Observations of the surface and atmosphere from remotely-piloted aircraft during MOSAiC

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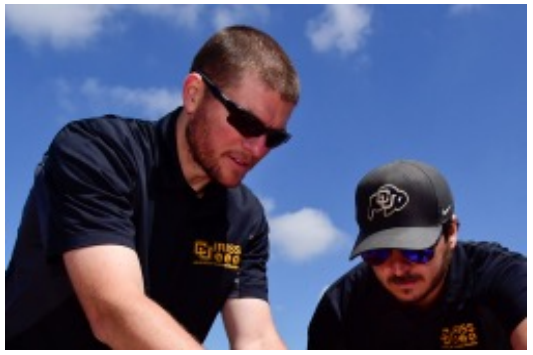
Introduction to Team and Science Targets











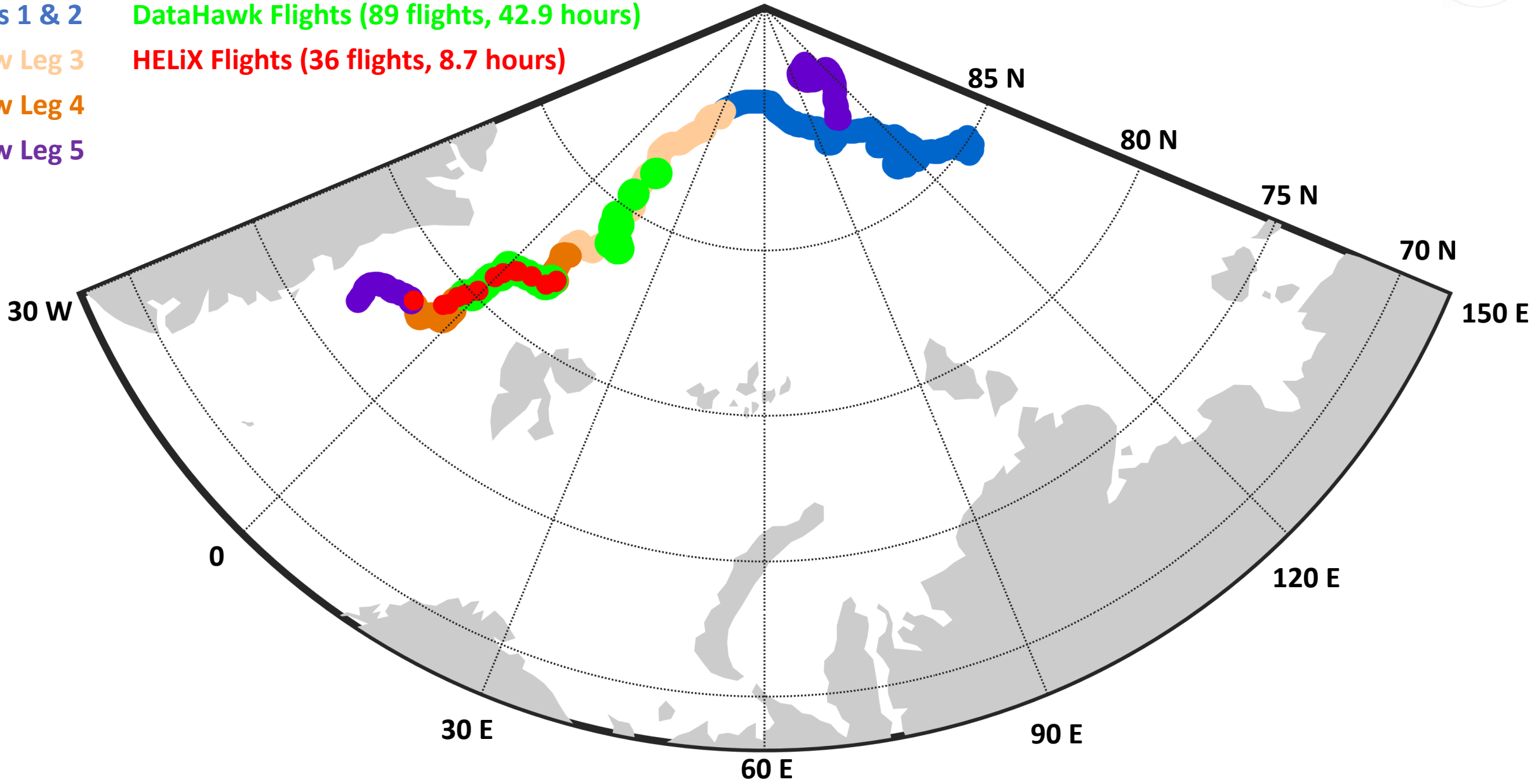
Primary MOSAiC UAS Science Targets:

