

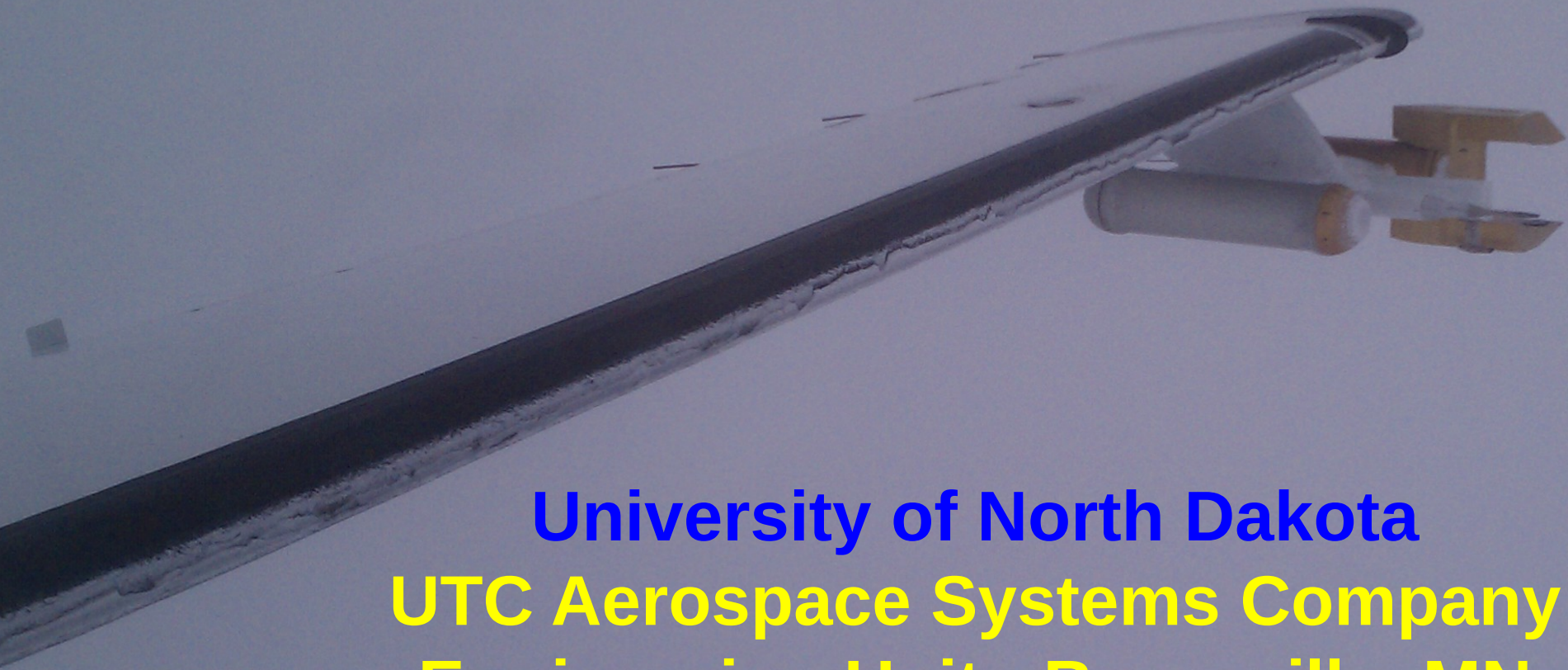
Industry Acceptance of Optical Ice Detector (OID)

Coherent Backscattering of Cloud Particles Project

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Optical Ice Detector (OID) on the North Dakota Citation Research Aircraft



Flight Engineer Seats

The image shows the interior of the aircraft's cabin. Two black leather flight engineer seats are positioned side-by-side. In front of each seat is a grey instrument rack mounted on a metal stand. Blue arrows point from the text label to the seats, and green arrows point from the text label below to the instrument racks. A red fire extinguisher is visible on the left side of the frame.

Racks with OID Instruments Installed

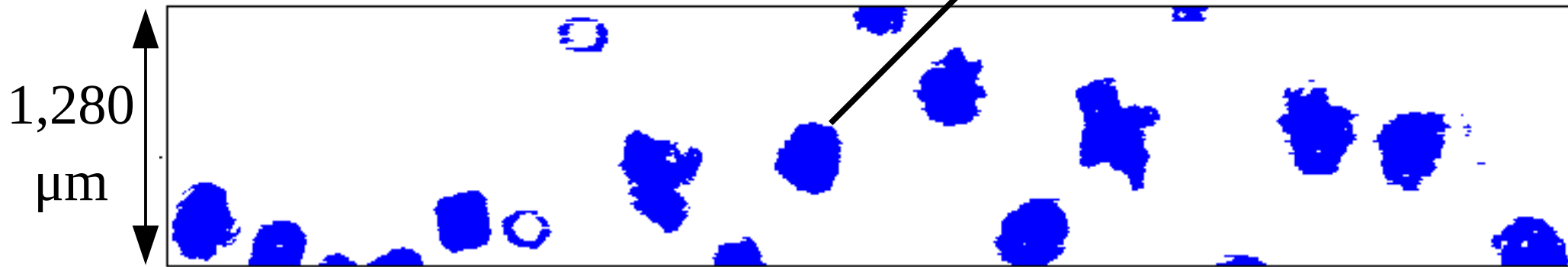
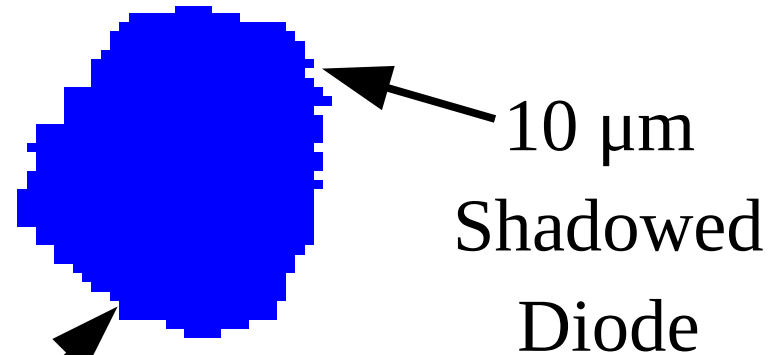


