



**Trafif**

Finnish Transport Safety Agency

## **Frostwing research project**

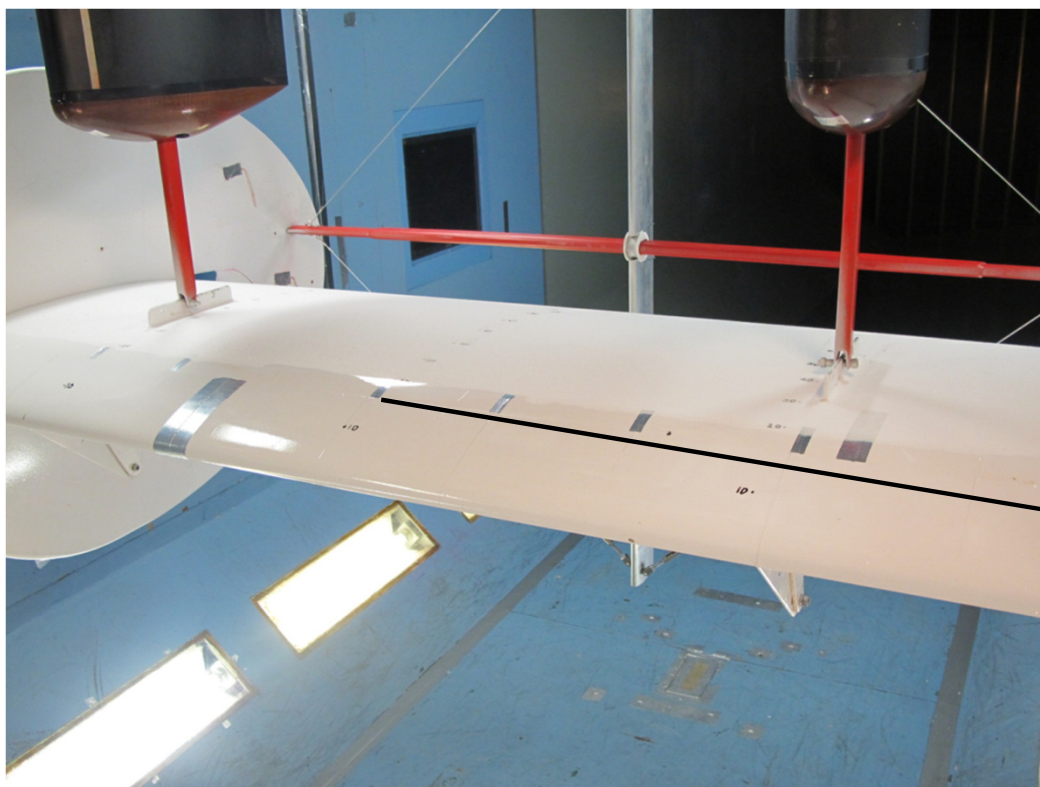
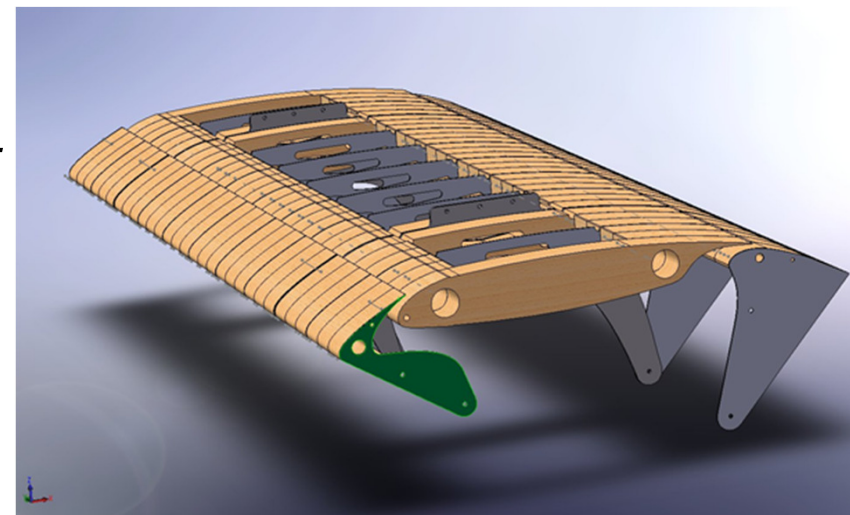
SAE AWG Meeting in Athens May 19<sup>th</sup> 2017  
Erkki Soinne

