Bonanza Creek LTER Education & Outreach

Year in review and next steps

Katie Spellman, Christa Mulder,
Elena Sparrow, Pat Doak, Diane Wagner

Photo Credit: Jasmine Shaw

BONANZA CREEK LTER
Boreal Forest Ecology

Undergraduate research at CPCRW, Credit: Kevin Huo

BNZ Education seeks to:

- Inspire wonder and appreciation of the boreal forest and how it is studied.
- Increase access to and use of BNZ assets (e.g. personnel, sites, data) by students, teachers, and the public
- Improve inclusion and diversity of people who are receiving the benefits of BNZ assets (training opportunities, use of BNZ products, etc.)
- Prepare students for ecological and related careers

BNZ Education Strategic Plan

Long-term goals (5 year) that will shape our next grant cycle

- *Long-term goal 1.* Formalize some of our opportunistic program offerings to increase efficiency and access to these programs.
- *Long-term goal 2.* Develop a program to assist BNZ faculty in incorporating BNZ datasets into their existing undergraduate course teaching.
- *Long-term goal 3.* Develop relationship with the UAF climate change minor program and the UAF Honors College Climate Scholars Program
- *Long-term goal 4.* Develop a BNZ graduate student orientation program.
- *Long-term goal 5.* Develop a BNZ Science communicator position and communication plan and deliver regular BNZ science communications to the public, stakeholders and partners.
- *Long-term goal 6.* Continue strengthening connection and tightening feedback loops between BNZ research and education through PPSR and leveraging of GLOBE and Fostering Science programs.

BNZ Strategic plan section link:
https://docs.google.com/document/d/1ouSfwpAGovr08UbgqPim_A82mlAhv3TH/edit?usp=sharing&ouid=115272221693528683102&rtpof=true&sd=true

BONANZA CREEK LTER
Boreal Forest Ecology

Bonanza Creek Education Programs

K12 & Schoolyard LTER

- Fostering Science
- Arctic and Earth SIGNs
- Community & Citizen Science Programs
- Day trips

Undergraduate & Graduate

- Graduate research and training
- Research Experience for Undergraduates
- Summer Climate Research Intensive
- **NEW** - BNZ data in Undergraduate classrooms (Wagner et al. RCN-UBE Incubator)

Adults

- Arctic and Earth SIGNs
- Community & Citizen Science Programs
- In a Time of Change

BONANZA CREEK LTER
Boreal Forest Ecology

Fostering Science

Enlisting the power of nature and the passion of scientists

Fostering Science

to empower youth in care

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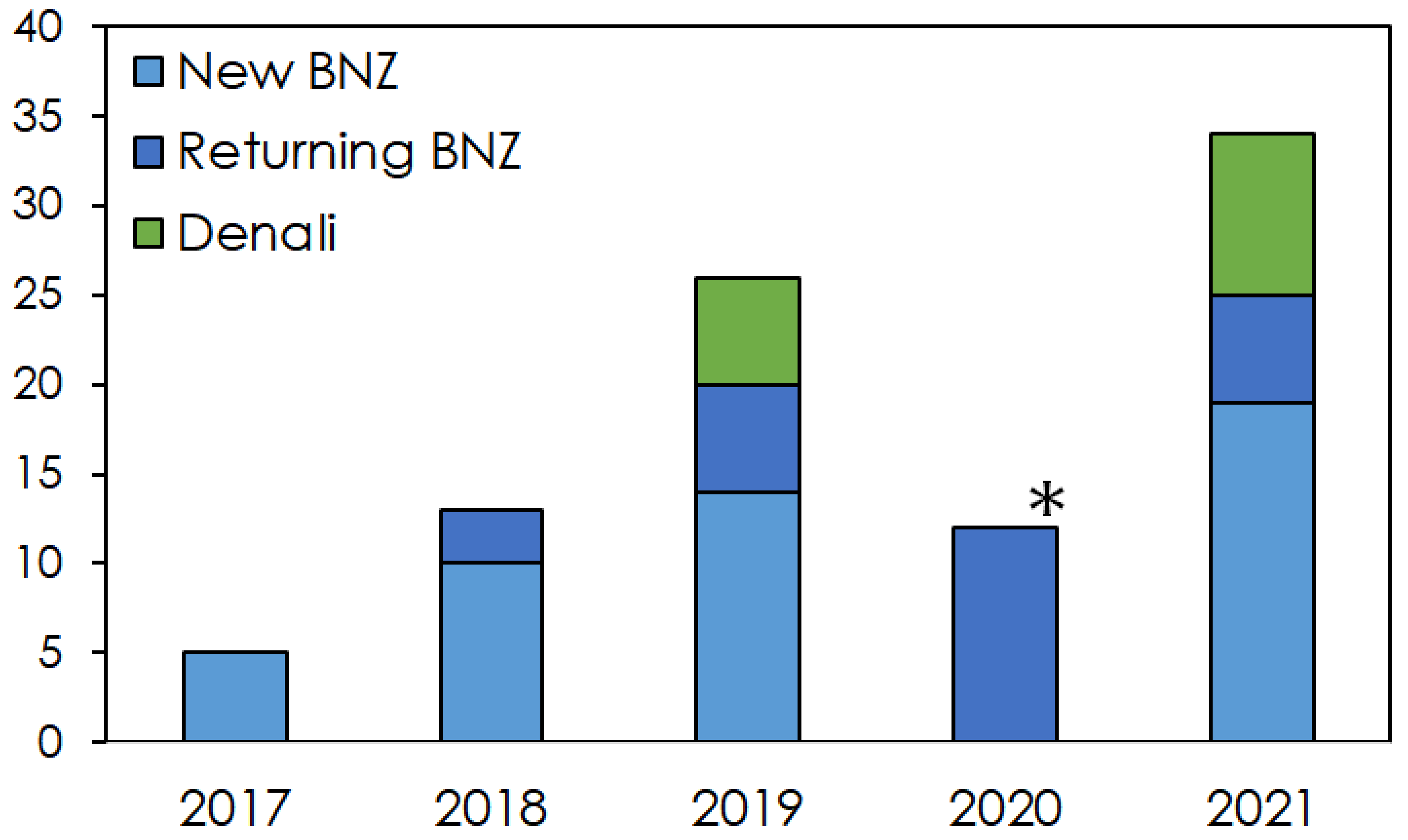
to empower youth in care



