PROJECT SUMMARY REPORT - 2013 SERF CAMPAIGN

Subproject: Project 3: Geophysical study of sea ice. Micrometeorological and thermal observations of frost flower growth on young sea ice.

Actual field dates: January 1-31, 2013
Field site: Sea-ice Environmental Research Facility (SERF), University of Manitoba, Winnipeg, Canada
Number of man-days in the field: 420

Summary:
Frost flowers are transient crystal structures that form on new and young sea ice surfaces given the appropriate atmospheric and surface conditions. They have been implicated in a variety of biological, chemical and physical processes at sea ice surfaces interacting with the atmosphere. We describe the atmospheric and radiative conditions and the physical and thermal properties of the sea ice that initiate, grow, decay and destroy frost flowers on young sea ice in an outdoor experimental facility using in situ observations and an infrared imaging camera. Frost flowers grew on a bare, brine-wetted highly saline (>20) sea ice surface whose mean surface temperature was 10-13°C warmer than the air temperature. Frost flowers were observed to form on nodules of surface roughness that were above the mean surface height by 5 mm and 5°C colder than the mean surface temperature. A high-pressure system developed prior to and during the formation event led to needle-like crystal habits due to intensely cold air temperatures, an atmosphere undersaturated with water vapour, and low surface and 10-m wind speeds. Frost flowers formed overnight in the absence of shortwave radiation, while the net longwave radiation was <-100 Wm^{-2} and dominated the net all-wave radiation balance at the surface. The thermal environment of frost flowers is observed to be much different from both the atmosphere and the mean and modal surface temperatures, which has implications for chemical extrapolations not based on in situ frost flower temperatures. The observed frost flowers decayed via sublimation due to a decreased difference in temperature between them and the air temperature. The decay may have been enhanced convectively by increasing wind speeds before being rapidly (<30 min) destroyed by new snowfall.

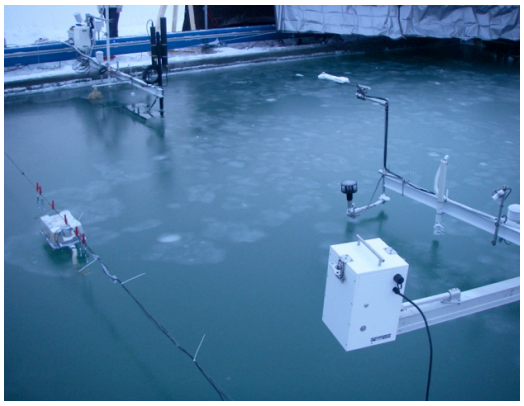

Figure 1

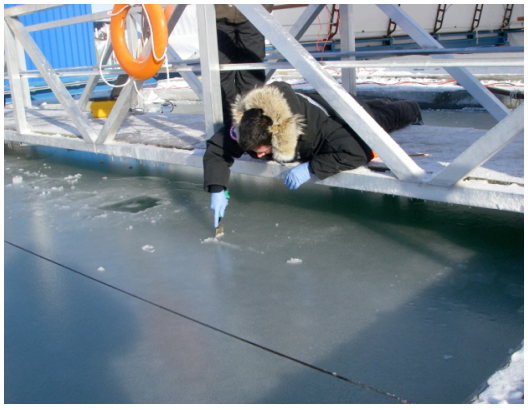

Figure 2

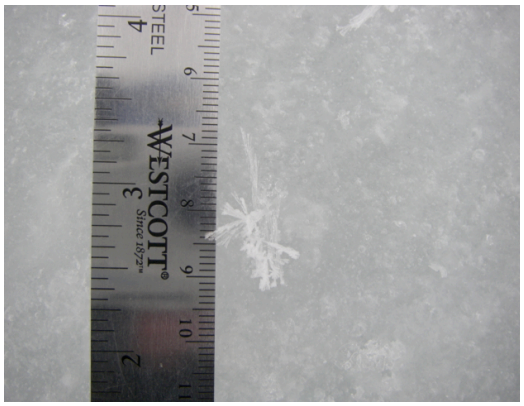

Figure 3

Fig.1: Instrumentation over new sea ice at SERF, Credit: R.J. Galley
Fig. 2: Nicolas-Xavier Geilfus sampling young sea ice at SERF
Credit: R.J. Galley
Fig. 3: Measuring frost flowers at SERF, Credit: R.J. Galley

Participants:
Ryan Galley, Brent Else, Nicolas-Xavier Geilfus, Tim Papakyriakou, Alex Hare, Dave Babb, Odile Crabeck, David Barber, Soren Rysgaard, Marcos Lemes, Rosina Grimm, Karley Campbell, Lise Lotte Sorensen, Jakob Sievers, D. Notz, Fei Wang, Jack Landy, Alex Komarov, Dustin Isleifson

Acknowledgements:
NSERC, ArcticNet and the Canada Excellence Research Chair.

For more information contact: ryan.galley@umanitoba.ca