100th Annual Meeting American Meteorological Society
17th Conference on Space Weather
New Instruments, Platforms, and Initiatives for Space Weather. Part III
Boston, MA January 13-16, 2020

Jet Propulsion Laboratory
California Institute of Technology

A Chapman Conference on Space Weather: Recommendations for the Community

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Outline

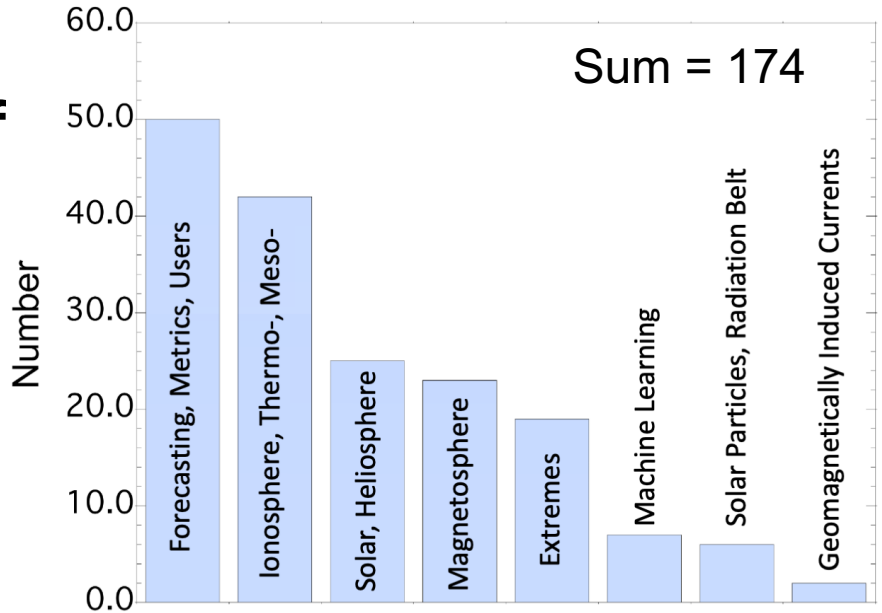
1. Conference objectives and summary
2. Post-meeting activities
3. Towards recommendations
4. Summary

100 attendees

Scientific Challenges Pertaining to Space Weather Forecasting Including Extremes
Pasadena, CA, USA • 11-15 February 2019
AGU 100 CHAPMAN CONFERENCE

Conference Objectives & Summary

- **Objective: "Perspectives that accelerate the development of forecasting"**
- **AGU: "Transformative"**
- **AGU: Pre- and post-meeting activities**
- **Special collection in *Space Weather***
- **Meeting artifacts will receive a DOI**



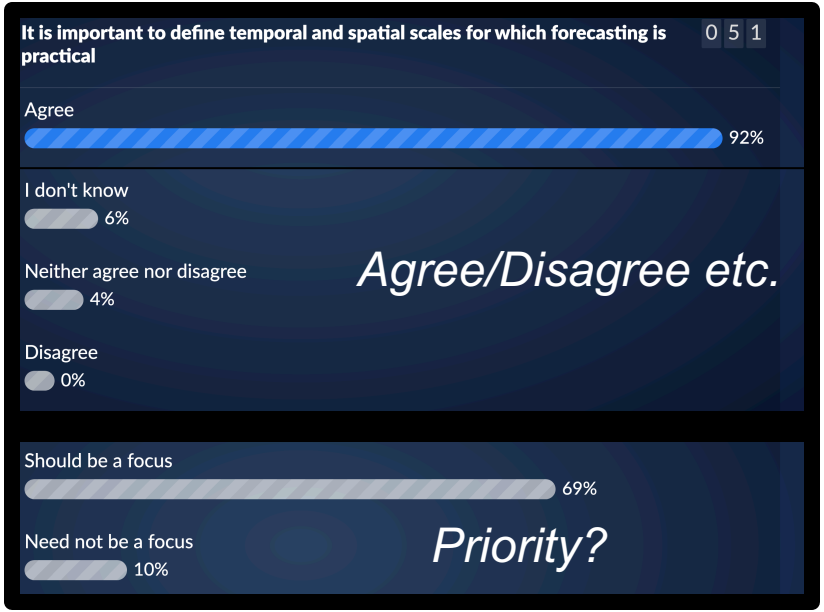
Talks (65) + Posters (48) = 113

4 days

Pre-Meeting Survey Highlights

Top focus questions:

- **It is important to define temporal and spatial scales for which forecasting is practical – *Agree***
- **Measures of forecast uncertainty are well understood and accepted across the community – *Disagree***

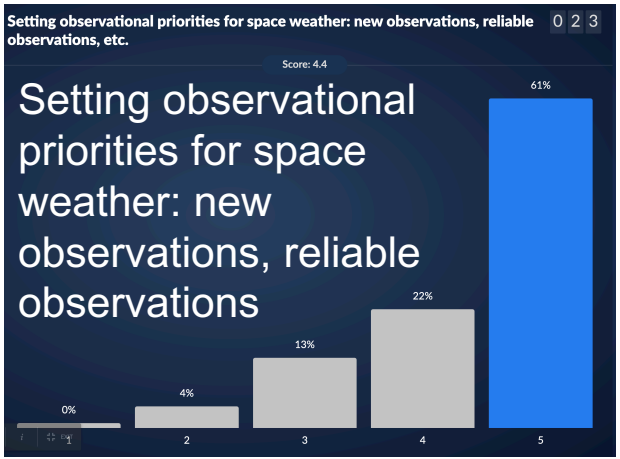


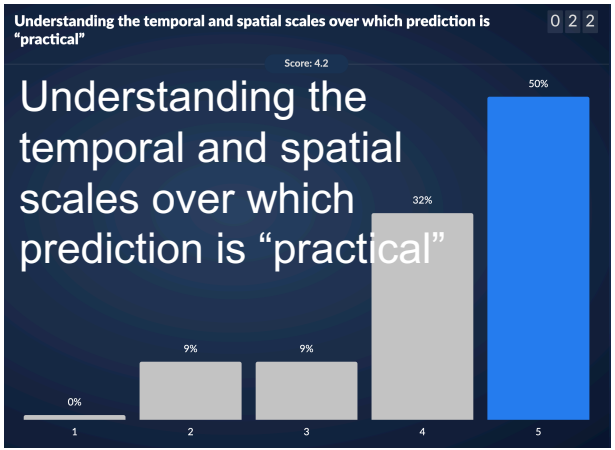
100 attendees
51 respondents

"Priorities" Survey Highlights

- **Released during the meeting**
- **Proposed priorities ranked from 1-5**

Top 2 priorities





Post-Meeting Activities

- Develop a “white paper” w/ recommendations
- Telecons
- Meeting documents with a permanent DOI:
  - Discussion notes from the meeting
  - Survey results
  - Post-meeting telecon notes
  - Free-form documents open during the meeting
  - Anonymous questions offered at the meeting
- Special collection in Space Weather Journal