* Virtual BNZ camp only

News and Plans

Funding:

1. We now have a Fostering Science General Support Fund for tax-free donations (thank you, Willy Gordon).
2. We have funding for 2 years from the Doug Schamel Fund. This will cover the costs of the Denali camp.

Camp Expansion:

- Expand day camp to 2 camps (16 kids maximum / camp)
- Add a Denali backcountry backpacking trip for experienced youth

Training expansion:

- Background on impacts of ACEs on youth and impacts on learning
- Building and diversifying our pool of instructors, including youth “aging out”

News and Plans

Enlisting the power of nature and the passion of scientists
Fostering Science
to empower youth in care

New Program: ScienceWeb:

- Internship program for older youth:
  - Field or lab work with LTER members
  - Job training / college preparation
  - Junior counselor positions
  - Near-peer mentoring
- Goals:
  - Provide pathway to STEM participation
  - Strengthen connections to youth and to adults
  - Contribute toward JEDI goals
    - Foster youth are hugely underrepresented in STEM
    - >50% of our campers are Alaska Native
    - 50% reported wanting to be a scientist or considering it after participating in camp

Community & Citizen Science

Pre-COVID Girl Scout
“Think like a Citizen
Scientist Day”

Arctic and Earth SIGNs

Weather

Permafrost Change

Erosion

Drought

Energy Resources

Seasonal Timing

Water Quality

Ice & Snow

Berries

Land

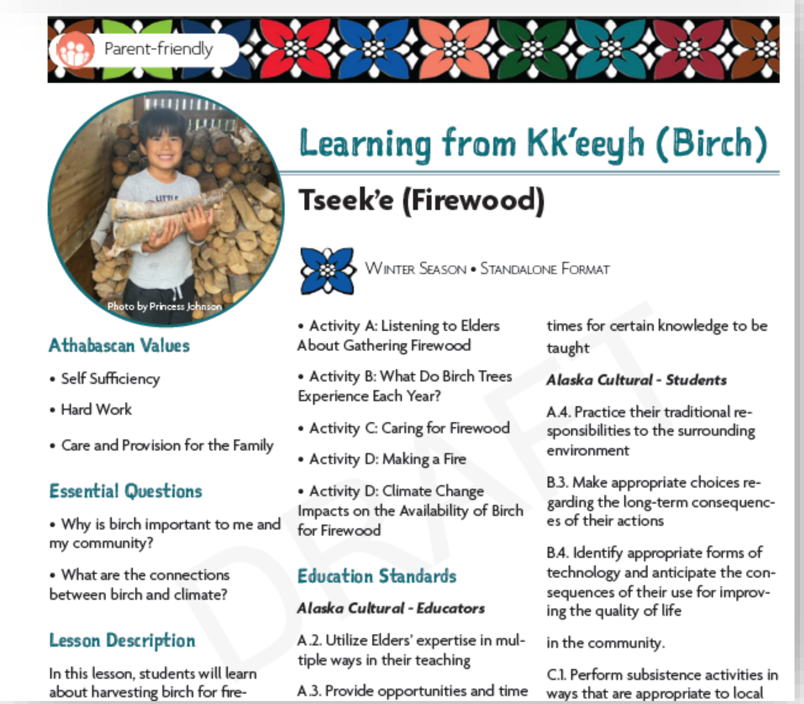
Fish

Forests

Approach: Use various ways of knowing and learning about the environment to help your community address climate change issues.

