



SCAR Group xxx
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Person xxx
Responsible:

**XXXIV SCAR Delegates Meeting
Kuala Lumpur, Malaysia, 29-30 August 2016**

**GRAPE-GNSS Research and Application for
Polar Environment (cross-link between SSG PS
and GS)**

Contact: Giorgiana De Franceschi- giorgiana.defranceschi@ingv.it

1-2 paragraph summary of activities from 2014-2016

After the SCAR OSC 2014 (Auckland, NZ, August 2014) GRAPE (www.grape.scar.org) meetings and scientific sessions have been organized within both URSI AT RASC (Gran Canaria, Spain, 18-22 May 2015) and Beacon Satellite Symposium (Trieste, 27 June -1 July 2016) aiming to disseminate the GRAPE results on the bi-polar neutral and upper atmosphere monitoring, investigations, and data management as well to attract new groups and institutions. A scientific session has been organized within the SCAR OSC 2016 in Kuala Lumpur (Session 16, 10 oral contributions and 6 posters contribution. New groups from Malaysia, not yet involved in GRAPE, submitted papers).

The GRAPE web site (www.grape.scar.org) has been maintained at INGV and updated regularly as well the SCAR web pages (www.scar.org) devoted to GRAPE.

A GRAPE task force has been established during URSI AT RASC to draft a possible new SRP to be discussed with all the communities interested during the SCAR OSC 2016 in Kuala Lumpur.

Recommendations that Delegates and Chief Officers should consider (if any): Please indicate if voting/approval is necessary or if they are just asked to note information.

**Date/Year Group Approved: August 2012 SCAR OSC 212-PORTLAND
Date/Year Group is to End:**



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All SCAR Groups are asked to produce a poster to highlight activities for the SCAR Open Science Conference. Do you plan to produce a poster?

Y



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Further Details:

GRAPE Meetings and scientific sessions:

- The GRAPE meeting within URSI AT RASC (www.at-rasc.org) was attended by more than 30 colleagues from different URSI Commissions (mainly from Commission G-Ionospheric Radio and Propagation). During the meeting SCAR Horizon Scan and scientific priorities were presented and discussed focusing on the GRAPE future contribution to this. A task force has been established to start a process toward a possible proposal leading to a SRP based on GRAPE and enlarged to other interested polar communities. The GRAPE scientific session was also quite interesting and more than 10 papers were submitted as oral presentations.
- A scientific session on the polar (high latitude) effects on GNSS has been organized in the frame of the Beacon Satellite Symposium 2016 (June 27- July 1, 2016 Trieste, Italy) (<http://t-ict4d.ictp.it/beacon2016/sessions>). The session received a good number of contributions as oral and posters (12 selected as oral and 6 as posters). Authors from USA, UK, IT, RU, NO, CA.

GRAPE participants from Italy, South Africa and Brazil supported the DemoGRAPE project 2014-2016 (www.demogrape.net) to build up a prototype of a new service based on local data and ad hoc processors, capable to demonstrate a significant improvement of the precise positioning over Antarctica. Antarctic facilities from these countries have been shared and thanks to the Cloud technology, the prototype will be accessible to a plethora of different stakeholders, from academic to private, interested in the high precision applications (e.g. geodetic prospections, land and glaciers monitoring,...), that need to be assisted by services capable to mitigate the ionospheric corruption on GNSS signals. The DemoGRAPE follow on has been recently submitted to PNRA (Italian National Program for Antarctic Research) in view to update the prototype and share this with other Antarctic Bases.

GRAPE has recently established a task force to arrange a proposal for a new SRP titled RESOURCE (Radio Sciences Research on AntarCtic AtmosphEre). It aims to gather the communities that investigate the bi-polar atmosphere, with particular reference to Antarctica, by means of radio probes into a common shared initiative. The task force is composed by scientists affiliated in several countries, among the others: Belgium, South Africa, Canada, Brazil, USA, Italy.



