

Engaging Students in Climate Science with Place-Based Data and Models

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au-then-tic
ô'THen(t)ik/
*Adjective : arising from scientific
enterprise; allows for meaningful
exploration and comprehension of real-
world issues*

Place-based climate data is **authentic** and **relevant**.

This data is needed in the classroom.

For the first time, science standards emphasize developing skill in **relevant** science and using **authentic** data in the classroom.

You, the climate research scientist, can make a difference to students by partnering with teachers to bring your work into the classroom...and we can show you how to do that.

rel-e-vant
'relavənt/
*Adjective: connected to everyday
experiences; holds value to culture,
history, and/or the environment*

The Opportunity.

For the very first time, the science of climate change and related human-climate interactions are components of elementary, middle, and high school national science education standards: The Next Generation Science Standards (NGSS). These standards are the first new set of national science education standards in nearly 15 years and bring students into the drivers seat of **authentic** science experiences and engineering practices. Never before has there been a more important or fertile opportunity to infuse science education with regional, national, and global scale climate change data analysis and model interpretation.

The Evidence.

Today students are learning more, and failing less, in classrooms that replace traditional lecture formats with active learning strategies (Freeman et al., 2014 and Schroeder et al., 2007). Science teaching is also much more effective when done by making connections between new concepts and previous experiences and **relevant** world problems (Schroeder et al., 2007). Classroom gains are evident in middle and high school science classes teaching climate literacy using active learning labs (DeWaters et al., 2014). For Native American students who see themselves as part of nature, place-based curriculum becomes even more important for student engagement (Medin and Bang, 2014). Both active engagement and connections to real world problems are seamlessly addressed using hands-on labs that integrate **authentic**, current, local climate change data. These kinds of labs, which are situated in an **authentic** learning environment, allow students to gain a deeper understanding of climate-related issues by applying what they have learned to **relevant** contexts (Greeno, 2006; Kolodner, 2006). High school teachers agree that using data and local climate impacts in their classrooms improves student learning (Fig. 1). Students are enthusiastic, and appreciate the high school climate course taught with labs (Table 1).

Fig. 1. Responses by high school science teachers in our network (participated in at least one of our workshops, and therefore live in the NW) to level of agreement with
In my classroom, students learn more climate-related content or retain it better when I also teach with...

