

# NOAA/SWPC OPERATIONAL MODEL PERFORMANCE DURING THE SEPTEMBER 2017 STORMS

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# OVERVIEW:

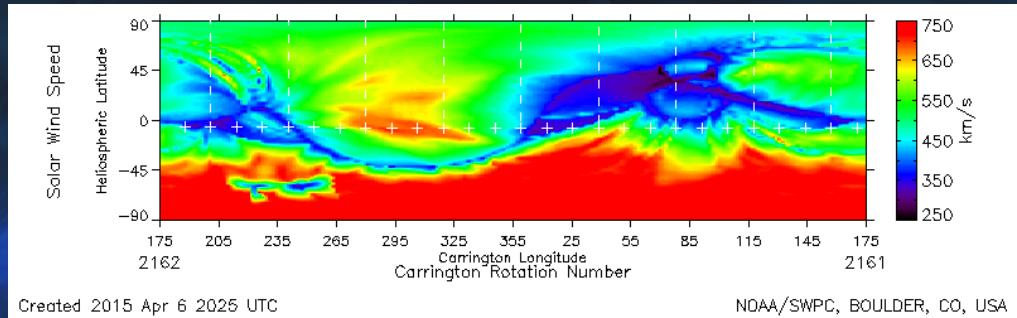
- **CURRENT OPERATIONAL LARGE-SCALE NUMERICAL MODELS**
  - WSA-Enlil Solar Wind Model
  - SWMF/Geospace Model
- **MODEL PERFORMANCE DURING SEPT STORMS**
- **NEXT STEPS / UPGRADE EFFORTS**

# WSA-ENLIL MODEL

OPERATIONAL SINCE 2012

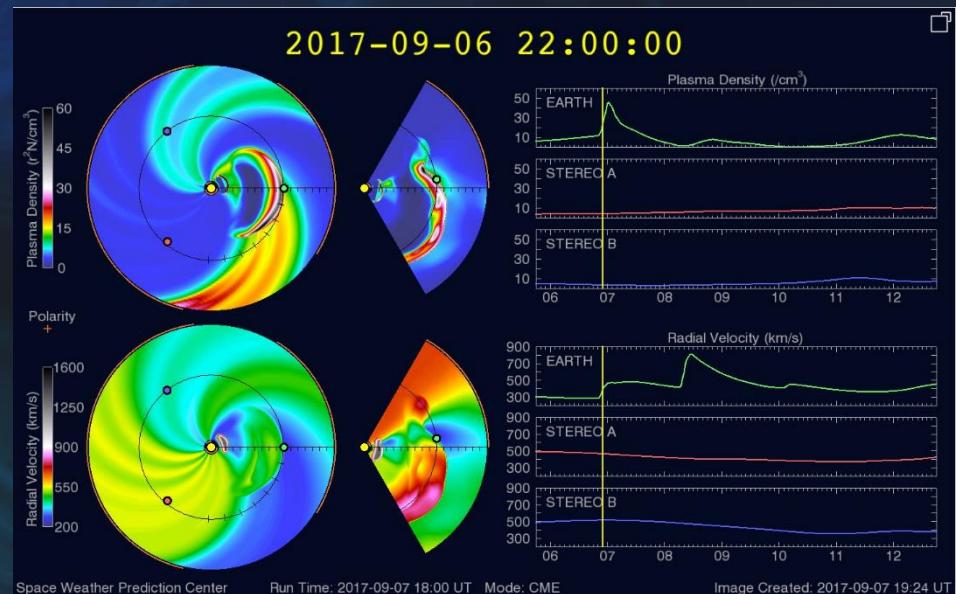
- WSA:

- Empirically determined relationship between flux tube expansion and solar wind velocity
- Uses static synoptic maps
- Provides mag and vel fields
- Solar surface to 21.5 Rs



- ENLIL:

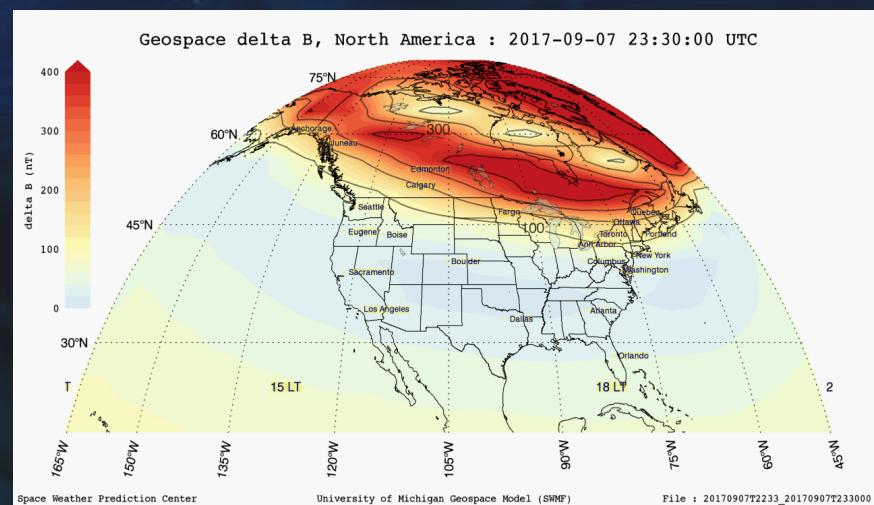
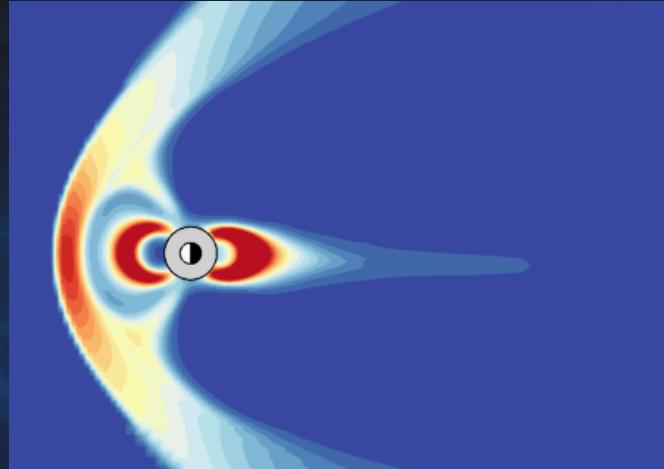
- MHD model of heliosphere
- Run every 2 hours in ops
- Estimate CME parameters with CAT tool
- Determines likelihood that a CME will interact with Earth and predicted time of arrival



