

# MAVEN

Mars Atmosphere and Volatile Evolution Mission

CU/LASP • GSFC • UCB/SSL • LM • JPL

## *MAVEN/M2M/CCMC Collaboration and Validation Project*

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NASA GSFC

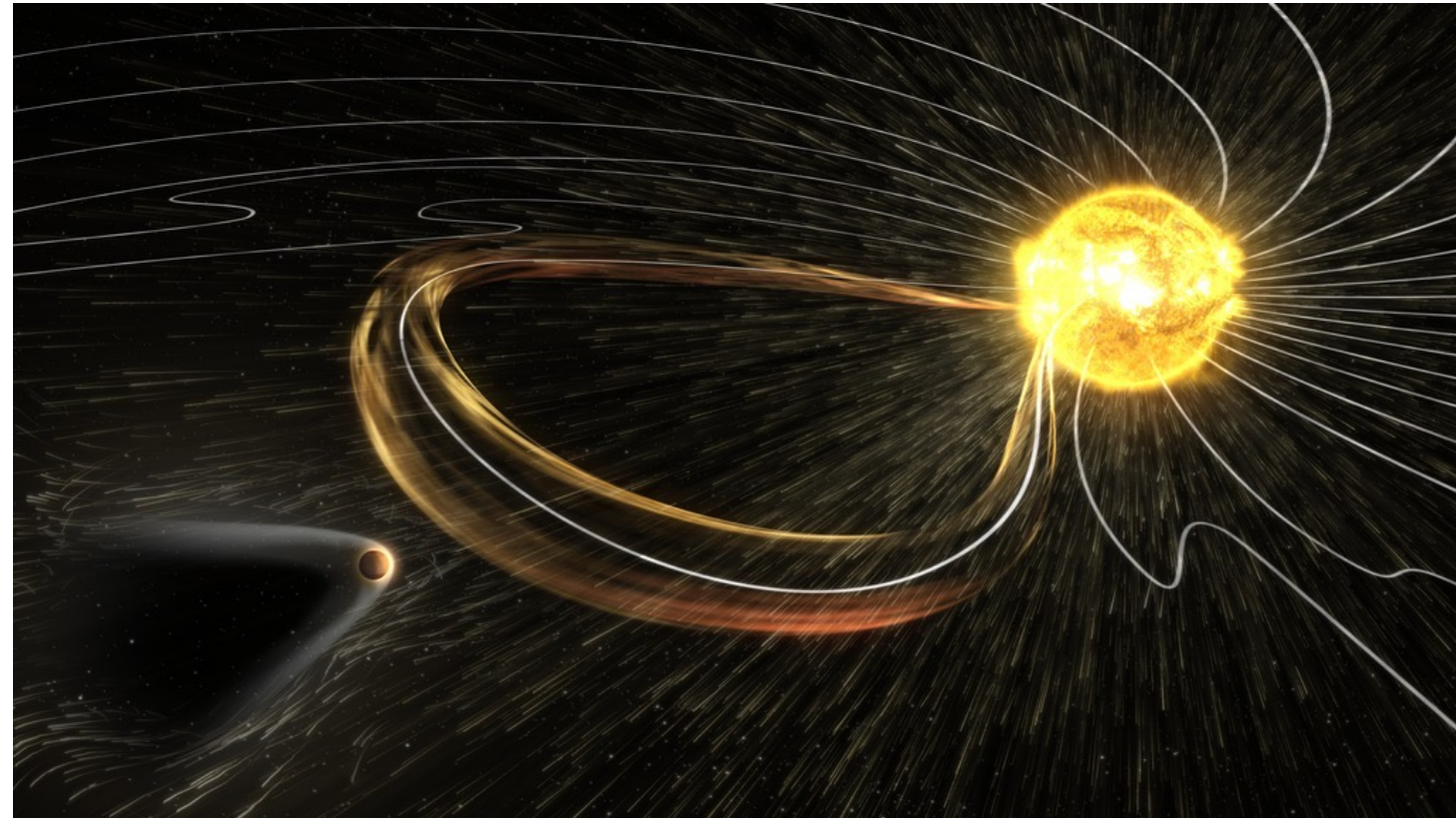
MAVEN, M2M, and CCMC Teams

12<sup>th</sup> NASA Space Exploration &  
Space Weather Workshop  
3 December 2021

[gina.a.dibraccio@nasa.gov](mailto:gina.a.dibraccio@nasa.gov)



- MAVEN data has applications for Planetary & Heliophysics science
- M2M/CCMC modeling tools help determine the impact of solar activity at Mars
- MAVEN observations confirm when events arrive at Mars to assist with model validation
- M2M/CCMC can support MAVEN in determining the timeline of events