- Learning from elders and community
- Co-produced youth-centered projects
- Resource matchmaking (GLOBE, BNZ, NASA, etc.)
- Indigenous curricula supports
- Meet-the scientist sessions
- Community action and sharing.

Arctic and Earth SIGNs



Parent-friendly

Learning from Kk'eeyh (Birch)

Tseek'e (Firewood)

Photo by Princess Johnson

WINTER SEASON • STANDALONE FORMAT

Athabascan Values

- Self Sufficiency
- Hard Work
- Care and Provision for the Family

Essential Questions

- Why is birch important to me and my community?
- What are the connections between birch and climate?

Lesson Description

In this lesson, students will learn about harvesting birch for fire-

- Activity A: Listening to Elders About Gathering Firewood
- Activity B: What Do Birch Trees Experience Each Year?
- Activity C: Caring for Firewood
- Activity D: Making a Fire
- Activity D: Climate Change Impacts on the Availability of Birch for Firewood

Education Standards

Alaska Cultural - Educators

A.2. Utilize Elders' expertise in multiple ways in their teaching

A.3. Provide opportunities and time times for certain knowledge to be taught

Alaska Cultural - Students

A.4. Practice their traditional responsibilities to the surrounding environment

B.3. Make appropriate choices regarding the long-term consequences of their actions

B.4. Identify appropriate forms of technology and anticipate the consequences of their use for improving the quality of life

in the community.

C.1. Perform subsistence activities in ways that are appropriate to local

DRAFT

Focus for 2020-21

- Birch forest change and cultural values
- Renewable energy potential - biomass

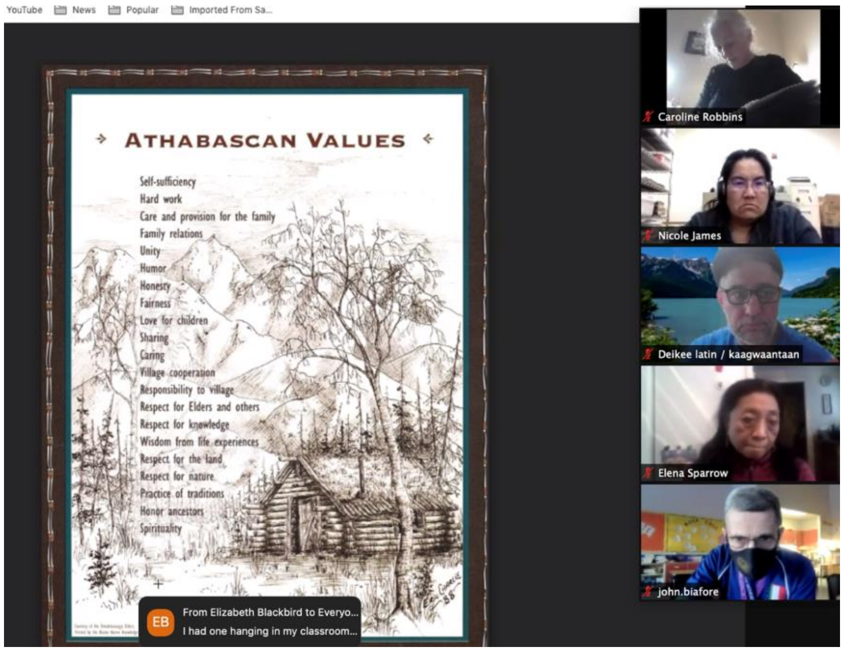
Major events:

- Virtual Educator workshop
- Learning from Kk'eeyh youth camp
- Meet the scientist sessions
- GLOBE Grandma birch phenology
- IBFRA citizen science workshop

BNZ Assets:

- Boreal Allometric equations (Yarie, Kane et al.)
- USFS Citizen Science program access (FIA)
- Sparrow, Spellman, Mulder, Genet, Young-Robertson