OID Optical Sampling Window

The image shows the exterior of the aircraft. A red circle highlights a small, circular, purple-tinted window on the fuselage. A red arrow points from the text label below to this window. To the right of the window is a larger, dark, rectangular door with a handle and the word 'OPEN' written above it.

Two-Dimensional Stereographic (2D-S) Probe

- Horizontal and vertically oriented laser.
- 128 Diodes, 10 μm each.
- Captures images of shadows from cloud particles.
- Data post-processing uses 29 size bins, 10 to 2,000 μm diameter
- Use one second-averaged data



Objective: Industry Acceptance of OLD

- Quantitative validation of the Optical Ice Detector's (OID) back-scatter of laser light from liquid and ice cloud particles.
 - Key university component is developed of software to enable direct analyse of flight test data.
 - Key company component is to conduct analysis and refine OLD instrument as necessary.



Proposed Technology Development

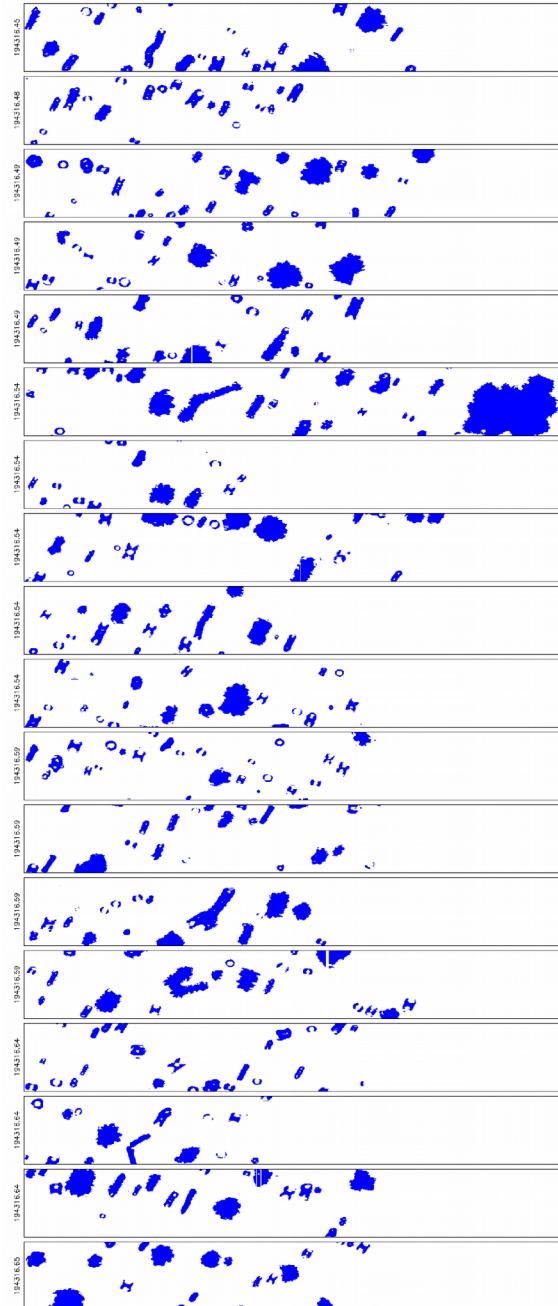
Observations

+

New Software

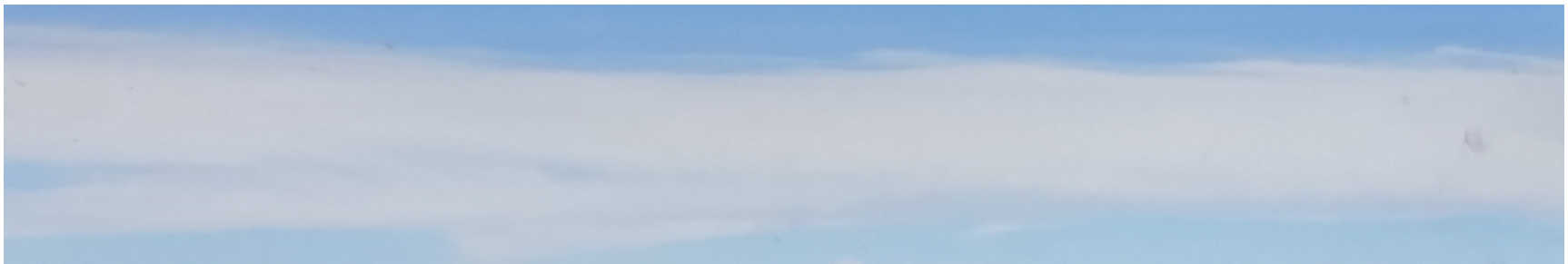
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Validated
Technology



