

3RD INTERNATIONAL ELECTRONIC CONFERENCE ON ATMOSPHERIC SCIENCES

# Winter atmospheric boundary layer observations over sea ice in the coastal zone of the Bothnian Bay (Baltic Sea)

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"Observations and modeling of  
sea ice interactions with the  
atmospheric and oceanic  
boundary layers" No.  
2018/31/B/ST10/00195 (financed  
by Polish National Research  
Center)



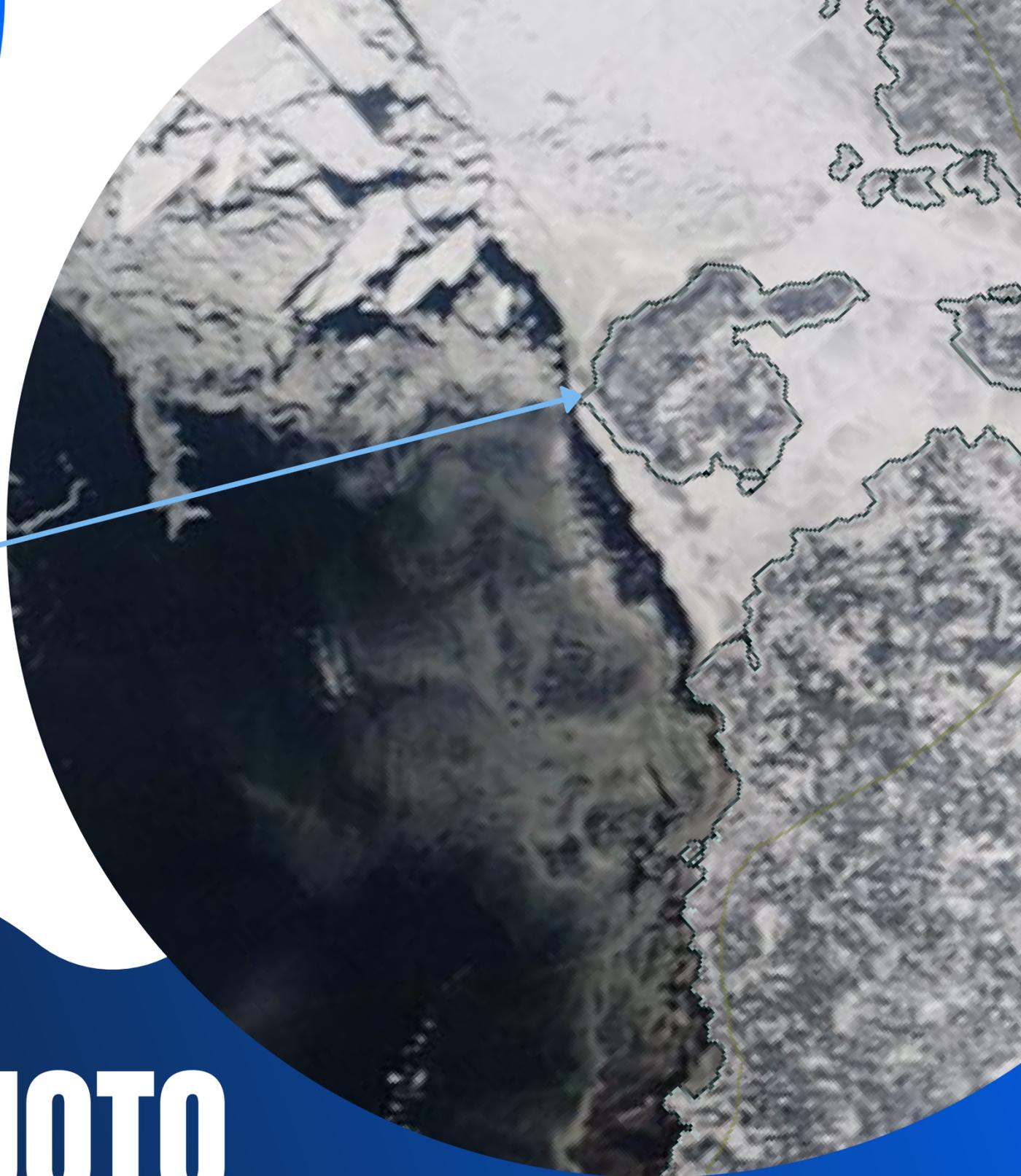
# Haiuloto Atmospheric Observations over Sea ice

## HAOS

27 February - 2 March 2020

TOTAL NUMBER OF 27  
FIXED WING UAV AND 4  
MULTIROTOR FLIGHTS.





**HAILUOTO**

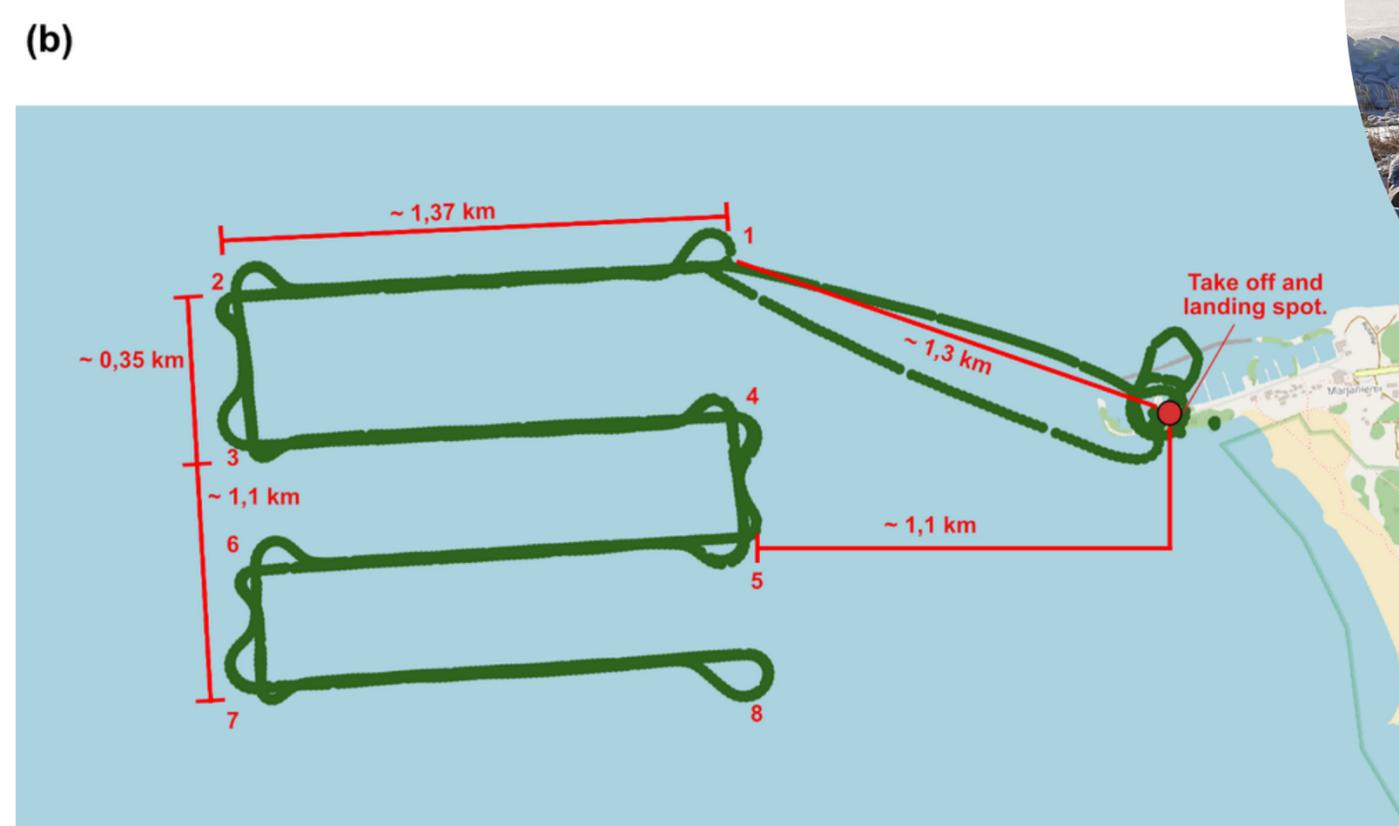
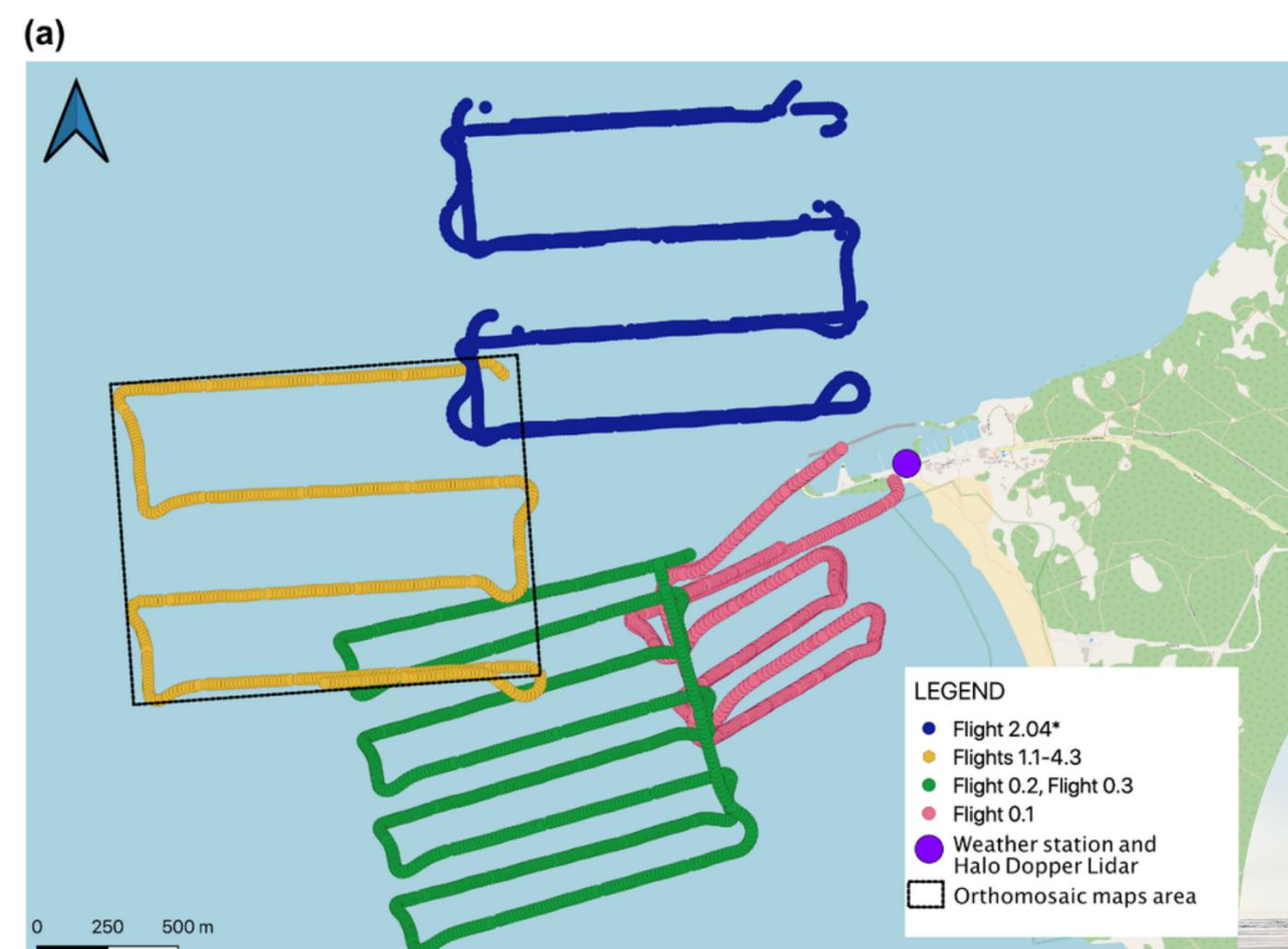
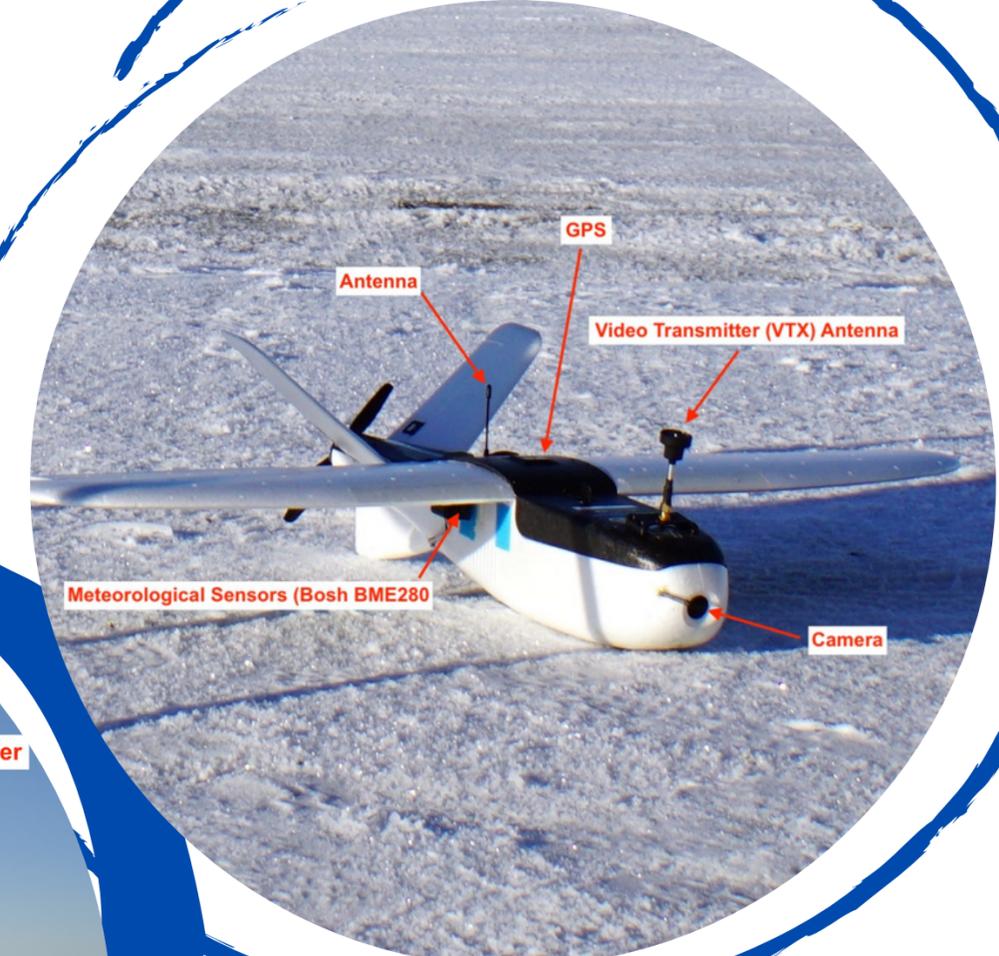
# OUR GOAL

