SENS4ICE

SENSORS AND CERTIFIABLE HYBRID ARCHITECTURES
FOR SAFER AVIATION IN ICING ENVIRONMENT

# SENS4ICE Project Conclusions

## FINAL DISSEMINATION EVENT OF SENS4ICE PROJECT

Carsten Schwarz (DLR)

Directorate General for Research and Innovation, Brussels, Belgium – 29 November 2023

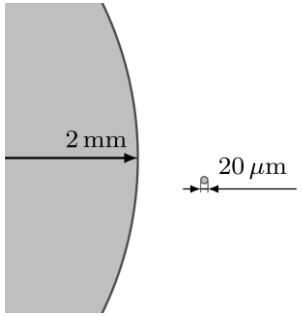
This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 824253

# SENS4ICE Challenge/Outcome

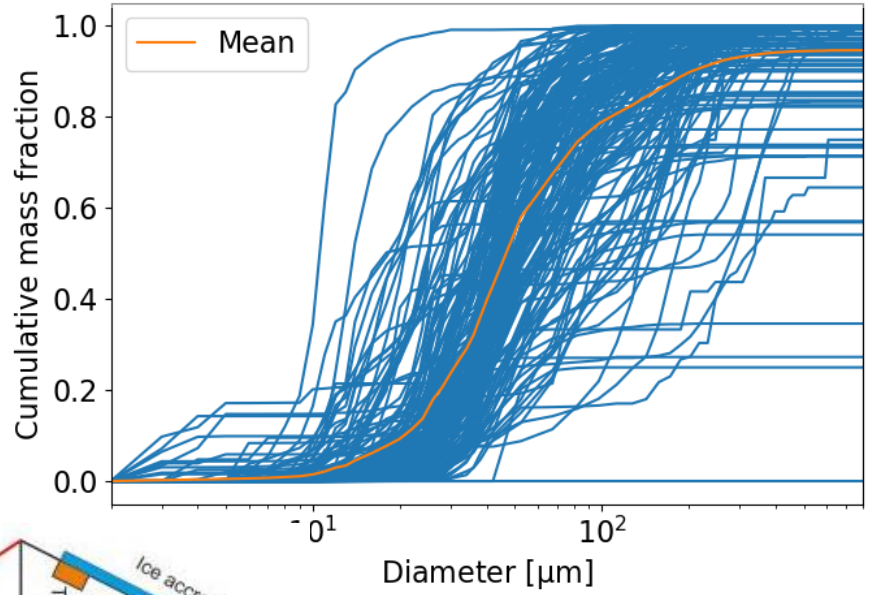
- Detect icing conditions – challenge: SLD

Solution/Innovation

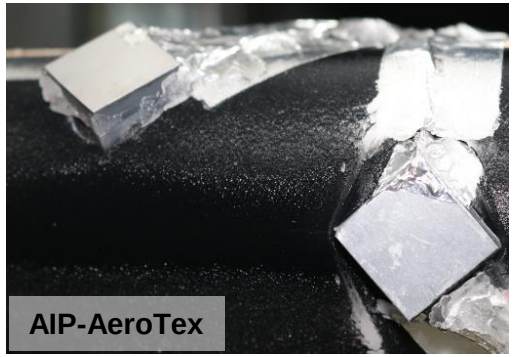
- 8 direct detection technologies matured & flight test demonstrated
- Hybrid approach – fusion of input data: sensor(s) and indirect detection




**SENS4ICE Flight Campaign Europe - Droplet diameter distribution**
**Microphysics data analysis - DLR Institute of Atmospheric Physics**

