Late Winter Observations of Sea Ice Pressure Ridge Sail Heights

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Introduction

- Sea ice pressure ridges play an important role in ice drift and influence the mass and energy budgets of the Arctic Ocean.

- An improved understanding of the regional distributions of ridge sail height, and their variability, is important to better quantify total sea ice mass, and can be used towards new model parameterizations of pressure ridges on sea ice, thereby supporting advances in sea ice forecasting.

- Here we present results describing sea ice pressure ridge sail height across the Arctic Ocean, **at the end of winter**.

- Sail heights are derived from high-resolution **Digital Mapping System (DMS)** imagery gathered during **NASA's Operation IceBridge (OIB)** missions between **2010-2018** following methodology presented in Duncan et al., 2018.

Methodology

$$H_S = L \times \tan \alpha$$

H_S = Sail height
L = Length of shadow
α = Solar elevation angle

n = 26165
H_S mean = 1.38 m
H_S mode = 0.6 m
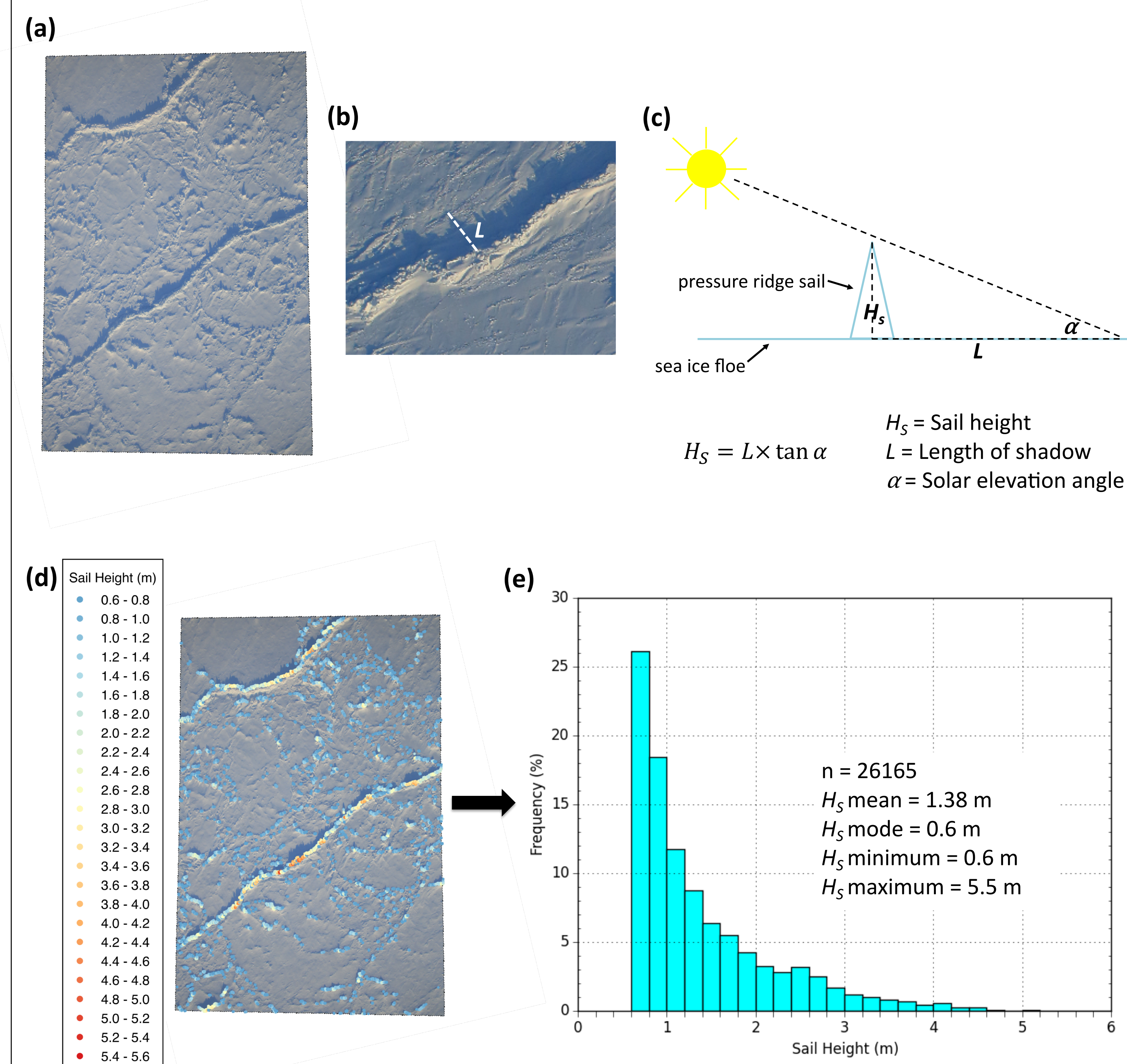H_S minimum = 0.6 m
H_S maximum = 5.5 m

Figure 1. Method to derive sea ice pressure ridge sail height from DMS data. (a) DMS image of Arctic sea ice floe with linear pressure ridge features. (b) Closeup of a pressure ridge showing cast shadows. White dashed line (L) shows the length of a shadow used in a single sail height calculation. (c) Depiction of geometry used for Sail Height (H_S) derivation. (d) Same DMS image as in (a) but overlain with derived H_S. (e) H_S Distribution and statistics for data shown in (d). Modified from Duncan et al., 2018.

