



NASA Icing Update – March 2025

Presentation for the
SAE AC-9C Technical Committee Meeting
March 31, 2025 | Orlando, FL

Presenter

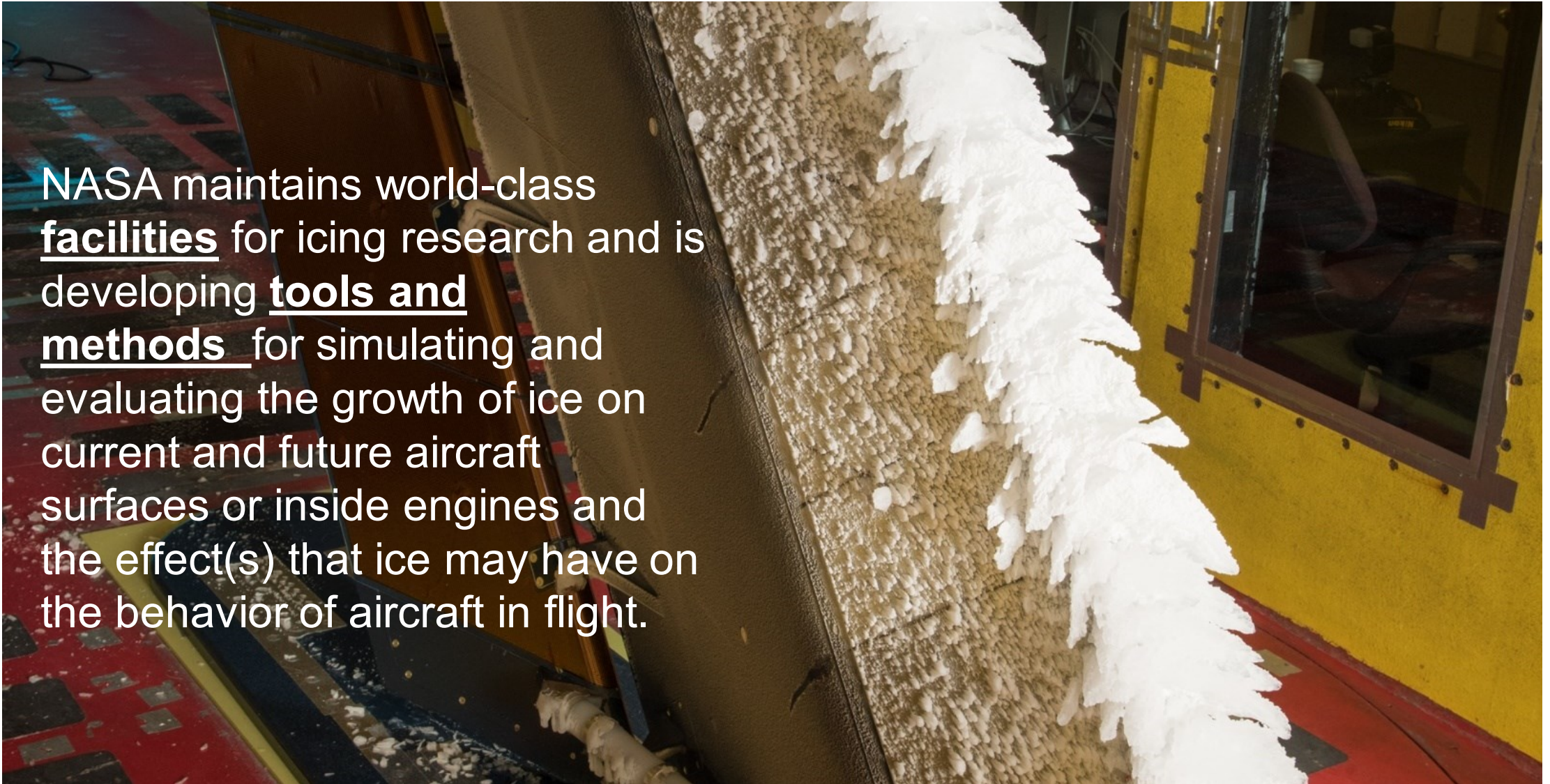
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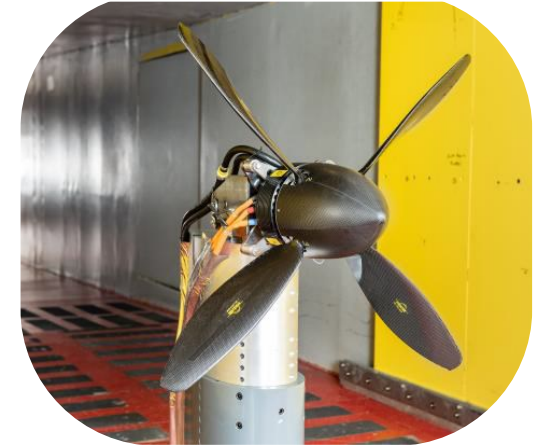
NASA's Mission in Icing

