Hikurangi subduction as seen by ambient noise

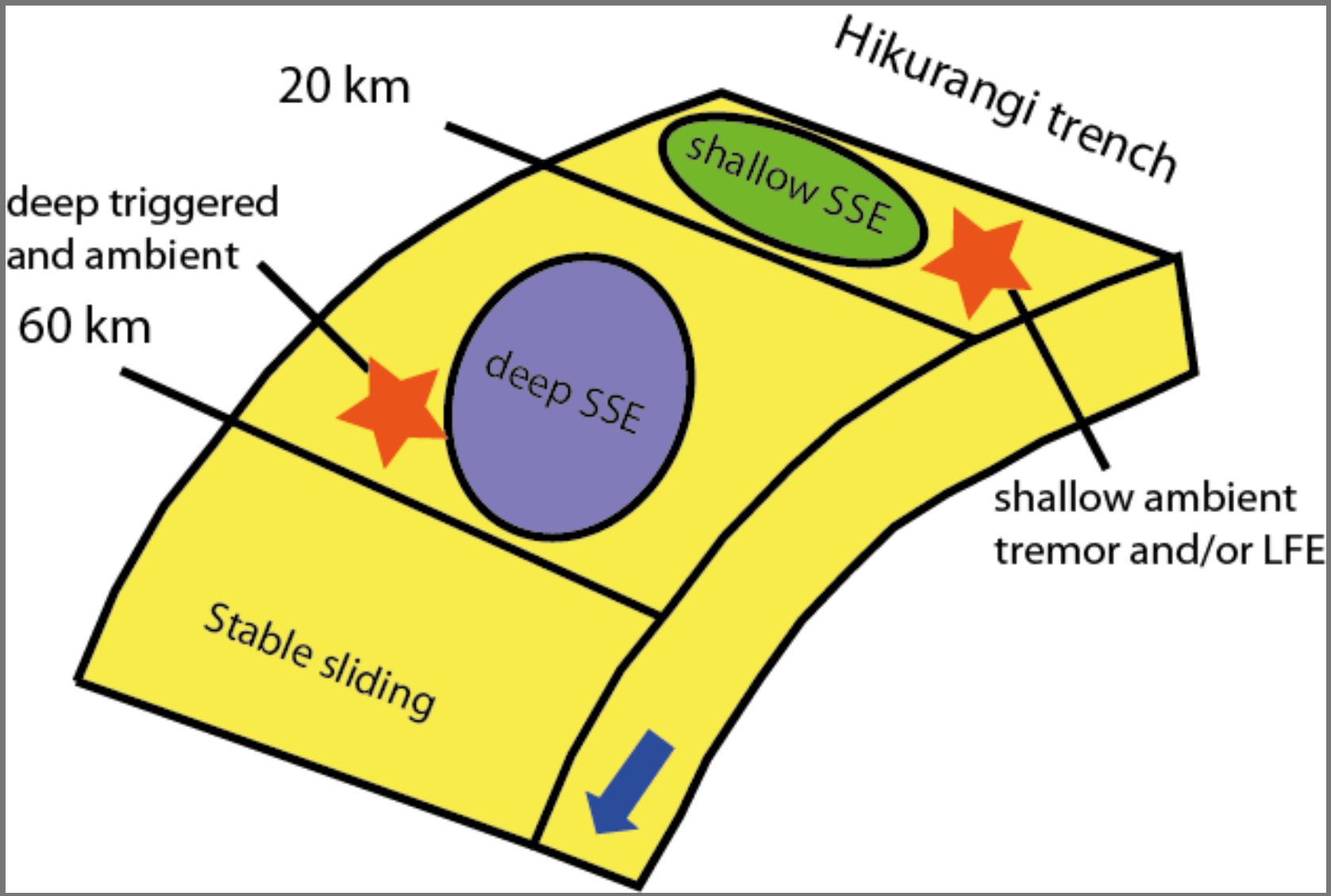
Bill Fry

Wednesday, December 17, 14, Goprisms mini workshop, AGU

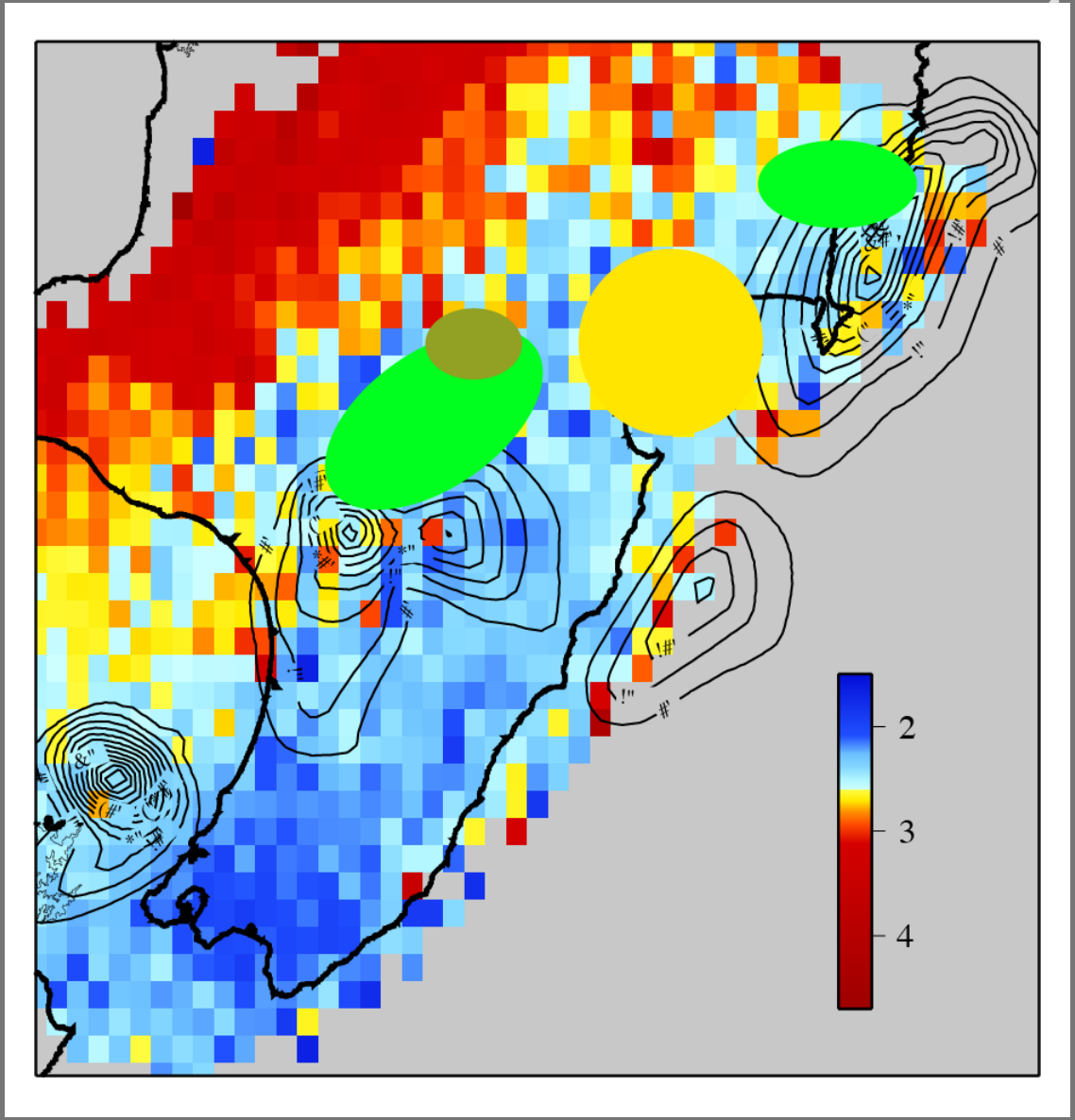
Ongoing work

- Tremor
- Anisotropy
- 3D Vs (slab and underlying LVZ)
