SCAR Delegates Report 2020

Expert Group "Geodetic Infrastructure in Antarctica" (GIANT)
2018-2020 Report

Summary

Report Author(s)

Mirko Scheinert (Germany, Mirko.Scheinert@tu-dresden.de),
Alessandro Capra (Italy)

Summary of activities from 2018-20

Geodetic GNSS measurements on bedrock are indispensable to determine vertical and horizontal deformations of the Earth's crust in order to provide in-situ information for the study of glacial-isostatic adjustment (GIA) and plate tectonics. During last Antarctic seasons GNSS measurements were contin-ued. New data – especially episodic GNSS data – are incorporated into the "SCAR GNSS Database" maintained at TU Dresden.

The new "Geodynamics In ANTarctica based on REprocessing GNSS dAta Initiative" (GIANT-REGAIN) was announced in 2016 to realize a major reprocessing of Antarctic GNSS data to infer a consistent set of coordinates and coordinate changes for further geoscientific investigation (especially GIA). This project is still in progress, first results are expected 2020/2021.

The "2nd SCAR Summer School on Polar Geodesy" was carried out in Ladozhskoe Ozero, Russia, 10–19 May 2018 and formed a contribution both to EG GIANT and to SCAR SRP SERCE. Members of GIANT contributed to further summer schools in the framework of SERCE, e.g. the GIA training school in Gävle, Sweden, in September 2019.

Members of GIANT actively supported the initiation of a new SCAR Scientific Research Program in sucession to SERCE and PAIS, namely *INStabilities and Thresholds in ANTarctica* (INSTANT). This new SRP proposal was submitted to SCAR EC in June 2020. Thus, EG GIANT requests the strong support of the SG Geosciences for this new SRP.

Summary Budget 2019 to 2022

	2019	2020	**2021**	**2022**
	Spent	Allocated	Request	Request
(US$)	0	3000	3000	3000

Progress to date

Sub-group Outcomes Summary

Contribution to training schools

The "2nd SCAR Summer School on Polar Geodesy" was already reported in 2018. GIANT members contributed to further E/O activities. Here we shall name the active participation as lecturers in the GIA Training School in Gävle, Sweden, in September 2019.

Major efforts were dedicated to the project **GIANT-REGAIN** (**G**eodynamics **I**n **ANT**-arctica based on **RE**processing **G**NSS d**A**ta **In**itiative) which was initiated at the SCAR Meeting in Kuala Lumpur in 2016. The aim is to realize a reprocessing of all GNSS data available in Antarctica to come up with best estimates of station coordinates and velocities to infer plate motion, vertical uplift (dedicated to glacial-isostatic adjustment) and further geodynamic parameters

By now, a lot of work was fulfilled with regard to the retrieval and compilation of data and metadata. The finalization of the list of stations (about 260) and the check of the respective metadata formed a major work task. Now, the re-processing of the entire dataset is being performed at three processing centres (TU Dresden, Germany; University of Tasmania, Hobart, Australia; and Ohio State University, Columbus, USA). First results can be expected in 2020/2021.

Sub-group Cash Flow

(*From previous Delegates meeting to date*)

Sub-group	Allocation	Amount spent		
		2018	**2019**	**2020**
EG GIANT		3,972	0	0
EG GIANT allocation for 2020	3,000			

Future plans

Planned activities in 2020 to 2022

1. The project GIANT-REGAIN (**G**eodynamics **I**n **ANT**arctica based on **RE**pro-cessing **G**NSS d**A**ta **In**itiative) enters the next phase when re-processing of the entire dataset will be performed at the three processing centres (TU Dresden, University of Tasmania, and Ohio State University). The aim is to provide a best estimated, consistent set of of station coordinates and velocities at these bedrock sites for further investigation of Antarctic geodynamics and neotectonics. There is an urgent need both to enhance the provision of in-situ data as well as to improve the consistency of geodetic data products. Station velocities are to be used as constraints for the investigation of glacial-isostatic adjustment which is a key to understand interactions between ice sheet, solid earth and sea level. Thus, it is also indispensable to continue and even densify measurements at geodetic GNSS sites in Antarctica.

