

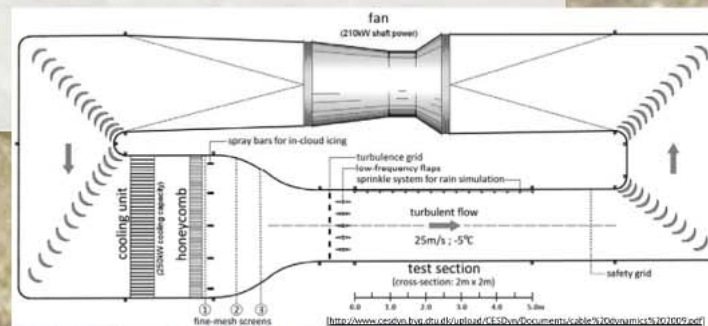
Experimental investigation of ice accretion on wind turbine blades

Winterwind 2013 – International Wind Energy Conference

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- Climatic wind tunnel with icing conditions at Force Technology in Kgs. Lyngby, Denmark
- Naca 64-618 profile - from LM Wind Power
- Different angles of attack and temperature
- Glaze and mix ice tests
- MVD~25 micron
- Ice accretion for 60 minutes
- $Re=900.000 - 1.000.000$

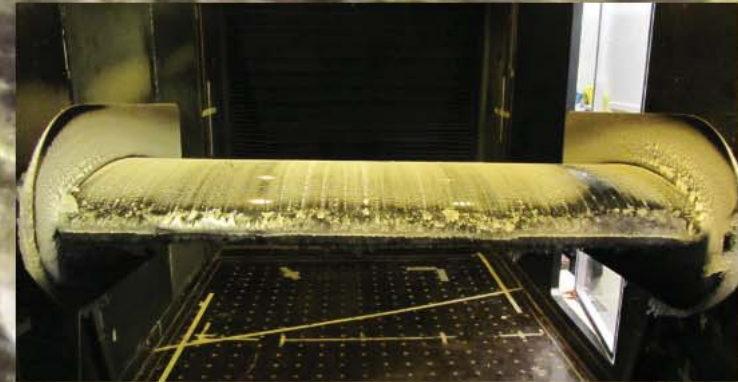


Wind tunnel tests

Before

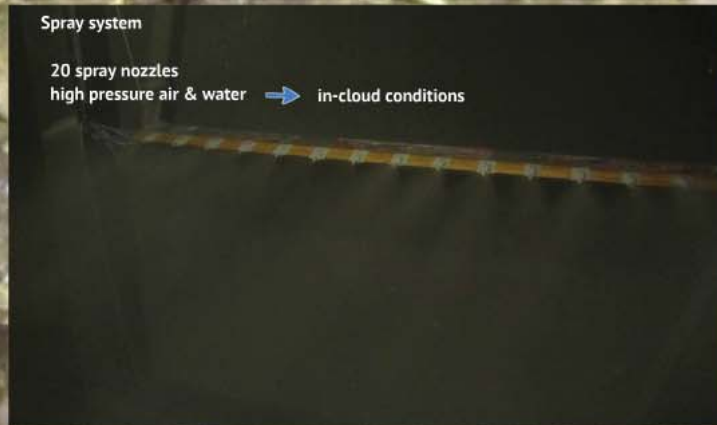


After



Spray system

20 spray nozzles
