



Modeling earthquakes with undergraduate students: challenges & highlights



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How is computer modeling unique?

BAM quasistatic forward modeling team

Goal: Determine long term slip rates along 3D non-planar, intersecting faults

Cascadia dynamic earthquake rupture modeling team of 1

Goal: Use energy budgeting to improve dynamic earthquake rupture models

3D fault geometry fieldwork team

Goal: Use LiDAR to find signatures in the landscape that reveal fault segmentation (or continuity) in 3D

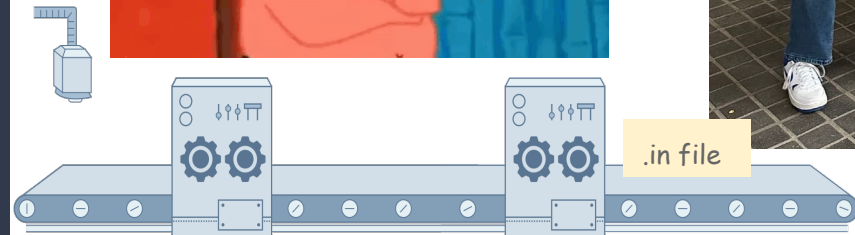
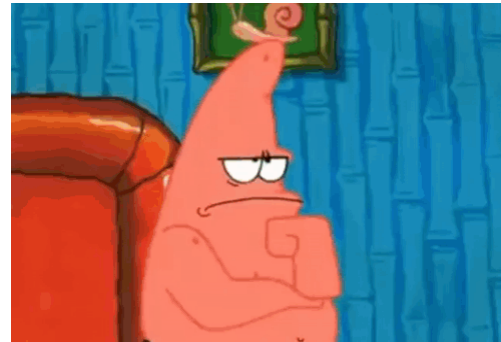
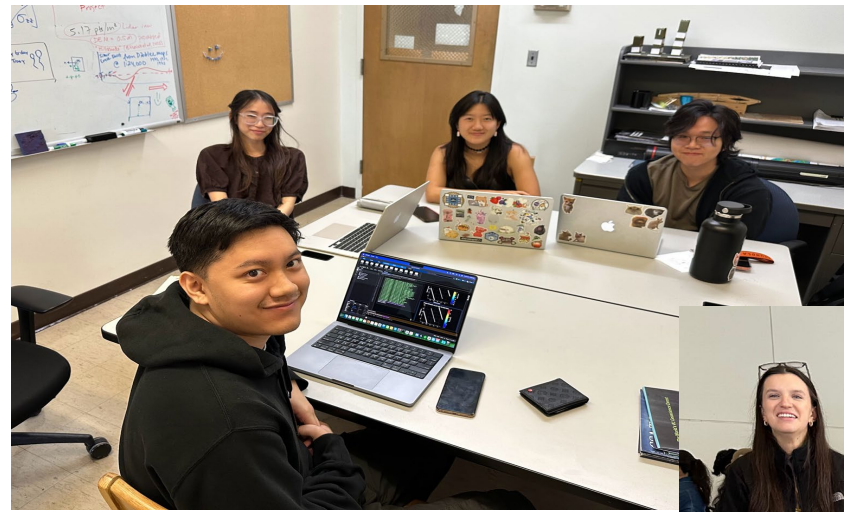
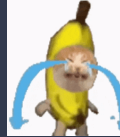
Fieldwork:

- Schedule fieldwork day
- Students meet up, go out, get data, return home
- Post-processing guidelines are available
- Dedicated hardware and software support available by phone
- Skills gained are clear and easily incorporated onto a resumé



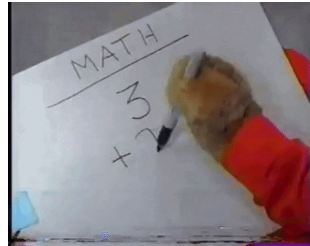
Modeling Workflow:

- Students meet weekly to share & work
- Modeling guidelines are available, but a diverse set of skills are required:
 - Command line interface
 - Perl, Python, C++ and/or Matlab
 - Software requires compilation
- Software support often is the user community
- High Performance Computing (HPC) platform support is mixed
- Programming skills can be added to a resumé, but what else?
- PI becomes the main source for help (ROADBLOCK!)



What motivated you to get involved in research?

- See how my (non-geology) major can be applied in other disciplines
- Apply concepts I learned in computer graphics and computer vision to help with seismic hazard modeling
- Learn about a different field
- Connect with people in other departments
- Be involved in geology and deepen my understanding
- Follow my passion
- Discover something!
- Mentorship
- Gain transferable skills



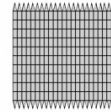
3-D Model



$p = (x, y, z)$



UV Map



$p = (u, v)$



Get burritoed idiot



Texture



Why do you stay involved in research?

