HSO - Data Driven Modeling

Case Study: *Enabling Technological Expansion*

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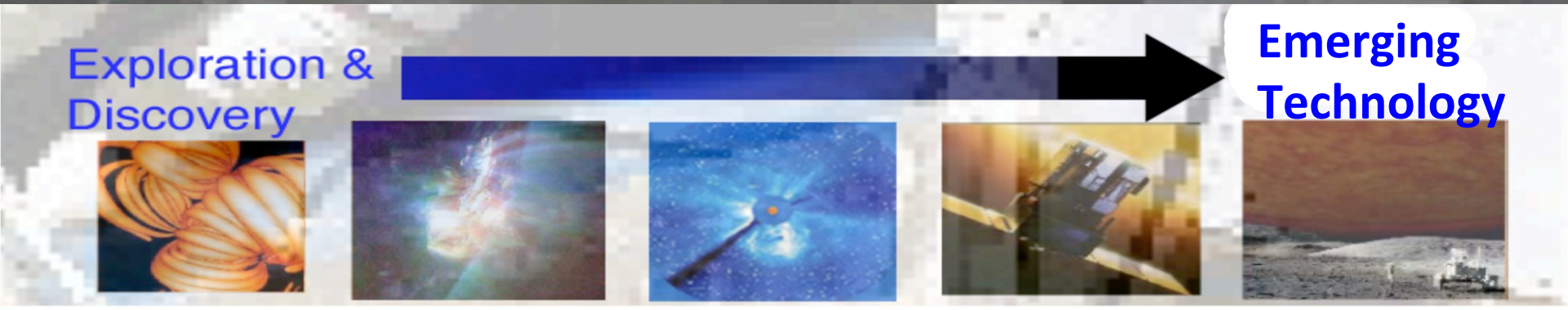