- Understanding sub-grid scale variability in the coupled system and the ability of today's modeling tools to capture features resulting from this variability
- Observing and understanding variability in sea ice and its contribution to energy transfer in the ice-atmosphere-ocean interface
- Understanding the impact of coarse vertical resolution in models on the proper representation of complex boundary layer structures in the central Arctic

MOSAiC Drift and Flights

Legs 1 & 2
New Leg 3
New Leg 4
New Leg 5

DataHawk Flights (89 flights, 42.9 hours)
HELiX Flights (36 flights, 8.7 hours)



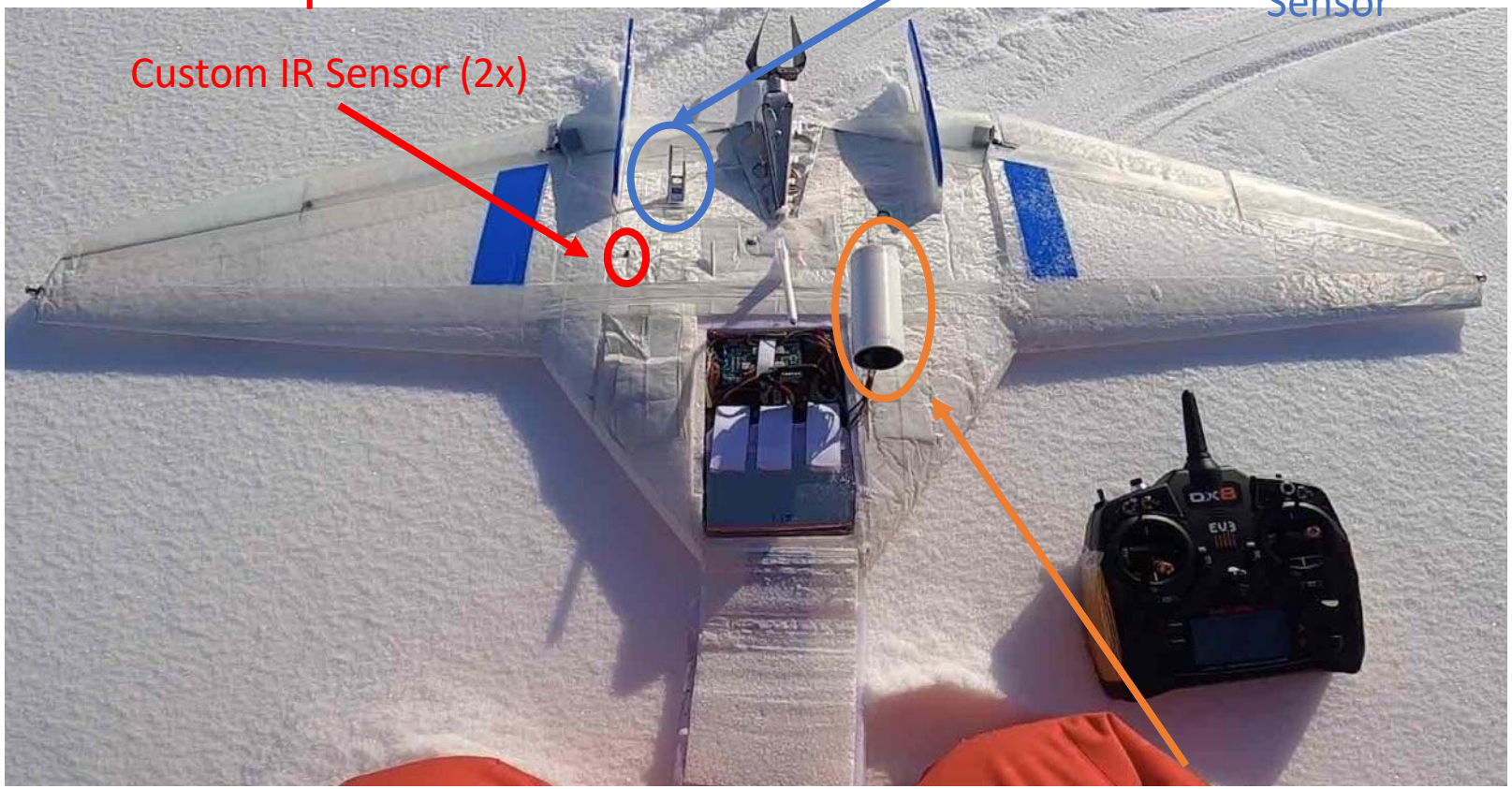
Platforms: DataHawk2

Aircraft Specs

- 1.1m wingspan
- 1.8kg weight
- 40-min endurance time

Measured Variables

- Temperature, pressure, humidity, wind speed
- IR temperature
- Turbulence

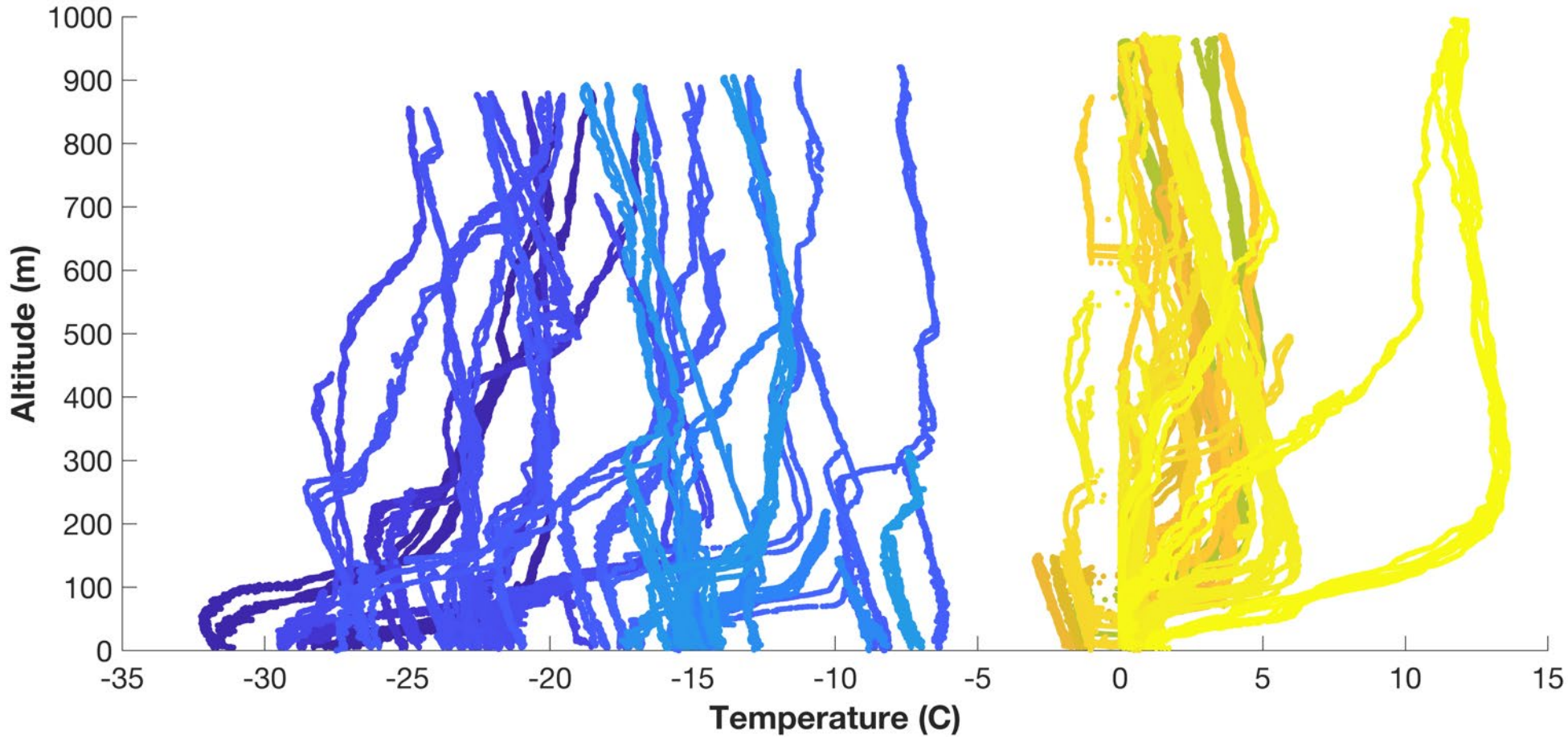


Objectives for the DataHawk2 focused on the **atmospheric boundary layer**, providing detailed observations of the **vertical structure of the lower atmosphere**

