Summary of ‘ground-motion modelling’ activities in QC DT1, and alignment with NSHM

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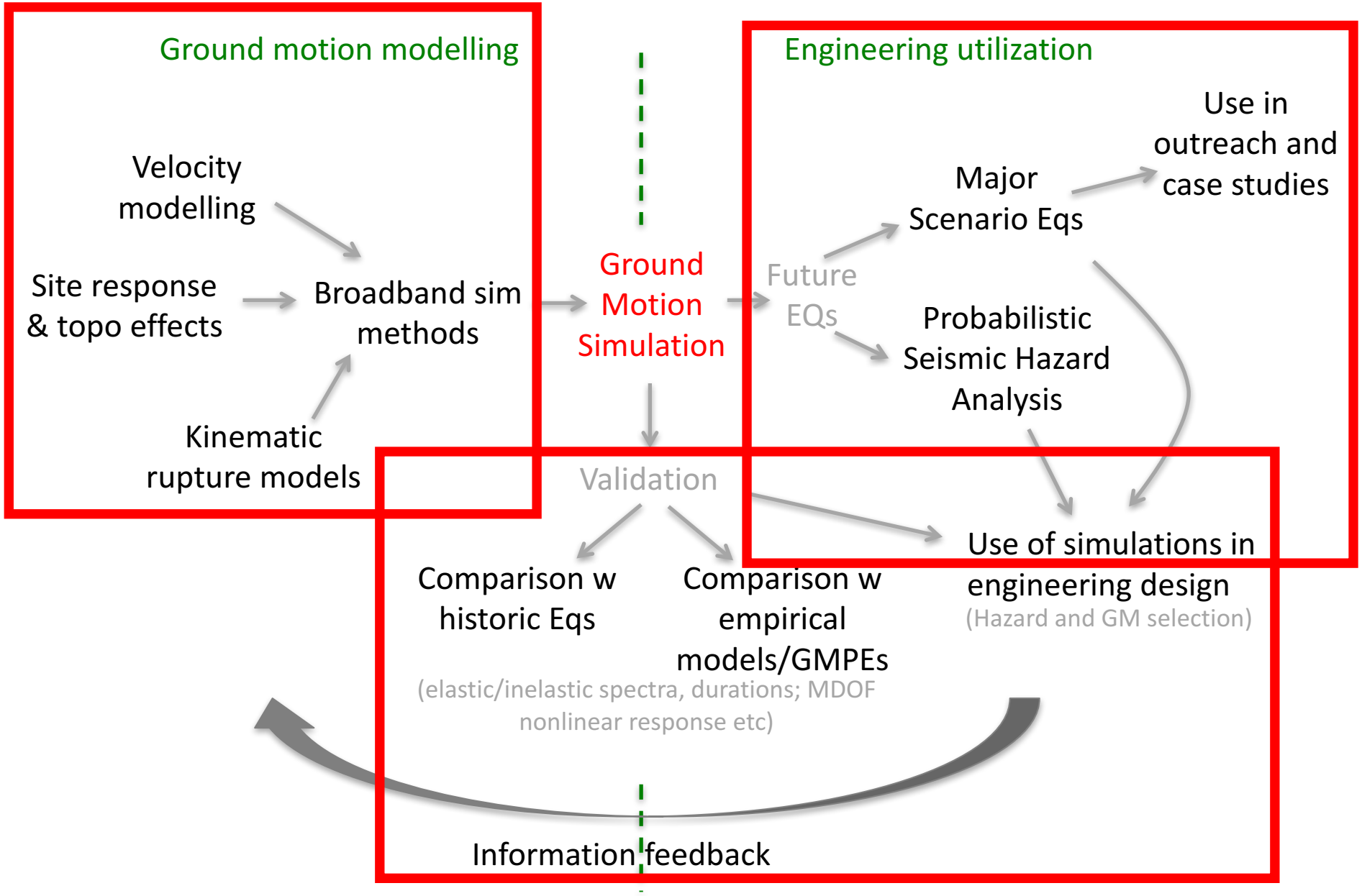
Wellington case study DT1 call

Historical context of DT1 ground-motion strand

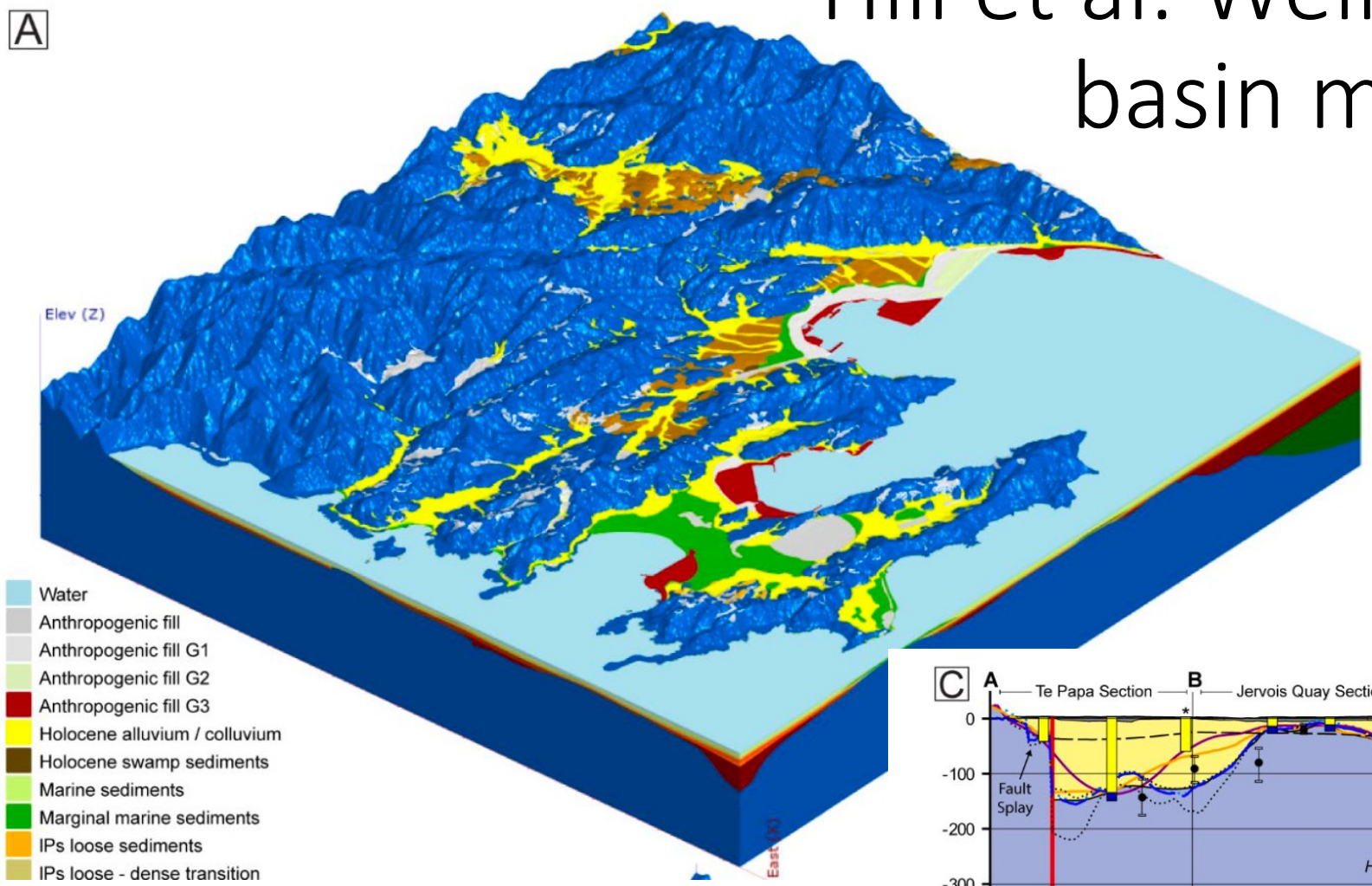
Spectrum of research



Current wellington-specific activities (a non-exhaustive list)

