CEDAR Virtual Meeting
June 22-26

Jet Propulsion Laboratory
California Institute of Technology

Recommendations From a Chapman Conference on Space Weather

Abstract author: Anthony J. Mannucci[1]

Co-conveners: Delores J. Knipp[2], Huixin Liu[3], Ryan M. McGranaghan[4], Xing Meng[1], A. Surjalal Sharma[5], Bruce T. Tsurutani[1], Olga Verkhoglyadova[1]

[1]*Jet Propulsion Laboratory, California Institute of Technology*
[2]*University of Colorado Boulder, USA*
[3]*Kyushu University, Japan*
[4]*Atmospheric and Space Technology Research Associates, LLC, USA*
[5]*University of Maryland, USA*

Contributors to presentation content: Chapman conference co-conveners, program committee, speakers, meeting attendees and post-meeting telecon participants

Responsible for errors/omissions: Anthony J. Mannucci

Conference Objectives & Summary

- **Objective: "Scientific perspectives that accelerate the development of space weather prediction"**

- **AGU: "Be Transformative"**

- **AGU: "Arrange pre- and post-meeting activities"**

- **Special collection in *Space Weather***

- **Meeting artifacts receive a DOI**
  Meeting artifacts: DOI:10.5281/zenodo.3693004
  Special Collection in Space Weather: https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1542-7390.FORECAST1

Sum = 174
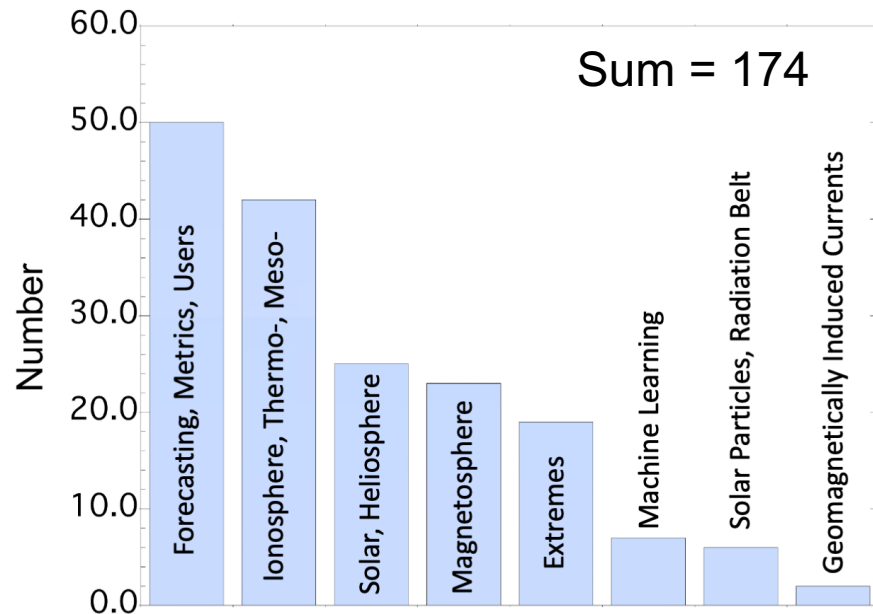
Talks (65) + Posters (48) = 113

4 days

Recommendations (1/1)

- **1-day workshop where the community discusses a "way forward" for developing predictive capabilities**
  - **Held adjacent to Space Weather Workshop (USA) and/or European Space Weather Week**
  - **Possibly expanding to an ongoing multi-day workshop**
- **Appeal for "disruptive" approaches**
- **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**

Recommendations (2/2)

Ob-
serv-
ations

- **Observations enable a future of *data assimilation***

- **Observations are needed within and at the boundaries of regions of interest**

- **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 predictive use case**

  - **"Observation system simulation experiment"**

Recent Comments On Draft Recommendations

- **How will observation-centric predictive capabilities actually be developed?**
  - **New program? New funding opportunities? New organization? New workshops?**

- **Can observations originate from other than the scientific community?**

- **Model validation is usage-specific**
  - **This may point to a future that is heterogeneous in terms of how predictive solutions are developed and used, a "market" approach involving academia, government and the commercial sector"**

Summary

Submit to our AGU session!
"All models are wrong but some are useful"

Conveners:
Huang/Mannucci

SPA-Aeronomy

zenodo   Search   Upload   Communities

March 1, 2020   Dataset   Open Access

Table of Contents for Meeting Artifacts from Chapman Conference on Scientific Challenges Pertaining to Space Weather Forecasting Including Extremes

Knipp, Delores; Mannucci, Anthony

Table of Contents of Meeting Artifacts and Output from the Chapman Conference on Scientific Challenges Pertaining to Space Weather Forecasting Including Extremes, 11-15 February 2019, Pasadena, CA, USA

Each entry in the table of contents provides a short description and/or artifact title, along with the number of associated files and a weblink showing the associated DOI or permanent URL.

