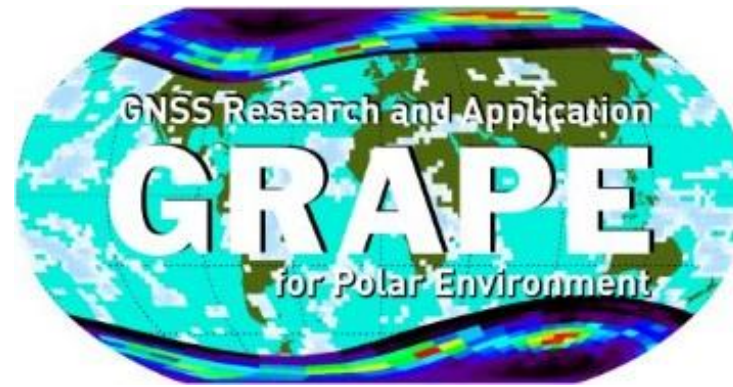




Istituto Nazionale di  
Geofisica e Vulcanologia



# “GNSS Research and Application for Polar Environment” (GRAPE)

*A joint SSG PS and GS Expert Group*

*Giorgiana De Franceschi, Istituto Nazionale di Geofisica e Vulcanologia, [giorgiana.defranceschi@ingv.it](mailto:giorgiana.defranceschi@ingv.it)*



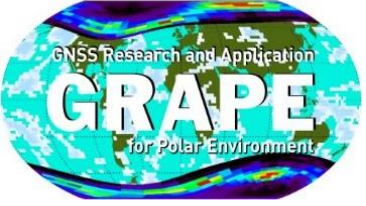
SCAR OSC 2016, GRAPE SIDE MEETING, 21 AUGUST 2016 RENAISSANCE HOTEL,  
KUALA LUMPUR, MALAYSIA

## GRAPE SIDE MEETING-21 August Renaissance Hotel Kuala Lumpur 14.00-16.00

<http://scar2016.com/side-meeting-travel-info.php>

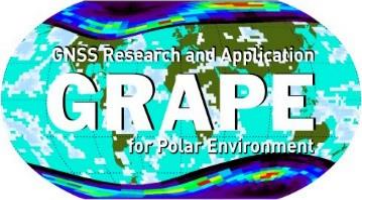
### AGENDA

- 14.00-14.15 GRAPE state of the art and future activities (Giorgiana De Franceschi)
- 14.15-15.00 GRAPE-National projects/initiatives:
  - Emilia Correia (INPE- Brazil)
  - Lucilla Alfonsi (ING-Italy)
  - Wayan Suparta (ANGKASA-Malaysia)
  - Nicolas Bergeot (ROB-Belgium)
  - Adriana Gulisano (IAA- Argentina)
- 15.00-15.15 The challenge on DATA sharing and management: the example of DemoGRAPE (Vincenzo Romano, Luca Pilosu, Olivier Terzo)
- 15.15-15.30 RESOURCE- The proposal for a new SRP (Lucilla Alfonsi, GRAPE task force)
- 15.30-16.00 Discussion and wrap up (All) **(NEW CANDIDATURES!)**



## GRAPE main objectives:

- Create and maintain distributed **networks** of specialized **GPS/GNSS** Ionospheric Scintillation and TEC Monitors
- Identify and quantify mechanisms that cause **scintillation** and control **interhemispheric** differences, asymmetries and commonalities
- 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.



# GRAPE structure

- **WG1-** Solar-Terrestrial interactions and ionospheric effects in the current solar-cycle  
(chair: Paul Prikryl- Canada, co-chair: Emilia Correia- Brazil)
- **WG2-** Lower atmosphere delay in GNSS based systems  
(chair: Monia Negusini – Italy)
- **WG3-** Modelling and models testing  
(chair: Cathryn Mitchell UK, co-chair Marcin Grzesiak, Poland)
- **WG4-** GNSS Data management strategy.  
(chair: Vincenzo Romano-Italy, co-chair: Pierre Cilliers-South Africa)
- **WG5-** Coordination with other programs inside and outside SCAR  
(chair: Maurizio Candidi Italy)

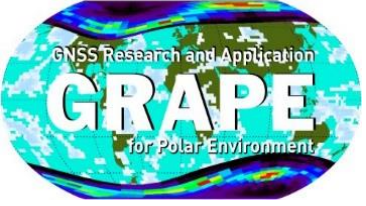
**TABLE OF NATIONAL ACTIVITIES SUPPORTING GRAPE**

