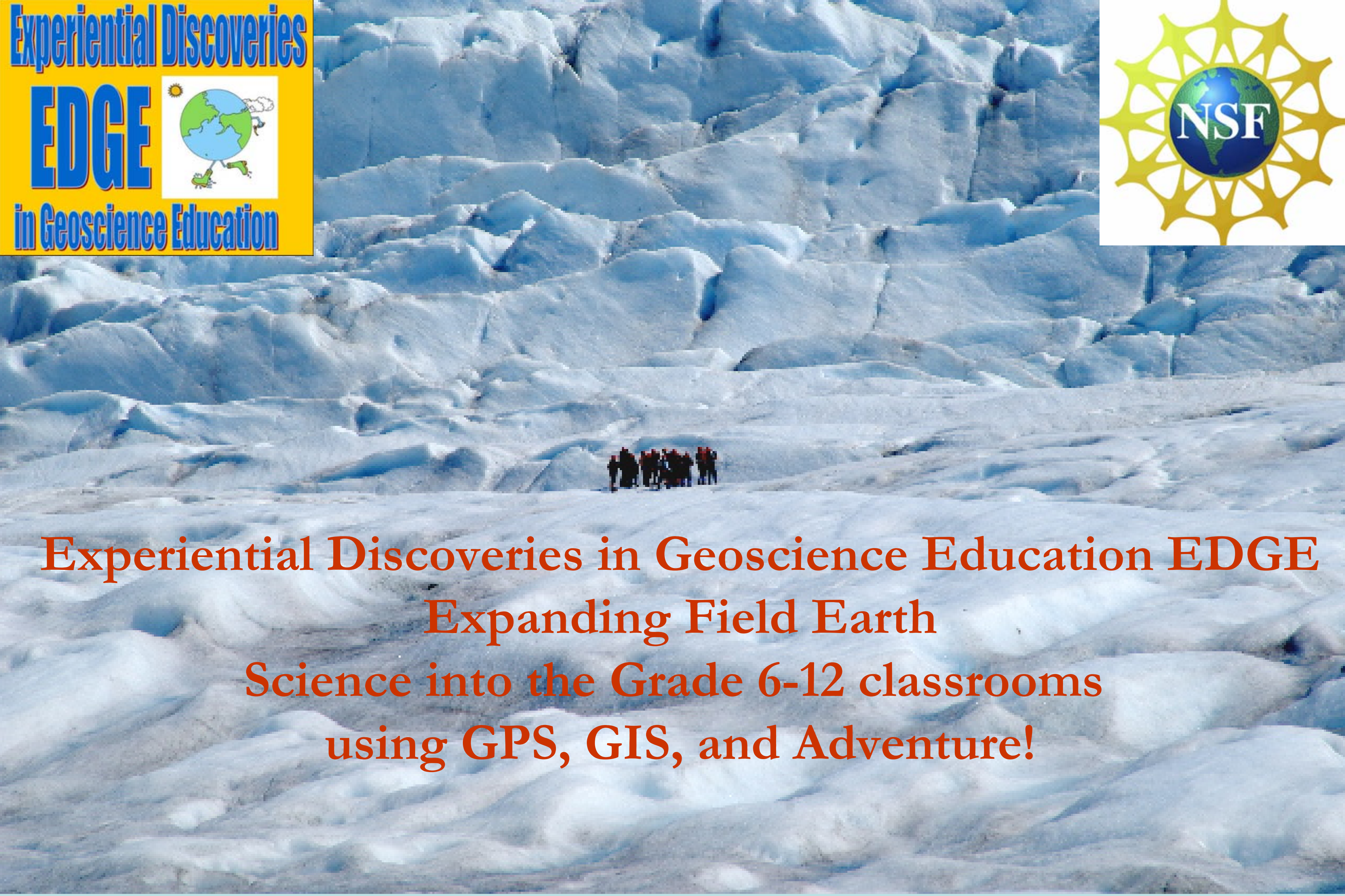


Experiential Discoveries in Geoscience Education EDGE Expanding Field Earth Science into the Grade 6-12 classrooms using GPS, GIS, and Adventure!

Cathy Connor-Department of Natural Sciences, UAS
Alaska Math Science Conference October 20, 2007
ASD Education Center and Highland Tech Center, Anchorage AK.

Why teach GIS to expand Earth Science in middle school and high schools?

- Alaska's students' strong ***Sense of Place*** and their need for Earth System Science knowledge to live in a resource rich state during a warming climate
- Availability of **Google Earth** as entry portal into **ArcGIS** and export of Arc maps as .kml files
- **Rapid Climate Change** in Alaska is increasing rates of geologic change at ***observable rates***
- X, Y coordinate use (latitude and longitude), map projection, spatial data enhances students understanding of ***mathematics and geography***
- Improve student knowledge of Alaska's relationship to the "***outside world***"
- ***Active and in context*** Science and Math ***improvement in SCIENCE section of statewide 4th, 8th, 10th grade assessment exams***
  Use of Earth Science as a foundation for other sciences.
- Provide ***authentic college experiences*** for first generation prospective college students
- Train EDGE students and teachers in ***an essential* AK workforce skill**

The Evolution of EDGE in Alaska

Teacher Training Opportunities in GIS evolve and expand

•**2004, 2005** NASA "Inspire the next generation of explorers through STEM Funding" to **Prakash** through Alaska Space grant UAF

•**2004, 2005** "Improve science education in 10 AK School Districts" Dept of Education Funds to **Brownlee/Connor** through UAS Science and Education Departments Partnership

•**2005** UAS 7 UAF Teachers' GIS Workshops served as "proof of project pilots" resulting in NSF Funding

•**2005-2008** "Improve Earth Science and College Readiness for Rural Alaskans" National Science Foundation Geoscience Education Grant to **Connor, Prakash, Brownlee**

Experiential Discoveries EDGE in Geoscience Education

We selected UAS because it is adjacent to a small Alaskan glacial watershed with moderately easy logistics. This provides a natural laboratory for introducing Middle School and High School teachers and their students to Earth Systems science and climate change

Experiential Discoveries EDGE in Geoscience Education

The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

INSERVICE SCIENCE TEACHERS

- June 2005, 2006, 2007 (10 day workshop/course-3 Credits)
- 10 hrs Earth System Science Lectures
- 25 hrs GIS/GPS Lectures-Nuts & bolts of using Spatial data
- 25 hrs ArcGIS 9.2 Lab applications, map production
- 10 hrs Field data collection and earth process exploration

1. Watershed delineation-component identification
2. Glacier Mass Balance
3. River Hydrology
4. Isostatic Rebound in estuarine wetlands-vegetation mapping






Experiential Discoveries
EDGE
in Geoscience Education

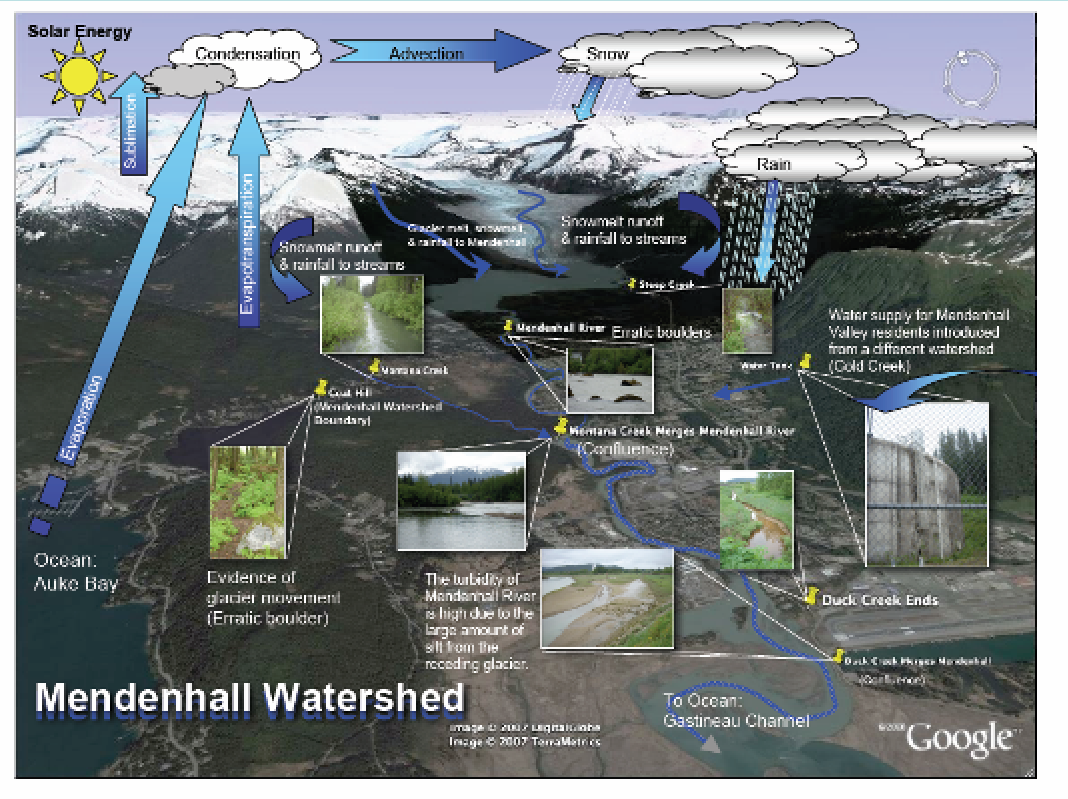
Analog Compass work leads to the digital data

