Applications of Iced Wind Turbine Noise Simulations

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Winterwind
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Noise may cause…

… annoyance

… psychological distress

… insomnia

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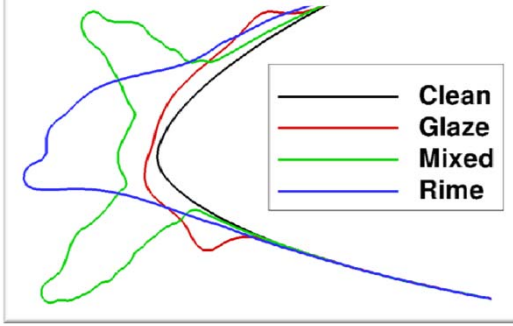
Wind turbine geometry

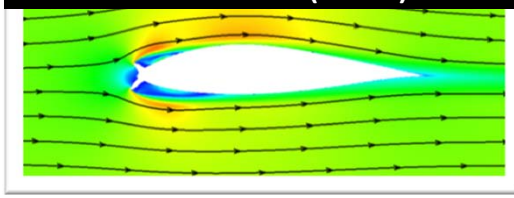
Icing simulation

Iced geometry



Computational fluid dynamics

Flowfield (CFD)



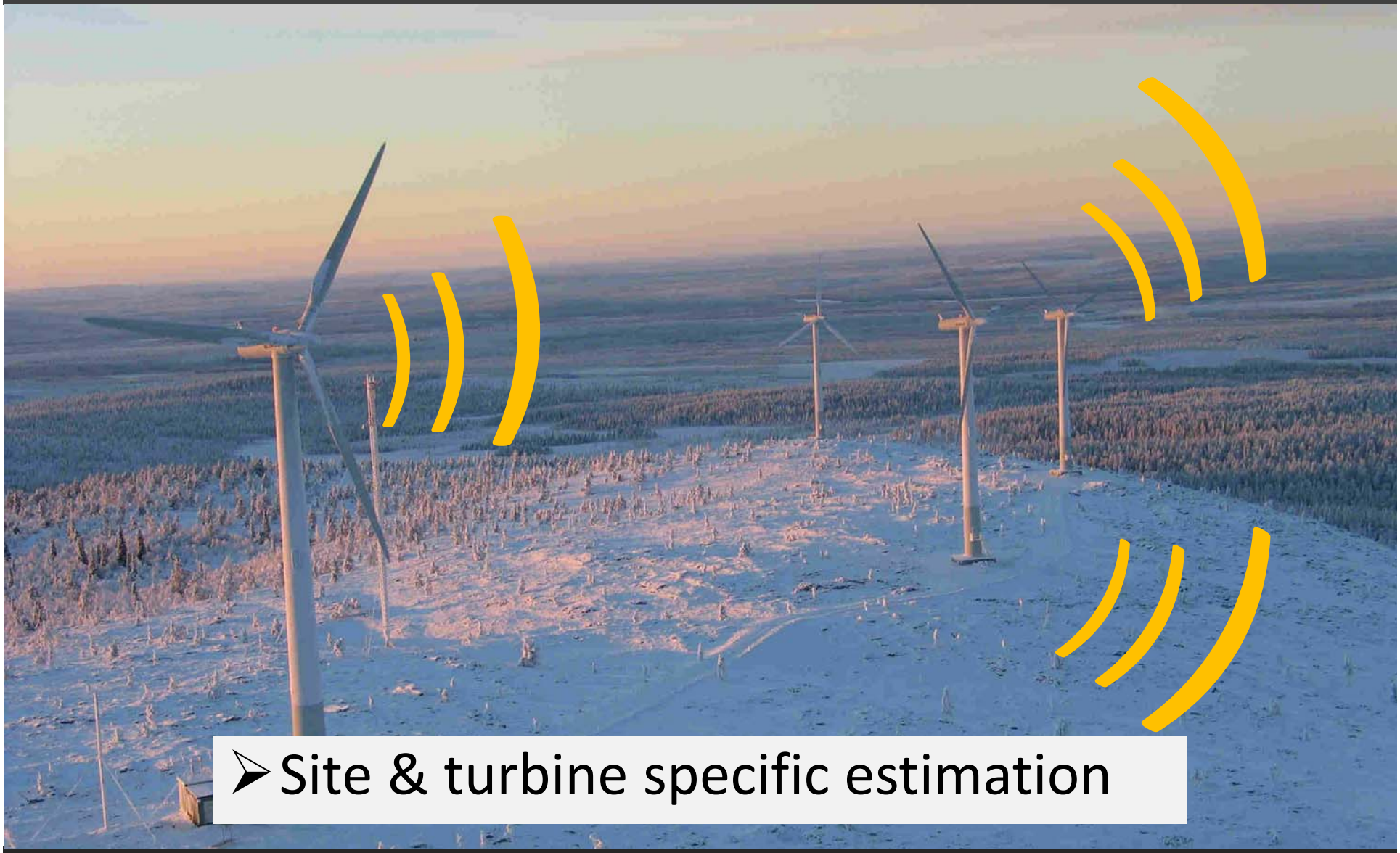
Computational aeroacoustics

Noise generation (CAA)

