

Dust-Drought Relationship in the Four Corners Region and Implications for Society

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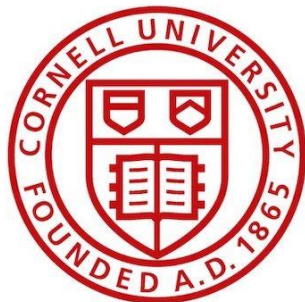
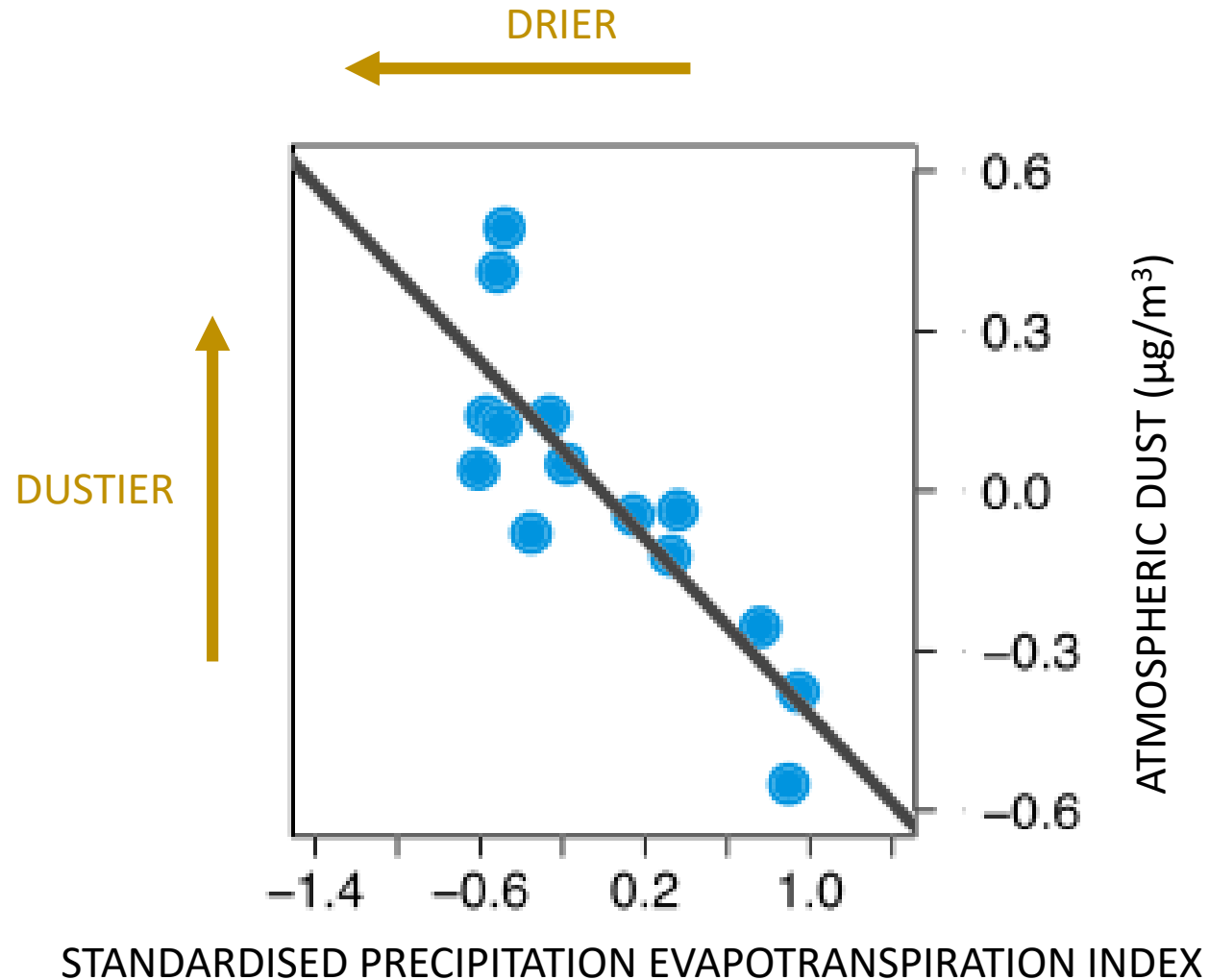


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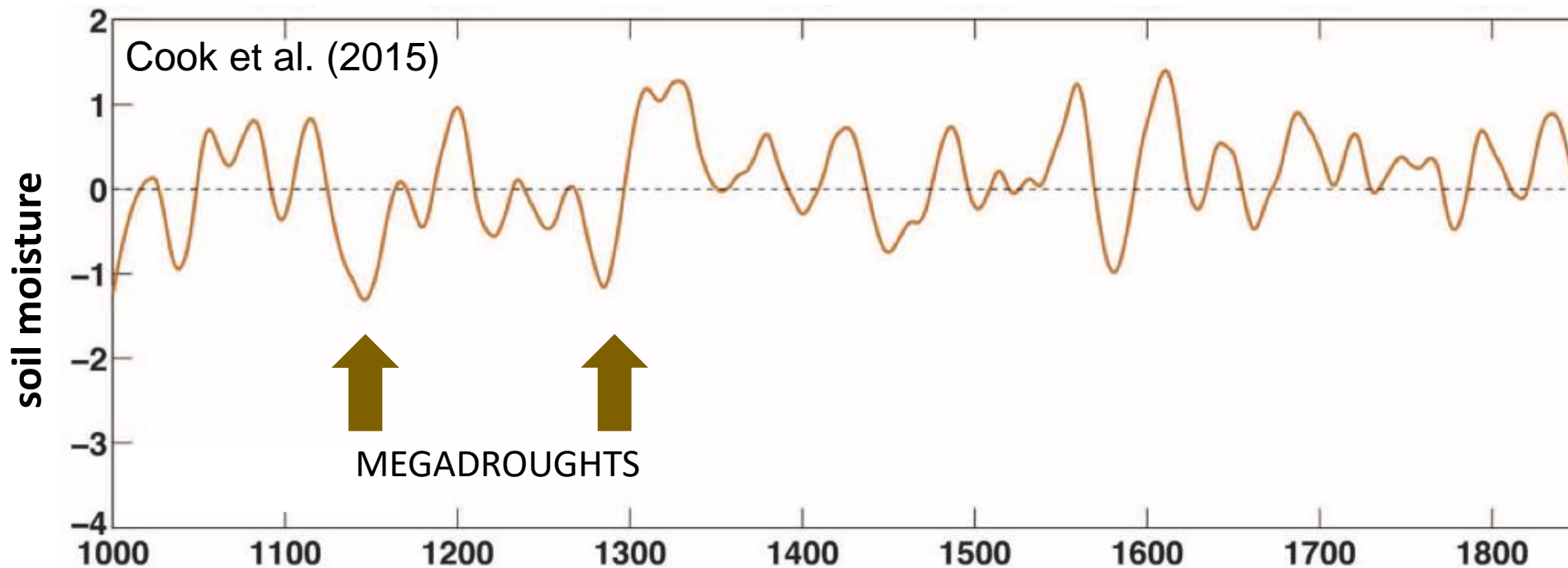
DUST-DROUGHT NEXUS