- to improve **model representation of key processes**
- to advance understanding of **energy transfer** between the surface and overlying atmosphere

Photo: Delphin Ruche

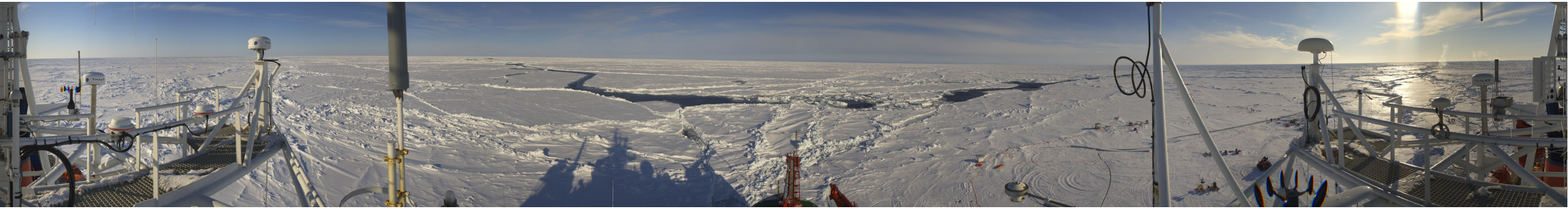
DataHawk2 Profiling

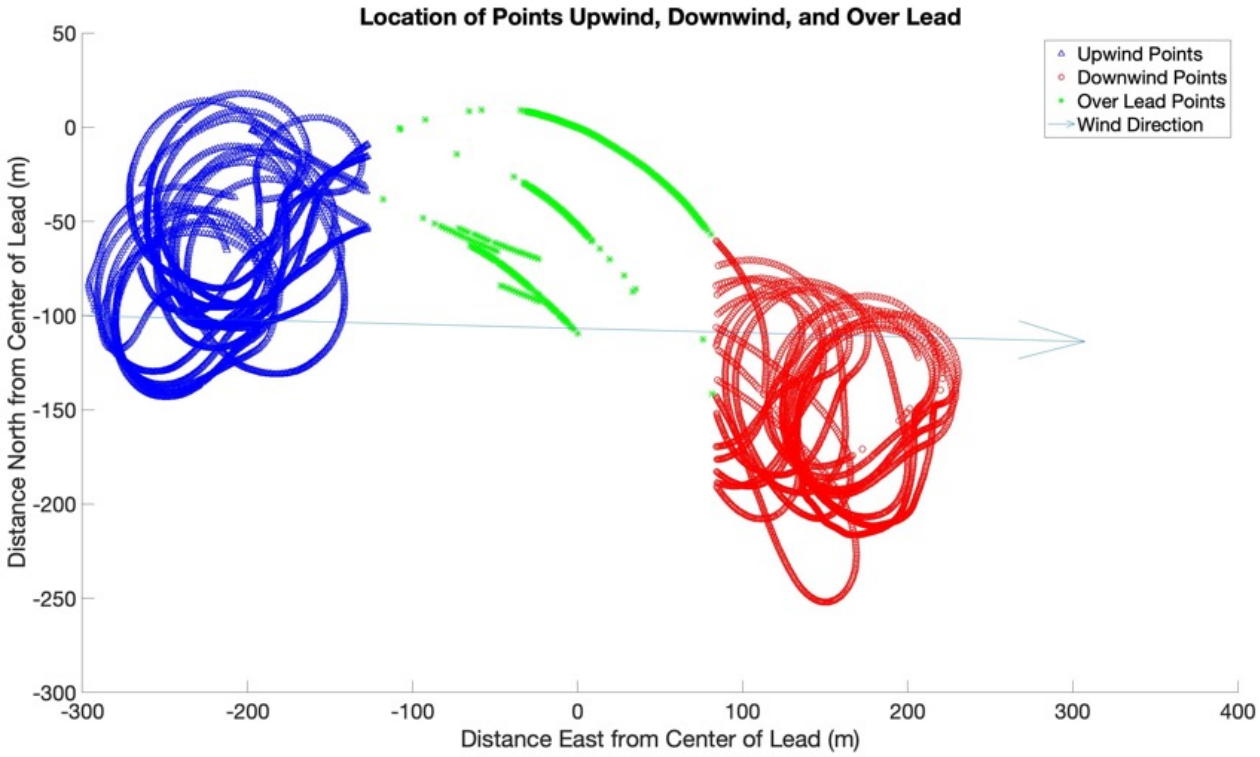


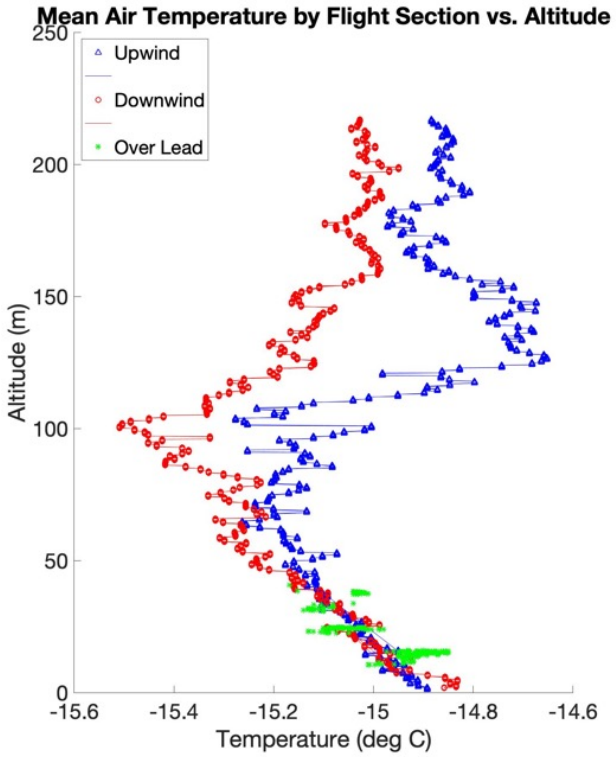
Leg 3 : March to May 2020