The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

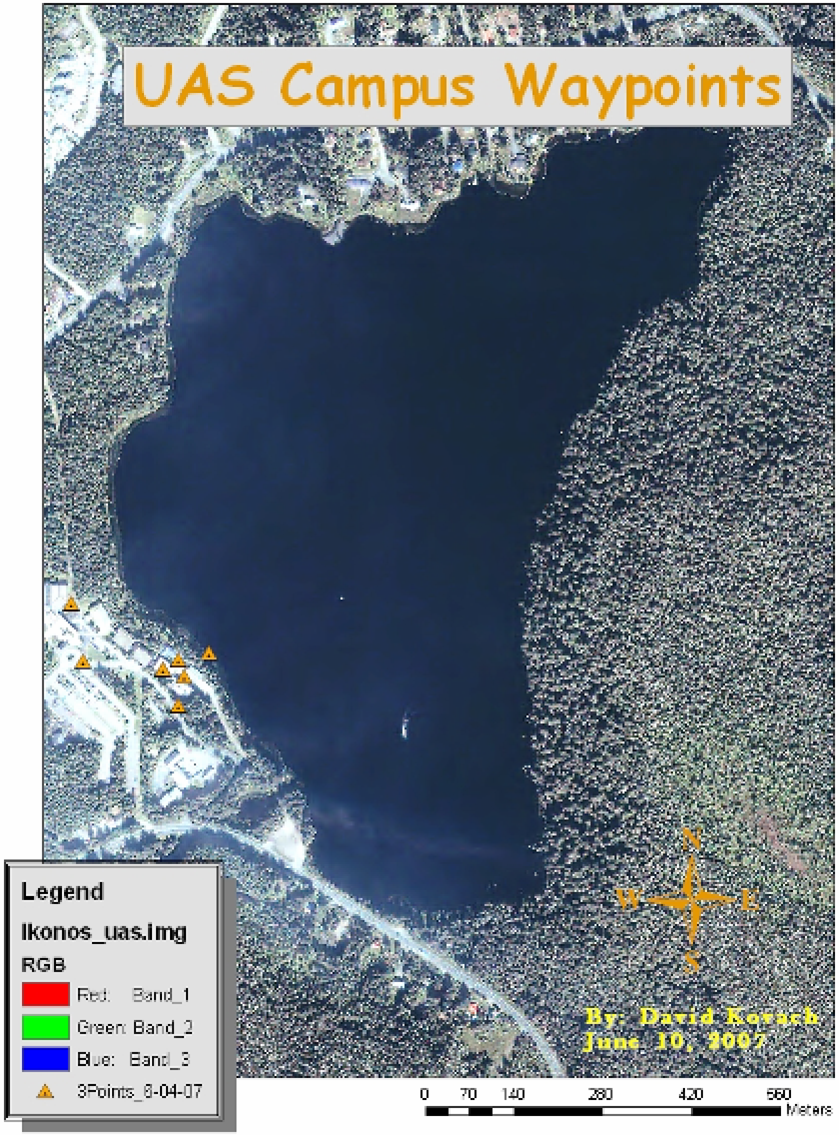
ESS Data/GIS Map Focus

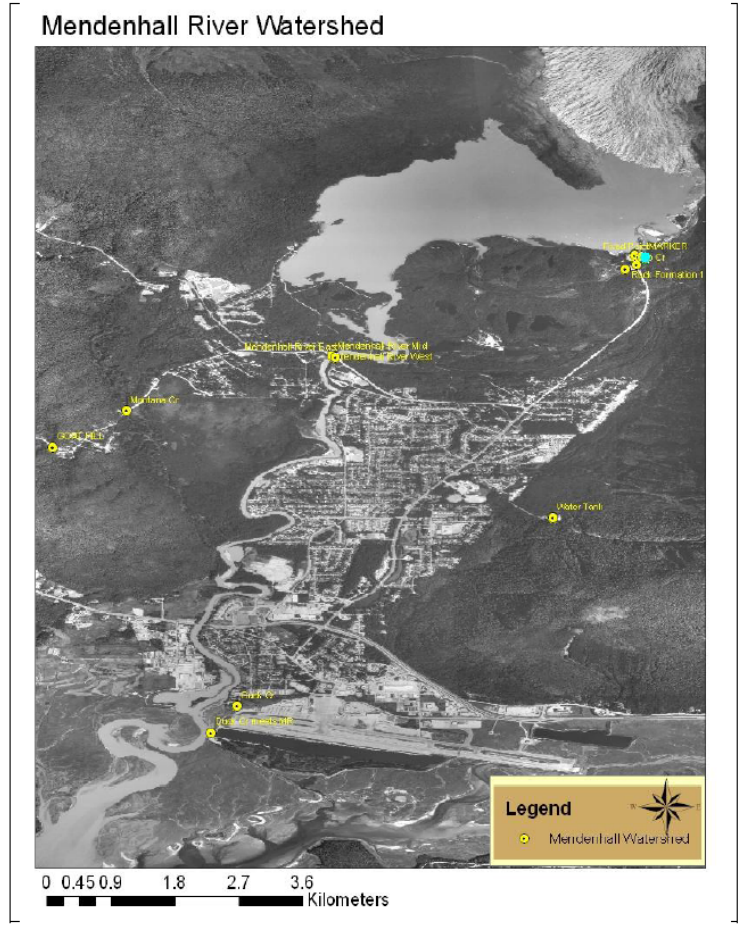
- UAS Campus Geocache
- Watershed Systems
- Montana Creek Hydro
- Mendenhall River Geomorphology
- Mendenhall Glacier Terminus Recession
- Post-glacial uplift Gastineau Channel wetlands



J.Wahl '07

GIS Techniques to Creating Maps from Teacher Waypoints





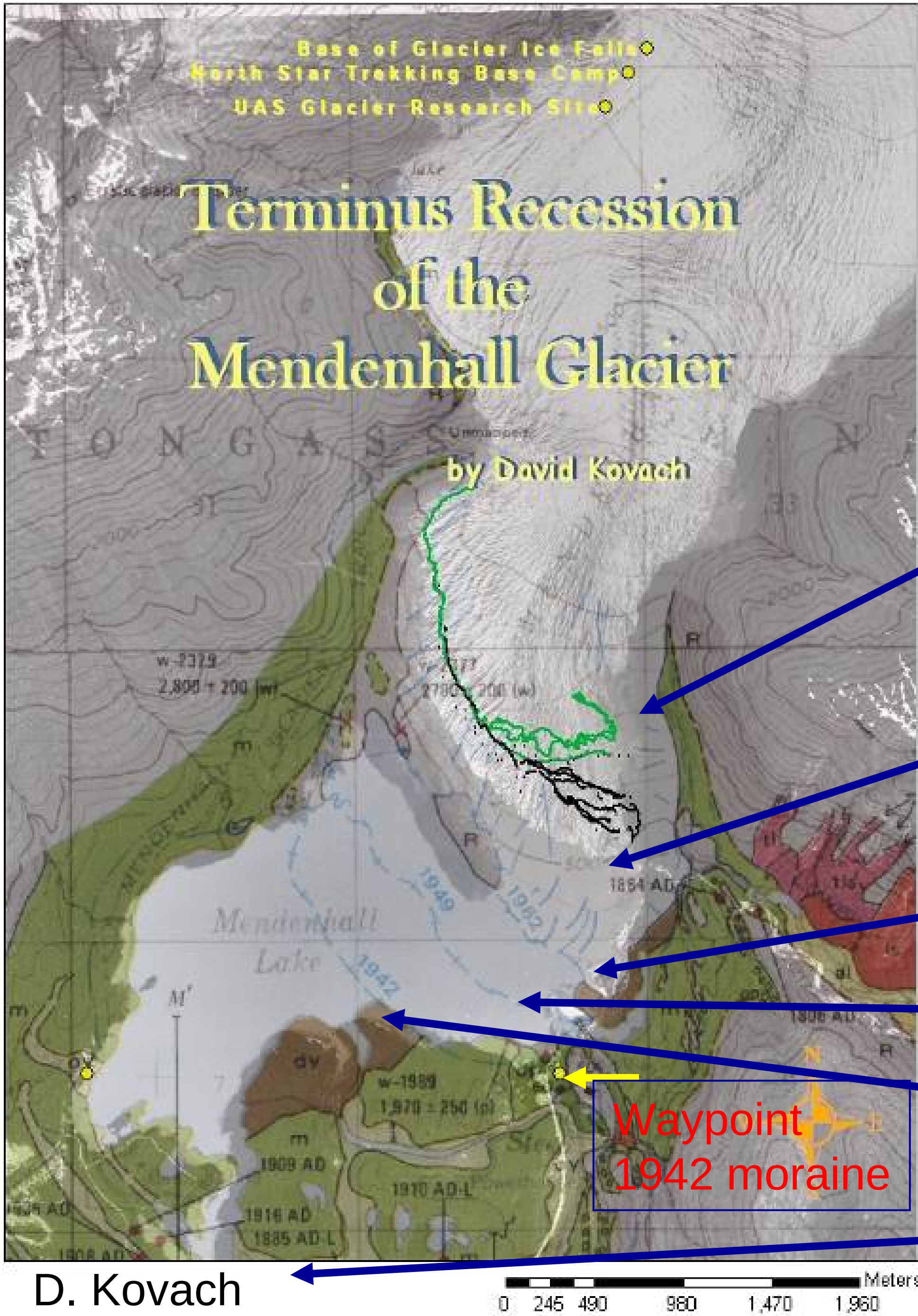
John Wahl

6/5/07

Using Locally Collected GIS glacier-related data

- Glacier Terminus positions (USGS, UAS Undergraduates 1750 to 2007)
- Surficial Geology Maps
- EDGE Teacher Waypoints
- 2007 USFS Bear Collar data

Experiential Discoveries
EDGE
in Geoscience Education



June 2007

2004

1982

1949

1942

1885

D. Kovach

The Mendenhall Glacier data above indicates that the most recent time period May-June 2007 has the greatest recession rate. The staggering difference (583 m/year vs. 65 m/year) is probably due primarily to a large calving event of late May. However, the trend is clear that present 10 year period has experienced the greatest glacier retreat. According to (Motyka et al, 2002), this is primarily due to climatic changes which have led to less snow build up on the ice field which feeds Mendenhall Glacier. Warmer temperatures in the summer cause melting and glacier advance. The relatively warmer temperatures of recent winters have led to less snowfall accumulation to feed the summer melting. In the publication "A Century of Thinning on the Mendenhall Glacier", Motyka points to a secondary reason for the steady advance of the past 100 years as being the creation of Mendenhall Lake. The lake has led to the front edge of the glacier experiencing a somewhat buoyant state which speeds calving (and glacier retreat).

Time Period	Recessional Distance	Rate (*meters/year)*
1769-2007	**4,315 meters**	**18 m/year**
1835-2007	**4,035 meters**	**24 m/year**
1908-2007	**3815 meters**	**39 m/year**
1942-2007	**1740 meters**	**32 m/year**
1949-2007	**1145 meters**	**25 m/year**
1962-2007	**860 meters**	**19 m/year**
1996-2007	**550 meters**	**50 m/year**
1998-2007	**375 meters**	**41 m/year**
2004-2007	**195 meters**	**65 m/year**
May 2007-June 2007	**70 meters**	**583 m/year**

Solar Reflectivity of Mendenhall Valley

by Ben McLuckie
Hoonah High School

EDGE Program, June 16, 2006

Introduction

How do different earth surfaces found in the Mendenhall Valley reflect solar radiation, and how might this be changing as the Valley develops?

Surfaces studied include representatives of all the surface types found in the Study area, including Auke Lake, cement, blacktop, cut grass, forest, and muskeg. Reflected heat and light intensity of each surface was measured at 3 heights above the ground at 0.5m, 1m and 2m. Solar heat and light was also measured at the ground. Data was treated in Microsoft Excel and spatially analyzed in ArcGIS.

Project Objectives

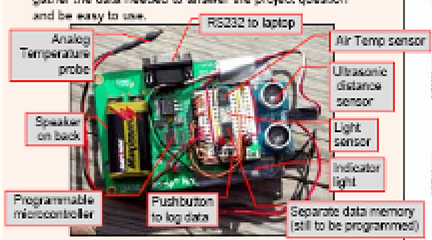
Determine the surface reflectivity for the Mendenhall Valley and identify any trends in reflectivity as the Mendenhall Valley has developed, ie... do some science.

Engineer a data logger with sensors that can be built and used by students within a math and science curriculum, collects volumes of data with a limited number of field trips, and supports a GIS workflow.

Learn the many skills needed with ArcGIS to support spatial analysis for scientific research and to teach GIS to students.

