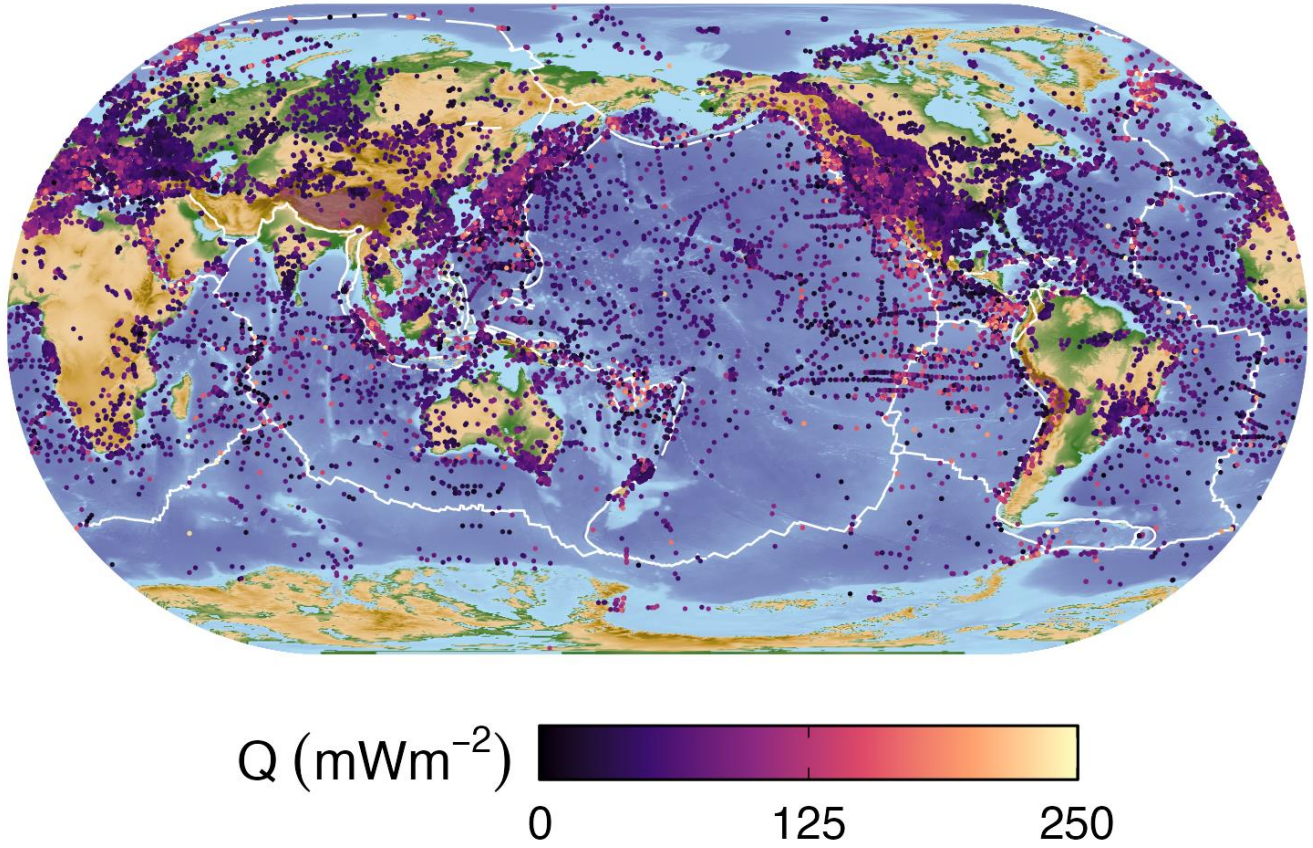
Comparing Heat Flow Interpolations Near SZs

How should we sample HF data for SZ research?



[1]*Buchanan Kerswell*

[2]*Matthew Kohn**

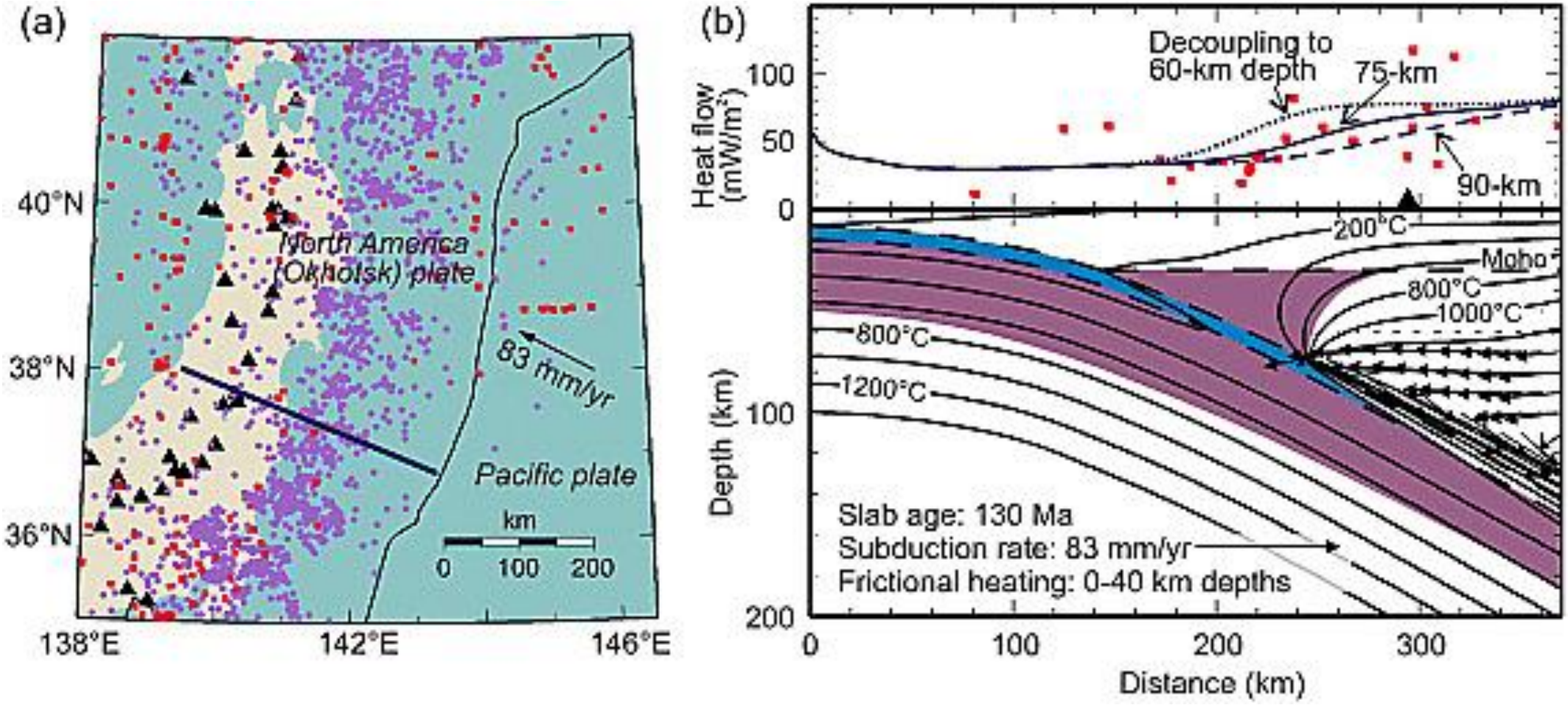
[1]*Geosciences Montpellier, University of Montpellier, CNRS, University of Antilles, Place Eugène Bataillon, 34095 Montpellier, France*

[2]*Department of Geosciences, Boise State University, Boise, ID, USA*

Global Heat Flow Data Assessment Group et al. (2024; GFZ data services)

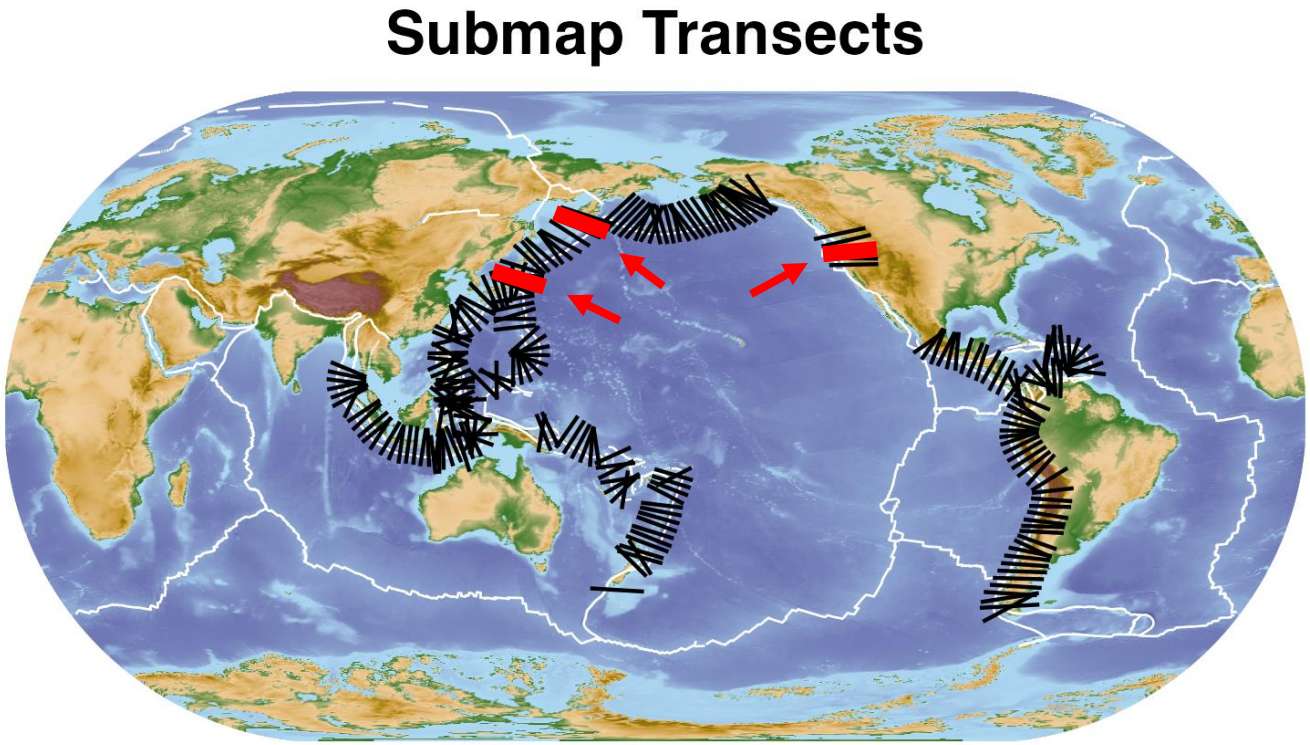
**Funded by National Science Foundation grant OISE 1545903 (M. Kohn, S. Penniston-Dorland, and M. Feineman)*

Thermal models suggest coupling at ~75 km for NE Japan



Furukawa (1993; JGR:SE) Wada & Wang (2009; G3)

Hypothesis: slab-mantle mechanical coupling depth is constant in most, if not all, SZs



Major impact:

Many thermal models of SZs have adopted a ”D80” (80 km coupling depth) boundary condition since 1993

Null hypothesis:

SZs have a range of different coupling depths

Wada & Wang (2009; G3) Lallemand & Heuret (2017; RMESES) https://submap.fr

Research questions:

Is there enough evidence to reject the null hypothesis?

