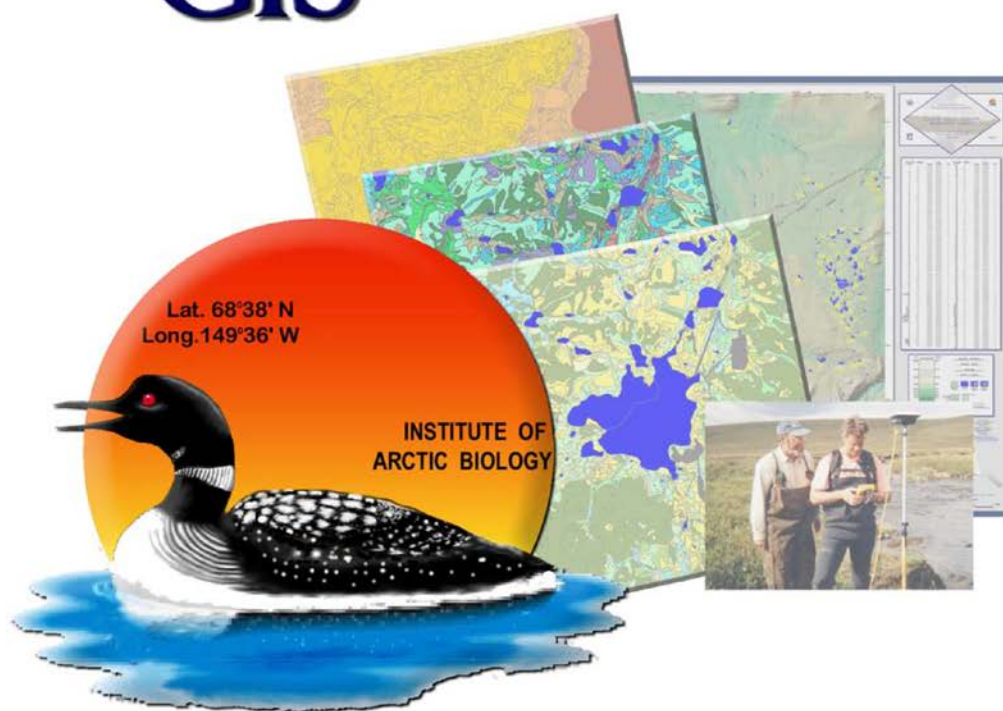

TOOLIK FIELD STATION GIS



ANNUAL REPORT
2013

Jason Stuckey, GIS & Remote Sensing Manager
Institute of Arctic Biology
University of Alaska Fairbanks

EXECUTIVE SUMMARY

GIS Services 2012-2013

This past year, Toolik Field Station continued to provide its standard suite of GIS services which included: assisting researchers with site-selection requests, recording the location of new sampling sites, collecting survey-grade data, producing customized maps, and providing comprehensive project support and analysis. This past year, Toolik GIS fulfilled over 200 requests from researchers from twenty-eight institutions. Like last year, all three staff members were at the field station during peak periods of June and July, and two staff members were on hand the remaining time. With three GIS staff members onsite, we were able to provide immediate turnaround for time sensitive requests, and still effectively monitor the influx of all researchers and record new research site locations. This year we provided field support for 3 new projects. As an ongoing service, Toolik GIS continued to provide researchers with site selection assistance and assisted 8 researchers with their projects. Toolik GIS continued collaborating with Beth Nielson creating 3D models of water depth at her Imnavait research site. Toolik GIS staff assisted the BLM archaeologist with his aerial archaeological survey of the Toolik Natural Research Area in support of the NSF-BLM MOU currently in development. Aerial photographs were collected over the field station and high-intensity research areas. Recommendations from the Science Vision Workshop such as the creation of a Toolik Data Service and the acquisition of high-resolution digital elevation models were pursued.

GIS Services 2013-2014

Toolik GIS will continue to provide on-site GIS and remote sensing services to support Toolik research and TFS administration and management. Direct support of individual projects includes field GPS data collection and analyses, data development and distribution, statistical summary, and production of figures for use in presentations and publications. Indirect support includes the upgrade and maintenance of GPS and GIS equipment and base stations, and the continued acquisition and integration of framework data into the GIS database. In order to remain up to date on the most current GIS and GPS software, techniques and equipment, Toolik GIS staff will attend two conferences within the next year. A PDF document containing a subset of bathymetric data for lakes throughout the Toolik region, including basic maps, 3D maps, and hypsographic curves, will be available on the Toolik GIS website by January 2014. Toolik GIS will reprocess historic aerial imagery to align correctly with the newly acquired 2013 aerial dataset. We will continue with our summer staffing level of 2.5 people, adjusting our work and overtime hours in response to user demand. We will maintain 2 staff members during the winter season to handle data maintenance, the larger time commitment involved in advanced GIS and remote sensing analyses, and the production of custom maps for publication.