- Velocity/basin model development and site characterization
  - Hill et al. - Wellington basin model iteration
  - Stern et al. - Wellington city gravity and seismic reflection studies
  - de la Torre et al. - Site characterization of Lower Hutt
  - Manea et al. - HVSR analysis at strong motion stations
- Ground motion prediction of historical Wellington events
  - Lee et al. - Ground motion simulations in Wellington to examine sedimentary basin observed response vs. predictions
  - Kaiser et al. - Considerations for Wellington-specific basin modelling in NSHM
  - de la Torre et al. – Residual analysis at Wellington strong motion stations
- Future events in Wellington
  - Dupuis et al. – Ground-motion simulation of Hikurangi subduction events

Hill et al. Wellington sedimentary basin model update (2022)



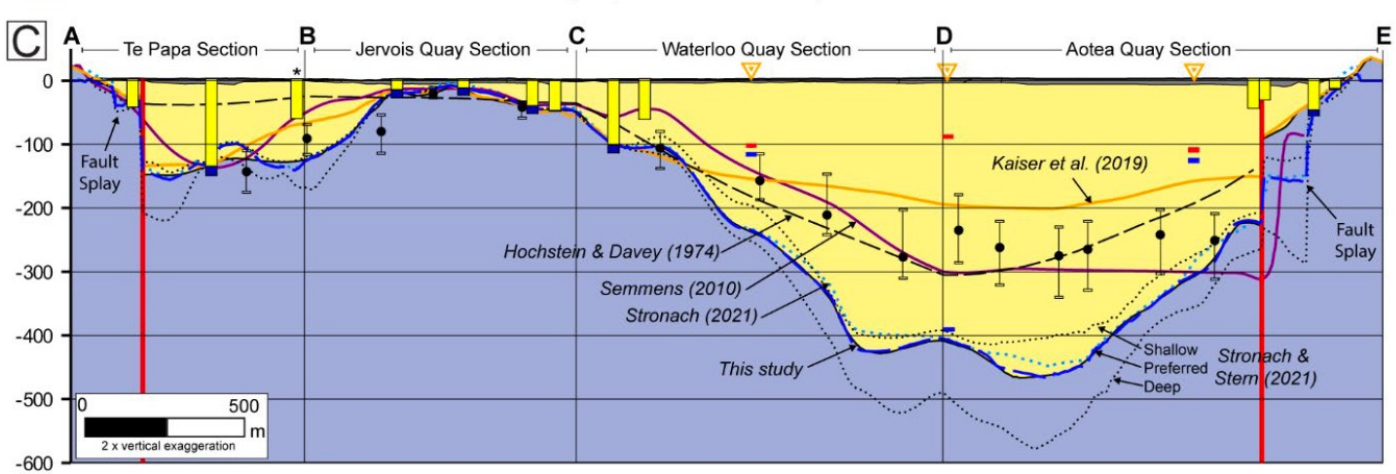
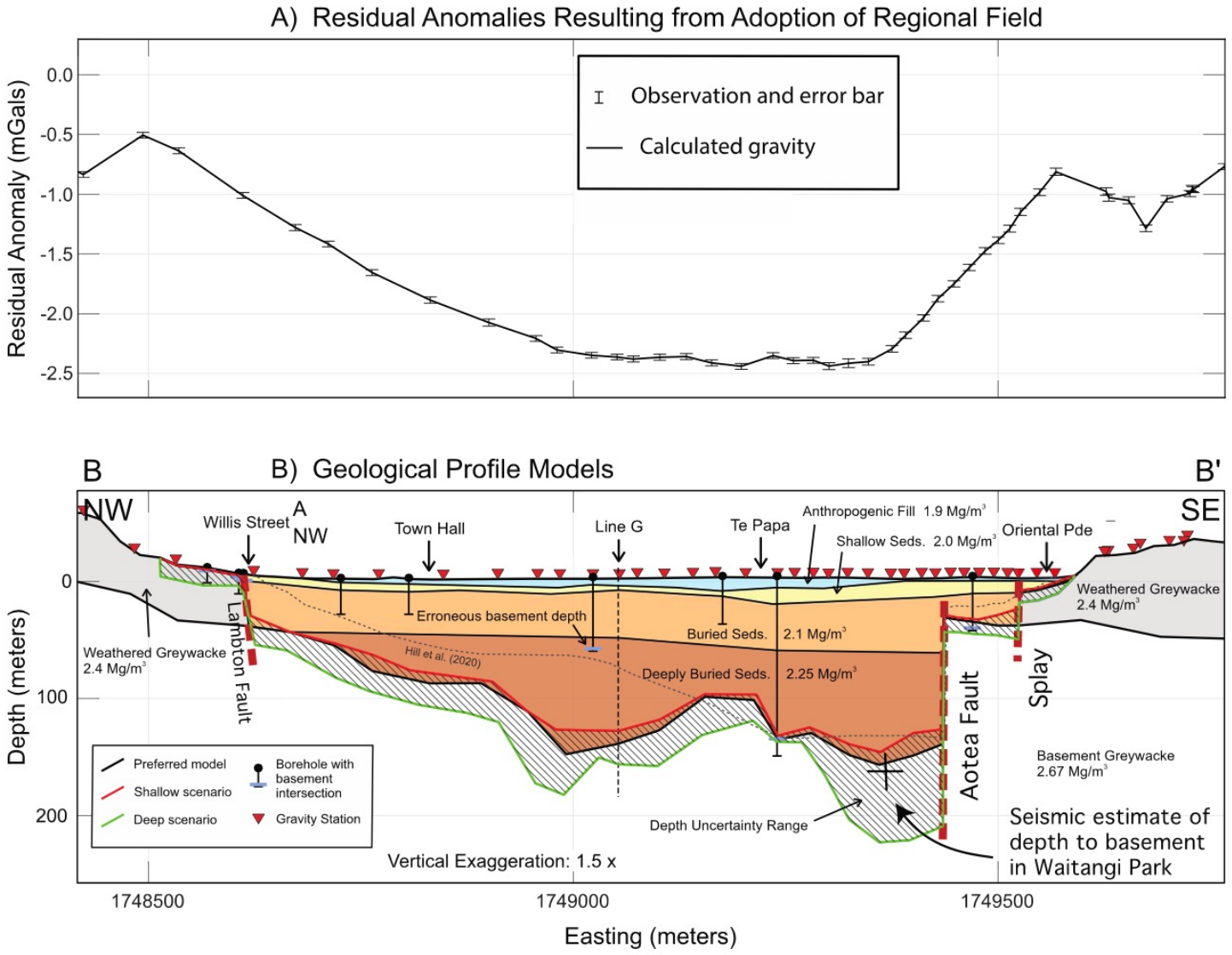


