# Relation between sea-ice freeboard and draft and its seasonal evolution in the Central Arctic

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Bundesministerium
für Bildung
und Forschung

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Objective 1: Relation between freeboard and draft

Objective 2: Calculate draft from only freeboard measurements
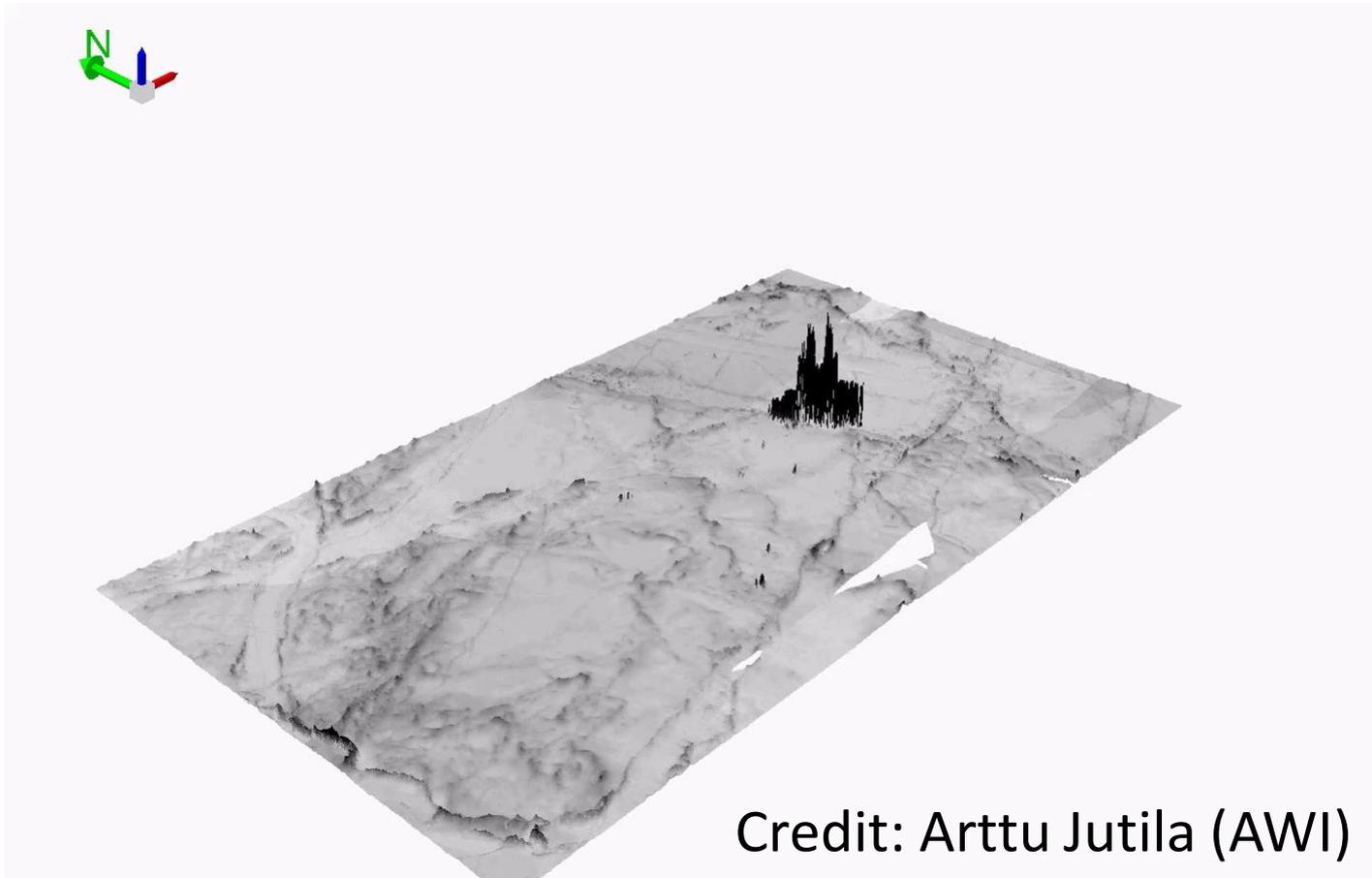
Credit: Arttu Jutila (AWI)

