

Summary for Session #19 SEP Modeling Challenge: Research to Operations

Organized by Katie Whitman and Ian Richardson

Thursday August 8, 2019

Session Focus and Discussion

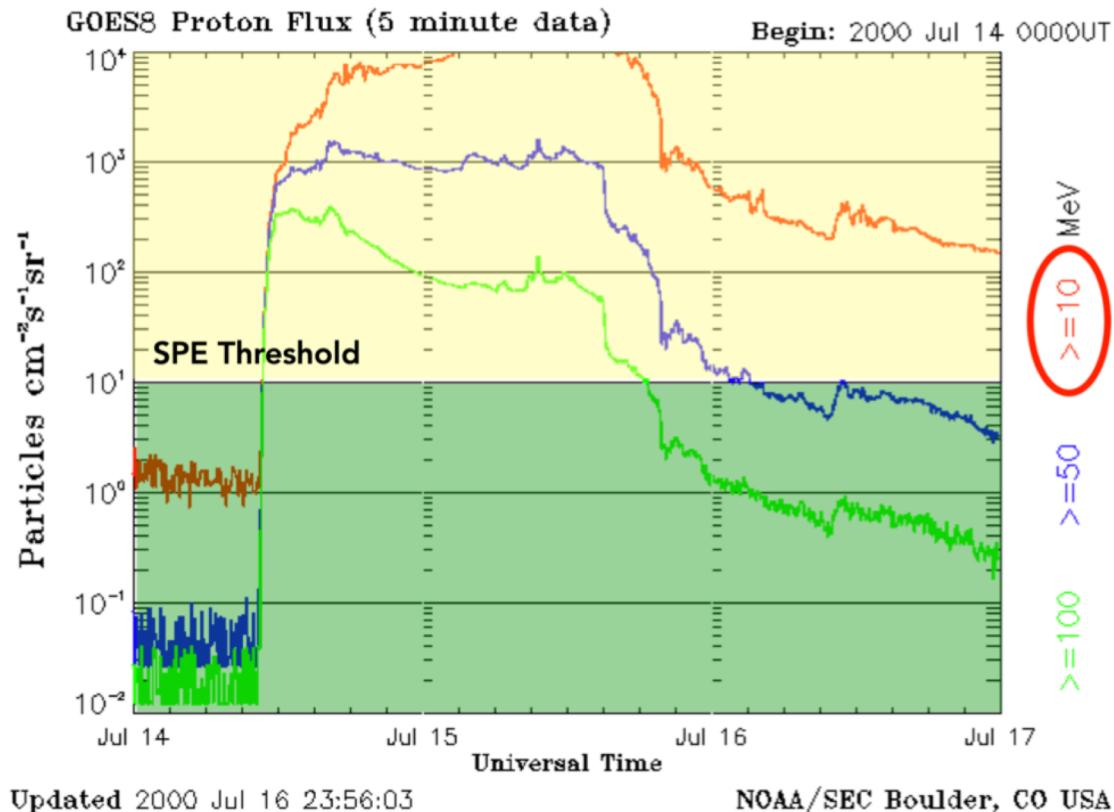
- *Brought together SEP modelers, observers, NASA space radiation operators, and NOAA space weather forecasters*
- Discussed:
 - What is needed from SEP models to support human space exploration? A variety of models desired to support operational needs.
 - Need for All Clear models to predict yes/no SEP event in next 24 hours.
 - Details around determining skill of forecasters and prediction efficiency. Exactly what do you count as hit or miss? How do you define an event?
 - No operational coronagraph with high cadence and low latency causes forecasters to “fly blind”. Can be 6+ hours after CME before data arrives.
 - Nearly all physics-based time profile models suffer from unknown seed population and solar wind models that start 20 Rsun from the solar corona.