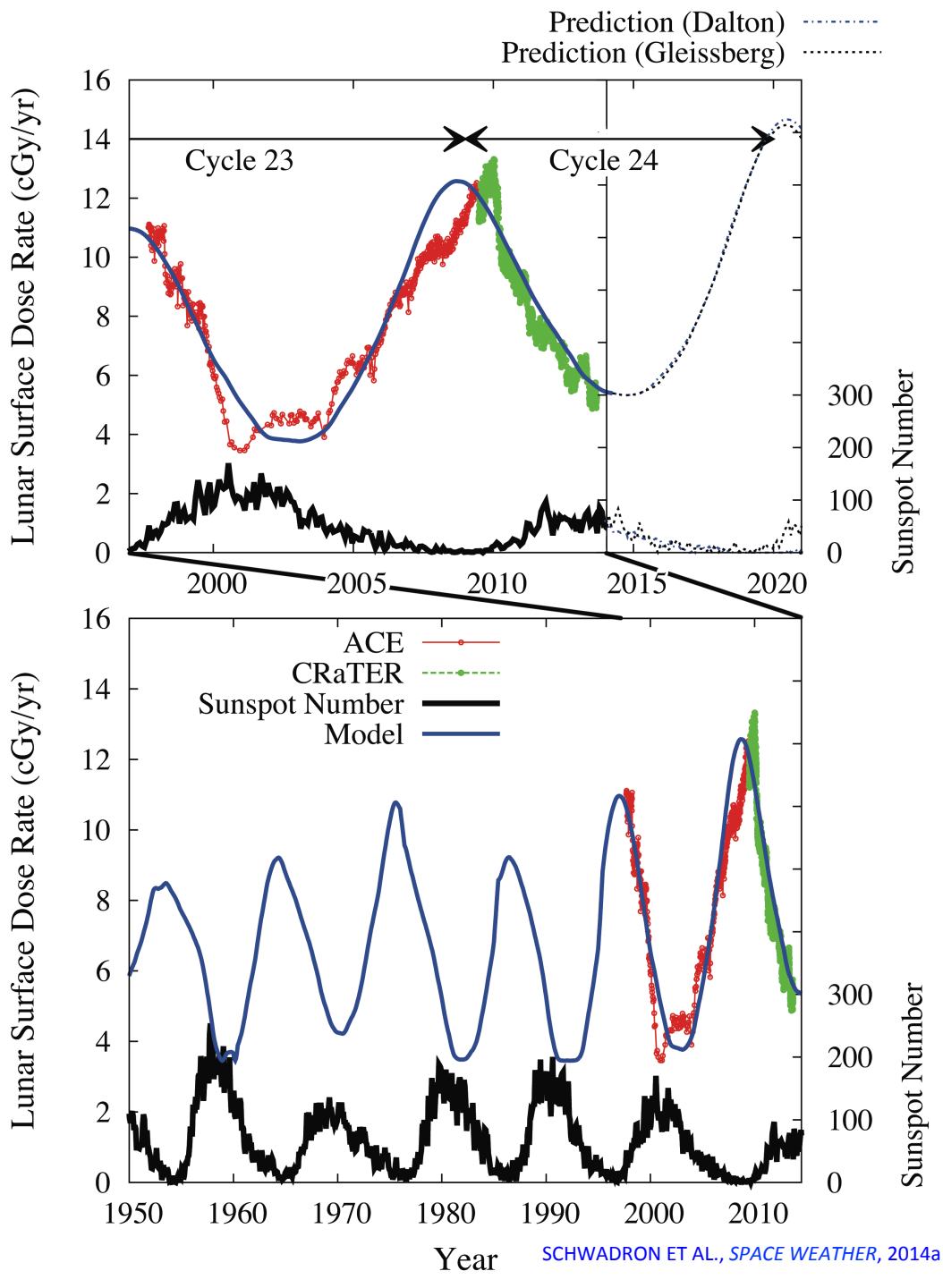
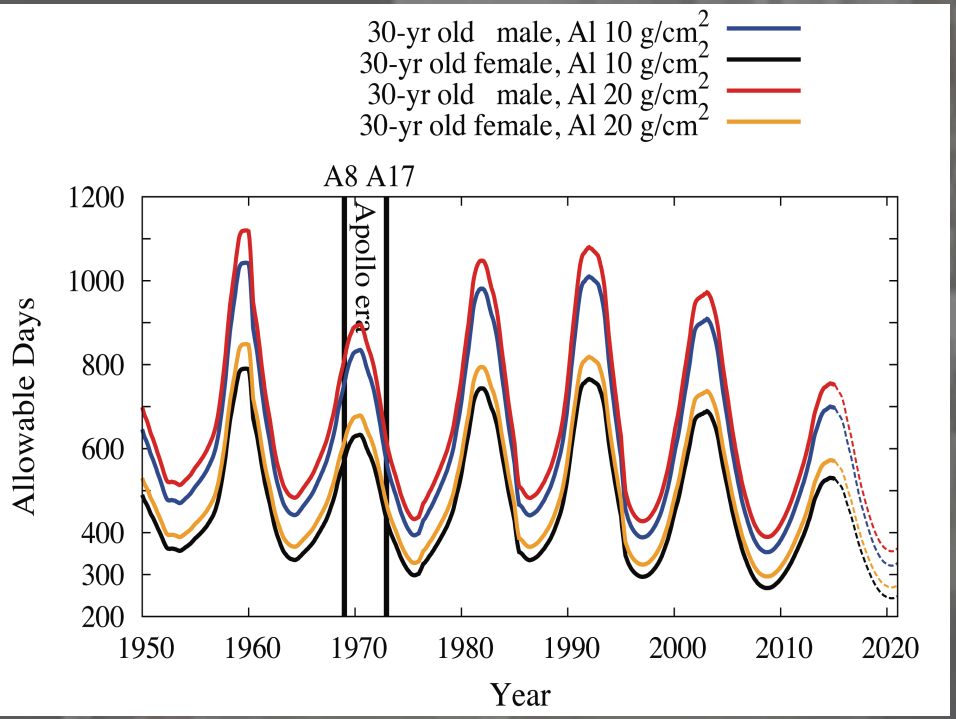
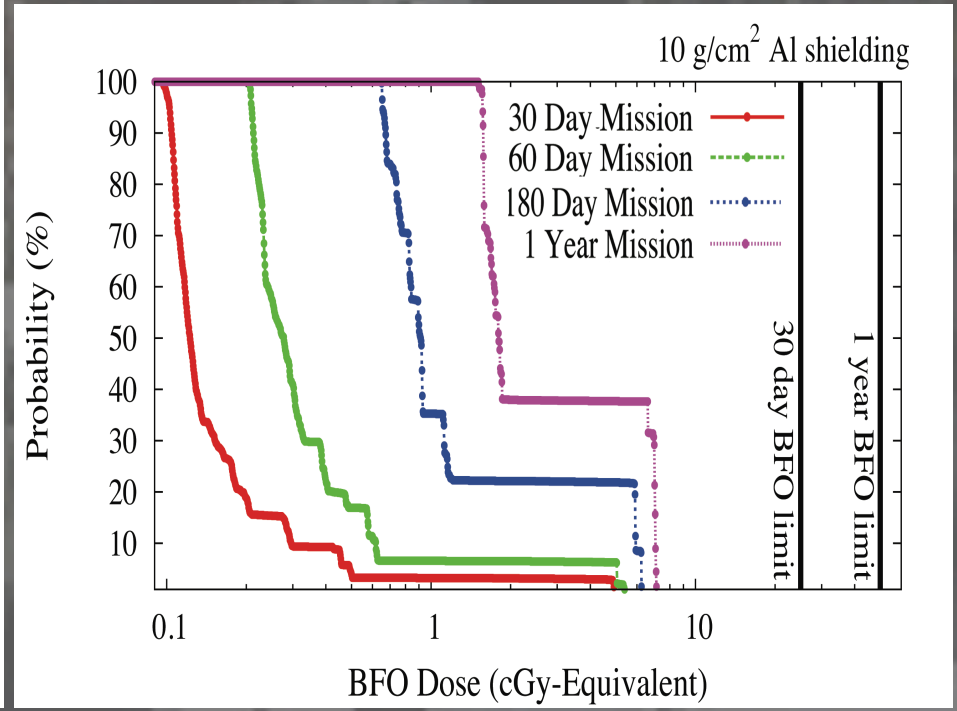




