Scripps Geophysics Graduate Online Info Session

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November 16, 2023

Welcome from the Geophysics Admission Team

Jennifer Hasse (chair)

Matti Morzfeld

Dave May

Contact | gp-admission@ucsd.edu

GP Online Info Session Schedule

- IGPP overview
- Geophysics graduate program overview
- Graduate school application process
- Geophysics student perspective
- Geophysics research group summaries
  - Deep Earth
  - Geodesy
  - Polar science
  - Marine geophysics
  - Seismology
  - Soft Earth Geophysics
  - Theoretical geophysics
- Questions

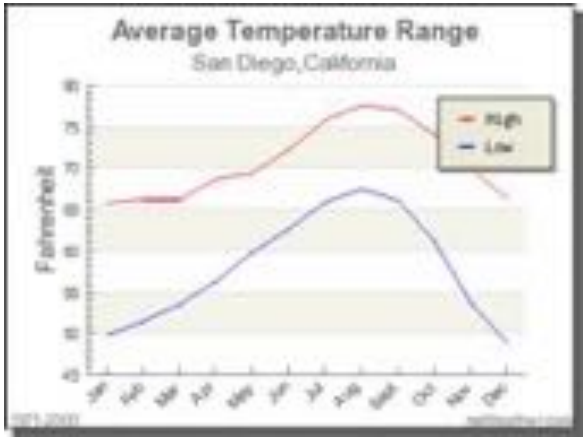
For more information about GP
https://igpp.ucsd.edu/

Contact | gp-admission@ucsd.edu

IGPP ≈ geophysics

IGPP Location


SAN DIEGO
America's Finest City


Average Temperature Range
San Diego, California
Fahrenheit

First-year geophysics students have their offices in the Keller, which enjoys perhaps the best views at SIO

You could be here!

Interior photo by Jeremy Wing Ching Wong

IGPP Size

- over 20 faculty in geophysics
- experts in seismology, geodesy, geodynamics, geomagnetism, marine geophysics, polar studies, and more
- strengths in theory, modeling, and observations (including instrument design)















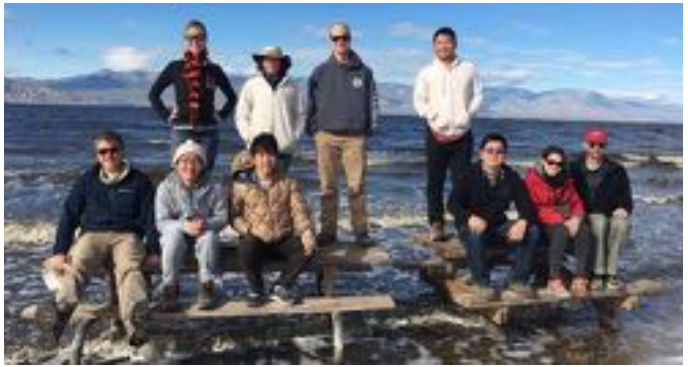







IGPP Science

- Pioneers in instrument design and data collection
- A tradition of theoretical rigor and innovative techniques



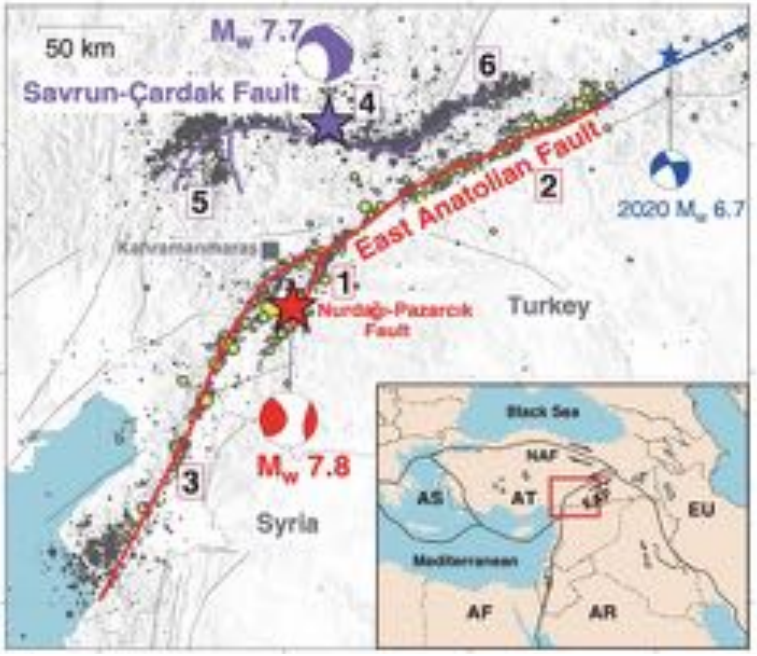
Science

The complex dynamics of the 2023 Kahramanmaraş, Turkey, M_w 7.8-7.7 earthquake doublet

Zhe Jia[1*], Zeyu Jin[1], Mathilde Marchandon[2], Thomas Ulrich[2], Alice-Agnes Gabriel[1,2], Wenyuan Fan[1], Peter Shearer[1], Xiaoyu Zou[1], John Rekoske[1], Fatih Bulut[3], Aslı Garagon[3], Yuri Fialko[1]

Zhe Jia (Green Scholar Postdoc)

- Integrated analysis using broad IGPP expertise to unravel the events' complex rupture history and stress-mediated fault interactions
- Three main slip episodes during initial Mw 7.8 event with delayed rupture initiation to the southwest
- The Mw 7.7 event occurred 9 hours later with greater slip and supershear rupture on its western branch
- Dynamic rupture modeling can explain these unexpected rupture paths



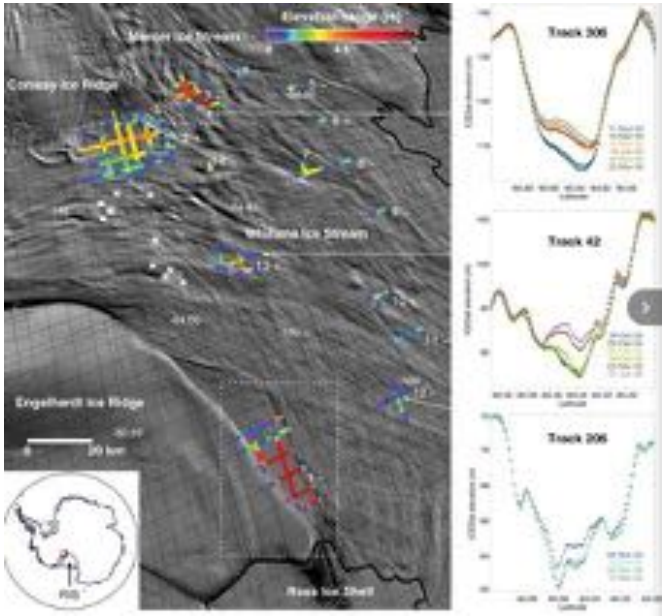
Science

An Active Subglacial Water System in West Antarctica Mapped from Space

HELEN AMANDA FRICKER, TED SCAMBOS, ROBERT BINDSCHADLER, AND LAURIE PADMAN Authors Info & Affiliations

Helen Fricker

- Used satellite altimetry data to map subglacial water movement and reveal a previously unknown subglacial lake under Antarctica
- Important for ice flow and mass balance calculations
- 494 citations to date



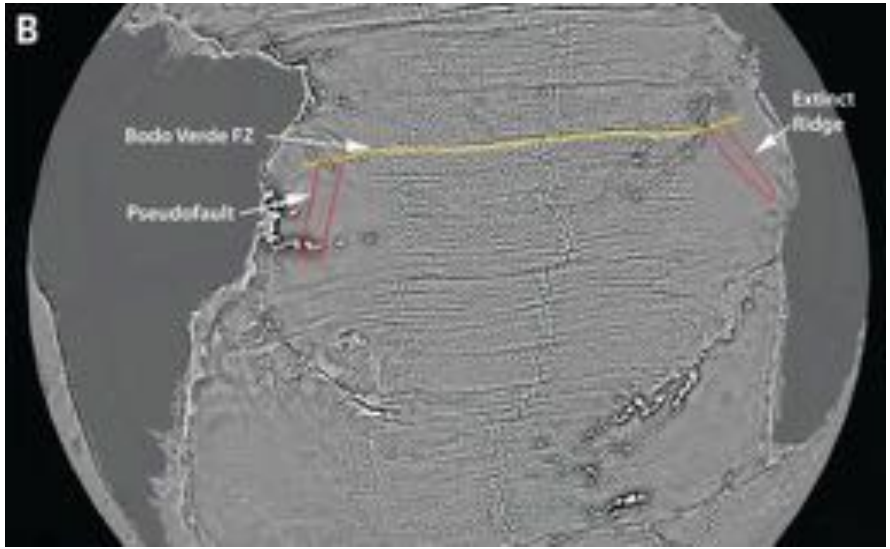
Science

New global marine gravity model from CryoSat-2 and Jason-1 reveals buried tectonic structure

DAVID T. SANDWELL , R. DIETMAR MÜLLER, WALTER H. F. SMITH, EMMANUEL GARCIA, AND RICHARD FRANCIS Authors Info & Affiliations

David Sandwell

- Used remote sensing data to create new marine gravity map with improved resolution
- Discovered many new features, including extinct spreading ridges and uncharted seamounts
- 1480 citations to date



GEOPHYSICS

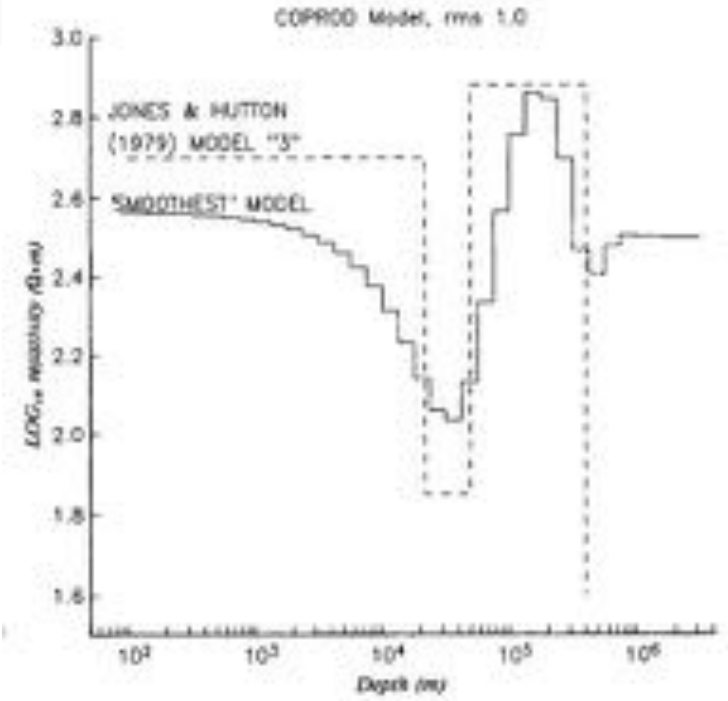
Occam's inversion: A practical algorithm for generating smooth models from electromagnetic sounding data

Authors:

Steven C. Constable, Robert L. Parker, and Catherine G. Constable

Steve Constable

- Applies regularization to stabilize inversion of electromagnetic sounding data, which have no unique solution
- A practical and computationally efficient approach to obtain the smoothest possible model
- 3572 citations to date

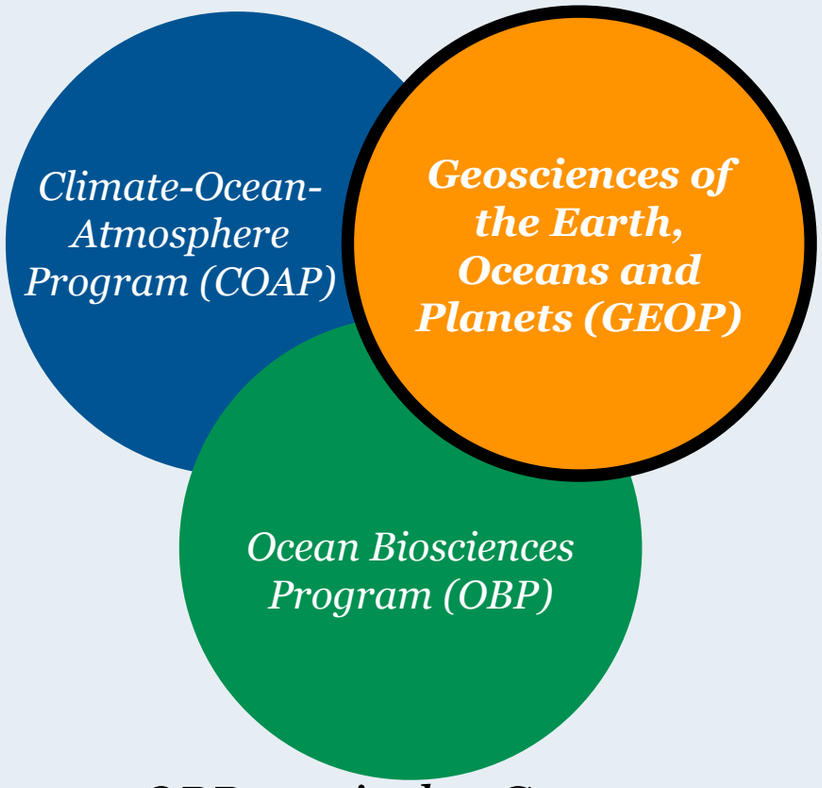


Graduate Program in Geophysics
Scripps Institution of Oceanography

SIO and GP Overview

Scripps Institution of Oceanography

COAP curricular Groups
- Climate Science
- Physical Oceanography
- Applied Ocean Science



GEOP curricular Groups
- **Geophysics (you)**
- Geosciences
- Marine Chemistry & Geochemistry

OBP curricular Groups
- Marine Biology
- Biological Oceanography

Common features across GEOP program
- Three person guidance committee
- Departmental exam
- Encouraged to begin research in year 1
- Qualifying exam with thesis proposal and Ph.D. committee by end of year three

Three degree names: MS or Ph.D. in
- **Earth Science (you)**
- Oceanography
- Marine Biology

Timeline

Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*
• Classes • Dept. Exam	• Classes • Research	• Research proposal • Form thesis committee • Qualifying exam	• Full time research	• Full time research	• Defense • Graduation	• Finish ASAP

Avg. Time to Ph.D.: **5.74** yrs

Timeline

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Specifics of Year 1

- Complete foundational course + electives.
- Consult with Guidance Committee (dept. committee + advisor) what courses to take.
- Consider research rotations during year 1.
- Decide on advisor by spring so you can focus on research during the 1st summer.
- Complete the Departmental exam (end of Spring).

Graduate Classes in Geophysics

https://scripps.ucsd.edu/education/courses#grad

Foundational 1st year
Electives offered alternate years
Electives offered every year
Expected before qualifier

			Fall	Winter	Spring
SIO 200 B/C/A	2	Geophysics Research Skills: Geophysics	Parnell-Turner	Gabriel	Constable
SIOG 223A	4	Geophysical Data Analysis I	Morzfeld		
SIOG 223B	4	Geophysical Data Analysis II		Agnew	
SIOG 225	4	Physics of Earth Materials	Fialko		
SIOG 234	4	Geodynamics		Sandwell	
SIOG 239	4	Practical PDEs			May
SIOG 227A	4	Introduction to Seismology	Gabriel		
SIOG 230	4	Introduction to Inverse Theory			C. Constable
SIOG 233	4	Introduction to Computing	Shearer		
SIOG 236	4	Satellite Remote Sensing			Fricker / Sandwell
SIOG 237	2	Space Geodesy		Sandwell/Fialko/	
SIOG 240	4	Marine Geology	Charles / Gee		
SIOG 232	2	Ethical and Professional Science			C. Constable / S.
SIOG 221	4	Plate Tectonics in Practice			Parnell-Turner *
SIOG224	4	Internal Constitution of the Earth			Stegman/Laske
SIOG 227B	4	Structural Seismology			Shearer/Laske *
SIOG 227C	4	Earthquake Source Seismology			Fan/Gabriel
SIOG 231	4	Geomagnetism and Electromagnetism		C. Constable/S.	
SIOG 229	4	Fundamentals of Gravity and Geodesy		Borsa*	
SIOG 239	4	Computational Tools for Inverse Problems		Morzfeld*	
SIOG 238	4	Numerical Methods for PDEs			May*
SIOG 222	4	Intro. to Industry Reflection Seismic			

Unique course series

- SIOG 200 A, B, C
  - Learn how to make figures, make posters, prepare and deliver different styles of oral presentations.
  - Learn how to write (papers and proposals/fellowship applications).
  - Learn who to read and synthesize scientific literature.

- Very popular course that is well received among the students.

- Instructors: Dept. Exam Committee.

Departmental Exam

Dept. Exam Committee

- Ross Parnell-Turner (chair)
- Alice Gabriel
- Steve Constable

Ross Parnell-Turner

Alice Gabriel

Steve Constable

- Helps with all things 1st-year.

Departmental Exam

- *Written*: Synthesize materials of foundational courses.
- *Oral*: Research and research paper discussion.
- Senior graduate students help you prepare.

GP Curricular Group Coordinator

Matthias Morzfeld

Departmental Committee

Ross Parnell-Turner

Alice Gabriel

Steve Constable

- Meets with you once per quarter.
- Helps with choosing classes (together with advisor).
- Coordinates GP Departmental Exam.
- General resource for all things 1st-year-grad-school.

Departmental Committee + Your advisor = **Your Guidance Committee**

Geophysics Support System

Incomplete list of other people you will probably interact with

- GP Curricular Group Coordinator (Matti)
- Departmental Committee (Ross, Alice, Steve)
- IGPP Director (Peter Shearer)
- Megan Smith (Building/Facilities)
- Netops (Computers, igppticket@ucsd.edu)
- Your advisor(s)
- Instructors of foundational classes
- Fellow GP students
- ***Your cohort***

Peter Shearer
(IGPP Director)

Our Philosophy

- Structured curriculum to provide foundational knowledge in geophysics.
- Educational diversity in undergraduate studies is welcome: e.g. geophysics, geology, mathematics, physics, engineering, computer science.
- Scripps provides a broad range of specialized and interdisciplinary courses as needed for your research interests - we encourage you to explore them.
- We want you to find an exciting research project and have fun doing it.
- We encourage you to take advantage of field and/or sea-going projects, great computational resources, within IGPP and Scripps.
- The size of Scripps faculty means there is something for everyone, and a huge diversity of potential colleagues and collaborators - Inter-disciplinary research activities are welcome.

UC San Diego | SCRIPPS INSTITUTION OF OCEANOGRAPHY

Geophysics Graduate Admissions

Prof. Jennifer Haase

I literally took this picture Monday.

Scripps Graduate Application Assistance Program

- Scripps-GAAP encompasses two separate programs:
  - Chat with a Scripps Scientist (CWSS)
  - SIO-Applicant Support & Knowledgebase (SIO-ASK).
- These programs demystify the application and admissions processes and create a more personal connection to help "close the gap" in the number and depth of applications Scripps receives from underserved vs. better-served students and communities.
- Students of all backgrounds and/or demographics are welcome to apply to participate, especially those from traditionally underrepresented backgrounds who attend HBCUs, HSIs, and/or TCUs
- https://scripps.ucsd.edu/diversity/access-success/graduate-application-assistance-programs

Application Process – Research Areas and Potential Advisors

- A research project in itself. Search here for keywords and links:
- https://scripps.ucsd.edu/people/faculty
- Read up on faculty research on linked web sites and scholar.google.com
- Take a look at some of the classes. Do the topics look interesting? Are you ready to put in the effort to succeed in solving these kind of research problems.
- ie: https://topex.ucsd.edu/geodynamics/
- Contact potential advisors by email, with your background and interests
- You can view Potential Advisors and Projects for Fall 2024 Admission on the IGPP webpage https://igpp.ucsd.edu/students
- You can apply to the program here https://grad.ucsd.edu/admissions/

MS vs PhD

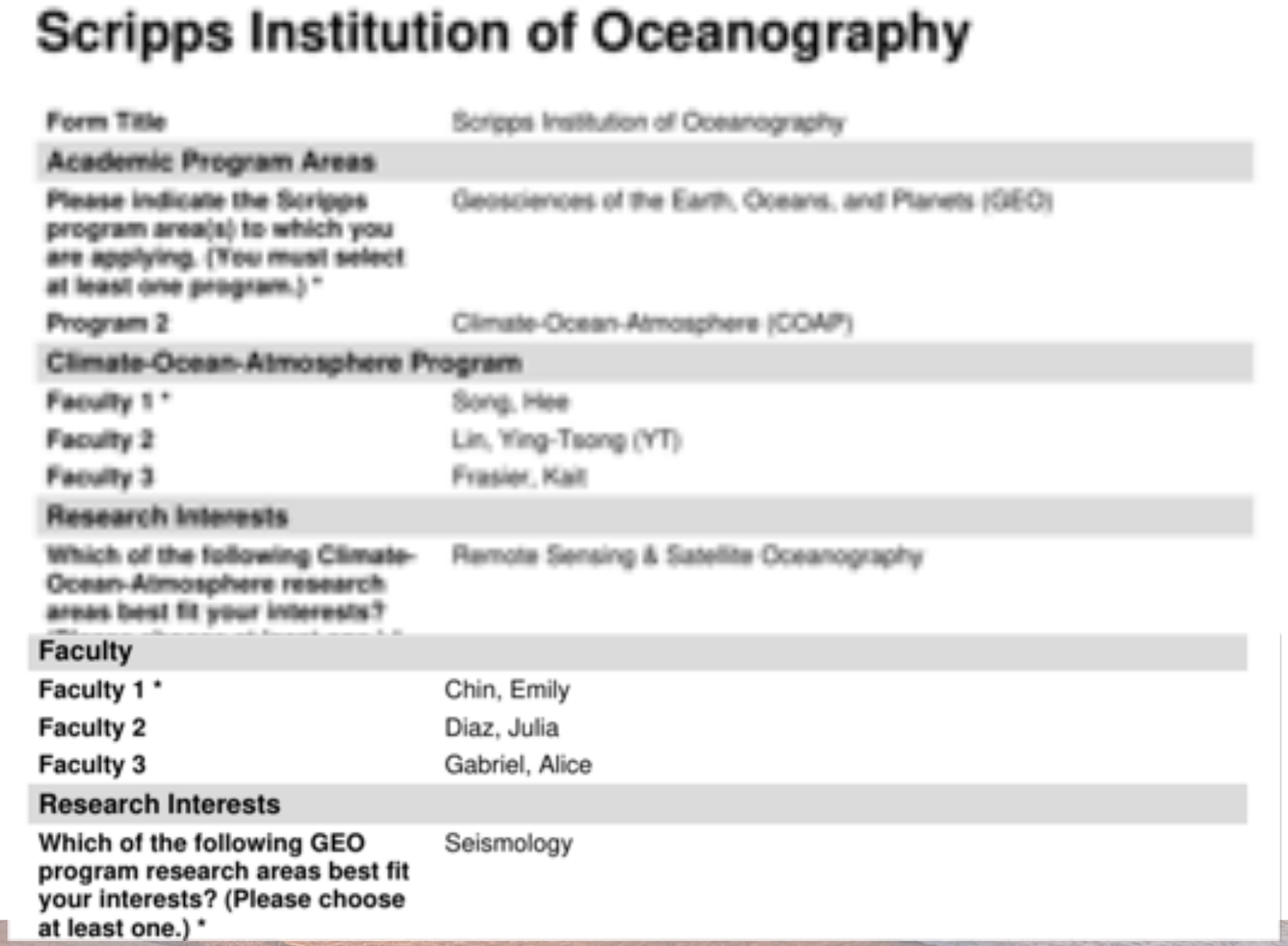
- The Scripps PhD program is a research-based doctoral program.
  - PhD students are guaranteed five years of funding
  - PhD students typically achieve their degrees after five or six years.
  - Funding can be from Fellowships, Research Assistantships (ie linked to a faculty grant), Teaching assistantships (good for gaining experience teaching for an academic career)
  - An MS degree is not required.
  - PhD students often obtain their MS along the way.
- The Scripps M.S. program is a relatively new program designed as a terminal degree.
  - M.S. students are self-funded and earn their degrees through either a one-year program with comprehensive exam, or a two-year program with a research thesis.
  - Admission requirements are the same for MS and PhD

Application Process - Programs & Curricular Groups

- Select a program
  - the curricular group you choose will determine the required classes (if any) and your 1st year departmental exam
- GEO (Geosciences of the earth, oceans, and planets) Program has 3 curricular groups:
  - Geophysics
  - Geosciences
  - Marine Chemistry & Geochemistry
- COAP (Climate-Ocean-Atmosphere) Program has 3 curricular groups:
  - Climate Sciences
  - Physical Oceanography
  - Applied Ocean Sciences
- Ocean Biosciences Program has 2 curricular groups:
  - Biological Oceanography
  - Marine Biology

Application Process - Programs & Curricular Groups

- Choose all the Programs you are interested in (GEO, COAP, OBP)
- Areas of research interest may cross disciplinary boundaries
- Choose faculty whose research interests you, don't worry if the topics don't fit in the defined categories



Scripps Institution of Oceanography

Form Title	Scripps Institution of Oceanography
Academic Program Areas	
Please indicate the Scripps program area(s) to which you are applying. (You must select at least one program.) *	Geosciences of the Earth, Oceans, and Planets (GEO)
Program 2	Climate-Ocean-Atmosphere (COAP)
Climate-Ocean-Atmosphere Program	
Faculty 1 *	Song, Hee
Faculty 2	Lin, Ying-Tsong (YT)
Faculty 3	Frasier, Kait
Research Interests	
Which of the following Climate-Ocean-Atmosphere research areas best fit your interests?	Remote Sensing & Satellite Oceanography
Faculty	
Faculty 1 *	Chin, Emily
Faculty 2	Diaz, Julia
Faculty 3	Gabriel, Alice
Research Interests	
Which of the following GEO program research areas best fit your interests? (Please choose at least one.) *	Seismology

Admission Criteria

- Academic Preparation
  - Grades and challenging / relevant courses
- Research statement
  - Describe any past research experience, depending on opportunities it could be a significant class project that illustrates scholarly potential
- Diversity Equity and Inclusion
  - Personal experiences or efforts to promote equity of access to higher education for marginalized groups and create an environment where all can succeed.
- Alignment with the Research Program
  - SIO cannot admit a person to work in an area where we do not have sufficient expertise to advise/mentor
  - List potential advisors and describe common interests
- Evidence or potential for growth
  - Describe strengths and weaknesses and the evidence or potential for growth
- Think about long-term goals, why are you getting a PhD

Additional Tips

- Background in geophysics
  - Some universities don’t offer geophysics
  - Some people discover later their interests in Earth science
  - Majors that include foundational mathematics and physics are an advantage
  - Geophysics/geoscience is not strictly required

- Diversity statement - Examples of EDI contributions include:
  - leadership roles in community building activities
  - acts of social justice (e.g. advancing access for members of underrepresented groups)
  - evidence of initiative, leadership, and impact of efforts
  - evidence of overcoming adversity or hardship affecting access to opportunities, experiences or academic achievement.