**TO STUDY THE ATMOSPHERIC  
BOUNDARY LAYER RESPONSE TO SEA  
ICE SURFACE INHOMOGENEITIES.**

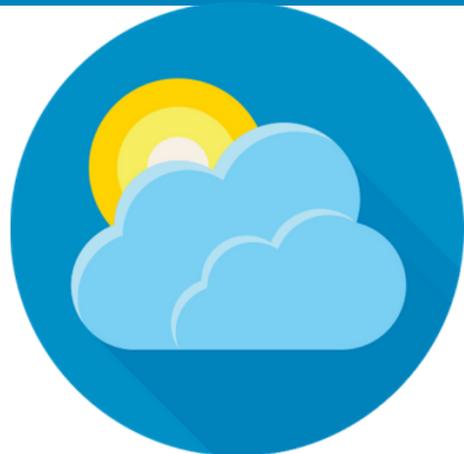
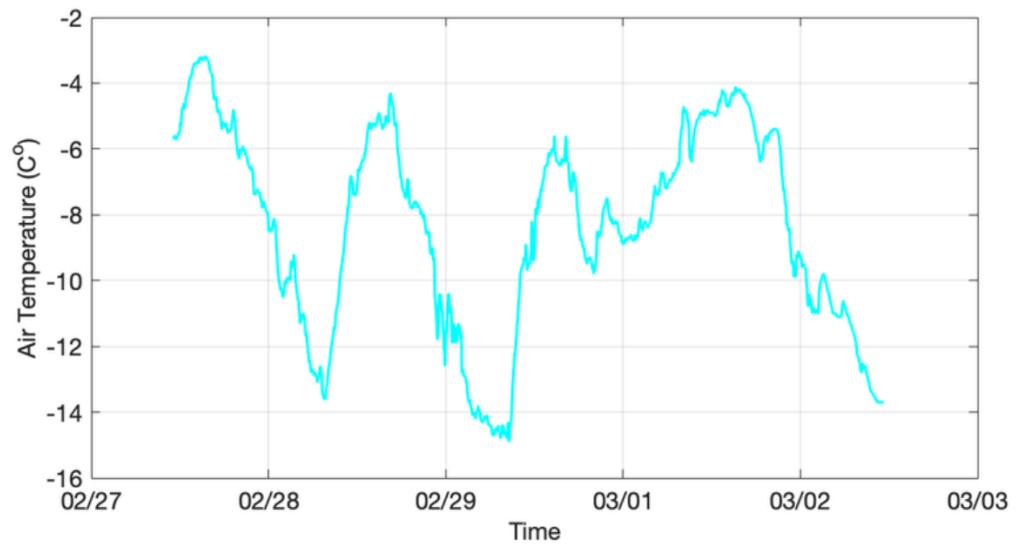
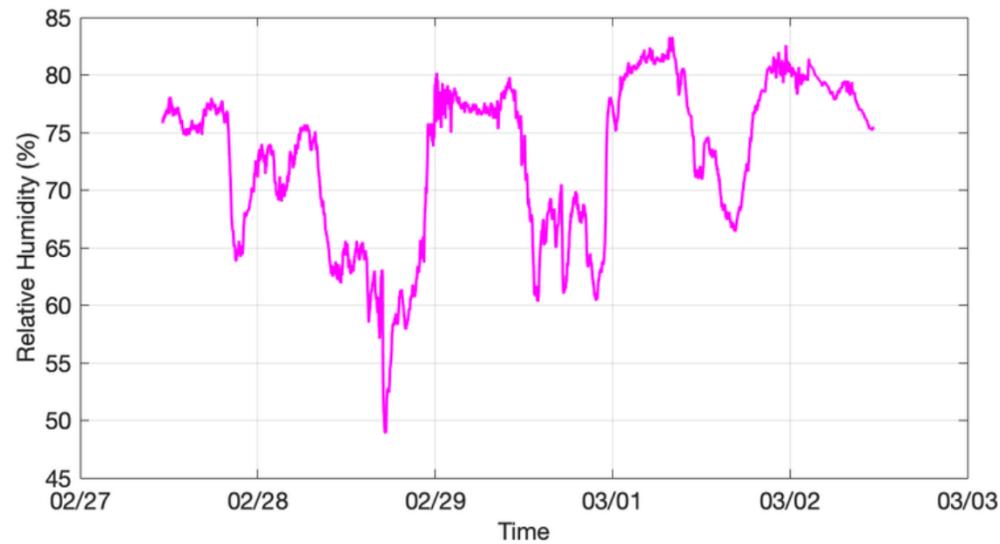
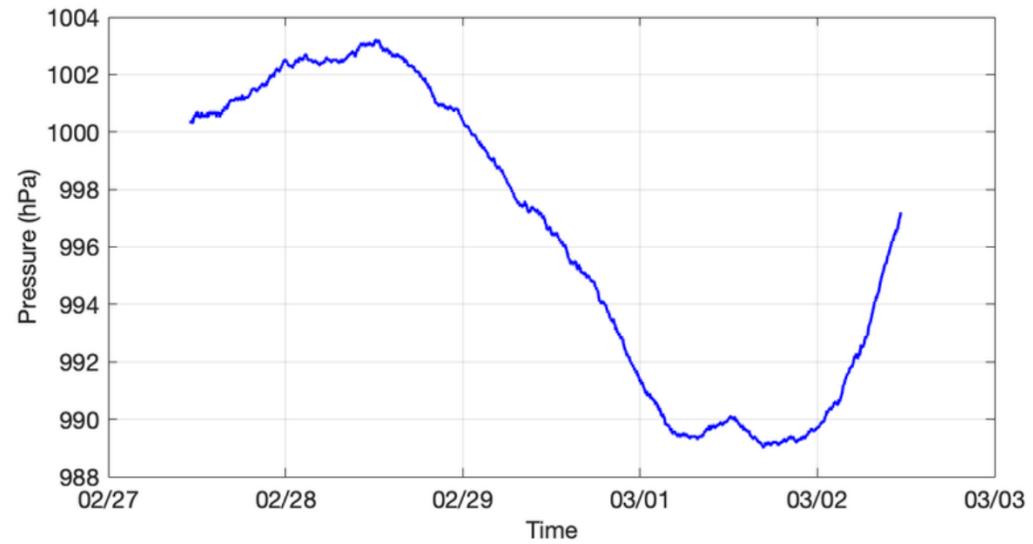
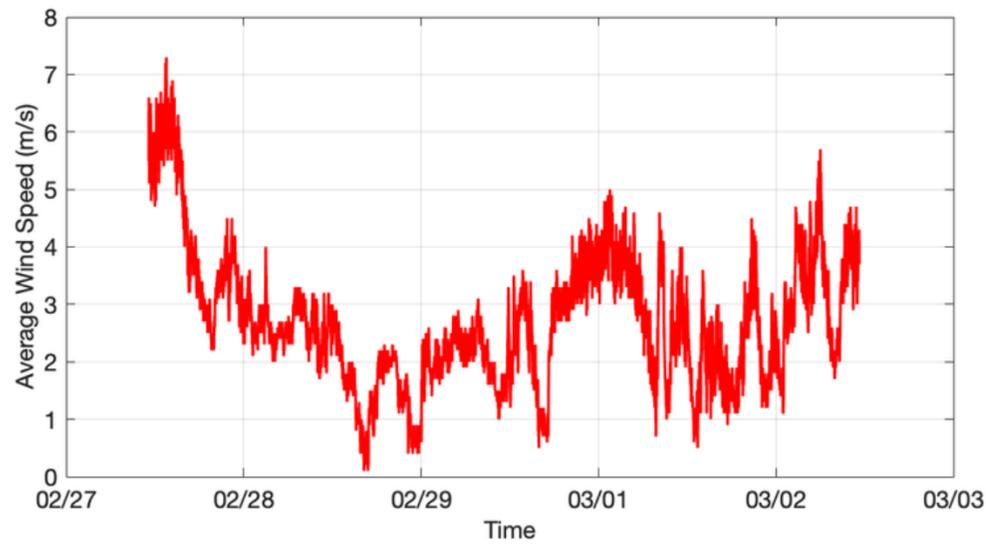
**TO ANALYZE DIURNAL CHANGES IN ABL  
PROPERTIES.**

