



# Releasing legacy velocity models: Challenges and opportunities

**Dr. Maureen Walton**

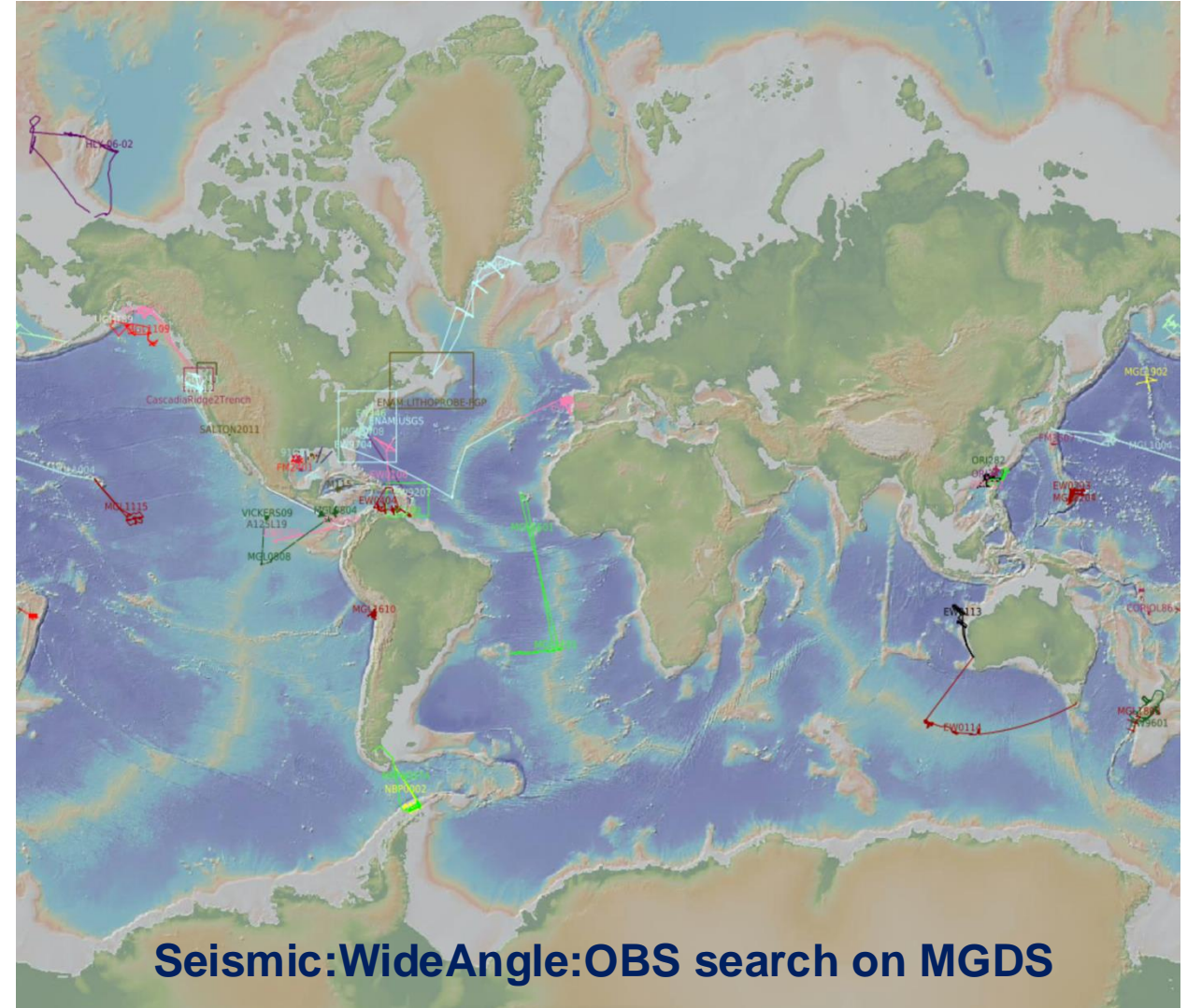
Research Geophysicist, US Naval Research Laboratory

**Motivation (challenges)**

Active-source **long-offset data** (MCS, OBS) provide unique information about the physical properties of the crust and upper lithosphere that are difficult-to-impossible to resolve with other means.

Increasing **uncertainty** with the R/V *Langseth* and the future of academic long-offset data collection and funding underscores the value of **legacy seismic data** from public sources (academic, government, and industry).

While hundreds of MCS and OBS surveys have been conducted, many individual seismic lines have gone **unanalyzed and/or unpublished**. These data offer tremendous value for advancing our understanding of the global seabed.





