

Final Data Report

Bingham Mine Cold-Air Pool Structure and Evolution

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This report provides information on the meteorological data collected as part of the University of Utah's Bingham Mine Cold-Air Pool Structure and Evolution experiment (Bingham Mine Experiment) for the winters of 2010-2011 through 2013-2014. Data from this experiment are provided as an attachment to this report in the form of a 64 GB USB flash drive containing 37 GB of data. Table 1 summarizes the data collected and analysis goals for each of the winters. The locations and resources used for the UU measurements varied from winter to winter depending on analysis goals. Data from the KUC automatic weather stations (AWSes) supplemented the UU data. These stations remained in place after they were installed and Table 2 provides information on their locations. Information is missing, however, regarding the Castro and Copper AWSes. The remaining sections of this report provide metadata for each of the winters, in order.

Table 1. Summary of meteorological data available for the Bingham Mine Experiment, including the instrumentation and analysis goals.

Winters	Instrumentation	Analysis Goals
2010-2011 late start	Temperature and relative humidity (RH) inside and outside; LiDAR winds late in season; Bingham Pass AWS, KUC AWSes	Salt Lake City Basin (SLC)-Bingham Canyon Mine (BCM) differences in inversion characteristics; stability; mixing
2011-2012	Temperature/RH inside and outside; LiDAR winds; Bingham Pass AWS, KUC AWSes	SLC-BCM differences in inversion characteristics; stability; mixing gap flows; waves
2012-2013	Temperature /RH outside; ceilometer outside, KUC AWSes	aerosol backscatter - temperature structure connection
2013-2014	Temperature /RH inside and outside; ceilometers inside & outside, KUC AWSes	aerosol backscatter - temperature structure connection; SLC-BCM aerosol depth differences

Table 2. Locations of automatic weather stations

Site	KUC	Years	N latitude	W longitude	Elev (ft)	Elev (m)
Large Reservoir	KUC	all	40° 33' 47.38" or 40.56316°	112° 05' 14.37" or 112.08733°	5367	1636
Dry Fork	KUC	all	40° 33' 43.15" or 40.56199°	112° 08' 57.80" or 112.14939°	6844	2086
Code 51	KUC	all	40° 32' 59.24 or 40.54979°	112° 07' 43.91" or 112.12886°	6612	2015
Bingham Pass	UU	2010-11 2011-12	40° 32' 40.78" or 40.54466°	112° 08' 25.73" or 112.14048°	6473	1973
East Butte	KUC	all	40° 32' 11.35" or 40.53649°	112° 08' 10.78" or 112.13633°	7368	2246
Keystone	KUC	all	40° 03' 40.93" or 40.52804°	112° 07' 00.67" or 112.11685°	6941	2116
SAPP	KUC	all	40° 30' 53.04" or 40.51473°	112° 10' 29.94" or 112.17498°	7421	2262
Galena	KUC	all	40° 30' 23.98" or 40.50666°	112° 09' 32.54" or 112.15904°	7584	2312
Castro	KUC	all	unknown	unknown	unk	unk
Copper	KUC	2012-13	40° 34' 00" or 40.56660°	112° 05' 33" or 112.09243°	5440	1658

Bingham Mine Experiment: 2010-2011

The 2010-2011 winter was characterized by many cloudy cold-air pools.

Sites where data were collected in the 2010-2011 Bingham Mine experiments are shown below in Figures 1 and 2. Additional data are available for this winter from a National Science Foundation (NSF)-funded research program conducted in the Salt Lake Valley. The NSF program was called the Persistent Cold-Air Pool Study (PCAPS); data from this study can be accessed at <http://pcaps.utah.edu>. A number of peer-reviewed journal articles are available from the NSF and Bingham studies. See the reference section at the end of this report.

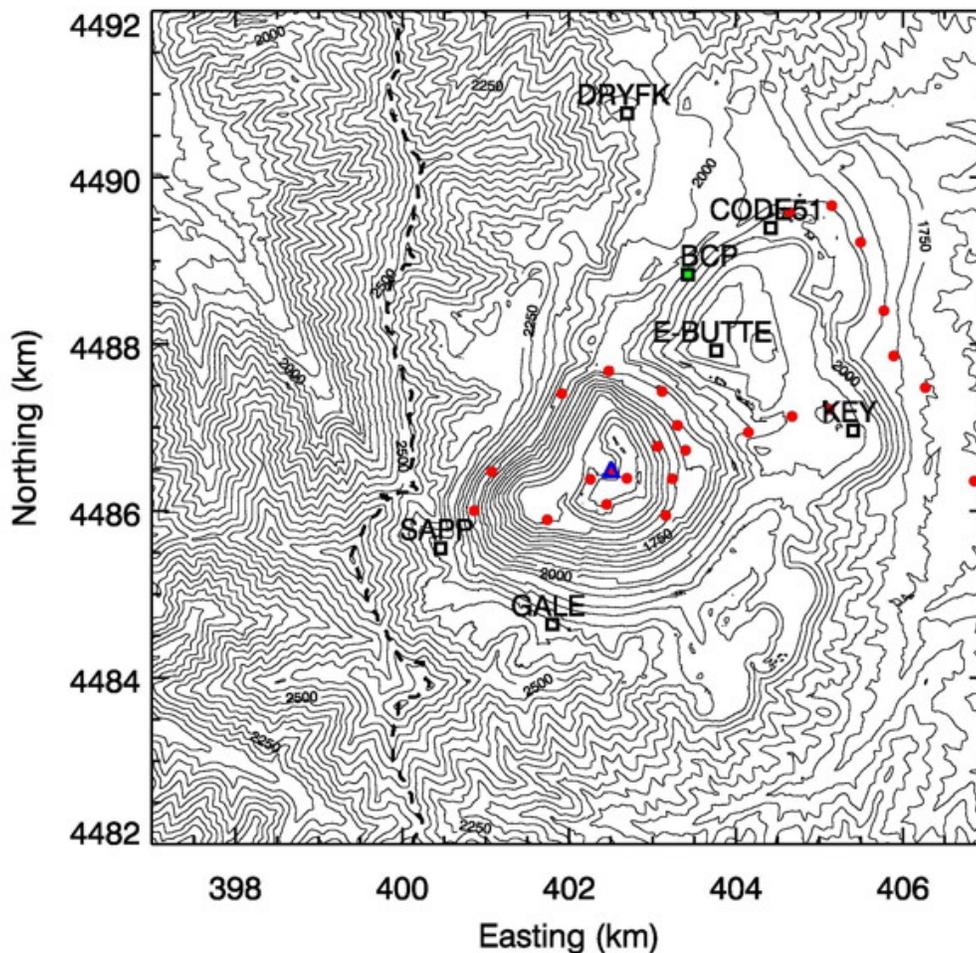


Figure 1. Sites in the immediate vicinity of the mine in 2010-2011. The red dots are HOBO® automatic temperature dataloggers, the triangle is the UU scanning Doppler wind LiDAR, the cyan colored square is the UU AWS at Bingham Pass (BCP), and the remaining sites with the alphanumeric IDs are the KUC AWSes.