Country	Projects (acronym, starting-end date, 1-sentence description)	Experimental Infrastructure, Station name and coordinates (IF APPLICABLE)	Contact person(s)
Argentina	<ul style="list-style-type: none"> <li>Permanent Measurements: Ionospheric vertical sounding, Cosmic noise for ionospheric absorption, relative magnetic field components and absolute magnetic measurements.</li> <li><b>LAGO (Latin American Giant Observatory) new</b></li> </ul>	Ionosonde, magnetometers, riometer, at Belgrano II Base, Nunatak Bertrab (bahia Vashel), costa Confin (Tierra de Coats) (77°51'S 34°33'W), San Martin Base, Islote Barry - islote San Martin (caleta Sanaviron, paso Mottet), islotes Debenham (bahia Margarita, costa Fallieres), (68°08'S 67°06'W)	<a href="mailto:agulisano@dna.gov.ar">agulisano@dna.gov.ar</a> <a href="mailto:diegogi@dna.gov.ar">diegogi@dna.gov.ar</a>
Belgium	<ul style="list-style-type: none"> <li>Permanent GNSS network in the frame IceCon project (Constraining Ice Mass Change in Antarctica - since 2012)</li> <li><b>ANTION: SUBMITTED</b></li> </ul>	GNSS receivers at Derwael Ice Rise (70.14S; 26.2 E), Yet Nuten (72.20S;22.6E ), Princess Elisabeth Station (71.5S;23.2E )	<a href="mailto:nicolas.bergeot@oma.be">nicolas.bergeot@oma.be</a>
Brazil	1) Sun-Earth connections inside the INCT-APA (National Institute of Science and Technology - Environment Antarctic Research, since 2009). 2) Characterization of the ionosphere dynamics over Antarctic region and your connection with the South America (monitoring the ionosphere using radio sounding techniques since 2013). 3) Monitoring the ionosphere using VLF and GPS-TEC receivers in Antarctica (since 2004).	Ionosonde, GPS-TEC JAVAD, GNSS for TEC and scintillation, riometers, VLF for ionosphere monitoring at Brazilian Antarctic Station Comandante Ferraz (EACF 62.8S, 58.4W). GNSS for TEC and Scintillation, riometers and VLF at Radio Observatory of Itapetinga (ROI, 23.2S, 46.6W)	<a href="mailto:ecorreia@craam.mackenzie.br">ecorreia@craam.mackenzie.br</a>
Canada	Canadian High Arctic Ionospheric Network (CHAIN) - An array of ground-based radio instruments including high data-rate Global Positioning System ionospheric scintillation and total electron content monitors and Canadian Advanced Digital Ionosondes operating since 2008	<a href="http://chain.physics.unb.ca/chain/pages/stations/">chain.physics.unb.ca/chain/pages/stations/</a>	<a href="mailto:paul.prikryl@unb.ca">paul.prikryl@unb.ca</a>

**TABLE OF NATIONAL ACTIVITIES SUPPORTING GRAPE**


Country	Projects (acronym, starting-end date, 1-sentence description)	Experimental Infrastructure, Station name and coordinates (IF APPLICABLE)	Contact person(s)
Italy	<p>1) DemoGRAPE (GRAPE Demonstrator), 2014-2016; 2) ISACCO (Ionospheric Scintillation Arctic and Antarctic Campaign Coordinated Observation), Permanent GNSS network, Since 2003; 3) IDIPOS (Italian Database Infrastructure for Polar Observation Sciences), Italian Antarctic Data Infrastructure 2012-2014,</p> <p><b>2) PNRA 2016-2018: CONCORDIA and MZS-New!</b></p> <p><b>3) GRAPEVINE: SUBMITTED! (IT-BE-SA-BR)</b></p>	<p>Ionosonde, GNSS for TEC and scintillation monitoring at Mario Zucchelli Station (74.7S, 164.1E, Antarctica); NyAlesund ( 79.9N, 11.9E,;Svalbard), Longyearbyen (78.2N, 15.9E; Svalbard), Concordia Station ( 75.1S, 123.3E, Antarctica,)</p>	<p>lucilla.alfonsi@ingv.it, vincenzo.romano@ingv.it, claudio.cesaroni@ingv.it</p>
	<p>1) VLNDEF (Geodetic and geophysical survey for geodynamical modelling of Northern Victoria Land) since 1999; 2)MALOX (Mass Lost in wind fluX), 2014-2016</p>		<p><a href="mailto:negusini@ira.inaf.it">negusini@ira.inaf.it</a></p>
Poland	<p>MISTECS (Monitoring Ionospheric Scintillation and TEC on Spitsbergen)</p>	<p>Ionosonde and GNSS receivers for TEC and scintillation monitoring, Hornsund (77.0 N; 15.33E)</p>	<p><a href="mailto:pajak@cbk.waw.pl">pajak@cbk.waw.pl</a></p>
South Africa	<p>1) Polar and high latitude ionospheric scintillation studies using permanent GNSS network in Antarctica, Marion Island, and Gough Island since 2006 2) SCAR DemoGRAPE (GPS research for Polar Environment) partner since 2012</p>	<p>HF radar, Magnetometers, GNSS receivers for TEC and scintillation monitoring at SANAE (Antarctica,72.0°S, 2.5°W), Marion Island (Indian Ocean, 46.87° S, 37.86°E) and Gough Island (Atlantic Ocean, 40.34°S, 9.88°W)</p>	<p>pjckilliers@sansa.org.za, sltoz@sansa.org.za, mkosch@sansa.org.za</p>
UK	<p>GNSS network in the frame of a EPSRC funded project, "GNSS scintillation: detection, forecasting and mitigation"</p>	<p>GNSS for TEC and scintillation monitoring at: Trondheim (63.42N; 10.41E, Norway); Lerwick (60.15N; 01.13W, UK);</p>	<p>sreeja.veetil@nottingham.ac.uk marcio.aquino@nottingham.ac.uk</p>