Additional Tips

- Covid Statement
  - Everything was affected by COVID
  - Some opportunities were not available
  - Explain any adversity and your efforts to compensate
- Academic preparation
  - Given COVID challenges, students may be interested in supplementing their preparation based on feedback during their discussions with faculty for example
  - https://giddingslab.ucsd.edu/teaching/matlab-bootcamp-2022/

Additional Tips

- Reference letters
  - Ask for letters from people that can speak to an individual project
  - Could be a class project if you have had no access to research internships
  - Don’t hesitate to remind them to get your letter in on time!
- CV
  - Include not just jobs but projects that you were responsible for
  - Describe skills - computational skills, leadership, teamwork
  - Evidence of progression and desire to learn

Important dates

- Application closes on December 6th, 2023
- February: Open House / campus visits for shortlisted or admitted students
- Most notifications of admission are received by April 1st
- Intent to Register Decision is due by April 15th
- Inquire about opportunities to work during the summer
- Orientation and Program starts mid-September

Joint Ph.D. in Earthquake Science and Applied Geophysics from San Diego State University and UC San Diego, Scripps Institution of Oceanography

San Diego State University and University of California San Diego are accepting applications for the Joint Doctoral Program in Geophysics. The SDSU/UCSD Joint Program (http://sci.sdsu.edu/geology/jdp/opportunity/) provides full access to the Geophysics curriculum of UCSD's Scripps Institution of Oceanography, with additional specialized courses and research opportunities offered by SDSU faculty. Assistantships for Fall 2024 are available for research in earthquake physics, wave propagation and strong motion modeling, crustal deformation and tsunami modeling, fault zone structure and dynamics, induced seismicity, hydrological modeling, computational seismology, and subsurface imaging. Competitive financial support package offered to successful applicants, who must meet doctoral admissions requirements of both universities. **Apply by December 15, 2023**. For application procedure and further information, see sci.sdsu.edu/geology/jdp/, or send inquiries to Professor Kim Olsen (kbolsen@sdsu.edu).

Areas of expertise of SDSU faculty are complementary to UCSD and can be found here: https://earth.sdsu.edu/faculty/

Questions

- What do you look for in a prospective student?
- Do you need to contact faculty prior to applying?
- Is it important to have a reply email from a professor to fill out the PhD application? Does no response from a professor mean zero chance of getting selected?
- Is admission offered in the winter?
- Are there other forms of funding besides fellowship opportunities?
- What if I majored in math, physics, engineering or some other field?

Additional information

Scripps Graduate Application Assistance Program

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Chat with a Scripps Scientist

- CWSS arranges one-on-one, introductory meetings between interested graduate school applicants and Scripps professors and/or current graduate students.
- CWSS will also offer a series of workshops crafted to help familiarize applicants with research and life at Scripps as well as the application process.
- Students who participate in all 4 workshops may be eligible for an application fee waiver.

SIO-ASK

- SIO-ASK is a mentorship program for prospective Scripps graduate students that matches applicants with current student mentors and provides personalized mentorship throughout the application process.
- https://scripps.ucsd.edu/diversity/access-success/graduate-application-assistance-programs

Student Life at IGPP

Ellis Vavra (he/him)
4th year PhD candidate
Geophysics representative
SIO Grad. Student Council

Geophysics student body

SIO: 300+ total graduate students
- 50-70 incoming grad students per year

IGPP: 45 graduate students
- 41 PhD (8 JDP w/ SDSU), 4 MS
- 5-12 students per cohort
- 60% US/40% international


Some of the 2021 first-year cohort


Party for postdoc Dan Blatter


2023 field trip to San Andreas Fault

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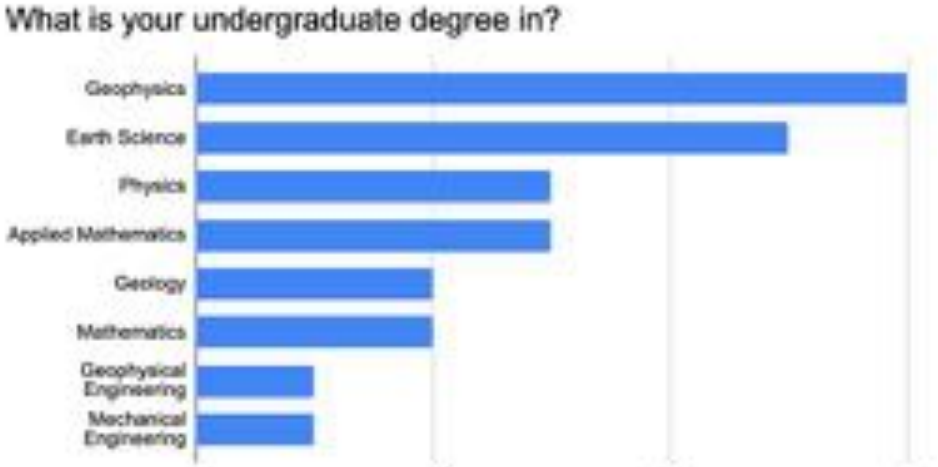

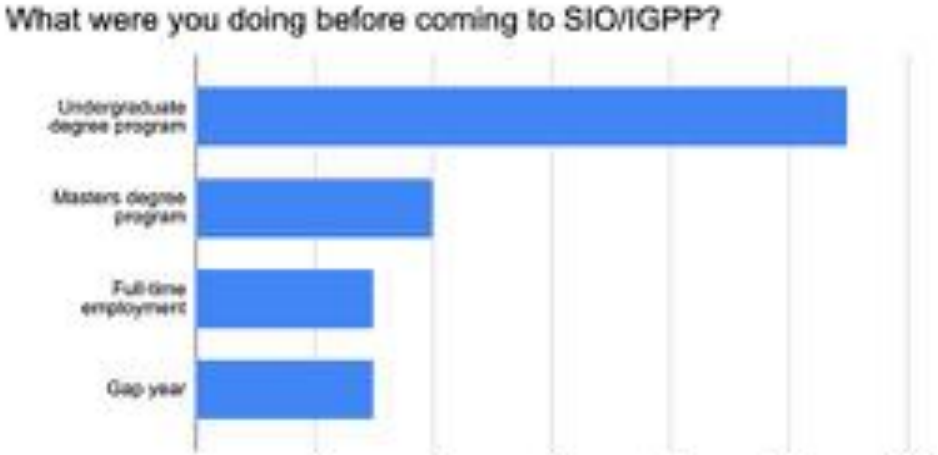

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According to themselves…

In 5 words or less, what do you study at SIO?/IGPP?

- Earthquakes
- Mapping/understanding seafloor phenomena/structures
- mid-ocean ridge seismicity
- Mechanics of strike-slip faults
- Planetary Geodynamics
- how water drives earth's deformation
- Electromagnetic imaging of earths structures
- Earth's magnetic field
- Earthquake dynamic rupture and tsunamis
- Earthquakes and other slip phenomena
- Planetary interior evolution numerical modeling
- Mid-ocean ridges
- Seismology
- geomagnetism and paleomagnetism
- Numerical modeling of subduction zones
- Surface Wave Seismology
- Earthquakes and engineering seismology
- Earthquake Seismology
- Data Assimilation for Cloud Microphysics
- Groundwater dynamics
- Structural seismology

IGPP Activities

First year

- The Keller - GP first year office
- Peer mentor program

IGPP events

- IGPP coffee on Mondays
- Dept. seminar on Tuesdays
- IGPP Tea on Wednesdays

Student Events

- SciChat (student seminar) every other Thursday
- Monthly student events: pizza parties, beach days, meme competitions, scavenger hunts, etc.
- Happy hour (TG) on Fridays
- GP camping trip (?)

View from the Keller

Award-winning meme

Surfside student lounge: the home of TG happy hour

Student-Led Groups/Activities at SIO

Community Leadership
- Scripps Graduate Student Council (SGSC)
- Graduate Student Union Organizing Committee

Mentoring
- Peer mentor program
- SIO Application and Support Knowledgebase (SIO-ASK)

Outreach
- Scripps Community Outreach for Public Education (SCOPE)
- Rosa Parks Tutoring Program (RPTP)

Academic Interests
- Scripps Student Symposium
- Climate Journal Club
- Machine Learners Group

Affinity Groups
- Queer@Scripps
- Women and Minorities in Science (WMIS)
- Parents and Caregivers Student Organization

Policy and Activism
- GPSA Legislative Advocacy Committee (LAC)
- Green New Deal at UCSD
- Graduate Student Union

Fun Stuff
- TG (beach-side happy hour)
- SIO Yarn Lovers
- Bike @ SIO
- Pier Gladiators (beach soccer)

San Diego according to GP students

Beach! Weather! Food!

- The weather! :)
- the weather
- weather + seaside
- Proximity to the ocean
- The climate and the ocean in front of IGPP!
- Beautiful weather year round!
- Beach
- The beach
- The beaches
- beach, mexican food,
- beach, mountains, desert all in an hour drive; weather
- Breweries
- it's my hometown so friends and family are the best
- People are pretty nice and I get to look at the ocean every day which is wild
- Weather
- There's always new things to experience- museums, bars, zoos, beaches, hikes.
- Climate
- The weather/ climate
- the ocean
- Sunshine

San Diego according to GP students

Cost-of-living/Housing

- Cost of living :(
- The cost of living
- Cost of living... (SD has recently been ranked as the most expensive place to live in U.S.)
- bad urbanism + expensive
- It's expensive -_-
- cost of living
- Expensive rent
- Finding housing

Transit

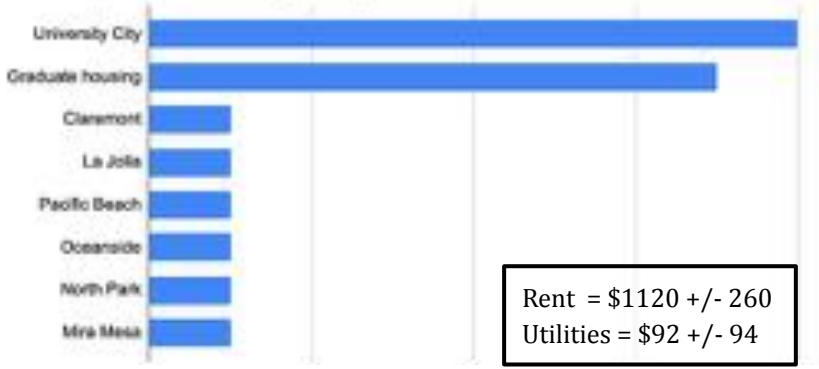
- Traffic/Driving
- traffic and cost of living
- The drivers and traffic
- Having to drive everywhere
- Poor public transit
- Impolite drivers who don't appreciate turn signals >:(

Other

- there's a lot of beautiful places but they're often so CROWDED. i'd say solitude is a rare commodity in the city
- Terrain
- Lack of tree covered trails
- cold office all year round
- Nothing!

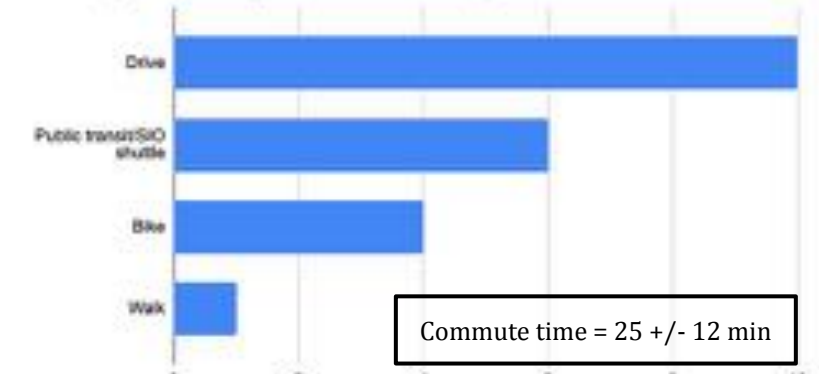
Living in San Diego

Housing



Rent = $1120 +/- 260
Utilities = $92 +/- 94

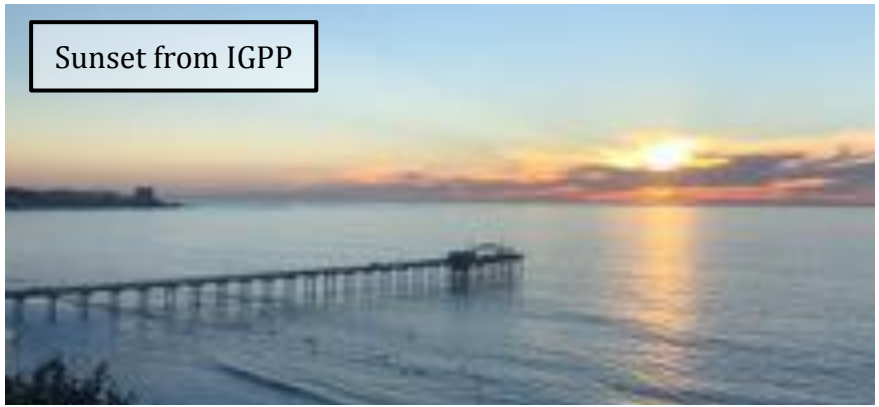
Transit



Commute time = 25 +/- 12 min

GP student favorite hobbies/pastimes:


Biking through SIO


Sunset from IGPP

GP student favorite restaurants

- Bahn Thai
- Tacos el Gordo
- pomegranate
- The Friendly
- menya ultra
- don carlos
- Taco Stand
- not sure
- Buona Forchetta
- Regents pizzeria
- Din tai fong
- sushi deli!
- Taco Stand
- The Yasai by RakiRaki
- Kura Sushi
- Rubios
- Cesarina
- Calvins Korean Hot Chicken
- Shancheng Lameizi Hot Pot
- Osteria Romantica

Any questions?

Email me (evavra@ucsd.edu)

Scripps Graduate Application Assistance Program

https://tinyurl.com/mw24feez

Earth Interior & Geodynamics

What lies deep below the surface, who studies it, and how?

Seismology

Gabi Laske

Peter Shearer

Computational Geodynamics

Dave May

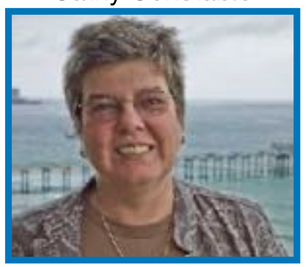
Dave Stegman

Electromagnetism, Geomagnetism, Geophysical Inversion

Matti Morzfeld

Steve Constable

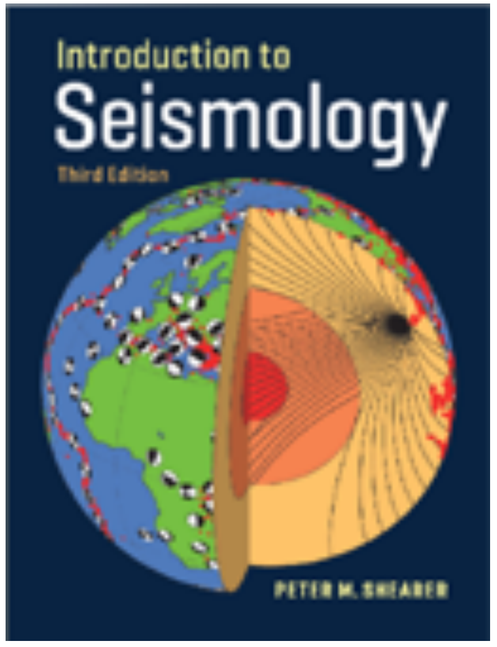
Cathy Constable

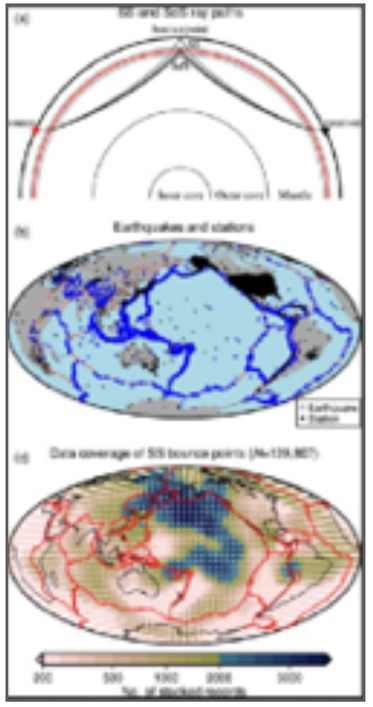


Theoretical, **observational,** and **experimental** approaches are all used

First hand experience in our major geophysical facilities:

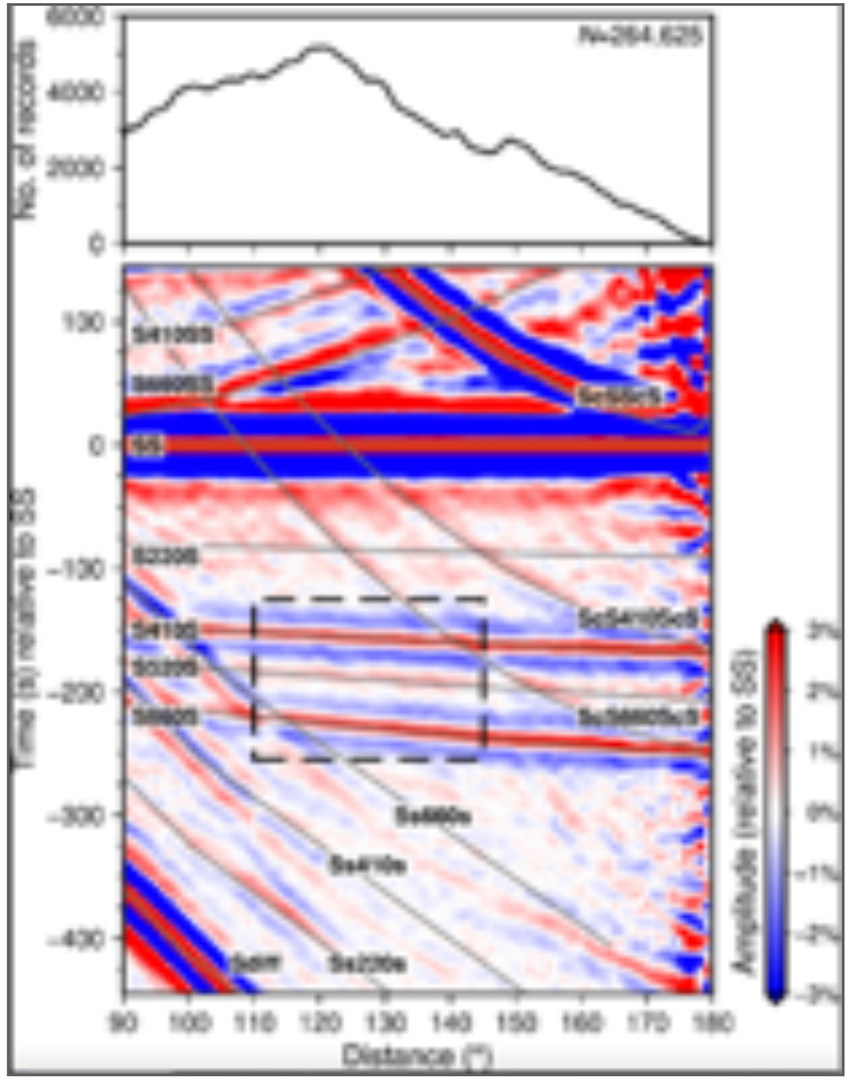
- Ocean Bottom Seismograph lab
- Electromagnetic Lab
- IRIS/IDA (part of the global seismic network)
- Piñon flat geophysics observatory



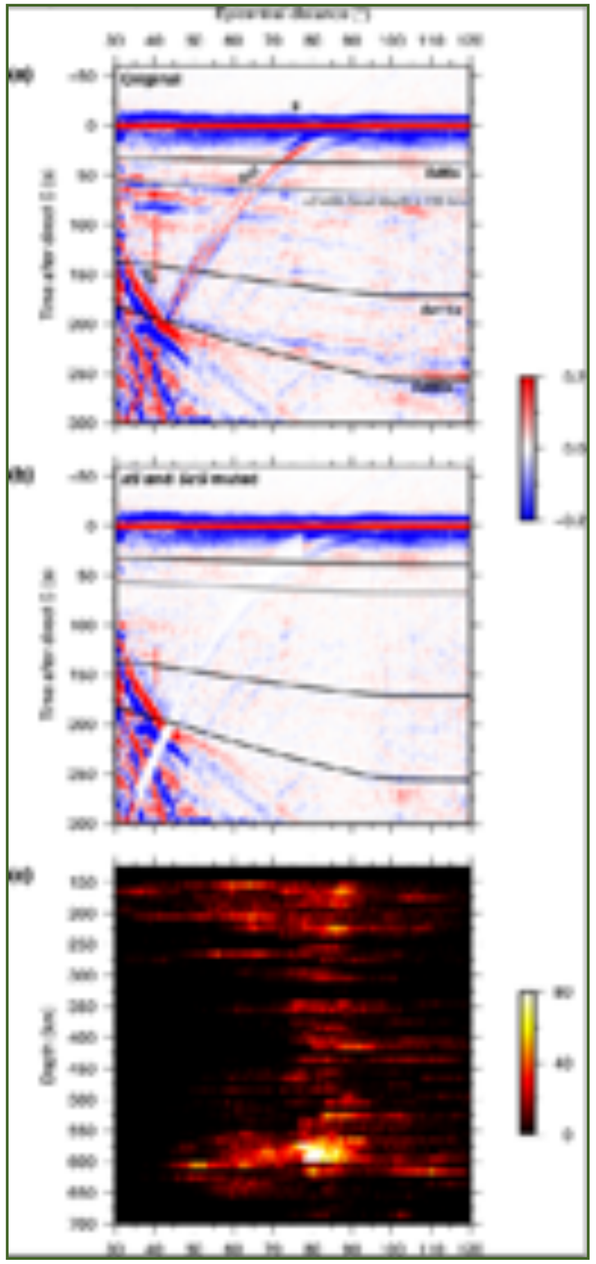


Upper Mantle Seismic Discontinuities

https://doi.org/10.1016/j.epsl.2020.116600

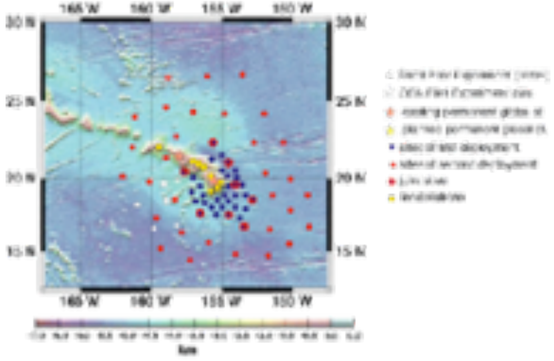


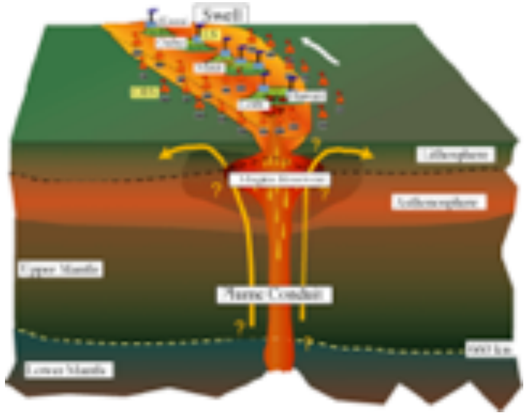
https://doi.org/10.1029/2020JB021624



Using Seismology to image the deep interior

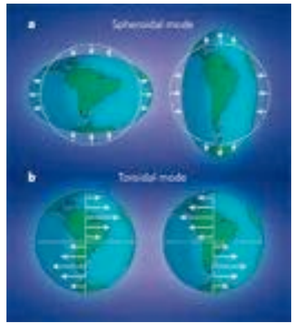
SWELL & the Hawaiian Plume

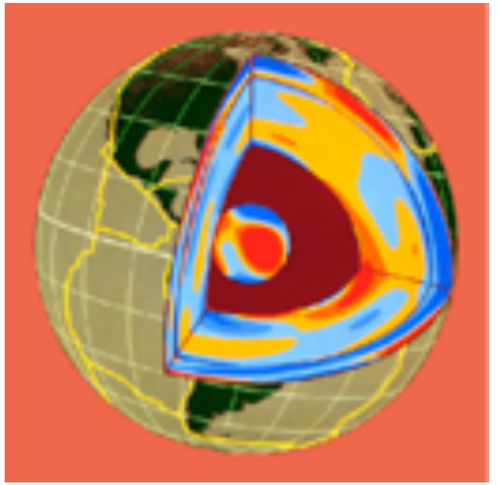


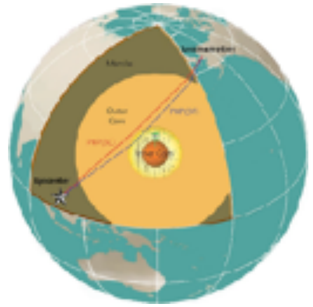


- Evolution and seismic imaging of the Hawaiian mantle plume, volcanic chain and swell
- Seismic anisotropy and mantle dynamics, on land and in the oceans
- Regional and global seismology
- Analysis methods for seismic surface waves and free oscillations
- Reference earth models
- Seismic noise and the development and propagation of storms
- Natural disasters and global change

