
A Comparison of Surface Heat Flow Interpolations Near Subduction Zones

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Outline

Acknowledgments



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Preprint

Part I: viscous coupling depth (CD)

Surface heat flow suggests CDs are uniform (invariant)

Part II: upper-plate thickness (UPT)

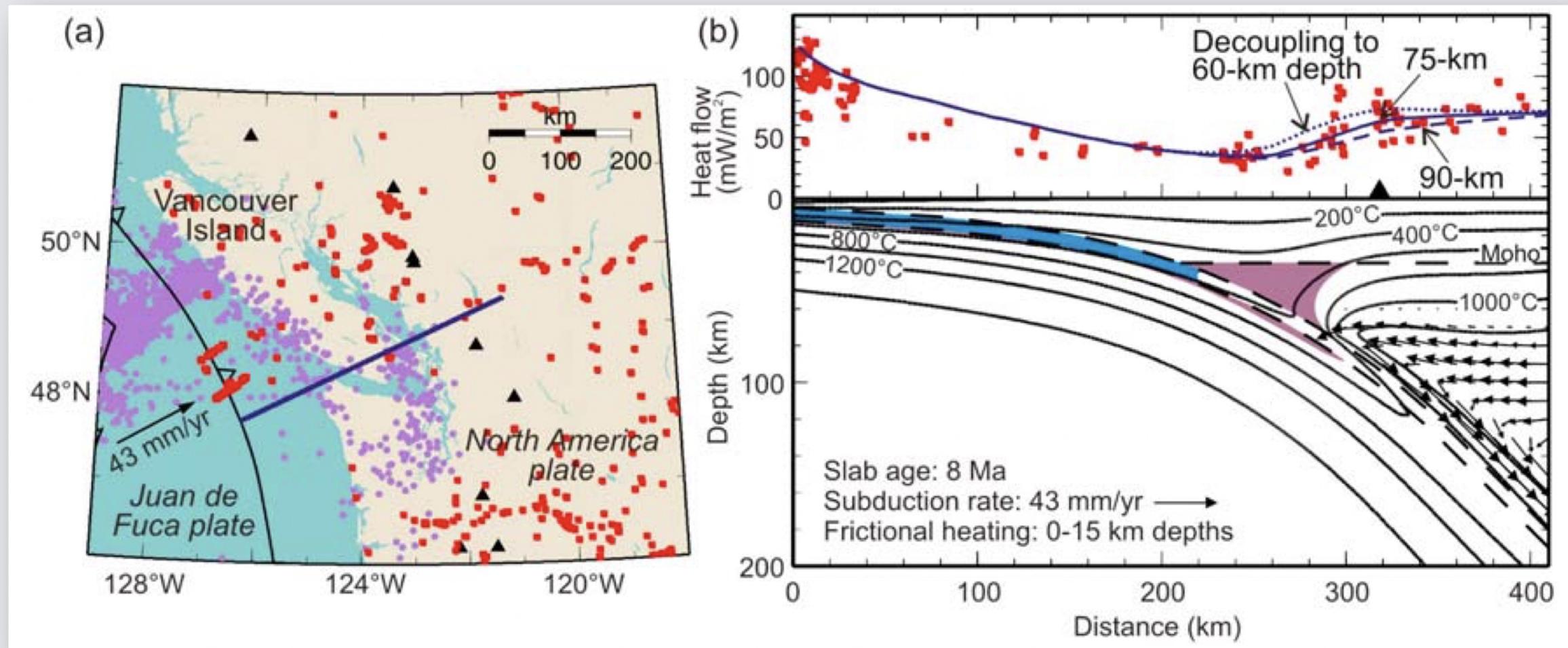
Numerical geodynamic models suggest CDs correlate with UPT

