Meteorological influences on the noise reduction potential of forests

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Meteorological influence on measured sound level

- Correlation between vertical gradient (10-2 m height) of effective sound speed (temperature and wind vector) and sound level
Scheme of model area:
Strip of forest

Modeled forest: Strip of different (homogeneous) forests within homogeneous grassland, bushes and young forest at the edges.
Simulation of meteorological quantities

15.07., 12 CET, deciduous forest

Horizontal wind velocity in m/s
Air temperature in K

Atmospheric boundary layer model **HIRVAC**
**HIgh Resolution Vegetation Atmosphere Coupler**

Results
Simulation of vertical sound speed gradients

15.07., 12 CET, upwind of forest (grassland)
Simulation of vertical sound speed gradients

15.07., 12 CET, inside forest

Results

![Graph showing sound speed gradients](image-url)
Simulation of vertical sound speed gradients

15.07., 12 CET, downwind of forest

Results
Scheme of model area:
Strip of forest

Methods
Simulation of sound attenuation

Sound frequency = 500 Hz

Sound wave model CNPE (after Wilson et al., 2012, InterNoise)
Simulation of sound attenuation
Sound frequency = 500 Hz

Results

- Increased sound attenuation for upwind conditions (besides decidious forest, large distance from source)
- Daily variability depending on scenario, distance, wind direction
- Increasing differences between scenarios with increasing distance

Red: deciduous forest, Green: coniferous forest, Black: Grassland
Simulation of sound attenuation
Sound frequency = 63 Hz

Red: deciduous forest, Green: coniferous forest, Black: Grassland

- Increased sound attenuation for upwind conditions (besides deciduous forest, small distance from source)
- Maximal daily variability during summer and for upwind conditions
- Increasing differences between scenarios with increasing distance
Measurements Clearing-Forest
August/September 2011

Tharandt Forest near Dresden
Scheme of model area: Clearing inside forest

Cross-section west-east adapted to measurements of plant area density within Tharandt forest
Comparison of sound attenuation: Simulation and measurement

03.09.2011 clearing/forest frequency: 63 Hz

48 m distance

164 m distance

- downwind: evening-morning, upwind: during daytime
- Higher attenuation inside forest due to direct vegetation influences
Measurements inside forest (Old spruce stand) August 2012
Comparison of attenuation: Clearing and forest

Averaged sound attenuation between R1 (ca. 26 m from source) and R2/
Distance between R1 and R2 (ca. 48 m)

- Higher sound attenuation for higher sound frequencies inside forest
- Difference forest-grass 500 Hz: 0.08 dB/m, 1000 Hz: 0.37 dB/m

Results
Different vertical profiles of temperature and wind velocity within forest and over grassland -> influence on sound propagation

Increasing daily and yearly variation of sound attenuation and differences between upwind and downwind with increasing sound frequency and distance

Maximal sound attenuation for downwind conditions due to forest meteorology:
  - Attenuation of 1-2 dB for 63 Hz (in comparison to grassland)
  - Attenuation of 1-12 dB for 500 Hz (in comparison to grassland)
Thank you for your attention