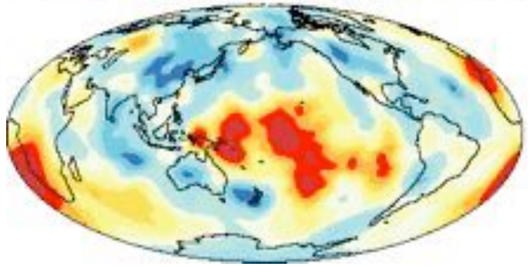
Normal Modes







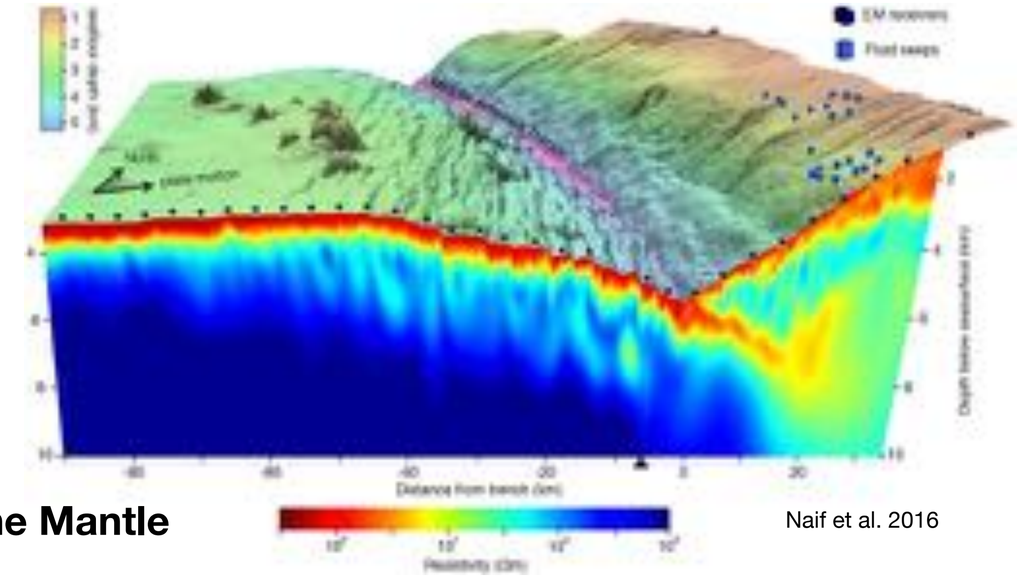
Shear velocity at the bottom of the mantle



Electromagnetic Induction Studies

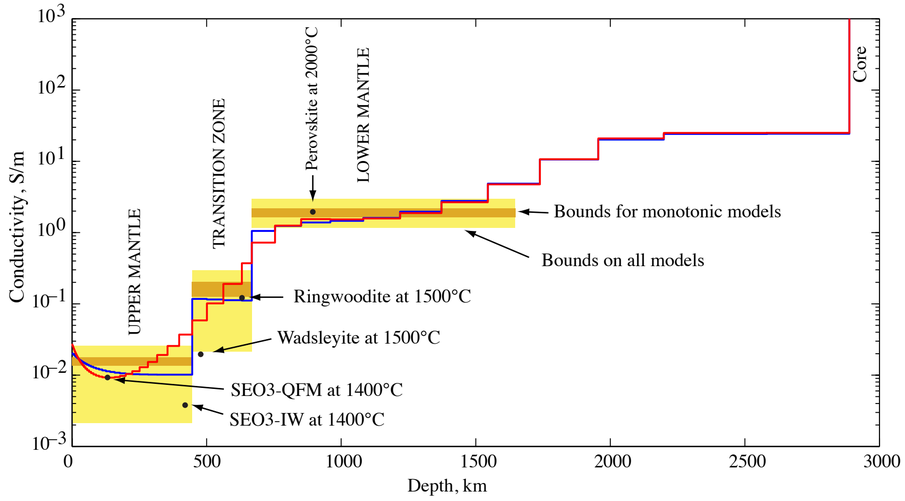
Subduction

Electrical Resistivity below Nicaragua



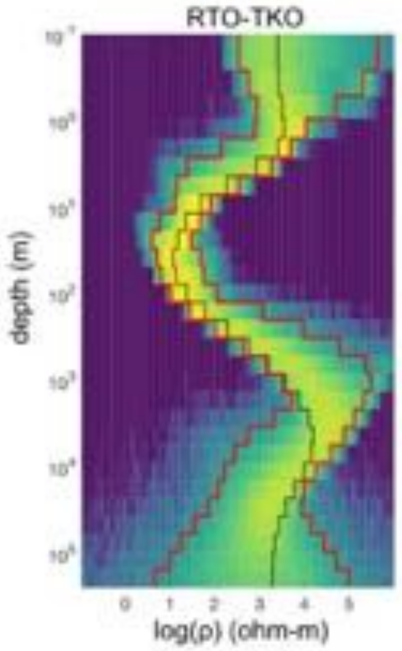
Naif et al. 2016

Electrical Conductivity of the Mantle



Geophysical Inversion - Uncertainty Quantification

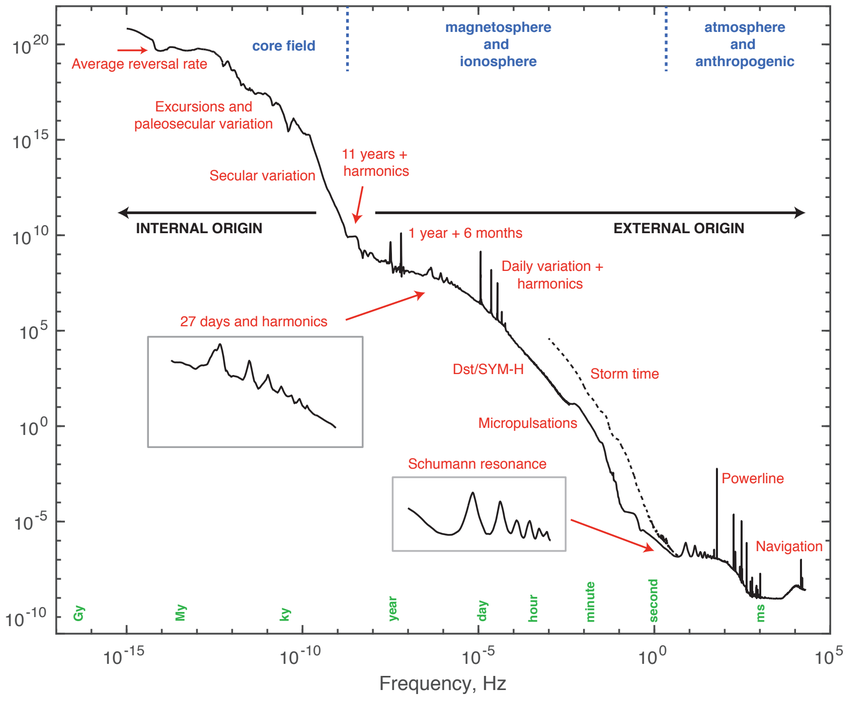
Combine regularized inversion, Bayesian sampling, and “randomize then optimize”



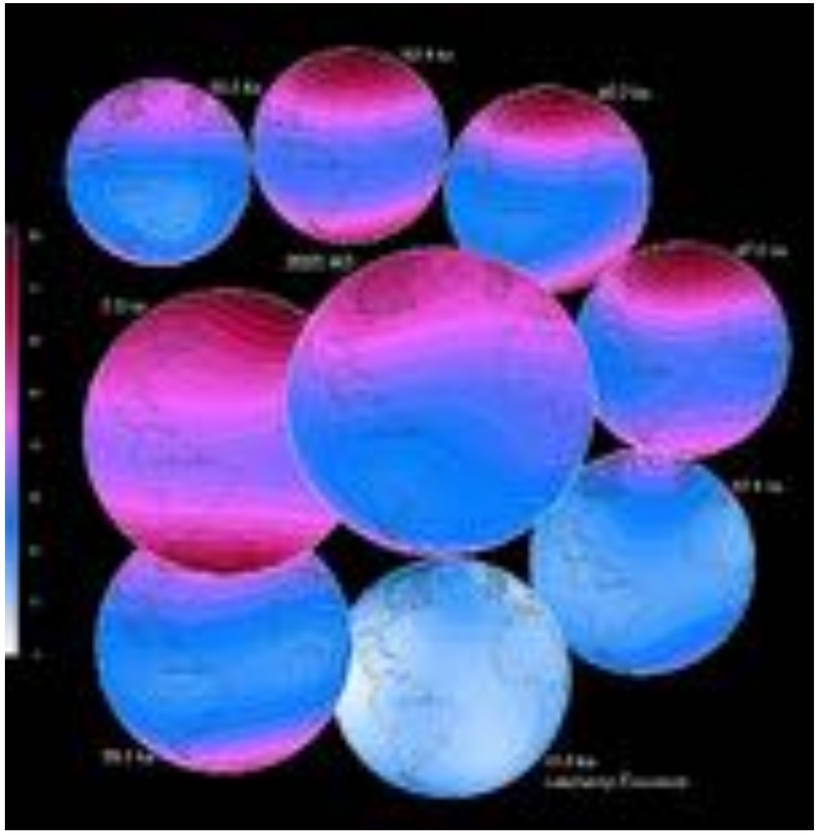
https://doi.org/10.1093/gji/ggac241

Geomagnetic Variations on all time scales

Grand spectrum of geomagnetic field variations



Paleofield Modeling- Geomagnetic Field from Earth's Core
Surface field strength from 85 ka to present

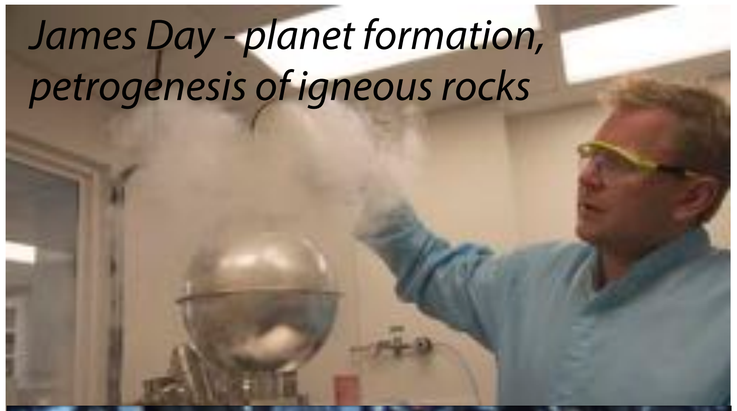


Stochastic Modeling of the geomagnetic field

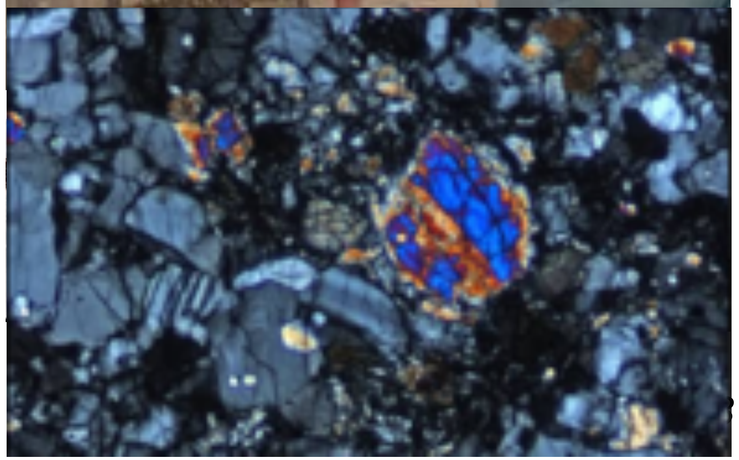
Can one use Earth's magnetic axial dipole field intensity to predict reversals?

Can machine learning reveal precursors of reversals of the geomagnetic axial dipole field?

Links to Geosciences - High temperature Geochemistry and the Deep Earth



James Day - planet formation, petrogenesis of igneous rocks



Emily Chin - origin and evolution of continental crust

Paleogeomagnetism

Jeff Gee

Why you should do geophysics graduate work at Scripps

- **Challenging** and **exciting** PhD program in a large, **supportive** community. Lots of choice about what to do.
- Alumni have great careers in research, industry, and policy
- Well-established program with clear **structure**, **funding,** and **timelines**
- Collaborative faculty engaged in all aspects of geophysics
- **Theoretical**, **observational,** and **experimental** approaches are all used
- Numerous opportunities for professional training
- First hand experience in our major geophysical facilities:
- Ocean Bottom Seismograph lab
- Electromagnetic Lab
- IRIS/IDA (part of the global seismic network)
- Piñon flat geophysics observatory

Graduate Fellowships in Geodesy at Scripps Institution of Oceanography – 2024-25 Academic Year

We invite applications for fully funded graduate student fellowship (stipend and tuition) for PhD study in Geodesy within the Geophysics Program (GP) at the Institute for Geophysics and Planetary Physics, UCSD. The 5-year fellowships are funded by the National Geodetic Survey to develop a time dependent geodetic reference system for Western North America based on combined GNSS and InSAR. We seek applicants with backgrounds in geodesy, geophysics, physics, mathematics, and computing as well as an interest in pursuing a PhD in a field that uses Geodetic Science for exploring the Earth. Our flexible curriculum and multidisciplinary researchers enable us to welcome graduate students from a diverse range of backgrounds in science and engineering, with the goal of expanding the pool of Geodetic Scientists who are well prepared for future careers in academia, industry, or public service. These fellowships are open to both U.S. citizens and permanent resident aliens. Applications for the Fall of 2024 will be open early September with a deadline in early December, 2023 (**https://scripps.ucsd.edu/doctoral/admissions/how-apply**)

Geodesy Curriculum

This proposal includes funding for new graduate students. The students are expected to take the Geodesy curriculum and have a geodesy-related thesis. One or more of the students should focus on time dependent geodetic reference system for western North America based on combined GNSS and InSAR.

Table 1. Geodesy Courses Offered at SIO

SIO course number	title	instructor(s)
229	*Reference Frames and Global Gravity*	Borsa/Bock
239*	*GNSS Geodesy (new in 2021 – course number pending)*	Haase
236	*Satellite Remote Sensing*	Fricker/Sandwell
237	*Space Geodesy Seminar (some field work)*	Fialko/Haase or Sandwell
(new) *	*Radar Interferometry*	Sandwell/Mellors
(new)	*Geodetic Field Work and Aircraft Gravity*	Greenbaum
239 *	*Seafloor Geodesy*	Zumberge/Sandwell
223 A/B	*Geophysical Data Analysis*	Agnew
210	*Introduction to Physical Oceanography*	Talley