Contributing Models and Speakers

Scene Setters: Phil Quinn (NASA JSC SRAG) and Hazel Bain (CU Boulder CIRES/NOAA SWPC)

Model	Author	Model Type
ENLIL+SEPMOD	Luhmann, Lee (Berkeley)	Physics-based: Time Profile
AFRL PPS and ADEPT	White, Kahler (AFRL)	Empirical: Onset, Peak Flux, Time profile
ENLIL+EPREM	Schwadron, Poduval (UNH)	Physics-based: Time Profile
STAT (MAS + EPREM)	Linker (PSI)	Physics-based: Time Profile
iPATH	Li (UAH)	Physics-based: Time Profile
SEPSTER	Richardson (U Maryland, GSFC)	Empirical: Peak Flux
UMASEP	Núñez (University of Malaga)	Empirical: Onset flux profile over 7 – 11 hours
ESPERTA	Laurenza (INAF)	Empirical: SEP Storm Class ($\geq S1, \geq S2$)
SEP Electron Transport	Du Toit Strauss (NWU)	Physics-based, Poster

Operational Thresholds and Actions for Crew Safety During EVAs

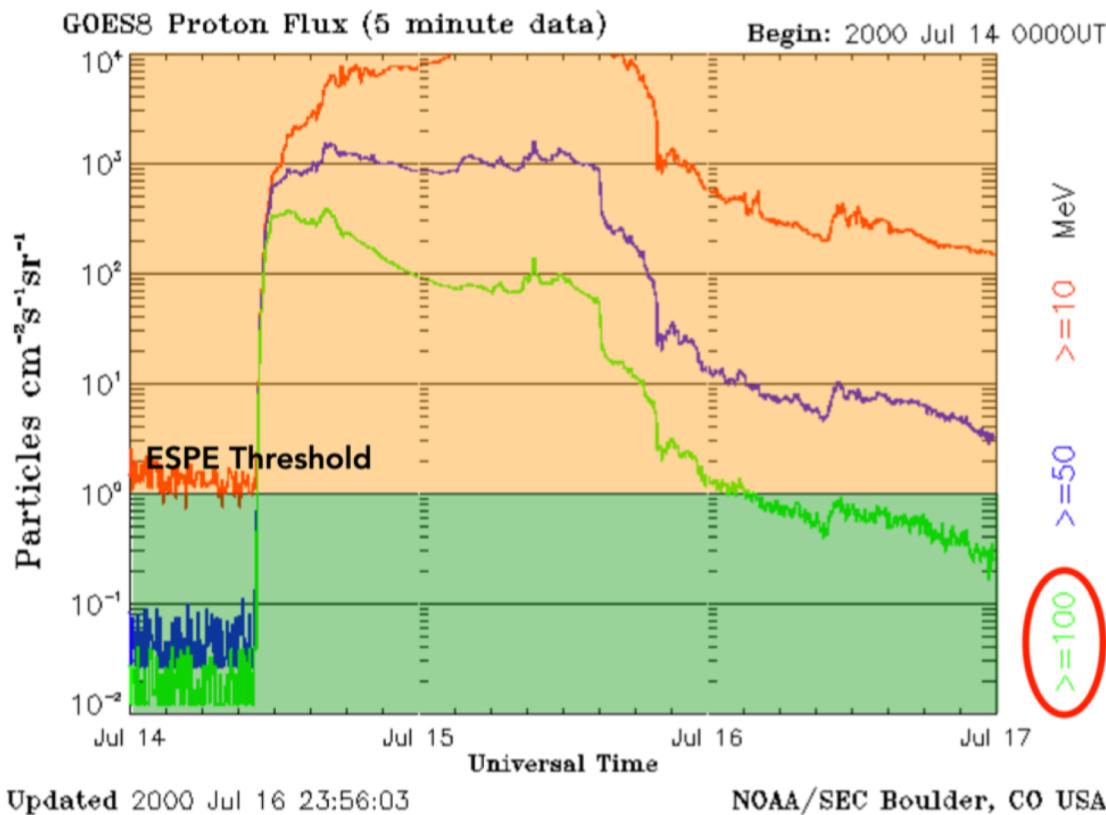


Solar Proton Event (SPE)

- Defined by GOES measurements when ≥ 10 MeV protons ≥ 10 pfu.
- Important during EVAs where crew is outside of spacecraft shielding.
- SRAG console operator predicts dose based on GOES proton flux and spacecraft location then gives a recommendation to Surgeon.