Part III: geodynamic continuity

Inferring geodynamic variance from surface heat flow interpolations

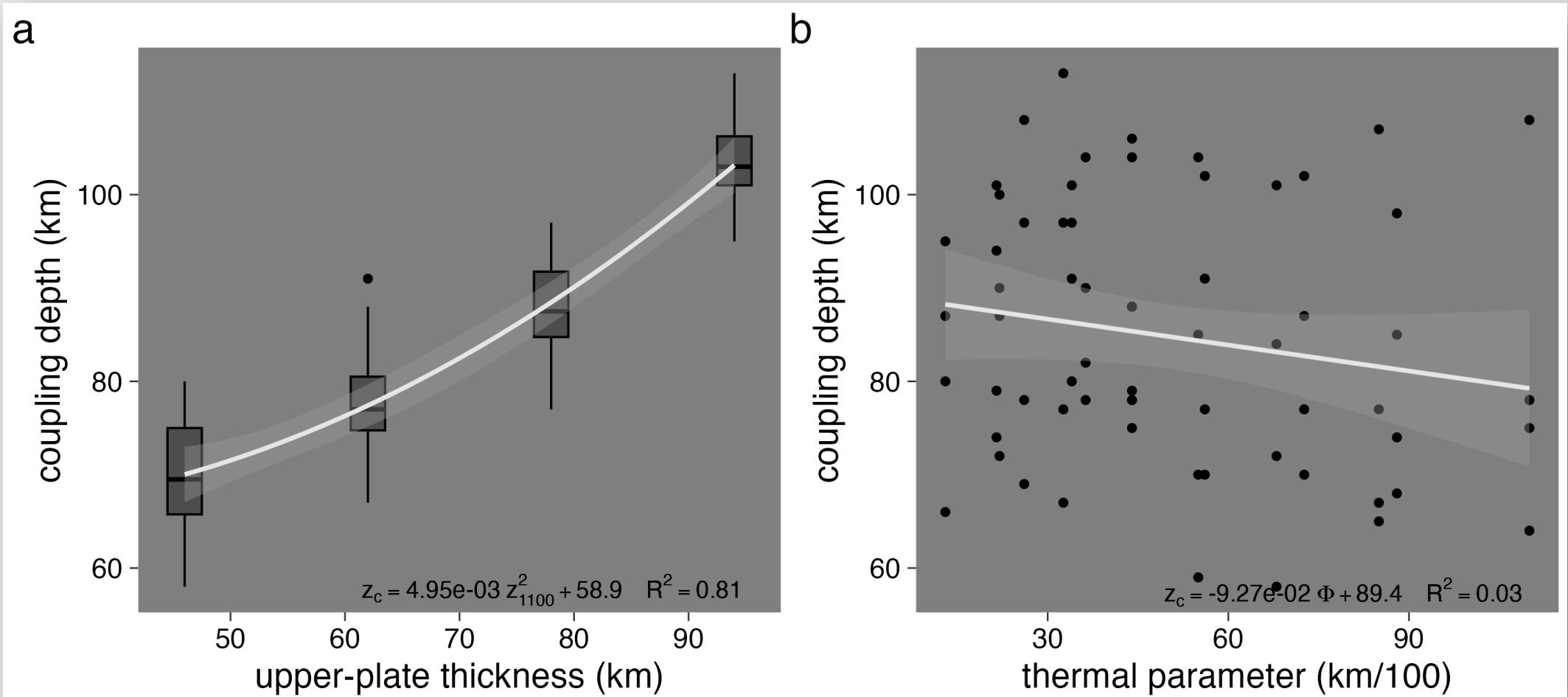
Part I: Viscous CDs

CDs **are ~ invariant** among subduction zone settings (Wada & Wang, 2009)



Part II: UPT

CDs **are not invariant** among subduction zone settings (Kerswell et. al, 2021)