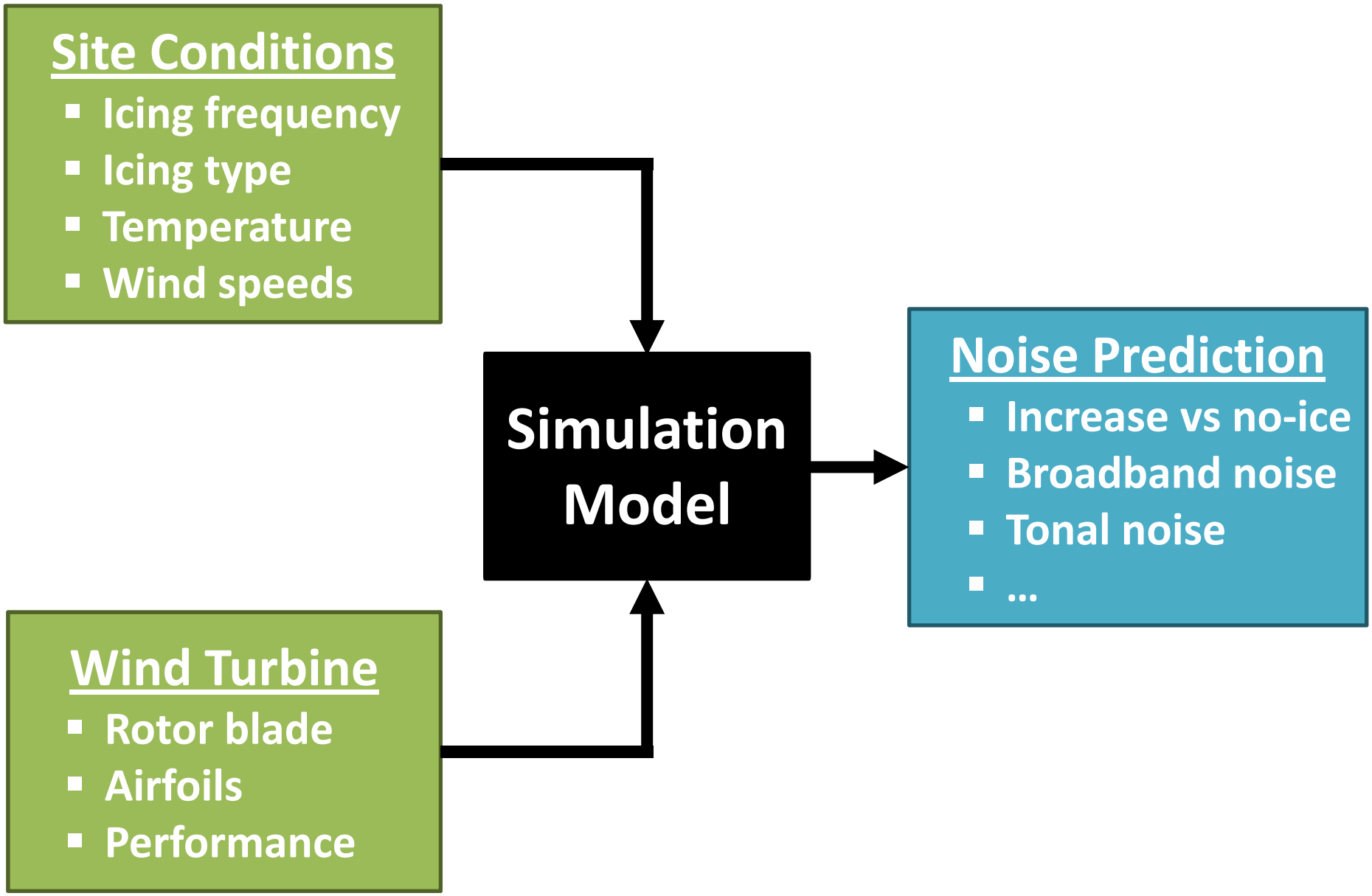
Understanding the physics

- Leading-edge vs trailing edge noise?
- Performance loss vs noise increase?
- De-icing vs anti-icing?

