GROUND GRAVITY MEASUREMENTS FROM GOLDSTREAM VALLEY, INTERIOR ALASKA

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GROUND GRAVITY MEASUREMENTS FROM GOLDSTREAM VALLEY, INTERIOR ALASKA

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ABSTRACT

The Goldstream Valley, located in Fairbanks, Alaska, is a semi-urban arctic watershed targeted for multidisciplinary investigations of interactions between permafrost, groundwater, surface hydrology, and biogeochemical cycles to understand the release of methane gas from degrading permafrost. To support concurrent research, Alaska Division of Geological & Geophysical Surveys (DGGS) staff collected gravity measurements from 105 stations throughout the Goldstream Valley during 2017 and 2018 (fig. 1). These stations were collected to help determine the depth of fill in the Goldstream Valley. Bouguer anomaly maps were created of the study area. All files can be downloaded from the DGGS website: http://doi.org/10.14509/30473.

DATA PRODUCTS

The following digital products were produced for this project:

- Processed data in ASCII and Geosoft database formats
- Simple Bouguer gravity[4,] data and grids (fig. 2.)
- Complete Bouguer gravity[5] data and grids (fig. 3)

DATA ACQUISITION AND EDITING

Data were collected on the ground using the LaCoste & Romberg gravimeter number 507. The gravimeter was primarily transported by bicycle. Station coordinates were positioned using a real-time or post-processed corrected differential GPS. Data were tied to absolute gravity using U.S. Geological Survey (USGS) absolute gravity station Fairbanks C. Repeat readings were made for data quality (table 1). The data were examined and filtered to remove erroneous locations or readings.

DATA PROCESSING

The gravity data were reduced to the simple Bouguer anomaly values. This processing removes the effects of instrument drift, moon induced tides, latitude, and elevation. The values were calculated using a reduction density of 2.67 g/cm^3. Several stations were also collected on packed snow or ice. Estimated densities of packed snow or ice and their effects were also included in the processing.

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[4] Simple Bougeur gravity = station gravity – latitutde correction + free-air elevation correction – Bouguer slab correction
[5] Complete Bouguer gravity = station gravity – latitutde correction + free-air elevation correction – Bouguer slab correction – terrain corrections

Terrain corrections were applied to a distance of 166.7 km using Alan Cogbill's algorithm (Cogbill, 1990) and digital terrain models derived from radar altimeter data (table 2). 166.7 km is the distance at which the effect of the earth's curvature has a greater influence than the effect of terrain for most places on earth. No earth curvature corrections were applied. After applying these corrections, remaining contrasts in the gravimetric response are caused by geology. Cogbill's algorithm creates a smooth surface using a multi-polynomial formula for the inner terrain correction and simple blocks for the outer terrain correction. The complete Bouguer anomaly was calculated by adding the simple Bouguer gravity and all the terrain corrections.

