Between Deadhorse and Lonely - First Results from an Arctic Meteorology Field Experiment

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Introduction

A preliminary ARM meteorological field experiment was conducted on the edge of the Arctic Ocean at Colville Village, Alaska, during the period from 16-26 June 1995. Colville Village (70.42°N, 150.38°W, 2 m MSL) is located on an island in the Colville River delta between Deadhorse and Lonely, Alaska.

- The goals of the experiment were
  - to gain operational and logistical experience in the Arctic, and
  - to make preliminary investigations of arctic stratus clouds

The Colville Village site was selected for the experiments after Federal Aviation Administration permission was refused for tethersonde flights at Barrow, Alaska. At Barrow, heavy aircraft traffic is sometimes present, and the published air traffic patterns will need to be changed in the Barrow Terminal Control Area before future tethered balloon flights will be allowed.

The Colville Village site was accessible via bush plane from the major airport at Prudhoe Bay, Alaska. Alaska Airlines provides good daily service to Prudhoe Bay, but the necessity of using an air taxi to get to final 60 miles to Colville Village is a disadvantage of this site. Weather conditions occasionally do not allow such flights to be performed safely, and so air travel is weather dependent. Special permission is required for government employees to use an air taxi service, so that plans must be made well in advance. Additionally, reliance on the weather-dependent taxi service can create operational and logistical problems that should be allowed for in the experiment planning.

At the beginning of the experiment on June 16 isolated snowdrifts were present on the tundra, and many small tundra lakes were still partially ice covered, although there was much standing water. Since the site is above the Arctic Circle, the sun stayed continuously above the horizon during the period of the experiments. There was much melting during this period, which saw the disappearance of many of the snowdrifts. Radiation measurements at this site are shown in Figure 1.

Colville Village is only 2 km from a major bay into which the Colville River empties, and is 8 km from the Beaufort Sea to the north. The arctic pack ice melted back from the shoreline during the 10-d experimental period, retreating from approximately 5 km offshore to 10 km offshore. Cold and moderately strong winds frequently blew onshore during the experimental period. These flows produced arctic stratus clouds in a generally narrow zone along the coast, and also

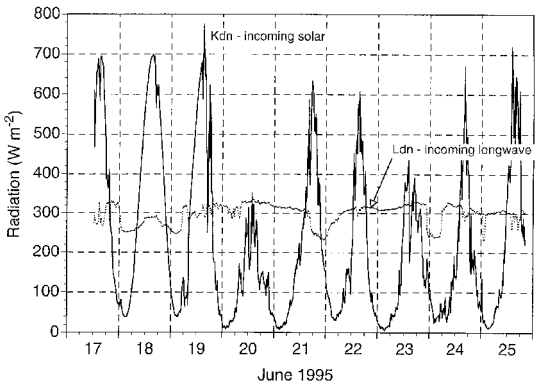

Figure 1. Surface-based short- and long-wave radiation measurements at Colville Village during the period 17 to 25 June 1995. Fifteen-minute averaging periods, plotted at the ending time, in local time.

produced occasional periods of drizzle and snow flurries. Measurements at a surface weather station, shown in Figure 2, document the temperature and relative humidity at this site. The cold air coming off the arctic ice pack was warmed and moistened from below as it came over the open water and the moist tundra areas within the delta, producing a shallow layer of stratus at the top of the growing internal or advective boundary layer. The temperature structure evolution through this layer at Colville Village is shown for June 23 in Figure 3.

About 30 upper air soundings were launched during the experiment, but few tethersonde ascents could be made in the nearly continuous 12-25 knot winds. The upper air soundings (Figure 4) showed a cold troposphere, a low and cold tropopause, and significant boundary layer structure within the stratus layer.

On the evening of June 23, the winds abated and ascents were made through the stratus with balloon-borne stabilized radiometers during a period when the sun was low in the sky and the stratus deck was dissipating. Results are shown in Figure 5.

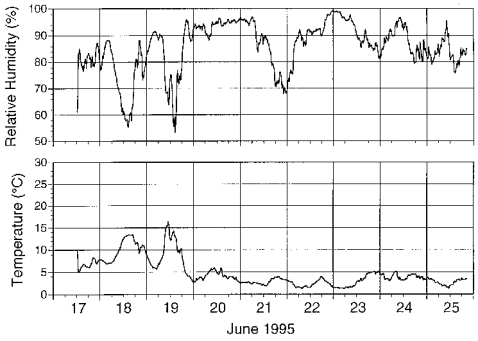

Figure 2. Temperature and relative humidity at Colville Village during the experimental period. Fifteen-minute averaging periods, plotted at the ending time, in local time.

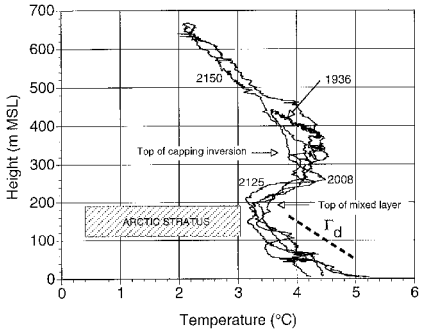

Figure 3. Series of tethered balloon temperature soundings at Colville Village on June 23, 1995. The starting times of the up-soundings (local time) are shown in the figure. Γ_d indicates the dry adiabatic lapse rate, and the approximate height of the arctic stratus is indicated.

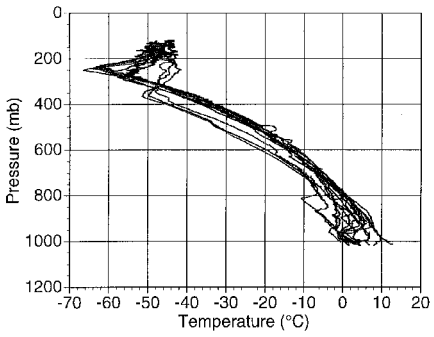

Figure 4. Radiosonde temperature soundings from Colville Village during the period 17-25 June 1995.

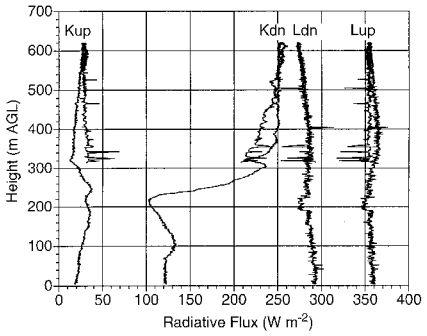

Figure 5. Balloon-borne stabilized radiometer soundings from Colville Village on June 23, 1995. The up-sounding started at 2135 local time, when the sky was covered with 6/10 stratocumulus. The stratocumulus thinned and cleared rapidly, becoming clear by half way through the ascent. Data collection ended just above the 300 m level on the balloon descent. Shown are the incoming shortwave (Kdn), reflected shortwave (Kup), incoming longwave (Ldn), and outgoing longwave (Lup) radiative flux profiles.