* - alternate years

Required for Geodesy Program Fellowship Funding

GP Core Course

Geodesy Field Surveys


2012


2008


2018


2008


2022

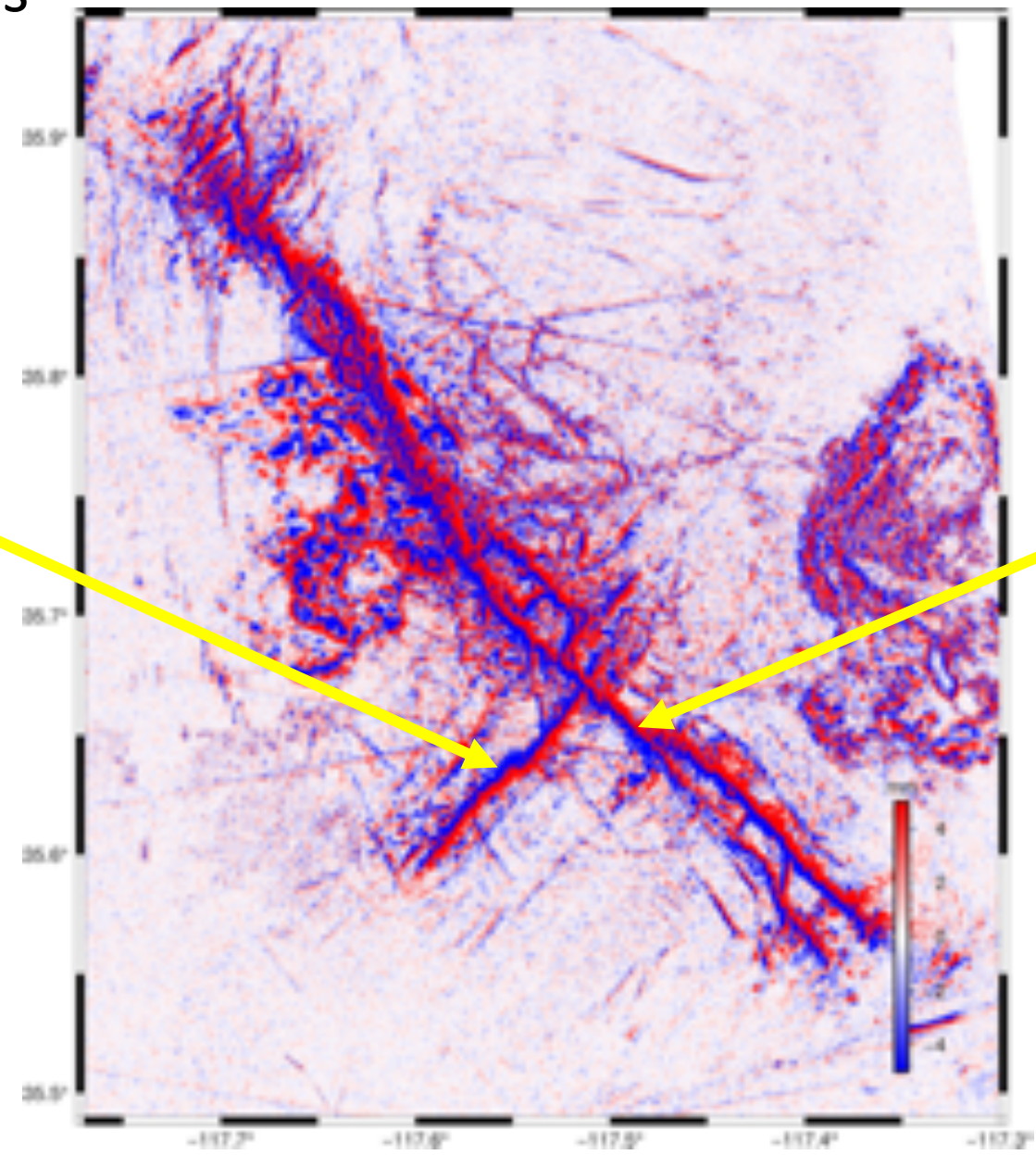

SIO/SDSU Field Trip
November 2019

Ridgecrest earthquakes

east-west displacement

Jennifer Haase
Eric Xu
Ignacio Sepulveda

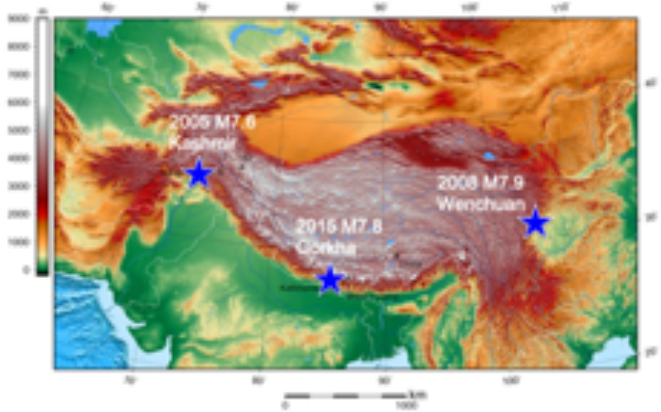
left lateral

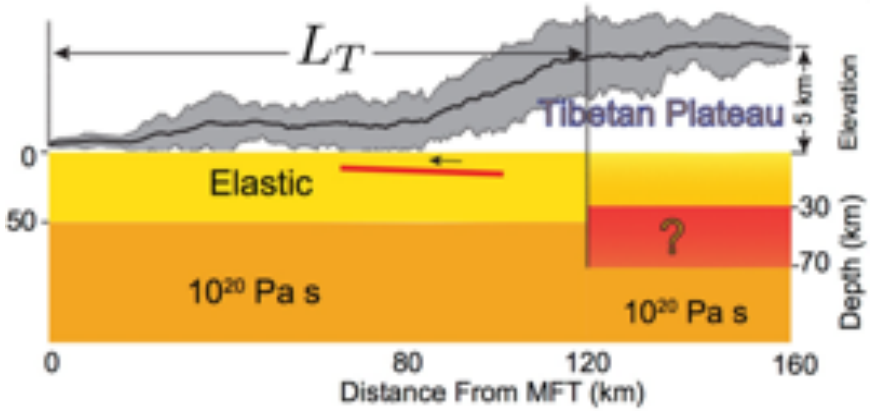


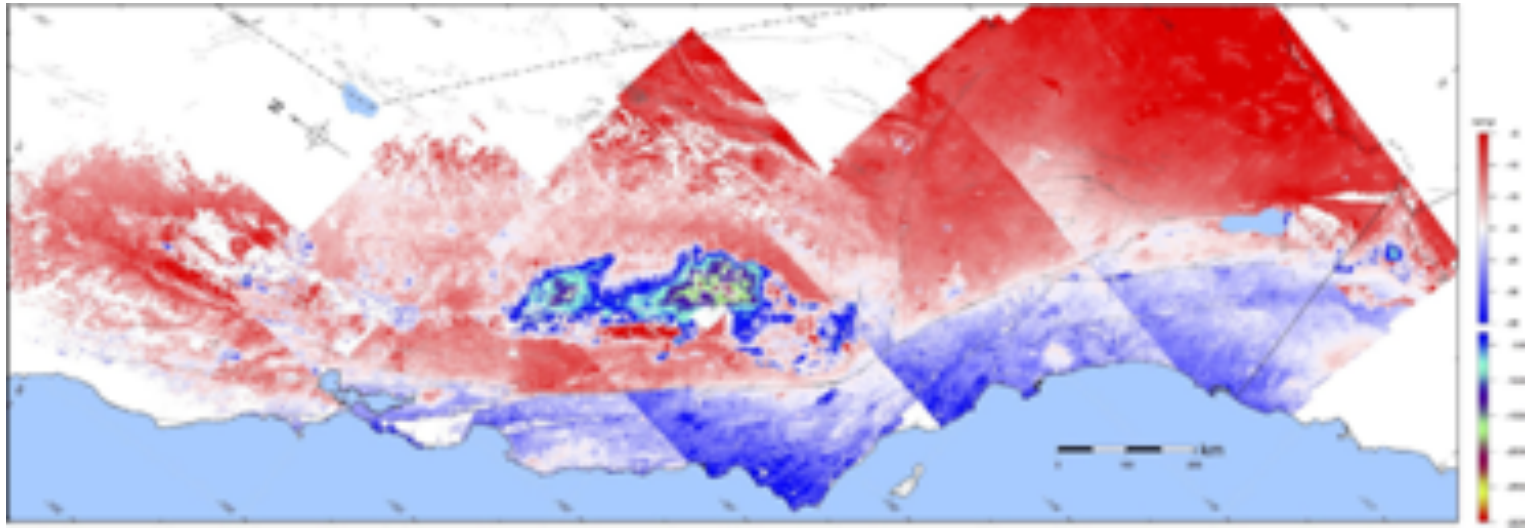
right lateral

Earthquake Cycle – GNSS and InSAR

Yehuda Bock
Yuri Fialko
Katherine Guns
Jennifer Haase
David Sandwell
Eric Xu



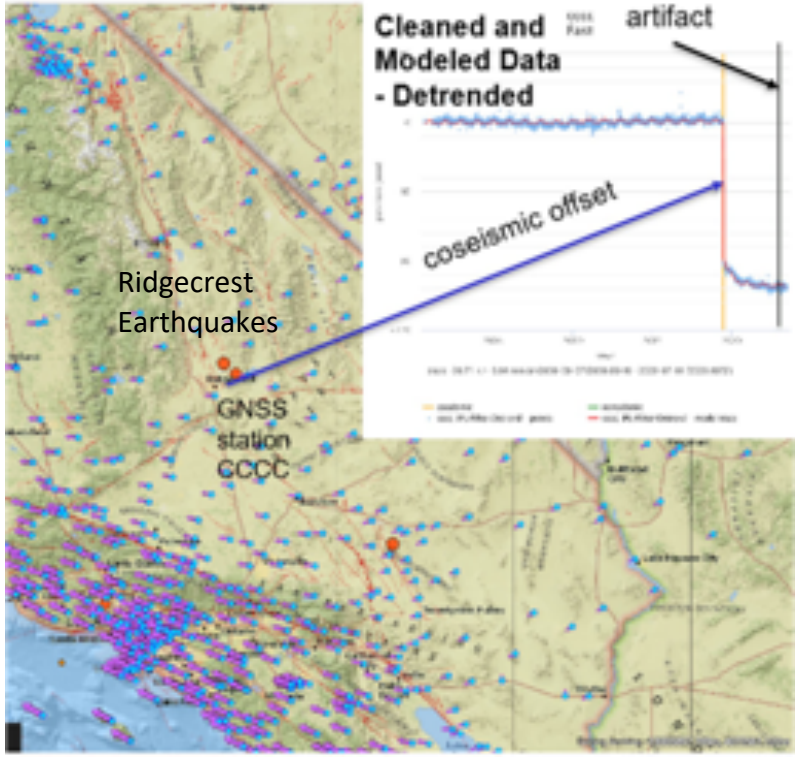




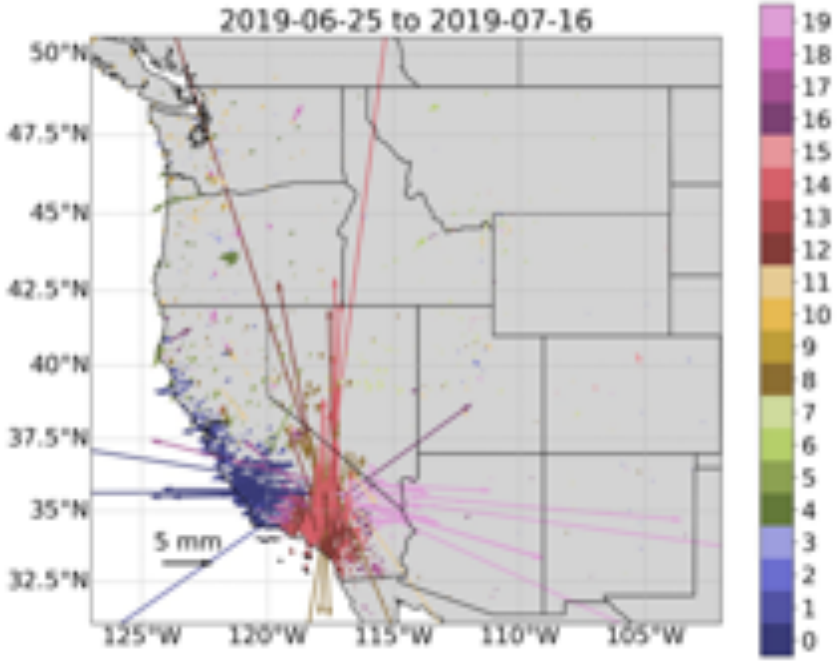

Yehuda

Data Science and Visualization

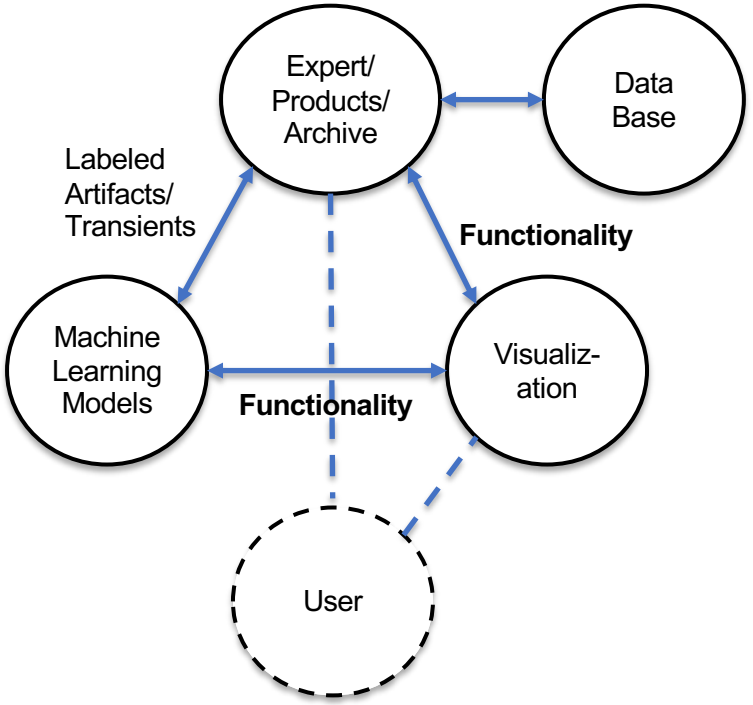
Yehuda Bock
Roland Hohensinn
Shibani Likhite
Kelly Luu
Rohith Rachala



Visualization portal and GPS displacement time series



K-means cluster analysis of coseismic displacements – July 6, 2019 Mw7.1 Ridgecrest earthquake