More dust with drier conditions today



- Unit decrease in 2-month SPEI associated with 0.22–0.43 $\mu\text{g}/\text{m}^3$ dust increase

Unprecedented 21st century drought risk in the American Southwest



Were megadroughts dustier?

PART 1
Paleo dust reconstruction

PART 2
Paleo model analysis

PART 3
Paleo model/data comparison

PART 1

Paleo dust reconstruction

- Lake network San Juan Mnts
- Grainsize and composition
- Compare to dust-on-snow
- Last 15,000 years

PART 2

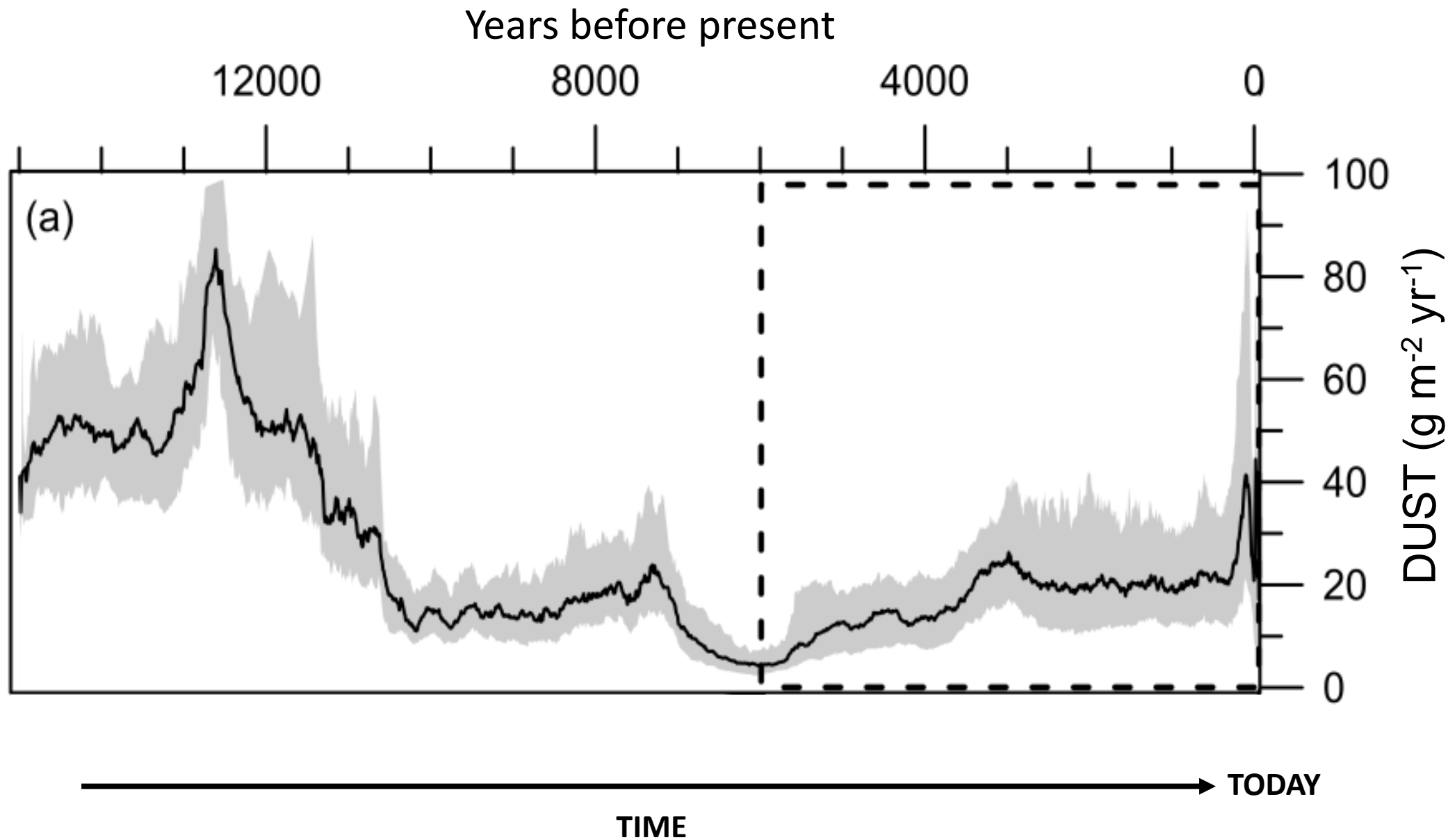
Paleo model analysis

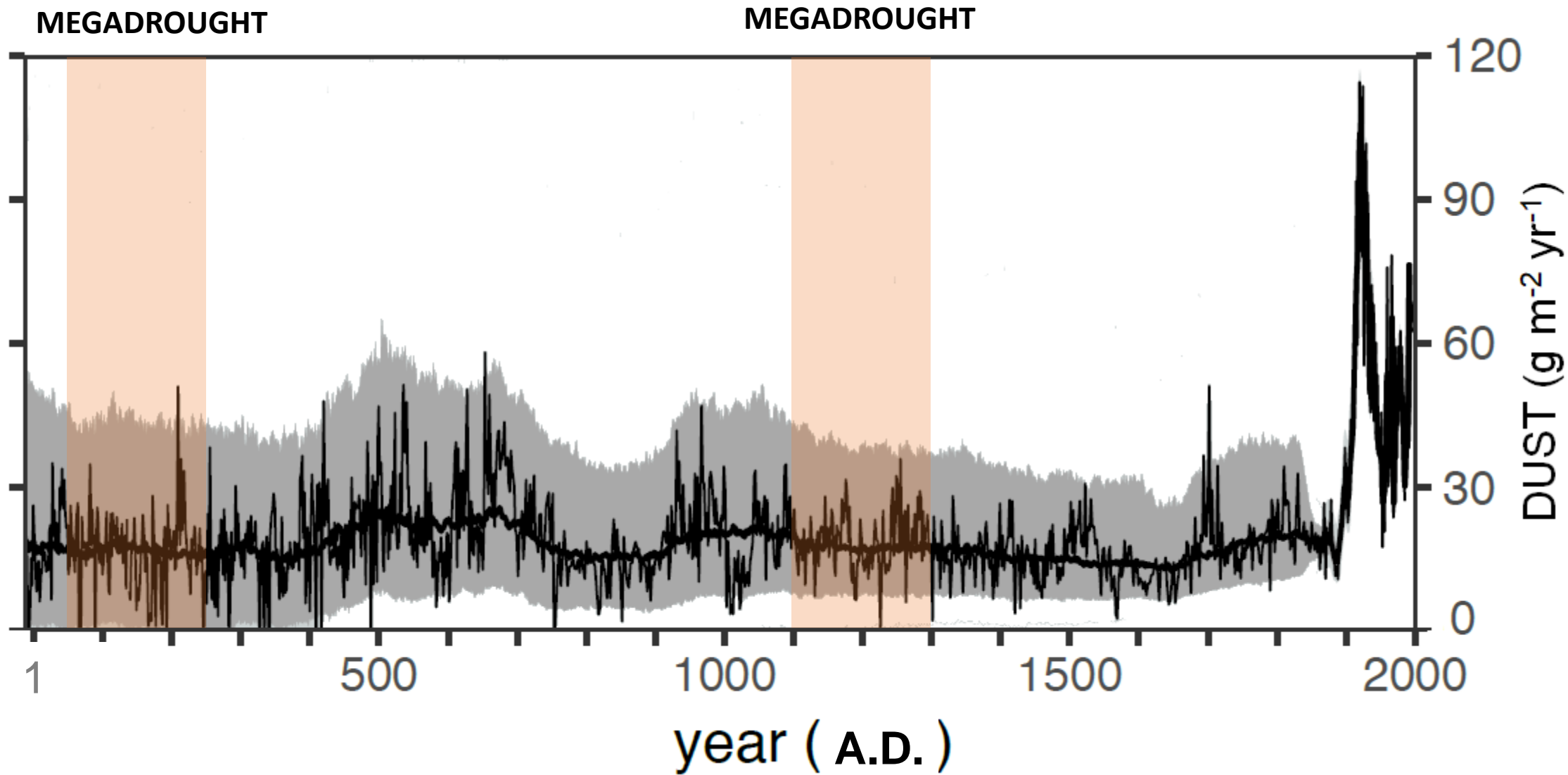
- Community Earth System Model
- Last Millennium Experiment
- Dust module
- Megadroughts
- Role of age uncertainty