**TO PROVIDE DATA FOR MODEL RESULTS  
VALIDATION.**

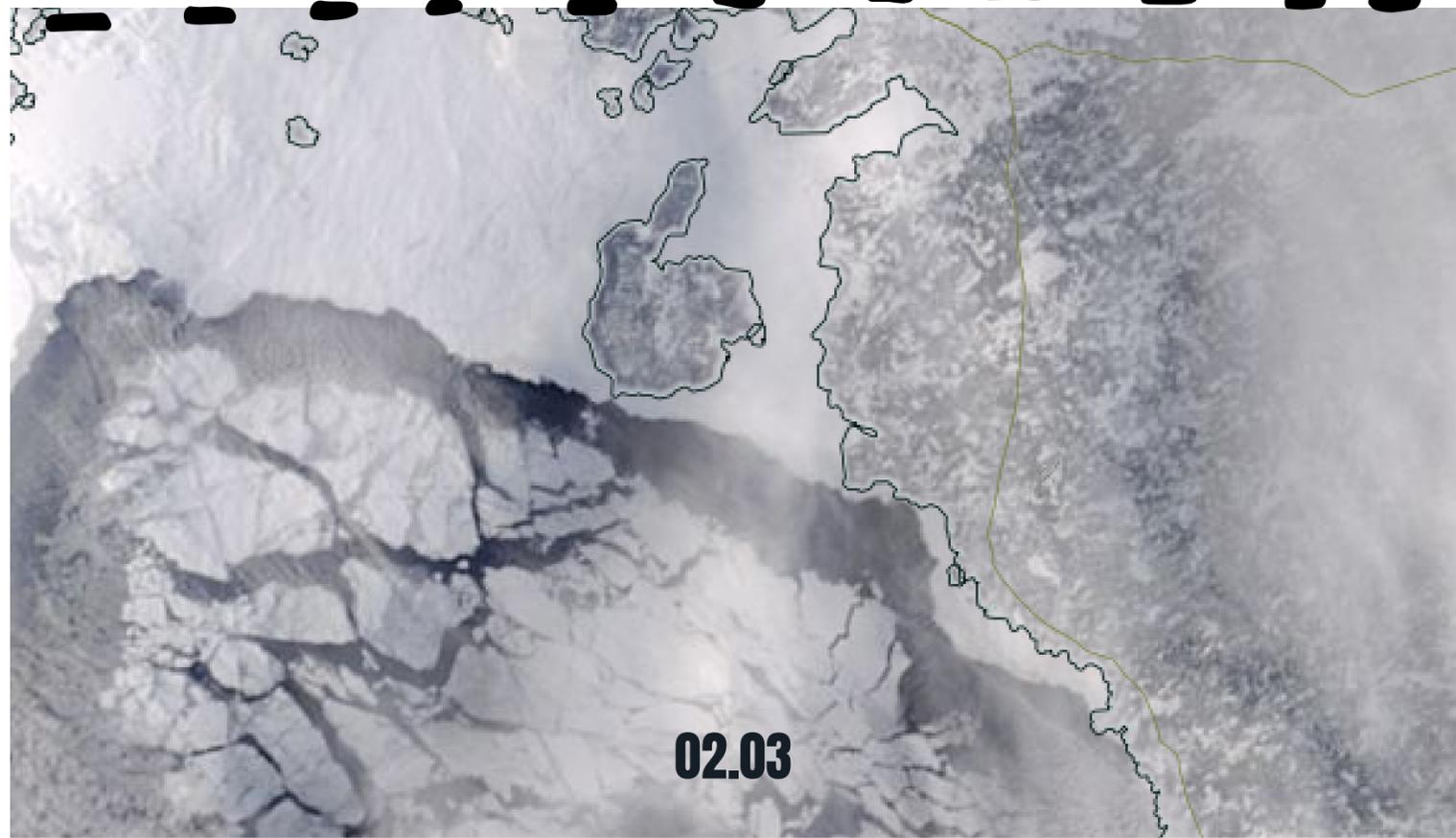
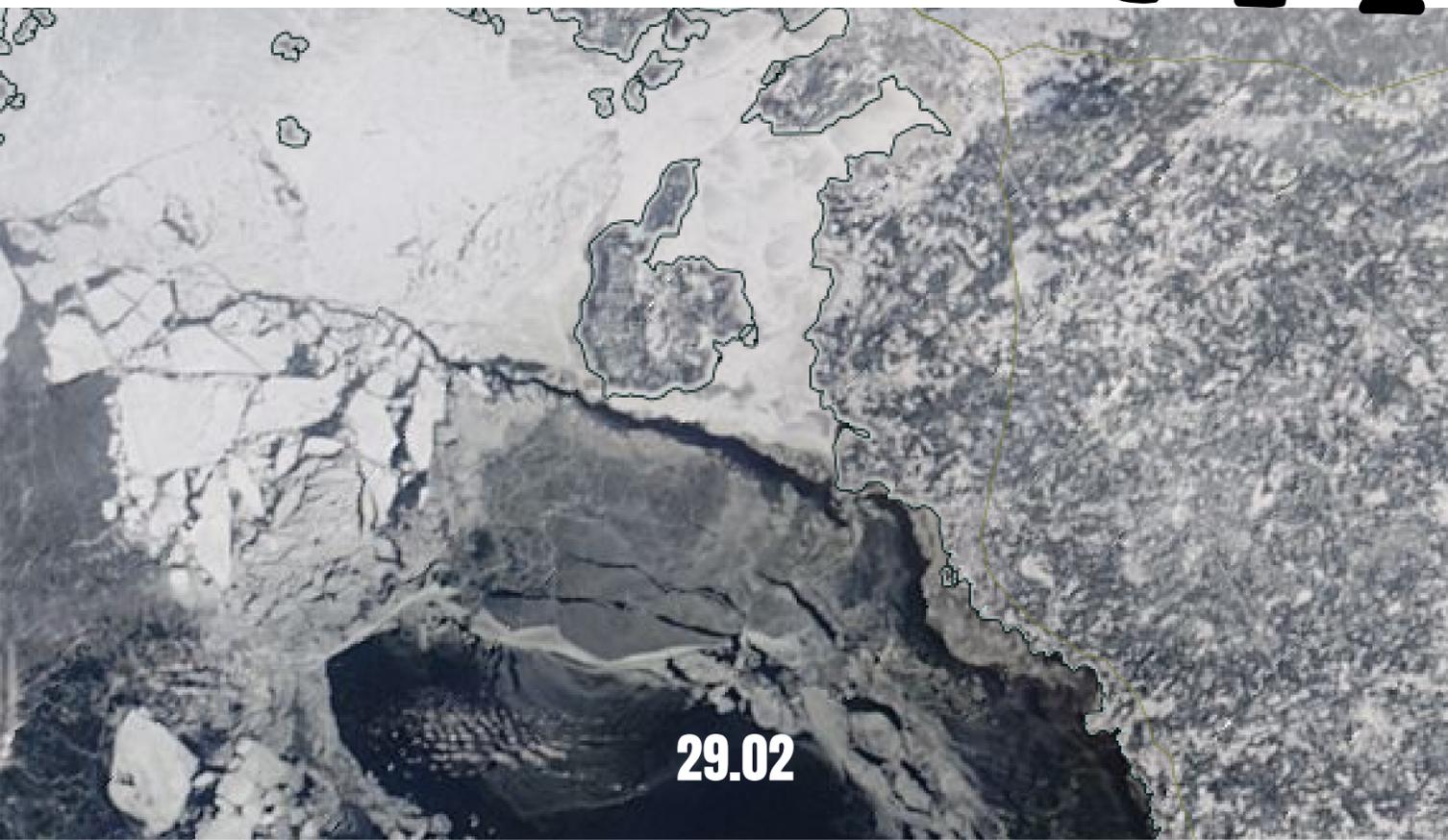
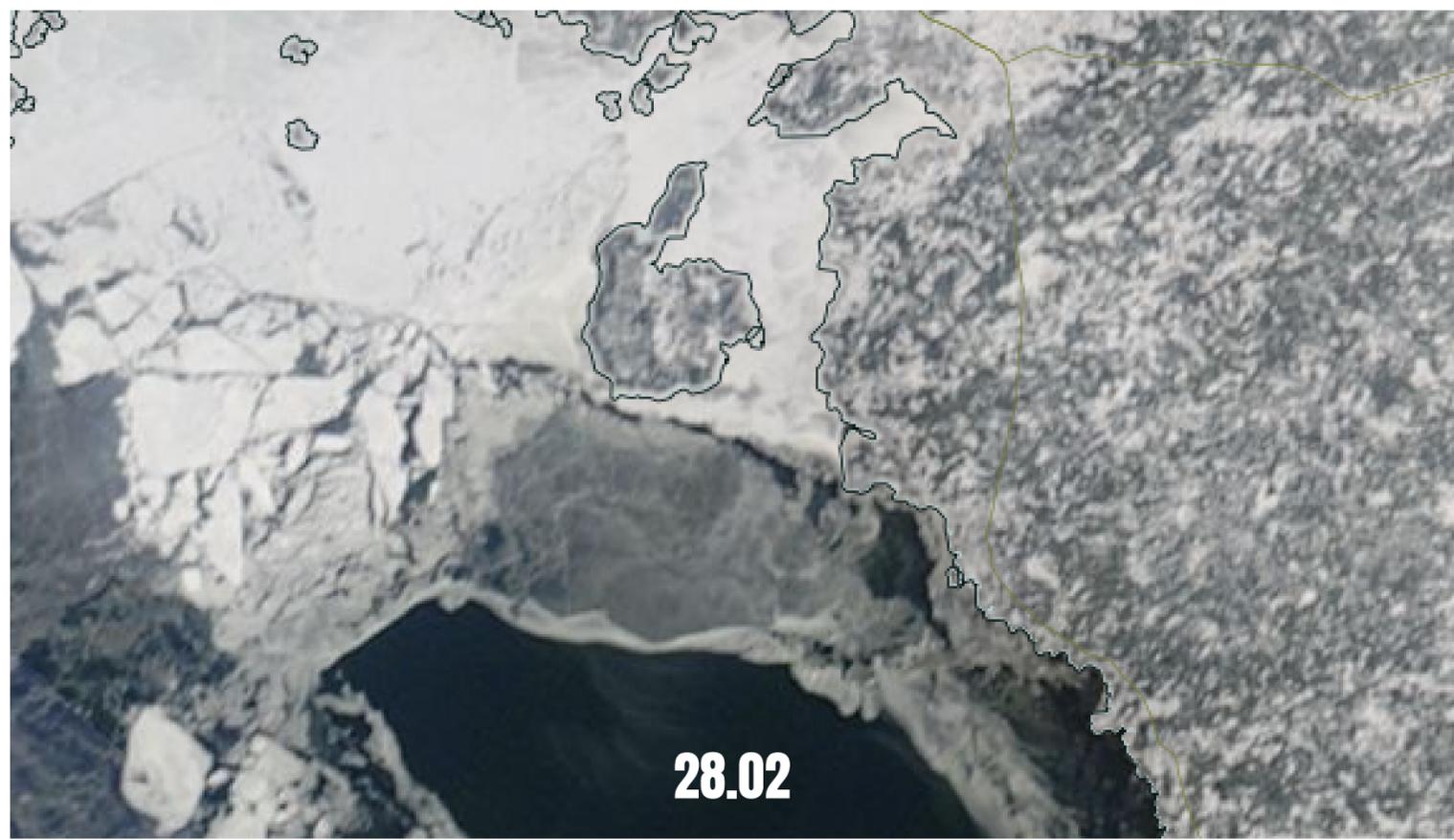
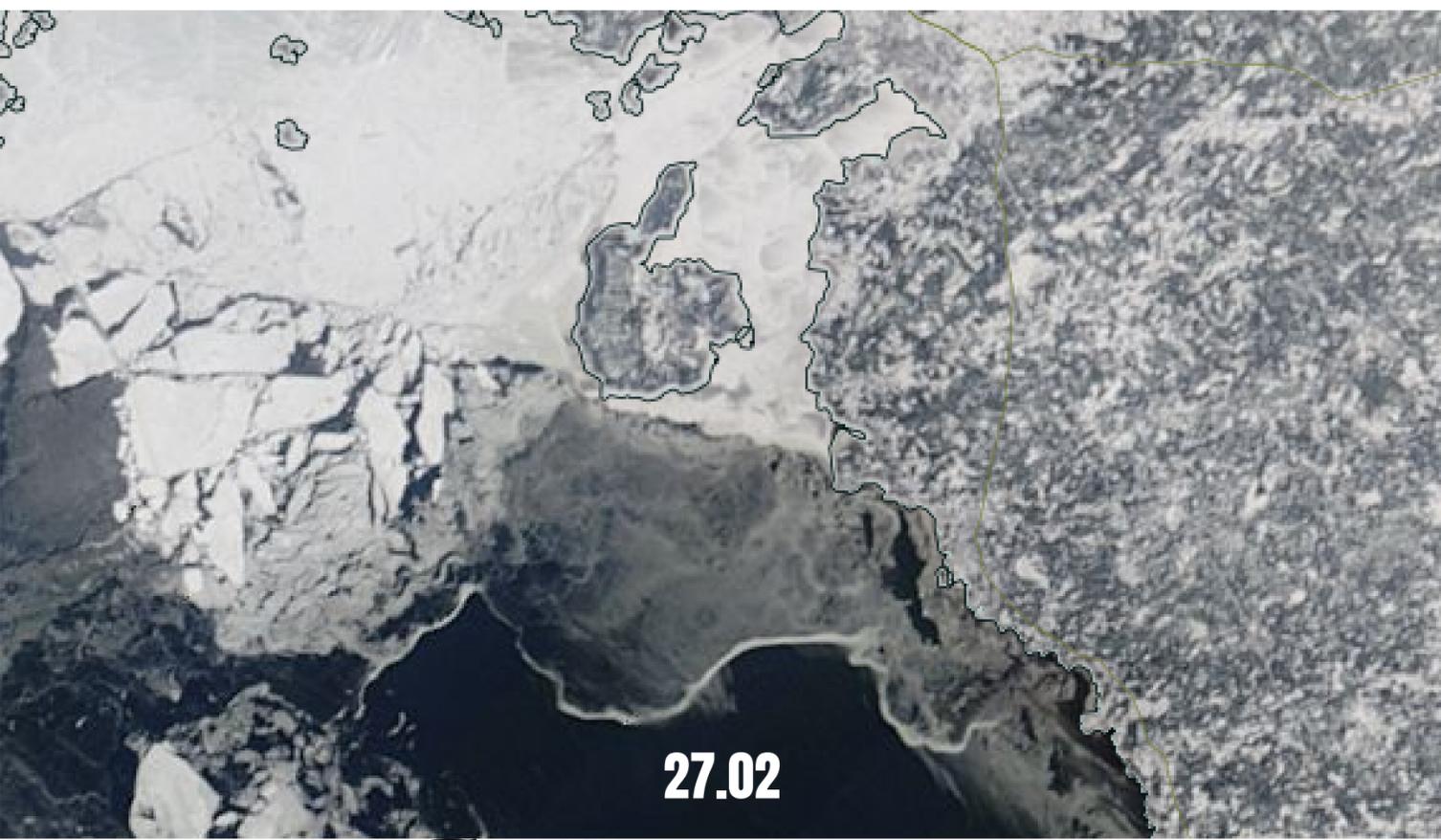
27 fixed winged UG1 flights  
 4 orthomosaic maps  
 4 days of ground measurements

