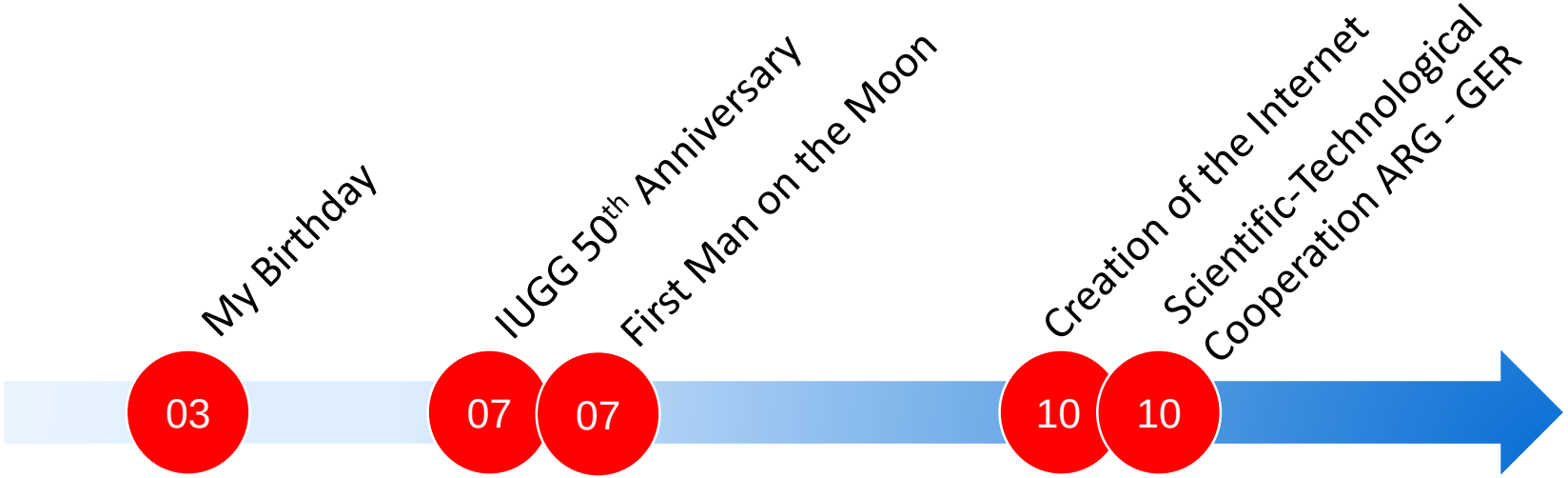
Federal Agency for Cartography and Geodesy

German efforts and challenges to install and maintain AGGO operational

Johannes Bouman

1969 was a good year …



AGGO is one of the flagships

More history: MTLRS (1984 – 1990)

- Modular Transportable Laser Ranging Systems MTLRS-1/2
- Joint project of the Delft University of Technology and the Institute of Applied Geodesy (IfAG), now BKG
- Satellite laser ranging (SLR) data collected at sites around the world between 1984 and 1990
- Used in geodynamic projects, such as in the eastern Mediterranean (WEGENER / MEDLAS)
- Note: GPS became only fully operational in 1995

More history: TIGO (2002 – 2014)

- Transportable Integrated Geodetic Observatory (TIGO)
- SLR, VLBI, GNSS, superconducting gravimeter, clocks
- Proposed in the late 80s by the German Research Group on Satellite Geodesy (FGS)
- Development and testing by BKG from 1992 – 1999
- After preparations for the shipment, site preparation, etc., TIGO became operational in 2002 in Concepción, Chile

TIGO → AGGO

- Maule 8.8 Mw earthquake of 27 February, 2010
- Funds of Chilean partner institutes were reduced
- New location in La Plata, Argentina was found
- Project partners are CONICET and BKG
- Note: “Acceptable sites should be located away from known, active faults” (*GGOS Requirements for Core Sites*)