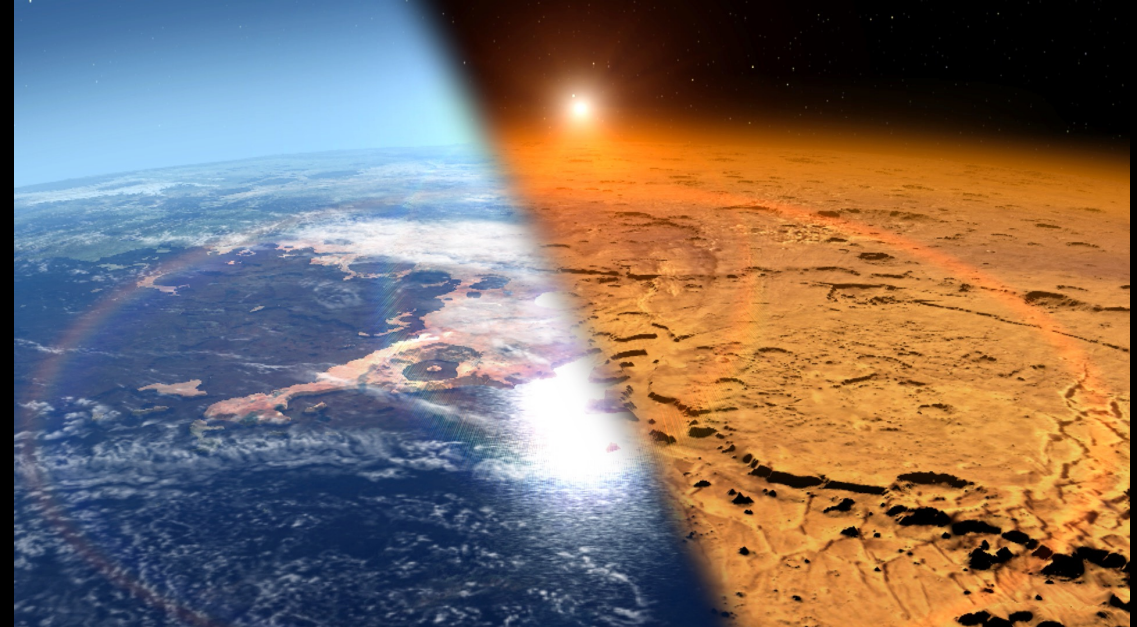
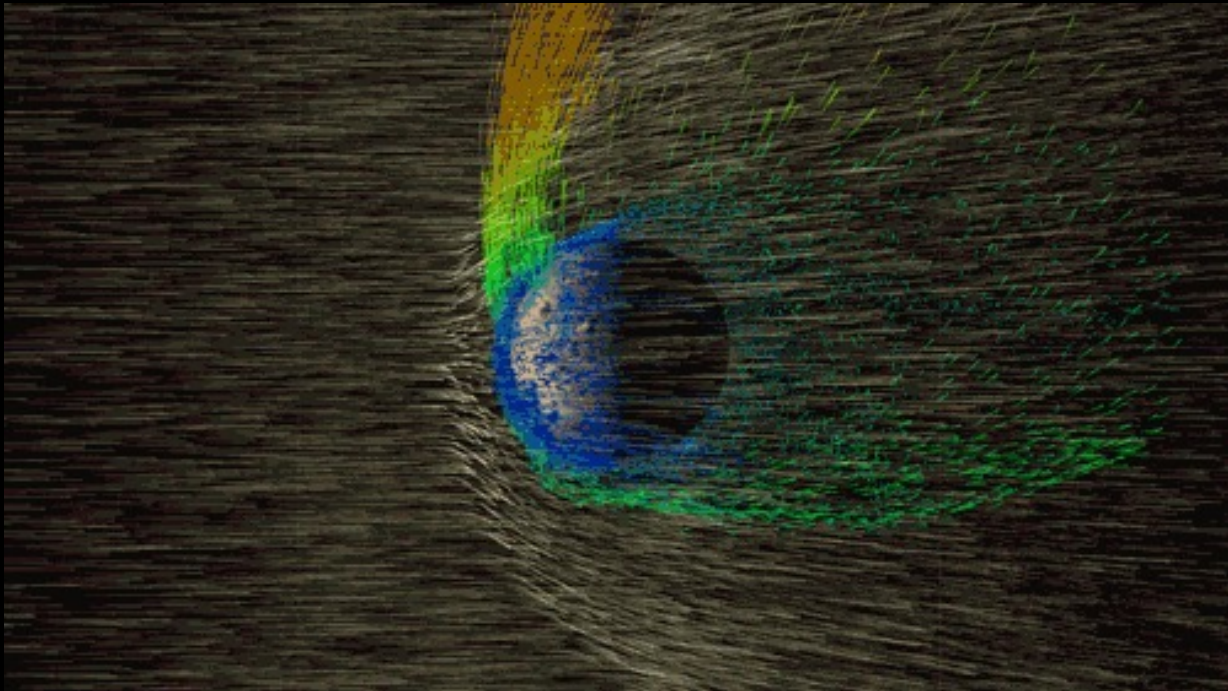
NASA GSFC/SVS

MAVEN is an ideal mission to form a collaboration with M2M/CCMC. This collaboration will help to prepare for human exploration at Mars. Given the increase in solar activity, now is the time to combine efforts.



# MAVEN Science Objectives

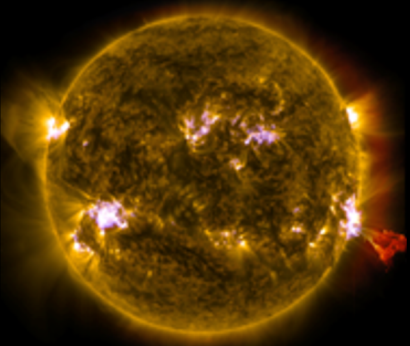
MAVEN is exploring Mars' climate evolution to understand how much of the water and atmosphere has been lost to space.



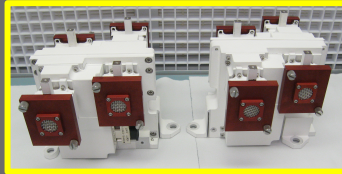
- Assess current state of the Martian atmosphere and its response to solar inputs
- Calculate atmospheric escape rate at the present epoch and over the history of Mars
- Determine total atmospheric loss to space over time



