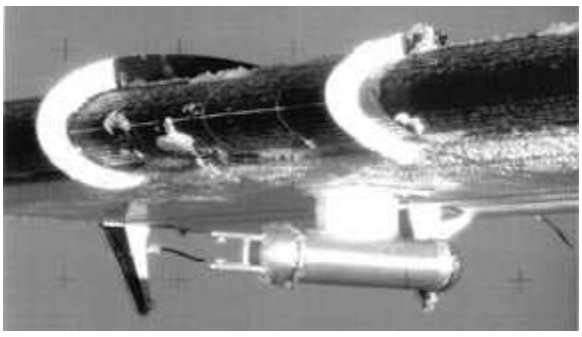
Supercooled Large Droplet Icing Flight Research Program

During the past three winters, the NASA Glenn Research Center at Lewis Field conducted icing research flights throughout the Great Lakes region to measure the characteristics of a severe icing condition having Supercooled Large Droplets (SLD). SLD was implicated in the 1994 crash of the ATR–72 commuter aircraft. This accident focused attention on the safety hazard associated with SLD, and it led the Federal Aviation Administration (FAA) to identify the need for a better understanding of the atmospheric characteristics of this icing condition.

In response to this need, Glenn developed a cooperative icing flight research program with the FAA, the National Center for Atmospheric Research, and the Atmospheric Environment Service of Canada. The primary objectives were to (1) characterize the SLD icing condition in terms of important icing-related parameters (such as cloud droplet size, cloud water content, and temperature), (2) develop and refine SLD icing weather forecast products, and (3) document and measure the effects of SLD ice accretions on aircraft performance.

NASA Twin Otter icing research aircraft.



Right wing of NASA Twin Otter showing SLD ice accretion and cloud-particle sizing probe.

SLD research flights were conducted with the NASA Glenn Twin Otter icing research aircraft during the winters of 1996–97, 1997–98, and 1998–99. National Center for Atmospheric Research meteorologists supported these flights by providing SLD icing

weather forecasts and in-flight guidance to the Twin Otter crew, enabling them to locate and safely fly into SLD icing conditions. Instrumentation onboard the Twin Otter was then used to sample SLD cloud characteristics, document the resultant SLD ice accretions, and measure their effect on aircraft performance. Ninety SLD icing research flights were conducted during the three winters, which resulted in a large SLD flight data base and the accomplishment of the program objectives:

1. SLD cloud characterization data were delivered to the FAA to develop a large droplet icing data base for regulatory examination that will provide the scientific basis for any changes and play a key role in the development of new atmospheric engineering standards of compliance.

2. SLD cloud characterization data were used by National Center for Atmospheric Research to develop improved SLD icing weather models. Feedback obtained from evaluating SLD forecast techniques from the 90 SLD flights facilitated the development of the National Center for Atmospheric Research's Integrated Icing Diagnostic Algorithm, which is being used by regional airlines to help pilots avoid SLD icing conditions.

3. NASA and the Atmospheric Environment Service sponsored an international SLD instrumentation test to compare the response of icing cloud instrumentation to SLD under controlled conditions. Results from this pioneering test quantified and intercompared instrument responses to SLD for the first time, and will lead to the development of improved SLD cloud instrumentation.

4. NASA and the Atmospheric Environment Service collaborated on the development of common methods for acquiring and analyzing SLD flight research data. These methods, which yielded high-quality SLD cloud characterization data, will form the basis for international acquisition and analysis standards.

Particle sizing probes in Glenn's Icing Research Tunnel during NASA/Atmospheric Environment Service international SLD instrumentation comparison test.

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