



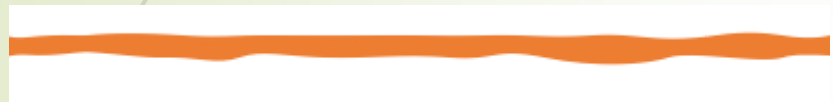
International Arctic
Research Center
University of Alaska Fairbanks



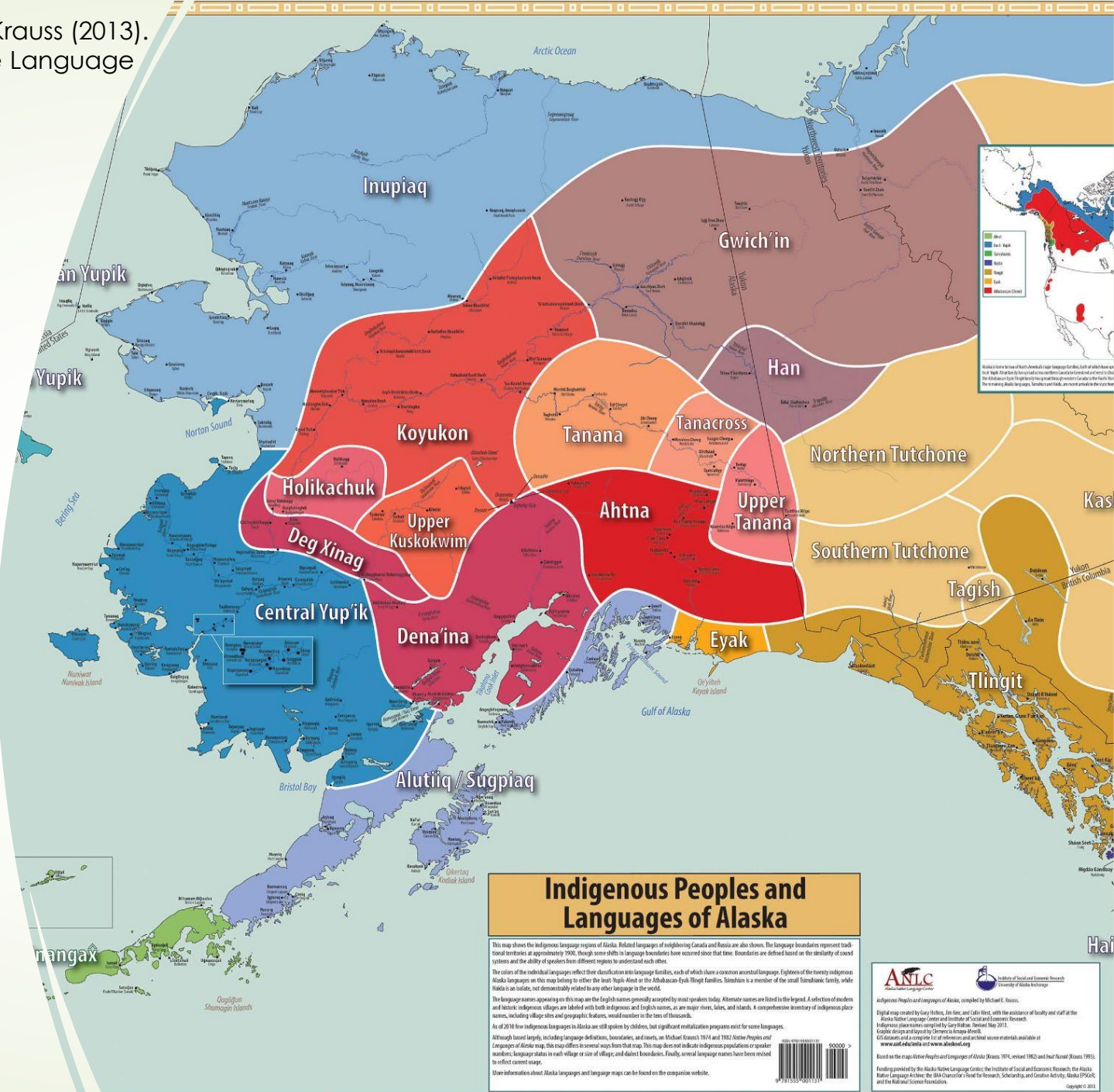
Phenology in the Past and Now

Dr. Elena Bautista Sparrow

Land Acknowledgement

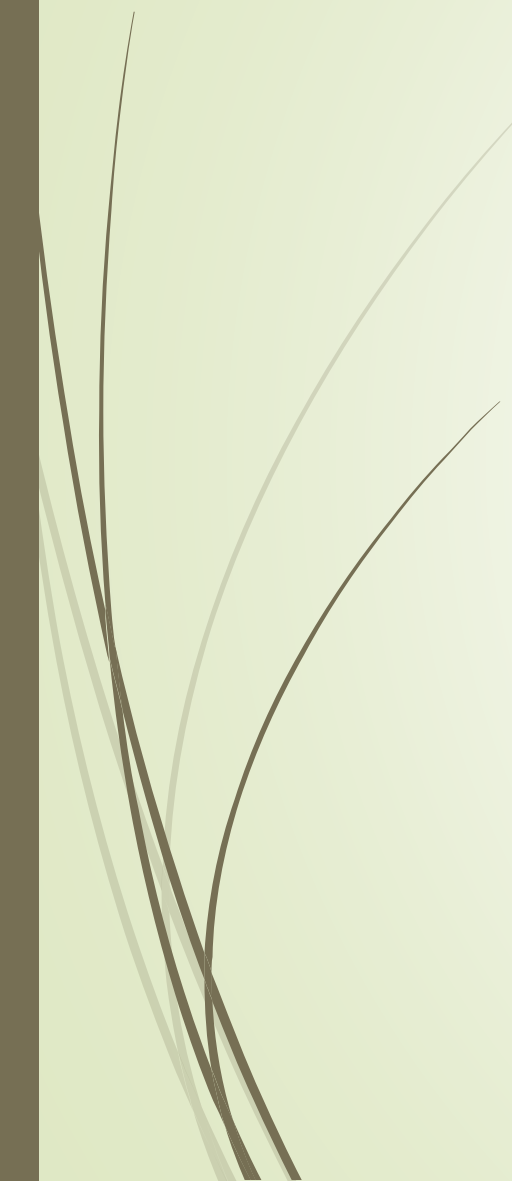


I am in Fairbanks, Alaska, on the traditional and unceded homelands of the Lower Tanana Dene People. I gratefully acknowledge and honor them, their past and current relationship with and care of the land. I am committed to building long term reciprocal partnerships with Indigenous individuals and organizations in my work in support of their sovereignty and self-determination.






Acknowledgements

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 - Ms. Martha Kopplin, Ms. Christine Butcher
 - Ms. Christina Buffington
 - Ms. Joy Hamilton, Ms. Cheryl Williams, Ms. Maxine Dibert,