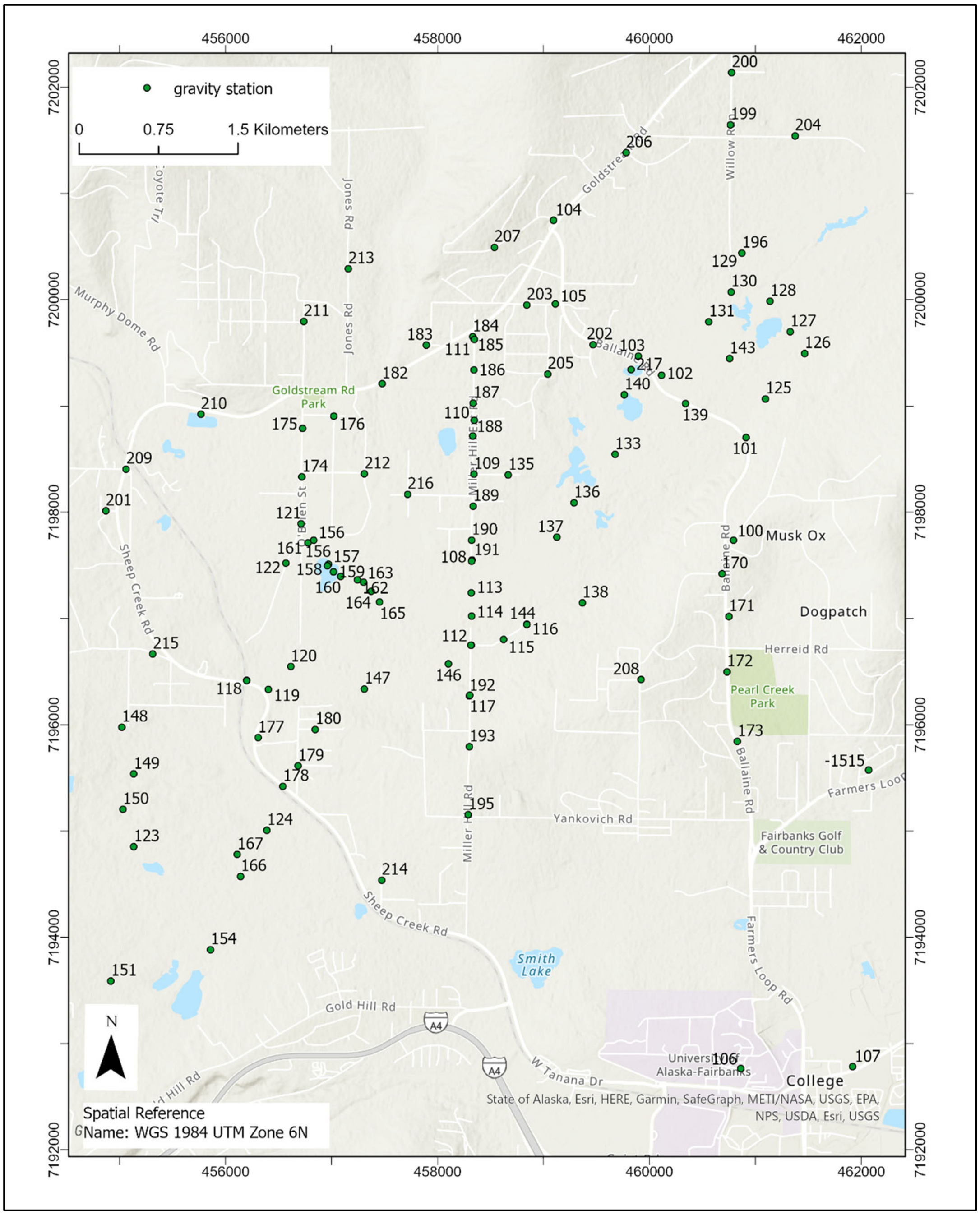

Figure 1. Map showing gravity station locations and nearby roads.