AGGO

- Argentinean German Geodetic Observatory (AGGO)
- Fundamental station ≠ transportable
- Time line:
  - Inauguration in July 2015
  - VLBI became operational in April 2019
  - SLR will become operational early 2020
- There is a story to tell …

German efforts: agreements

- 2013: BKG – CONICET
- 2017: BKG – CONICET – IGN (National Geographical Institute)
- 2019: BKG – CONICET – SHN (Hydrographical Service)

CONVENIO ENTRE BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE (BKG) AGENCIA FEDERAL DE CARTOGRAFÍA Y GEODESIA Y CONSEJO NACIONAL DE INVESTIGACIONES CIENTÍFICAS Y TÉCNICAS (CONICET) CONSEJO NACIONAL DE INVESTIGACIONES CIENTÍFICAS Y TÉCNICAS DE LA REPÚBLICA ARGENTINA para la puesta en funcionamiento cooperativo de un OBSERVATORIO GEODÉSICO en La Plata, Argentina.

1. General

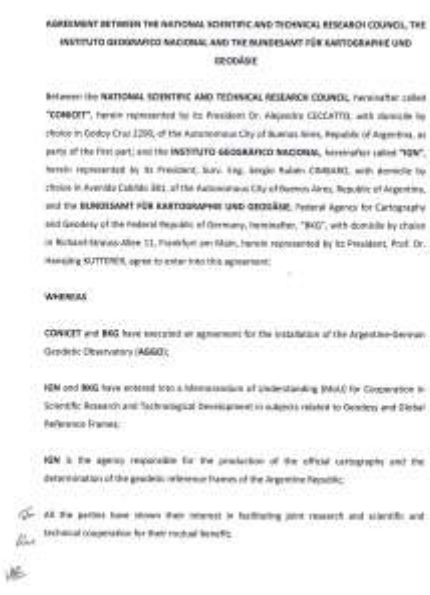
El presente convenio surge como resultado de una consulta realizada por la Embajada de Alemania, en Buenos Aires, a CONICET, sobre la posibilidad de instalar un Observatorio Geodésico en la Argentina y desarrollar la geodesia como disciplina de investigación y como ciencia aplicada a comienzos de 2011. La respuesta afirmativa de CONICET dio origen a conversaciones posteriores entre dicha organismo y BKG en abril y noviembre de 2013 en cuanto a las implicancias de instalar, en forma cooperativa, un Observatorio Geodésico en La Plata.

Hasta el presente, el Observatorio Geodésico Integrado Transportable alemán (TIGO por sus siglas en inglés) está ubicado en Concepción/Chile a efectos de llevar a cabo observaciones geodésicas en América del Sur. Dado que TIGO es único en América Latina, es preferible mantener los instrumentos en funcionamiento en la región sudamericana para no debilitar las marcos de referencia globales.

El Observatorio Geodésico Argentino-Germánico (AGGO, por sus siglas en inglés), a instalarse en Argentina, estará inicialmente constituido por componentes de TIGO. Aportará información para uso regional a efectos de mejorar las conexiones del Sistema de Referencia Geocéntrico para las Américas (SIRGAS) [hay versión en inglés: *Geocentric Reference System for the Americas*] el Marco de Referencia Terrestre Internacional (ITRF, por sus siglas en inglés) y para extender los fenómenos geofísicos y geodésicos.

BKG y CONICET se comprometieron a perfeccionar el funcionamiento actual de TIGO y ampliar su uso científico junto al Institute de Radioastronomía (IAR), cerca de la ciudad de La Plata, tareas éstas que se consideran la base de la operación conjunta del Observatorio Geodésico Argentino-Germánico (AGGO) en la Argentina.