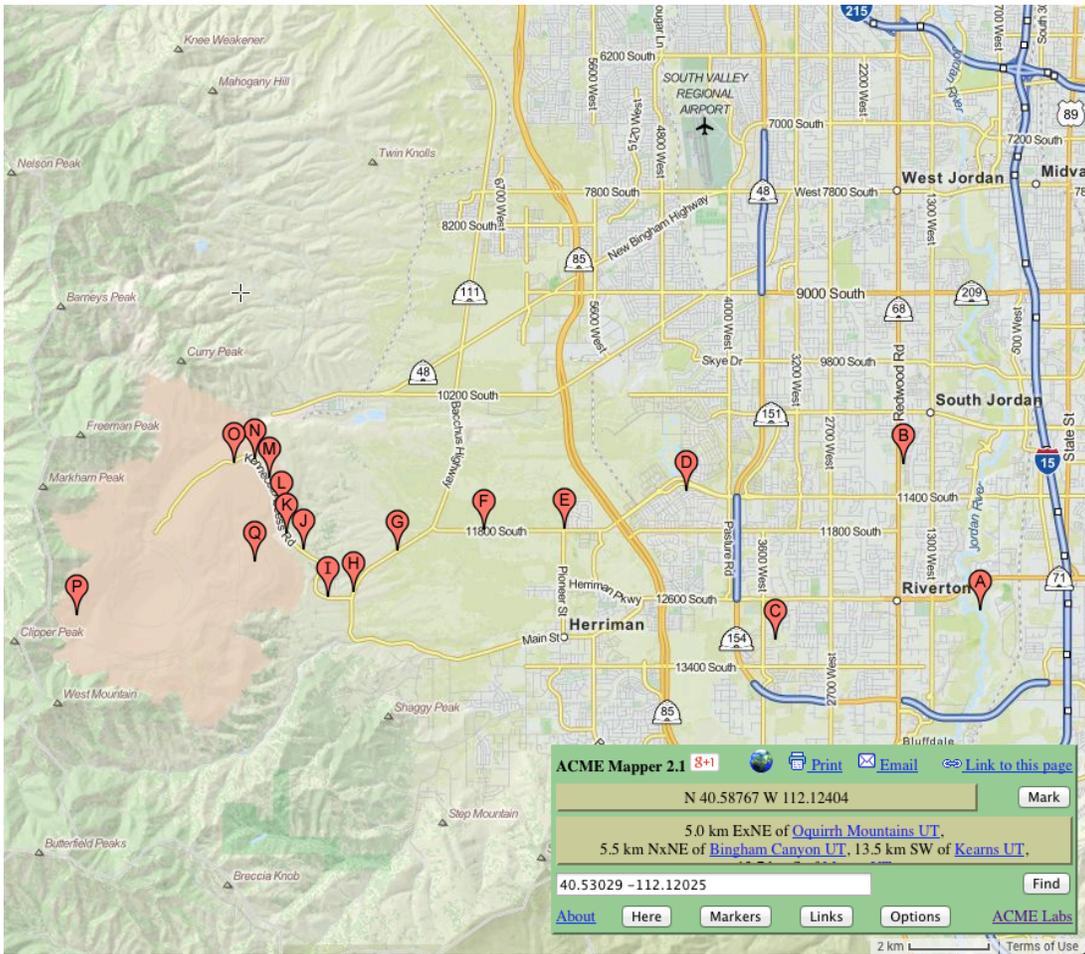


Figure 2. Line of HOBO® temperature data loggers (A-Q) outside the mine in 2010-2011. Letter designators are defined in the first column of Table 3 below. From Acme Mapper (mapper.acme.com).

Automatic temperature data loggers (HOBO®s)

Number of loggers: 33

Period of record: 1200 UTC 30 Nov 2010 to 25, 26, or 30 Apr 2011.

Sites: see table below

33 HOBO® temperature data loggers were deployed with thermistor temperature sensors exposed in self-aspirated radiation shields. Most of the HOBO®s also measured relative humidity (RH). Loggers were set to record samples at 5-min intervals. Altitudes are approximately ± 25 m. Sites are shown in maps above.

Table 3. Locations of HOBO® temperature data loggers during the winter of 2010-2011. Site names designate whether they were inside the mine (Imxxxx), outside the mine (Omxxxx) or on the Kennecott line (Klxxxx) running from the base of the outside of the mine into Riverton, UT.

Site ID	RH?	Latitude (°N)	Longitude (°E)	Actual elevation (m MSL)
Im1372BOTTOM		40.52254	-112.14875	1355
Im1400		40.51969	-112.15157	1388
Im1450HB		40.52239	-112.15393	1445
Im1450		40.52350	-112.15091	1480
Im1550		40.51795	-112.15995	1543
Im1600		40.52603	-112.14447	1607
Im1650		40.52256	-112.14235	1670
Im1700		40.51859	-112.14319	1700
Im1800		40.52833	-112.14171	1773
Im1800B		40.52565	-112.14052	1805
Im1850		40.53198	-112.14393	1843
Im1900		40.53410	-112.15152	1885
Im1950		40.53161	-112.15813	1935
Im2000		40.52307	-112.16788	2010
Im2050	No	40.52769	-112.13165	2052
Im2100		40.52946	-112.12551	2107
Im2150-Q		40.53029	-112.12025	2157
Im2050WEST-P	No	40.51882	-112.17030	2057
Om2000-O		40.55149	-112.12614	1997
Om1950-N	No	40.55229	-112.12026	1950
Om1900-M		40.54837	-112.11611	1898
Om1850-L	No	40.54101	-112.11269	1850
Om1800-K		40.53614	-112.11123	1813
Om1750-J	No	40.53276	-112.10670	1765
Om1700-I		40.52272	-112.09960	1712
Om1650-H	No	40.52382	-112.09233	1673
Kl1600-G		40.53264	-112.08009	1608
Kl1550-F	No	40.53709	-112.05581	1551
Kl1500-E		40.53720	-112.03304	1503
Kl1450-D	No	40.54528	-111.99863	1461
Kl1400-C		40.51361	-111.97361	1395
Kl1350-B		40.55111	-111.93772	1354
Kl1325LOW-A		40.51985	-111.91613	1328

LiDAR winds

Period of Record: 09 February 2011 - 04 May 2011

Site: 40.52350°N, -112.1510°E, 1480 m MSL

The Halo Streamline wind lidar was delivered to UU in early January and the lidar and various communication approaches were tested at a location near the center of the Salt Lake Valley (PCAPS/ISS site; N 40.60056, W 111.92556) before being deployed at the mine on 9 Feb 2011. The range gates were set to 24 m and the lidar was programmed to cycle through a variety of scanning strategies to familiarize ourselves with the lidar and its software. The processed daily wind profiles report the range gate and the wind direction and wind speed from the Doppler Beam Swinging (DBS) scans at 5-min intervals. The 'tar' files provided with the data disk include data from all scanning strategies (DBS, stare, etc.).

Automatic weather stations (KUC and UU)

15-min-average data were available from eight KUC-owned automatic weather stations during this winter. Six were in the immediate vicinity of the Bingham Mine (see Fig. 1). Data were processed in a batch for the 6 stations for both the winters of 2010-2011 and 2011-2012 (see dates in table below). Data are in raw format for the remaining stations. Table 4. Periods of record and meteorological variables sampled at KUC and UU automatic weather stations during the winter of 2010-2011.

