# The Surface Magnetic Assessment in Real Time (SMART) Ground-based Magnetometer Network: An Update

**Peter J. Chi and the SMART Team**

HAMSci Workshop
March 19, 2022

SMART Team:
, Brian Anderson, Bing Chen, Peter Chi (PI), Anthea Coster, Jerry Goldstein, William Greer, William Jensen, Matt Lacaire, Peggy Li, Noel Petit, Kazue Takahashi, Chris Russell (Co-I), Alexa Roosnovo, Deborah Scherrer, Paul Seifert, Linda Winkler, Matthew Yoshida, Eden Zafran, Brandon Zhao, Eric Broman, Elona Khoshaba, and Alan Michael

Stations include those from a 2010 Falcon Magnetometer Project as well as some new stations

Present Stations:
- CCNV (Carson City, NV) - operational & uploading data
- PTRS (Petersburg, AK) - operational & (intermittently) uploading data
- RMUS (Remus, MI) - unknown status
- SWNO (Shawano, WI) - unknown status
- HRIS (Harris, MN) - operational & uploading data
- AMER (Americus, KS) - unknown status
- GLYN (Glyndon, MN) - unknown status
- SATX (San Antonio, TX) - not set up yet due to remote work
- WRTH (Worthington, MN) - operational & collecting data

## Science Objectives

- SMART uses ground-based magnetometer measurements assisted by other geospace observations to investigate outstanding questions in both travel-time and normal-mode magnetoseismologies.
- The ground-based magnetometer data are also useful for supporting research on many other topics in geospace science.



## Operational Objectives

- SMART reorganizes, repairs, and updates the existing UCLA magnetometer systems in the US deployed by McMAC, THEMIS, and Falcon projects.
- The current reorganization plan will lead to a 14-station network that can provide the minimal magnetoseismic observations to address the science goals.
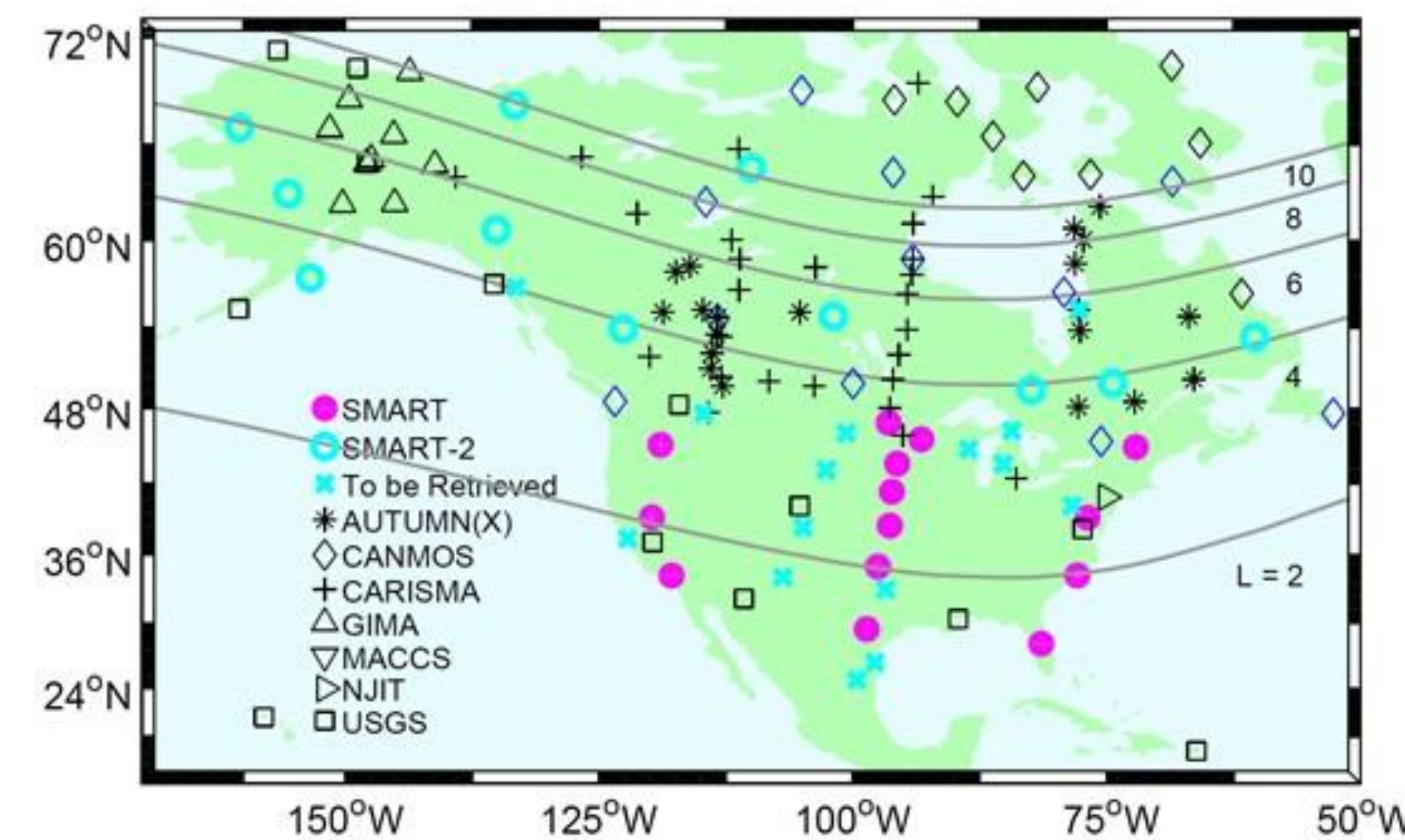