El siguiente convenio, conforme al Artículo I (3) del "CONTRATO PRINCIPAL" del 31 de marzo de 1969, firmado por el Gobierno de la República Federal de Alemania y el Gobierno de la República Argentina sobre cooperación en investigación científica y desarrollo tecnológico, regirá la cooperación entre BKG y CONICET. (Referencia)



AGREEMENT BETWEEN THE NATIONAL SCIENTIFIC AND TECHNICAL RESEARCH COUNCIL, THE INSTITUTO GEOGRAFICO NACIONAL AND THE BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE

Between the **NATIONAL SCIENTIFIC AND TECHNICAL RESEARCH COUNCIL**, hereinafter called "**CONICET**", herein represented by its President Dr. Alejandro CECATTO, with domicile by choice in Godoy Cruz 2290, of the Autonomous City of Buenos Aires, Republic of Argentina, as party of the first part; and the **INSTITUTO GEOGRAFICO NACIONAL**, hereinafter called "**IGN**", herein represented by its President, Surv. Eng. Sergio Ruben CIMBARO, with domicile by choice in Avenida Cabildo 381, of the Autonomous City of Buenos Aires, Republic of Argentina, and the **BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE**, Federal Agency for Cartography and Geodesy of the Federal Republic of Germany, hereinafter, "BKG", with domicile by choice at Richard-Strauss-Allee 11, Frankfurt am Main, herein represented by its President, Prof. Dr. Hansjörg KUTTERER, agree to enter into this agreement:

WHEREAS

CONICET and **BKG** have executed an agreement for the installation of the Argentine-German Geodetic Observatory (**AGGO**);

IGN and **BKG** have entered into a Memorandum of Understanding (MoU) for Cooperation in Scientific Research and Technological Development in subjects related to Geodesy and Global Reference Frames;

IGN is the agency responsible for the production of the official cartography and the determination of the geodetic reference frames of the Argentine Republic;

All the parties have shown their interest in facilitating joint research and scientific and technical cooperation for their mutual benefit;

LETTER OF INTENT

The SERVICIO DE HIDROGRAFÍA NAVAL dependent on the MINISTERIO DE DEFENSA de la Presidencia de la Nación Argentina, here after the SHN, represented by its Director;

The CONSEJO NACIONAL DE INVESTIGACIONES CIENTÍFICAS Y TÉCNICAS dependent on the MINISTERIO DE EDUCACIÓN, CULTURA, CIENCIA Y TECNOLOGÍA de la Presidencia de la Nación Argentina, here after the CONICET, represented by its President; and

The BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE, hereafter the BKG, represented by its President

BASED ON

The fruitful relationship sustained for more than 20 years between SHN and CONICET for the execution of joint projects in the field of Geodesy and Hydrography;

The positive results achieved jointly by the projects "Vertical Reference System in Argentina by Tide Gauges and Satellite Altimetry (SIRVIMAR) and "Tide Gauge Benchmark Monitoring Pilot Project" (TIGA), including in both projects the active participation of a German institution (Deutsches Geodätisches Forschungsinstitut) as international partner;

The mutual benefits achieved during the execution of those projects by both, the Argentine institutions that provided infrastructure and logistics for the installation and operation of instruments in the field, and the German institution that provided cutting edge instruments and valuable know-how;

The cooperation sustained since 2013 between the BKG and CONICET for the joint maintenance and operation of the Argentine - German Geodetic Observatory (AGGO) in the vicinity of the cities of Buenos Aires and La Plata, in Argentina;

The availability in AGGO of sophisticated instruments, unique in Latin America, for the measurement of fundamental geodetic variables for the materialization of reference frames of time, space and gravity;

The interest of AGGO to promote scientific-technological cooperation in its field of competence with Argentine institutions, helping them to fulfill their missions in a more effective way;

The interest of the SHN to cooperate with AGGO by providing data from its tide gauge network in the Río de la Plata and the Argentine Atlantic shoreline and Fore Ile above, tide standards, as well elaborate products such as astronomical tidal models and storm surge models.

THE INSTITUTIONS AGREE

To join their efforts for the execution of scientific and technological projects based on AGGO, identifying, initially, the following relevant topics:

- Provision, installation, operation and maintenance of new hydrographic instruments in the Río de La Plata;
- Exchange of data and knowledge related to the study of variations in water height at event and subseries and its geometric and gravimetric effects in the surrounding regions in general, and in Río de La Plata and its surrounding region in particular.