Machine learning models & visualization


Mark

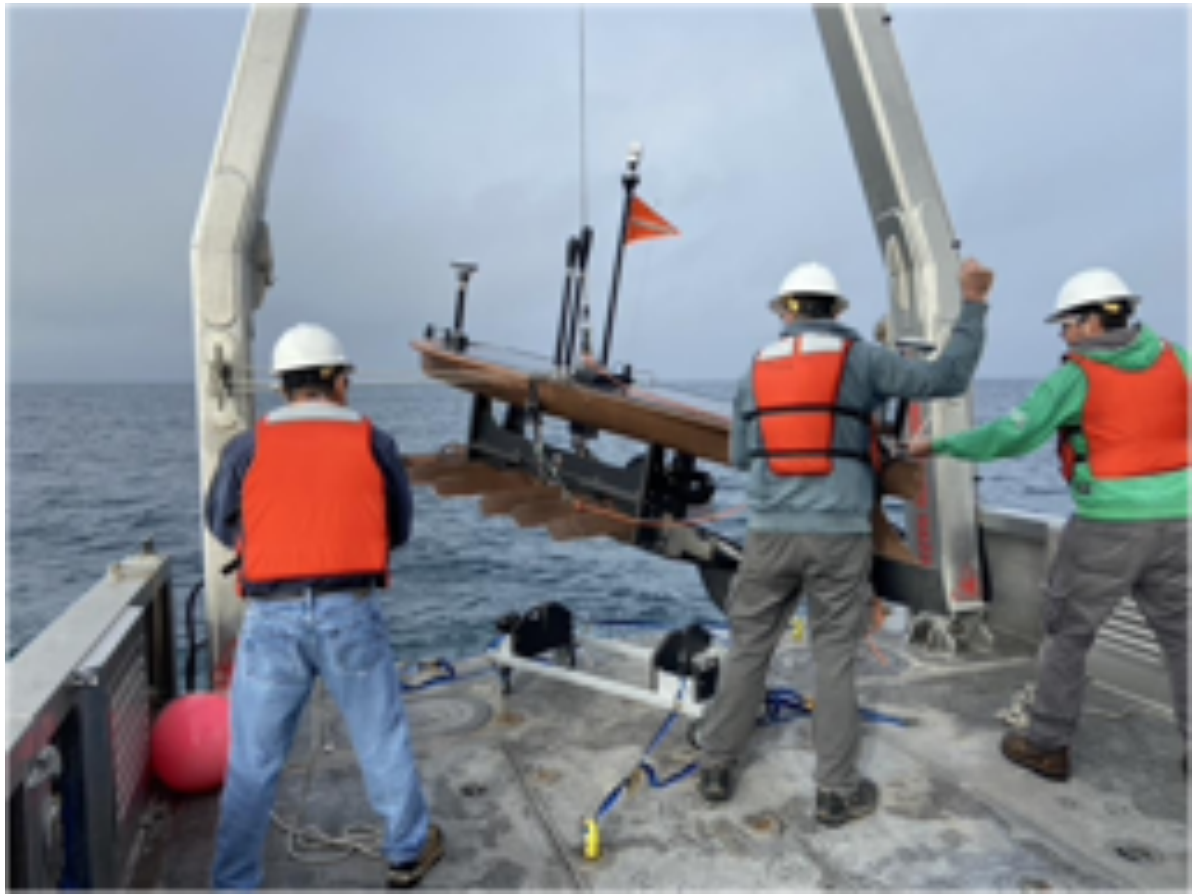
Seafloor Geodesy at Subduction Zones

Mark Zumberge
Glenn Sasagawa


Glenn

GPS Acoustics

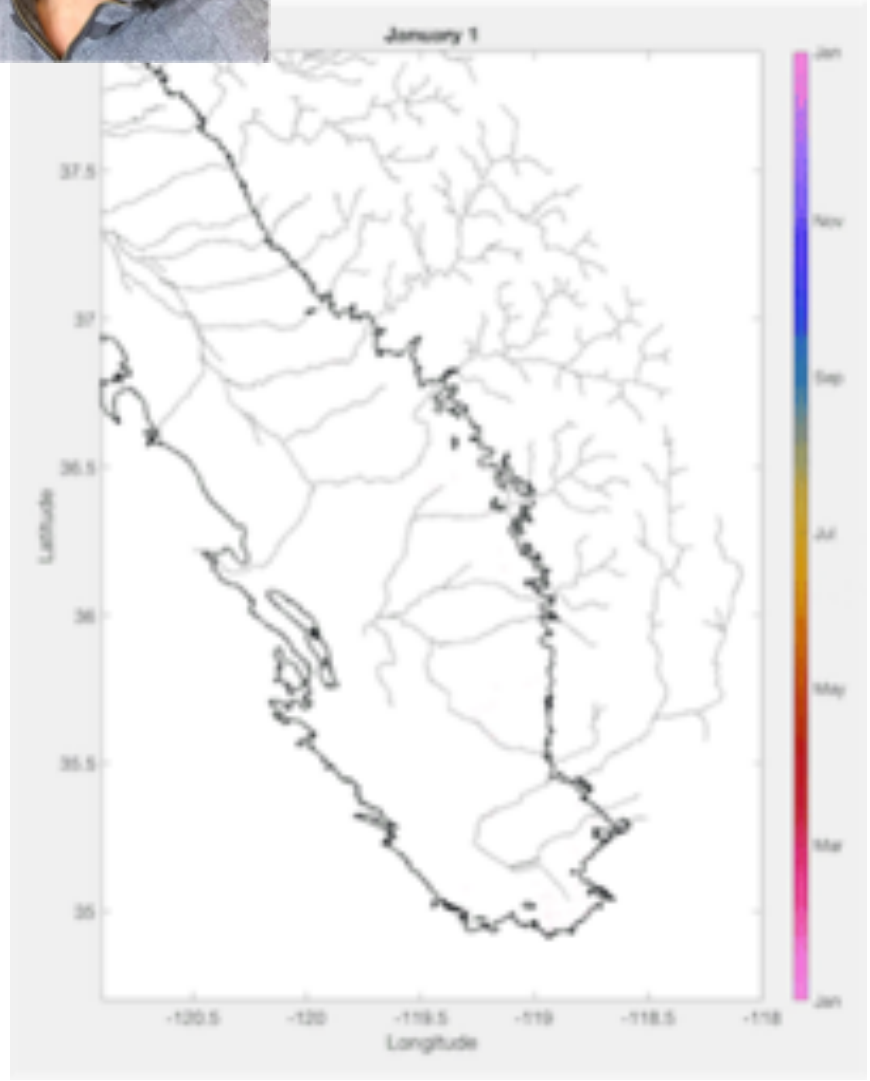
Bottom Pressure

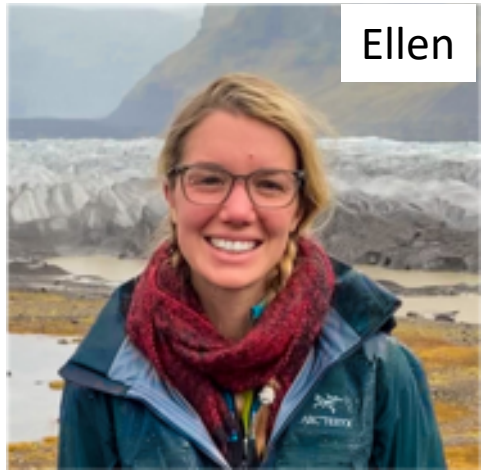


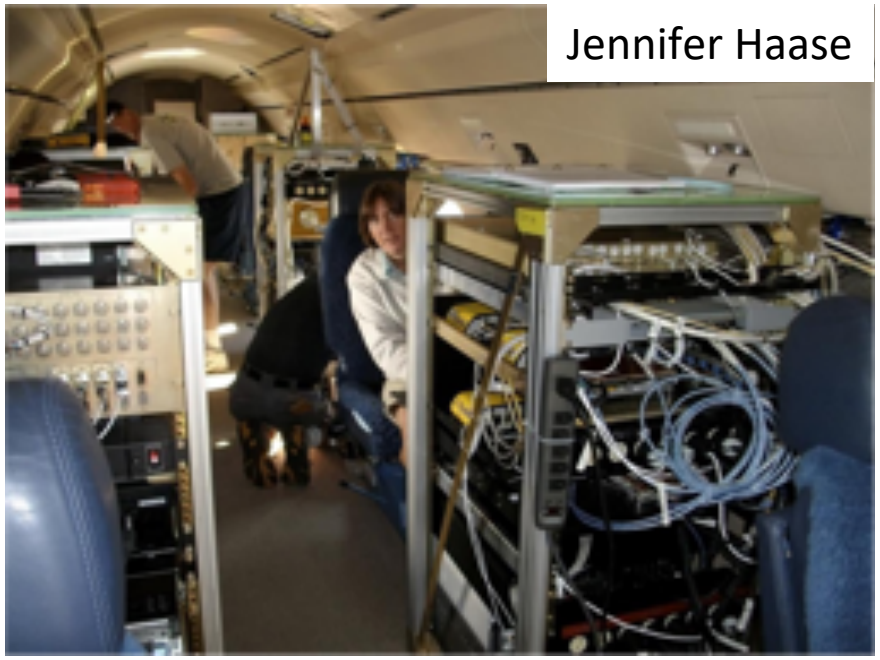

Adrian

Hydrogeodesy and Atmospheric/Climate Interactions

Adrian Borsa
Ellen Knappe
Wes Neeley




Ellen


Jennifer Haase

Marine Geophysics at IGPP

Steven Constable

Matthew Dzieciuch

Wenyuan Fan

Jeff Gee

Jamin Greenbaum

Gabi Laske

Ross Parnell-Turner

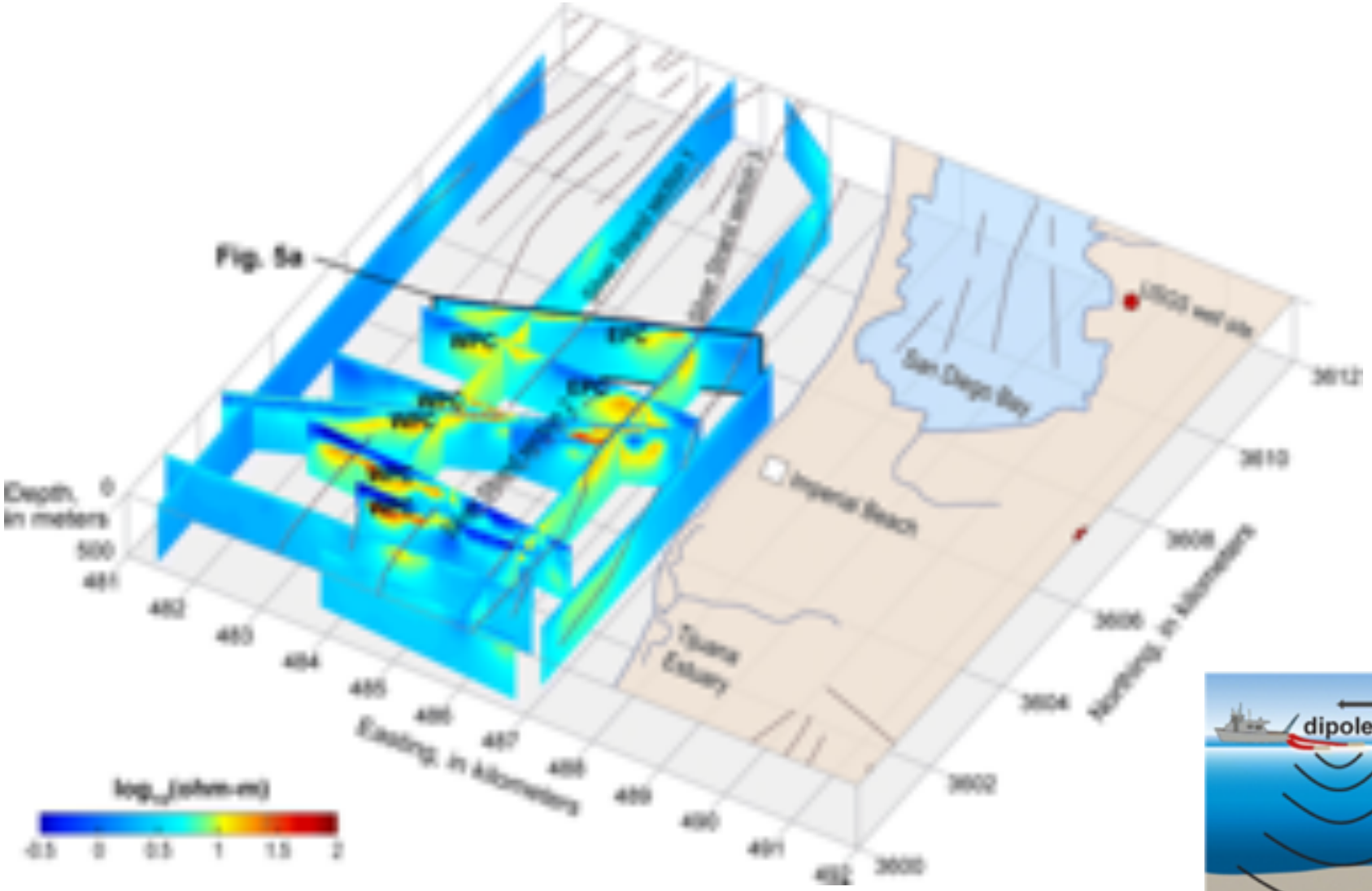
David Sandwell

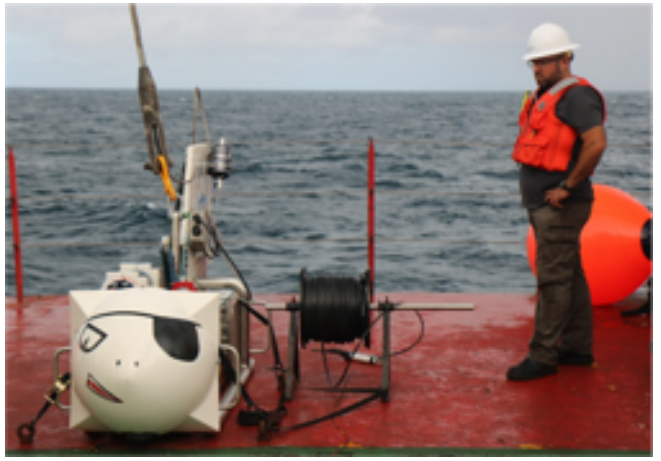
Vashan Wright

Mark Zumberge

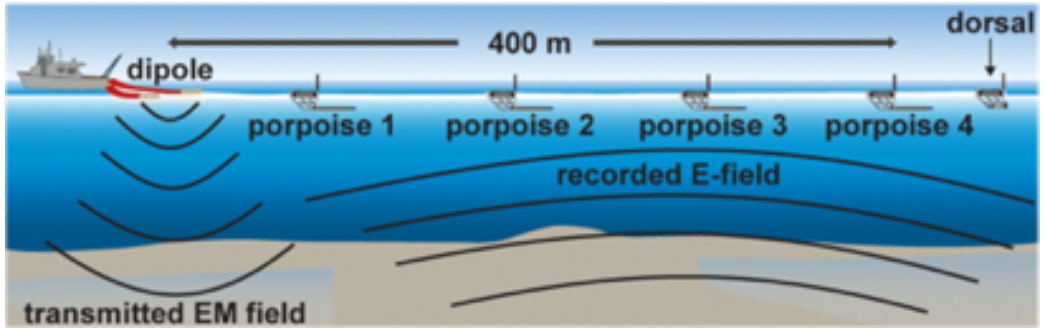
Among the things we have in common…

Marine Electromagnetics

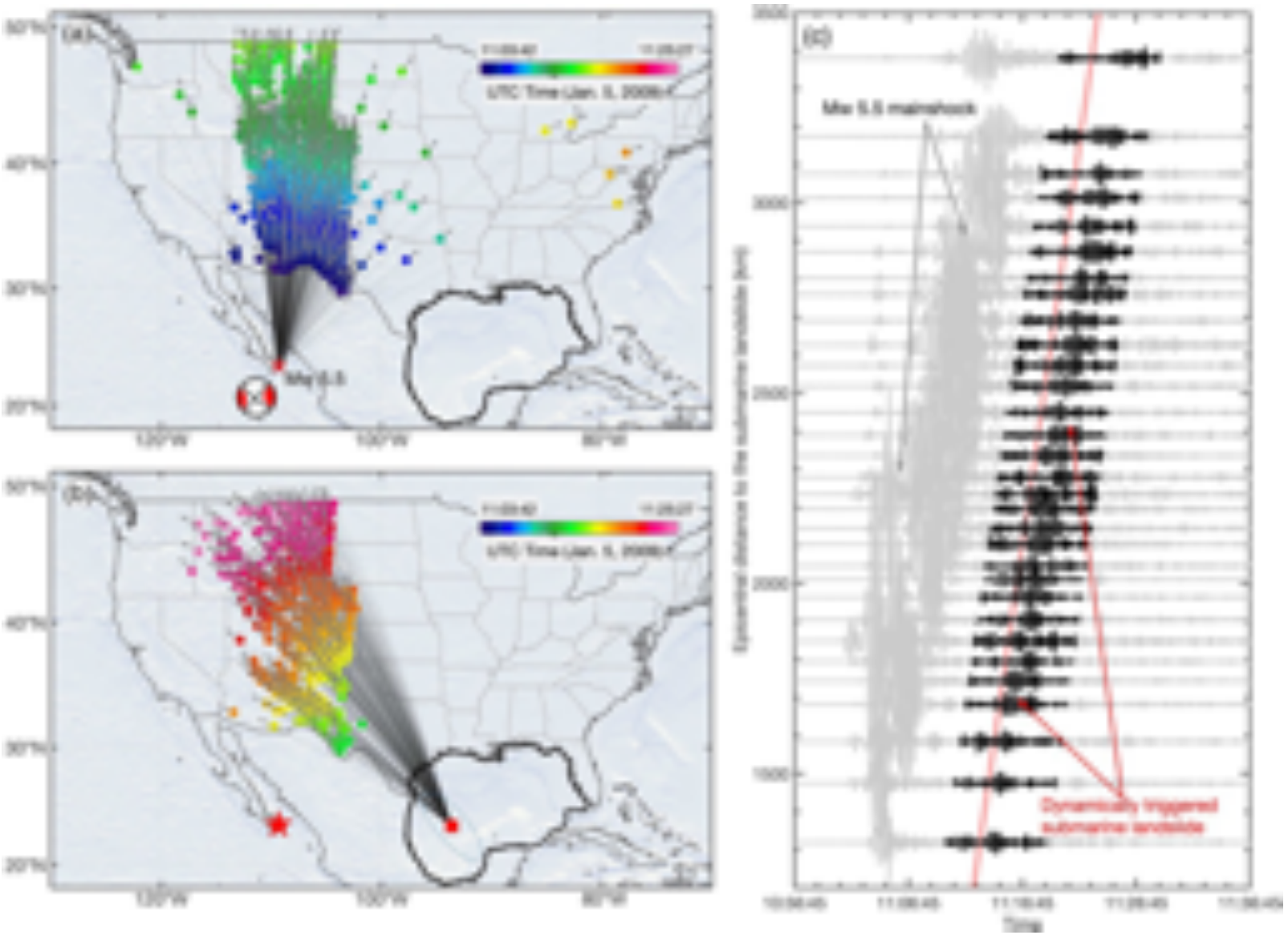




Offshore groundwater, San Diego

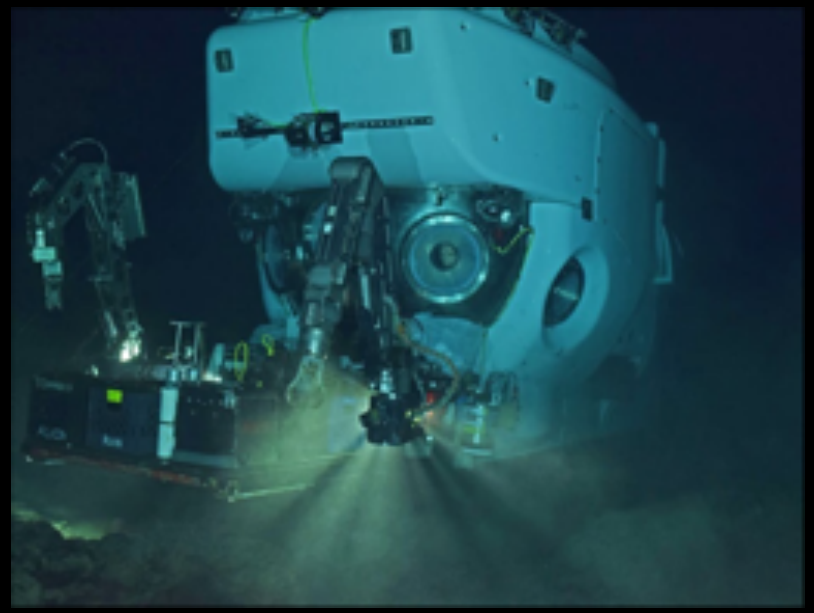


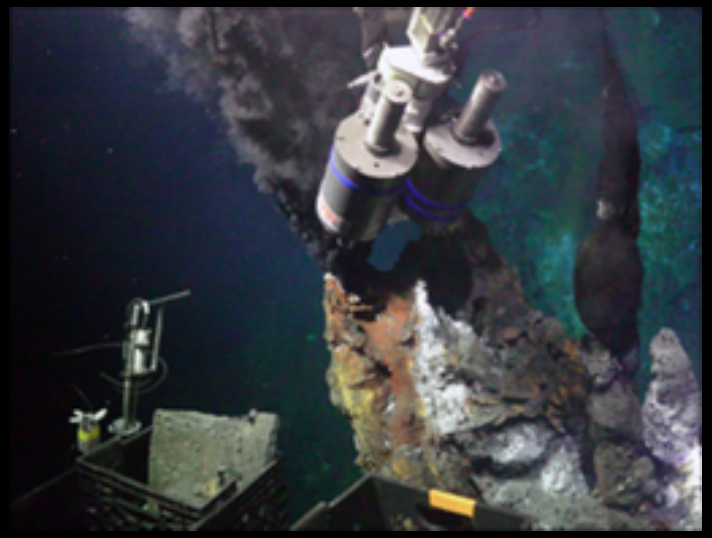
Marine Seismology



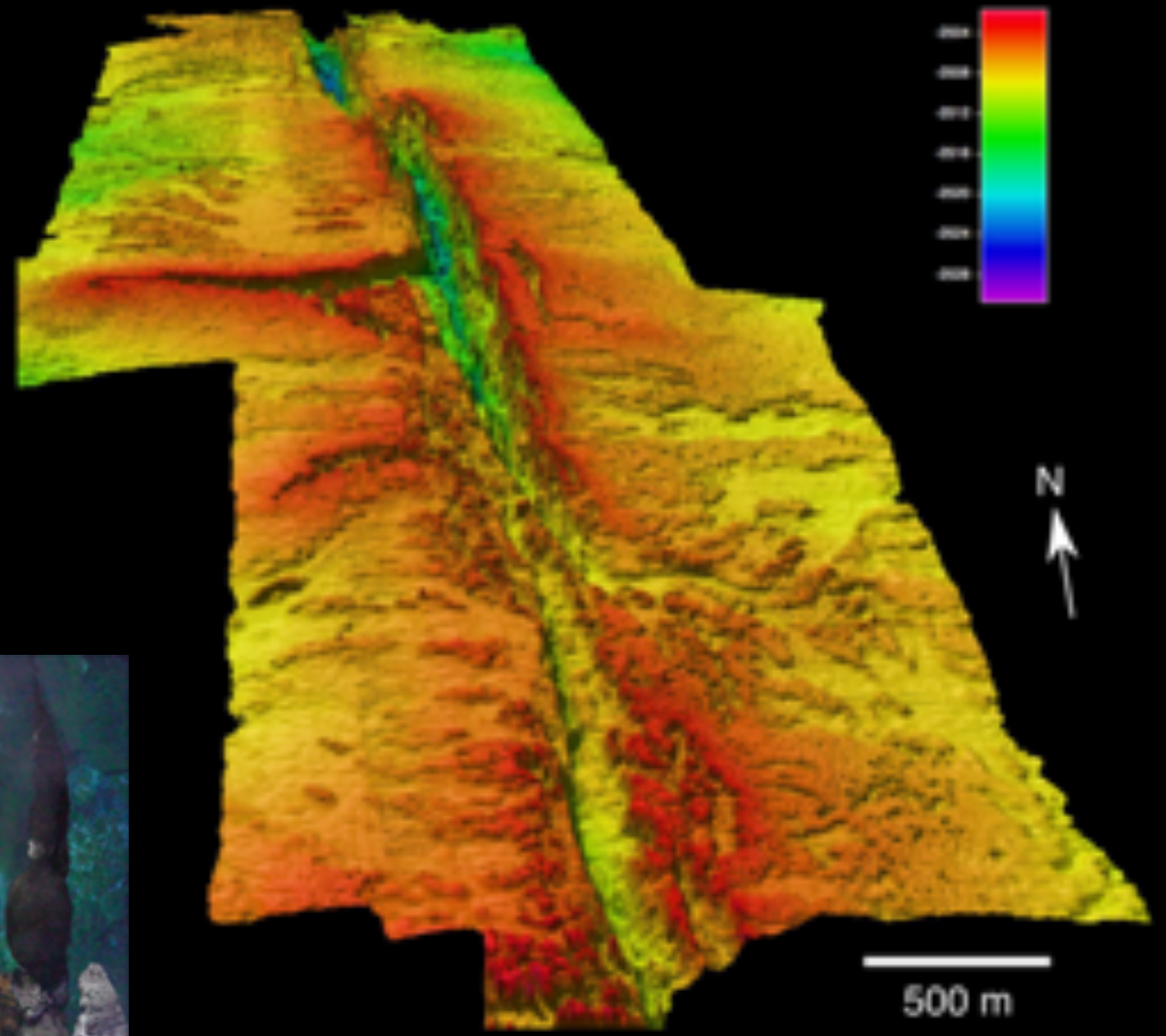
Submarine Landslides in Gulf of Mexico

Mid-Ocean Ridges



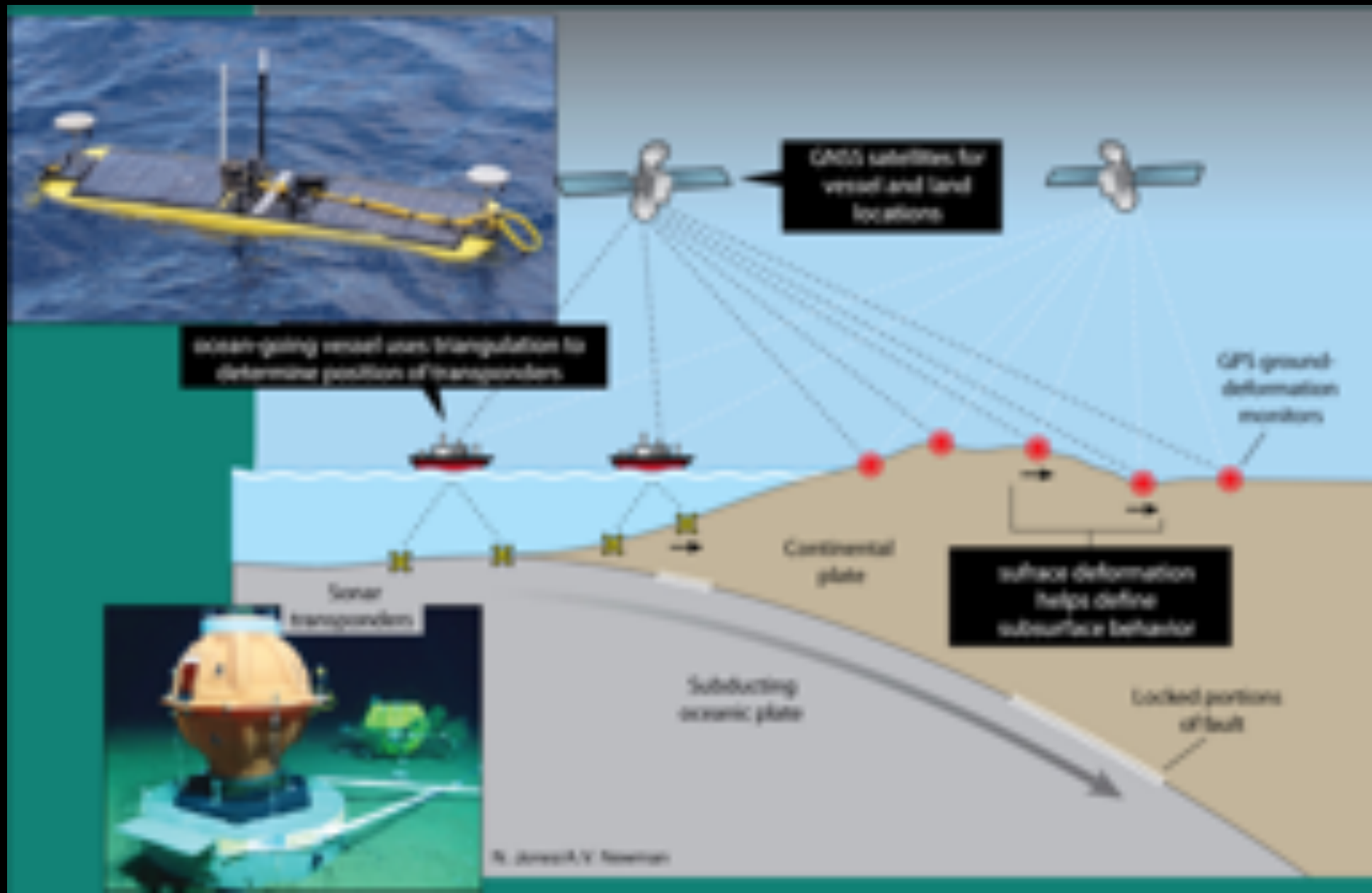


Measuring hydrothermal flux at black smokers



Seafloor geodesy

Cascadia subduction zone



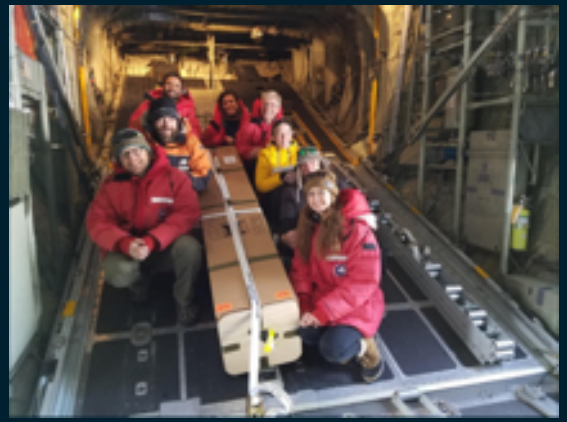
Ice sheet-ocean interaction

GP Faculty: Helen Amanda Fricker, Wenyuan Fan, & Jamin Greenbaum

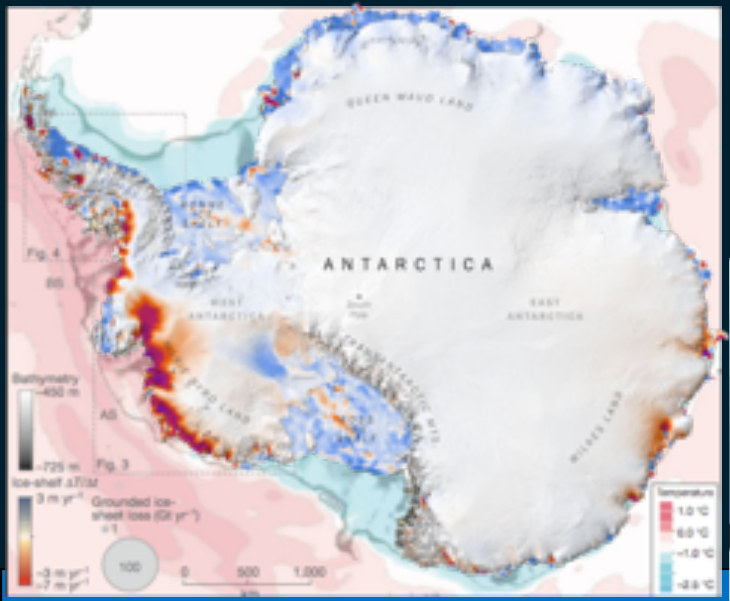
PhD students: Susheel Adusumilli, Maya Becker, Philipp Arndt
MSc student: Canyon Breyer
Postdoc: Cyrille Mosbeux

https://polar.ucsd.edu/education/phd/

ALAMO sensor deployment from a C-130 Hercules, West Antarctica



Satellite-derived ice elevation change and ocean temperatures:



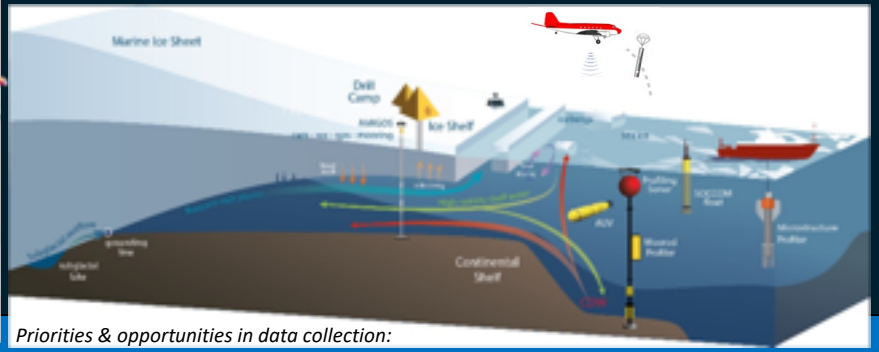
Research topics

- Ice sheet mass balance
- Ice shelf mass loss processes
- Subglacial lakes

Techniques

- Satellite radar and laser altimetry
- GPS & radar sounding (fieldwork)
- Gravimetry

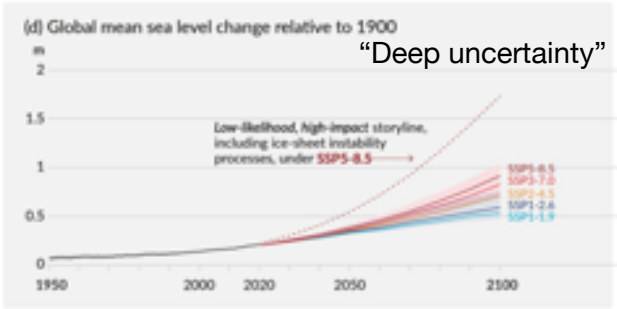
Priorities & opportunities in data collection:



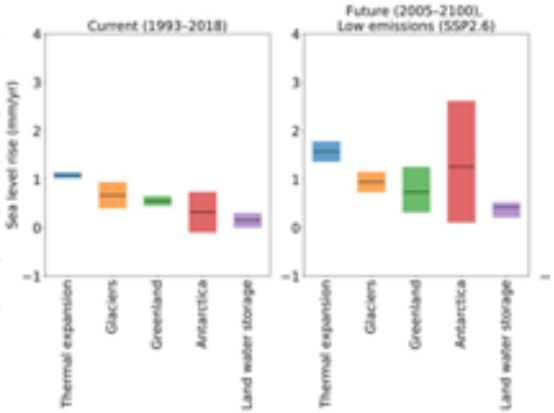
Sonobuoy deployment from a BT-67 Basler, East Antarctica:

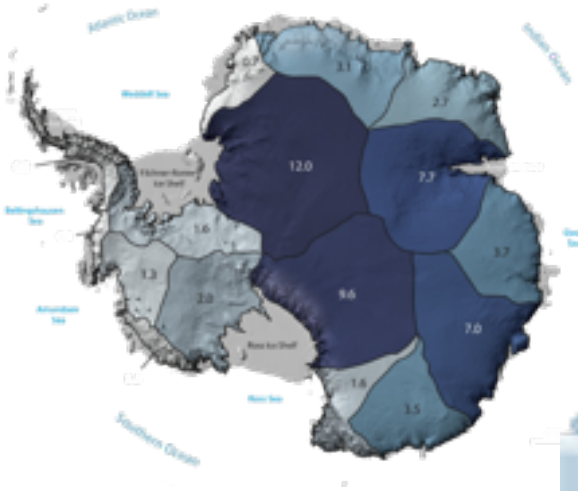
Ice sheets and sea level

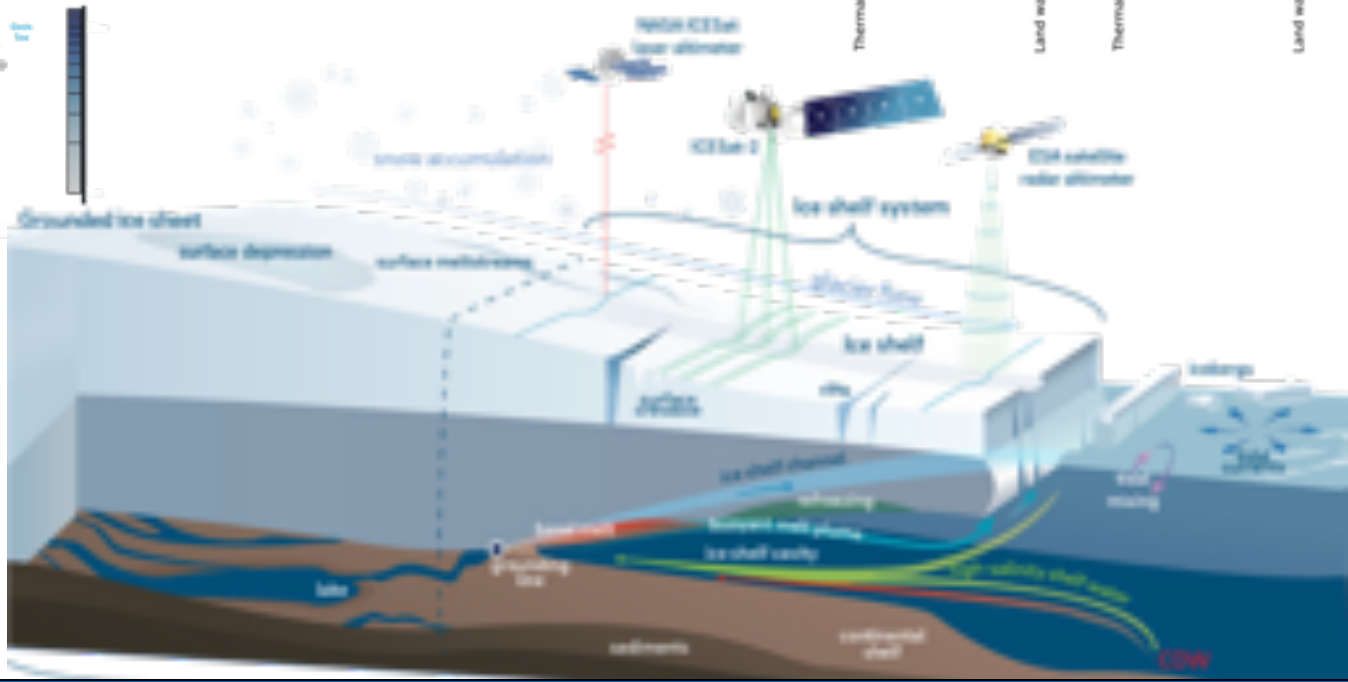
IPCC AR6



"Deep uncertainty"





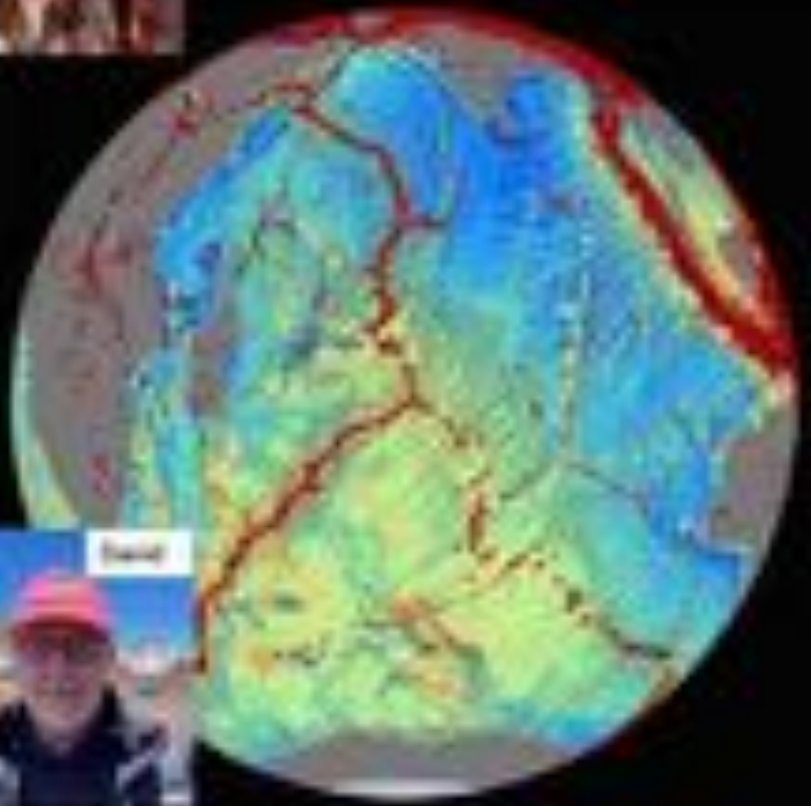


ICESat-2
ICE, CLOUD, AND LAND ELEVATION SATELLITE-2

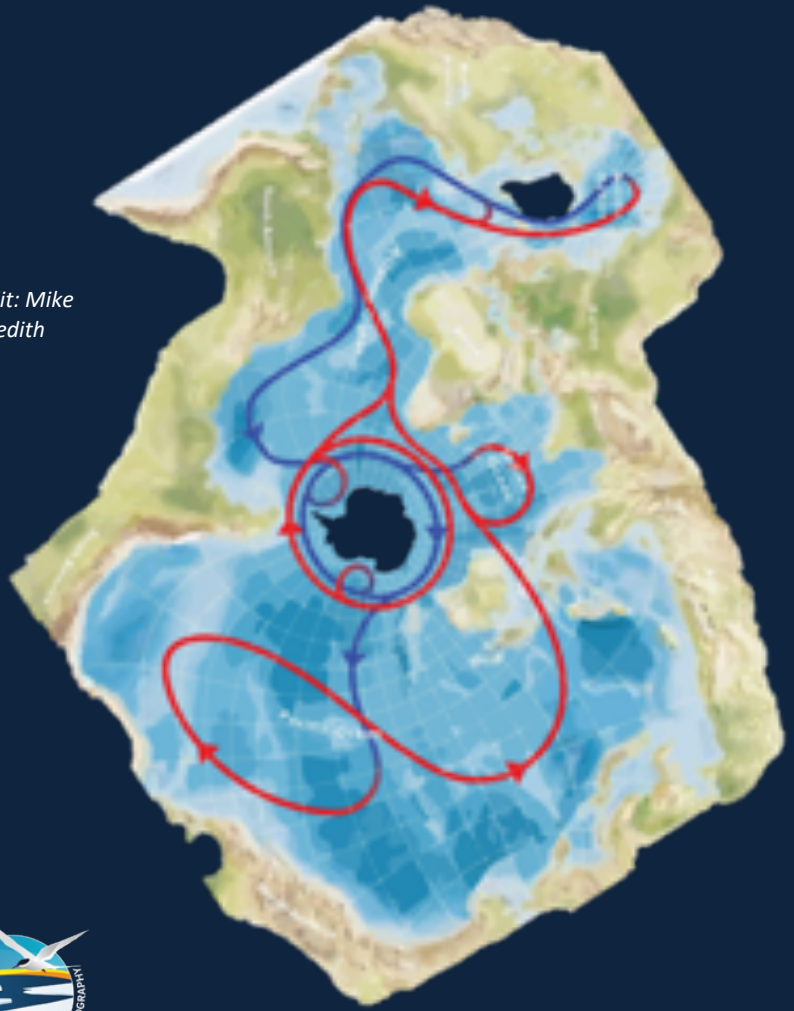
Marine Gravity from Satellite Altimetry

marine gravity and bathymetry

Tectonics

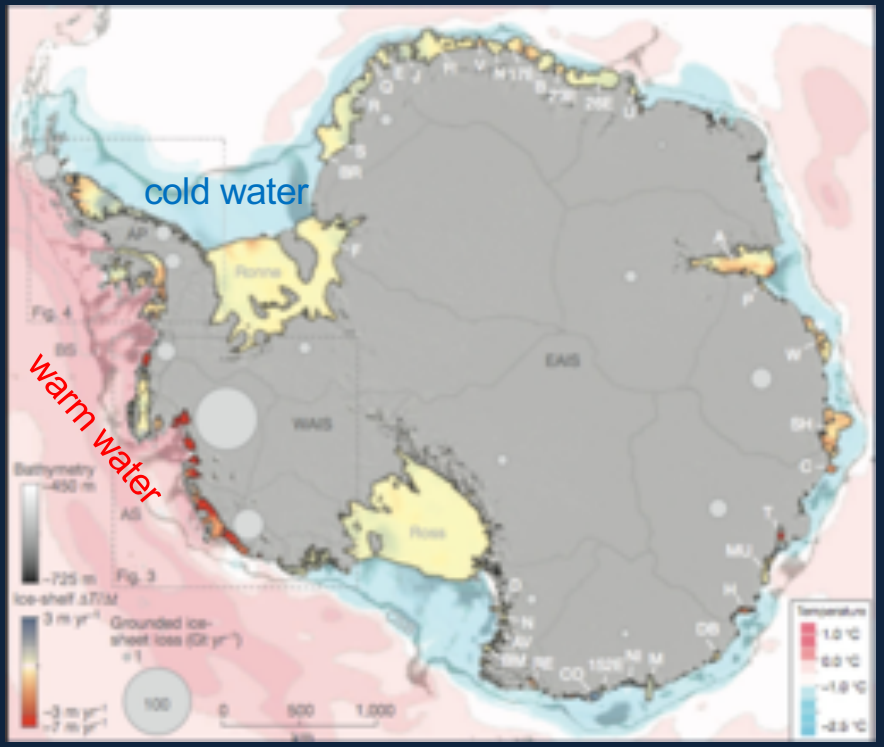


2010's



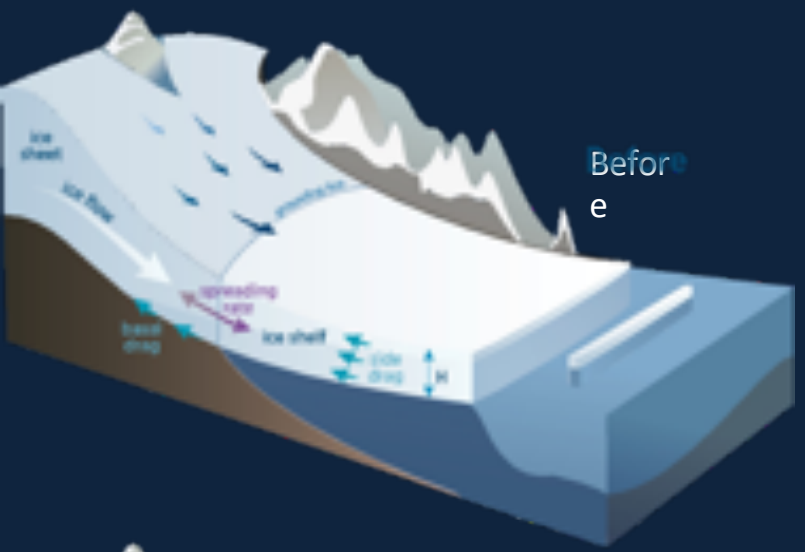
Credit: Mike Meredith

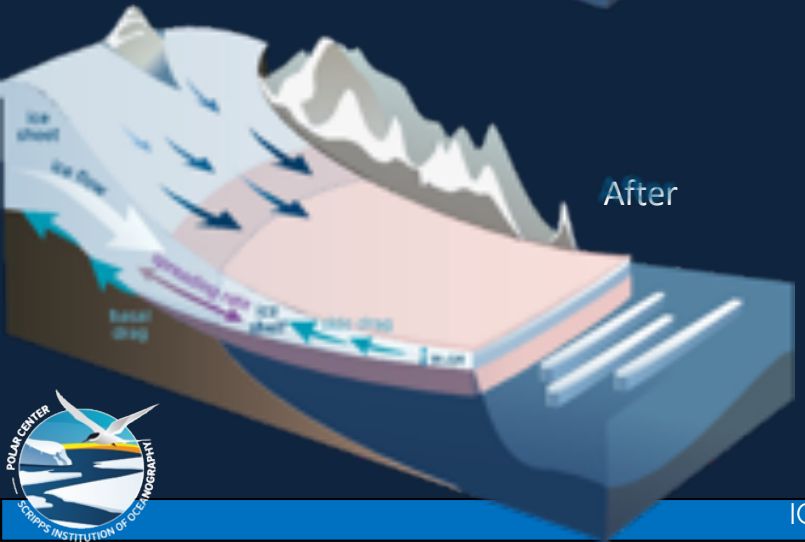
ICESat 2003-2008



Pritchard et al., 2012

[1293 cites]