## MGDS long-offset data:

- Seismic:WideAngle (157 datasets)
- **Seismic:WideAngle:OBS (77 datasets)**
- Seismic:Reflection:MCS (505 datasets)
- Seismic:Reflection:MCS:raw (243 datasets)

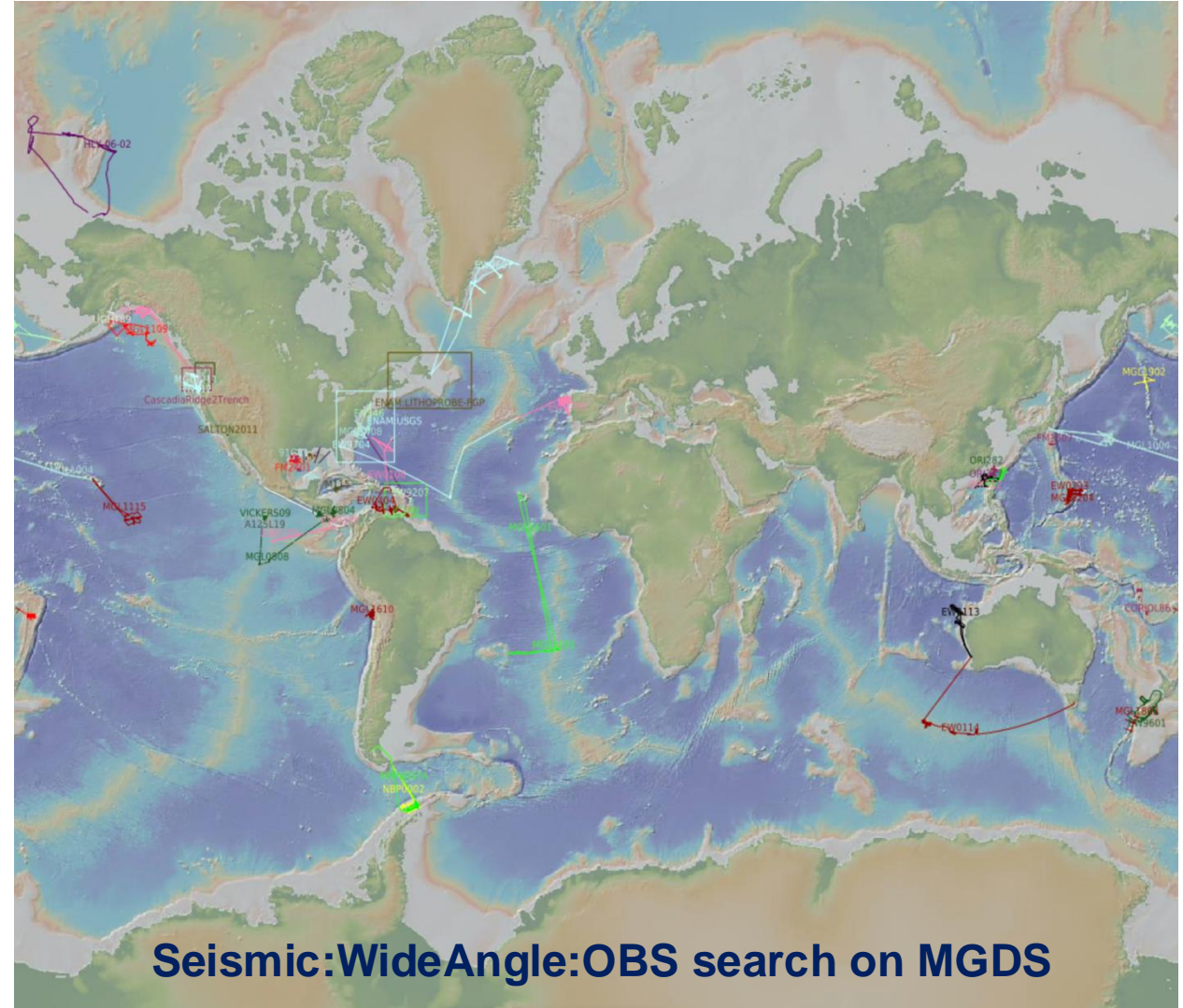
## MGDS seismic velocity datasets: 39

- These are from both MCS and OBS
- Datasets may have multiple lines, but typically not every line from a survey dataset
- Shout-out to Gail who did 1/3 (13) of these!



## Challenges:

- Publishing data not broadly required until the last ~decade
- More model data exist – some only published as figures in papers



Seismic:WideAngle:OBS search on MGDS

**Motivation (opportunities)**

Lots of applications for legacy data...

- Fundamental science, new/different analyses
- Data synthesis (e.g., Christeson et al. 2019, oceanic crustal structure; right)