TOOLIK FIELD STATION GIS & REMOTE SENSING

SUMMARY

Toolik Field Station GIS continued to provide an array of services for Toolik research, administration and management. Direct support followed the model of previous years, and included a variety of requests, analyses, data development and distribution, statistical summary, and production of graphs, tables, maps, and figures for use in presentations, reports, and publications.

Like last year, all three staff members were at the field station during peak periods of June and July, and two staff members were on hand the remaining time. With three GIS staff members onsite, we were able to provide immediate turnaround for time sensitive requests, and still effectively monitor the influx of all researchers and record new research site locations.

This year we provided field support for 3 new projects. One example of a project we supported was Lee Vierling's LiDAR project. Bathymetric data was collected for 17 different lakes and added to our bathymetric dataset now totaling nearly 70 lakes. As an ongoing service, Toolik GIS continued to provide researchers with site selection assistance, and assisted 8 researchers with their projects. Of note was our continued collaboration with Beth Nielson creating 3D models of water depth at her Imnavait research site. Toolik GIS staff assisted the BLM archaeologist with his aerial archaeological survey of the Toolik Natural Research Area in support of the NSF-BLM MOU currently in development. Aerial photographs were collected over the field station and high-intensity research areas. Recommendations from the Science Vision Workshop such as the creation of a Toolik Data Service and the acquisition of high-resolution digital elevation models were pursued.

DIRECT SUPPORT

Examples of direct support include one or more of the following major categories: 1) data development, 2) spatial analysis, 3) logistical support, 4) statistical summary and 5) production of maps/graphs/tables/figures for presentations/reports/publications. The following examples for FY2011 illustrate some typical examples.

Data Development and Spatial Analysis

Last year Toolik GIS developed 3D models of the terrain, permafrost layer, and pools within one of Dr. Neilson's study areas at Imnavait Creek. This year, we used water elevation measurements recorded every 15 minutes by piezometers distributed throughout the same study area to create multiple, spatially and temporally explicit 3D models of water depth. We added these 3D water models into last year's models so that Dr. Neilson can begin to explore the spatial and temporal movement of water across the terrain, along the permafrost layers, and into and out of the pools of her study area.

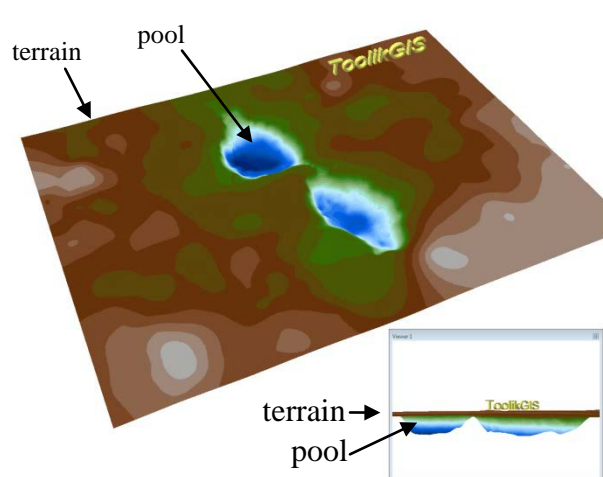


Figure 7.3.1: The beige and light tan areas of the terrain indicate areas of high elevation. Dark brown and green areas are areas of mid-level elevation. Dark blue areas within the ponds are the lowest (deepest) areas of elevation.