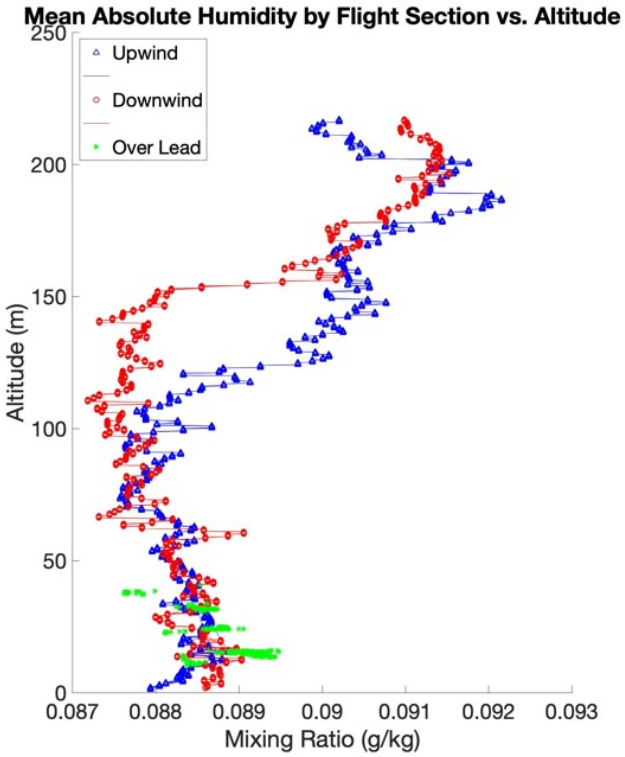
Leg 4 : June to July 2020

DataHawk2 Lead Sampling









Platforms: HELiX

Aircraft Specs

- 12kg weight
- 20-min endurance

Measurements

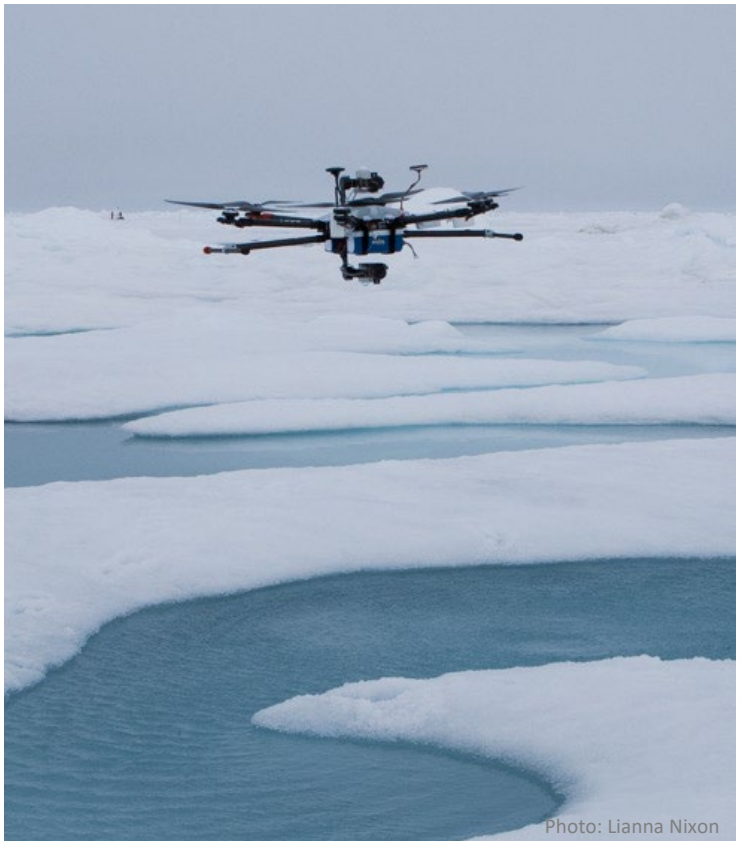
- Upwelling and downwelling shortwave radiation – albedo
- Multispectral camera for surface imaging
