SCAR Sub-Group	**xxx**
SG	PS/LS/GS
Person Responsible:	xxx

SCAR Delegates Report 2020

GRAPE (GNSS Research and Application for Polar Environment)

2018-2020 Report

Summary

GRAPE was born in 2012 and it is a **joint Physical Science and Geoscience group**. In the last two years the group efforts have been addressed to organize a summer school, meetings, scientific sessions at SCAR2020 OSC and URSI GASS2020 Conference, to coordinate polar (Arctic and Antarctic) experimental campaign, to manage data, archive, and data base. The group worked to enlarge the scientific and technological issues within Solar Terrestrial interactions and Space Weather, including the interaction between neutral and ionized atmosphere, mainly based on Radio Science. This action has been concluded and **a new Proposal Planning Group named RESOURCE (has been recently submitted to SCAR** for consideration by the EXCOMM and SCAR delegates. The initial core membership includes 29 members from 18 Countries, representing the physical sciences and the geosciences. The proposed SRP, taking advantage of the experience of GRAPE, aims to gather the communities that investigate the polar atmosphere, with particular reference to Antarctica but with a bi-polar perspective, by means of radio probes into a common shared initiative. The scope is to improve the current understanding of the Antarctic atmosphere by sharing the expertise and the experience achieved by several scientific teams in the world, thus facilitating the advancement in the field and avoiding any duplication of activities already in action.

Due to the pandemic COVID 19 and the cancelled SCAR2020, **we do not know if the PPG RESOURCE will be considered to start within 2020. If not, GRAPE (planned to be embedded in the PPG) would continue its activity until the next SCAR2022.**

The remaining funds 2020 (4250USD from PS and GS) were to be spend to support 2 ECRs presenting a paper at SCAR2020 (session1&11) and 2 registration fees for attenders from the GRAPE community. **We would like to have the possibility to spend the 2020 funds allocated to GRAPE within 2021-2022.**

This report is submitted to both Physical Science and Geosciences Groups Officers.

Summary of activities from 2018-20

- Organization of the International School of Space Science - "The Polar Upper Atmosphere: from science to operational issues", L'Aquila, Italy, 21-27 September 2018. http://www.cifs-isss.org/pastcourses.asp
- Coordination of the GRAPE community for the organization of scientific sessions within SCAR2020 (Session1- Astronomy and geo-space observations from Antarctica, Session11 "Remote Sensing of the Polar Regions") and URSI GASS 2020 (Session GHJ "The Polar Environment and Geospace")
- Maintenance and updating of the GRAPE web.
- Coordination of international efforts for drafting the new PPG RESOURCE, submitted recently in March 2020.
- Coordination of activity for a review paper related to GRAPE/RESOURCE, to be tentatively submitted within September 2020.

- Coordination for data management and archive from Arctic and Antarctic experimental infrastructures of GRAPE interest.
- Publications 2019-2020.
- Outreaches activities have been carried out at national level
- Organization of the GRAPE on line workshop, free of charge, scheduled 1-3 July 2020. The format for the online workshop comprises a short opening plenary session where the state of the art of GRAPE and the potential offered by RESOURCE will be presented with opportunities for questions. The second day three parallel sessions (duration 2 hours) are planned with a number of presentations in order to highlight current gaps in data/knowledge, the next steps beyond the state of the art, potential of international collaborations to facilitate and support the next steps. Feedback from the parallel sessions will be presented in a closing plenary session (duration 1 hour). Four ECR are invited to give their presentations at the Opening Plenary Session. Info will be available from the end of May 2020 on www.grape.scar.org.

Summary Budget 2019 to 2022

	2019	2020**	**2021**	**2022**
	Spent	Allocated	Request	Request
(US$)	4250	4250	**5000**	**5000**

***Please note that the budget 2019-2020 allocated to GRAPE come from Physical Science (2019: 2250USD, 2020:2250USD) and Geoscience (2019: 2000USD; 2020:2000USD).**
****Due to pandemic COVID 2019 we will not able to spend the funds 2020.**

Progress to date

Sub-group Outcomes Summary
(*Summarize the above and in each case provide your sub-group name in left hand column to assist Science Group COs in compiling their reports*)

