Developing site-specific high-frequency simulation componentary

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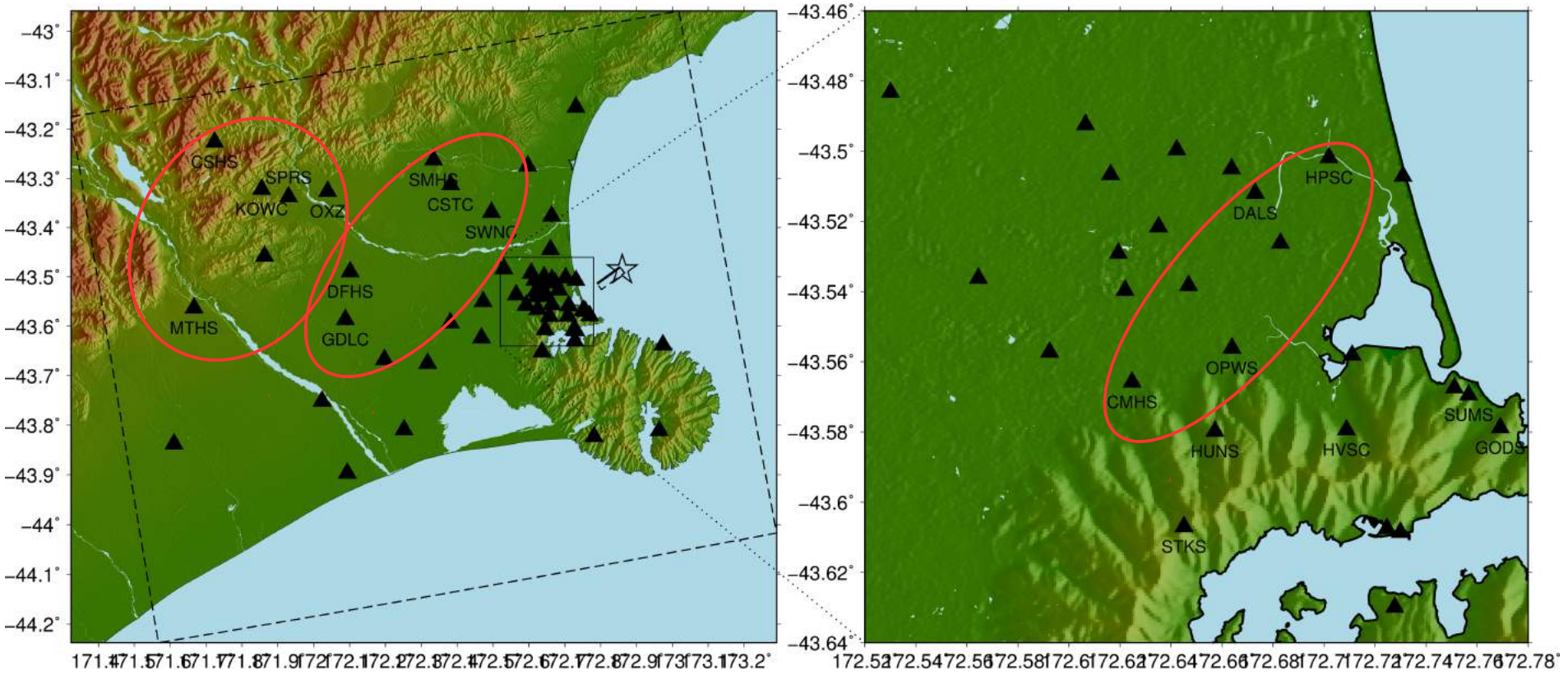
Introduction

- $A(M_0, R, f) = S(M_0, f) * P(R, f) * G(f)$

  [Boore, 2003; Graves and Pitarka, (2010, 2016)]

- Use site-specific profiles instead of generic profile.
- Using different profiles affect path and site terms.
- First objective: How site-specific profiles affect site or path or site+path terms and consequently ground-motions.
- Second objective: Apply site-specific method to different earthquakes e.g. 2016 Valentine EQ, 2011 Christchurch EQ, 2010 Darfield EQ.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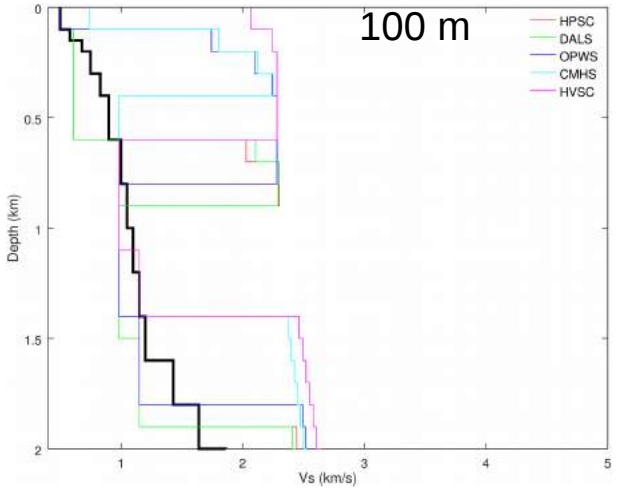
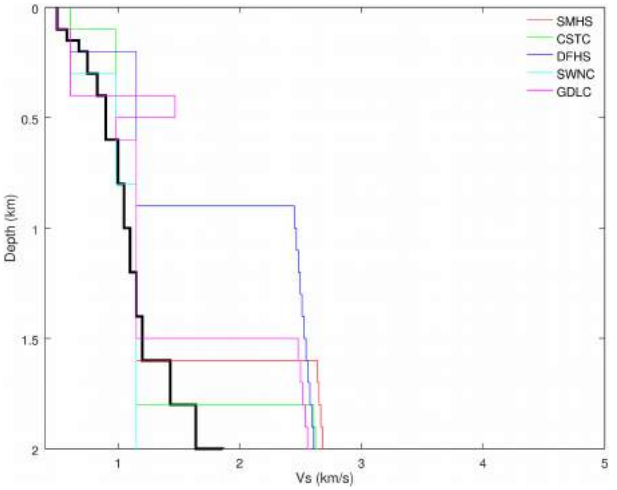
SPRS
KOWC
OXZ
SMHS
CSTC
SWNC
DFHS
MTHS
GDLC
HPSC
DALS
OPWS
CMHS
SUMS
HUNS
HVSC
GODS
STKS