Table 4. Automatic weather station periods of record, variables and averaging times.

Site	Period of record	Variables	Avg
Large Reservoir	1645 MST 07 Dec 2010- 1645 MST 10 Feb 2011 and 0530 MST 19 Feb 2011- 1615 MST 12 May 2011	WS, WD, Sig, Gust, T, RH, P, Rain, BATT	15-min
Dry Fork	1415 MST 17 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Code 51	1345 MST 16 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Bingham Pass	1205 MST 03 Dec 2010- 0850 MST 04 May 2011	BATT, T, RH, Kdn, P, WS, WD	5-min
East Butte	0800 MST 28 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Keystone	1530 MST 16 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvNR, BATT	15-min
SAPP	1515 MST 09 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT	15-min
Galena	1330 MST 09 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT	15-min
Castro	0945 MST 08 Dec 2010- 0845 MST 21 Jan 2011	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min

Bingham Mine Experiment: 2011-2012

The 2011-2012 winter was characterized by few cold-air pools.

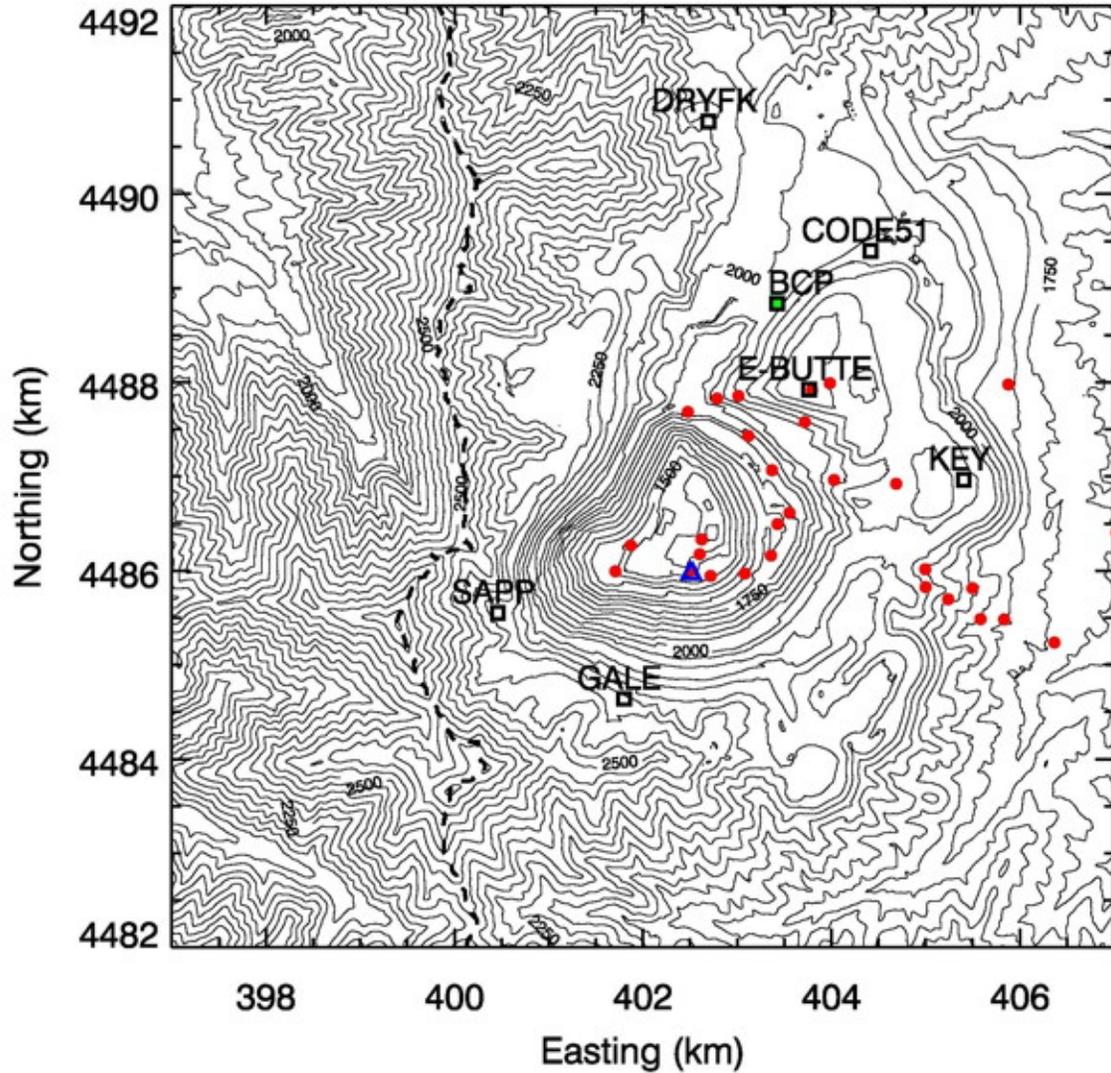


Figure 3. Sites used in 2011-2012. The red dots are HOBO®s, the blue triangle is the LiDAR, the cyan colored square is the AWS at Bingham Pass (BCP), and the remaining sites with alphanumeric IDs are the KUC automatic weather stations.

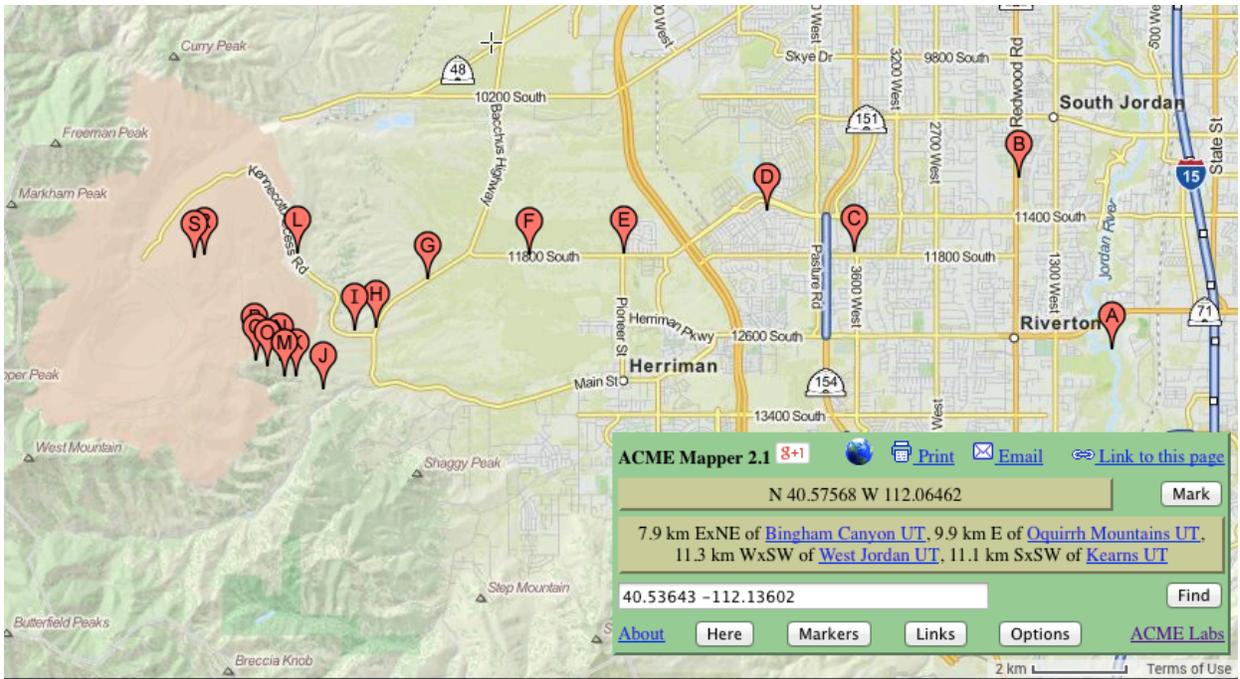


Figure 4. Line of HOBO®s (A-S) outside of the mine in 2011-2012. Labels are defined in the first column of Table 9 below. From Acme Mapper (mapper.acme.com).