# Cool data … but why?

**Geoscience**
- Melting and freezing processes of different ice types
- Estimating the ice thickness distribution for large-scale modelling

**Atmospheric & ocean science**
- Determining roughness to derive wind and water drag coefficients

**Industry**
- Risk evaluation of offshore structures
- Model dynamics and confinement of oil spills

**Navigation**
- Assessing the mechanical force that ships need to overcome
- Sound scattering of acoustic positioning systems

- Sea-ice draft from an acoustic multibeam sonar

Philipp Anhaus, Christian Katlein, Marcel Nicolaus



560 m
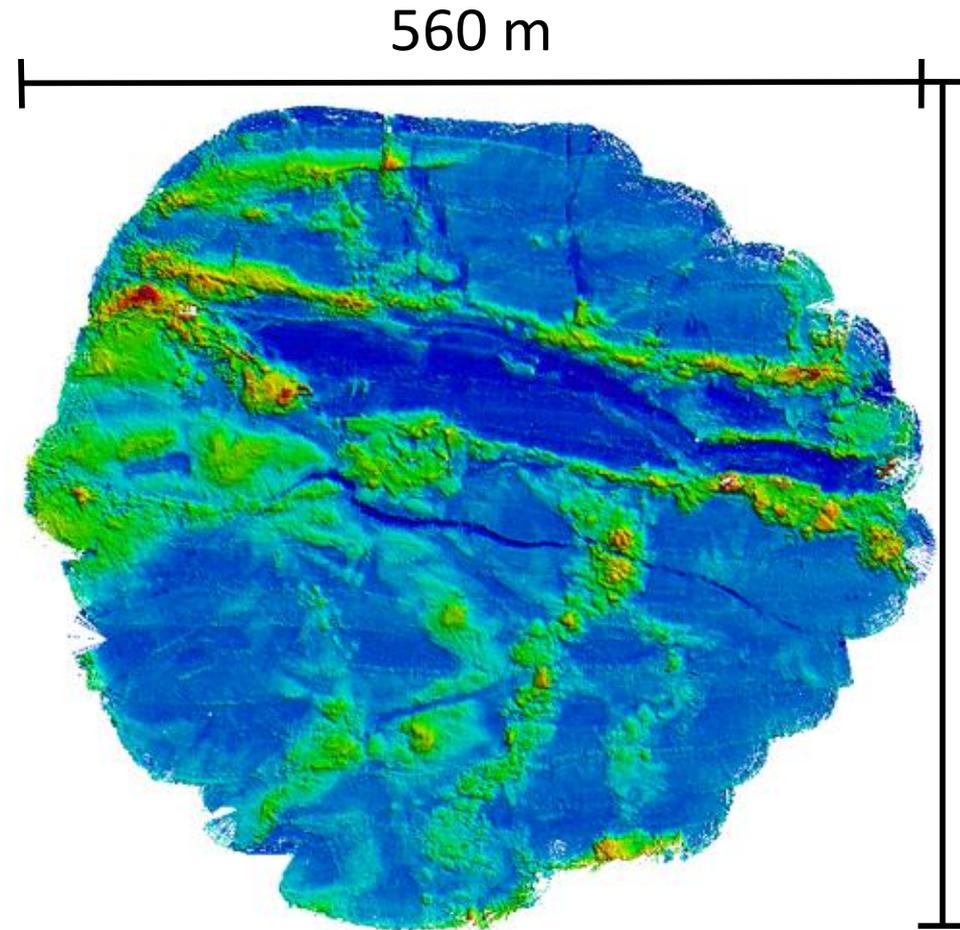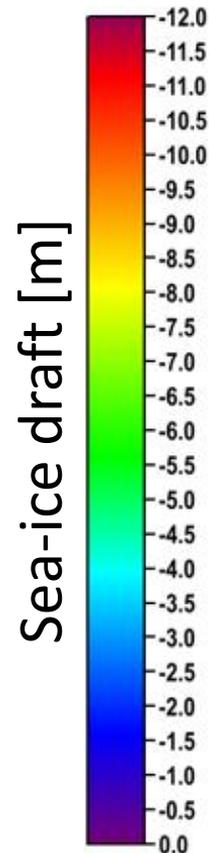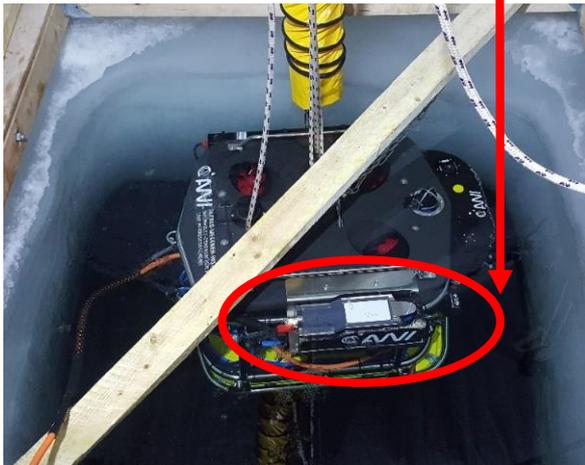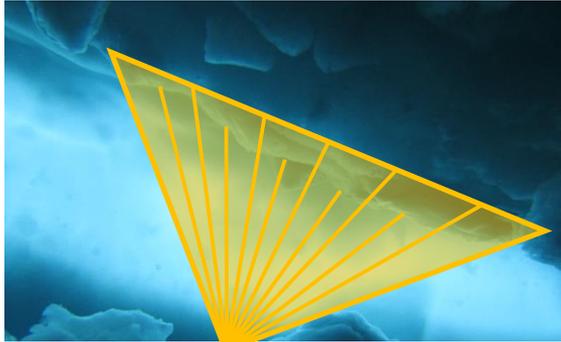
- Freeboard estimates from an airborne laser scanner