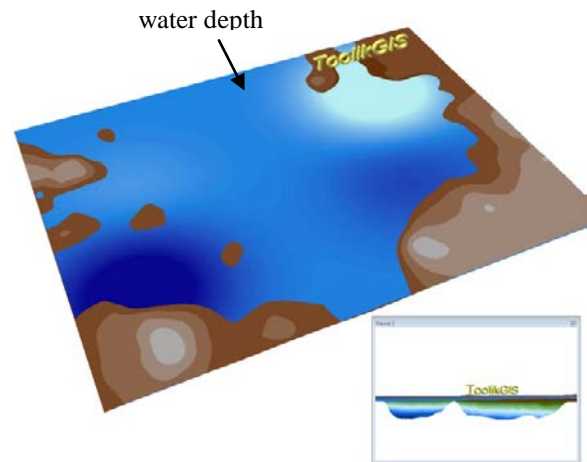


Figure 7.3.2: Dark blue area indicate areas of deep water; light blue area indicates areas of shallow water depth.

Summer Field Support

This year we provided field support for 3 new projects. One example of a project we supported was Lee Vierling's LiDAR project. Toolik GIS staff worked with Dr. Vierling and his graduate student to establish 23 ground control sites to support an aerial LiDAR data collection. Over the course of one month, mobile GPS stations were deployed for a 24 time period at each site and then retrieved. The GPS data was downloaded and processed by Toolik GIS staff and delivered to the LiDAR contractor for accuracy assessment. By providing this service, the Vierling research group was able to focus on their primary research goals during their time at the field station.

Bathymetric Mapping of Research Lakes

This summer Toolik GIS staff collected and processed bathymetric data of 17 different lakes for Will Longo's research project. Field maps, 3D maps, hypsographic curves, and histograms were derived from the dataset, and will be used by Mr. Longo to look for relationships between lake morphometry and different types of biomarkers. Specifically, the bathymetric data will help him understand how lake morphometry affects the temperature signal recorded by these biomarkers, and will also help model air temperature using the lake water temperatures that some of these proxies record. These lakes will be added to our bathymetric dataset and made available to the Toolik research community.

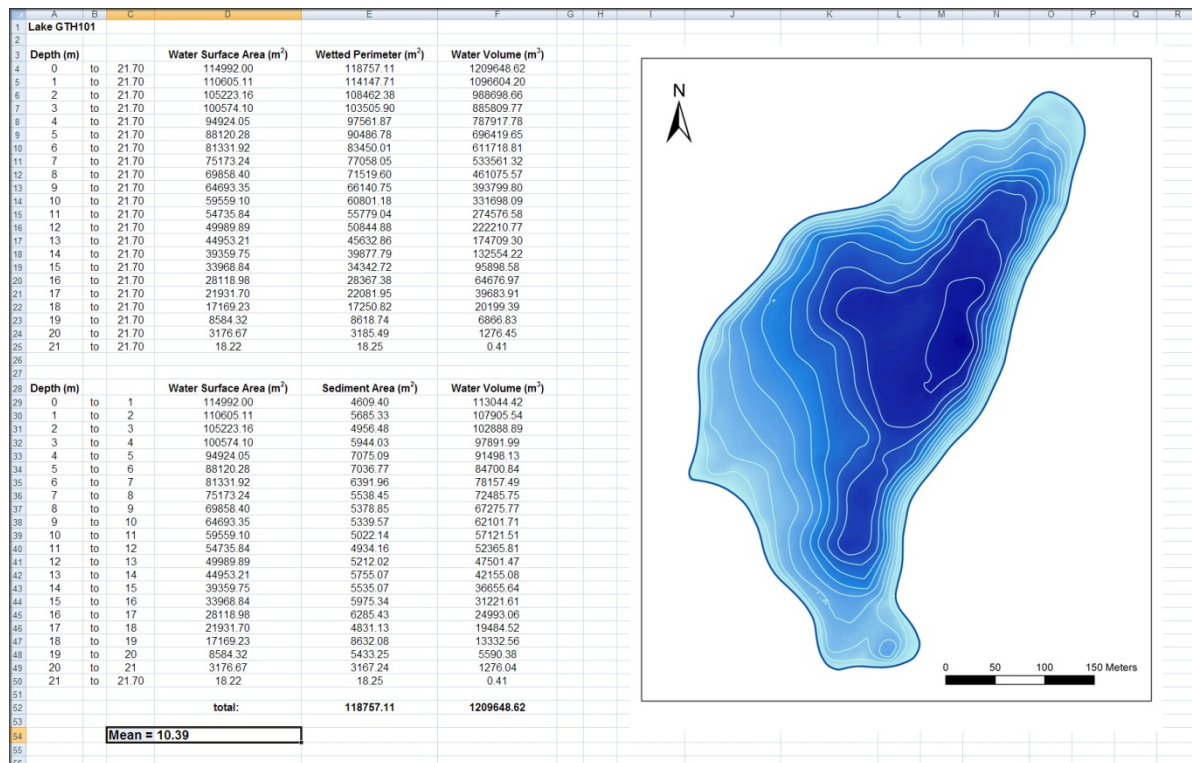


Figure 7.3.3: Spreadsheet of hypsographic curve and field map for lake GTH-101.