Part II: UPT

Inferring CDs from heat flow

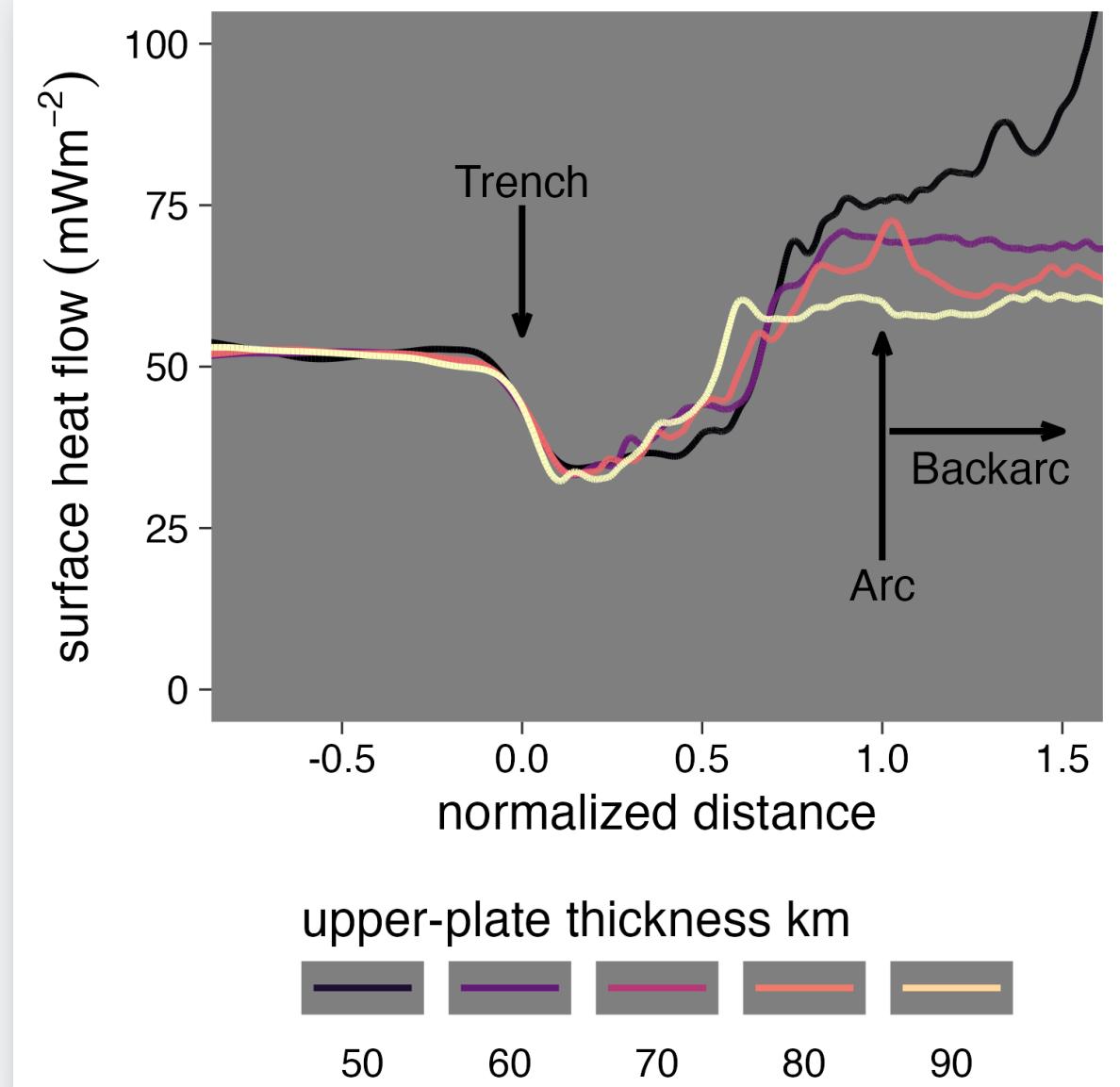
Jaupart & Mareschal (2007)

Furlong & Chapman (2013)

Kerswell et al. (2021)