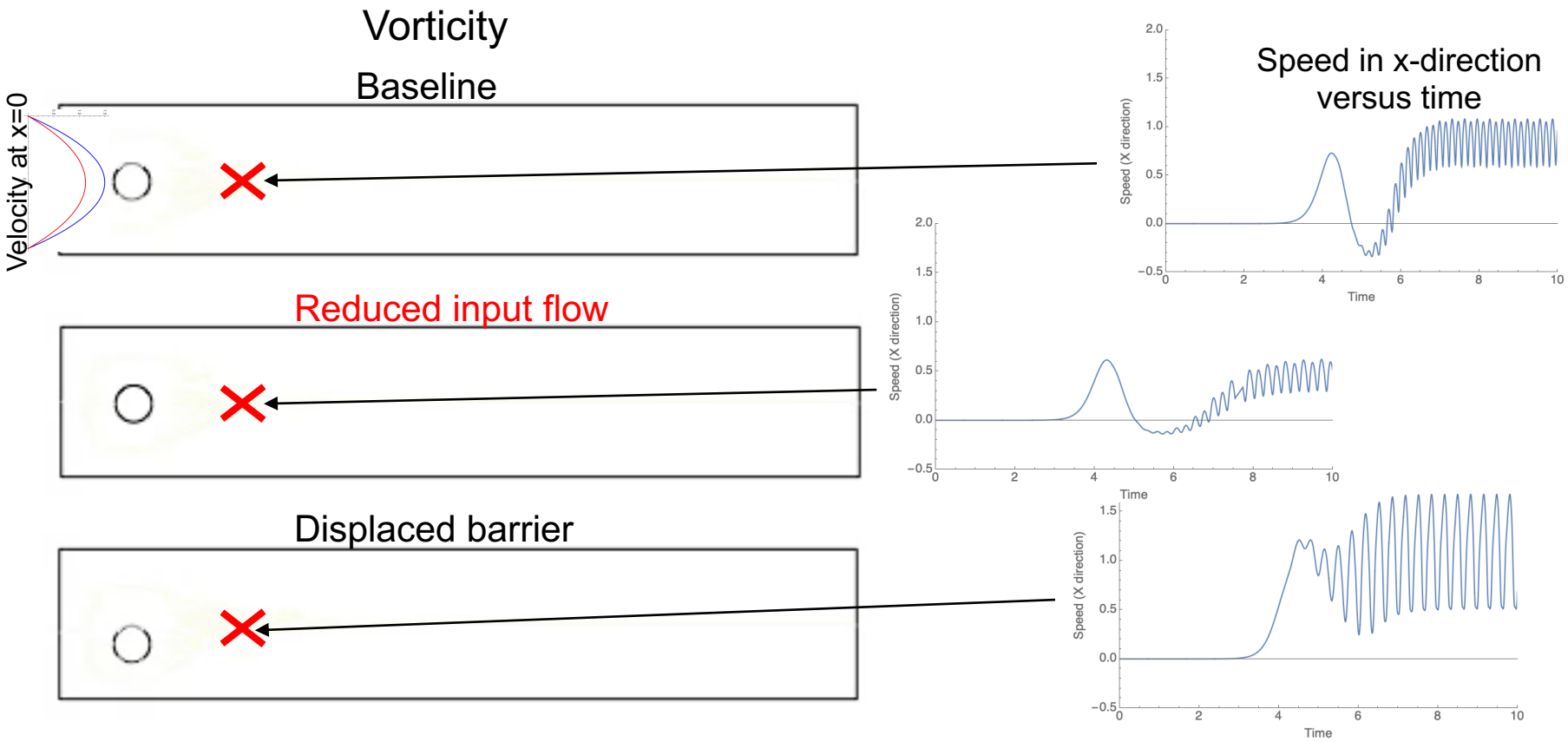
Recommendations (1/1)

- 1-day workshop where the community discusses a "way forward" for developing predictive capabilities
  - Held adjacent to Space Weather Workshop, Boulder
  - Possibly expanding to an ongoing multi-day workshop
- Rationale: adapting the approach used by terrestrial weather prediction "won't work"
  - Weather has one primary equation as the basis for prediction: Navier-Stokes
  - Space weather has six primary equations
- Appeal for "disruptive" approaches

Recommendations (2/2)

- **Observations enable a future of *data assimilation***
- **The expense of observations requires that we understand the *value proposition***
- **As a community, we need to develop the capability to *estimate the value of a given observing system* in terms of how it benefits a specific use case**
  - **“Observation system simulation experiment”**

Example: Navier-Stokes Equation



Paradigms from the Literature

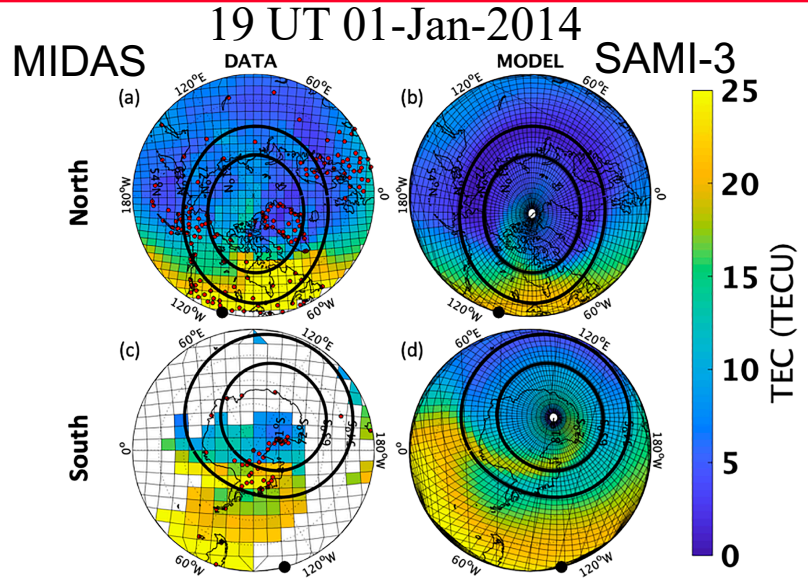


Figure 2. High-latitude TEC from (a and c) MIDAS and (b and d) SAMI3 at 19 UT on 1 January 2014. Black rings show 60° and 70° MLAT (at 300-km apex). Black dots at perimeter indicate local noon. Red dots indicate GPS ground stations.