Sub-group	Activity/Outcome/Benefit/Achievement
GRAPE	Summer School "The Polar Upper Atmosphere: from science to operational issues", L'Aquila, Italy, 21-27 September 2018. http://www.cifs-isss.org/pastcourses.asp
GRAPE	One week meeting at INGV for drafting the PPG RESOURCE (2019).
GRAPE	PPG RESOURCE submitted in March 2020.
GRAPE	Planning and organization of two sessions at SCAR2020, reviewing of the submitted abstracts and program session delivery according with the LOC.
GRAPE	Planning and organization of one session at URSI GASS 2020, reviewing of the submitted abstracts and program session delivery according with the LOC.
GRAPE	Coordination of international efforts for a review paper. The submission is foreseen within 2020.
GRAPE	Planning of the GRAPE on line workshop(1-3 July 2020), including operational activity to make this possible (web updating to host the event, online registration form, abstracts and presentations uploading facility and management, etc…)

Sub-group Cash Flow
(*From previous Delegates meeting to date*)

Sub-group	Allocation	Amount spent 2018	2019	2020
GRAPE	**8500 (2019-2020)**		**4250**	

In 2018 GRAPE spent funds allocated in 2018 (from the budget 2016-2018) i.e. 4600USD.

Future plans

Planned activities in 2020 to 2022

Sub-group	Planned activity
GRAPE	GRAPE on line workshop
GRAPE	Review paper submission
GRAPE	URSI GASS2021session
GRAPE	URSI AT RASC 2022 session
GRAPE	SCAR2022 sessions
GRAPE	Web management and updating

Planned use of funds for 2020 to 2022

Year (YYYY)	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
2021	Review paper publication	2000	Nicolas Bergeot	
2021	URSI GASS2021/Support to ECRs	2000	Giorgiana De Franceschi	
2021	Web maintenance and updating	1000	Giorgiana De Franceschi	
2022	SCAR2022/support to ECRs and registration fees for session conveners from GRAPE	3000	Nicolas Bergeot	
2022	URSI AT RASC support to ECRs	2000	Giorgiana De Franceschi	
Total		**10000USD**		

Email: Giorgiana.defranceschi@ingv.it **;** Nicolas.bergeot@oma.be

Any additional detail on funds usage and desired results/outcomes

Percentage of the budget to be used for support of early-career researchers

2020:-
2021:50%
2022:50%

Percentage of the budget to be used for support of scientists from countries with developing Antarctic programmes

2020:-
2021:30%
2022:30%

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Chief officer	Giorgiana	De Franceschi	INGV	Italy	Giorgiana.defranceschi@ingv.it	August 2012	
Deputy chief officer	Nicolas	Bergeot	OMA	Belgium	nicolas.bergeot@oma.be	August 2016	

*Please identify early-career researchers with * in first column*
Other members

The full list of GRAPE members is available at www.grape.scar.org

First Name	Last Name	Affiliation	Country	Email

*Please identify early-career researchers with * in first column*

Additional information (optional)

Please add any more detail here that you wish, on your subgroup activities, papers published, etc.

Notable Papers

(*Five to ten most notable papers – see the example below, which includes a brief statement (shaded) indicating the link to the group*)

1. Correia, E., Raunheitte, L. T. M., Bageston, J. V., & D'Amico, D. E. (2020, March). Characterization of gravity waves in the lower ionosphere using very low frequency observations at Comandante Ferraz Brazilian Antarctic Station. In *Annales Geophysicae* (Vol. 38, No. 2, pp. 385-394).

They investigated the gravity wave (GW) characteristics in the lower ionosphere using very low frequency (VLF) radio signals. The analysis considered the VLF signal transmitted from the US Cutler, Maine (NAA) station that was received at Comandante Ferraz Brazilian Antarctic Station (EACF), with its great circle path crossing the Drake Passage longitudinally. The wave periods of the GWs detected in the low ionosphere are obtained using the wavelet analysis applied to the VLF amplitude. These results show that VLF technique is a powerful tool to obtain the wave period and duration of GW events in the lower ionosphere, with the advantage of being independent of sky conditions, and it can be used during the whole day and year-round.