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Major Future Initiatives and Actions, including rough timeline, for at least the next 2 years

- Efforts will be addressed to maintain, improve, update the GNSS network, data and tools to assist the mitigation of the ionosphere impact on a variety of applications. The sharing of infrastructures and facilities will be also pursued.
- Activities addressed to the harmonization of all contributions for drafting the new SRP proposal (RESOURCE) will be continued in order to be mature for submitting the proposal to SSG PS and GS.
- The GRAPE web site will be maintained and updated.
- A scientific session on the polar ionosphere will be organized within the URSI GAS 2017. This will be an occasion to discuss the advancement in the field within an enlarged community in particular those involved in ionosphere, space weather and remote sensing (Commissions G and F).

Proposed Budget for 2017 and 2018

Month/Year	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
01/2017	GRAPE web updating	2500	Giorgiana De Franceschi	Giorgiana.defranceschi@ingv.it
04/2017	URSI GAS registration fees for GRAPE participants of which 3 earlier career scientists presenting a paper.	5000	Giorgiana De Franceschi	Giorgiana.defranceschi@ingv.it
09/2017	SA,BE,BR scientific visits at INGV or viceversa	5000	Claudio Cesaroni, Pierre Cilliers Nicolas Benoit	Claudio.cesaroni@ingv.it
03/2018	SCAR OSC registration fees for GRAPE participants of which 3 earlier career scientists presenting a	5000	Giorgiana De Franceschi Lucilla Alfonsi Pierre Cilliers Nicolas Benoit	Giorgiana.defranceschi@ingv.it



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	paper.			

Budget Justification (please indicate % of budget to support early career scientists and scientists from countries with small Antarctic programmes):

The total budget requested of 17500USD should be shared between SSG PS and GS. 20% of the budget (as minimum depending on how many earlier career scientists and/or scientists from countries with small Antarctic programmes are involved in the field). GRAPE launched the earlier career scientists/scientists from developing countries call for papers submission during the last SCAR OSC 2014 with two earlier career scientists that received a travel grant.

External Linkages – Support and Coordination beyond SCAR:

URSI
 BSS

Please describe your outreach, communication and capacity building activities:

Several activities for outreach and communication to the general public have been carried out (see e.g. the DemoGRAPE web site www.demogrape.net). This project gave an example of capacity building too through the national infrastructures and facilities sharing.

Moreover papers have been presented during public conferences such as:

Nicolas Bergeot, Why do we need to continue scientific research in Antarctica? Cognac Rotary Club, France, March 2 2016 <http://rotary-cognac.org/conference-antartique/>

Publications of your group to date:

Note: Please use the APA style. <http://www.citationmachine.net/apa/cite-a-journal> can help you. We will only ask for a complete list this year, after this we will ask for new publications every 2 years.



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GRAPE-LIST OF PUBLICATIONS 2012-2016

2012

- Deshpande, K. B., G. S. Bust, C. R. Clauer, H. Kim, J. E. Macon, T. E. Humphreys, J. A. Bhatti, S. B. Musko, G. Crowley, and A. T. Weatherwax (2012), Initial GPS scintillation results from CASES receiver at South Pole, Antarctica, *Radio Sci.*, 47, RS5009, doi:10.1029/2012RS005061.
- Moro, J., Denardini, C.M., Abdu, M.A., Correia, E., Schuch, N.J., MAKITA, K. Correlation between the cosmic noise absorption calculated from the SARINET data and the energetic particles measured by MEPED: Simultaneous observations over SAMA region. *Advances in Space Research.* , v.51, p.1692 - 1700, 2012.
- Moro, J., Denardini, C.M., Correia, E., Abdu, M.A., Schuch, N.J., MAKITA, K. A comparison of two different techniques for deriving the quiet day curve from SARINET riometer data. *Annales Geophysicae (Berlin).* , v.30, p.1159 - 1168, 2012.
- Moro, J., C. M. Denardini, M. A. Abdu, E. Correia, N. J. Schuch, and K. Makita (2012), Latitudinal dependence of cosmic noise absorption in the ionosphere over the SAMA region during the September 2008 magnetic storm, *J. Geophys. Res.*, 117, A06311, doi:10.1029/2011JA017405.
- Jayachandran, P. T., K. Hosokawa, K. Shiokawa, Y. Otsuka, C. J. Watson, S. C. Mushini, J. W. MacDougall, P. Prikryl, R. Chadwick, and T. D. Kelly (2012), GPS Total Electron Content Variations Associated with Poleward Moving Sun Aligned Arcs, *J. Geophys. Res.*, doi:10.1029/2011JA017423
- Kinrade, J., C. N. Mitchell, P. Yin, N. Smith, M. J. Jarvis, D. J. Maxfield, M. C. Rose, G. S. Bust, and A. T. Weatherwax (2012), Ionospheric scintillation over Antarctica during the storm of 5–6 April 2010, *J. Geophys. Res.*, 117, A05304, doi:[10.1029/2011JA017073](https://doi.org/10.1029/2011JA017073).
- Prikryl, P., P. T. Jayachandran, S. C. Mushini, and I. G. Richardson (2012), Toward the probabilistic forecasting of high-latitude GPS phase scintillation, *Space Weather*, 10, S08005, doi:10.1029/2012SW000800.