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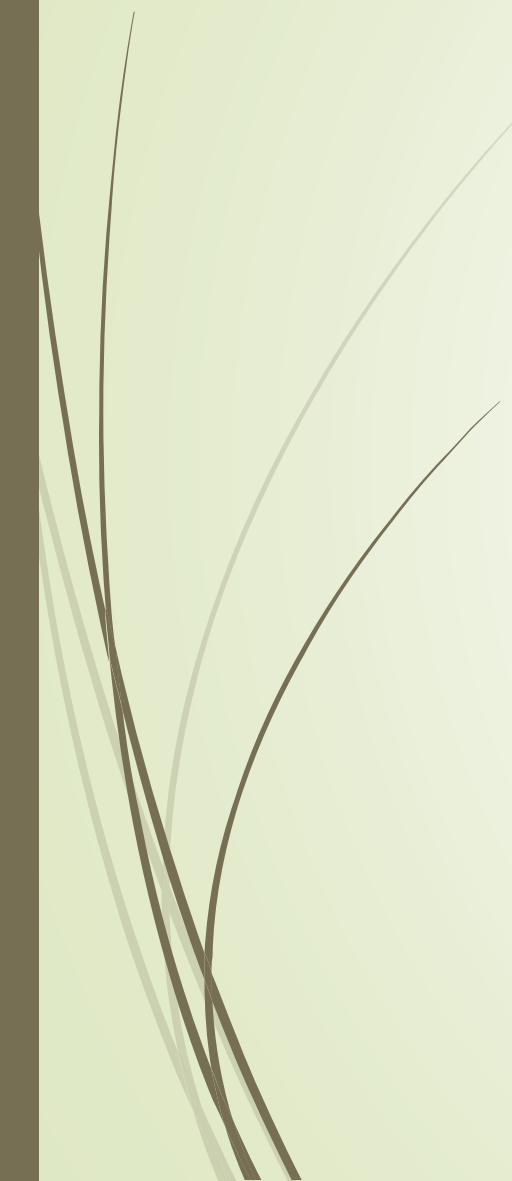


Outline

- Importance of Phenology
 - To Whom
 - Why
 - Use of GLOBE and Indigenous Science in environmental studies in rural Alaska
- 



Who cares about Phenology

- Naturalists in Britain, Scandinavia, and Japan for hundreds of years
 - Educators
 - Climate Scientists
 - Earth Scientists
 - General Public
 - Indigenous Peoples
- 

A 250-year index of first flowering dates and its response to temperature changes

Amano et. al., 2010. doi: 10.1098/rspb.2010.0291
(Proceedings of the Royal Society- Biological Sciences)



Records of citizen scientists have been combined with those of scientists collated back to 1753, to create a 250 year index of first flowering.

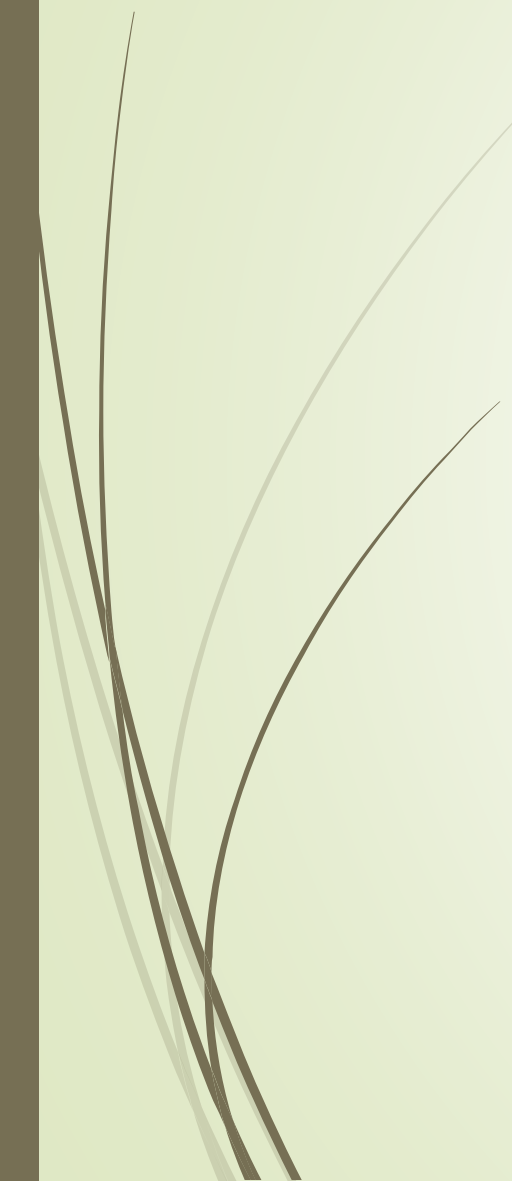
It has demonstrated that Britain's plants are flowering five days earlier for every one degree C rise in temperature.