SCHWADRON ET AL., *SPACE WEATHER*, 2014a

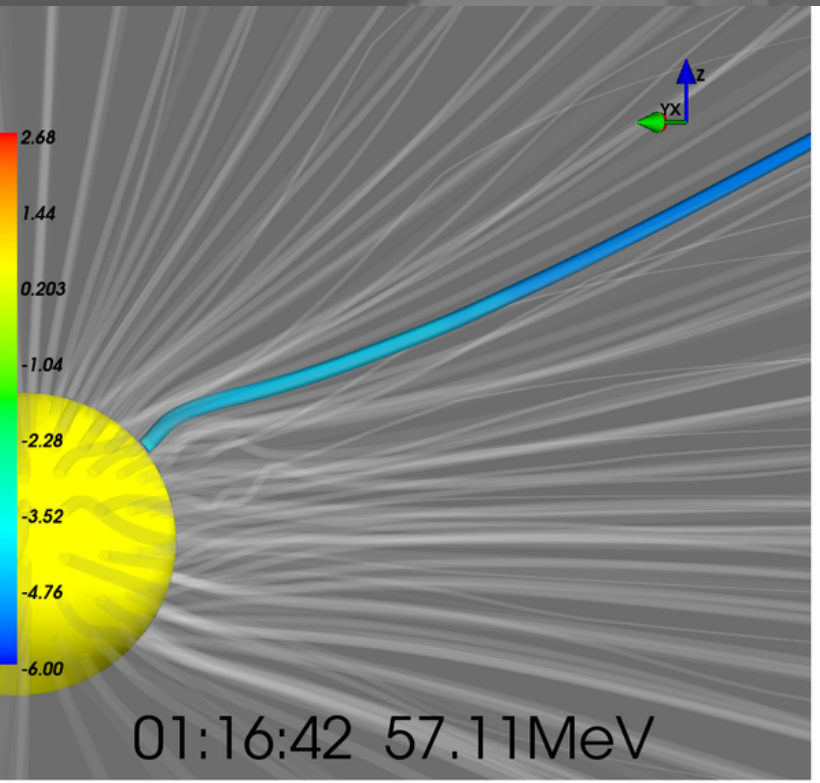
Changing Space Weather Environment

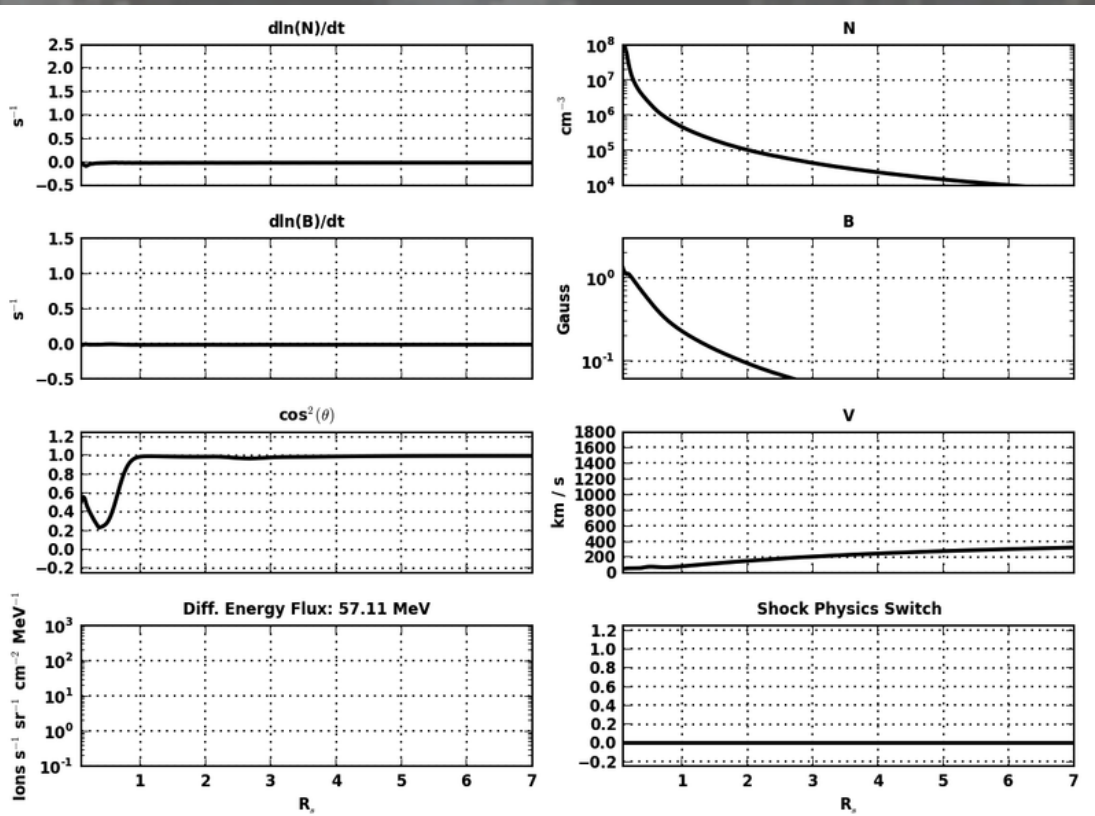




SCHWADRON ET AL., *SPACE WEATHER*, 2014a

Development of SEP Events

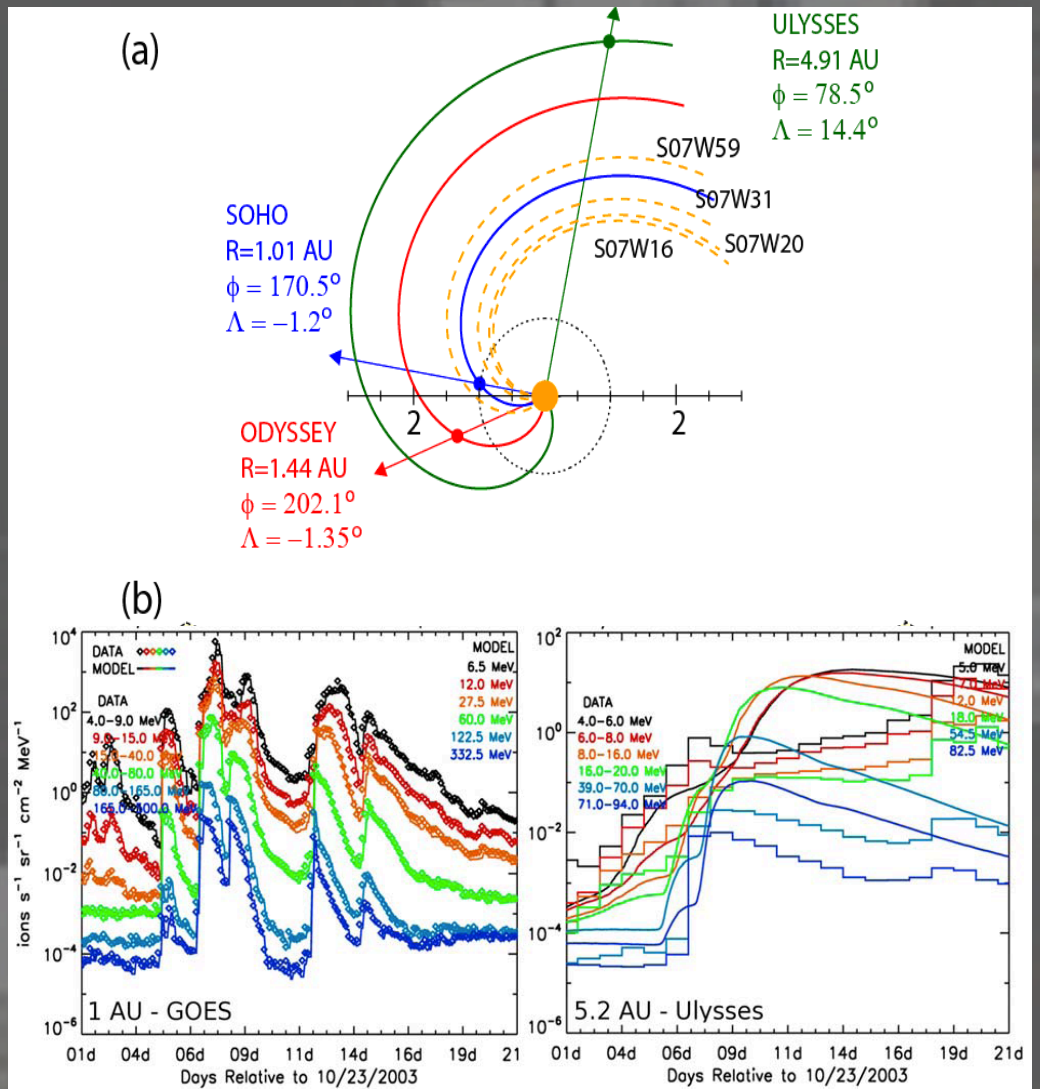