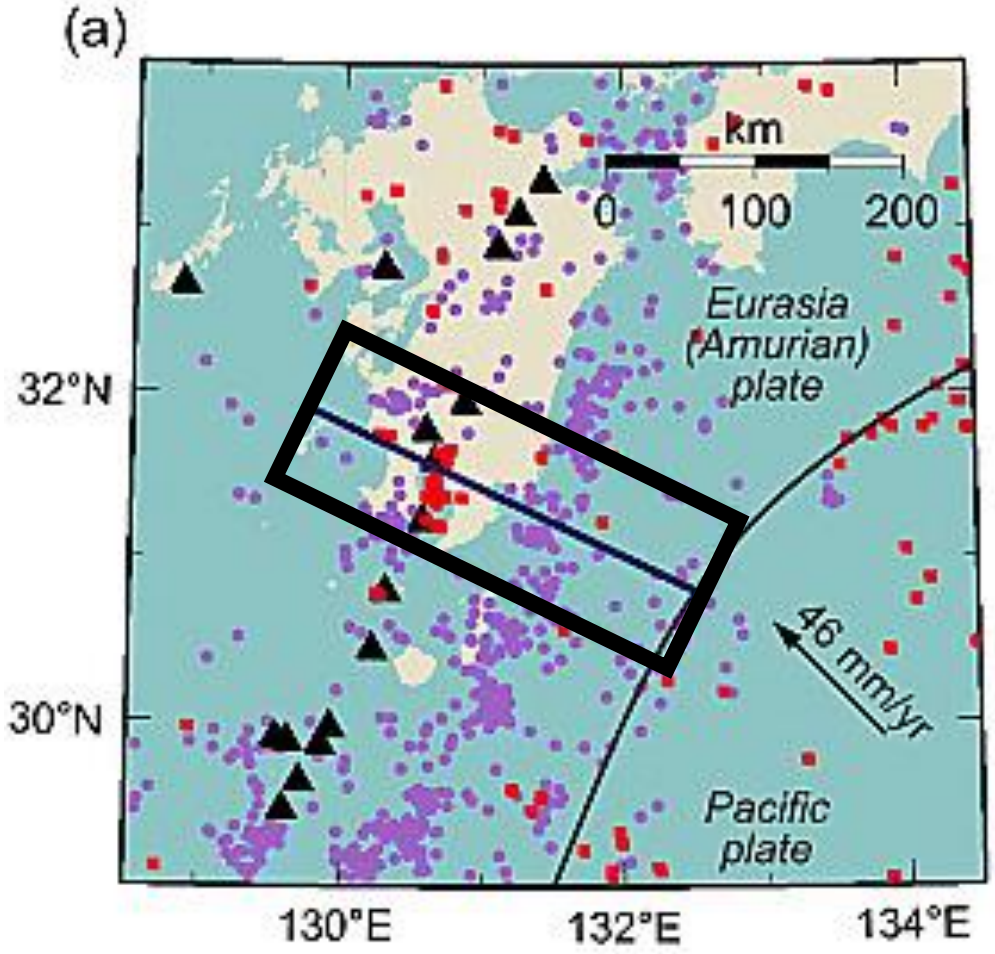
Can we improve strategies for sampling HF data near SZs?

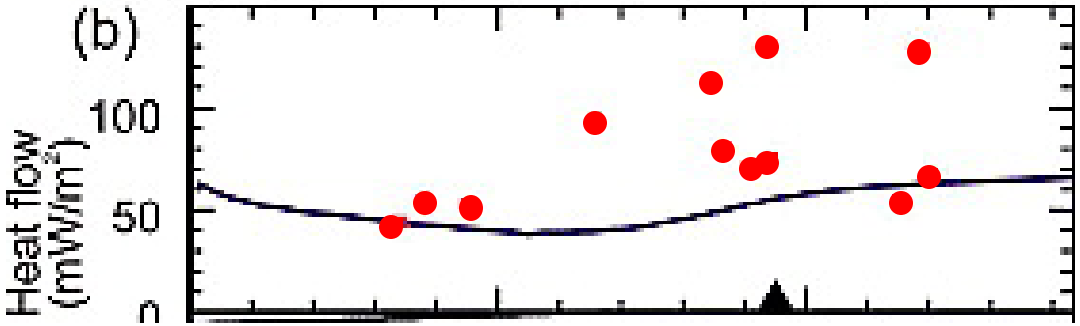
My own hypothesis:

Active SZs will show a range of correlated and uncorrelated trench-perpendicular HF profiles

Spatial interpolation techniques provide a more robust and reproducible strategy for sampling HF data near SZs

Strategies for sampling HF data are critical for SZ research

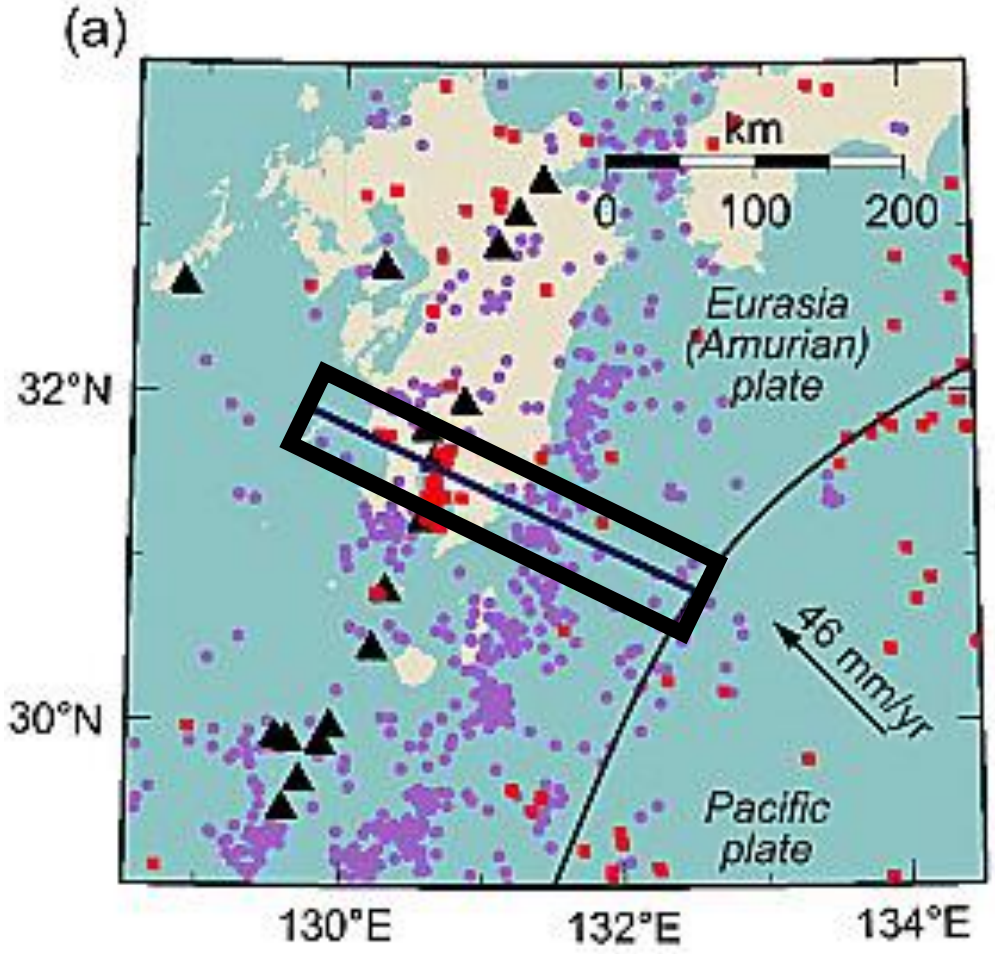


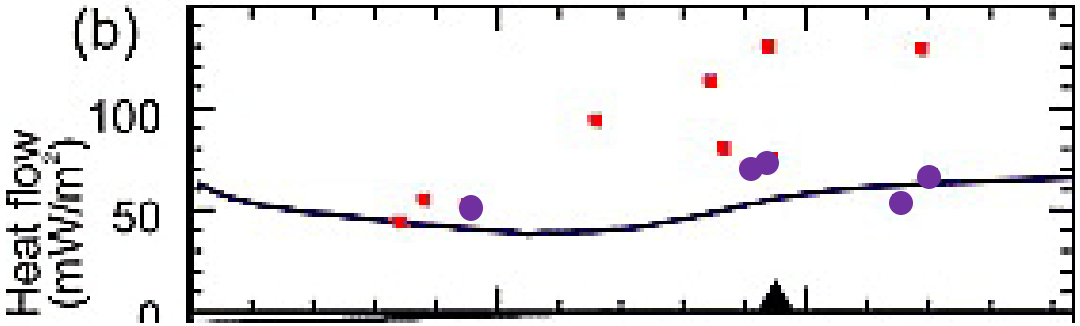


RMSE = sqrt(Σ(data – model)^2 / N)

Wada & Wang (2009; G3)

Strategies for sampling HF data are critical for SZ research

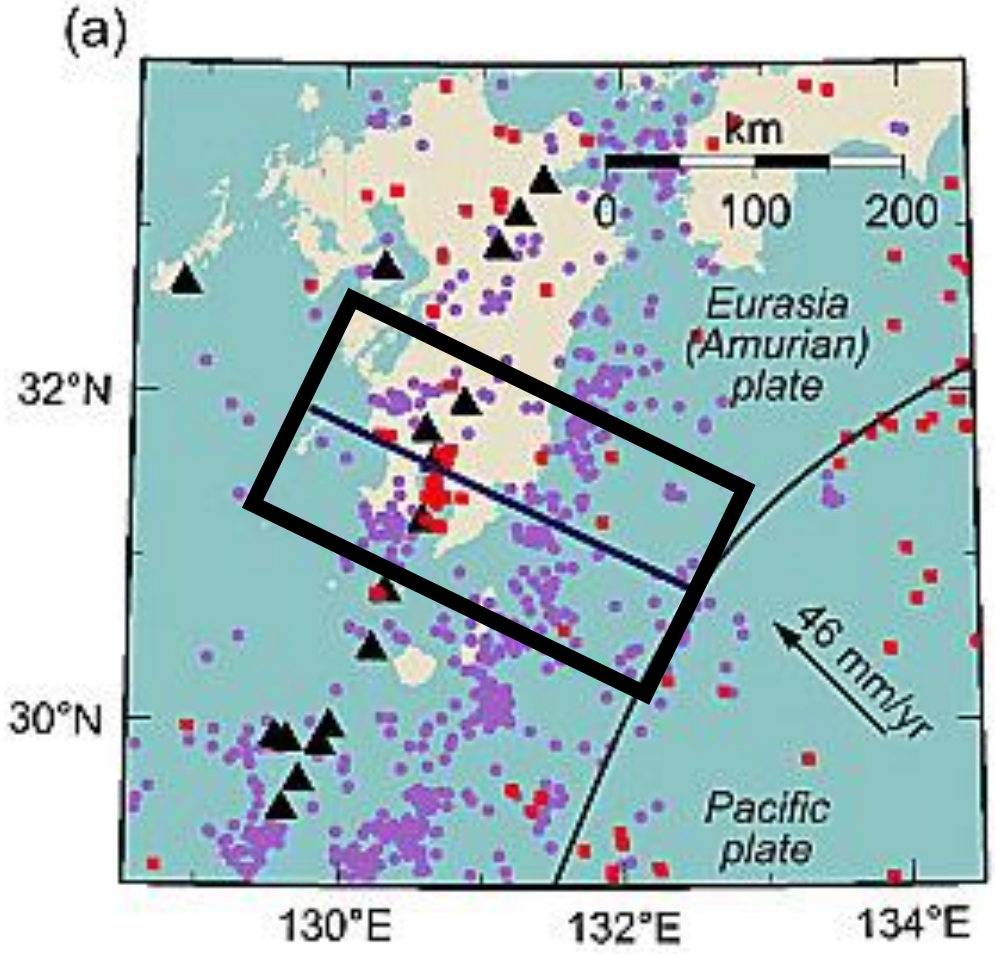


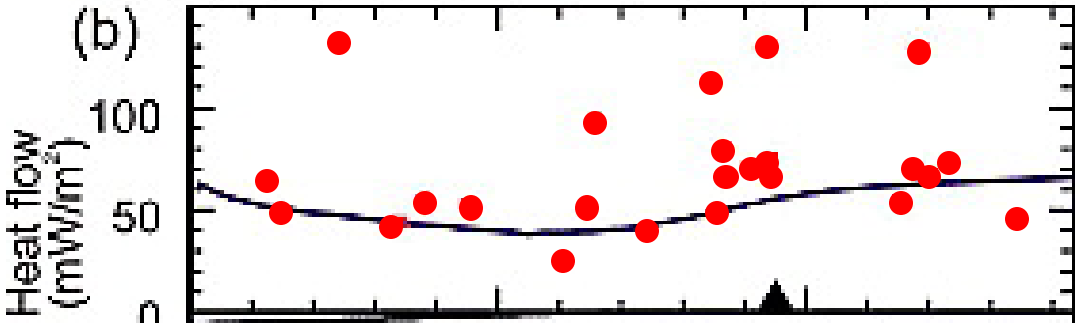


RMSE = sqrt(Σ(data – model)^2 / N)

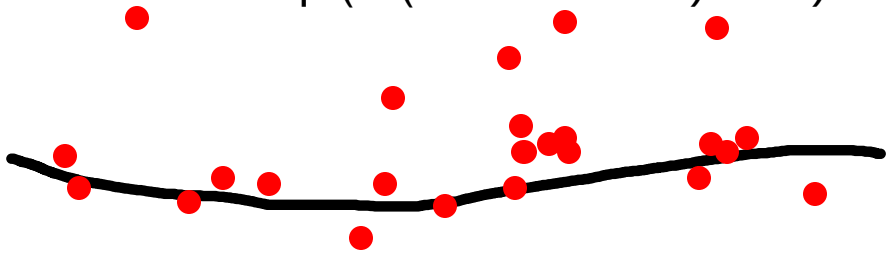
Wada & Wang (2009; G3)