Condition	Upcoming EVA	EVA in Progress
Predicted Dose < Action Level	Delay up to 2 days	Continue but do not add tasks
Predicted Dose > Action Level	Delay up to 14 days	Continue and expedite tasks
Predicted Dose Rate > High Dose Rate Limits	Reschedule	Expedite by deleting tasks
Predicted Dose > Joint Exposure Limits	Reschedule	Terminate

Operational Thresholds and Actions for Crew Safety During IVAs



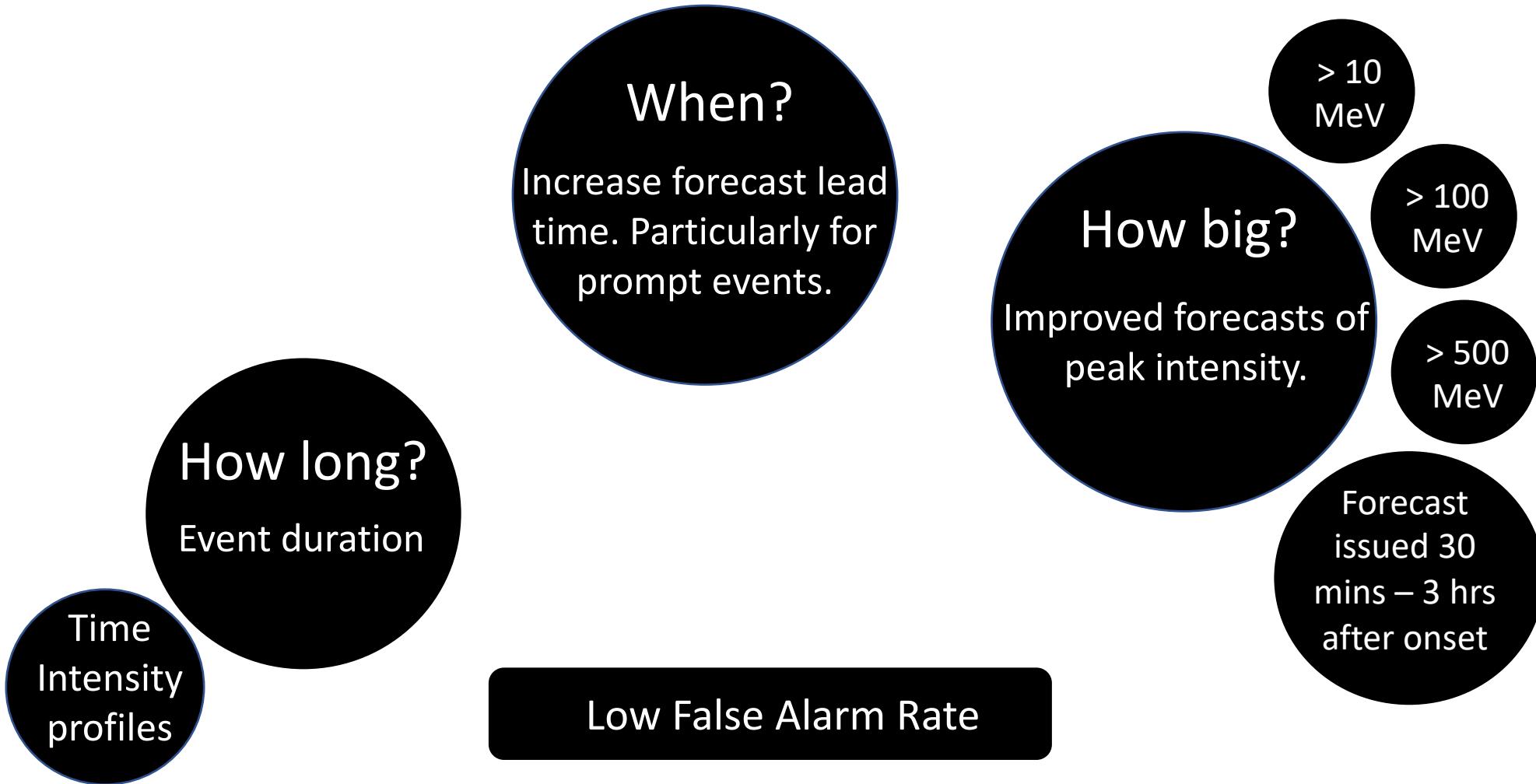
Energetic Solar Proton Event (ESPE)

- Defined by GOES measurements when $\geq 100 \text{ MeV}$ protons $\geq 1 \text{ pfu}$.
- Important during IVAs since higher energy protons can penetrate the lower shielded areas of the spacecraft.
- If threshold is crossed, SRAG console operator alerts the FCT.
- SRAG console operators remains on console for the entire event duration.

