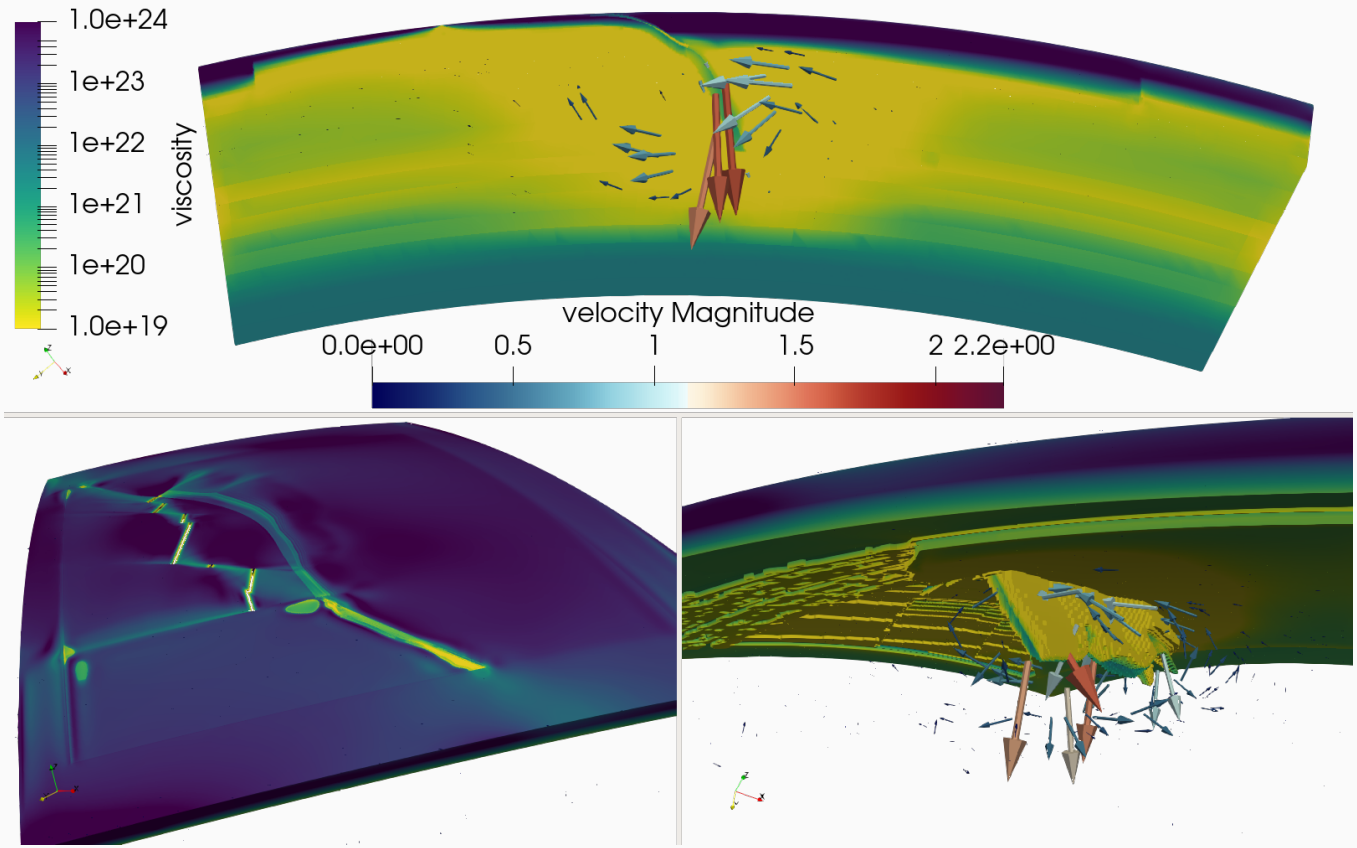


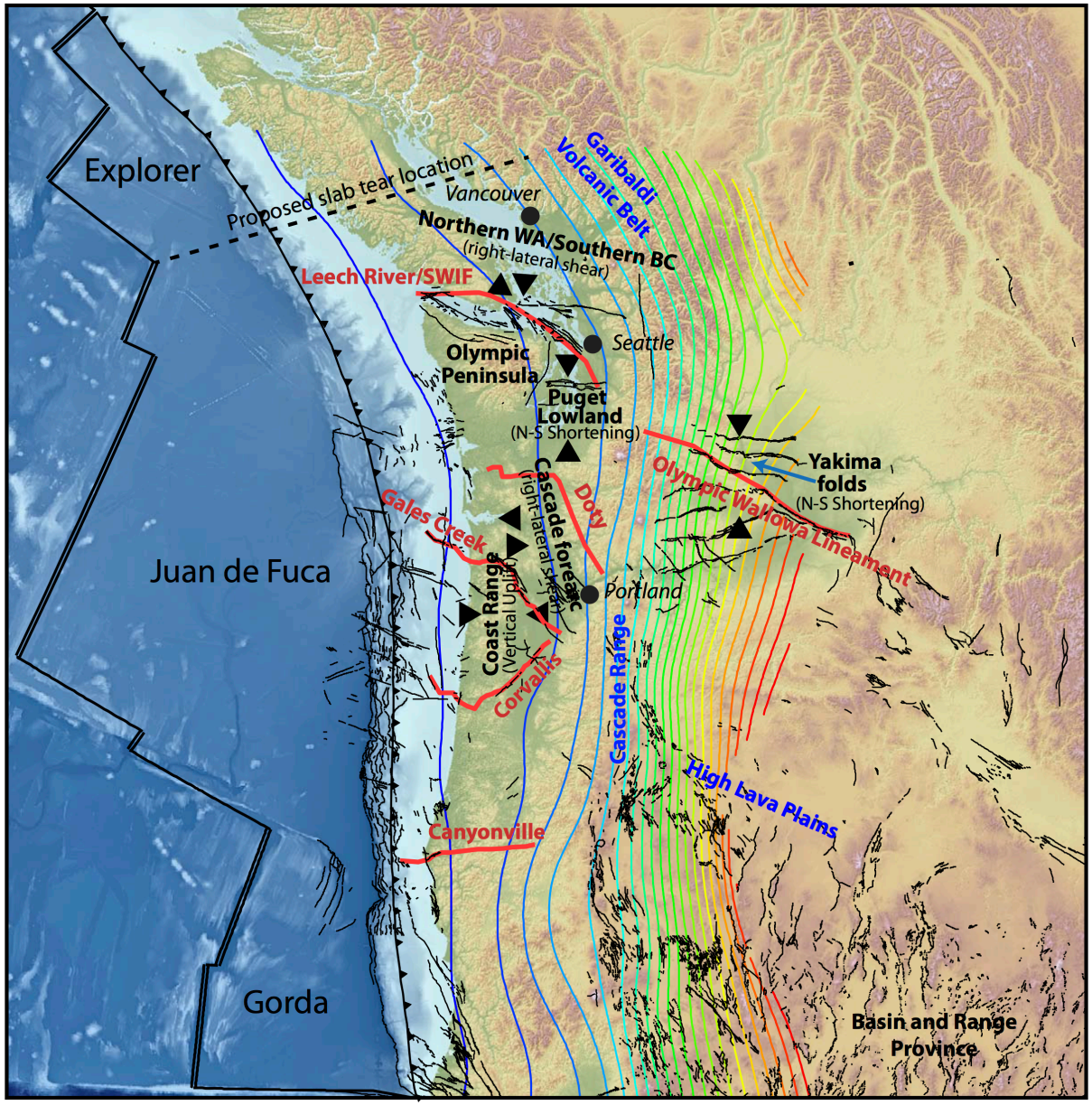
Exploring the Cascadia slab structure coupling 3D thermomechinal and CPO modeling

Menno Fraters, Magali Billen, John Naliboff, Lyda Staisch, Janet Watt and Haoyuan Li