Strategies for sampling HF data are critical for SZ research



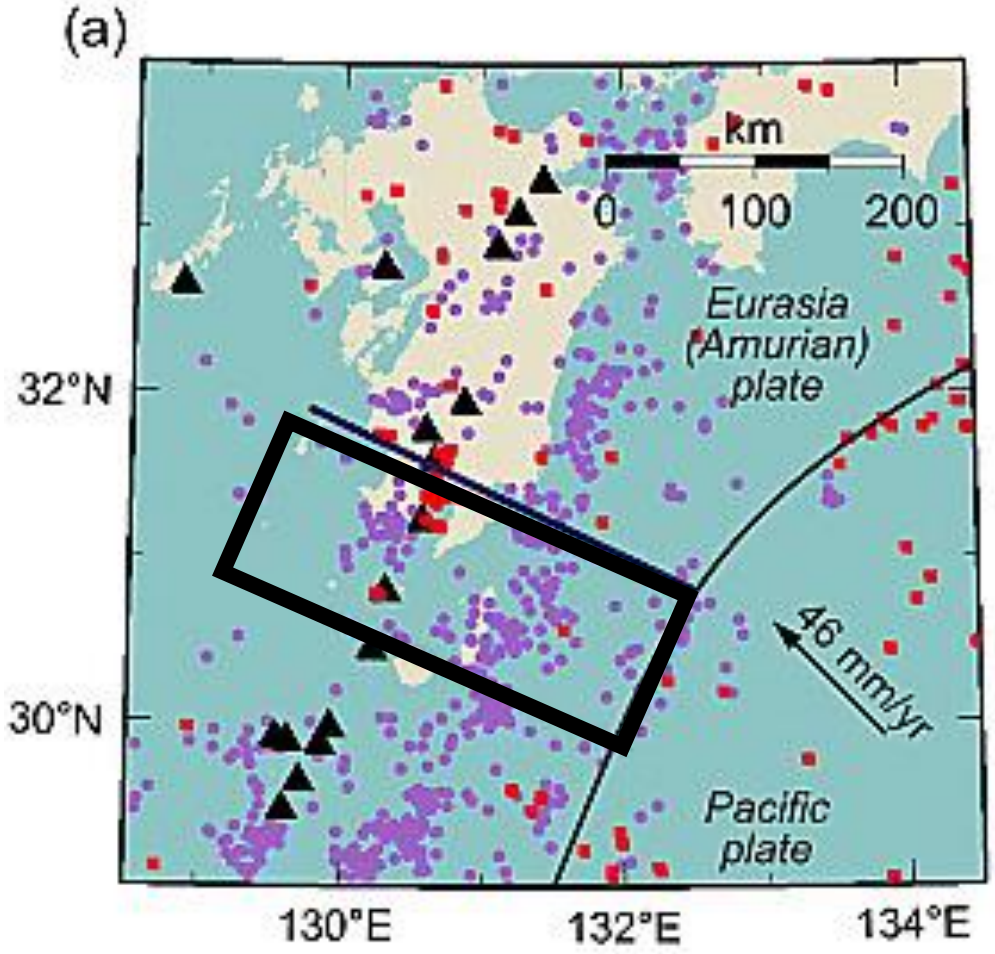


RMSE = sqrt(Σ(data – model)^2 / N)



Wada & Wang (2009; G3)

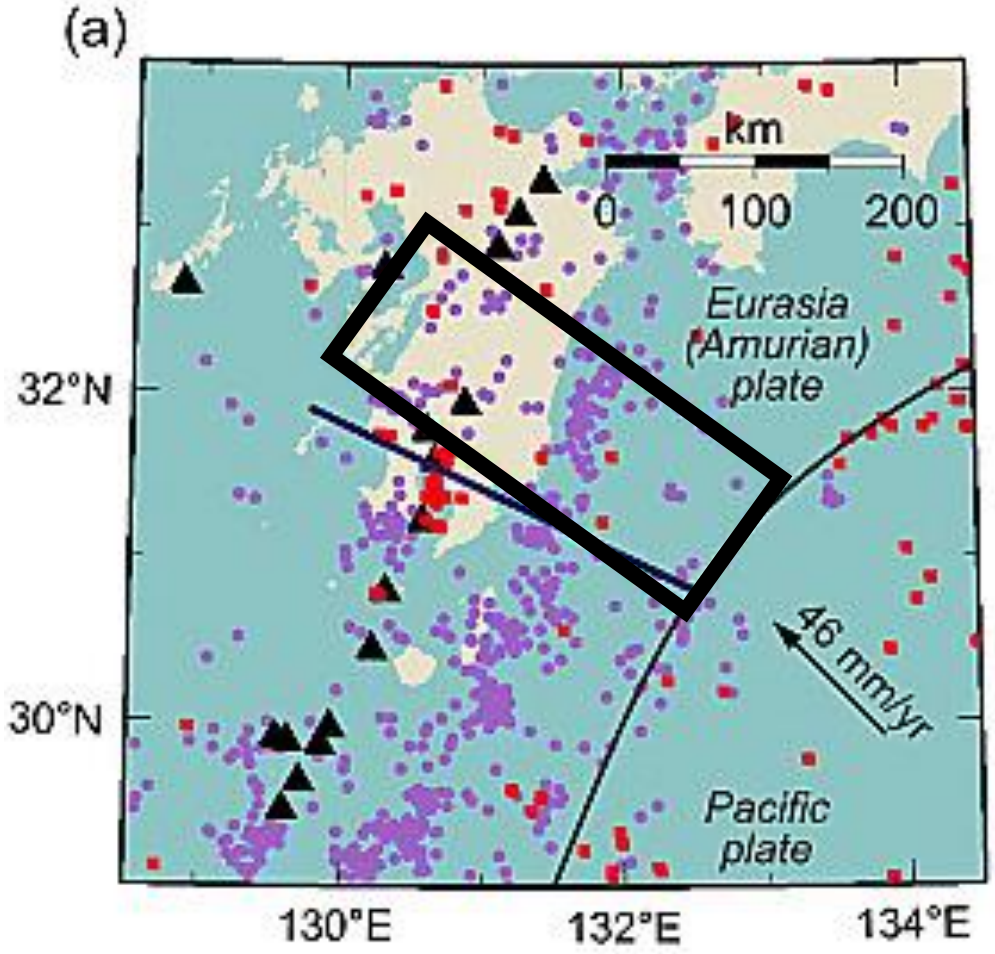
Strategies for sampling HF data are critical for SZ research



??

Wada & Wang (2009; G3)

Strategies for sampling HF data are critical for SZ research

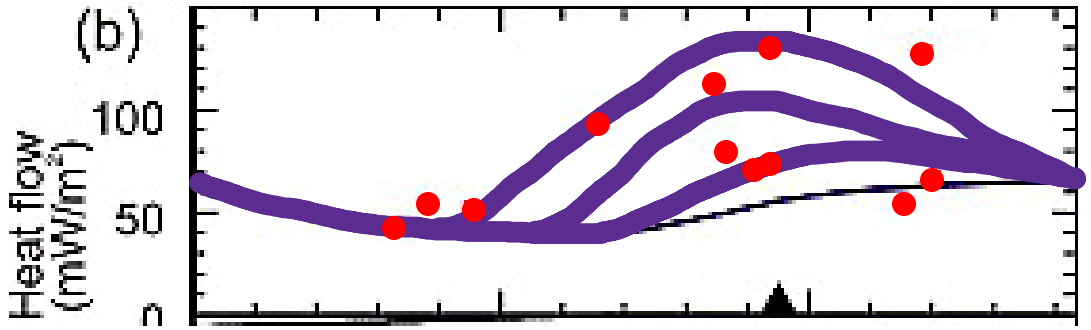


??

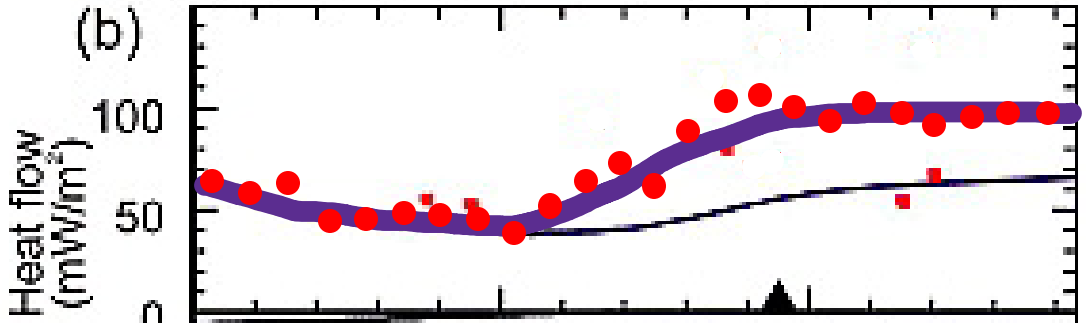
Wada & Wang (2009; G3)

Noisy HF observations lead to spurious and uncertain results

Fitting thermal models to raw HF

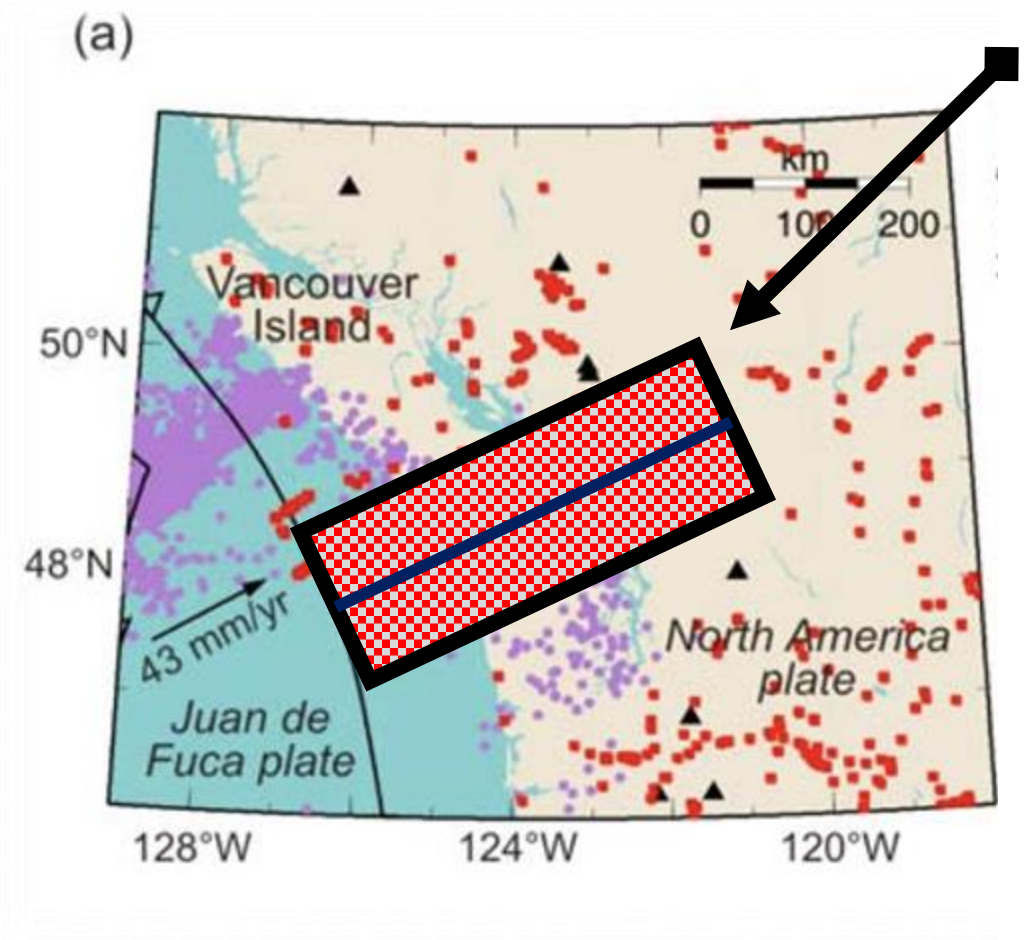


Fitting thermal models to spatial interpolation (prediction)



Wada & Wang (2009; G3)