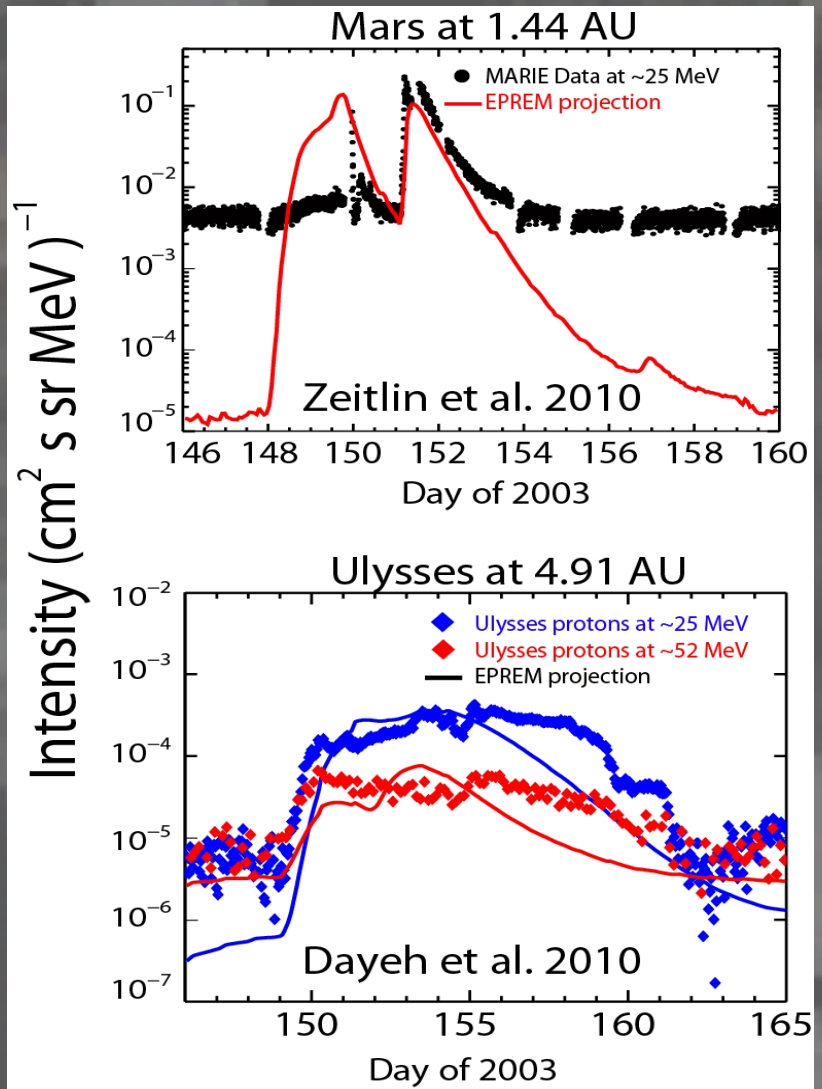


Gorby et al., In Work, 2014

Connecting Events Through the Heliosphere

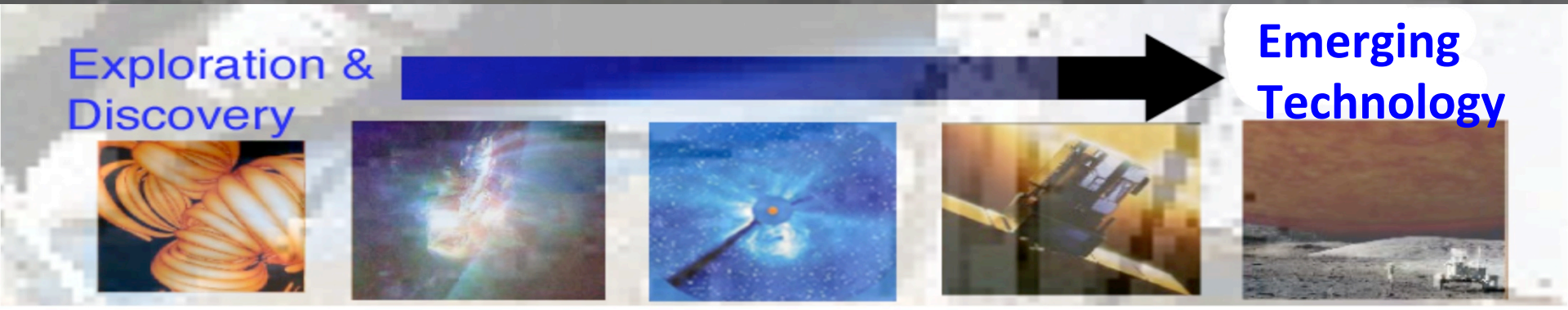
Power of Distributed Observers: *Broad Longitudinal extent of SEP events has proved very useful for predicting SEP spectra and radiation doses at different locations in the inner heliosphere. Figures below show two recent papers by which SEP time profiles, onset, and radiation estimates were successfully predicted at Mars (Odyssey) and Ulysses located at 1.44 AU and 4.91 AU, respectively. 1 AU measurement from ACE, SoHO, and GOES*