  Nils Hutter, Arttu Jutila, Stefan Hendricks, Christian Haas
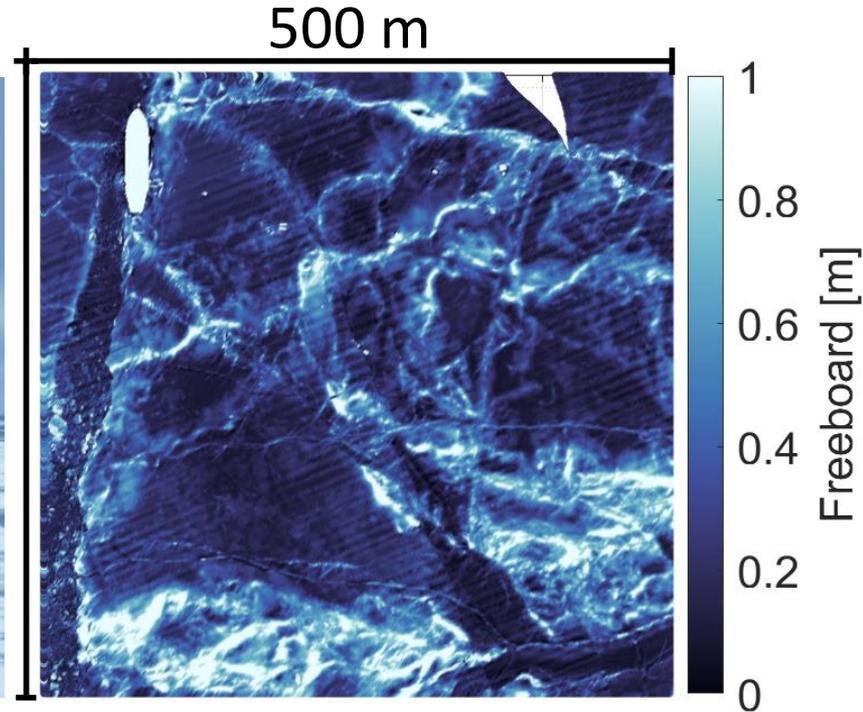
# Merging to 3D