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2013

- De Franceschi Giorgiana and Candidi Maurizio, GRAPE, GNSS Research and Application for Polar Environment, Expert Group of SCAR. Annals of Geophysics, Special Issue, Vol. 56, No2 (2013), ISSN 2037-416X.
<http://www.annalsofgeophysics.eu/index.php/annals/issue/view/488>.
- Prikryl, P., Ghoddousi-Fard, R., Kunduri, B. S. R., Thomas, E. G., Coster, A. J., Jayachandran, P. T., Spanswick, E., and Danskin, D. W.: GPS phase scintillation and proxy index at high latitudes during a moderate geomagnetic storm, Ann. Geophys., 31, 805-816, doi:10.5194/angeo-31-805-2013, 2013.
- Prikryl, P., Y. Zhang, Y. Ebihara, R. Ghoddousi-Fard, P. T. Jayachandran, J. Kinrade, C. N. Mitchell, A. T. Weatherwax, G. Bust, P. J. Cilliers, L. Spogli, L. Alfonsi, G. De Franceschi, V. Romano, B. Ning, G. Li, M. J. Jarvis, D. W. Danskin, E. Spanswick, E. Donovan and M. Terkildsen, An interhemispheric comparison of GPS phase scintillation with auroral emission observed at South Pole and from DMSP satellite, Special Issue of Annals of Geophysics, 56, 2, 2013, R0216; doi:10.4401/ag-6227.
- Prikryl, P. V. Sreeja, M. Aquino, and P. T. Jayachandran, Probabilistic forecasting of ionospheric scintillation and GNSS receiver signal tracking performance at high latitudes, Special Issue of Annals of Geophysics, 56, 2, 2013, R0222; doi:10.4401/ag-6219.
- Sarti P., Negusini M., Tomasi C., Petkov B., Capra A. (2013). Thirteen years of integrated precipitable water derived by GPS at Mario Zucchelli Station, Antarctica. Annals of Geophysics, Special Issue, 56, 2, 2013. ISSN: 2037-416X. doi: 10.4401/ag-6228
- Correia, E., Paz, A. J., Gende, M.A. Characterization of GPS-TEC in Antarctica from 2004 to 2011. Annals of Geophysics. , v.56, p.R0217-1 - R0217-5, 2013.
- Fernandez, José Henrique, Correia, E. Electron precipitation events in the lower ionosphere and the geospace conditions. Annals of Geophysics. , v.56, p.R0218-1 - R0218-10, 2013.
- Spogli, L., Alfonsi, L., Cilliers, P., Correia, E., De Franceschi, G., Mitchell, C.N., Romano, V., Kinrade, J., Cabrera, M. A. GPS scintillations and TEC climatology in the southern low, middle and high 2 latitude regions. Annals of Geophysics. , v.56, p.R0220-1 - R0220-12, 2013.