# GEOSPACE MODEL

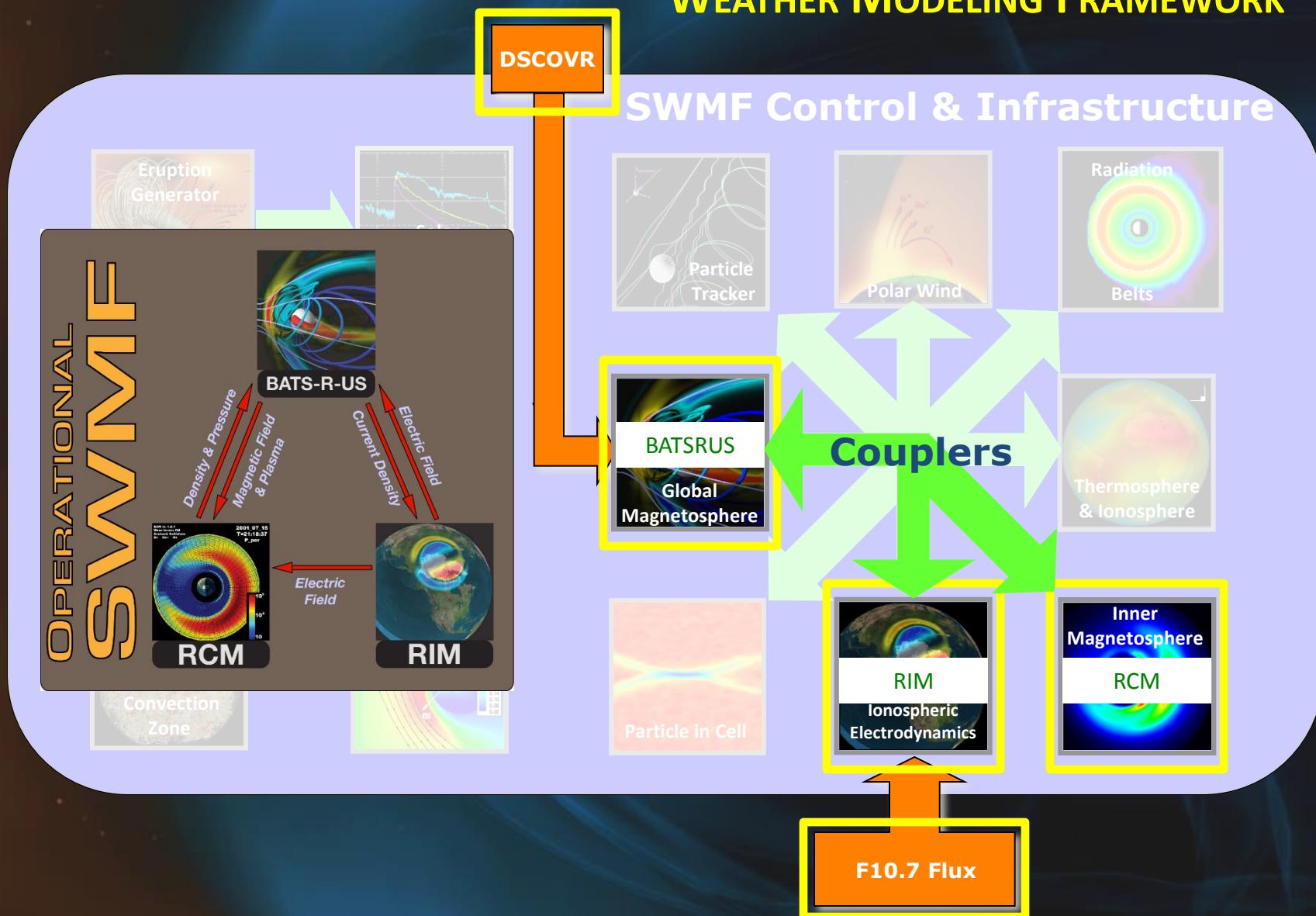
OPERATIONAL AS OF OCTOBER 2016

- Geospace Model:
  - MHD model of Earth's magnetosphere
  - 32 Re upstream to ~120 Re down tail
  - U. Michigan's Space Weather Modeling Framework (SWMF)
  - Running every minute as long as solar wind data are available
- Provides regional geomagnetic storm predictions supporting space weather forecasters and electric power industry



