**Friday Sep 30th**

**Opening:**

**Mike Jackson:** Antarctic Science lead for NSF and program officer

International collab will be prioritized

R2 schools prioritized

**GIA**

**Seismics**

**Session 1: Observational networks and processing efforts**

**Terry Wilson: A decade of GPS and seismic measurements**

Autonomous tech (GPS, seismic) changed the game

>90% data return

Open-source

Core project of POLENET-ANET

- GIA / solid earth / ice sheet / sea level

Ivins et al. 2021

no GIA models match the measured uplift

even inverse models don’t match magnitudes

where mantle visc is low, there is a viscous (delayed) response, not just elastic (instant)

bedrock uplift can display water, increasing SLR

Book et al. Stabilizing thwiates

New vew is GIA is fast and crucial for future SLR projections

**Pippa Whitehouse: Overview of UKANET GNSS network**

Open-source

30 continous bedrock instruments, can be deployed for years

Mostly along AP

Goals: 1) year-round power, 2) transmit data, 3) remote monitoring

- mostly achieved

Users: geodesists, GIA modellers, mass balance from data-inversion, tectonics, ionosphere, glaciologist, post-seismic studies

Funded till july 2025 (for modeller)

**Eric Buchta: analysis of geodetic GNSS records for geodetic and geodynamic applications**

GAINT-REGAIN project

Reprocessing GNSS data

289 sites (141 permanent, 148 campaign sites)

**Discussion:**

Needs to be international coordinations to keep GNSS sites viable

NSF will pay for IRIDIUM data transfer if it’s instantly put to open-access

Starlink is massively cheaper than IRIDIUM

**Session 2: GNSS – application of continuous and scattered time series**

**Peter Clarke / Achraf Koulali: RECORDED. Elastic deformation from surface mass balance variability in the AP**

King and SantaMaria Gomez 2016: Tectonic deformation

Ligtenberg et al. 2011: firn densification

Modeled short term variations in surface deformation with purely elastic model

Background linear-rate derived from GPS time series depends on how well we can model present day elastic deformation.

Github/koulali

**Matt King: Common mode error, noise, and late Holocene readvance**

Directory of ACEAS

GIA models in substantial disagreement (Whitehouse et al. 2019)

- especially in EANT

Deployed networks across Indian Ocean sector

Co-located seismometers (Anya Reading)

- also MT from Kate Selway

Lack of snowfall resulted in >1mm/yr of uplift

Surface mass balance if powerful at long period wavelengths

- must correct for it to getting velocities

Common Mode Error

- few stable sites in region

- use low-frequency portions of time series to correct

CME and SMB lower the uplift rates

Widespread subsidence (counter-intuitive)

- from late Holocene readvance

- readvance by nature covers evidence of it

Uplift in Totten, large-scale retreat

GPS indicates subsidence, hypothesis is that its from Holocene readvance

King et al. 2022, GPS Rates of Vertical Bedrock

**Demian Gomez: GNSS contribution to the international terrestrial reference frame**

Global Geodetic Reference Frame (GGRF), 2015

Big asymmetry of station distribution between high and low latitudes

**Mike Bevis: Future crustal deformation in Antarctica, insights from Greenland**

Temp through time diagram: younger dryas, holocene

Ice mas balance (IMB)

Crustal uplift = Elastic rebound + GIA

2013-2014 North Atlantic Occilation switched phase, leading to stopping of the 10year acceleration of ice mass loss from Greenland.

In the past, the variation possible in NAO switch was still too cold to affect change

Surface meltwater that refreees warms the ice and changes the rheology, leading to faster flow

**Michael Hartinger: Partnerships with the Space Weather Research Community**

Why do cryosphere geophysicists care about space weather?

Space weather instruments (magnetometers) useful for space weather field

**Discussion:**

Maxwell rheology is not good for GIA, should use power law physics, even though its computationally expensive

Illustrations of the Huttonian Theory of the Earth – book, 1800.

“better to have facts without theories rather than theories without facts …”

**Session 3: Seismology – benefits of short-term vs. long-term records**

**Sam Hansen: Core-Mantle Boundary**

ULVZ – ultra low velocity zones

Might be former mid-ocean ridge basalts (MORB) along the core-mantle boundary

**Vera Schulte-Pelkum: Seasonal and long-term variations in the Polar seismic record**

Receiver functions: delay between P and slower S wave tells you about velocity anomalies

Rayleigh wave H/V ratio tells you about near surface structures

Globally, more events in summer time than winter

**Doug Wiens: Upper mantle viscosity structure and litho thickness**

Lloyd et al. 2020 velocity model

258 earthquakes, from surrounding plate boundaries, recorded at 300 stations

EANT is fast, WANT is slow, Eastern Ross Embayment is very slow.