Kriging and Similarity interpolation techniques



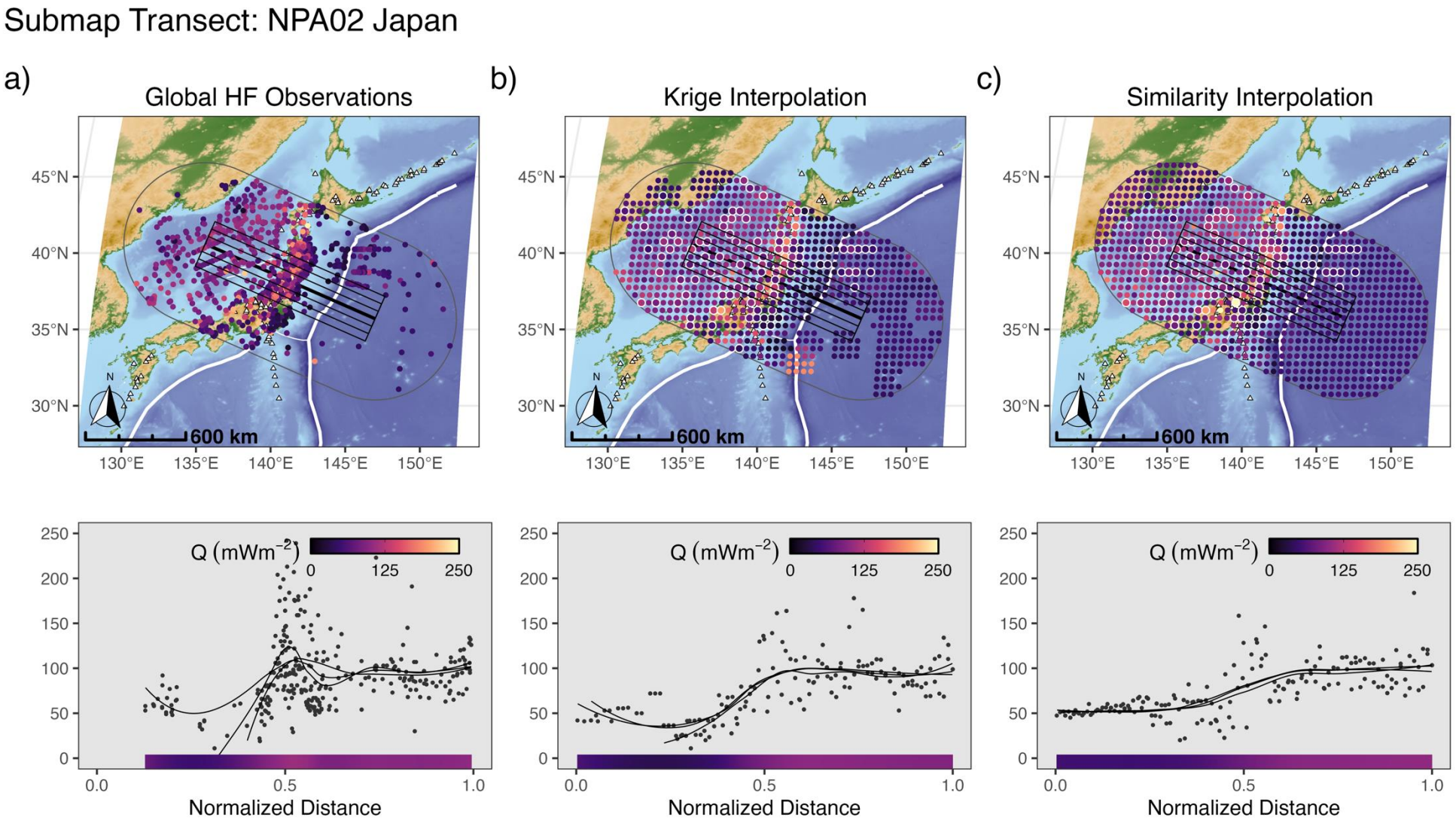
Predicted HF distribution based on fundmaental laws of geostatistics:

1st Law (Krige, 1951):
Everything is related everything else, but nearer things are more related (spatial autocorrelation)

3rd Law (Zhu et al., 2018):
The more similar the geographic [geological] configuration, the more similar the target variable [HF] (i.e., Similarity; Lucazeau, 2019)

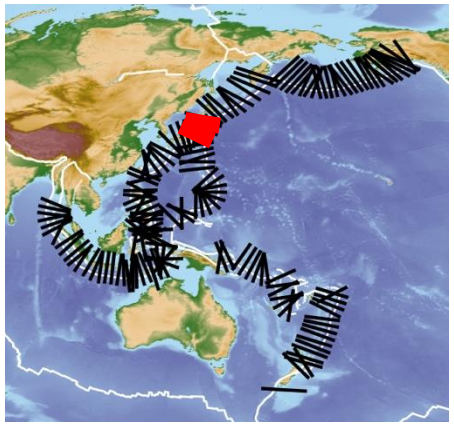
Wada & Wang (2009; G3)

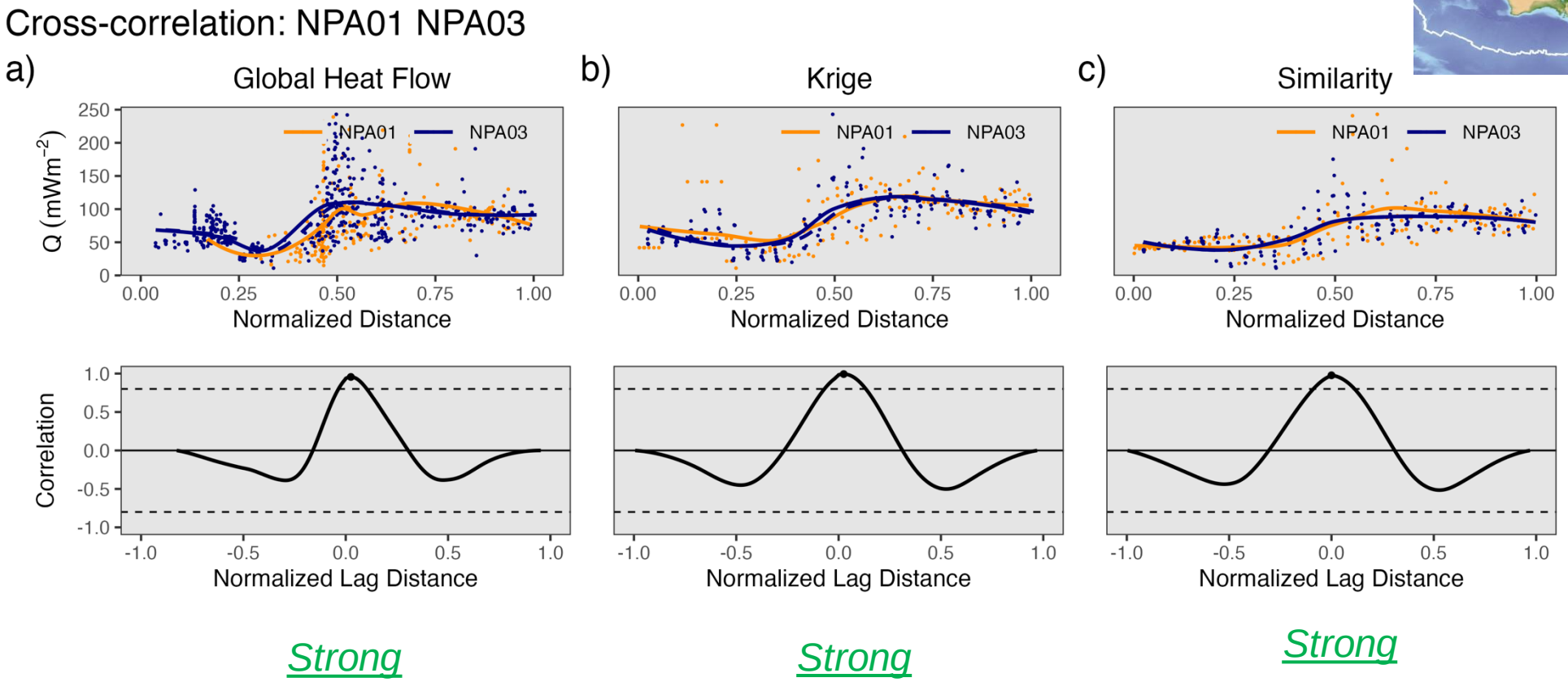
Interpolations smooth out noisy data



Kerswell & Kohn (in prep.)

HF patterns for nearby transects correlate well

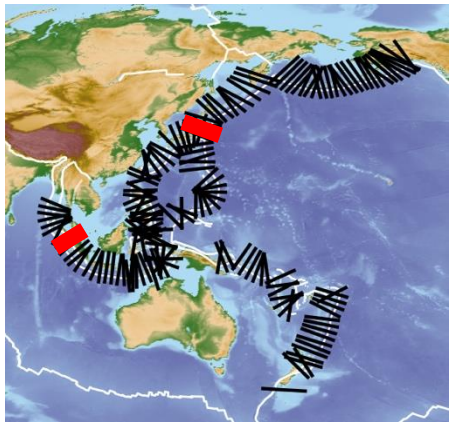


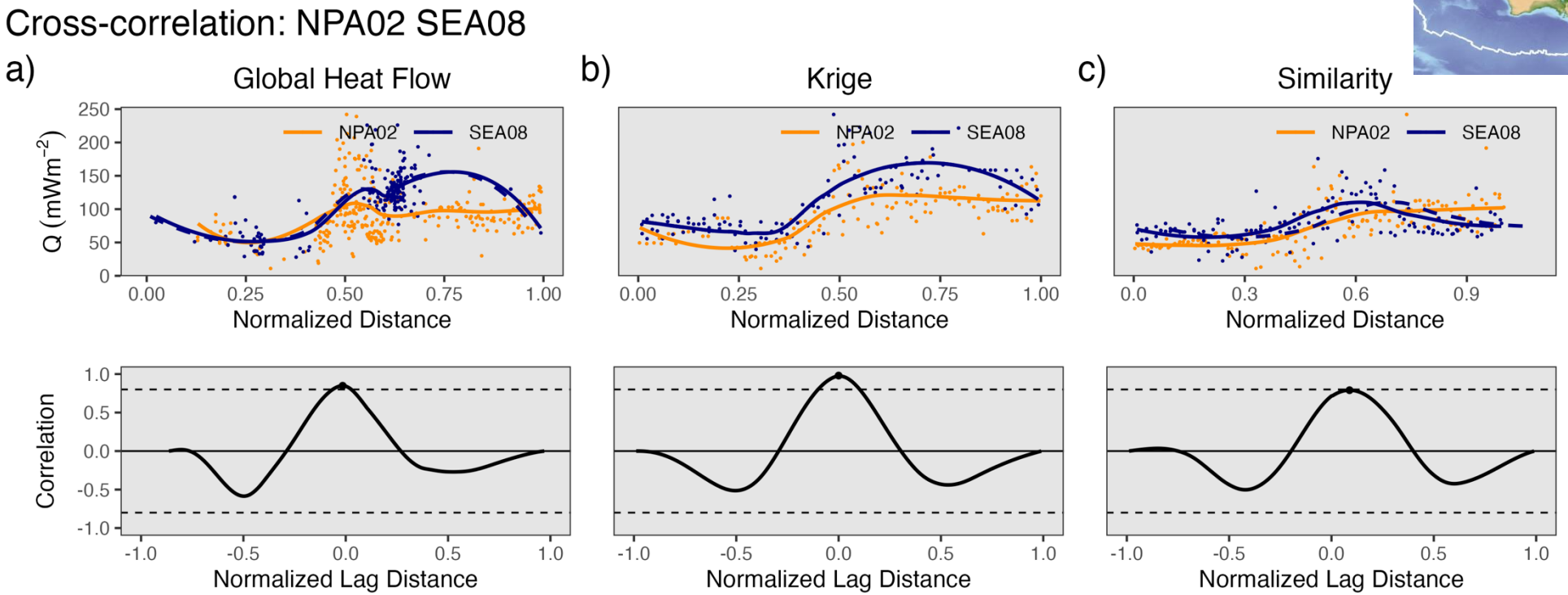


Strong *Strong* *Strong*

Kerswell & Kohn (in prep.)