Steps & Methods

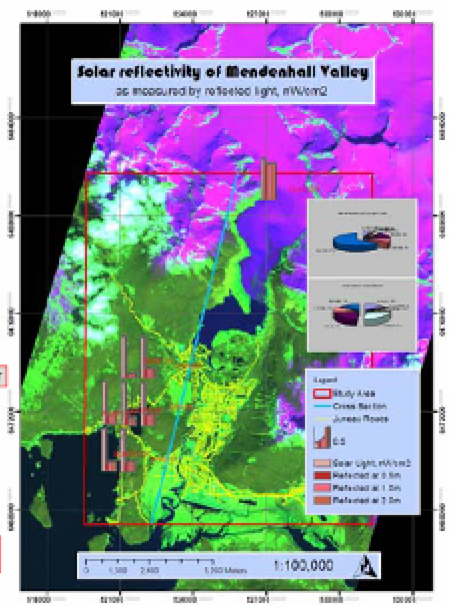
1) Select sensors and construct a data logger that will gather the data needed to answer the project question and be easy to use.

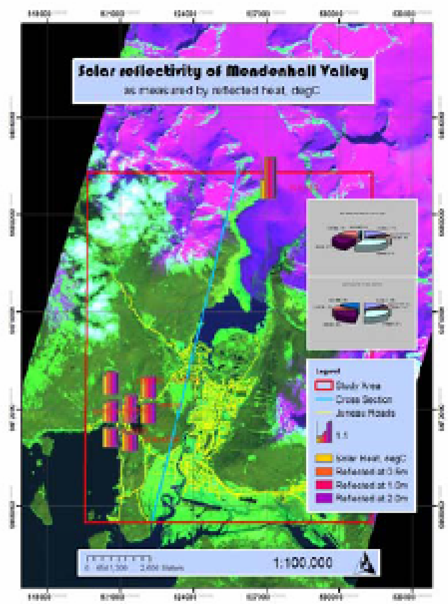


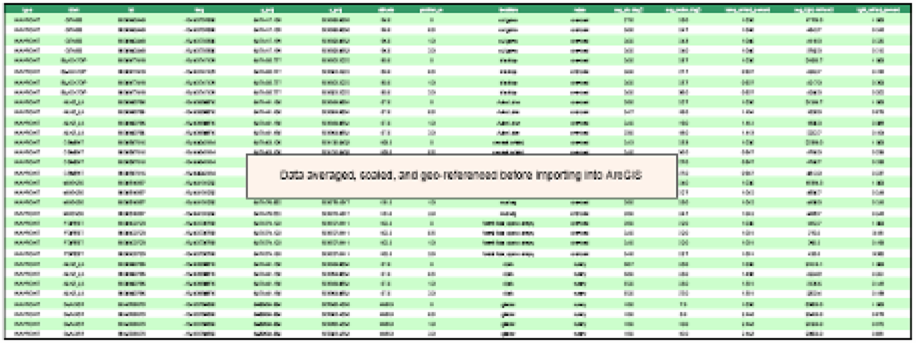
Future improvements: Build in a GPS module so the data collected is automatically time stamped and geo-referenced. Enclose the data logger in a water proof box, with buttons on the outside that are easy to reach. Add 64k of memory to support months of data logging at 15 minute intervals.

2) Program the data logger in PBASIC using a Windows editor to collect the data from each sensor, convert and scale the values, store the data in memory, erase the memory, and dump the data into an Excel spreadsheet. The program is modular so a change in sensors can be easily accommodated. Double precision calculations with decimal constants proved difficult with integer math. During most of the data collection a memory leak would overwrite the program and much data did get lost. Best would be to put the data and program memory into separate ICs so data could be retrieved even if the logger failed. A code snippet from the 315 line program:

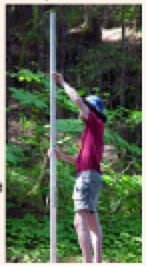
```
'TSL230 light sensor, double precision
[illegible] = 4096                   'Set light sensitivity to 10x
COUNT 10,1000,lightraw10             'Count pulses on [illegible] for 1 second
[illegible] = lightraw10 ** [illegible] - lightraw10   'convert to uW/cm2
GOSUB Write_Data_Word                'Write the data to EEPROM
```







Steps & Methods (continued)



3) Measure solar reflectivity between 10 am and 2 pm when the sun is mostly overhead. Since reflectivity is calculated as a percent of solar reflected, variations in sunlight on different days and cloud conditions are accounted for. A Stadia rod was used to measure height.

4) Use StampDAQ ActiveX control to download data from the data logger directly into Microsoft Excel and do basic data treatment, calculations, and geo-referencing. Export as a text file.

5) Import the Excel text file into ArcView, export to a shape file, and project the points. ArcGIS only allows letters and numbers in field names, so there were many round trips to step 2 above getting the formats correct.

6) Build the ArcView maps shown here. Draw a representative cross-section and determine percents for each surface type along the section.

Next time: Get surface type GIS base maps from the US Forest Service so that the area of each surface type can be calculated in ArcGIS using polygons.

Conclusions

Even though glaciers only cover 15% of the cross section, they contribute an overwhelming 67% of reflected light. This suggests that the changes in Mendenhall Valley in the last 30 years from vegetation to roads, cement, and cut grass are insignificant compared to the ice and snow contribution, even accounting for cover percent.

No patterns emerged from measuring reflected heat. Temperature of the substrate and direct heating of the air seemed more significant than reflected heat. Therefore, nothing can be concluded from this study concerning reflected heat. Different sensors need to be used.

References

Allen, Tracy. 2004. Applied Sensors. *A high school curriculum for teaching about data logging and earth measurements.*

Hebel, Martin. 2001. StampDAQ. *ActiveX control for downloading data into Microsoft Excel.*

Parallax http://www.parallax.com. *Source of sensors, microcontroller, PBASIC editor, and high school curriculum.* Datasheets and application notes for all sensors.

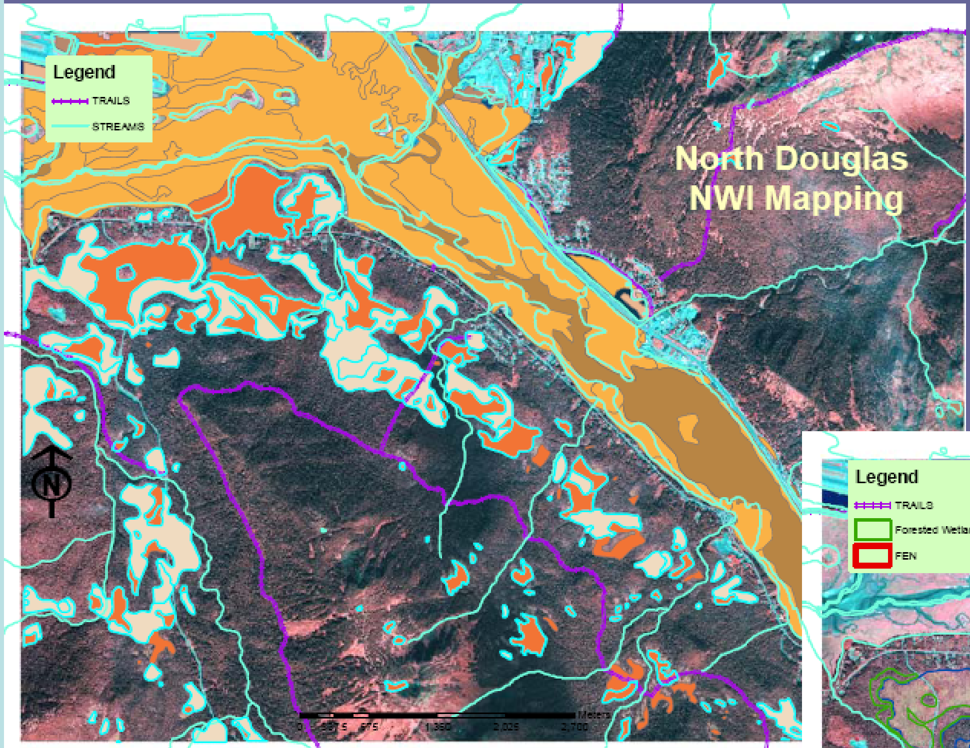
Acknowledgments

Wow have I learned a lot. Dr. Cathy Connor and Dr. Anupma Prakash provided leadership and inspiration. Edwin Knuth provided first aid for ArcGIS. Finally, all the staff of the EDGE program that made this project possible.

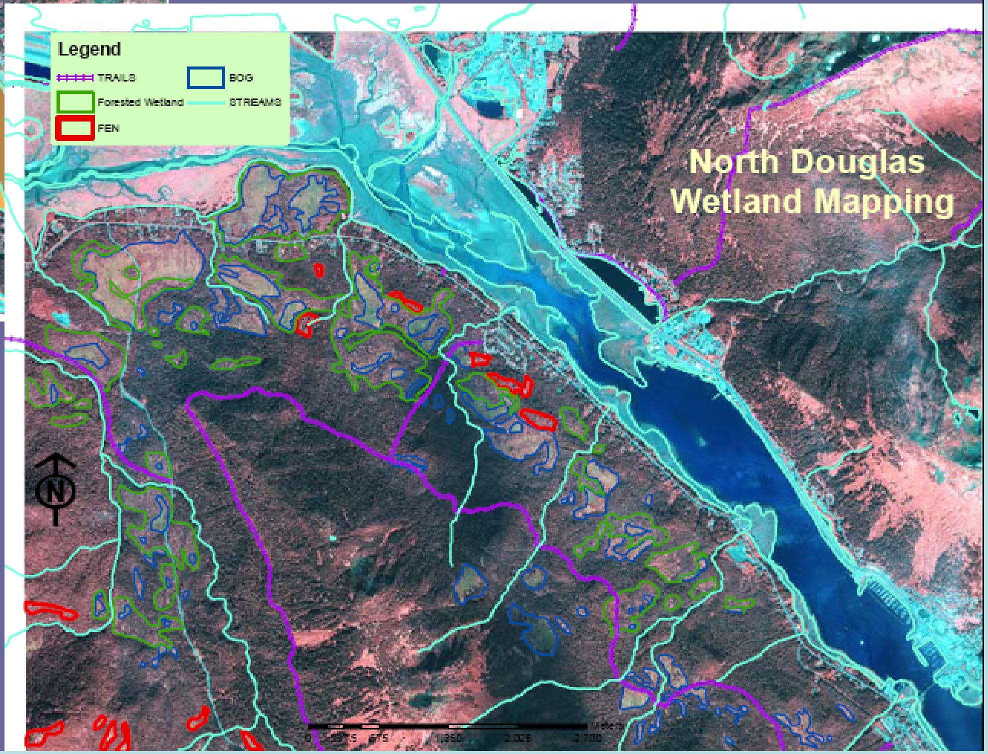
For further information

Please contact *ben.mcluckie@starband.net*.

Comparative Wetland Mapping



Using NWI, wetland area totals 728 hectares



Using aerial photo interpretation, wetland area totals 653 hectares

Koren Bosworth 2006

Experiential Discoveries
EDGE
in Geoscience Education

SPUHN ISLAND PARKING PROBLEM – ANALYSIS AND RECOMMENDATIONS

Chris Jacobson and Sue Skvorc
Correspondence Study School & Colony High School,

Grades 7-12, EDGE Program, June 16, 2006

Introduction

The Spuhn Island LLC is developing and selling 38 luxury homesites on the island, which is just south of Smuggler's Cove, at the end of Fritz Cove Road. Access to Spuhn Island will be solely by boat, so a dock has been built on the island. Parking on the mainland is a problem, both for boats and cars. We have identified existing public parking for cars within 2 miles of the island, around Auke Bay and the Mendenhall Peninsula, and will recommend possible solutions to the access/parking problem.

The dock is located here:
The trail is indicated by the red line.