Condition	Action
$\geq 100 \text{ MeV}$ protons $\geq 1 \text{ pfu}$	Inform crew to avoid lower shielded areas
$\geq 100 \text{ MeV}$ protons $\geq 100 \text{ pfu}$	Inform crew to stay in higher shielded areas

Future SEP Forecasting Requirements

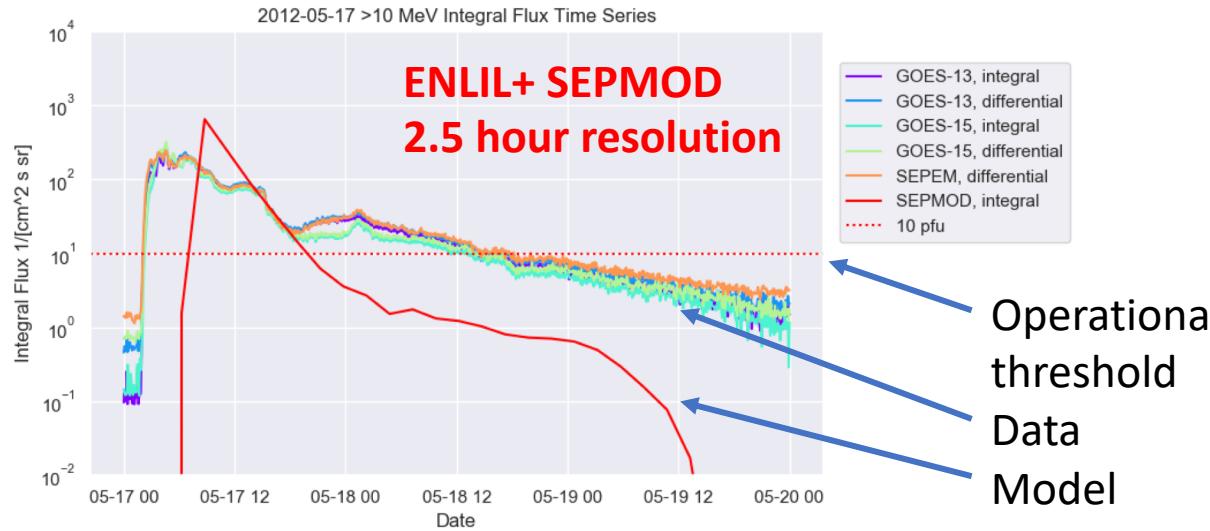
Courtesy: Hazel Bain (CU Boulder CIRES/ NOAA SWPC)



