Ice Throw Hazard

Experiences and Recent Developments in Germany

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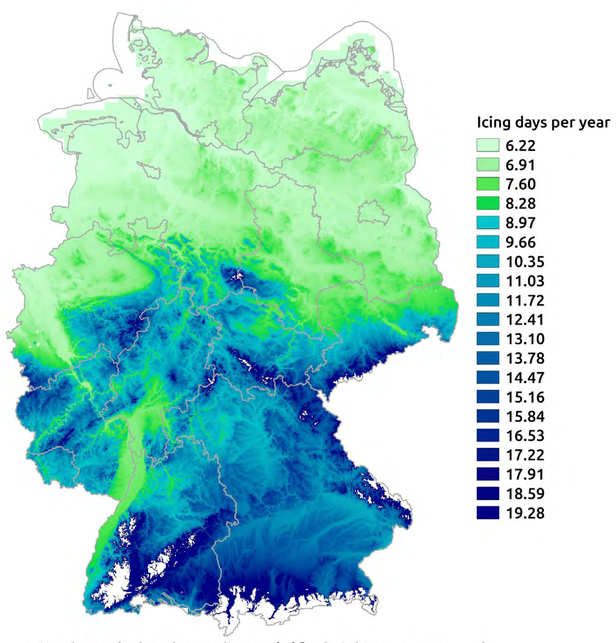
Abstract

Ice throw from wind turbines is a serious hazard. Especially close to traffic ways there is a demand of an individual risk analysis. No national or international standards exist but are urgently needed. The aim of this poster is to give an overview over the critical points which should be assessed in a future guideline.

Annual Icing Events

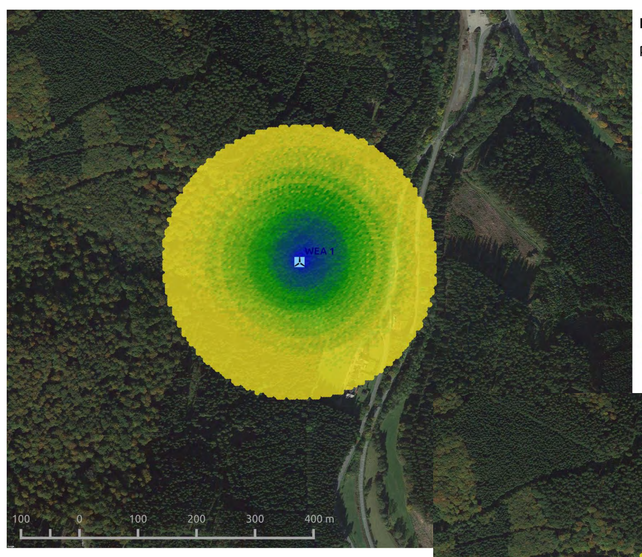


Icing days calculated according to /1/ for heights up to 700m asl.

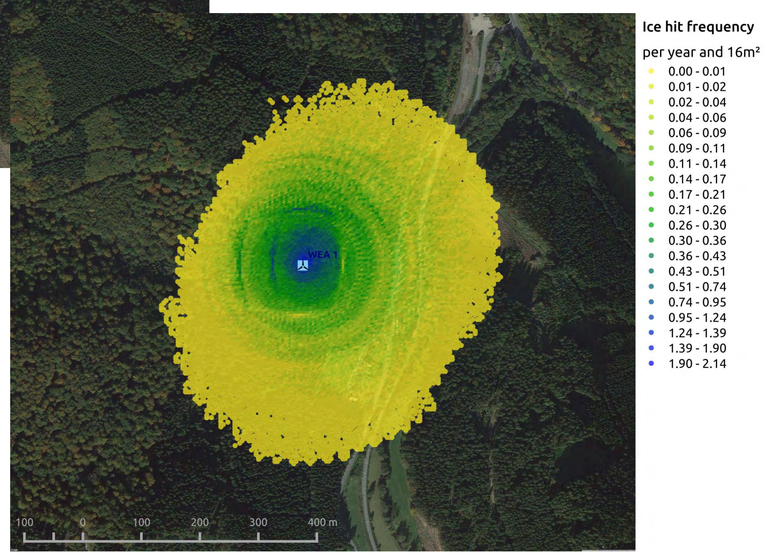
- Typically no long term measurements available at wind farm sites
- High uncertainty when extrapolating data from meteorological stations to wind farm sites and hub heights
- Germany's National Meteorological Service (DWD) published a method to calculate icing which includes effects of local topography /1/
- Actual ice mass per icing event depends on blade geometry