## Education and Public Outreach

- An important objective of SMART is to involve students and teachers who do not usually participate in scientific activities for geospace research.
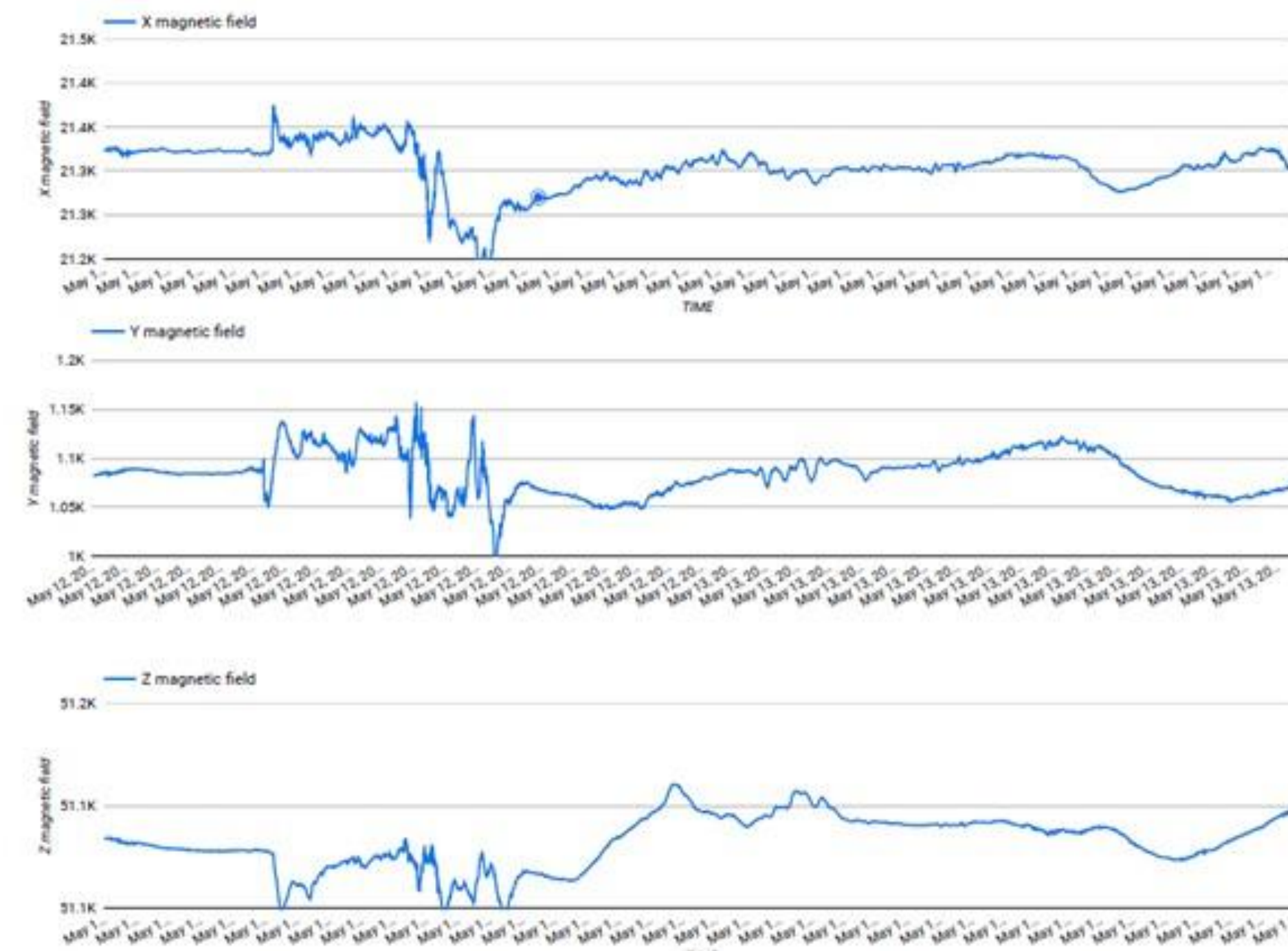- EPO efforts include communication through webinars, the project website, and Twitter.



SMART website:
https://smartmagnet.org

SMART Twitter:
https://twitter.com/Ucla SMARTMag

## Observations

- Below is the magnetometer measurements at the Harris (MN) station during the May 12-13, 2021, the largest magnetic storm in the last 12 months.



