

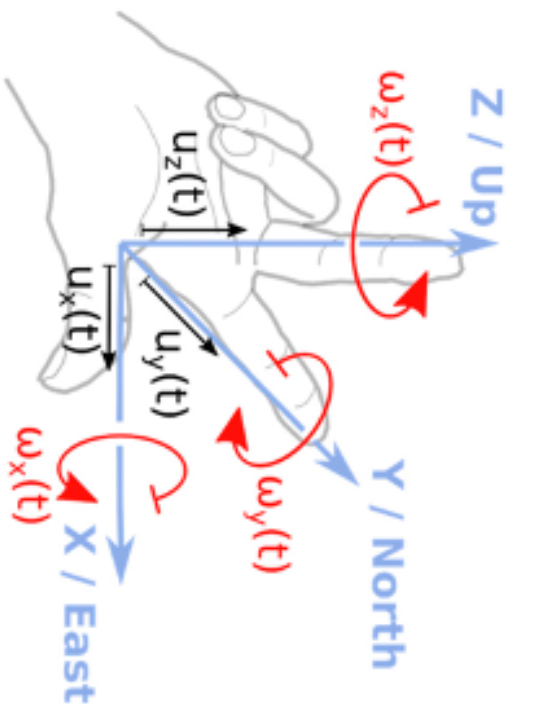
Possible Roles for Rotational Seismology in Cascadia?

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What is Rotational Seismology?

Observation and analysis of the twists, tilts, rolls, pitches, & yaws of ground motions of seismic waves.



How do Rotational Motions Arise?

- Curl of the vector displacement field
- Asymmetric part of the displacement gradient matrix
- Essentially: When ground motion not in propagation direction:
 - Part of the linear elastic wavefield (weak)
 - Non-linear wave propagation like anisotropy, non-homogeneity, near-field, layering. (Interesting, complicated, and provide additional constraints)

How are Seismic Rotations Observed?

- Seismic Arrays**
- Rotaphone**
- Moment of Inertia Gyroscopes**
- Pendulums**
- Wheels**
- Vibrating Strings (tuning forks)**
- MEMS**
- Sagnac Effect**
- Ring lasers**
- FOGs**
- Others**
- Fluid-filled**
- Beam Balance**

Goal: Low power, robust, wide-band, vault-friendly, sensitive (at the low-noise model), high dynamic range. Perhaps one day: seafloor deployable.

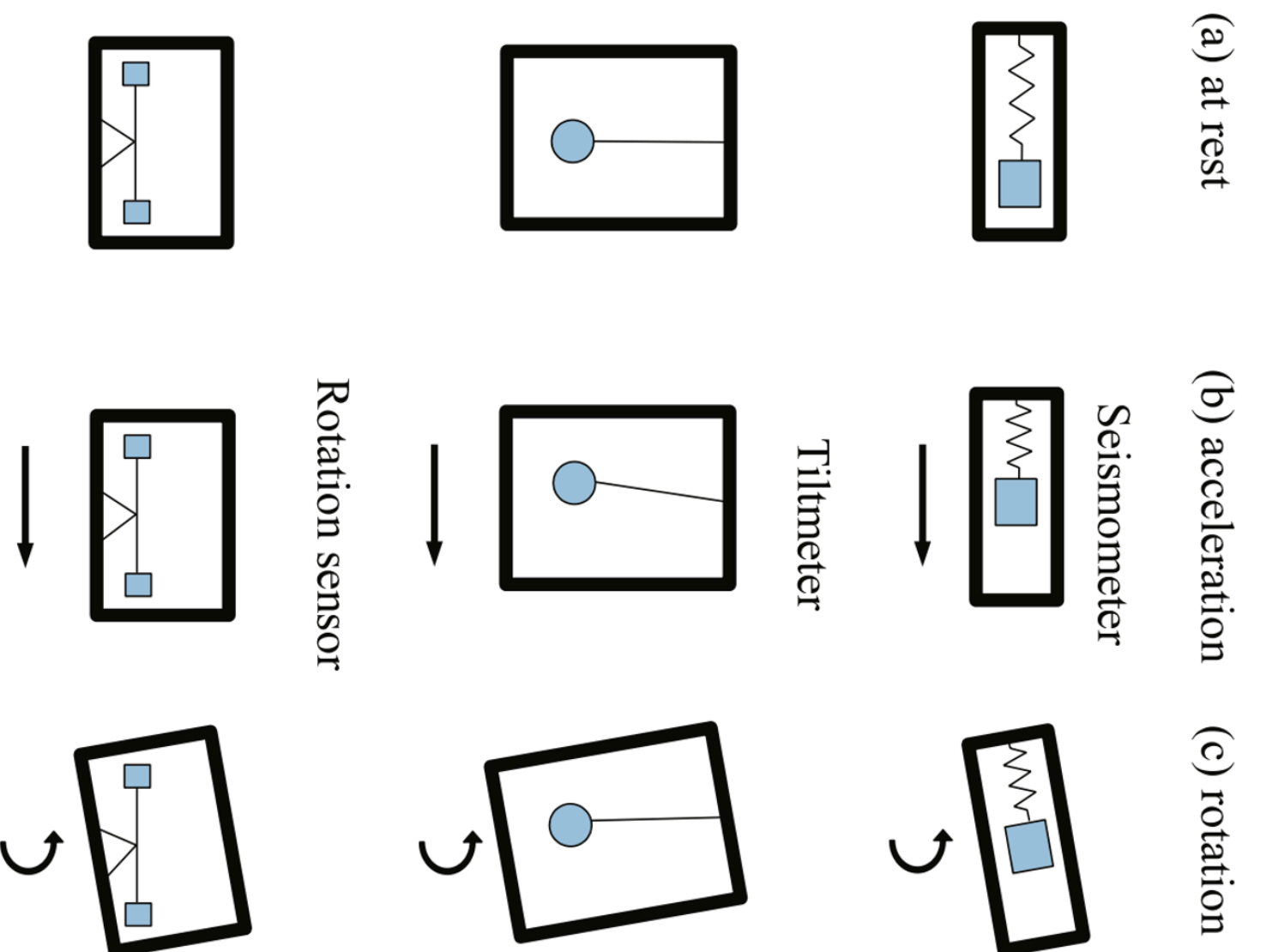
Is There a Rotational Seismology Community?