2. Themens, D. R., Jayachandran, P. T., Reid, B., & McCaffrey, A. M. (2020). The limits of empirical electron density modeling: Examining the capacity of E-CHAIM and the IRI for modeling intermediate (1- to 30-day) timescales at high latitudes. Radio Science, 54. https://doi.org/10.1029/2018RS006763.

E-CHAIM (Empirical Canadian High Arctic Ionospheric Model model outperforms the IRI (International Reference Ionosphere) at 1- to 30-day timescales within the polar cap. E-CHAIM is capable of explaining 4–25% of the foF2 (the frequency of the F2 ionospheric layer) variance at storm timescales at high latitudes. Storm models are capable of improving overall model performance beyond the best monthly median representation.

3. Wang, Y., Zhang, Q.-H., Ma, Y.-Z., Jayachandran, P. T., Xing, Z.-Y., Balan, N., & Zhang, S.-R. (2020). Polar ionospheric large-scale structures and dynamics revealed by TEC keogram extracted from TEC maps. Journal of Geophysical Research: Space Physics, 125, e2019JA027020. https://doi.org/ 10.1029/2019JA027020

A tool named TEC (Total Electron Content) keogram is introduced for continuously monitoring the dynamics of large-scale structures in the polar region. Inspired by auroral keogram, the TEC keogram is developed from a time series of TEC lines obtained from long-term TEC maps. With this tool, case and statistical studies are carried out to infer the average moving speed and formation mechanism of polar patches.

4. De Franceschi, G., Spogli, L., Alfonsi, L., Romano, V., Cesaroni, C. Hunstad, I. (2019). The ionospheric irregularities climatology over Svalbard from solar cycle 23. Scientific Reports, Nature Publishing Group, https://doi.org/10.1038/s41598-019-44829-5

This work provides an unprecedented description of the climatology of ionospheric irregularities over the Arctic derived from the longest GNSS data series ever collected for this specific aim. The results offer realistic features of the high latitude ionosphere that can substantially contribute to the necessary improvements of forecasting models, providing a broad spectrum of ionospheric reactions to different space weather conditions.

5. Prikryl, P., Nikitina, L., and Rusin, V. (2019), Rapid intensification of tropical cyclones in the context of the solar wind-magnetosphere-ionosphere-atmosphere coupling, Journal of Atmospheric and Solar-Terrestrial Physics, 183, 36-60. https://doi.org/10.1016/j.jastp.2018.12.009

This work highlights the interaction between lower and upper atmosphere and the influence of the polar/high latitude on the tropical cyclones. Rapid intensification of tropical storms tends to follow arrivals of high-speed solar wind. Atmospheric gravity waves launched from high latitudes can reach tropical cyclones, can trigger moist instabilities leading to convective bursts, linked to rapid intensification of tropical cyclones.

Direct support from outside organisations received for your activities

(*Numbered list with values indicated if direct cash support. Please restrict in-kind support to substantive in-kind support only*)

The activity is mainly supported by individual national programs, funding national projects.

Major collaborations your Science Group has with other SCAR groups and with organisations/groups beyond SCAR

(*Numbered list of substantive collaborations*)

Within SCA

1. Physical Science and Geoscience Groups. SERCE program

Outside SCAR

1. URSI COMMISSIONS G, H, J

Outreach, communication and capacity-building activities

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Outreaches activities are carried out by national initiatives. Seminars, fairs, events are yearly supported by GRAPE community. Regularly GRAPE events are communicated to the SCAR board for spreading through suitable channels.

SCAR fellowship reviewers

As part of SCAR's Capacity Building efforts, such as the Fellowships and Visiting Scholar Awards, we are looking for people from all the SCAR groups to form a 'review panel' so if applications in your field are submitted we have people to contact to help assess relevant applications. Please list one or more people (name and email address) from your group who would be willing to serve as reviewers for the next few years, along with 1-3 keywords on their principal expertise.

First Name	Last Name	E-mail	Principal Expertise
Nicolas	Bergeot	nicolas.bergeot@oma.be	Ionosphere, plasmashere, geodesy
Lucilla	Alfonsi	lucilla.alfonsi@ingv.it	Ionosphere, space weather
Monia	Negusini	negusini@ira.inaf.it	Neutral atmosphere, water vapor
Emilia	Correia	ecorreia@craam.mackenzie.br	Multi-instrument monitoring, space weather, VLF