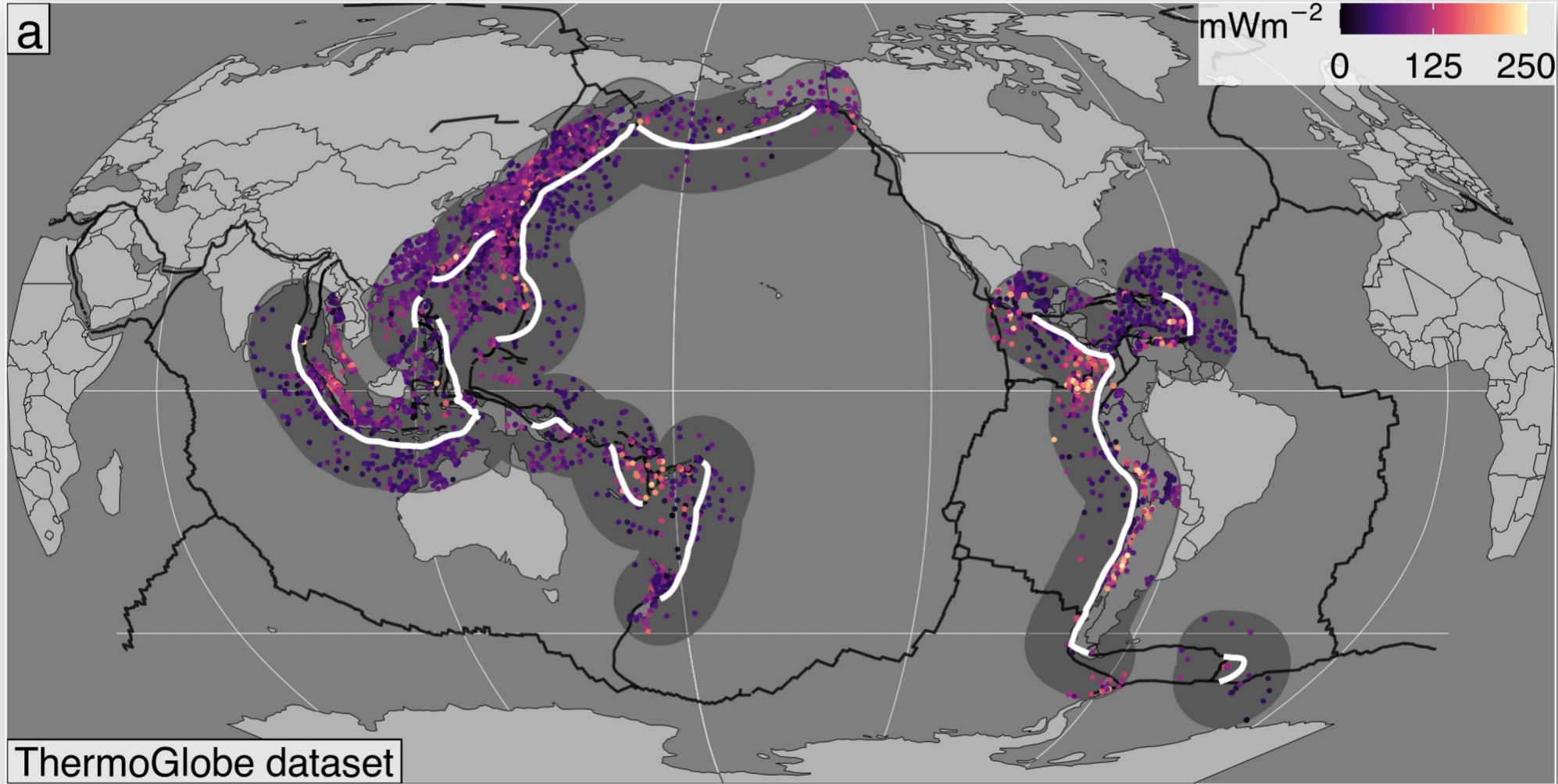
Research question:

What is the continuous 2D variability of surface heat flow near subduction zones?



Part III: dataset

Thermoglobe (Jennings & Hasterok, 2021) contains approx. 71k datapoints of variable quality. Kerswell & Kohn (in prep)