## Multibeam sonar
## 07 Jan 2020
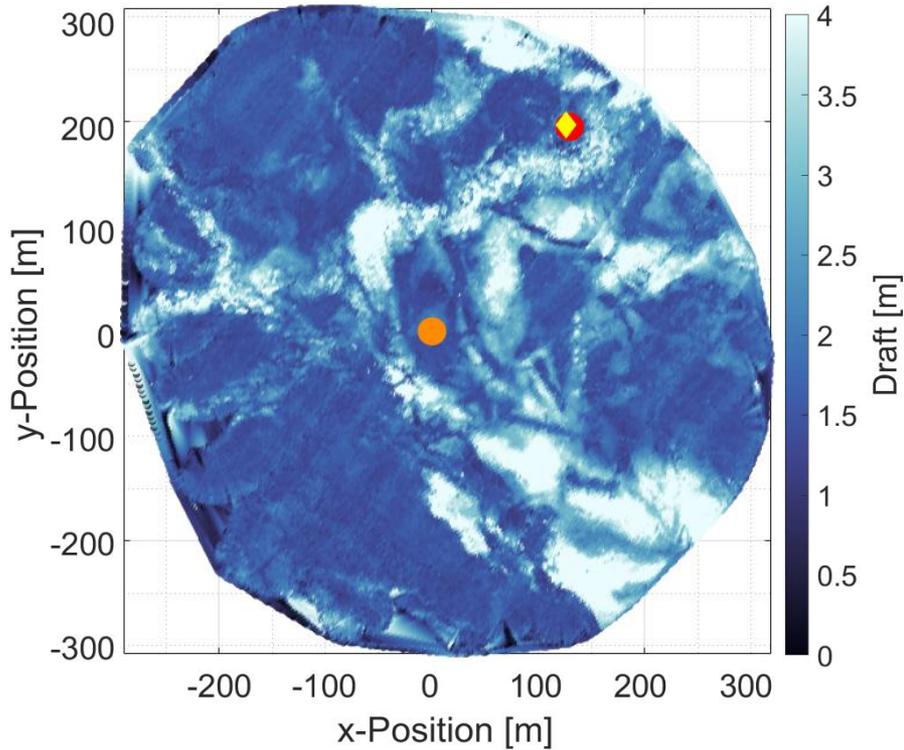


## Airborne laser scanner
## 07 Jan 2020
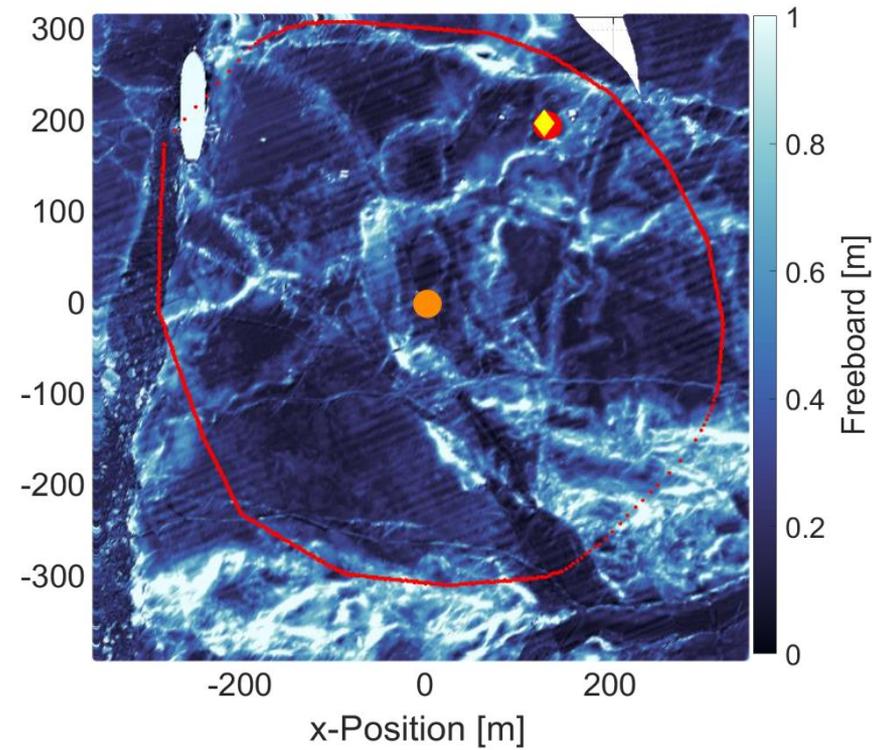


• Turbulence cluster, ROV coord.  • ROV hole
♦ Turbulence cluster, ALS coord.

R = sea-ice draft / freeboard

Winter

Summer