Litho thickness from seismic velocities

- GIA litho is defined rheologically, seismic is defined by high Vs

- can be defined as largest negative gradient in Vs

- 60-80km thick around WANT

- can use 1250 C isotherm as definition

- thicker litho along Siple Coast

Calibrating viscosity conversion

- Ivins et al. 2022

- Hazzard et al. in press

Lateral variation in WANT litho thickness and viscosity are not mapped in detail

**Marianna Karplus: Seismic signals from Thwaites shear margin**

Same talk as at WAIS

**Discussion:**

Use already setup traverses to deploy arrays

**Rapid Poster Introductions:**

**Session 4: Further data synthesis**

**Siyuan Sui: Chemical composition of Antarctic crust and thermal structure**

Difference in continental GHF and local surveys around South Pole

Higher SiO2, probably means high heat producing elements, high radiogenic heat production

2022 paper, unsure of authors

Correlation between silica content and seismic properies

- high silica, low Vp/Vs ratio and low Vs

Separate crystalline crust from shallow layer

South Pole silica content is higher than craton should be

Monte Carlo simulation with CPD, seismic GHF, Moho temp, surface temp

Shows SP have high GHF from radiogenic heat production

Sui et al. in prep

**Eileen Martin: Quick glacier seismology array analysis**

DAS – distributed acoustic sensing

Interigator unit: lazer through fiberoptic cable

Issue is it creates alots of data! Cant transfer remote.

She’s built a realtime processor into the integrator to remotely transmit some smaller data products

Github.com/eileenmartin/DASDataProducts

**Ian Dalziel: Geodetic observations and Scotia Arc Tectonics**

AP to South America is only zone around Ant without a spreading ridge

**Grace Nield: Post-seismic deformation in the AP**

**Ingo Sasgen / Mirko Scheinert: relevance of GNSS to inverse GIA estimation**

IMB methods: gravimetric, geometric, input-output method

- GIA strongly effects gravimetric method

GIA forward modelling: ice and ocean loading and earth structure/rheology

Li et al. 2022, GNSS to validate GIA forward models

Need correct treatment of gravimetry mass change estimates to have reliable knowledge of GIA. Both for AIS and oceans

**Discussion:**

EANT was contiguous with Laurentia at 750ma, should look at Yavapai Mazatal for radiogenic estimates

**Saturday Oct 1st**

**Session 5: Broad implications – GIA and beyond**

**Surenda Adhikari: GIA MISI and SLC**

**Natalya Gomez / Maryam Yousefi (virtual): Resolving GIA and the impact on SLR**

**Lambert Caron (presented by somone else): Evidence of anelastic deformation in ASE**

**Andrew Lloyd (virtual) : GIA imaging of solid Earth Structure**

How do GPS measuremetns sense Earth viscosity strucutre/

Assume 1d mantle visc struct, ice history, and synthetic dataset

Use adjoint method to see how GPS and GIA sense earths viscosity structure

Can invert GIA obs to image mantle viscosity

**Discussion**

Can you measure GIA under the ice? (Evelyn Powell)

- Dusty Schrodinger, maybe use radar to see changes in bed topo

**Session 6: Infrastructure, Logistics, and Coordination**

**Glen Mattioli: SAGE and GAGE Facility Polar PI project**

Overview of UNAVCO, IRIS-PASSCAL-NMT

- IRIS and UNAVCO are merging

PASSCAL

- MT, multi-channel cabled geophones, controlled sources, det cord etc..

**Robert Anthony: global seismographic network (GSN) stations in Antarctica**

GSN: monitoring for earthquakes / nuclear, fundamental research, education/outreach

**Anya Reading: Optimized field deployments for conventional and data-driven research**

Conventional: physics-based, deterministic

Data-driven: statistic based, predictive, ML

Compute Antarctic Group

- mostly seismics with other geophysics as well

-link to ACEAS

GRIT instrument facility

MT (kate selway), 8 sets

Seismic (anya) 14 sets

GNSS (matt king)

Remirez and Selway in press (GJR)

- adding MT to seismic data narrows the mantle viscosity constraints

Ebbing, running framework for global and regional reference models

Agrid: python library for multivariate analysis Stal and Reading, 2020

Reading et al. in press: GHF of Antarctica

Stal et al 2021 (aq1), Shen et al 2020, Losing et al. 2021 (multivariate), Shapiro and Ritzwoller 2004 (seismic)

Using uncertainty metrics to aid in deployments

Star performers:

Seismic tomography and derived products (LAB depth)

Sub glacial topo (bedmap2)

Also important

Satellite gravity products (shape index)

How do you invision using records of rock samples (Polar Rock Repository) as an input to the radiogenic portion of these GHF models?

**Terry Wilson: Models of international coordinate for large science programs**

Jointly funded multinational collab

- ANDRILL, international thwaites glacier collab etc.

Consortium

- IODP

Coordination model

- SOOS

Need whitepaper to summarize needs of science community

**Discussion**

Models normally within modern grounding line (Andrew Lloyd)

- no reason except for consistancy

- Aq2 will be across the continental shelf

Monitoring would blow budget for NSF

- should be on organization such as NOAA for weather

- USGS?

- is it monitoring yet? Or still just science from observations?

- NSF is already monitoring for certain programs

Use CISMIP 6 objectives to justify keeping GPS monitoring, will highlight negative feedbacks which can eliminate the worst case scenarios for climate migitation.

**Break-out groups**

What are the most important aspects discussed during the workshop?

- what are the major science questions, both on a short term and long term?

- pros and cons regarding priorities?

In which way observational infrastructure should be and can be continued

- prioritization? Co-location of techniques?

- new technologies?

- coordination of field campaigns? (decrease carbon footprint)

- actions need to improve cooperation between national programs / agencies?

How do we build better community?

Discuss ideas how to outline White Paper?

**Reports:**

SCAR INSTANT sep 11-14 2023 Trieste Italy

**Discussions:**

Talked with Anya Reading about setting up a meeting with her and/or Tobias Stall to get advice on GHF modeling

Talked with Karsten Gohl about GHF and issues with point measurements

**Need to talk to:**