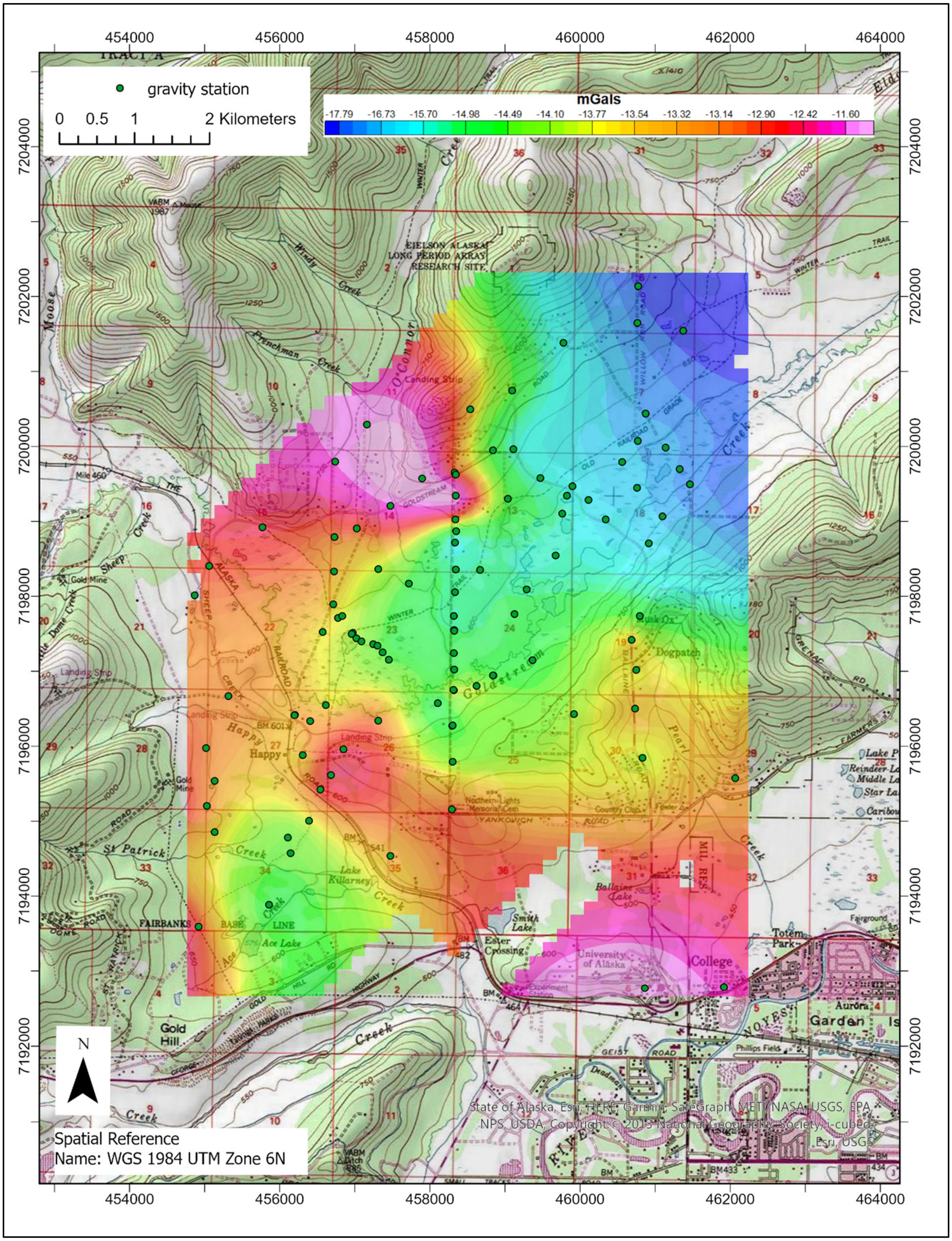

Figure 2. Preview of the simple bouguer anomaly grid, station locations, and UTM grid. Maps, grids, and point data are available in the digital data distribution package of this report.