Arctic and Earth SIGNs



ATHABASCAN VALUES

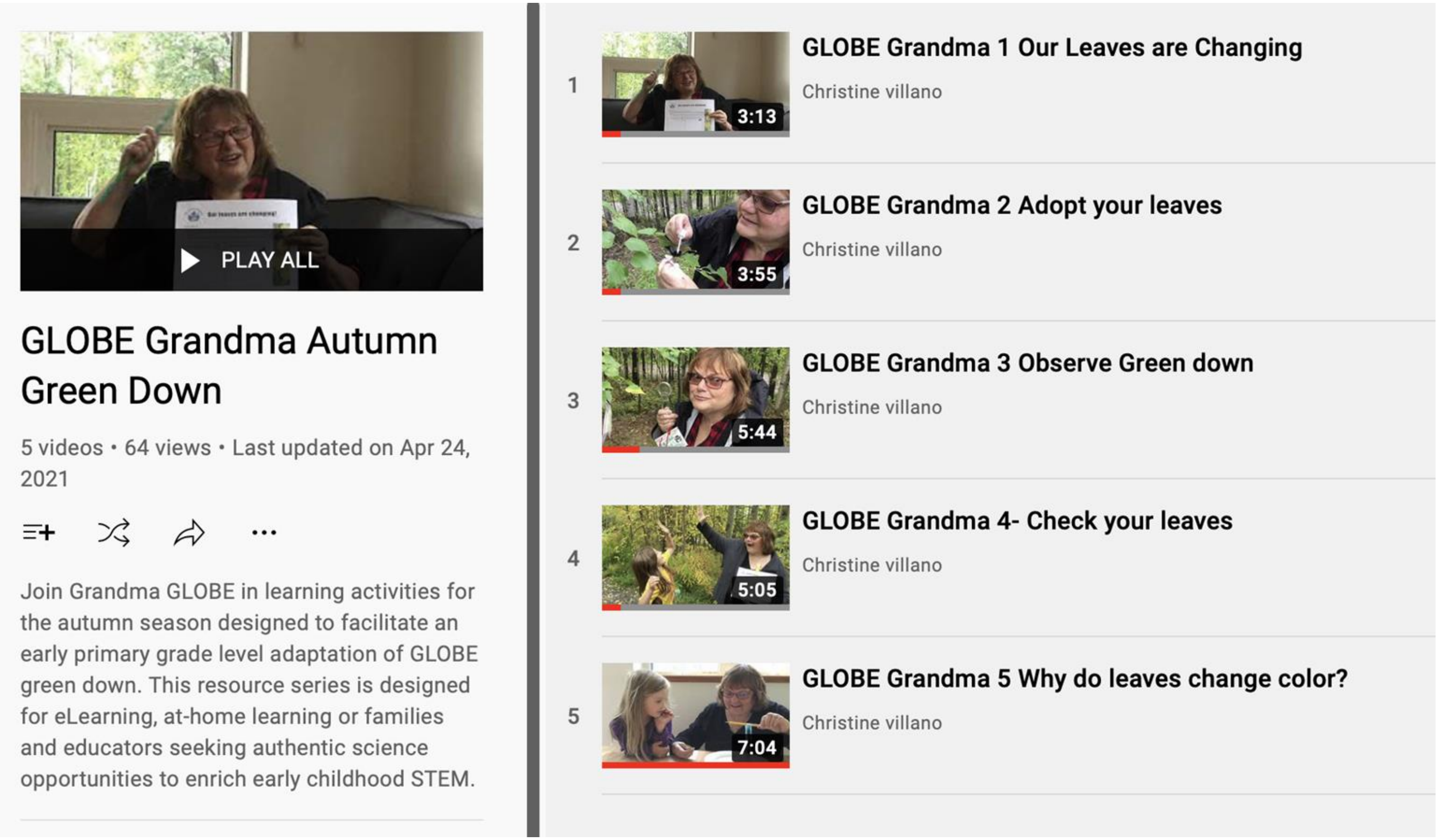
- Self-sufficiency
- Hard work
- Care and provision for the family
- Family relations
- Unity
- Humor
- Honesty
- Fairness
- Love for children
- Sharing
- Caring
- Village cooperation
- Responsibility to village
- Respect for Elders and others
- Respect for knowledge
- Wisdom from life experiences
- Respect for the land
- Respect for nature
- Practice of traditions
- Honor ancestors
- Spirituality

From Elizabeth Blackbird to Everyo...
I had one hanging in my classroom...

Educator workshop on boreal forest renewable energy resources and Indigenous relationships with birch.