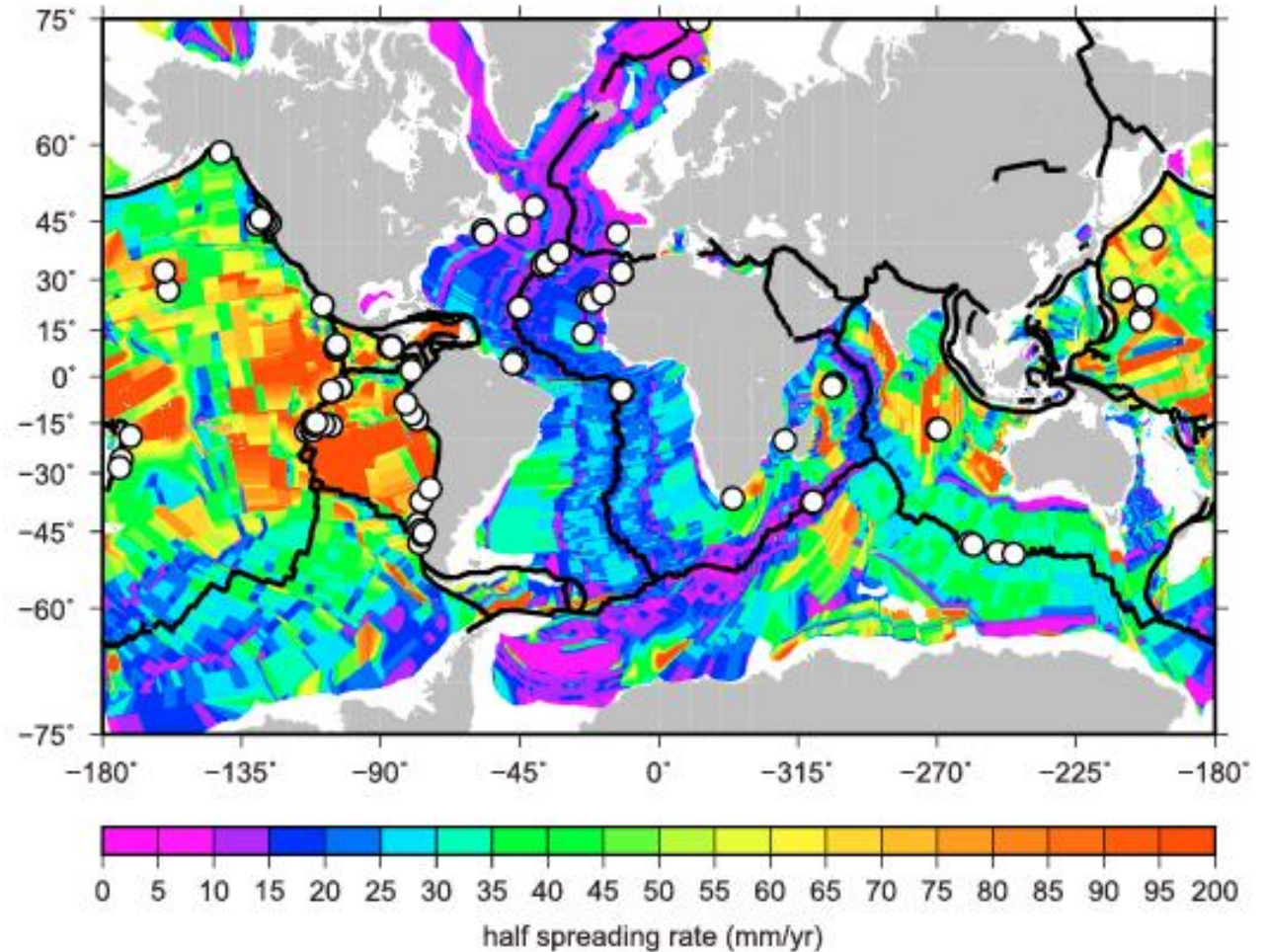
General shift toward big data / AI / machine learning:

- Paradigm shift toward data-driven science
- Huge potential knowledge gain
- Critical to consistently archive data
- Proper data archival has numerous benefits and research opportunities beyond AI/ML

Naval interests:

- Global mandate to understand seabed geoacoustics
- Need global predictions of sediment thickness, crustal thickness, age, sound speed, etc.

Locations of compiled velocity-depth functions for crustal structure analysis (Christeson et al., 2019)