Below is a photo of lot 1

From Spuhn Island LLC website:
Nine of 38 lots already sold.

Materials and methods

Starting from Smuggler's Cove via kayak, data was gathered by taking GPS waypoints around the perimeter of Spuhn Island and returning to Auke Bay harbor. We also marked the parking lots with GPS coordinates to fix their locations on CBJ plat maps. In addition, we interviewed the harbormaster, reviewed the Spuhn Island website for number of lots to be sold, reviewed data from the CBJ assessor's office, and captured digital photographs of the Spuhn Island area and Auke Bay harbor. ArcGIS was used to create an ArcMap document outlining the entire study area on a satellite image.

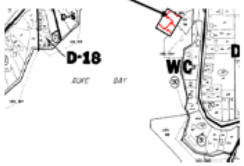
GPS coordinates and photos of the island were obtained from a kayak

Coordinates of parking areas were located with GPS units

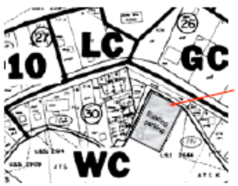
Results

Our surveys found that 3 possible sites could accommodate the Spuhn Island residents without acquiring any new parking lots. The city has purchased DeHart's Marina (100 boat slips) and parking for 80 renters' vehicles. There is no feasible parking on the southeast portion of Mendenhall Peninsula. Mainland boat landing sites are still a problem, to be solved by yet another team of GIS experts. As of June 2006, the boat harbor has about 650 slips and parking for 118 vehicles, according to the Auke Bay harbormaster.

Auke Bay boat harbor parking -118 spaces



Parking lot across from Chan's Thai place – 50 spaces



Red oval indicates current parking near smuggler's cove.
Can fit 12 vehicles w/o trailers.

SE portion of Mendenhall peninsula – not
Feasible for parking/ boat landing site.

Conclusion

We found that there are currently about 168 vehicle parking spaces in the 3 parking lots mapped out in the results section. With 650 slips in the boat harbor and few vacancies, Spuhn Island LLC will have to purchase additional real estate for boat and vehicle parking, or residents will have to make their own arrangements in the Auke Bay boat harbor.

Acknowledgements: The authors would like to thank Dr. Cathy Connor, Ed Knuth, Dr. Anupma Prakash, Dr. Rosemary Walling and other nice people who helped us with all our data collection.

Where are the good yard sales?

Jim Parkin

Chatham School District grades 7-12, EDGE Program, June 16, 2006

1

Introduction

For my project I chose to study sailing, I mean yard sale-ing. I have enjoyed going to yard sales for many years. It can be lucrative. Once I purchased a first edition Charlotte's Web for 25 cents.(fig1), but I'm not in it for the money. It's fun! Kind of like an Easter egg hunt or a hunt for spent shotgun shells. The problem is that there are sometimes to many loser yard sales in proportion to winner yard sales. My project hoped to unravel the mystery of finding the winner yard sales.

Fig. 1.
published: 1952
Format: Hardcover
Book condition: Good-dust-jacket. Ordering information
$1800.00

2

Methods

Five surveyors representing a spectrum of age groups and both sexes were asked to evaluate 25 yard sales based on:

•cost of home

•quantity of infant, male, female, and adolescent goods

•amount of money spent

• overall quality of the yard sale.

A corresponding GPS waypoint was taken at each yard sale.

The data was input to GIS software and then queried to see if relationships could be found that would discover the secretes of finding the sweet yard sales.

3

Materials

1992 Dodge Caravan (mint condition yard sale value $500.00)

Dell Inspiron 9400 (too new and too expensive to be found at a yard sale- give it a few months)

ArcGIS software package (you don't want to know)

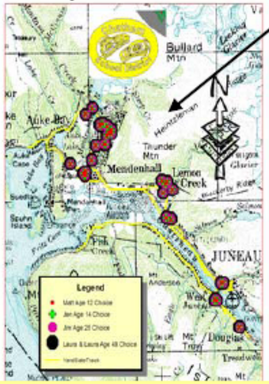
Local map image (Do you believe in magic?)

GPS (just get it at the store)

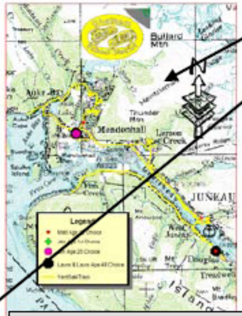
$85.00 cash money in small bills and coinage

4

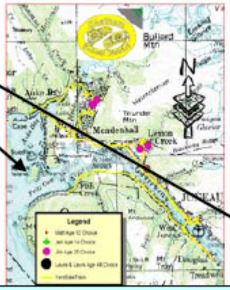
Results



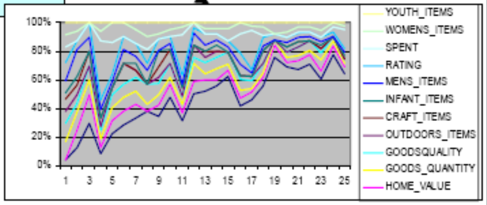
Map shows all yard sales visited, trip map of route taken and all surveyors selected



Home rating of 2 and overall quality rating of 3



This map reflects a query about which yard sales were at homes listed by the researchers as very expensive.



Literature cited

IOBABooks.com. 2006. Pricing on *Charlotte's Web*. <http://www.iobabooks.com/details.php?dcx=3123435&aid=frg>. Accessed 2006 June 16.

5

Conclusions

Looking back I guess the project question should have been what can I buy at yard sales for $85.00.

Acknowledgments

I would like to thank creators of the fliers for the program which I misunderstood to state that the students and teacher would be receiving lap tops etc.... otherwise I might not have signed up for the program and I would have missed out on a wonderful adventure in learning and the opportunity to write such a long sentence.

I would also like to thank master Edwin one kanobi for his tutelage. Shurly I would have been overcome by the dark side of the GIS program if not for his instruction.

I would of course like to thank Cathy, Rosemary, Marla, Anupma, Tom, Kelly, Sonia, Richard and anyone else remotely connected with the project.......oh yes! I will get even!

For further information

Please contact jwparkin@chathamsd.org for more information on the project or to invest in GISale.org. Pictures related to this project can be obtained at http://adobe.kodakgallery.com The user name is jwparkin@chathamsd.org and the password is edgejuneau. A link to an online, PDF-version of the poster would be nice, but at 2:30a.m. forget

Experiential Discoveries EDGE in Geoscience Education

WILL THIS BE "A ROAD LESS TRAVELLED"?

Patty Brown

Haines Elementary School, Grades 4-8, EDGE Program, June 16, 2006

Haines Borough School District

Introduction

A road connecting the capital city of Juneau, Alaska, to the interstate highway system has long been considered, in hopes of achieving the following:

- Increased convenience to traveler
- Reduced state costs
- Lower travelers' expense
- Improved flexibility
- Lower travel time
- Encouraging tourism

Fig. 1. Route of road and ferry with proximal cities

Fig. 2. Sign at current road's end at Echo Cove. Note bumper sticker added by someone with strong feelings.

Materials and methods

Using a base Landsat map overlain on a USGS topographic map, the road was demarcated with the DOT Supplemental Draft EIS as a reference. A file of slide data from the US Forest Service was added as a layer, depicting the areas where mitigation will be necessary.

Results

Fig. 3 Road alignment with USFS slide data

Fig. 4. Avalanche paths as viewed in summer

Fig. 5 Avalanche into Lynn Canal spring 2006

Fig. 6. Use of "avalauncher" to release avalanches from distant slopes

Fig. 7. Highway through avalanche-prone Thompson Pass near Valdez.

Graphics Needed

New GIS displays are needed using the most complete up-to-date and thorough avalanche data. As technology has evolved, information from multiple historical sources could be merged into a comprehensive document and made available to the public.

Fig. 8 Example of path maps in SDEIS

Controversy Continues

According to DOT personnel, half of the road's maintenance budget would go to avalanche control. It would require helicopter-dropped bombs, howitzers, and blaster boxes. Some of the howitzer blasts would be launched from nearby islands. Some areas would require as much as 20 blasts per year. Helicopters would be used to monitor the snow pack; noise from helicopter use in the area of Haines has fueled much debate already.

Fig. 9 SEAAC Postcard

Conclusion

The 51.5 mile road proposed to be built between Echo Cove and the Katzehin River is in very treacherous avalanche country. This can endanger maintenance crews as well as the travelling public. As the protracted public process has been carried out in a somewhat illogical way, it cannot be certain that potential drivers are aware of all the dangers. Documenting the frequency of avalanches in known paths, particularly those east of Anyaka Island, over the next ten years before commencing construction is a minimal precaution. Additionally, as the cost of fuel increases, true costs must be recalculated frequently to assess the cost/benefit of this project.

Acknowledgments

We thank Ed, Rosemary and Cathy of UAS for technical support, Tim Reed and Chuck Hakari of DOT for graphics suggestions, Bonnie Hedrick of Chilkat Valley News for archival information, USFS for slide data, and Bill Glude of Southeast Alaska Avalanche Center for philosophy and technical data.

For further information

Please contact Southeast Alaska Avalanche Center, Southeast Alaska Conservation Council, and Alaska Department of Transportation and Public Facilities personnel.

Materials & Support Given to EDGE Teachers

- Laptop computers with ArcGIS, MS Office, Adobe Photoshop, GOOGLE Earth, DNR Garmin software
- Garmin Etrex GPS (with WAIS) receivers
- Digital Cameras
- Silva Compasses
- Earth System Science Books, CDs, DVDs
- Miscellaneous Rite in Rain notebooks, office supplies, rechargeable batteries, USB-Serial port converters etc.
- Tuition for Summer and Fall Credits
- Travel to Juneau for workshop and symposium

The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

EDGE Students

- 6 Day Summer Earth System science/GIS/ GPS Course-2 college credits
- Residence in UAS Dorms/Cafeteria Meals
- Field Experiences and training

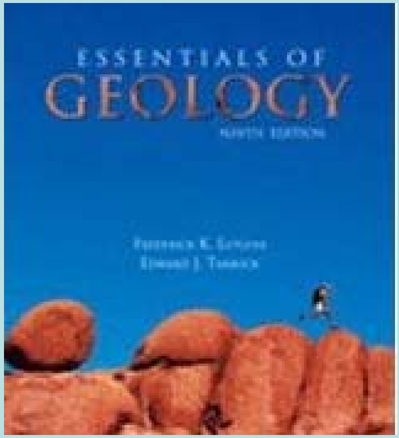
Some of the 2006 EDGE student cohort

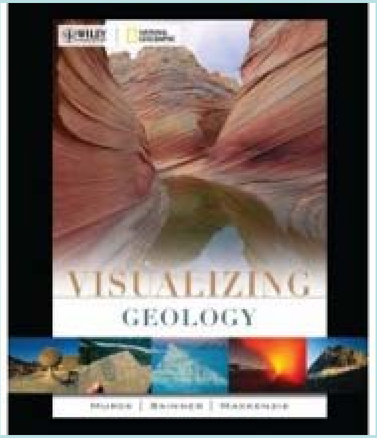
The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

EDGE TEACHER ESS CONTENT COURSE

- Fall 15-week,online Earth Science Content Course 3 credits
- Weekly homework assignments, quizzes, final exam
- Guidance for teacher mentoring of EDGE student semester-scale projects
- EDGE Student assignments components of science fair project





