Air and Ground Surface Temperatures from the Kuparuk Basin, Alaska, 1994-1996

collected and assembled by

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Update

Previously, we had archived a set of air temperatures from the Kuparuk Basin, 1994-1996. Now we include a companion set of ground surface temperatures. An ASCII file containing these data is included and the data description and protocols that follow have been revised to discuss these additional data. Figure 1 (previously air temperature only) has been modified to include a complete ground surface temperature record. The ASCII file containing the air temperature data has not been modified.

Overview

Air and ground surface temperatures were recorded at 31 sites in the Kuparuk Basin between November 1994 and November 1995 using inexpensive, miniature data loggers and a simplified instrument mounting system. Air and ground surface temperature monitoring continued at most sites beyond the one year proposed with half of the sites still active in November, 1996, when all instruments were removed. The system was originally designed for recording winter temperatures only, but was run in the summer as well at the request of other LAII investigators. Summer temperatures may be adversely affected by solar heating and should be used with caution. Example air and ground surface temperature records for a site are presented in Figure 1; vertical lines delineate the four data collection periods.

Site Descriptions

The location of each site is given in Table 1. The sites define a south-to-north transect along the length of the Kuparuk Basin (Figure 2).

Table 1: Site locations and installation dates

Site	Installed	Site Description	Decimal Lat.	Decimal Long.
1	9-Nov-94	intermediate	68.80708	149.01680
2	9-Nov-94	ridge top	68.81475	149.03755
3	9-Nov-94	intermediate (water track)	68.83398	149.09823
4	9-Nov-94	broad ridge top	68.94947	149.07892
5	9-Nov-94	ridge, windward slope	68.95733	149.10307
6	9-Nov-94	ridge, windward slope	68.97472	149.15727
7	9-Nov-94	valley (willows)	69.03245	149.32478
8	9-Nov-94	valley (terrace)	69.03263	149.33588
9	10-Nov-94	intermediate (water track)	69.14470	149.33512

10	10-Nov-94	broad ridge top	69.18743	149.38525
11	10-Nov-94	gentle hill	69.19248	149.39903
12	10-Nov-94	valley	69.25000	149.39797
13	10-Nov-94	valley	69.28020	149.39582
14	10-Nov-94	valley (dwarf willows)	69.39242	149.38083
14.5	10-Apr-95	flat	69.40805	149.37782
15	10-Nov-94	valley bench (willows)	69.52297	149.49267
16	10-Nov-94	gentle hill	69.52955	149.49383
17	10-Nov-94	broad ridge top	69.54602	149.49392
18	10-Nov-94	ridge top	69.62652	149.51117
19	11-Nov-94	intermediate (terrace)	69.65002	149.52032
20	11-Nov-94	coastal plain	69.74987	149.47483
21	11-Nov-94	coastal plain (dry)	69.81167	149.34433
22	11-Nov-94	coast. (terrace w/ willows)	69.82695	149.31297
23	11-Nov-94	coastal plain	69.88835	149.18362
24	11-Nov-94	coastal plain	69.90542	149.14702
25	11-Nov-94	coastal plain	69.95832	149.01828
26	11-Nov-94	coastal plain	70.02263	148.89315
27	11-Nov-94	coastal plain	70.04548	148.84692
28	11-Nov-94	coastal plain	70.07283	148.77942
29	11-Nov-94	coastal plain (long grass)	70.13692	148.65087
30	11-Nov-94	coastal plain	70.18853	148.49223

Note: Intermediate is a broad category meaning neither near a ridge top nor valley bottom.

Instruments & Mounting System

Each air temperature sensor consisted of a white plastic can, 6 cm in diameter and 9 cm long, open at the bottom, in which a thermistor (a temperature sensitive resistance device) was mounted. The thermistor was positioned near the top of the can to avoid direct sun. The sensor (thermistor and can) was mounted on the top of a metal rod 1.5 m high. Ground surface thermistors were placed about 0.7 m northwest of each metal rod, pinned to the ground by thin wire clips. Each ground thermistor was covered by white heat shrink. Thermistors were directly on the ground when vegetation was sparse, otherwise they were placed on the vegetative mat below any existing canopy. In areas with tussocks, thermistors were positioned just above the base of the tussock rather than in the low between tussocks. Data were recorded using a miniature data logger (Hobo XT manufactured by Onset Computer Corp., 536 MacArthur Blvd., Pocasset, MA 02559-3450: 508-563-9000), also mounted on the post. A separate data logger was used for each thermistor.

Data Collection

Site visits to download data and maintain instruments took place in March-April, 1995; November, 1995; April, 1996; and November, 1996 and are summarized in Table 2. The site visits serve to break the two years of data collection into four periods: winter 1994-95, summer 1995, winter 1995-96, and summer 96. Data logging intervals for these four periods were 2.4, 3.2, 2.4, 3.2 hours, respectively. All instruments were removed in November, 1996.

Table 2: Site visits and data coverage for air ground surface temperature data.