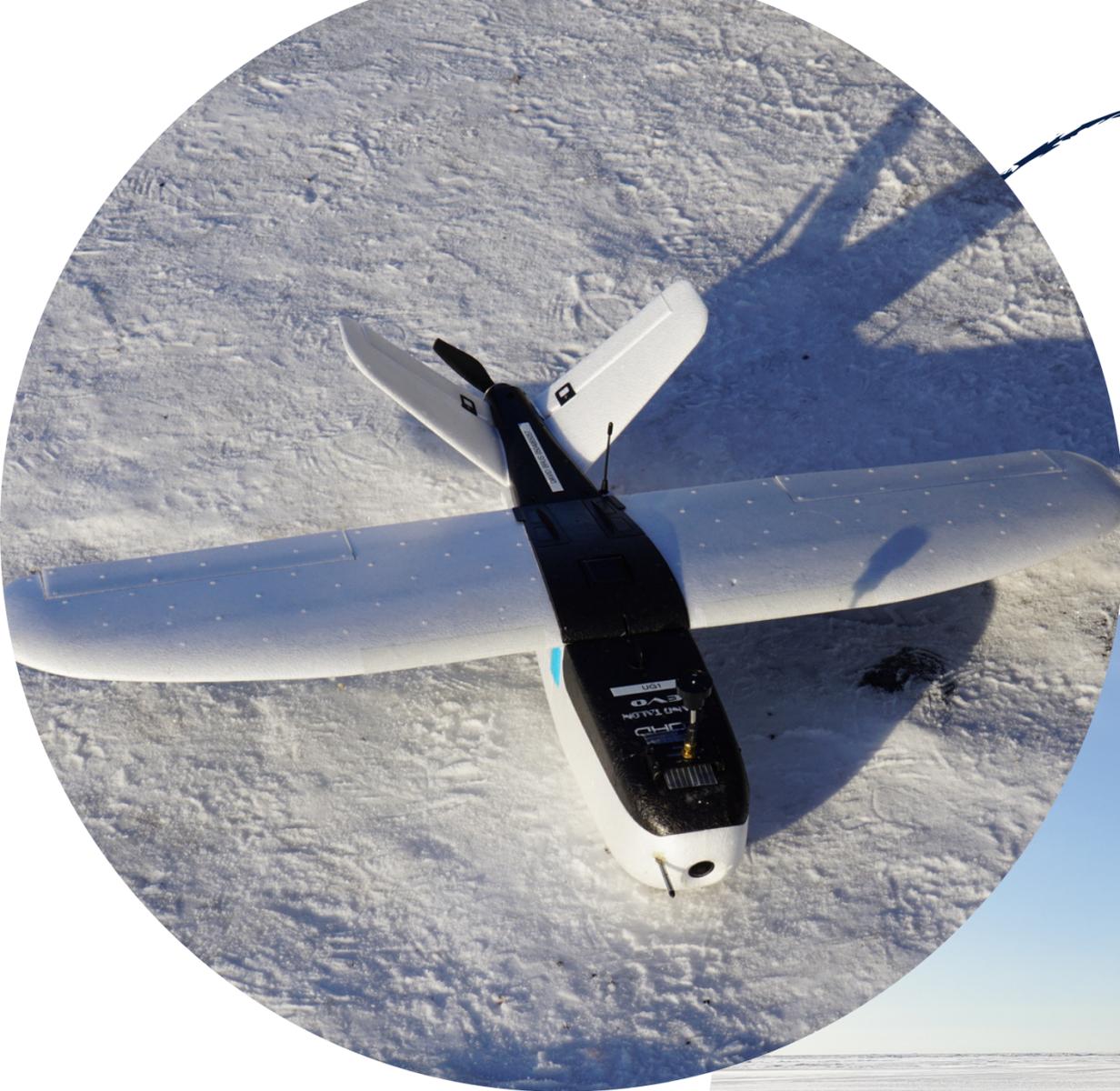


Automaitc Weather Station



**weather conditions**





## UG1 UAV

air temperature  
relative humidity  
air pressure

## AUTOMATIC WEATHER STATION

wind speed  
wind direction  
air temperature  
relative humidity  
air pressure  
precipitation