27 May 2022

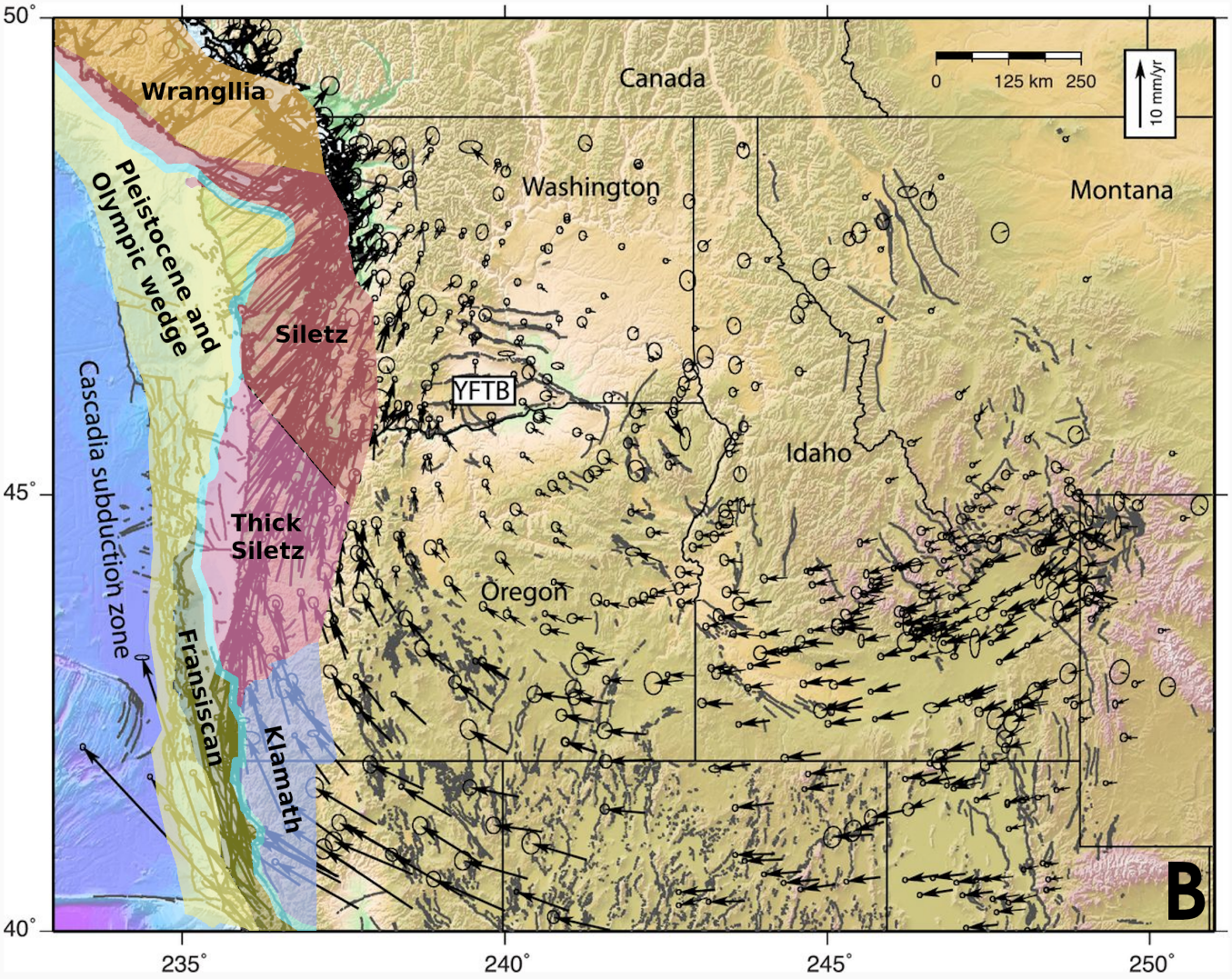
Question: can we improve our seismic hazard risk assessment in Cascadia?

Understanding Crustal dynamics



Based on data from Hayes et al. (2018), USGS (2019), Wells et al. (2017) and Mullen and Weis (2015).

The region also contains large terrains



Based on McCaffrey et al. (2016) and Trehu et al., (1994)

So how can we improve our seismic hazard risk assessment?

Stress!

Improving our understanding of the stress state by modelling

- Improving our understanding of the stress state by modelling

Improving our understanding of the stress state by modelling

- Improving our understanding of the stress state by modelling
- **BUT we first need to understand slab geometry and dynamics**

Improving our understanding of the stress state by modelling

- Improving our understanding of the stress state by modelling
- **BUT we first need to understand slab geometry and dynamics**
- And they are not well constrained...

Improving our understanding of the stress state by modelling

- Improving our understanding of the stress state by modelling
- **BUT we first need to understand slab geometry and dynamics**
- And they are not well constrained...
- But can do it through constraining mantle flow!

