A Comparison of Surface Heat Flow Interpolations Near Subduction Zones

Buchanan Kerswell

Géosciences Montpellier

Université de Montpellier

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Outline

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Preprint

Viscous coupling depth (CD)

Surface heat flow suggests CDs are uniform (invariant)

Upper-plate thickness (UPT)

Numerical geodynamic models suggest CDs correlate with UPT

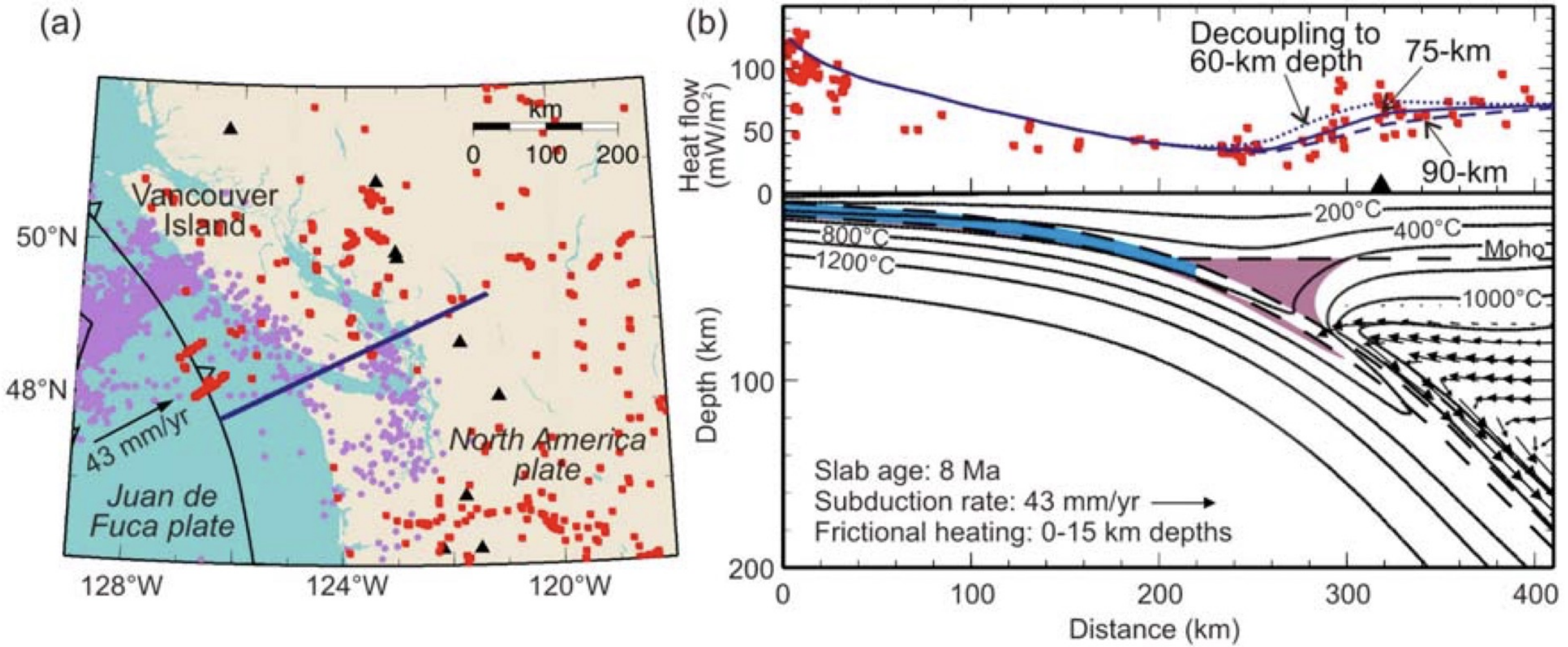