Technology Advancement

- Light scattering software allows refinement of the OLD algorithms to distinguish water from ice and determination of crystal size and concentration.
- Direct comparison of the OLD algorithms against airborne research instruments is important for industry acceptance **(Deliverable)**.
- With industry acceptance, the OLD will have a large market share in aircraft companies needing to meet new Federal Aviation Administration flight safety requirements for detection of high ice concentration conditions.



Summary of Potential Markets

- **OID for Commercial Aircraft**
 - UTC Aerospace System
Market Focus
- **Research Version**
 - UTC Aerospace System License Technology
to North Dakota Company.
- **Weather Data from OID on Aircraft**
 - European Union, and now U.S., buying data.
- **Developing Markets**
 - Unmanned Aircraft Systems and Wind Energy



Commercial Aircraft

- UTC Aerospace Systems Core Business
 - Boeing predicts there will be 35,000 new commercial aircraft added to the global fleet in the next two decades.



Research Version

- Not UTC Aerospace Systems Business Focus, License Technology to North Dakota Company.
 - Research aircraft and UAS platforms
 - 30 potential customers, \$100,000 each.



Weather Data from OID on Aircraft

- Improve Weather Forecast Models
 - European Union In-Service Aircraft for a Global Observing System has deployed an instrument similar to the OID on commercial aircraft.
 - Panasonic Avionics Corporation announced recently they will supply aircraft weather data to the U.S. National Weather Service.
- OID would provide unique cloud observations which are difficult or impossible for satellites and radar systems to provide.



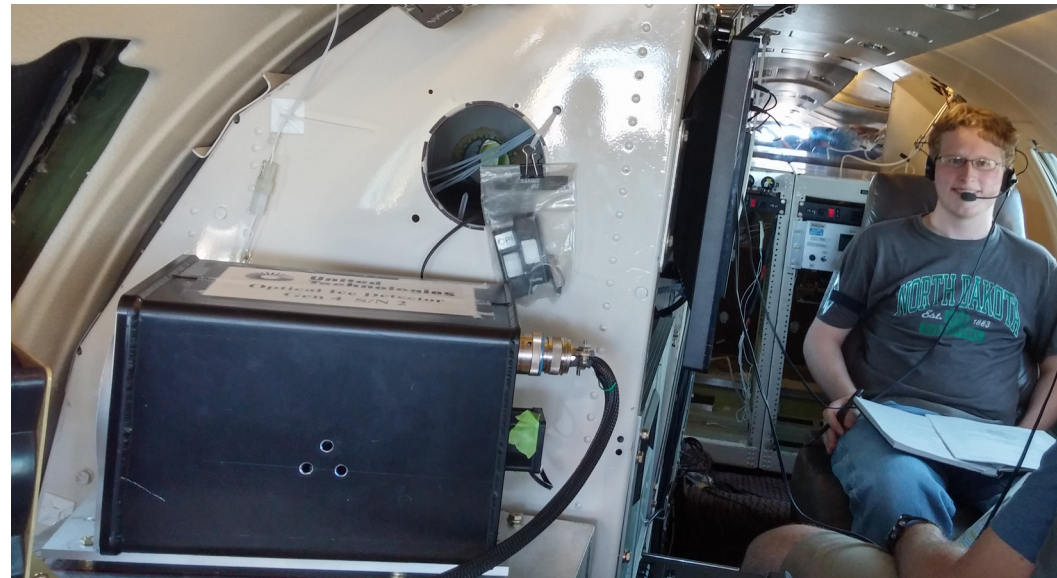
Developing Markets

- Unmanned Aircraft Systems
 - OID provides sensing capabilities.
 - Safe flight requirements will likely require UAS to know if they fly into clouds.
- Surface Observations
 - Precipitation on road surfaces.
- Wind Energy
 - OID could provide precipitation measurements at wind farms.
 - Approximately 8 % of winds energy is lost annually due to icing issues on blades; hence, measurements that qualify precipitation amount and type are very useful for wind farm operations.



Conclusion

- Software development is key missing technology that benefit whole aerospace industry.
- Validation of OID for commercial aircraft.
- Application of OID technology to atmospheric research, UAS, and wind energy.
- Expand relationship between UND and UTC Aerospace Systems.
- Encourage placement of new facilities in North Dakota.





**Questions
Comments
Discussion**

North Dakota Citation Research Aircraft