## 3D ANEMOMETER

u, v, w wind components and acoustic temperature in 10hz resolution

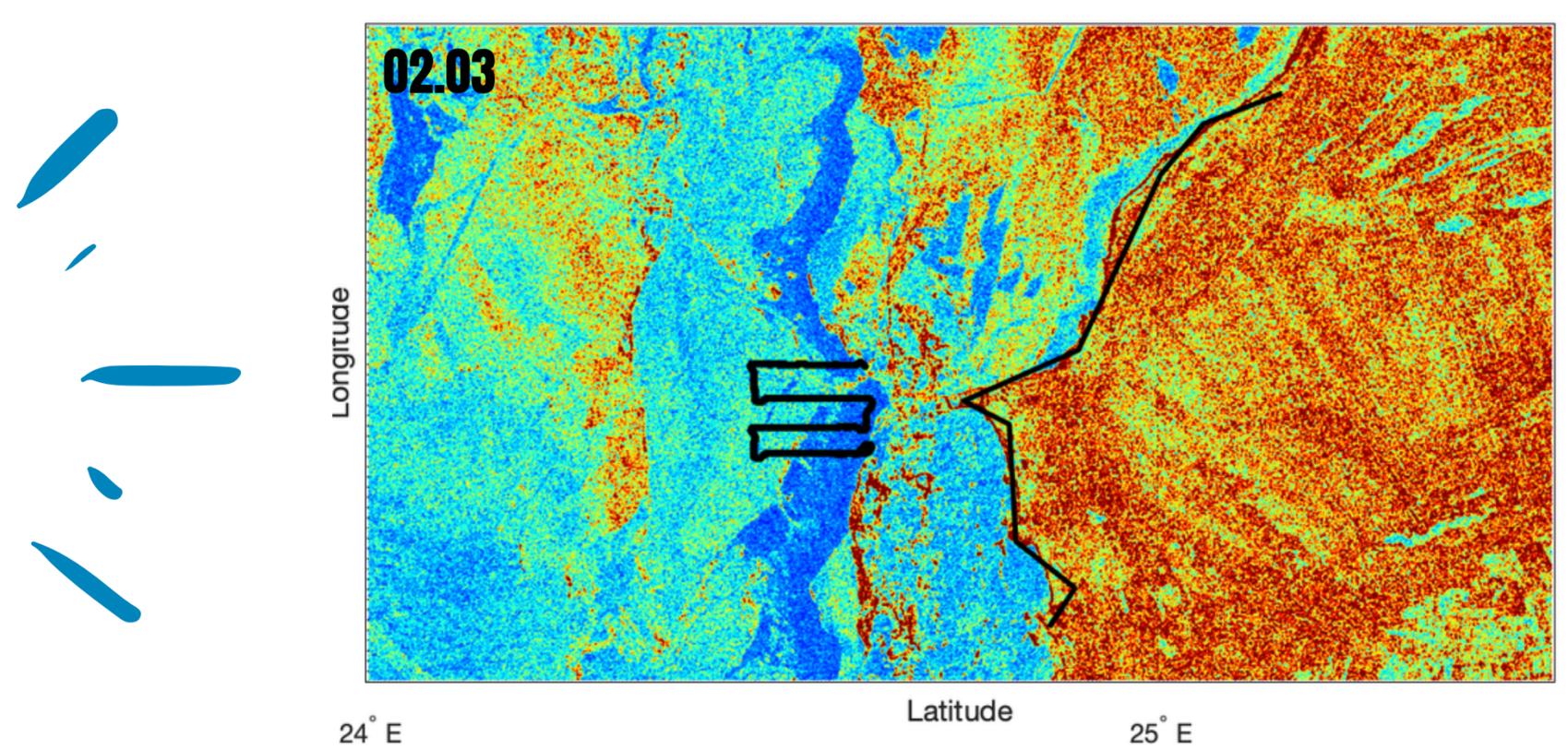
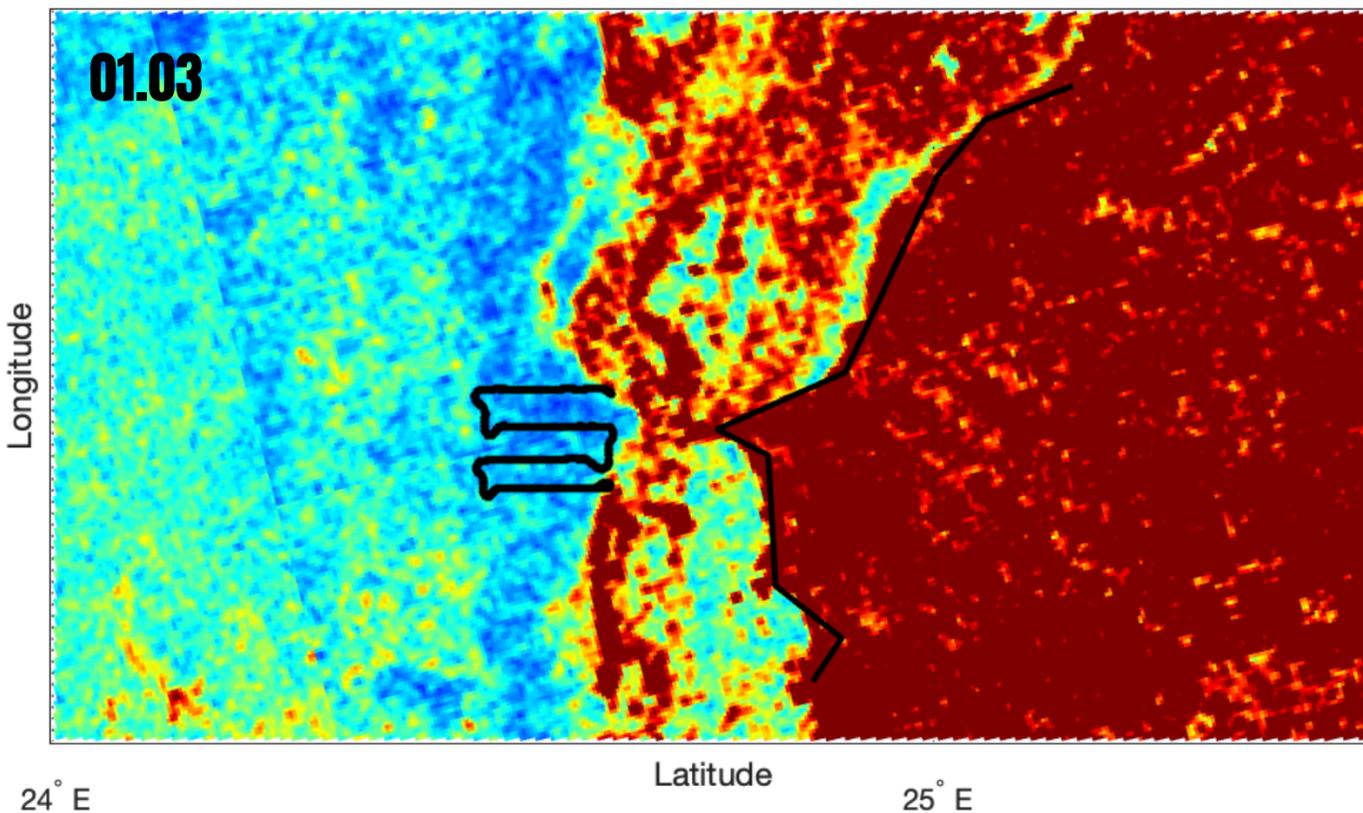
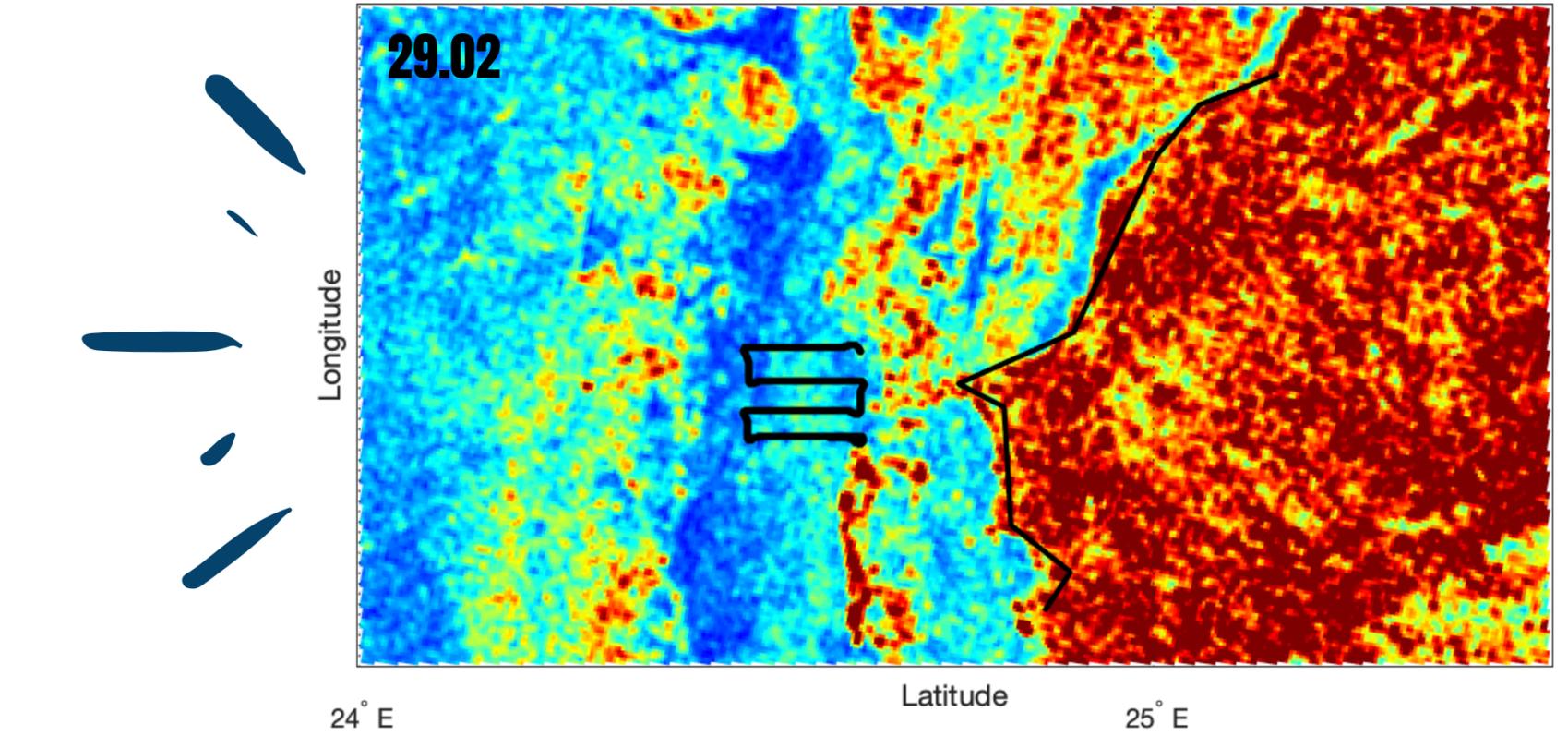
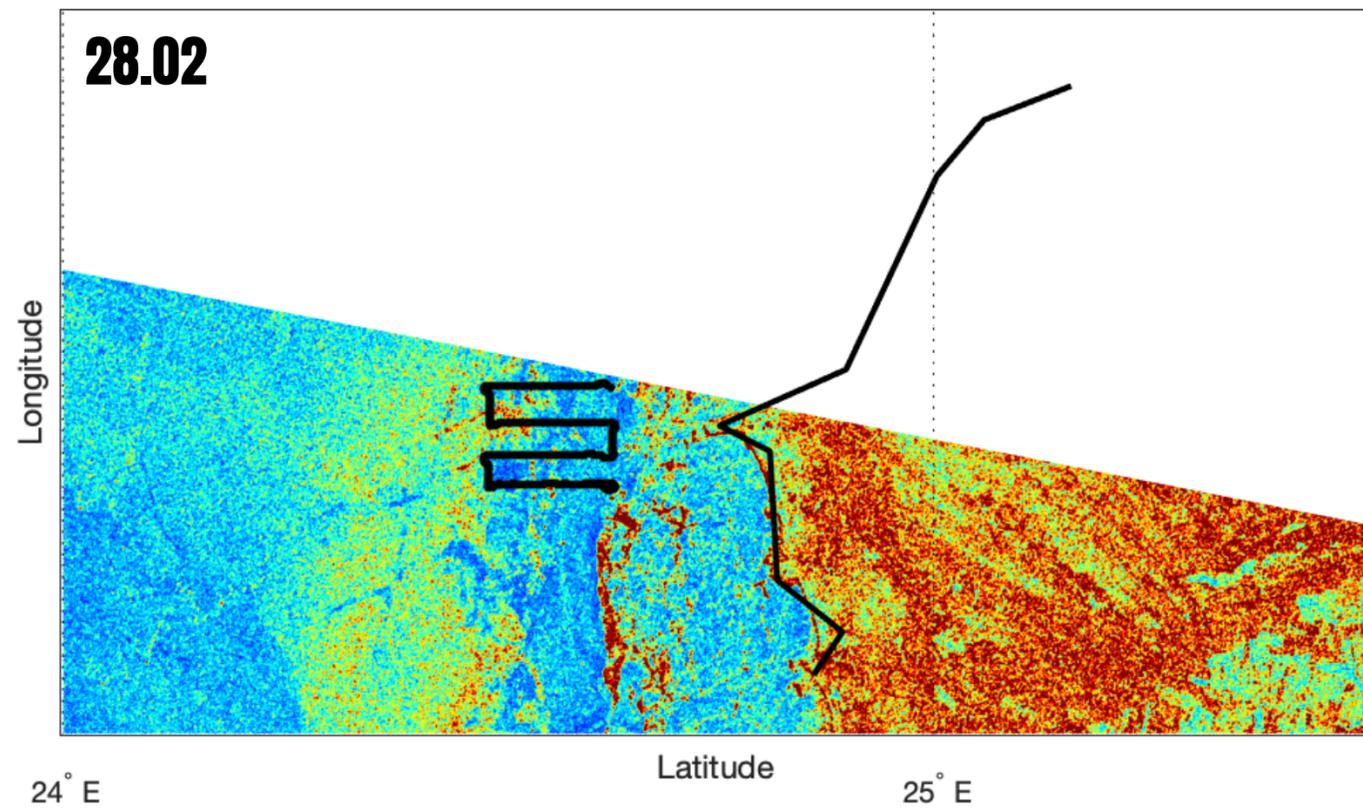
## HALO DOPPLER LIDAR

