Agile Collaboration: Citizen Science as a Transdisciplinary Approach to Heliophysics

Vincent Ledvina[1,2] Elizabeth MacDonald[3,2], Laura Brandt Edson[2,3], Don Hampton[1]

(1) University of Alaska-Fairbanks, Fairbanks, AK, USA
(2) Aurorasaurus, New Mexico Consortium, Los Alamos, NM, USA
(3) NASA Goddard Space Flight Center, Greenbelt, MD, USA

What is citizen science?

"Organized research in which members of the public engage in the processes of scientific investigations by asking questions, collecting data, and/or interpreting results (Citizen Science Central)."

10 principles of citizen science (as defined by the European Citizen Science Association):

1. Projects actively involve citizens to **generate new knowledge or understanding**. Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.
2. Projects have a **genuine scientific outcome.**
3. Both the professional scientists and the **citizen scientists benefit from taking part.**
4. Citizen scientists may **participate in multiple stages of the scientific process.**
5. **Citizen scientists receive feedback** from the project.
6. Like any form of research, citizen science has its limitations and biases. However, citizen science provides opportunity for greater **public engagement and democratization of science.**
1. Citizen science project data and metadata are made **publicly available** and results are published in an **open access format.**
2. **Citizen scientists are acknowledged** in project results and publications.
3. Citizen science **projects and programs are evaluated** for their scientific output, data quality, participant experience and wider impact.
4. The leaders of citizen science projects **take into consideration legal and ethical issues** surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

Citizen Scientists as Agile Collaborators *(e.g., aurora chasers)*

- Agility in the science context: the extent to which a person, group of people, technology, or project can work efficiently, pivot, and adapt to adversity.
- Citizen scientists are agile
  - Unbiased recognition, identification, classification
    - *The “discovery” of STEVE by aurora chasers*

Citizen Scientists as Agile Collaborators *(e.g., aurora chasers)*

- Citizen scientists produce scientifically valuable data
  - Data quality depends on the quality of the project's design
  - The quality of directly sourced data depends on who produces them
    - *Aurora chasers already value the scientific capabilities of their photos*

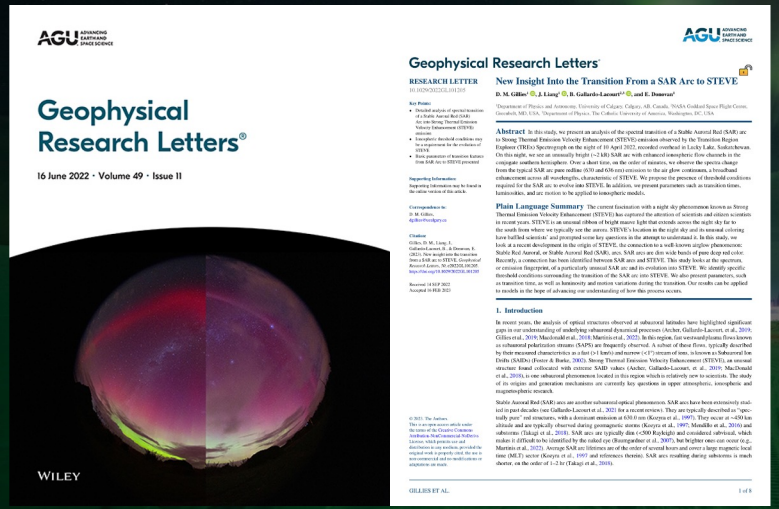


Figure 1, 2: Semeter et al., 2020.
Images from Alexi Chernenkoff

Citizen Scientists as Agile Collaborators *(e.g., aurora chasers)*

- Citizen scientists have both contributory and experiential expertise
  - Contributory: the capability of contributing to what is known about a topic
    - *Experts in astrophotography and other technical backgrounds*
  - Experiential: developed directly through personal experience
    - *Hundreds or thousands of hours in the field observing auroral behavior*


Credit: Alysa Ferguson


Credit: Alysa Ferguson

Citizen Scientists as Agile Collaborators *(e.g., aurora chasers)*

- Citizen scientists bridge professional science and the public
  - Projects engage, educate, and inspire