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- Correia, E., Raulin, J. P., Kaufmann, P., Bertoni, F. C., Quevedo, M.T. Inter-hemispheric analysis of daytime low ionosphere behavior from 2007 to 2011. *Journal of Atmospheric and Solar-Terrestrial Physics.* , v.92, p.51 - 58, 2013.
- Correia, E., Raulin, J. P., Kaufmann, P., Gavilán, H. R. Atmospheric changes observed in antarctica related to the sun-earth interactions. *Annual Activity Report - INCT-APA.* , v.3, p.20 - 25, 2013.
- Correia, E., Makhmutov, Vladimir S, Raulin, Jean Pierre, Makita, K. Mid- and low-latitude response of the lower ionosphere to solar proton events on January 2012. *IOP Conference Series. Earth and Environmental Science (Online).* , v.409, p.1/012186 - 4, 2013.

2014

- Koustov, A. V., P. V. Ponomarenko, M. Ghezelbash, D. R. Themens, and P. T. Jayachandran (2014), Electron density and electric field over Resolute Bay and F region ionospheric echo detection with the Rankin Inlet and Inuvik SuperDARN radars, *Radio Sci.*, 49, doi:10.1002/2014RS005579.
- Prikryl P., Jayachandran P. T., Mushini S. C., Richardson I. G., High-latitude GPS phase scintillation and cycle slips during high speed solar wind streams and interplanetary coronal mass ejections: A superposed epoch analysis, *Earth, Planets and Space*, **66** :62, 2014.
- Raulin, Jean Pierre, Trottet, Gerard, Gimenez de Castro, C. G., Correia, E., Macotela, E. L. Nighttime Sensitivity of Ionospheric VLF Measurements to X-ray Bursts From a Remote Cosmic Source. *Journal of Geophysical Research: Space Physics.*, 2014. DOI:10.1002/2013JA019670
- Ghezelbash, M., A. Koustov, D.R. Themens, and P.T. Jayachandran (2014). Seasonal and diurnal variations of PolarDARN F region echo occurrence in the polar cap and their causes, *J. Geophys. Res. Space Physics*, 119, 10,426–10,439, doi:10.1002/2014JA020726.
- Themens, D. R., P. T. Jayachandran, M. J. Nicolls, and J. W. MacDougall (2014), A top to bottom evaluation of IRI 2007 within the polar cap, *J. Geophys. Res. Space Physics*, 119, 6689–6703, doi:10.1002/2014JA020052.



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2015

- Athieno, R., P.T. Jayachandran, D.R. Themens, and D.W. Danskin (2015), Comparison of observed and predicted MUF(3000)F2 in the Polar cap region , *Radio Sci.*, 50, 509–517. doi:10.1002/2015RS005725.
- Prikryl, P., Ghoddousi-Fard, R., Spogli, L., Mitchell, C. N., Li, G., Ning, B., Cilliers, P. J., Sreeja, V., Aquino, M., Terkildsen, M., Jayachandran, P. T., Jiao, Y., Morton, Y. T., Ruohoniemi, J. M., Thomas, E. G., Zhang, Y., Weatherwax, A. T., Alfonsi, L., De Franceschi, G., and Romano, V.: GPS phase scintillation at high latitudes during geomagnetic storms of 7–17 March 2012 – Part 2: Interhemispheric comparison, *Ann. Geophys.*, 33, 657-670, doi:10.5194/angeo-33-657-2015, 2015.
- Linty, N., Romero, R., DAVIS, F., & Alfonsi, L. (2015, May). Benefits of GNSS software receivers for ionospheric monitoring at high latitudes. In *Radio Science Conference (URSI AT-RASC), 2015 1st URSI Atlantic* (pp. 1-6). IEEE. doi: [10.1109/URSI-AT-RASC.2015.7303110](https://doi.org/10.1109/URSI-AT-RASC.2015.7303110)
- Cilliers, P., Alfonsi, L., & Spogli, L. (2015, May). GNSS scintillation climatology at SANAE-IV, Antarctica: 2006 to 2014. In *Radio Science Conference (URSI AT-RASC), 2015 1st URSI Atlantic* (pp. 1-1). IEEE. doi: 10.1109/URSI-AT-RASC.2015.7303100
- Terzo, O., Ruiu, P., Alfonsi, L., Romano, V., & Spogli, L. (2015, May). International cloud infrastructure for space weather data management: The DemoGRAPE challenge. In *Radio Science Conference (URSI AT-RASC), 2015 1st URSI Atlantic* (pp. 1-1). IEEE. doi: 10.1109/URSI-AT-RASC.2015.7303109
- Themens, D. R., P. T. Jayachandran, and R. B. Langley (2015), The nature of GPS differential receiver bias variability: An examination in the polar cap region, *J. Geophys. Res. Space Physics*, 120, 8155–8175, doi:10.1002/2015JA021639