Site	Installed	Spring 95	Fall 95	Spring 96	Fall 96
1 air	11/9/94	3/31	11/7	4/3 (rmvd)	NV
1 gnd	11/9/94	3/31 (1/7)	11/7 (ND)	4/3 (ND, rmvd)	NV
2 air	11/9/94	3/31	11/7	4/3 (ND)	11/11
2 gnd	11/9/94	3/31	11/7	4/3	11/11(5/17)
3 air	11/9/94	4/2	11/7 (6/22)	4/3 (ND)	11/11

3	gnd	11/9/94	4/2	11/7 (8/15)	4/3	11/11
4	air	11/9/94	4/2	11/7 (7/4)	4/5	11/11 (7/26)
4	gnd	11/9/94	4/2	11/7 (ND)	4/5	11/11(7/26)
5	air	11/9/94	4/3	11/8 (6/17)	4/5 (ND, rmvd)	11/11 (ND)
5	gnd	11/9/94	4/3	11/8 (8/14)	4/5 (ND, rmvd)	11/11 (ND)
6	air	11/9/94	4/3	11/8	4/5	11/11
6	gnd	11/9/94	4/3	11/8 (7/3)	4/5 (ND)	11/11 (6/2)
7	air	11/9/94	4/4	11/8	4/6 (2/24)	11/11
7	gnd	11/9/94	4/4 (3/17)	11/8	4/6(1/28)	11/11 (ND)
8	air	11/9/94	4/4	11/8 (ND)	4/6 (ND, rmvd)	NV
8	gnd	11/9/94	4/4	11/8 (6/30)	4/6 (ND, rmvd)	NV
9	air	11/10/94	4/5	11/8	4/6	11/11
9	gnd	11/10/94	4/5	11/8	4/6	11/11 (8/6)
10	air	11/10/94	4/5	11/9 (7/26)	4/6 (ND)	11/12
10	gnd	11/10/94	4/5	11/9 (8/19)	4/6	11/12 (ND)
11	air	11/10/94	4/6	11/9	4/6	11/12 (ND)
11	gnd	11/10/94	4/6	11/9	4/6	11/12
12	air	11/10/94	4/6	NV	4/6 (12/2)	11/12 (ND)
12	gnd	11/10/94	4/6	NV	4/6 (12/2)	11/12 (ND)
13	air	11/10/94	4/6	NV	4/6 (ND)	11/12
13	gnd	11/10/94	4/6	NV	4/6 (12/2)	11/12
14	air	11/10/94	4/6	11/9	4/6	11/12
14	gnd	11/10/94	4/6	11/9	4/6	11/12
14.5	air	4/7/95	4/7(ND)	11/10	4/11	11/12 (ND)
14.5	gnd	4/7/95	4/7 (ND)	11/10	4/11	11/12 (6/29)
15	air	11/10/94	4/8	NV	4/13 (ND, rmvd)	NV
15	gnd	11/10/94	4/8	NV	4/13 (5/26, rmvd)	NV
16	air	11/10/94	4/8	NV	4/13 (ND, rmvd)	NV
16	gnd	11/10/94	4/8	NV	4/13 (ND, rmvd)	NV
17	air	11/10/94	4/8	NV	4/13 (12/4)	11/13
17	gnd	11/10/94	4/8	NV	4/13 (10/30)	11/13 (ND)
18	air	11/10/94	4/9	NV	4/14 (12/5)	11/13
18	gnd	11/10/94	4/9	NV	4/14 (6/5)	11/13 (6/21)
19	air	11/11/94	4/11	NV	4/15 (5/21)	11/13(9/9)
19	gnd	11/11/94	4/11	NV	4/15 (5/21)	11/13
20	air	11/11/94	4/11	NV	4/15 (ND, rmvd)	NV
20	gnd	11/11/94	4/11	NV	4/15 (ND, rmvd)	NV
21	air	11/11/94	4/11	NV	4/15 (ND, rmvd)	NV
21	gnd	11/11/94	4/11	NV	4/15 (12/7, rmvd)	NV
22	air	11/11/94	4/11	NV	4/15 (12/7, rmvd)	NV
22	gnd	11/11/94	4/11	NV	4/15 (6/13, rmvd)	NV
23	air	11/11/94	4/11	NV	4/16 (9/27)	11/14 (ND)
23	gnd	11/11/94	4/11	NV	4/16 (8/25)	11/14 (ND)
24	air	11/11/94	4/11	NV	4/16 (12/7)	11/14 (ND)
24	gnd	11/11/94	4/11	NV	4/16 (5/26)	11/14 (ND)
25	air	11/11/94	4/12 (11/10)	NV	4/16 (12/8, rmvd)	NV
25	gnd	11/11/94	4/12	NV	4/16 (10/12, rmvd)	NV
26	air	11/11/94	4/12	NV	4/17 (9/19, rmvd)	NV
26	gnd	11/11/94	4/12	NV	4/17 (ND, rmvd)	NV
27	air	11/11/94	4/12	NV	4/17 (ND, rmvd)	NV
27	gnd	11/11/94	4/12	NV	4/17 (ND, rmvd)	NV
28	air	11/11/94	4/13	NV	4/17 (6/17)	11/14 (ND)
28	gnd	11/11/94	4/13	NV	4/17 (9/11)	11/14 (ND)
29	air	11/11/94	4/13	NV	4/17 (ND, rmvd)	NV