Fall EDGE Teachers Mentor EDGE Students through Projects

http://www.jsd.k12.ak.us/jdhs/frameit/?url=http://www.ptialaska.net/~gennie/SEASF.htm

INTEL International Science and Engineering Fair FORMAT

-Hypothesis

-Project plan

-Submission Form

-Data Log/Science Notebook

-Data Analysis

-Project Synthesis

Poster Development, Notebook completion

EDGE Symposium

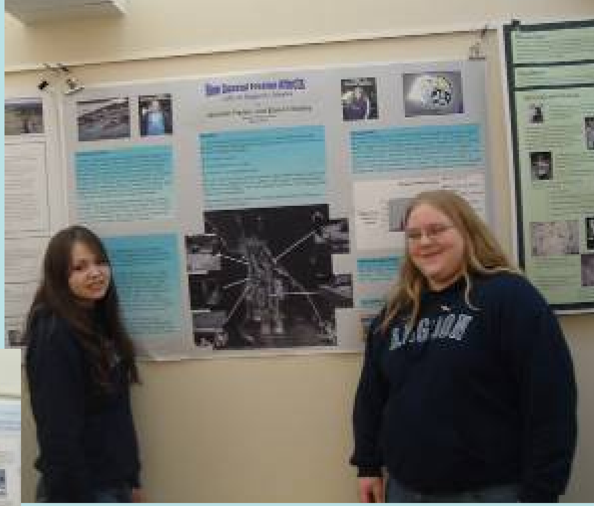
March

<u>EDGE Students</u>

- Present their projects to
- University undergraduate and faculty judges, and peers
- HS students compete in
- SEAK regional Science
- Fair-winners to INTEL

<u>EDGE teachers</u>

- Mentor Students
- Serve as judges at Science Fair




Mapping an Alaskan Village
Nunapitchuk, Kuskokwim River Delta

Janet Brink and Marie Seal
Anna Tobeluk Memorial School

EDGE Symposium March 16, 2007


Introduction

Nunapitchuk is a Yup'ik Eskimo village located on the Johnson River in western Alaska about 30 miles west of Bethel on the Kuskokwim River Delta. There are 3 villages within sight of Nunapitchuk. The area known as *Akulmiut* (a-gool-me-yoot).

On this poster you will find some maps that we made and a variety of information and photos that we hope will be interesting and informative.

Background

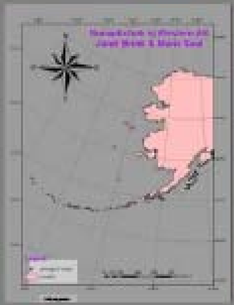
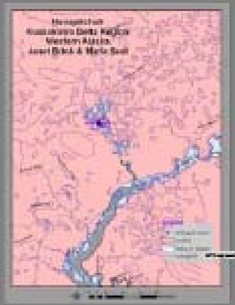
Nunapitchuk is getting very watery because the permafrost is melting. We might have to move to the bluffs. Some people don't like Nunapitchuk because of too many waters. Some people like Nunapitchuk because they go berry picking and hunting. During the summer times, people always go camping, berry picking, and hunting. Then in winter times we go jigging for salmon fish, pike, and other fish. Men go hunting for caribou, moose, and other animals that Yup'ik people eat. We have a lot of places to get food near our village. And when our parents were young they built a new school because more people started living here.

One of the villages next to us is Kasigluk; they are split into 2 villages. Akiuk was the old side and a lot of people moved to Akula because Akiuk is an island and everyone could not live there. Akiuk is 2.5 miles away and Akula is 3 miles away from Nunapitchuk. Atmautluak is 8 miles away from us. People moved from here to Atmautluak. Atmautluak is closer to Bethel and the Kuskowim River. Where we live today is not where Nunapitchuk started. Also, the other side of the river used to be called Aklacuaq, but it is now part of Nunapitchuk. You would not know this from looking at the maps there are of our area now.

Materials and methods

This fall we collected GPS waypoints of the buildings and homes in our village. Sometimes the weather was very cold and we had to go in people's houses to get warm. We wanted to have a better map of where we live. Our mentor teacher Carey Steele and Professor Cathy Connor at UAS in Juneau helped us to make the maps in ArcGIS and Google Earth.



Results

Google Earth has a picture of our village, but parts of it are wrong and some stuff is missing. Some of the boardwalks are even in the river on their photo. When we exported out waypoints into Google earth some of them ended up in the river! The last time they did a topo map that was only of our village was 1956. There is one that was made in 01/05/04, but it doesn't have details about Nunapitchuk. It's important to have a good map of Nunapitchuk.

When people go hunting they might use a GPS. In the wintertime, we can have a lot of blizzards. If someone is hunting and they have a good map of Nunapithuk on there they should make it home safely.

Also, we want people to know that there are people living in Nunapitchuk. If there isn't a map how will they know we are here?

Reference

ATMS website http://www.lksd.org/Nunapitchuk

Acknowledgements:
Dr. Cathy Connor, Carey Steele
Ewa Orlikowska who printed the maps at UAS
Natinal Science Foundation who paid for the EDGE Program

Nunapitchuk EDGE Students:
- Kelsey Larsen,
- Cynthia Jacobs,
- Marie Seal
- Janet Brink

Alaska State Capitol Juneau, August 2006

Experiential Discoveries
EDGE
In Geoscience Education

Why Does the Water in Hoonah Harbor Get So Mucky?

by Cody Anderson, Jordan Sheakley, Ben McLuckie, et al.
Hoonah High School
EDGE, Winter 2006

Introduction

In the fall and spring, the turbidity of Hoonah Harbor can get visibly muddy after big rains and wind, measured at 100 JTU or more. During the dry season in the summer and the snow and ice season during the winter, the water is clear with a measured turbidity of 0 JTU (the water is as clear as bottled water). Why is there such a huge range in water quality? This question is important because the quality of the water is important to the health of the organisms that live in the water, organisms that we and the land animals depend on.

Study Area

The Hoonah Harbor watershed is composed of 5 drainages, the largest being Garteeni Creek. All drainages are impacted by road building, clear cuttings, and other construction. Natural ground cover is dominantly spruce and hemlock forest with patches of muskeg. Elevations vary from 3406 ft at Ear Mountain in the south, 1838 ft at Hoonah Mtn. in the north all the way down to sea level.

Fig. 1. Two views of the study area. The satellite photo on the left is from Google Earth. The USGS topographic map on the right shows the entire study watershed boundaries in orange, and divides the area into 5 drainages by fill color. Drainages, from top to bottom: Cemetary Creek, Gunz Creek, Dalton Creek, Shotter Creek, and Garteeni Creek (the largest).

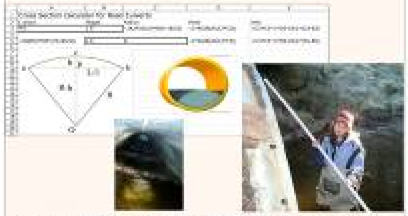
Creek	Area (ft2)	Discharge (ft3/sec)
Cemetary	29,443	
Gunz	34,684	
Dalton	34,684	2.6
Shotter	54,694	3.9
Garteeni	655,661	39.1
Totals	**803,735**	

Materials and methods

Surface Area of the watersheds and drainages were calculated by visually defining the areas on a USGS topographic map, then counting squares on a transparent graph paper calibrated to the map's scale. This winter we plan to recalculate surface areas with greater accuracy by drawing polygons in GIS software. First step is to learn the GIS software!

Streamflow area and **Discharge** is calculated for Garteeni Creek at the Whitestone Bridge using standard methods using 2 foot measurement widths, impeller sticks, tape measures and stadia rods made from PVC tubing. Calculations of cross-sectional area, velocity, and discharge were don in Microsoft Excel

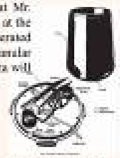
The other 4 creeks are measured at road culverts, so only water depth and velocity are measured. Cross section is calculated with an Excel calculator.



Water quality represented by **temperature, dissolved oxygen, turbidity,** and **pH** are measured using the World Water Monitoring Day kit of the Water Environment Federation and sold by LaMotte.

Methods in development

Rainfall, Wind Speed, and **Air Temperature** will be measured at a weather station now being built at Mr. McLuckie's house. The automated weather station at the Hoonah Seaplane dock and Hoonah Airport are operated by NOAA, but the published data is not granular enough for our study - 1 hour averages at best. Data will be collected on 5 minute averages by a datalogger.



A modular datalogger is being developed that will collect data in real-time and record the data at 5 minute averages. Criteria:
* Data can easily be imported into Excel and GIS software
* Easily programmable to allow for custom sensors
* Cost effective and modular
* Logging can store a month or more of data at 5 minute averages

Revolution Education from the UK has developed cheap microcontrollers ($3 each, $10 with development board) and supporting curriculum for secondary and trade schools. They developed a datalogger for the science classroom with a Windows-based wizard that programs the microcontroller based on simple prompts, and downloads the data into Excel. However, the datalogger has no provision to control the sensors. The circuit was modified to allow sensor control and flexibility. Ultrasonic **stream depth** sensor is not shown below.

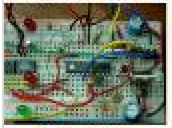


Fig. 2. Prototype datalogger

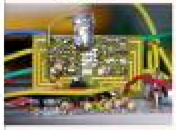


Fig. 3. Bare **turbidity, water color** and **water temperature sensors,** before waterproofing with heat shrink tubing and clear epoxy.

Fig. 3. Datalogger nearly completed in a waterproof Pelican case. Hidden are the lithium batteries and the GPS module used as an **atomic clock**. Empty sockets are for memory expansion to 2Mbytes.

Dataloggers will be installed at each road culvert and the Garteeni bridge. Every month we will visit the dataloggers with our EDGE laptop, download the data, and replace the batteries.

Background Studies

As a class, we studied the following topics in our textbook, supplemented by the Earth Revealed video series, internet research, and explorations in Google Earth.
* Models of the Earth
* The Water Cycle
* Water Erosion and Deposition and the landforms they create
* The Force of Moving Water (slope and discharge)
* Water Quality

Working Hypotheses

(will become "Results" & "Conclusions" in final poster)

* The turbidity of Hoonah Harbor increases dramatically only when it rains hard. It takes a couple of tide cycles to reduce the turbidity to baseline levels.
• The higher the discharge the greater the turbidity of Hoonah Harbor.
• Higher peak discharges by percent are caused by steeper slopes and ground cover types that have low saturation levels and surface depressional storage. These slopes and ground cover types contribute the greatest turbidity by volume to the Hoonah Harbor.
* The greater the turbidity of stream water, the greater the turbidity in the Hoonah Harbor.
• The stronger the color of stream water is to mud color, the higher the turbidity of water in the Hoonah Harbor.
• Silts and sands are the primary components of stream water that lead to high turbidity.

Challenges

The original timetable of research was predicated on a warm, late and wet winter, very much in keeping with the last few winters. The weather has turned out much colder, breaking cold records in November and on many occasions registering 30 degrees F below historical averages. It is possible that turbidity will be unmeasurable through March and possibly summer. If this happens, our research will be missing conclusions. However, the methods and materials we have developed here will be prepared for next years Earth Science class!

Literature cited

To be filled in - there is lots of literature we have used, but will do the final cut when our poster is finalized.