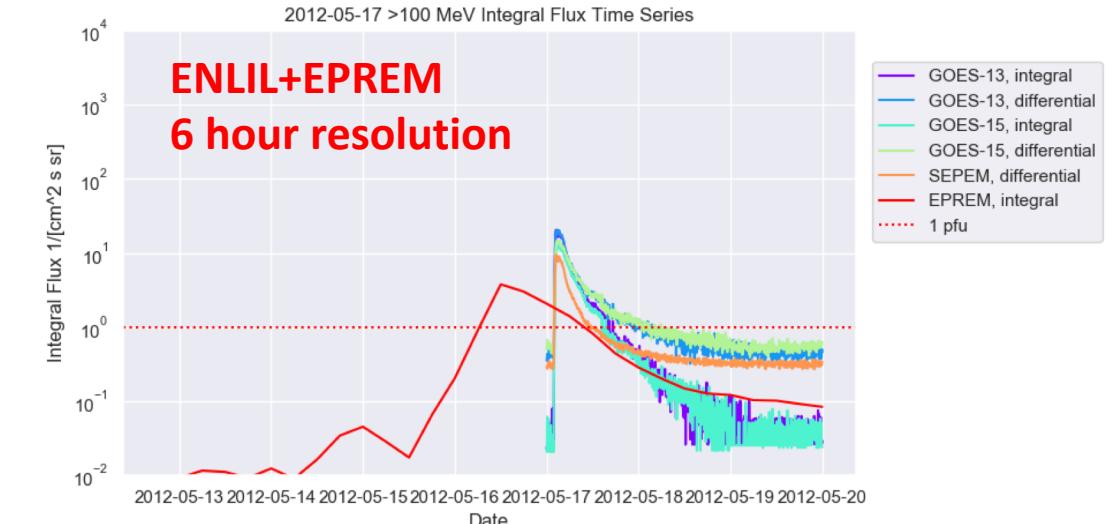
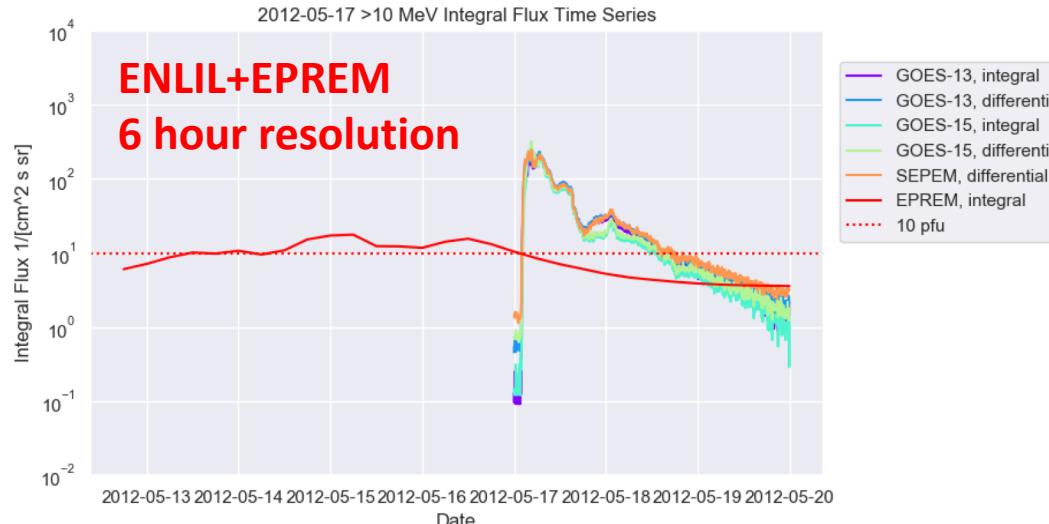
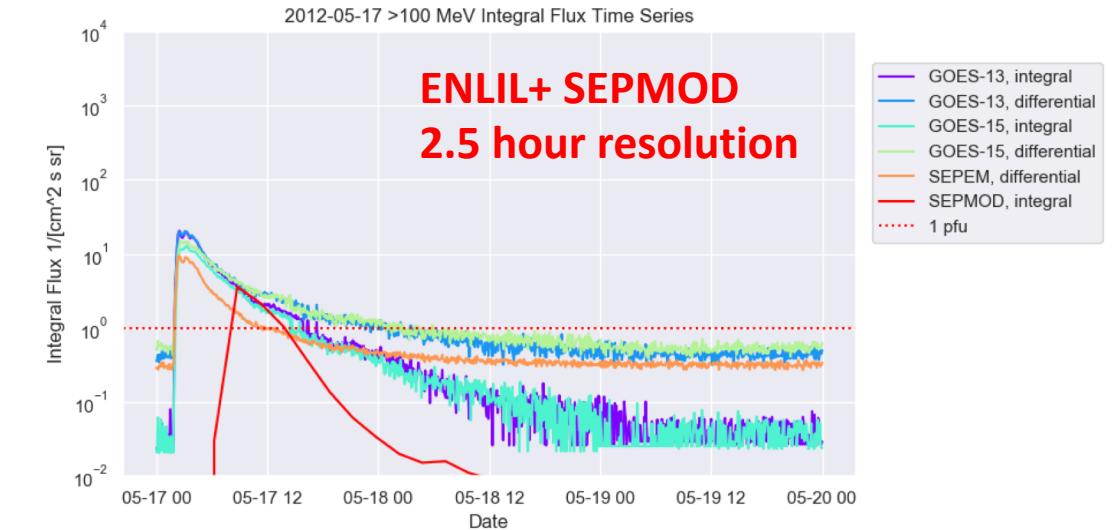
May 17, 2012 Predictions – Preliminary Results