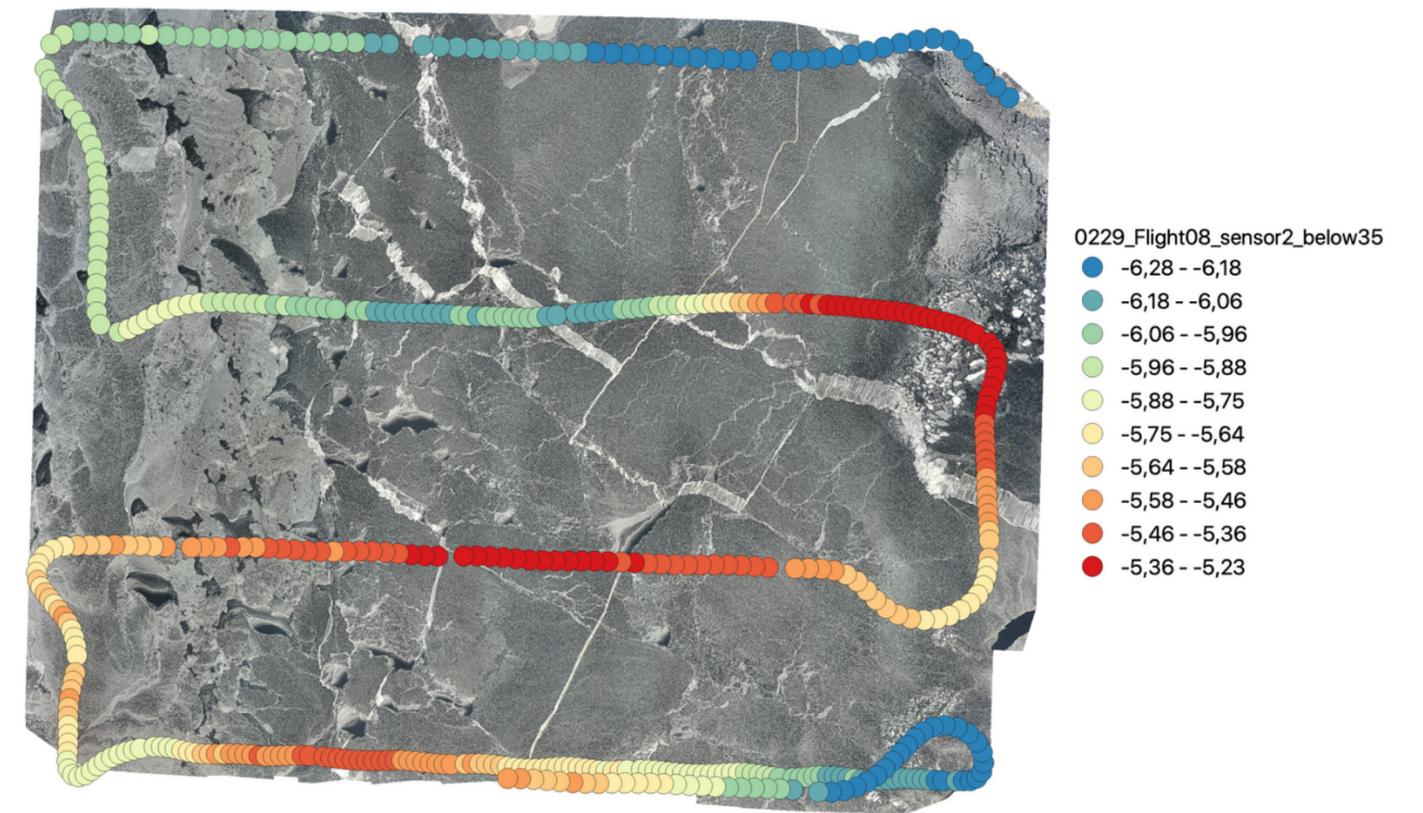
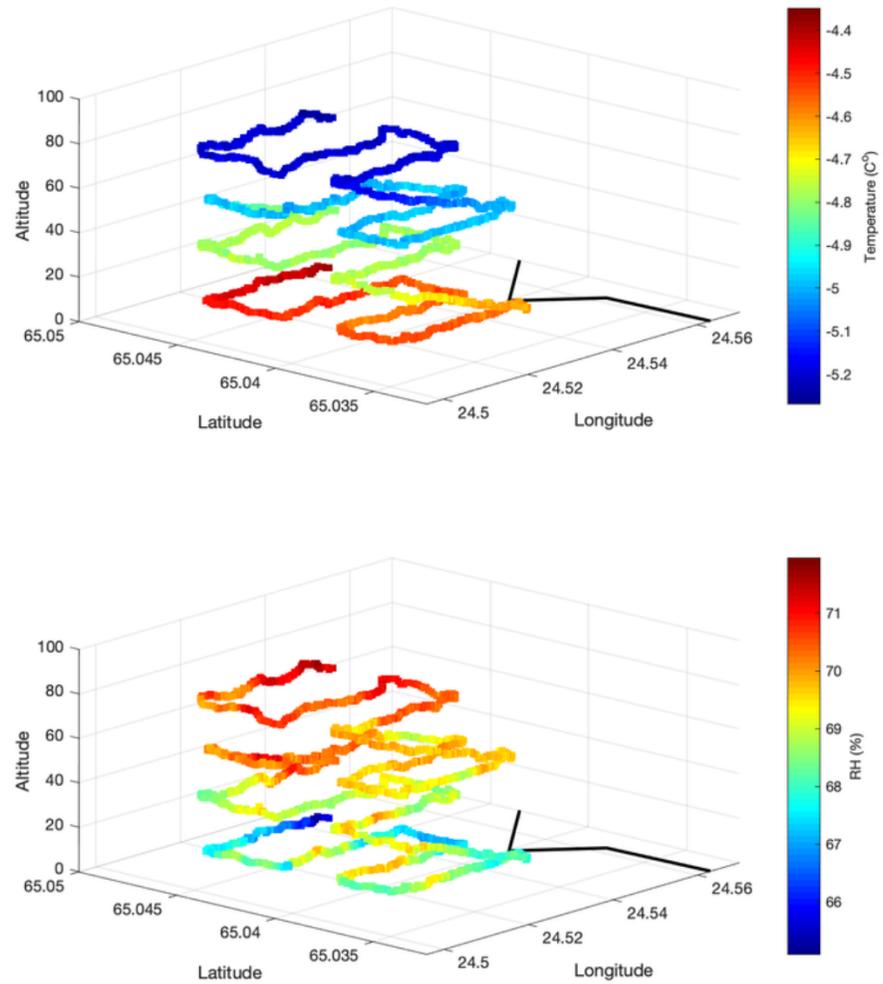
horizontal wind speed and direction  
TKE dissipation rate  
turbulence proxy



# MEASURED PROPERTIES

# SENTINEL-1 SYNTHETIC APERTURE RADAR (SAR)





## RESULTS

Presented dataset gives us a thorough description of atmospheric conditions over newly formed sea ice near Hailuoto island.