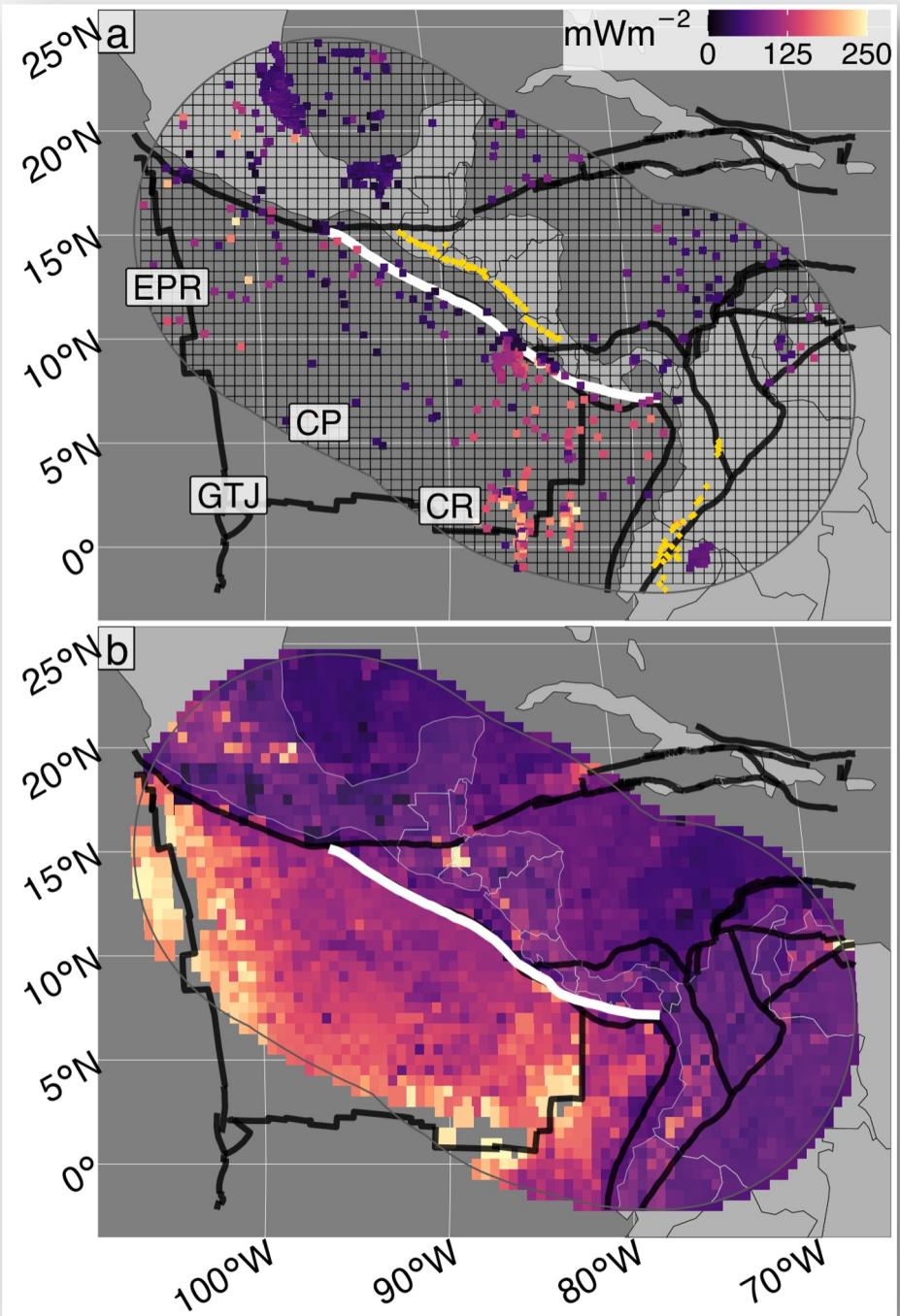
Part III: interpolations

Comparing interpolations based on different laws of geography:

Kerswell & Kohn (*in prep*)

Similarity: similar geological context should have similar values of the same process under investigation (Zhu et al. 2018)

Kriging: everything is related, but nearer things are more related (Krige, 1951)



Part III: optimization

Different Kriging parameters can produce different results:

Kerswell & Kohn (*in prep*)