- Pressure, temperature, relative humidity

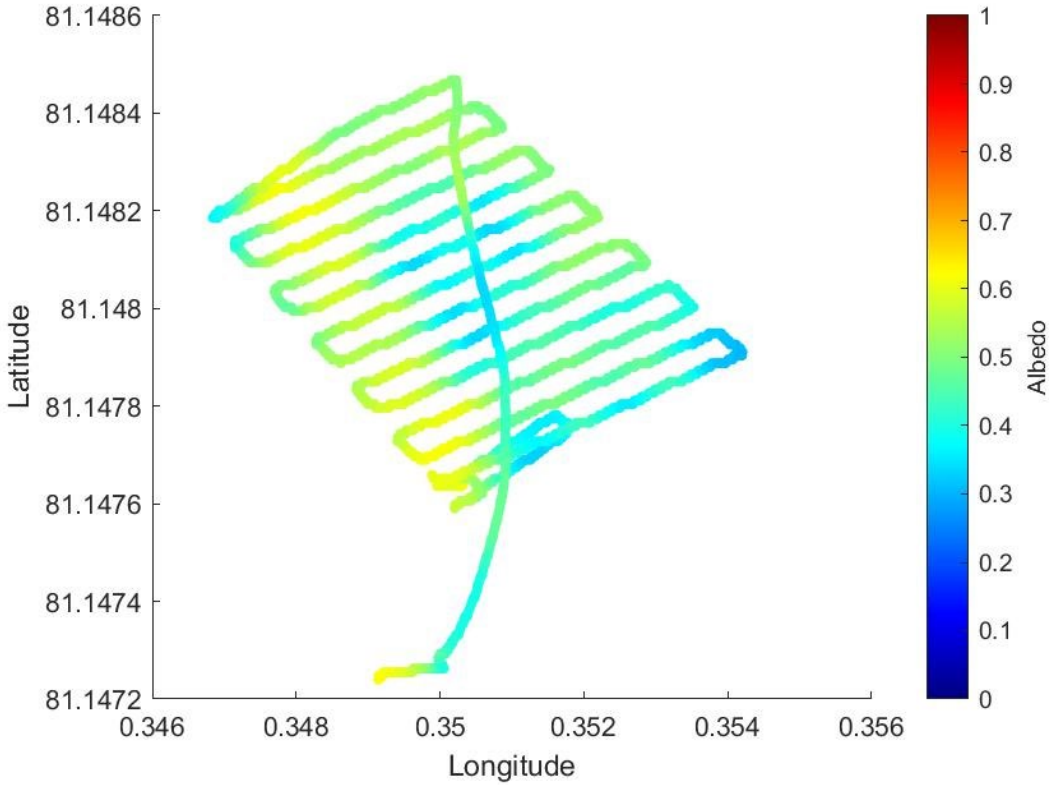
Objectives for the HELiX included characterization of surface properties, including **surface albedo**, the **sea ice and melt pond fractions**

- to improve **model representation of key processes**
- to **provide context** for measurements from other systems