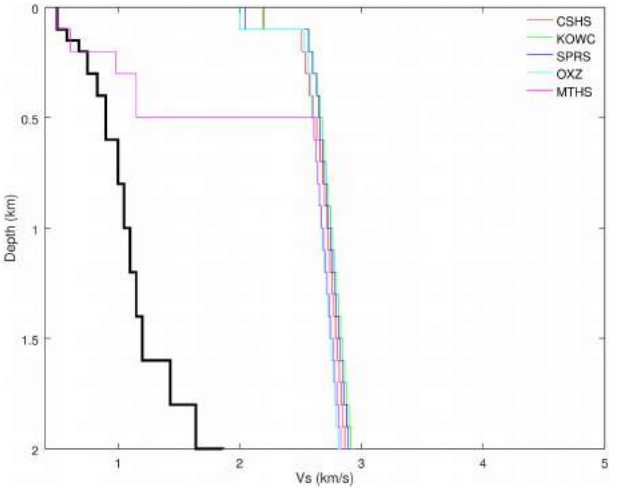
Port Hill

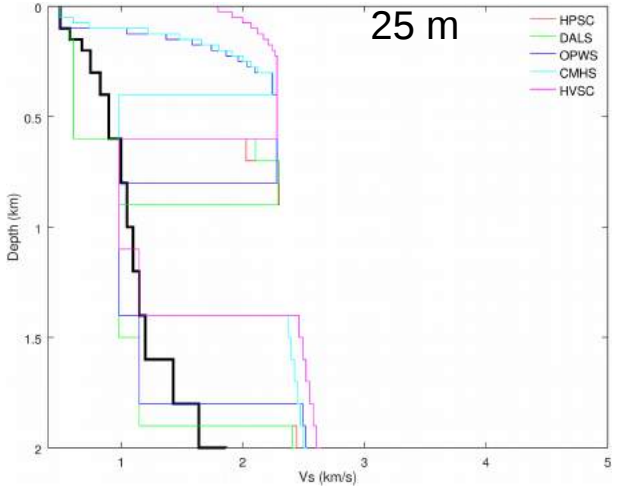
Basin

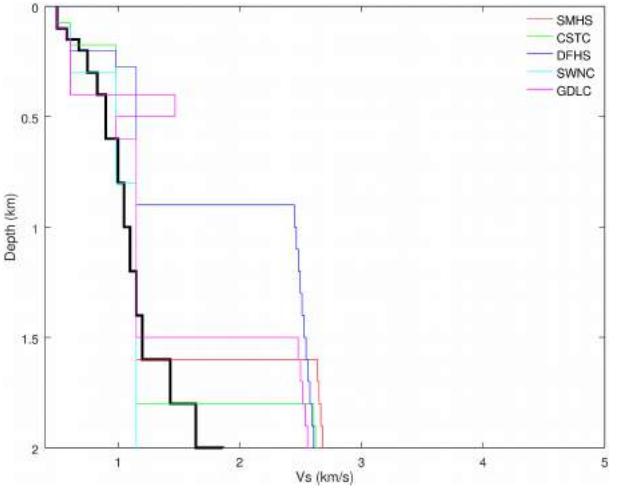
Canterbury Foot Hill

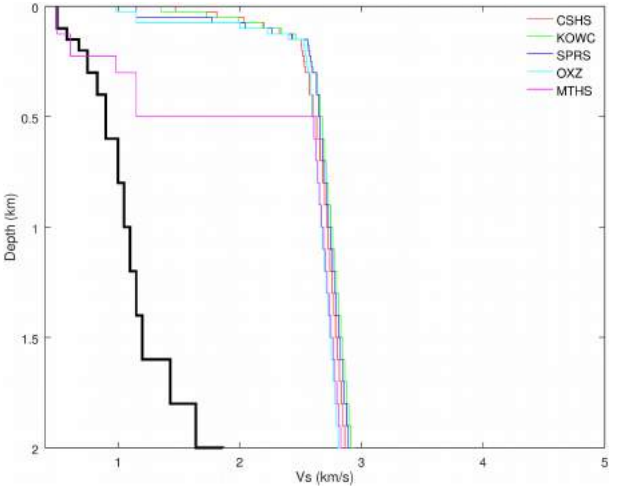












Site term

$$G(f) = A(f) * D(f)$$

[Boore, 2003]

- A(f) is computed using “quarter wavelength theory”.

  A(f) = Square root of ratio of source to site impedences.

  [Boore and Joyner, 1997]

- D(f) = exp(-pi * k * f)

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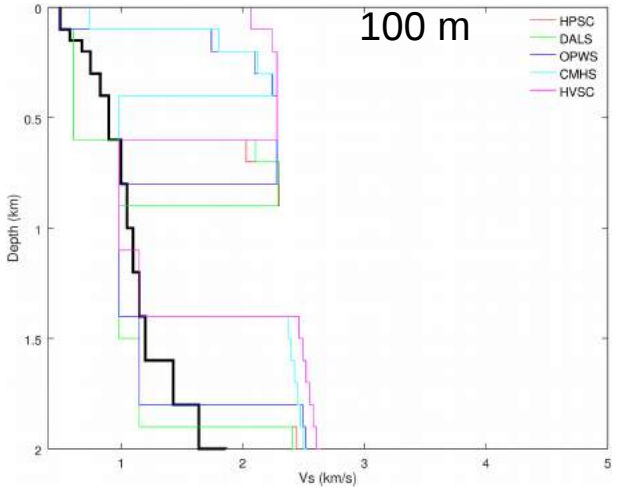

