

## Subproject: Measurement of sea ice physical properties using Multilevel Transmission Lines and Ground Penetrating Radar (GPR)

Actual field dates: February, 8-26, 2016

Field site: Sea-ice Environmental Research Facility (SERF), University of Manitoba, Winnipeg (Canada)

Number of man-days in the field: 55

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### Summary:

The field campaign was devoted to develop a strategy to estimate sea ice physical properties using non-destructive electromagnetic techniques. We performed dielectric measurements of the sea ice while it was growing downward, using vertical and horizontal transmission lines. To this aim we designed and built a multilevel probe made of 10 horizontal three-prong transmission lines, located 4 cm apart and having a length of 15 cm. We also built 6 vertical probes (three-prong transmission lines) having different lengths (10, 15, 20, 25, 30, 35 cm). The dielectric parameters (permittivity and conductivity) were acquired using a portable Vector Network Analyzer (VNA) operating between 10 KHz and 3 GHz.

Furthermore, we used a bistatic GPR equipped with 1GHz antennas to collect data both in reflection and CMP modes along orthogonal lines and on X-Y grids, to evaluate the capability of this technique to precisely estimate sea ice thickness and investigate sea ice anisotropy.

The first day we installed the multilevel and the vertical probes in the water, as well as 3 horizontal metal rods to be used to calibrate the GPR data. We started to collect data on February 13<sup>th</sup>, when the ice was about 4 cm thick. Subsequently we acquired data every day to “follow” the vertical ice growth. During the campaign the UoM research unit provided several data, such as: ice thickness, water salinity and water temperature. At the end of the campaign, UoM also collected a core to measure brine content vs. depth using X-ray analysis; these results will be compared with the values obtained inverting the dielectric data collected using the multilevel probe.

As the weather did not cooperate during the campaign, the maximum ice thickness reached during the measurements was only 13 cm; as a consequence the quantity and quality of the data was limited. Nevertheless, we have been able to verify the validity of the experimental approach.

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### Photos:

Fig.1: Vertical (left) and multi-level horizontal (right) transmission line probes encased in sea ice at SERF. Credit: Elena Pettinelli

Fig. 2: GPR data acquisition using the 1 GHz antenna. Credit: Elena Pettinelli

Fig. 3: The multi-level horizontal transmission line probes extracted from the ice at the end of the experiment. Credit: Elena Pettinelli



Figure 1



Figure 2

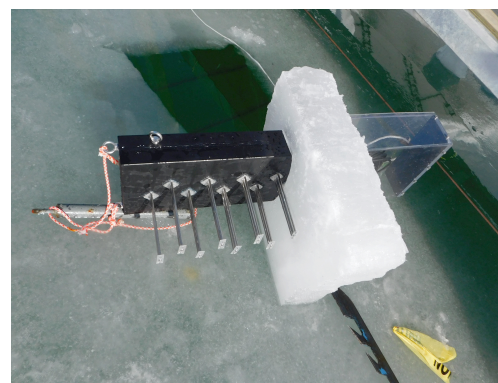


Figure 3

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