Sparse Data

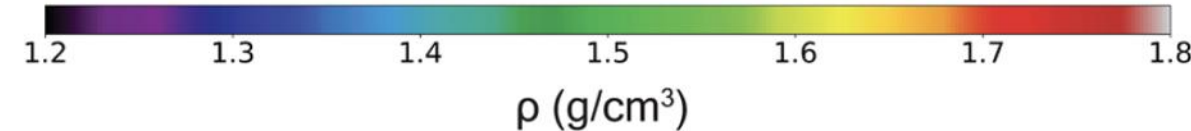
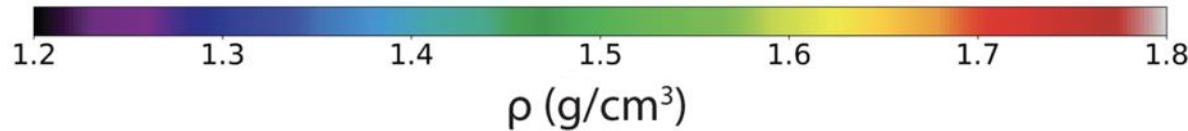
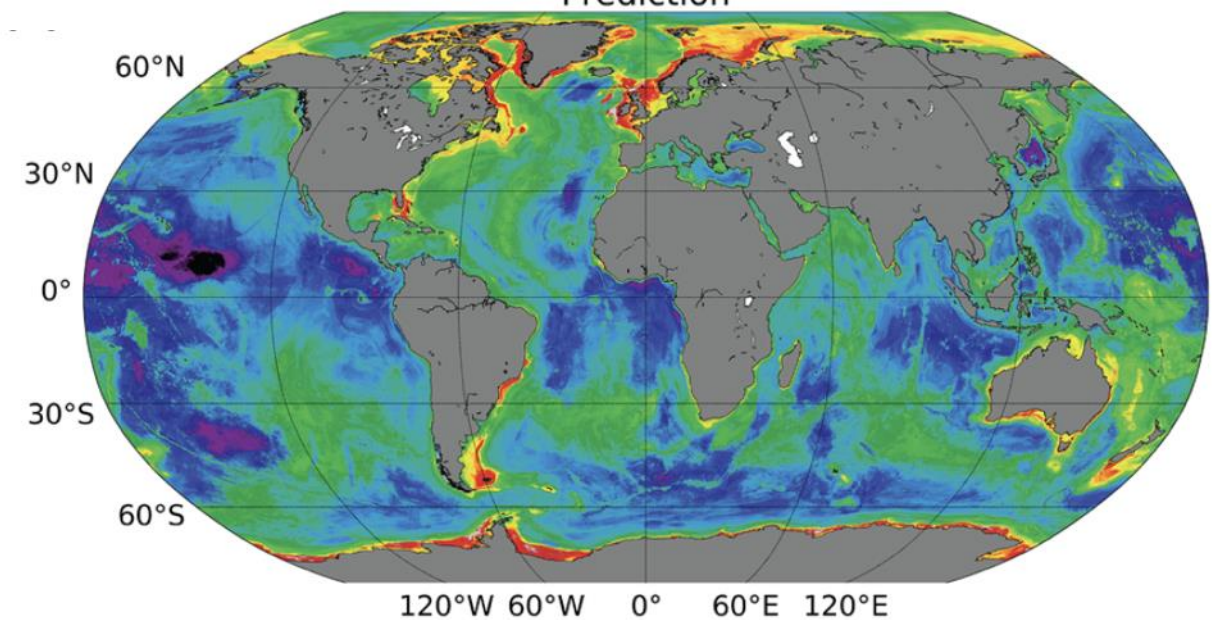
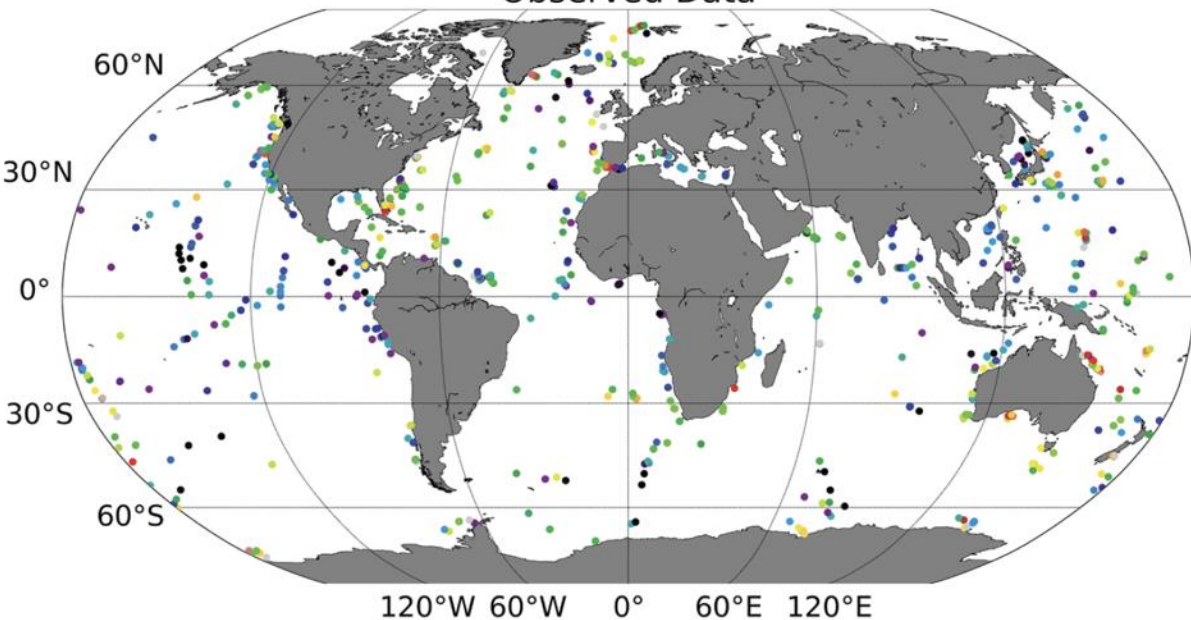
**GML**