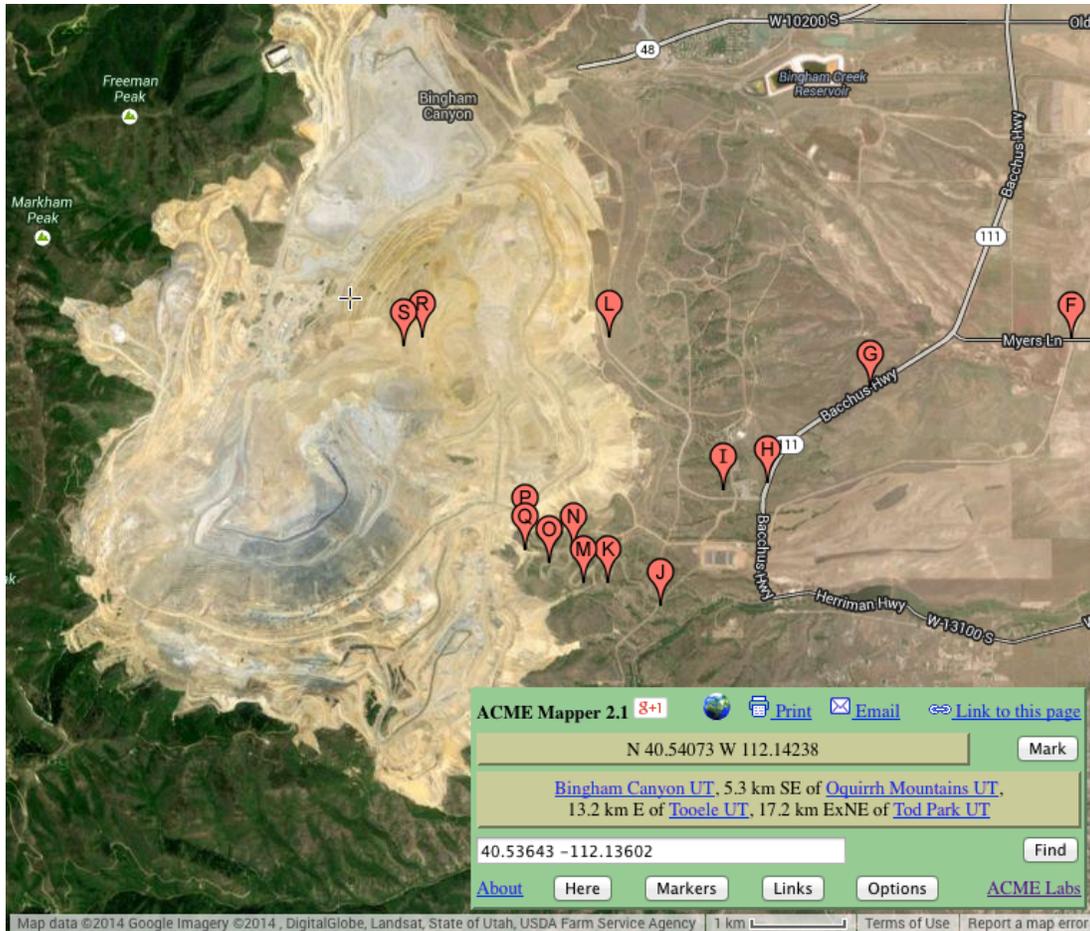


Figure 5. Close-up map of partial HOBO® line (F-S) outside the mine in 2011-2012. From Acme Mapper (mapper.acme.com).

Automatic temperature data loggers (HOBO®s)

Number of loggers: 37

Period of record: 0000 UTC 19 Dec 2011 - 0955 UTC 03 Mar 2012, 5-min data

Sites: see table below

37 HOBO®s were deployed in and around the mine in 2011-2012. These were at different sites than for 2010-2011, with HOBO®s outside the mine starting down the Burma Road rather than along the mine access road. There were a limited number of HOBO®s with relative humidity sensors, as in the year before. H17 was buried in snow partway through the winter. H09 was lost and later recovered. Locations: H01 was at the bottom of the mine; H03 was co-located with the lidar; H07 was at the 5390 substation, H09 was at the conveyor; H14 was at the Visitor Center; H15 at Production Control, H19 at the summit of East Butte; H21 at Burma Summit; H25 at Burma Gate; H29 at Lark; H32 was outside the haul road; H33 at the high school; H34 at the glass house; H35 at a gas station; H36 at Enterprise, and H37 at the Golf Course.

Table 5. Locations of HOBO® temperature data loggers during the winter of 2011-2012.

Site ID	RH?	Latitude (°N)	Longitude (°E)	Map elevation (m MSL)
H01		40.52201	-112.14957	1352
H02		40.52058	-112.14979	1405
H03		40.51905	-112.15083	1442
H04	No	40.51856	-112.14831	1490
H05		40.52134	-112.15845	1490
H06	No	40.51885	-112.16032	1525
H07		40.51880	-112.14411	1643
H08	No	40.52357	-112.14009	1677
H09		40.52055	-112.14086	1703
H10	No	40.52465	-112.13861	1750
H11		40.52871	-112.14088	1797
H12	No	40.53196	-112.14389	1843
H13		40.53418	-112.15151	1888
H14	No	40.53550	-112.14787	1958
H15		40.53577	-112.14520	2040
H16	No	40.53336	-112.13684	2037
H17		40.52785	-112.13309	2037
H18		40.52756	-112.12529	2120
H19-S		40.53643	-112.13602	2247
H20-R		40.53710	-112.13377	2187
H21-Q		40.51772	-112.12144	2045
H22-P		40.51943	-112.12151	2003
H23-O	No	40.51659	-112.11859	1962
H24-N		40.51767	-112.11558	1905
H25-M	No	40.51473	-112.11452	1845
H26-L	No	40.53720	-112.11140	1822
H27-K		40.51473	-112.11155	1807
H28-J		40.51257	-112.10523	1742
H29-I		40.52316	-112.09756	1702
H30-H	No	40.52384	-112.09235	1666
H31-G		40.53257	-112.08001	1608
H32-F	No	40.53706	-112.05581	1551
H33-E		40.53716	-112.03297	1503
H34-D	No	40.54523	-111.99867	1461
H35-C		40.53765	-111.97768	1391
H36-B	No	40.55115	-111.93819	1352
H37-A		40.51984	-111.91613	1328

LIDAR winds

Period of Record: 20 December 2011 - 06 April 2012

Site: 40.51905°N, 112.15083°W, 1445 m MSL

The lidar was operated much like in 2010-2011, but from a different site. 'Tar' files include data from all scanning strategies. Wind profile data are available in separate files every 5 minutes. These data, which include range gate, wind direction and wind speed are plotted as daily wind speed and wind vector profile time-height cross sections.