HF patterns: NE Japan & N Sumatra

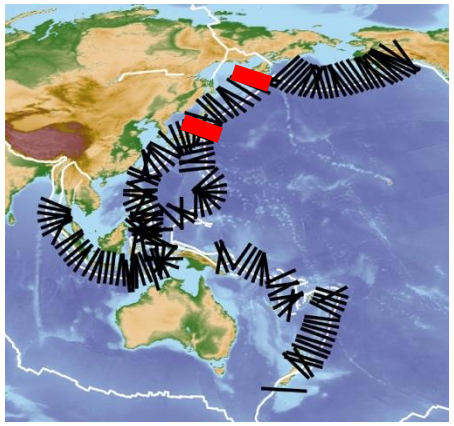


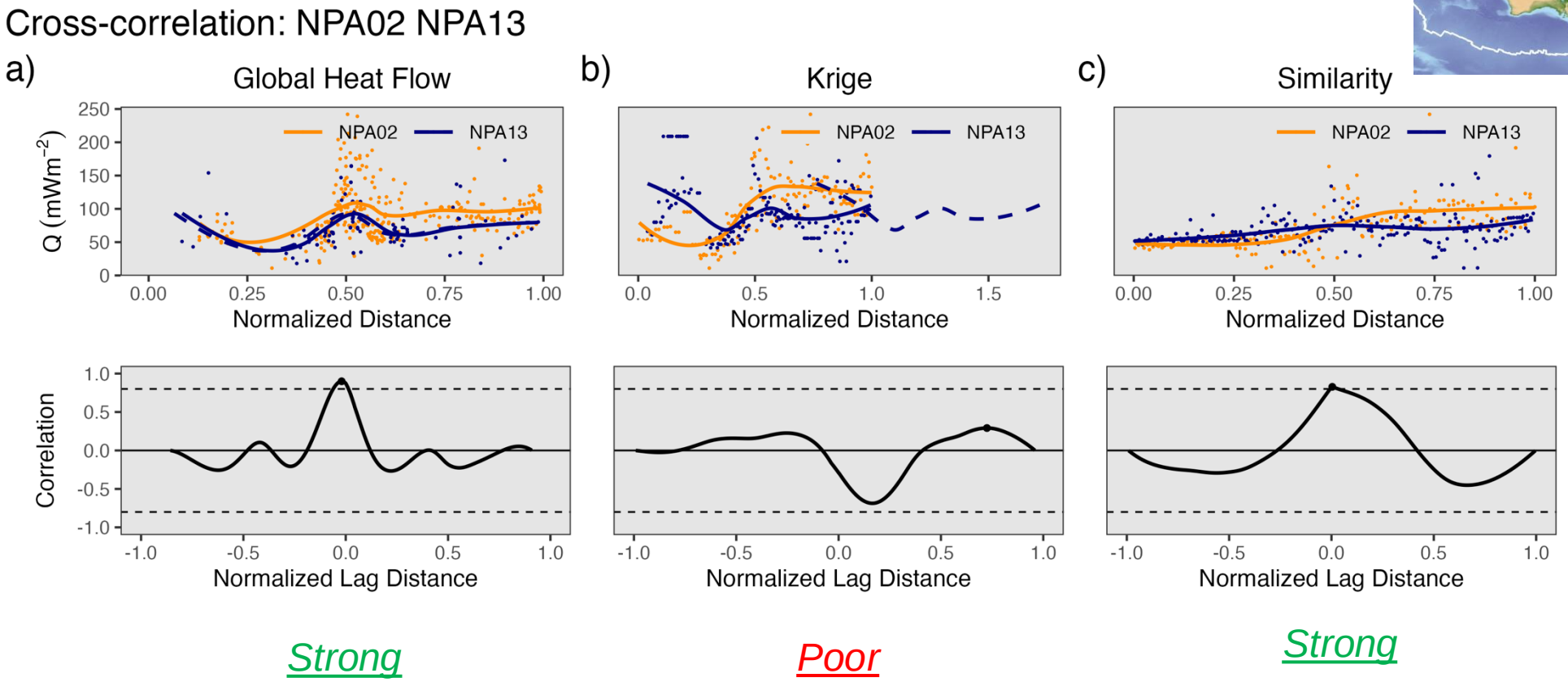


Strong *Strong* *Strong*

Kerswell & Kohn (in prep.)

HF patterns: NE Japan & Kamchatka

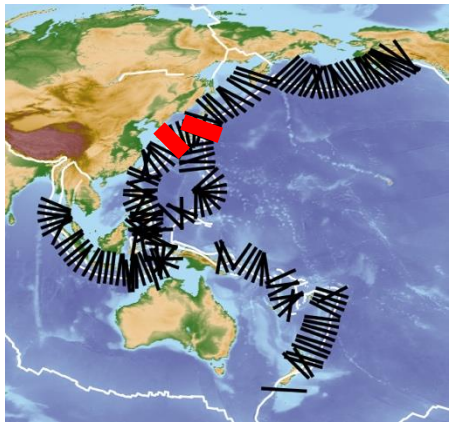


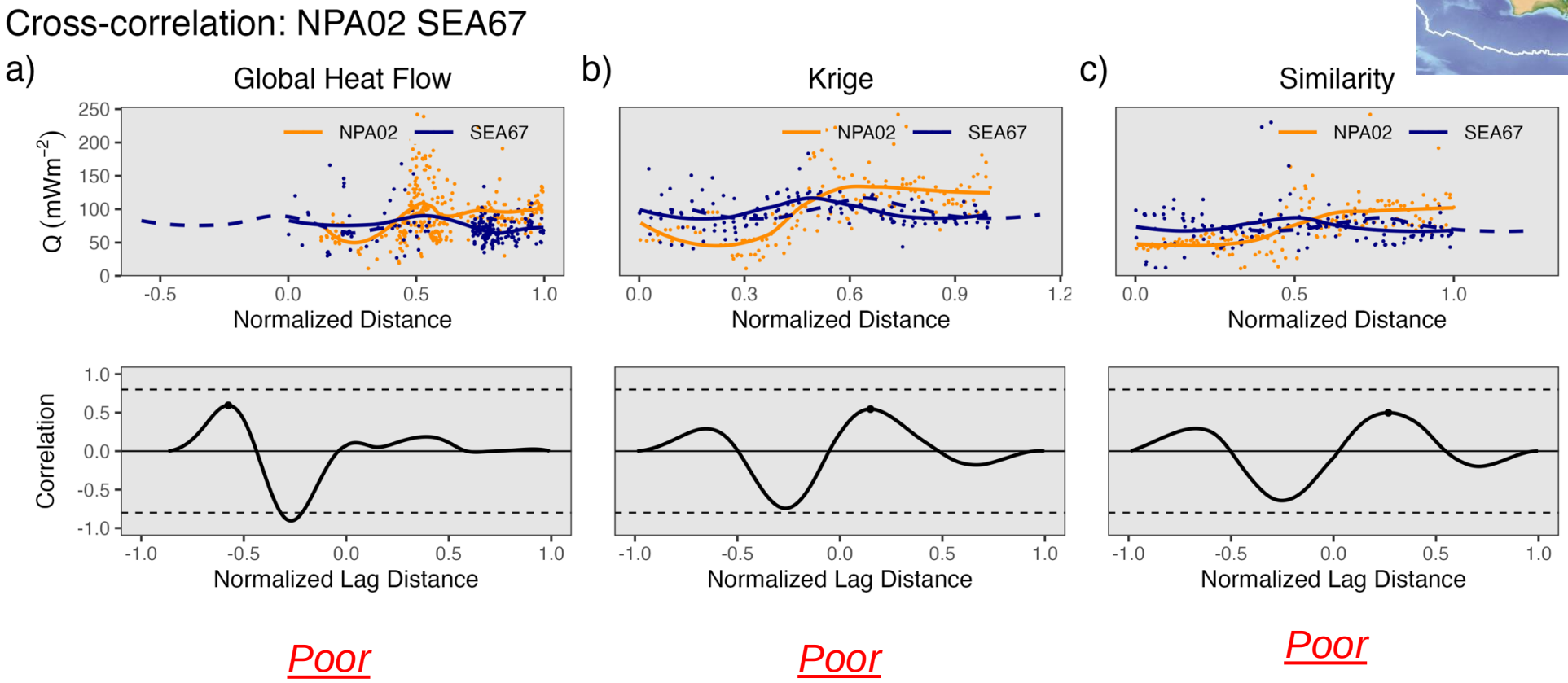


Strong *Poor* *Strong*

Kerswell & Kohn (in prep.)

HF patterns: NE Japan & Ryukyus

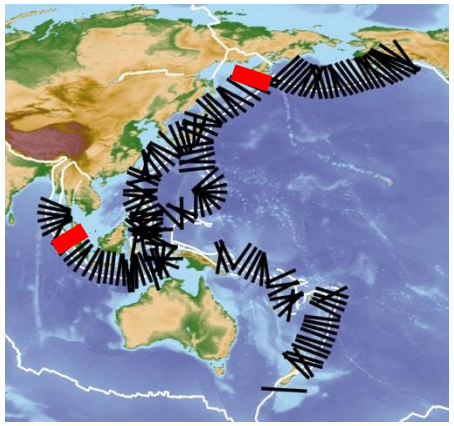


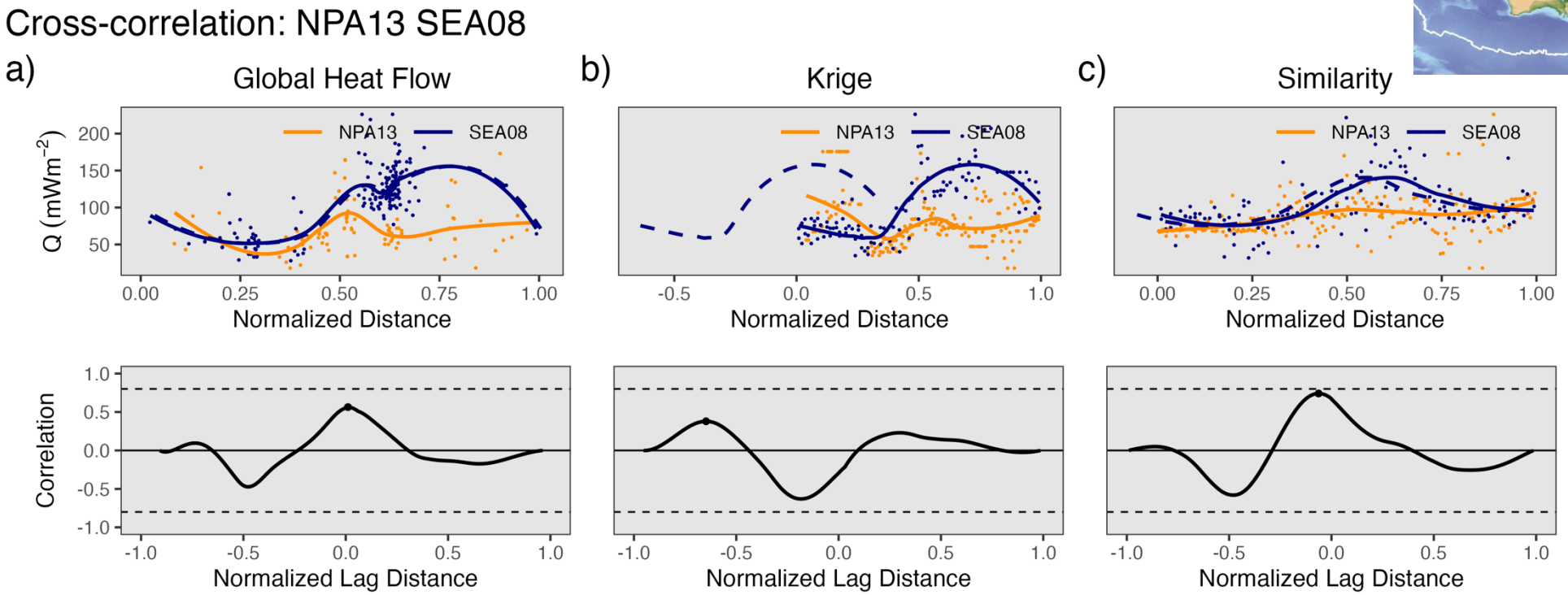


Poor *Poor* *Poor*

Kerswell & Kohn (in prep.)