SHINE 2019

>10 MeV Flux Profile



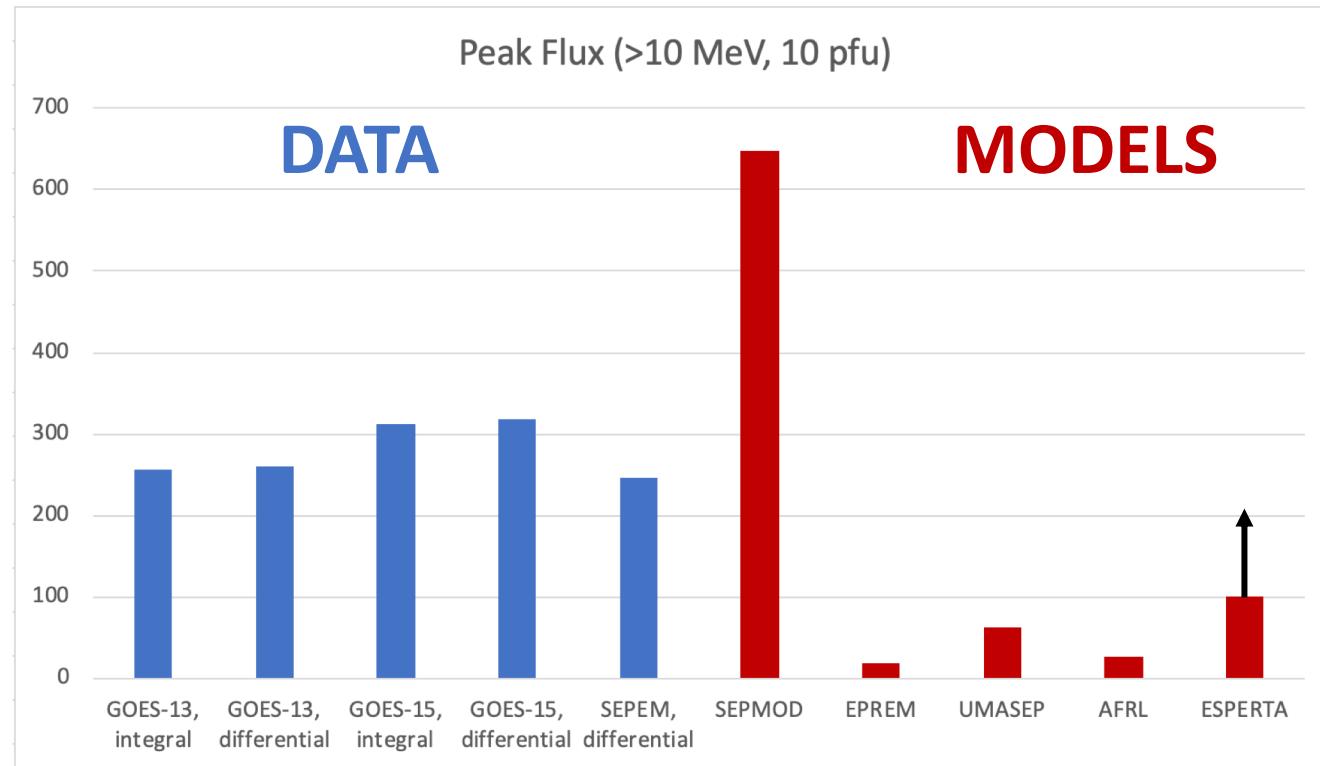
>100 MeV Flux Profile



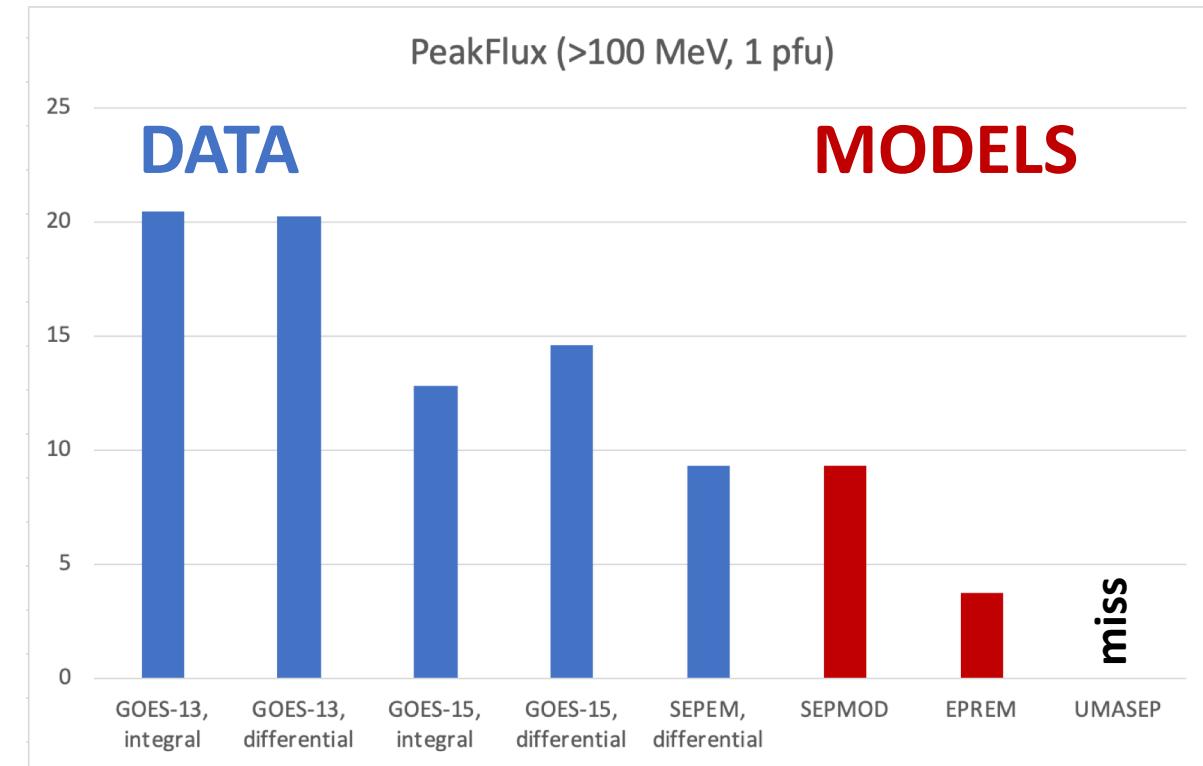
Peak Flux Data – Model Comparison

May 17, 2012