Acknowledgments

A BIG thank you to Dr. Cathy Connor and the EDGE staff for making this entire research experience possible. Thanks to Edward Neal of the USGS-Juneau who pointed out flaws in thinking about the question (which have since been fixed). Finally, thanks to Sara Brandy of the USFS Hoonah District for her participation in our field trips.

For further information

Please contact Ben McLuckie at mcluckieb@hcs.k12.ak.us or visit the classroom website at: http://math.hoonahschools.org and click on the Earth Science course link. (http://math.hoonahschools.org/moodle/course/view.php?id=15)

Effect of Aspect on Inorganic Properties of Two Creeks in the Government Peak Watershed

By Sean Boyden, Kalli Brettrager, Susan Skvorc

Colony High School EDGE Program, March 16, 2007

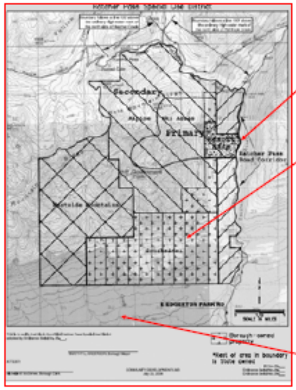
Introduction

Government Peak is the site of a current and proposed ski area in Hatcher Pass, near Palmer, Alaska. Before development proceeds, we would like to know the characteristics of the creeks in the watershed. Since the east face of Govt. Peak is being considered for a downhill ski area, and the south face for nordic skiing, we chose to study a creek on both faces to see if the different mountain aspects influence the inorganic qualities of the creeks. We studied Government Creek on the south face and an unnamed creek at mile 11 of the Willow-Fishhook Road on the east face. As development proceeds, it is our hope that the creeks will continue to be monitored as a means to protect their health.

Materials and methods

We used Hach portable sampling kits to measure turbidity, phosphate level, hardness, nitrates, dissolved oxygen, alkalinity, iron, chlorinity and ammonia. We measured temperature, pH, flow rate and discharge as well. Both creeks were sampled within two weeks in October and at about the same time of day.

Fig. 1: Map of the Hatcher Pass Ski Area (proposed)



Mile 11 creek site

Government Creek

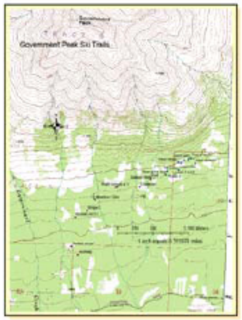


Fig. 2 Nordic ski area on south face

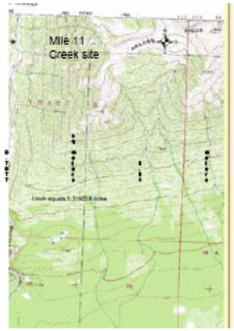


Fig. 3 Mile 11 creek site

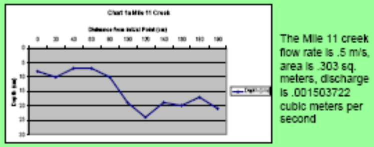
Mile 11 creek

Results

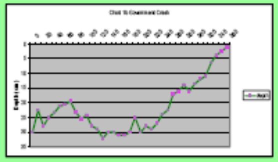
Chart 1a presents data for mile 11 creek.

Chart 1b presents data for Government Creek.

Both creeks have similar characteristics, making it unlikely that aspect has an effect on them. These data values provide a baseline from which to assess any changes that may be due to development in the area.



The Mile 11 creek flow rate is .5 m/s, area is .303 sq. meters, discharge is .001503722 cubic meters per second



Government Creek flow rate is .91m/s, area is 0.7877 sq. meters, discharge is .716807 cubic meters per second

Table 1 shows data from each test at mile 11 creek and Government Creek.

	Government Creek	Mile 11 creek
Date	10/24/2006	10/20/2006
Time	2:54pm	2:30pm
Temperature	2C	na
pH	7.7	8.4
Turbidity	0	0
Dissolved Oxygen	15mg/l	13mg/l
Iron	0	0
Nitrate	0	2
Phosphate	1ppm	1
Alkalinity	80	60
Hardness	85.5 mg/L	68.4mg/l
Free chlorine	0	0
Total Chlorine	0	0
Flow rate estimate	1.15m/s	2.02m/s

Conclusions

Our results show that both creeks have similar physical characteristics. Government Creek is a larger creek, with greater flow, but it appears that the aspect of the creek does not affect its chemical and physical characteristics. Both creeks should continue to have similar traits. Therefore, if development occurs, both creeks should remain similar. Since the mile 11 creek is at the downhill resort base and government creek is in a residential area, any deviation from baseline results may be suspected to be due to commercial development.

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For further information

Please contact Susan.Skvorc@matsuk12.us. for more information on this project.

National Science Foundation

Acknowledgments

We thank Dr. Cathy Connor and all her staff for their assistance with this project.

How Location affects Potential Tidal Energy

Sam Bornstein

March 17, 2007

Purpose

My purpose was to determine the tidal flow rate of different locations and their potential tidal energy output. I then determined if a tidal power generator in Juneau would be practical. My hypothesis was that there would be no difference in flow rate between each location.

Procedure

I tested the tidal flow rate of five locations:

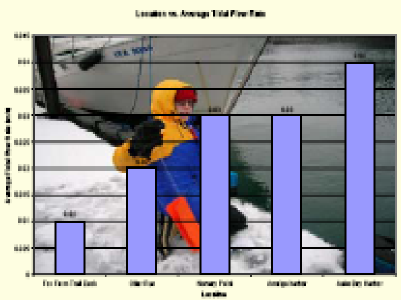
- Auke Bay
- Amalga harbor
- Norway Point
- Otter Run (near Smugglers Cove)
- Fox Farm Trail

I tested each site at mid tide. To take each measurement I used a drift card and a two meter long string. I timed the card while it floated away with the tide until the string was taut, meaning that the card was two meters away. I took ten measurements per site. I divided the average time for each site by two to get the average s/m. I then took the inverse of this to get the average surface flow rate of each location in m/s. Calculating the potential energy output took three steps:

1. Velocity = Surface Velocity (measured) x (Gradient Depth/Total Depth) $^{1/10}$
2. Power Density = ½ Water Density (1024 kg/m³) x Velocity³ (from first formula)
3. Power Density x Cross Sectional Area = Potential Tidal Energy (watts)

The cross sectional area was found by multiplying the average depth by the distance across each location.

Results

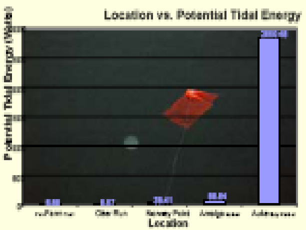


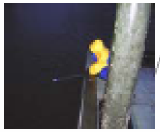
My experiments showed that Auke Bay had the fastest tidal flow with the water in the bay flowing at 0.04m/s. Amalga Harbor and Norway Point had flow rates of 0.03m/s. Otter Run had a flow rate of 0.02m/s, and the Fox Farm Trail had a flow rate of 0.01m/s. Analysis of my data using an ANOVA test did not support the null hypothesis that all locations I tested would have the same flow rate ($p<.05$).

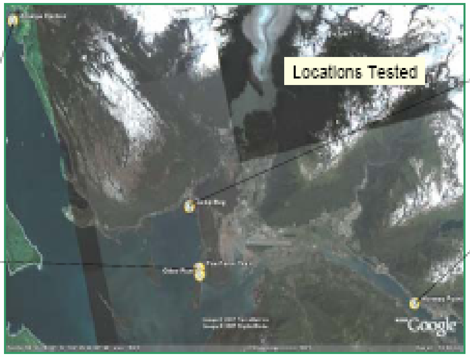
Conclusion

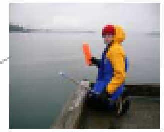
- Auke Bay had an energy potential of 2850.48 watts
- Amalga Harbor had an energy potential of 88.84 watts
- Norway Point had an energy potential of 38.41 watts
- Otter Run had an energy potential of 8.57 watts
- Fox Farm Trail had an energy potential of 6.89 watts.

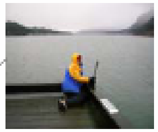
A 60 watt light bulb could only be powered from Auke Bay or Amalga Harbor. However, only Auke Bay can produce enough energy to power at least two houses.











Applications

There have been a couple of articles in the Juneau Empire during the past year about tidal energy and companies looking into testing sites around Alaska and even in Juneau. If a tidal farm were set up in Juneau, it should go in Auke Bay. However, Auke Bay probably has the most boat traffic, therefore the placement of tidal turbines may be a problem there. There also is too small an amount of energy generated for it to be economically practical.

How Location affects Potential Tidal Energy

Location	Fox Farm Trail	Otter Run	Norway Point	Amalga harbor	Auke Bay Harbor
Time (min. per 2m)	2:25	2:00	1:10	0:55	1:10
	3:00	1:40	0:50	1:00	1:40
	4:00	1:35	0:45	1:55	1:15
	4:30	1:10	2:10	1:40	1:05
	1:25	1:00	0:40	1:25	0:30
	2:30	1:00	0:45	0:45	0:35
	1:25	1:20	0:40	1:05	0:35
	1:30	1:25	0:50	1:30	0:30
	1:25	2:40	1:00	1:15	0:30
	1:30	3:10	2:35	0:55	0:35
Data Average	2:22	1:42	1:08	1:14	0:50
Average min./m	1:11	0:51	0:34	0:37	0:25
Average m/s	0.01	0.02	0.03	0.03	0.04
Depth (m)	3.88	7.77	12.89	43.89	33.69
Rounded to nearest m	4	8	12	44	34
Distance across (m)	195.596	369.4178	551.896	170.9926	3372.492
Potential Power Energy (w)	6.89	8.57	38.41	88.84	2850.48

All photographs taken by Tom Bornstein.

Logging and It's Effects on Anadromous Fish of Yakutat

Valerie Jensen and Sylvie Schumacher

Yakutatk High School

EDGE Symposium March 2007

Photo courtesy of RE Johnson Photography, http://www.rejohnson.com/

Introduction

Yakutat Alaska is located in the north gulf coast of Alaska and is a community of approximately 800 people. The landscape is a combination of muskeg, wetlands, and temperate rain forests. Yakutat is home to many different species of anadromous fish: Steelhead, Eulachon, Lampreys, and King, Sockeye, Chum, Pink, and Coho Salmon.

Yakutat residents depend heavily on the abundance of salmon for local income through commercial and subsistence fishing. The Situk River is the most productive salmon river in the pacific northwest per kilometer of river, it provides more than a way of life for the residents.

The Research Behind Our Project

Salmon are anadromous fish, living in fresh and saltwater. They migrate for miles from the ocean to little streams and rivers to their birth place to spawn. Salmon end up swimming through many obstacles; from jumping up waterfalls, struggling through culverts, to avoiding predators. Salmon rely on Spruce forests, due to the protection the canopy provides. Yakutat's forests consist of mainly Sitka Spruce and Hemlock. The abundance of Spruce trees have made Yakutat a great place of logging. However, logging greatly effects the rivers, streams, and salmon species surrounding the area. Removing the canopy of the trees increases the temperature of the water, which causes the water to evaporate at an increased rate. As the water evaporates, the water level decreases, making it harder for salmon to survive.