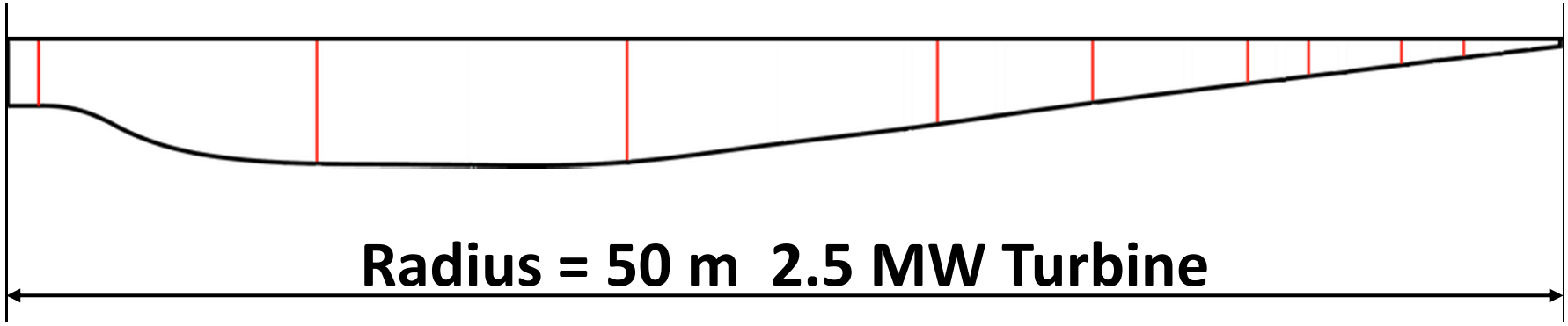
Estimate the overall impact



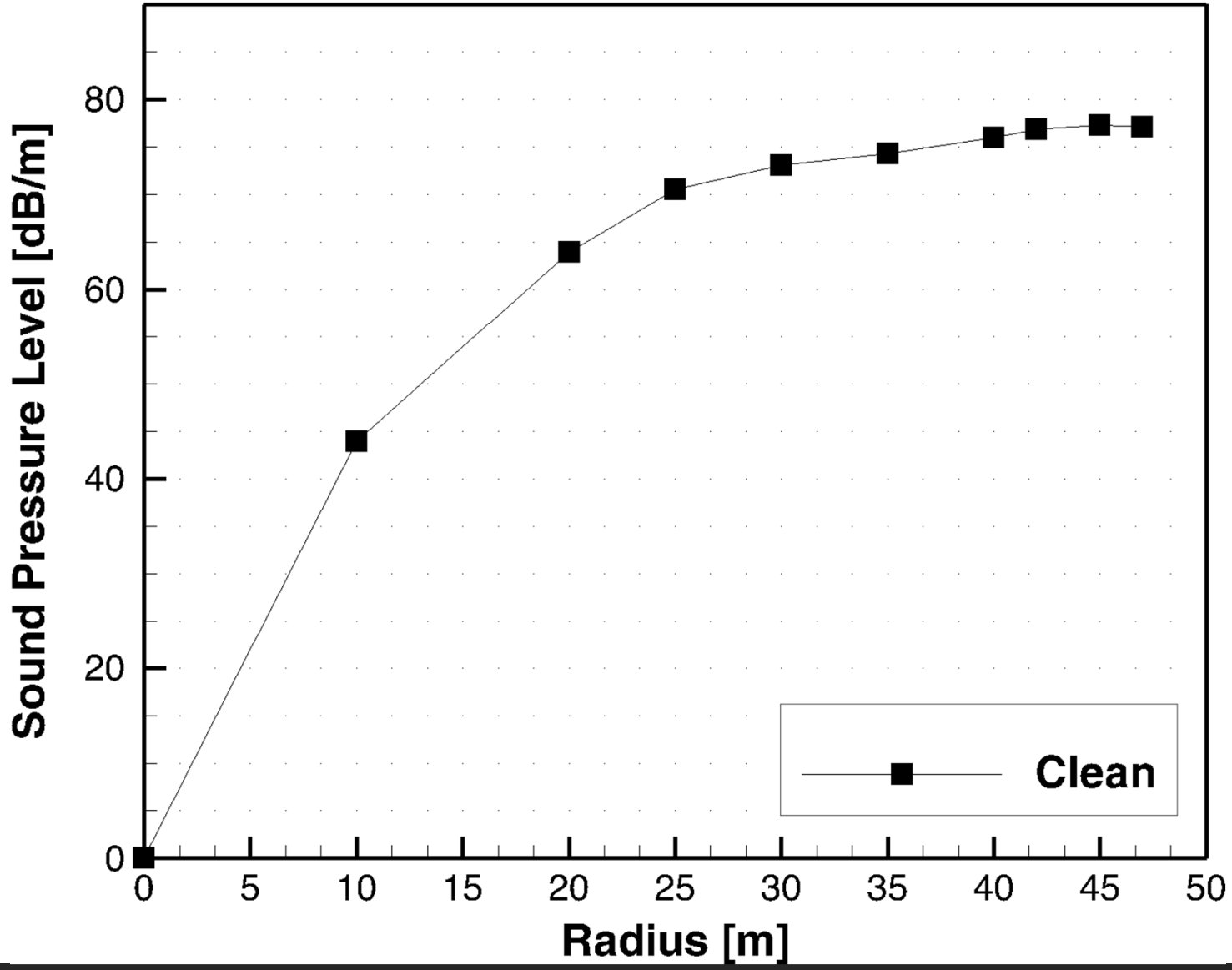
- Site & turbine specific estimation


Site Conditions
Icing frequency
Icing type
Temperature
Wind speeds
Simulation Model
Noise Prediction
Increase vs no-ice
Broadband noise
Tonal noise
…
Wind Turbine
Rotor blade
Airfoils
Performance