PART 3

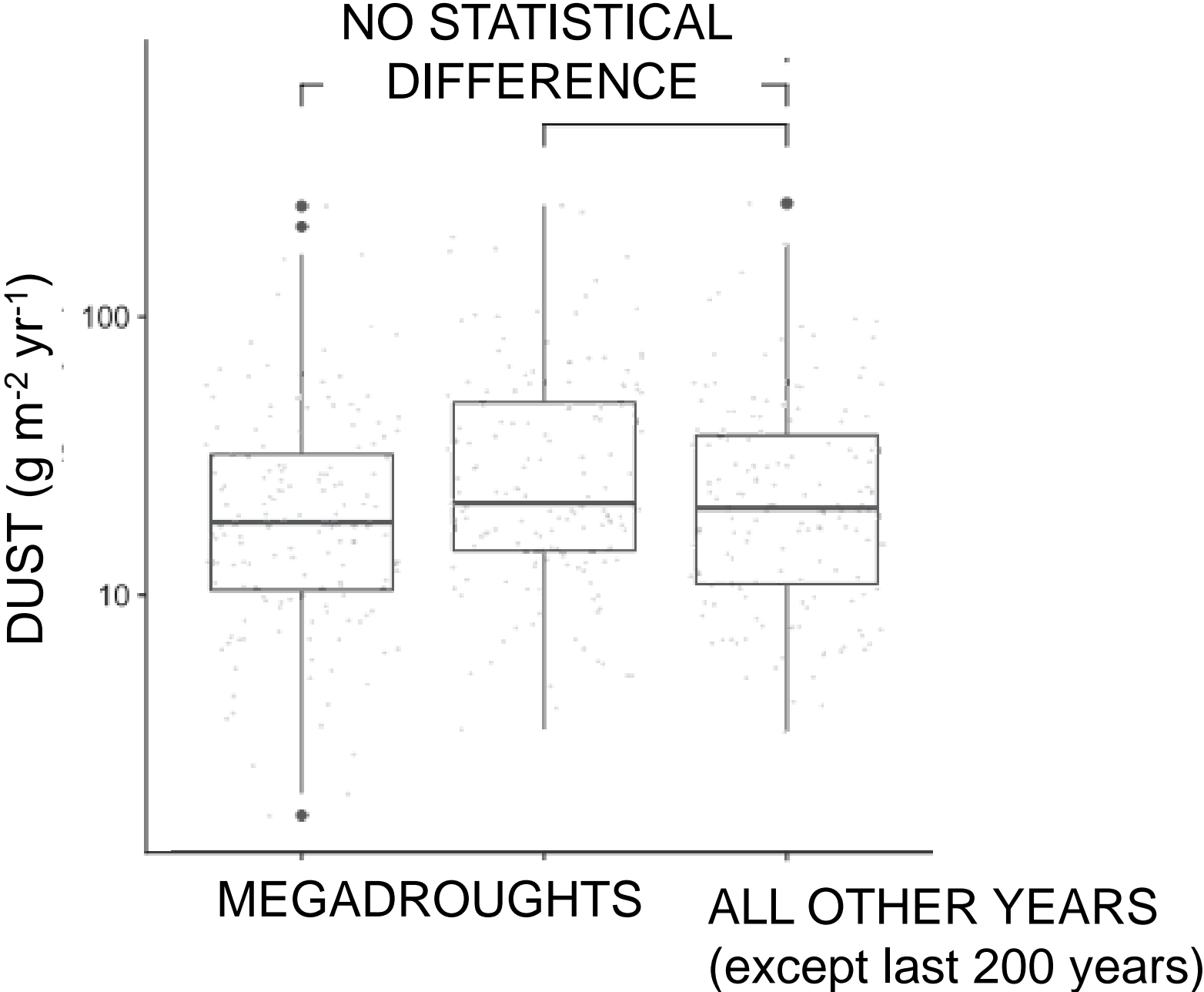
Paleo model/data comparison

- Spatiotemporal comparison
- Dust during megadroughts





Dust from lake sediment
Drought from tree-rings



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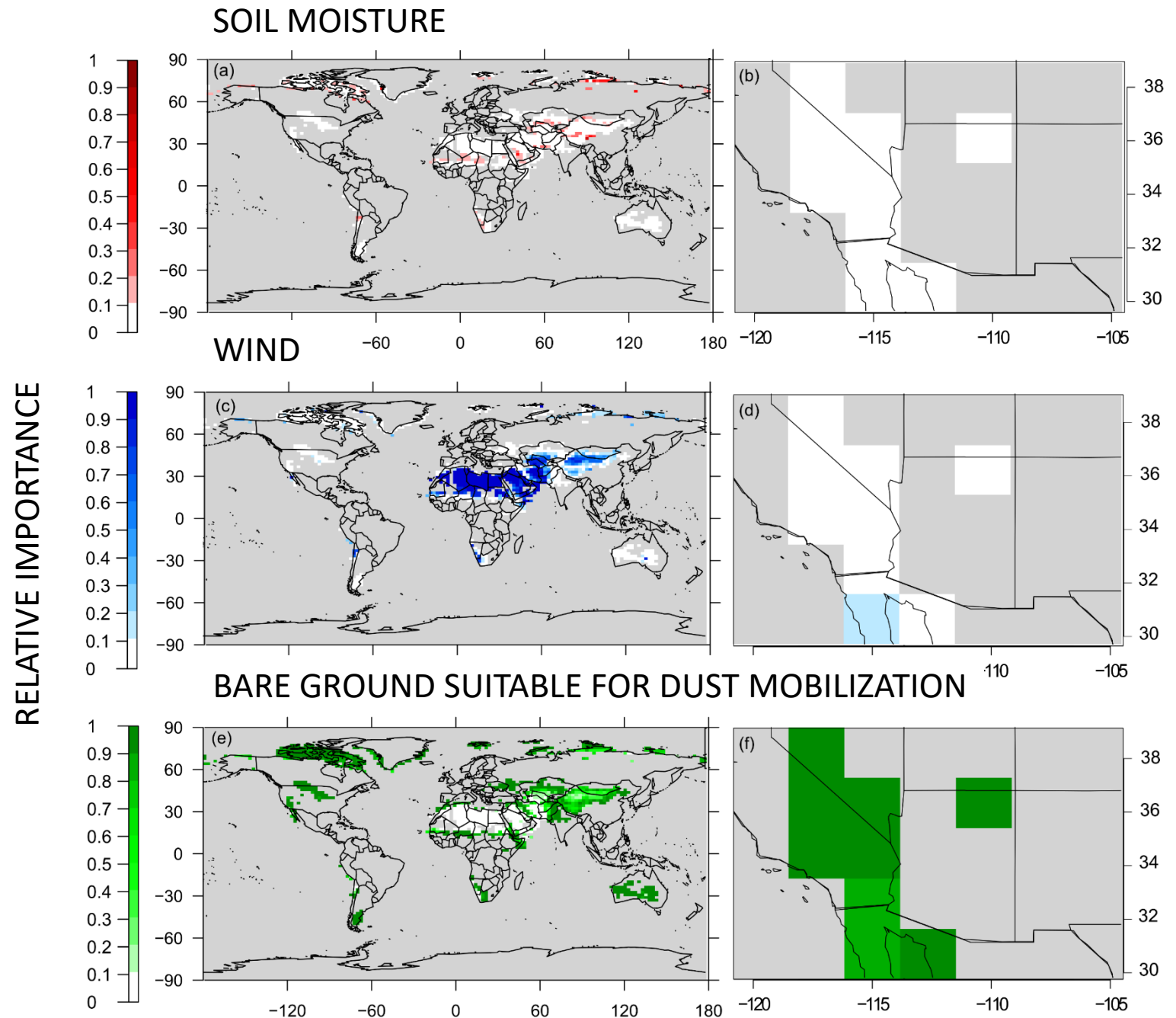