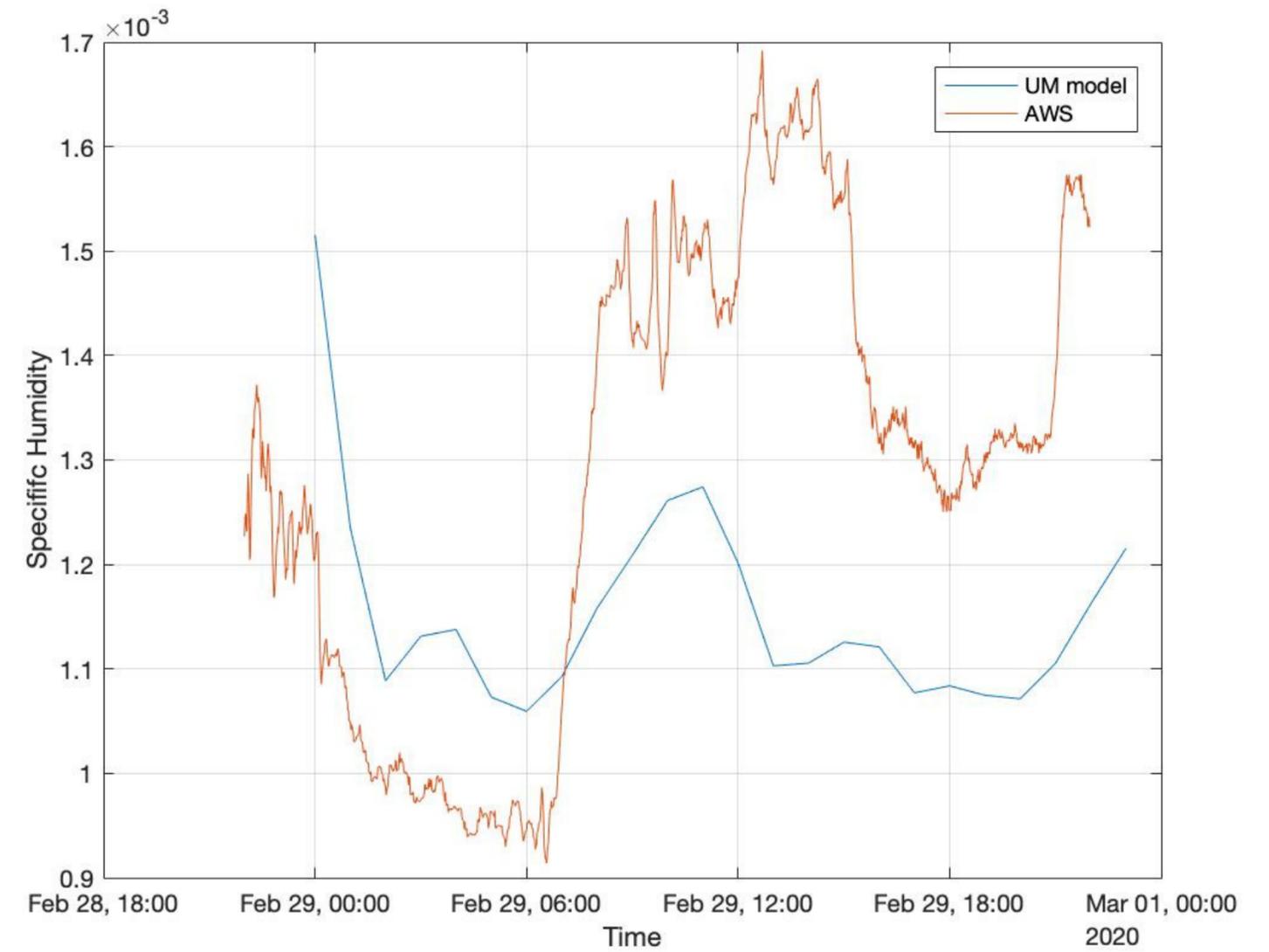
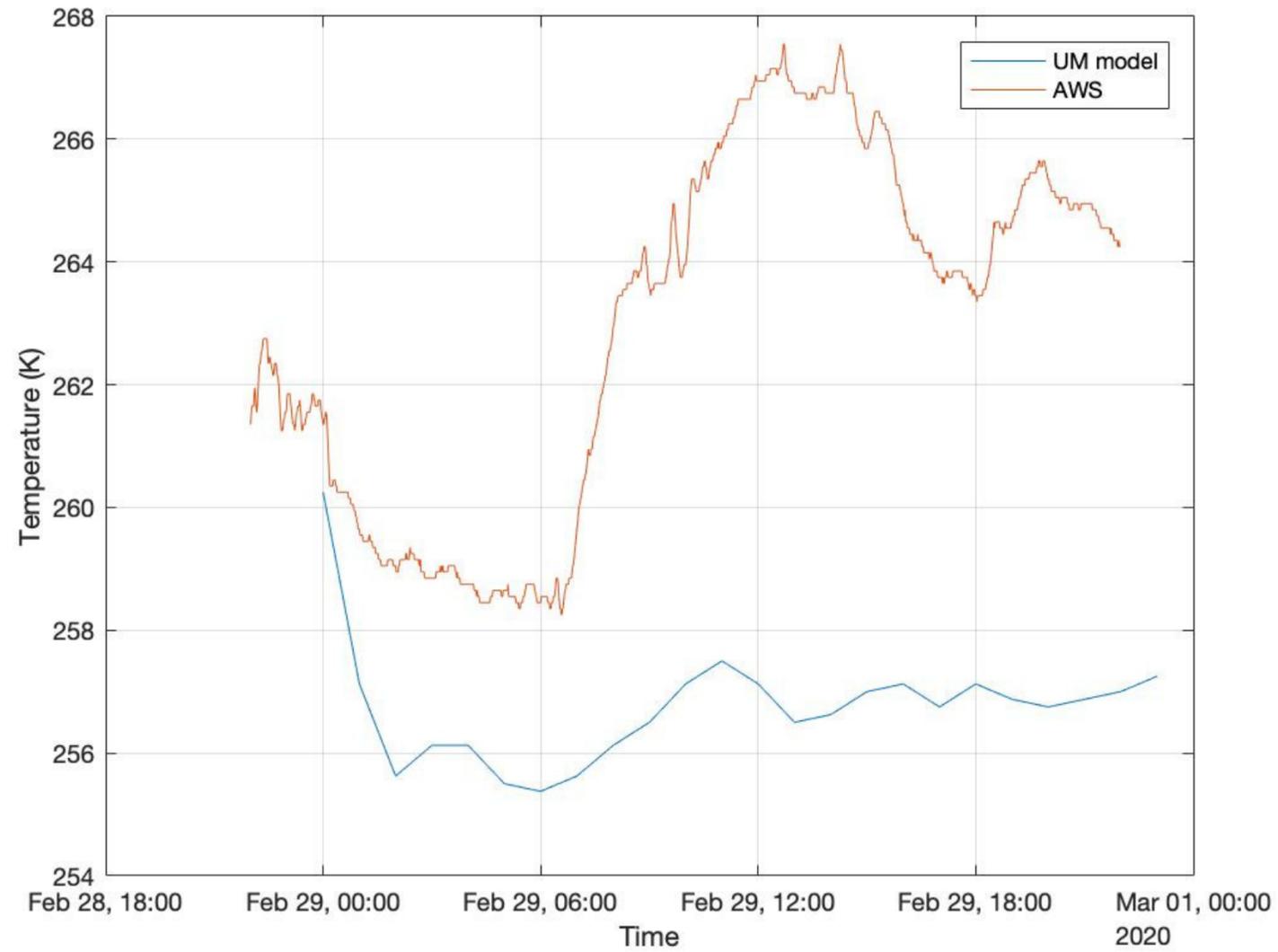
Detailed orthomosaic maps provide us an unique and extremely detailed view on the newly formed sea ice and its changes in the span of 4 days.

**Considering the scarcity of recent ABL observations over diminishing sea ice over in the Bay of Bothnia presented dataset may be considered as valuable source of information and the basis for further studies on sea ice-atmospheric interactions in this region.**

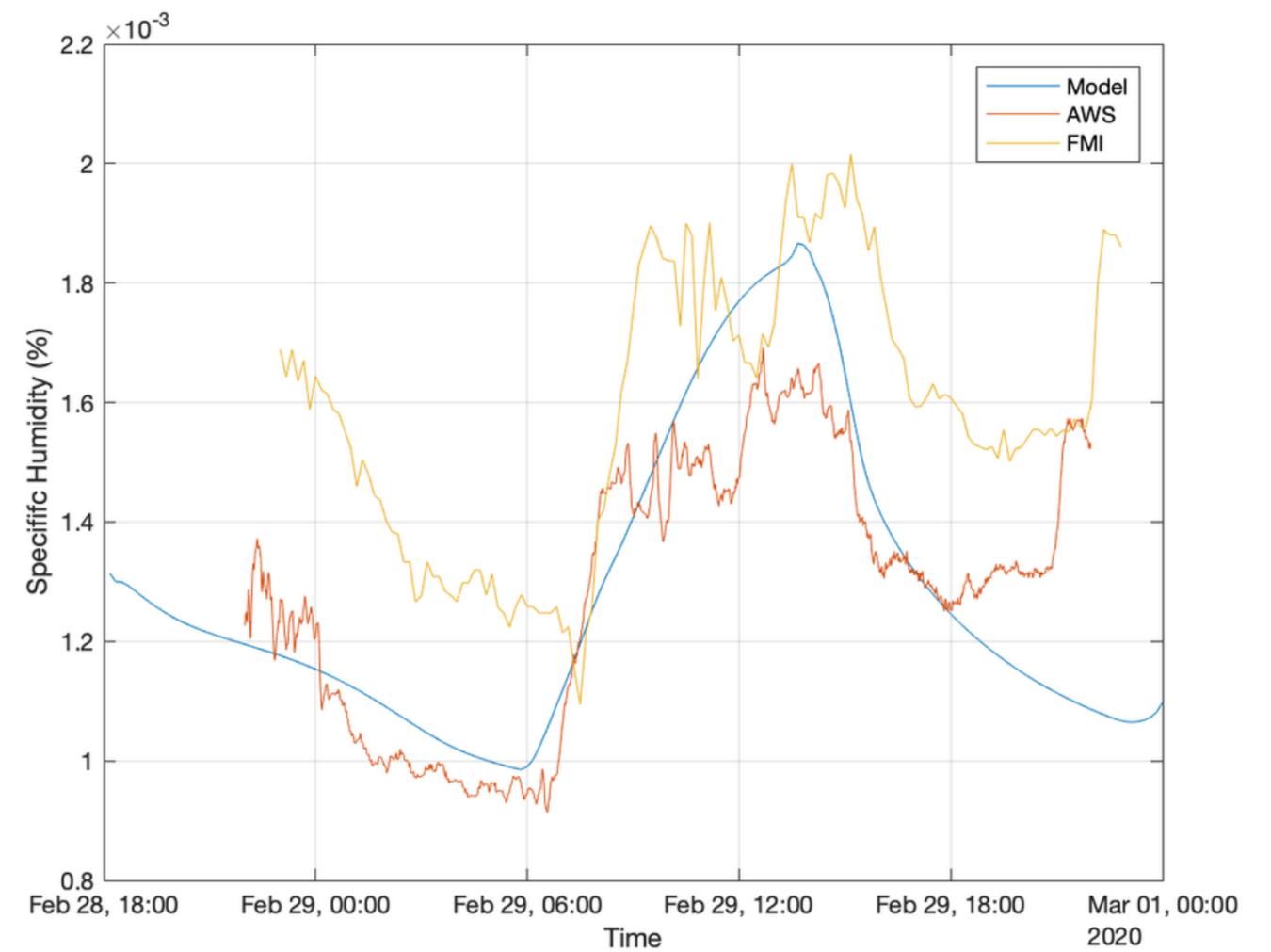
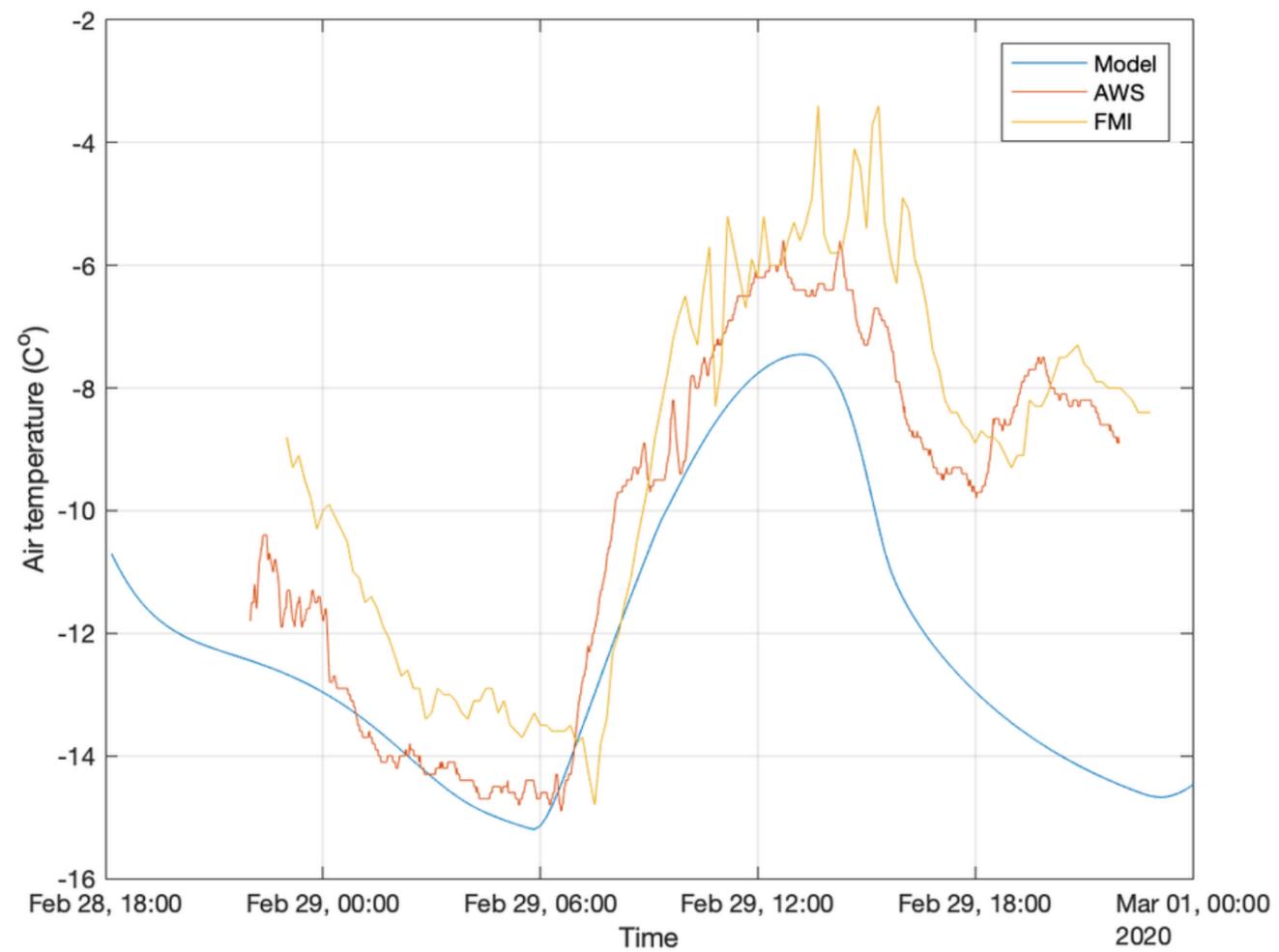
# DATA+MODEL

- COMPARE MEASUREMENTS WITH 1D MODEL RESULTS.
- ANALYZE WHETHER MODELS SIMULATES WELL THE DIURNAL CHANGES OF THE ABL ABOVE SEA ICE.
- VERIFY WHETHER THE ABL RESPONSE TO CHANGES IN SEA ICE SURFACE STRUCTURE (SNOW, ALBEDO) ARE REFLECTED IN MODEL RESULTS.
- IF THERE ARE DIFFERENCES, CHECK WHETHER THEY ARE CAUSED BY INSUFFICIENT PARAMETRIZATIONS OR INPUT CONDITIONS?



