

# Product description of the snow depth on Arctic sea ice dataset version v1.1.

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## 1 Introduction

In this document, the snow depth on Arctic sea ice dataset version 1.1 is described. To ensure a correct usage of the data, we recommend to carefully read the product description. More information about the retrieval can be found in Rostosky et al. (2018). The snow depth is derived from passive microwave satellite observation from the AMSRE/2 sensors for the period from 2002 to now. The data are available on a daily basis gridded to a polar stereographic grid with 25 km x 25 km resolution. Over first-year ice the retrieval is valid for the winter season from November to April/May. Over multiyear ice, the retrieval is valid from March to April/May.

The files contain the following data:

- snow depth [cm]
- snow depth uncertainty [cm]

## 2 Basic Algorithm

The algorithm is based on a linear relation between the gradient ratio of brightness temperatures at 18.7 GHz and 6.9 GHz ( $GR(19/7)$ , equation 1) and the snow depth  $Sd$  [cm] (equation 2). The retrieval coefficients  $a$  and  $b$  are derived from a comparison of satellite observations with airborne snow depth measurements obtained during the Operation IceBridge campaign (Newmann et al., 2014). More details are described in Rostosky et al. (2018).

$$GR(Tb_{\nu 1}, Tb_{\nu 2}) = \frac{Tb_{\nu 1} - Tb_{\nu 2}}{Tb_{\nu 1} + Tb_{\nu 2}} \quad (1)$$

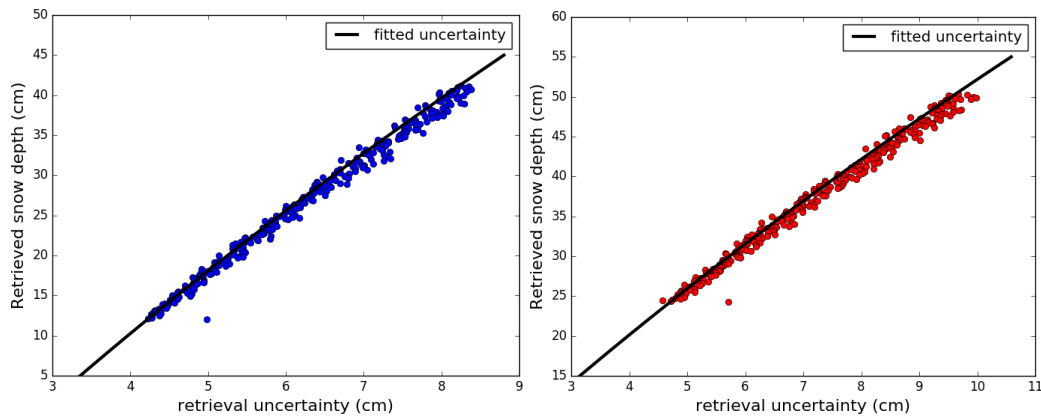
$$Sd = a + b * GR_{\nu 1, \nu 2} \quad (2)$$

The coefficients of the retrieval are  $a = 19.2$  and  $b = -553$  over first-year ice and  $a = 19.3$  and  $b = -368$  over multiyear ice.

### 3 Uncertainty Estimation

The uncertainty of the retrieved snow depth calculated based on a Monte-Carlo uncertainty estimation as described in Rostosky, Spreen, Gerland, Huntemann, and Mech (2020).

Figure 1 shows the resulting retrieval uncertainty versus the retrieved snow depth for FYI (left) and MYI (right). The uncertainty increases with increasing snow depth and is slightly higher over MYI than over FYI.



**Figure 1.** Uncertainty of the retrieved snow depth for first-year ice (left) and multiyear ice (right). The black line gives the fitted uncertainty curve.

### 4 Open issues

This is version V1.1 of the snow depth retrieval and further improvements are planned.

Open issues:

- High surface temperatures can cause melting in the snow. This has a huge impact on the retrieved snow depth. The files of possible melt-contaminated days contain a '\_FLAG' in their name.
- over thin ice, the signal of the ocean can influence GR(19/7) leading to wrongly retrieved, negative snow depths. Files containing more than 100 grid cells with negative snow depth contain a '\_FLAG' in their name.

- It was found that sea ice roughness has an impact on the observed gradient ratio. So far, the influence of sea ice roughness on the retrieved snow depth is not considered in the uncertainty estimation.

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