ERS-1/ERS-2/Envisat
1994-2012

2010's

Rate of ice thickness change
(m/decade)
-25
0
+10

Thickness change (%)
loss
gain

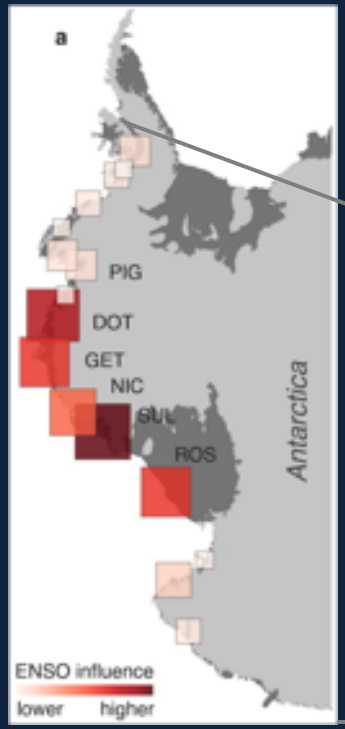
Queen Maud
Larsen
B
C
D
Amery
East Antarctica
West Antarctica
VEN
THW
CRO
DOT
GET
WIT
Ross
Wilkes
TOT
MOS

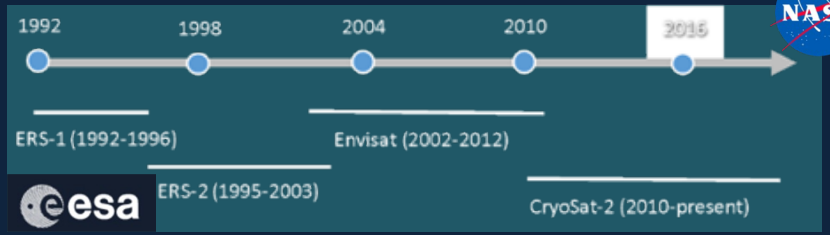
Paolo et al., 2015

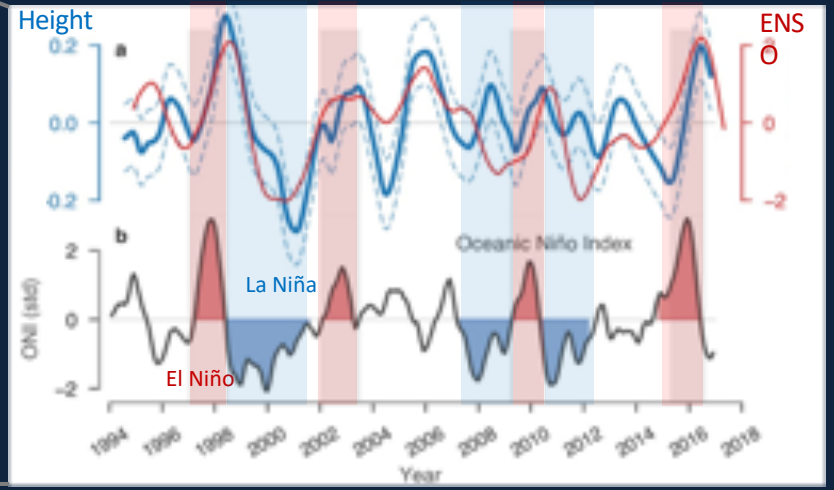
[759 cites]

Time series allow us to look at processes

2010's







Paolo et al., 2018

Links between grounded and floating ice

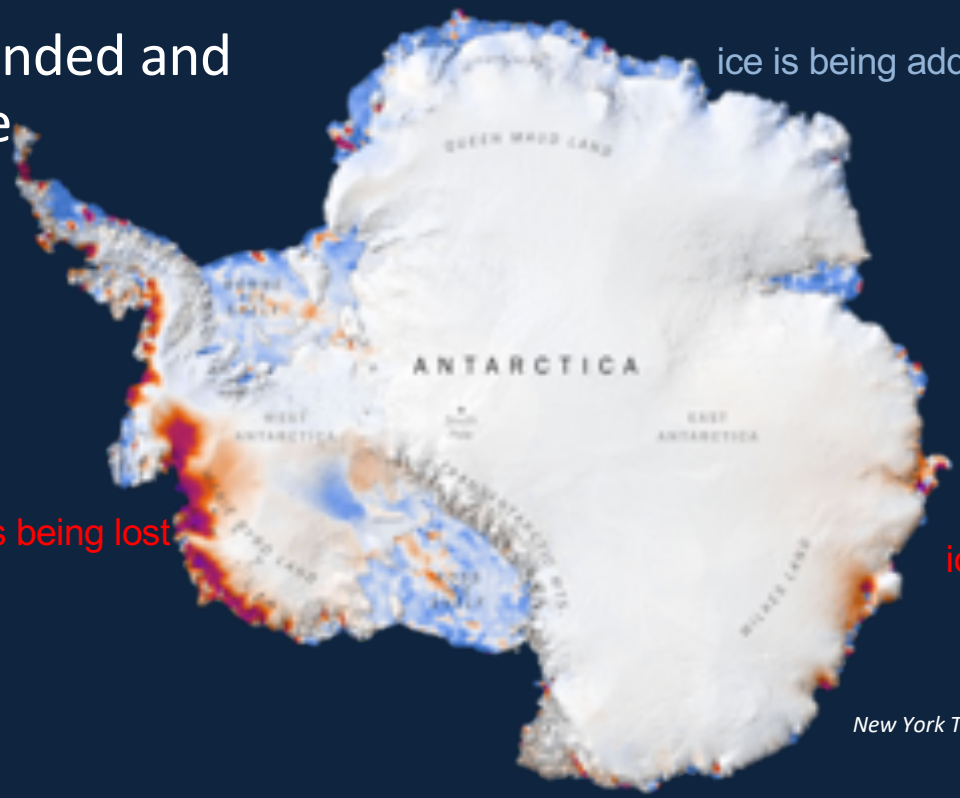
2020's

ICESat-2 minus ICESat
2003-2019

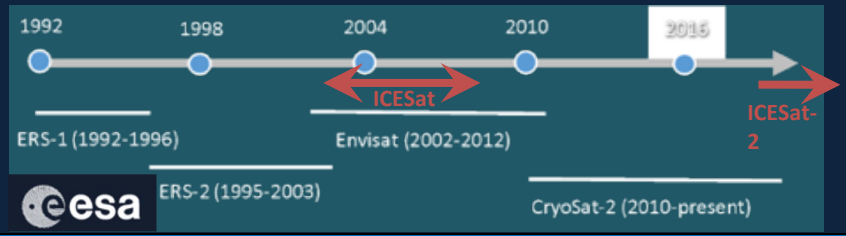
ice is being added

ice is being lost

ice is being lost



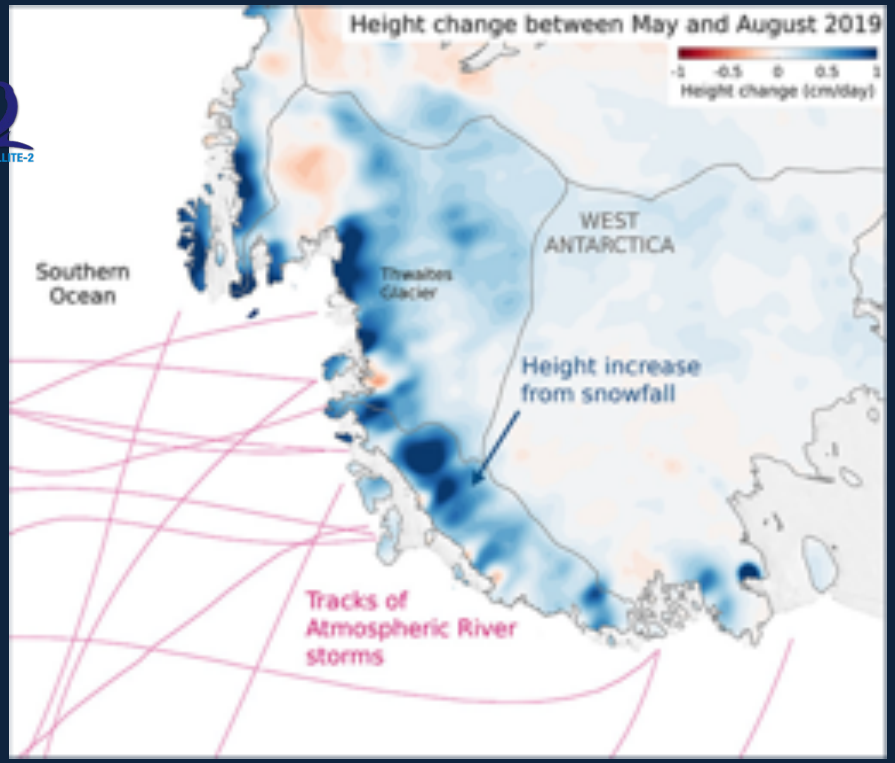
New York Times



Smith et al., 2020

[329 cites]

Atmospheric rivers delivered large quantities of snowfall to West Antarctica



ICESat-2 observed rapid increases in height over West Antarctica in winter 2019.

41% of these height increases were from snow accumulation via extreme precipitation events – & 63% of those associated with landfalling ARs.

Adusumilli et al., GRL, 2021

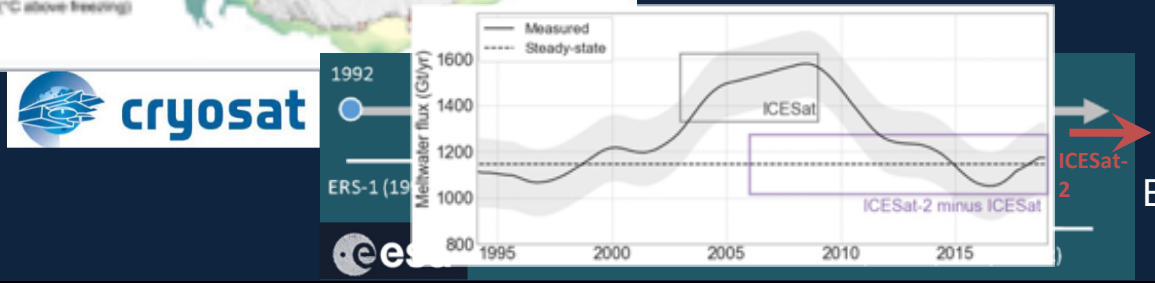
[206 cites]

Time-varying basal melt rates from satellite altimetry

2020's

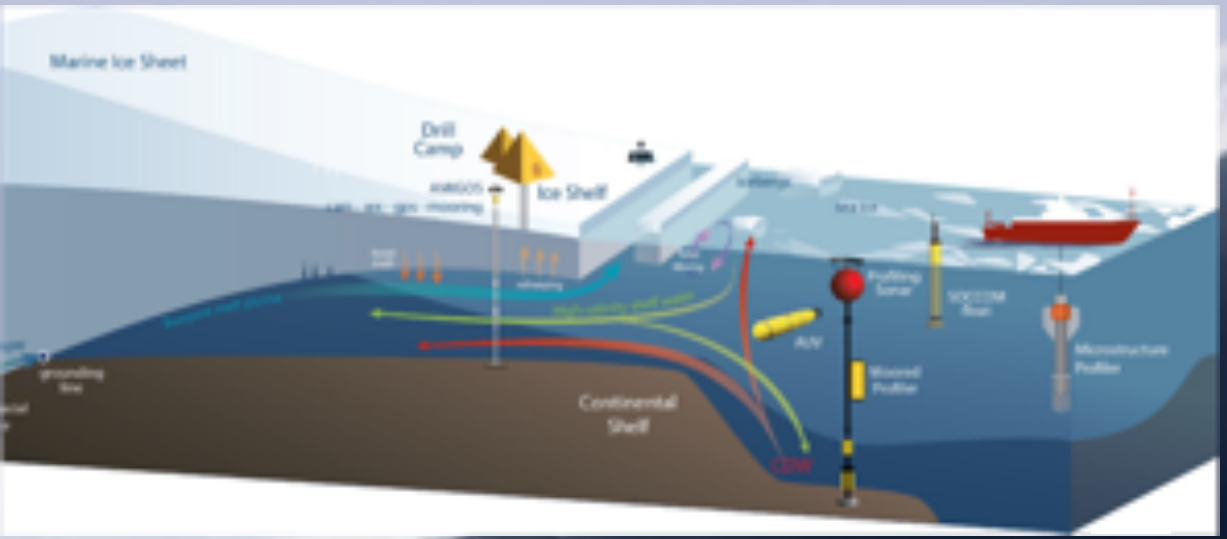
CryoSat-2 (2010–2018) ⇒ melt rates at high spatial resolution

25 years of radar altimetry ⇒ time-varying melt rates



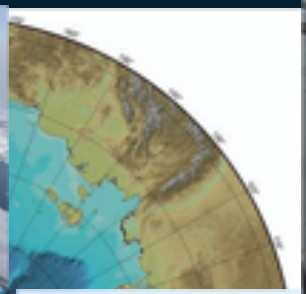
ERS-1/ERS-2/Envisat/CryoSat-2

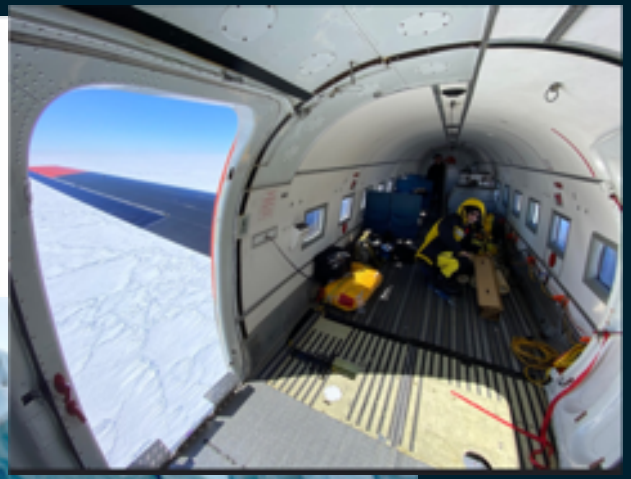
Adusumilli et al., 2020

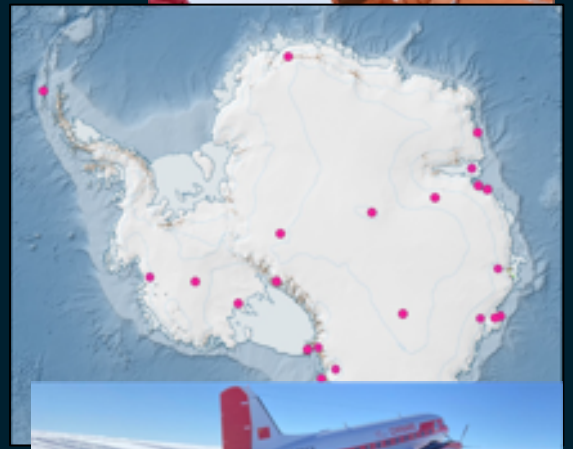

Marine Ice Sheet
Drill Camp
Ice Shelf
AUV
Continental Shelf
CDW

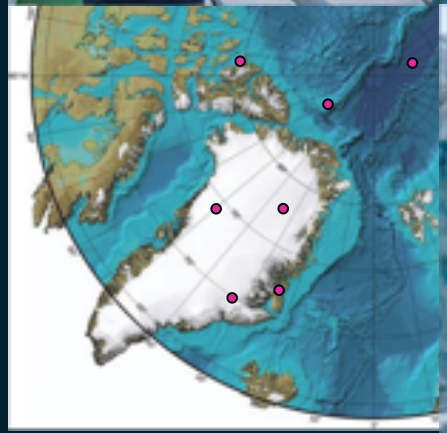
Where is SIO Polar?

Many existing and growing opportunities for international, interdisciplinary work all over the Arctic and Antarctic









IGPP students make discoveries in Antarctica

Journal of Glaciology, Vol. 53, No. 183, 2007 523

Seismicity and deformation associated with ice-shelf rift propagation

Jeremy N. BASSIS,[1] Helen A. FRICKER,[2] Richard COLEMAN,[2,3,4] Yehuda BOCK,[1] James BEHRENS,[1] Dennis DARNELL,[1] Marianne OKAL,[1] Jean-Bernard MINSTER[1]

[1]Institute for Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California-San Diego, La Jolla, California 92093-0225, USA. E-mail: jbassis@ucsd.edu

[2]Center for Marine Science, University of Tasmania, Private Bag 78, Hobart, Tasmania 7001, Australia

[3]CSIRO Marine and Atmospheric Research, GPO Box1538, Hobart, Tasmania 7001, Australia

[4]Antarctic Climate and Ecosystems CRC, Box252-80, Hobart, Tasmania 7001, Australia

ABSTRACT. Previous observations have shown that rift propagation on the Amery Ice Shelf (AIS), East Antarctica, is episodic, occurring in bursts of several hours with typical recurrence times of several weeks. Propagation events were deduced from seismic swarms (detected with seismometers) concurrent

The New York Times

F.D.A. PANEL URGES NEW 'LIVING DRUG' TO FIGHT CANCER

Treatment That Alters a Patient's Own Cells to Fight Back

Antarctica Sheds Huge Iceberg That Hints at Future Calamity

BBC NEWS

Climate change: Satellites record history of Antarctic melting

By Jonathan Amos
BBC Science Correspondent

10 August 2020

Ice shelves can extend under the water for many hundreds of metres

Huge volume of water detected under Antarctic ice

Jonathan Amos
Science correspondent
@BBCAmos

5 May

Climate change

The team collected their measurements during a multi-week expedition

Vast quantities of water have be
part of the West Antarctic ice sh

POLAR CENTER — SCRIPPS INSTITUTION OF OCEANOGRAPHY

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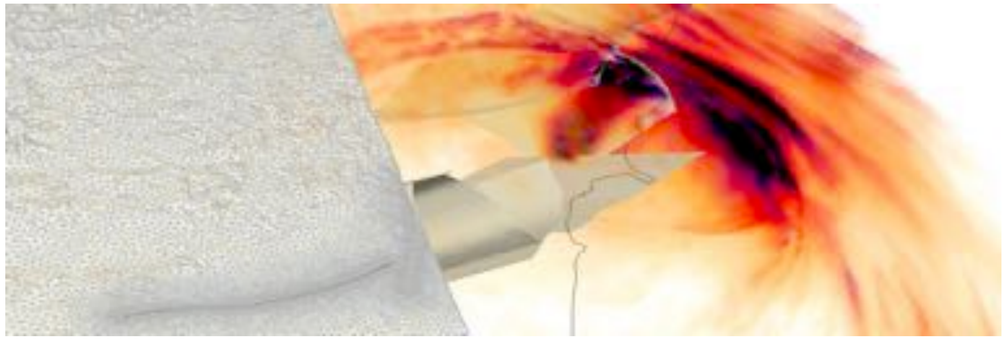
Contact IGPP seismologists to discuss potential projects!

1. Large datasets
2. High performance computing
3. Offshore/Polar observations

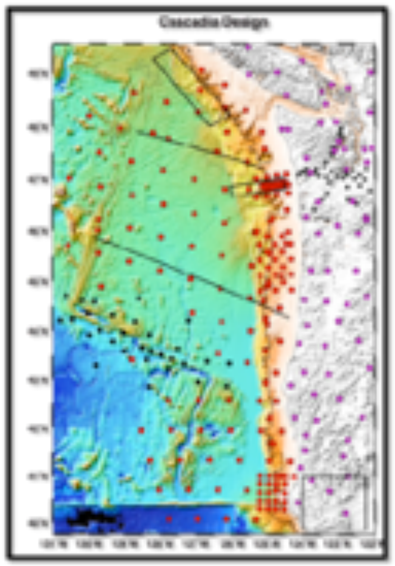
Please follow up with us!

