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TOWARDS AN AUTOMATED E-CALLISTO RADIO BURST IDENTIFICATION AND EVENT REPORTING SYSTEM FOR THE SPACE WEATHER COMMUNITY

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Cutting-edge space weather forecasting demands quick user-friendly access to solar observations around the globe and agile cross-match functionality. In this paper, progress on a new quicklook service to be provided by the e-Callisto global network is presented. The new service will include Deep-Neural-Network-based (DNN) solar burst identification taylored to each working e-Callisto station, automatic event reporting and a centralized database with cross-matches between satellite- and ground-based burst catalogs. As an implementation example, missing e-Callisto reports from the past are being produced.

Solar radio bursts (SRBs) play a key role in the study of particle acceleration and propagation processes at the heart of solar flares and coronal mass ejections:

- Since features like the presence of open magnetic field lines, shock waves or particle confinement are revealed by different types of bursts (types III, II and IV, respectively), good-quality burst identification and discrimination is crucial.

- Since early forecasting of potentially-hazardous Solar Energetic Particle events (SEPs) hinges on the empirical association between SEPs and SRBs –the latter signals reaching us well in advance–, prompt burst reporting is a must.

Event-scene reconstruction involves careful cross-matching of data collected both by space-borne devices, either in situ or via remote sensing, and by Earth-based observatories. Among the latter, the e-Callisto worldwide network of order-one-hundred inexpensive radio spectrometers around the globe offers full-day coverage of the Sun with the redundant event perspective given by typically ten to thirty stations active at any given time. FITS-format dynamic spectra in the 20 – 870 MHz range (station-dependent and tunable) is centralized at Fachhochschule Nordwestschweiz, published on the internet in near-real time and quicklooked by an expert

before a daily event report is issued.

This kind of data, with significant spectral and time resolution, provides valuable information about prompt phases of SEP acceleration. In combination with satellite measurements of X-ray and particle flux, it helps reconstructing the sequence of phases in episodic events: flare onset, early CME, mature CME. At long time scales, where short events ride over a continuum of solar activity in an 11-year-long cycle, this wealth of data may become a mine for statistical studies of SRBs: types, duration, grouping, ordered sequences, solar cycle comparison. Yet, in order for the scientific community to benefit from its full potential, the implementation of automatic burst identification and event reporting seems mandatory, as current manual inspection of thousands of files a day cannot be sustained much longer.

In this paper:

i) an automatic burst detection system based on DNN is described and its performance, evaluated;

ii) its application to systematic event report generation is shown for missing years 2012-2015, a period of special relevance corresponding to the rise, maximum and fall of solar cycle 24;

iii) examples are given of burst cross-matching between e-Callisto and other ground-based and space-borne observatories incorporating recently-launched satellites like Solar Orbiter and Parker Solar Probe.