The Chapman Conference was supported by NSF Award AGS 1848885 and NASA grants 936723.02.01.09.14 and 936723.02.01.11.21

Browse the artifacts!
- Discussion notes
- Survey results

Visit the Special Collection!
https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1542-7390.FORECAST1

White paper/recommendations to be published soon!

https://zenodo.org/record/3693004#.XvROTvJ7ITY
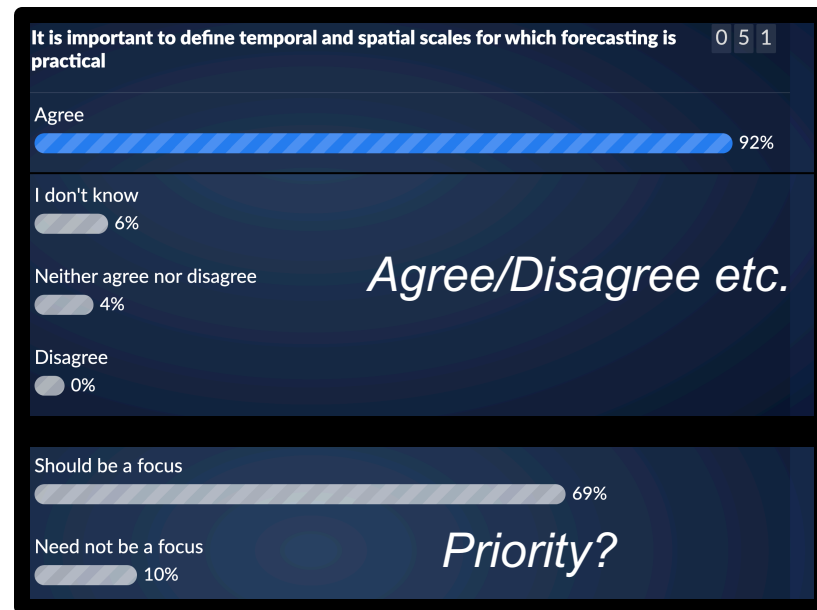
BACKUP

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*


It is important to define temporal and spatial scales for which forecasting is practical   0 5 1