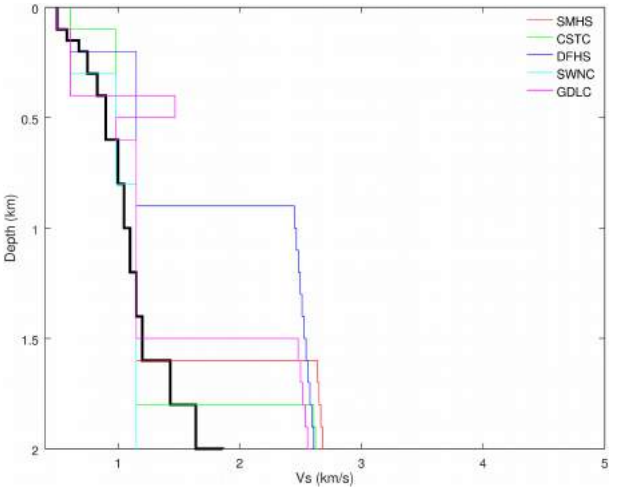

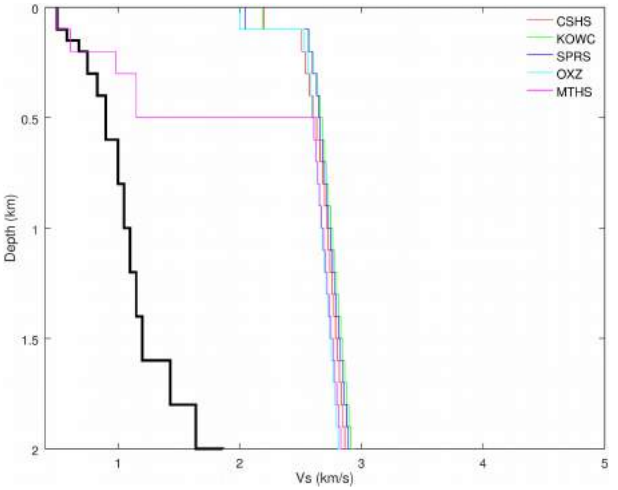

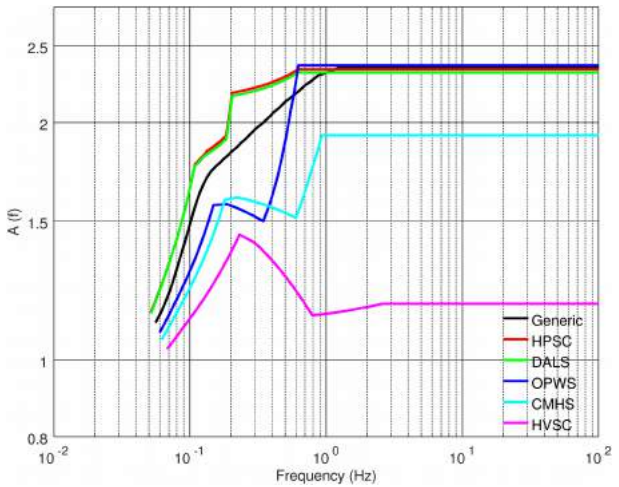

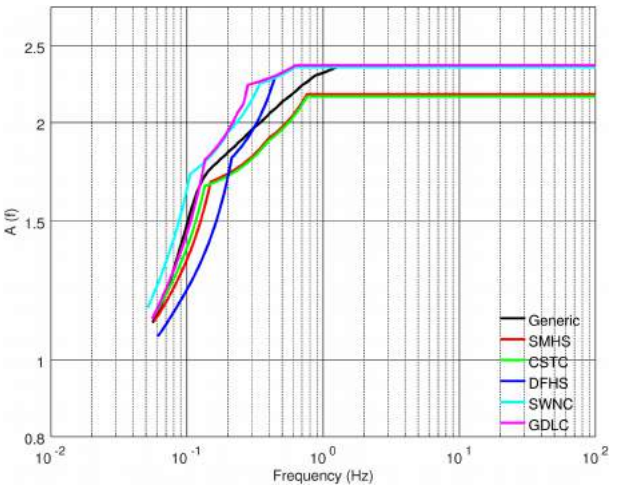

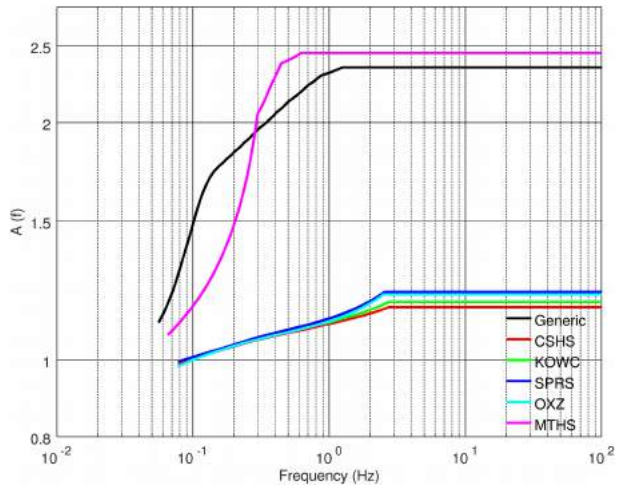

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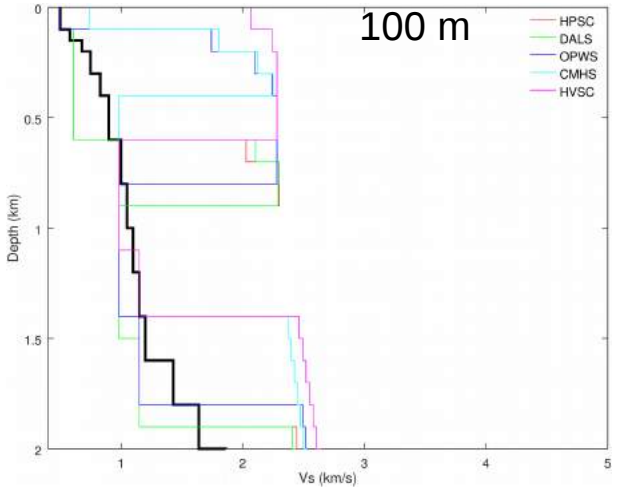
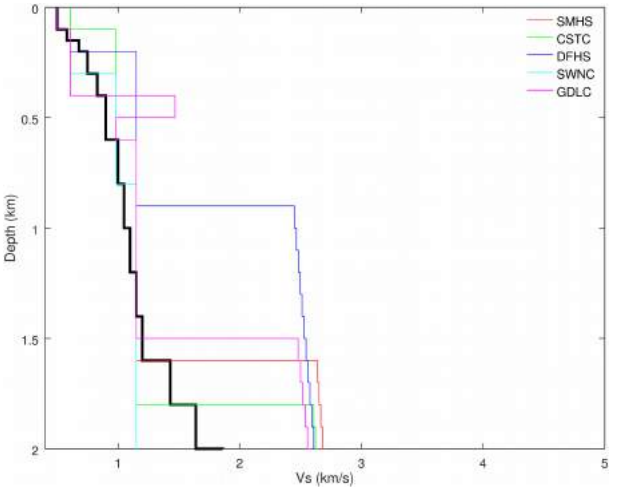
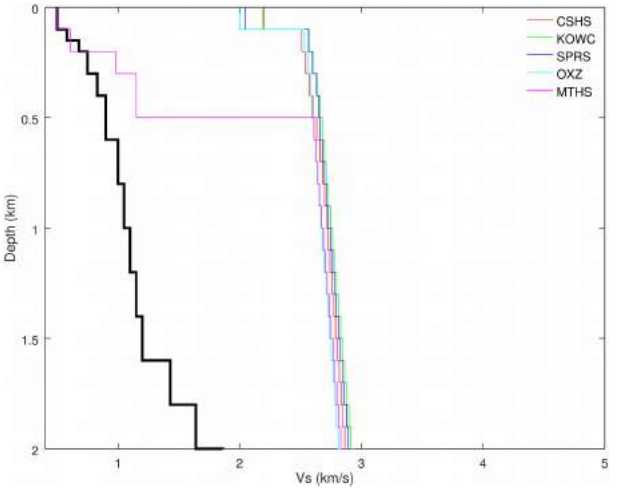
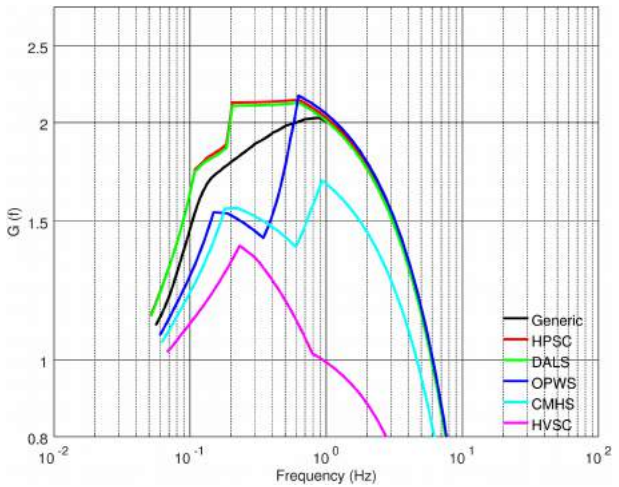
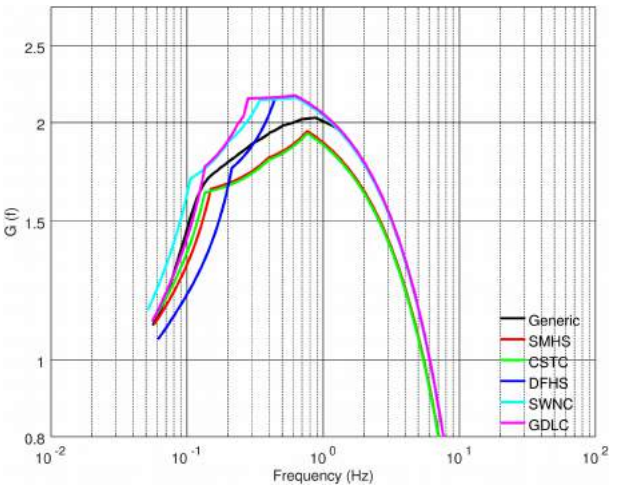
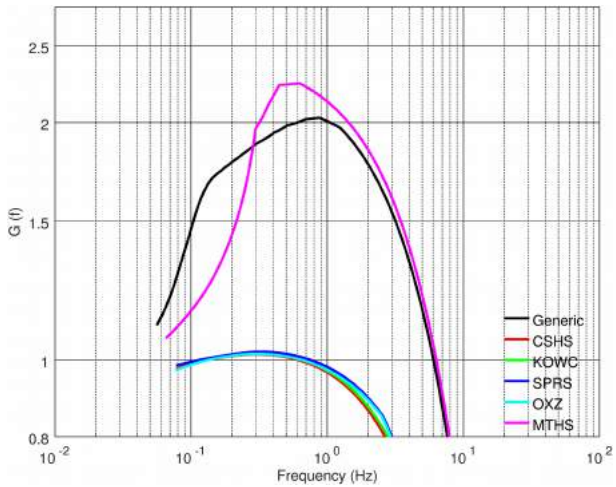


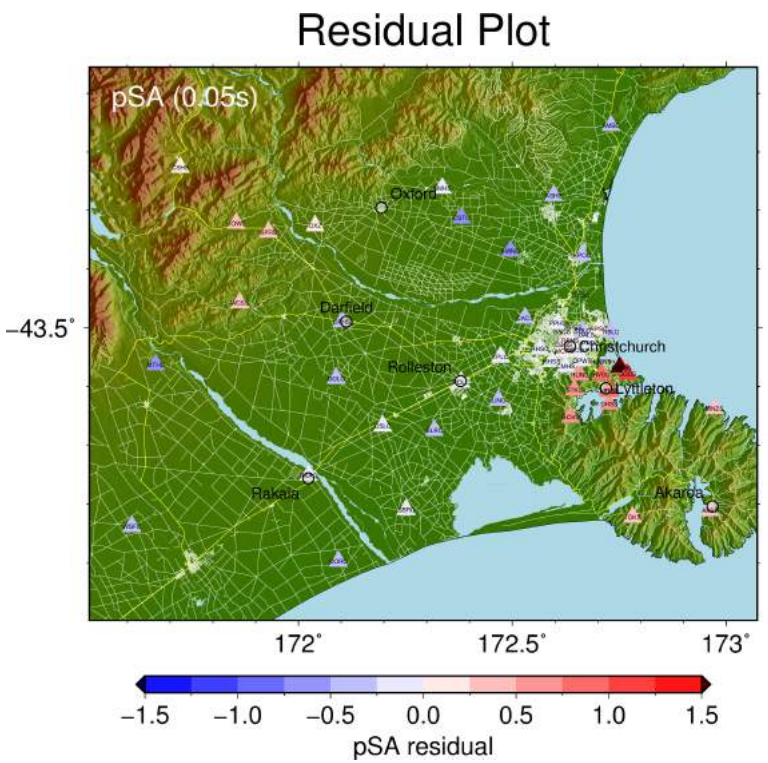


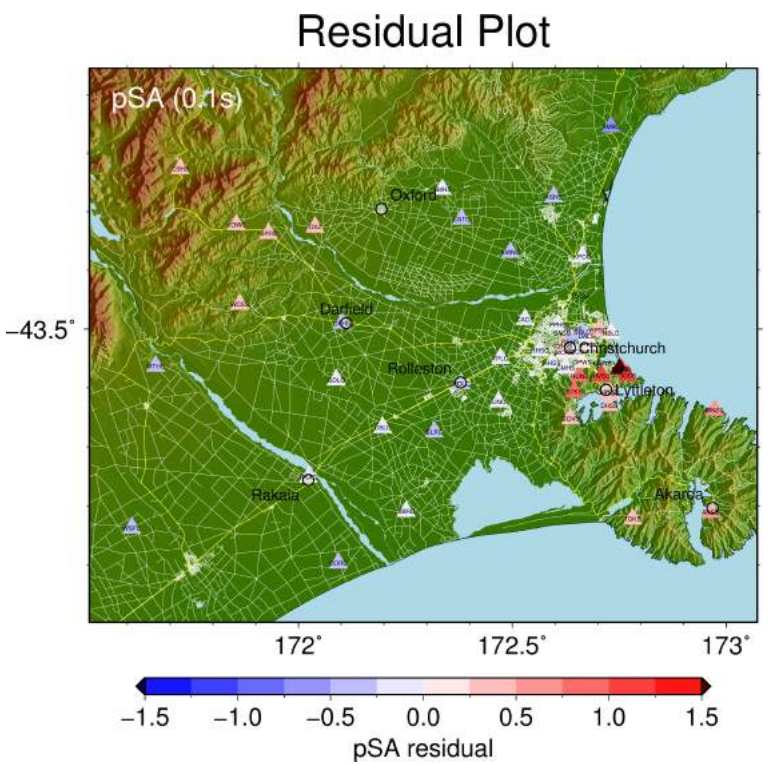









Residual Plot
pSA (0.05s)
Oxford
Darfield
Christchurch
Rolleston
Lyttleton
Rakaia
Akaroa
−43.5°
172°
172.5°
173°
−1.5 −1.0 −0.5 0.0 0.5 1.0 1.5
pSA residual