NASA maintains world-class facilities for icing research and is developing tools and methods for simulating and evaluating the growth of ice on current and future aircraft surfaces or inside engines and the effect(s) that ice may have on the behavior of aircraft in flight.



Outline

- Rotational Icing Scaling
- GlennICE Update
- Adaptive Icing Tunnel Update
- Transonic Truss-Braced Wing Icing Update



GlennICE

Glenn Icing Computational Environment

Software tool for addressing icing challenges on aircrafts and engines

FEATURES

- **ADAPTIVE**
Use with your existing software
- **STREAMLINED**
Intuitive user interface
- **ECONOMICAL**
Leverages Lagrangian algorithms for more efficient computations
- **ACCURATE**
Validated against NASA data
- **UNIQUE**
Algorithms adaptively release particles to improve solutions
- **PARALLEL COMPUTING**
Scalable optimization suited for any analysis



IMPACTS

SAFETY & SAVINGS

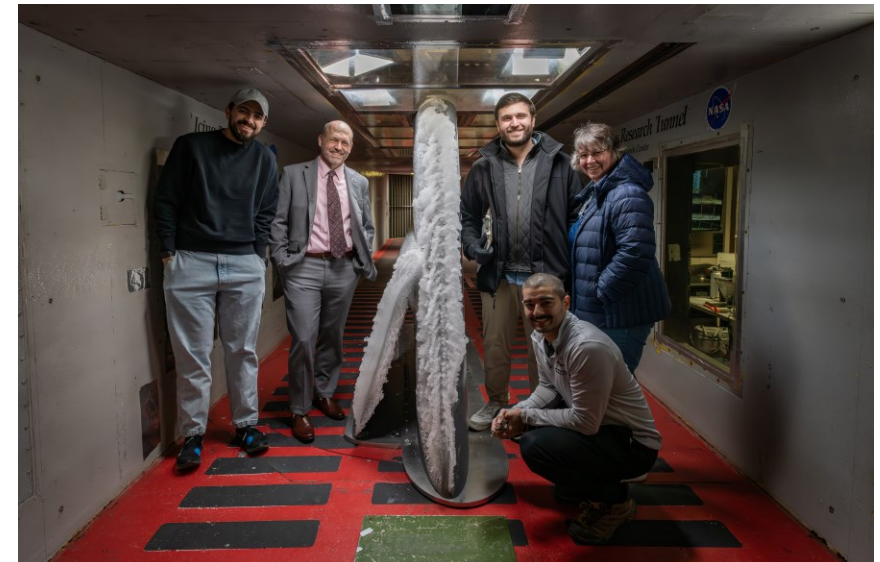
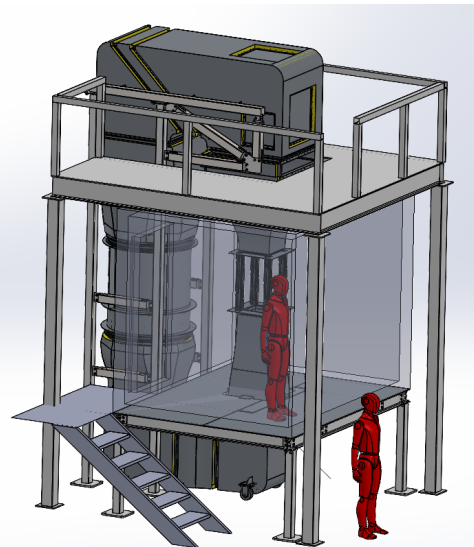
Integrates icing factors earlier in the design process to reduce costs and increase safety