Agree   92%

I don't know   6%

Neither agree nor disagree   4%   *Agree/Disagree etc.*

Disagree   0%

Should be a focus   69%

Need not be a focus   10%   *Priority?*

100 attendees
51 respondents

"Priorities" Survey Highlights

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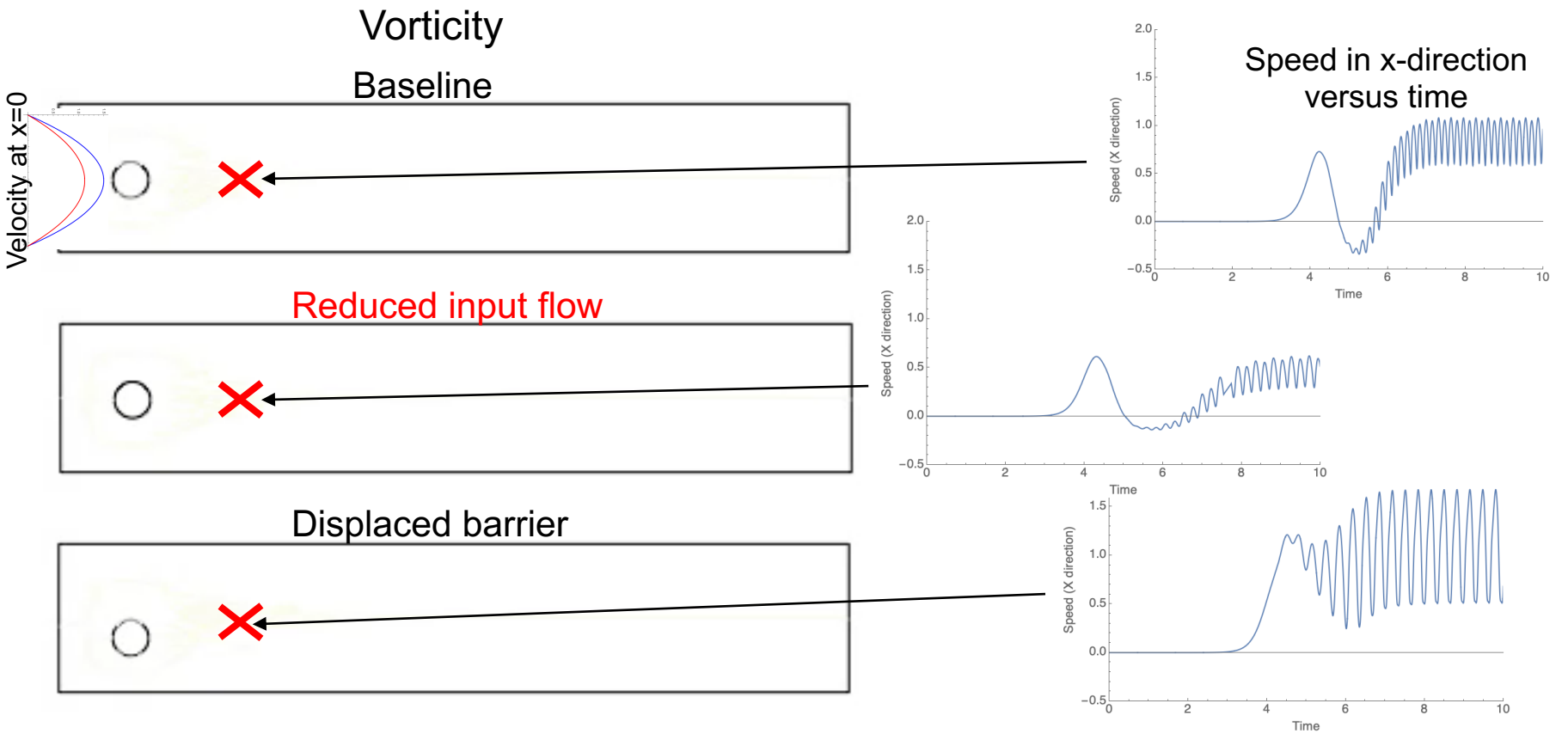- **Proposed priorities ranked from 1-5**

Top 2 priorities
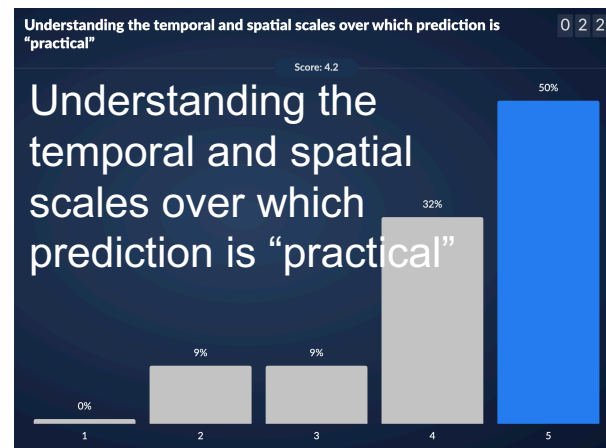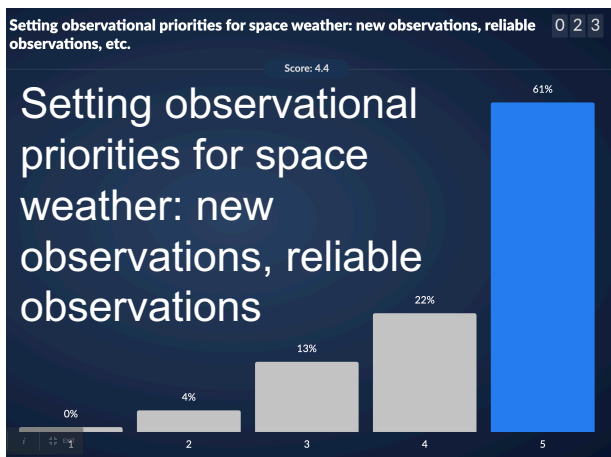
Post-Meeting Activities