Full Coverage

Observed Data

Prediction



**GML prediction of global marine sediment density**

Graw et al., 2020

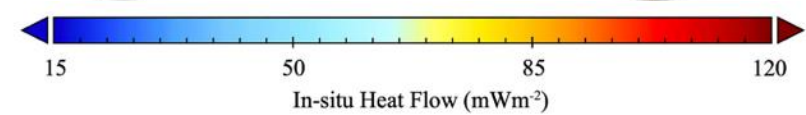
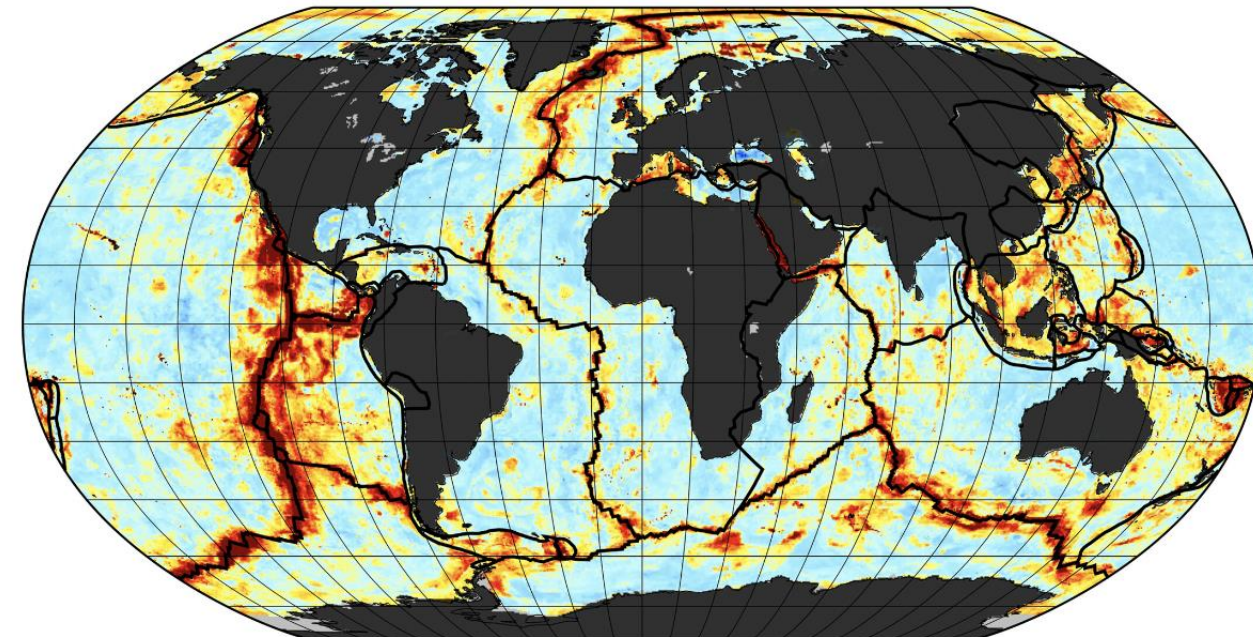
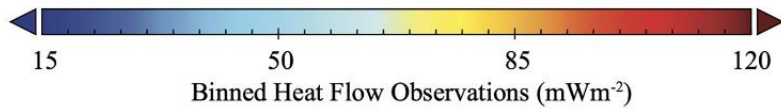
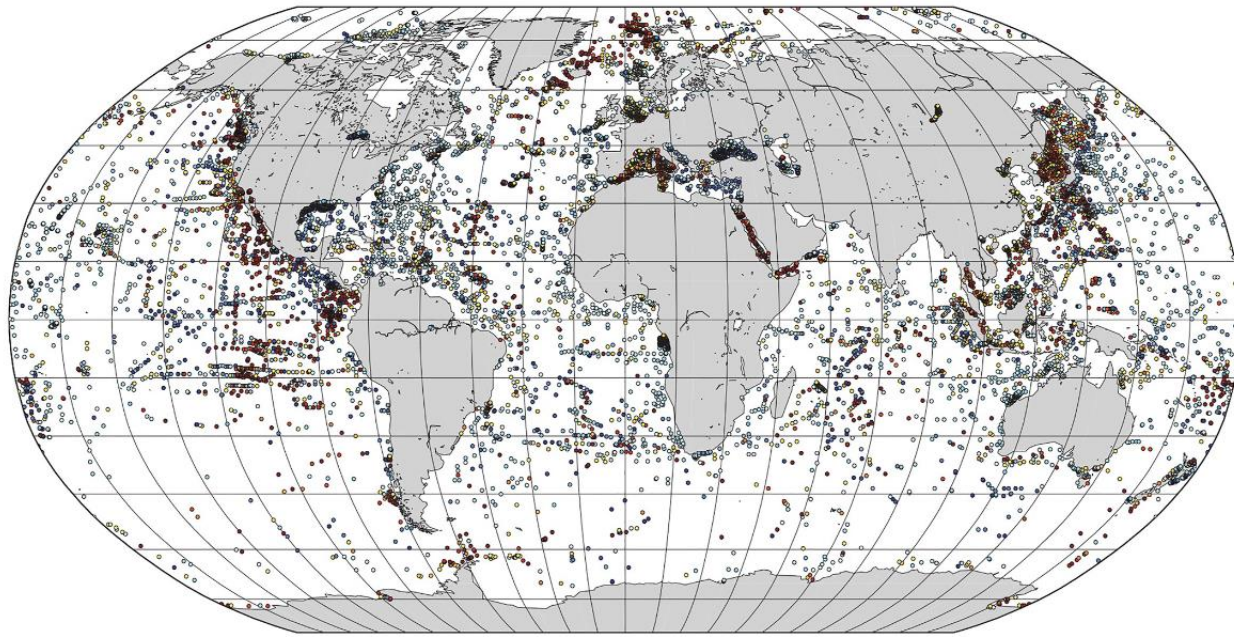


