Topical Discussion Meeting report

A Topical Discussion Meeting aims at active participation or interaction between the participants. The participants work and discuss on a predefined theme or problem heading towards an outcome or target. A working meeting is a 1h 15min informal afternoon meeting with NO abstract submission form and therefore NO poster contributions.

Name of the meeting: **t06 - Improving our Sun-to-Belts nowcasting and forecasting capabilities**

Conveners:
Ioannis A. Daglis (IAD), Department of Physics, National and Kapodistrian University of Athens
Stefaan Poedts (SP), Department of Mathematics, KU Leuven
Yuri Sphrits (YS), GFZ, Potsdam

Richard Mace (RM), virtual-facing co-chair, Met Office
TDM Secretary: Afroditi Nasi, Department of Physics, National and Kapodistrian University of Athens.

Date – Time – Room: October 26, 11:15, Conference Room 6/7

TDM type: 3. Service/Project Feedback

Number of participants: 15 on site / 45 online at the same time

Objective of the TDM

There is a recognized need for accurate nowcasting and forecasting of the Van Allen radiation belts, as they are a space hazard posing significant risks for spacecraft. The three space weather projects selected for funding in 2019 by the European Commission (EUHFORIA 2.0, PAGER and SafeSpace) deal with all aspects of solar disturbance identification, the propagation of the resulting interplanetary disturbances to geospace and with the effects of these disturbances on the Van Allen belts, but also on other parts of geospace. The presentations on the concept, objectives, achievements and challenges of three EC projects, focusing on different aspects of the Sun-to-Belts chain, will be followed by active interaction with the participants.

Some discussion highlights

The highlights of the discussion were related to strengths and shortcomings of the three project approaches presented during the TDM.

Main conclusion of the meeting

The various space weather forecasting efforts presented and discussed at this meeting have achieved significant progress, but still face a number of critical issues. Coupling and cross-checking their results will benefit all of them.

Annexes

Minutes of meeting

Active participants, mentioned hereafter:

EH	Edmund Henley
IAD	Ioannis A. Daglis
PJ	Piers Jiggens
POB	Paul O'Brien
PQ	Phil Quinn
SP	Stefaan Poedts
YS	Yuri Sprits

Minutes of meeting:

Ioannis A. Daglis (IAD) welcomed all attendees to the Topical Discussion Meeting, both virtual and physical participants. IAD opened the discussion with a presentation on SafeSpace, a Horizon 2020 Scientific Research Programme, listing its main targets and accomplishments thus far. SafeSpace is coordinated by the National and Kapodistrian University of Athens, and is performed by close collaboration between academia (NKUA, ONERA, KUL, IAP, UPS, IASB-BIRA), a major European space industry (TAS) and a space-oriented SME (SPARC). Using a neural network, the Kp index is computed by propagating solar wind conditions, a pre-calculated diffusion coefficient database is being used to estimate the wave influence on the radiation belt electrons, so that electron fluxes can be forecasted with a lead time of four days.

Question by on site participant: Why use Kp index for forecasting? How are the diffusion coefficients being calculated? Is the main element of SafeSpace a neural network?

Answer by IAD: The Kp index is used because it is available in near-real time, unlike other geomagnetic indices as for example Dst or AE. We use a neural network only for the computation/forecast of the Kp index, which then is used for the forecast of plasma density (through the BIRA/IASB model), which in turn is used for the forecast of the VLF diffusion coefficients. The ULF diffusion coefficients are forecasted through a Machine Learning code that uses the forecasted solar wind parameters at L1. After computing the diffusion coefficients, we use the Salammbo code of ONERA to calculate the electron fluxes at three different orbits.

Question by on site participant: Models may not be realistic, they usually are not entirely physically accurate.

Answer by IAD: That is true, but the only way to move forward is to aim at making our models as accurate as possible.

IAD continued his presentation by mentioning that the SafeSpace team has defined some indicators that could be useful to the space industry, and hopes that in the next ESWW event, a working service will be available for demonstration.