*Responsible traffic.  
Courage and co-operation.*

# Icewing

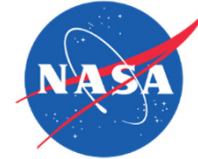
## ***Icewing programme 2011-2015***

- *Generic Airbus type DLR-F15 three element airfoil with wing tank cooling*
- *Wind tunnel testing of fluid effects*
- *Wind tunnel testing of real frost effects*



Real frost

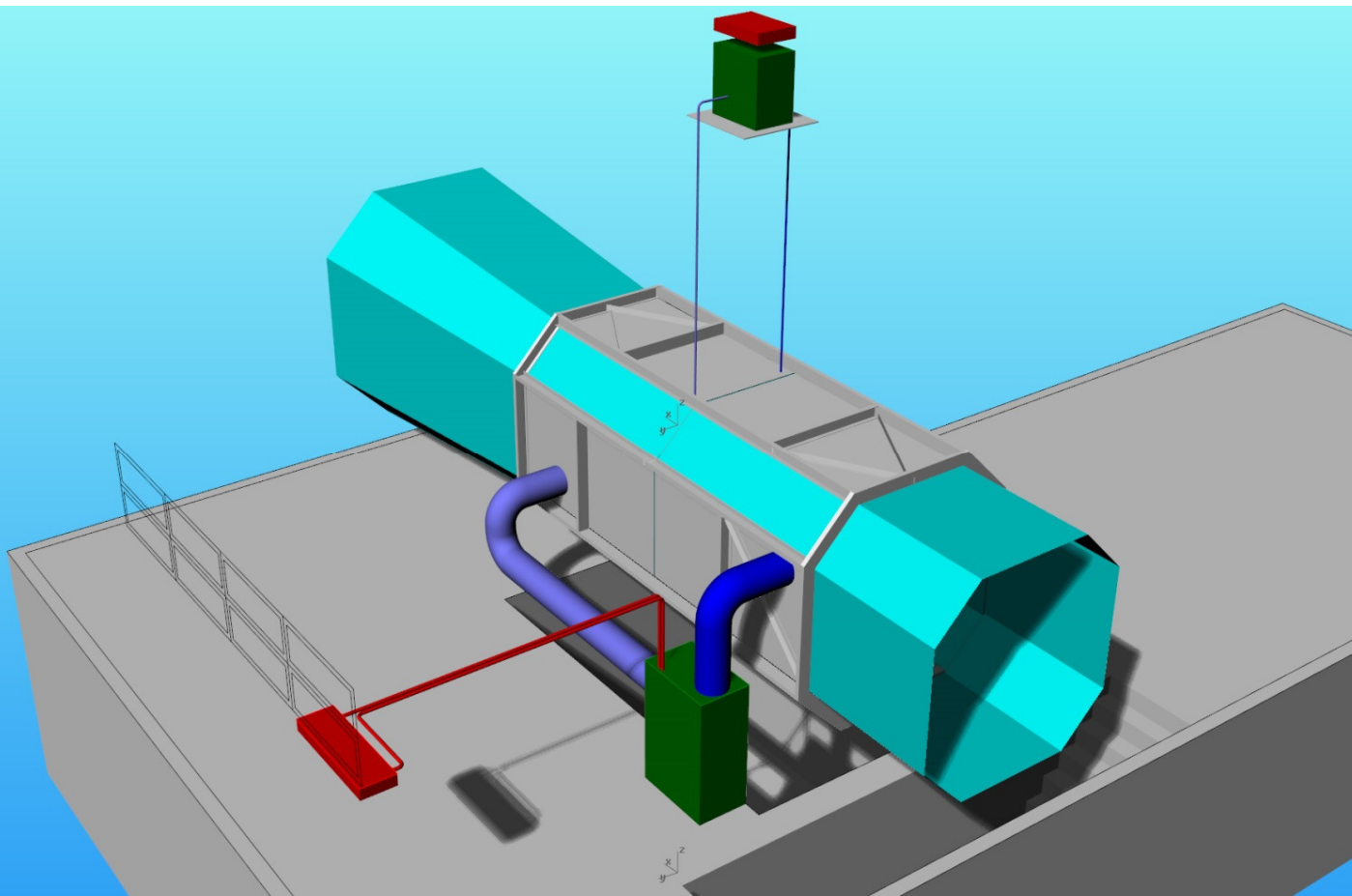
# Frostwing



- The FAA and Traficom have signed year 2015 a three year framework agreement of research co-operation on aircraft anti-icing fluids and Cold Soaked Fuel Frost (CSFF).
- The research is performed in Helsinki by Arteform Oy together with NASA and National Land Survey of Finland
- The present research plan contains the following themes:
  - Laser scanning of CSFF on wing model
  - 3D photogrammetry of CSFF on wing model
  - Wind tunnel tests of CSFF on wing model
  - Wind tunnel tests of anti-icing fluid on wing model
  - Wind tunnel tests of secondary wave on wing model
  - Study of anti-icing fluids on a flat plate wind tunnel model
  - CFD computations of anti-icing fluids on a flat plate model

# Arteform Wind Tunnel

- Low speed closed circuit wind tunnel with 2x2 m test section
- turbulence level  $<0.28\%$  at a wind tunnel speed of 60 m/s
- Temperature controlled cooling system in the test section and wing model for frost generation before the test