# GNSS network – Northern hemisphere

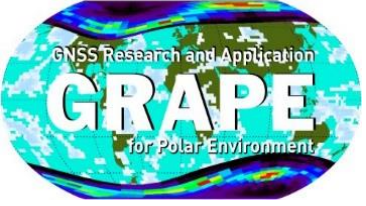


  
GISTM receivers

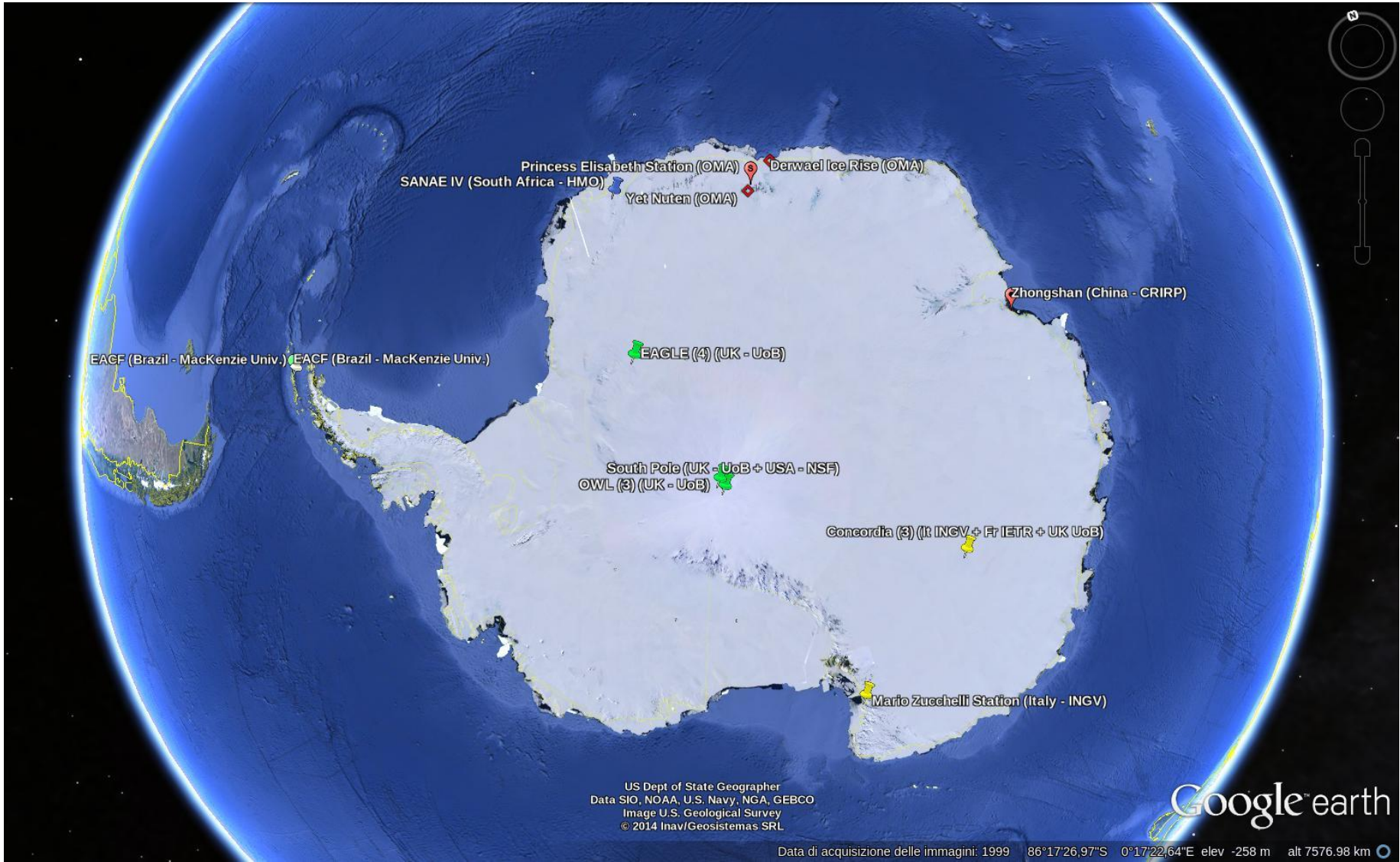
  
CJW-1 receiver

  
PolaRxs receivers



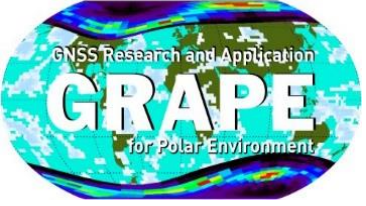


# GNSS network – Southern hemisphere

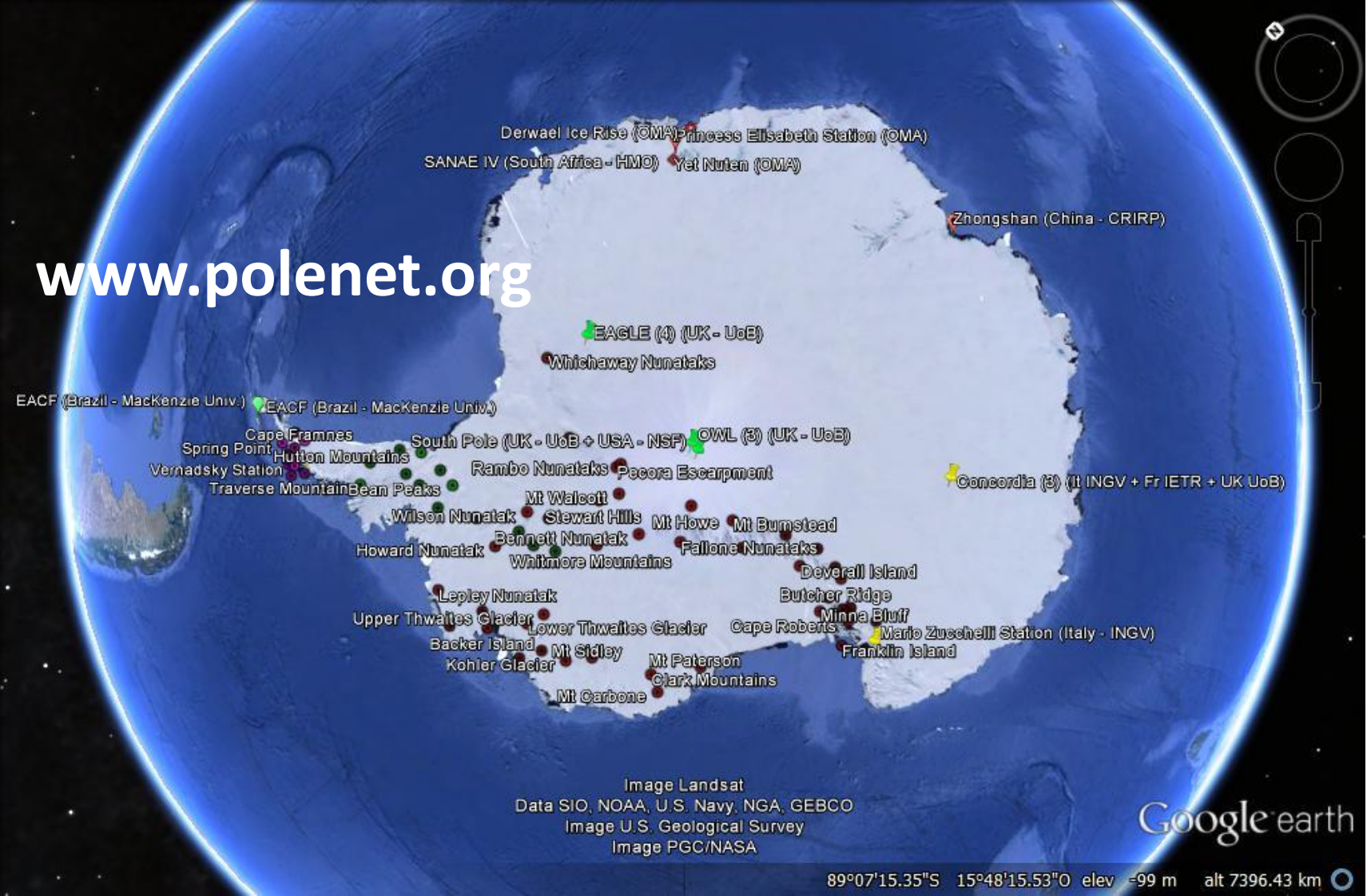


GISTM receivers	CJW-1 receiver	Javad receiver	PolaRxs receiver	Trimble receivers







# GNSS network – Southern hemisphere




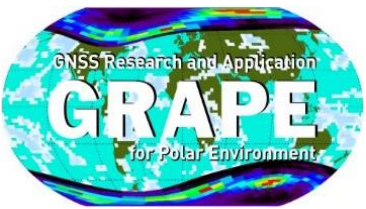
  