DUST = WIND + SOIL MOISTURE + BARE GROUND

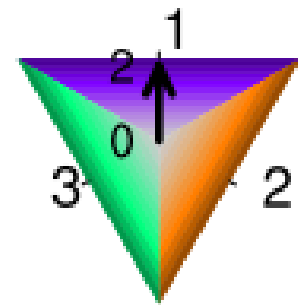
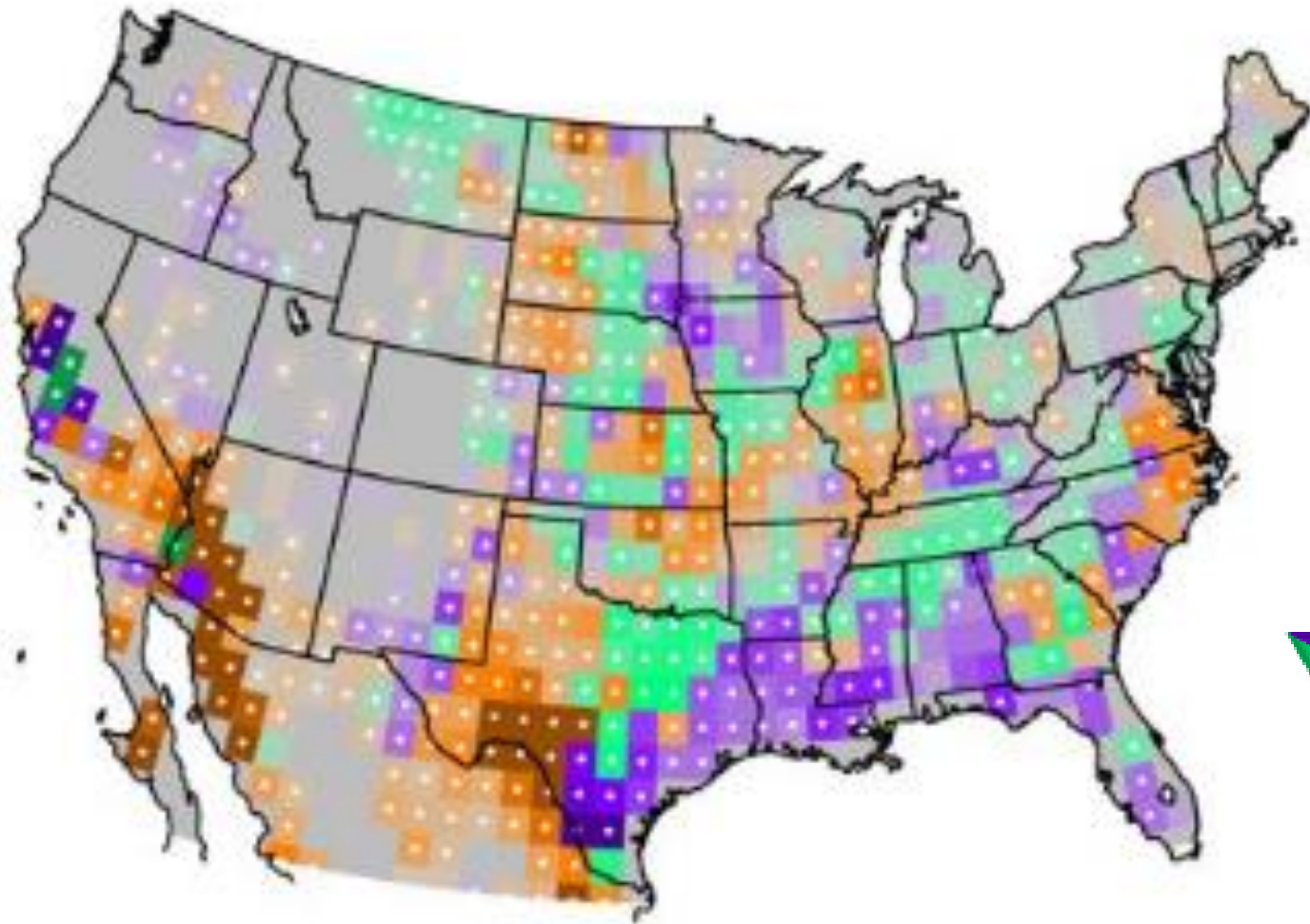
Photo credit: Mike Olbinski

Paleo model

- Bare ground is the primary control of dust emissions in the SW
- Limited influence of soil moisture



SPRING



- 1- PRECIPITATION
- 2- Bareness
- 3- VEGETATION

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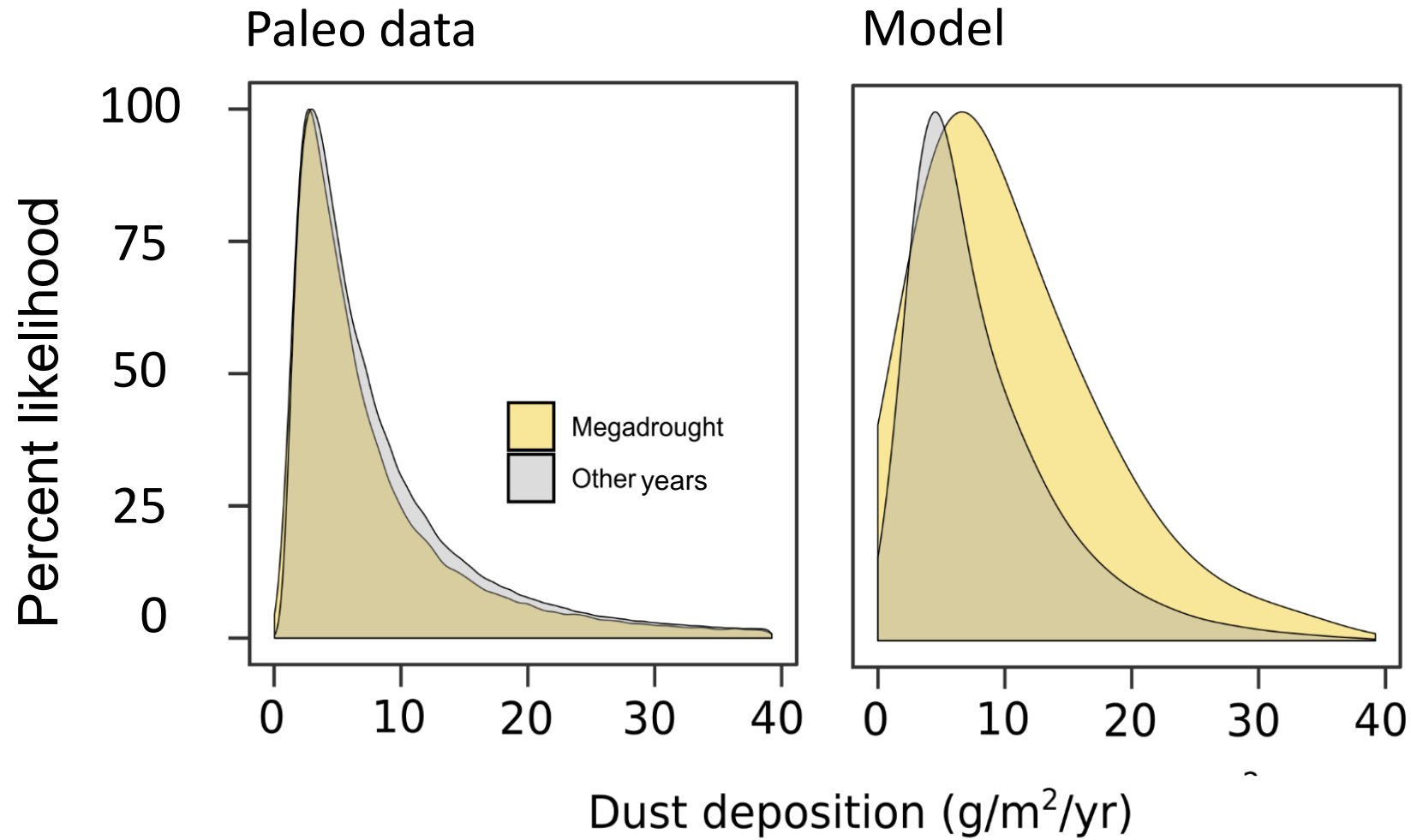
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Paleo model/data comparison

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Paleo model and data agree



A wide-angle photograph of a dry lake bed. The foreground is dominated by a dense pattern of polygonal, cracked mud plates in shades of grey and brown. The middle ground shows a flat, sandy expanse leading to a range of dark, silhouetted mountains under a heavy, overcast sky with grey and white clouds. The overall mood is desolate and arid.