Geodynamic continuity

Inferring geodynamic variance from surface heat flow interpolations

Viscous Coupling

Heat flow suggests coupling depths are invariant among subduction zone settings

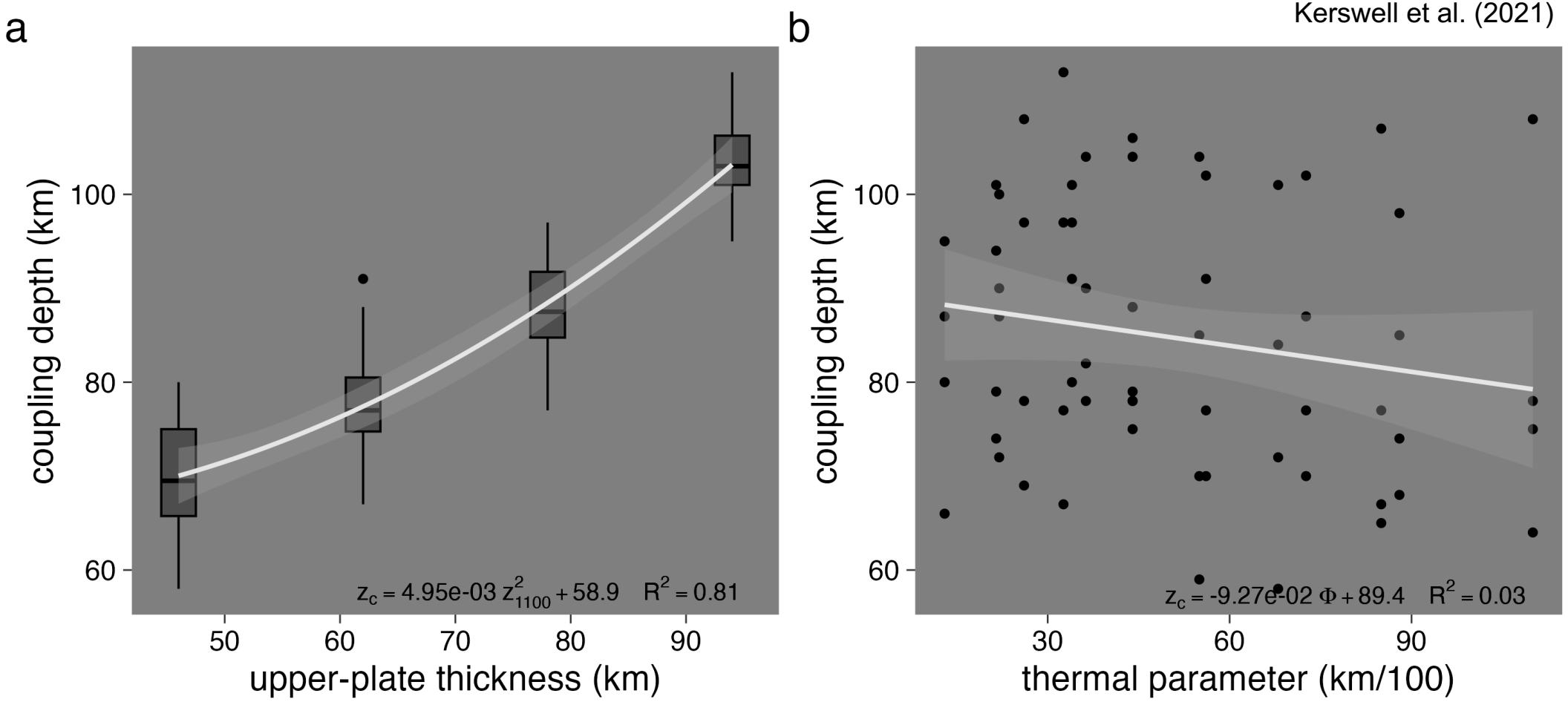
Wada & Wang (2009)



Upper-plate thickness

*Numerical geodynamic models suggest coupling depths **are not** invariant*

Kerswell et al. (2021)



Upper-plate thickness

Estimating coupling depths with 1D heat conduction models:

Jaupart & Mareschal (2007)

