Topical Discussion Meeting report

Name of the meeting: Validation: SEP Working Team and Scoreboard
TDM webpage: http://www.stce.be/esww15/program/tdm.php?nr=2
Team webpage: https://ccmc.gsfc.nasa.gov/assessment/topics/helio-sep.php
Link to download TDM presentations: https://ccmc.gsfc.nasa.gov/assessment/topics/SEP/campaign.php
Conveners: M. Leila Mays (NASA GSFC), Mark Dierckxsens (BIRA-IASB), Mike Marsh (UK Met. Office), Ian Richardson (UMd/NASA GSFC)
Data – Time – Room: Monday 5/11, 17:15-18:30, 00.15 - Small lecture room
Nr of participants: 25 people

Objective of the TDM

There are now over 20 physics-based or empirical solar energetic particle (SEP) models developed by the community - but how well do these models predict SEP events throughout the heliosphere? In the literature, most physics-based models focus on event studies, while empirical models take a statistical approach to build and validate their models. The CCMC SEP Working Team was established with the goals to:

(1) Evaluate how well different models/techniques can predict historical SEP events throughout the heliosphere;

(2) Establish community metrics; and

(3) Provide a benchmark against which future models/model updates can be assessed.

Related to this working team, the SEP "Scoreboard" (https://ccmc.gsfc.nasa.gov/challenges/sep.php) was established to allow a consistent real-time comparison of various operational and research forecasts. The purpose of this TDM was to discuss the following:

- Status of the SEP Working Team and Scoreboard.
- Potential performance benchmarks for physics-based models in a systematic, controlled way and for longer time periods.
- How well do the models predict SEP events throughout the heliosphere and what are the challenges?
- Results from the session on two community campaign events held at the August 2018 SHINE meeting (Cocoa Beach, Florida, USA).

Modelers were invited to model (using a physics-based or empirical model) the two community campaign events and consider: How did your optimized run results differ from the initial run? What aspects of the event does your model capture well, and what aspects were more difficult to capture? What are the next steps for your modeling technique?

Community campaign events:

1) 10 September 2017 (GLE 72). Other optional SEP events in this period: Observed at Earth on 4, 6, 10 September; Observed at STEREO A on 4, 11, 18 September; Observed at Mars on 10 September.

2) 23 July 2017. Other optional SEP events in this period: Earth: Observed at Earth: 14 July; Observed at STEREO A on 23 July

Some discussion highlights

Discussion items from campaign result presentations:
FORSPEF (Presenter: Athanasios Papaioannou):
- Q: Is the CME position angle currently being used as part of prediction scheme. A: Not at present.
- Q: How will this model be developed? A: The ASPECS project (http://proteus.space.noa.gr/~aspecs/) will predict the SEP profile by combining the SOLPENCO model with the Keller [Should this be Cliver?] & Ling model presented in a poster at the meeting.

COMSEP SEPForecast (Presenter: Mark Dierckxsens):
- Q: Is the flare location used in the forecast? A: The forecast probability depends on the location of the flare and width of the CME (if available), but not the prediction of the peak particle flux.

ESPERTA (Presenter: Monica Laurenza):
- Q: Do you have access to real-time radio data from Wind/WAVES? A: Unfortunately this essential data is not available in real time.

SEPSTER (Presenter: Ian Richardson):
- Q: The model relies on receiving timely coronagraph CME images to estimate the CME speed and direction. Will coronagraph observations from L5 help with your model? A: Yes, they should help to obtain improved CME parameters provided that the observations are made available with minimal delay..
- Q: The model doesn't cover the higher energies currently (since it is derived from 14-24 MeV proton observations at the STEREO and near-Earth spacecraft). Are there plans to extend this? A: Yes, either by using typical spectra or ratios between other energy ranges and 14-24 MeV to translate the predictions to another energy range, or use the STEREO/near-Earth observations to derive the CME speed/direction/SEP intensity relationship for other energy ranges. PAMELA observations of SEPs (Bruno et al., 2018 https://doi.org/10.3847/1538-4357/aacc26) also may be used to obtain this relationship at higher energies.

HESPERIA REleASE (Presenter Olga Malandraki):
- Q: Will the availability of the real-time ACE/EPAM data improve? A: For the moment the situation will remain the same, i.e. real-time data will be available but there will be significant data gaps.

Sep 2017 event discussion:
- Q: Is there a big difference between real-time CME parameters and those derived low in the corona? The 10 September CME near the Sun was around 4300 km/s. A: Yes, CME parameters derived in real-time at CCMC for ENLIL simulations are derived at a height of 10-15 Rs and extrapolated to 21.5 Rs. The real-time parameters will be different than those obtained using level 2 science quality data and retrospective interpretation (e.g., the CDAW catalog). They also depend on the number of coronagraph view points available and their separation, the measurement technique used, and the skill of the person making the measurements. In this case, the speed ranges for the real-time and later derived parameters for this height were similar.

- Q: Are there any probabilistic SEP forecasts for quantities other than the probability that there will be a SEP within a certain time frame? A: No, not that we are aware of.

- Q: What about using new validation methods for SEP forecasts such as the skill score developed by Morley? A: Leila Mays has started looking into Morley's score for the SEPSTER model and found some issues (for example, it was developed for the radiation belts vs. SEP events [correct?]), but it should be investigated further.

- Comment: It was suggested that the parameters needed from each model should be defined and metrics agreed on.

Main conclusion of the meeting

- Excellent response from European modelers to the community campaign effort, complementing the similar response to the SHINE session in the US. Nearly all the current models were represented between the two sessions. All models presented during this TDM submitted results, and the SOLPENCO model will submit results soon.
- Plan to draft a manuscript on campaign study results with modellers that agree to participate.
- Several important measurements for SEP forecasting are only available with a delay (SOHO/LASCO), with significant gaps (ACE/EPAM) or not available in real-time at all (Wind/WAVES).
- Next steps: Move beyond case studies; Define a validation time period and agree on metrics and quantities required from each model.

Annexes:

Leila Mays presented the status of the SEP scoreboard, and briefly summarized the SEP working team campaign started at SHINE and continued at this session.

This was followed by brief presentations by several models on the campaign event results and related discussion:

> Athanasios Papaioannou - FORSPEF
> Mark Dierckxsens - COMESEP SEPForecast
> Monica Laurenza - ESPERTA
> Ian Richardson - SEPSTER
> Olga Malandraki - HESPERIA REleASE

- \+   Audience members