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# AMSR-2 Daily Snow Depth Data Product Using a Neural Network Algorithm Trained by Collocated ICESat-2 Measurements

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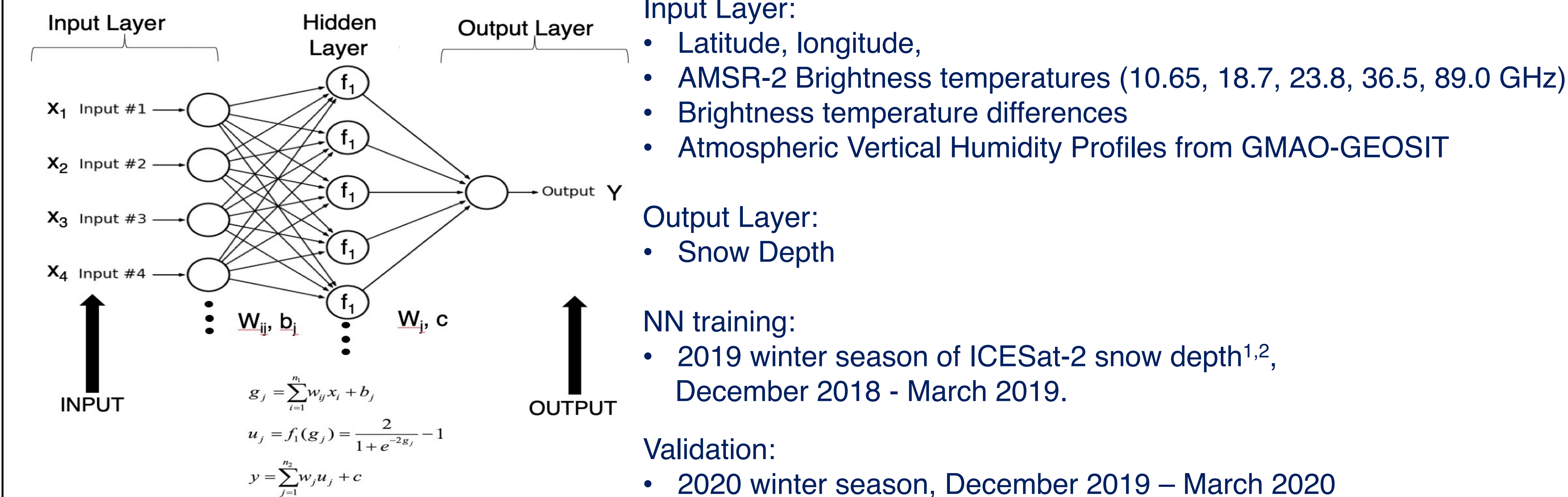
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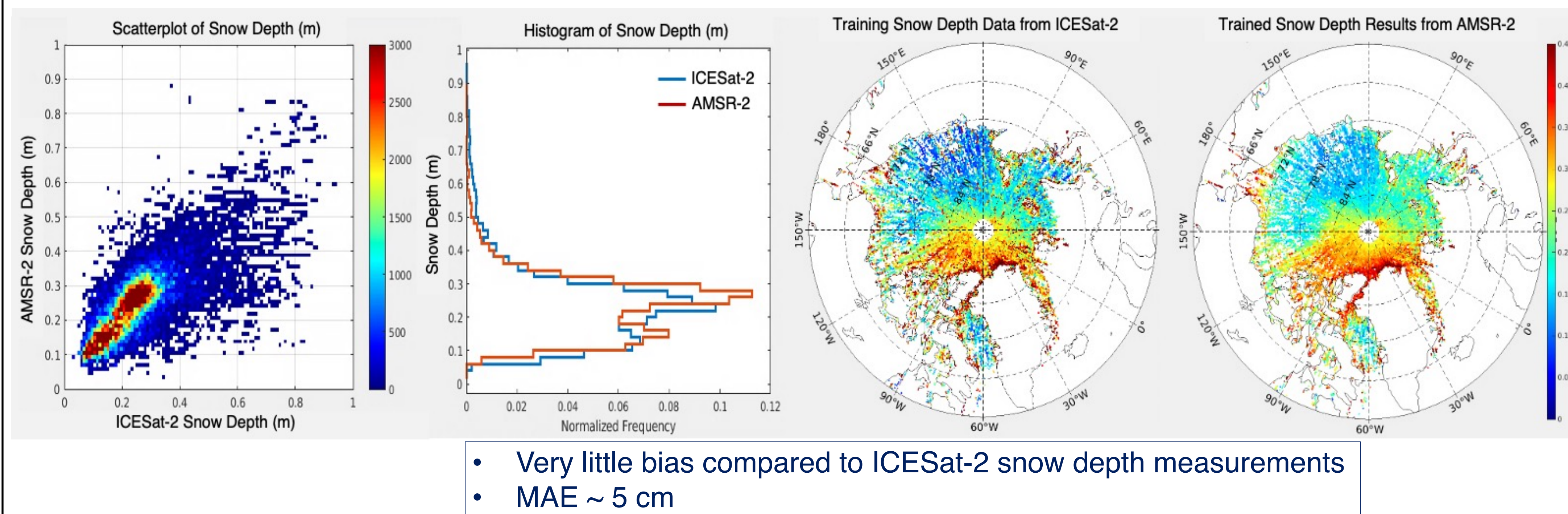
## Introduction