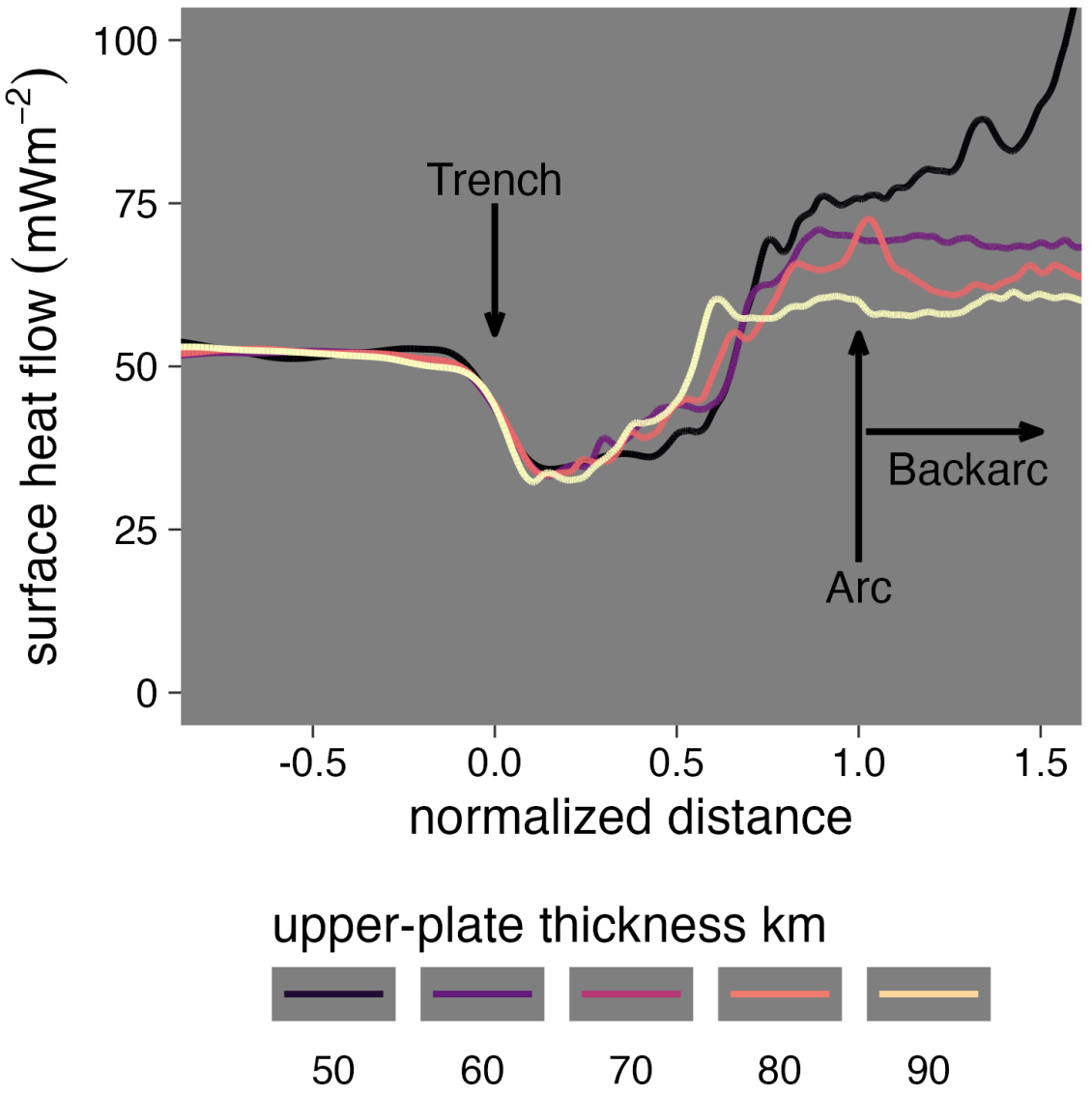
Furlong & Chapman (2013)

Kerswell et al. (2021)

Research question:

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

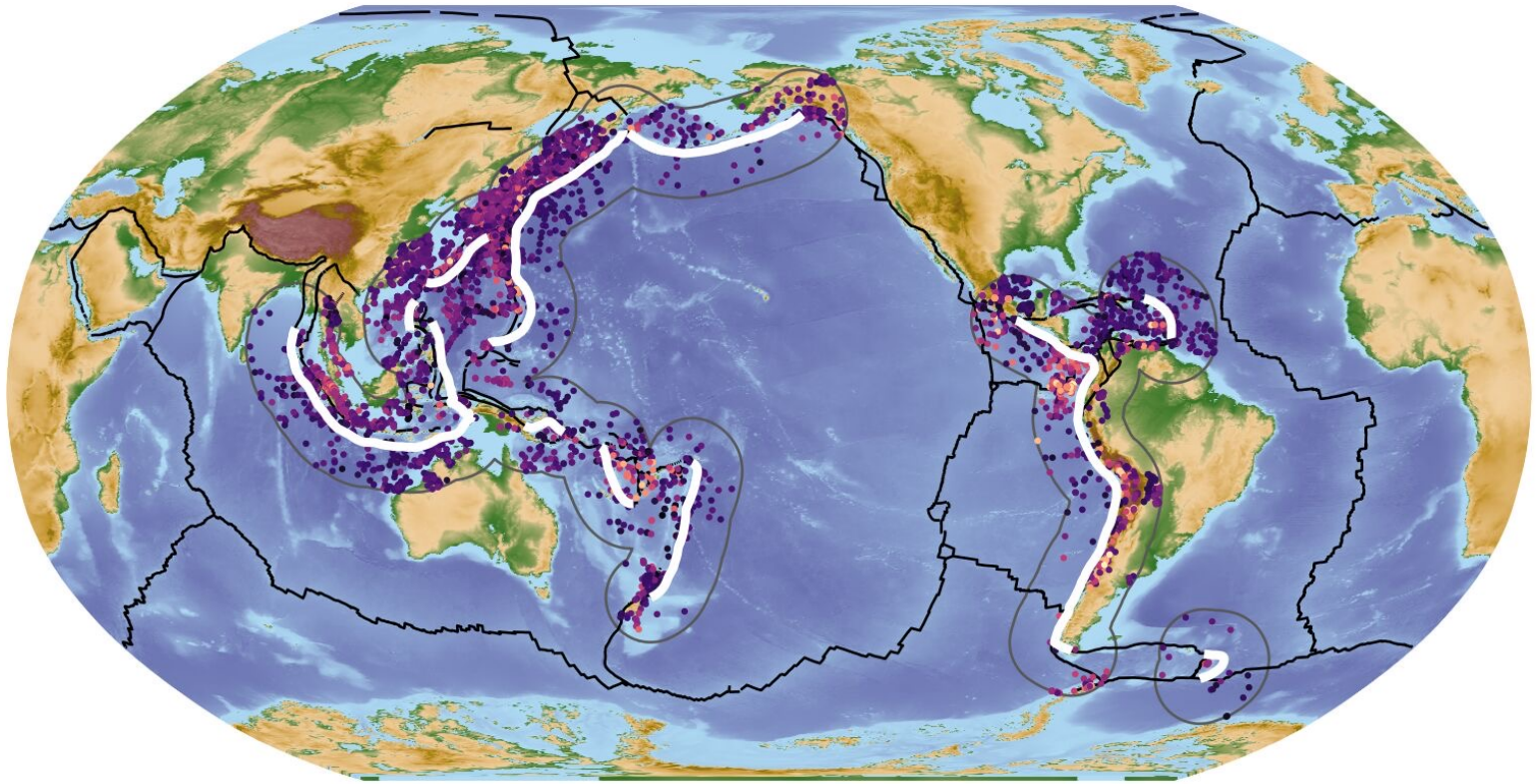
Kerswell et al. (2021)