Figure 4.15 Cross-section of basement surface interpretations. (A) Map of cross-section trace through the

Stern et al. Wellington basin gravity and seismic reflection studies



2019 Wellington Basin model
(Kaiser et al., 2019)

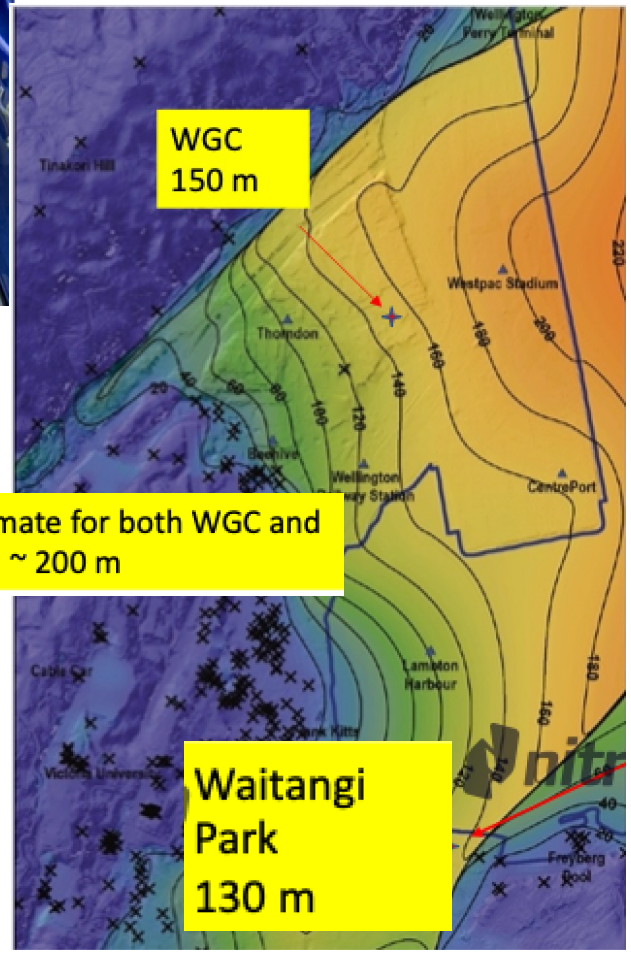


Figure 2: Line B (Figure 1 C) residual anomalies and profile model. A) Observed residual anomalies and

de la Torre et al. Lower hutt basin characterisation

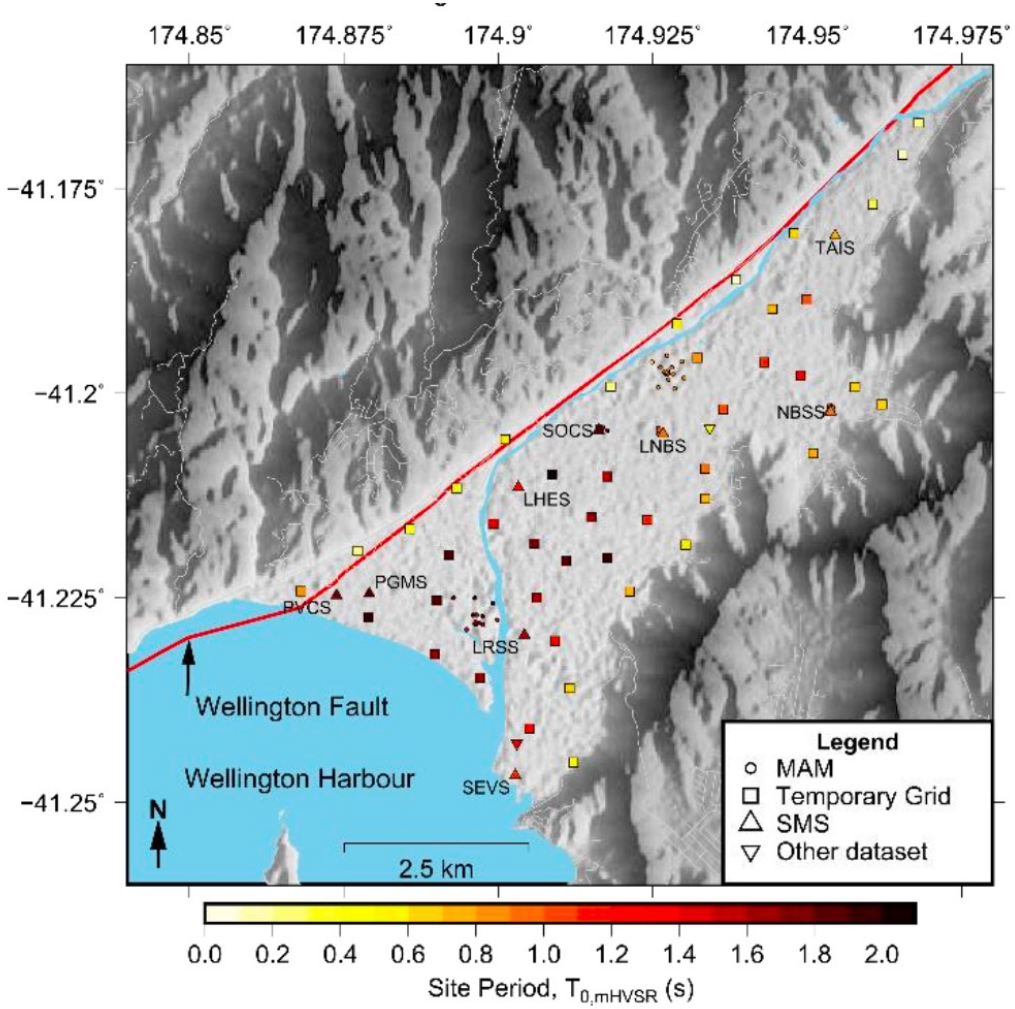


Fig. 1. Map of the Lower Hutt region showing the location of all microtremor field measurements for hSSR, mHVSR, and MAM. The nine reference SMS used for the hSSR method are labeled.