Meet the Scientist event with USFS and BNZ scientists with McGrath School. Tree biomass measurements using GLOBE Observer Trees

Arctic and Earth SIGNs



PLAY ALL

GLOBE Grandma Autumn Green Down

5 videos • 64 views • Last updated on Apr 24, 2021

Join Grandma GLOBE in learning activities for the autumn season designed to facilitate an early primary grade level adaptation of GLOBE green down. This resource series is designed for eLearning, at-home learning or families and educators seeking authentic science opportunities to enrich early childhood STEM.

1. GLOBE Grandma 1 Our Leaves are Changing — Christine villano — 3:13
2. GLOBE Grandma 2 Adopt your leaves — Christine villano — 3:55
3. GLOBE Grandma 3 Observe Green down — Christine villano — 5:44
4. GLOBE Grandma 4- Check your leaves — Christine villano — 5:05
5. GLOBE Grandma 5 Why do leaves change color? — Christine villano — 7:04

Over 100 families tracked leaf green down of birch, aspen and poplar last fall and 5 classrooms this year using GLOBE Grandma. 456 views!

Winterberry

2020-21 Highlights

- Demand for continuation of the program by educators and Tribal organizations
- Museum of the North Berry Month
- Total of 32 communities involved, 1500 volunteers and 17,000 observations
- Mulder et al. *In Press.* Natural History of Berry Loss
- Spellman et al. 2021 Linking data to planning for action through scenarios

BNZ Assets:

- BNZ pilot funding and graduate student support,
- ITOC wearable art examples
- Katie Spellman, Christa Mulder, Elena Sparrow, Lindsay Parkinson, Kristin Schroder, Laura Weingartner
- Data Archiving- Jason Downing

New directions: Alaska’s Berry Future

New directions in Berry science
- Gather information needs and concerns of communities
- Identify datasets available on berries across the state
- Identify gaps in science and future science
- Tightly align our science to the climate adaptation needs of our communities
- MicroBerry!

BNZ Assets:
- a decade+ of prior BNZ research on berry species
- Mulder, Spellman, Muscarella, Sparrow, Heeringa, Chase

Fresh Eyes on Ice

Ice thickness, snow pack & snow water equivalent, ice phenology

2020-21 Highlights

- Continued ice and snow monitoring and learning with 14 community teams
- NASA Community Eyes on River Ice needs assessment
- photo observation expansion
- New partnerships with TCC, NWS, GLOBE and NASA

BNZ Assets:

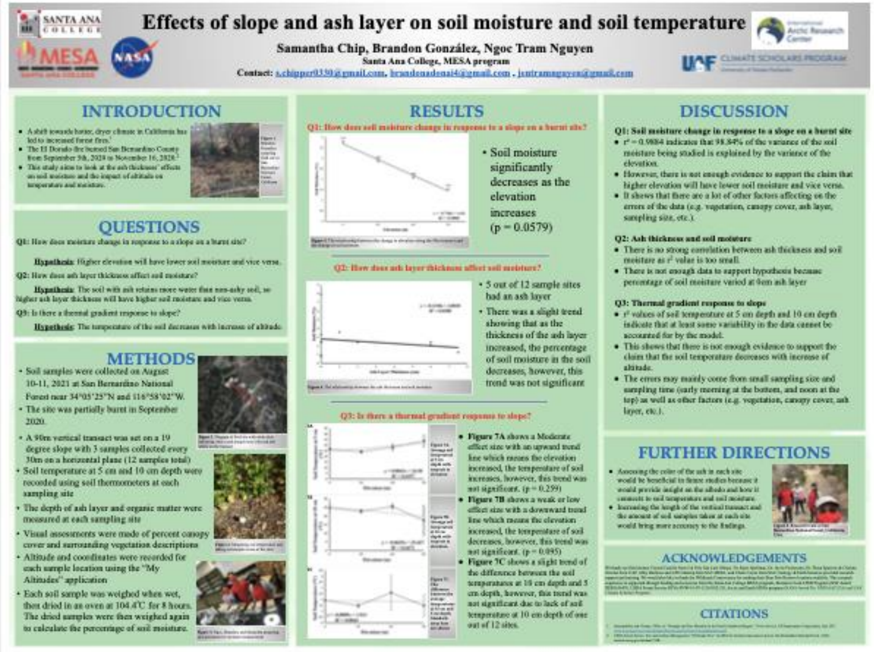
- Tanana River Ice Camera at BNZ
- Dana Brown, Katie Spellman, Elena Sparrow

Summer Research Intensive

- 5th year of the program
- First generation college students from Santa Ana College MESA program 2021
- Addition of UAF Climate Scholars Program students
- Aug 2021 - Hybrid Engagement in SoCal and AK, 2 credits HONR F395

2021 Numbers-

- 15 students (66% from groups underrepresented in STEM)
- 7 research projects completed
- 3 locations (Porto, Portugal; Bear Paw Reserve, CA; CPCRW)



Effects of slope and ash layer on soil moisture and soil temperature

Samantha Chip, Brandon González, Ngoc Tram Nguyen
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INTRODUCTION

- A shift towards hotter, dryer climate in California has led to increased forest fires.[1]
- The El Dorado fire burned San Bernardino County from September 5th, 2020 to November 16, 2020.[2]
- This study aims to look at the ash thickness' effects on soil moisture and the impact of altitude on temperature and moisture.