Geodyn. Continuity

71k heat flow measurements

a) Thermoglobe observations



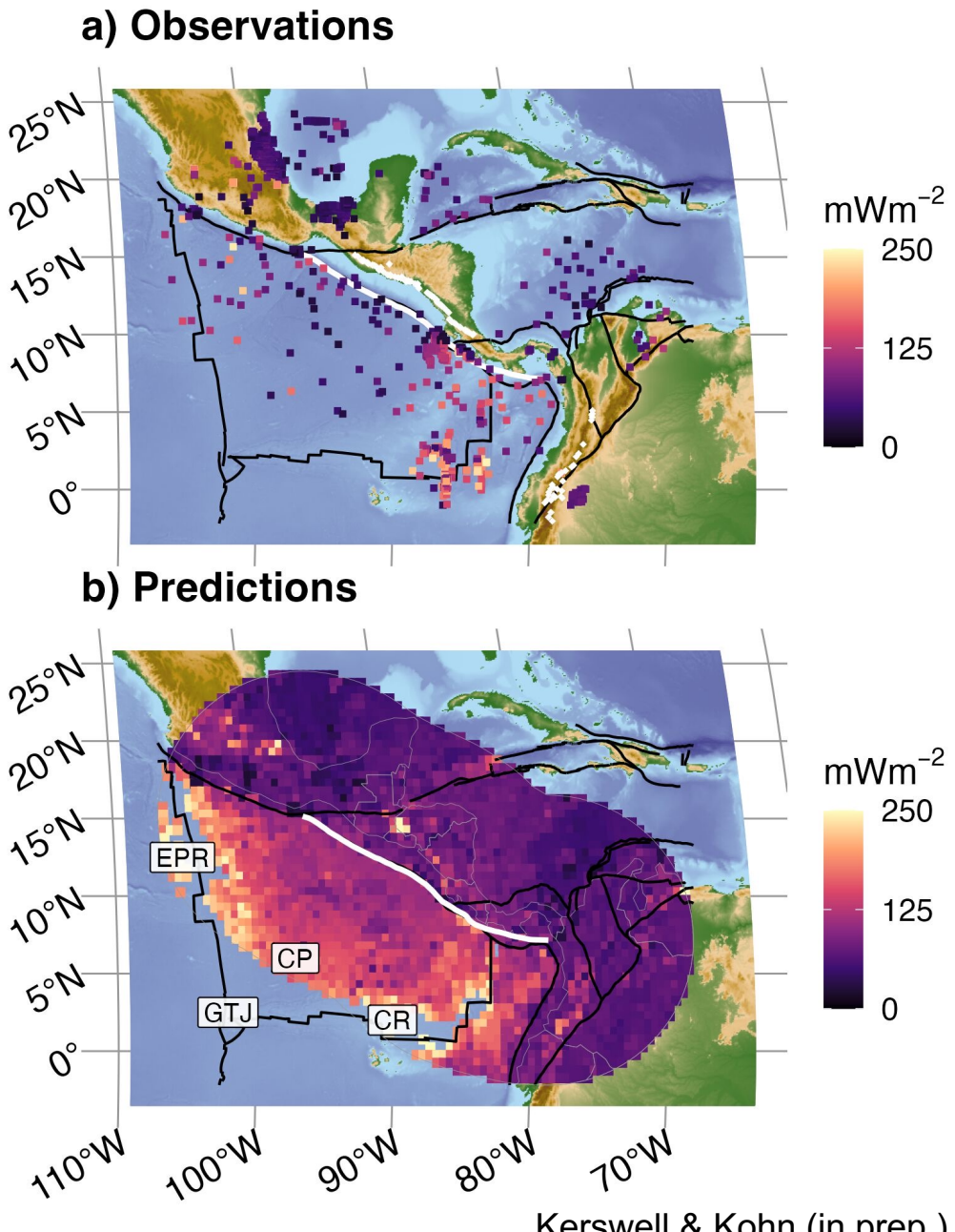
Kerswell & Kohn (in prep.) Data from Jennings & Hasterok (2021)

Geodyn. Continuity

Laws of geography applied to interpolating surface heat flow

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)*



Kerswell & Kohn (in prep.)

Geodyn. Continuity

Different Kriging parameters can produce different results:

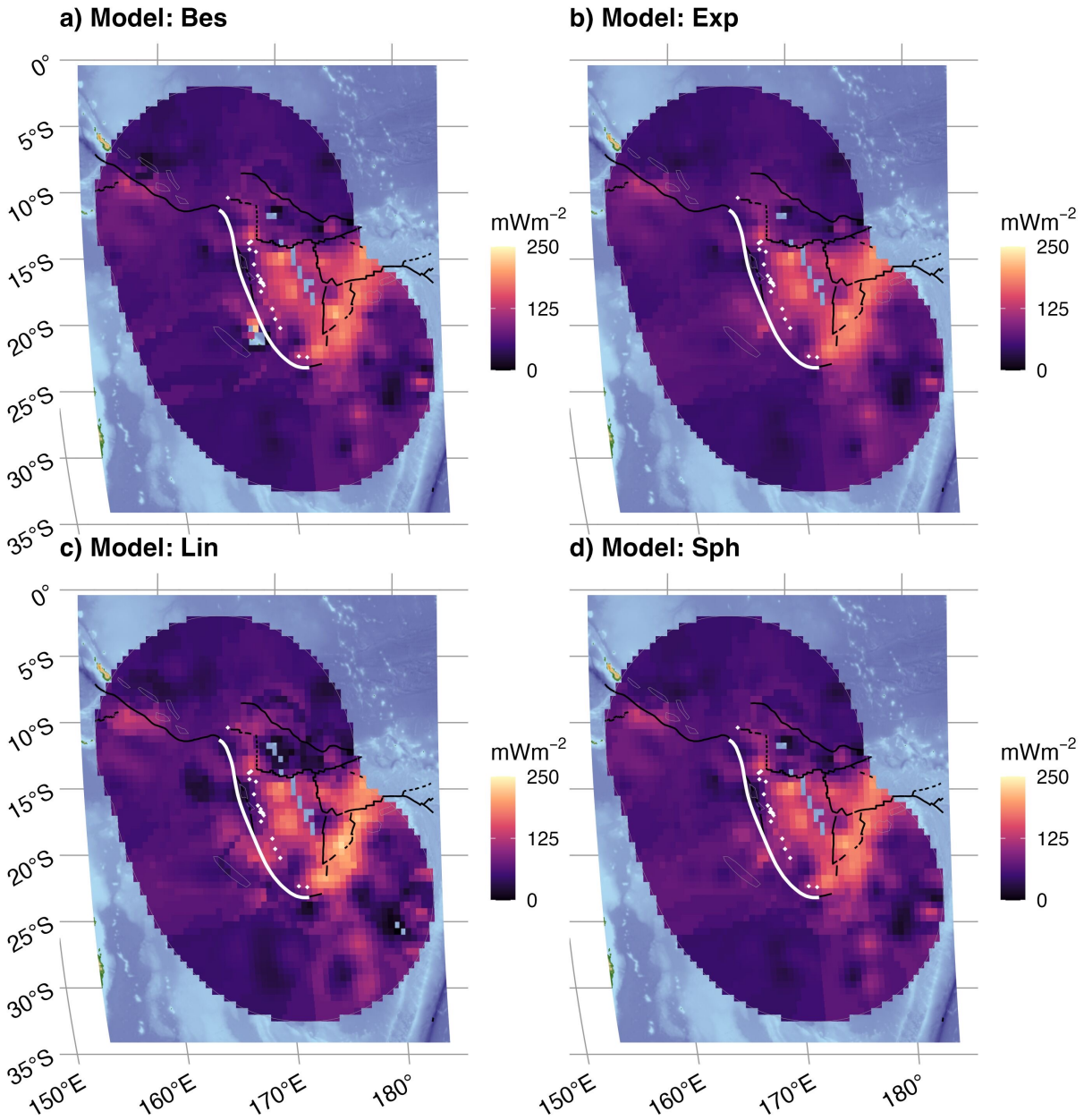
- *Check accuracy by computing residuals*
- *Use optimization algorithm to converge on the best fit for 5 parameters (θ)*