Residual Plot
pSA (0.1s)
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Darfield
Christchurch
Rolleston
Lyttleton
Rakaia
Akaroa
−43.5°
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173°
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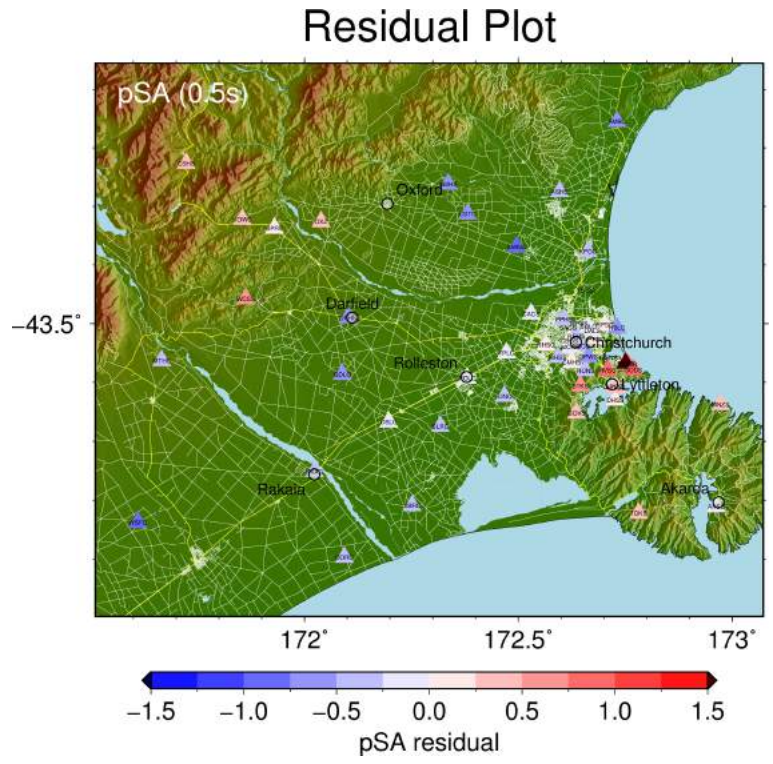
pSA residual


Residual Plot
pSA (0.5s)
Oxford
Darfield
Christchurch
Rolleston
Lyttleton
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−43.5°
172°
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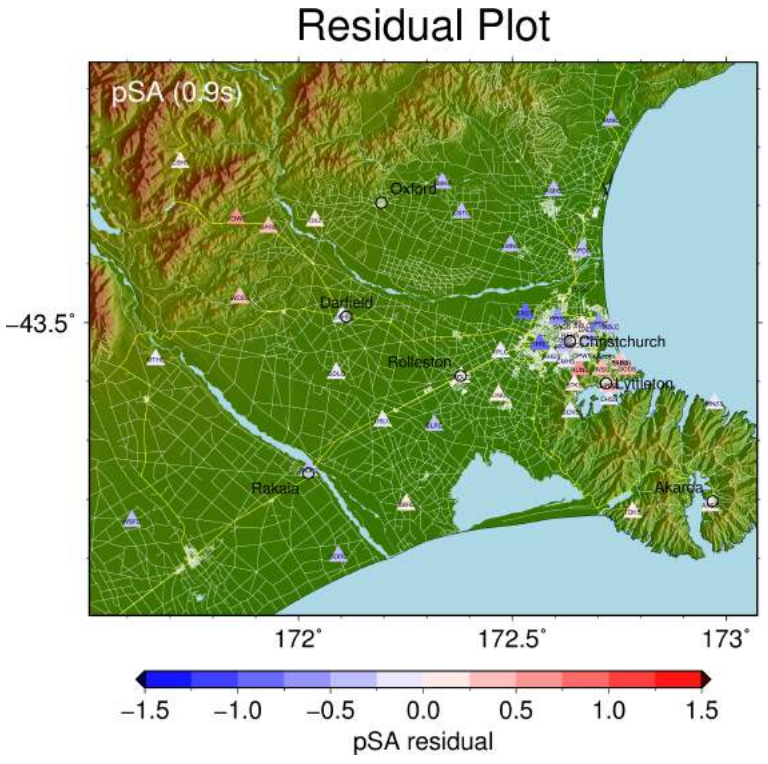
pSA residual


Residual Plot
pSA (0.9s)
Oxford
Darfield
Christchurch
Rolleston
Lyttleton
Rakaia
Akaroa
−43.5°
172°
172.5°
173°
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pSA residual

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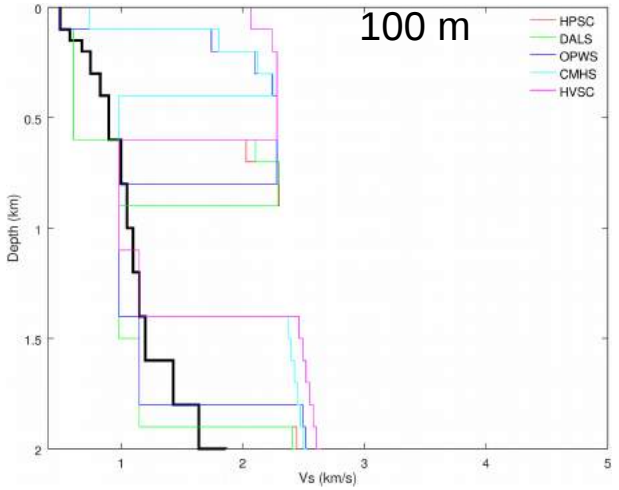