NOVEL DESIGNS

Delivers data needed for novel vehicle and engine designs to address the icing conditions in new regulations

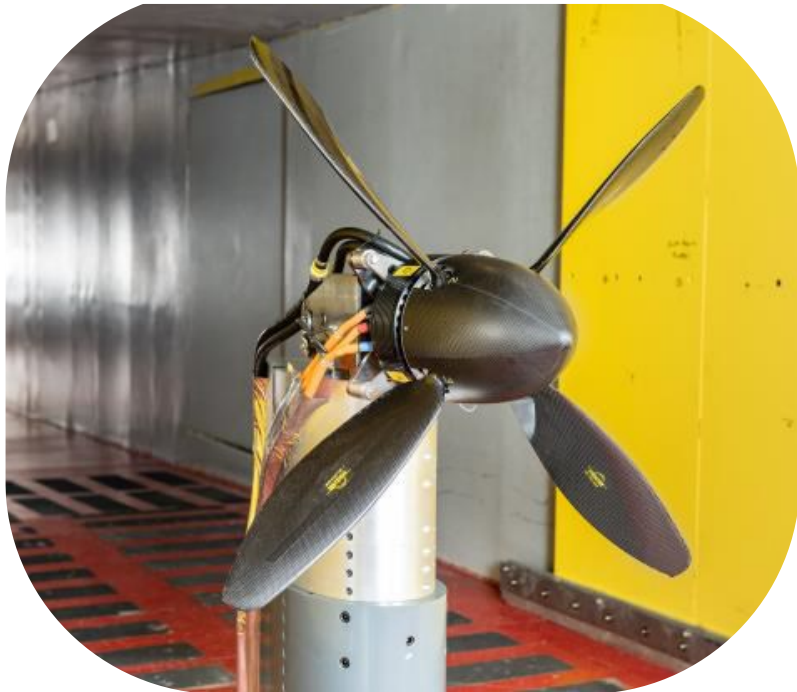
EMERGING MARKETS

Helps accelerate market entry for Urban Air Mobility / Supersonics



Rotational Icing Scaling

- Evaluating scaling relationships for rotational systems
 - IRT tests planned later in FY25
 - 0.5m and 1.0m diameter propeller
- Established Space Act Agreement with the Rail Tec Arsenal (RTA)
 - Topic: Propeller Icing Scaling Research



- Joint Testing:
 - NACA 0012 testing in IRT and RTA to understand interfacility differences (late FY25)
 - Additional 2m propeller test at RTA*

* RTA propeller testing contingent on Austrian funding availability



GlennICE Update

As of 2018, GlennICE is the foundational code through which NASA will develop and evaluate physical models associated with ice accretion

- CFD post processor
- Lagrangian droplet tracking with adaptive refinement
- Fully 3D icing simulation and particle tracking tool
- Predicts water impingement & resulting ice growth
- Fully parallelized trajectory scheme built for HPCs