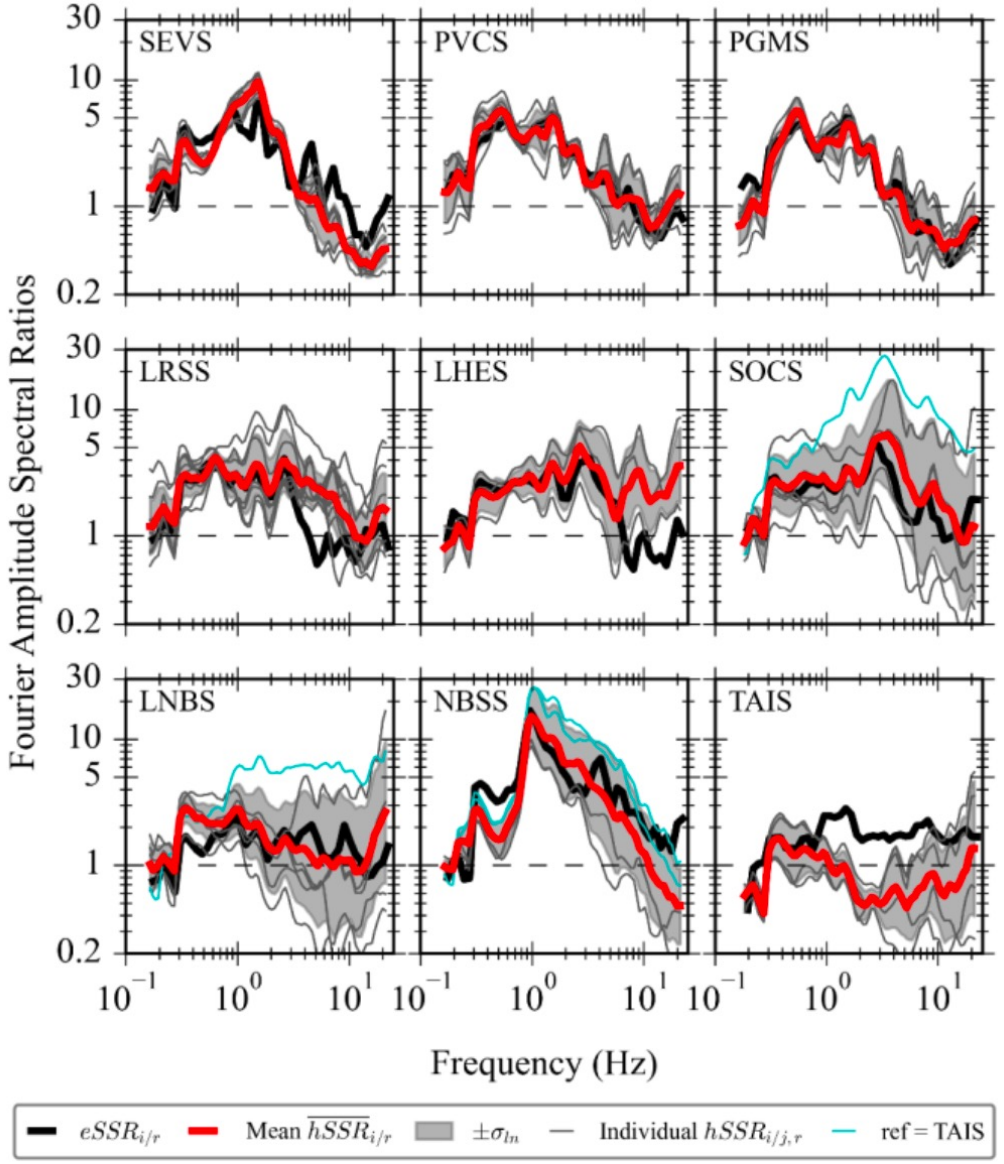
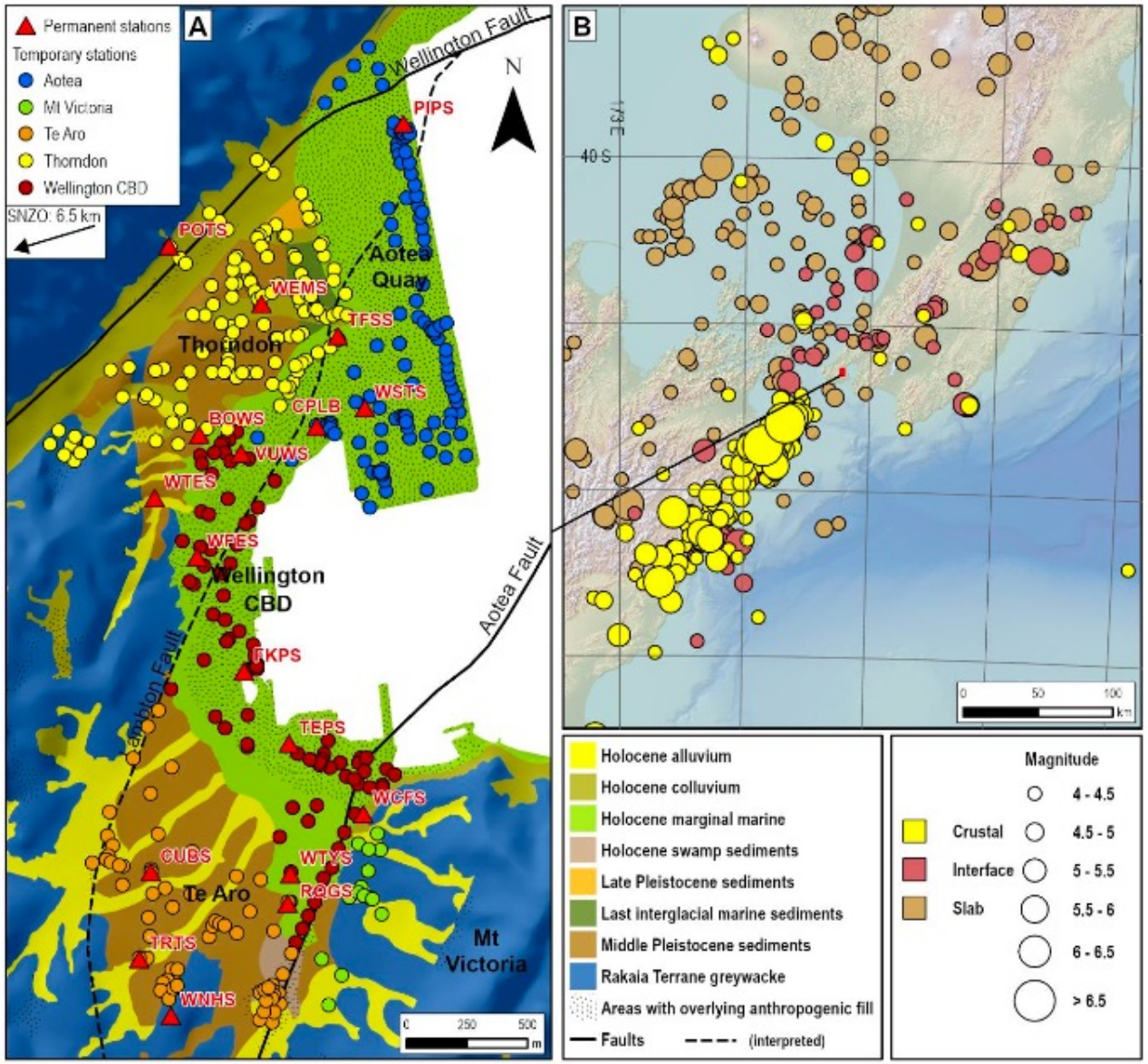
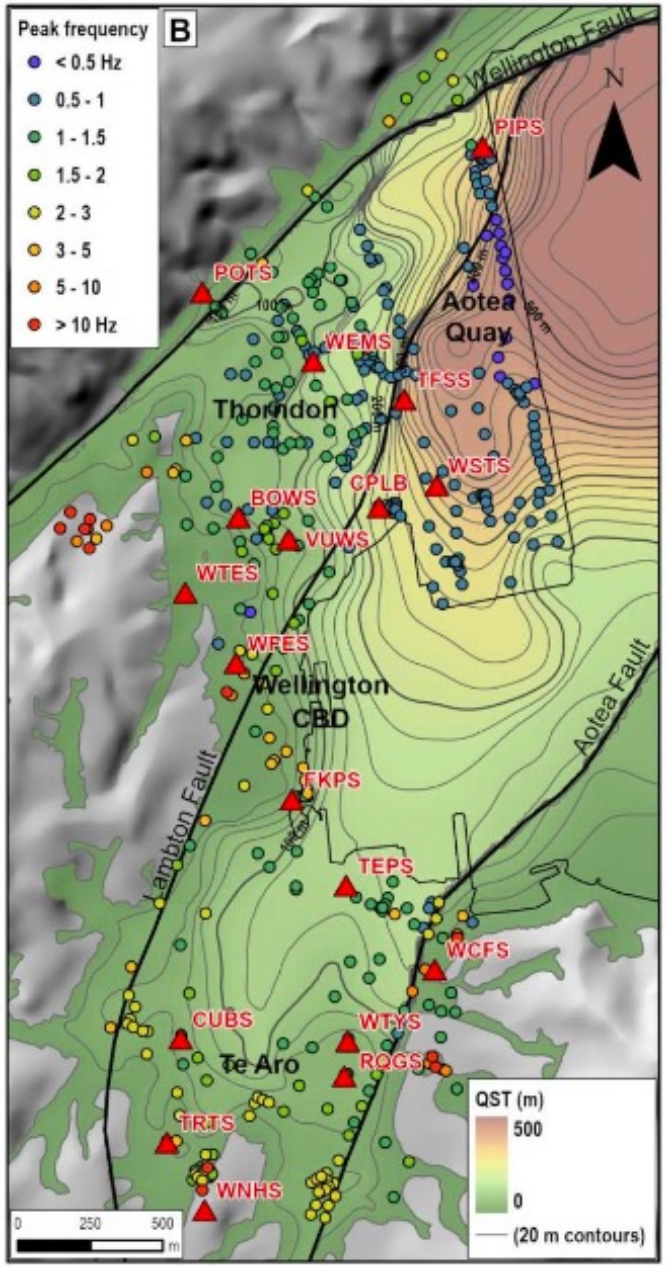