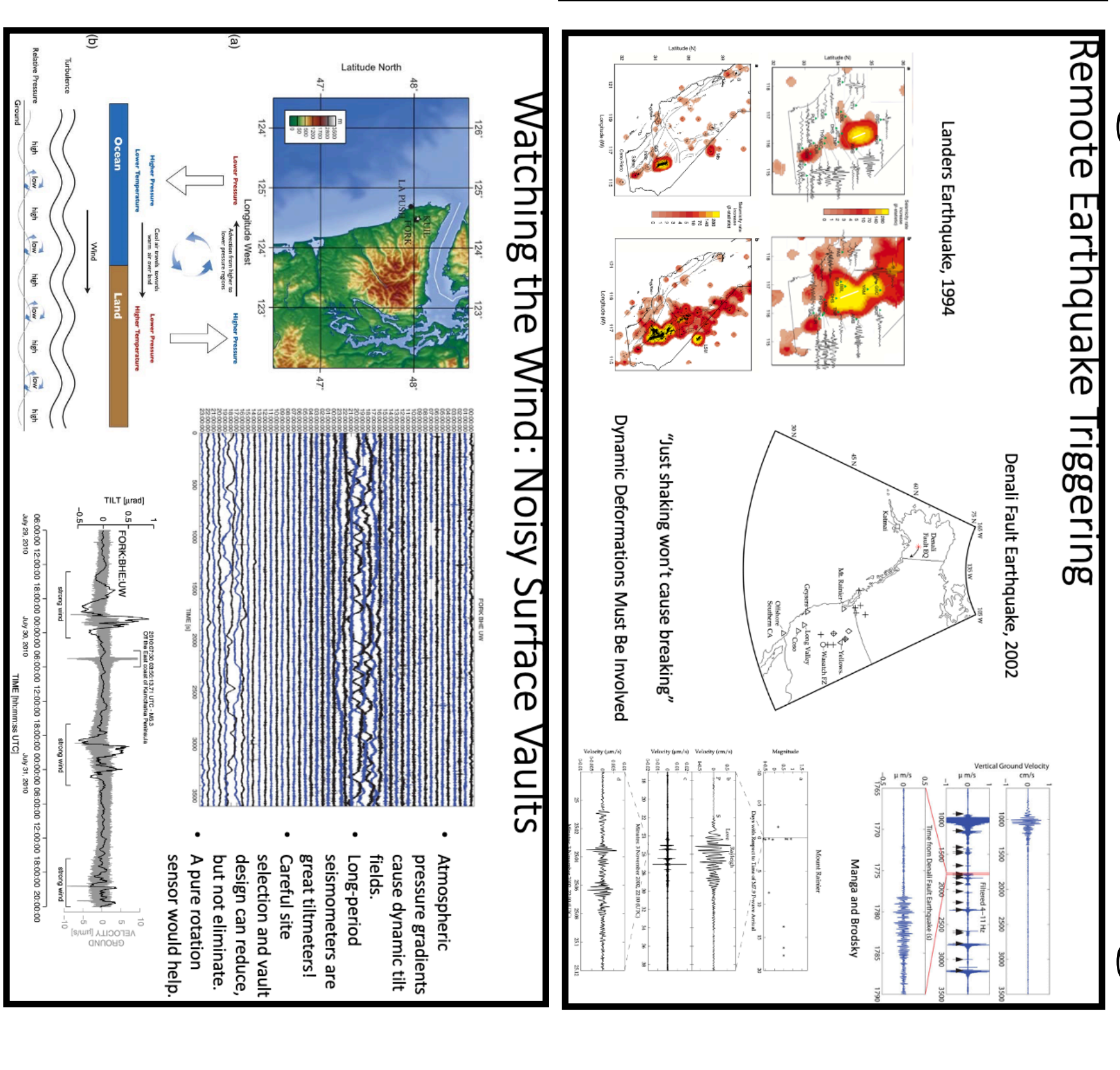
