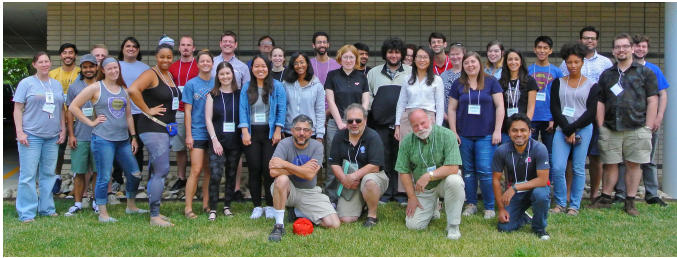




### History

The Space Weather Summer School started in 2000 under the Center for Integrated Space Modeling (CISM), at Boston University, with Jeff Hughes as Principal Investigator and Dean. It moved to Boulder in 2013 and Mike Wiltberger served as Dean through 2017, succeeded by Mark Miesch, Steve Cranmar (CU), and Stan Solomon. The School is now a NSF-funded program administrated by the High Altitude Observatory (HAO), which is the solar-terrestrial division of the National Center for Atmospheric Research (NCAR).



Class of 2018

### Curriculum

#### SW 101: The Solar-Terrestrial System

"Reality"

The solar interior and dynamo, magnetic flux emergence and photospheric active regions (sunspots), the solar chromosphere and corona, Solar wind acceleration and propagation, eruptive events, including flares and coronal mass ejections (CMEs), the heliosphere, the Earth's magnetosphere and ionosphere, coupling of space weather phenomena between the upper and lower atmosphere, solar irradiance and climate.

#### SW 102: Space Weather Effects and Consequences

"Harsh Reality"

Electrical power grids, satellites, satellite navigation systems such as GPS, telecommunications and radio blackouts, radiation hazards to astronauts, airline crews, and airline passengers, effects on economic sectors including power, aviation, transportation, communications, finance, and how should government and industry respond to space weather hazards?

#### SW 103: Modeling and Forecasting

"Virtual Reality"

The equations of magnetohydrodynamics, numerical methods, model assumptions and inputs, assimilation of observational data, model limitations, visualization, analysis, and interpretation of model output, accuracy of current forecasts, what can we do to improve forecast accuracy?

See class schedule at <https://www2.hao.ucar.edu/SWSS>

## Twenty Years of Space Weather Summer School

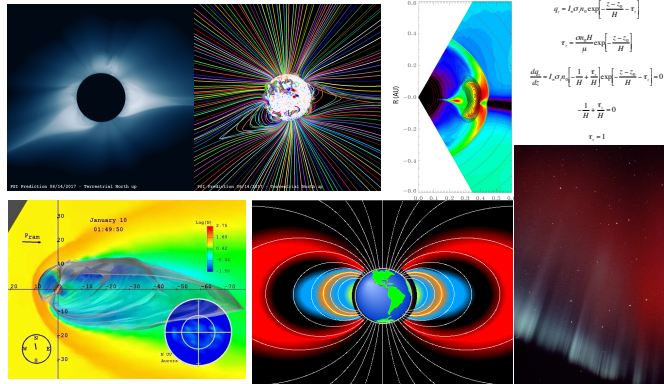
Stanley C. Solomon<sup>1</sup>, Joan Burkepile<sup>1</sup>, Steven Cranmer<sup>2</sup>, Nicholas A. Gross<sup>3</sup>, W. Jeffrey Hughes<sup>3</sup>, Delores J. Knipp<sup>2</sup>, Susan Lynds<sup>2</sup>, Mark S. Miesch<sup>1</sup>, Howard J. Singer<sup>4</sup>, and Michael J. Wiltberger<sup>1</sup>

<sup>1</sup>UCAR <sup>2</sup>University of Colorado <sup>3</sup>Boston University <sup>4</sup>NOAA/SWPC

**Abstract.** The Boulder Space Weather Summer School began in July 2001, as the Center for Integrated Space Weather Modeling (CISM) Summer School, and moved from Boston to Boulder in 2013. Its purpose, then and now, was and is to provide an overview of the physics behind the diverse areas that define space physics, the elements of numerical modeling, the processes that cause changes in the solar-terrestrial environment, and the impacts on technological systems and on human space flight. The primary target audience is early-stage graduate students, including those just entering graduate programs and advanced undergraduates considering them, but we have also included professionals working in space weather forecast activities who desire a broader purview or deeper knowledge of the processes they monitor. Space physics programs at Universities generally exist in departments such as Physics, Astronomy, Engineering, or Atmospheric Science, yet many students pursue highly specialized curricula in various subfields, gaining instrumentation, observational, or modeling experience, but sometimes without much context. Thus, the field needs activities that are both broadening and unifying, and we think that there is additional value in early-career scientists getting to know their future peers in related sub-fields. As the School opens applications for its 20th season, we summarize its trajectory and describe its curriculum, including the computer-laboratory activities that allow participants to interact with data, models and each other. We also describe other pedagogical techniques used to maintain engagement, and the evaluation methodology.

Summer 2020: June 29 – July 10, at the High Altitude Observatory, NCAR, Boulder, Colorado. Applications are open at <https://www2.hao.ucar.edu/SWSS>

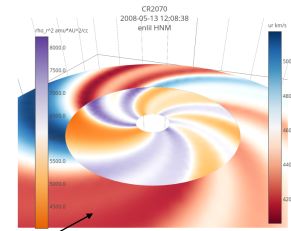
### Lectures



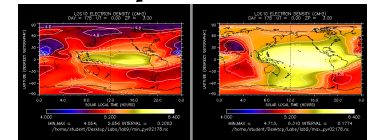
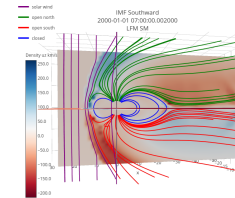
American Geophysical Union 2019 Fall Meeting • San Francisco, California • 12 December 2019



### Labs



Examples of student-generated lab graphics



Several practices that were innovative when we started this, but some are now commonplace in higher education:

- "Time out to think" questions during lectures
- Written questions after lectures; extemporaneous answers after lunch
- Computer labs using real data and model output
- "Capstone" project with specialist groups and end-to-end analysis groups

### Didactics



### Evaluation

- Formal evaluation by a professional educational evaluator
- Daily feedback surveys and reports
- Pre- and post-event surveys
- Longitudinal follow-up studies
- Informal channels, too