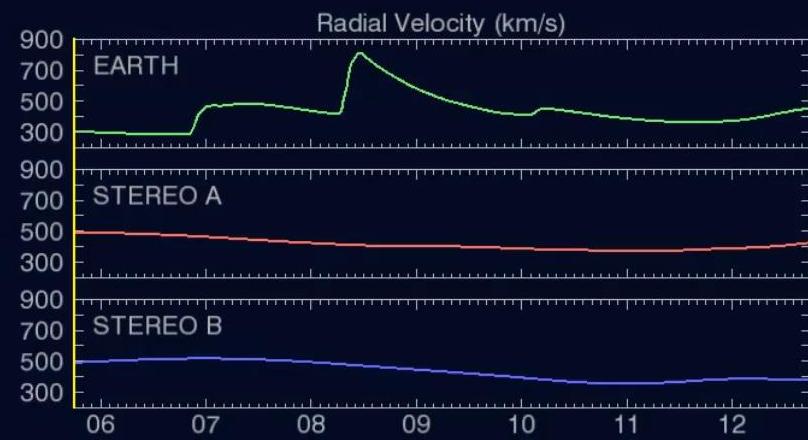
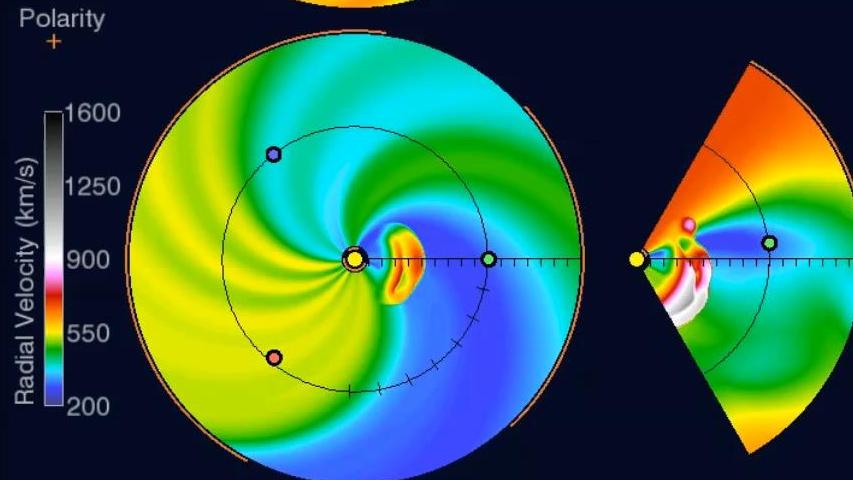
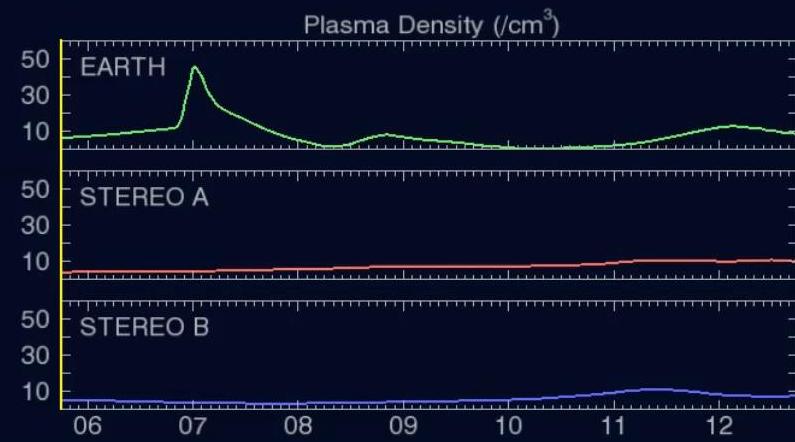
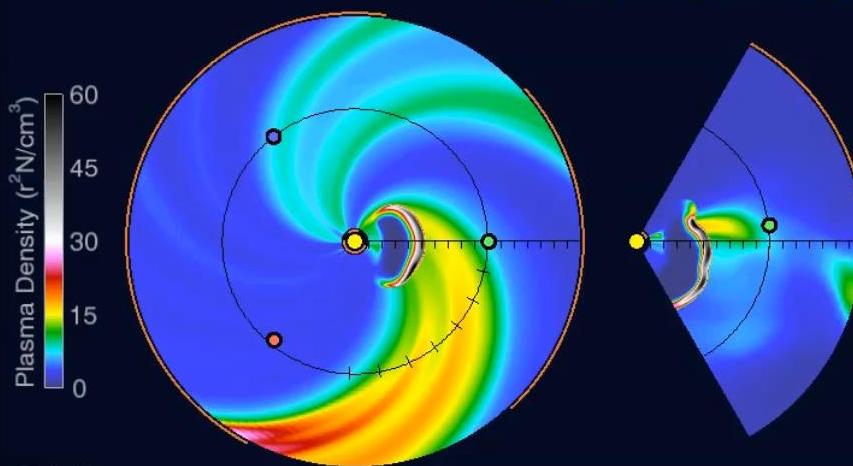
# GEOSPACE MODEL:

# UNIVERSITY OF MICHIGAN'S SPACE WEATHER MODELING FRAMEWORK



# WSA-ENLIL MODEL PREDICTION

2017-09-05 18:00:00

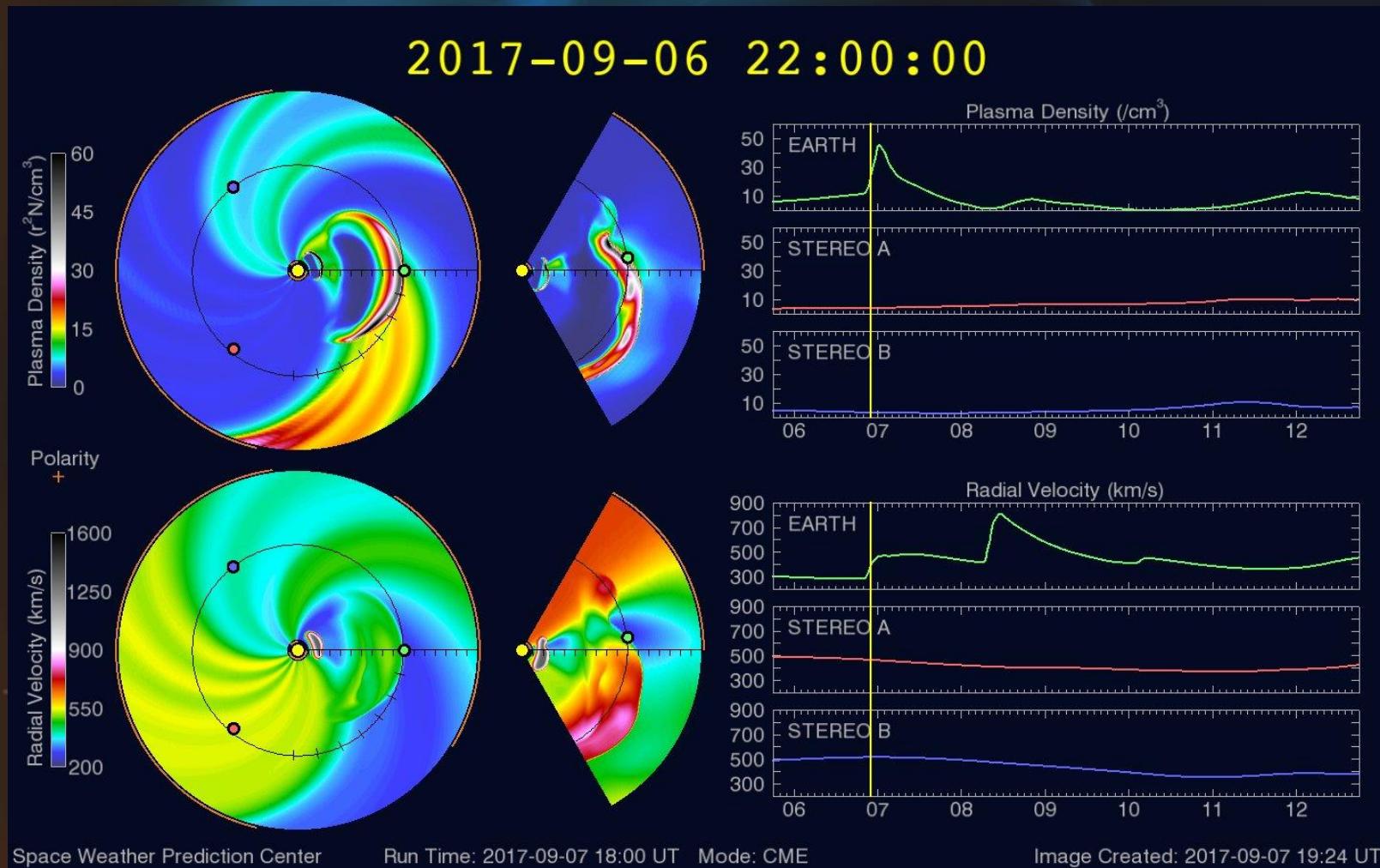


Space Weather Prediction Center

Run Time: 2017-09-07 18:00 UT Mode: CME

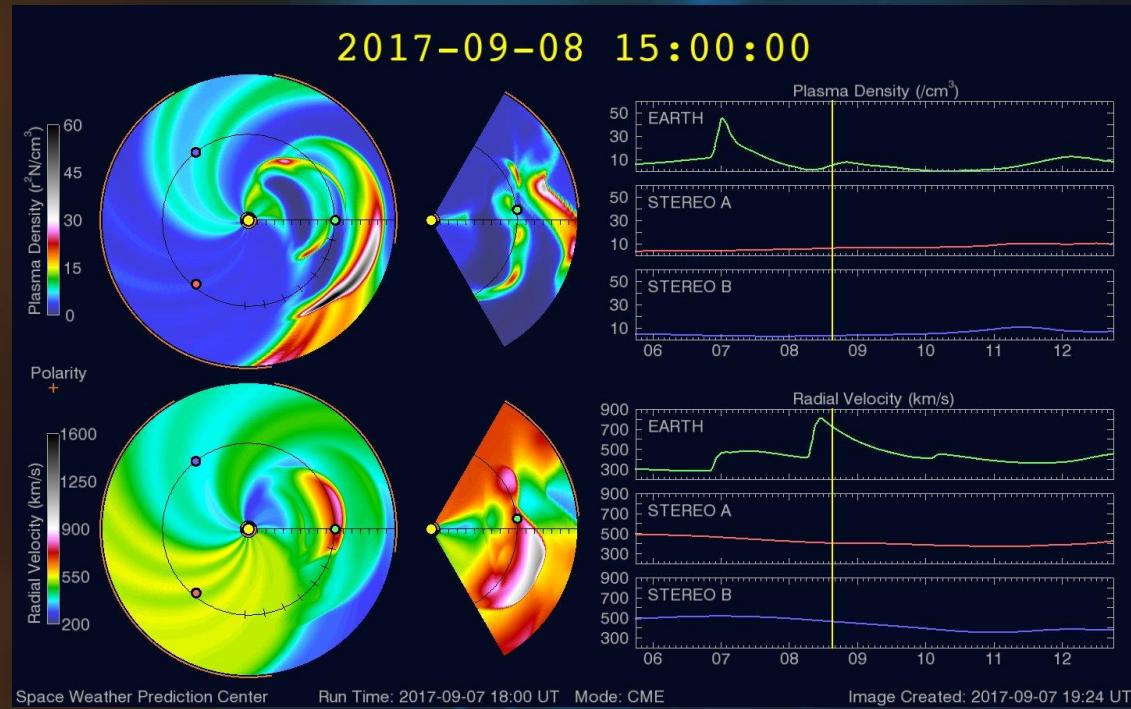
Image Created: 2017-09-07 19:24 UT