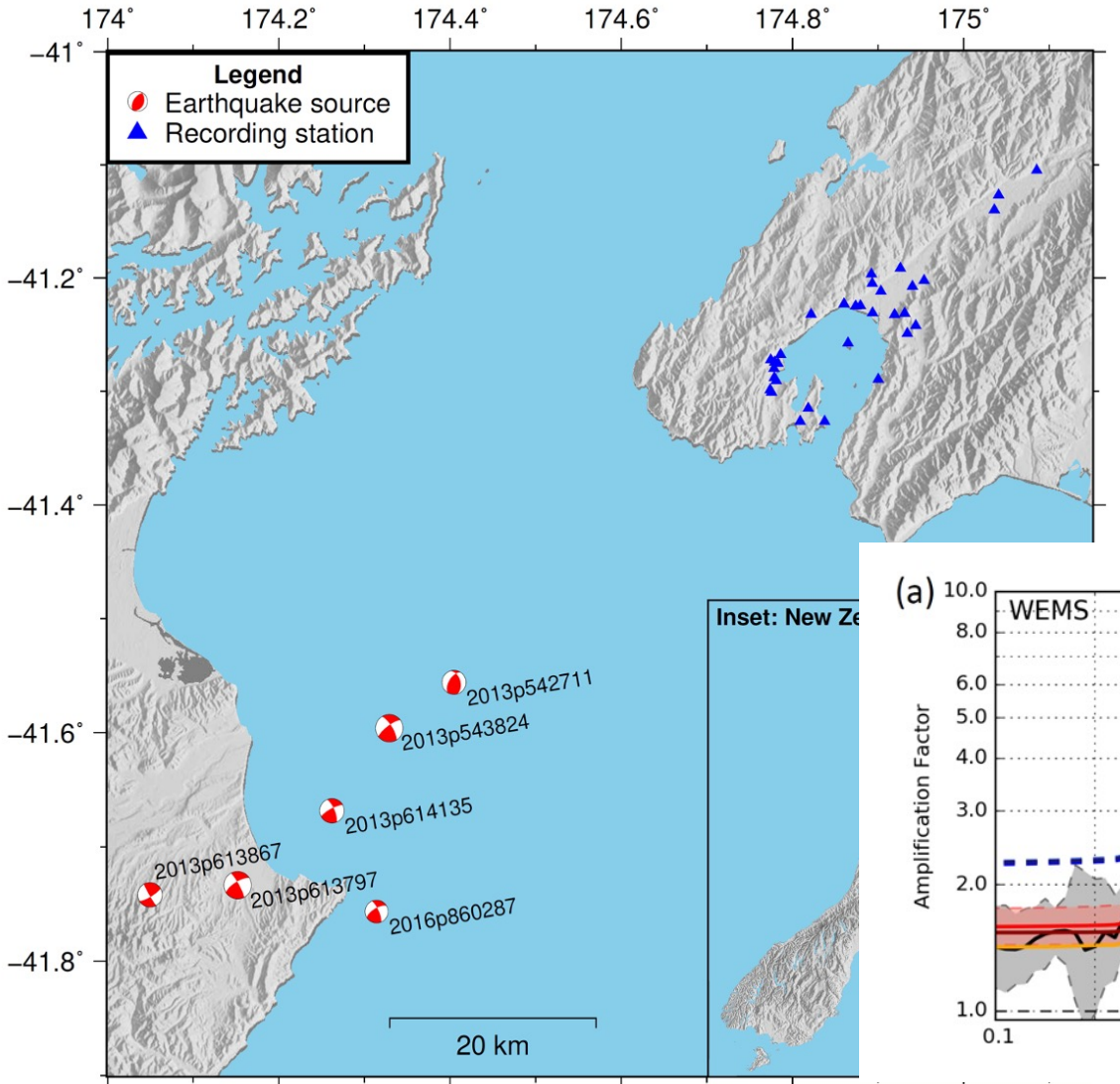
Fig. 5. Validation of predicted hSSR with observed eSSR for all SMS used as reference basin sites. All results are for synchronized data. Each grey line corresponds to an individual reference site *j*. Subplots are ordered from top left to bottom right in increasing distance from the harbor waterfront.

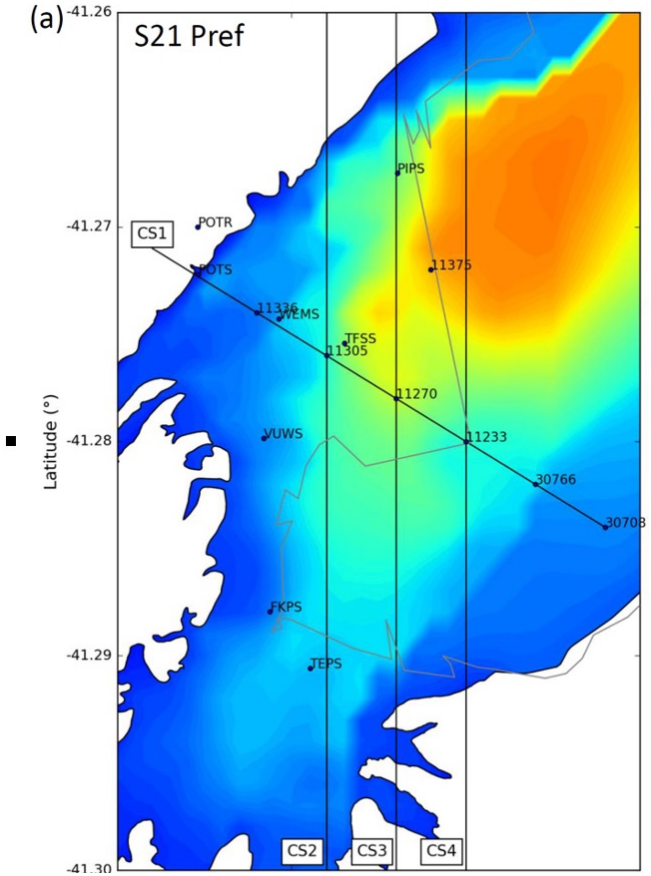
Manea et al. HVSR analysis of Wellington stations

