sabine (10.02.2020, 515 events) and Friderike (18.01.2018, 360 events). During winter storm days the majority of events occurs in those areas affected by high wind speeds. Tree fall disturbances peak during the winter storm season between January and March, while branch fall disturbances peak between June and August. However, a high number of events occurs also during times of low wind speeds. Additionally, high wind speeds do not necessarily lead to vegetation disturbances. It is clear that other meteorological and tree related factors need to be taken into account. Compound events as well as previous weather and soil conditions are expected to affect wind throw risks.