GISTM receivers

  
CJW-1 receiver

  
Javad receiver

  
PolarXs receiver

  
Trimble receivers



eSWua  
www.eswua.ingv.it

Madrigal home page

Choose instrument type:  
Ground Based Satellite Receivers

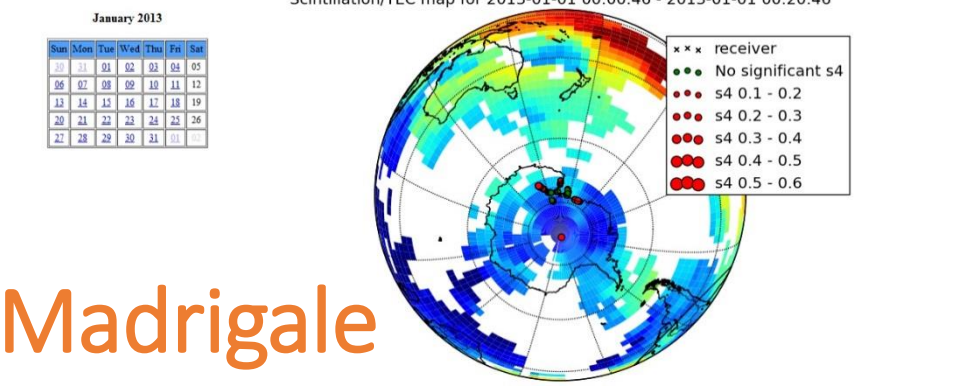
Selected Instrument:  
McMurdo Scintillation Receiver  
PI: Allan T. Weatherwax - please contact before using this data

Experiment: Scintillation: 2013-01-01 00:00:46 - 2013-01-01 23:59:46