# WSA-ENLIL MODEL PREDICTION



First CME Arrival Observed at 23:08 UTC at DSCOVR

# WSA-ENLIL MODEL PREDICTION



Model doesn't handle CMEs in quick succession very well

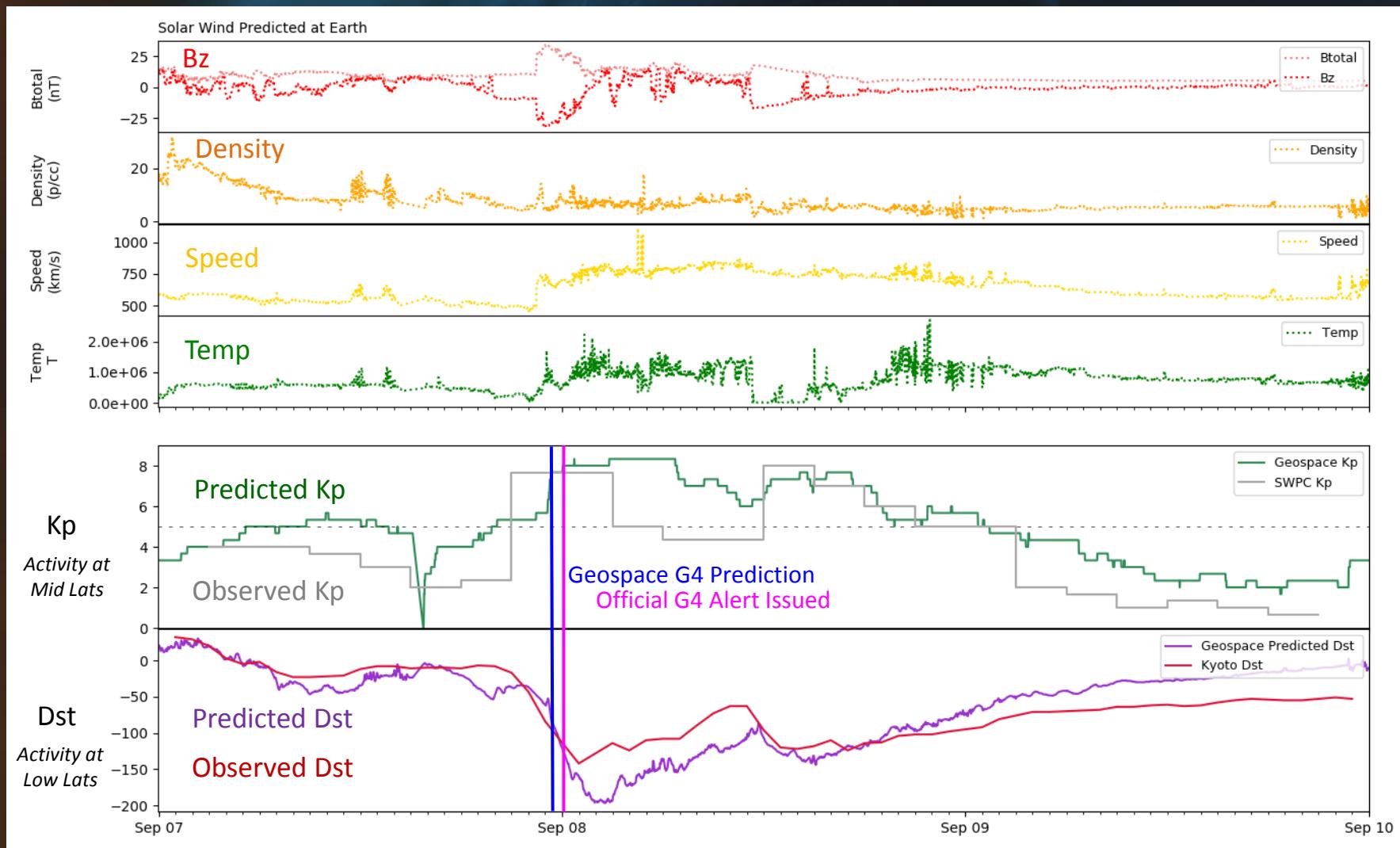
With multiple CMEs additional uncertainty introduced into arrival time of second CME