QUESTIONS

Q1: How does moisture change in response to a slope on a burnt site?

Hypothesis: Higher elevation will have lower soil moisture and vice versa.

Q2: How does ash layer thickness affect soil moisture?

Hypothesis: The soil with ash retains more water than non-ashy soil, so higher ash layer thickness will have higher soil moisture and vice versa.

Q3: Is there a thermal gradient response to slope?

Hypothesis: The temperature of the soil decreases with increase of altitude.

METHODS

- Soil samples were collected on August 10-11, 2021 at San Bernardino National Forest near 34°05'25"N and 116°58'02"W.
- The site was partially burnt in September 2020.
- A 90m vertical transect was set on a 19 degree slope with 3 samples collected every 30m on a horizontal plane (12 samples total)
- Soil temperature at 5 cm and 10 cm depth were recorded using soil thermometers at each sampling site
- The depth of ash layer and organic matter were measured at each sampling site
- Visual assessments were made of percent canopy cover and surrounding vegetation descriptions
- Altitude and coordinates were recorded for each sample location using the "My Altitudes" application
- Each soil sample was weighed when wet, then dried in an oven at 104.4°C for 8 hours. The dried samples were then weighed again to calculate the percentage of soil moisture.

RESULTS

Q1: How does soil moisture change in response to a slope on a burnt site?

- Soil moisture significantly decreases as the elevation increases ($p = 0.0579$)

Q2: How does ash layer thickness affect soil moisture?

- 5 out of 12 sample sites had an ash layer
- There was a slight trend showing that as the thickness of the ash layer increased, the percentage of soil moisture in the soil decreases, however, this trend was not significant

Q3: Is there a thermal gradient response to slope?

- **Figure 7A** shows a Moderate effect size with an upward trend line which means the elevation increased, the temperature of soil increases, however, this trend was not significant. ($p = 0.259$)
- **Figure 7B** shows a weak or low effect size with a downward trend line which means the elevation increased, the temperature of soil decreases, however, this trend was not significant. ($p = 0.095$)
- **Figure 7C** shows a slight trend of the difference between the soil temperatures at 10 cm depth and 5 cm depth, however, this trend was not significant due to lack of soil temperature at 10 cm depth of one out of 12 sites.

DISCUSSION

Q1: Soil moisture change in response to a slope on a burnt site

- $r^2 = 0.9884$ indicates that 98.84% of the variance of the soil moisture being studied is explained by the variance of the elevation.
- However, there is not enough evidence to support the claim that higher elevation will have lower soil moisture and vice versa.
- It shows that there are a lot of other factors affecting on the errors of the data (e.g. vegetation, canopy cover, ash layer, sampling size, etc.).

Q2: Ash thickness and soil moisture

- There is no strong correlation between ash thickness and soil moisture as r^2 value is too small.
- There is not enough data to support hypothesis because percentage of soil moisture varied at 0cm ash layer