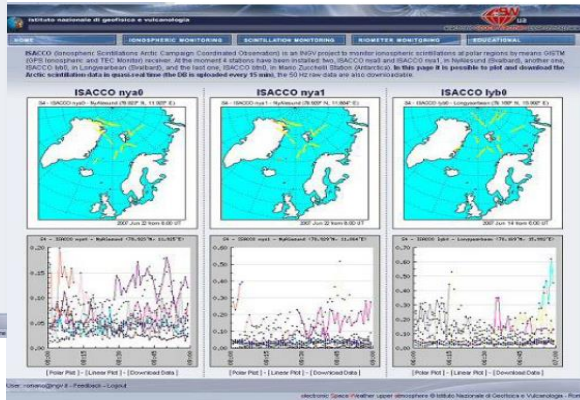
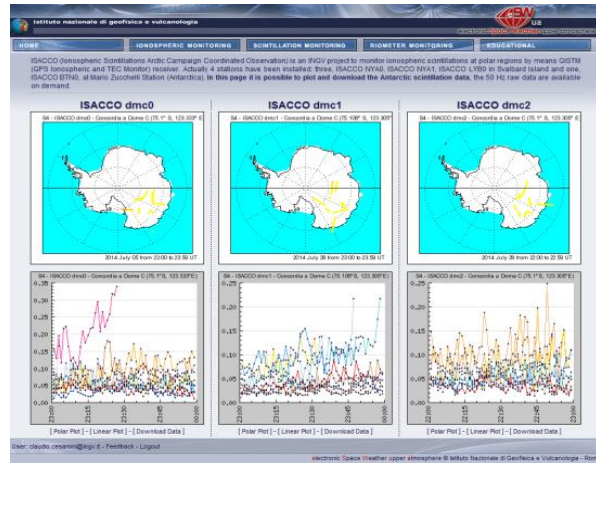
Select File:  
1721\_2\_00 gps\_all\_out ionospheric scintillation - Final

Download data Print data View info Show Pls

Year: 2013  
Month: January



Madrigale  
<http://cedar.openmadrigal.org/>

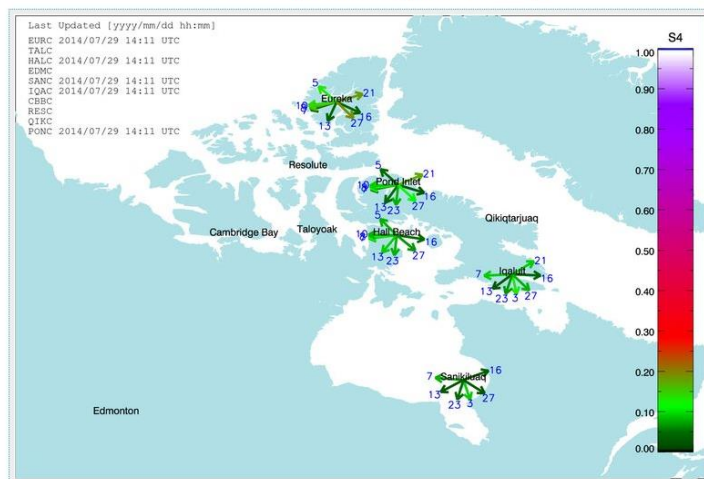


**CHAIN**  
the Canadian High Arctic Ionspheric Network

Home About People Instruments Stations Data Products Photos Publications Software