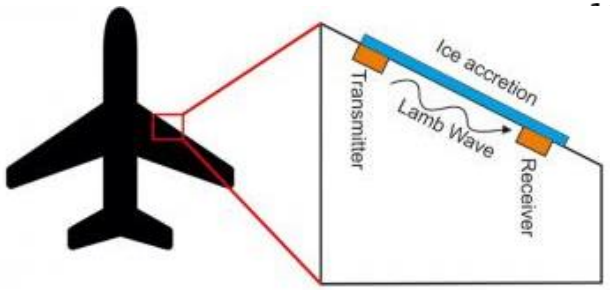



**HIDS-Safran/ IIDS-DLR**



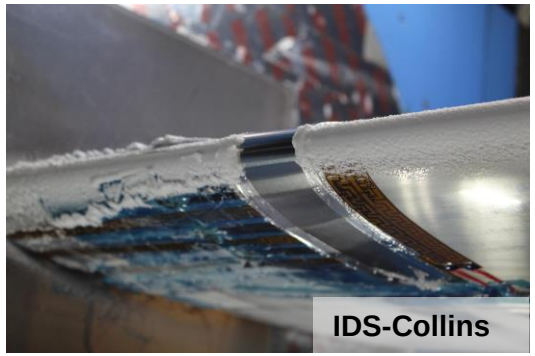
**AIP-AeroTex**

**PFIDS-Safran**



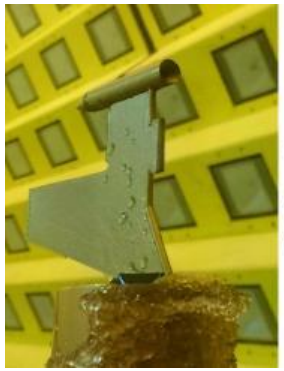

**LILD-DLR**

**AMPERA-ONERA**



**IDS-Collins**

**SRP-Honeywell**



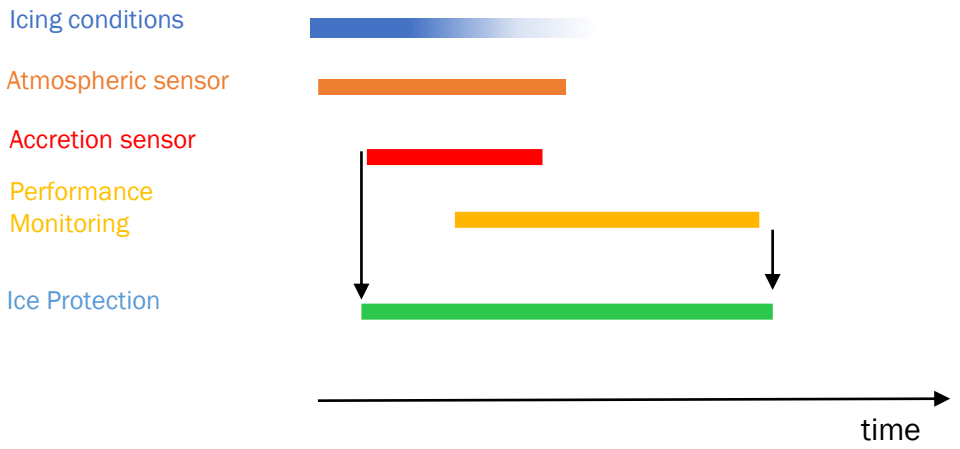
**CM2D-DLR**

**FOD-INTA**

# EU Project SENS4ICE - Results

## SENSors and certifiable hybrid architectures for safer aviation in ICing Environment

- **Direct, indirect and remote ice detection technologies particularly for SLD** (Supercooled Large Droplets) icing
- successfully demonstrated in operational environment (many technologies TRL 6)
  → while certification envelope is multi-dimensional and much larger
- **Broad and promising technology application** for different purposes/vehicles
- Game changer **hybrid solution** for challenging task of SLD detection
  - successfully tested/demonstrated in two flight campaigns (TRL 5 reached)
  - benefits of quick warnings and continuous ice accretion and flight performance monitoring
  - IPS efficiency optimisation



# SENS4ICE – Conclusion & Outlook

## SENSors and certifiable hybrid architectures for safer aviation in ICing Environment

- Particularly for App O/ SLD improve physical understanding, forecasting/nowcasting capabilities: Extensive data collection with enhanced icing wind tunnels and in natural icing conditions in flight required as sufficient data is not available today specifically freezing rain
- Enhancing aviation icing safety including for rare SLD conditions may involve revolutionary hybrid approach including novel detection technologies – challenge detecting few large droplets/ low liquid water content
  - further research/ development/ testing of detection technologies in enhanced icing wind tunnels and in natural icing conditions in flight required covering the full range of App O, specifically freezing rain
  - develop robust and reliable discrimination of safety relevant icing conditions (e.g. freezing drizzle/rain)
  - no clear path for certification requirements for sensor technologies (including software algorithms)
- Enhancing aviation icing safety including for rare SLD conditions for conventional aircraft and also make it possible for future unconventional vehicles like UAV, UAM, more/all electric vehicles due to low size/weight/power solutions
  - dedicated research and development required e.g. for small/ low speed/ low altitude vehicles and atmospheric conditions, including efficient and smart IPS
- Safe aircraft operation in icing conditions related not solely to atmospheric icing conditions but ice formation on airframe and degradation of flight characteristics
  - SENS4ICE showed impact of SLD icing in App. O must always be considered by effect on aircraft (relevant for certification) and not only detection of icing conditions.
  - changes for view on certification path/ definition acceptable means of compliance (AMC/MoC) particularly for new aircraft designs.

This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 824253.

If not acknowledged, images courtesy of the consortium partners.



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