high pressure air & water → in-cloud conditions

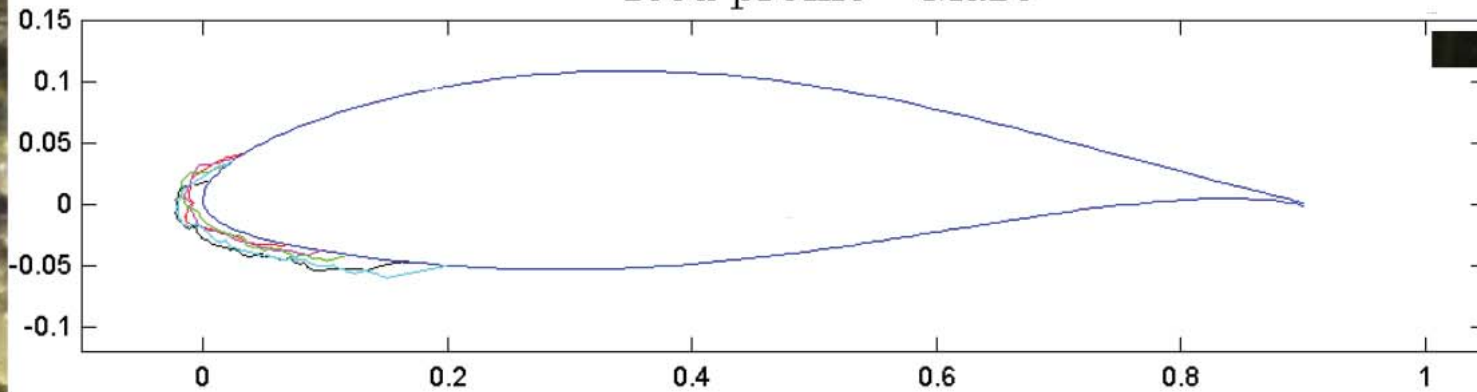




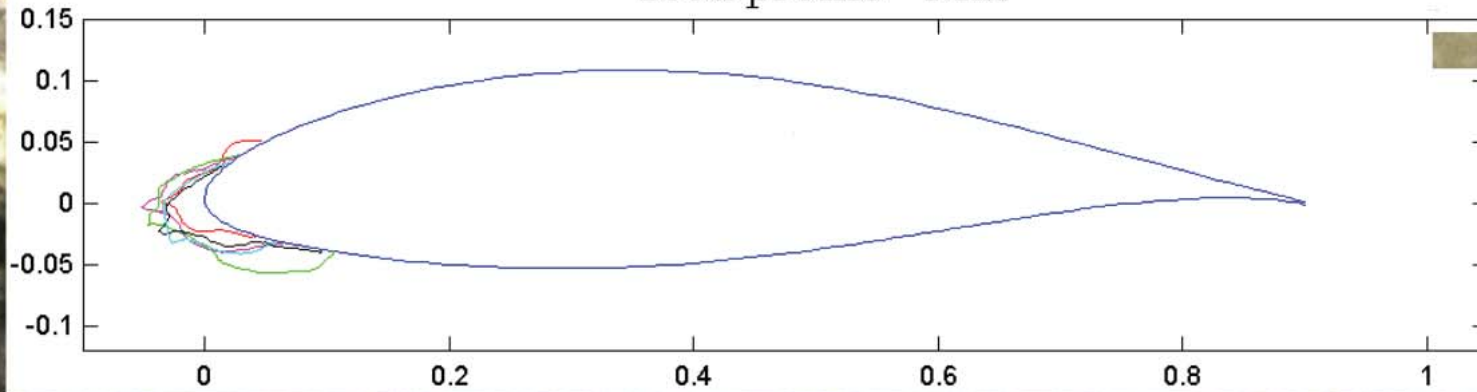
Results - profiles

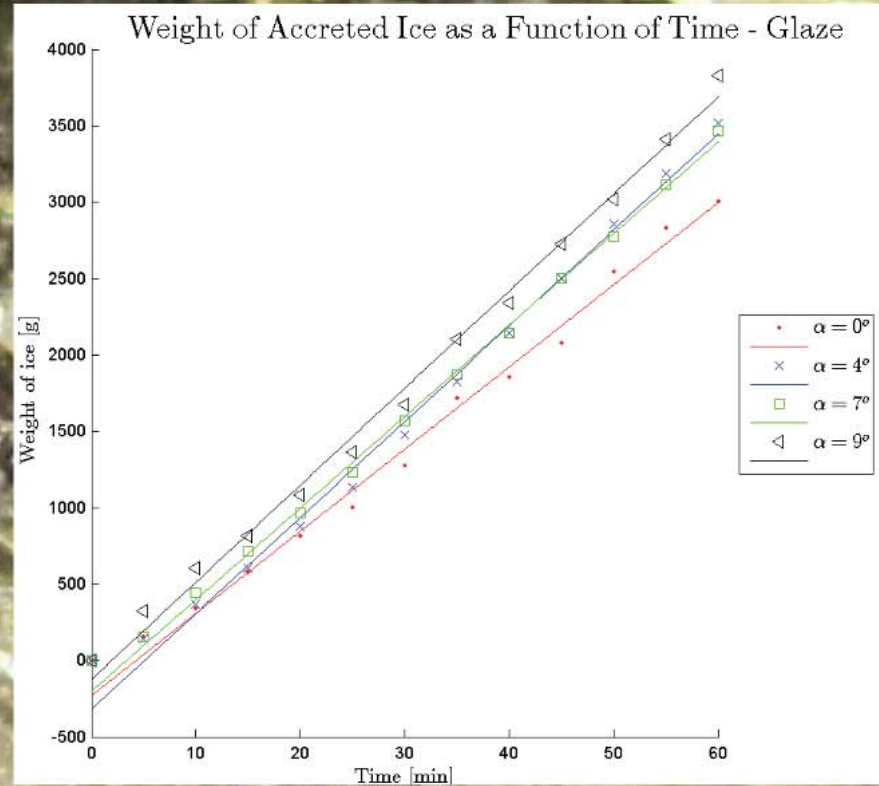
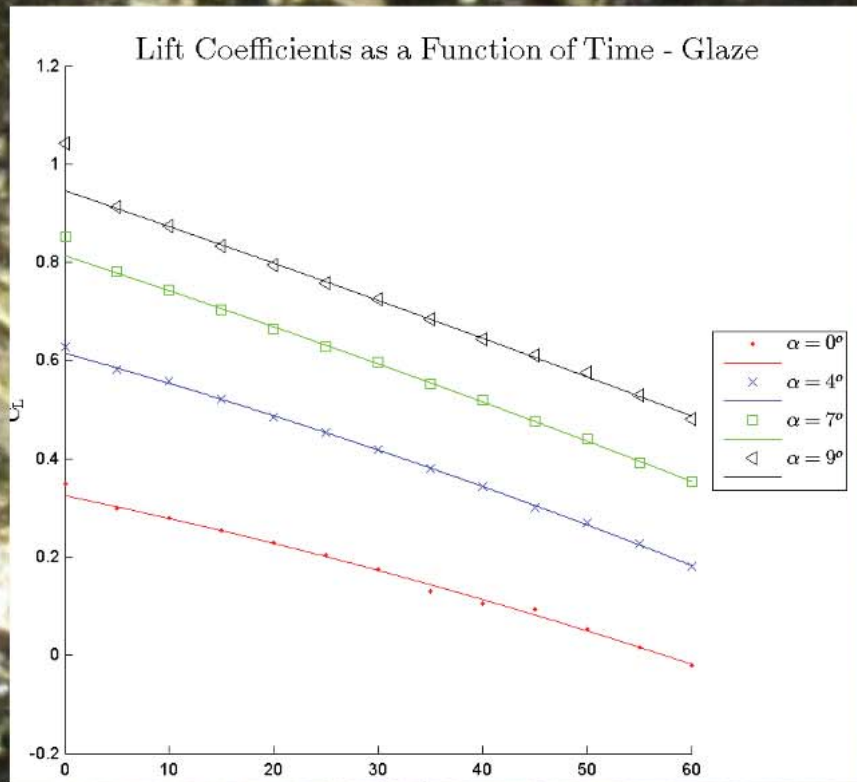
— profile — $\alpha = 0^\circ$ — $\alpha = 4^\circ$ — $\alpha = 7^\circ$ — $\alpha = 9^\circ$ — $\alpha = 11^\circ$