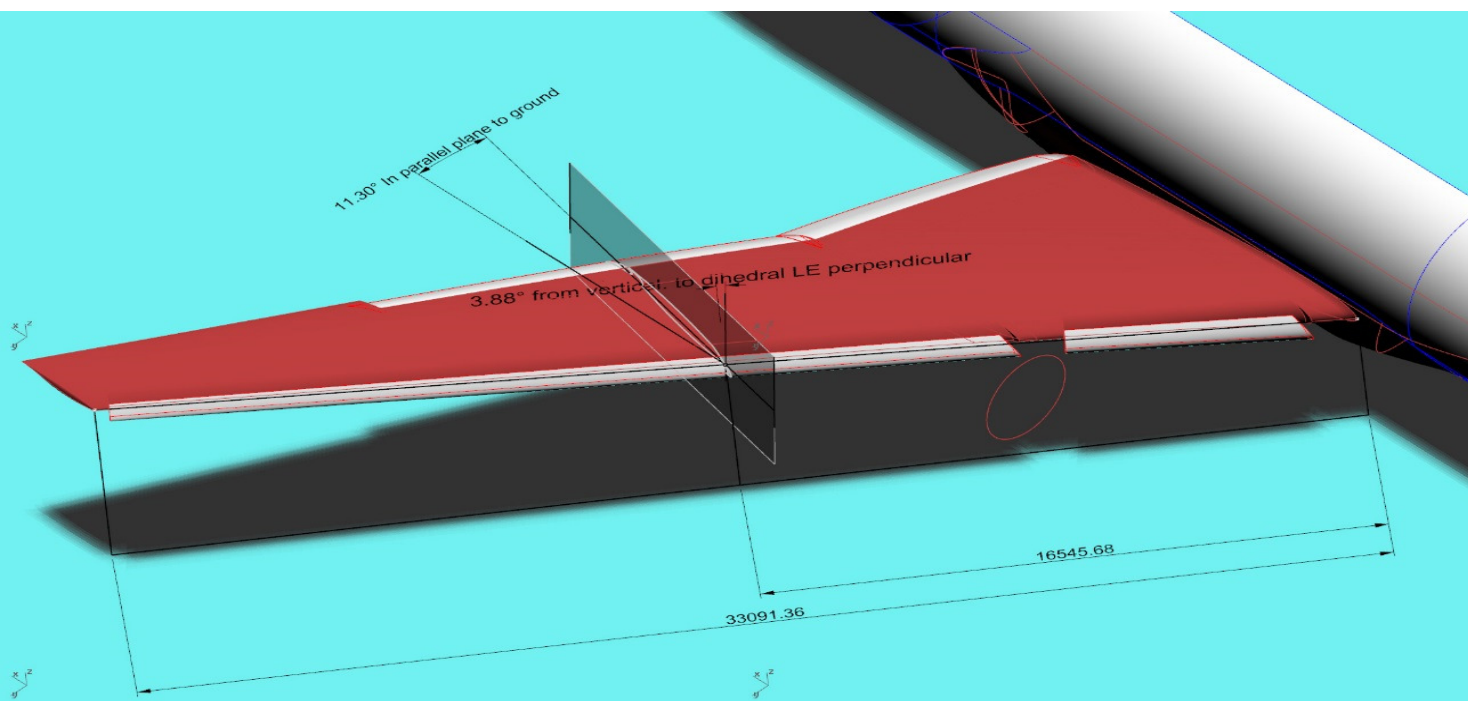
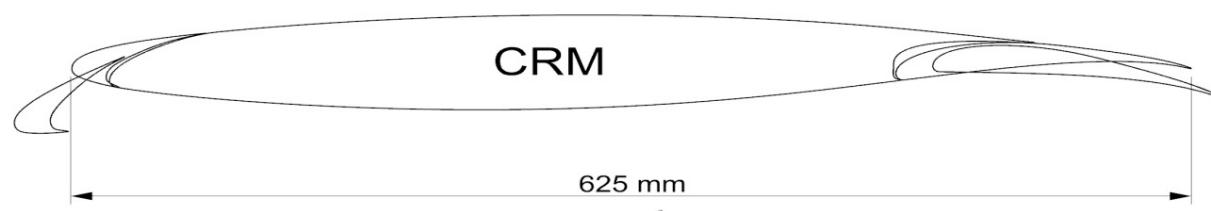
## Common Research Model

- CRM is a generic long range, twin engine configuration for future Transonic Transport aircraft
- HL-CRM is the High Lift configuration of the aircraft (ref. AIAA Paper 2016-0308)