This shows that on average plants flowered 2-12 days earlier over the last 25 years compared with any other consecutive 25 year period.

- http://www.naturescalendar.org.uk/findings/250_years_of_spring



Why do I care about phenology

- It affects my health, leisure activities and spirituality
 - It is a means for getting funding for research and education
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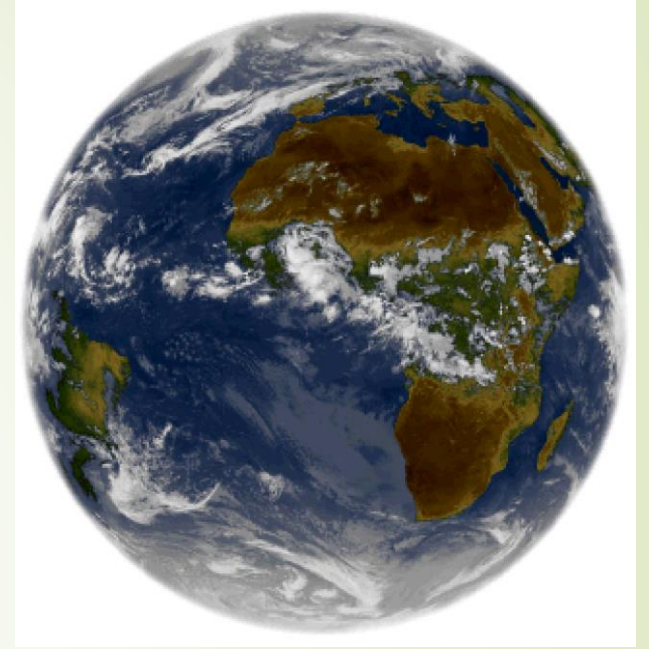
GLOBE phenology – Green-up and Green-down

- Investigates the timing and length of plant growing season
- Leaf emergence, expansion, and senescence



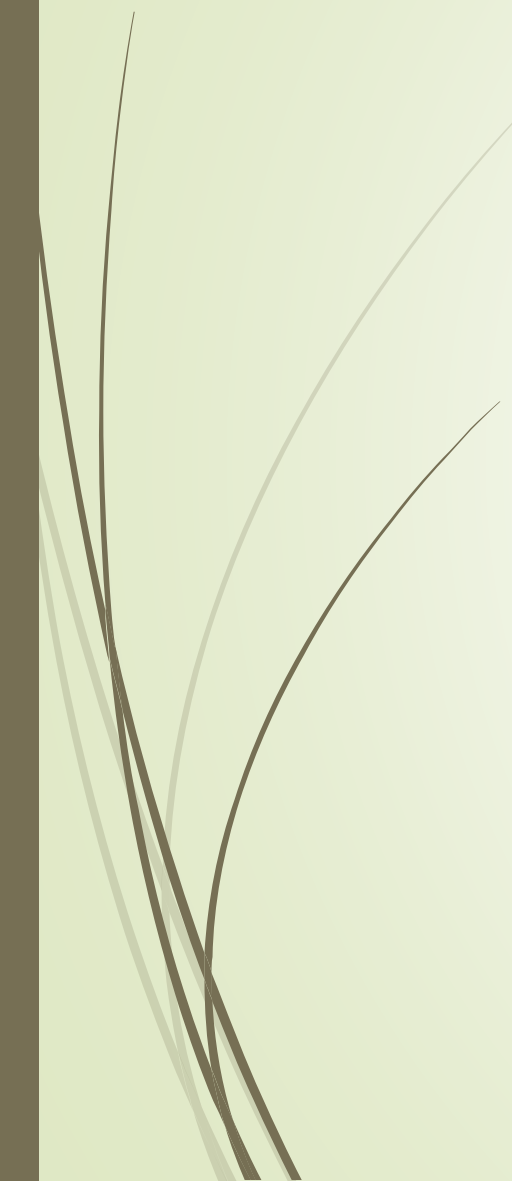
Why should anyone care

- At least four reasons:
 - Education
 - Climatology
 - Ecology- carbon and water cycles
 - Earth system science- measurement