Welcome to the Canadian High Arctic Ionspheric Network

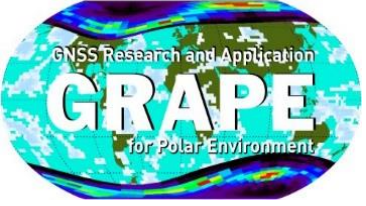
Real-time Scintillation Activity in the Polar Cap



CHAIN  
<http://chain.physics.unb.ca/chain/>

DATA from the network are available on request;  
visit the GRAPE web






# GRAPE 2012-2016 RESULTS (1/2)

- **WEB** [www.grape.scar.org](http://www.grape.scar.org) , contribution to [www.scar.org](http://www.scar.org) pages
- **Outreaches –INGV**







## Expedition to the South Pole: a role play for pupils

Lucilla Alfonsi <sup>1</sup>, Claudio Cesaroni <sup>1</sup>, Massimo Crescimbeni <sup>1</sup>,  
Federica La Longa <sup>1</sup>, Vincenzo Romano <sup>1,2</sup>

<sup>1</sup> Istituto Nazionale di Geofisica e Vulcanologia  
<sup>2</sup> SpacEarth Technology S.r.l.



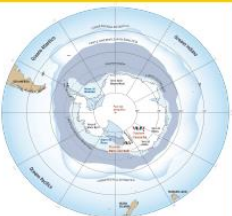
**Motivation**



The idea to communicate and to share the experience of the scientific research in Antarctica with the public and with the school is a challenge that a team of INGV researchers, engaged for many years in scientific missions in Antarctica, carries on with great enthusiasm within the several outreach activities of the Italian National Program for Antarctic Research (PNRA).

The present work reports the experience of the outreach laboratory "Expedition to the South Pole", realized in the frame of events organized by INGV and dedicated to the primary school (8-11 years).

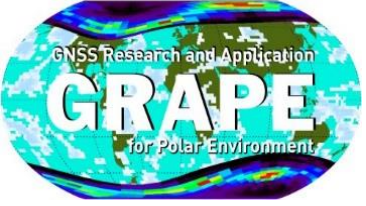
The educational themes developed within the laboratory concern the research in Antarctica, with particular focus on the human aspects, the geophysics and the progress of new technologies. The innovative aspect of the laboratory stands in the strategy to deal with Antarctica with an educational aim, proposing Antarctica as a natural laboratory, not only from a scientific point of view, but also as a laboratory of human experiences sharing.



*From the book: Lost and Found by Oliver Jeffers*



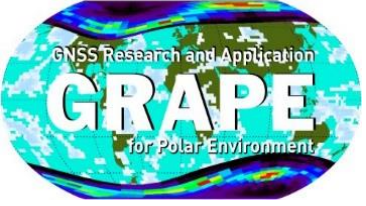
N. Bergeot (ROB, Be), Why do we need to continue scientific research in Antarctica? Cognac Rotary Club, France, March 2, 2016



# GRAPE 2012-2016 RESULTS (2/2)

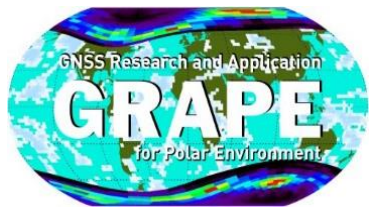
- **Publications** (full list at [www.grape.scar.org](http://www.grape.scar.org)) > **30 papers including Conference Proceedings**
- **SCAR reports**
- **Conferences, Meetings, Workshops**
  - **IPY 2012** Conference (Montreal, Canada)
  - **XXXII SCAR OSC 2012** (Portland, Oregon - USA): GRAPE Session and Satellite Meeting
  - **XXXIII SCAR OSC 2014** (Auckland, New Zealand): GRAPE Session and Satellite Meeting
  - **KoM DemoGRAPE project 2014** (Rome, Italy)
  - **URSI AT RASC 2015** (Gran Canaria, Spain): **GRAPE Oral session and side meeting** (>30 attending people from URSI community)
  - **BSS, 2016** (Trieste, Italy): **Session 7-Polar (high-latitude) Effects on GNSS** (20 papers presented)
  - **SCAR OSC 2016** (Kuala Lumpur, Malaysia)- **GRAPE session and side meeting**