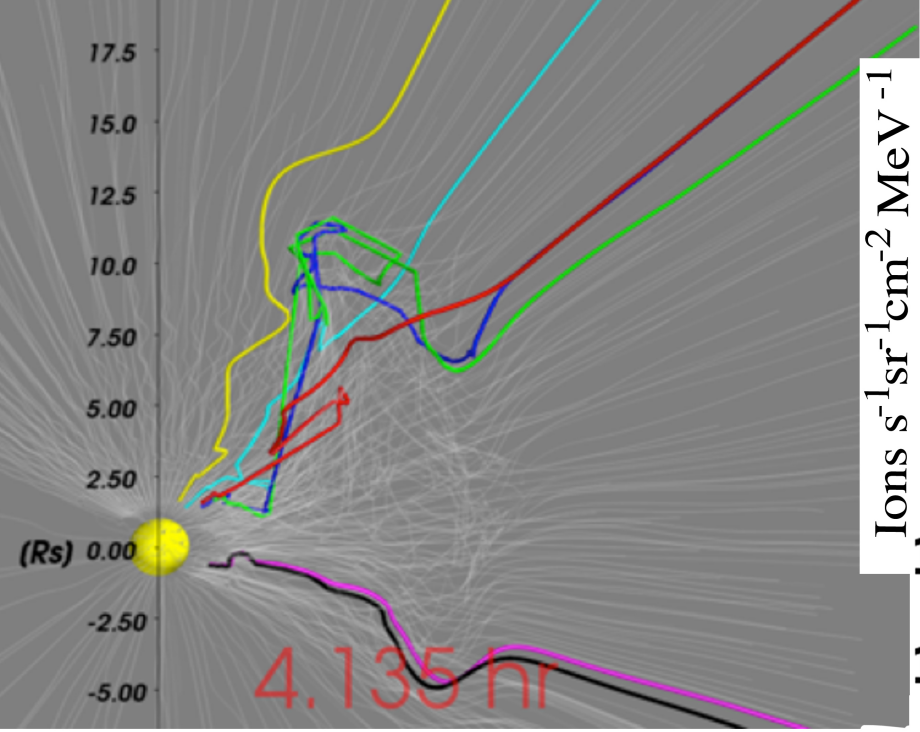


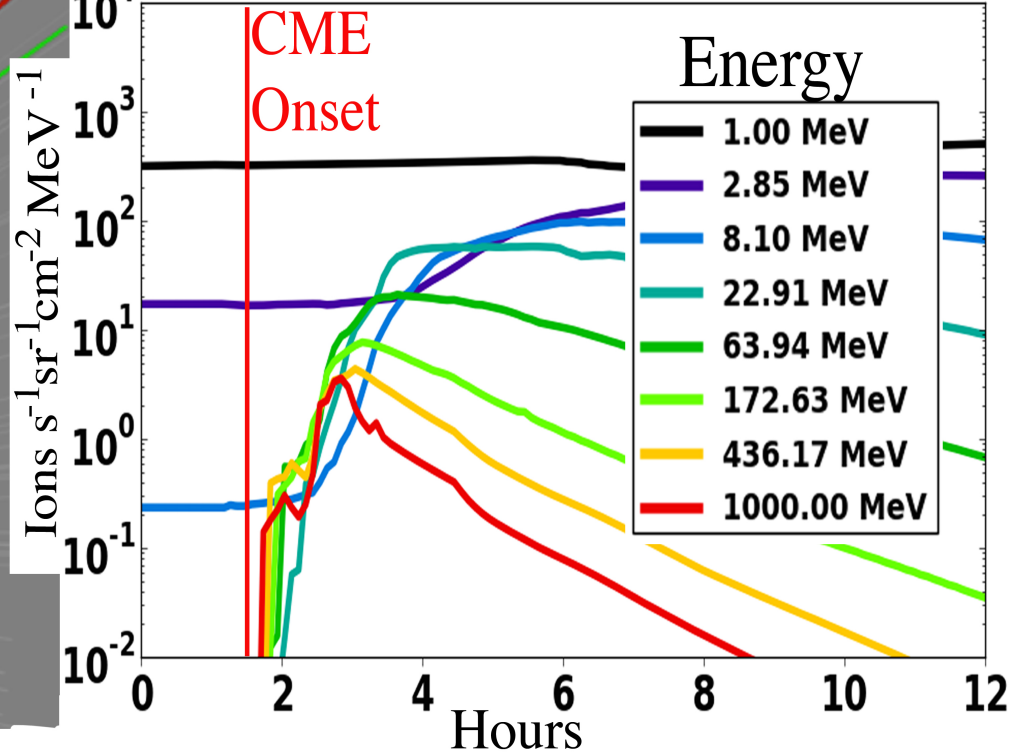


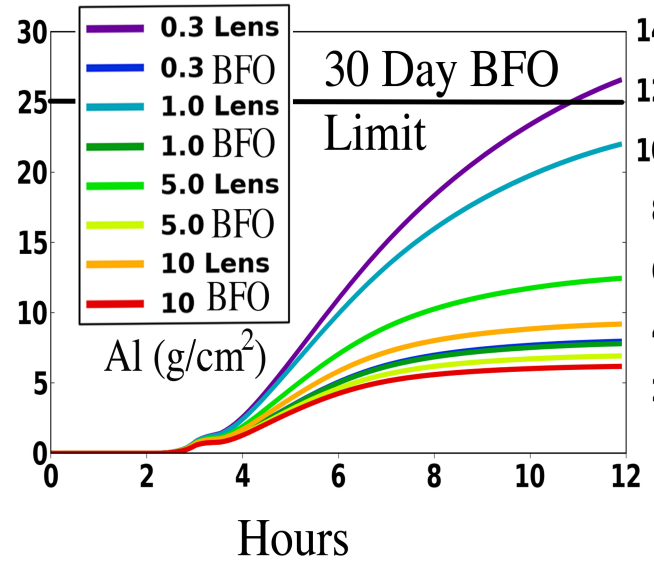
Expanded Role of HSO enabling Technological Expansion

- Deepest Solar Minimum and Weakest Maximum more than 80 years
  - Increased GCR radiation intensity in solar minima
  - Lower probability of SEP events → *Enabler* for launching missions near solar maxima
- Need Improved Understanding/Predictability of SEPs
  - Probability of Extreme Events
  - Resolve physics and predictability of extreme events
  - Statistical methods for forecasting based on existing systems (e.g., PREDICCS, http://prediccs.sr.unh.edu)
- Small missions involving longitudinally distributed observers
- New Mission Line focused on small missions and enabling technological expansion