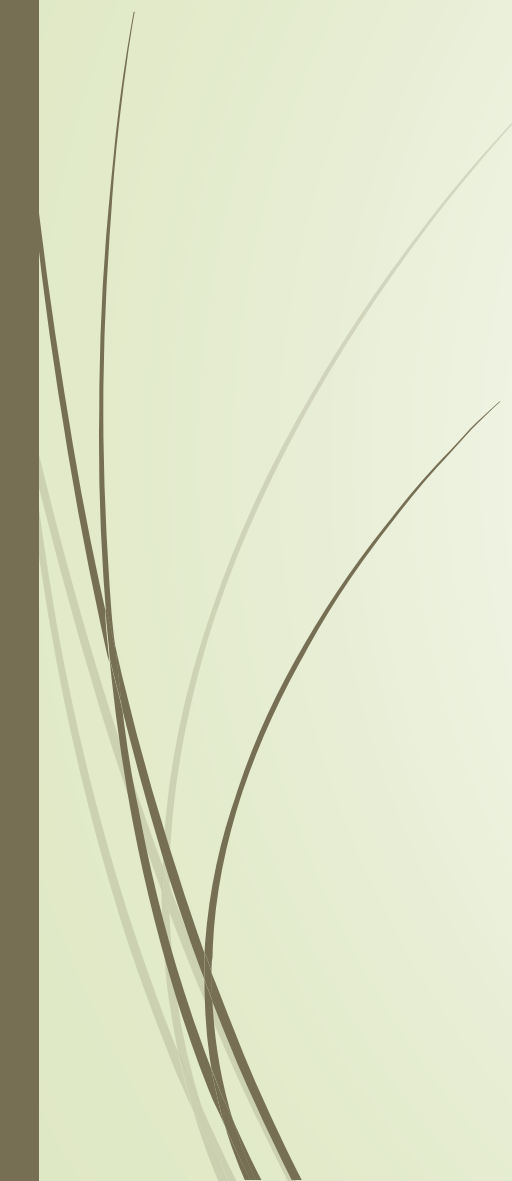


1. Education

- Phenology happens everywhere
 - Low cost and easy to observe
 - Simple Easy to observe
 - Closely connected with the Earth System
 - People may not be aware
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For students

- Simple to set up inquiries based on phenological observations
 - Excellent example of how variation in climate can influence the development of plants
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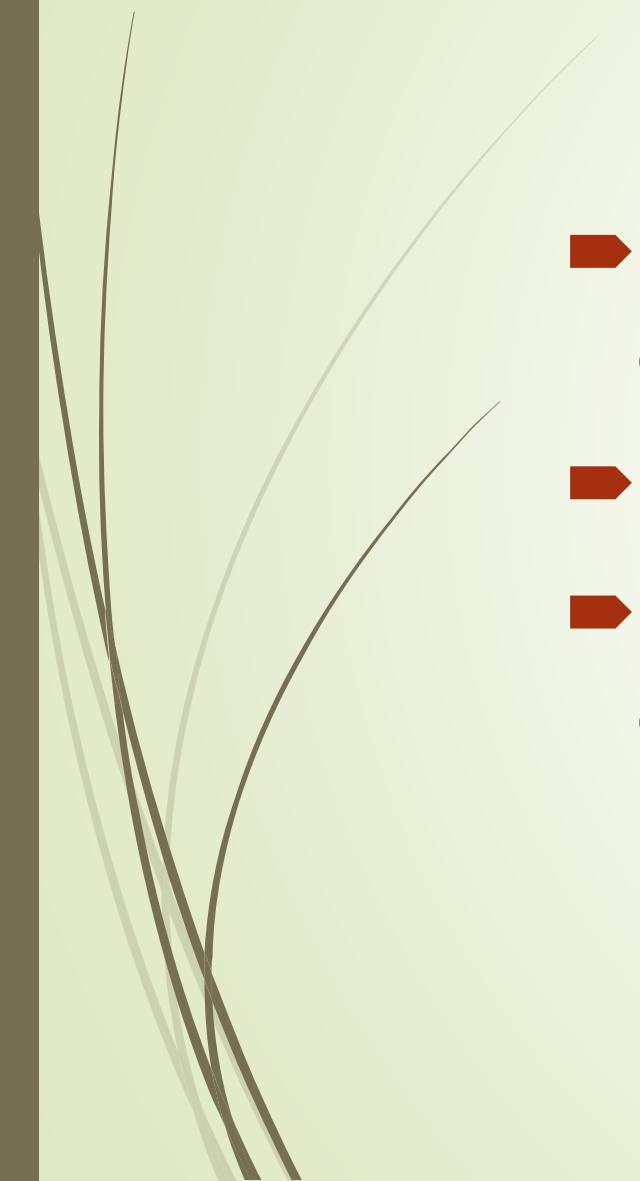


2. Climatology

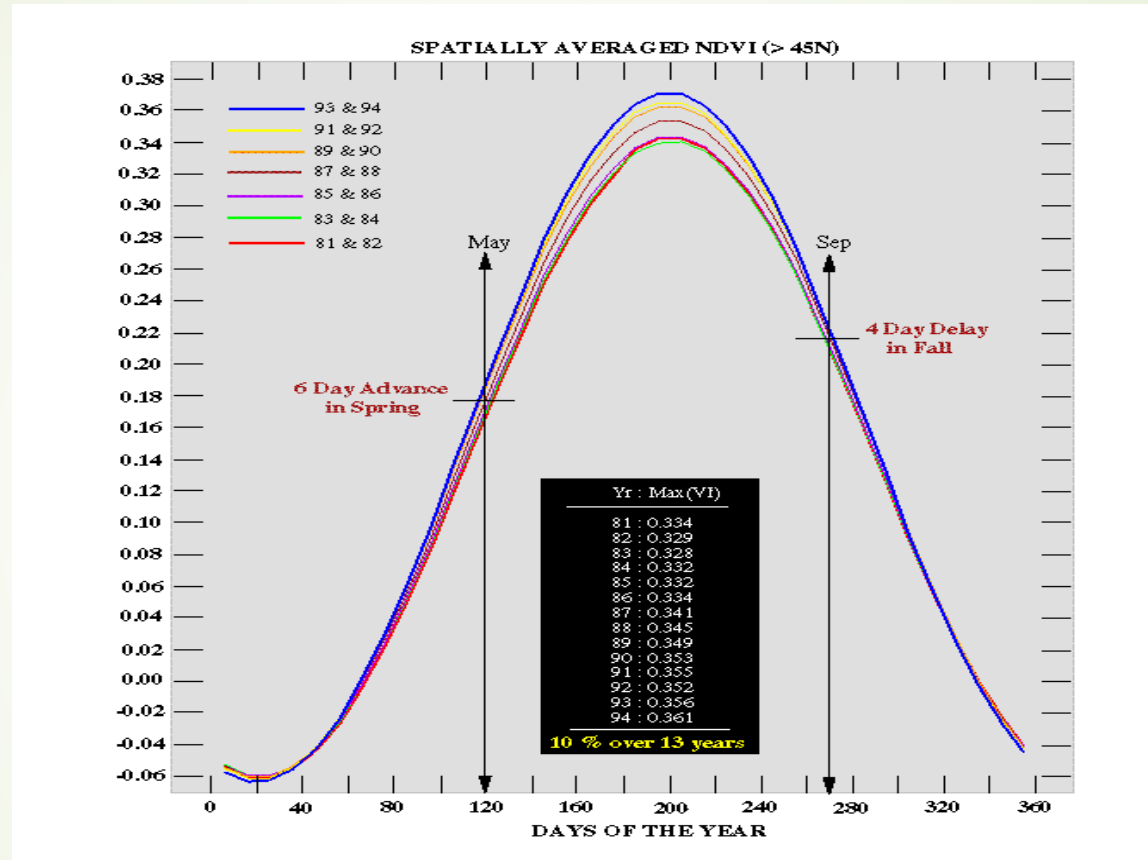
- Climate affects phenology
- But phenology also affects climate
- The partitioning of net radiation into latent and sensible heat
 - $R_n = LE + H$
- When we have plants, more energy is used in latent heat, reducing sensible heat
- Albedo – plants are usually darker than soils
 - Absorb more radiation



