



**SCAR SSG Business Meeting**

SSGs

LS/PS/GS

**Portland, USA, 15 & 20 July 2012**

Person Responsible:

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**1. Rationale for the Group**

Higher exposure of GNSS based technology to solar perturbations, particularly in polar region, will require more extended investigations, both in variety of approaches and spatial coverage. Increased coverage in the Arctic and Antarctic will provide remote sensing tools to map the ionospheric total electron content (TEC) and precipitable water vapour (PWV) that will make it possible to assess the impact of solar disturbances on the newly attained precision positioning during the next solar maximum that is expected for 2013, and throughout the declining phase of the solar cycle. It may also help in improving short term weather forecasts and in remote sensing for climate change studies.

The International Polar Year (IPY) and International Heliophysical Year (IHY) initiatives left an important heritage in terms of data sharing, expertise exchange and increasing awareness of the current scientific capabilities. In particular, the GWSWF (GPS for Weather and Space Weather Forecasting) [www.gwswf.scar.org](http://www.gwswf.scar.org), a joint SSG GS and PS Action Group, took advantage of the Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR) and the Polar Earth Observing Network (POLENET) experiences that lead to creation of working groups on specific themes such as the use of geodetic data to study space weather events.

Built on the AG GWSWF, the Expert Group GRAPE intend to continue to follow this route, intensifying the efforts to build and coordinate a robust network of collaborations in order to answer a variety of space weather related needs through ad hoc data sharing and model development.

*GRAPE is based on the use of the classical GPS POLENET array and the growing coverage of modern GNSS systems, on the availability of advanced modelling and on the opportunity offered by the advancing solar cycle. The main objectives are:*

- Create and maintain distributed networks of specialized GPS/GNSS Ionospheric Scintillation and TEC Monitors particularly at high latitudes.
- Identify and quantify mechanisms that cause scintillation and control interhemispheric differences, asymmetries and commonalities in scintillation occurrence and intensity as a result of the geospace environment conditions.
- Develop ionospheric scintillation climatology, tracking and mitigation models to improve prediction capabilities of space weather.
- Retrieve tropospheric PWV for input to weather forecast models and to develop regional PWV climatology for atmospheric sensing in remote areas.



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## **2. Report on Progress**

The II GWSWF meeting has been held at the Università di Modena e Reggio Emilia, Modena (Italy) 11-12 April 2011, to discuss the objectives in the perspective of the next SCAR OSC and Business Meetings in Portland (USA), 2012. The meeting was attended by representatives from Brazil, Canada, UK, USA, Slovenia and Italy. The main goal, based on the initial success of the AG GWSWF, was the agreement to update the AG in the more ambitious Expert Group GRAPE. The meeting also underlined the need to enhance collaboration to work in synergy with other SCAR EGs or SRPs on the assessment of the ionosphere over the poles. The task is very challenging especially because different scientific contexts mean different data format, different data processing and different data interpretation. On the other hand, the group considers such heterogeneity as a strong point to stimulate advancement of our understanding of space weather effects in polar regions. Several presentations highlighted the bi-polar GNSS network maintenance and enlargement, the data availability through ad hoc data bases, e.g. [www.eswua.ingv.it](http://www.eswua.ingv.it), and investigations carried out with the contribution of different Countries/Institutions. Several expressions of interest have been received through the gwsfw web portal, meaning the usefulness of this facility for coordinating the efforts, disseminating the results and attracting new collaborations.

Recent publications (2011) on peer review journals are listed below:

Alfonsi, L., L. Spogli, G. De Franceschi, V. Romano, M. Aquino, A. Dodson, and C. N. Mitchell (2011), Bipolar climatology of GPS ionospheric scintillation at solar minimum, *Radio Sci.*, doi:10.1029/2010RS004571.

Grzesiak M. and A. Świątek, Solar terminator-related ionosphere derived from GPS TEC measurements - a case study (2011), *Acta Geophysica*, doi: 10.2478/s11600-011-0048-7.

Jayachandran, P. T., C. Watson, I. J. Rae, J. W. MacDougall, D. W. Danskin, R. Chadwick, T. D. Kelly, P. Prikryl, K. Meziane, and K. Shiokawa: High-latitude GPS TEC changes associated with a sudden magnetospheric compression (2011), *Geophys. Res. Lett.*, 38, L23104, doi:10.1029/2011GL050041.

Pokhotelov, D., Jayachandran, P. T., Mitchell, C. N., MacDougall, J. W. and Denton, M. H., 2011. GPS tomography in the polar cap: comparison with ionosondes and in situ spacecraft data. *GPS Solutions*, 15 (1), pp. 79-87.

Prikryl, P., Jayachandran, P. T., Mushini, S. C., and Chadwick, R.: Climatology of GPS phase scintillation and HF radar backscatter for the high-latitude ionosphere



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under solar minimum conditions (2011), *Ann. Geophys.*, 29, 377-392, doi:10.5194/angeo-29-377-2011.

Prikryl, P., Spogli, L., Jayachandran, P. T., Kinrade, J., Mitchell, C. N., Ning, B., Li, G., Cilliers, P. J., Terkildsen, M., Danskin, D. W., Spanswick, E., Donovan, E., Weatherwax, A. T., Bristow, W. A., Alfonsi, L., De Franceschi, G., Romano, V., Ngwira, C.M., Opperman, B. D. L.: Interhemispheric comparison of GPS phase scintillation at high latitudes during the magnetic-cloud-induced geomagnetic storm of 5–7 April 2010, *Ann. Geophys.*, 29, 2287-2304, doi:10.5194/angeo-29-2287-2011, 2011.

Wernik A. W. and M. Grzesiak, Scintillation Caused by the Ionosphere With non-Gaussian Statistics of Irregularities (2011), *RADIO SCIENCE*, VOL. 46, RS6011, 9 PP., doi:10.1029/2011RS004716.

### **3. Future Plans**

Efforts will be addressed to maintain and update the current GWSWF web portal into a new version that will highlight the subgroups activities of GRAPE. In particular a data portal development is planned to facilitate sharing and utilization of the GNSS/GPS and geophysical databases. The data portal will be linked to other useful databases for easy access, and encourage the collaboration, data sharing and help in interpretation of the results.

A special issue of *Annals of Geophysics* is in preparation aiming to collect the papers that will be presented during the next SCAR OSC in Portland in the field of interest of GRAPE.

A GRAPE meeting-workshop will be organized in 2013-2014 to provide forum for discussions and to focus the community efforts towards the GWSWF project goals.

### **4. Budgetary Issues**

GRAPE EG is expected to be active along the next 4 years (2012-2015). SCAR SSG PS financial support is requested for improving the existing WEB ([www.GWSWF.SCAR.org](http://www.GWSWF.SCAR.org)), for meetings organization, for publications, for participating to international Conferences.

The table below summarizes the budget needs.



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<b>Year</b>	<b>Meeting Organization (USD)</b>	<b>Publications (USD)</b>	<b>Web (USD)</b>	<b>Participation to conferences (USD)</b>
2012		1000	3500 (Improvement)	2000
2013	3000	1000	2000 (Improvement/ maintenance)	2000
2014		1000	2000 (Updating/ maintenance)	2000
2015	3000	1000	2000 (Updating/ maintenance)	2000
<b>Total</b>	<b>27500USD</b>			