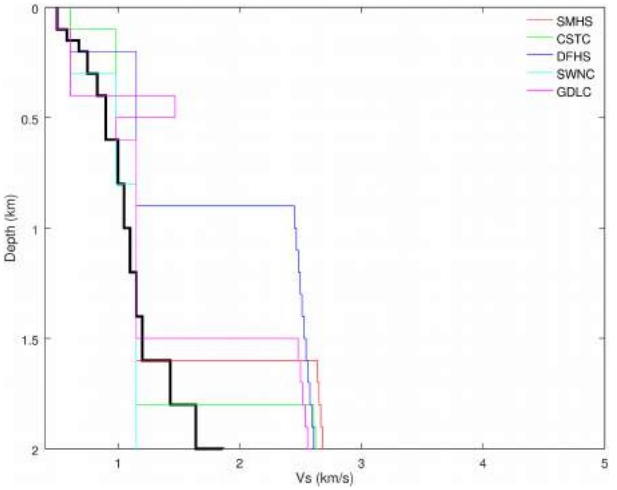

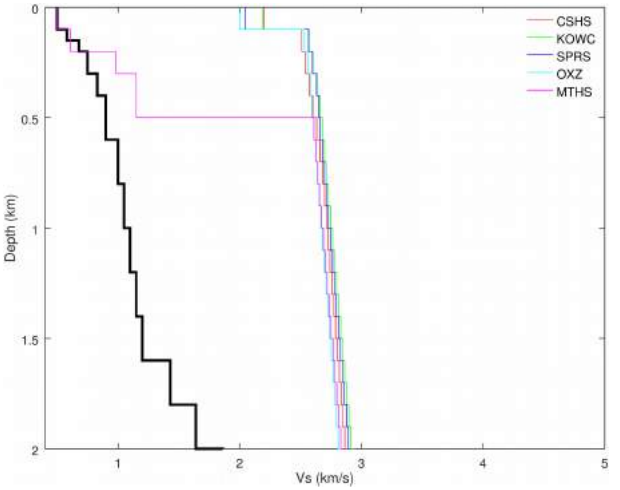

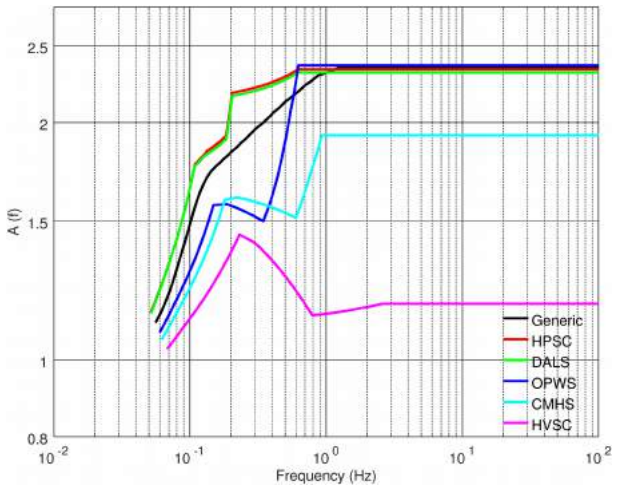

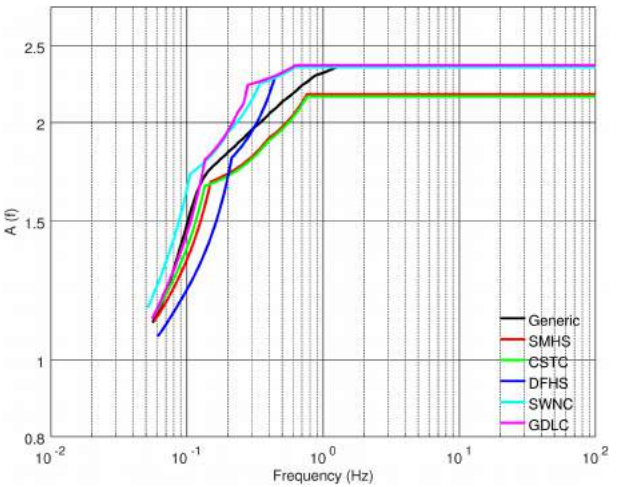

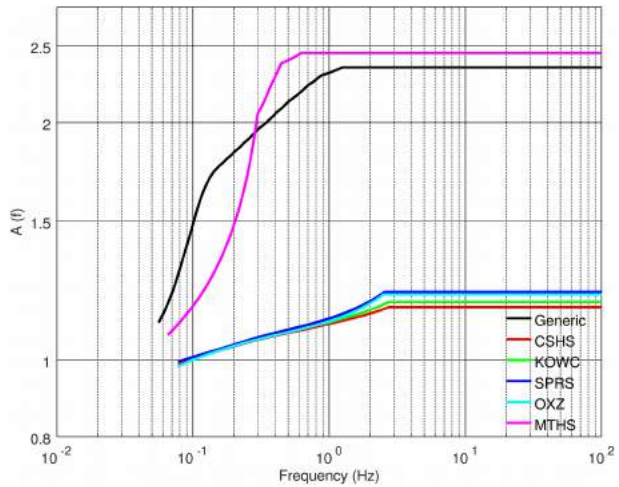

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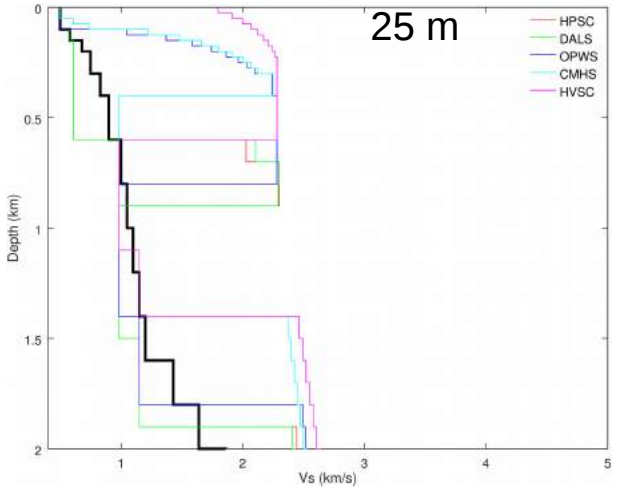
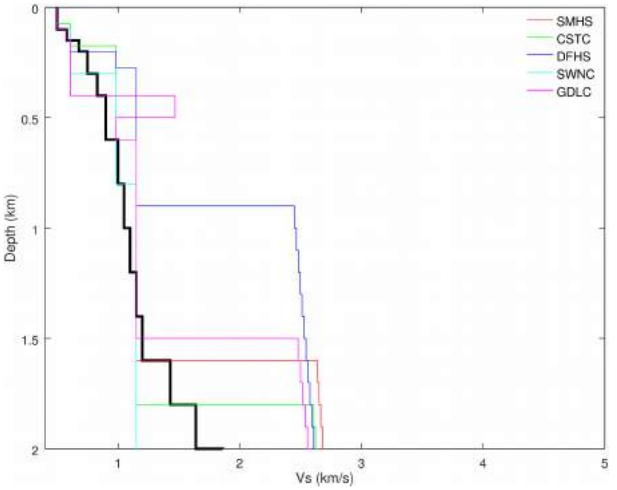
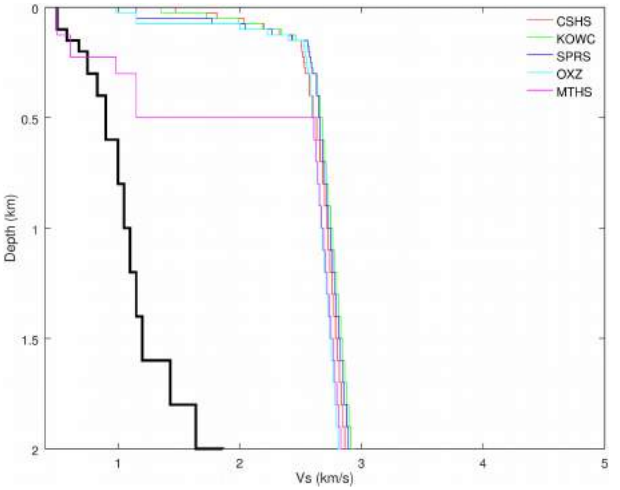
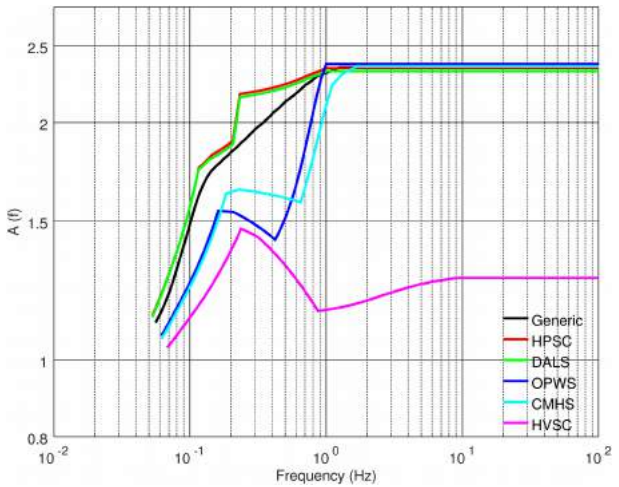
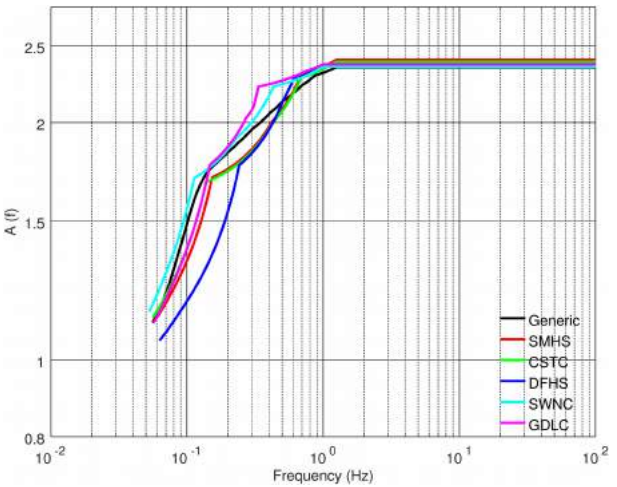
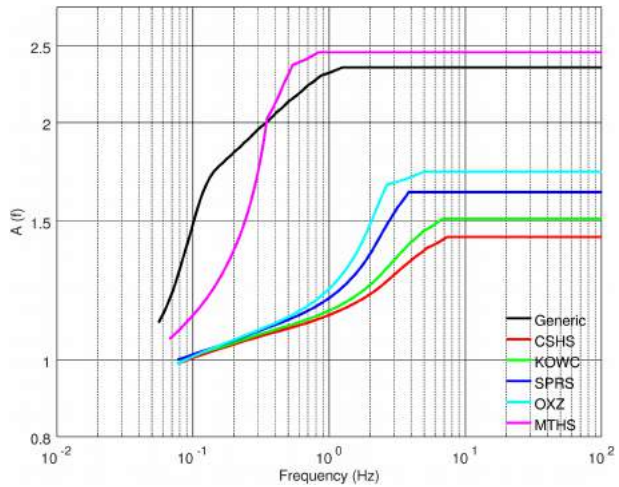