3. Ecology -Carbon cycle

- Research has suggested that the length of active plant growth has been extended
 - May mean increased carbon storage
 - Responsible for the up and down appearance of the global CO₂ curve
- 

Increase in plant growing season length according to remotely sensed data

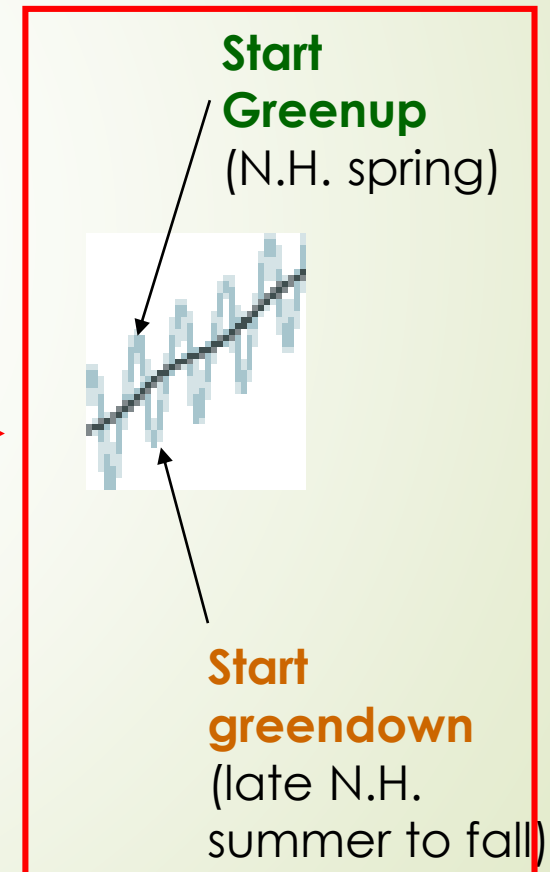
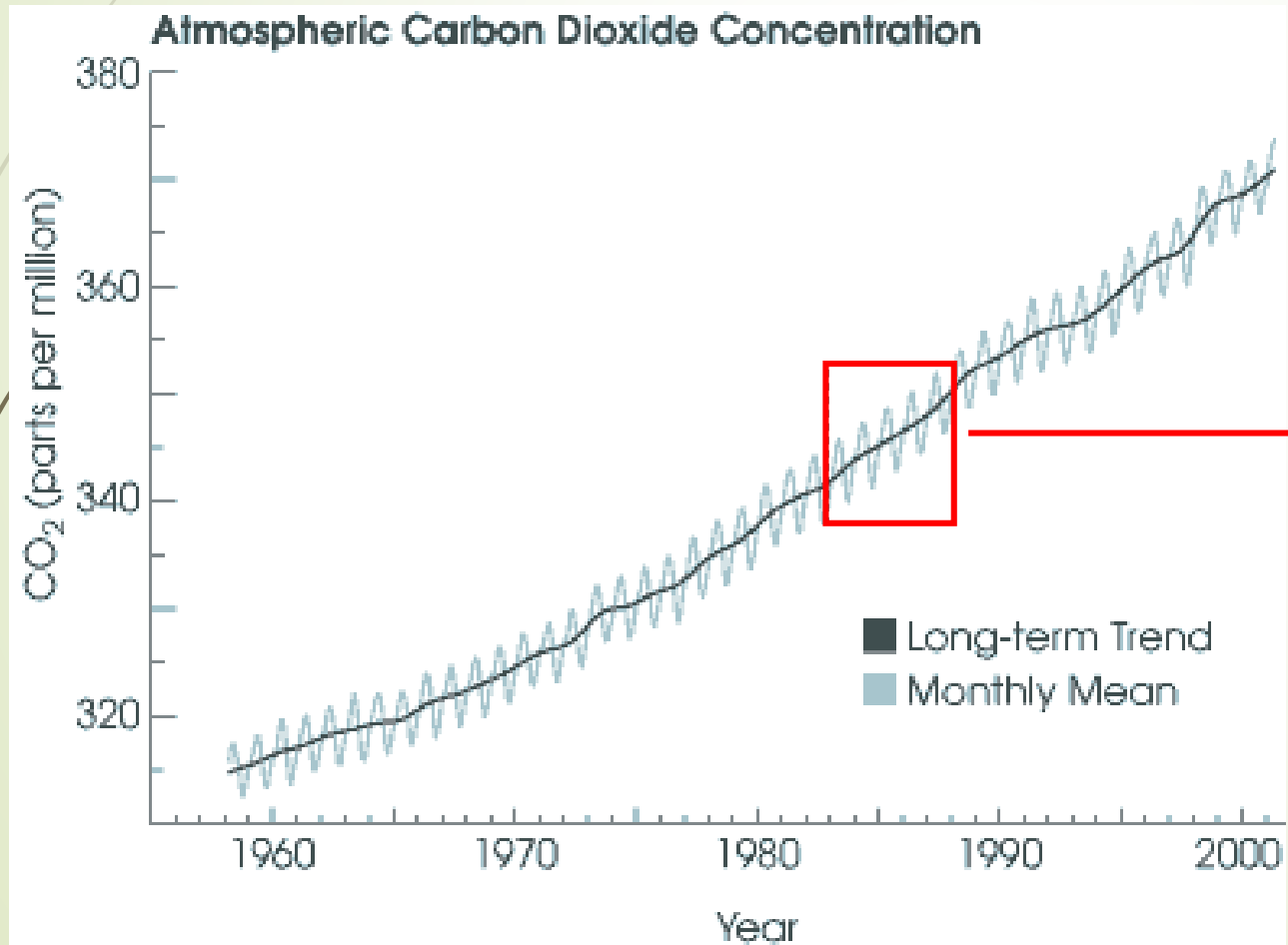