## Second CME:

- Forecasted to arrive midday on Sept. 8th
- Arrival observed at DSCOVR late on Sept. 7th

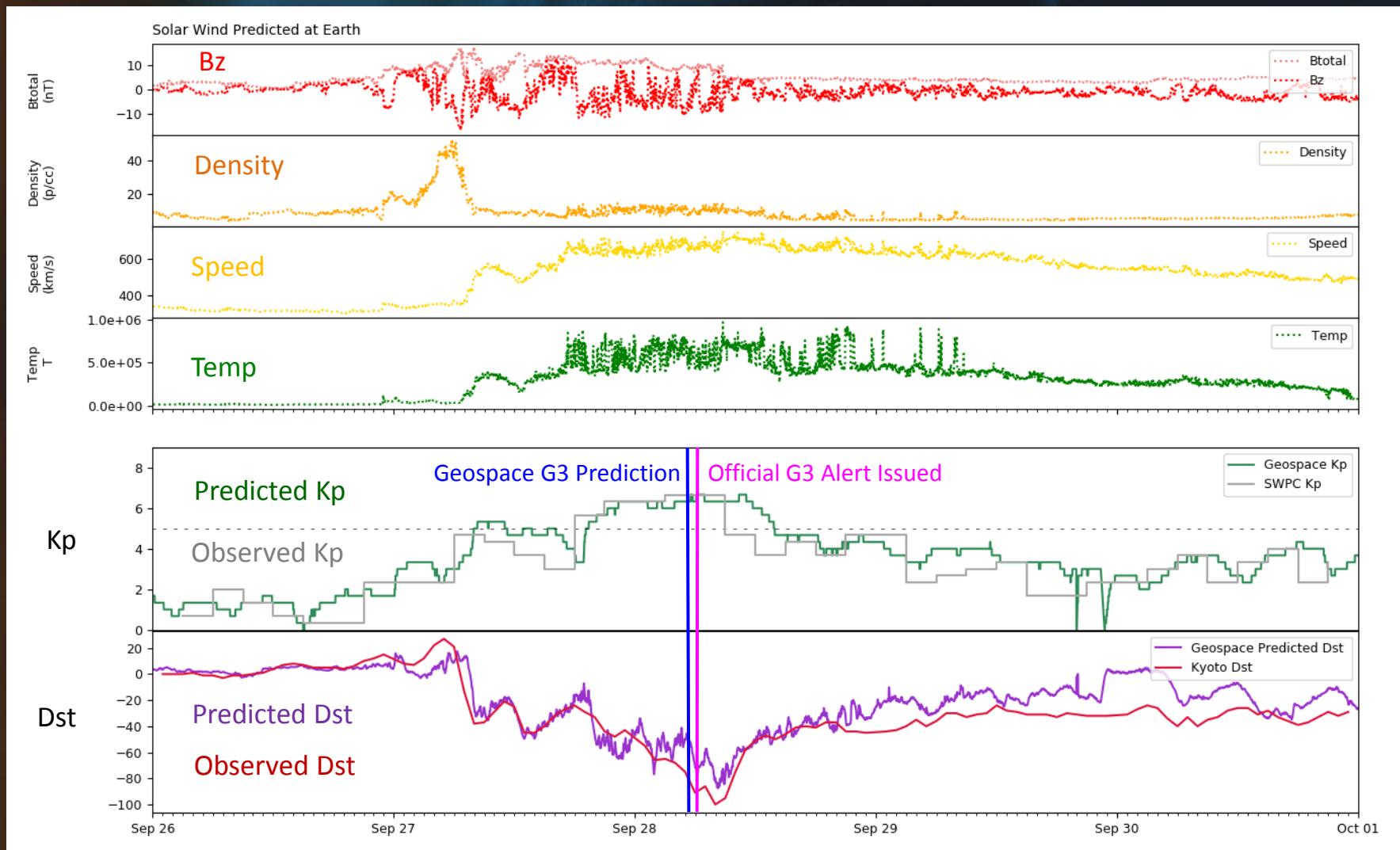
# GEOSPACE MODEL PREDICTION

## SEPTEMBER 7-10, 2017



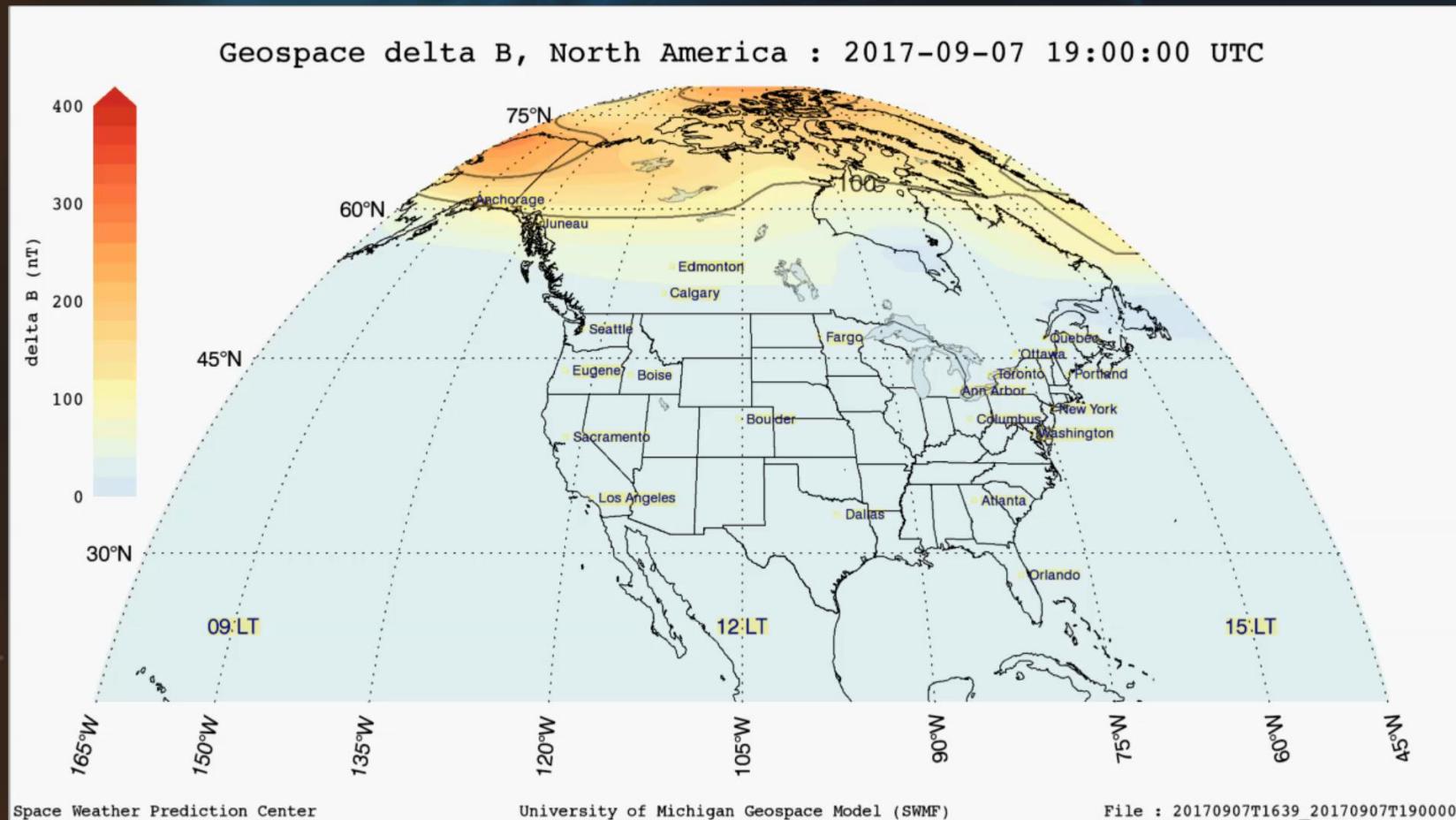
# GEOSPACE MODEL PREDICTION

## SEPTEMBER 26-30, 2017



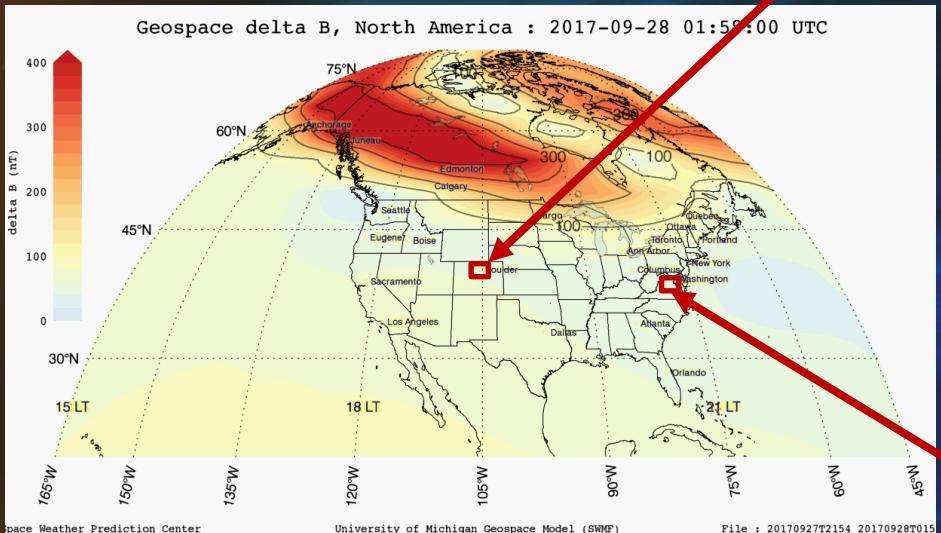
# SEPTEMBER 2017 STORM

## SEPT 7-9, 2017



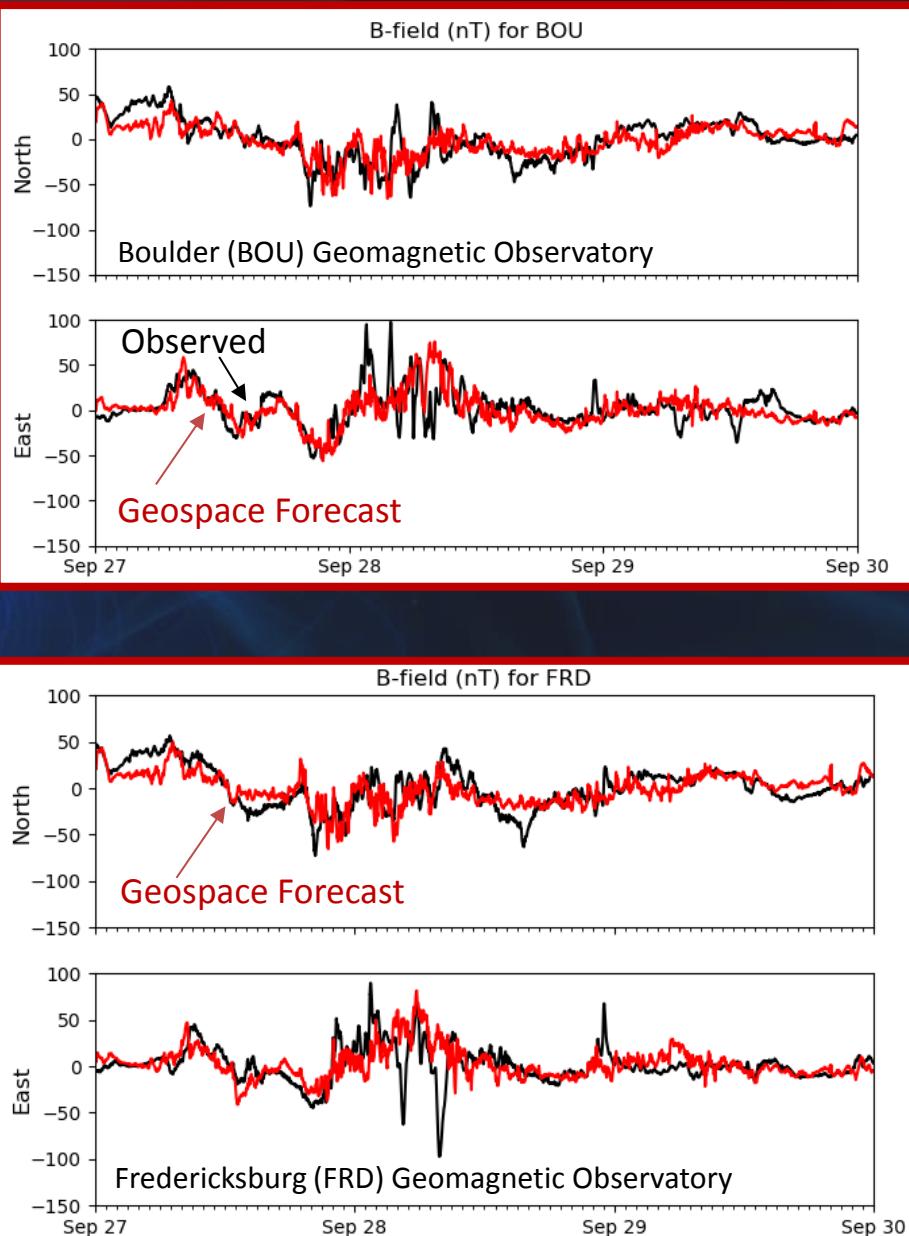