Methods for Ice Throw Calculation

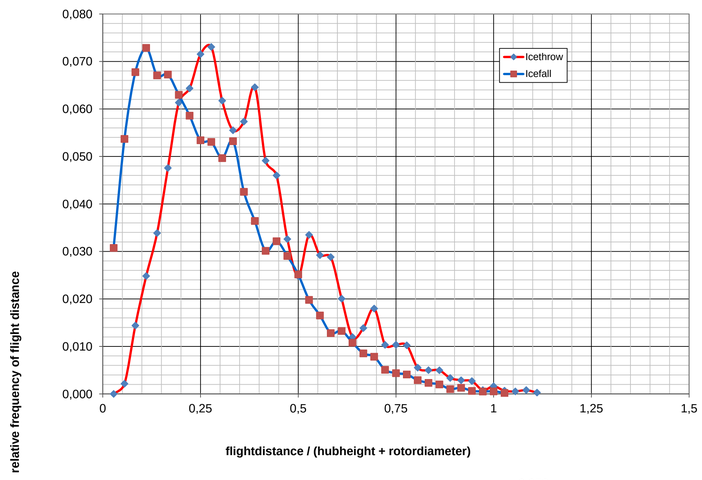
- Monte Carlo Simulation of ~1 million 3-dimensional ice pieces
- Moments of inertia and aerodynamical forces included
- Ice hit distribution and flight distance may strongly depend on the terrain



Ice hit distribution without terrain influence

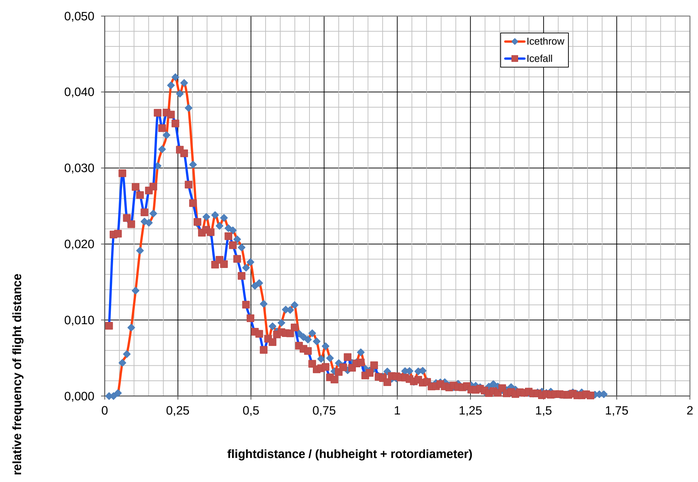


Ice hit distribution with terrain influence



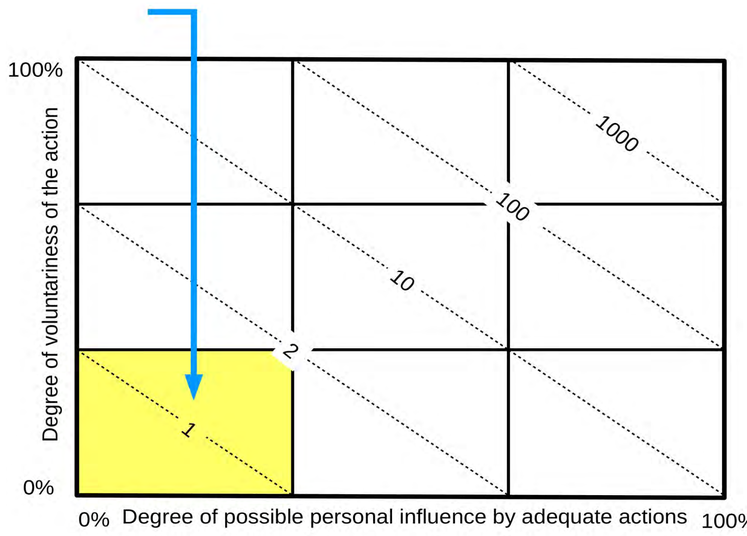
Distribution of ice hits for ice fall and ice throw in non complex terrain:
Shift to larger distances
Maximum distance dominated by storm events

Distribution of ice hits for ice fall and ice throw in complex terrain:
Strong influence of terrain on flight distance



Risk Analysis

Minimum Endogenous Mortality (MEM) /3/:
Hazard due to a new technical system should not significantly augment the mortality. Accepted risk per 100 000 persons per year: 1.



Accepted risks of death per 100 000 persons per year /2/.

Conclusions

The demand for risk assessments of ice throw from wind turbines has increased in the German market during the last few years. The technical part of calculating the trajectories of ice fragments can be solved quite accurately. There is much more uncertainty in the assessment of icing days and the risk threshold that can be applied. During the last years approaches and methods have developed within the German market, but there is still a strong need for a standardization of the methods.

References

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2. Schneider J., Schlatter H. P.; Sicherheit und Zuverlässigkeit im Bauwesen - Grundwissen für Ingenieure; 1. Auflage, B. G. Teubner, Stuttgart, 1994.
3. DIN EN 50126, Bahnanwendungen – Spezifikation und Nachweis der Zuverlässigkeit, Verfügbarkeit, Instandhaltbarkeit und Sicherheit (RAMS), Deutsches Institut für Normung e.V., März 2000.

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