Chartier, A. T., J. D. Huba, and C. N. Mitchell (2019), On the Annual Asymmetry of High-Latitude Sporadic F, *Space Weather*, *46*(4), 619–9, doi:10.1029/2019SW002305.

"SAMI3 is not expected to provide accurate instantaneous predictions, but can provide insights into climatological behavior." – sufficiently for the science question.

- No data assimilated into SAMI-3
- Model agrees with TEC reconstruction to ~1 TECU
  - Regional median
- Model range about ½ range of data

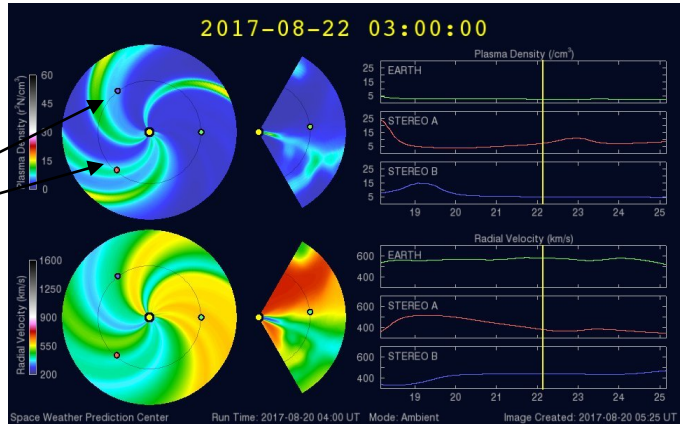
VERB Radiation Belt Model

https://rbm.epss.ucla.edu/realtime-forecast/

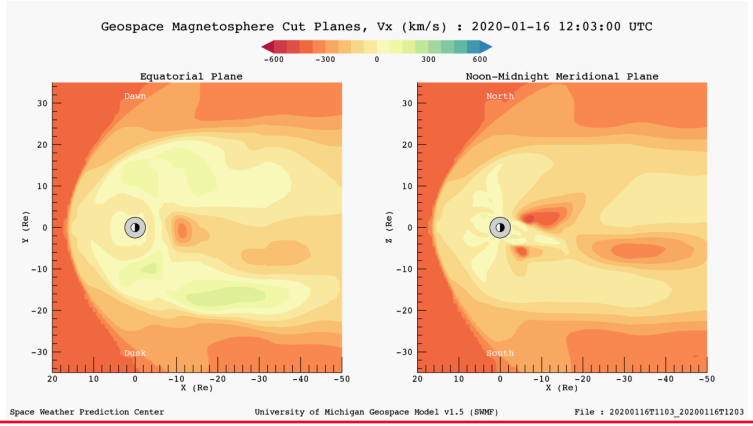
- Starts with primitive equations for the electron phase space density
- Uses a Kalman filter and real-time data
  - "combines measurements that are irregularly distributed in space and time with a physics-based model to estimate the evolution of the system's state in time"
- Can no longer assimilate Van Allen Probe data

Transitioned NOAA models

STEREO spacecraft



- ENLIL-based forecasts (MHD)
- Data source is photospheric magnetogram
- Not the same as “traditional” data assimilation that samples the model domain



- MHD-based forecasts
- Data source is solar wind at L1 and various empirical inputs
- Not the same as “traditional” data assimilation that samples the model domain in real-time

Summary

- An exciting Chapman conference with excellent presentations and discussion – "space weather" is vibrant!
- Pre- and post-meeting activities
  - Meeting artifacts online (soon)
  - Special collection in Space Weather Journal
- Recommendations (undergoing refinement):
  - Workshop to discuss way forward given the complexity of space weather
  - Developing approaches to assessing the "value proposition" for proposed observing systems and specific use cases
  - A means of prioritizing observational strategies

Space weather advances are made possible by the fundamental discoveries, observations, model developments and system deployments that have occurred over the past 20 years

BACKUP