Arctic Ocean Pressure Ridge Sail Height, March-April, 2010-2018
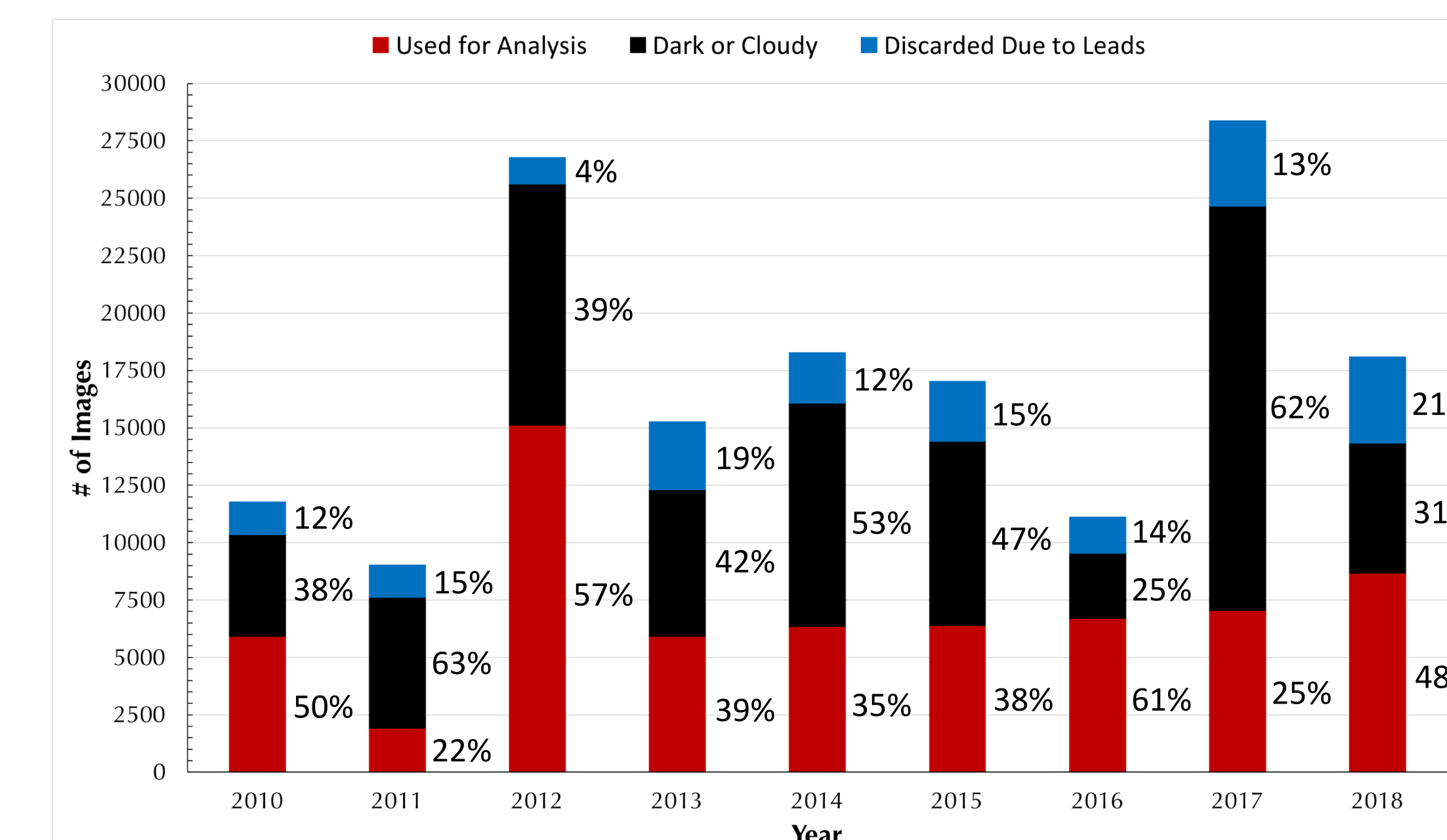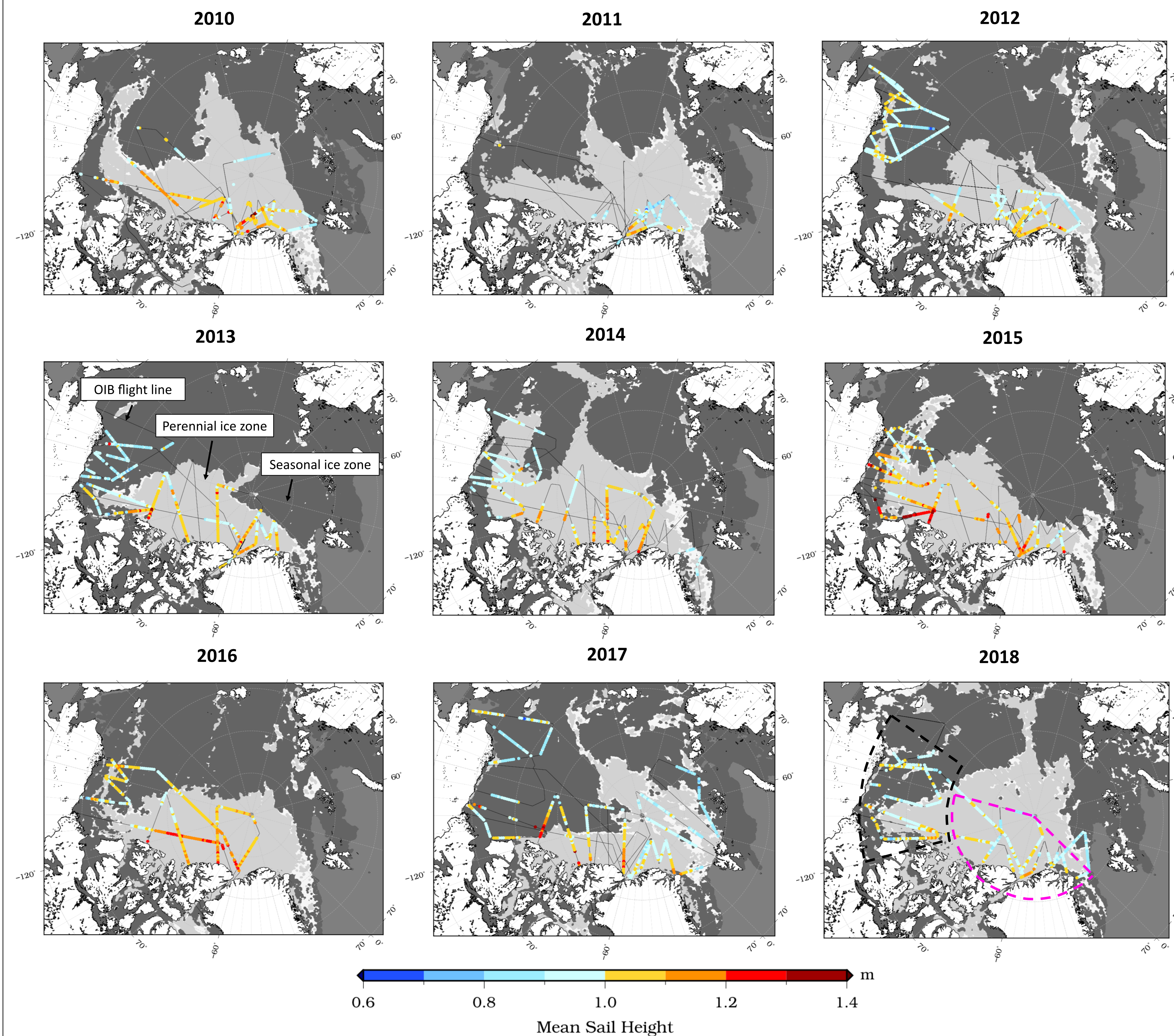