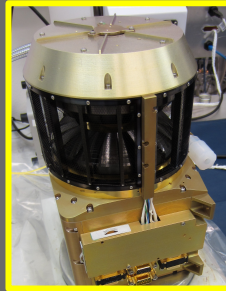
# The MAVEN Science Instruments



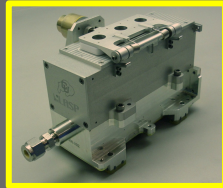
## Solar EUV, Solar Wind, Solar Storms



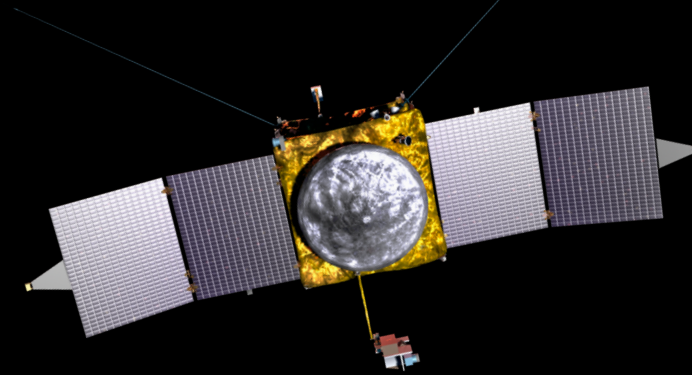
SEP



SWIA



EUVM



400 km  
open

closed

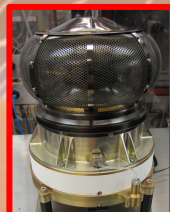
open

100 km

## Magnetic Field and Topology

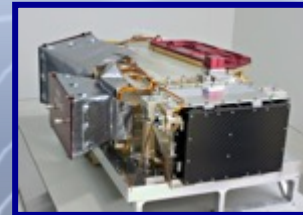


MAG

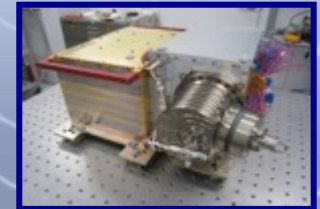


SWEA

## Atmosphere and Ionosphere Plus Evolution



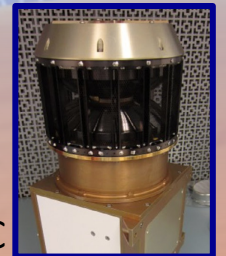
IUVS



NGIMS



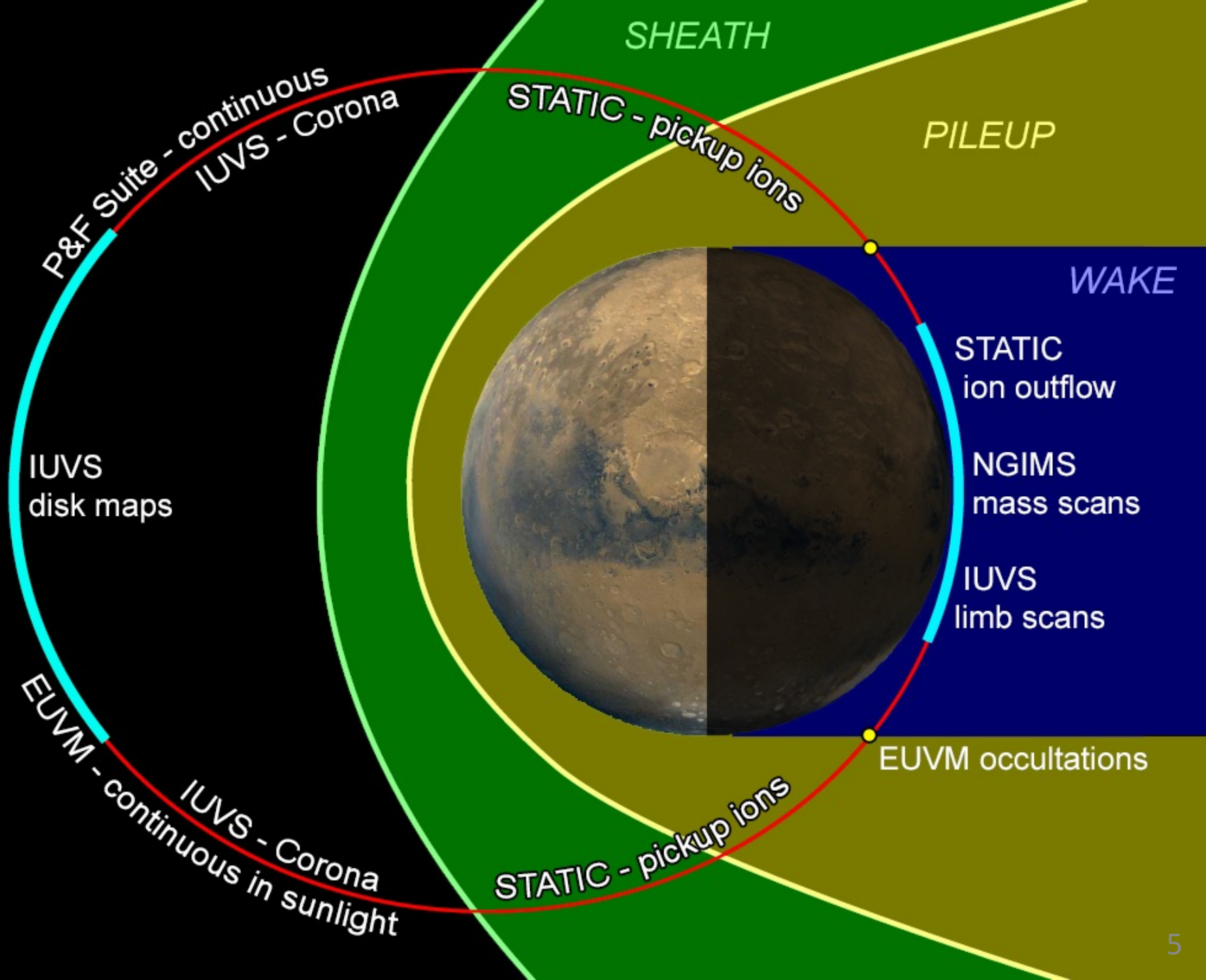
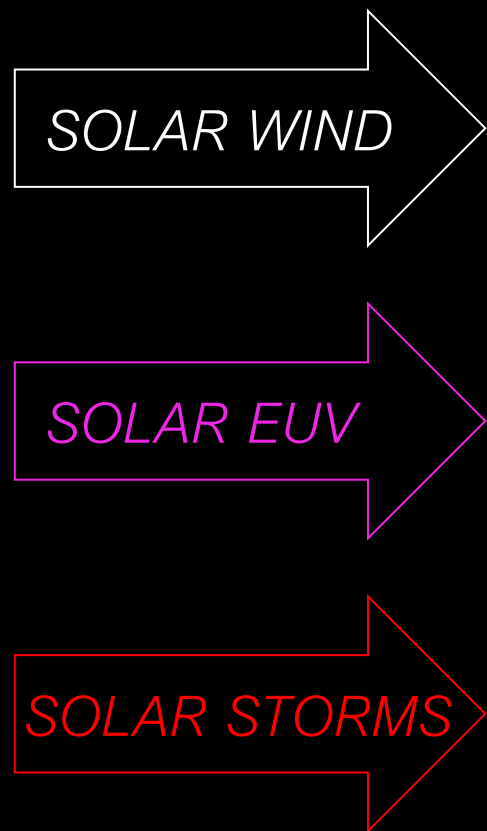
LPW