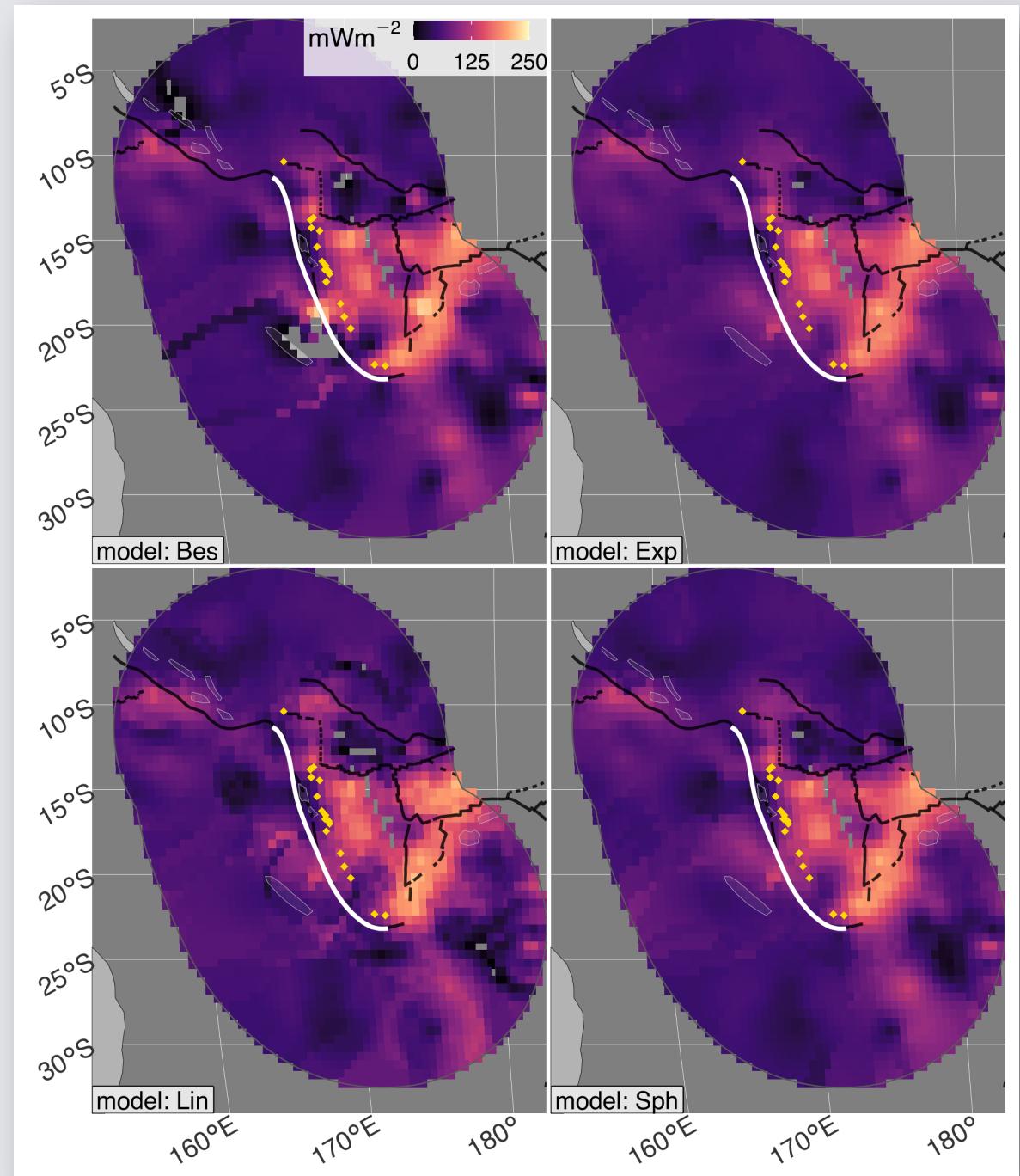
- Check accuracy by computing residuals
- Use optimization algorithm to converge on the best fit for 5 parameters (θ)