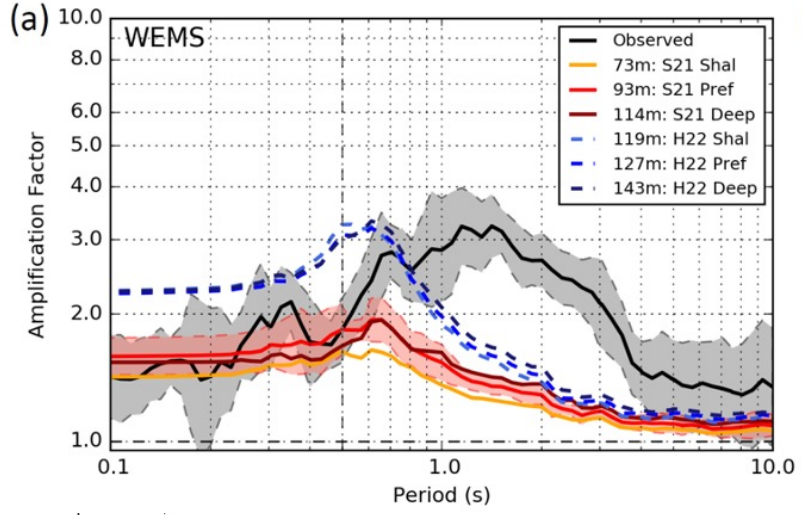


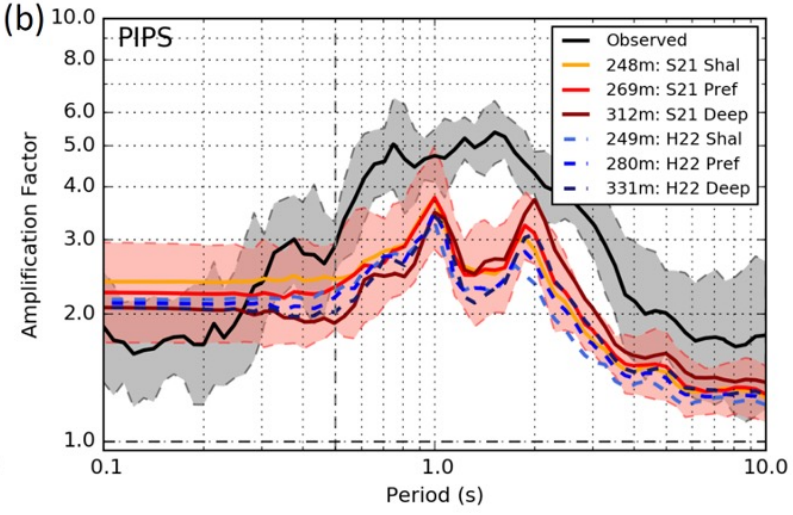


Lee et al. Simulation of Wellington basin response vs. observations

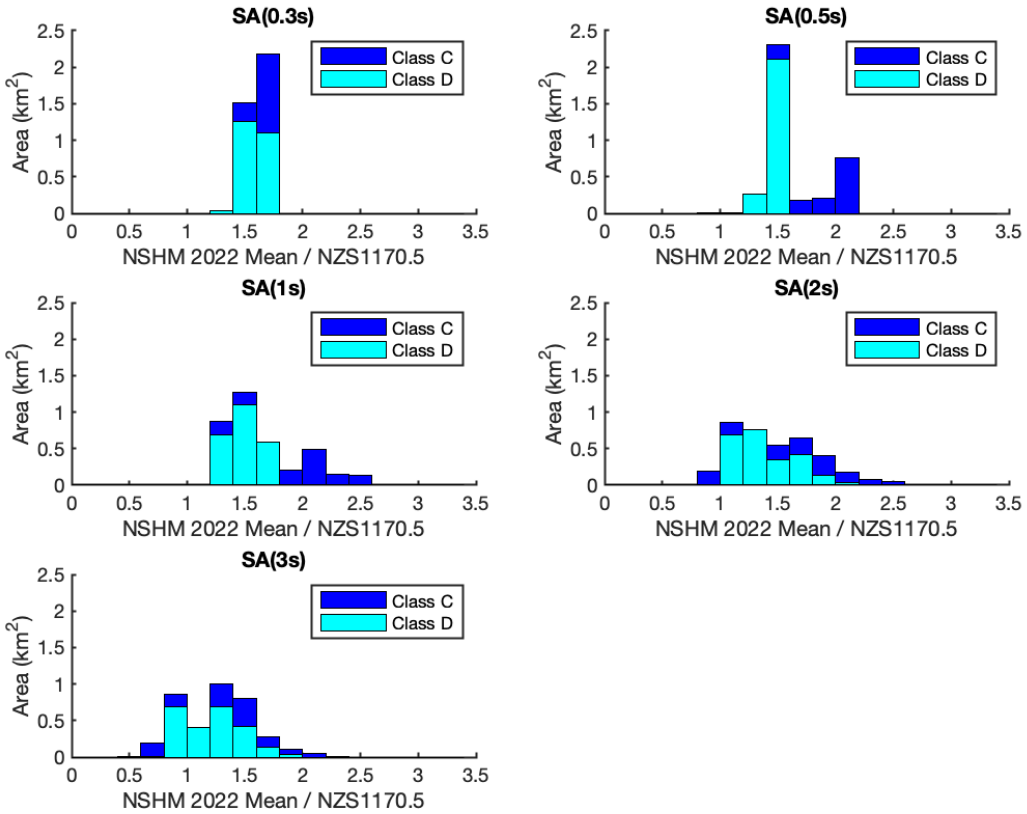


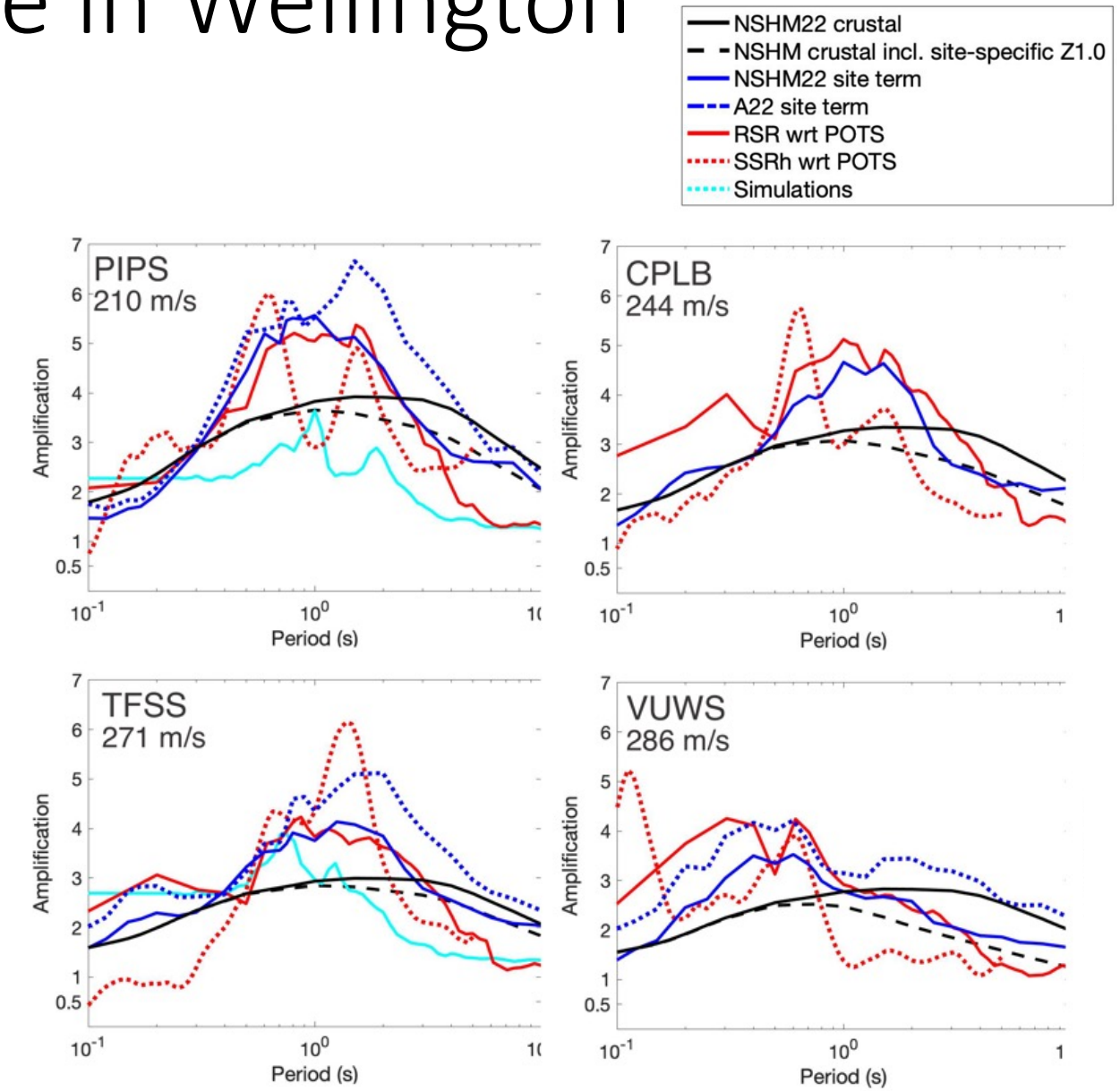






Kaiser et al. Considerations for incorporating sedimentary basin response in Wellington