Myneni, R.B. et al. 1997. *Nature*, 386, 698-702.

There's a need for ground observations/data.

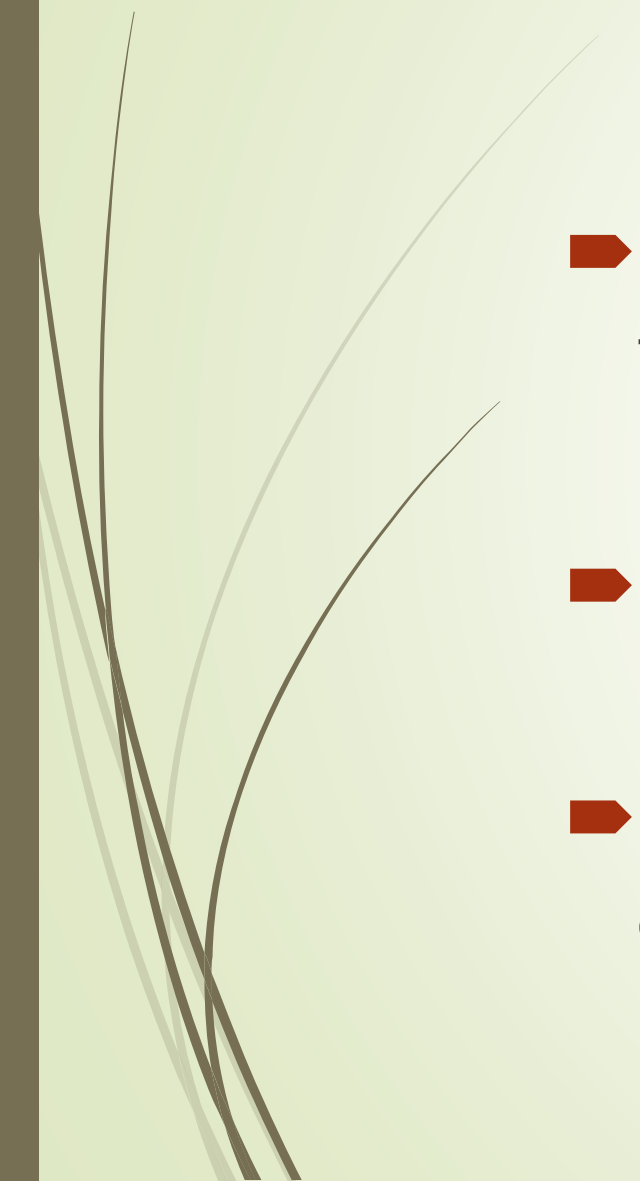
The “Keeling” Curve

Concentration of CO₂ at Mauna Loa, Hawaii



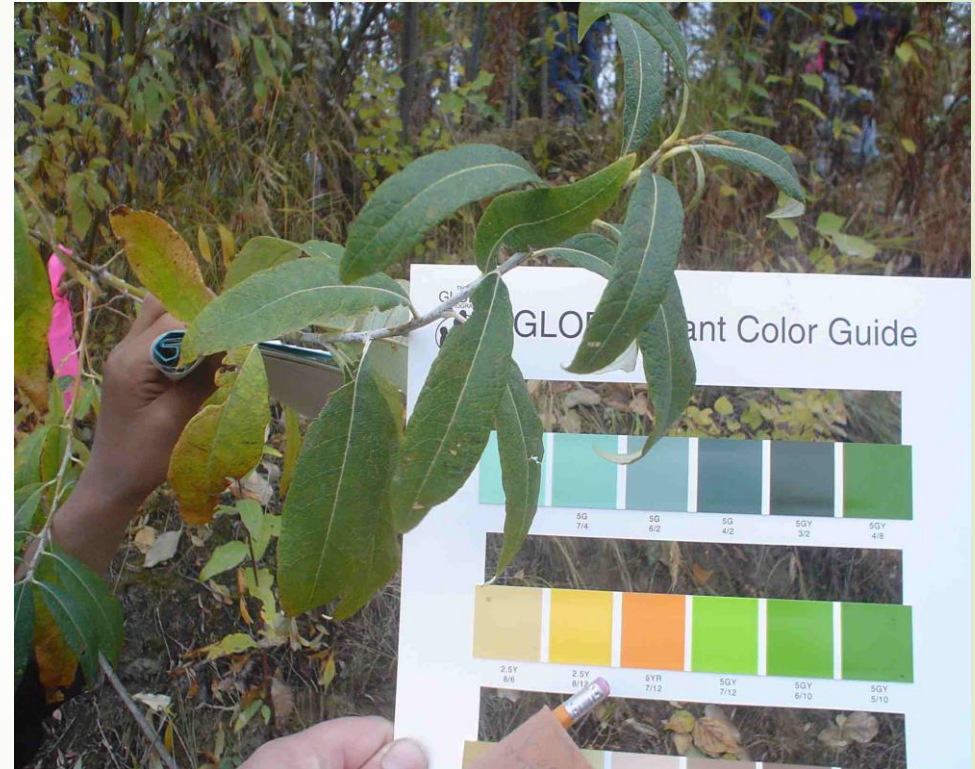


3. Ecology -Water cycle

- Much recent research has suggested that the length of active plant growth has been extended
 - May mean increased transpiration and humidity
 - In boreal forests green-up may result in afternoon showers
- 


Critical feature

- Processes occurring at the leaf level strongly influence global processes
- The movement of water vapor out of leaves and CO_2 into leaves, a function of phenology, is tremendously important for Earth System Science





4. Earth as a system