Sparse Data

**GML**



Full Coverage

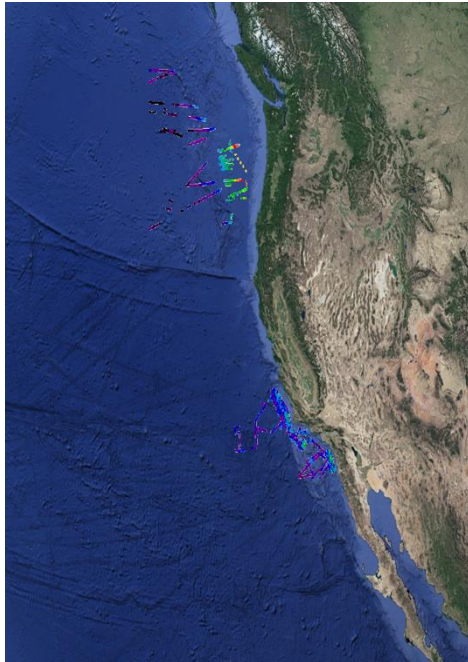


**GML prediction of global in situ marine heat flow**

Graw et al., 2023



## Sparse Data



two-way travel time (s)



## GML

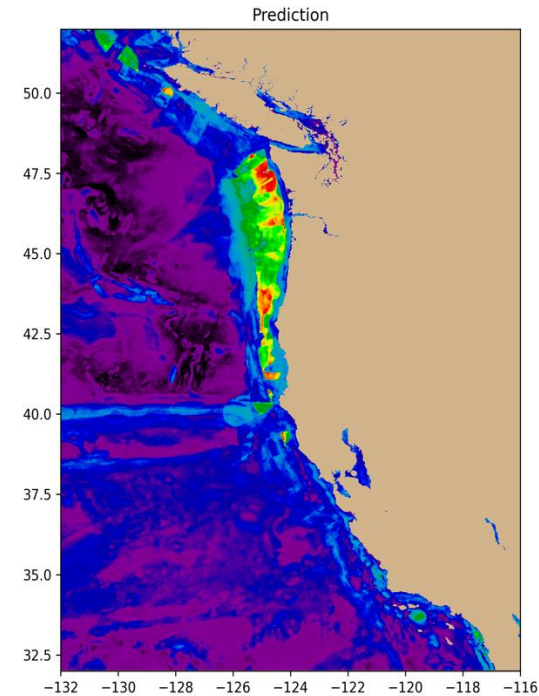


To this point, we've been using interpreted crust picks from MCS and SCS stacks as observed data.

Highly variable quality, penetration, and interpretive error; need to move toward quantitative observations w/ velocity models.

“Garbage in, garbage out” – primary challenge is rescuing and curating quality data.

## Full Coverage



two-way travel time (s)