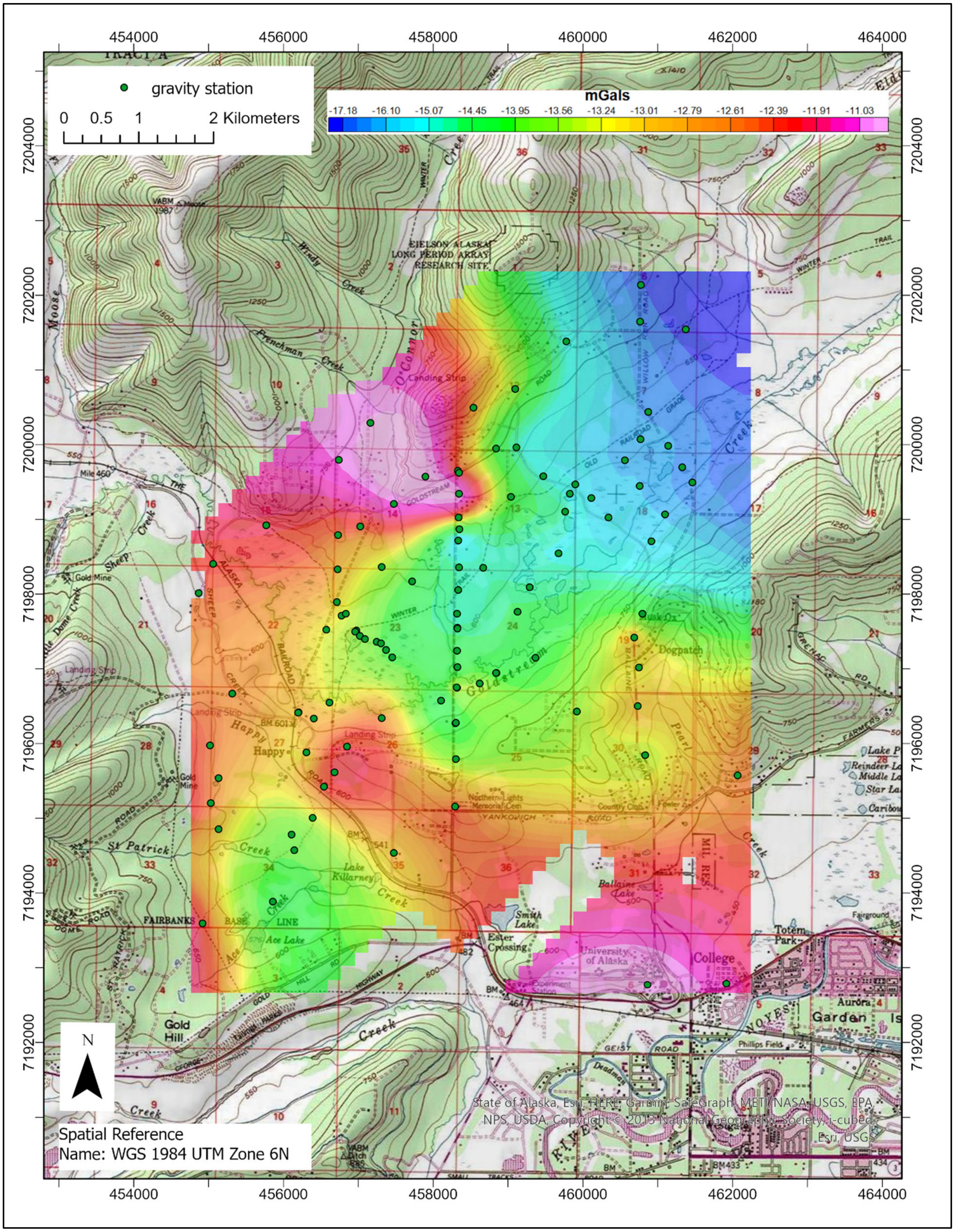

Figure 3. Preview of the complete bouguer anomaly grid, station locations, and UTM grid. Maps, grids, and point data are available in the digital data distribution package of this report.

Table 1. Repeated stations.

Station Name	Reading count	Range in mGal
mhr	10	0.07
sheeprr	9	0.28
balaineppull	5	0.09
1515correct	4	0.09
fairbanks-c	4	0.04
mailbox2080	4	0.08
dggs-E-20170	3	0.02
rr00	3	0.22
rr013a	3	0.02
vollata	3	0.04
2243	2	0.19
chili	2	0.07
dl001	2	0.01
eldorado	2	0.08
gsv010	2	0.02
gsvw06	2	0.42
gsvw10	2	0.04
mhex01	2	0.03

Table 2. Distance, digital terrain model, and the algorithm used to calculate terrain corrections.

Distance	Digital terrain model	Algorithm
5m-1,500m	5m radar grid	Cogbill algorithm, smooth integrated surface
1,500m-3km	30m radar grid	Cogbill algorithm, smooth integrated surface
3km -14km	30m radar grid	Cogbill algorithm, flat-topped prisms
14km -166.7km	30-arcsecond grid	Cogbill algorithm, flat-topped prisms

ACKNOWLEDGMENTS

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