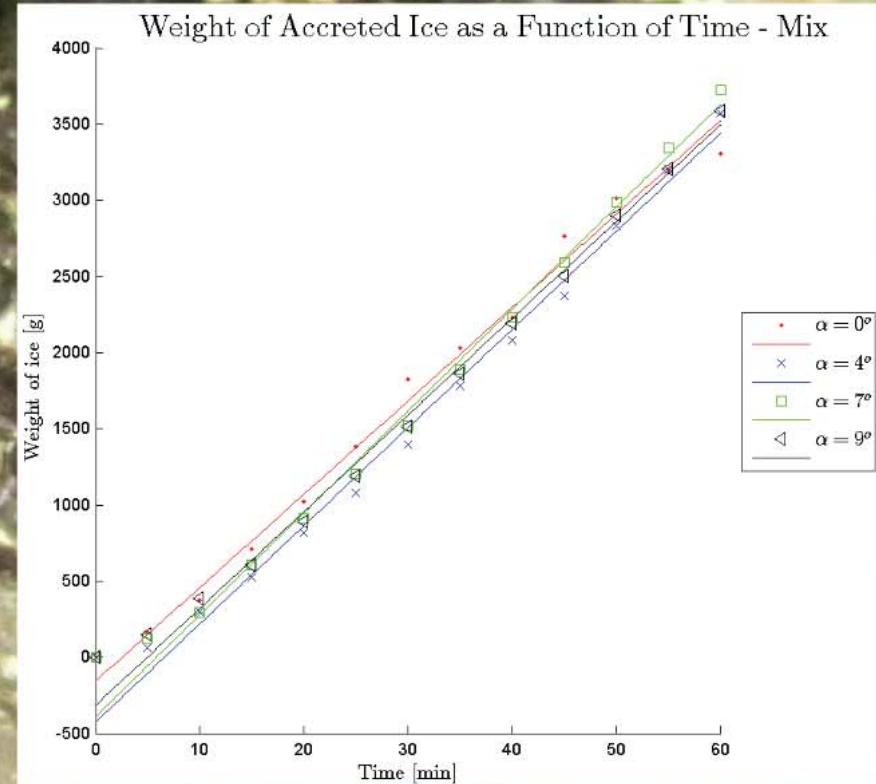
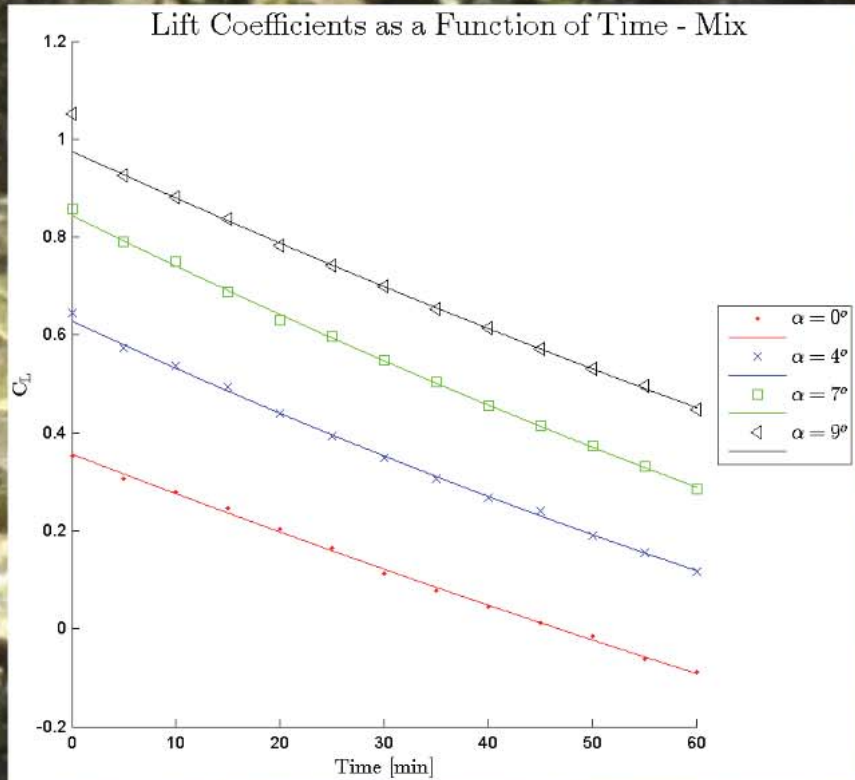
Iced profile - Glaze



Iced profile - Mix







Main findings:

- Linear ice accretion
- Dramatic lift coefficient degradation
- Most amount of ice accretion and least decrease in Cl for 9 deg AOA - glaze tests
- Least amount of ice accretion and most decrease in Cl for 0 AOA

Further plans:

- Include rime ice tests
- Comparison of the three different ice types
- Numerical analysis of the profiles

Thank you for your attention!
If you have any questions, contact:
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