By using diffusion theory and Monte Carlo lidar radiative transfer simulations, Hu<sup>1</sup> et al. (2022b) has derived snow depth from the first-, second- and third-order moments of the lidar backscattering pathlength distribution. Lu<sup>2</sup> et al. (2022,2024) calculated the snow depth by applying the methods to the satellite ICESat-2 lidar measurements over the Arctic sea ice, as well as land surfaces of Northern Hemisphere. In this paper, a neural network (NN) algorithm, employing several channels from AMSR-2 and the humidity vertical profiles GMAO GEOS-IT, is trained to determine snow depth identified by time and geolocation matched 2019 ICESat-2 snow-depth data during winter months over the Arctic sea ice. The trained NN snow-depth was applied to 2014-2020 AMSR-2 clear pixel data, although the algorithms perform reasonably well in thinner clouds. This paper used AMSR-2 data, a passive microwave instrument to generate a wide range of snow depth data, covering extensive spatial areas in the cross-orbit direction

## Method

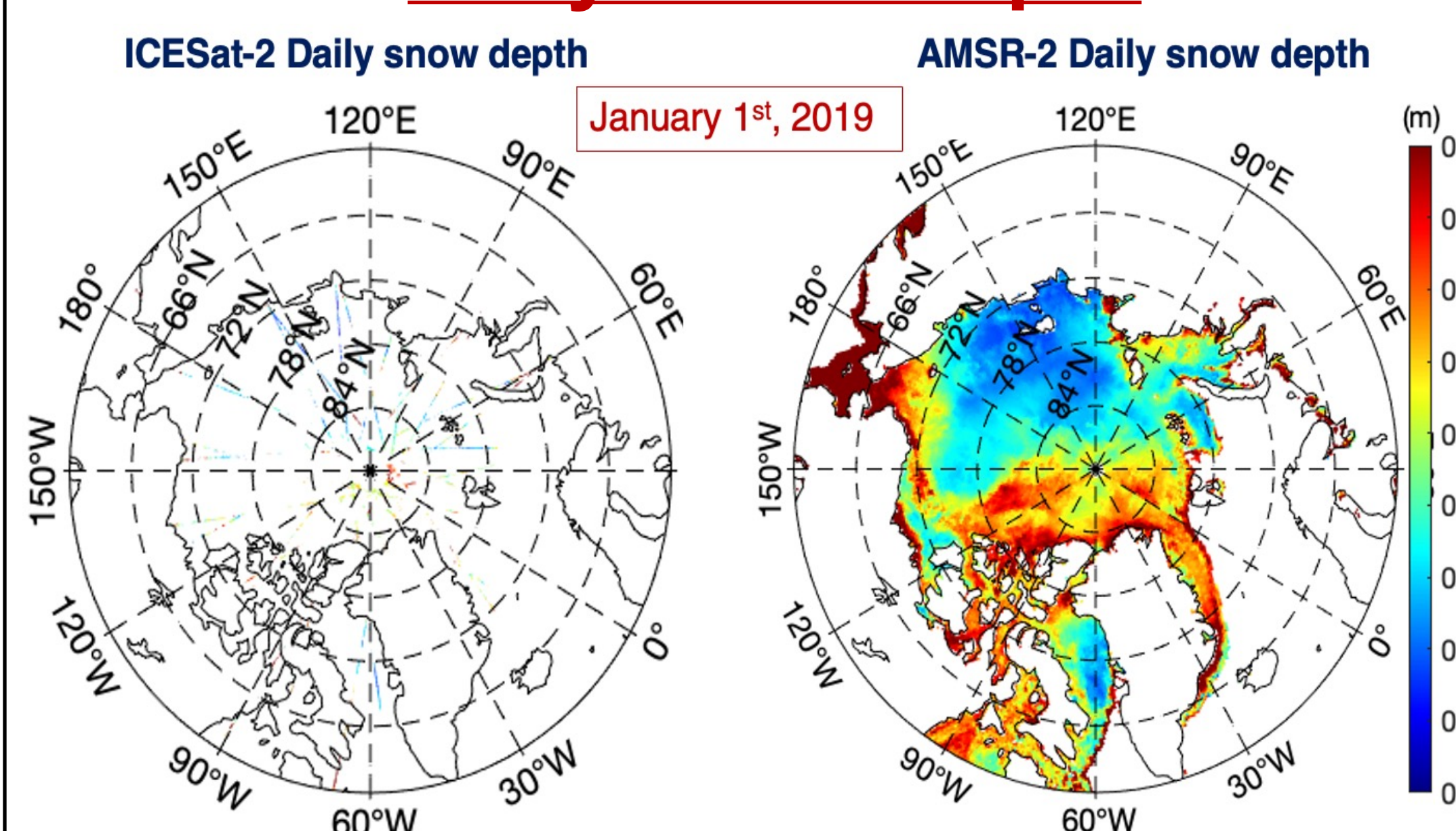


## Neural Network Training

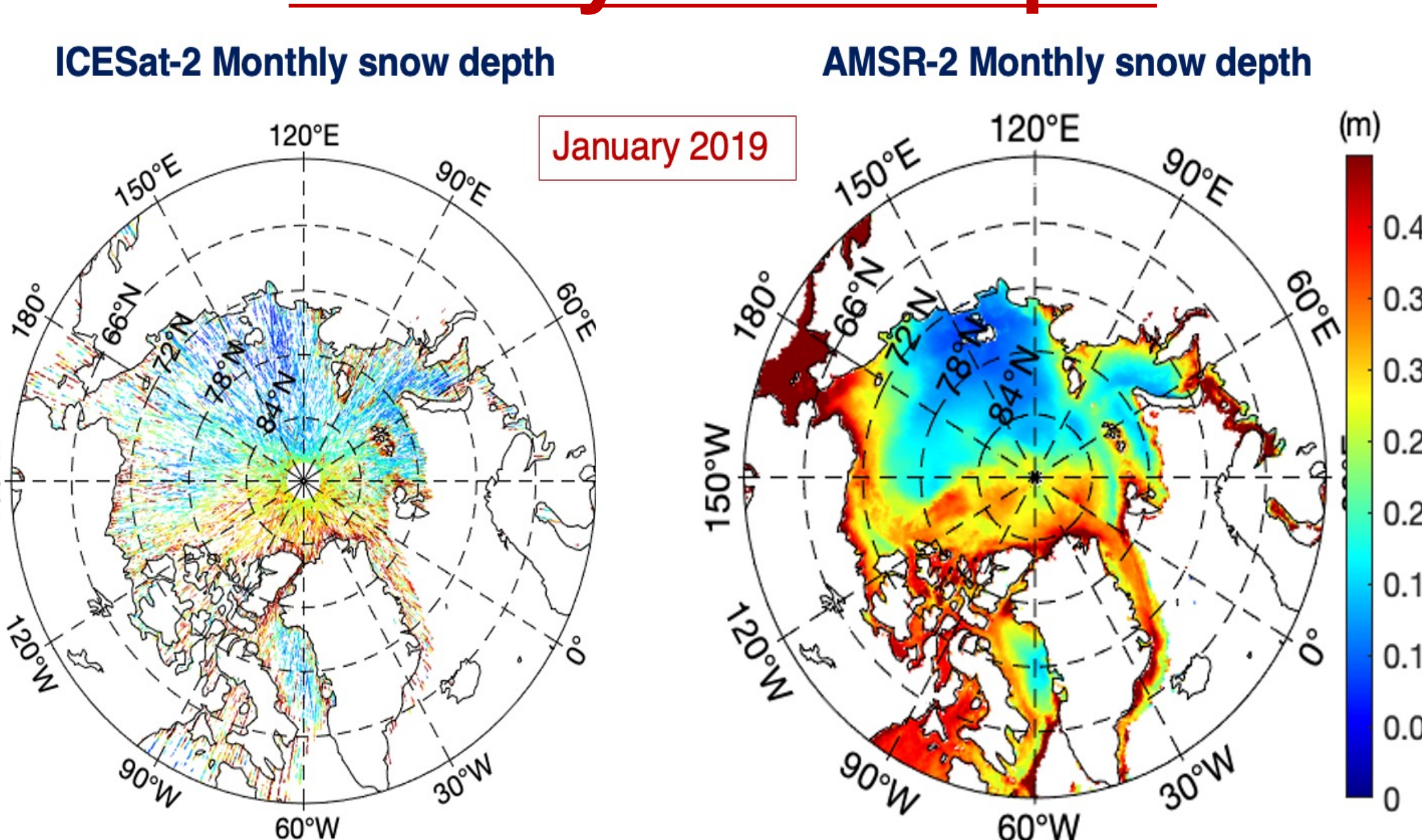


