Alfred-Wegener-Institut
für Polar- und Meeresforschung
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SIZONet 2012

Data Acquisition Report

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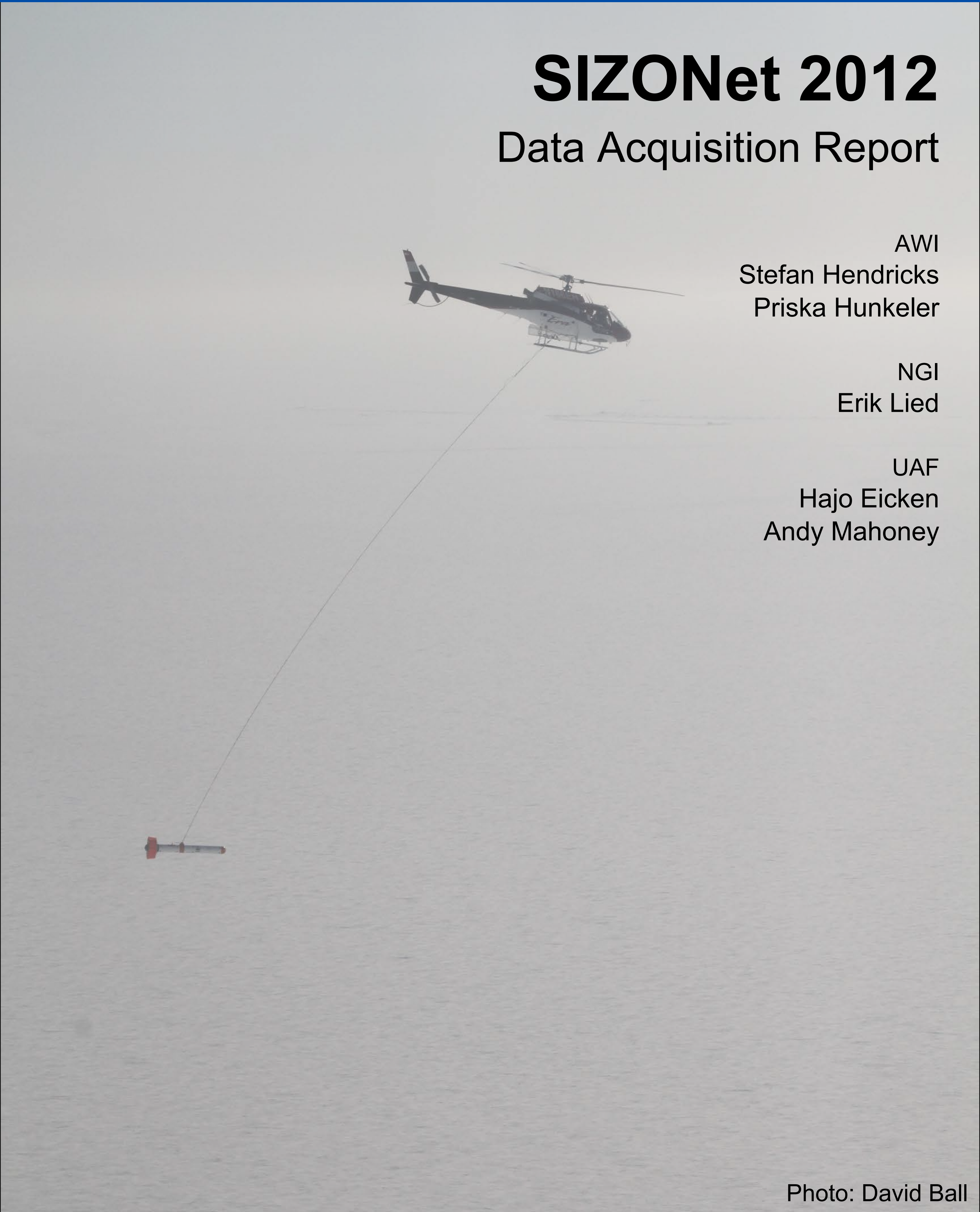

Photo: David Ball

Contents

1 Overview

The SIZONet project (Integrated Seasonal Ice Zone Observing NETwork) investigates the environmental, geo-political and socio-economic impact of the changing sea ice cover near the coast of the arctic ocean in Alaska. As a basic parameter, the knowledge of the thickness of the drifting sea ice as well as the land-fast ice is crucial for the overall ice physics, the role of sea ice as a habitat for marine mammals and commercial operations.