- Onshore MT

- Traditional studies:
  - Mahia example
  - Gisborne example

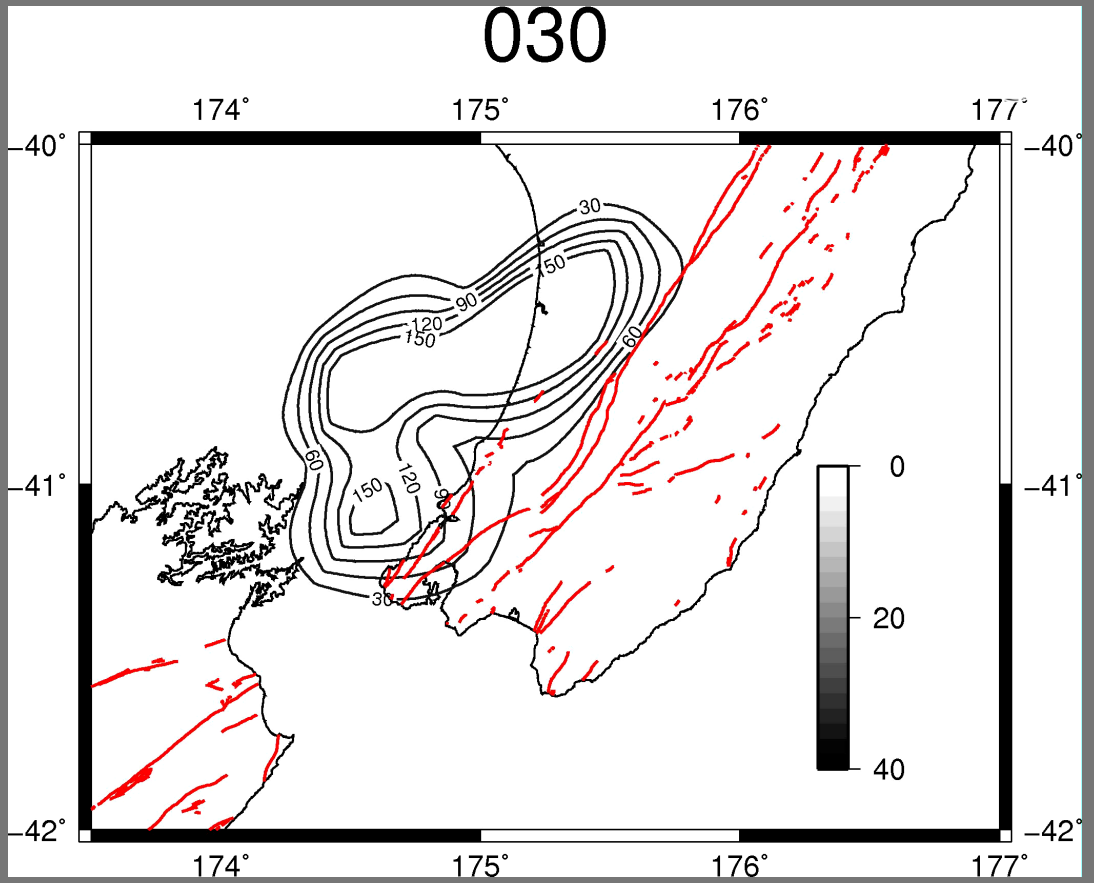

Hikurangi trench
20 km
shallow SSE
deep triggered
and ambient
60 km
deep SSE
shallow ambient
tremor and/or LFE
Stable sliding