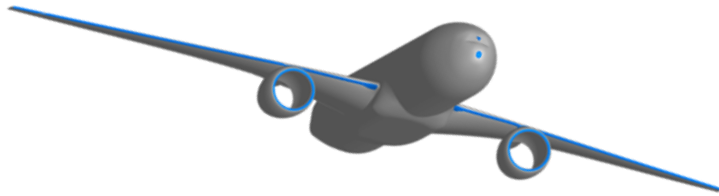
Development Plan

External Icing

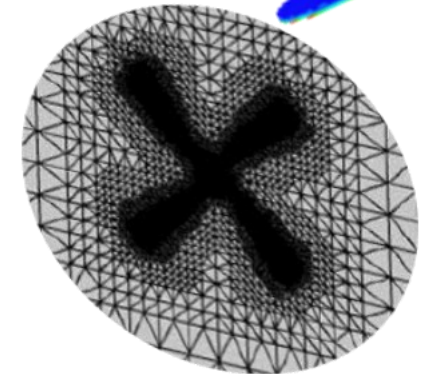
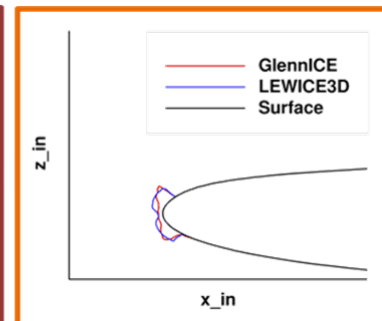
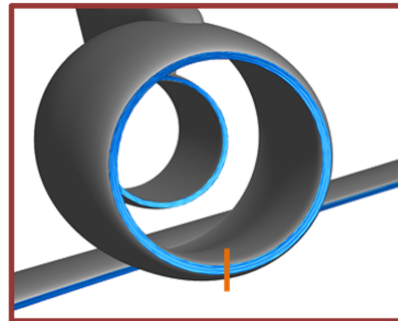
Rotational Icing

Ice Crystal Icing

Common Research Model - High Lift



Transonic Truss Braced Wing



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GlennICE Release

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- URL:
 - <https://software.nasa.gov/>
- Date available:
 - Soon
- Restrictions:
 - US Persons Only (software)
 - Results are not export controlled
- Contact:
 - GlennICE-support@lists.nasa.gov
 - Send email to be added to distribution list
- Release: Version 5.1.0
 - Numbering
- Plan is to update software tri-annually, including
 - User's Manual [1]
 - Validation and Verification Report
- Webinar to be offered after release

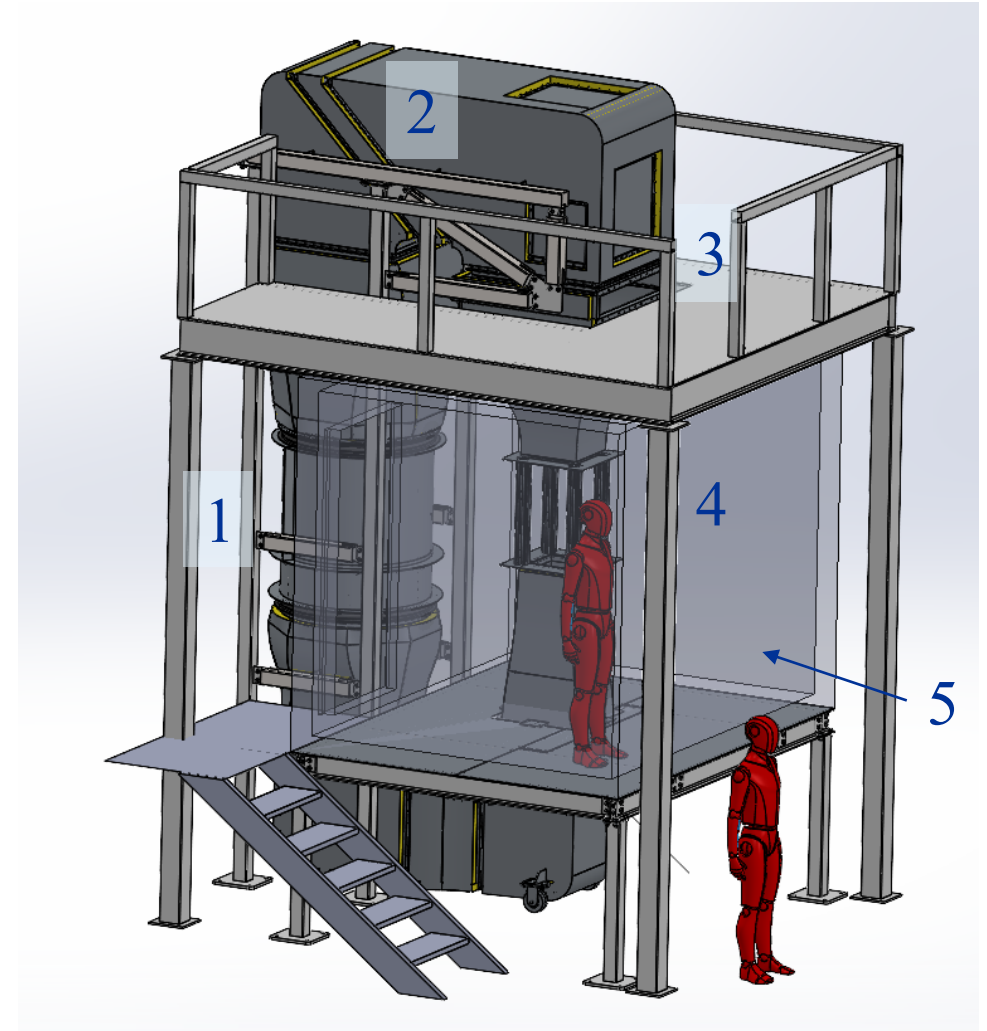
Adaptive Icing Tunnel (AIT)