29 gnd	11/11/94	4/13	NV	4/17 (ND, rmvd)	NV
30 air	11/11/94	4/16	NV	4/20 (12/12)	11/14
30 gnd	11/11/94	4/16	NV	4/20 (11/1)	11/14 (9/26)

Note: Some sites were not visited (NV) in November, 1995 due to limited snow at the time of the field excursion. Complete records were downloaded at each site visit unless otherwise indicated by "ND" (i.e., no data) or "(date)", specifying the date the record terminated prematurely due to icing, foxes chewing the cables, exceeding data logger capacity limits, etc. Removal of instruments is indicated by "rmvd".

Measurement Uncertainties

Thermistors were capable of measuring temperatures between -37° and +46°C with an accuracy stated by the manufacturer to range between 0.5 and 1%. This translates to uncertainties of up to ±0.5°C for recorded temperatures. To be conservative, we think the uncertainty should be considered ±1°C. Temperatures lower than -37°C are recorded as -37°C, so periods of extreme cold are represented as "flat" spots in the temperature record.

The data loggers recorded the time each datum was collected in Alaska Standard Time. A "worst case" timing error due to data logger drift of about 45 minutes was calculated for the longest period of operation (eight months) based on the manufacturer's specifications. Logger times were reset to computer time during each site visit at which time uncertainties due drift were reset to zero.

Data acquisition among the sites was not synchronous. As such, data from different sites can not be unambiguously assigned to common data collection intervals, as one would do to obtain a "snap-shot" of temperatures along the transect. A preliminary analysis indicates that time differences for data assigned to a single 3.2 hour interval could be as large as 2 hours, with a confidence limit of approximately 95%. Timing differences would be less for the 2.4 hour interval.

Uncertainties in time due to the combined effects of drift and asynchronous data collection can be as large as 3.25 hours (for the 3.2 hour interval). A conservative approach in interpreting these data is to consider each datum as possibly belonging to an adjacent interval; therefore, two data assigned to an interval are considered as possibly separated in actual time by up to one complete interval. For more information on the analysis of the data uncertainties please contact Dr. Matthew Sturm as provided above.

Data Reduction

Data records from the four data collection periods were concatenated with obviously erroneous values (due to equipment failure) removed. All erroneous data were removed as a block from the beginning and/or end of a record; therefore, the data remaining for each collection period forms a "core" block which is continuous in time.

Air temperature thermistors at two sites, #7 and #9, were buried by snow on March 5, 1995 and March 8, 1995, respectively. They were excavated from the snow on April 4 (#7) and on April 5 (#9), but between March and April, recorded temperatures are buffered by 10 to 40 cm of snow cover and should be used with caution. Data from neighboring sites may give better values for air temperatures during these periods.

Air and ground surface temperature records are stored separately in two EXCEL text (ASCII) files tab-separated, each consisting of 62 columns. There are more than 200,000 temperature records; these records and their associated times occupy 2.9 MB (Table 3). Each data record is identified by site number. For each site, the first column contains the day of year in decimal days beginning in 1994. Values greater than 365 indicate data from 1995 & 1996 and can be c orrected to the day of the year in 1995 and 1996 by subtracting 365 and 730, respectively. The second column is the temperature in degrees Celsius. Column headings corresponding to the air temperature records for

site 1 are “kup1_aday” and “kup1_atemp” where Kup=Kuparuk Basin, 1=site 1, atemp=air temperature, aday=the corresponding decimal day. Column headings corresponding to ground surface temperature records are structured similarly with “g” substituted for “a”; that is, “kup1_gday” and “kup1_gtemp”.

Table 3: Number of data collected .

Site No.	No. of air data	No. of gnd data
1	4,560	568
2	4,733	4,858
3	2,051	5,572
4	4,431	3,749
5	2,010	2,423
6	6,232	2,538
7	5,811	3,706
8	1,456	2,091
9	6,019	5,486
10	3,952	3,963
11	4,589	6,224
12	3,270	3,257
13	3,119	4,906
14	6,237	6,225
14.5	3,152	5,212
15	1,488	1,836
16	1,488	1,477
17	4,882	3,013
18	4,792	2,421
19	2,917	3,399
20	1,509	1,506
21	1,509	3,306
22	3,308	1,982
23	2,778	2,530
24	3,309	1,848
25	1,788	2,890
26	2,716	1,519
27	1,521	1,520
28	2,016	2,656
29	1,528	1,528
30	4,910	4,241
Subtotals	104,081	98,450
Grand Total	202,531	