Why weren't past megadroughts dustier?

Photo credit: NASA Goddard

Paleo data

- Errors in differentiating between dust and locally derived material
- Error in radiocarbon dating
- Transport processes

Model

- Wetter climate than observed
- Does not include all variables

Vegetation and soil crust



Implications

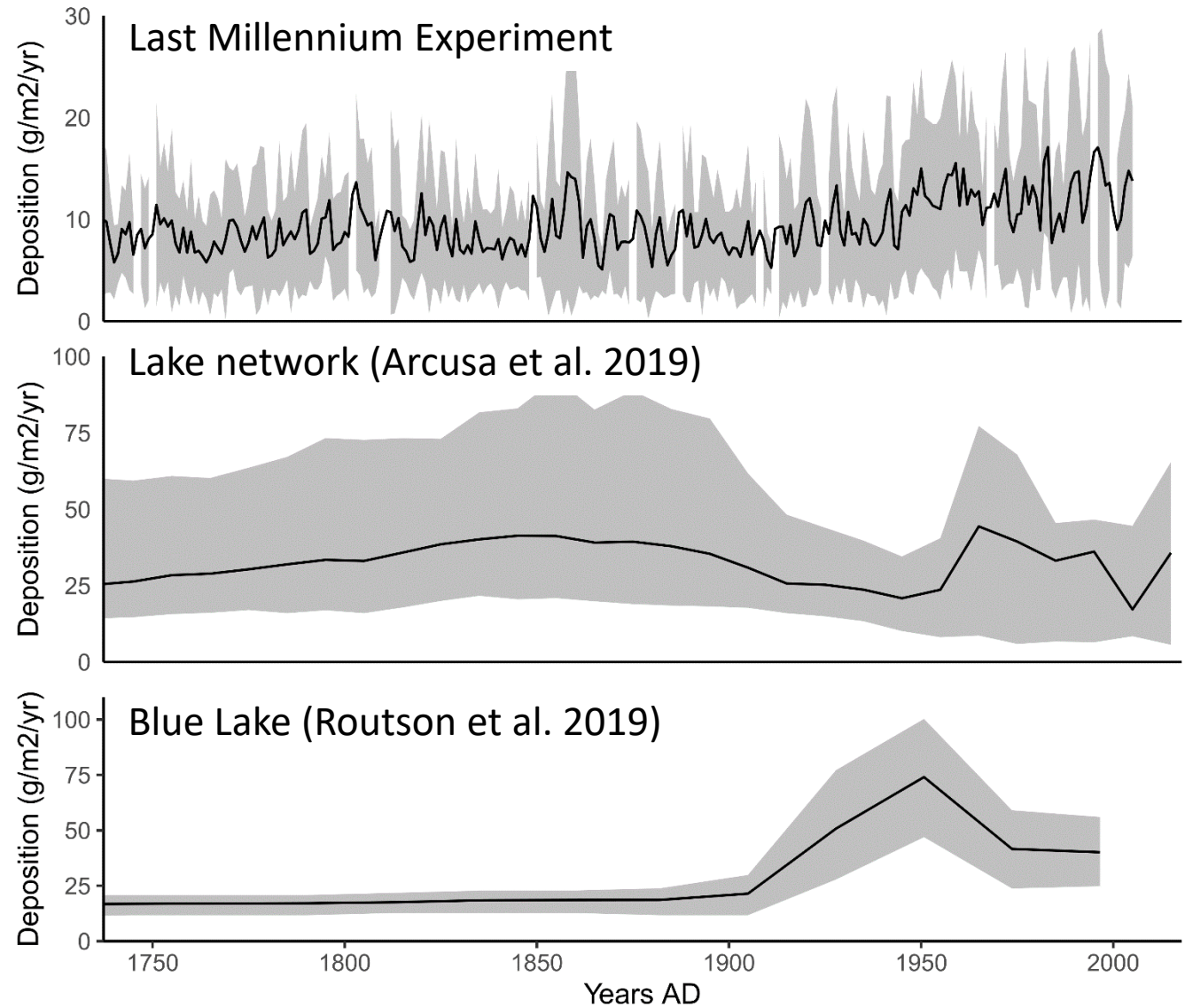
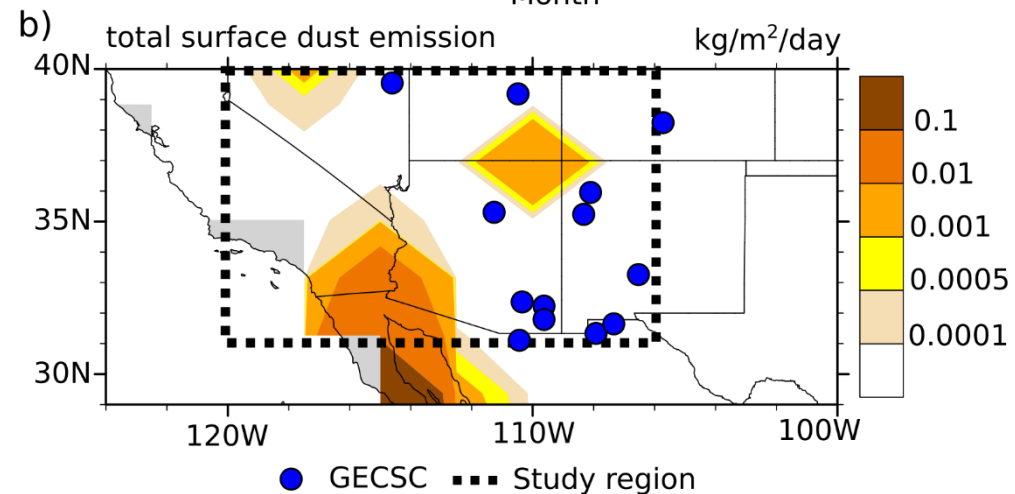
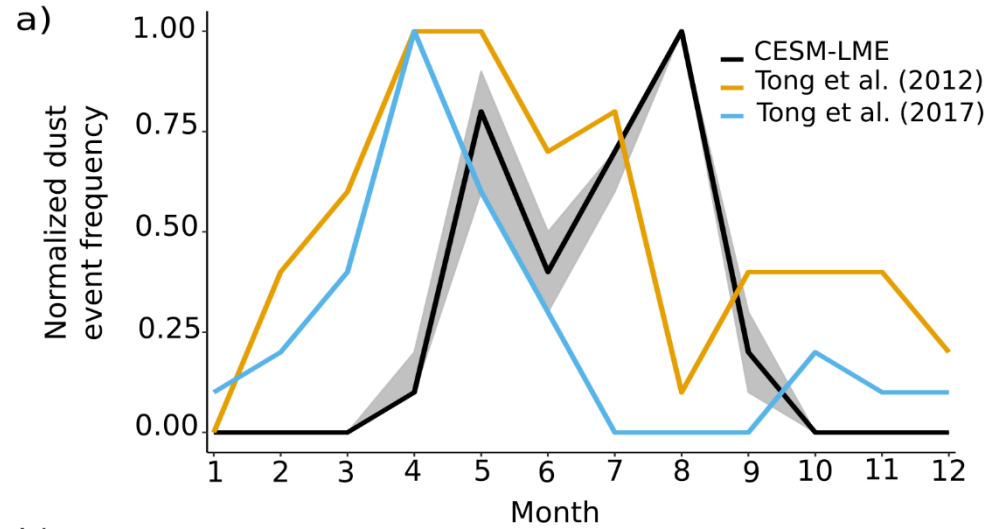
- Paleo data and model agree.
- Weak dust-drought relationship during past megadroughts.
- Main difference between then and now: **land disturbance**.
- With continued disturbance of crust and vegetation, can expect more dust during drought.