Administration & Management

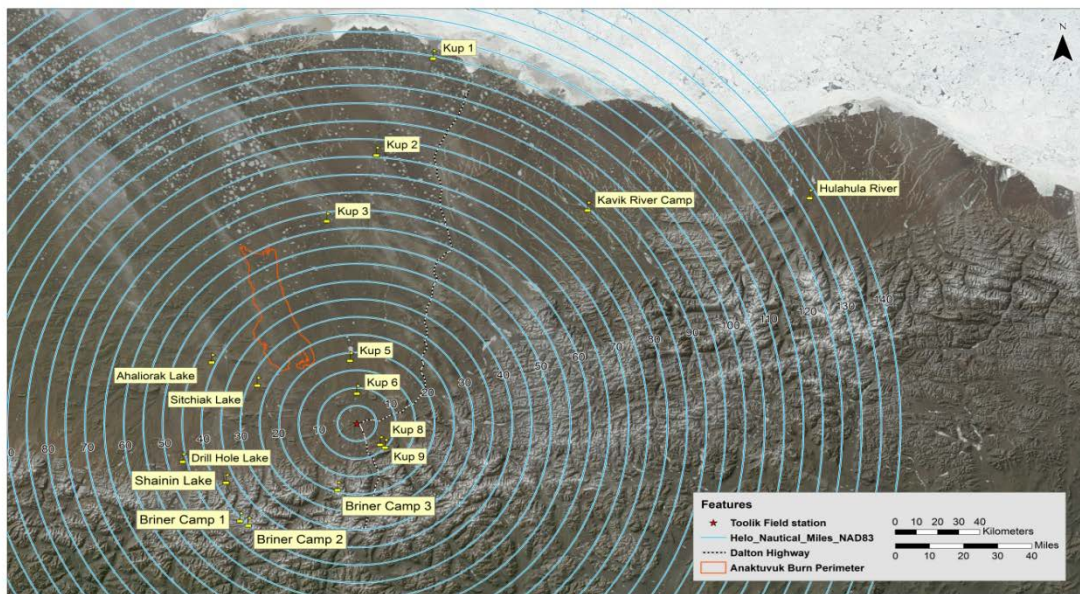
BLM Archaeological Aerial Survey

In support of the NSF-BLM MOU currently in development, Toolik GIS accompanied BLM archaeologist Bill Hedman on his aerial archaeological survey of the Toolik Natural Research Area, June 11-12. Toolik GIS recorded the GPS location of all the aerial photographs that Mr. Hedman took and georeferenced each photograph in our GIS software. Mr. Hedman will use these photographs along with other GIS data layers to begin identifying those areas within the Toolik RNA that have a high probability of containing archaeological artifacts. This work will be used to complete the first draft of the MOU.



Support for Helicopter Coordinator

In response to multiple requests for mapping and GPS logistical support from the CPS Helicopter Coordinators, Toolik GIS created a map and Google Earth KMZ file for use as a reference tool. The map and Google Earth file provided the helicopter coordinators the reference information they needed in order to provide efficient helicopter support to scientists. Toolik GIS not only created a solution for the coordinators' current needs, but this resource can be updated and used in subsequent years.



INDIRECT SUPPORT

In order to remain responsive to Toolik-user requests, TFS GIS must pay substantial attention to continued acquisition, ingest and maintenance of primary framework data, and to the update and expansion of critical infrastructure - primarily equipment. Below are some examples of Toolik GIS activities/involvement that do not address any one project in particular, but instead maintain the program's ability to remain current, responsive, well-informed, and efficient.

Aerial Photo Collection 2013

A series of aerial photographs were acquired, processed, and incorporated into the GIS database in 2013. These are repeat photos flown with the same specifications as the existing 2002 and 2007 aerial images. They are part of a plan to provide information related to changes in landscape features, vegetation, aquatic resources, research sites, facilities and infrastructure for the Toolik community. The plan is to continue this service on a five year interval. It is likely that the next acquisition, in 2018, will take advantage of rapidly expanding capabilities of satellite-based, digital imagery rather than aerial photos.