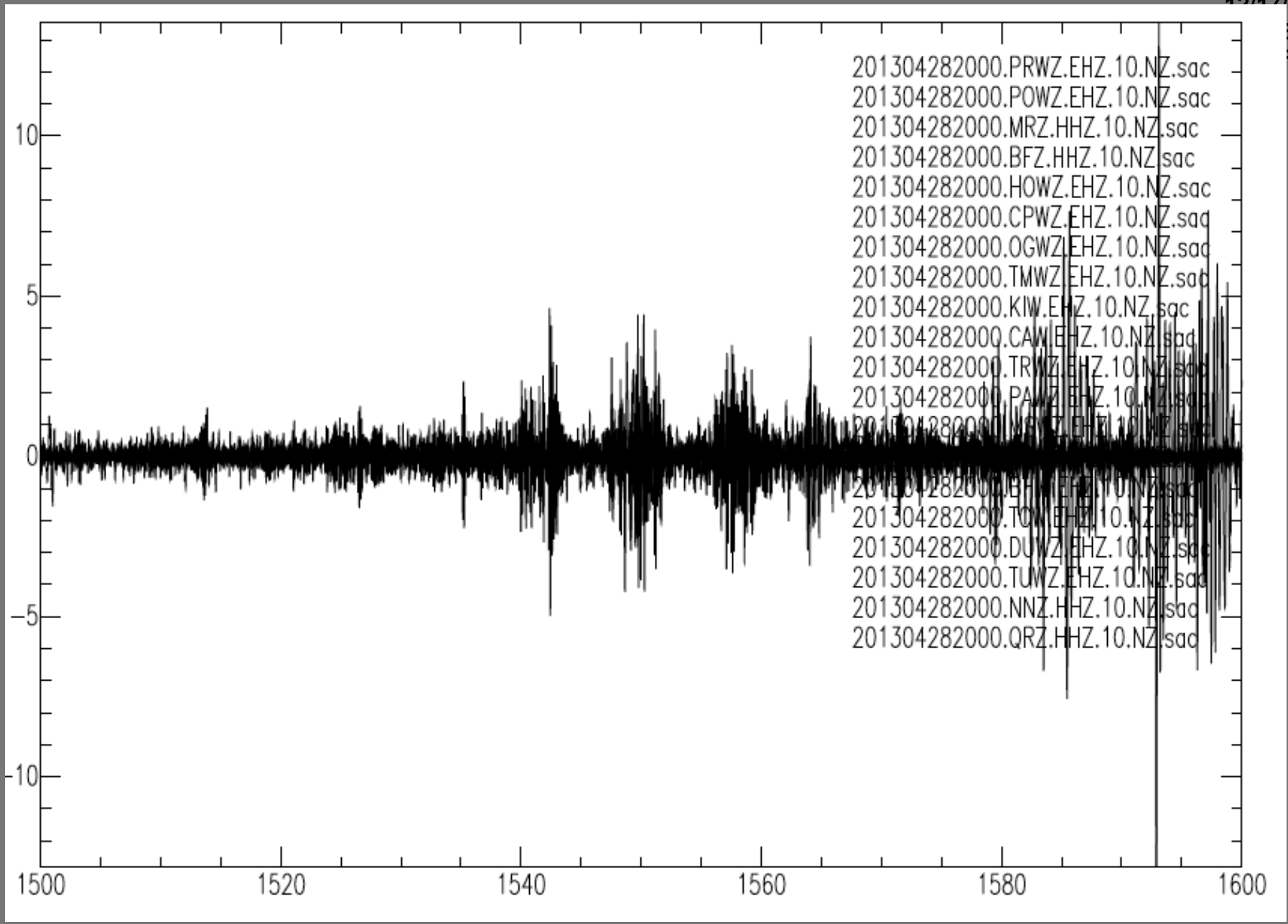
Hikurangi tremor



SSE from L.Wallace, tremor from Fry et al., 2011, Kim et al., 2011, Ide, 2012, and Fry (unpublished)