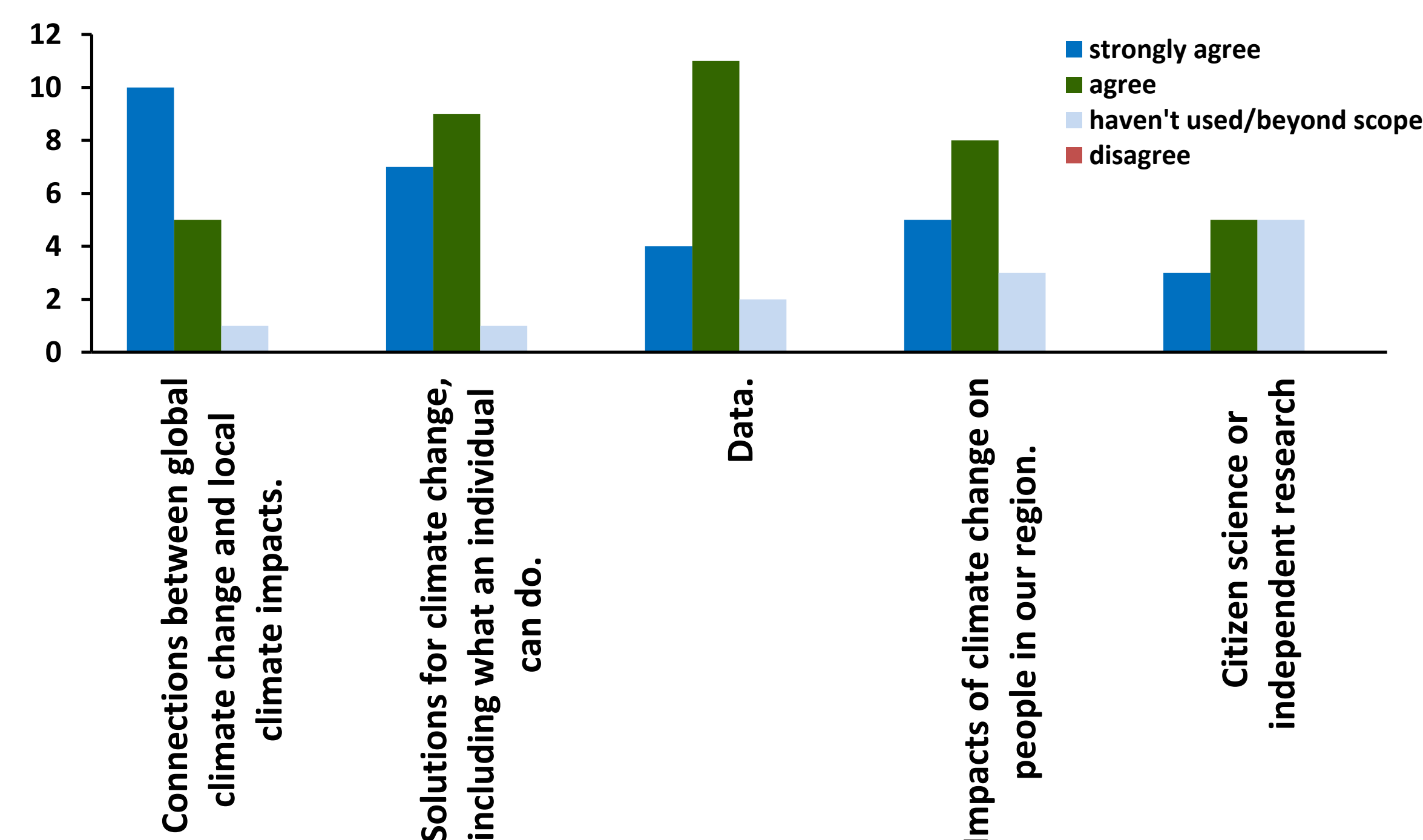


Table 1: What students say about the lab-focused climate science course taught in 2014 by Esler at Lake City High School, Coeur d'Alene, Idaho:

Esler: "What aspects of this class contributed most to your learning?"

"The hands on labs with real data collected from glaciers and ice sheets." "The class discussions and the labs that make you able to see how it works." "Labs." "Probably when we put it in terms of where we live and how it related to us."

Esler: "Was this class intellectually stimulating? Did it stretch your thinking?"

"...it taught us how to interpret real data! Also it stretched my thinking by making me realize how one component of the Earth can cause a major shift in climate."

"I had to think of the Earth as one big system working together."

"This class was difficult but was perfectly doable. The information was real world and relative to life problems which I greatly appreciated."

"I learned more in this class than probably in any other class for the last 4 years."

"Yes, because we had to think about how it could affect the world and what might cause some of the things."

A Pathway.

Reiser (2013) summarizes current educational research, showing that teachers need more than a lesson plan, they need to collaborate and deeply engage as they work to implement the NGSS. Additionally, Reiser (2013) states that professional development should be connected to subject matter while considering how to teach the subject, it should involve active learning, and have follow-up support on how to apply the new content in the classroom. Our program employs these strategies to connect scientists to teachers to bring climate science into the classroom.

History.

What began in 2008 as a summer camp on climate and video for high school students, grew into a collaboration bringing climate scientists from across UW campus together to develop a high school curriculum through a NASA GCCE grant. Our climate science course was first offered in several high schools in 2011 and today a global warming course is currently offered for UW credit to high school students with faculty oversight from UW Atmospheric Sciences. With the growing need to bring the current state of climate science to the public we now focus our teacher-scientist partnership efforts on annual workshops and development and distribution of hands-on labs.

Program Elements.

Workshops-connecting scientists and teachers. Coordinated by UW Program on Climate Change and tailored to anticipated need of teacher audience and expertise of presenters.

- High School science teachers—Biology/Chemistry/Physics (honors, AP, regular); Geology/Oceanography/Climate (primarily UWHS); AP Environmental Science; 9th grade integrated science.
- UW faculty and graduate students, united through the UW Program on Climate Change, and working on different aspects of the climate system, from the dynamics to impacts on water resources.
- Each participant brings his/her own research and understanding to teaching other scientists and teachers.

Collaborative lesson development. Originating from a teacher or scientist, **authentic** modules (collections of resources and teaching materials) are created around defined learning goals that bring **relevant**, place-based climate change concepts into the classroom (Fig.2)

Free Access to Curriculum and Resources. Modules are organized by specific topics with necessary print-outs and answer keys. Year-long curriculum and unit plans on climate science are available as well at <http://tinyurl.com/oqo8ml7>.