USArray

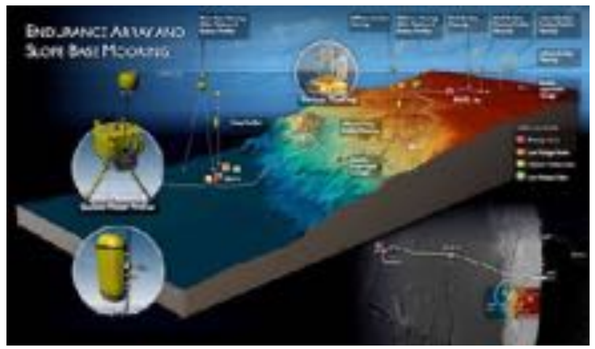
High performance computing



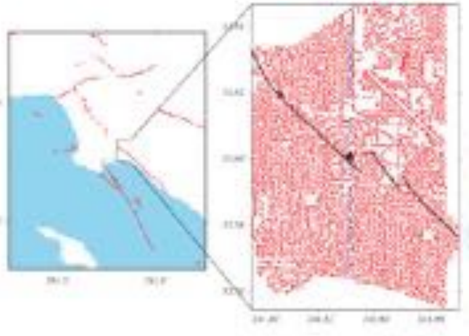
Cascadia Initiative



OOI Cascadia cable array



Large-N nodal array



NOTA (PBO)

cascadiaoffshore.org; unavco.org; usarray.org; iris.edu

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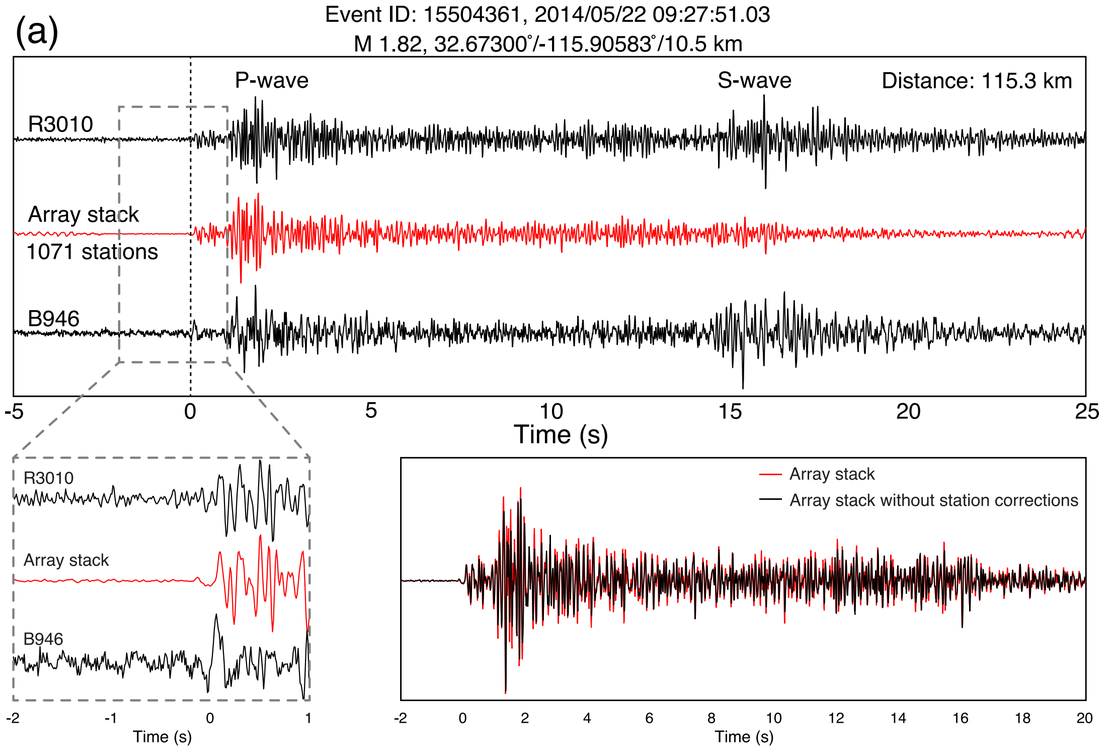
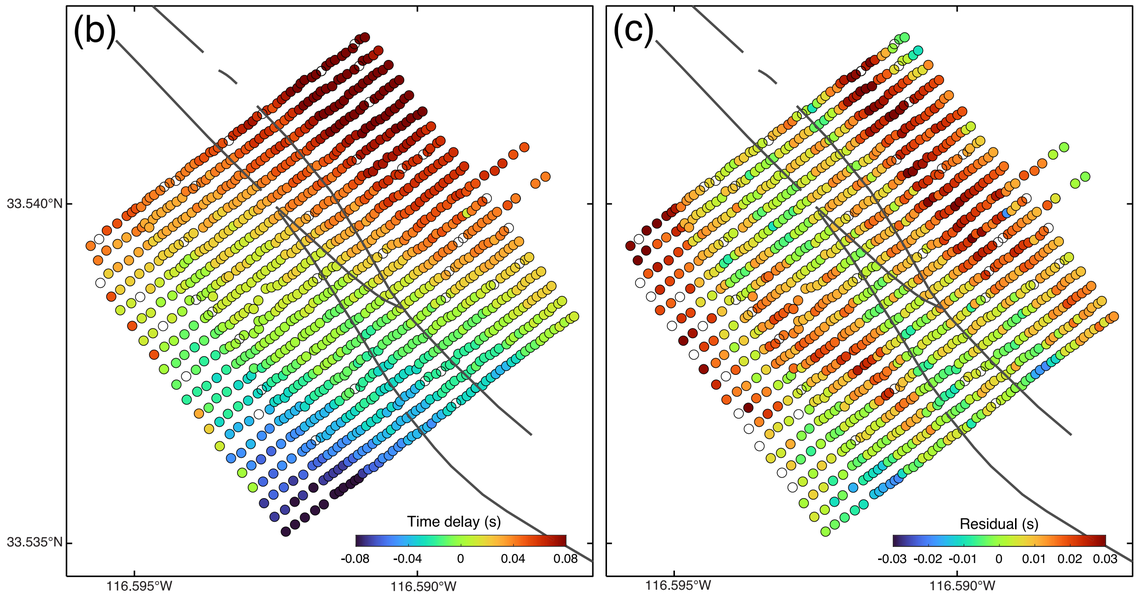
Earth and planetary interior
Earthquakes





Shearer et al., *JGR*, 2023

Rob Mellors
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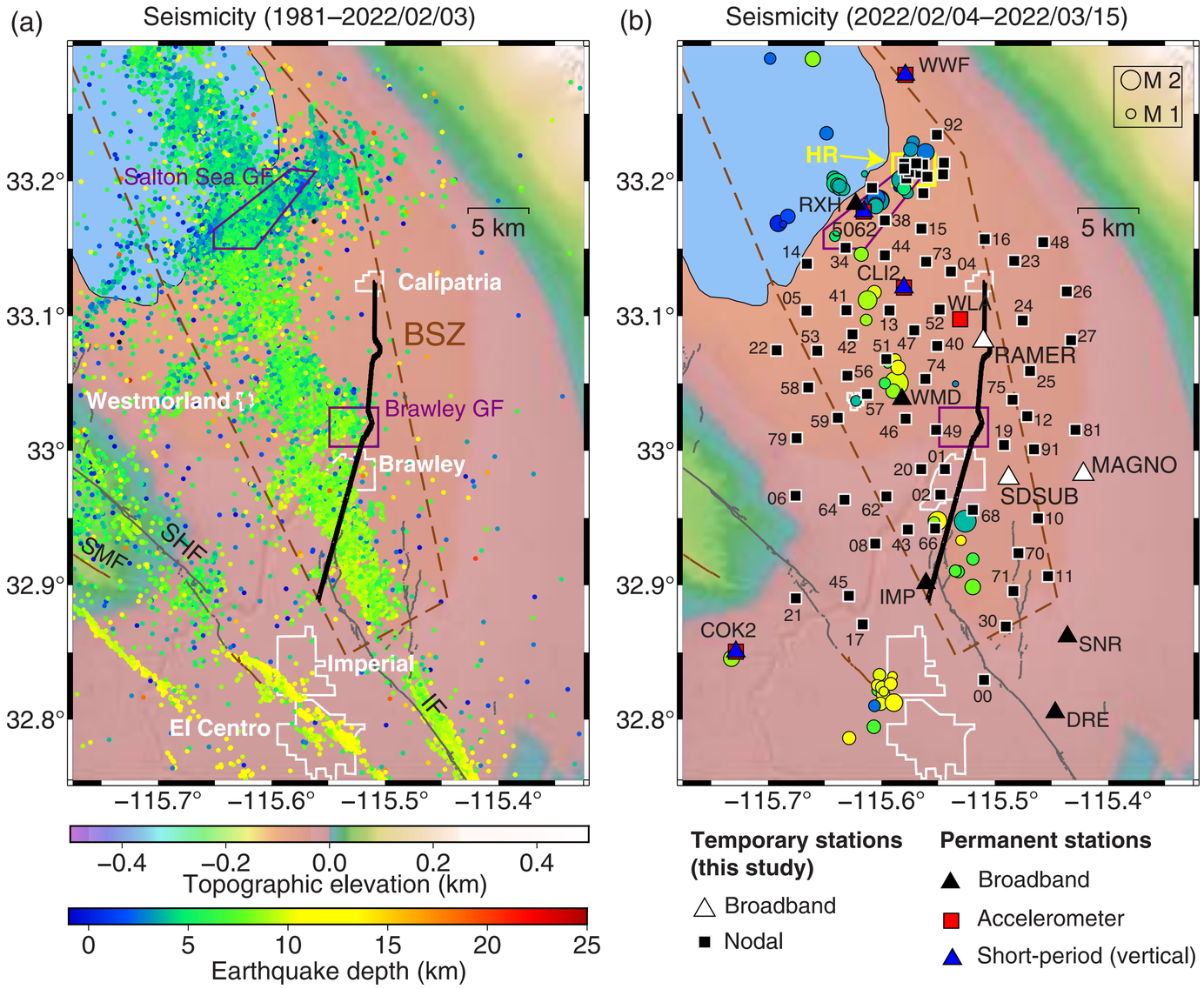

Nayak et al., *SRL*, 2023

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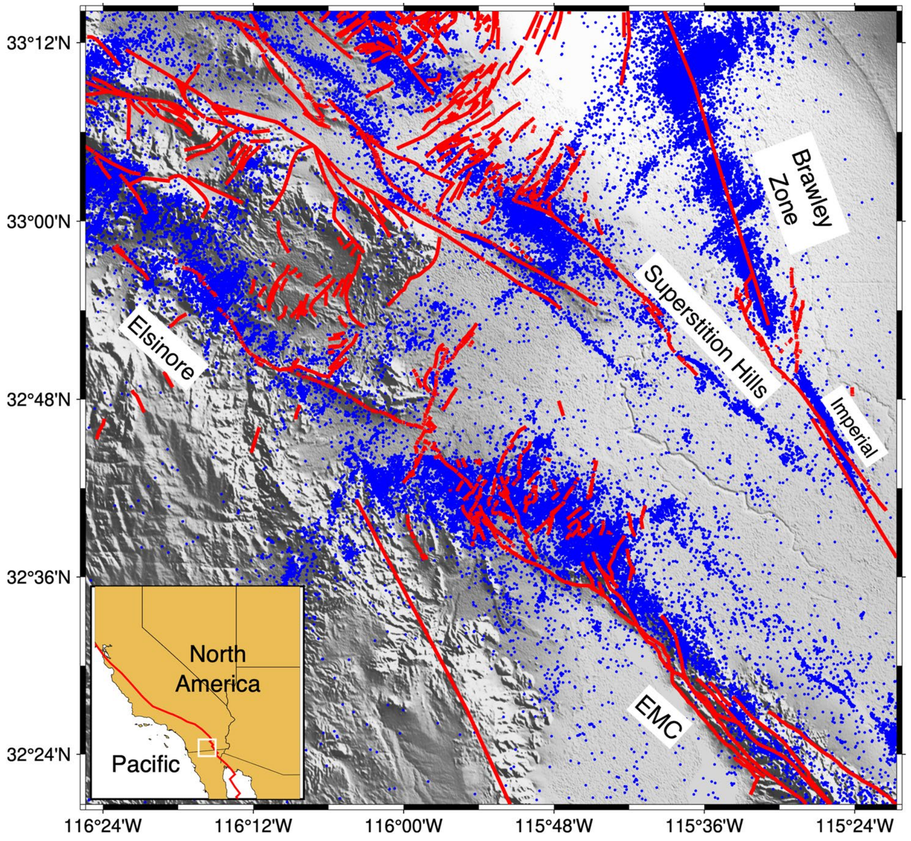
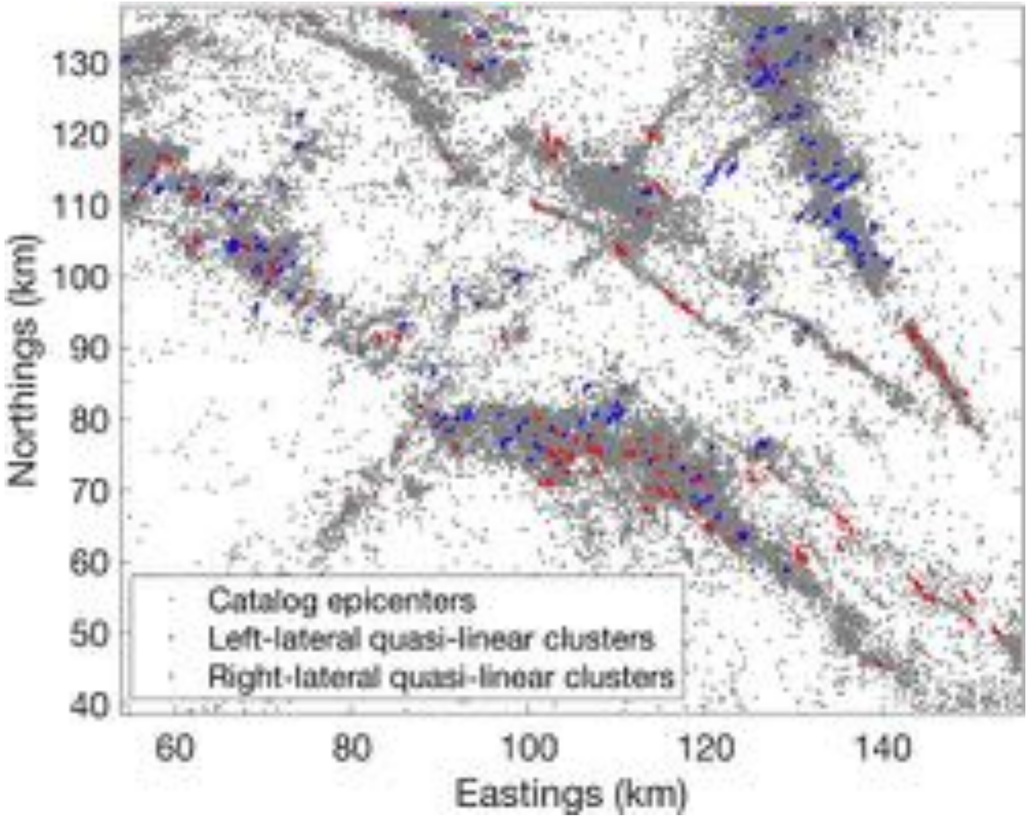
Earthquakes





Zou et al., *GRL*, 2023

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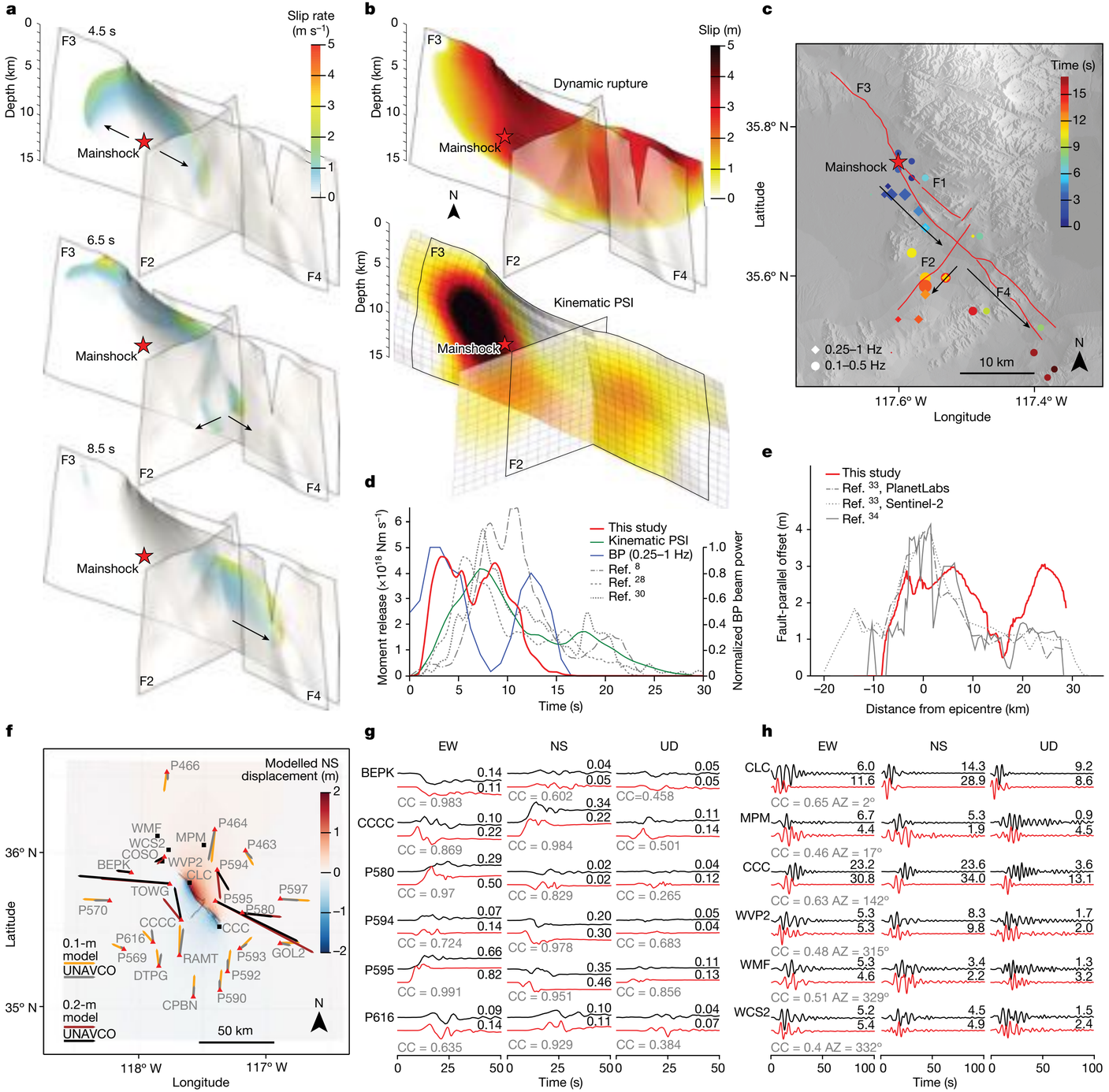
Computational and theoretical seismology
Earthquakes

Taufiqurrahman et al., *Nature*, 2023



Ross Parnell-Turner
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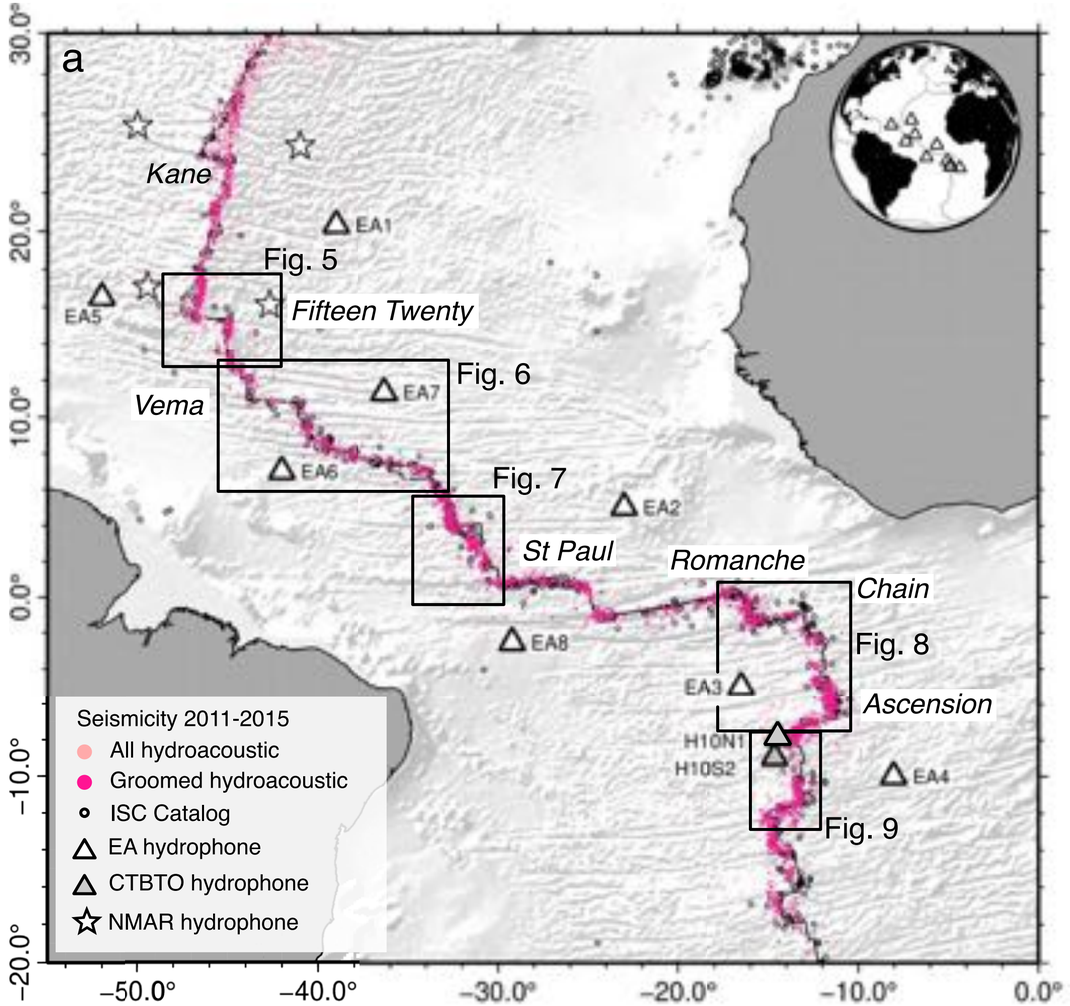
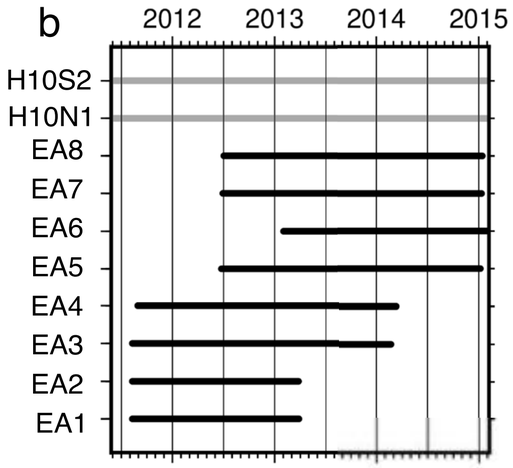
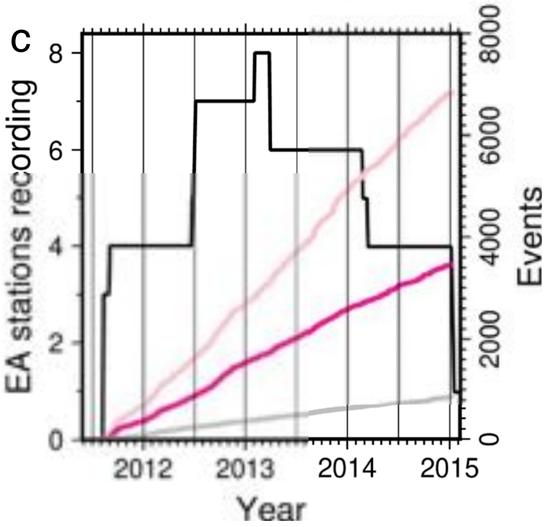
Marine geophysics
Earth and planetary interior

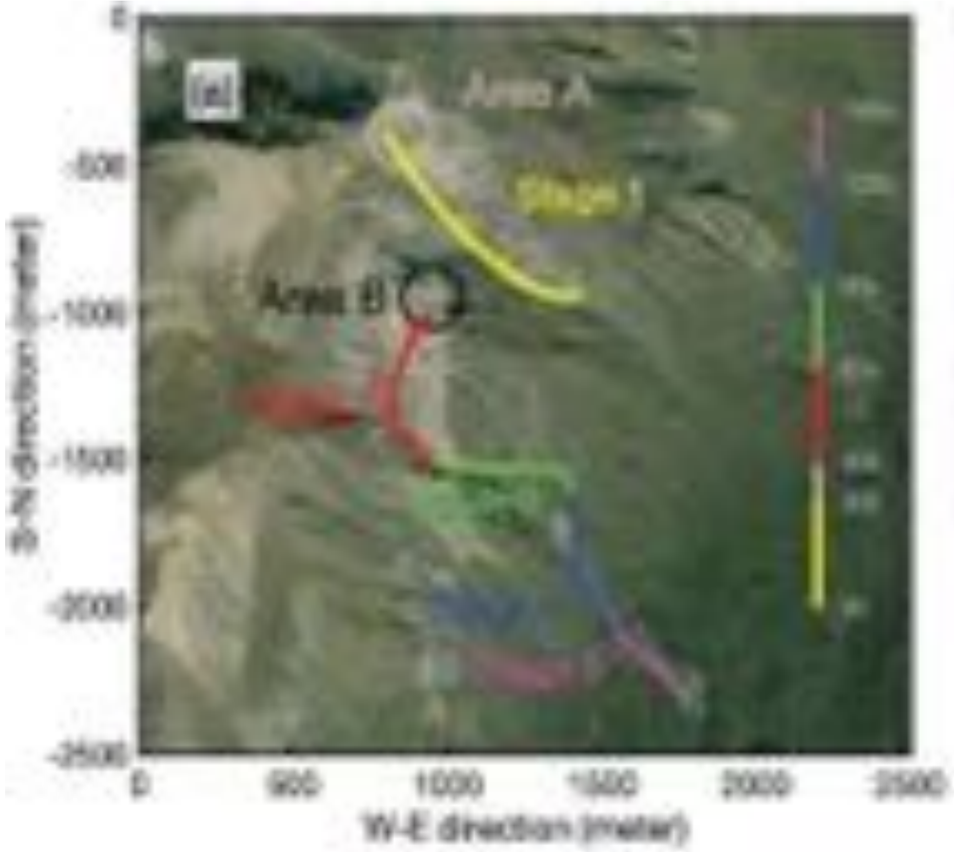


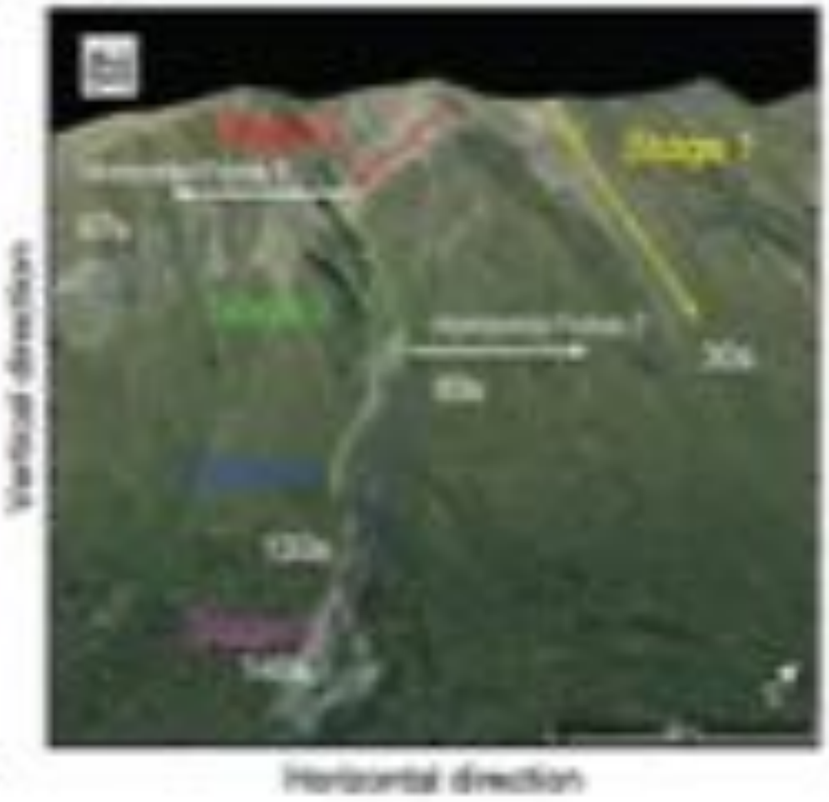




Parnell-Turner et al., *JGR*, 2022

Wenyuan Fan
<wenyuanfan@ucsd.edu>
Marine geophysics
Earthquakes
Environmental seismic sources

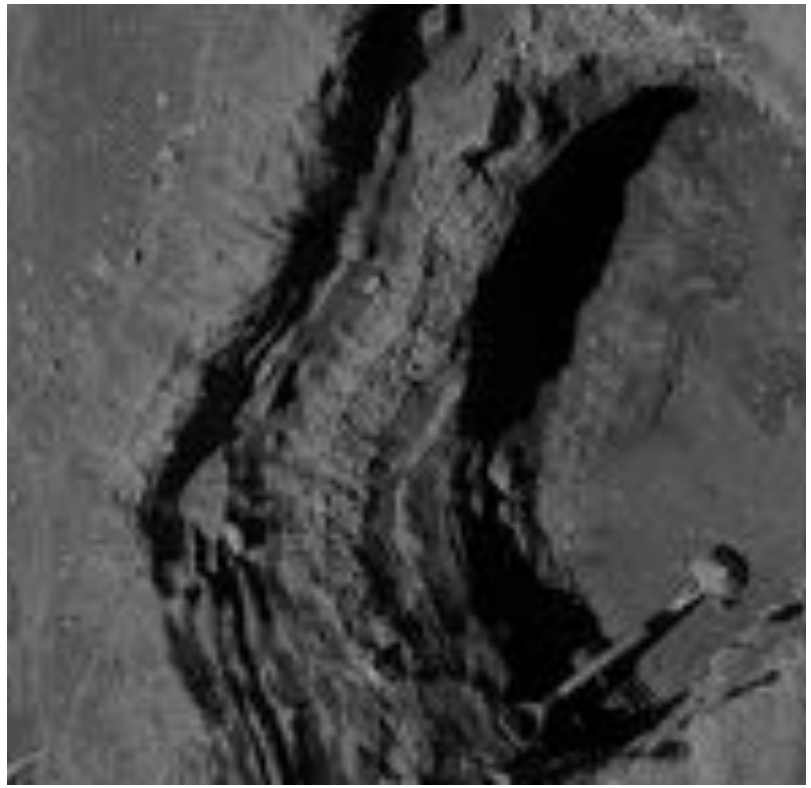




Luo et al., *JGR*, 2023

Contact IGPP seismologists
to discuss potential projects!