2. We aim to improve the visibility of GIANT to other SCAR entities and both geo-scientific and non-geoscientific disciplines. It is timely to disseminate information on the importance and value of geodetic measurements. Geodesy provides key data to maintain the terrestrial reference frame in Antarctica and to determine the regional gravity field at high resolution. Especially GNSS observation at bedrock sites provide in-situ data for further investigations in geodynamics but also refer-ence to link local or regional surveys to a proper reference frame solution. Thus, EG GIANT through its observational projects is a key Antarctic geosciences are based on. Therefore, we will further develop web services and long-term archiv-ing facilities. This includes to compile metadata and assist to fulfil requirements evolving from recommendations (e.g. on geodetic monuments, see above) and from the SCAR scientific research program SERCE. We will further improve link-ages with GIS developments and information platforms like Quantarctica and SOOS. This forms an ongoing task.

3. We aim to involving early career scientists to take over responsibilities, and to supporting them in realizing (short) research stays and taking part in conferences with GIANT-related sessions. The latter is an ongoing major goal to foster scien-tific exchange and discussion. For this, in close coordination with the new SRP INSTANT, we will organize special session(s) at upcoming conferences. Focus shall be given on the scientific applications of geodetic measurements in geodesy, geodynamics and glaciology.

Due to the described major activities (cf. especially 1 and 2) and Terms of Reference it is needed to continue geodetic observations for all kind of applications (mainte-nance of reference frame; investigation of changing dynamics of the Antarctic ice sheet, especially the study of glacial-isostatic adjustment; in-situ data for validation of satellite missions and products especially w.r.t. CryoSat-2, ICESat-2 and GRACE-FO). In terms of the changing ice sheet and linked sea-level change there is also a strong monitoring aspect. **Therefore, the Expert Group GIANT is to be continued.**

Planned use of funds for 2020 to 2022

Year (YYYY)	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
2020	Financial support for sci-en-tific student assistant: Development of web and GIS-related services and applications for SCAR GNSS Database	2,000	Mirko Scheinert	Mirko.Scheinert @tu-dresden.de
2020	Travel Support for early career scientists to realize research stay and/or attend GIANT-related conferences	1,000	Alessandro Capra, Mirko Scheinert, Matt King	Alessandro. Capra @unimore.it
2021	Financial support for sci-en-tific student assistant: Development of web and GIS-related services and applications for SCAR GNSS Database	1,500	Mirko Scheinert	Mirko.Scheinert @tu-dresden.de
2021	Travel Support for early career scientists to realize research stay and/or attend GIANT-related conferences	1,500	Alessandro Capra, Mirko Scheinert, Matt King	Alessandro. Capra @unimore.it
2022	Travel Support for early career scientists to realize research stay and/or attend GIANT-related conferences	3,000	Alessandro Capra, Mirko Scheinert, Matt King	Alessandro. Capra @unimore.it
Total		**9,000**		

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

2020: 33%
2021: 50%
2022: 100%

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

2020: tbd
2021: tbd
2022: tbd

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Chair	Alessandro	Capra	Universita di Modena e Reggio Emilia	Italy	Alessandro.Capra@unimore.it	2014	
Co-Chair	Mirko	Scheinert	TU Dresden	Germany	Mirko.Scheinert@ tu-dresden.de	2014	

Other members
*Please identify Early Career Scientists with * in first column*

First name	Last name	Affiliation	Country	Email
Manuel	Berrocoso	Universidad de Cadiz	Spain	manuel.berrocoso@uca.es
Graeme	Blick	LINZ	New Zealand	gblick@linz.govt.nz
Jan	Cisak	IGIK	Poland	jcisak@igik.edu.pl
Beata	Csatho	University of Buffalo	USA	bcsatho@buffalo.edu
John	Dawson	Geoscience Australia	Australia	john.dawson@ga.gov.au
Koishiro	Doi	National Institute of Polar Research	Japan	doi@nipr.ac.jp
Rene	Forsberg	DTU Space	Denmark	rf@space.dtu.dk
Brendan	Hodge	UNAVCO	USA	hodge@unavco.org
Larry	Hothem	USGS	USA	ldhothem@gmail.com
Asparuh	Kamburov	University of Mining and Geology Sofia	Bulgaria	asparuh.kamburov@mgu.bg
Matt	King	University of Tasmania	Australia	Matt.King@utas.edu.au
*Christoph	Knöfel	TU Dresden	Germany	Christoph.Knoefel@tu-dresden.de
Jeronimo	Lopez	Universidad Autonoma de Madrid	Spain	jeronimo.lopez@uam.es
Jaakko	Mäkinen	Finnish Geodetic Institute	Finland	jaakko.makinen@fgi.fi
Alexey	Matveev	Aerogeodeziya	Russia	matveev@agspb.ru
Gennadi	Milinevsky	University of Kyiv	Ukraine	gennadim@gmail.com
Markku	Poutanen	Finnish Geodetic Institute	Finland	Markku.Poutanen@fgi.fi
Goncalo	Prates	Univ. Algarve	Portugal	gprates@ualg.pt
Yves	Rogister	Univ. Strasbourg	France	Yves.Rogister@unistra.fr
Lars	Sjöberg	KTH Royal Institute of Technology	Sweden	lars.sjoberg@abe.kth.se
Norbertino	Suarez	Servicio Geografico Militar	Uruguay	norbertinosuarez@gmail.com
Andrés	Zakrajsek	Instituto Antartico Argentina	Argentina	afz@dna.gov.ar

