

## First application of a newly developed drone radar for snow on sea ice

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Snow on sea ice is a key earth system variable which is particularly hard to measure and not well understood. We are especially interested in quantifying sea ice thickness from freeboard measurements and ocean-atmosphere heat flux in ice covered areas to better understand sea ice trends in the southern ocean. Both requires the knowledge of snow depth on sea ice.

We conducted radar experiments on sea ice using a horn antenna and a vector network analyser in McMurdo Sound in 2016 with the aim to specify the design of a new drone radar. The horn antenna was moved over the sea ice in a controlled experiment with coincident measurements for snow depth, as well as depth profiles for snow density, permittivity, and conductivity. The measurements were basis for the design of a purpose built stepped frequency radar to be deployed on a drone to obtain snow depth from 5 meters flight level at 5 cm accuracy.

Mounted on a multirotor remotely piloted aircraft the snow radar was tested in November 2017 over sea ice in McMurdo Sound. A multitude of tests were conducted flying the radar with varying speeds and flight levels. The snow measurements were validated with in-situ data along transects of up to 2 kilometres length. We showcase our results which exceed the nominal specifications and which are basis for further radar development.