Animation



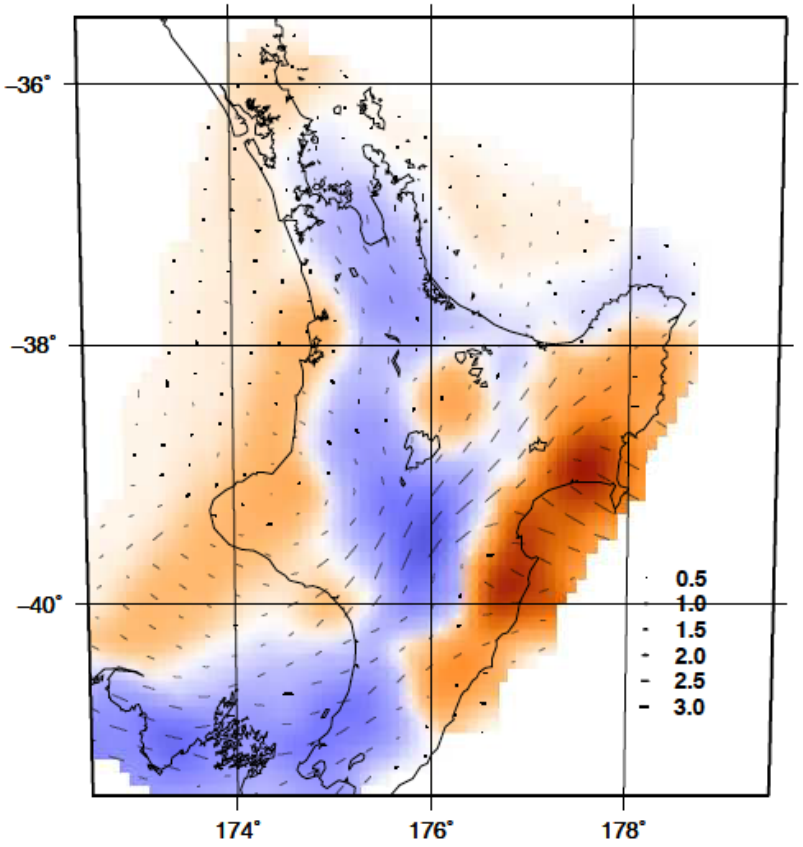

201304282000.PRWZ.EHZ.10.NZ.sac
201304282000.POWZ.EHZ.10.NZ.sac
201304282000.MRZ.HHZ.10.NZ.sac
201304282000.BFZ.HHZ.10.NZ.sac
201304282000.HOWZ.EHZ.10.NZ.sac
201304282000.CPWZ.EHZ.10.NZ.sac
201304282000.OGWZ.EHZ.10.NZ.sac
201304282000.TMWZ.EHZ.10.NZ.sac
201304282000.KIW.EHZ.10.NZ.sac
201304282000.CAW.EHZ.10.NZ.sac
201304282000.TRWZ.EHZ.10.NZ.sac
201304282000.PAWZ.EHZ.10.NZ.sac
201304282000.TOAZ.EHZ.10.NZ.sac
201304282000.DUWZ.EHZ.10.NZ.sac
201304282000.TUWZ.EHZ.10.NZ.sac
201304282000.NNZ.HHZ.10.NZ.sac
201304282000.QRZ.HHZ.10.NZ.sac
10
5
0
−5
−10
1500
1520
1540
1560
1580
1600

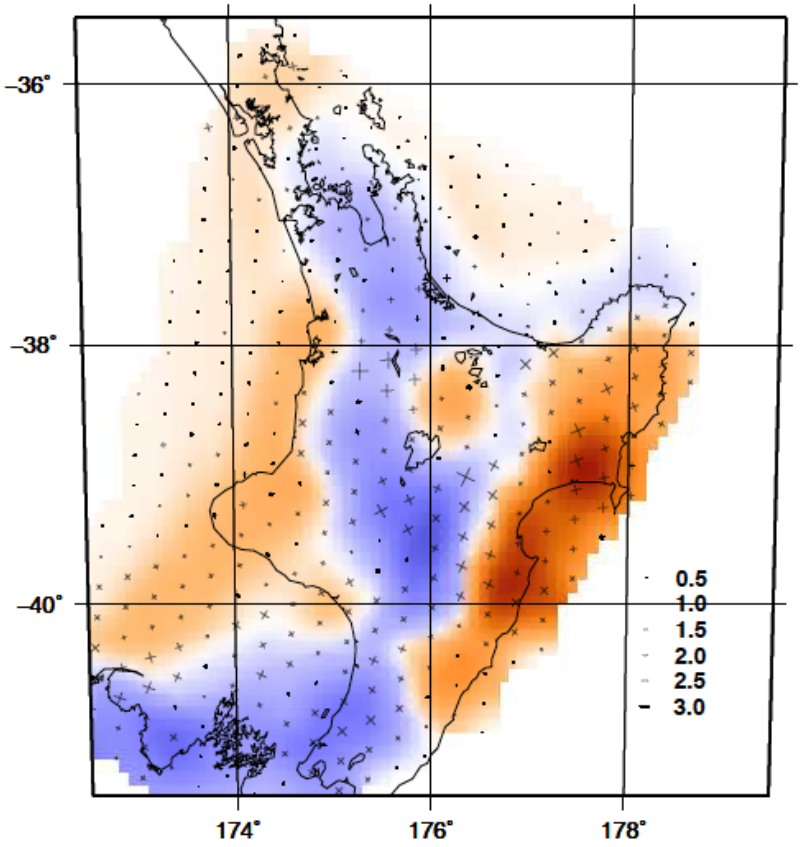
Passive imaging

- Anisotropy
- 3D Vs (slab and underlying LVZ)

period: 010 s
number of paths: 221
knot spacing: 25 km

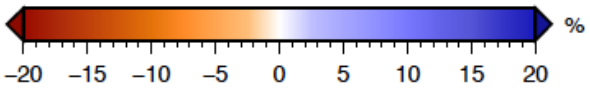
Norms: 0.16 0.16 0.20
Smoothings: 0.10 2.20 2.90
Reference Velocity: 2.517426 km/s