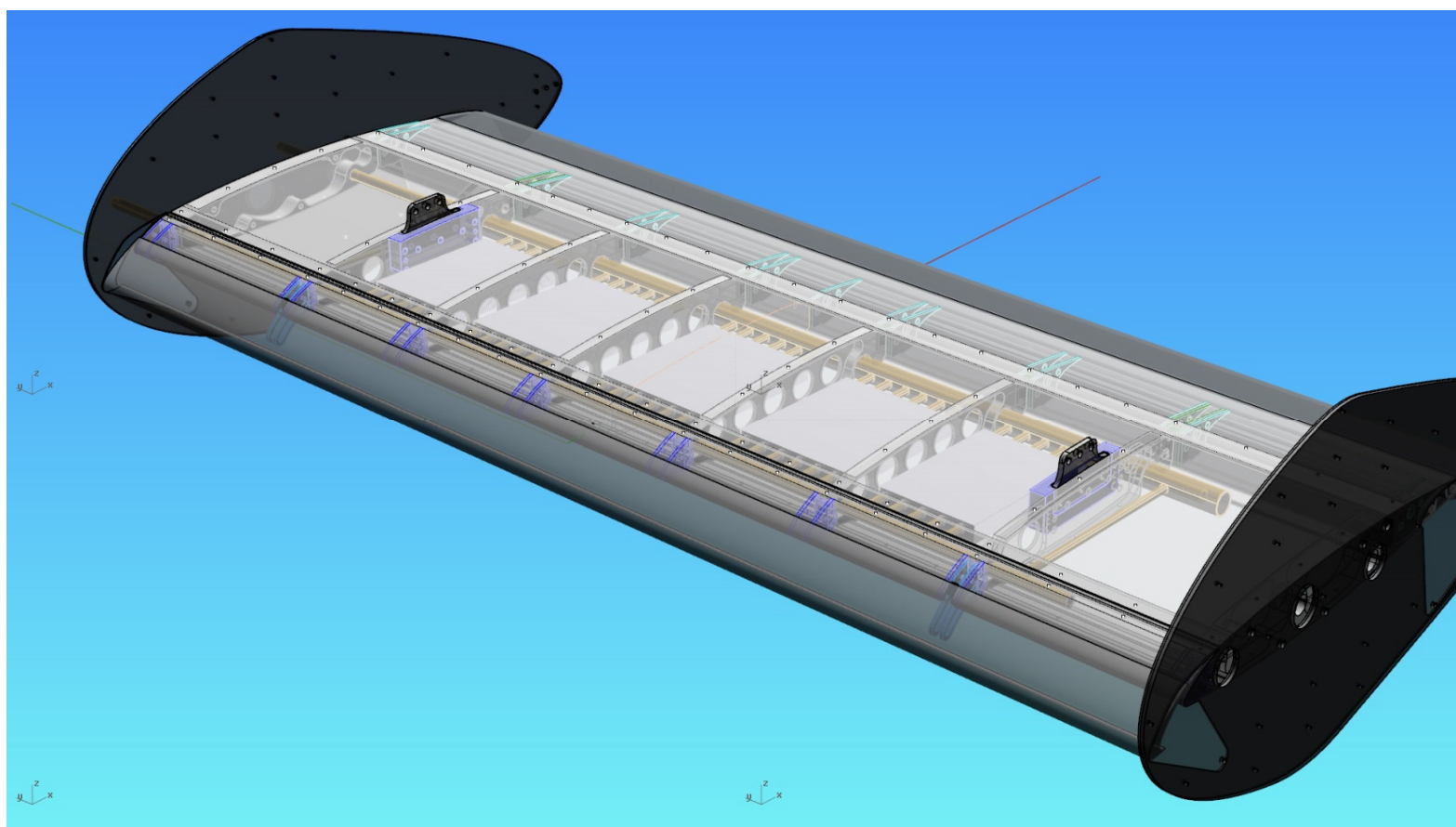


# CRM Wing model

- The section was taken in the vicinity of the wing MAC in a direction representative for the upper surface local flow conditions
- In take-off configuration the slat deflection is  $22^\circ$  and the flap deflection  $10^\circ$