Please follow up with us!

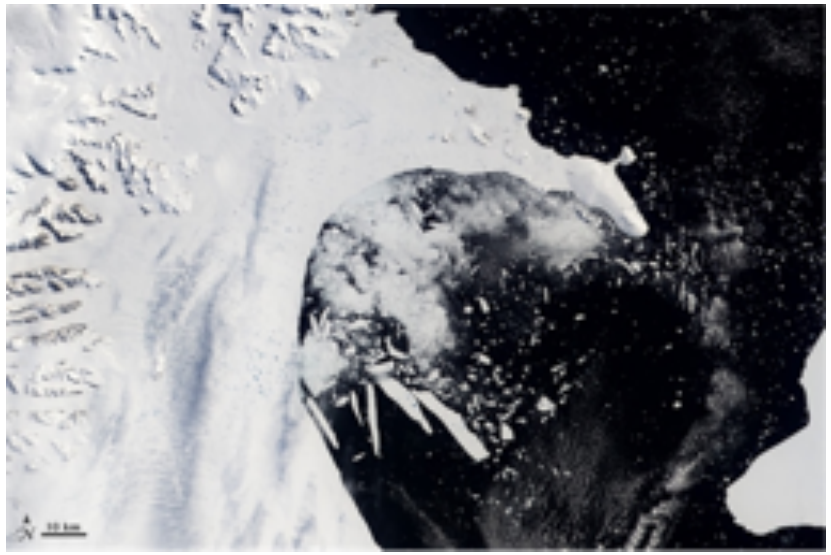


Soft Earth Geophysics
at IGPP

www.stripplelab.ucsd.edu

Granular flow underpins many critical geophysical processes

Ice shelf collapse, glaciers



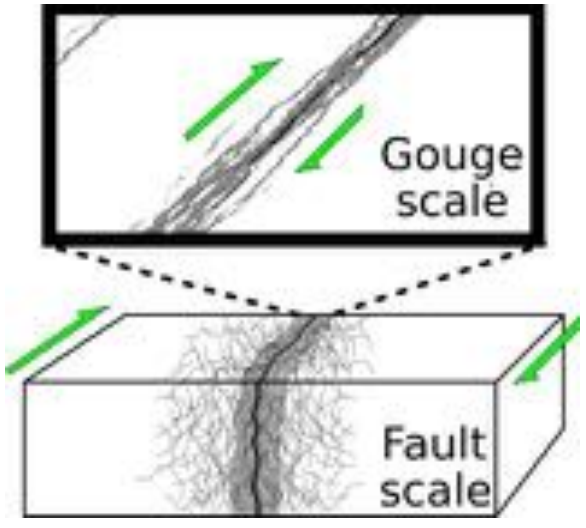
Crystal-rich magmas

Slope failures

Pyroclastic density currents

Liquefaction

Earthquakes



Slide note:
Modified from Doug Jerolmack 'Landscapes of Glass' talk

Forecasting granular flow is very **CHALLENGING**

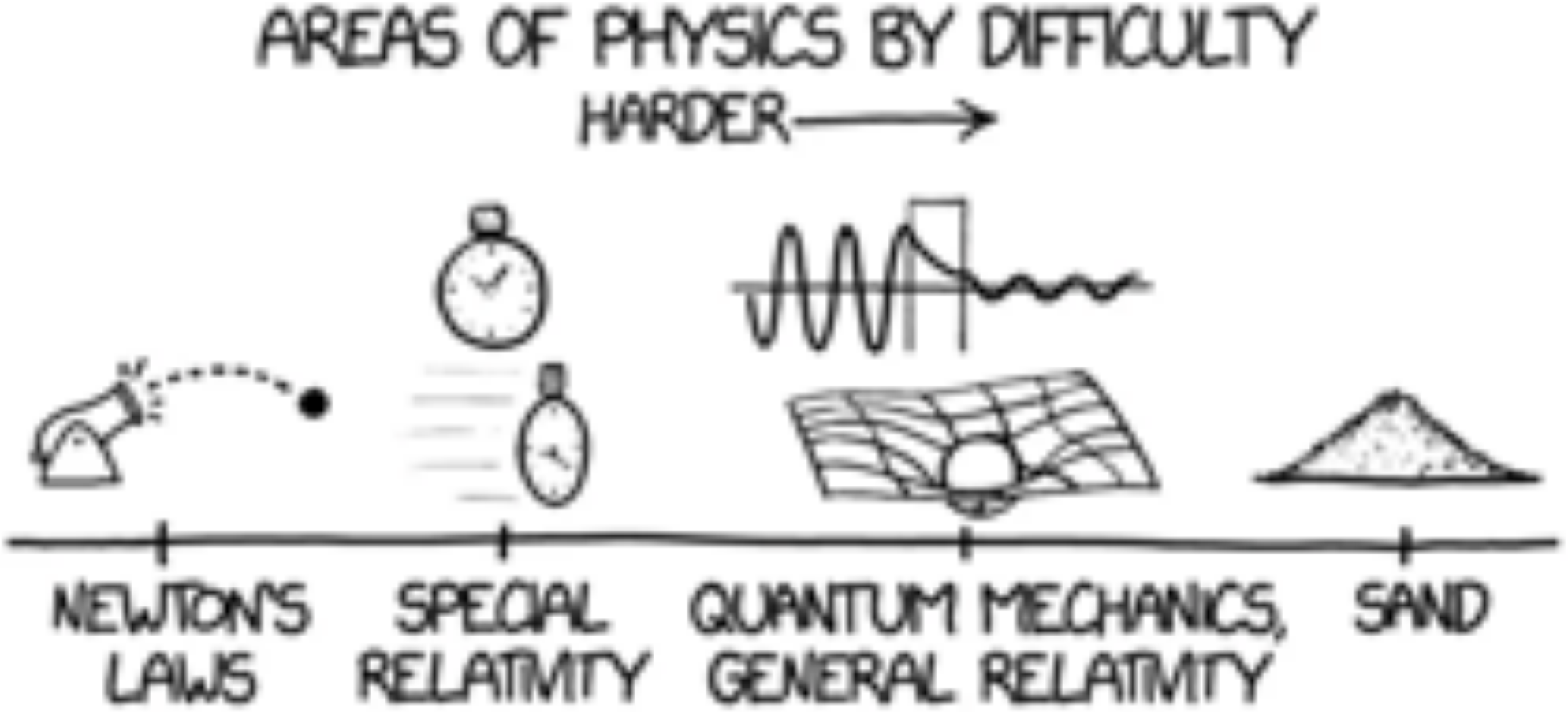
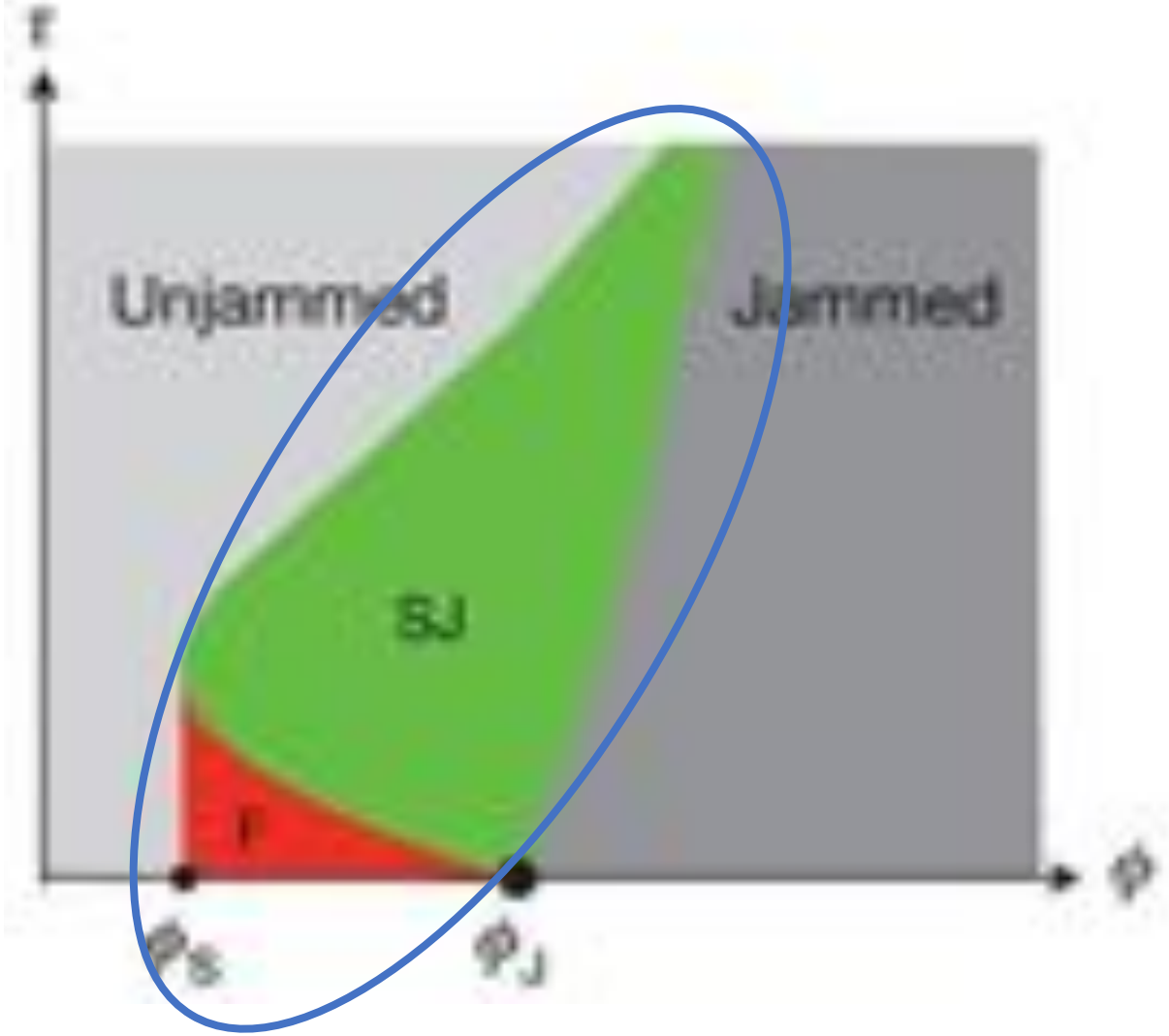


Image: https://www.nytimes.com/2020/11/09/science/what-makes-sand-soft.html#:~:text=Sand%20with%20rounder%20grains%20usually,Dr.

Recognizing that earth materials are a part of a broad class of

SOFT MATTER helps!

Connecting geophysics and statistical physics may help



- -- Dilantancy & shear theories
- -- Spatial vibrational patterns
- -- Free energy landscapes
- -- Fabrics and strain evolution
- -- Complex systems theory

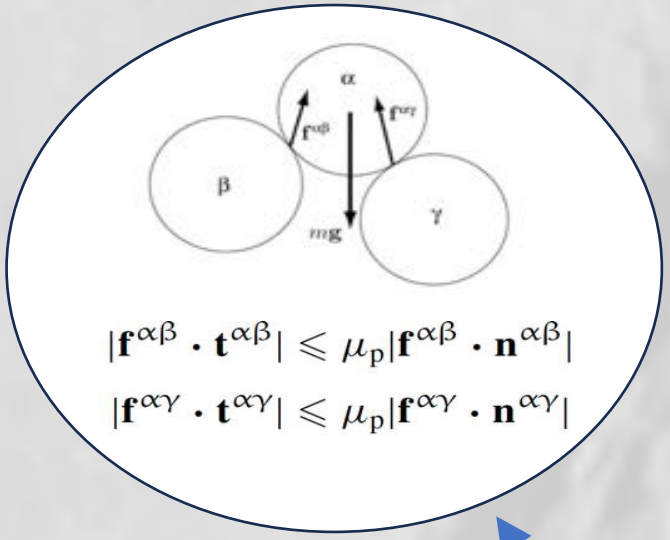
FRICTIONAL JAMMING,

a potential unifying concept for all amorphous materials

Image: Adapted from Bi et al., (2011)

We use phenomenological studies that test and expand theories

Theory



Phenomenologies

Lab experiments

Pheno-menologies

Inform each other

Field observations

We use phenomenological studies that test and expand theories

Theory

Lab experiments

Is the Soft Earth complicated, wherein complete knowledge and complicated models are needed, or is it complex and amenable to novel theoretical insights?

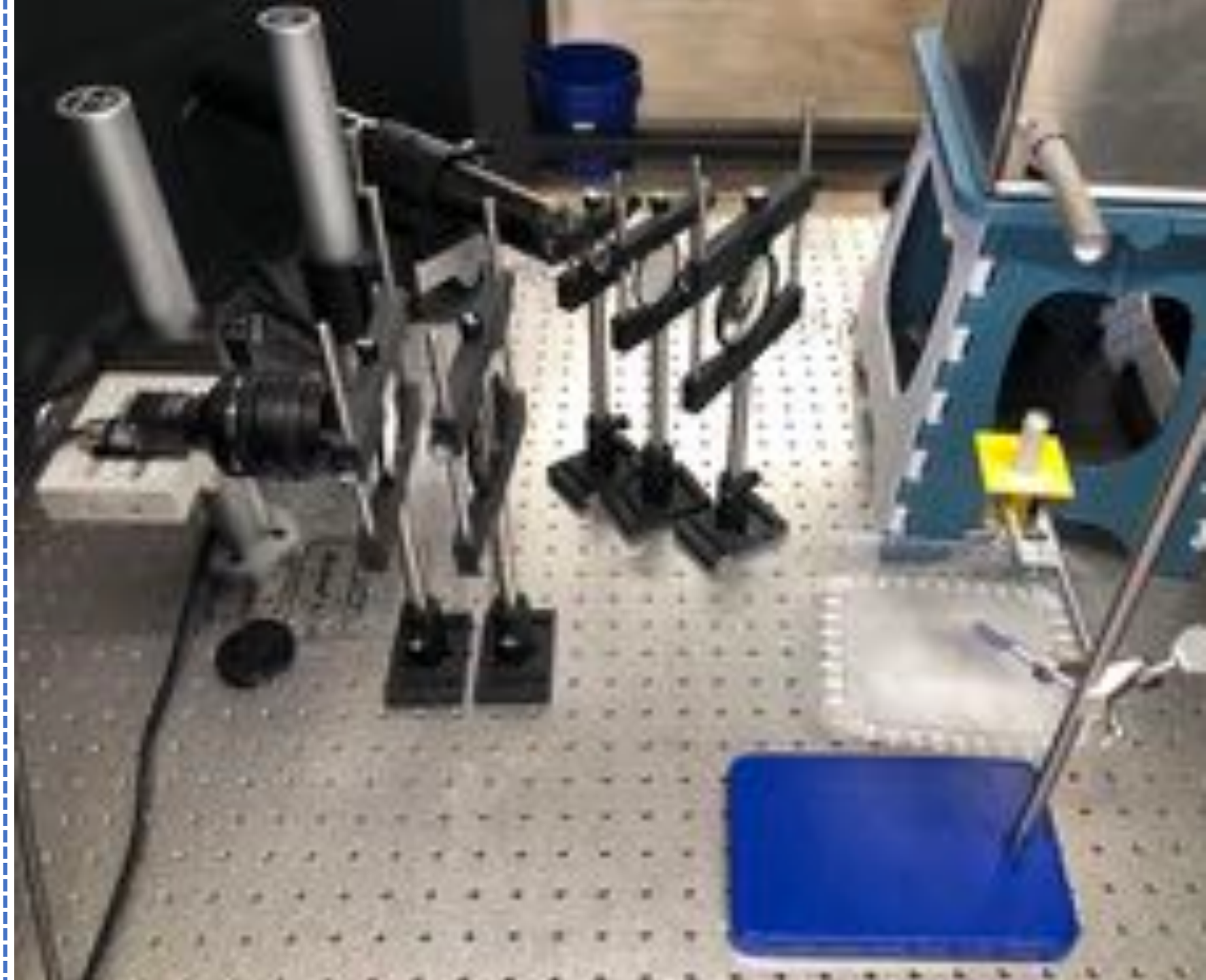
- ❑ What are the limits of predictability for granular flow behaviors?
- ❑ Can identifying state variables that control solid-like to liquid-like state transitions and associated critical states help us with the metastability of granular materials?
- ❑ How can earth materials inspire new areas of physics?
- ❑ Can we help with forecasting natural hazards?

Field observations

X-ray micro-tomography to image grains in 3-D

Rheometer, microscopes, lasers, and cameras to

track particle motion, force networks, stress, strain



Collect samples and geophysical data in field

- Sediment core collection
- Seismic refraction surveys
- Seismic reflection surveys
- Ambient noise surveys
- Trenching and site excavations

A cycle of memory creation, erasure, and solid-like to fluid-like state transitions encoded in granular assemblages sheared by natural faults

Jhardel Dasent
Scripps Institution of Oceanography

Vashan Wright
Scripps Institution of Oceanography

Richard Kilburn
Scripps Institution of Oceanography

Shipra Gudekar
University of California San Diego

Kenneth Su
University of California San Diego

Kate Scharer
United States Geological Survey

Michael Manga
University of California Berkeley

Constraining the distribution of friction and stresses within the fault gouge and walls under different shearing conditions and their importance for earthquake physics and granular flows

Jhardel Dasent
Scripps Institution of Oceanography

Melanie Adams
Scripps Institution of Oceanography

Vashan Wright
Scripps Institution of Oceanography

Density of excited vibrational modes, a new way to forecast the failure of geomaterials

Vashan Wright
Scripps Institution of Oceanography

Richard Kilburn
Scripps Institution of Oceanography

Jhardel Dasent
Scripps Institution of Oceanography

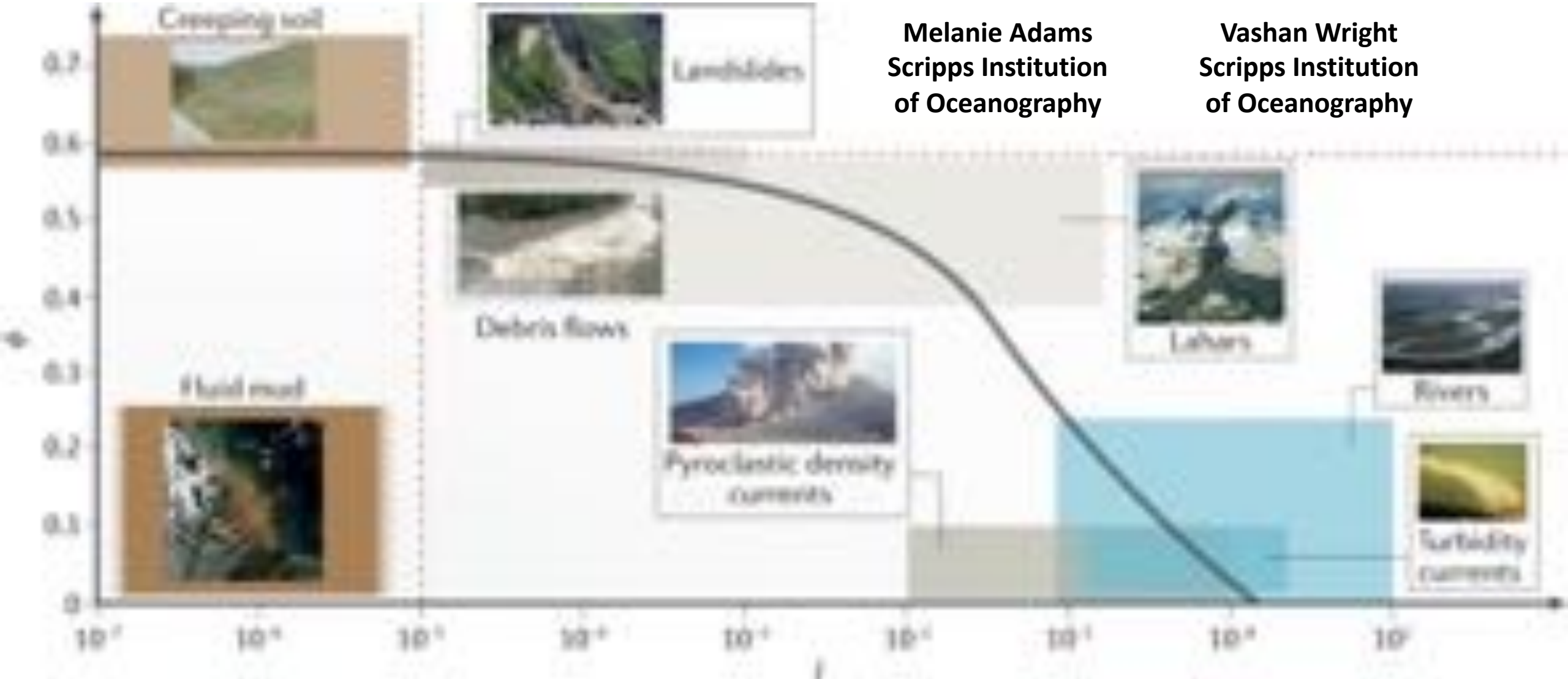
Michael Manga
University of California Berkeley

Mattias Morzfeld
Scripps Institution of Oceanography

From non-affine deformation to creeping to flowing regimes: exploring if & how network complexity, free energy landscapes, and disorder control micro and mesoscopic flows in granular materials

Melanie Adams
Scripps Institution of Oceanography

Vashan Wright
Scripps Institution of Oceanography



Effects of energy during deposition on the microstructural organization and strain in granular materials

Evie Gedmenas
Scripps Institution of Oceanography

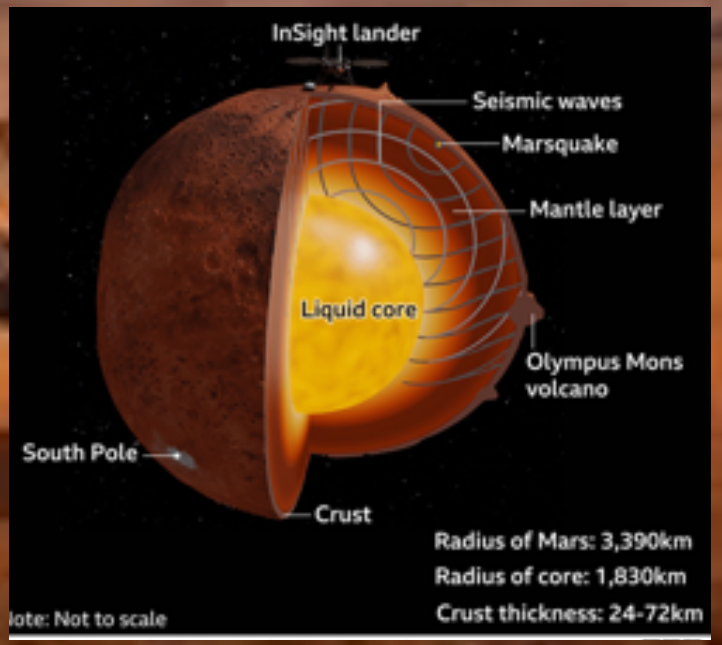
Kenneth Su
Scripps Institution of Oceanography

Vashan Wright
Scripps Institution of Oceanography

Richard Kilburn
Scripps Institution of Oceanography

Jhardel Dasent
Scripps Institution of Oceanography

Using granular physics, seismic velocities, and gravity to decipher the subsurface evolution of Mars since it lost its atmosphere



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