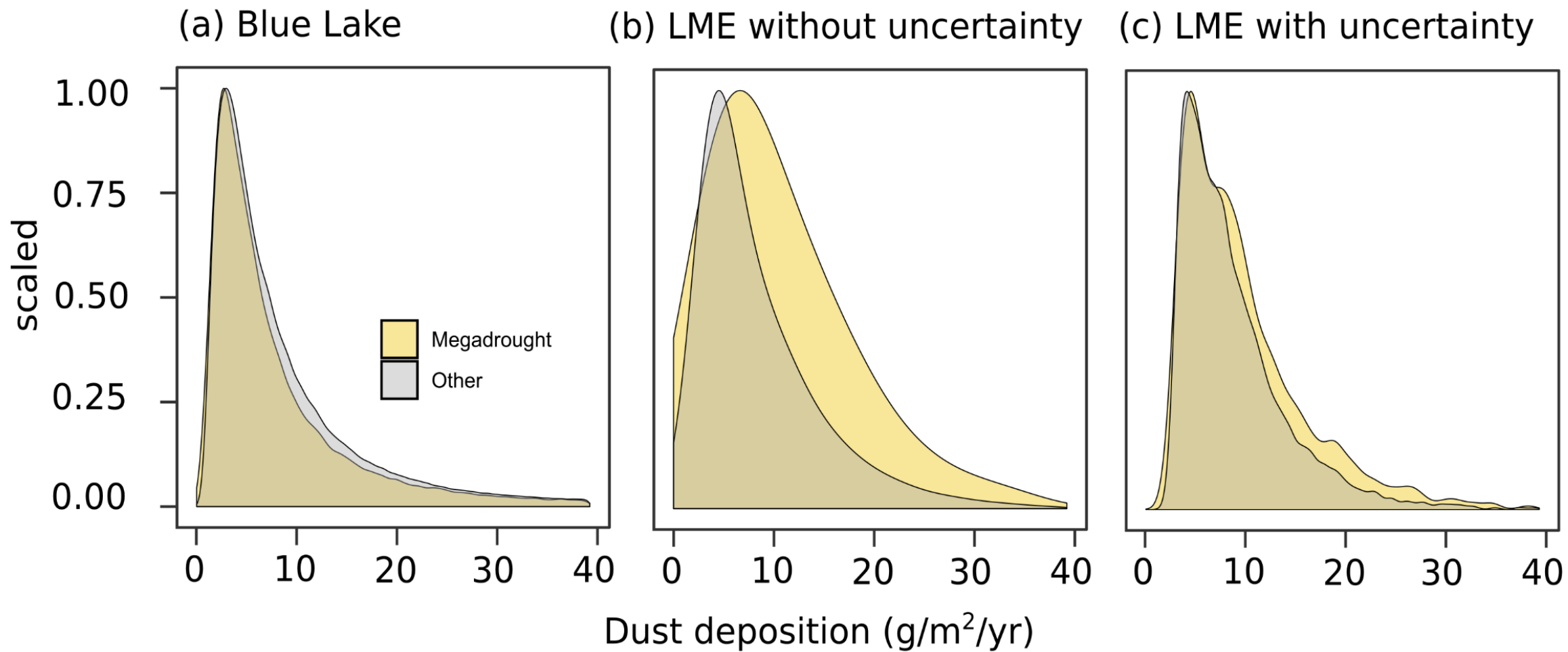
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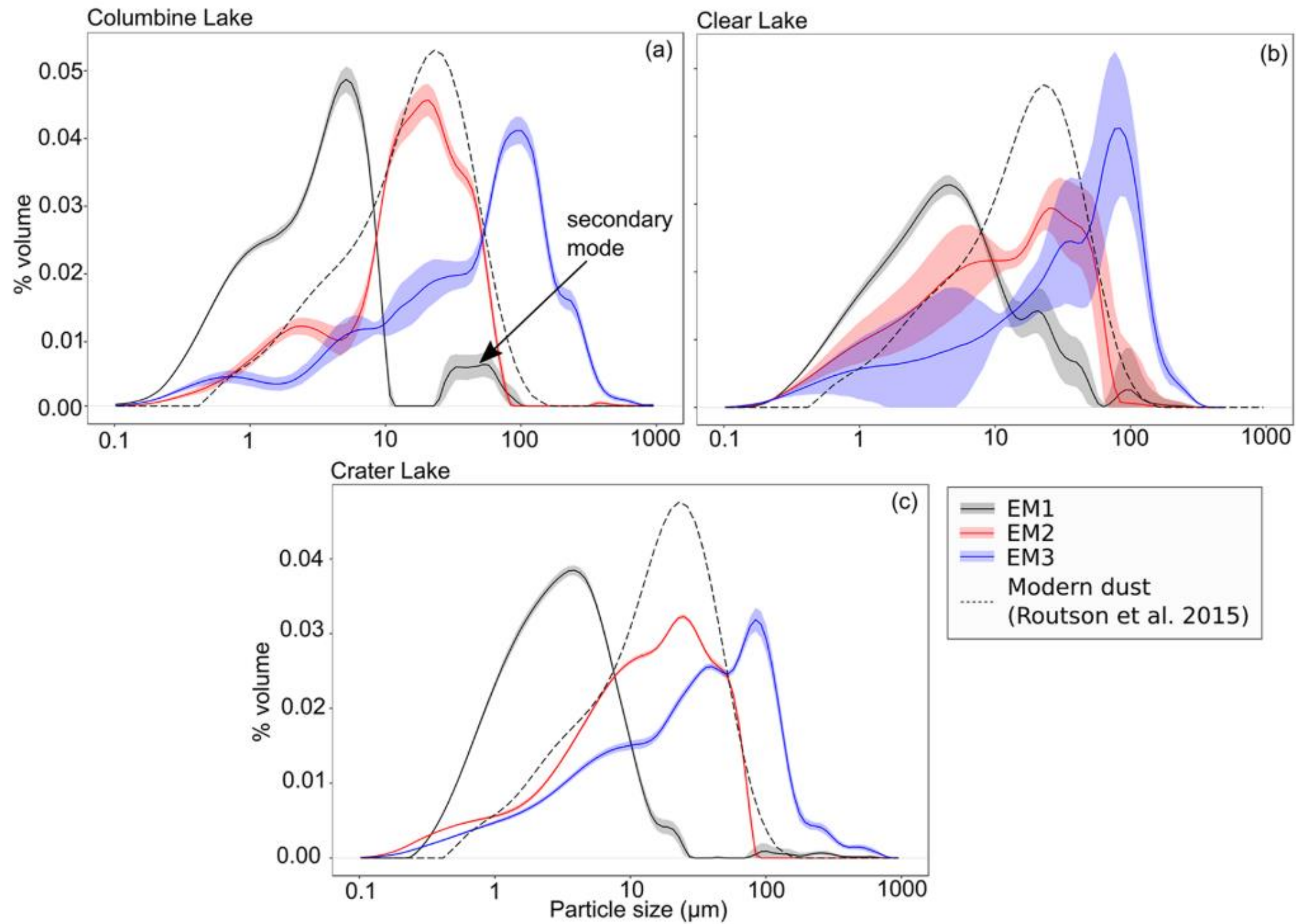