## UCLA GMAG: The SMART Update

- SMART updates the UCLA GMAG system with a Raspberry Pi single-board computer and an improved software suite.
- This update was developed by Noel Petit with the UCLA team and successfully tested at the Harris (MN) station.
- The hardware and software for this update have been delivered to four other stations: Glyndon (MN), Worthington (MN), Americus (KS), and San Antonio (TX).
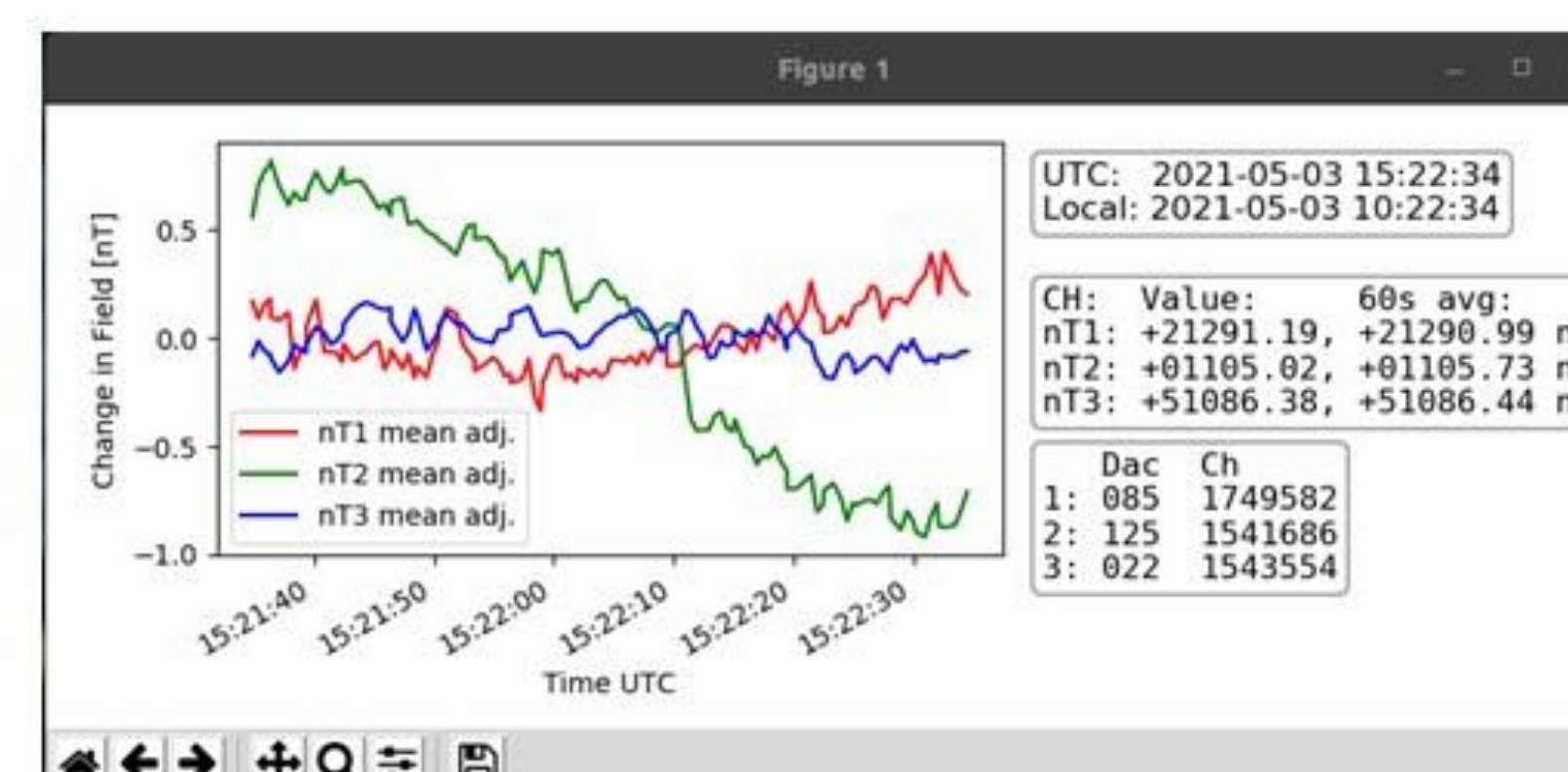


## UCLA Ground-based Magnetometer (Themis/McMAC version)



### System Features

- ±72KnT dynamic range @ 0.01nT Resolution (~23 bits)
- Offset DAC system for 256 possible ranges per axis
- Sigma-delta modulator design
- 2 vectors per second data rate
- Low power < 4W
- Small size 22cm x 13cm x 5cm
- Ruggedized all weather sensor design
- USB interface for data retrieval and firmware upload
- GPS antenna and electronics Integrated into one package
- NTP compatible (1msec time accuracy)

4