As an international partner, the Alfred Wegener Institute for Polar and Marine Research (AWI) provides extensive measurements of sea ice parameters from airborne platforms. In 2012, the AWI contribution consisted of 4 helicopter sea ice thickness surveys. The surveys were carried out with a new airborne sea ice thickness sensor: MAiSIE, the Multi-sensor Airborne Sea Ice Explorer. The system is designed to increase the accuracy of ice thickness measurements of deformed sea ice with a novel multi-frequency and multi-component EM concept. However, to ensure a fast data release and comparability to thickness data from previous years, data from MAiSIE was processed with standard ice thickness retrieval algorithms. The full exploitation of MAiSIE data with 2D/3D inversion algorithms is under development and will result in an updated ice thickness data release in the future.

The purpose of this document is to give an overview of data acquisition, a summary of processing steps and data delivery format.

1.1 Acknowledgments

SIZONet is a NSF funded project (Award Nr. 0632130). Helicopter operation were carried out by ERA Helicopters

2 Airborne Sea Ice Thickness

2.1 MAiSIE: Multi-Sensor Airborne Sea Ice Explorer

Figure 2.1: MAiSIE: Multi-sensor Airborne Sea Ice Explorer at Roger Wiley Airport in Barrow Alaska. (Photo: Priska Hunkeler)

The SIZONet 2012 field campaign was the premiere of a new type of airborne sea-ice thickness sensors. MAiSIE, the Multi-sensor Airborne Sea Ice Explorer is a joint development of the Alfred Wegener Institute and the Norwegian Geotechnical Institute. Compared to previously used single frequency EM-Bird, MAiSIE aims to resolve changes of sea-ice thickness on smaller scale by utilization of several frequencies and receiver configurations (*Pfaffhuber et al.*, 2012, 2013).
During the campaign, MAiSIE was operated with 4 frequencies (500Hz, 1010Hz, 4090Hz and 7960Hz) and three faint control signals, which shall be used to monitor and post-correct temperature-driven sensor drift. Three ferrite core magnetometers sampled all vector components of the received signal at a rate of 25kHz. A combined GPS/INS unit records instrument attitude and position with differential GPS accuracy. Therefore it is intended to use the installed laser altimeter also for snow freeboard estimation.

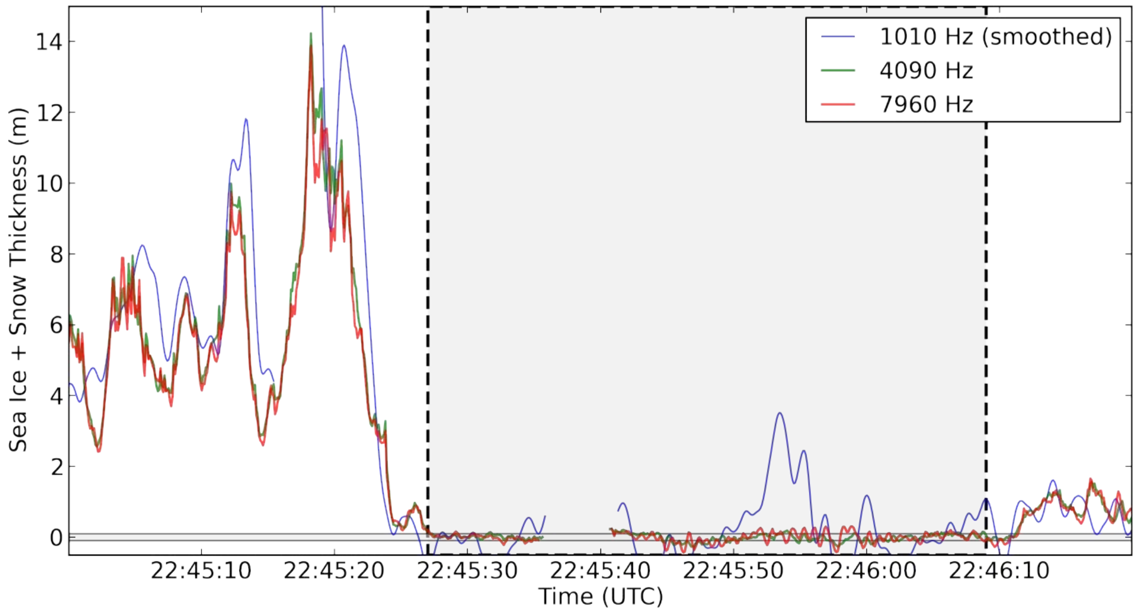

Figure 2.2: First results of MAiSIE data quality of a profile section containing open water