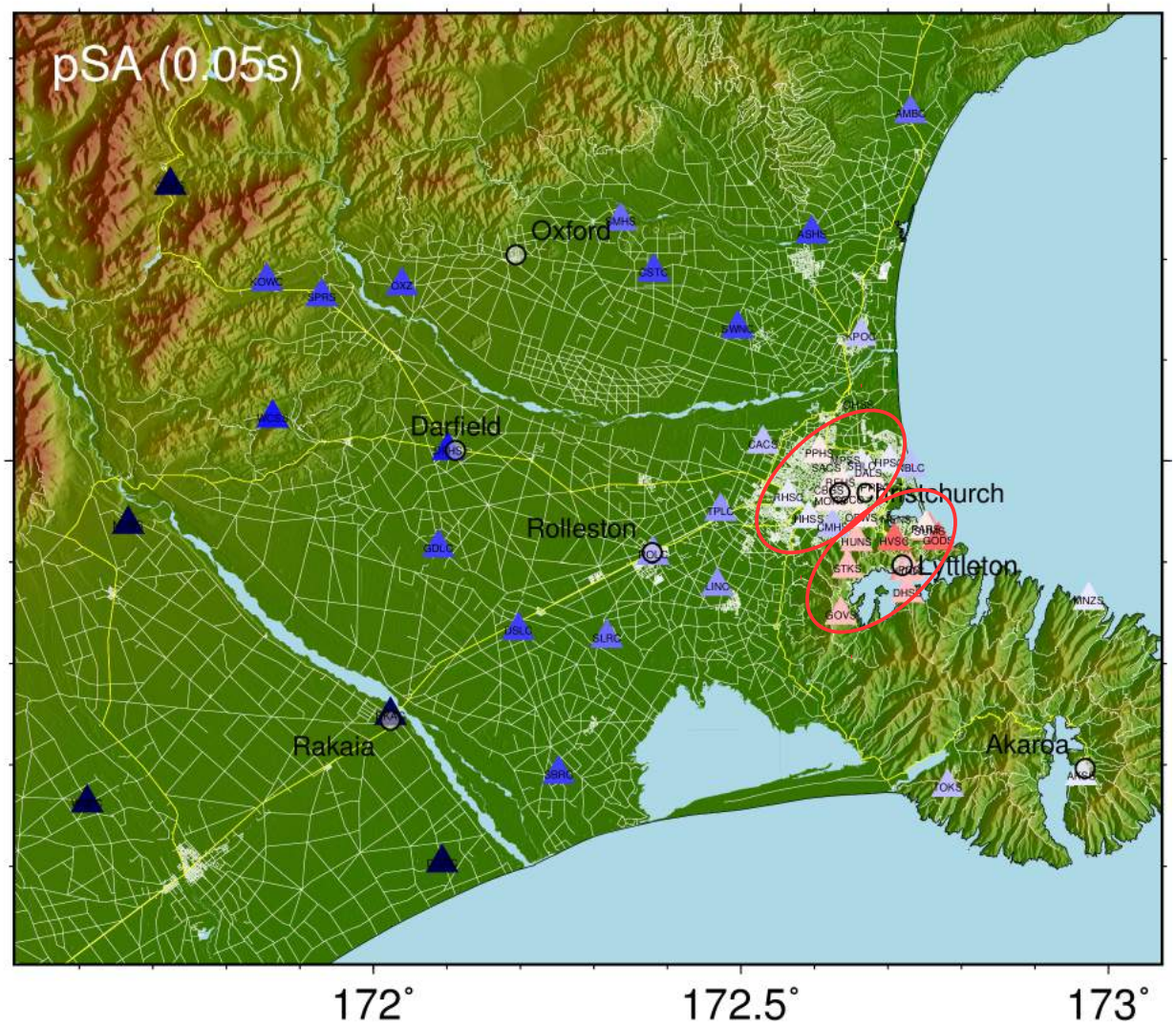


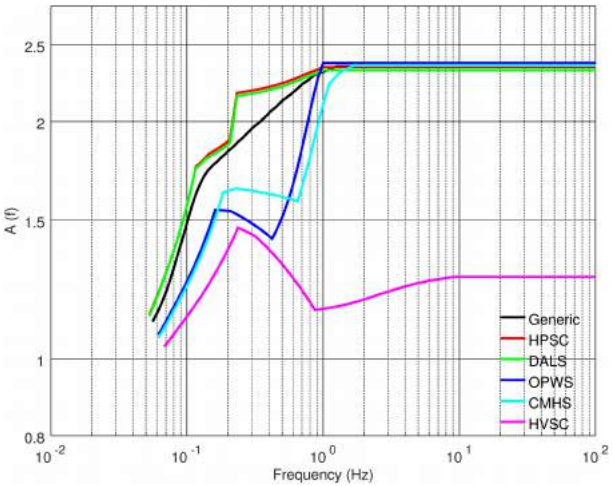


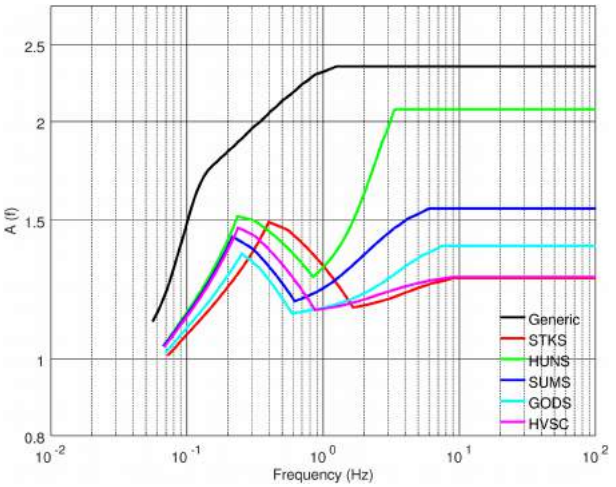




Residual Plot







- Summary:
  - We understand/evaluate how the different 1D velocity profiles affect the site term and consequently ground-motions.
  - Velocity variations in top 300 to 500 m depth significantly affects the site amplification/term (depicts the importance of weathering function).

- Future work:
  - Need to better understand combined path and site components.
  - Apply to different earthquakes to show/check the improvement in ground-motion estimation.

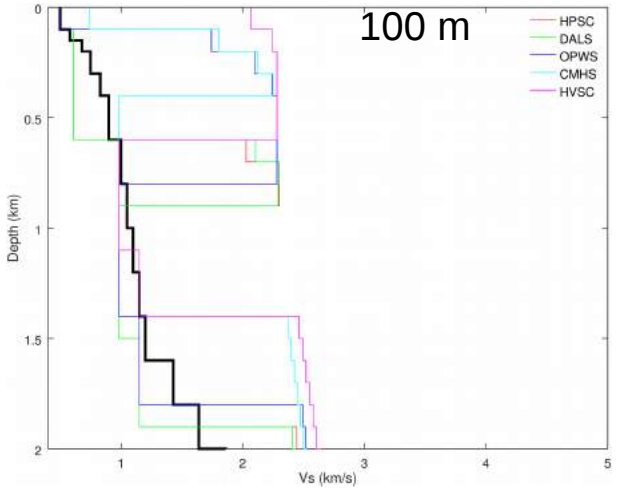
Thanks ....

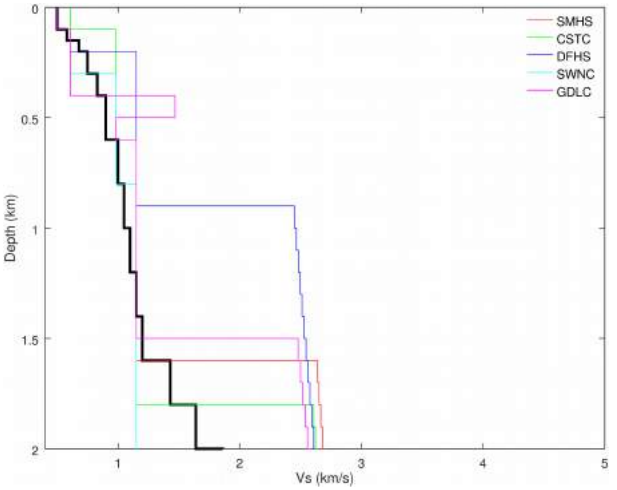
Acknowledgements: Thanks to Sung, Robin and Karim for several fruitful discussion.

