A method to classify weather conditions for long-term averaging of sound levels

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The laboratory of environmental acoustics of EMPA has taken great efforts in the last years to develop sound propagation models that can take weather effects into account (ray tracing, finite differences in the time domain). To allow a comparison of calculated results with measured sound exposure levels, it is necessary to characterize the meteorological conditions from an acoustical point of view. Therefore, a project has been started with the goal to derive the relevant parameters from meteorological data available and to predict sound propagation conditions based on those parameters.

Wind and temperature gradients are the most important influences of weather on sound propagation. As temperature gradients are difficult to measure, it is proposed to derive them indirectly by assessing the atmospheric stability. This can be done by a scheme according to Polster [1], which has as a major advantage the possibility to use either observations, measurements or calculations as input parameters. From the analysis of the radiation balance, it can be shown that positive temperature gradients with height only occur at nighttime in situations with low winds and limited cloud cover.

Sound propagation simulation with typical wind and temperature stratifications show a dominating influence of wind with wind speeds greater than 2 m/s (reference height 10 m). Based on this result, a classification system for sound propagation conditions has been developed that separates meteorological situations into two classes, namely a class for conducive sound propagation conditions and one for hindering conditions. A method is derived that permits determination of the propagation class in the field using wind speed and cloud cover as the only parameters. The ability to easily determine the necessary parameters in the field as well as from meteorological statistics is a major advantage of this approach. It is furthermore shown that long-term averages can be determined with higher accuracy and still reduced expenditure when using the proposed method to take weather effects into account.

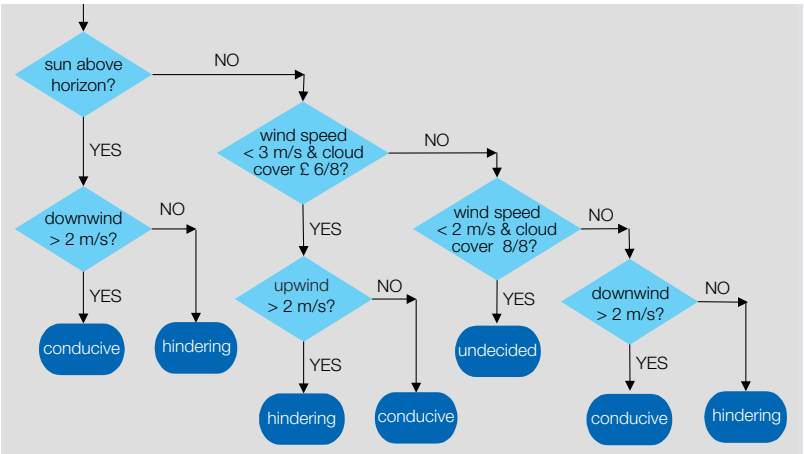

Fig. 1: *Classification of propagation conditions in* ***conducive*** *and* ***hindering*** *situations based on observations of the wind speed and direction, solar altitude and percentage of cloud-cover. Remark 1: The solar altitude can be derived from the geographical position, day and hour. For the scheme, a geographical position representative for central Europe had been chosen. Remark 2: Only the projection of the wind speed vector onto the direction of sound propagation must be taken into account.*

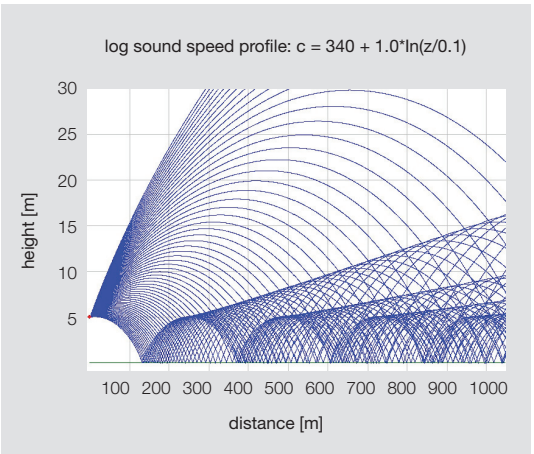

Fig. 2: *Visualization of weather influence on sound propagation using ray tracing. A situation with strong downwind conditions is shown.*

[1] G. Polster. Erfahrungen mit Strahlungs-, Temperaturgradient- und Windmessungen, Meteorologische Rundschau 22, 6 (1999).

Support: GR

Links: www.empa.ch/akustik

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References:
J. M. Wunderli et al., Acta Acoustica, submitted (2002)