## West coast sediment thickness prediction

Uwaifo et al., AGU 2023

**...Back to the challenges**



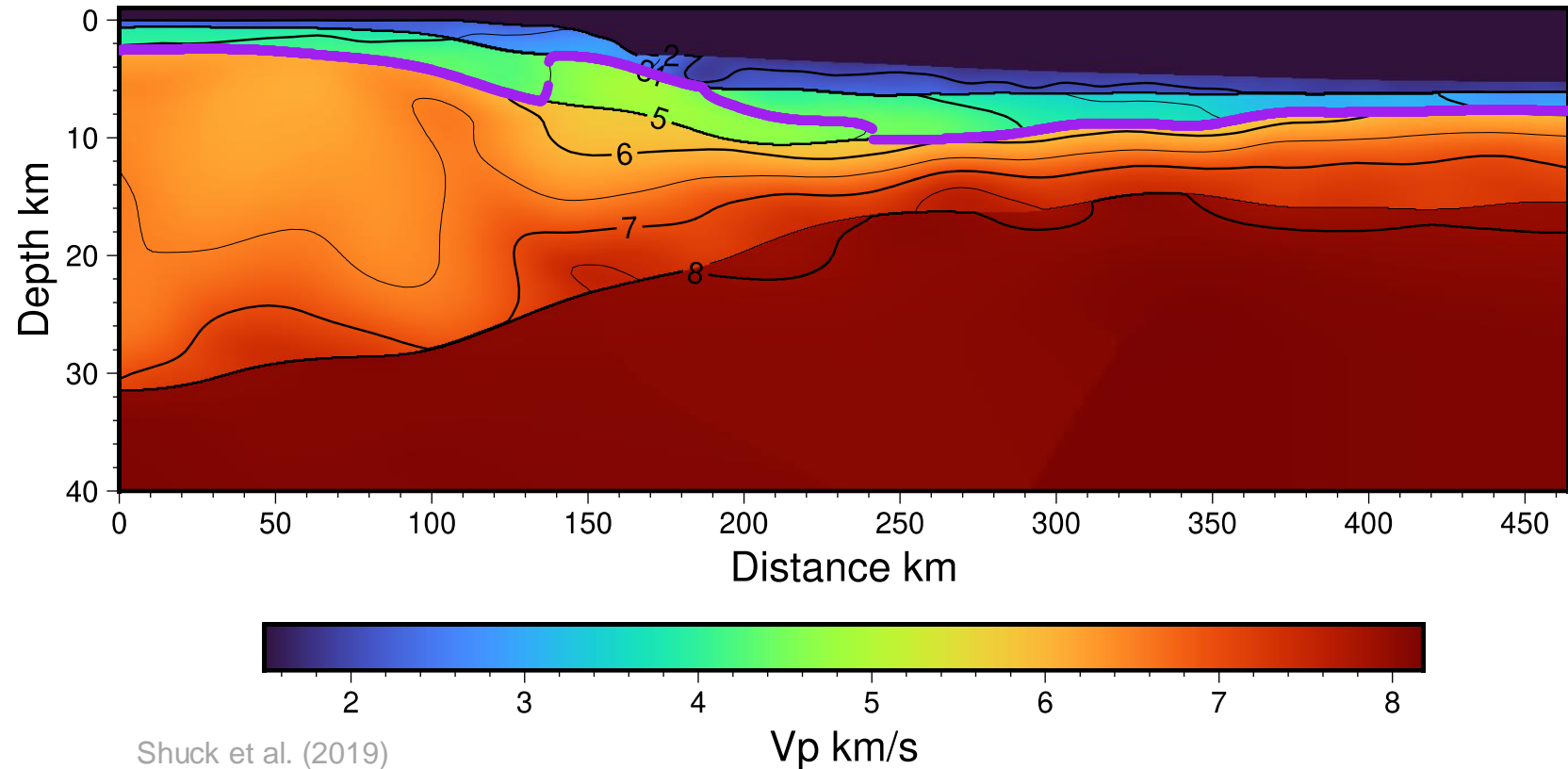
In summary: For a variety of reasons, **we need to archive velocity model data.** (Yes – yours)

Amongst other things, you may be thinking:

- Old models are on hard drives who-knows-where
- Which model did I even publish?
- Where is that navigation file?!
- Am I going to have to reformat?
- I don't have time for this
- What's in it for me?
- Can't I just (keep) ignoring people who ask?

As of now, benefits are limited to 1) gold stars at MSROC, 2) moral superiority, and 3) no one ever emailing you and asking for the data again. This isn't enough!

## Example of 4.5 km/s depth contour extraction using ENAM data released via Shuck et al. (2019)



Shuck et al. (2019)

## Low-effort option:

- Just send us the data – we'll format, do metadata, and submit to MGDS for you! ([maureen.walton@nrlssc.navy.mil](mailto:maureen.walton@nrlssc.navy.mil))
- Beggars can't be choosers – we'll take any data, in any format, as long as there's positioning/navigation info
- We'll list you first on the data pub (which has a DOI) and link any published journal articles to the dataset

## Higher-effort, higher-reward (?) option(s):

- Potential pay-per-line option: we will compensate you for your time – can treat your lab as a seismic facility/cost center
- If we pay for the data, we'll have some modest formatting requirements (netCDF = great!, no txt headers = not so great)
- We can fund students over the summer to work on long-offset data (NREIP program: <https://www.navalsteminterns.us/nreip/>)

In either case: We are very happy to consider **co-authorship** for data contributors on future high-impact publications that result from synthesis efforts (e.g., global sediment thickness).

NRL



This Photo by Unknown Author is licensed under [CC BY-SA-NC](https://creativecommons.org/licenses/by-sa/4.0/)

