Topical Discussion Meeting report

Name of the meeting: Advance Predictions of Solar Wind Conditions at L1: Quantifying Performance

Conveners: M. Leila Mays (NASA GSFC); Christine Verbeke (KU Leuven); Matthew J West (ROB); Barbara Thompson (NASA GSFC); Christian Moestl (Space Research Centre Graz); Neel Savani (UMBC/NASA GSFC)

Date – Time – Room: Tuesday 28/11, 17:15 - 18:30, Ridderzaal

Nr of participants: 30-40

Objective of the TDM

Discussion. How successfully can various models or techniques predict solar wind conditions at L1? In what aspects do the models perform well, and where do the models need improvement?

Some discussion highlights

(see detailed notes in the annexes below)

- Background solar wind validation is important and we need to investigate how to quantify the effect of errors in the background solar wind model on the CME arrival time prediction in models. How do we know if the CME arrival time error is from the background solar wind error, or from CME inputs, or model limitations? There was a suggestion to do a model-based idealized iterative parametric study by adjusting model ambient parameters. Another idea was to build up statistics of isolated CME event arrival times in which there is a variety of good and bad background solar wind predictions.
- Can a universal CME ID be created similar to flares? This could be a combination of the instrument, time, height, and position angle. But what about ambiguous events, do we agree that there is a CME or multiple CMEs in an image?
- Lively discussions about CME inputs. CME arrival team needs inputs that are not all available in one catalog. 3D CME kinematics team proposes a way to link CMEs from multiple catalogs together and provide more context about the parameters derived. Fit images would be appreciated. Need community involvement for providing data and linkages. CME parameters are themselves a technique and should have their metadata defined. Which data model to use? VOEvent or SPASE? What metadata is needed? Decide as a community.

Main conclusion of the meeting

- **Three working teams (3D CME Kinematics, CME arrival time, IMF Bz at L1) from the International Forum for SW Capabilities Assessment will be lead the Topical Discussion Meeting.**
- **To stay informed or get involved with these activities you may join mailing lists by contacting the team leads (https://ccmc.gsfc.nasa.gov/assessment/communications.php)**
- **There were some good ideas on how to quantify the effect of the background wind on arrival time, this needs to be investigated.**

- CME arrival time validation: It is hard to extract all CME inputs needed for validation from catalogs and so we need to obtain at least some of these from the 3D CME kinematics team as a solution.
- There is wide support for 3D CME kinematics team to lead the community metadata definition and data model for CME measurement techniques. A standard metadata definition and data model will allow consistent use, interaction, and linking between different catalogs/databases.

- Investigate a universal CME ID similar to flares.

Annexes

Meeting website with presentation materials:
https://ccmc.gsfc.nasa.gov/assessment/topics/CME/esww14/esww14_wm.php

Meeting agenda:
17:15—17:20: Introduction (5 minutes) (Leila Mays)
17:20—17:35: Each team will present a very brief summary (~5 minutes/topic)

- **CME Arrival Time and Impact Working Team (Christine Verbeke)**
- **3D CME Kinematics and Topology Working Team (Barbara Thompson)**
- **IMF Bz at L1 (Matt West on behalf of Neel Savani)**

17:35—18:30: Open for discussion on each topic (~20 minutes/topic)

Detailed Discussion notes:
- For predicted vs observed (or reverse) scatter plots do not only show the correlation coefficient which shows the scatter, but also the slope of the linear field to get the trend.
- For scientific validation, interested in comparing many quantities (e.g. peak vs mean ICME speed)
- Make sure methods are clear if they can predict the peak or mean speed and be consistent about the comparison with observations.
- For arrival time we have decided on clear ICME shock arrivals (not MC arrival). Use catalogs (see CME team report)
- For model arrival time, how we determine this? Most are fine with a fixed algorithm for different model types. A suggestion for MHD models is to subtract the ambient model. Another suggestion is a threshold crossing of the derivative of a parameter. For other methods, how to standardize?
- What about the effect of the background wind? Much discussion on this. Leila showed two examples (see slides)
    - No clear study on how to quantify this
    - compare with ACE and adjust model parameters? Feedback loop?
    - new project looking into how background solar wind influence arrival beginning by validating the background wind model.
    - what model parameters to change to better match?
    - choose isolated events with good and bad background predictions for this comparison?
    - take a theoretical approach with a model? A few case studies have been done, but no statistics
    - magnetograms themselves have issues and disagreement with eachother and should themselves be considered a model. For the purposes of the CME arrival team everyone will use the same magnetogram.
- DBM predictions for Mars were better than ENLIL because they were launched from the Earth

- Some models require uncertainties to predict the arrival of CMEs. It may be prefered to provide this for all events. This would be in good agreement of what the CME 3D kinematics team has in mind to proceed.

- There will be 100 events for the CME arrival team. About 10-15 events from 2010-2011 were released. Manuela has identified issues with 1-2 events, this needs correction, but also highlights the issues of extracting information from multiple catalogs, each themselves not containing the full information for each event.
- There are also 33 additional events as part of the SWPC-CCMC validation project using real-time SWPC CME parameters that the community can also test their methods against. Magnetograms (GONG) and WSA files will be provided for those interested in running their models in parallel with the SWPC-CCMC validation project. https://ccmc.gsfc.nasa.gov/annex/

- CME inputs: lively discussion on this.
    - Each model needs different inputs. Provide as much as possible? Or leave for modelers to come up with in between technique (applied the same across all events) to extract what they need?
    - There are many places to get CME information: HELCATS, Aneminos, CDAW, DONKI, ISEST wiki.. what if we could link all of these together so it is clear which CMEs are the same? (see slides)
    - There is wide support for 3D CME kinematics team to lead the metadata definition and data model for CME measurement techniques. A standard metadata definition and data model can be consistently used by many different catalogs/databases.
    - Needs community involvement for providing data and linkages, too big a project for one person. Multiple community portals could serve this purpose, which to start with? Services should be linked and able to retrieve/show information from other services/catalogs.
    - CME parameters are themselves a technique and should have their metadata defined as they are part of the chain of modeling. It is needed to make careful notes on what a scientist/forecaster has measured in observations to extract the CME parameters, to remove any ambiguity in the future. This can give us insight in what people measure and how this relates to the large spread in measurements that we currently have.
    - HEK has thought these through but does not have all the needed metadata defined for CMEs. They use the VOEvent data model
    - Which data model to use? VOEvent or SPASE?
    - What metadata is needed? Images showing the fit technique will help users understand what was measured.
    - Can a universal CME ID be created similar to flares? This could be a combination of the instrument, time, height, and position angle.
    - How to deal with ambiguous CME events, e.g. disagreement between observers on if there are 1 or 2 CMEs in an image? Can you comment/like/dislike in the database?
    - Start with a small set of unambiguous events.

- Briefly went over IMF Bz validation ideas to use ROC curves, contact the team leads for more information