HF patterns: Kamchatka & N Sumatra





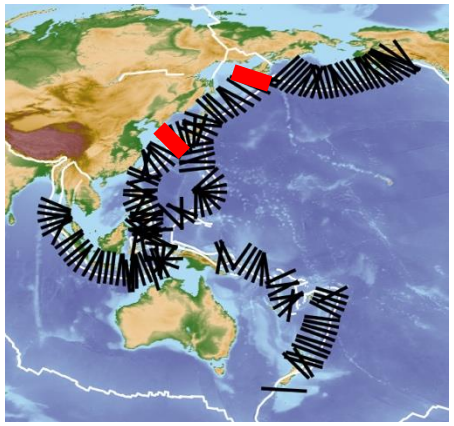
Poor

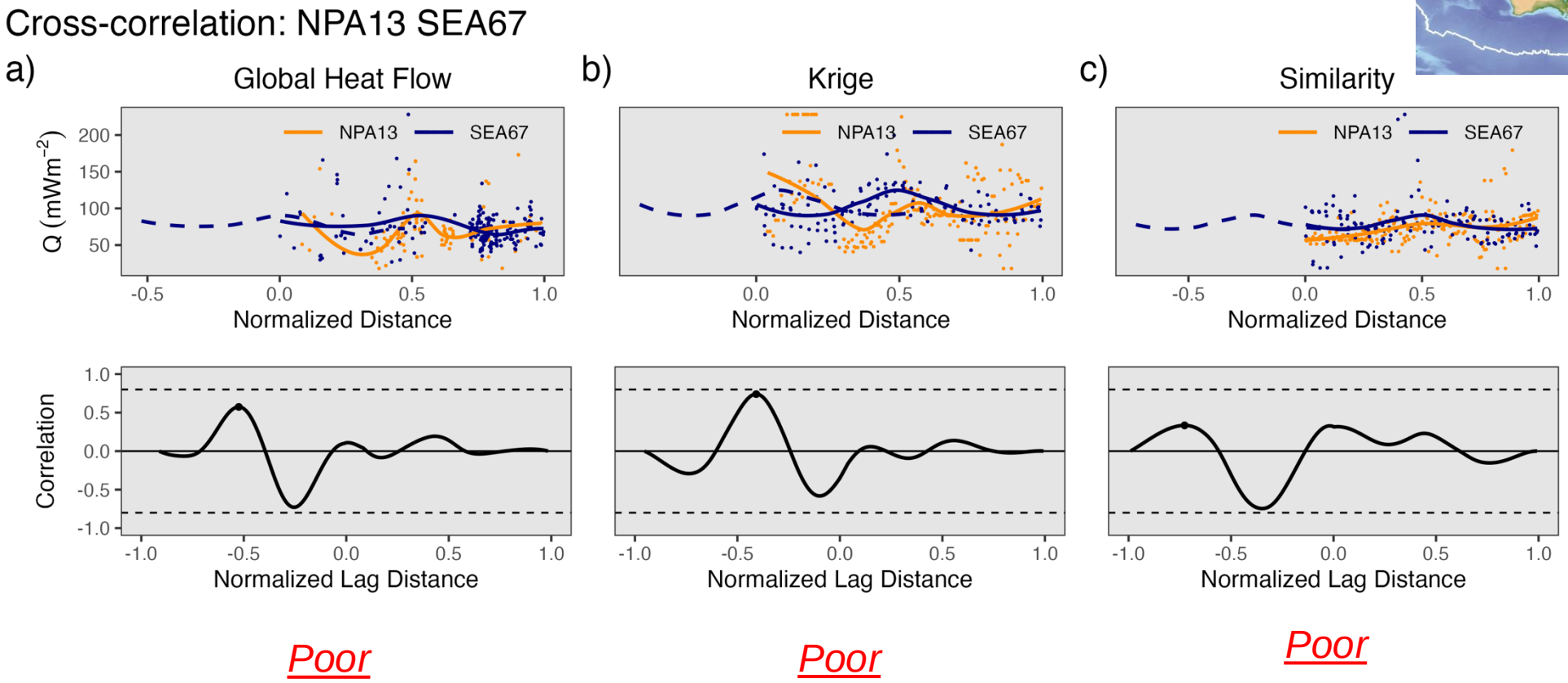
Poor

Moderate

Kerswell & Kohn (in prep.)

HF patterns: Kamchatka & Ryukyus



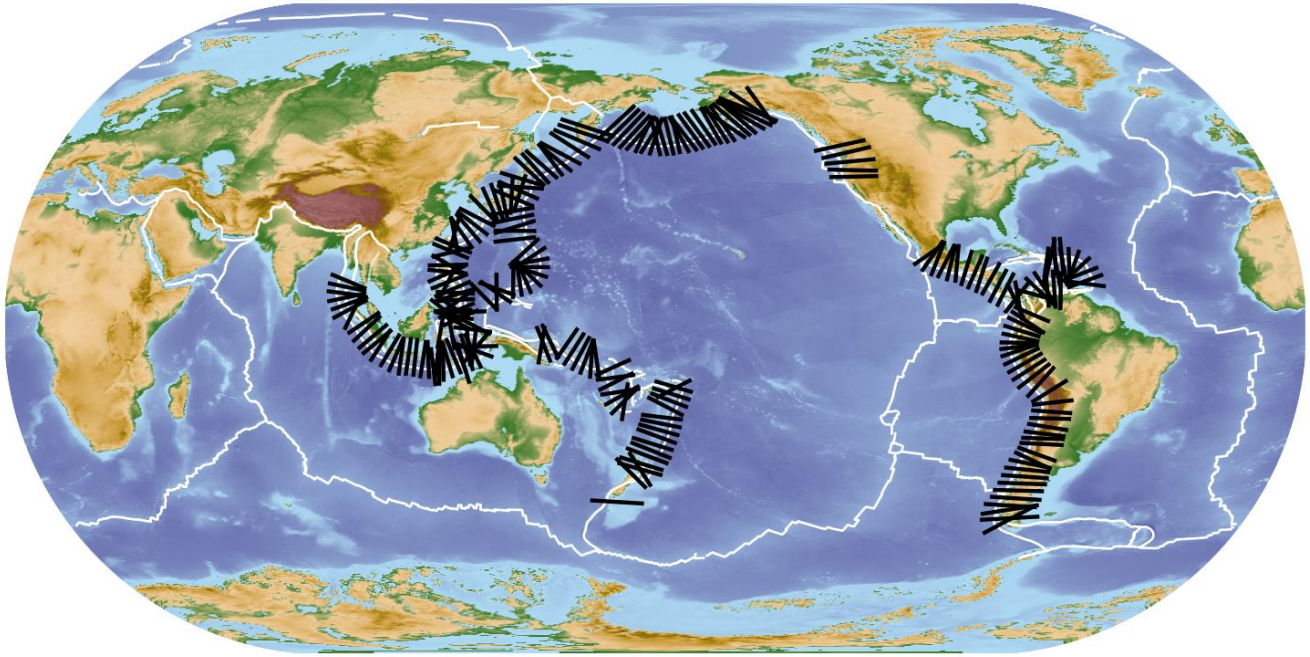


Poor *Poor* *Poor*

Kerswell & Kohn (in prep.)

In summary, similar coupling depths among distant SZs are exceptional coincidences, rather than a global trend

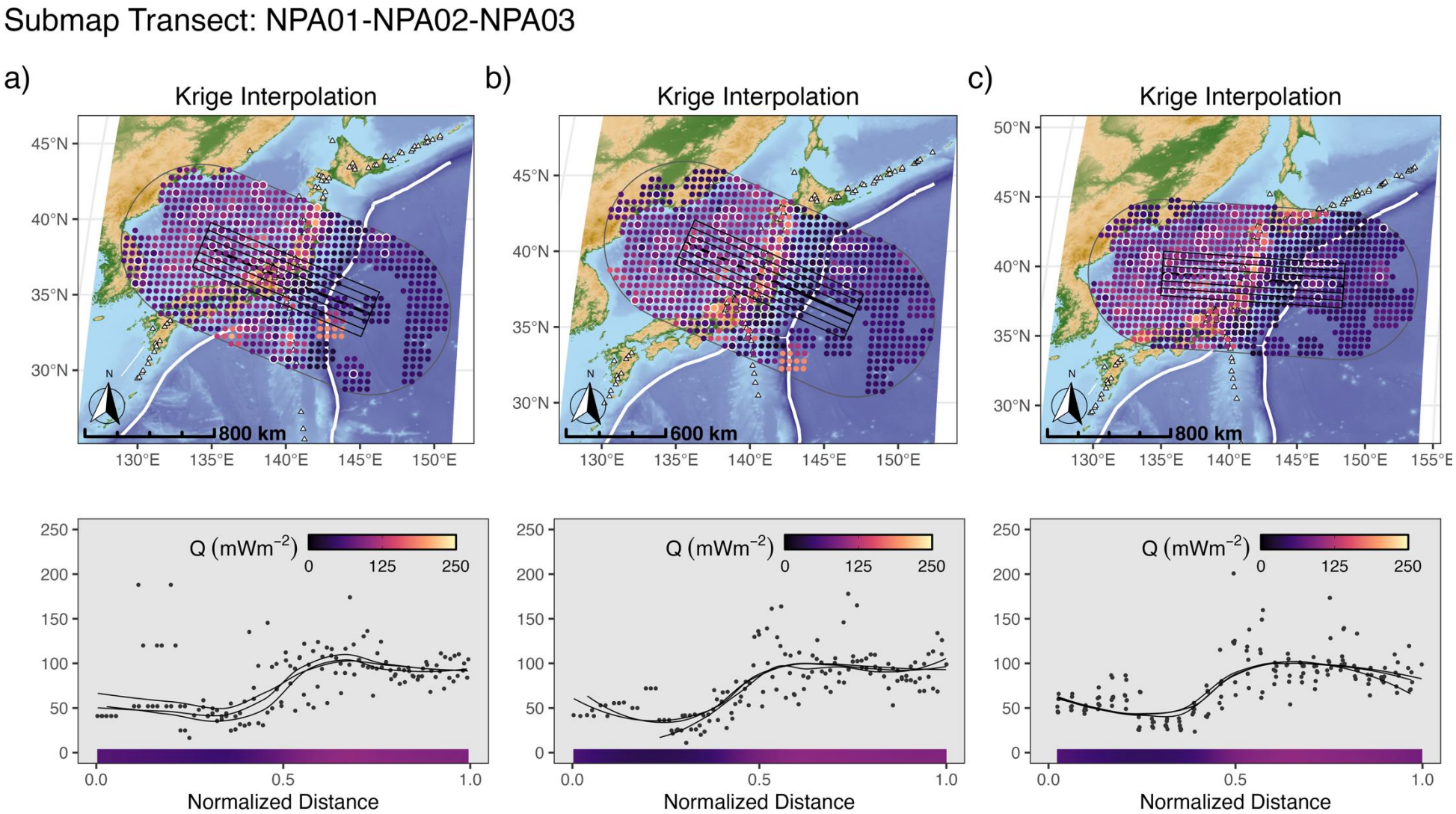
Submap Transects



Similarity and Kriging interpolation methods provide complementary information about the local HF distributions

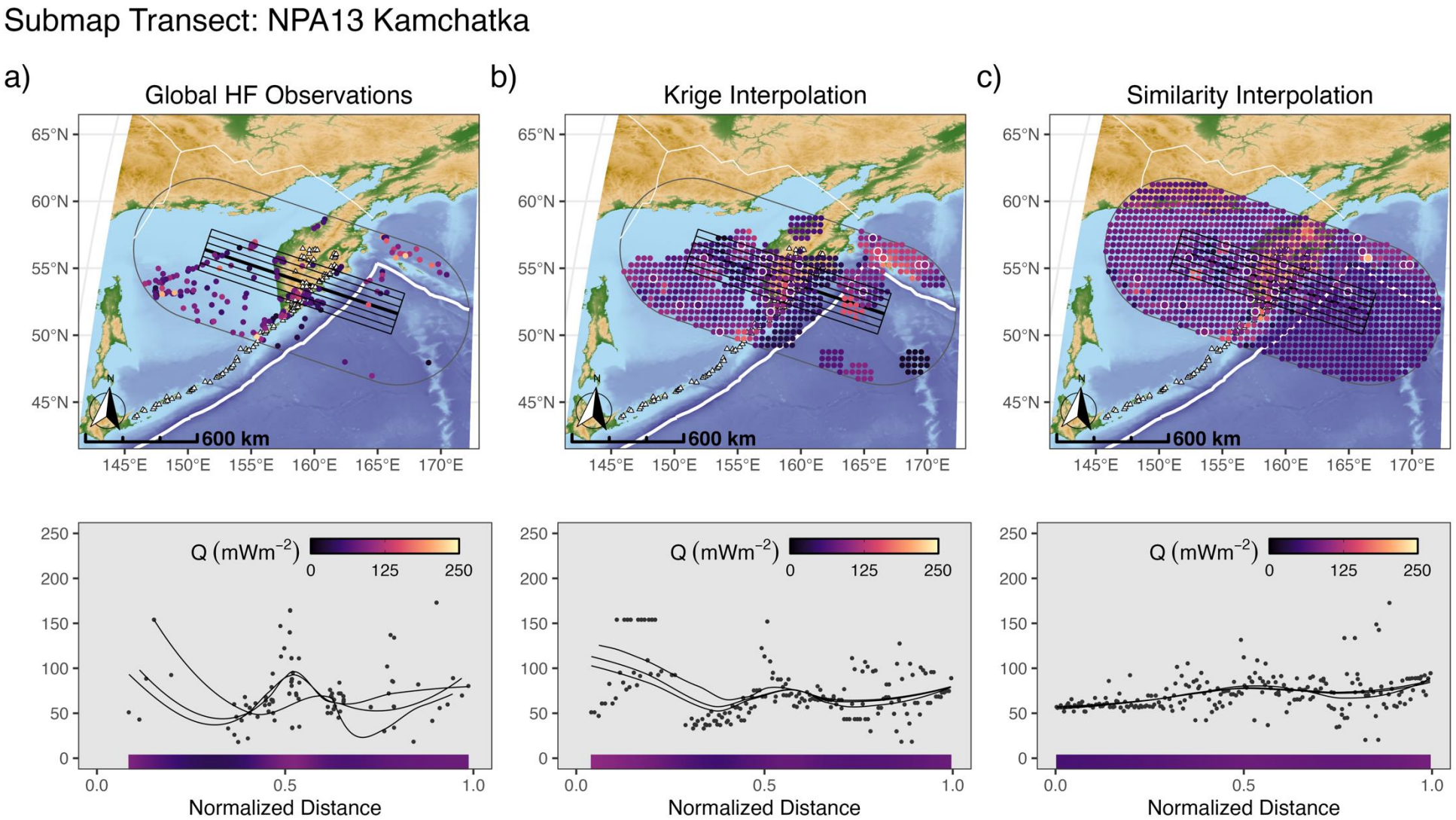
Questions?