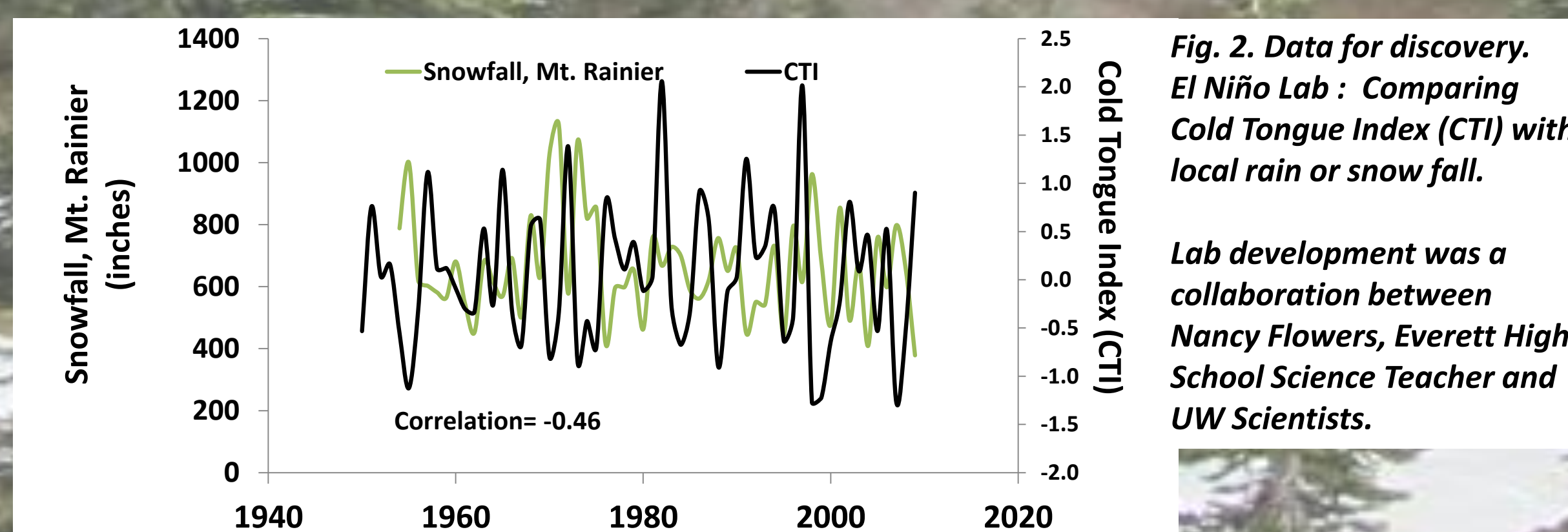


Fig. 2. Data for discovery. El Niño Lab : Comparing Cold Tongue Index (CTI) with local rain or snow fall.

Lab development was a collaboration between Nancy Flowers, Everett High School Science Teacher and UW Scientists.



How can you participate?

Make Data Accessible (after Taber et al., 2012)

- Basic, Universally Accessible Format** (e.g. Excel) - students can utilize fundamental spreadsheet applications to explore and analyze data through graphing and statistics
- Variables Mapped with Known Spatial Scales on Grid** - students can work with GIS maps to observe and evaluate spatiotemporal changes to Earth's systems
- Visually Display Data Analysis or Model Output** (e.g. line graph or map) - students can do image analysis, modeling, classification

Introduce Science and Module Idea to Group of Teachers

- Identify general learning goals and outcomes that introduce students to an **authentic** and **relevant** dataset or research.
- Capitalize on annual workshops hosted by the UWPCC to promote discussion of new ideas for labs with teachers and other scientists.

Collaborate, pilot, assess, revise

Work with interested teachers and UWPCC to bring datasets and research into a curricular module that is easily taught with confidence: module includes focus questions, performance expectations/learning standards, prior knowledge needed, assessment, detailed lesson plan, student worksheets, answer keys, and prompts for starting discussions.

Utilize UWPCC Platform to Reach Teachers-locally and globally

UWPCC curates labs and supporting materials, YouTube, social media (@PCCeduc) and hosts annual workshops

Request Funding. Optional, but very helpful....examples...

- NSF and other Broader Impacts (often using UWPCC footprint in teachers community)
- NOAA Climate Stewards (awards to educators)
- PolarTREC – Polar Teachers and Researchers Exploring and Collaborating

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