2016

- Linty, N., DAVIS, F., Romero, R., Cristodaro, C., Alfonsi, L., Correia, E., "Monitoring Ionosphere Over Antarctica by Means of a GNSS Signal



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Acquisition System and a Software Radio Receiver," *Proceedings of the 2016 International Technical Meeting of The Institute of Navigation*, Monterey, California, January 2016, pp. 549-555.

- Themens, D.R., and P.T. Jayachandran (2016), Solar Activity Variability in the IRI at high latitudes: Comparisons with GPS Total Electron Content, *J. Geophys. Res. Space Physics*, 121, 3793–3807, doi:10.1002/2016JA022664.
- A. Favenza, N. Linty, F. Dosis, "Exploiting Standardized Metadata For GNSS SDR Remote Processing: a Case Study.", *Proceedings of the 29th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+ 2016)*, Portland (Oregon), September 12-16, 2016, ([in publication](#)).
- Linty N., Romero R., Cristodaro C., Dosis F., Bavaro M., Curran J., Fortuny-Guasch J., Ward J., Lamprecht G., Riley P., Cilliers P., Correia E. and L. Alfonsi (2016), Ionospheric scintillation threats to GNSS in polar regions: the DemoGRAPE case study in Antarctica, ENC 2016 IEEE Xplore Database and Conference Proceedings ([in publication](#)).
- Yamazaki, Y., M. J. Kosch, Y. Ogawa, and D. R. Themens (2016), High-latitude Ion Temperature Climatology during the International Polar Year 2007–2008, *Journal of Space Weather and Space Climate*. ([Submitted March 4th, 2016](#))
- Bergeot N., Chevalier J.-M., Bruyninx C., Denis G., Camelbeeck T., Van Dam T. and Francis O., Study of space weather impact on Antarctica ionosphere from GNSS data, BNCGG - BNCAR symposium, Brussels, Belgium, April 29, 2016 (Presentation).
- Bruyninx C., Bergeot N., Van Dam T., Camelbeeck T., Francis O. and Tabibi S., High precision GNSS infrastructure around the Princess Elisabeth Base, BNCGG - BNCAR symposium, Brussels, Belgium, April 29, 2016 (Presentation)

As part of SCAR's Capacity Building efforts, such as the Fellowships and Visiting Professor Awards, we are looking for people from all the SCAR groups to act form a 'review panel' so if applications in your field are submitted we have people to contact to help assess relevant applications.



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Please list one or more people from your group who would be willing to serve as fellowship reviewers for the next few years.

Lucilla Alfonsi (lucilla.alfonsingv.it) and Claudio Cesaroni (claudio.cesaroni) would be willing to serve as fellowship reviewers/contacts on behalf of the GRAPE community.

Webpages:

Many of the webpages for SCAR Groups have little information or are not updated regularly. Significant improvements are needed, and funding may be withheld until webpages are updated.

Please include any updates for your website below:

See info on GRAPE web above.

If you have suggestions on how to improve the structure of your group's webpages, please provide them below:

Members:

The complete list of people that are involved in GRAPE and in the previous group (action group) GWSWF (GNSS Weather and Space Weather Forecasting) is available at www.grape.scar.org.

Chair(s) Duration of Term

First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Giorgiana	De Franceschi	INGV	IT	Giorgiana.defranceschi@ingv.it	2008	



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