2.2 Data Processing and Availability

Initial evaluation of the data quality shows comparable levels of data quality of the 4kHz signal component in comparison to sensor systems used at previous SIZONet field campaigns. A full calibration of the signal was conducted on the basis of measurements over open sea, which were frequently recorded during the field campaign. An example of resulting sea-ice thickness data over sea ice and a lead in is shown Figure 2.2. The two higher frequencies (4010 & 7960Hz) are very able to reach an accuracy of +/- 10 cm over open water, though a possible correction for instrument pitch and roll has not been applied at this stage. The two high frequencies also show subtle differences over thicker deformed ice, which might be used for more accurate interpretation of deformed ice thicknesses from airborne EM. The signal of the 1010Hz signal has a high sensitivity to environmental EM noise and had to smoothed by a box filter. The 510Hz has been omitted completely due to noise problems.

The processing of the data using its full possibilities, e.g. a 1D or 2D inversion utilizing all frequencies and receiver components, is a current research project that will last a few years. In order to provide a rapid release of sea ice thickness data, a quicklook data product has been created from the MAiSIE 4Khz signal. The characteristics of the frequency, transmitter-receiver orientations and processing are identical to data releases of previous field campaigns. The dataset has been released and was already used in *Lindsay et al.* (2012).

Update September 2013:
A reprocessing of the SIZONet 2012 dataset using an updated 1D algorithms with advanced drift correction, signal noise reduction and Bird attitude correction is scheduled for 1Q of 2014

3 Deliverables

3.1 List of HEM Profiles

Airborne Survey 1 (2012/04/07)