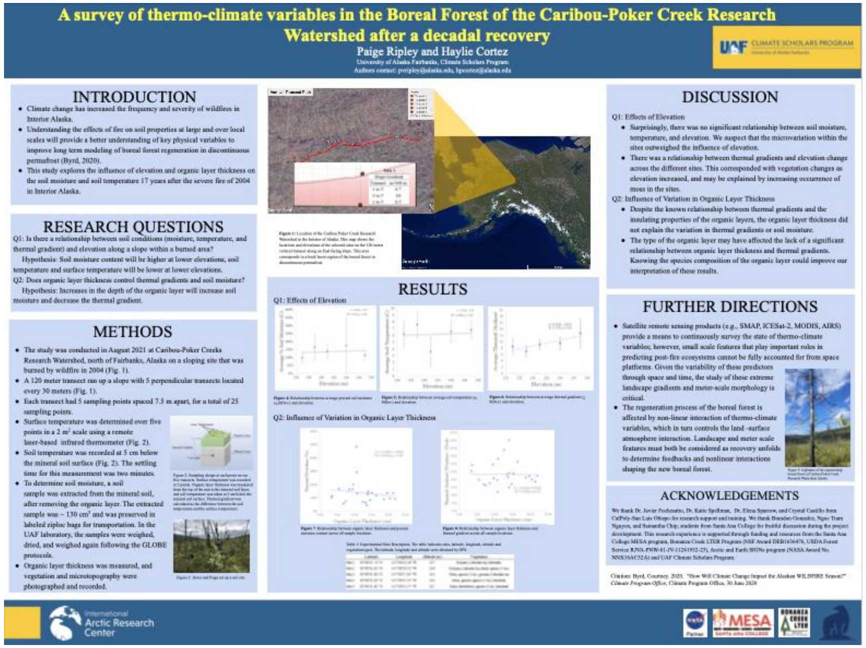
Q3: Thermal gradient response to slope

- r^2 values of soil temperature at 5 cm depth and 10 cm depth indicate that at least some variability in the data cannot be accounted for by the model.
- This shows that there is not enough evidence to support the claim that the soil temperature decreases with increase of altitude.
- The errors may mainly come from small sampling size and sampling time (early morning at the bottom, and noon at the top) as well as other factors (e.g. vegetation, canopy cover, ash layer, etc.).

FURTHER DIRECTIONS

ACKNOWLEDGEMENTS

CITATIONS



A survey of thermo-climate variables in the Boreal Forest of the Caribou-Poker Creek Research Watershed after a decadal recovery

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INTRODUCTION

- Climate change has increased the frequency and severity of wildfires in Interior Alaska.
- Understanding the effects of fire on soil properties at large and over local scales will provide a better understanding of key physical variables to improve long term modeling of boreal forest regeneration in discontinuous permafrost (Byrd, 2020).
- This study explores the influence of elevation and organic layer thickness on the soil moisture and soil temperature 17 years after the severe fire of 2004 in Interior Alaska.

RESEARCH QUESTIONS

Q1: Is there a relationship between soil conditions (moisture, temperature, and thermal gradient) and elevation along a slope within a burned area?

Hypothesis: Soil moisture content will be higher at lower elevations, soil temperature and surface temperature will be lower at lower elevations.

Q2: Does organic layer thickness control thermal gradients and soil moisture?

Hypothesis: Increases in the depth of the organic layer will increase soil moisture and decrease the thermal gradient.

METHODS

- The study was conducted in August 2021 at Caribou-Poker Creeks Research Watershed, north of Fairbanks, Alaska on a sloping site that was burned by wildfire in 2004 (Fig. 1).
- A 120 meter transect ran up a slope with 5 perpendicular transects located every 30 meters (Fig. 1).
- Each transect had 5 sampling points spaced 7.5 m apart, for a total of 25 sampling points.
- Surface temperature was determined over five points in a 2 m^2 scale using a remote laser-based infrared thermometer (Fig. 2).
- Soil temperature was recorded at 5 cm below the mineral soil surface (Fig. 2). The settling time for this measurement was two minutes.
- To determine soil moisture, a soil sample was extracted from the mineral soil, after removing the organic layer. The extracted sample was ~ 130 cm^3 and was preserved in labeled ziploc bags for transportation. In the UAF laboratory, the samples were weighed, dried, and weighed again following the GLOBE protocols.
- Organic layer thickness was measured, and vegetation and microtopography were photographed and recorded.

RESULTS

Q1: Effects of Elevation

Q2: Influence of Variation in Organic Layer Thickness

DISCUSSION

Q1: Effects of Elevation

- Surprisingly, there was no significant relationship between soil moisture, temperature, and elevation. We suspect that the microvariation within the sites outweighed the influence of elevation.
- There was a relationship between thermal gradients and elevation change across the different sites. This corresponded with vegetation changes as elevation increased, and may be explained by increasing occurrence of moss in the sites.

Q2: Influence of Variation in Organic Layer Thickness

- Despite the known relationship between thermal gradients and the insulating properties of the organic layers, the organic layer thickness did not explain the variation in thermal gradients or soil moisture.
- The type of the organic layer may have affected the lack of a significant relationship between organic layer thickness and thermal gradients. Knowing the species composition of the organic layer could improve our interpretation of these results.

FURTHER DIRECTIONS

- Satellite remote sensing products (e.g., SMAP, ICESat-2, MODIS, AIRS) provide a means to continuously survey the state of thermo-climate variables; however, small scale features that play important roles in predicting post-fire ecosystems cannot be fully accounted for from space platforms. Given the variability of these predictors through space and time, the study of these extreme landscape gradients and meter-scale morphology is critical.
- The regeneration process of the boreal forest is affected by non-linear interaction of thermo-climate variables, which in turn controls the land -surface atmosphere interaction. Landscape and meter scale features must both be considered as recovery unfolds to determine feedbacks and nonlinear interactions shaping the new boreal forest.