STATIC

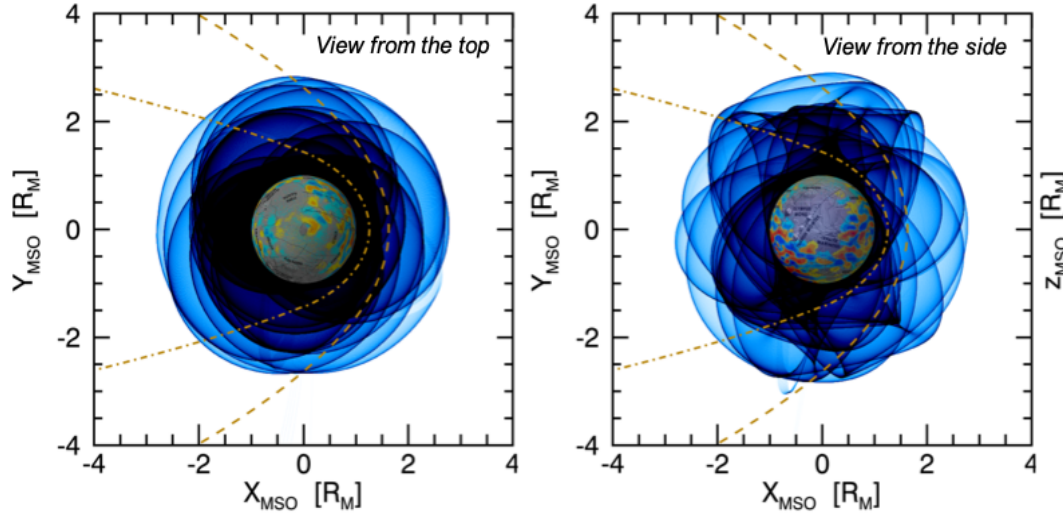


# MAVEN Orbit Design



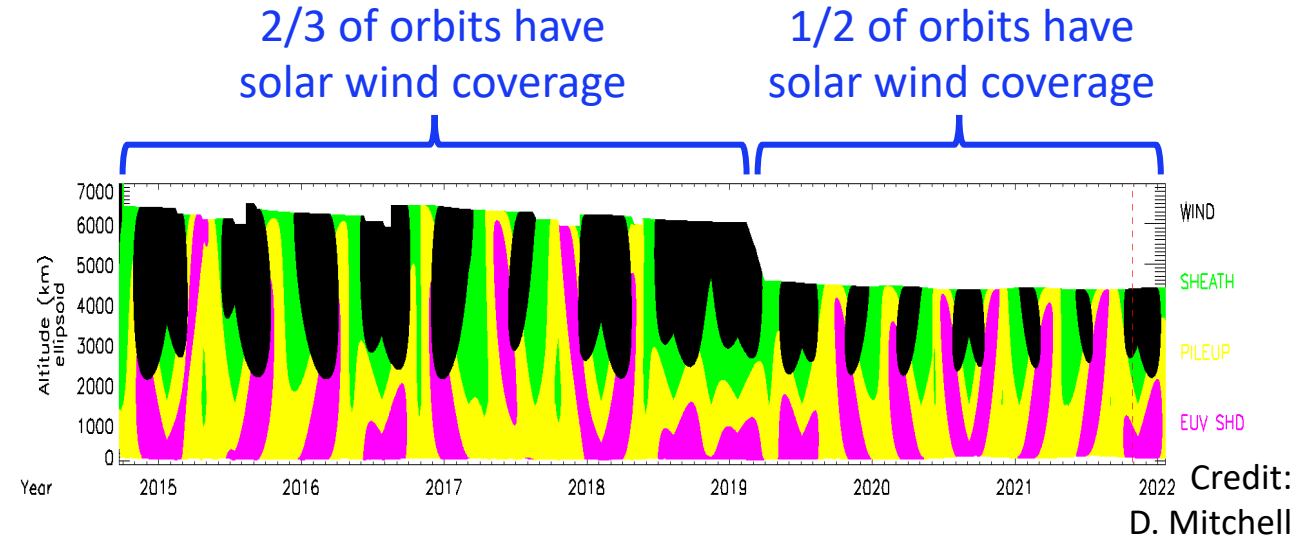


# Monitoring Solar Inputs at Mars

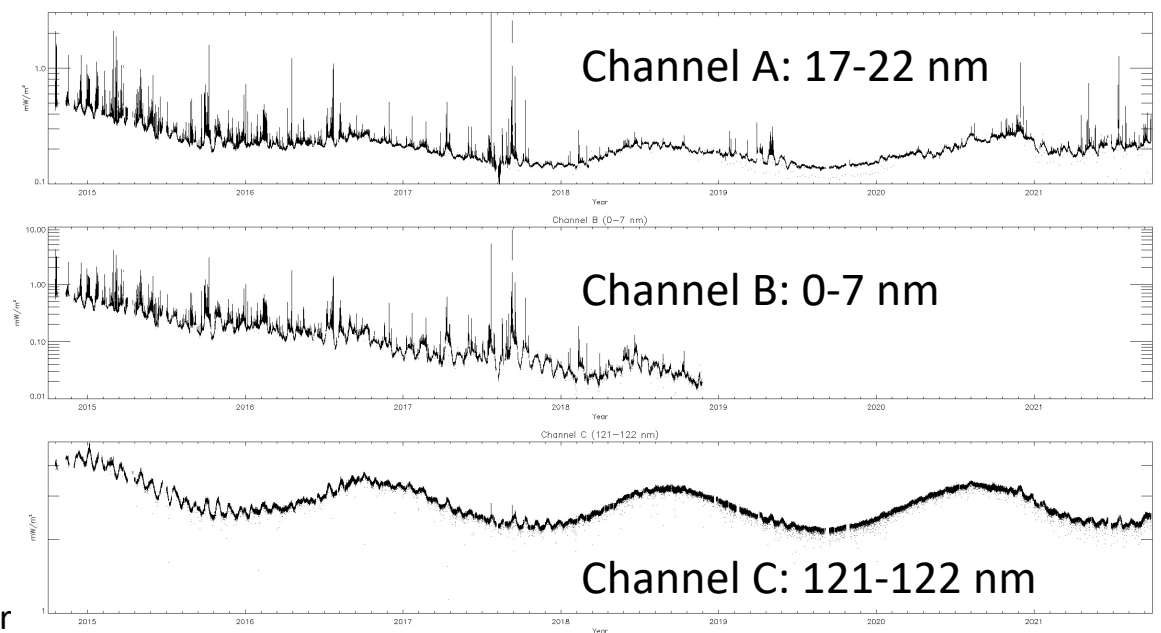


- MAVEN has completed over 15,000 orbits
- MAVEN provides *in situ* observations of the solar wind and IMF at Mars
- Proxies have been created to infer upstream conditions when direct observations are not available