Parameters

$\boldsymbol{\Theta} = \{v_{model}, n_{lag}, max_{lag}, n_{max}, shift_{lag}\}$

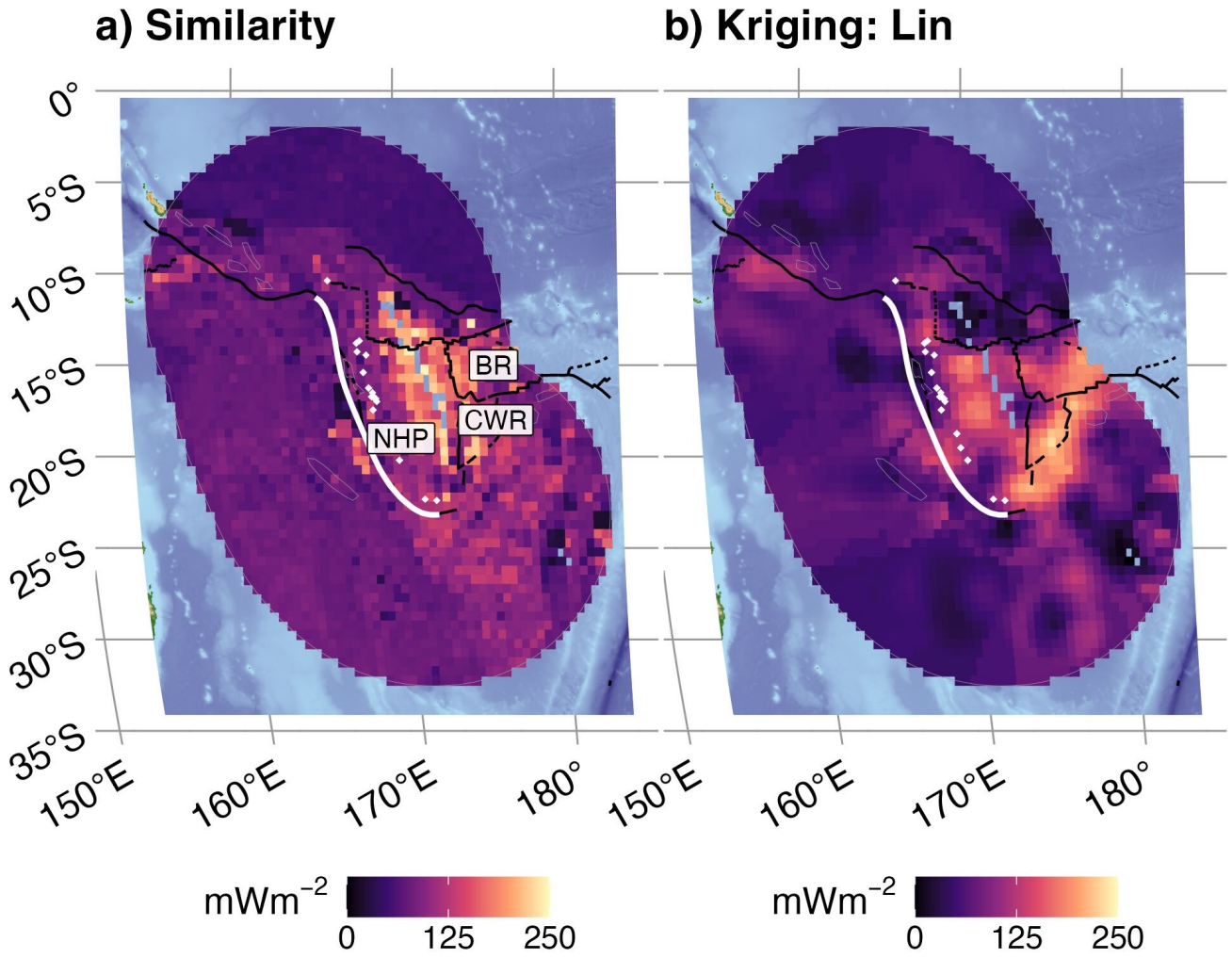
Cost function

$$C(\Theta) = w_{vgrm}C_{vgrm}(\Theta) + w_{interp}C_{interp}(\Theta)$$



Kerswell & Kohn (in prep.)

Geodyn. Continuity



Kerswell & Kohn (in prep.)

Vanuatu example:

- *Interpolation accuracies are broadly comparable*

  ***37.1** vs. **54.6** mWm^{-2} RMSE*

- *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!

