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REVIEW OF STATEMENT OF GUIDANCE

(Submitted by T. Onsager)

Summary and Purpose of Document

The first Statement of Guidance for Space Weather Observations was developed by the ICTSW and accepted by ET-EGOS-7 on 11 May, 2012. This Statement of Guidance provides an overview of the major gaps in current and future observing capabilities and offers a set of recommendation for actions. The analysis of observing systems took into account the needs for operational services, climatology, as well as research to improve space weather capabilities. The plan of ICTSW is to review and revise the Statement of Guidance every two years.

With the initial Statement of Guidance in place, the ICTSW can now address changes in observing systems and plans as well as any deficiencies in the original document. The following questions can be considered for this update of the Statement of Guidance:

1. Which observations are currently being made by research instruments that may not be available in the near future?
2. Which observations are being made that currently are not available for space weather services?
3. Which observations could be significantly more valuable if they were available with lower latency, higher accuracy, or with improved intercalibration with other observations?
4. Where are the important areas for which the value of observations has not been adequately quantified?

ACTION PROPOSED

The Inter-Programme Coordination Team is invited to review the Statement of Guidance for Space Weather Observations and take action to update as needed.

REFERENCE Statement of Guidance for Space Weather Observations: http://www.wmo.int/pages/prog/www/OSY/SOG/SoG-SW.doc

DISCUSSION

1. INTRODUCTION

The first Statement of Guidance [1] and gap analysis for space weather observations was drafted by the Inter-Programme Coordination Team on Space Weather (ICTSW) in the spring of 2012 and approved by the ET-EGOS-7 on 11 May, 2012. As detailed in the Statement of Guidance, this initial effort did not undertake to catalog all existing observations. Rather, the emphasis was placed on documenting the areas identified as most important for: 1. maintaining services in cases where the long-term continuity of observations is in doubt; 2. improving existing services, either through increased spatial coverage, improved timeliness or improved accuracy; and 3. enabling new services. Also, this effort did not include a comprehensive documentation of customer requirements. Nonetheless, the recommendations were based on knowledge of space weather customers, whose needs can vary considerably from one region to another, and on the adequacy of existing and planned observations for current or future products.

As part of its regular work plan, the ICTSW has agreed to review and revise the Statement of Guidance every other year. The original Statement of Guidance was drafted in 2012, and therefore its first revision will be conducted in 2014. During years that the Statement of Guidance is not being reviewed, effort is placed on reviewing and revising the space weather observing requirements. During 2013, the observing requirements were updated to include measurement of thermospheric properties and radiation dose rates at aircraft altitudes. As a minimum, the 2014 revision to the Statement of Guidance will need to reflect these modifications to the observing requirements.

The space weather observations considered in the original gap analysis were those required for the following applications: to forecast the occurrence probability of space weather disturbances; to drive hazard alerts when disturbance thresholds are crossed; to maintain awareness of current environmental conditions; to determine climatological conditions for the design of both space-based systems (i.e., satellites and astronaut safety procedures) and ground-based systems (i.e., electric power grid protection and airline traffic management); to develop and validate numerical models; and to conduct research that will enhance our understanding.

The Statement of Guidance was organized by five broad categories of observations, similar to the categories of space weather products available in the WMO Space Weather Product Portal. These categories are: Ionospheric, Geomagnetic, Energetic Particles, Solar, and Solar Wind observations. Although it is understood that the observations in one domain can be used for products in a different domain (e.g., solar wind data needed for ionospheric, geomagnetic, and energetic-particle products), these main categories were considered as a useful basis to conduct the assessment of space weather observations .

2. STATEMENT OF GUIDANCE RECOMMENDATIONS

The following recommendations were made in the 2012 Statement of Guidance:

1. All Members are encouraged to improve the collection and open dissemination of all ground-based and space-based space weather data.