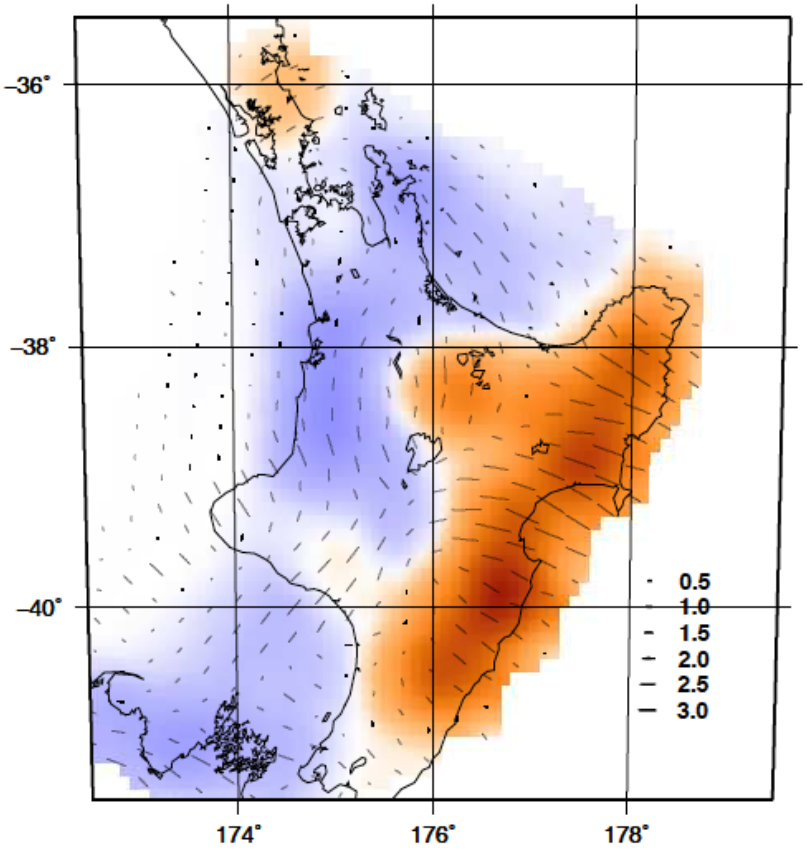
Number of Iterations, remaining variance: 8 0.751368

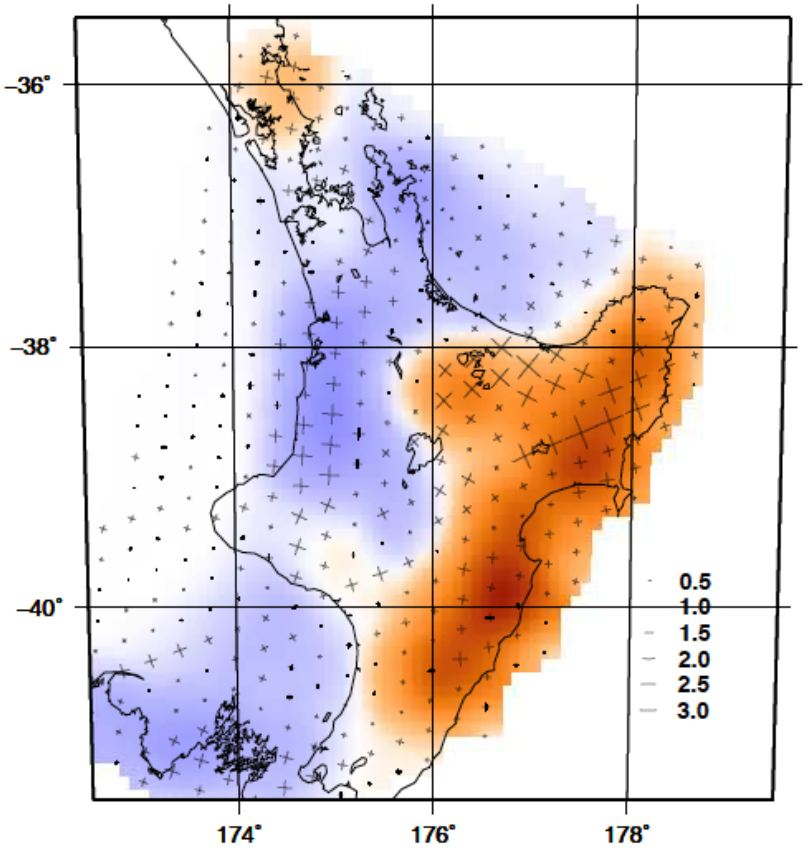
(saturated-scale limits are 1,0.1 of the max)



period: 018 s
number of paths: 213
knot spacing: 25 km

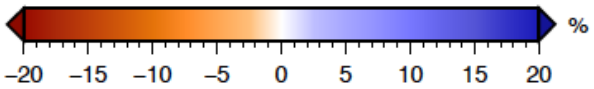
Norms: 0.16 0.16 0.32
Smoothings: 0.80 2.10 2.80
Reference Velocity: 2.626620 km/s





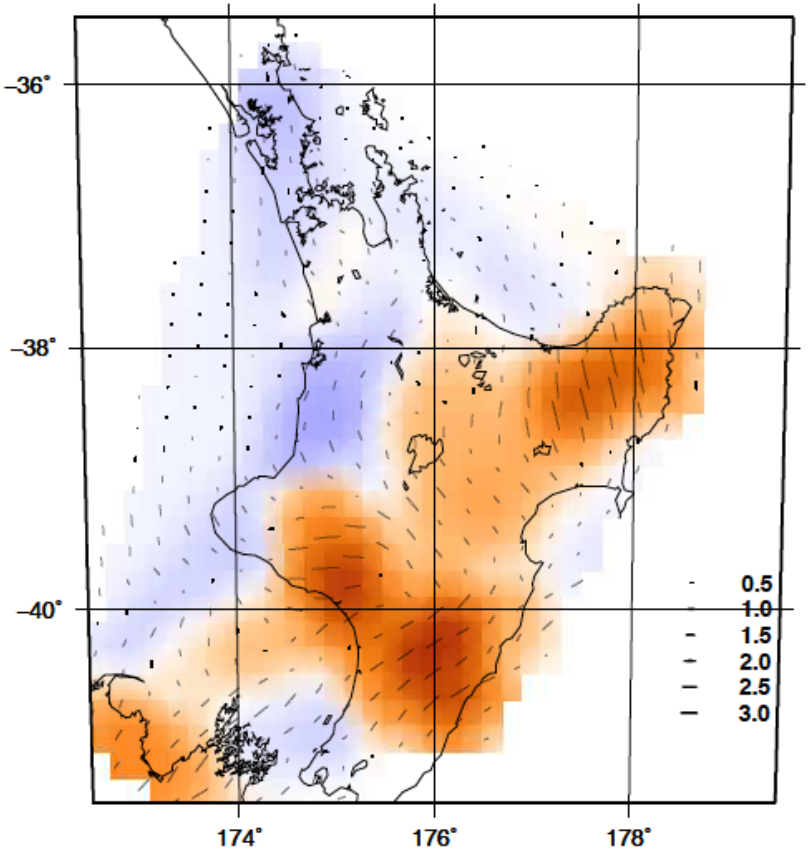
Number of iterations, remaining variance: 8 0.660994