Capabilities

- Laboratory scale icing wind tunnel
- Closed loop, vertical
- Test section 1 x 1 ft (0.3 x 0.3 m)
- Airspeeds up to ~210 knots (~110 m/s)
- Temperatures as cold as -20°C
- Walk-in freezer around test section
- Supercooled Liquid and Ice Crystal

Features

1. Fan
2. Heat Exchanger
3. Spray Bars
4. Test Section
5. Walk-in Freezer



Adaptive Icing Tunnel - Progress

March 2024



- 1. Fan
- 2. Heat Exch.
- 3. Spray bars
- 4. Test Section

August 2024



- 5. Walk-in Freezer installed

March 2025

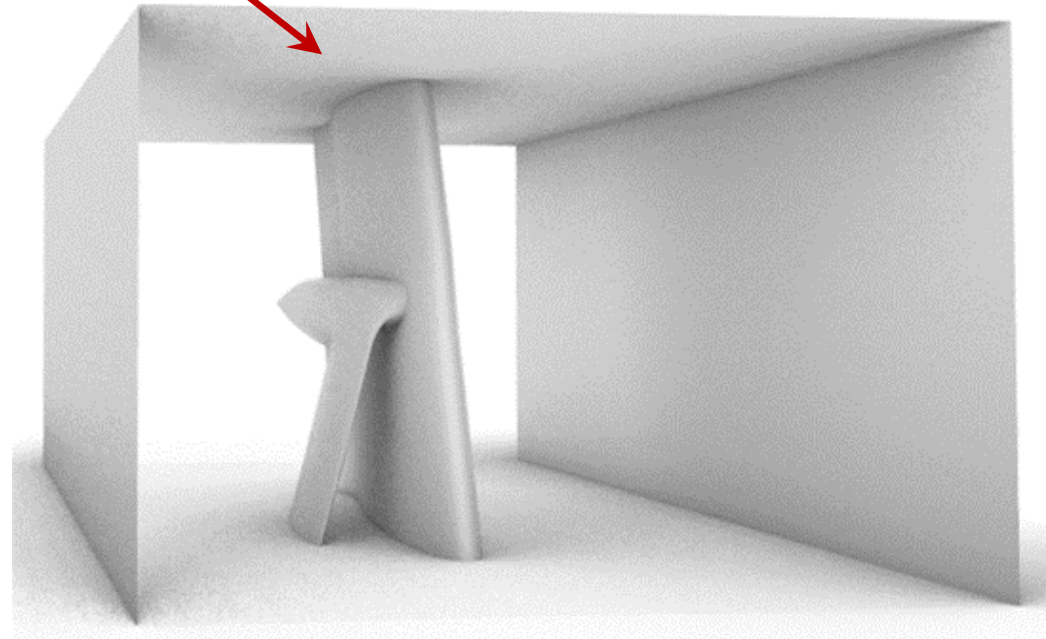


- 6. Access platform & stairs

Transonic Truss-Braced Wing Icing

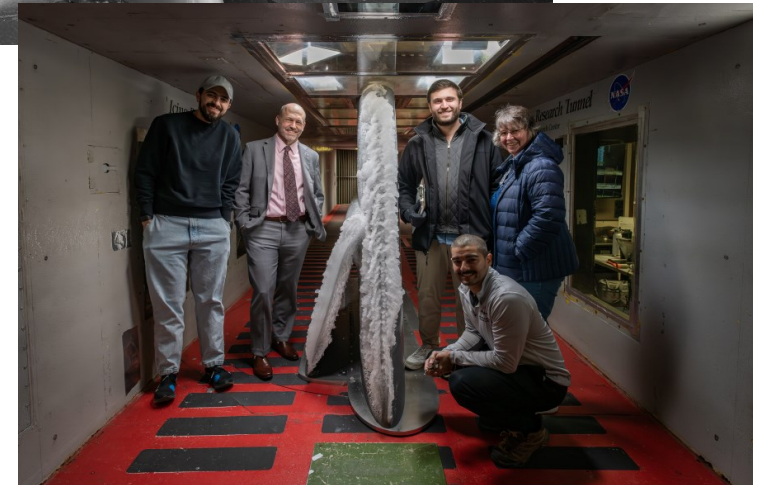
Background

- NASA is collaborating with Boeing as a part of the Subsonic Ultra-Green Aircraft Research (SUGAR).
- Includes exploring the impacts of icing on the TTBW configuration.