Online GPS Reservation Page

During the winter of 2012, Toolik GIS staff worked with our IAB programmer to design an online reservation page for our GPS equipment. The reservation page allows researchers to see what GPS units are available, and easily reserve and checkout units for use. The reservation page allows Toolik GIS staff to track GPS usage, and generate metrics for reporting.

ToolikGIS Equipment Calendar and Reservation Form

Please be courteous to others needing equipment and **do not request any equipment for more than 3 consecutive dates**. [Contact the GIS staff](#) if you need anything longer than that. Requests can and will be denied as necessary.

October 2013

Instrument	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T							
Recreation Grade Rover																															
Garmin eTrex 20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Mapping Grade Rover																															
Trimble GeoXH (TFS B)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Trimble GeoXH (TFS C)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Trimble GeoXH (TFS D)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Trimble ProXR (TFS E)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Survey Grade Unit																															
Trimble 5700	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Bathymetric Unit																															
Sonarmite	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Dates with red background (1) indicate the equipment is reserved. To request equipment for the displayed month, click on any open date(s) so its background is green (1), fill in your name and email address, and then click the 'Make Reservation' button. You must submit a separate request for each month you need equipment. Also note you cannot select a date prior to today's date.

Name:

Email:

Comment:

Figure 7.3.6: Online reservation page for GPS equipment.

Recommendations from the Science Vision Workshop

Many recommendations came out of the various discussions held at the Science Vision Workshop. Priorities pertaining to Toolik GIS included the need for the creation of a Toolik Information System, which would contain information about projects, publications, grant information, theses, white papers, and reports. The need for high-resolution digital elevation models of the main research areas around TFS was also identified as a top priority.

During FY2013, Toolik GIS moved forward with these recommendations. Toolik GIS staff met with Tom Hienrichs at the Geographic Information Network of Alaska at UAF to discuss using an existing framework for the Toolik Data Service. The quote was estimated at \$50,000 per year to host and maintain the online service. Toolik GIS explored other options such as creating the service in-house. However, at this time we do not have sufficient resources to design the online service ourselves.

Toolik GIS has been working with the Polar Geospatial Center (PGC) to create a 2m DEM from stereo-images. A preliminary dataset was created but contained significant errors. An updated DEM is being created by PGC utilizing GPS ground control points collected by Toolik GIS staff this summer. The new DEM is expected to be completed by January 2014.

CONFERENCES & TRAININGS

2012 URISA Annual Conference for GIS Professionals

During the fall of 2012, Toolik GIS staff attended the 2012 URISA Annual Conference for GIS Professionals. While at the conference, Toolik GIS staff explored potential options to create a Toolik Data Service per recommendations from the Science Vision Workshop. A 1-day ArcPad training was attended where Toolik GIS staff learned how to use ESRI's ArcPad in order to provide a seamless transition of GIS data between the office and field environment. This program was used to create photo-points during the BLM Archaeological Aerial Survey.

PROGRAM PLAN 2013-2014

Training and Conferences

Remaining up to date with the most current software, techniques and equipment is important for the GIS program in order to offer the best available services to the Toolik research community. To accomplish this, Toolik GIS staff will attend the 2014 URISA Annual Conference for GIS Professionals and the 2014 Alaska Mapping & Surveying Conference. At these conferences, GIS professionals will meet and discuss the latest developments and practices related to GIS mapping and GPS surveying. In addition, Toolik GIS staff will be taking advantage of the various technical training courses these conferences offer.

Library of Bathymetric Maps and Datasets

Toolik GIS has bathymetric data for nearly 70 lakes throughout the Toolik Lake region collected over the past 10 years. Various products exist for these lakes, including basic maps, 3D maps, and hypsographic curves. We have begun to take these disparate maps, data, and graphs, and combine them into one complete collection. Our goal is to create a single PDF document that organizes this information by lake name, so researchers can easily find information for their lake of interest. A PDF document containing a subset of the bathymetric dataset will be available on the Toolik GIS website by January 2014.

Reprocess Historic Aerial Imagery

Due to changes in processing software and techniques, our historic aerial imagery has a significant offset from the newly acquired 2013 aerial imagery. Toolik GIS will reprocess the historic imagery to improve alignment and minimize offsets.