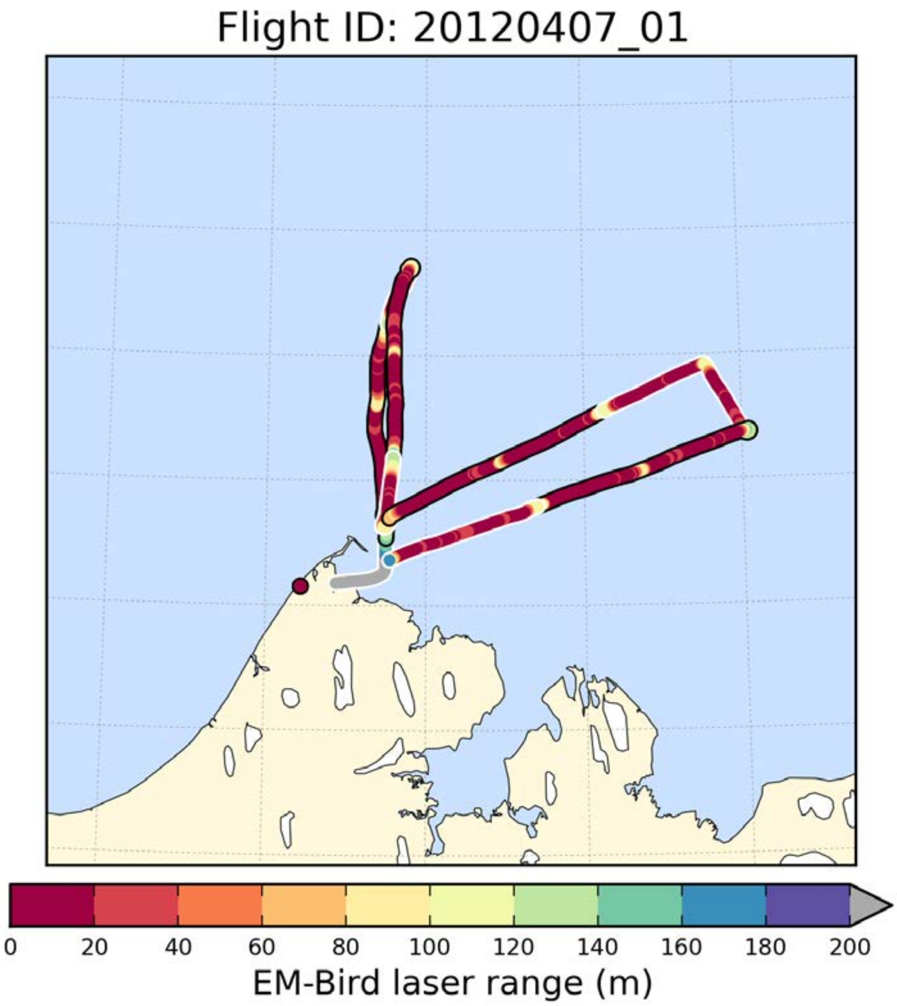

Figure 3.1: Flight track (2012/04/07) with color-coded EM-Bird altitude (sea-ice data acquisition below 20 m)

The first airborne sea ice thickness survey was planned to go as far north from point Barrow as possible. The northern track had to be aborted due to unfavorable weather conditions and the remaining flight time was used for an survey to the east of Point Barrow.

Notes

- The GPS/INS system of MAiSIE failed to capture data throughout the entire flight. The data was synchronized with a GPS track recorded by a handheld device in the helicopter cabin (A. Mahoney).
- File ID: HEM_SIZ12_20120407T214258_20120407T234956

Airborne Survey 2 (2012/04/09) Flight #1

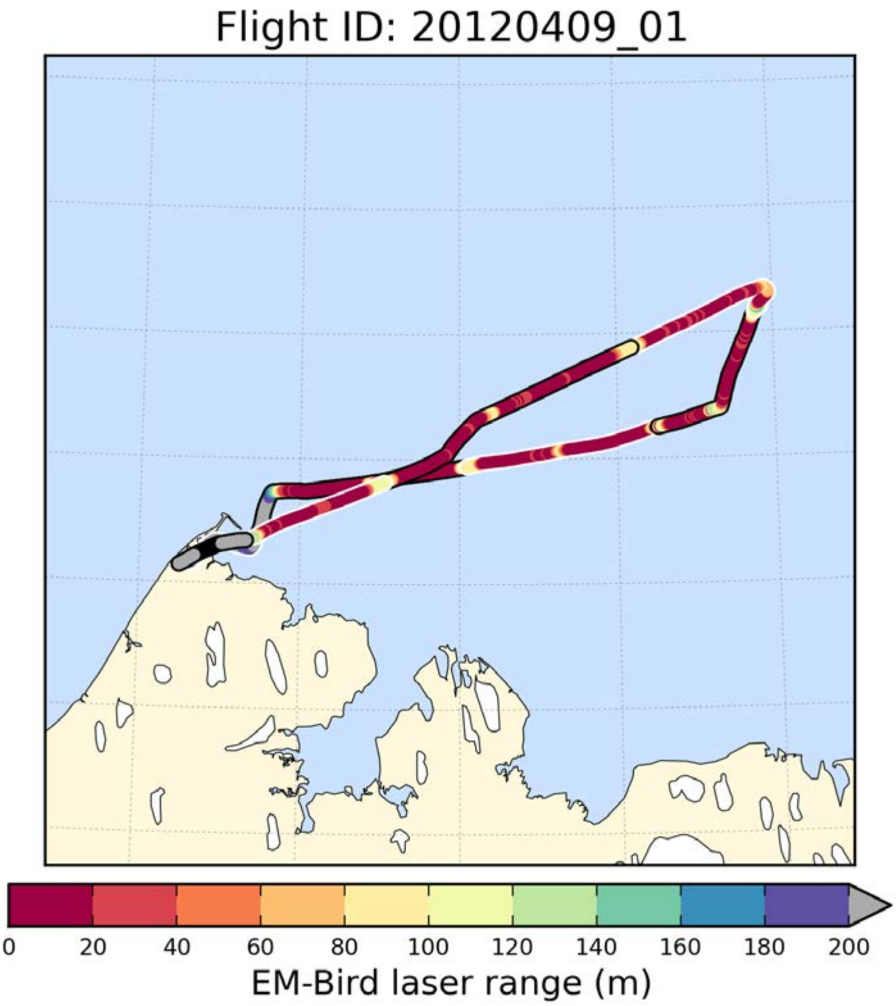

Figure 3.2: Flight track (2012/04/09 Flight #1) with color-coded EM-Bird altitude (sea-ice data acquisition below 20 m)

Good weather conditions lead to two helicopter surveys on April 9, 2012. The first flight was conducted in coincidence with a Twin Otter to a sea ice region north-east of Point Barrow. The Twin Otter was operated by the US Naval Research Laboratory (NRL) and equipped with a scanning laser and a radar altimeter system.