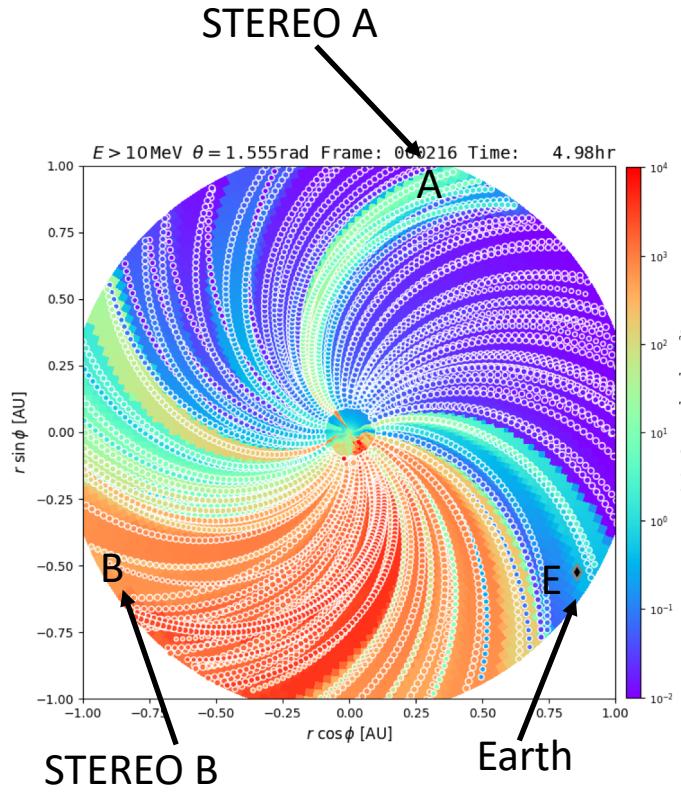
>10 MeV Peak Flux



>100 MeV Peak Flux



STAT March 7, 2012 Particle Simulation with Focused Transport



Session Discussion:
Have to do better than
choosing a single magnetic
field line.