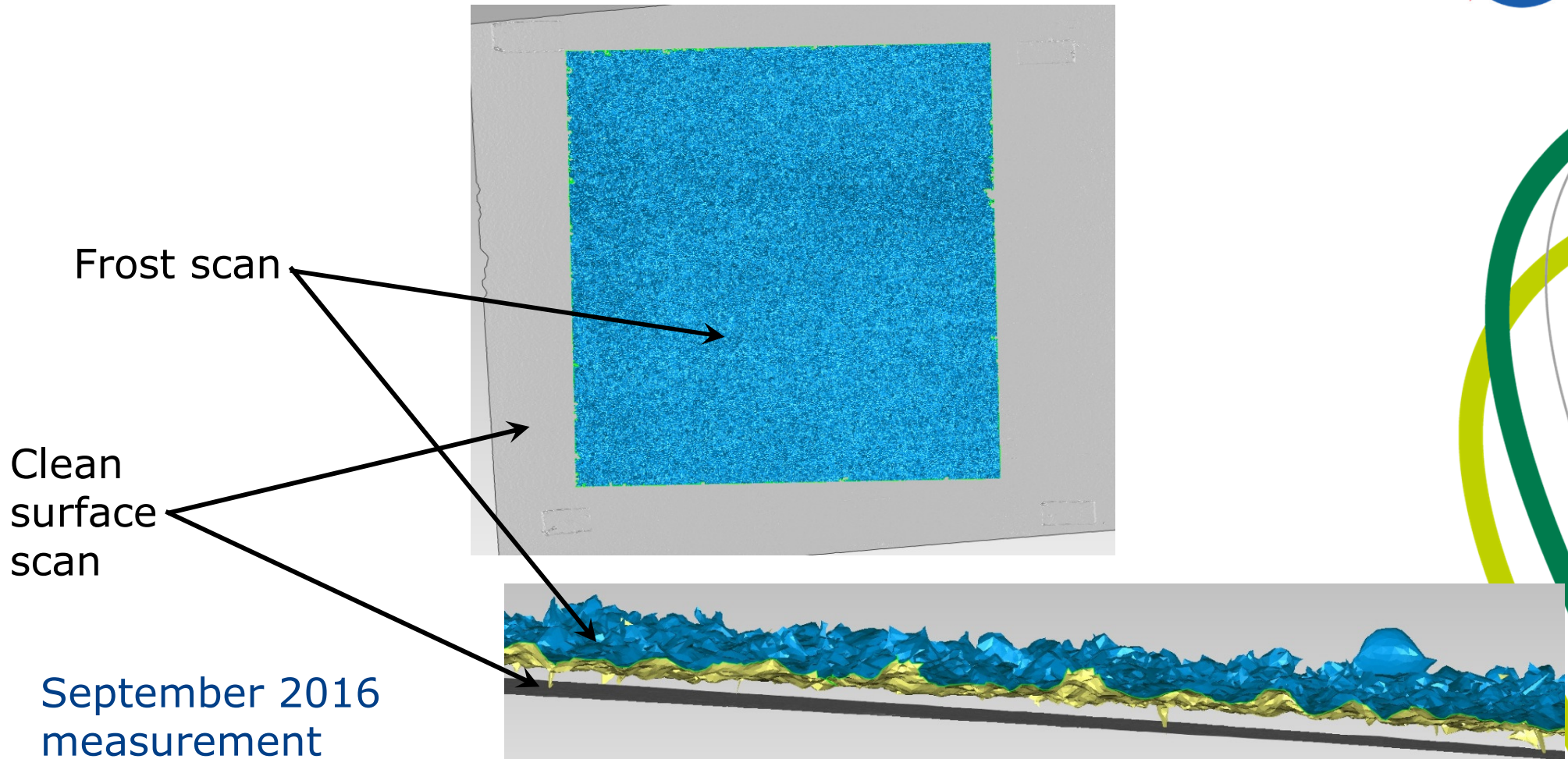


- Aerospace aluminum construction with 1,5 mm skin thickness
- Slats and flaps in carbon fiber
- Coolant liquid in the wing tank with heat exchangers