Constraining mantle flow through seismic anisotropy and CPO

Mantle flow -> CPO -> seismic anisotropy

- If we can forward model the problem and track CPO

Mantle flow -> CPO -> seismic anisotropy

- If we can forward model the problem and track CPO
- We can compare it to the seismic anistotropy observations

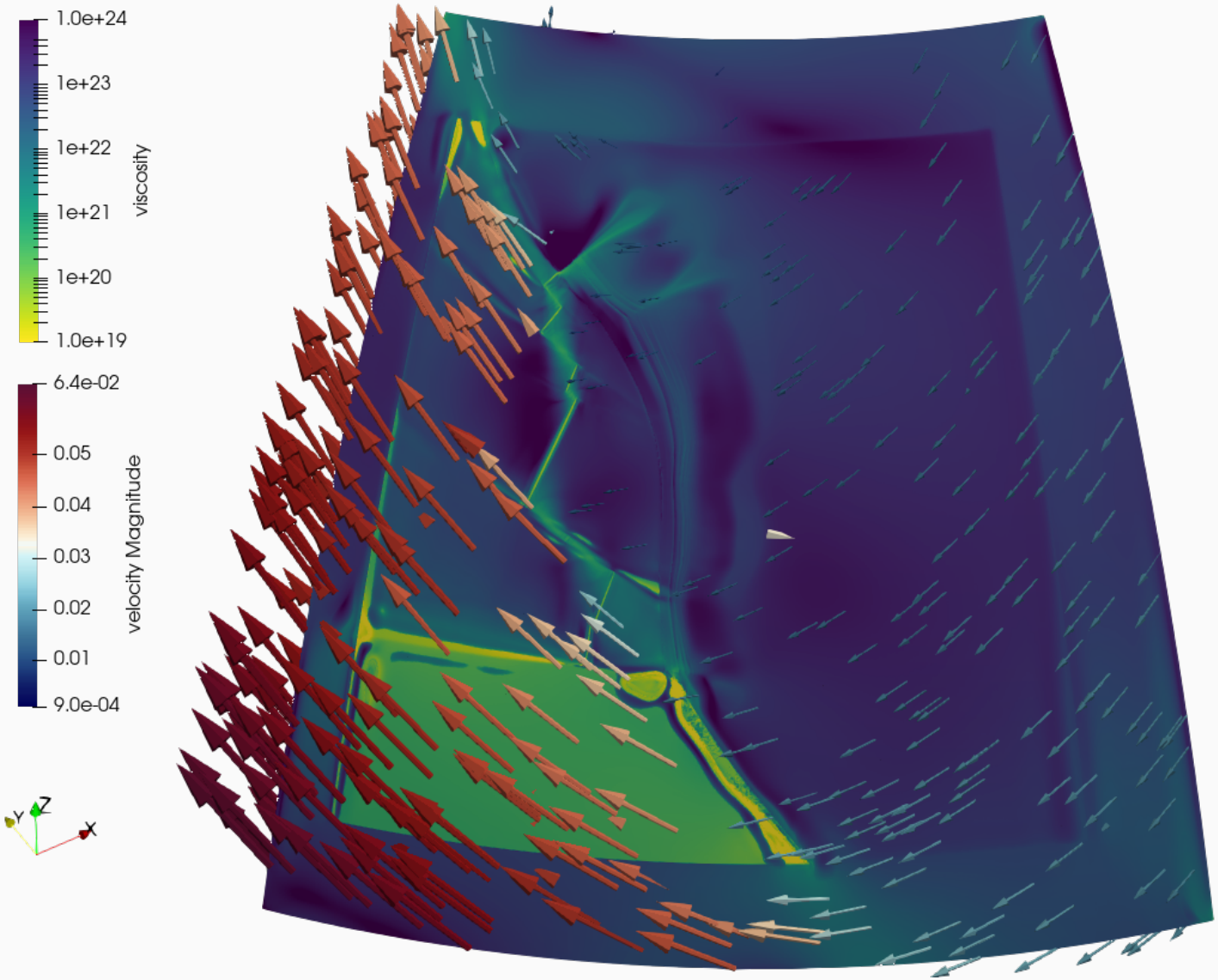
Mantle flow -> CPO -> seismic anisotropy

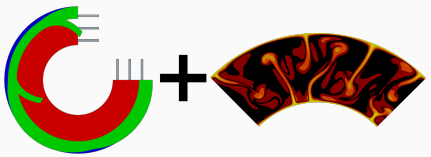
- If we can forward model the problem and track CPO
- We can compare it to the seismic anistotropy observations
- And constrain the slab dynamics through mantle flow!

So go forth and ...