GEOSPACE GROUND MAGNETIC PERTURBATION MAP

# REGIONAL GEOSPACE FORECASTS



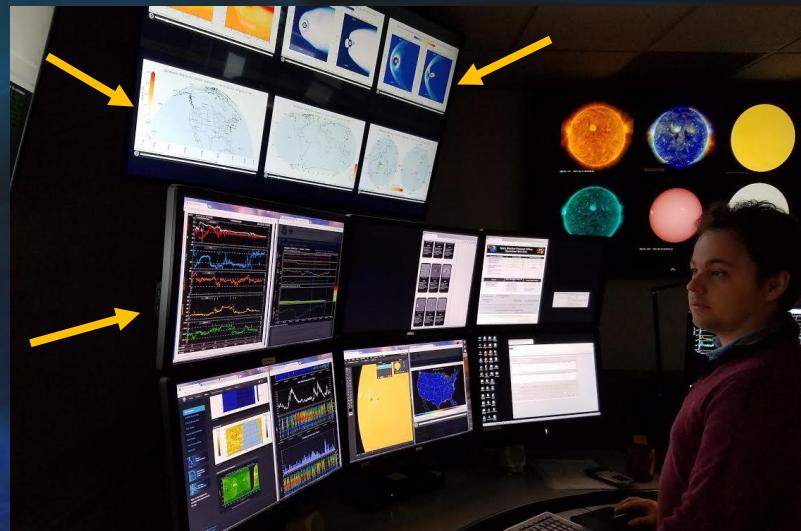
Capture activity well during active periods

More validation is needed to provide confidence levels



# SUMMARY AND NEXT STEPS

- Operational models did a reasonable job forecasting the September 2017 storms
- Model products are displayed in real-time in the SWFO and the forecasters use the output to guide decisions about issuing geomagnetic storm warnings
- Operational models demonstrated useful predictive capabilities during the September 2017 Strom period
- Validation efforts are underway



*Geospace products displayed in the Forecast Office*

## Next Steps:

- Upgrade WSA-Enlil to time depended version of Enlil using ADAPT maps
- Upgrade Geospace model to version 2.0 with high-resolution
- New and improved products