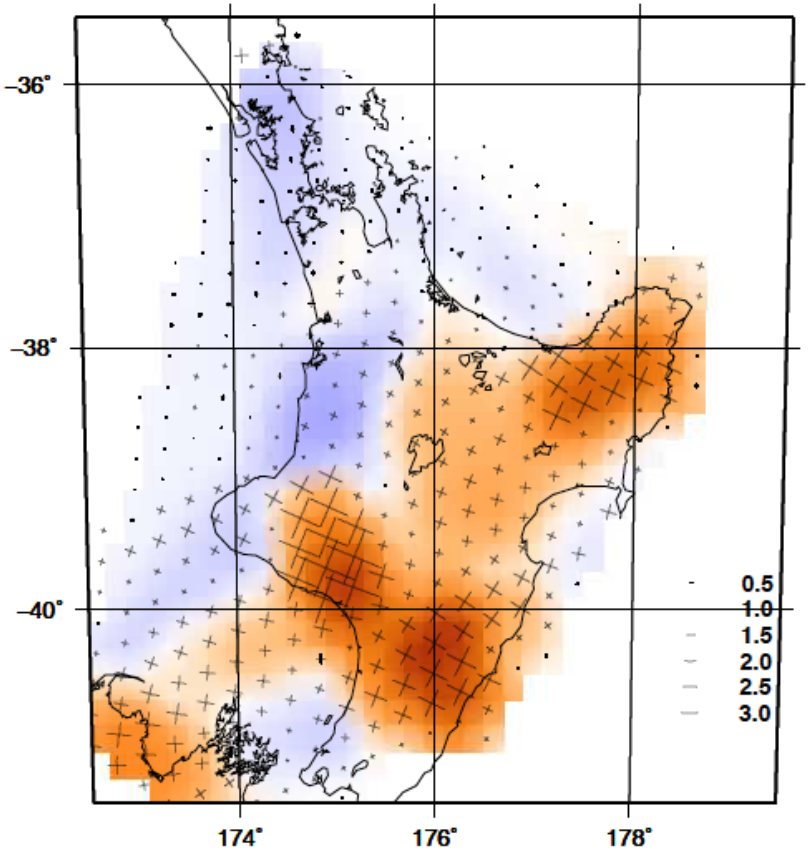
(saturated-scale limits are 1,0.1 of the max)



period: 044 s
number of paths: 85
knot spacing: 25 km

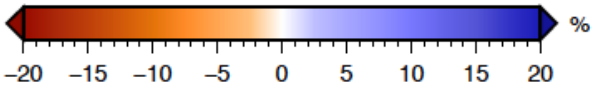
Norms: 0.16 0.16 0.30
Smoothings: 0.50 2.00 2.40
Reference Velocity: 3.357257 km/s