- IRT testing of TTBW wing-truss junction region
- Background provided during October 2024 AC-9C meeting.



Transonic Truss-Braced Wing Icing

- Since Oct. 2024 AC-9C meeting, conducted two IRT tests:
 - Oct. 15 – Nov. 4, 2024
 - Mar. 3 – 21, 2025
- Unprotected leading edge ice shapes.
- Collected ice shapes for:
 - Critical ice shapes based upon certification conditions
 - Parametric variations of air temperatures, exposure time and cloud MVD
 - Effect of strut/pylon
- Data to be used for GlennICE validation and to inform subsequent aerodynamic testing with artificial ice shapes.

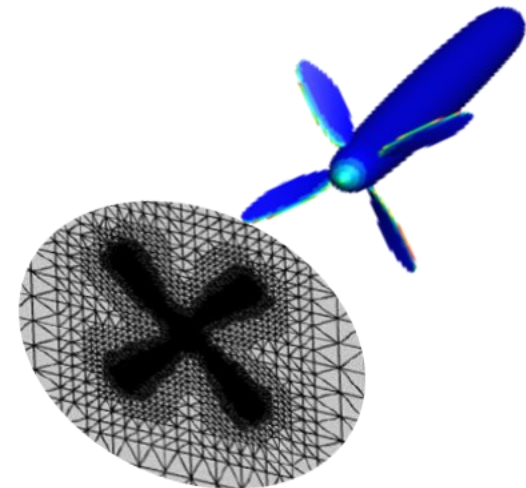
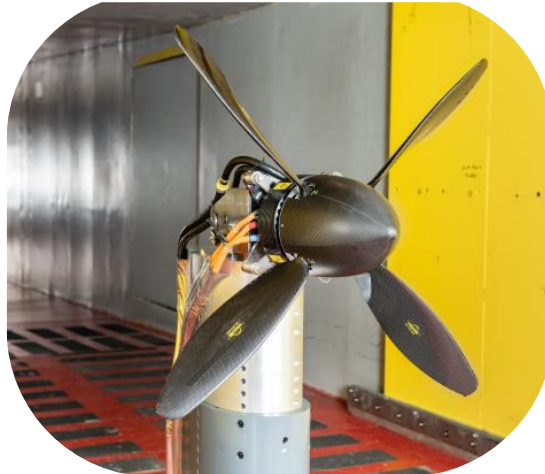
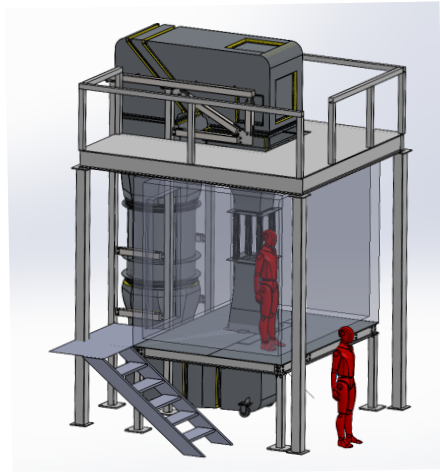


Summary



Icing research in this briefing:

- Rotational Icing Scaling
- GlennICE Update
- Adaptive Icing Tunnel
- Transonic Truss-Braced Wing Icing Update





Thank You!