- Phenological variation is influenced by many areas of the Earth system and vice versa
 - Climate
 - Soils
 - Biology
 - Human activity
- 



Summary



- Phenology is easy to observe
- Influences many Earth processes
- Excellent biospheric measurement of vegetation response to climate variability
- Indicator of climate change impact on plants and animals
- Phenology reflects connectivity and synchrony in ecological systems

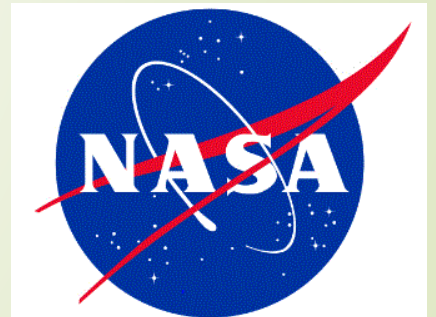
Use of GLOBE and Indigenous science in environmental studies in rural Alaska

- Introduction to Arctic and Earth SIGNs (STEM Integration of GLOBE and NASA) video

<https://www.youtube.com/watch?v=Hr4fyjNpUxE>



**Association of Interior
Native Educators**



Partner



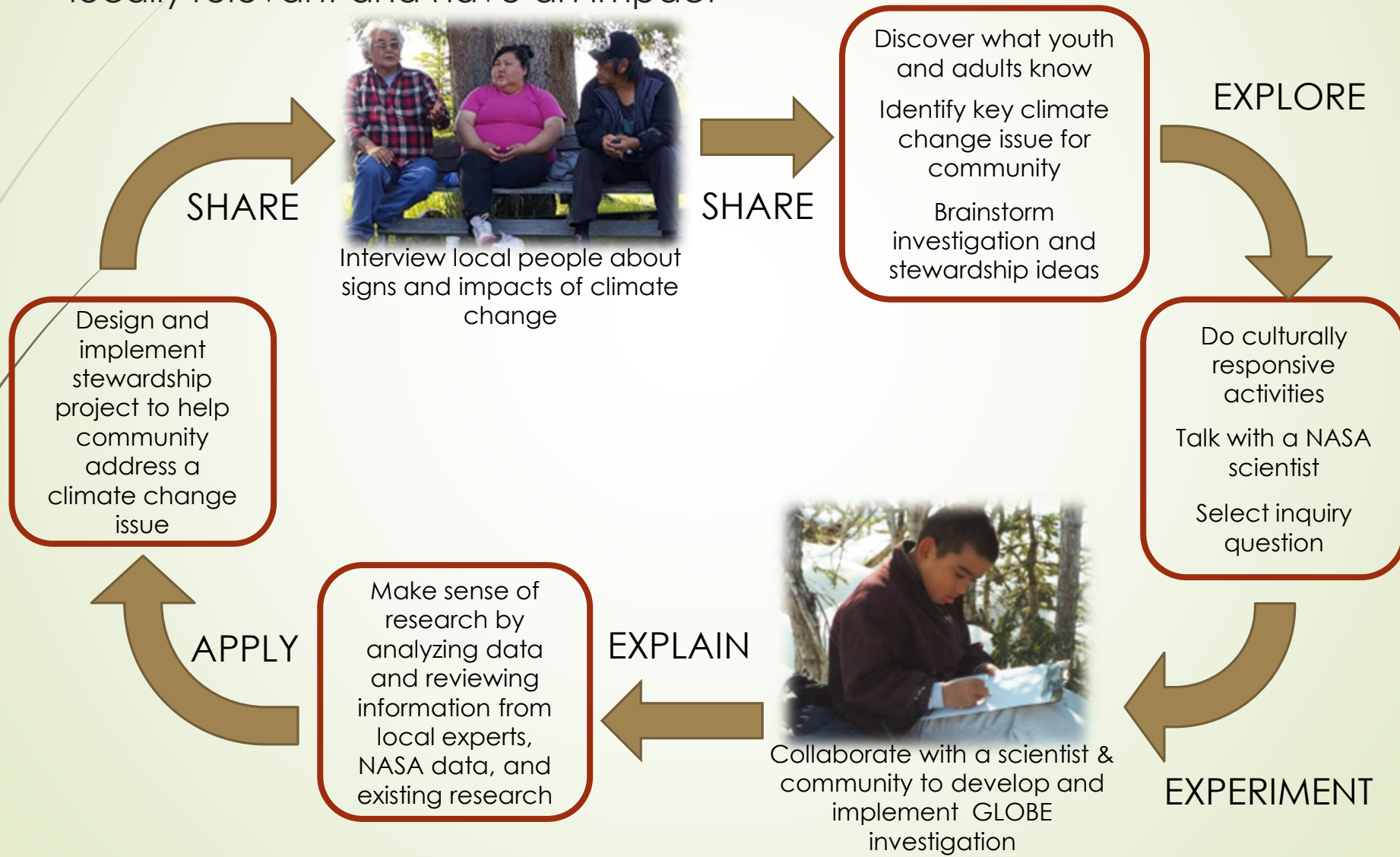
- Elders and scientists are key influentials