Winter plot legend: 07 Jan 2020, 28 Jan 2020

Mode 6.65
Mean 6.24

Mode 4.75
Mean 5.71

Summer plot legend: 21/22 Jul 2020

Mode 4.50
Mean 7.11
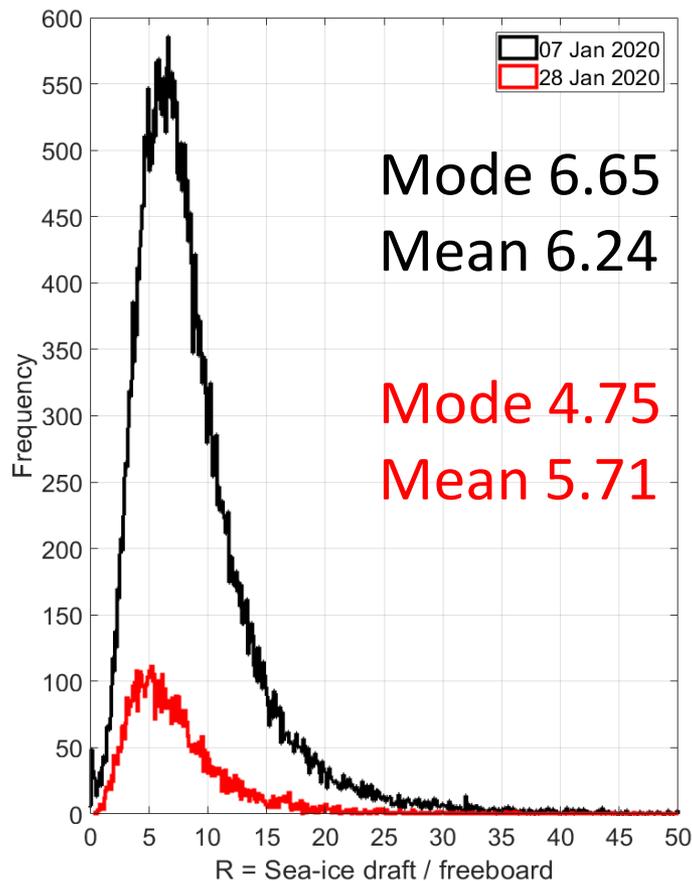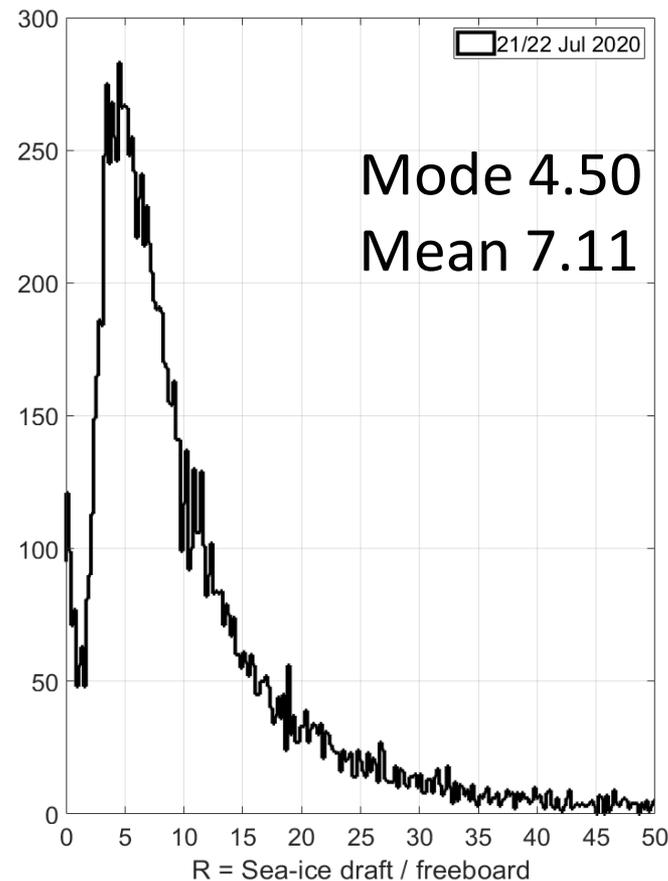
- Comiso et al. (1991) & Wadhams et al. (1992): Mean 7.89