Automatic weather stations

Processed automatic weather station data for this year are duplicates of the processed files described for 2010-2011. The 6 closest KUC stations to the mine are fully processed and there were no changes in site locations between these two winters. Castro and Large Reservoir were located a long way from the mine; while raw data are available for these two sites, the data have not been processed. The UU AWS at Bingham Pass was located in the same spot as for 2010-2011 and the same variables were measured. These data are in UTC, starting at 0000 UTC 20 Dec 2011 and running through 1430 UTC 02 May 2012. The data are in a raw CSV-delimited file.

Table 6. Periods of record and meteorological variables sampled at KUC and UU automatic weather stations during the winter of 2011-2012.

Site	Period of record	Variables	Avg
Large Reservoir	Missing	WS, WD, Sig, Gust, T, RH, P, Rain, BATT	15-min
Dry Fork	1415 MST 17 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Code 51	1345 MST 16 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Bingham Pass	0000 UTC 20 Dec 2011 - 1430 UTC 02 May 2012	BATT, T, RH, Kdn, P, WS, WD	5-min
East Butte	0800 MST 28 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min
Keystone	1530 MST 16 Dec 2010- 1100 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvNR, BATT	15-min
SAPP	1515 MST 09 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT	15-min
Galena	1330 MST 09 Dec 2010- 1115 MST 01 May 2012	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT	15-min
Castro	0945 MST 08 Dec 2010- 0845 MST 21 Jan 2011	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT	15-min

Bingham Mine Experiment: 2012-2013

The 2012-2013 winter had many cold-air pools.

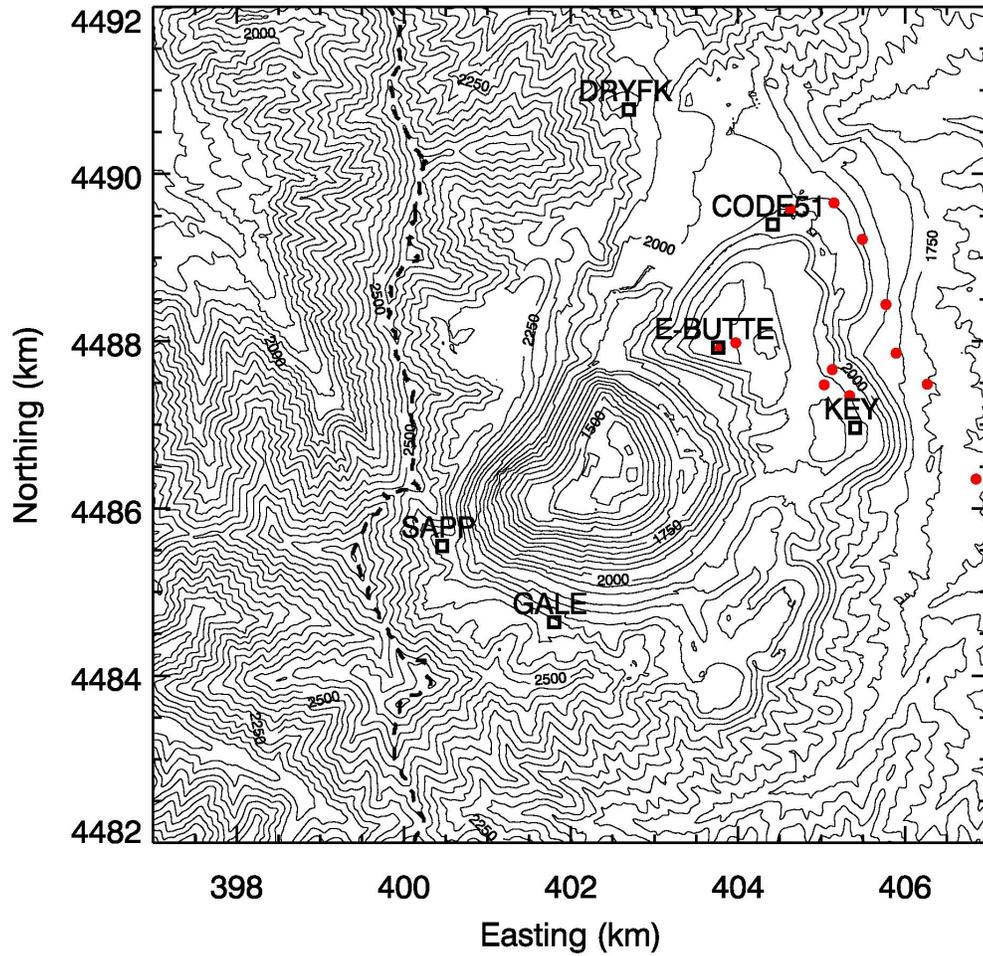


Figure 6. Sites used in 2012-2013. The red dots are HOBOS, and the sites with numeric IDs are the KUC automatic weather stations.