2. High-level coordination of satellite-based assets to maintain continuity of solar measurements, solar wind and interplanetary magnetic field measurements, and

[1] Statement of Guidance: http://www.wmo.int/pages/prog/www/OSY/SOG/SoG-SW.doc

heliospheric imaging should be established. This coordination effort should include consideration of measurements at the L1 Lagrange point and at other locations in interplanetary space, such as the L5 Lagrange point and on the Sun-Earth line upstream from the L1 point, as well as the required global network of ground-based antennas for data reception and processing. This could be done under the auspices of WMO through the Coordination Group for Meteorological Satellites (CGMS) and in consultation with appropriate international committees such as the United Nations Committee on Peaceful Uses of Outer Space (UN-COPUOS).

3. Efforts should be made to coordinate and to standardize the existing ground-based solar data, and to expand them where required for redundancy, including defining an approach for a common data portal or virtual observatory concept accessible via WIS and creating advanced, combined products and image-processing techniques.

4. Efforts should be made to encourage and improve numerical modeling of the solar and interplanetary plasma, in particular with the purpose to develop operational software for numerical space weather prediction. This implies that the numerical modeling should be capable of ingesting as much as possible real-time data, and the models should be fast enough to yield sufficient lead times for their output to be translated into forecast variables.

5. Efforts should be made to increase the spatial resolution of ground-based Global Navigation Satellite System (GNSS) observations (Total Electron Content (TEC) and scintillation), either by deploying additional receivers in regions with sparse coverage (e.g. Africa), making the data from existing receivers accessible, or by utilizing different means of receiving GNSS data, such as aircraft-mounted receivers, to reduce gaps over the oceans.

6. Efforts should be made to increase the use of space-based GNSS measurements onboard Low Earth Orbit (LEO) satellites to get information about the vertical electron density distribution of the ionosphere/plasmasphere system. In parallel, the timeliness of space-based GNSS measurements should be improved (e.g. by use of a network of satellite ground stations for rapid transmission).

7. Actions should be taken to enable sharing of ground-based GNSS data and GNSS radio occultation (RO) data among the meteorological and space weather communities, and to facilitate the timely access to these data through WIS. The International Radio-Occultation Working Group (IROWG) established in 2011 by CGMS and WMO can be an appropriate forum to address these issues.

8. Data assimilation and related techniques should be developed to produce a more accurate, higher resolution representation of the 3D electron density distribution in the ionosphere and plasmasphere. These techniques effectively reduce propagation errors in GNSS applications. The combination of ground- and space-based GNSS measurements is required in order to avoid problems related to lack of global coverage and poor data timeliness, respectively.

9. The coordinated use of dual-frequency radar altimeter observations should be ensured to improve or validate ionospheric models and for operational TEC monitoring in combination with ground-based GNSS measurements in order to fill data gaps over the oceans.

10. Efforts should be made to increase the availability of ground-based magnetometer data with high timeliness. This can be accomplished by: (i) considering the deployment of magnetometers in regions with limited coverage; (ii) utilizing the WMO data infrastructure to disseminate data from existing magnetometers; and (iii)

working with providers of proprietary data to allow their data to be used in space weather products.

11. The priorities for maintaining and improving space weather services for the plasma and energetic particle environment are: (1) maintain long-term continuity, and if possible improve the spatial resolution, of measurements at all altitudes from LEO to GEO orbits; (2) improve the sharing of existing and planned plasma and energetic particle measurements; (3) include energetic particle sensors on Highly Elliptical Orbit (HEO) satellites; (4) conduct research to incorporate the plasma and energetic particle data into numerical models to give flux estimates at all locations where our satellites are in orbit.

3. STATEMENT OF GUIDANCE REVIEW

With the initial Statement of Guidance in place, the ICTSW has the opportunity now to update this analysis of gaps in observing capabilities[2]. Among the considerations for this review are the following questions:

1. Which observations, among those required for routine operations, are currently being made by research instruments that may not be available in the near future?
2. Which observations are being made that currently are not available for space weather services?
3. Which observations could be significantly more valuable if they were available with lower latency, higher accuracy, or with improved intercalibration with other observations?
4. Where are the important areas for which the value of observation have not been adequately quantified?

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[2] For the review of space-based capabilities, the ICTSW may wish to take advantage of the inventory of space-based observing capabilities recorded in OSCAR (www.wmo.int/oscar).