Logging requires immense road building, which can spread over miles of land, sometimes crossing streams and rivers. Culverts are installed to keep the salmon flow going. When logging took place in Yakutat in 1984, time wasn't taken to put the proper sized culverts in. This also makes it hard for salmon to swim through, depending on how strong the currents are. If the stream flow is strong and encounters a small culvert, it shoots out the other side, making it difficult for the salmon fry to get through.

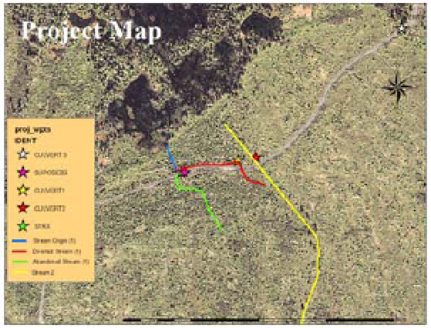
Project Description

We selected a section of logging road to complete our project, where we surveyed and identified culvert and stream crossing locations. One of our missions were to identify whether or not the culverts were suitable for fish passage, and make recommendations for replacement.

Some indicators of the culvert being inappropriate for a stream, was a pool of water built up on either side of the culvert. The culvert would most likely end up being impacted with wood debris. The culvert should be as wide as the channel at high water events.

In most cases, the roads interrupted the stream passage. The proper installation of the culverts through the roads would prevent the stream from diverting into a ditch, parallel to the road.

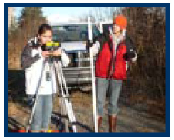
The roads in our study area are trenched out with banks built up on both sides, making our study site look like a valley. We surveyed for culvert elevation, culvert width, and culvert gradient using a survey grade auto level.



Results

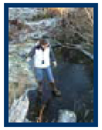
We observed and recorded each culvert's upstream and downstream gradient, and the culvert's gradient, height, width, and length. Here are our results:

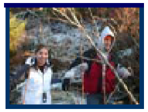
	Culvert 2	Culvert 3
Upstream Gradient	1.67	0.0018
Downstream Gradient	1.09	0.0062
Culvert Gradient	0.975	0.025



	culvert height	culvert width	culvert length
Culvert1	1.2 feet	1.2 feet	15.5 feet
Culvert2	1.5 feet	1.5 feet	22 feet
Culvert3	2.0 feet	2.0 feet	24 feet

These are some of the measurements we took from each culvert





Conclusions

This whole project has opened our eyes to what a big difference fixing each culvert or the land would do for the Situk river and the salmon that thrive in its waters.

As we mentioned before, Situk provides a way of life for a lot of Yakutat's population. It is important that the passage ways to the spawning areas are clear to swim through without struggle.

We now know that the size of the culverts are wrong and need to be replaced. Replacing a culvert wont necessarily be easy; it's going to cost a lot of money and a lot of time to fix everything to the way it should be.

Our recommendations for culvert #1 is that it should be replaced with a culvert double its current size, however, the stream is diverted into the ditch and runs along the road, so we would like to put a culvert on the other side, where it is suppose to be. The reason we recommend moving the culvert is because we found a of water that builds up behind beaver damn.

Sources

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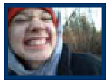
Acknowledgments

We would like to thank Kevin Schaberg from the Yakutat Salmon board, Debbie Caron of the Yakutat School District, Bob Pate of Pate Construction, and Bill Lucy of the Yakutat Salmon Board.

For further information

Please contact *Valerie and Sylvia.*

For more information on this and related projects can be obtained from Kevin Schaberg of the Yakutat Salmon Board.



Southeast Alaska Regional Science Fair

Southeast Alaska Regional HS Science Fair
Juneau-Douglas HS
University Alaska Southeast
March 28, 29, 2008

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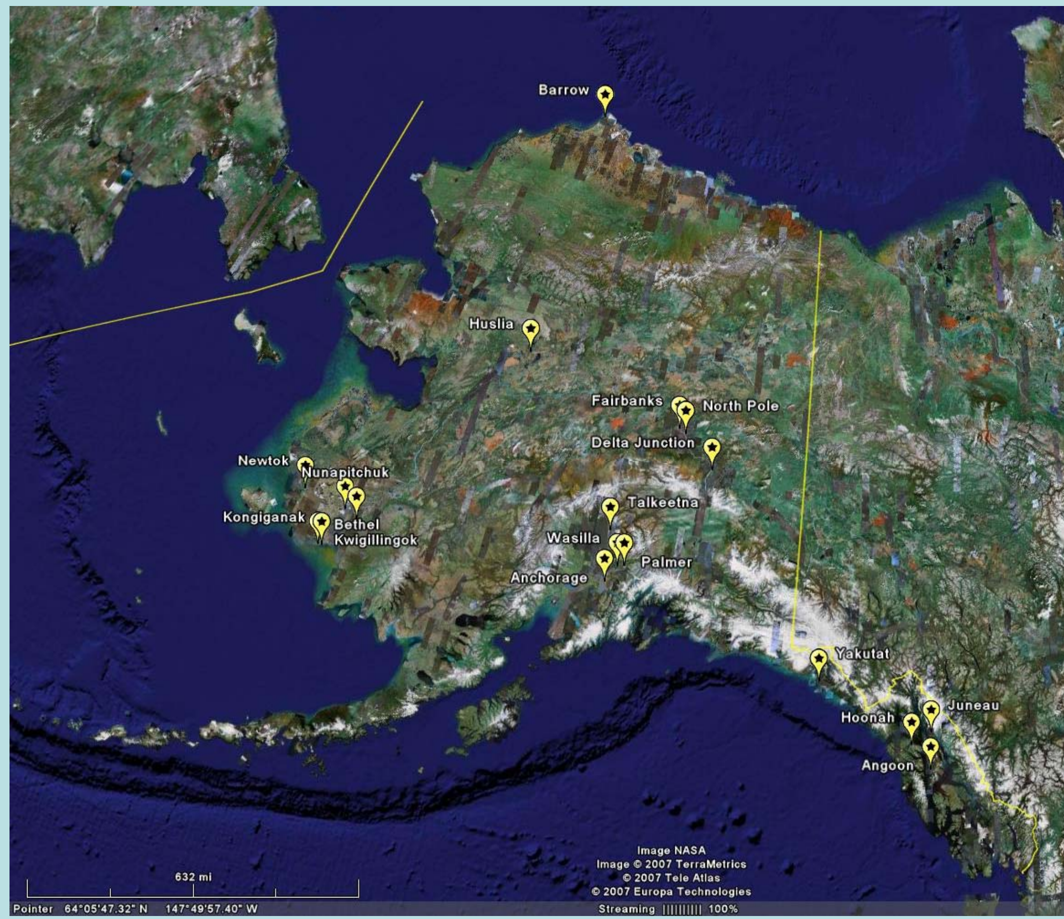
- 8 (2007) and 10 (2008) EDGE HS student teams present science projects in Southeast Alaska Regional Science Fair
- 20 EDGE teachers receive training as science project reviewers-Science Fair Judges

EDGE-AK Space Grant
GIS Schools
2005, 2006, 2007, 2008

(12 school districts, >25 schools)

HS	MS
Alyeska CSS	Begich
Angoon	Central
Barrow	Dzanti'ki Heeni
Ben Eilsen	Dryden
Bethel	IDEA
Colony	Haines
Delta	Juneau Charter
Huslia	Palmer
IDEA	Ryan
Juneau-Douglas	Susitna
Kongiganak	
Kwigillingok	
Mat Su CSS	
Newtok	
Nunapitchuk	
West Valley	
Yakutat	



EDGE Teacher Influence of 2006 AK Secondary Science Students

The EDGE program has now reached 12 out of 54 (22%) of AK school districts.
These districts contain 63% of the grade 6-12 student population

EDGE teachers are now influencing 58 % of AK Middle Schools and 10% of AK High Schools by student population.

EDGE-Influenced Alaska Secondary School Districts By Grades 6-12 Student Population

EDGE Districts	MS (6-8)	HS (9-12)		%
Anchorage	11325	15449	0.3693	37
Fairbanks	3774	4853	0.1123	11.2
Matsu	3290	1818	0.0520	5.2
Juneau	1202	918	0.0417	4.2
Lower Kusko	736	918	0.0228	2.3
Northslope	339	559	0.0124	1.2
Delta Greely	306	557	0.0119	1.2
Yukon-Koyukuk	309	493	0.0110	1.1
Haines	74	105	0.0025	0.3
Chatham 44	74	0.0016	0.2	
Hoonah	32	66	0.0014	0.1
All Alaska	30027	42481	1.0000	100.00

Experiential Discoveries
EDGE
in Geoscience Education

EDGE Teacher Inspired Secondary Outreach Programs

EDGE Year 2006-28 Participants

Juneau School District Geotreks Training

Floyd Dryden MS Galau, Morris, Ferrell-250 8th graders
Gastineau Elementary-Savikko-Knotweed Invasive Species Project-20 4th graders

EDGE Year 2007-20 Participants

- Anchorage Central Middle School GPS-Earth Science Geocaching-
  L. Gillam-44 MS Students
- Juneau School District Geotreks Training
  Galau, Morris, Ferrell-250 8th graders
- Juneau NOAA/Springboard HS Oceanography Camp-40 Students
  Galau & Savikko-20
- GPS Club-Gastineau 3rd Graders-Geocaching
  11 3rd-5th graders-Wahl, Savikko

Southeast Regional Science Fair-12 EDGE Students

>600 Alaskan MS and HS students across this state have collected GPS data and used GIS through the EDGE program

Unit Design Template

Project Title

Mendenhall Glacier...Past, Present, and In the Future

Project Designers

David Kovach

Grade Level/Content Areas

Grade 7 & 8 Physical Science

Project Synopsis/Description

This unit is designed to introduce students to topics in physical science, GPS technology, the scientific method, and help them become more familiar with their local environment. Students will study the physical properties of glacier ice including density, materials present and their abundance, and melting rates of different types of ice. Students will also use GPS technology to mark waypoints of physical features caused by glacier movement and then transfer these waypoints/locations onto a map of the area. Students will then use available data to make estimations of how long ago the glacier was at the location of the waypoints they marked. They will culminate the unit by using available USGS GPS data and historical maps of the glacier to determine a method for estimating glacial retreat. Students will use their method and calculations to make predictions for how long it will take for the Mendenhall Glacier's face to retreat out of Mendenhall Lake to the point of it being a "hanging glacier".

Stage 1: Desired Results

Standards:

I. Science A1: *Students develop an understanding of process of science and use it to investigate problems, design and conduct repeatable scientific investigations and defend arguments.*

8th grade SA 1.2: Collaborate to design and conduct repeatable investigations in order to record, analyze, interpret data, and present findings.

II. Technology C1: *Students should use technology to observe, analyze, interpret, and draw conclusions.*

Enduring Understanding:

The student will understand that science is a process that gives people the ability to make conclusions to a question, predictions about phenomenon, and/or make recommendations for improvement to an issue under investigation.