HF patterns among nearby transects correlate well



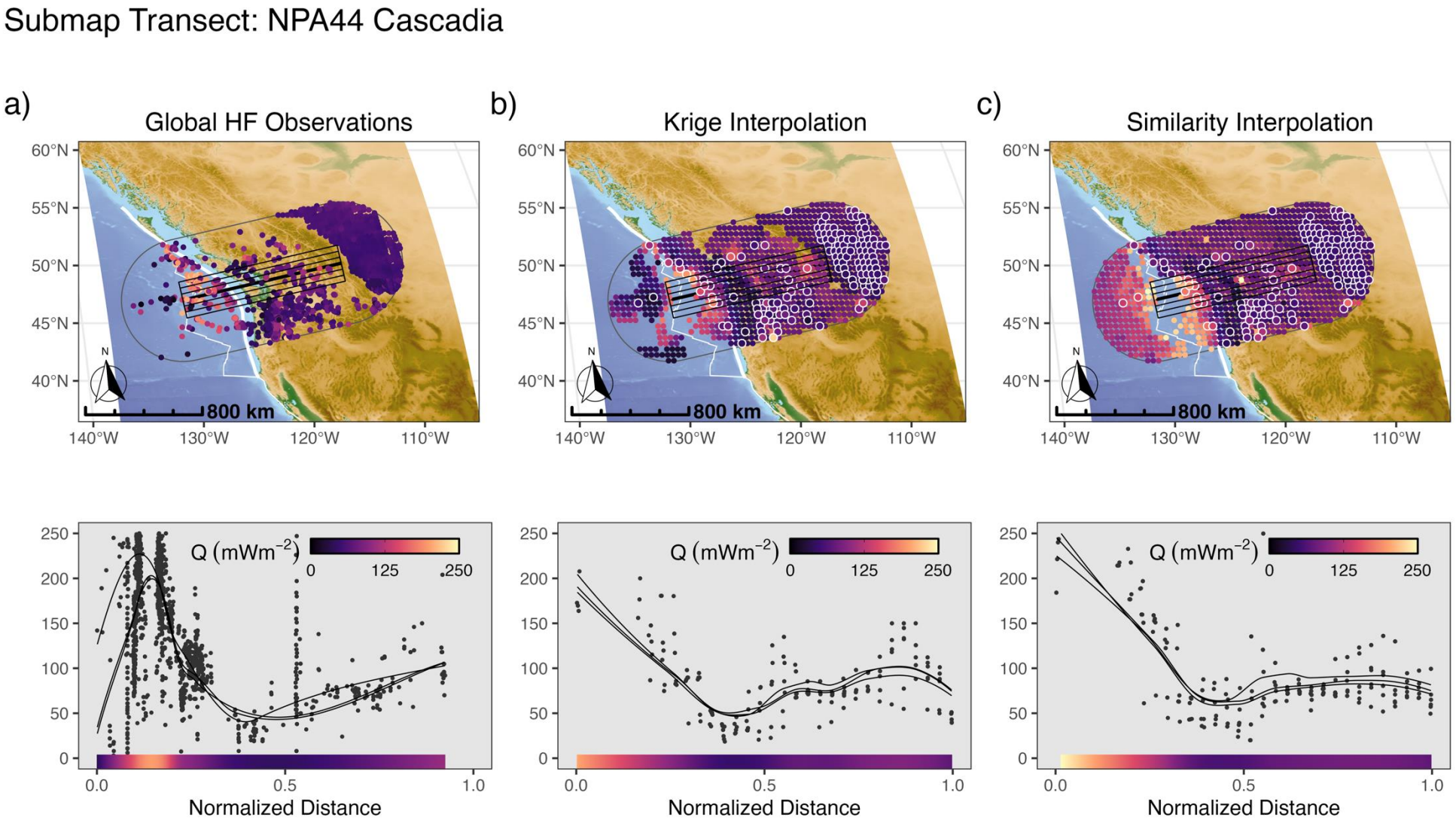
Kerswell & Kohn (in prep.)

Recognizable HF profile patterns emerge from noisy data



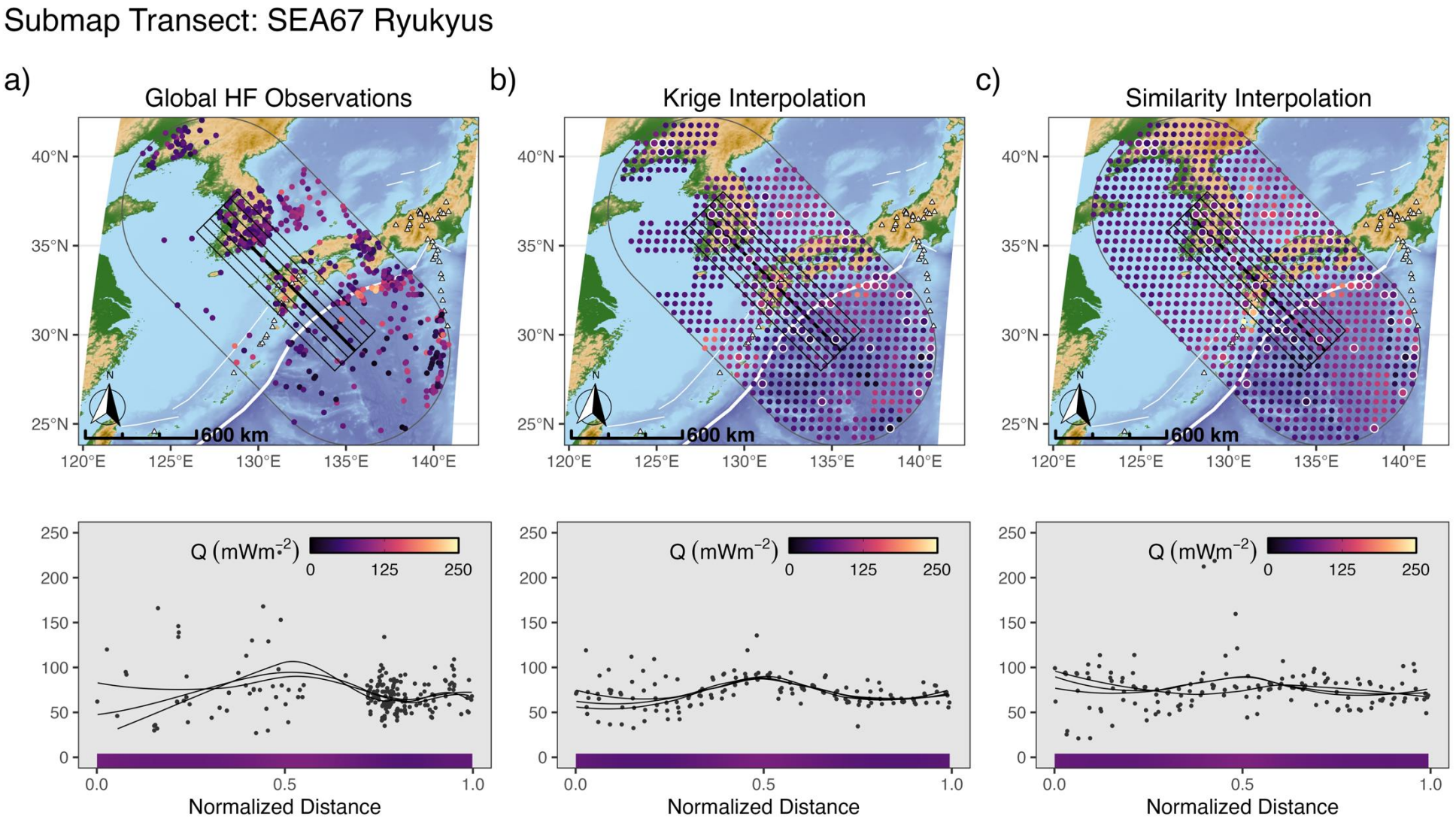
Kerswell & Kohn (in prep.)

Recognizable HF profile patterns emerge from noisy data



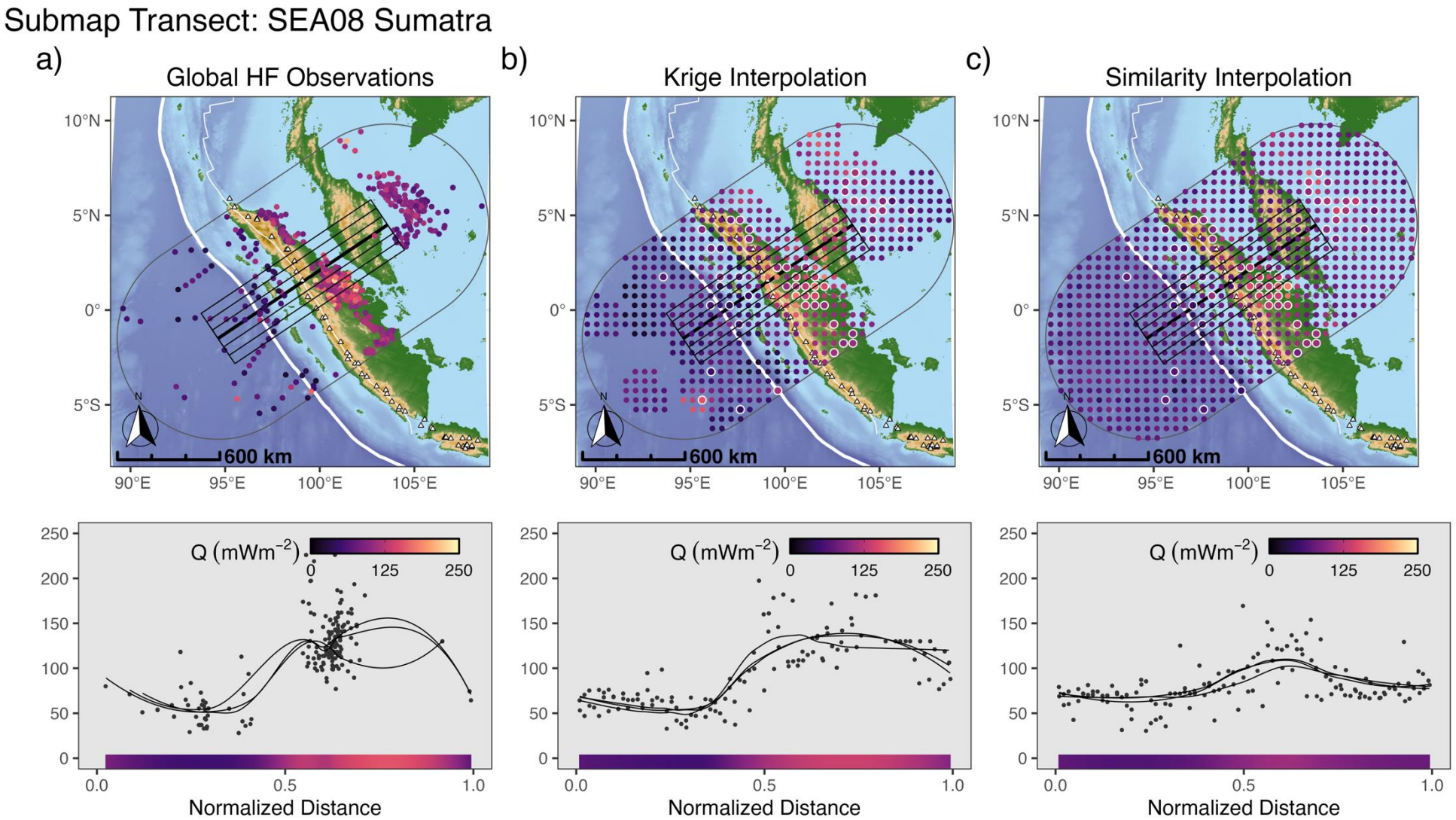
Kerswell & Kohn (in prep.)