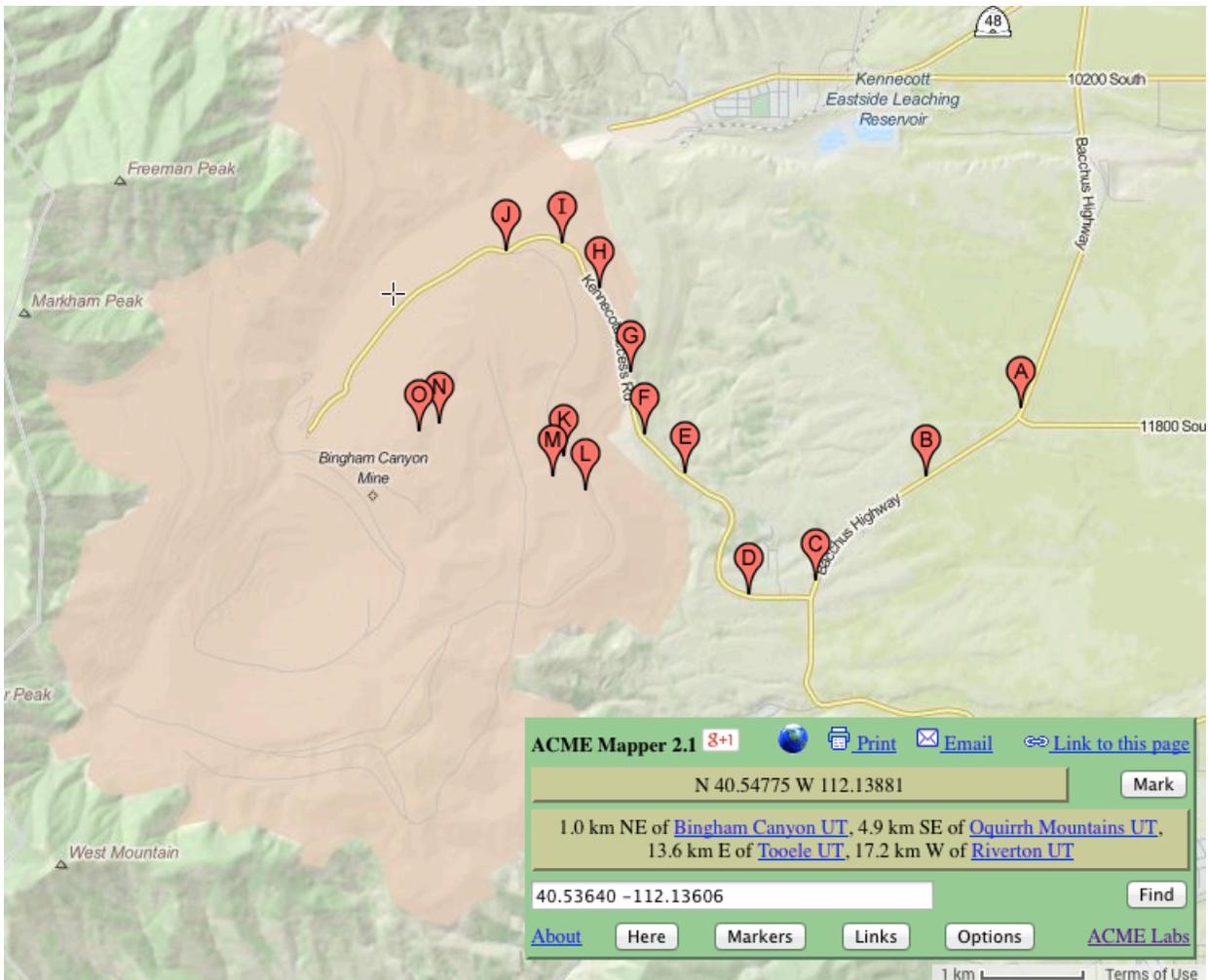


Figure 7. Line of HOBO®s (A-M) outside the mine in 2012-2013. Labels are defined in the first column of Table 7 below. From Acme Mapper.

Automatic Temperature data loggers (HOBO®s)

Number of loggers: 15

Period of record: 0000 UTC 20 Dec 2012 - 1955 UTC 19 May 2013, 5-min data

Sites: see table below

15 HOBO®s were deployed in the winter of 2012-2013, with no HOBO®s placed inside the mine. A major landslide occurred in the mine on Wednesday, 10 April 2013. We were fortunate to have no equipment inside the mine this winter, although we lost the top-most two HOBO®s in the landslide. The lowest elevation data started on 8 January 2013. Elevations are estimated for the three lowest elevation sites.

Table 7. Locations of HOBO® temperature data loggers during the winter of 2012-2013.

Site ID	Latitude (°N)	Longitude (°E)	Nominal elevation (m MSL)	Google_ Earth elevation (m MSL)	HOBO® serial number
H163-O	40.53640	-112.13606	2250	2251	9806349
H164-N	40.53701	-112.13387	2200	2196	9806352
H165-M	40.53260	-112.12130	2150	2146	9806344/6
H166-L	40.53148	-112.11769	2100	2107	9784029
H167-K	40.53426	-112.12018	2050	2071	9806358
H162-J	40.55149	-112.12638	2000	2003	9806336
H161-I	40.55221	-112.12024	1950	1956	9806337
H160-H	40.54833	-112.11617	1900	1905	9806346
H159-G	40.54134	-112.11272	1850	1860	9806353
H158-F	40.53611	-112.11119	1800	1817	9784028
H157-E	40.53281	-112.10674	1750	1769	9806342
H156-D	40.52266	-112.09967	1700	1721	9806354
H169-C	40.52383	-112.09232	1650	1673	9806339
H168-B	40.53264	-112.08007	1600	1608	9806356
H170-A	40.53840	-112.06965	1600	1583	9784027 Ceilometer & HOBO®

Ceilometer outside mine

Period of record: 12 Jan to 31 Mar 2012

Site: 11702 Bacchus Highway, Herriman, UT 84096, 40.53840°N, -112.06965°E, ~1600 m MSL

A Vaisala Model CL-31 laser ceilometer was operated during the winter of 2012-2013 at a site on KUC land next to Highway 111 near the intersection of W 11800 S. Vertical backscatter profiles were generated every 16 seconds to a maximum range of 7700 m, with range gates every 10 m. These data were automatically sent to the University of Utah every 24 hours through an AT&T phone modem. The data were then automatically plotted and uploaded to a webpage for access by the public. Because of phone modem dropouts there were substantial periods of missing data (Fig. 8)

Backscatter figures have been generated for each day for two height ranges: 2000 and 3500 m AGL.

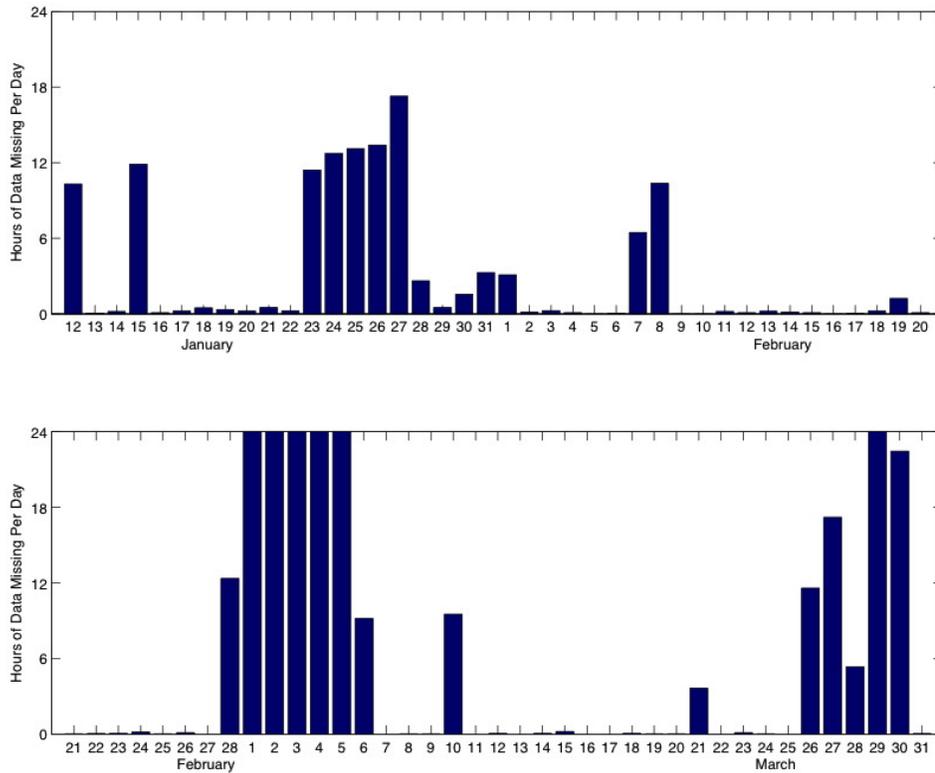


Figure 8. Missing hourly ceilometer data for the winter of 2012-2013.