Photo: Lianna Nixon

HELiX Albedo Mapping





Albedo

Multi-spectral camera
Assembled images

HELiX Feature Albedo Sampling

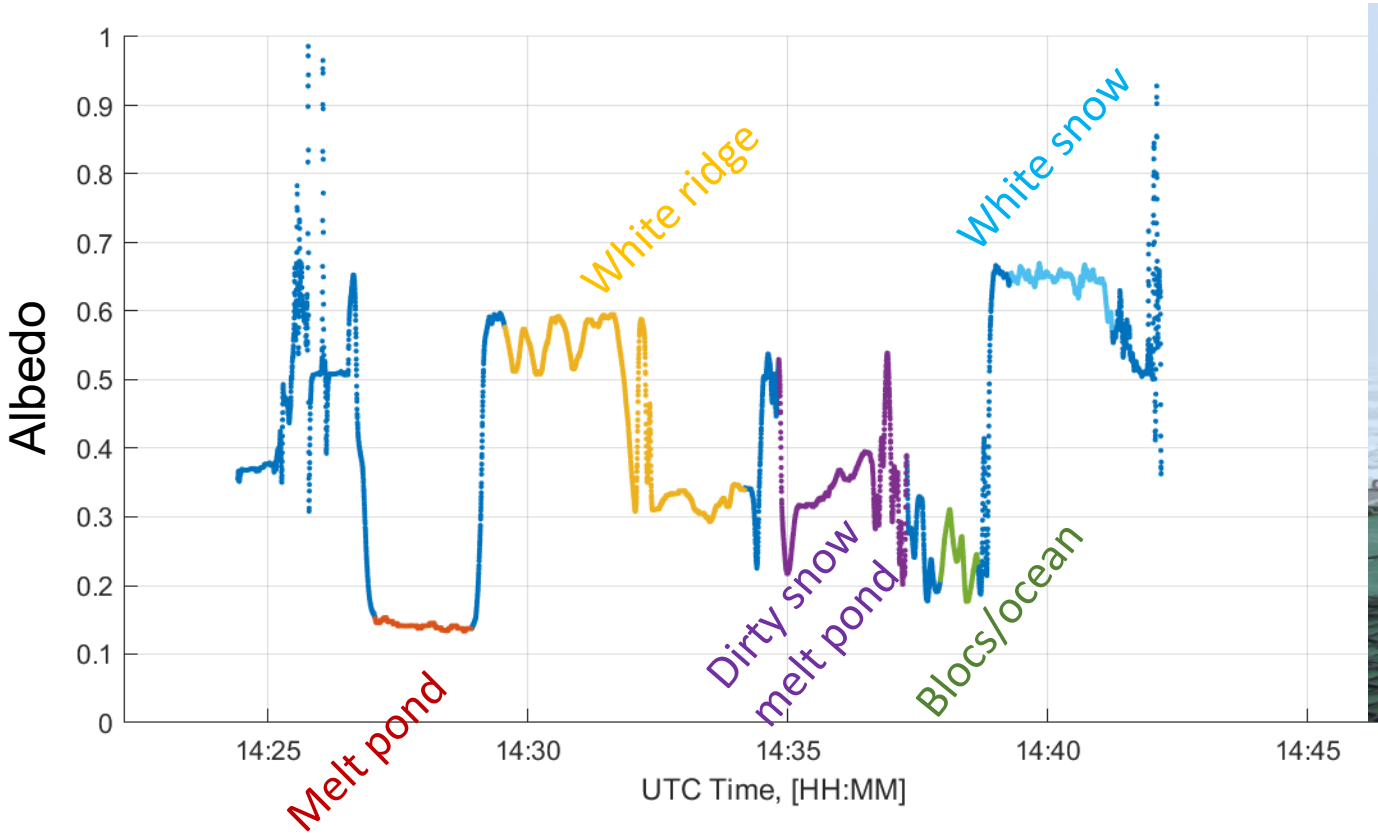


Photo: Michael Lonardi

HELiX Albedo Profiling To Understand Scales

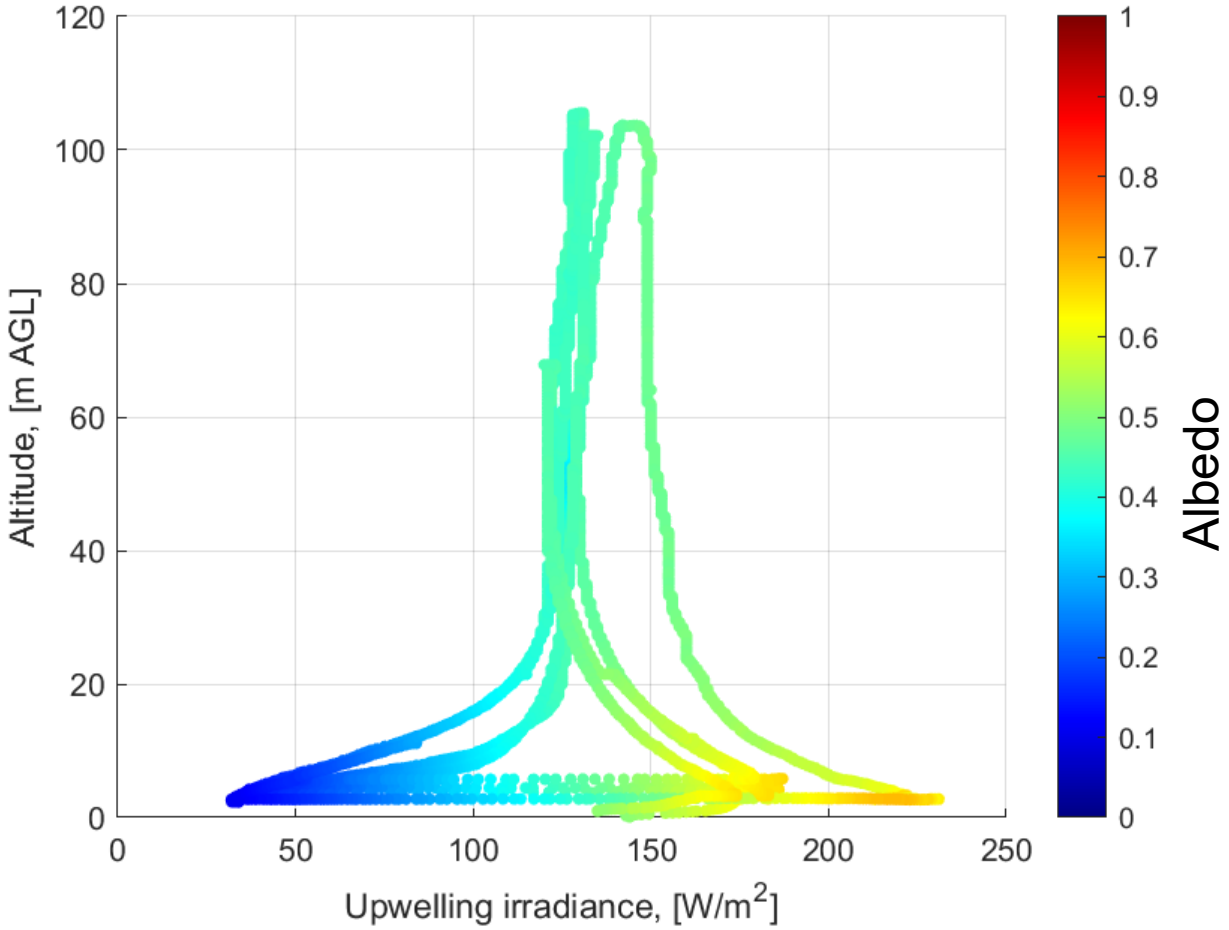


Photo: Lianna Nixon

Engagement with Modeling Community

- Combined development of case studies, centered on specific phenomena of interest
- Evaluation of existing parameterizations through single-column framework
- Evaluation of heat transfer resulting from leads in the ice pack
  - Some initial work with S. Kreuger and X. Li at the U. of Utah to combine our observations with their LES of the lead environment
- Support development and advancement of parameterizations developed around older datasets
  - Initial meetings with CICE team about possible value of HELiX-based albedo measurements
- Evaluation of simulations specific to MOSAiC (e.g. CAFS or other modeling systems)


Photo: Calle Schonning

Summary and Impacts

- First successful *extended* deployment of small UAS systems in the "high" Arctic for Earth system research (to our knowledge)
- Detailed data collected documenting the thermodynamic and kinematic state of the lower Arctic atmosphere during legs 3-4 of MOSAiC
- Extended sampling of surface albedo throughout the melt season during leg 4 of MOSAiC
- Data are being processed and quality control metrics are being applied. Aim to share all data by spring 2021 through the NSF Arctic Data Center (https://arcticdata.io).
- Initial studies leveraging the atmospheric measurements to understand the impact of small leads, and to understand relationships between atmospheric state and lower-atmospheric mixing and turbulence are underway
- We would like to engage the model-development community to identify the most impactful ways for these observations to be leveraged. Are there case studies that may be developed? Or ways to connect to parameterization evaluation and development efforts?

Photo: Manuel Ernst