SURFACE ENERGY BUDGET AND ATMOSPHERIC EFFECTS OF A FREEZING LEAD

AMS abstract

Evolution of Lead near Atlanta on April 28th 1998:

A lead opened just 60 m from the "Atlanta" flux-PAM station at 1815 UTC on April 28. The lead was located approximately 2 km NNE of the Des Groseilliers in the interior of a typically-sized multiyear ice flow. Cold surface air temperatures and an across-lead fetch resulted in rapid buildup of frazil ice on the downwind edge of the lead. The frazil ice appeared to form in the center of the lead, organizing in a linear fashion oriented with the mean wind due to langmuir circulations in the ocean [Pease, 1987]. Measurements of the radiometric properties of the new ice surface were obtained from 1946 UTC on 28 April to 1908 UTC on April 29. The lead was nearly covered with new ice after less than 6 hours. The ice cover continued to thicken and drifting snow began to accumulate so that after 5 days the mean ice thickness within 50 m of the ice edge was 12 cm overlain by about 10 cm of snow. Further away from the lead edge the snow cover rapidly diminished. Without the insulating effects of snow cover ice thickness beyond 50 m from the lead edge increased to 20 cm.

Discussion

The evolution of the surface conditions of the freezing lead are evident in the timeseries of upwelling shortwave radiation (Fig. 1) and surface skin temperature (Fig 2). As the ice thickness increases (Fig. 3) the surface albedo increases. This coincides with an observed graying of the sea ice. The increase in albedo can be seen by comparing the ratio of LICOR readings and DSWR at 19.15 and 19.75 UTC. The surface skin temperature of the new ice in the lead is seen to steadily cool for the first 18 hours; however, with the fairly strong spring sun and relatively low surface albedo, the ice surface within the lead begins to warm just after sunrise on Jday 119. Interestingly, the surface warming appears to be less than observed in the 2-m air temperatures both just above the lead and far from the lead at the Baltimore site. The warming effect of the lead on the surface layer of the boundary layer downwind is evident in the difference between 2-m air temperatures observed above the lead with the MRP and away from the lead at Baltimore. Evidence of this warming is found over 2 km downstream in the NOAA/ETL 20-m tower data (see AMS 1999 extended abstract).

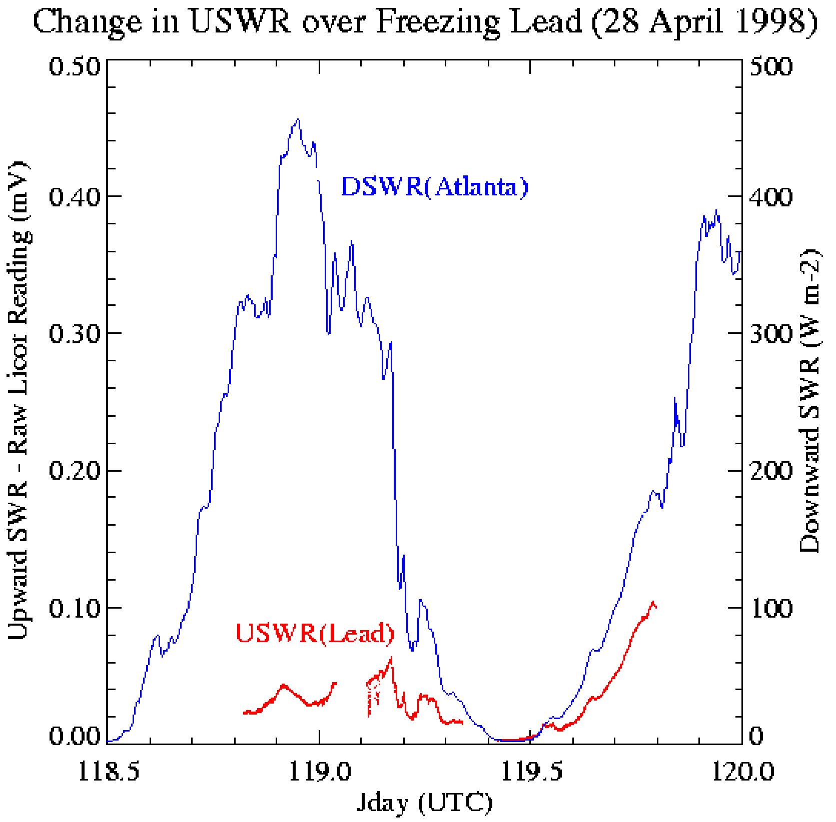

Figure 1. Time series of downward shortwave radiation at the "Atlanta" flux-PAM site (blue) and raw signal detected by a downward-looking Licor pyranometer mounted on a 1.5 m boom extended from the MRP (red). The flux-PAM data are 5-min averages while the Licor data are recorded every 10 s.

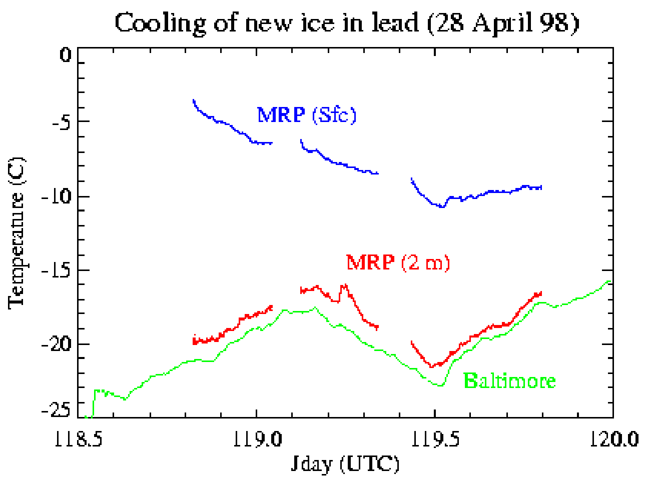

Figure 2. Time series of surface skin temperature of new ice in the lead obtained with a KT-19 radiometer (blue) and air temperature (red) on a 1.5 m boom extended over the lead and of 2-m air temperature at the "Baltimore" flux-PAM station (green). The flux-PAM data are 5-min averages while the Licor data are recorded every 10 s. The "Baltimore" site was located several kilometers away so that it was unaffected by this lead. Gaps in the MRP data correspond with periods of battery recharging.

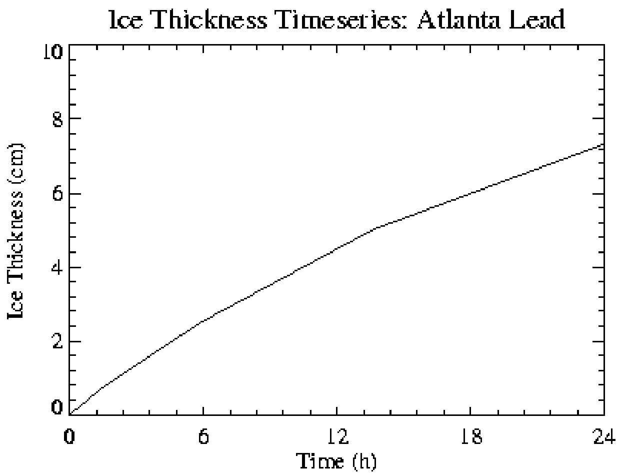

Figure 3. Time series beginning at 1815 UTC on Jday 118 of ice thickness approximately 0.3 m from the edge of the lead.