Draft_derived = R_mean * freeboard_measured

| 07 Jan | 28 Jan | 21 Jul | Draft_measured |
|--------|--------|--------|----------------|
| 28 Jan | 07 Jan | 07 Jan | R_mean |
| 0.19 | 0.54 | 0.20 | Correlation R |

## Seasonal evolution

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | - | 4 | 1 | 4 | 4 | 6 | 4 | 2 | 2 | 5 | 2 | 6 | #36 ROV multibeam |
| | 2 | 3 | 3 | 8 | 4 | 2 | 2 | 1 | 2 | 4 | - | 4 | #35 Heli airborne laser scanner |

Leg 1 — 2019/2020 — Leg 2 — Leg 3 — Gap — Leg 4 — Gap — Leg 5
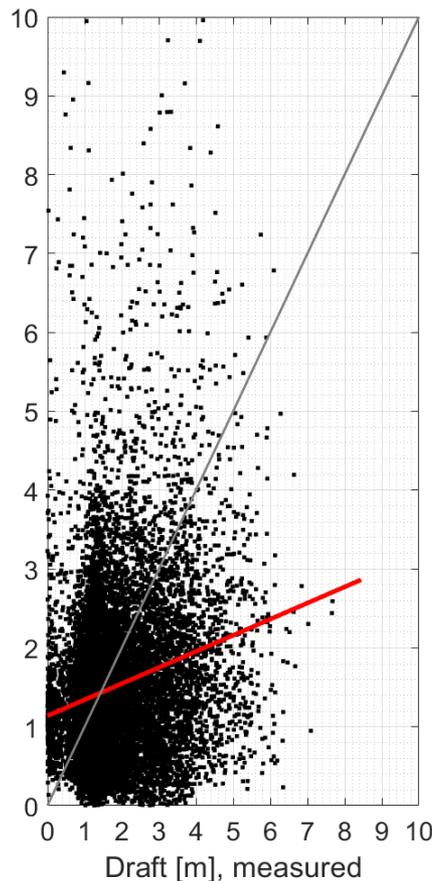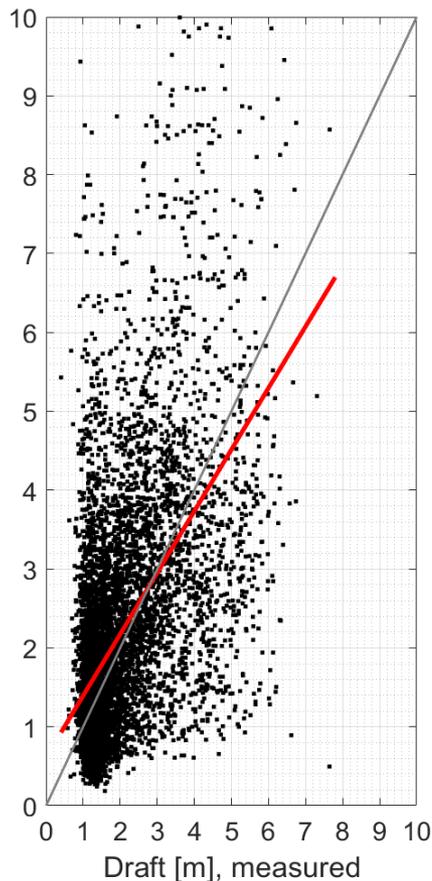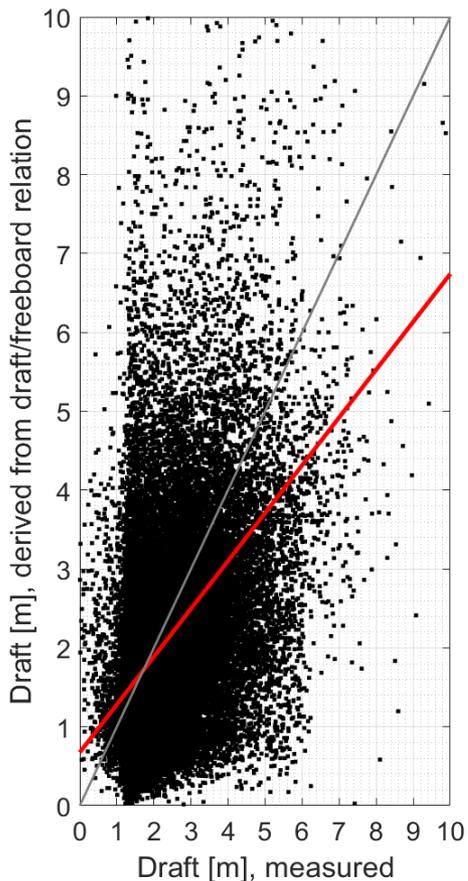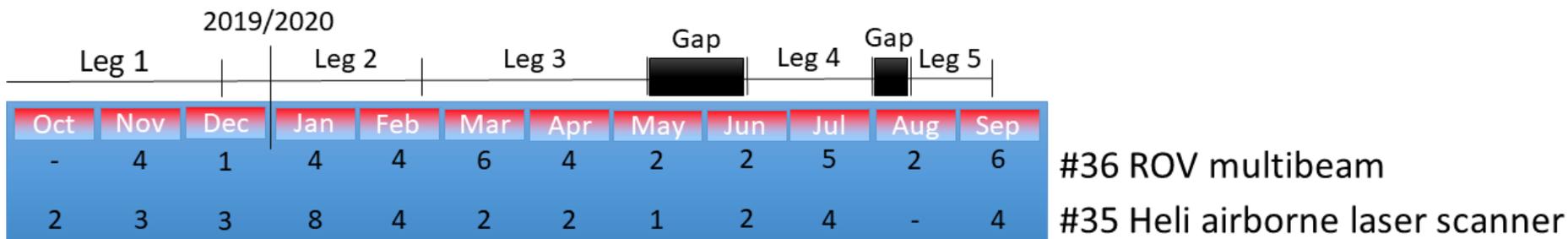
## 3D topography model     youtube.com/watch?v=KJf5XOkB5m0
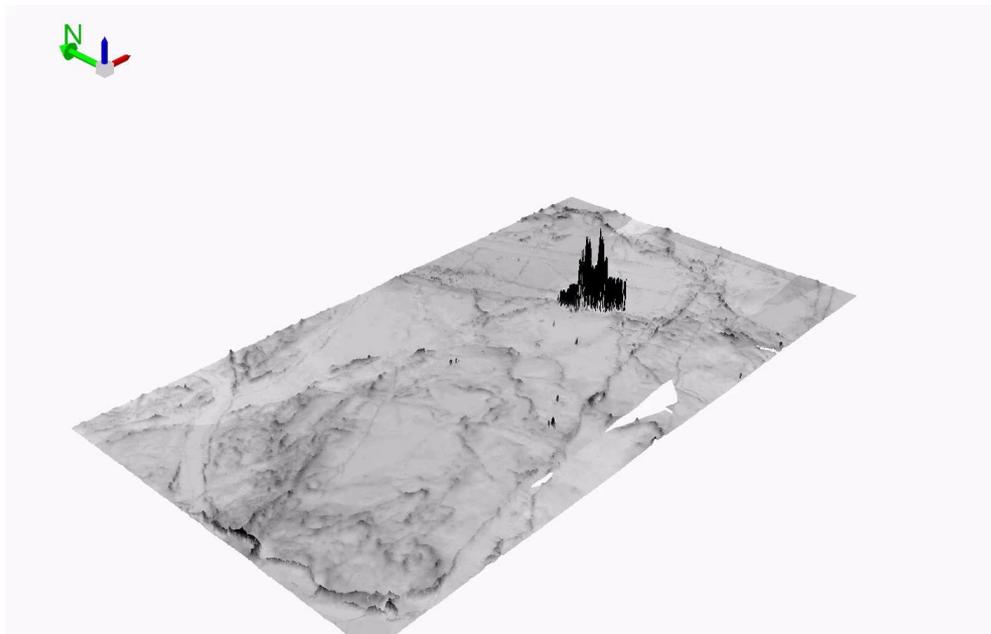
2023
**IGS SYMPOSIUM ON SEA ICE**
ACROSS SPATIAL AND TEMPORAL SCALES
BREMERHAVEN | GERMANY