KUC AWSes

All stations except C2 have 15-min wind speed (m/s), wind gust (m/s), wind direction (deg), sigma, average temperature ($^{\circ}\text{C}$), and average relative humidity (%). For C2, we have only 1-min wind speed and direction and only for 1 November. Castro, Galena, and Large Reservoir are missing data. The processed data files have filled in missing data with NaNs and a ReadMe file describes the columns of data. Figures for each site for the entire time period are also in the AWS folder.

Table 8. Periods of record and meteorological variables sampled at KUC automatic weather stations during the winter of 2012-2013.

Site	Pd of record	Variables	Avg
Large Reservoir	0015 MST 01 Nov 2012-0000 MST 01 Apr 2013	WS, WD, Sigma, Gust, T, RH	15-min
Dry Fork	0015 MST 01 Nov 2012-0000 MST 01 Apr 2013	WS, WD, Sigma, Gust, T, RH	15-min
Code 51	0015 MST 01 Nov 2012-1200 MST 01 April 2013	WS, WD, Sigma, Gust, T, RH	15-min
East Butte	0015 MST 01 Nov 2012-1200 MST 01 April 2013	WS, WD, Sigma, Gust, T, RH	15-min
Keystone	0015 MST 01 Nov 2012-1200 MST 01 April 2013	WS, WD, Sigma, Gust, T, RHv	15-min
SAPP	0015 MST 01 Nov 2012-1200 MST 01 April 2013	WS, WD, Sigma, Gust, T, RH	15-min
Galena	0015 MST 01 Nov 2012-1200 MST 01 April 2013	WS, WD, Sigma, Gust, T, RH	15-min
Castro	1015 MST 16 Nov 2012-0415 MST 19 Jan 2013 and 0115 MST 18 Feb 2013-0000 MST 01 Apr 2013	WS, WD, Sigma, Gust, T, RH	15-min
Copperton AQ C2_1	0011 MST 01 Nov 2012-0010 MST 02 Nov 2012	WS, WD (one day only)	1-min
Copper	0015 MST 01 Nov 2012-0000 MST 01 Apr 2013	WS, WD, Sigma, Gust, T, RH	15-min

Bingham Mine Experiment: 2013-2014

This winter had many cold-air pools.

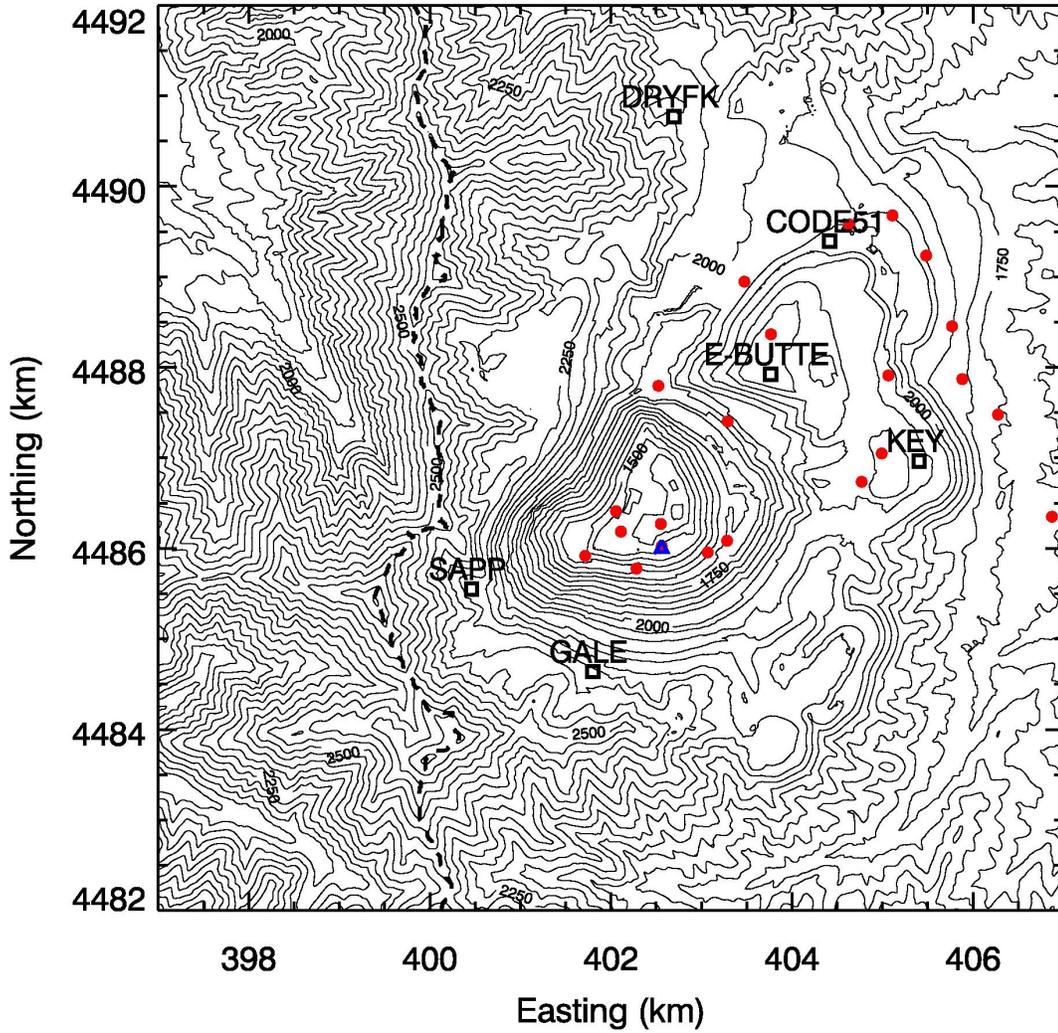


Figure 9. Sites used in 2013-2014. The red dots are HOBO®s, the blue triangle is the ceilometer, and the sites with alphanumeric IDs are the KUC automatic weather stations.