Credit: F. Eparvier

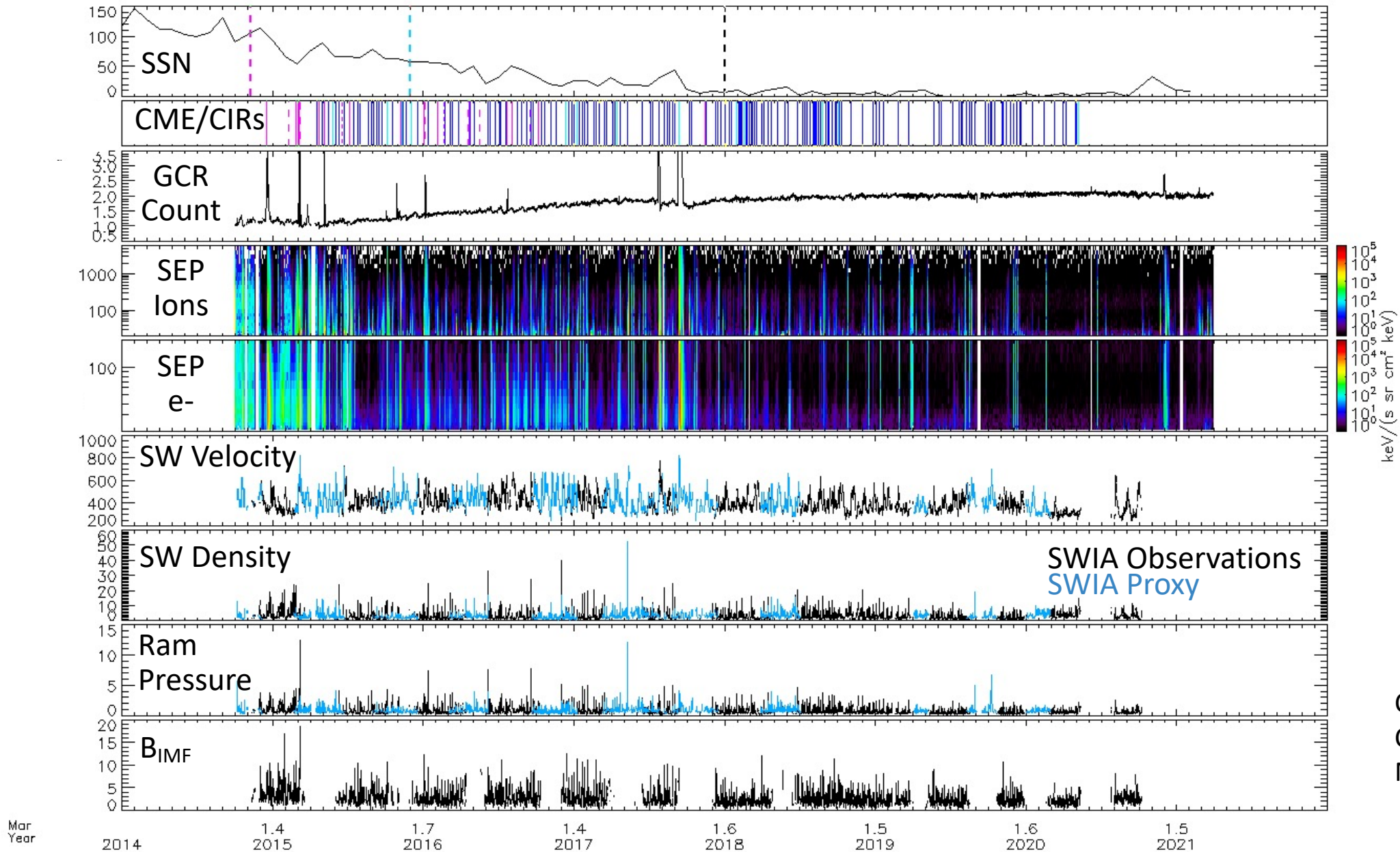


Solar EUV Irradiance Observed at Mars





# Monitoring Solar Inputs at Mars

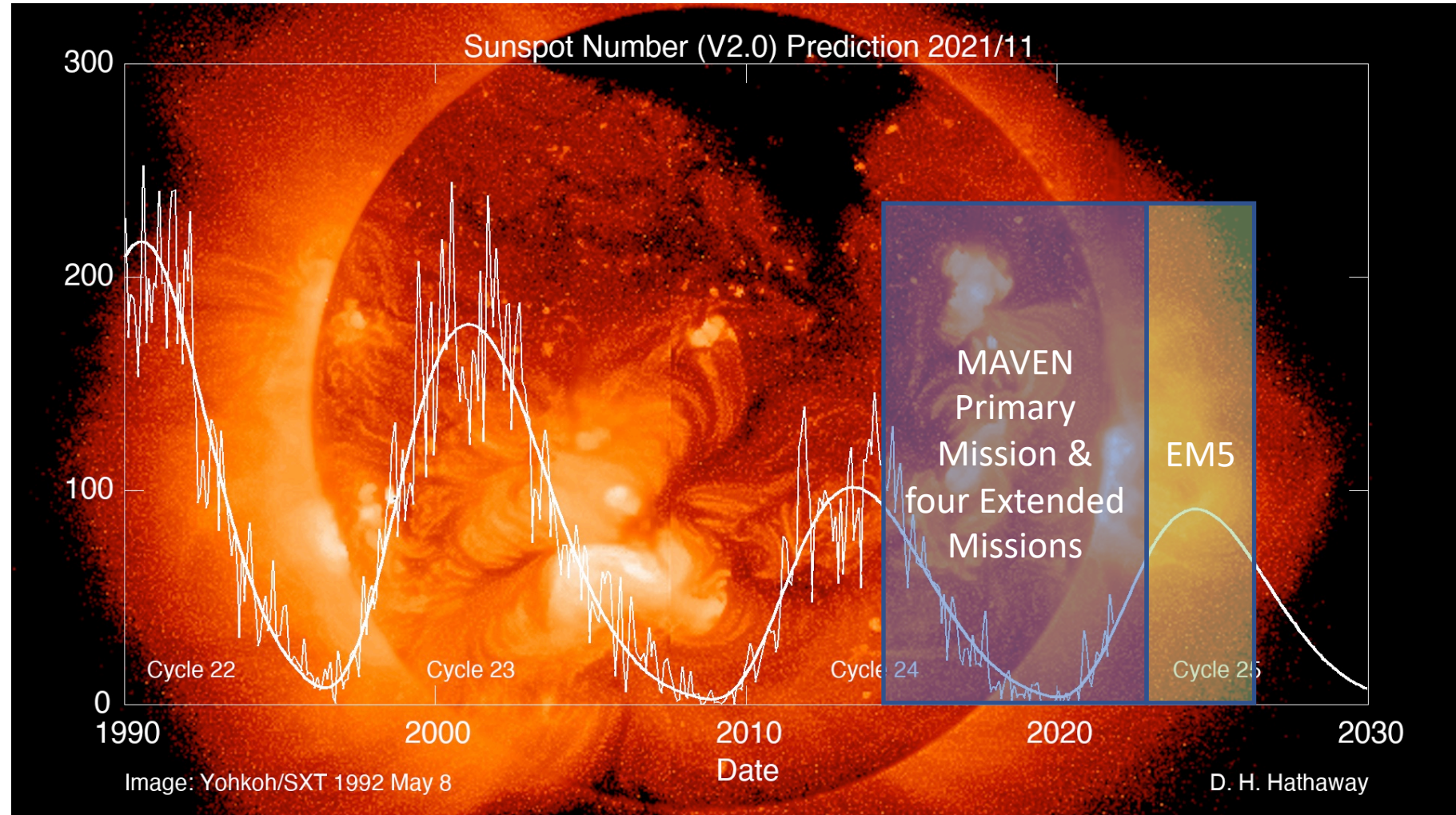


Credit:  
C. Lee &  
MAVEN Team



# MAVEN and the Solar Cycle

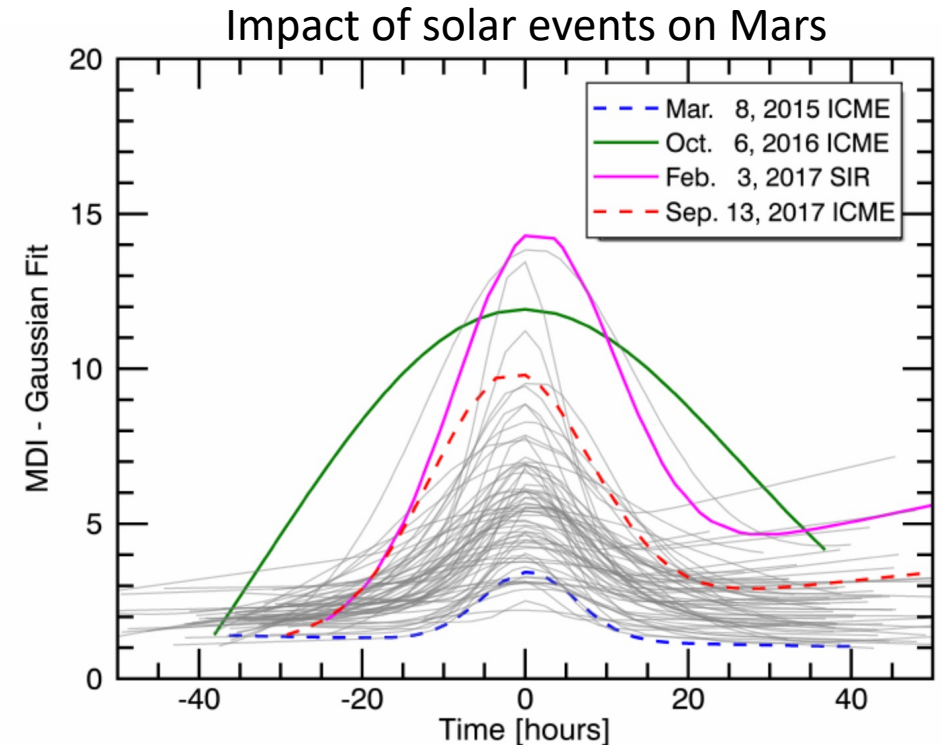