You



shutterstock.com - 187780241



# Discussion questions

**What are the biggest barriers to releasing model data?**

**Will the proposed incentives work?**

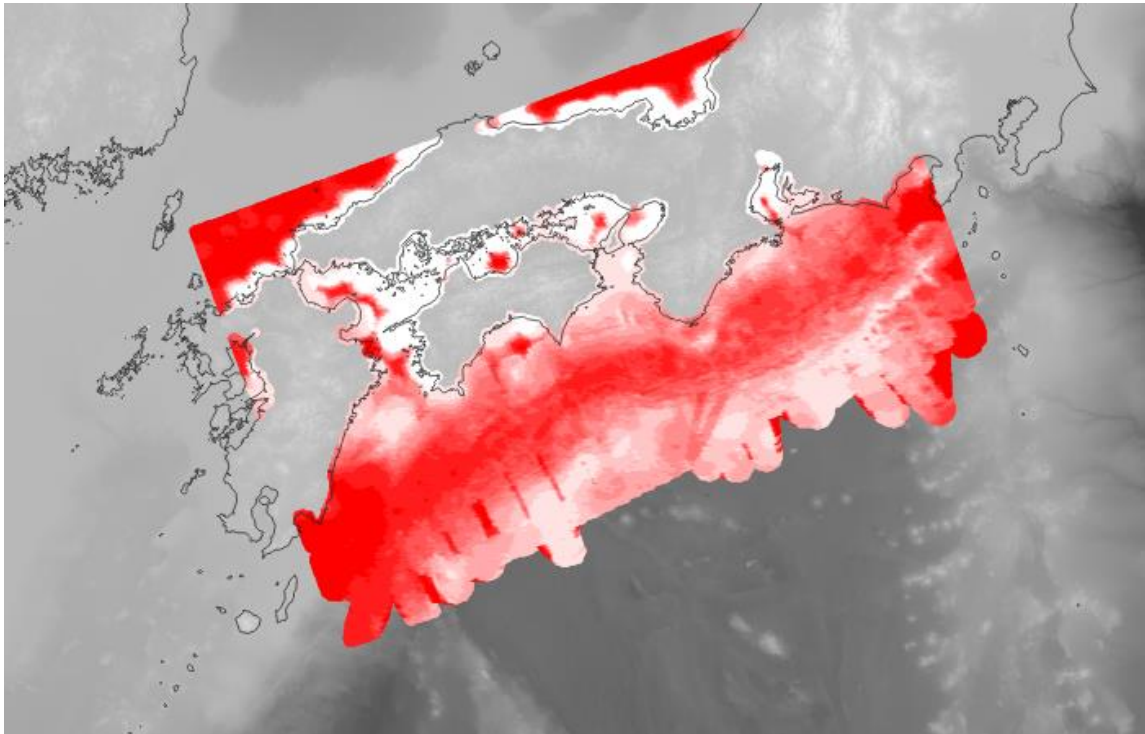
**Are there other ways we can help?**

**End**

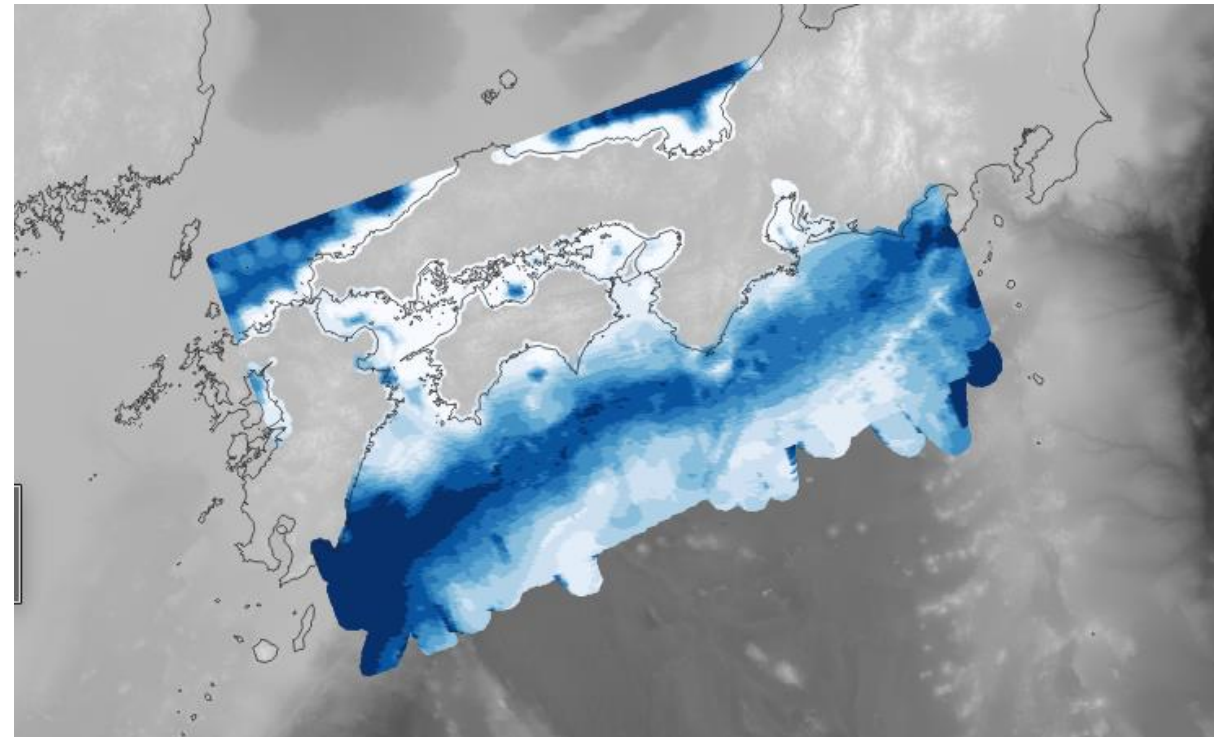


# Another example: Nankai 3D

**Sediment thickness in Nankai, Japan area from 4.5 km/s 3D velocity contour (Arnulf et al.)**



TWTT conversion ~0-25 s



Depth 0-20 km