SURFACE ENERGY BALANCE, CLOUDS AND RADIATION OVER ANTARCTIC SEA ICE DURING AUSTRAL SPRING

M. Vancoppenolle[1], S.F. Ackley[2], D.K. Perovich[3], J.L. Tison[4]
1 - Universite Catholique de Louvain, Institut Georges Lemaitre
2 - Dept of Geol. Sciences, University of San Antonio, Texas, USA
3 - CRREL, Hannover, New Hampshire, USA
4 - Laboratoire de Glaciologie, Universite Libre de Bruxelles, Belgium
vancop@astr.ucl.ac.be

In Sept-Oct 2007, a sea ice drift station, *Ice Station Belgica*, was established in the Bellingshausen Sea. Over twenty-seven days, measurements of meteorological variables, radiation and surface albedo were performed by combining ship-based and in situ data, in order to assess the surface energy balance. Visual observations of the state of the sky (clear or overcast) were also done. The sampled floe was characterized by thin (0.6m) and medium thick (1.1m) first-year ice and older, second-year ice of greater than 2m mean thickness. Snow cover depth varied from zero cm over the new ice to > 0.8m on the second year ice.

The weather at Ice Station Belgica was characterized by typical spring conditions. Synoptic variability was mostly driven by the wind direction, which determines the origin – continental or oceanic – of the air masses. Under northerly winds, warm (from -5 to 0 °C) and wet (relative humidity from 90 to 100%) oceanic air was advected on the floe. Under southerlies, cold (from -20 to -10°C) and dry (70-85 %) continental air was brought on site. In turn, this also determined the state of the sky, with clear (overcast) skies mostly associated to continental (oceanic) weather.

The incoming solar radiation was on average 124 W/m?, with a trend of 3.5 W/m? over the ice station, while the incoming longwave radiation was on average 227 W/m?, with no trend. As expected, the incoming solar radiation shows a marked diurnal cycle, while LW does not. The day-to-day variability in radiation is largely determined by changes in the state of the sky.

Broadband surface albedo was measured in situ, using a bidirectional pyranometer, on two sites respectively covered by thin (10-15 cm) and deep (30-40 cm) snow. Both sites were visited every 5 days and albedo was measured on 6 points, spaced by 5 m on an 25-m long "albedo" line. Snow depth was also monitored every meter along the albedo line. The mean albedo is 0.83 ± 0.05. Variations around this mean value are explained primarily by the nature of the light (diffuse or direct), controlled by the local cloud – clear sky pattern. Cloud-sky albedo is on average higher and less variable (0.85 ± 0.03) than under clear sky (0.81 ± 0.06). Secondary factors controlling surface albedo are snow depth and age. The deep snow site has a slightly higher clould-sky albedo (0.87 ± 0.01) than the thin-snow site (0.84 ± 0.03). The albedo was the highest under cloudy skies and over deep, young snow.

As the state of the sky and the associated change in the type of the light (direct or diffuse) induces large changes in radiation as well as changes in broadband surface albedo, it is crucial to work toward inclusion of clouds in future assesments of surface energy balance in polar regions.