- Wing tank temperature monitored with thermo elements



# Example of laser scan result

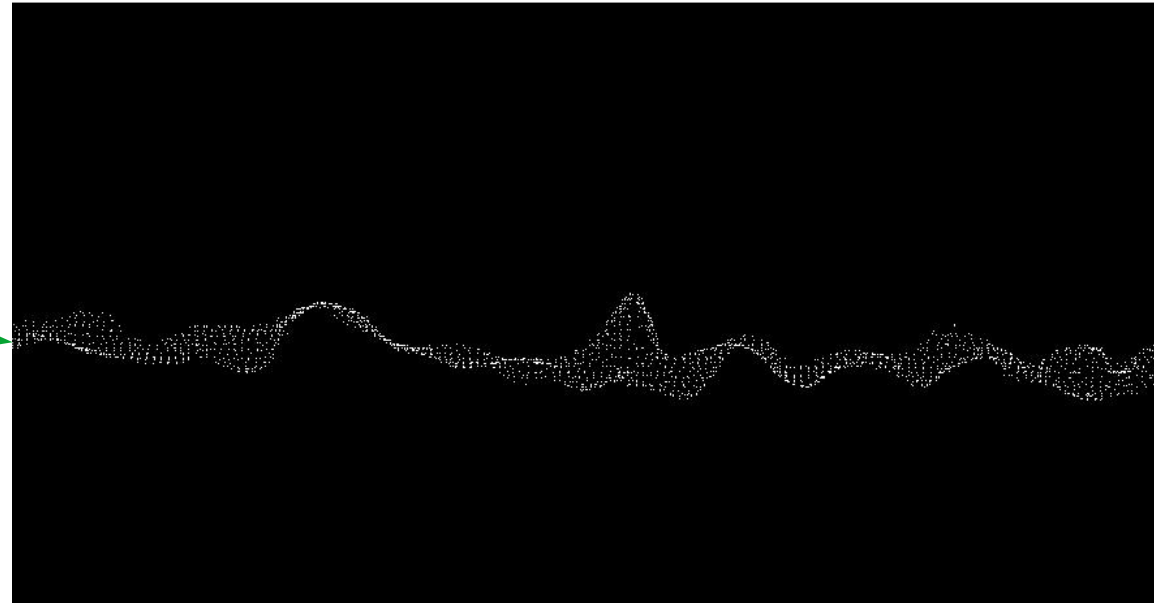
- The painted frost scan was aligned to clean wing surface scan to extract quantitative information.