Notes

- File ID: HEM_SIZ12_20120409T181644_20120409T194212

Airborne Survey 3 (2012/04/09) Flight #2

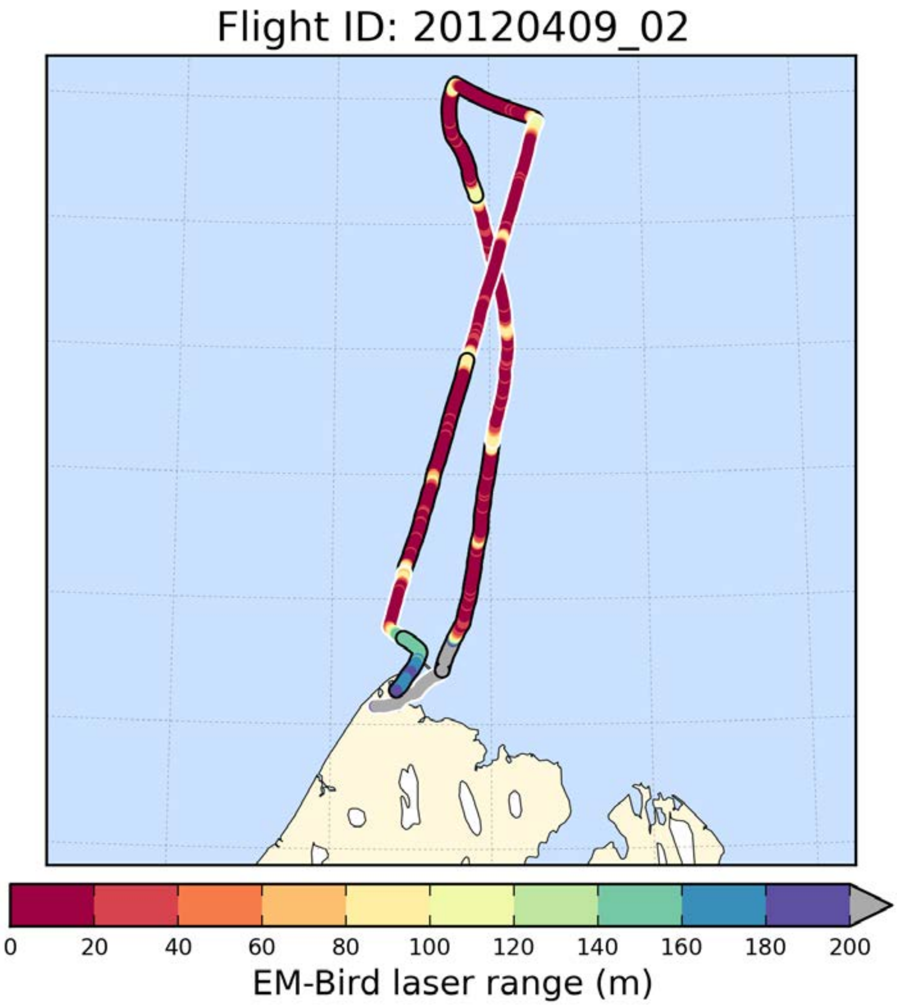

Figure 3.3: Flight track (2012/04/09 Flight #2) with color-coded EM-Bird altitude (sea-ice data acquisition below 20 m)

The second flight on April 9, 2012 targeted again the region north of Point Barrow and flight planning was synchronized to a GeoSAR overflight of an airplane by Fuggro. In the end there was, however, a significant deviation from the planned flight track.