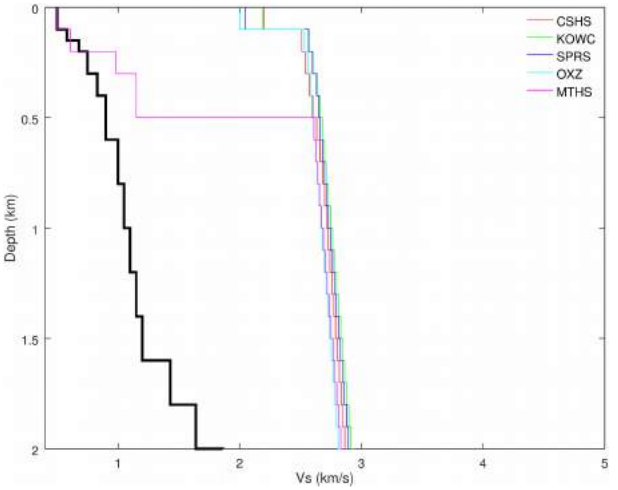
Port Hill

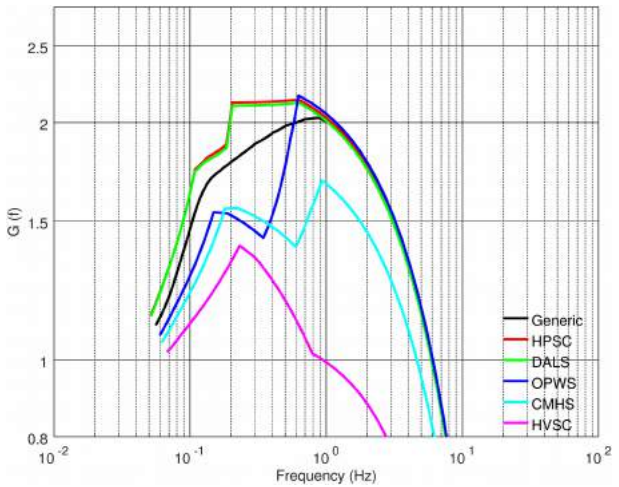
Basin

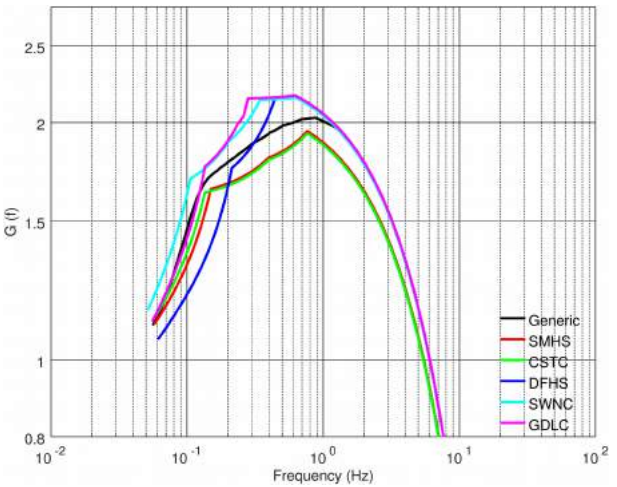
Canterbury Foot Hill

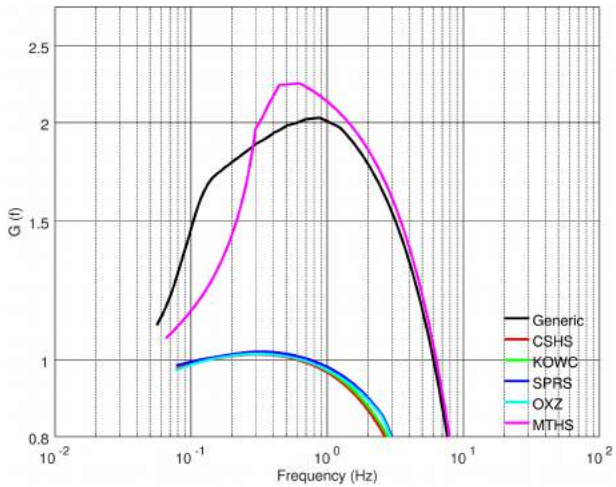












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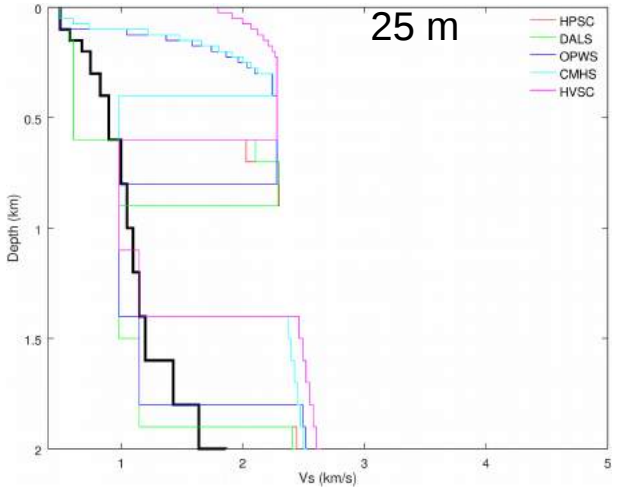