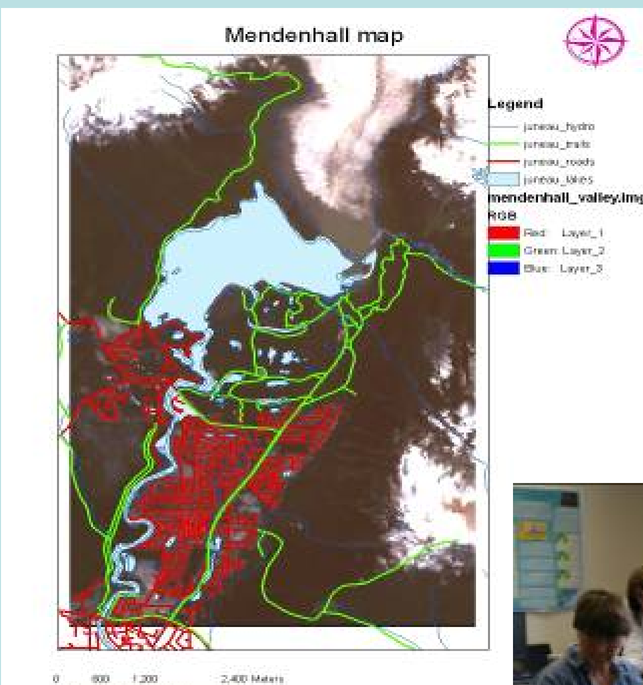
The student will understand that changes in Earth's surface over time are due to the interaction of many physical forces.

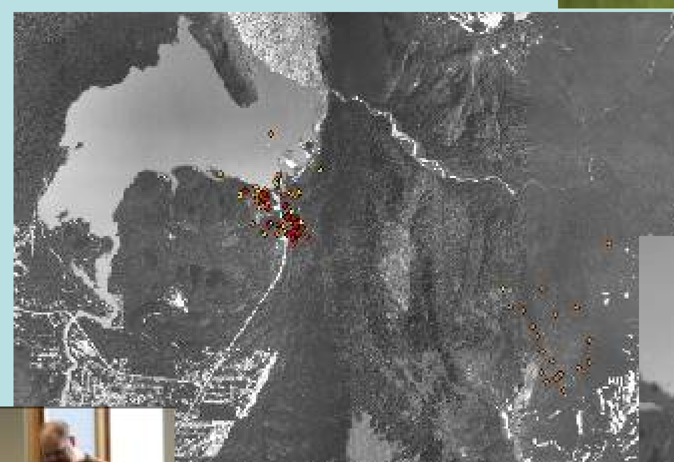
Essential Questions:

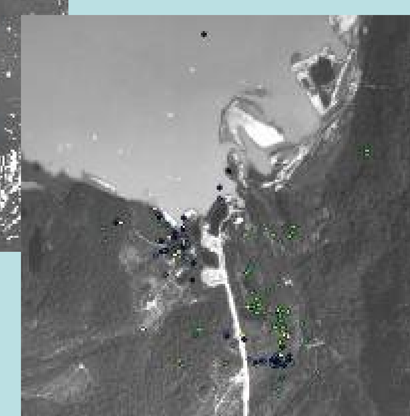
***Can we use science to predict the future?**

Juneau School District

550 Juneau Middle School students carry out GPS GIS research (Glacier recession, Plant Succession, Bear use of habitat)







Can Plant Succession Be Used To Find When a Glacier Receded?

Aven Handley-Merk and JoDarryl Gone
Floyd Dryden Middle School

Introduction

Plant succession can be used to date when a glacier has receded from an area if you know when plants grow back (see fifth slide). For example, if you see only small plants, such as moss and grasses, you know that the glacier receded around 5 years ago. If you see large hemlocks, you know that it's been at least 350 years since the glacier receded.

Methods

We went to the glacier and marked areas using GPS. We traveled along the Trail of Time and marked waypoints where the glacier's terminus is known. These can be used to see how accurate our predictions are. We then found places where the glacier limits were unknown, and made predictions using plant succession, and then dated when the glacier was there. Using ARCmap, we added our waypoints to maps and marked the glacier's terminus. Finally, we compared our plant succession waypoints to the Miller Map, which shows the glacier's old terminuses.

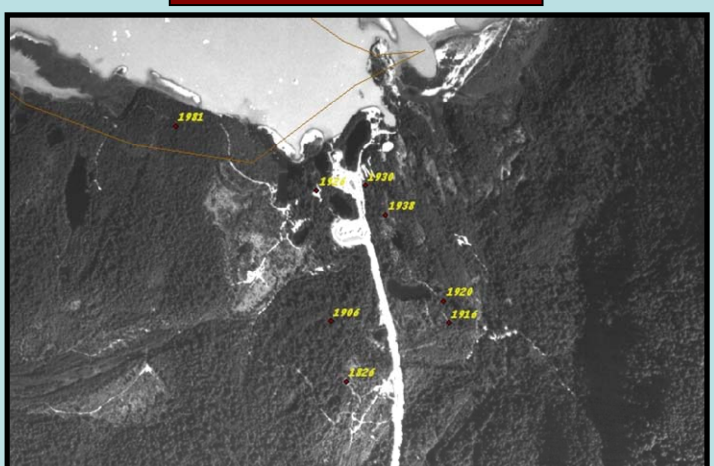
References

1) Hocker, K. The Mendenhall Glacier: A River of Ice. 2003 Alaska Natural History Association.

2) Miller, R. Surficial Geologic map of the Juneau Urban Area and Vicinity, Alaska. 1975. U.S. Geological Survey.

Trail of Time Map

Modified Miller Map



Results

We found that our waypoints are mostly accurate. Our trail of time waypoints are correct. The waypoints on both maps are in similar positions relative to the glacier. You can see our waypoints are accurate by comparing where they are in relation to the Miller Map waypoints. Our **1826** waypoint is a reasonable distance from Mr. Robert Miller's **1916** waypoint; our **1906** waypoint is close to his **1920** waypoint; our **1926** waypoint is very near to his **1930** waypoint**.** The only inaccurate one is our **1981** waypoint**,** which is too far north in comparison to Mr. Miller's **1930** waypoint**.** although the mark **1981** is off. This could be because of floods, fires, or human influence (mentioned under Discussion).

Discussion

The most reliable way to find out where a glacier terminus is to mark the terminus BEFORE it recedes; plant succession can be unreliable. Other ways that plant life can be set back are floods, fires, and human influence. These can seriously affect your predictions on where the terminus was and when. In conclusion, plant succession cannot always be relied upon to show when a glacier receded. A way to make our information more accurate would be to return to the glacier and mark more waypoints, keeping in mind what we have learned about the accuracy of our current waypoints

EDGE Publications/Presentations

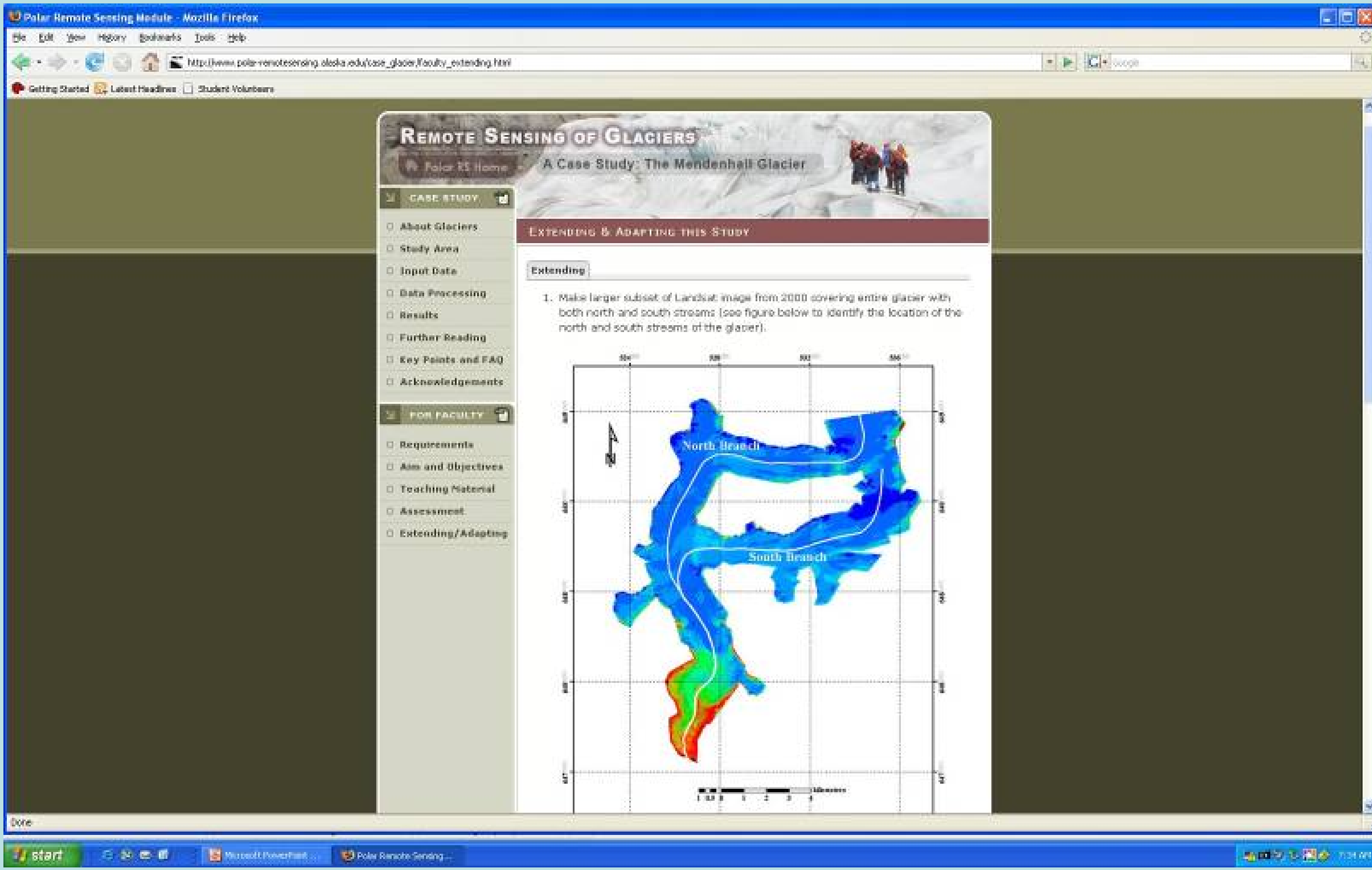
- **Connor, C., and Prakash, A., 2007, Changing the culture of accidental Earth science majors in Alaska. *Journal of Geoscience Education*, (in revision).**

- **Prakash, A., Connor, C., and Smikrud, K., 2007, Authentic geoscience research experiences using GPS-GIS skills to excite Alaska's middle and high school students about Earth science. *Geological Society of America*, Denver, Abstracts.**

- **Connor, C., Prakash, A., Berner, L., Hood, E., and Heavner, M., 2007, Glacier Surface Field Experiences and GIS training provide Alaska's Science Teachers with Climate Change Assessment tools for use in Middle School and High School classrooms. *Geological Society of America*, Denver, Abstracts.**

Remote Sensing of Glaciers
The Mendenhall (an on line case study for undergraduates)

http://www.polar-remotesensing.alaska.edu/case_glacier/faculty_extending.html



GIS/GPS and Geoinfomatics Technology Enters AK Secondary Science Classrooms

UAF Fairbanks
UAA Anchorage
UAS Juneau

GIS Capability at Juneau's Middle Schools

Geocaching in Anchorage Central Middle School

Flying into the future EDGE 2.0….. What’s Next?