Notes

- File ID: HEM_SIZ12_20120409T220307_20120409T233050

Airborne Survey 3 (2012/04/12)

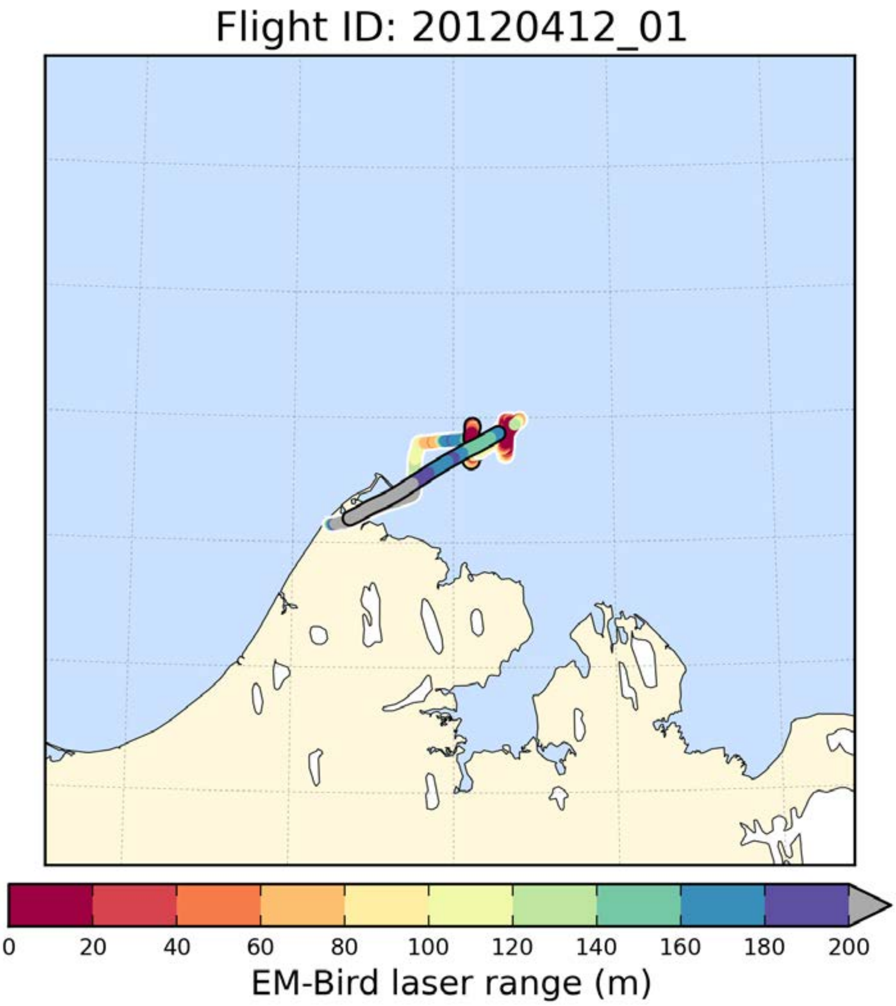

Figure 3.4: Flight track (2012/04/12) with color-coded EM-Bird altitude (sea-ice data acquisition below 20 m)

The last flight of the SIZONet 2012 field campaign solely focused on grounded pressure ridges in the fast ice. Two features were visually identified and surveyed in multiple overflights.

Notes

- Due to the nature of a pure process study of sampling the thickness of two pressure ridges in shallow waters, this data has not been released as part of the quick-look dataset.

3.2 File Naming Conventions

The filename contains a shortcut for the campaign and the start and stop time of the data file. The id for the SIZONet 2012 field campaign is given by `SIZ12`.

`HEM_CMPID_SSSSSSSSSSSSSSS_PPPPPPPPPPPPPPP.dat`

Token	*Description*
`CMPID`	Contains campaign name (3 letters + 2 digits of year)
`SSSSSSSSSSSSSSS` `PPPPPPPPPPPPPPP`	`YYYYMMDDTHHMMSS` : Start and Stop time

Table 3.1: File naming convention of EM data files

3.3 Data Format

The EM data is delivered in blank separated ASCII data format described in table 3.2. All time tags are standard UTC time.

Column	*Description*	*Format*	*Unit*
1	Year	I4	–
2	Month	I2	–
3	Day	I2	–
4	Time	F8.2	Seconds of the day
5	Fiducial Number	I9	–
6	Latitude	F12.7	degree
7	Longitude	F12.7	degree
8	Distance	F12.3	m
9	Thickness	F8.3	m
10	Laser Range	F8.3	m

Table 3.2: File format for EM data delivery

One flight is separated into several profiles with a calibration at the beginning and the end. The distance flown is calculated for this individual profiles and therefore not cumulative for the entire flight. The fiducial number can be discontinuous if a reboot of the system was necessary during the flight.

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Bibliography

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