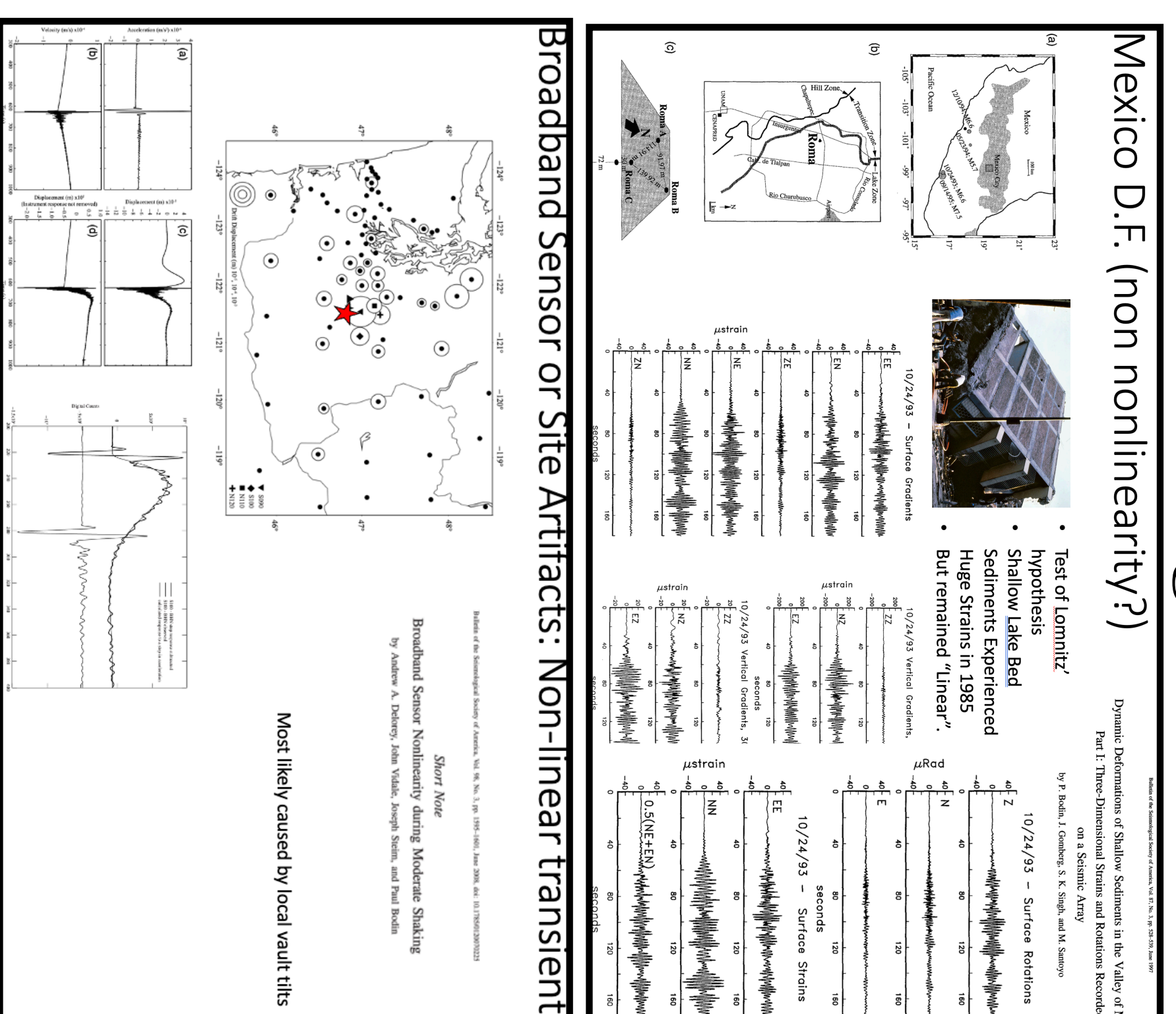
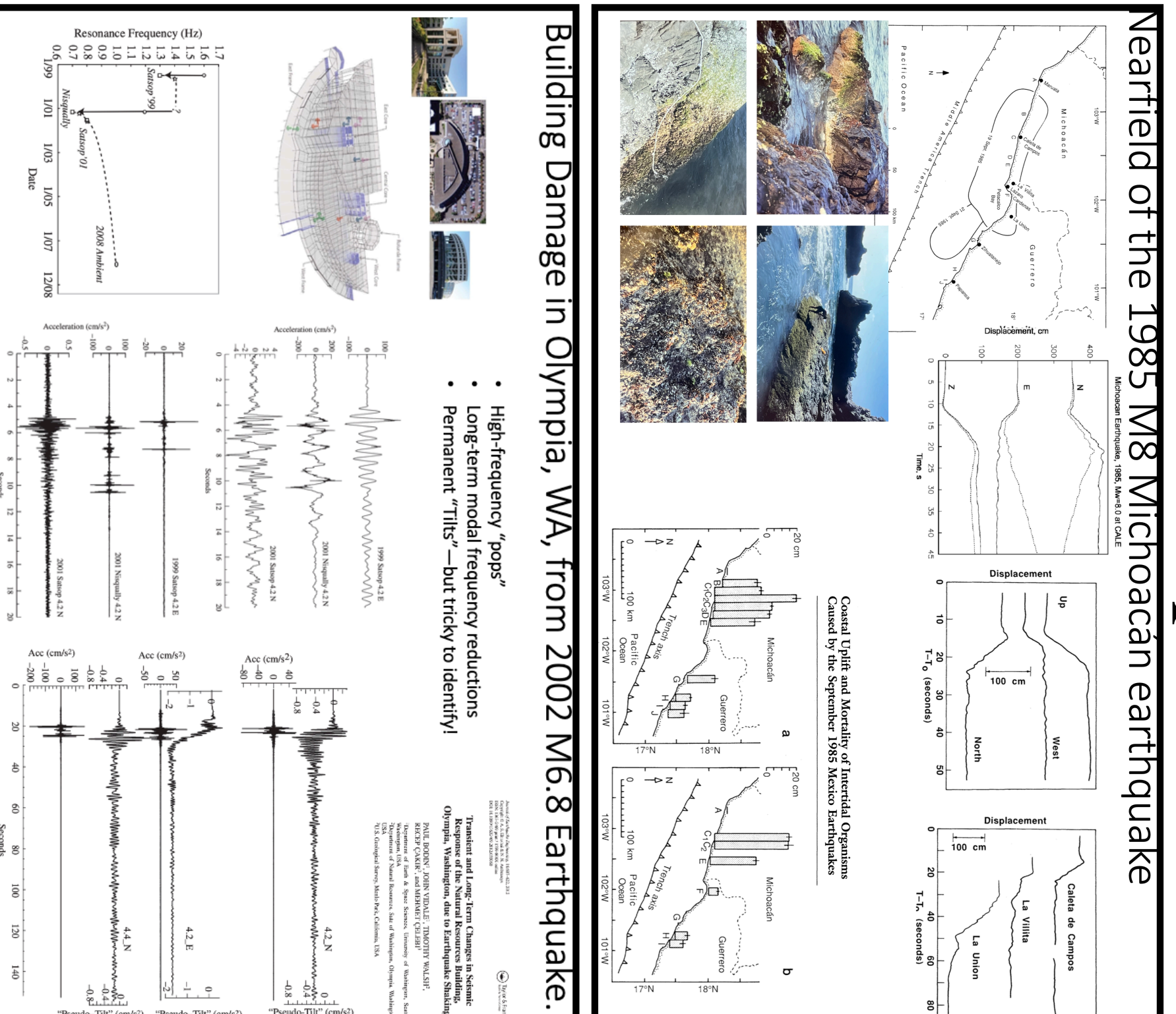
Yes. It is overwhelmingly European