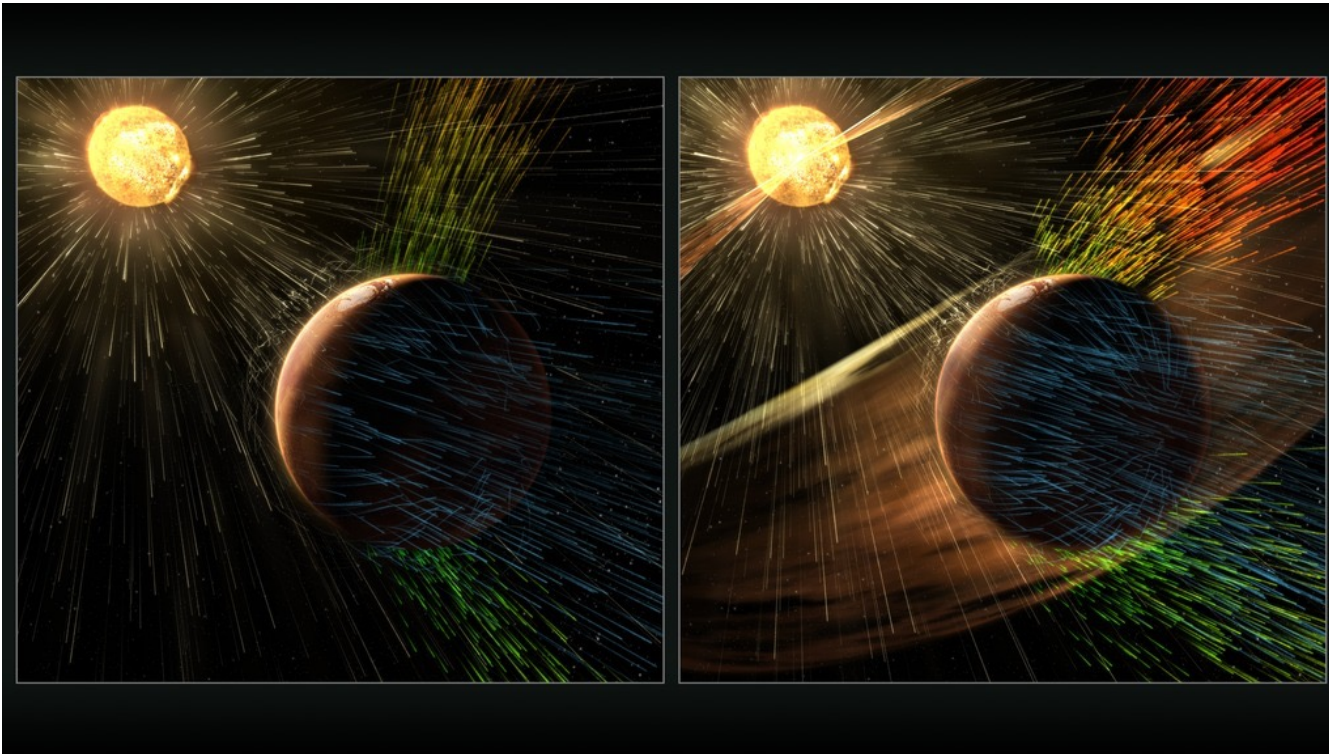
- MAVEN has been observing Mars since the decline of Solar Cycle 24
- Currently in Extended Mission 4 (EM4) and observing the start of Solar Cycle 25
- If approved, Extended Mission 5 (EM5) will take MAVEN through solar maximum





# Observing Solar Activity at Mars

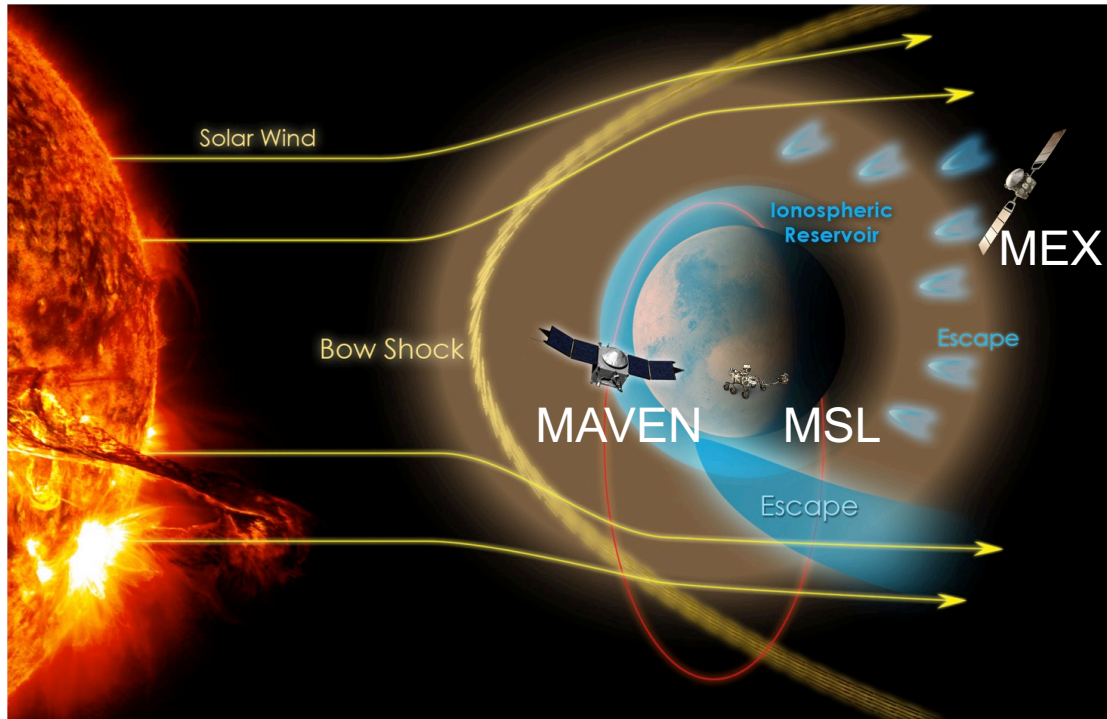
- MAVEN observes various solar events: both solar inputs and planetary response
- Magnetosphere Disturbance Index (MDI) was created to determine the impact of a solar event on the Martian magnetosphere
- The MAVEN team sends out Mars Space Weather Notifications to Mars community