The discussion continued with Stefaan Poedts (SP) presenting EUHFORIA 2.0. The overall project goal is to develop a revolutionary space weather forecasting tool for geomagnetic disturbances and SEP event as well as their effects.

Comment in Zoom chat by Edmund Henley (EH): "G*reat on the CME Bz/geoeffectiveness capability for EUHFORIA - Can you discuss a little on how you intend to use this in real-time - e.g. using observations to constrain the initial flux rope conditions such that modelled Bz at Earth is somehow representative. I ask as I've only ever seen research implementations, and I don't have a good idea on how well these can translate to operations - it would be great to find out more!*"

The discussion continued with Yuri Sprits (YS) presenting PAGER. Its aims are to make predictions starting from solar images, allowing long-term probabilistic prediction.

Question in Zoom chat, by EH for SP: "*Do you think you might be able to do a look-up table approach - a little like SPARX does say? Pre-compute loads of flux ropes offline for, let's say, representative conditions, and find closest match? Or is it unfeasible?*"

Answer by SP: It would be feasible but it is not the goal of this particular project.

Question in Zoom chat, by EH for IAD: "*If not planned for already, would you be able to say a bit about the work you've done with users to define radiation metrics / thresholds e.t.c.?*"

IAD showed a matrix of planned indicators.

Answer by IAD: The thresholds will be left for each service user to decide and set, so they will be customizable, in a sense. When the service will be working, a live event will be organized for evaluation and collection of some user feedback. Additionally, during this ESWW event, there is a dedicated poster (by IAD) as well as some dedicated talks (by C. Katsavrias and A. Nasi) about specific aspects of the Project, that the participants can explore.

Question in Zoom chat, by EH for IAD: "*user-customisable thresholds sounds great - are you intending to do any hand-holding w users on what they might do (e.g. via in-house examination of their historic anomaly data) to define sensible levels? Or are all users you've spoken with confident on defining their own thresholds? Or just talk them through this in workshop with synthetic example anomaly data if confidentiality reasons mean not possible to do joint work on real anomaly data?*"

IAD: That's a really good idea. We have not been discussing it to such a detail, but it is a good idea to look into their anomaly data. We plan to hold some meetings with users for feedback on this matter.

Question in Zoom chat, by Piers Jiggens (PJ): "*any plans to do a cross-comparison exercise from PAGER/SafeSpace etc?*"

IAD: That would be very fruitful.

Question in Zoom chat, by POB: "*Yannis, is it possible to share a couple of slides?*"

POB sharing screen: Summary of the Telephone Fallacy. Every interface loses information. Empirical models work better because of fewer interfaces but only some can extrapolate to extreme conditions.

EH to POB: "*it's a good point re empirical extrapolation limitation, but worth remembering that most physics-based models have some parameterisation embedded somewhere inside, which is often based ultimately on obs in limited region of "phase space", which mean they can be limited - nice discussion of this in Welling et al 2016 doi.org/10.1002/2016Sw001505*"

IAD: We have discussed on these points. We still have a long way to go.

SP: The transformation of the information – losing information when coupling from one model to the other …

PJ to POB/SP: I think this is why end-to-end or coupled validations as we (Stefaan et al.) are implementing in the VSWMC are important.

Question in Zoom chat, by EH to YS: "*Have you got a link for the radiation belt challenge - sorry, done superficial dig on CCMC but Google-fu failing me!*"

Question in Zoom chat, by Phil Quinn (PQ): "*Can the link be posted in chat? I would also like it.*"

Question in Zoom chat, by YS to POB: "*Can you find the link to our challenge. I can't find it right away.*"

EH: "*Got it, thanks Yuri"* https://www.iswat-cospar.org/g3

POB: https://drive.google.com/file/d/18pMh-HV8JbB7EULJdJq6soVLoYo0X9Dp/view

IAD thanked again all attendees for their participation in this Topical Discussion Meeting.

End of meeting.