Knotty Problem: Translational Motion Artifacts

Venkateswara et al.



Are There Examples of the Need For Including Rotations in Regional Seismic Monitoring?

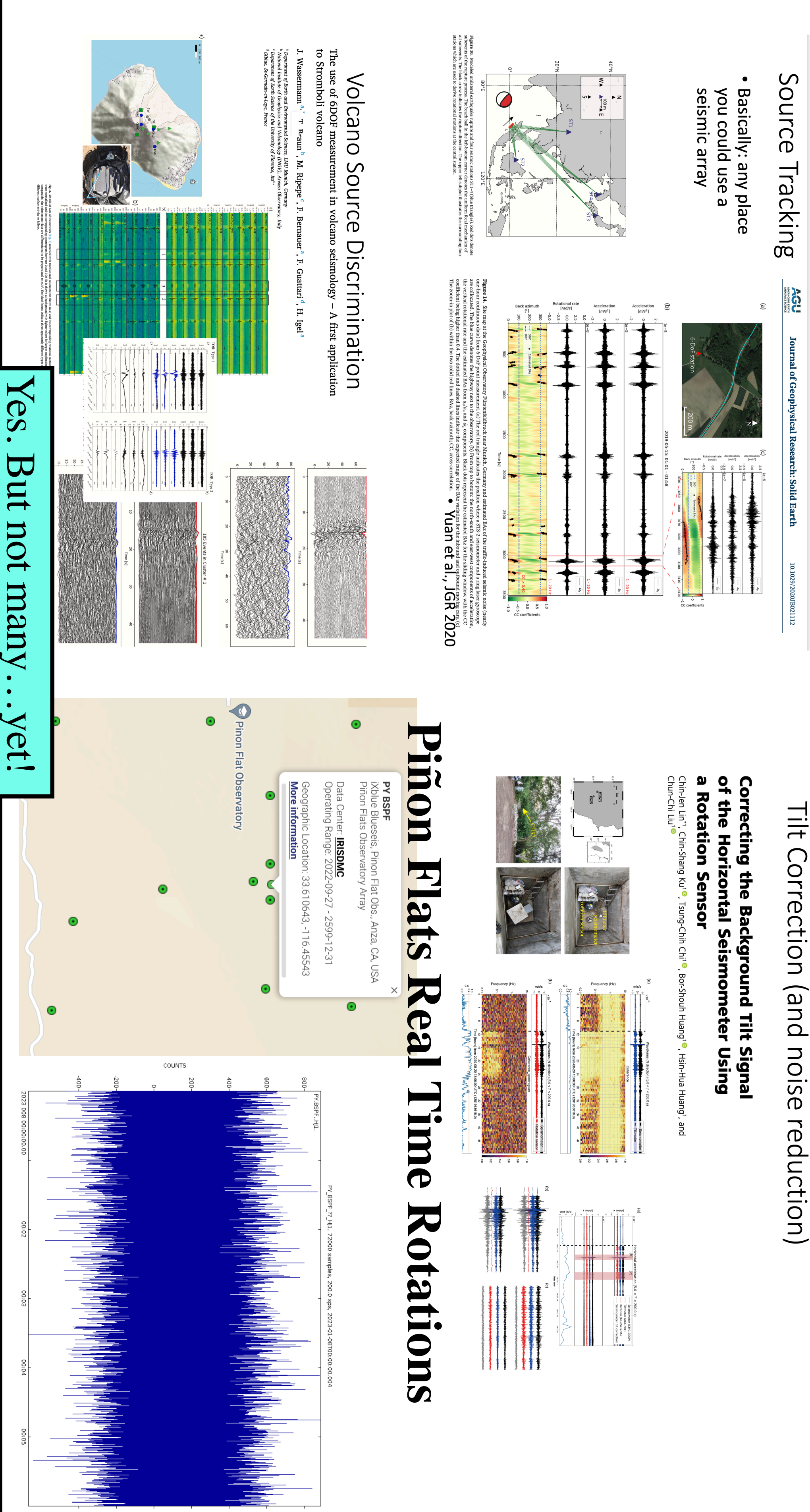


3 Translations + 3 Rotations = 6 Degrees of Freedom (6DoF)

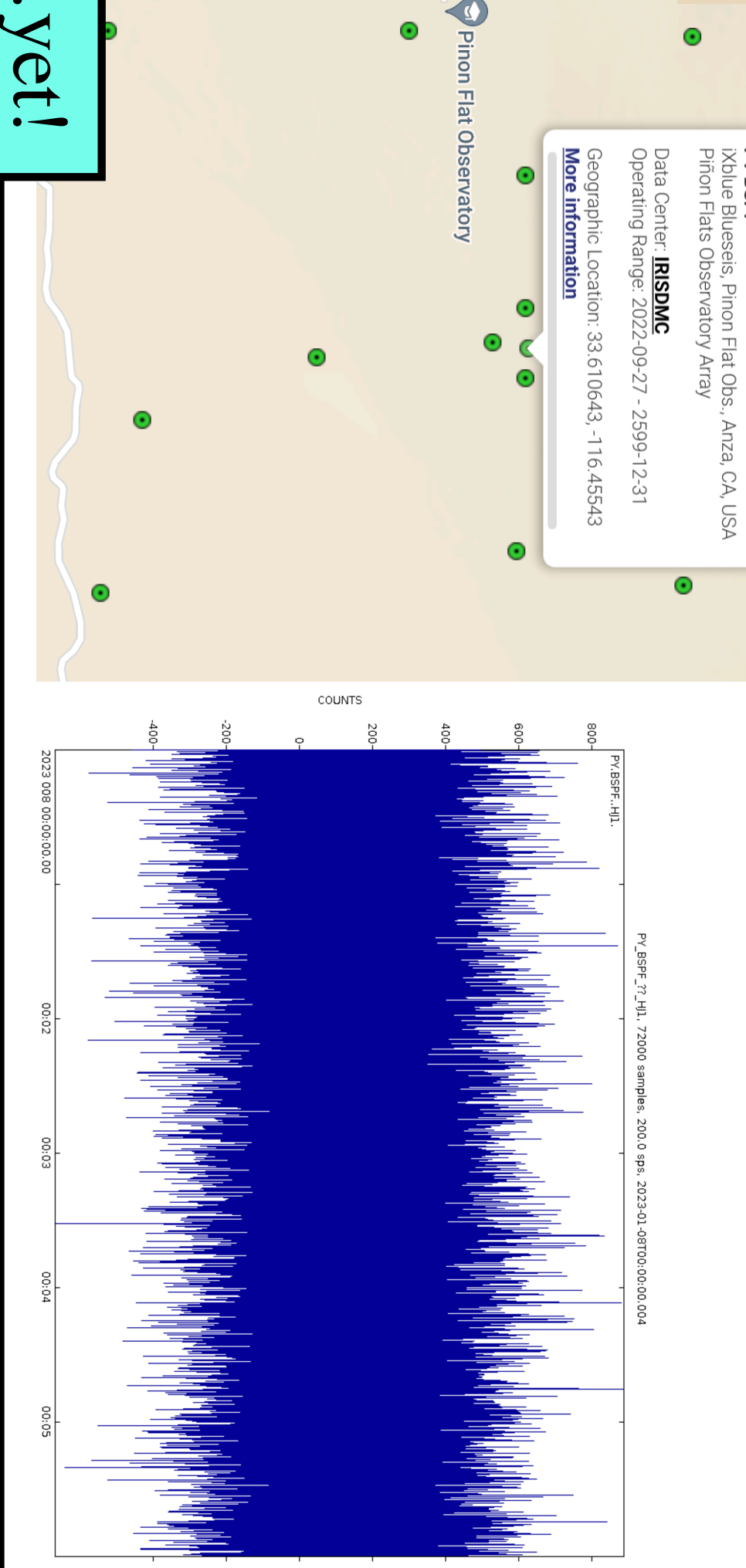
What Could 6DoF Monitoring Sites Contribute in Cascadia?

- RS's possible contributions in regional monitoring using 6DoF stations leverage:
 - Its "mini-array" capabilities (replaces several instruments and function as an array)
 - Its ability to "correct" translational sensors.
 - Potential to better characterize actual ground input motions to structures and motions within them.
- Needed developments include both hardware and software work:
 - Higher sensitivity (at the low-noise model)
 - Low power consumption & robustness
 - Seafloor sensors
- What Developments are Needed?

Are There Examples of 6DoF Stations Contributing to Regional Issues?



Pinon Flats Real Time Rotations



Basic Science
Near-field Effects
Off-Network Sources
Non-linear Ground Motion
Landslides
Volcanoes
Gap Coverage
Early Warning
Source Tracking
Structural Response
Laahs