## AMSR-2 Daily & Monthly Products

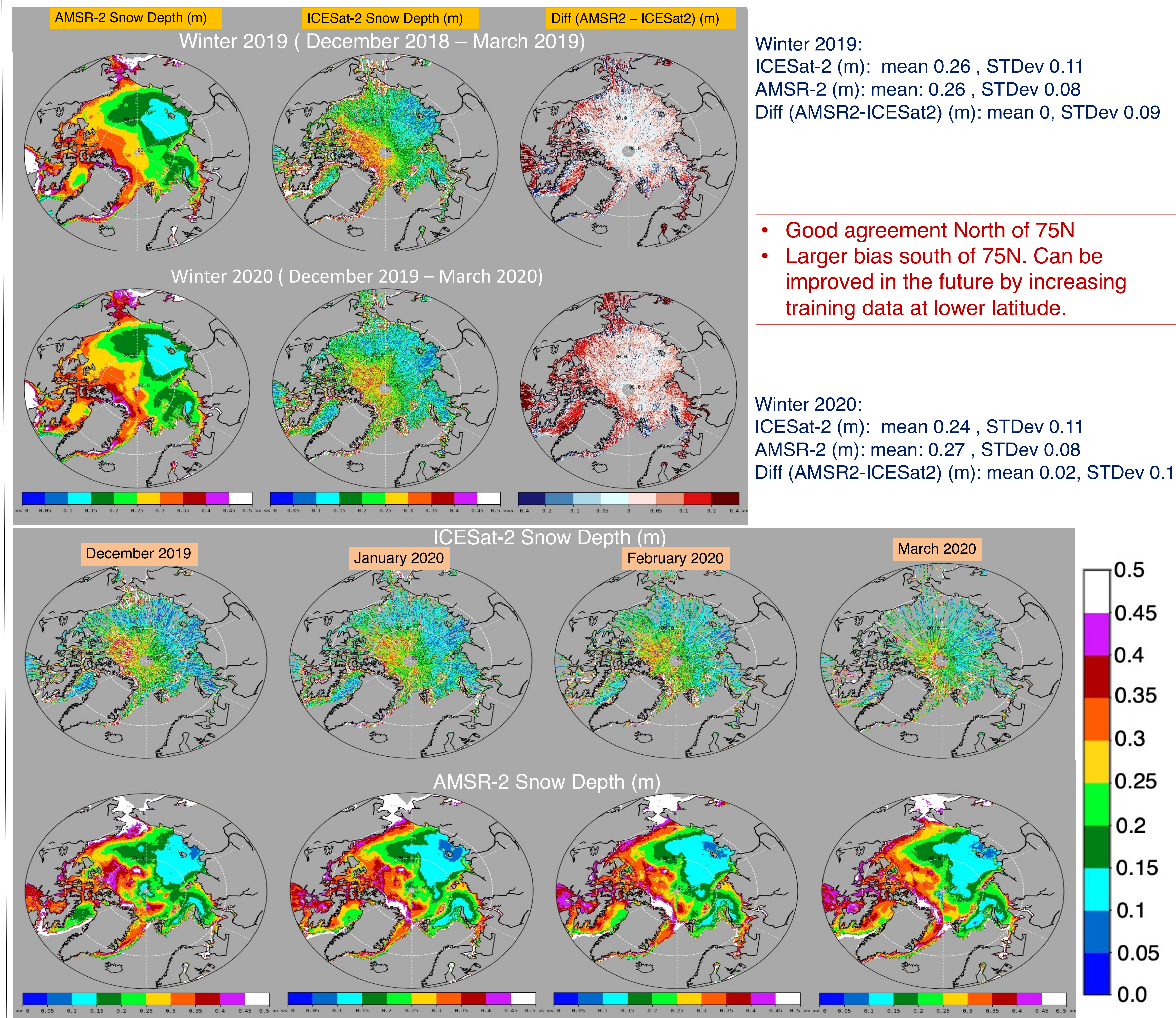
### Daily Snow Depth



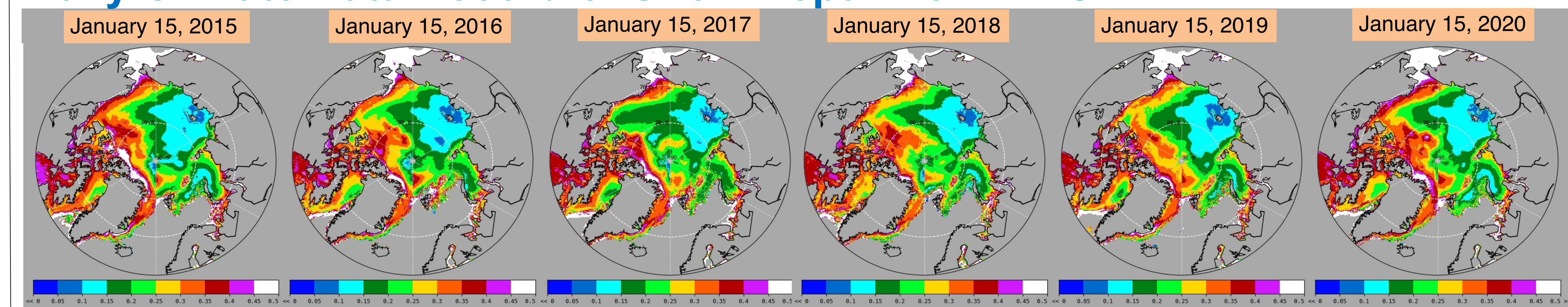
### Monthly Snow Depth



## Validation



## Daily Climate Data Record of Snow Depth from AMSR-2



## Summery

- The new daily high resolution snow depth product provides constraints to physical processes in weather and climate models, e.g. snowfall & snow melting processes.
- Monthly Arctic ocean agreement with ICESat-2 within 3-5 cm & STDev ~ 10 cm. Better agreement North of 75N
- Larger bias, 10 – 20 cm, south of 75N. Can be improved in the future by increasing training data for lower latitudes.

## Reference

- Hu, Y., Lu, X., Zeng, X., Stamnes, S. A., Neuman, T. A., Kurtz, N. T., et al.. Deriving Snow Depth From ICESat-2 Lidar Multiple Scattering Measurements. *Front. Remote Sens.* 3. doi: 10.3389/frsen.2022.855159 (2022)
- Lu, X., Hu, Y., Zeng, X., Stamnes, S. A., Neuman, T. A., Kurtz, N. T., et al.. Deriving Snow Depth From ICESat-2 Lidar Multiple Scattering Measurements: Uncertainty Analyses. *Front. Remote Sens.* Accepted (2022)