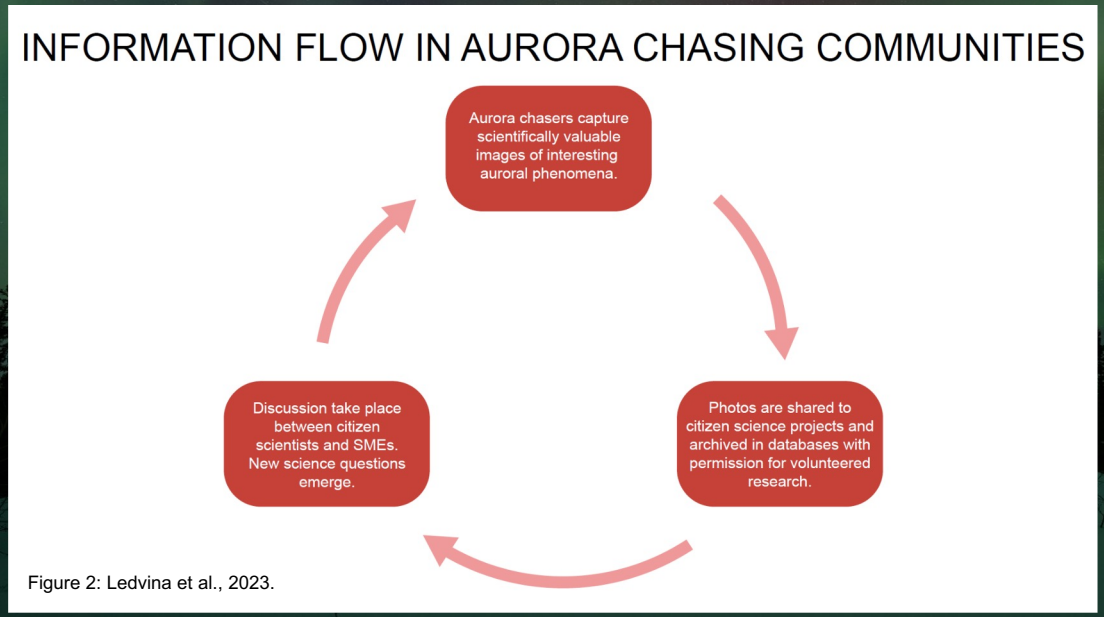
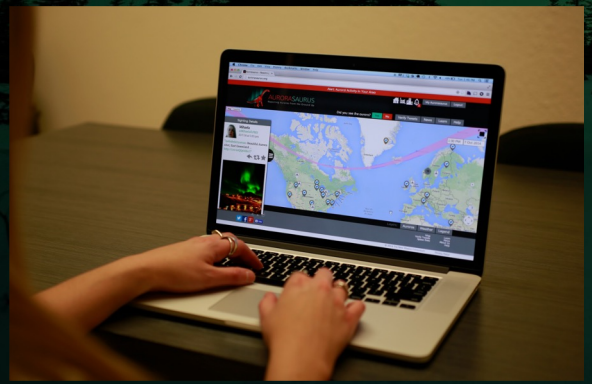


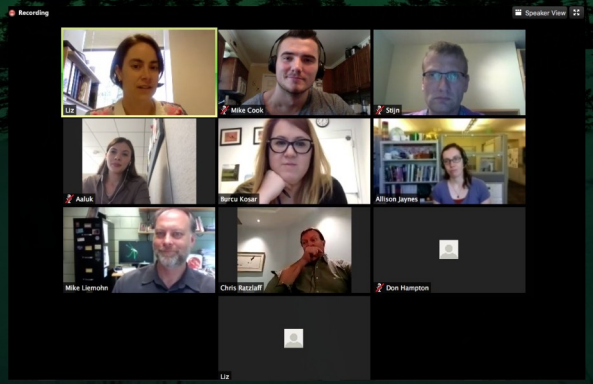
Figure 2: Ledvina et al., 2023.