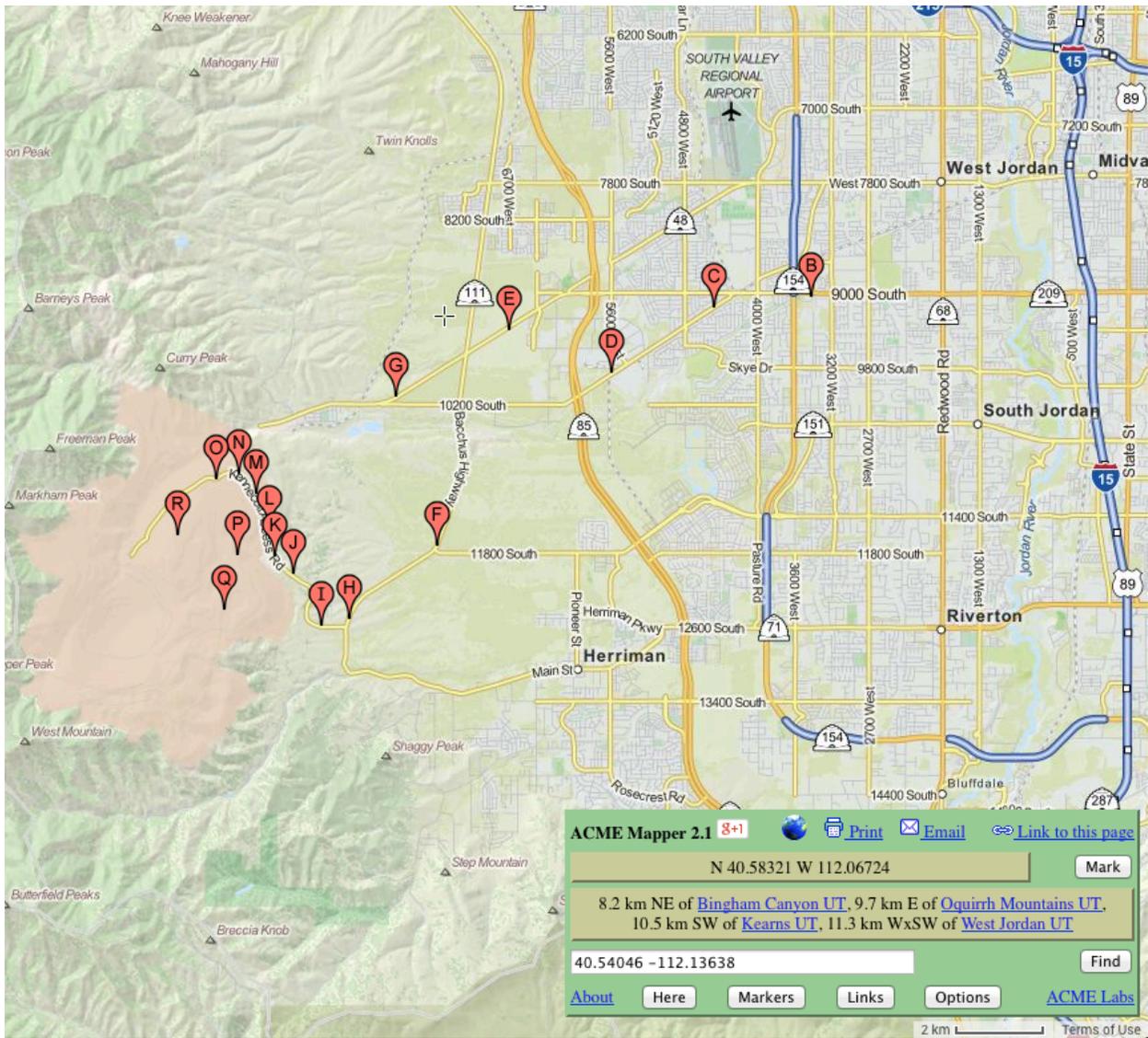


Figure 10. Line of HOBO®s (A-R) outside the mine in 2013-2014. Labels are defined in the first column of Table 9 below. Site A is off the map far to the NE near 9th East and 9th South in Salt Lake City. From Acme Mapper (mapper.acme.com).

Temperature data loggers

Number of loggers: 28

Period of record: 0000 UTC 3 Dec 2013 - 1940 UTC 02 May 2014, 10-min data

Sites: see table below. 2 HOBO®s were lost during the winter (plowed under?): 187 and 197

Table 9. Locations of HOBO® temperature data loggers during the winter of 2013-2014.

Waypoint	inside/outside	Latitude (°N)	Longitude (°E)	Elevation (m MSL)	Description
198	in	40.52063	-112.15560	1405	bottom/PITRAM
208	in	40.51923	-112.15026	1457	ceilo/pump
196	in	40.52265	-112.15628	1472	10%West
195	in	40.51817	-112.16022	1544	10%SWCorner
194	in	40.51696	-112.15353	1608	10%PipelineRd
193	in	40.51867	-112.14426	1648	10%Pump
192	in	40.51986	-112.14175	1710	10%Laser
191	in	40.53174	-112.14188	1830	10%Slide
190	in	40.53518	-112.15096	1890	10%Goat
189	out-in	40.54566	-112.13992	1979	Bingham_Pass
188-R	out-in	40.54046	-112.13638	2231	EastButte
186-Q	out	40.52589	-112.12430	2131	CodeX
185-P	out	40.53651	-112.12099	2089	CodeX
184-O	out	40.55149	-112.12632	2014	Access_road
183-N	out	40.55243	-112.12072	1970	Access_road
182-M	out	40.54848	-112.11626	1915	Access_road
181-L	out	40.54148	-112.11277	1873	Access_road
180-K	out	40.53624	-112.11134	1831	Access_road
179-J	out	40.53275	-112.10663	1789	Access_road
178-I	out	40.52266	-112.09943	1720	Access_road
199-H	out	40.52396	-112.09221	1673	LarkGate
205-G	out	40.56768	-112.08011	1634	zone6_Copperton
200-F	out	40.53842	-112.06944	1583	HWY111Meyers
204-E	out	40.58071	-112.05104	1539	terminal field
203-D	out	40.57224	-112.02443	1496	3MG_field
202-C	out	40.58506	-111.99796	1435	oldHW
201-B	out	40.58707	-111.97312	1397	cemeterytank
207-A	out	40.75150	-111.86759	1311	backyard

Ceilometer inside mine

Period of record: 18 Dec 2013 through 28 Mar 2014

Site: 40.51923°N latitude, -112.15026°E longitude, 1457 m MSL

A Vaisala Model CL31 laser ceilometer was operated during the winter of 2013-2014 at a site near the floor of the Bingham Mine. Vertical backscatter profiles were generated every 16 seconds to a maximum range of 7700 m, with range gates every 10 m. These data were stored locally on a Raspberry Pi (RPI) computer. At the end of the day the RPI assembles and compresses a daily file that is copied to a local directory. Servers at the

University then automatically establish a connection to the RPI and download the data to our computer file system, where it is processed, quality controlled, plotted and uploaded to a publicly accessible webpage.

Ceilometer outside mine

Period of record: 19 Dec 2013 through 22 Apr 2014

Site: 40.75150°N latitude, -112.86759°E longitude, 1307 m MSL

A second Vaisala Model CL-31 laser ceilometer was operated during the winter of 2013-2014 at a site near 9th East and 9th South in Salt Lake City. Vertical backscatter profiles were generated every 16 seconds to a maximum range of 7700 m, with range gates every 10 m. These data were processed like the ceilometer data from inside the mine.

KUC AWSes

Table 10. Periods of record and meteorological variables sampled at KUC automatic weather stations during the winter of 2013-2014. The East Butte site was destroyed in a landslide in April 2013, so that no data are available for the winter of 2013-2014.

Site	Period of record	Variables (NOT YET KNOWN)	Avg
Large Reservoir	0015 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min
Dry Fork	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min
Code 51	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min
East Butte	0000 MST 01 Jan 2013-2000 MST 10 Apr 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min
Keystone	0000 MST 01 Jan 2013-2300 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvNR, BATT, WS_mph, T°F	15-min
SAPP	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT	15-min
Galena	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, AvSWE, BATT, WS_mph, T°F	15-min
Castro	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sig, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min
Copper	0000 MST 01 Jan 2013-2345 MST 17 Jul 2014	WS, WD, Sigma, Gust, T, RH, P, Rain, AvSR, BATT, WS_mph, T°F	15-min