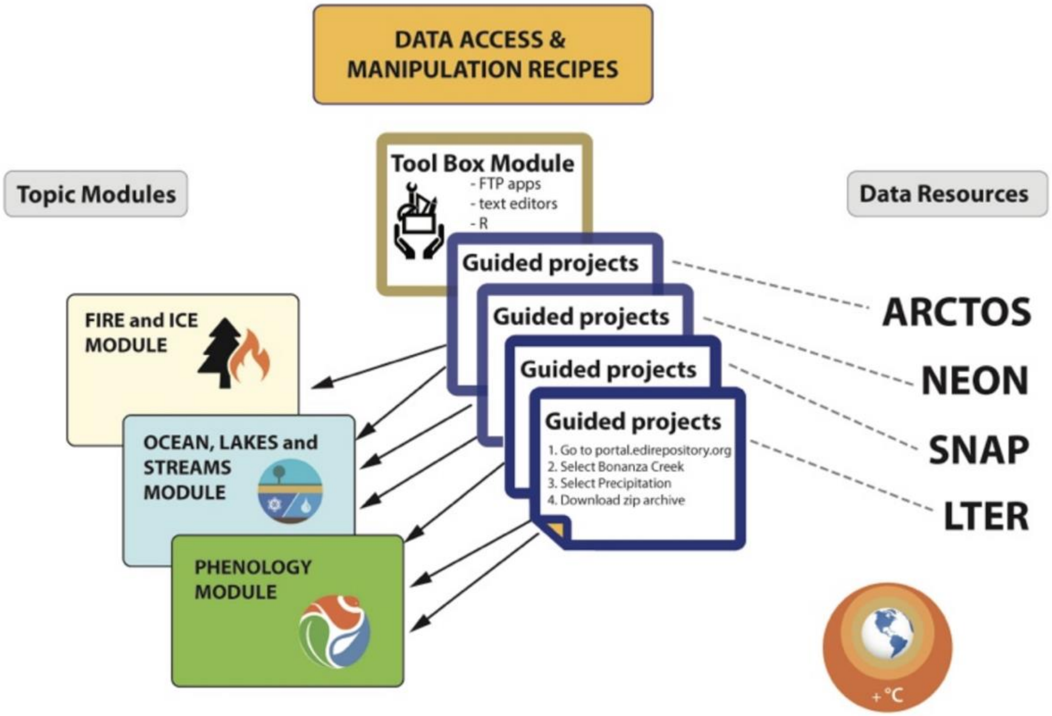
ACKNOWLEDGEMENTS

We thank Dr. Javier Fochesatto, Dr. Katie Spellman, Dr. Elena Sparrow, and Crystal Castillo from CalPoly-San Luis Obispo for research support and training. We thank Brandon Gonzalez, Ngoc Tram Nguyen, and Samantha Chip, students from Santa Ana College for fruitful discussion during the project development. This research experience is supported through funding and resources from the Santa Ana College MESA program, Bonanza Creek LTER Program (NSF Award DEB1636476, USDA Forest Service RJVA-PNW-01-JV-11261952-231), Arctic and Earth SIGNs program (NASA Award No. NNX16AC52A) and UAF Climate Scholars Program.

Citation: Byrd, Courtney. 2020. "How Will Climate Change Impact the Alaskan WILDFIRE Season?" *Climate Program Office*, Climate Program Office, 30 June 2020

BNZ data in the undergraduate classroom

- New RCN-UBE grant to better use publicly-available data on Alaska’s changing environment in undergraduate teaching
- Teaching module development, encouragement to use data in student research



1. Go to portal.edirepository.org
2. Select Bonanza Creek
3. Select Precipitation
4. Download zip archive

Emergent themes and needs

Themes:

- Alignment of community priorities, learner needs, BNZ assets
- BNZ rising to serve when a call arises
- Adaptability
- Pathways for youth engagement as they mature, pathway for inclusion
- Leveraging partnerships

Programmatic Needs:

- People power to sustain and strengthen efforts (Student engagement and outreach coordinator?)
- Dedicated science communicator
- Ways to support student and public BNZ identity (gathering space, orientation, etc)
- Easy pathway for BNZ researchers to “plug in”

“This research experience has meant to me more than just a research project. This wonderful experience has helped me determine what I want for my future career.”

-1st generation college student at the Undergraduate Research Intensive