## GRAPE future activities (1/4)

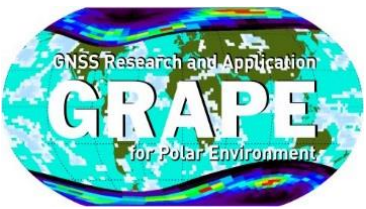
- **Contribute** to one of the six priorities for Antarctic Science (Theme: Observe space and the Universe- *Solar events impact on global communications and power systems*)
- **Maintain** and improve **the networks** of specialized GPS/GNSS Ionospheric Scintillation and TEC Monitors and **encourage multi-instrument data** approach to investigate the neutral and ionized atmosphere (SuperDARN, magnetometers, ionosondes, all-sky camera, in-situ data, etc....)
  - **Encourage** the scientific and technological **cooperation** among institutions/countries
  - **Develop** data management strategies and algorithms (**ICT**) to combine data from different sources
  - **Disseminate the results** (SCAR reports, conferences, publications, web



# GRAPE future activities (2/4)

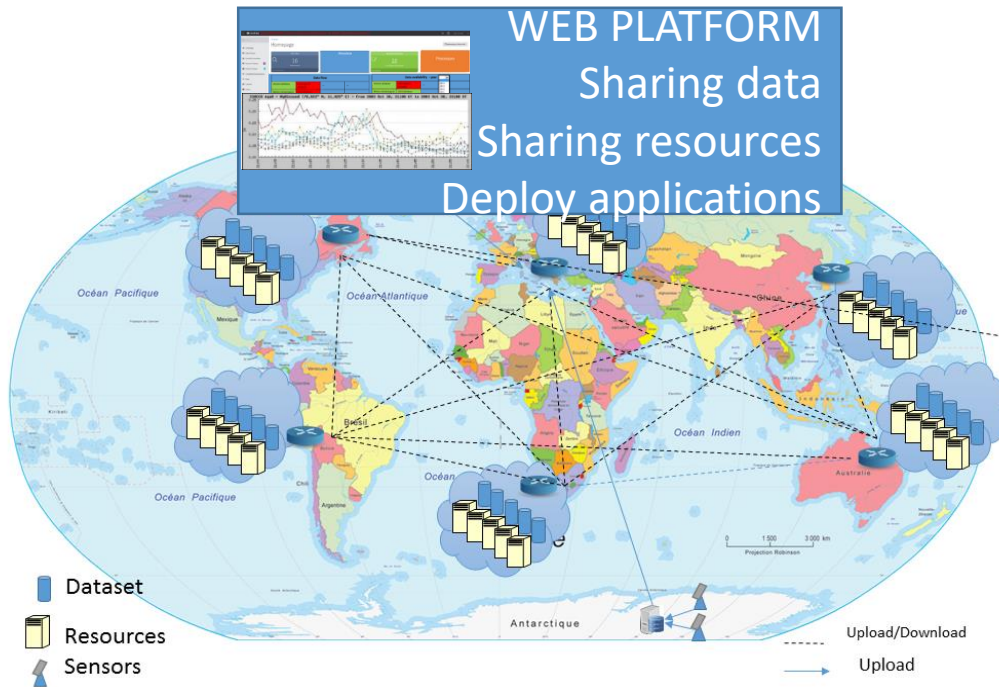
## Contribute to Theme: Observe space and the Universe

- Task force established in May 2015
- **RESOURCE (Radio Sciences Research on AntarctiC AtmospherE)** aiming to
  1. **promote the coordination of multi-disciplinary and multi-instrumental studies to look at the atmosphere and its impact on complementary measurements** also in collaboration with other programmes acting inside and outside SCAR.
  2. **support the definition of the best practices addressed to the protection of the Intellectual Property Rights (IPR) on the data and software sharing.** The question is of paramount importance and some best practices adopted within the GRAPE community, as the use of **Cloud computing, will be extended to all the involved communities.** That part of the job will be coordinated in **close contact with SC-ADM, the SCAR Standing Committee on Antarctic Data Management.**



# GRAPE future activities (3/4)

**RESOURCE GOAL N.2** Based on the outcome from DemoGRAPE project (PNRA 2014-2016 IT, SA, BR) efforts will be addressed to ICT development for DATA and TOOLS managements

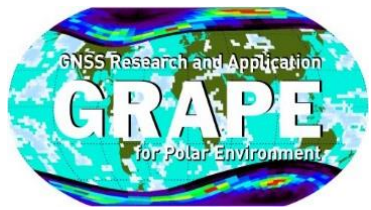


## INFRASTRUCTURE MODEL PROPOSED

- **Federation of infrastructures by cloud**
- **Open cloud Standard for Interoperability**