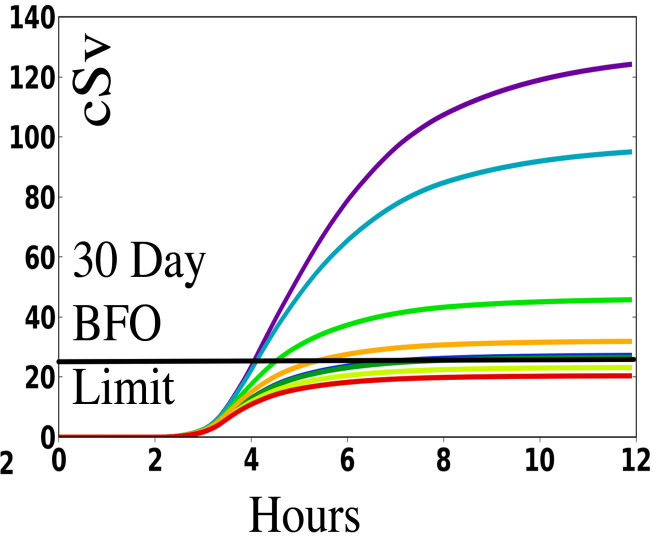




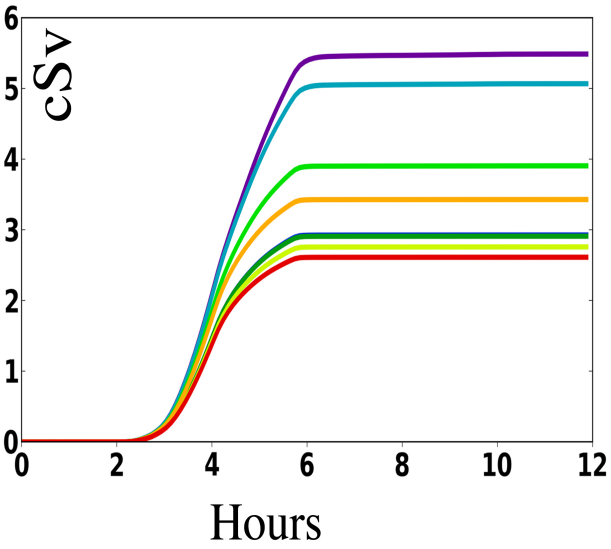




Observer retrograde 60°



Near Earth Observer



Observer Prograde 60°
Poor magnetic connection

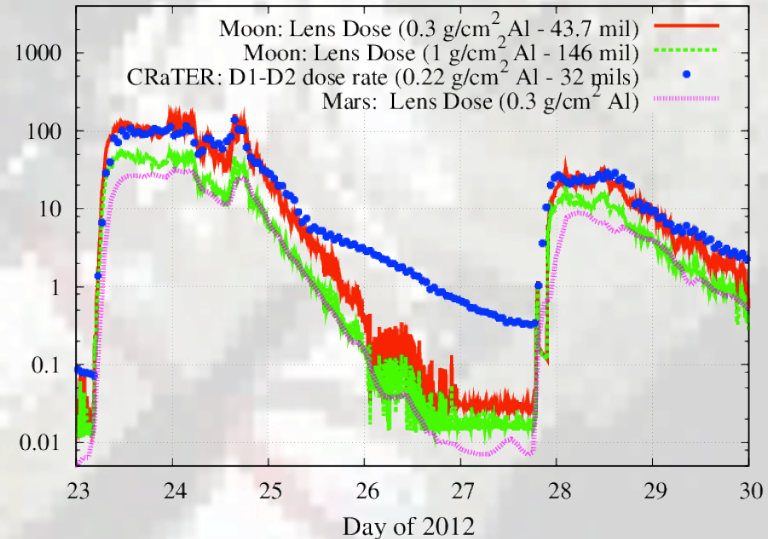
SCHWADRON ET AL., *SPACE WEATHER*, 2014b

SEP events with PREDICCS

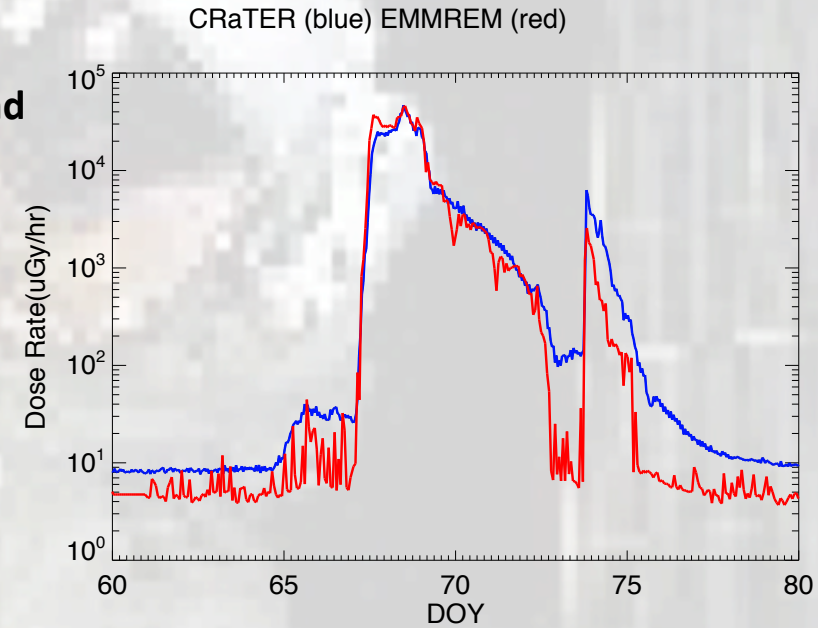
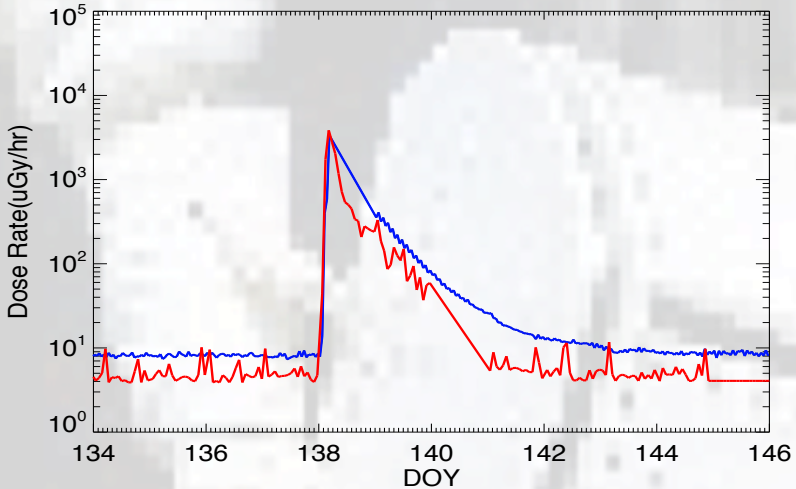
SEP Events During 2012: Indicators of Larger SEP Events in the New Cycle (24)

- **Shown here are the major SEP events of 2012 and the comparisons between CRaTER observations (blue) and prediccs predictions (red and green).**
- **Agreement reveals overall accuracy of models, while deviations likely reveal heavy ion contributions to dose observed by CRaTER**

Jan. 23rd, 2012 Event



Mar 7, 2012 Event



May 16, 2012 Event