- Storytelling makes climate science relevant, meaningful, and actionable



The Arctic and Earth SIGNs learning model

Using Indigenous , GLOBE & NASA Science to make STEM learning locally relevant and have an impact



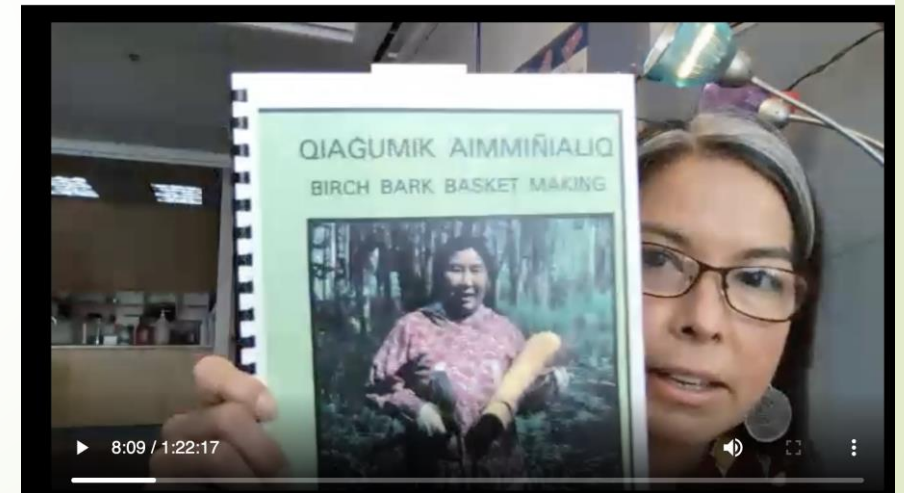
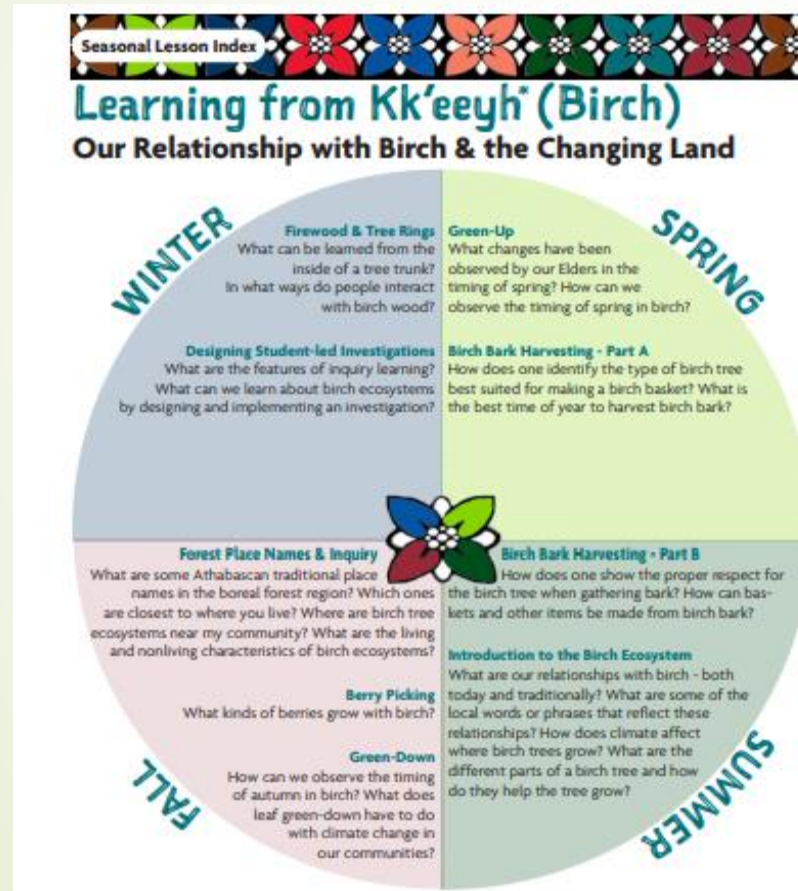
Kwethluk River Bank Erosion Study



- ▶ Alaska Native students at their study site and at a GLOBE international conference in Ireland
- ▶ They shared who they are and real life climate change experience through the science session and the cultural session.



Culturally Responsive Curriculum



A climate change learning and data story



Native Village of Kongiganak



Credit: Association of Village Council Presidents

- **Edward David** Elder
- **Cassius Brown**
Assistant Principal,
Teacher
- **Joseph Mute** Tribal
Administrator





Thank
you