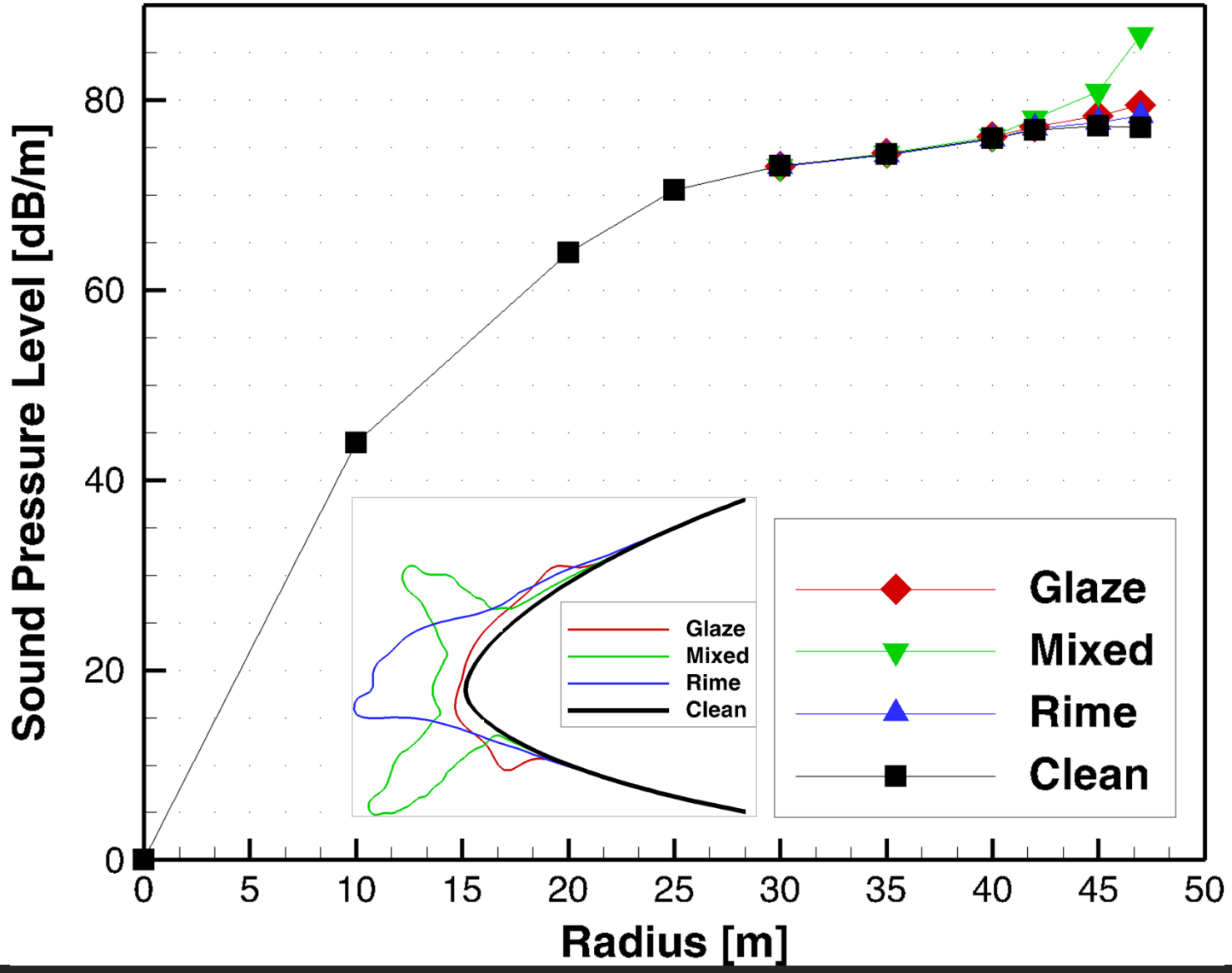
Combined simulation results



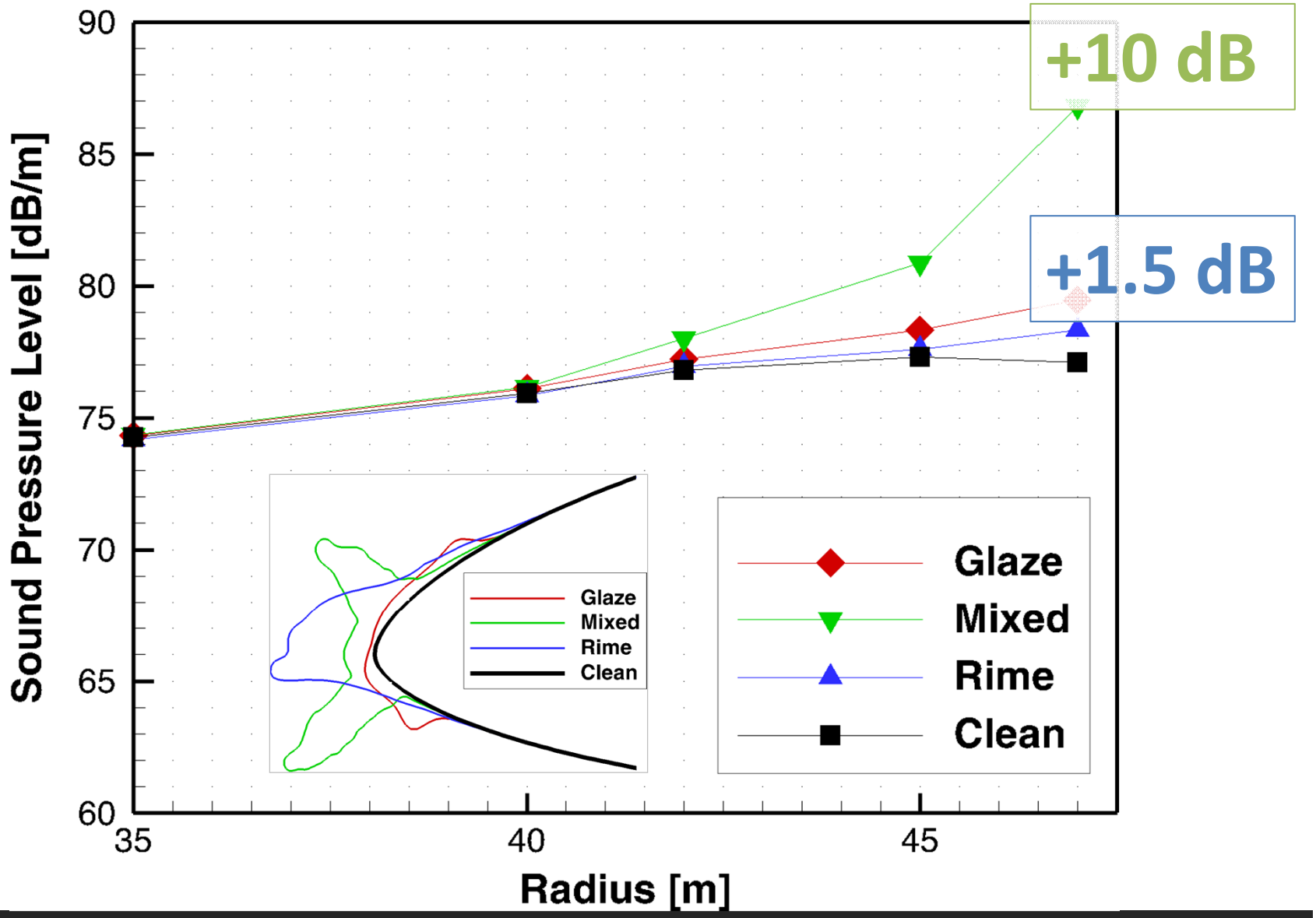
Combined simulation results



Combined simulation results



Combined simulation results



Summary

Photo: VTT

- Simulations are key to CC turbine noise
- Fundamental questions still unanswered
- Experimental validation needed