Geodyn. Continuity

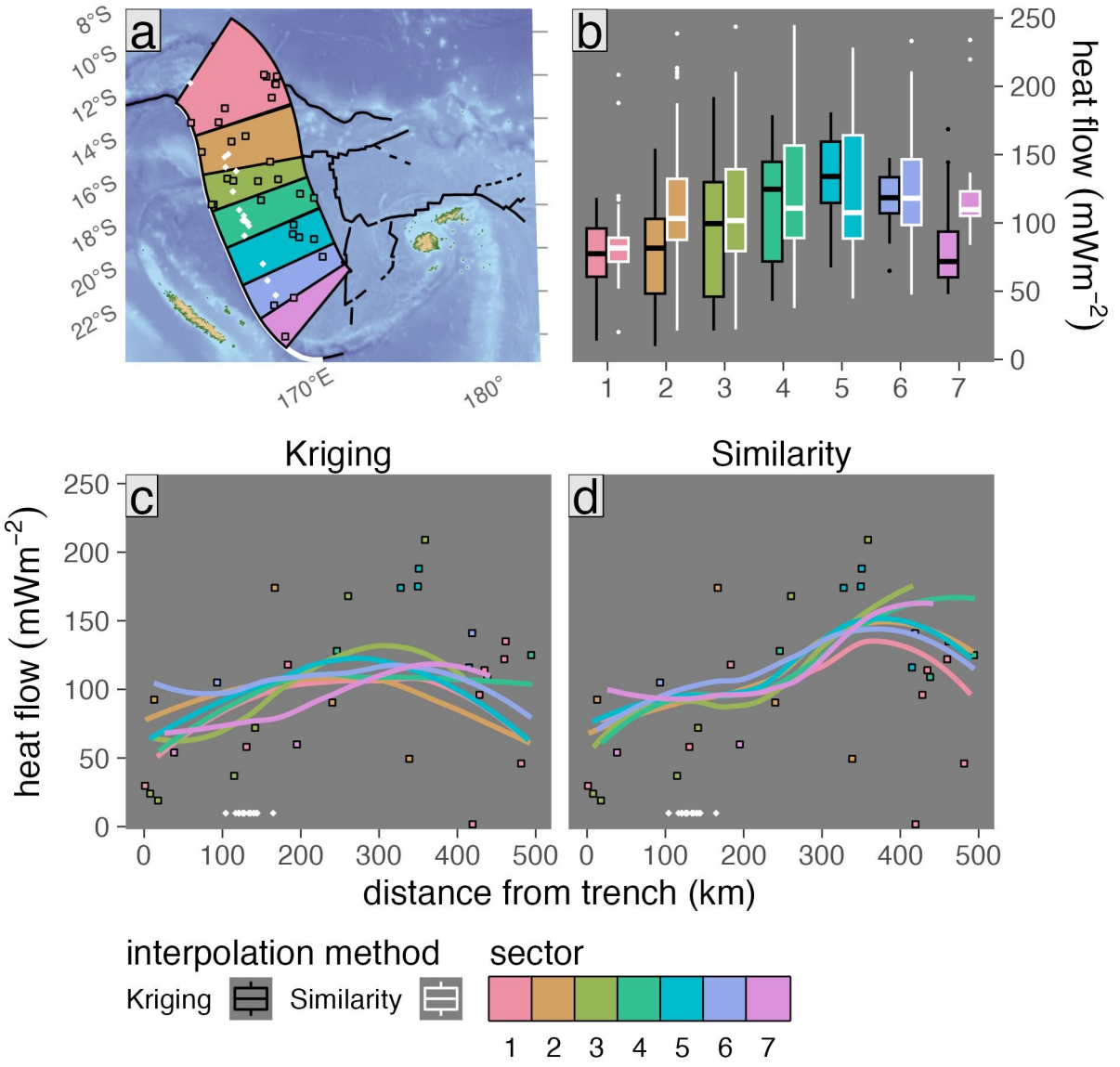
A kaleidoscope of profiles exists among all 13 segments:

Various profiles suggests:

- *Discontinuous lithospheric thickness and/or heat-transferring processes*
- *Observational density is low relative to the spatial variability of subsurface thermal structure*

Useful info for future survey targets!

Comparing heat flow interpolations by sector



Kerswell & Kohn (in prep.)

Poster tomorrow!

Kerswell et al. (2023)

Where are rocks recovered from subduction interfaces, and how many?