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. Barletta, V. R., M. Bevis, B. E. Smith, T. Wilson, A. Brown, A. Bordoni, M. Willis: A. Khan, M. Rovira-Navarro, I. Dalziel, R. Smalley, E. Kendrick: Konfal, D. J. Caccamise, R. C. Aster, A. Nyblade and D. A. Wiens (2018). Observed rapid bedrock uplift in Amandsen Sea Embayment promotes ice-sheet stability. *Science*, 360(6395): 1335–1339. DOI: 10.1126/science.aao1447.

This paper provides an investigation on GIA-driven crustal deformation in the Amundsen Sea Embayment, West Antarctica, and a respective modeling to explain the large uplift rates observed in this region by geodetic GNSS.

2. Caron, L., E. R. Ivins, E. Larour: Adhikari, J. Nilsson and G. Blewitt (2018). GIA Model Statistics for GRACE Hydrology, Cryosphere, and Ocean Science. Geophys. Res. Lett., 45(5): 2203–2212. DOI: 10.1002/2017GL076644.

This paper presents a novel approach to GIA modeling including a thorough analysis of model uncertainty statistics. In Antarctica, GNSS observational results were introduced as constraining data.

3. Schröder, L., M. Horwath, R. Dietrich, V. Helm, M. R. van den Broeke, S. R. M. Ligtenberg (2019). Four decades of Antarctic surface elevation changes from multi-mission satellite altimetry. Cryosph., 13:427–449, DOI: 10.5194/tc-13-427-2019

This paper presents the results of a thorough analysis of all available satellite altimetry data over Antarctica to come up with ice surface elevation and its temporal change over a period of 40 years. It provides a consistent data set of the geometric change of the Antarctic Ice Sheet which is of utmost value for further analyses, especially for the computation of present-day ice mass changes and the subsequently induced elastic deformation.

4. Zanutta, A., M. Negusini, L. Vittuari, L. Martelli, P. Cianfarra, F. Salvini, F. Mancini, P. Sterzai, M. Dubbini, A. Capra, A. (2018): New Geodetic and Gravimetric Maps to Infer Geodynamics of Antarctica with Insights on Victoria Land. Remote Sens. 10: 1608. DOI:10.3390/rs10101608

This paper presents the results of a long-term investigation on geodynamics in North Victoria Land, East Antarctica.

Direct support from outside organisations received for your activities
None in the respective period.

Major collaborations your sub-group has with other SCAR groups and with organisations/groups beyond SCAR

Within SCAR
1. Scientific Research Program SERCE
2. Scientific Research Program PAIS
3. Expert Group ADMAP
4. Expert Group GRAPE
5. SCAR Product Quantarctica
6. Standing Committee on Antarctic Geographic Information (SCAGI)
7. Standing Committee on Antarctic Data Management (SCADM)

Outside SCAR
1. International Association of Geodesy (IAG) Subcommission 1.3f: Regional reference frame in Antarctica
2. IAG Subcommission 2.4: Gravity and Geoid in Antarctica

Outreach, communication and capacity-building activities

1. Communication is being maintained through the SCAR GIANT website as well as through a GIANT mailing list that is open to all interested scientists.
2. There is a strong component for capacity building in supporting (master and PhD) students as well as PostDocs to participate in dedicated confer-ences as well as in exchange at expert institutions (activities 1 and 3, see above).
3. Also, we support capacity building when acting as a host for SCAR / COMNAP Fellowships.

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	Email	Principal Expertise
Matt	King	Matt.King@utas.edu.au	Geodesy, GNSS, GIA
Mirko	Scheinert	Mirko.Scheinert@tu-dresden.de	Geodesy, GNSS
René	Forsberg	rf@space.dtu.dk	Geodesy, gravity field