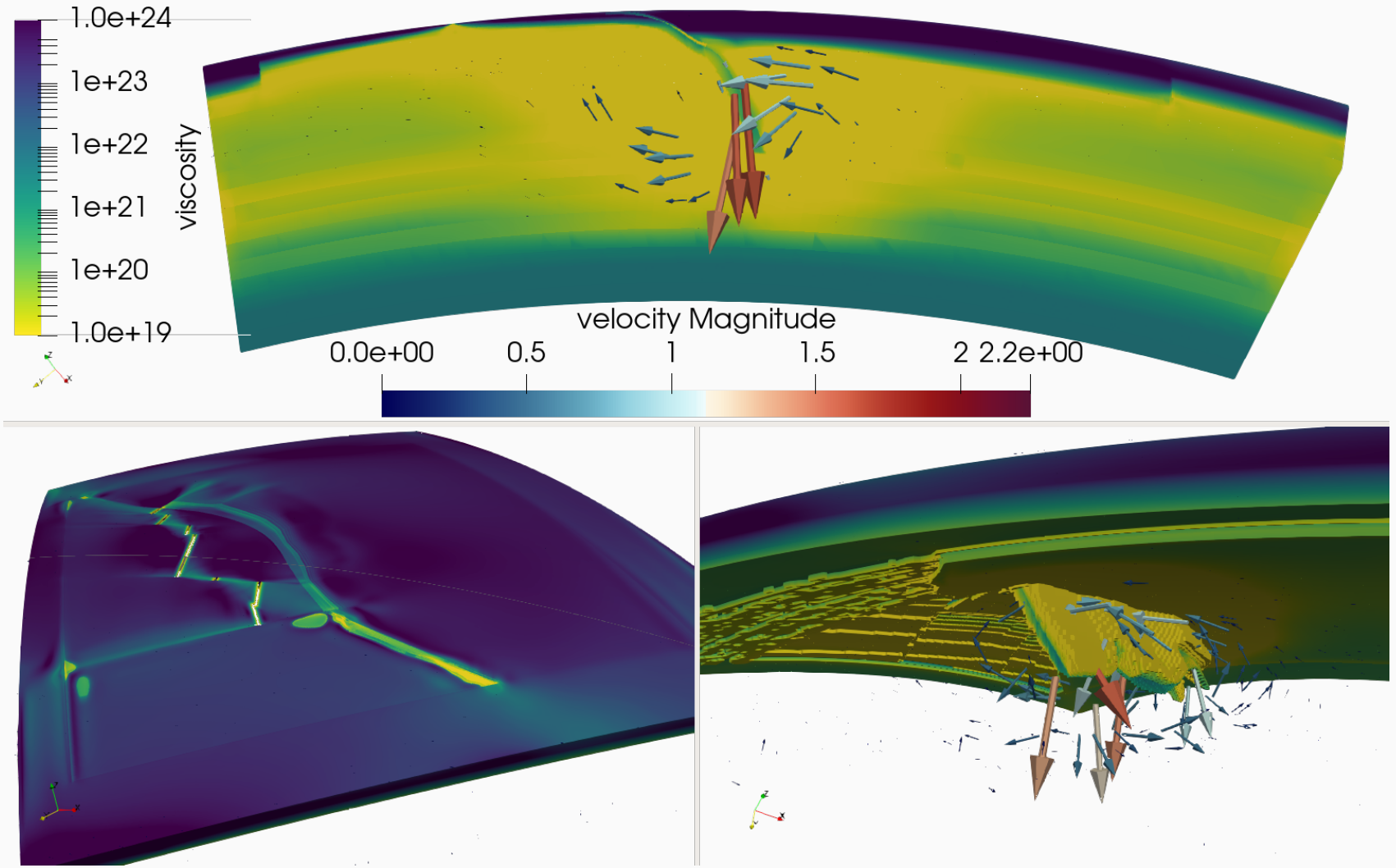
So go forth and … Model!

Model Setup


1.0e+24
1e+23
1e+22
1e+21
1e+20
1.0e+19
viscosity
6.4e-02
0.05
0.04
0.03
0.02
0.01
9.0e-04
velocity Magnitude
Z
Y
X



(Very) Preliminary Model Results



What is next?

Correct Rheology -> constrain slab -> model overriding plate!

- Correct slab rheology to that we match constrains from observations

Correct Rheology -> constrain slab -> model overriding plate!

- Correct slab rheology to that we match constrains from observations
- More detail in the overriding plate

Correct Rheology -> constrain slab -> model overriding plate!

- Correct slab rheology to that we match constrains from observations
- More detail in the overriding plate
- Constrain the stress!

Thank you for your attention!