Parameters

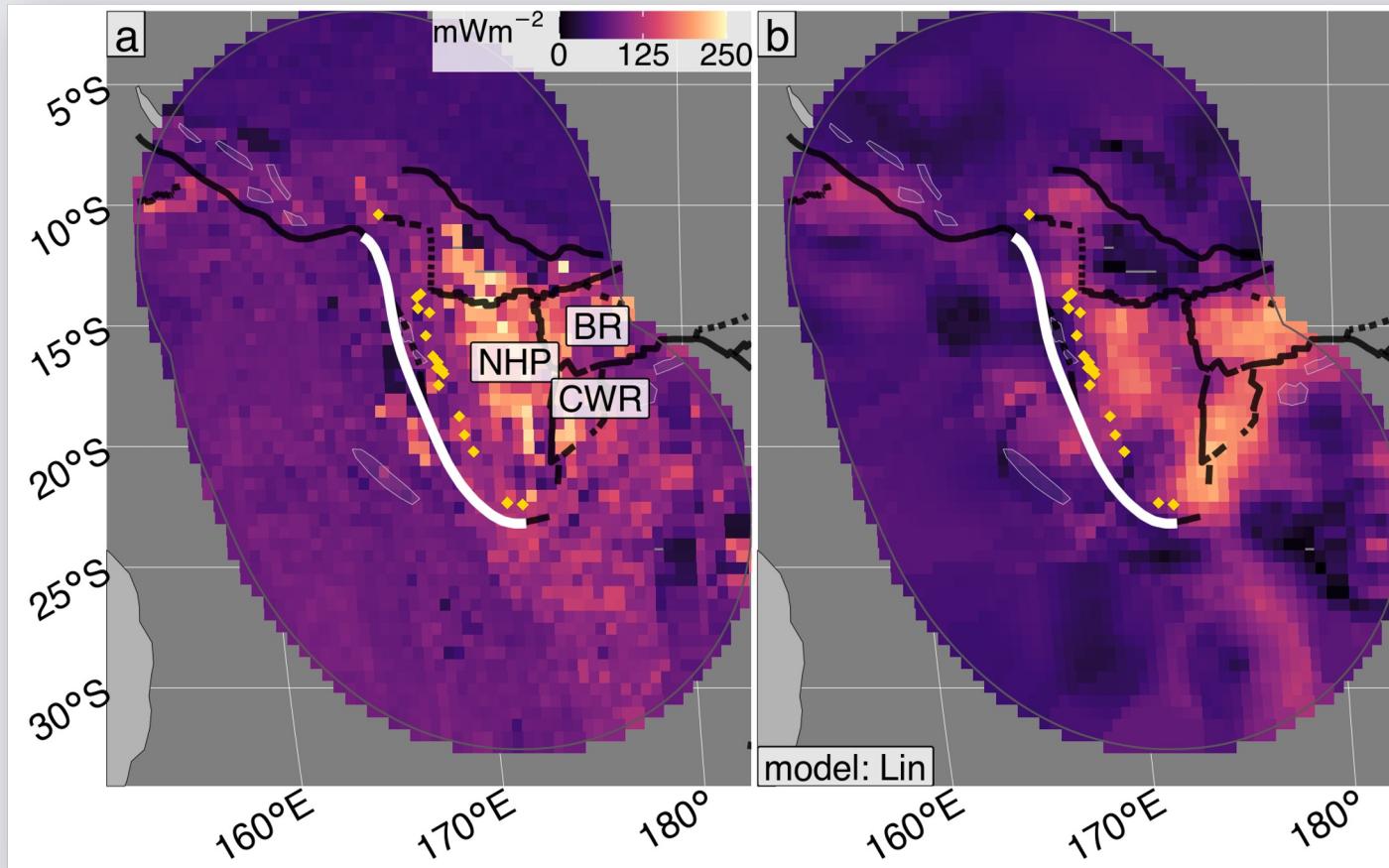
$$\theta = \{v_{\text{model}}, n_{\text{lag}}, \max_{\text{lag}}, n_{\text{max}}, \text{shift}_{\text{lag}}\}$$

Cost function

$$C(\theta) = w_{\text{vgm}} C_{\text{vgm}}(\theta) + w_{\text{interp}} C_{\text{interp}}(\theta)$$



Part III: subtle differences



Vanuatu example:
Kerswell & Kohn (in prep)

- *Interpolation accuracies are broadly comparable (RMSE: 37.1 vs. 54.6 mWm^{-2})*
- *Heat flow varies along strike*
- *Subtleties between Similarity & Kriging reflect mathematical approaches to interpolation*