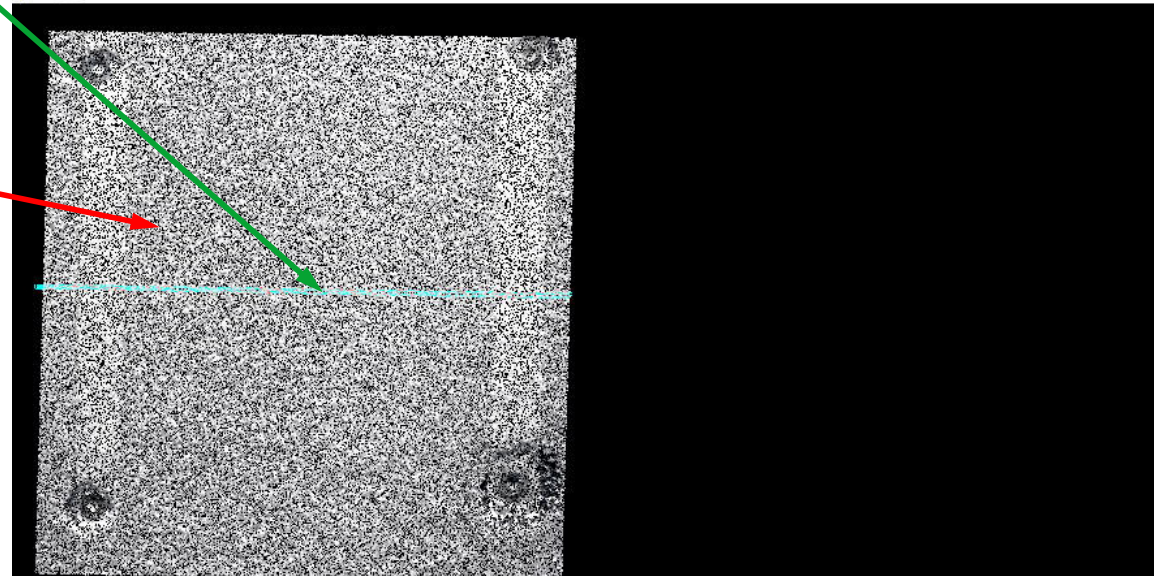
# Example of photogrammetry

Photogrammetry  
result sectional  
cut



PAN 8X 4.38 -81.16

Frost surface  
photogrammetry



March 2017  
measurement

- More data on Trafif web page:  
[https://www.trafi.fi/en/aviation/aviation\\_and\\_the\\_environment/icewing\\_-\\_research\\_on\\_aircraft\\_wing\\_de\\_anti-icing\\_fluids](https://www.trafi.fi/en/aviation/aviation_and_the_environment/icewing_-_research_on_aircraft_wing_de_anti-icing_fluids)
- Trafif is interested in co-operation with other research organizations

**Thank you!**