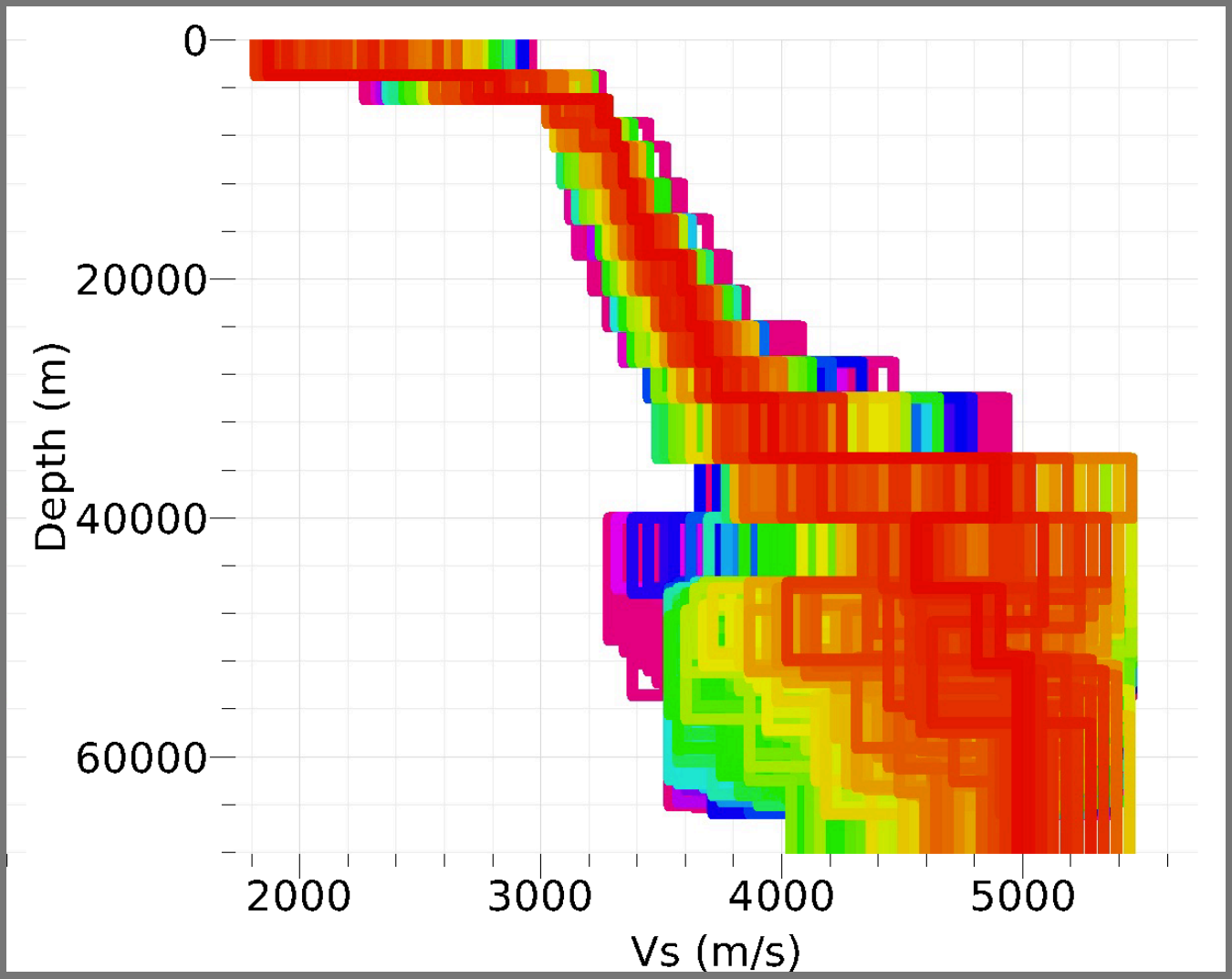


Number of iterations, remaining variance: 9 0.710493

(saturated-scale limits are 1,0.2 of the max)



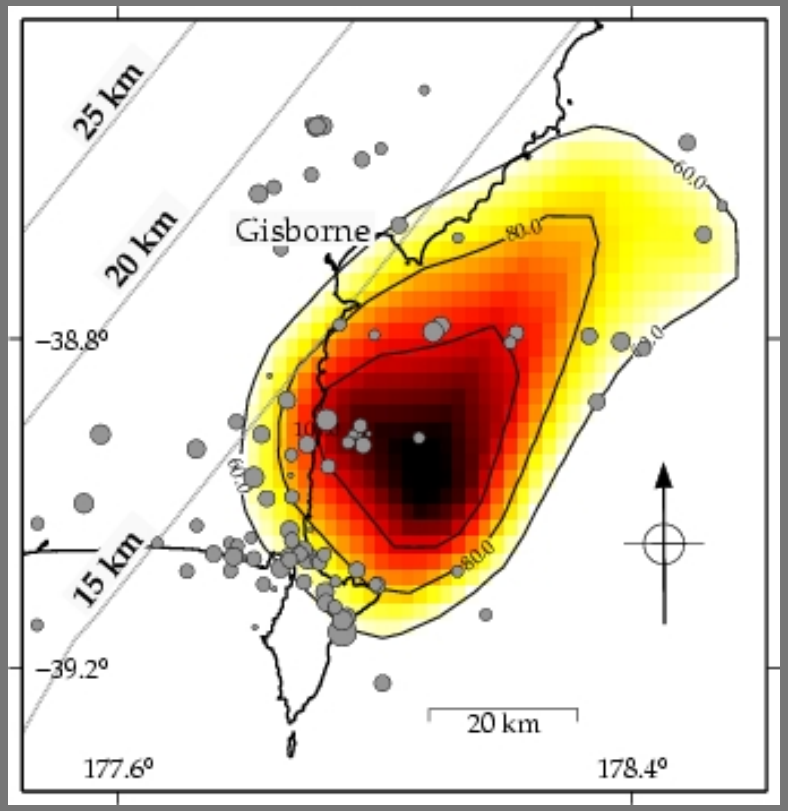
LVS under the HP

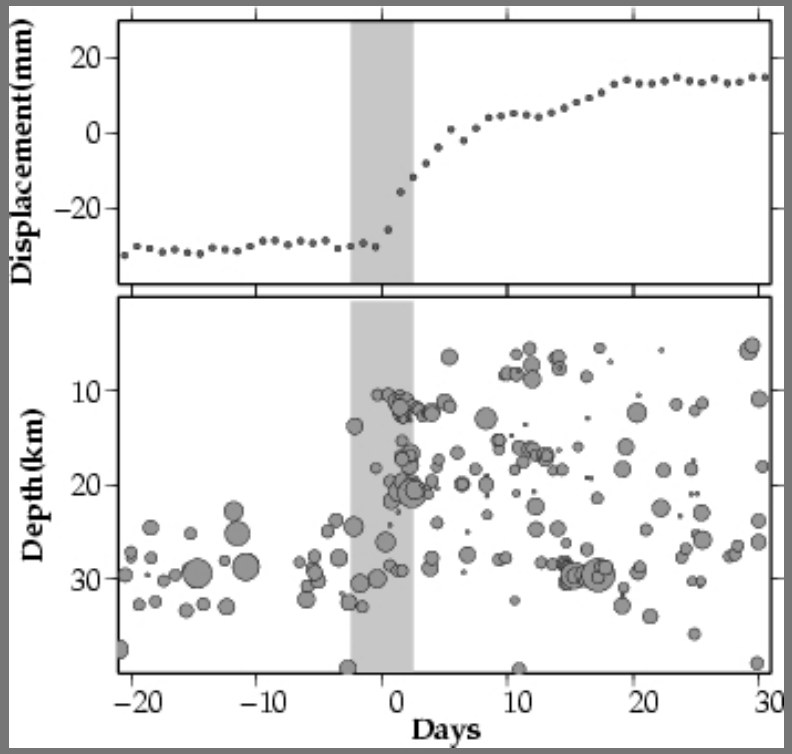


Important questions:

- What is the role of SSE in loading locked megathrust and upper plate faults?
- What is the stress state of the megathrust before, during, and after SSE?
- Can seismicity inform us about physical properties of the interface?
  - Heterogeneous attenuation?
  - Source parameters of interface events?
  - Frequency dependence of seismic observables (anisotropy, Q, Ta, etc)
- Time scales of triggering (or interaction between SSE, tremor, earthquakes, and potential great earthquakes.

Mahia-Gisborne : seismic activity synchronous with 2010-Feb SSE



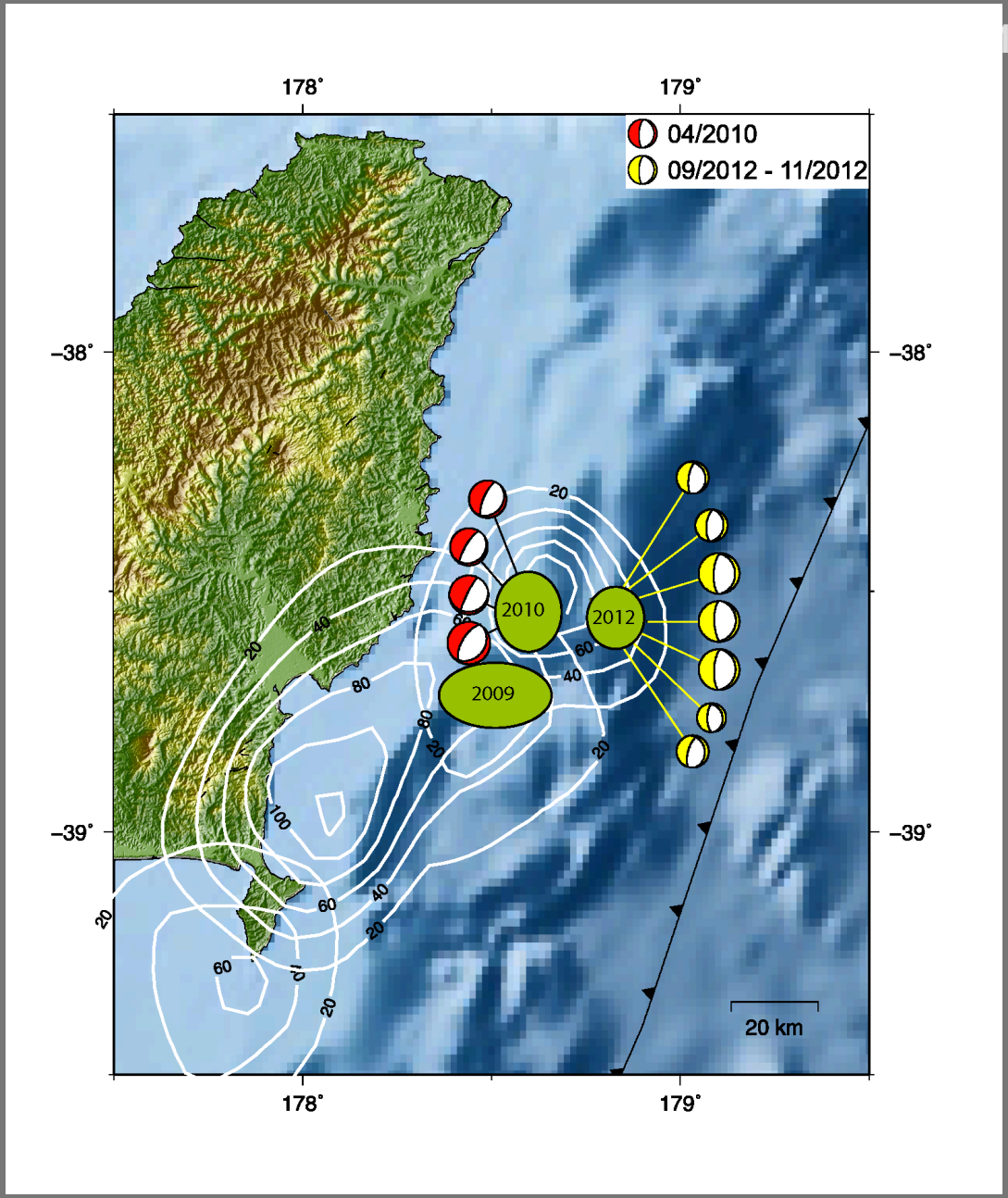


SSE inversion from L. Wallace and seismicity from S. Bannister

Swarms of larger events

Events > M4

Regional moment tensor solutions from J. Ristau



Thoughts:

- Seismic association with SSE includes tremor, micro-, and macro-seismicity
- Some SSE have no obvious associated seismicity, some do
- Shallow nature of plate interface offshore Gisborne yields increased sensitivity of monitoring equipment -> maybe we can "fill-in" the continuum of seismic and aseismic observations with OBS
- Time scales of triggering (or interaction between SSE, tremor, earthquakes, and potential great earthquakes.