Recognizable HF profile patterns emerge from noisy data



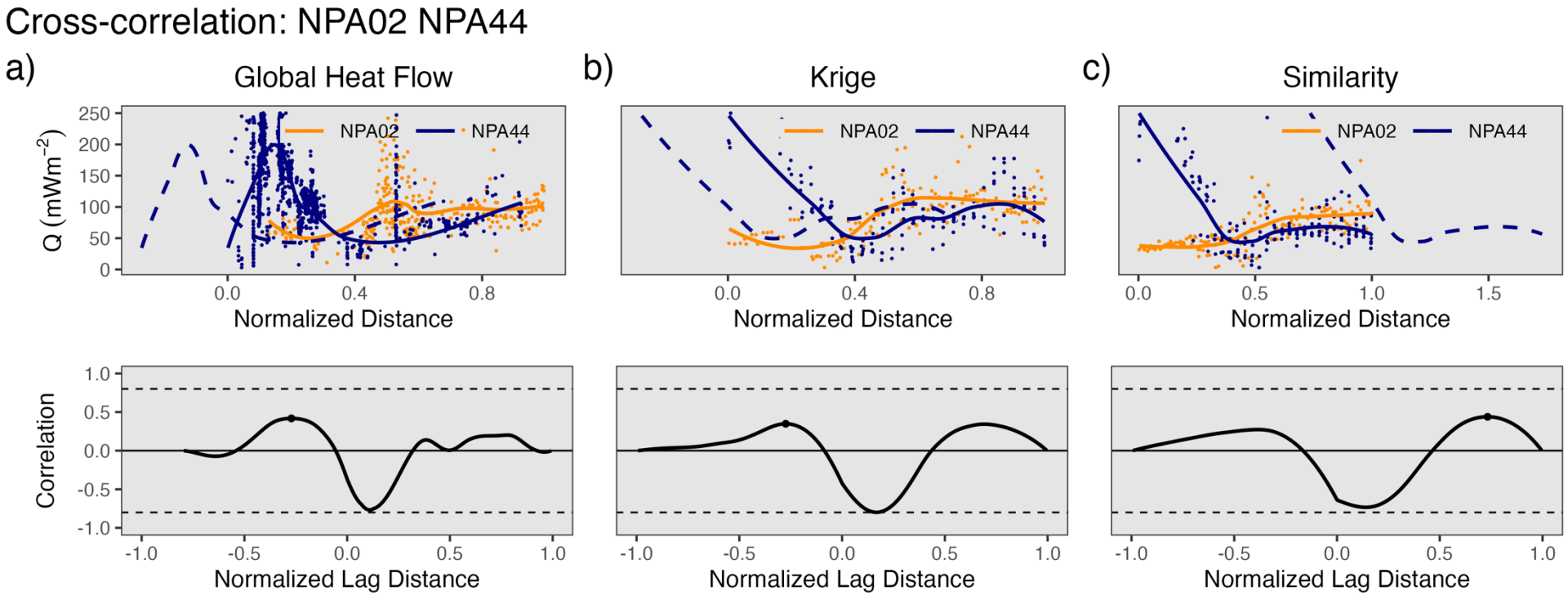
Kerswell & Kohn (in prep.)

Recognizable HF profile patterns emerge from noisy data



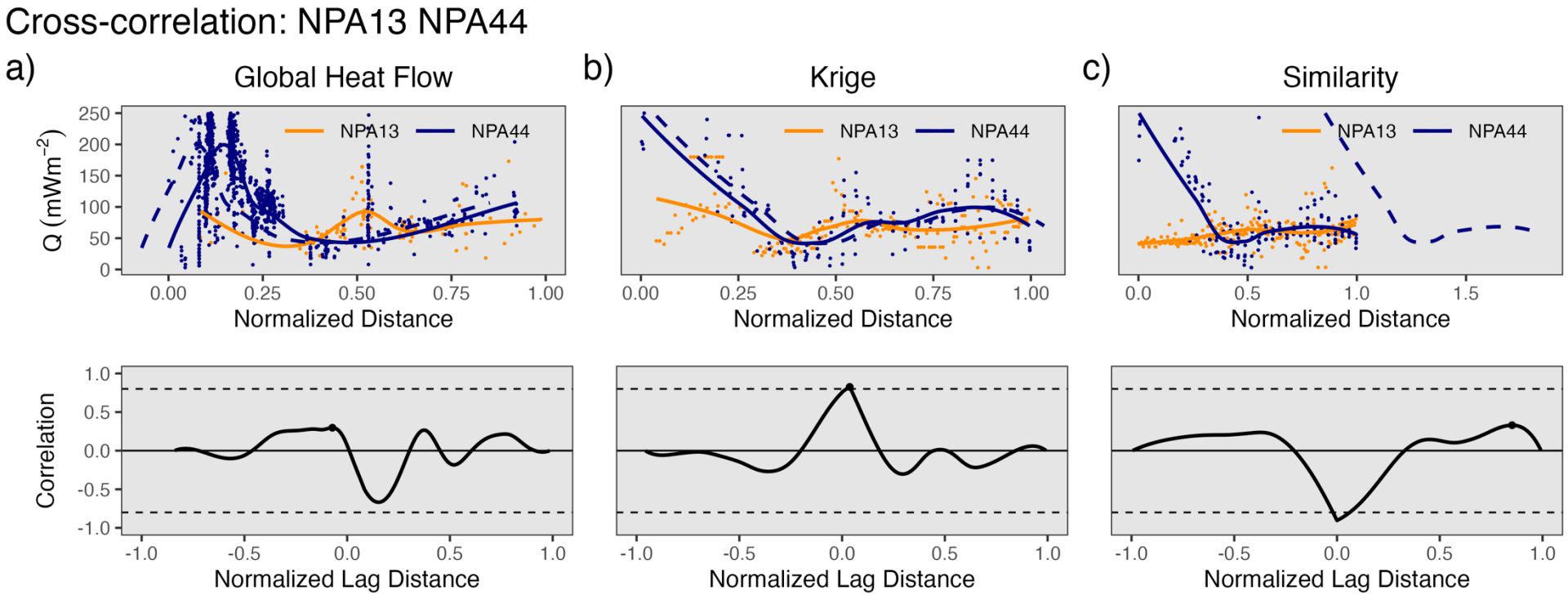
Kerswell & Kohn (in prep.)

HF patterns: NE Japan & N Cascadia



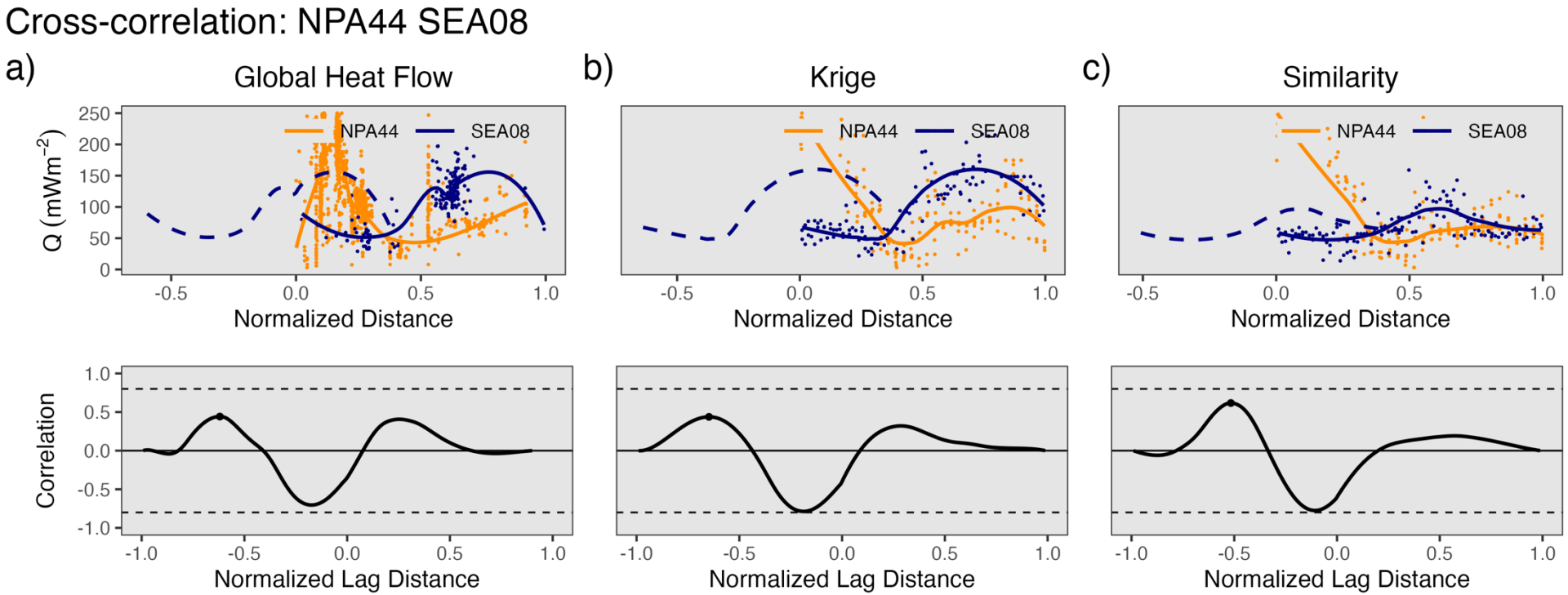
Kerswell & Kohn (in prep.)

HF patterns: Kamchatka & N Cascadia



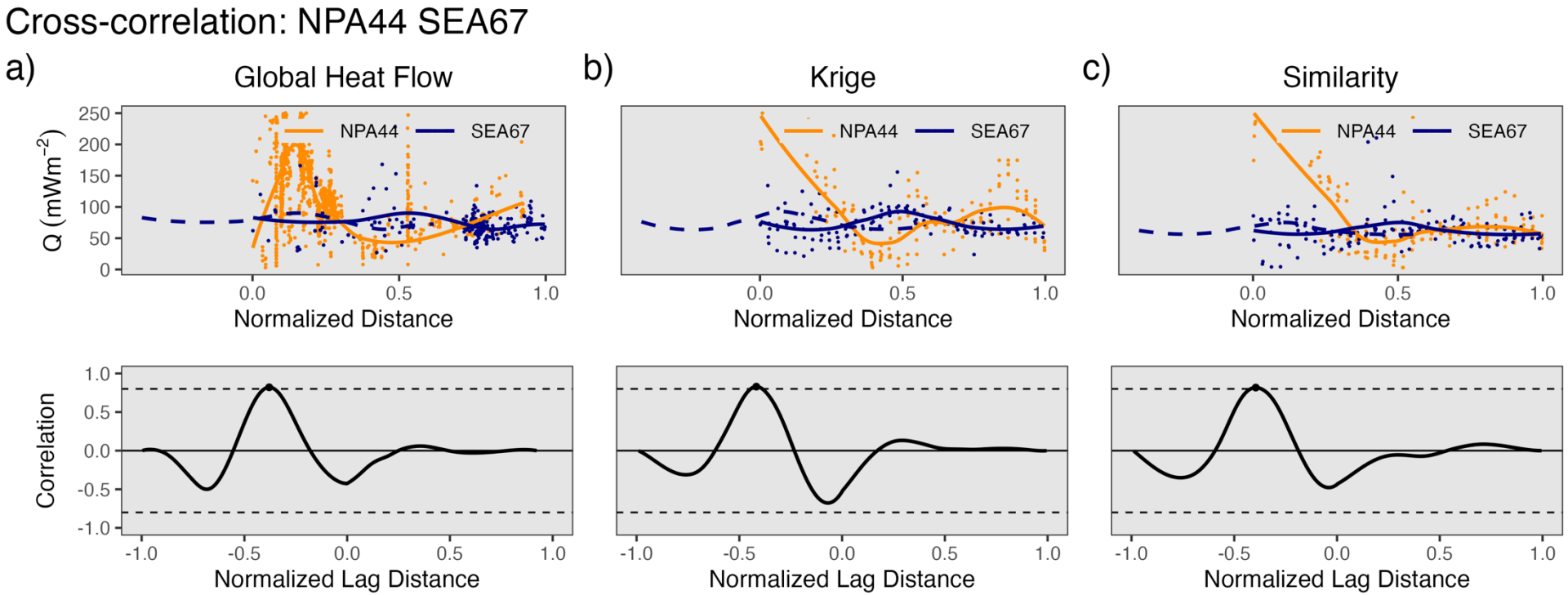
Kerswell & Kohn (in prep.)

HF patterns: N Cascadia & N Sumatra



Kerswell & Kohn (in prep.)

HF patterns: N Cascadia & Ryukyus



Kerswell & Kohn (in prep.)