**Abstract submission by TODAY !!!**

Early bird registration by 28 March 2023

- Processed datasets of sea-ice draft and freeboard (version 1)
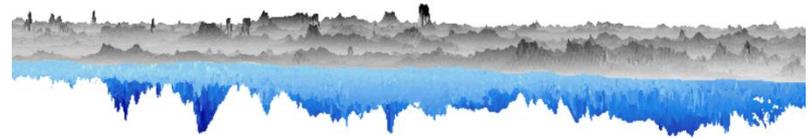


- Merging to 3D for a few selected dates was successful

- Relations R = draft / freeboard are meaningful



- Calculating draft from only freeboard needs more work/other approaches

- Work on the role of density and assumptions made
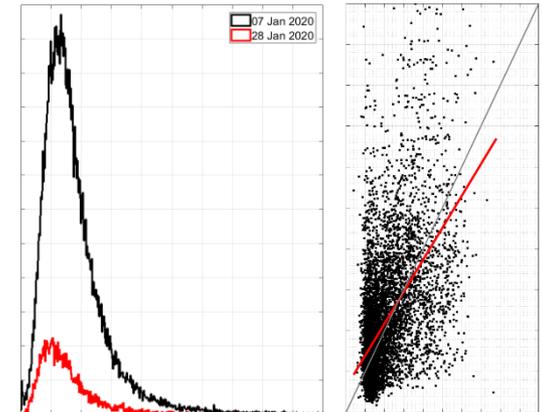
Please, contact me: philipp.anhaus@awi.de