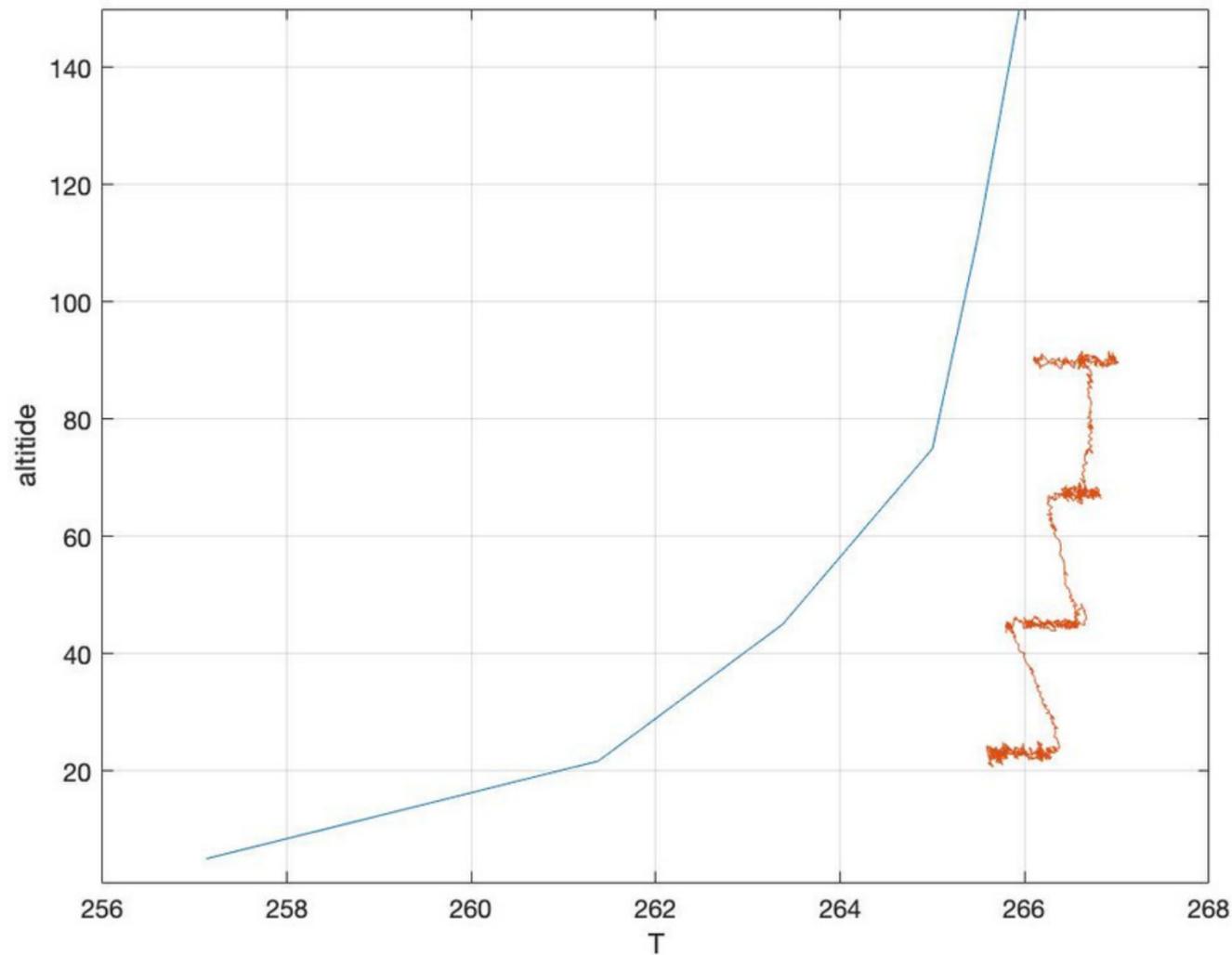


- HIGH RESOLUTION UM ICM MODEL (GRID SPACING OF 4KM) DOES NOT RESOLVE WELL THE TEMPORAL CHANGES OF TEMPERATURE AND SPECIFIC HUMIDITY THROUGHOUT THE TIME OF OUR MEASUREMENTS (AWS STATION)

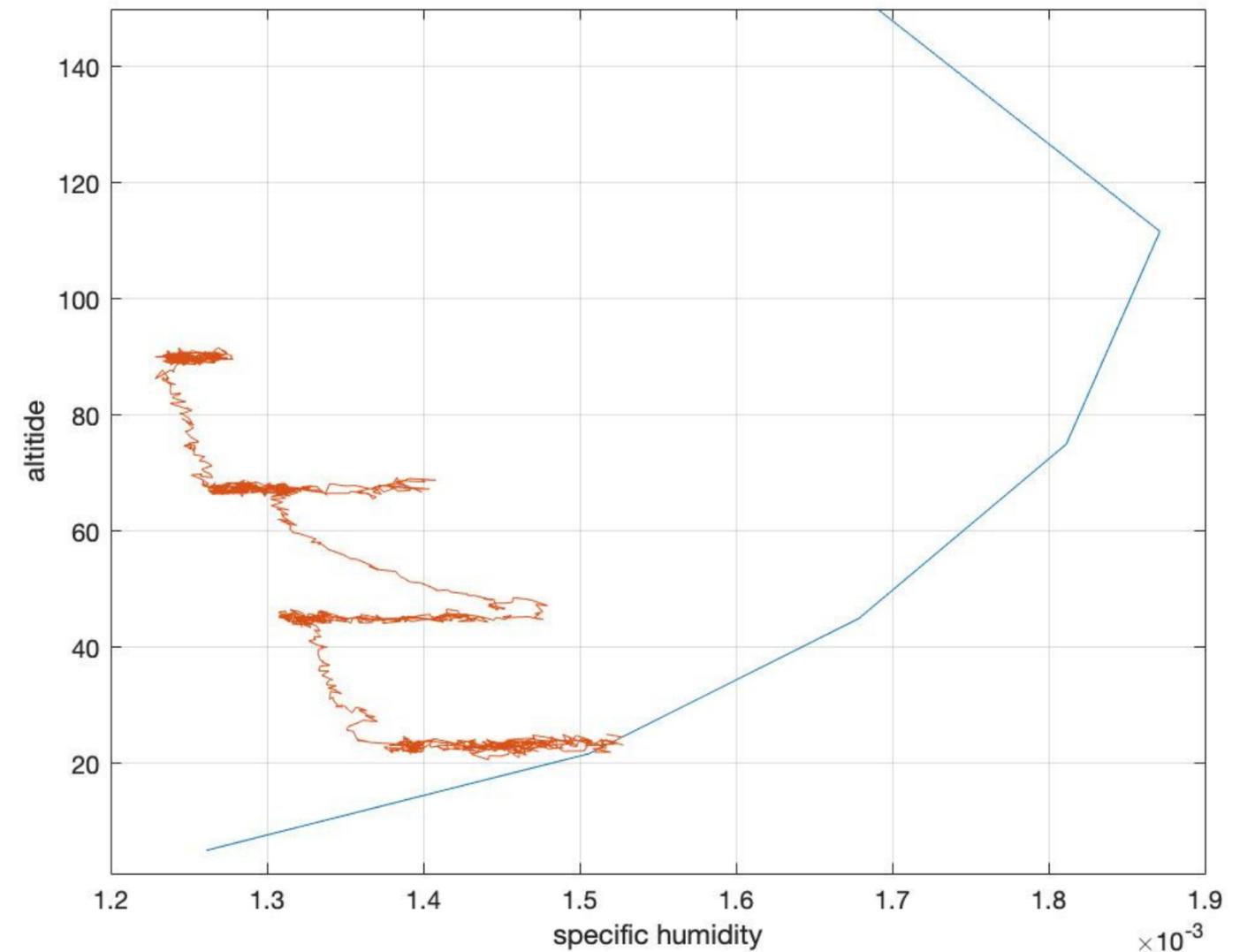


- THE WRF SCM WAS INITIALIZED WITH THE DATA FROM UM ICM MODEL AND ADJUSTED TO THE CONDITIONS IN HAILUOTO (SEA ICE TEMPERATURE, ICE THICKNESS)

Humidity inversion present in model results (blue line), absent in the UAV measurements (red line).



Unnderestimated temperature, with negative bias.



The **HAOS** (Hailuoto Atmospheric Observations over Sea Ice) campaign took place off the westernmost point of the Hailuoto island, Baltic Sea between 27 February and 2 March 2020.

Measurements of temperature, relative humidity and air pressure at different heights have been carried out with fixed wing UAV 1.5 km off the coast.

The detailed structure of the surface below was photographed by a multicopter drone; the images were later used to create orthomosaic maps.

Additionally, throughout the time of the campaign a weather station and Halo Doppler Lidar operated on the pier of Hailuoto Marjaniemi.



HAOS contributes to the studies on UAVs capabilities in the ABL and surface observations over sea ice in areas inaccessible by foot and conditions similar to the ones found in the Arctic.



# FUTURE

- ARTICLE DESCRIBING IN DETAIL THE MEASUREMENTS AND DATASETS CREATED DURING HAOS CAMPAIGN IS CURRENTLY UNDER PREPARATION.
- DATA ANALYSIS AND CONCLUSIONS WILL BE PUBLISHED AND PRESENTED LATER IN 2020.
- NEXT YEAR WE PLAN TO REPEAT THE CAMPAIGN IN THE SAME LOCATION.

**DATASET:** Winter atmospheric boundary layer observations over sea ice in the coastal zone of the Bothnian Bay (Baltic Sea).

Wenta, Marta; Brus, David; Doulgeris, Konstantinos-Matthaios; Vakkari, Ville; Herman, Agnieszka

<https://doi.org/10.1594/PANGAEA.918823>

**ARTICLE:** Wenta, M., Brus, D., Doulgeris, K., Vakkari, V., and Herman, A.: Winter atmospheric boundary layer observations over sea ice in the coastal zone of the Bothnian Bay (Baltic Sea), *Earth Syst. Sci. Data, Discuss.*, <https://doi.org/10.5194/essd-2020-153>, in review, 2020.



**THANK YOU FOR  
YOUR ATTENTION!**