

Report on COSPAR 2021 session PSW.3 held on Wednesday, 3 February 2021 **Now- and forecast of Ionospheric indices and related scales for space weather services** MSO:

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In this half day session, 7 pre-recorded full video presentations were submitted and available on the COSPAR portal. The 7 short summary videos were shown during the live Q/A sessions at Block 1, chaired by Tim Fuller Rowell, and Block 2 chaired by Norbert Jakowski. Unfortunately, 4 originally accepted talks were withdrawn because authors were unable to attend COSPAR 2021. Nevertheless, it can be stated that the talks fully addressed the main issues of this session indicated in the session description. The session was well attended. Following the short video presentations there were intensive discussions on practically all aspects related to ionospheric index approaches.

Considering the current NOAA Space Weather Scales, the need to establish an ionospheric space weather scale in particular for users of Global Navigation Satellite Systems (GNSS) like GPS or Galileo was clearly expressed. In particular, reliable information on the perturbation degree of the ionosphere is required in safety of life applications (e.g. Space or Ground Based Augmentation Systems to guide aircraft landing) or precise navigation and positioning in many GNSS applications with permanently growing challenges concerning accuracy, continuity, availability and integrity. Space weather services are able to help customers of these systems by providing compact and easy to use information on the perturbation degree of the ionosphere via appropriate indices clearly defined and scaled and understandable in a plain language for customers. The common view of speakers and debaters was to focus on developing a trans ionospheric weather scale based on permanent growing and globally distributed geodetic GNSS networks, with a possibility to augment with space-based GNSS observations in the future for improved global coverage.

The session contributions reviewed current approaches, presented new ideas for describing ionospheric perturbations, and were also open to learning forecasting aspects from geomagnetic approaches developed for a PC index that has been related to space weather-initiated power line loss at high latitudes. In contradiction to a rather low number of internationally well accepted geomagnetic or solar indices, the situation is different in the ionospheric community where numerous approaches for ionospheric indices have been developed. This demonstrates clearly the complexity of ionospheric perturbations covering a broad spectrum of spatial and temporal scales, and their impact on a wide variety of use cases. To reduce the number of ionospheric indices for a broader and well accepted use by the ionospheric community was agreed. As the discussion has shown, this is a challenging task that requires more discussion and comparative studies considering many aspects such as spatial and temporal resolution, local, regional, or global characteristic, near real time capability, accuracy, forecast capability, and absolute or relative scaling in relation to the impact on different applications. Since such a task requires intensive international collaboration of space scientists, COSPAR can continue to support this discussion via the COSPAR ISWAT platform. So, we plan to continue the discussion via the COSPAR ISWAT initiative platform in preparation for the recently proposed session on “Ionospheric Indices

and scaling” at the 44<sup>th</sup> COSPAR assembly in Athens in 2022.

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