de la Torre et al. Residual analysis of Wellington site response

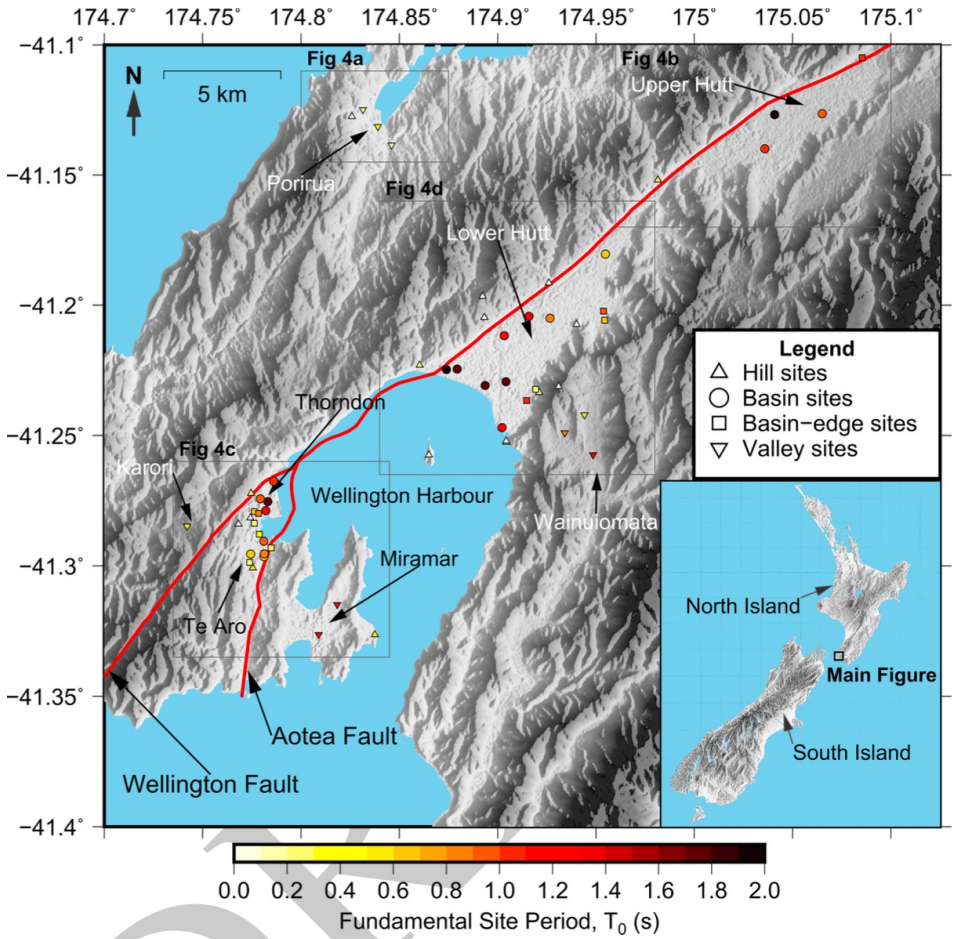


Figure 3. A map showing the location of all sites in the greater Wellington region. Site symbols are color-coded by T_0 and the symbol shape indicates the geomorphic category assigned to each site as indicated in the legend.