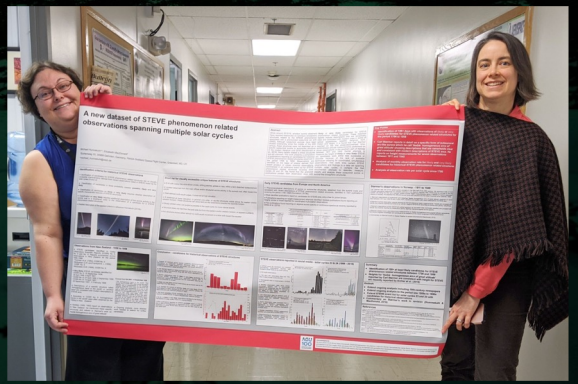
AURORASAURUS

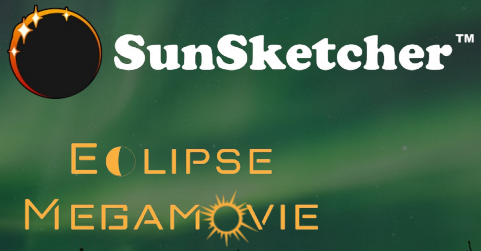
Reporting Auroras From the Ground Up

- Crowdsourced aurora sightings on aurorasaurus.org
- Provides more accurate predictions of where the aurora can be seen
- Facilitates agile collaboration
  - Ambassador program directly connecting citizen scientists with SMEs
  - Project design leverages aurora chasers' agility
  - Educational content teaches participants the science and how to use the platform



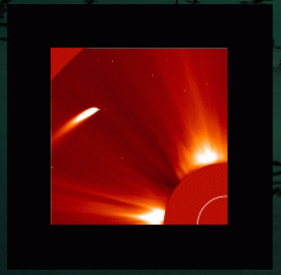




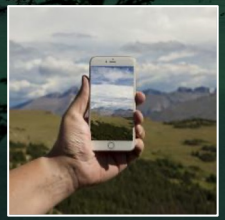


EZIE MAG + more
by Semeter, Young

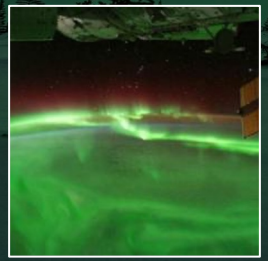
Sungrazer



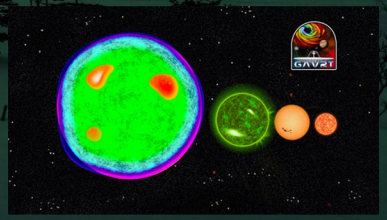
GLOBE



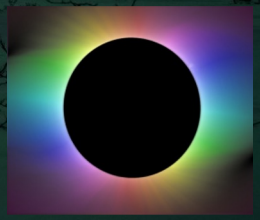
Aurorasaurus



Solar Patrol (GAVRT)

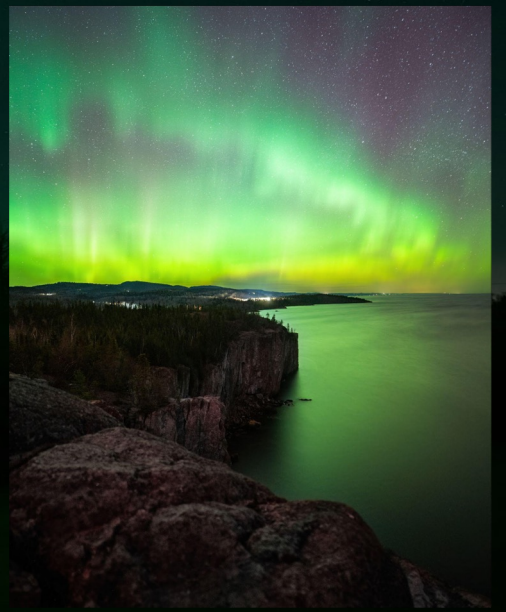


Citizen CATE



Concluding Thoughts

- Heliophysics is becoming increasingly technology-driven and collaborative—citizen science emerges as a solution to solving grand challenges in our field.
- The agility of citizen science is integral to:
  - Solving big-data problems
  - Engaging the public with agency efforts
  - Cultivating science that bridges disciplines
  - Approaching science problems in new ways
- Consider citizen science for your next project.



Funding open for two ROSES opportunities:
F.9 CSSFP (seed funding) - HPD, BPS, PSD, ASD
CSSFP23 NOIs Due Nov 21, 2023 & CSSFP23 Proposals Due Jan 24, 2024

B.21 Heliophysics Citizen Science Investigations (3 yr)
H-CSI Step-1 proposals are due November 15, 2023, and Step-2 proposals are due January 26, 2024.


Thank you for your attention!
Questions?
vledvina@alaska.edu