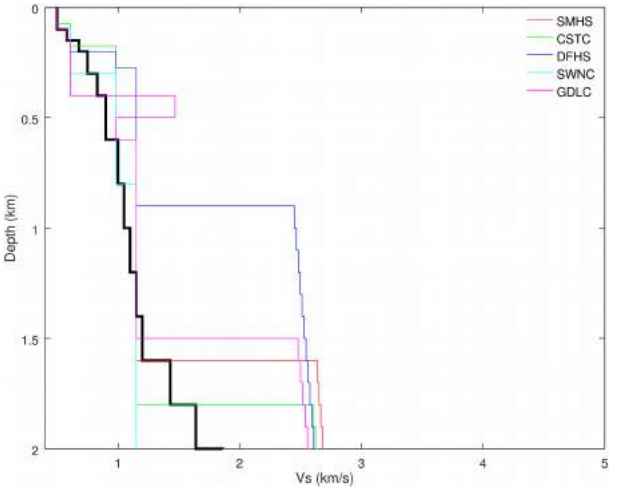

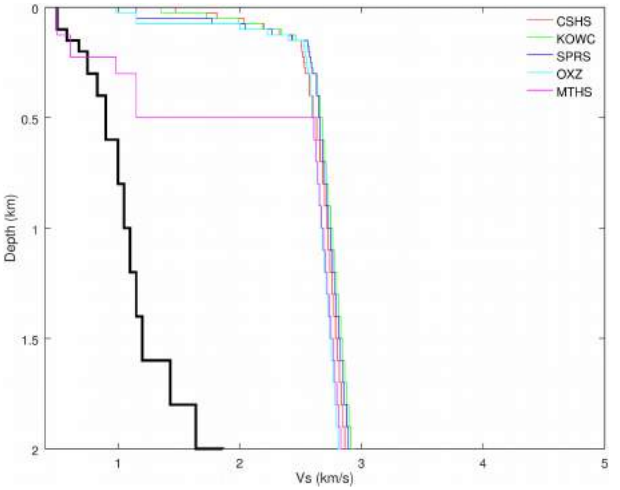

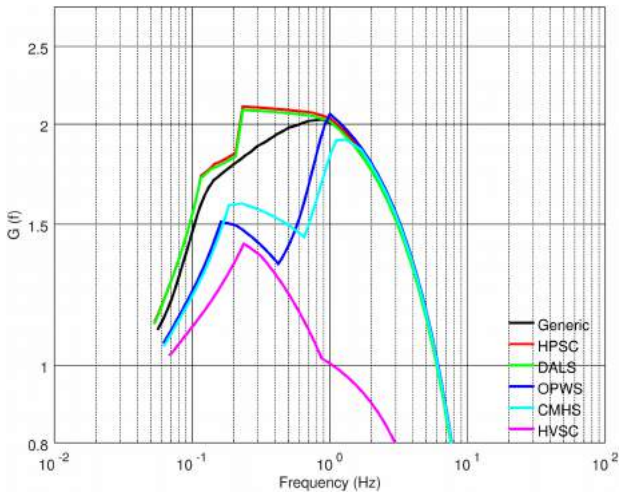

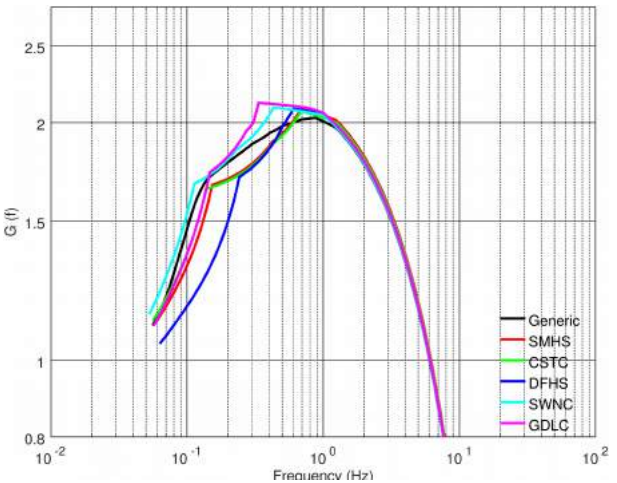

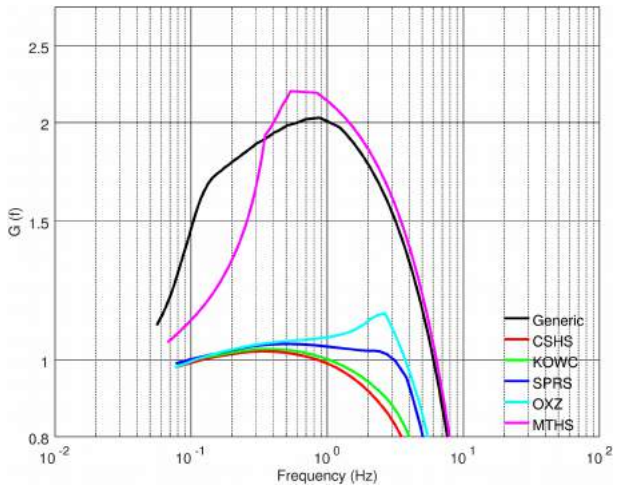

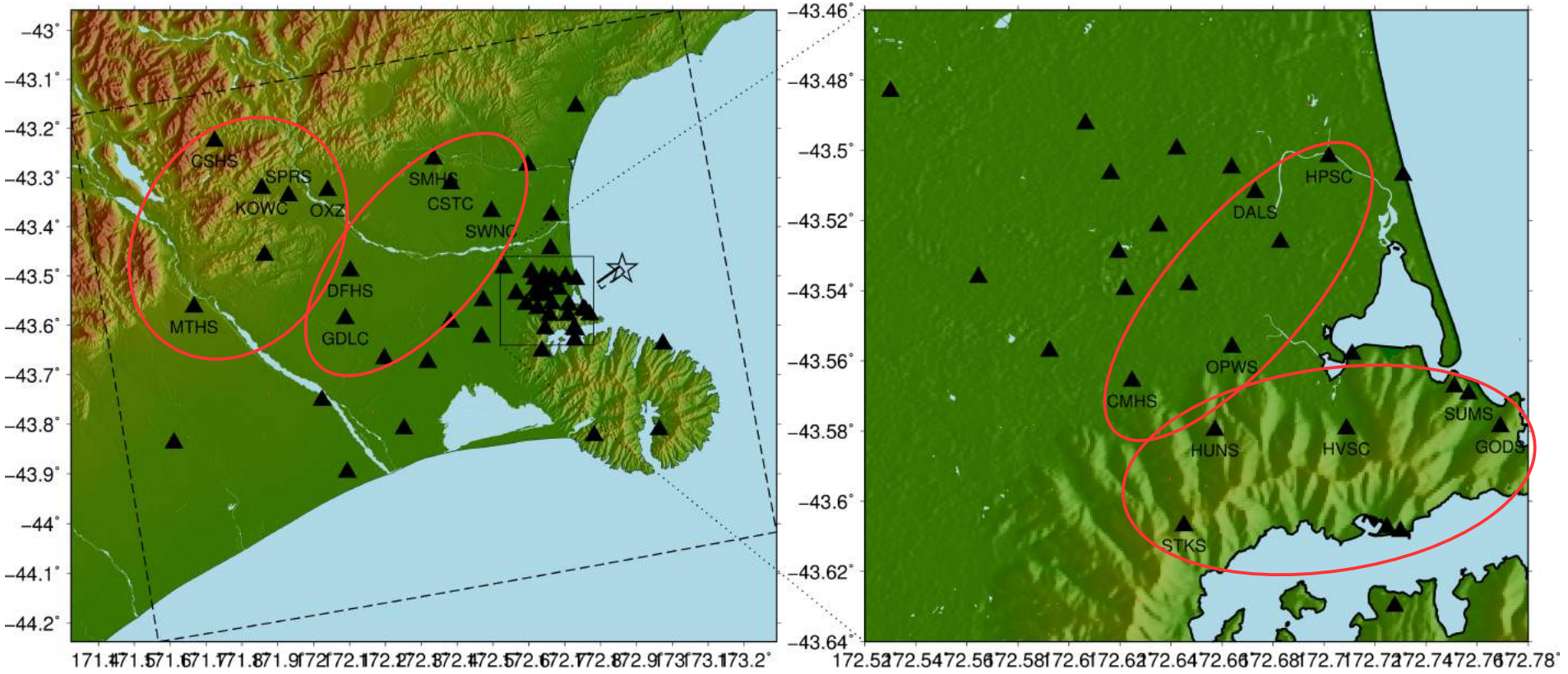
CSHS
SPRS
KOWC
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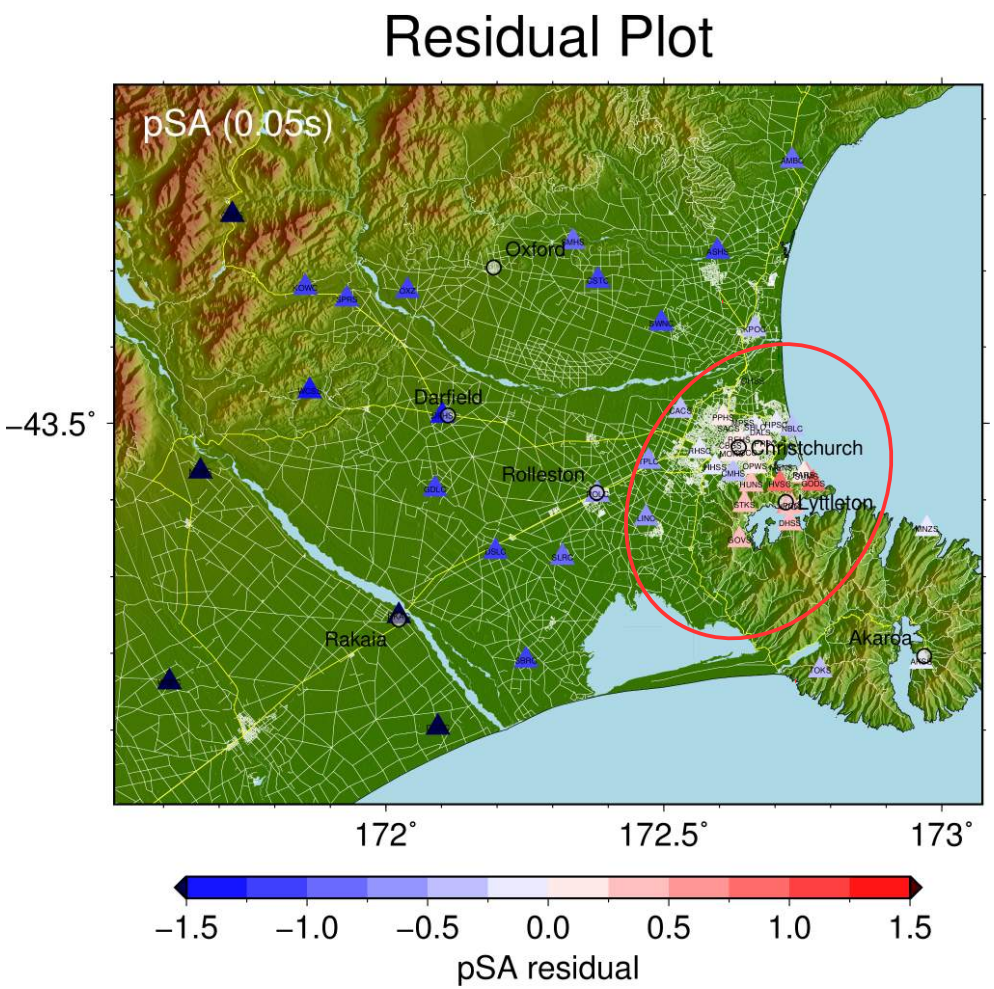
HVSC
GODS
STKS

25 m


Residual Plot
pSA (0.05s)
Oxford
Darfield
Rolleston
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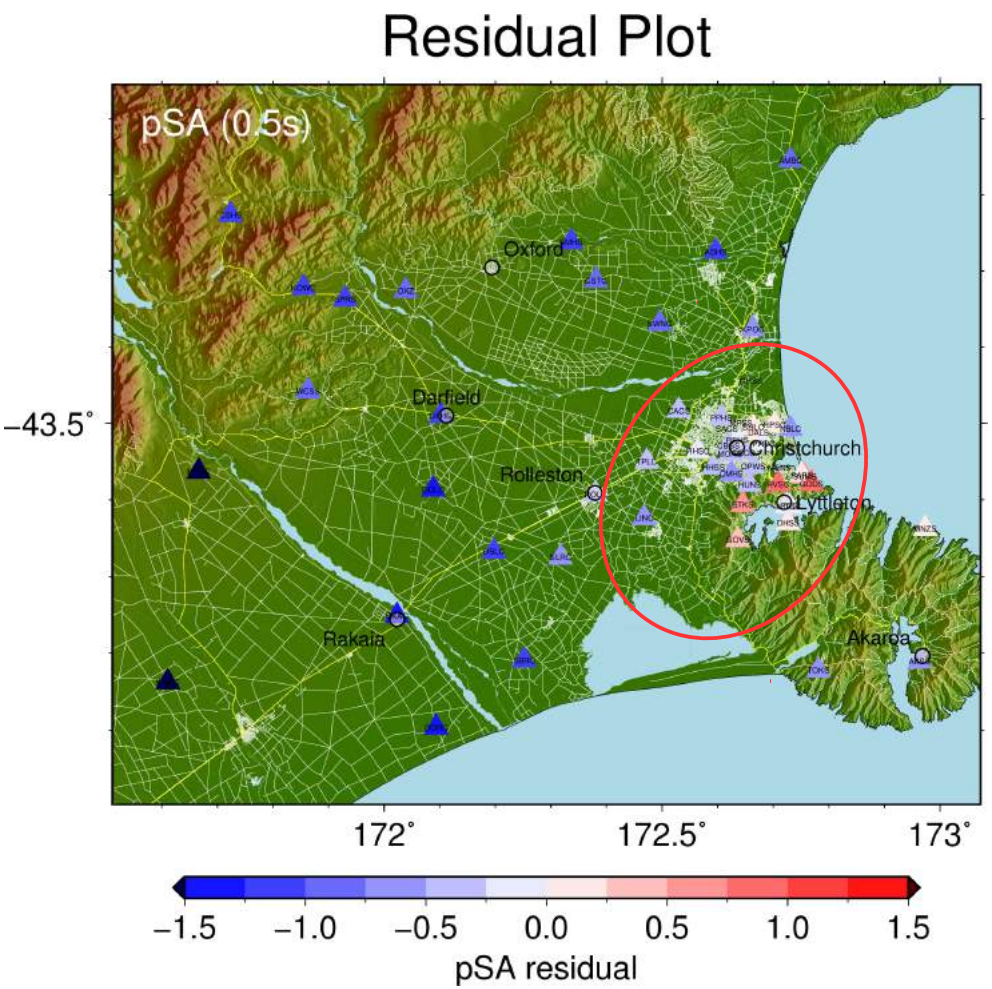
Lyttleton
Rakaia
Akaroa
−43.5˚
172˚
172.5˚
173˚
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
pSA residual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pSA residual