## NEEDS

- **Improve data accessibility/management**
- **Share data/algorithms and resources**
- **Improve applications/data interoperability**
- **Flexible datasets discovery mechanism**
- **Data availability** for different teams, communities
- **Computational resources availability** for analysis
- **Reduce complexity of IT resources and data management**



## GRAPE future activities (4/4)



Montreal-CA, 19-26 August 2017

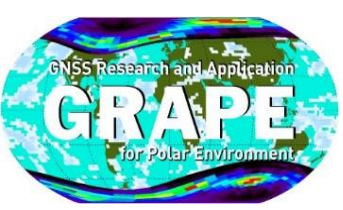
### **Comissions G-F joint Scientific Session** **Radio Studies on Polar Aeronomy**

***Conveners: G. De Franceschi (INGV, IT) -V. Chandrasekar (Colorado Sate Univ, USA)- L. Baldini (CNR, IT)***

At high and low latitudes, the ionosphere can be particularly perturbed and this can be exacerbated around solar activity maxima (but not only). **Ionosphere can in turn significantly affect L band (and lower frequency) remote sensing radar systems for Earth science** dedicated to observations of surface deformation, cryosphere dynamics, etc...**To pose a solid bridge between the ionosphere and remote sensing communities, this session solicits contributions to facilitate exchange of information on their respective states of the art as well as on their future needs.** Contributions are welcome on **ionosphere and lower troposphere research at high latitudes** from GNSS and satellites in situ data dealing with ionospheric irregularities, scintillation, total electron content (TEC) gradients, as well as water vapor measurements. Papers dealing with the assessment and mitigation of "atmosphere" **impacts on different applications** such as positioning, space weather and **remote sensing** are highly encouraged. Papers focusing on data processing to support models development are also welcome, as are those based on a multi- instrument approach. Finally, contributions highlighting differences and similarities at high and low latitudes are also appreciated.

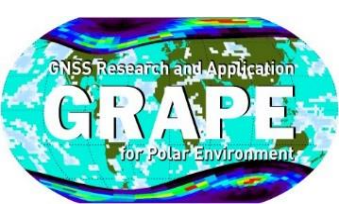
**PAPER SUBMISSION DEADILE: JANUARY 30, 2017 [www.gass2017.org](http://www.gass2017.org)**





## PROPOSED BUDGET 2017-2018

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 paper.	5000	Giorgiana De Franceschi  Lucilla Alfonsi Pierre Cilliers Nicolas Benoit	Giorgiana.defranceschi@ingv.it



## **OTHER ACTIONS:**

### **1) GRAPE: NEW CANDIDATURES AS OFFICER- ELECTION**

#### **RESULTS OF THE MEETING -**

**CHAIR: GDF-Italy**

**VICE-CHAIR: N.B. Belgium**

**1b) Malaysia (ANGKASA, UKM) will support GRAPE and RESOURCE, WAYAN SUPARTA.**

### **2) RESOURCE: IMPLEMENTATION PLAN, CANDIDATURES TO COORDINATE THE SRP PROCESS**

**3) LA will spread the doc related to RESOURCE. LA will coordinate with AW, EC, PC, NB, MC, AG during the SCAR OSC to carry out the best way to proceed till the URSI GASS 2017 when the final proposal must be ready.**

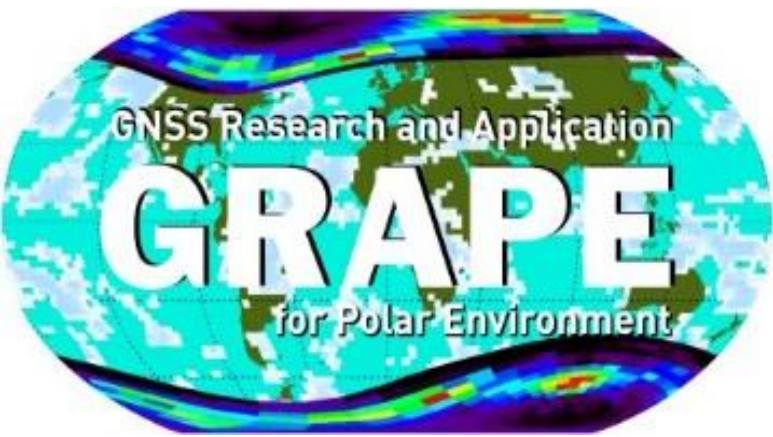
**4) GRAPE participants are asked to contact their SCADM representatives to support and to disseminate the question of ICT data and tools management.**

**5) Representative from CANADA-CHAIN.**

**6) SERANT AND GRAPE WILL COORDINATE WITH THE SAME GOAL OF THE NEW SRP PROJECT.**

**7) Mark Clilverd will be included in the GRAPE mailing list.**

**18.00 grape side meeting close**



**THANKS**

[WWW.GRAPE.SCAR.ORG](http://WWW.GRAPE.SCAR.ORG)