- Socializing!
- Sense of responsibility and wanting to see the project through
- Learning more about my topic and what other students are researching
- Mentorship
- Passion and curiosity



RECRUITMENT

When considering getting involved in research...

..the opportunity to get paid was NEUTRAL.



..working with other students on a team was NEUTRAL.



..enhancing my resume was VERY IMPORTANT.



RETENTION

*Shout out to the
CRESCENT
Twinning Program!*

Now that I am involved in a research project...

... the opportunity to get paid is IMPORTANT.

... working with other students on a team is VERY IMPORTANT.

... enhancing my resume is VERY IMPORTANT.

Favorite



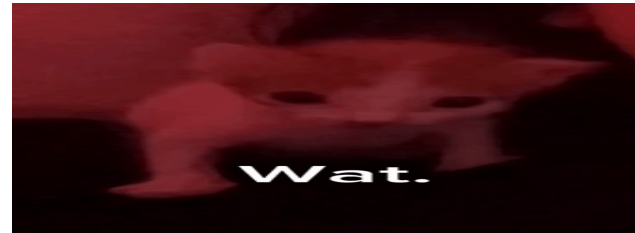
- Being involved
- Having the concepts click, learning a new topic more in depth
- Working with peers, talking with group members on research related topics
- That feeling when something works!
- Finding new workflows
- Seeing how everyone's different backgrounds help in research
- Just checking in, in general

poly3d

Least favorite

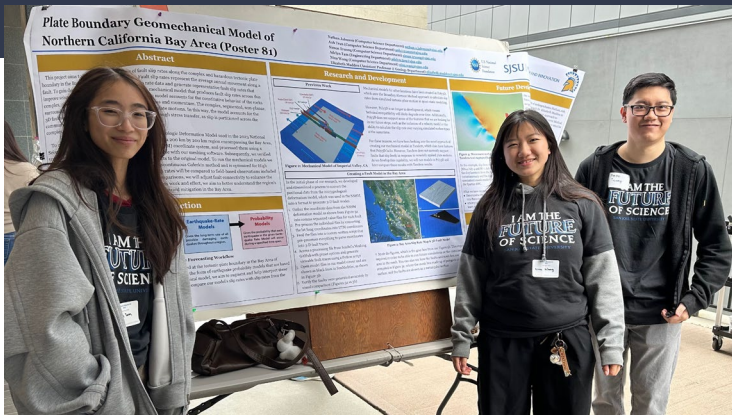
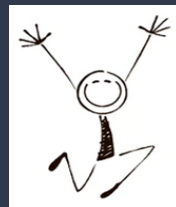


- Going out in the field and not getting anything done, especially in the desert.
- Failing and being stuck :(
- The roadblocks, like when seissol took forever to download ha ha
- How much time it can take to get results; the amount of trial and error it can take.
- How tedious it can be when doing data collection and analysis. **Also coding, that sucked but it was important.**
- Waiting for programs to run or download



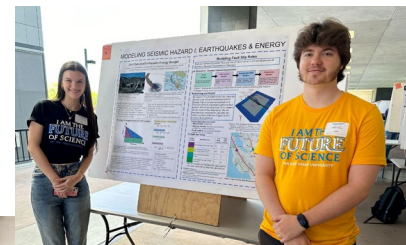
Harness the energy!

With attention, the rewards can be huge



Maybe modeling work should look more like fieldwork:

- Schedule a day
- Work through a certain number of model preparation steps, runs or analyses
- End & celebrate



- ❖ Teamwork! Students like to combine work and socializing, and more hands on the small problems leads to more rapid progress.
- ❖ Weekly meetings. A lot of the progress happens when challenges can be met directly and problems solved together.
- ❖ Recruit students from other fields (with relevant skills)



3D fault geometry fieldwork team

Goal: Use LiDAR to find signatures in the landscape that reveal fault segmentation (or continuity) in 3D

MS student: Karen Castaneda (Geology)
Undergrads: Josue Rebollar (Aerospace Engineering)
Gibson Sacramento (Applied Math)
Researcher: Alex Witney (Geology)
(former undergrad, MS applicant)

BAM quasistatic forward modeling team

Goal: Determine long term slip rates along 3D non-planar, intersecting faults

Undergrads: Simon Trang (CS)
Anh Bao Tran (CS, Geology minor)
Nina Wang (CS)
Adelyn Tam (Computer Engineering)

Cascadia dynamic earthquake rupture modeling team

Goal: Use energy budgeting to improve earthquake rupture models

MS student: Sean Hsieh (CS)
Undergrads: Lindsay Gross (Applied Math)
Corey Lisemby (Meteorology, Geology minor)

Research group practices:

- Meet weekly as a team to discuss (and make) progress
- Meet weekly as a research group to share research progress & challenges