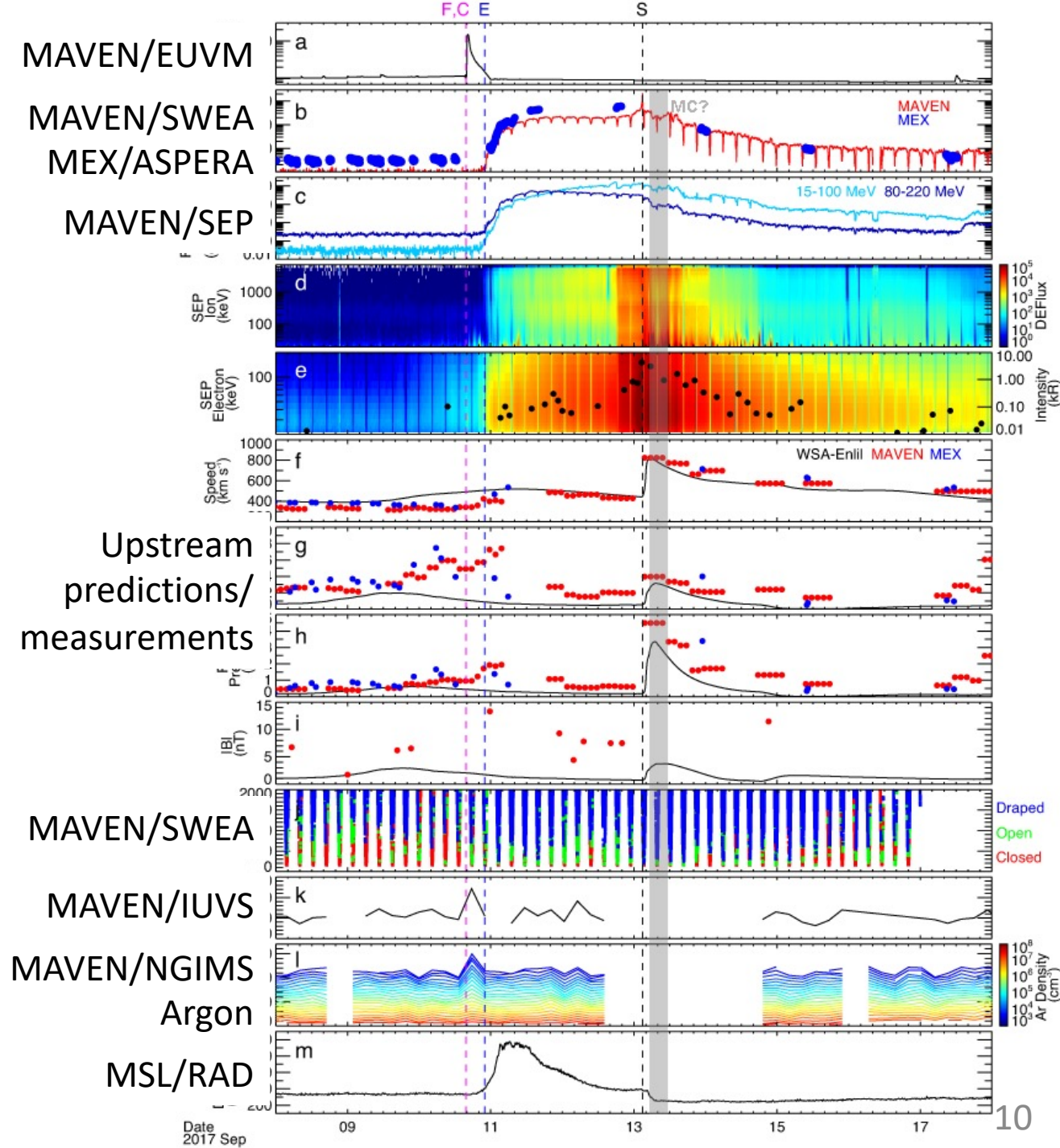
Gruesbeck et al. [2021]

# Solar Flares Directed Toward Mars

September 2017  
Solar Flare Event



Lee et al. [GRL, 2018]





## Currently:

- MAVEN has been informally collaborating with M2M/CCMC to analyze large events
- Recently created a formal MAVEN/M2M/CCMC collaboration
  - Established a working group with key personnel from each team and meet regularly

## Future:

- MAVEN observations will inform M2M/CCMC models and predictions for Mars
  - Validate arrival times (CMEs, SEPs, etc)
  - Confirm whether events have impacted Mars (past and future events)
- Teams will work together to create Mars scoreboards
- M2M/CCMC will provide a modeling resources for understanding MAVEN events
- Communication teams will work to report newsworthy events that MAVEN has observed





- SEPs at Mars around same time as X-class flare at Earth