LIST OF PRIMARY SERVICES

Year Round Services

Map reproduction and distribution

Custom cartography/figures

- Hardcopy maps
- PowerPoint figures
- Publication figures

Data and metadata distribution

Custom data development

Simple metrics

- Coordinate locations
- Estimates of area, distance
- Landscape characteristics
- Presence/absence/number of specific features

Custom analyses

- Site selection
- Landscape characteristics
- Synthesis of field data with spatial data
- Modeling
- Data manipulation

Project Level Support

- Scoping
- Proposal help
- Analysis & data development
- Written & Verbal presentation

Field Season Services (additional to Year Round Services)

GPS equipment available to Toolik users

- Post-processed (code and carrier phase; to sub-meter precision)
- RTK (real-time kinematic) processed (to sub-meter in real-time)

GPS technical training (informal)

GPS field work/consultation

- Mission planning
- Data collection
- Post-processing
- Data manipulation
- Data distribution and archiving

Assistance for site location and landscape/permit management

Assistance for field planning and last-minute adjustment

Spatial data support for aircraft-based work (helicopter and small fixed-wing)

PEOPLE & INSTITUTIONS SERVED

PI/Administrator/Group	Affiliation	Daily Request (<5 days)	Larger Request (>5 days)
Barnes, Brian*	UAF	Y	
BLM*	BLM	Y	
Boelman, Natalie*	Columbia Univ.	X	
Bowden, Breck*	UVM	Y	X
Bret-Harte, Donie*	UAF	Y	
Budy, Phaedra*	Utah State Univ.	Y	Y
CPS	CPS	Y	
Crain, Renee	NSF	Y	
Daniels, Will	MBL	Y	
Davie-Martin, Cleo	Univ. of Otago, NZ	Y	X
Deegan, Linda*	MBL	Y	
Env. Data Center	TFS	Y	
Eugster, Werner	ETH Zurich	Y	
Giblin, Anne	MBL	X	
Godsey, Sarah*	Idaho State Univ.	Y	X
Harms, Tamara	UAF	Y	
Hobbie, John	LTER	X	
Huebner, Diane	UAF	Y	
Iwahana, Go	UAF	X	
Kling, George*	Univ. of Michigan	Y	
Koltz, Amanda*	Duke Univ.	Y	
LaBelle, Jim	Dartmouth	Y	
Luecke, Chris	Utah State Univ.	X	
MacIntyre, Sally*	UCSB	Y	

*** indicates a group (PI s, research assistants, students, post-docs, staff)**

X indicates single request

Y indicates multiple requests

(continued next page)

PI/Administrator/Group	Affiliation	Daily Request (<5 days)	Larger Request (>5 days)
Nielson, Beth*	Utah State Univ.	Y	X
Oberbauer, Steve*	FAU	Y	
Obracay, Thorstn	Institute for Avian Research, Germany	X	
Page, Sarah	ETH Zurich	X	
Polar Geospatial Center	Univ. of Minnesota	X	
Romanofsky, Marilyn*	UC Davis	Y	
Ray, Peter	UAF	Y	
Rocha, Adrian	Univ. of Notre Dame	Y	
Rowe, Rebecca	Univ. of New Hampshire	X	
Sherrif, Michael*	UAF	Y	
Starr, Greg	Univ. of Alabama	Y	
Toolik Management	UAF	Y	
Tweedie, Craig	Univ. of Texas, El Paso	X	
Vierling, Lee*	Univ. of Idaho	Y	X
Wallenstein, Matt	Colorado State Univ.	X	
Welker, Jeff	UAA	Y	
Wylie, Bruce	USGS	Y	

*** indicates a group (PI s, research assistants, students, post-docs, staff)**

X indicates single request

Y indicates multiple requests

	Science Support Requests		Management Support Requests		Data Development		Computer /Network Support
	Daily	Larger	Daily	Larger	Framework	Project Specific	
Field Season	50%	<25%	5%	0%	10%	<5%	<5%
Rest of Year	40%	<5%	10%	10%	20%	15%	<5%

Request Category	# Requests Filled
GPS Training	17
GPS Use	72
GPS Survey Data Collection and Analysis	18
Site Map w/ Coordinates	12
Consultation/Site Selection/ Permit Assistance	24
Stock Maps	4
Custom Maps/Posters	52
GIS/RS Analysis	7
Total	206