Notice the predicted heat flow for the northern microplate

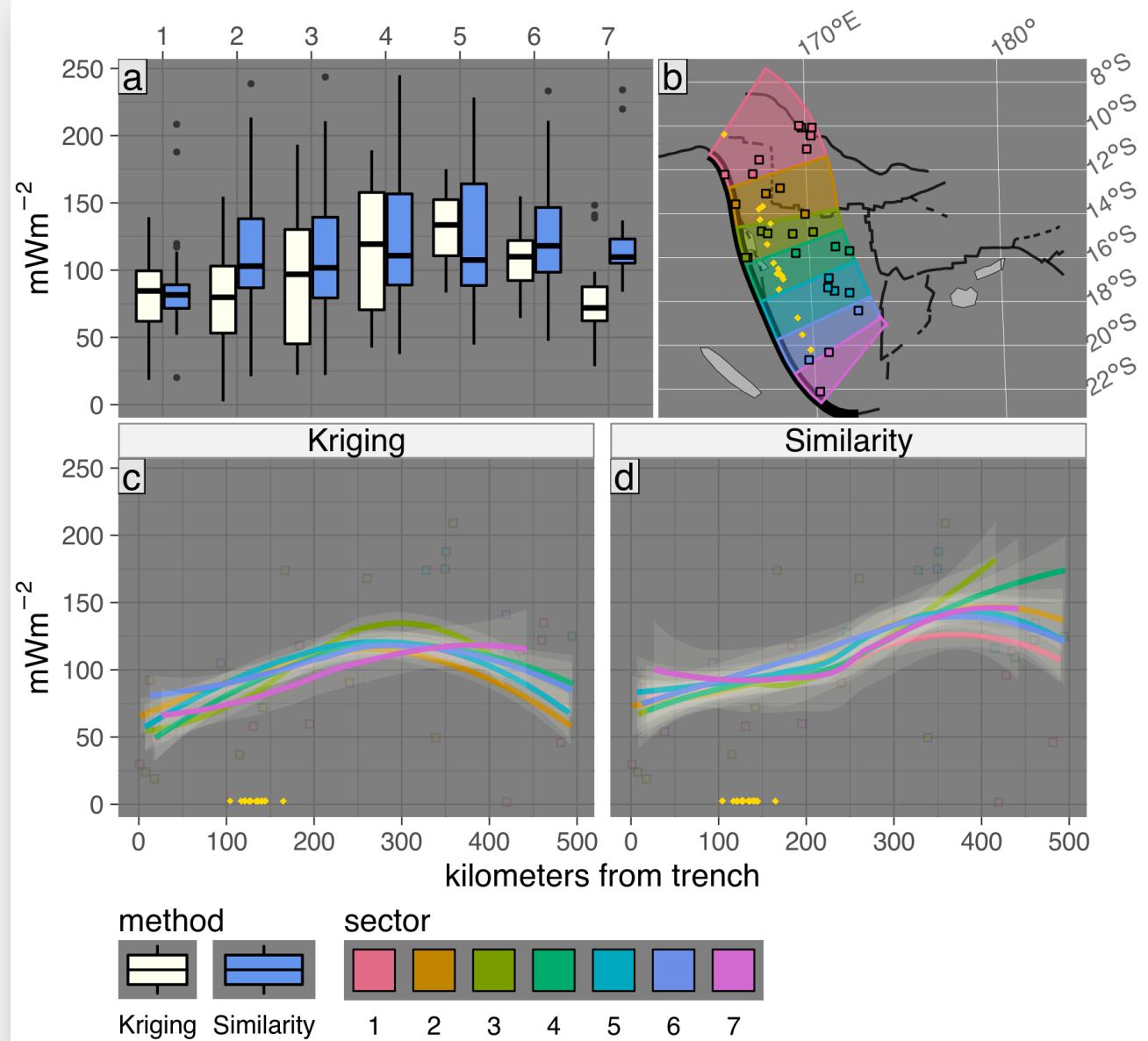
Useful info for future surveys!

Part III: profiles

Among all 13 segments:

Kerswell & Kohn (in prep)

A kaleidoscope of profiles exists



Part III: conclusion

Among all 13 segments:

Kerswell & Kohn (in prep)

A kaleidoscope of profiles exists

Various profiles suggests:

- Lithospheric thickness is discontinuous
- Heat-transferring processes are discontinuous
- Observational density is low relative to the spatial variability of subsurface thermal structure

Useful info for future survey targets!