Agreement BKG – CONICET: Stages

Three stages are defined:

- Stage I: Started with the transport from Chile to Argentina. Includes the installation of the station in La Plata and ends when AGGO is fully operational
- Stage II: For a period of 3 years, common operation of the observatory is foreseen. Move from containers to permanent facilities and ETCB
- Stage III: CONICET sole responsible for the operation and maintenance of AGGO with a small, but not yet defined, role for BKG

Agreement BKG – CONICET: Responsibilities

BKG

- Provide and maintain instruments
- Contribute personnel resources (VLBI, SLR, ETCB)
- Technical assistance from Germany (VLBI, SLR, gravimetry, clocks)

CONICET

- Contribute personnel resources
- Operators for VLBI and SLR, guard
- Infrastructure (at the site, road, electricity, internet, …)
- Scientific exploitation in collaboration with BKG

Claudio will give more details

German efforts: major investments

- Instruments: VLBI, SLR, GNSS, superconducting and absolute gravimeters, clocks, etc.
- AGGO is technically being upgraded
  - Modernization of the geodetic instruments
  - Stabilizing the power supply
- Relocation from containers to permanent facilities
- Major investments include
  - SLR TCU
  - Large Uninterrupted Power Supply (UPS)
  - Extension of the solar array
  - Surveying equipment
  - Etc.

German efforts: personnel

- Permanent staff at the station
- Visiting staff
- Preparation of shipments from Germany to Argentina / Chile
- Technical support from Wettzell
- Education, Training and Capacity Building
- Procurement, Legal support, …

Challenges & Solutions

Challenge	Solution
AGGO came with legacy instruments • higher chances of failure • challenging to find spare parts	Instrument modernization • SLR shows good progress • VGOS telescope?
High import taxes • shipment to Chile, transportation over land • time consuming	Import: diplomatic channel
AGGO located in rural environment → power supply is an issue	Uninterrupted Power Supply (a whole package)
Limited resources at BKG & CONICET for operations	Operators: agreement between CONICET and MINDEF

Challenges & Solutions

General

- Government budget planning
  - Germany: 2 years in advance + procurement procedures → time consuming
  - Argentina: see presentation Brunini
- Extension of Phase II (common operation) from 3 to 10 years is under discussion
- Sustainability under UN-GGRF Framework?

Patience, mutual understanding and close collaboration

Benefits (1/2)

- GGOS: reference frame accuracy ≤ 1 mm, stability ≤ 0.1 mm/a
- To meet the GGOS requirements, 30 Core Sites are needed that are globally distributed, use modern technology and operate routinely
- Requirements are not met, large data gaps Southern Hemisphere
  - The global network will require four core sites, well distributed in South America
  - This underlines the importance of AGGO and the relevance of modernizing the technology, which is ongoing
- Strategic interest
  - Operation of the Galileo satellite navigation system requires, among others, regular determination of dUT1 with short latency
  - Baseline GOW – AGGO allows in principle to do so independently

Benefits (2/2)

- UN General Assembly resolution on the Global Geodetic Reference Frame (GGRF) for sustainable development
  - Calls for commitments by Member States to improve national and global geodetic infrastructure as an essential means to enhance the GGRF
- The sustainable establishment of AGGO as a GGOS Core Site is part of the commitment by Argentina and Germany to the GGRF and its fundamental role in societal and scientific applications

Summary

- Geodesy provides the basis for the operation of satellite navigation systems and the observation of global change
- This requires a globally well distributed network of core sites
- The current distribution does not fulfill this requirement with large data gaps in particular in the Southern Hemisphere
- The Argentinean-German collaboration in AGGO improves the global situation
- AGGO is close to being fully operational and collaboration ARG-GER works well in general
- Naturally, challenges remain, but the efforts are worth it:
  - Contribution of Argentina and Germany to the sustainability of the GGRF
  - Contribution to reach the GGOS goals

Thank you for your kind attention!

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