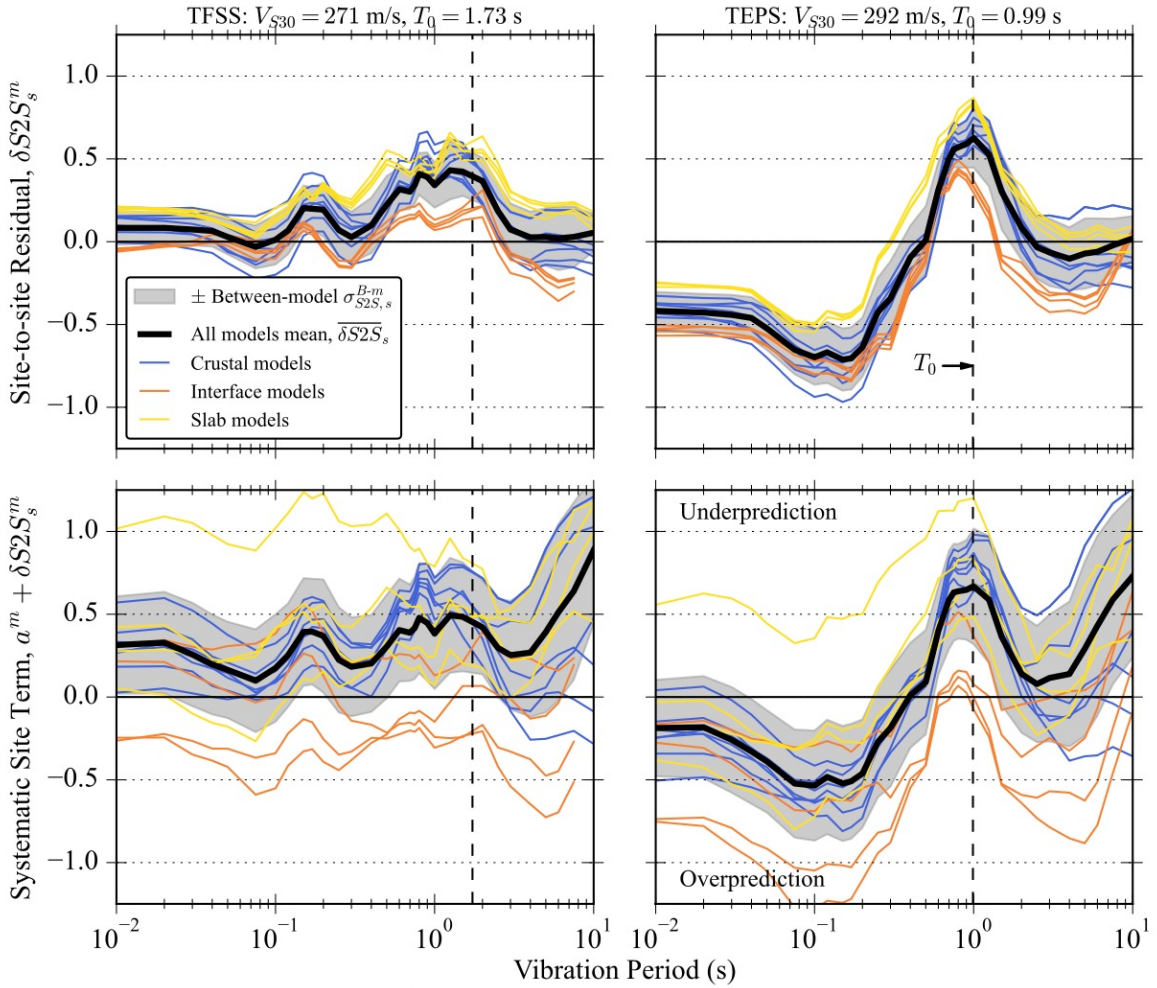
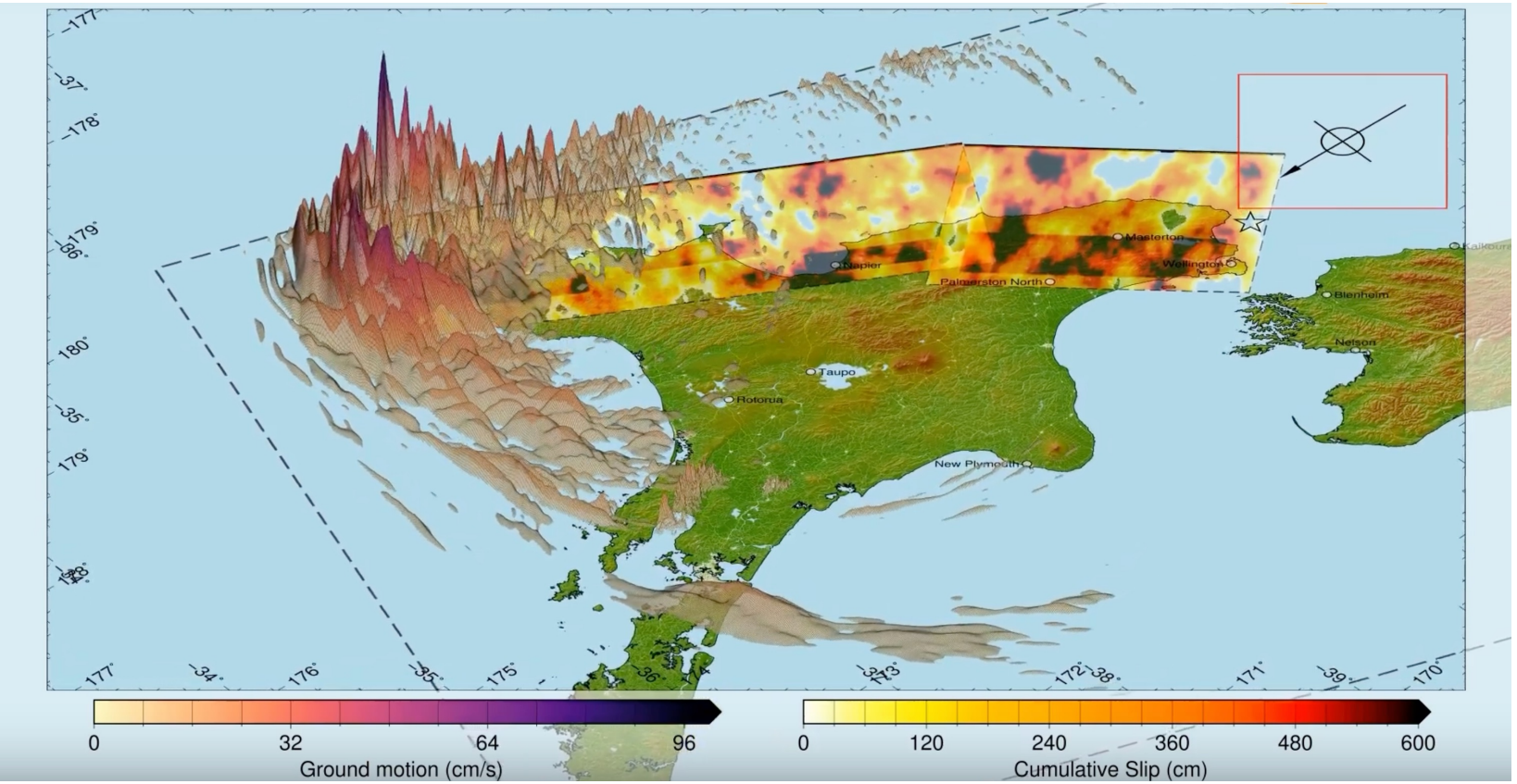


Figure 5. Site-to-site residuals, $\delta S2S_s^m$ (top panels), and systematic site terms, $a + \delta S2S_s^m$ (bottom panels), as a function of period for two example basin sites in the Wellington region. For each site, $\delta S2S_s^m$ from individual GMMs are included as well as the weighted mean ($\overline{\delta S2S}_s$) and standard deviation ($\sigma_{S2S,s}^{B\text{-}m}$) of all GMMs from Equations 6 and 7. Lines for individual GMMs are color-coded by tectonic type (i.e., crustal, interface, and slab).



Dupuis et al. Hikurangi subduction ground motion simulations

Table 4. Rupture characteristics to be investigated in sensitivity studies of multiple rupture scenarios where depths are relative to top of rupture as a percentage of rupture width, W, and positions are relative to the centre of the top of rupture as a percentage of rupture length, L.

	Property	Median	Lower Limit	Upper Limit
Subevents	Along-strike position	Mid-strike	-10% L	+10% L
	Along-dip depth	75% W	65% W	85% W
	Magnitude, M_w	7.9	7.7	8.1
Hypocentre	Along-strike position	Mid-strike	-50% AS	+50% AS
	Along-dip depth	60% W	0% W	100% W
Rupture	Rupture velocity (% of V_s)	75%	60%	90%
	Stress parameter (bar)	10+1.25D	5+0.625D	15+1.875D

Currently considering up to ~2000 model combinations for rupture scenarios.

Questions ?