- **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**

Example: Navier-Stokes Equation

Vorticity

Baseline

Velocity at x=0

Reduced input flow

Displaced barrier

Speed in x-direction versus time
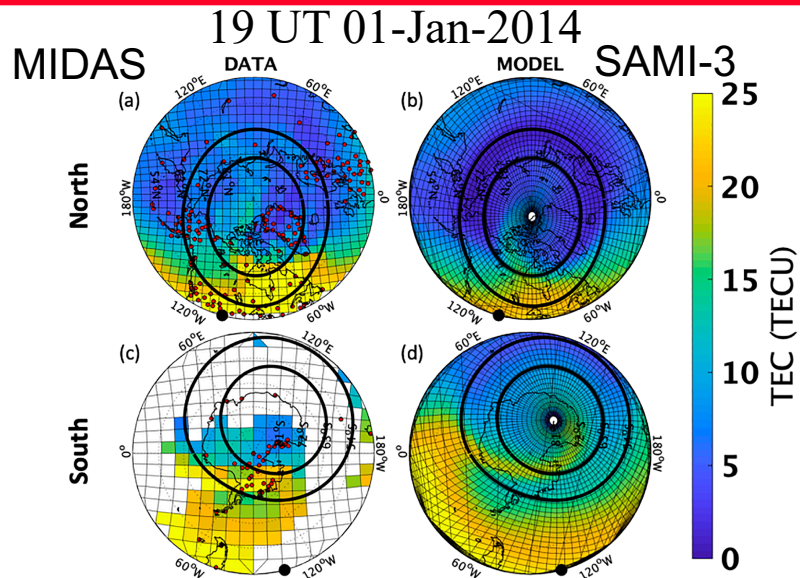
Paradigms from the Literature

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
  - o Regional median
- Model range about ½ range of data

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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
  - o "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
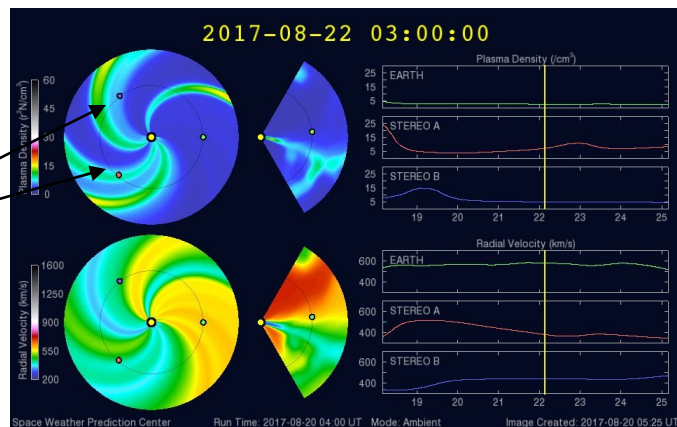
- ENLIL-based forecasts (MHD)
- Data source is photospheric magnetogram
- Not the same as "traditional" data assimilation that samples the model domain
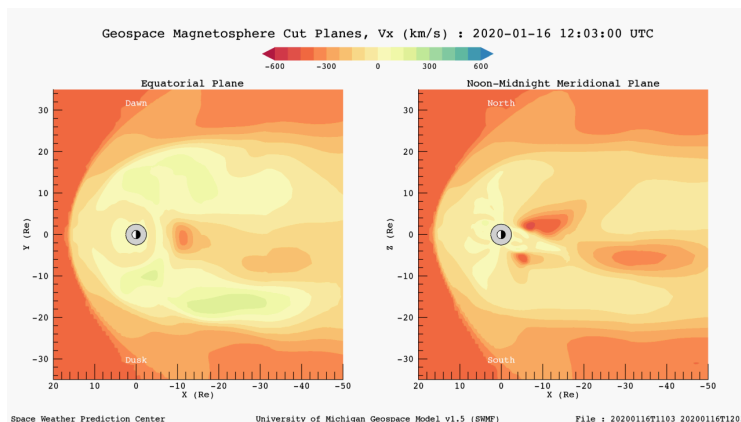
- MHD-based forecasts
- Data source is solar wind at L1 and various empirical inputs
- Not the same as "traditional" data assimilation that samples the model domain in real-time

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

Outline

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

Scientific Challenges Pertaining to Space Weather
Forecasting Including Extremes

AGU 100 CHAPMAN CONFERENCE

Pasadena, CA, USA • 11-15 February 2019

100 attendees