Figure 2. Number of DMS images per year that were used for analysis (red), dark and/or cloudy (black), and discarded due to leads being present (blue).

Results

- Over **64,000 DMS images** from 74 OIB flights used in analysis, producing over **33 million individual H_S measurements**.

- We find distinct H_S characteristics depending on the ice type in which the pressure ridge formed.

- The mean of H_S on seasonal ice is 0.06 m lower than those formed on perennial ice and the 99th percentile of H_S on seasonal ice is 0.36 m lower on average than those on perennial ice.

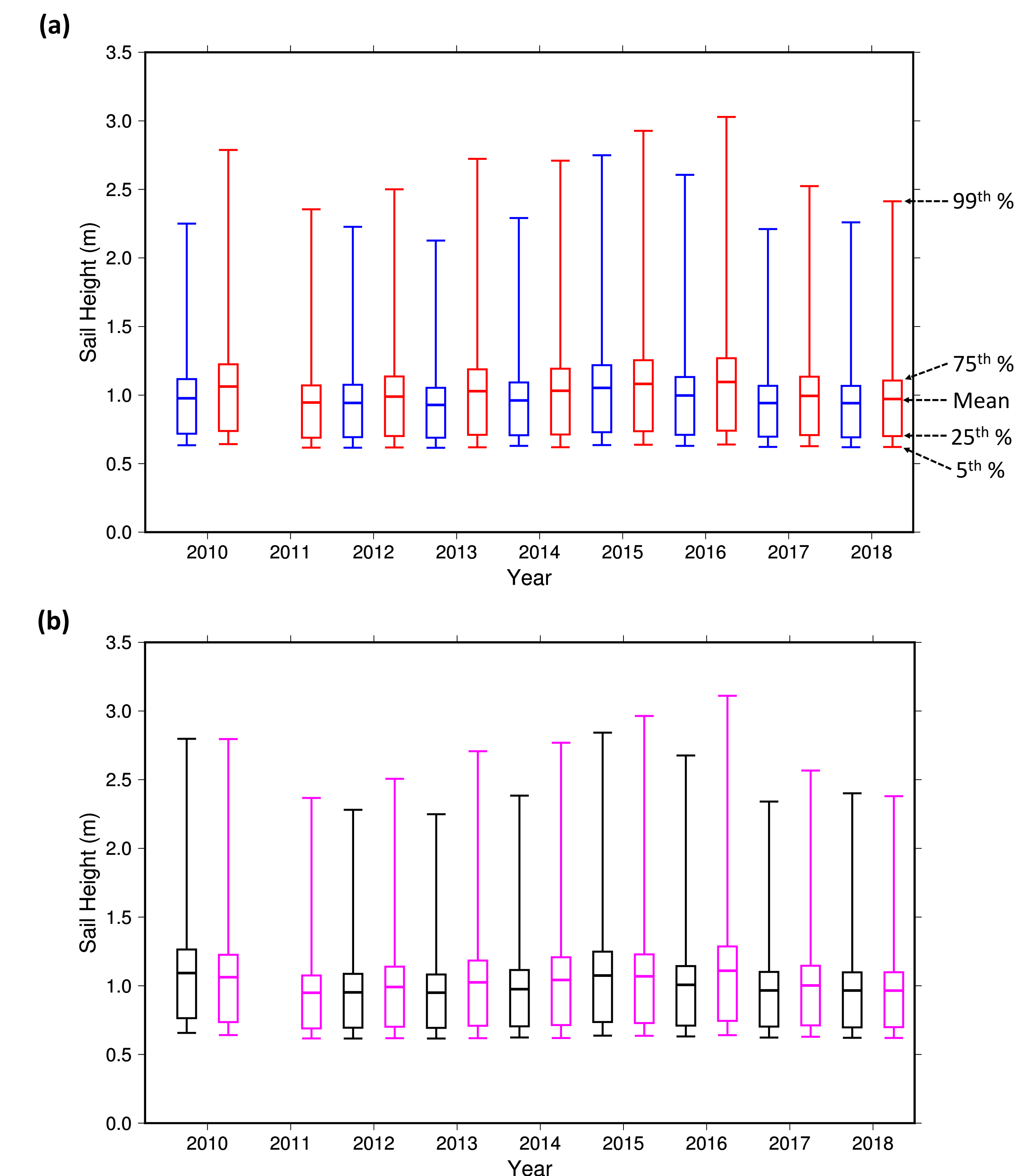## Variability in Pressure Ridge Sail Height

Figure 3. (a) H_S by parent ice type. H_S for new ridges formed in seasonal ice (blue) and for new ridges formed in perennial ice (red). (b) Pressure ridge sail heights by region. H_S obtained in the Beaufort region (black dashed line in 2018 sail height map) (black) and H_S obtained in the Central Arctic region (magenta dashed line in 2018 sail height map) (magenta).

Data Access

The NOAA Laboratory for Satellite Altimetry (LSA) releases fully quality assessed and quality controlled sea ice data products to the community. Data shown here can be accessed through the LSA public FTP site at:
ftp://ftp.star.nesdis.noaa.gov/pub/socd/lsa/SeaIceProducts/IceBridge/PressureRidgeSailHeight/

Please acknowledge NOAA / NESDIS Center for Satellite Applications and Research (STAR) and cite the following with any use of this data:

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References
Duncan, K., Farrell, S., Connor, L., Richter-Menge, J., Hutchings, J., & Dominguez, R. (2018). High-resolution airborne observations of sea-ice pressure ridge sail height. *Annals of Glaciology, 59*(76pt2), 137-147. doi:10.1017/aog.2018.2