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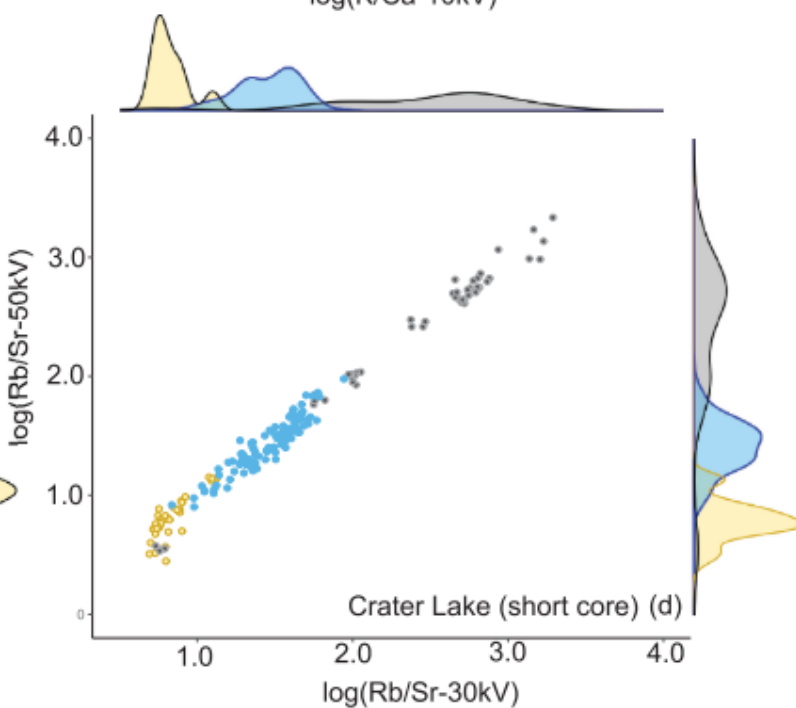
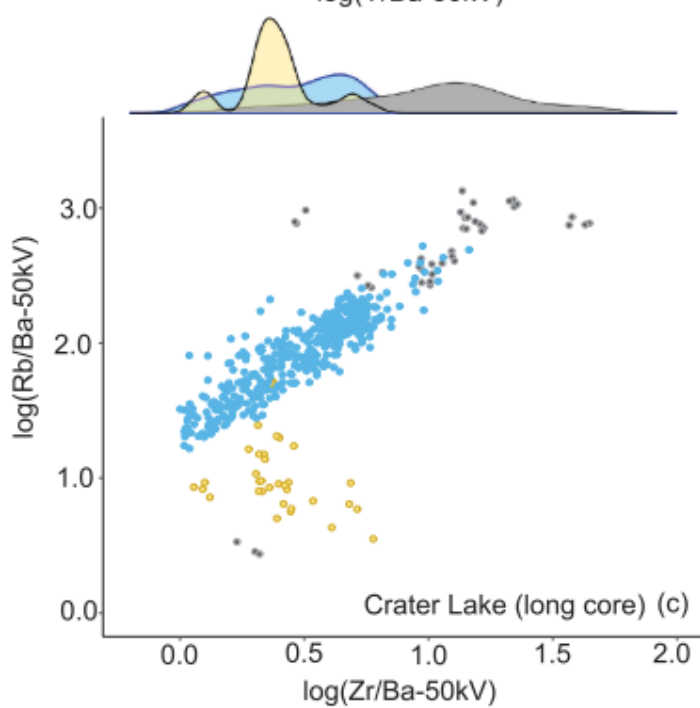
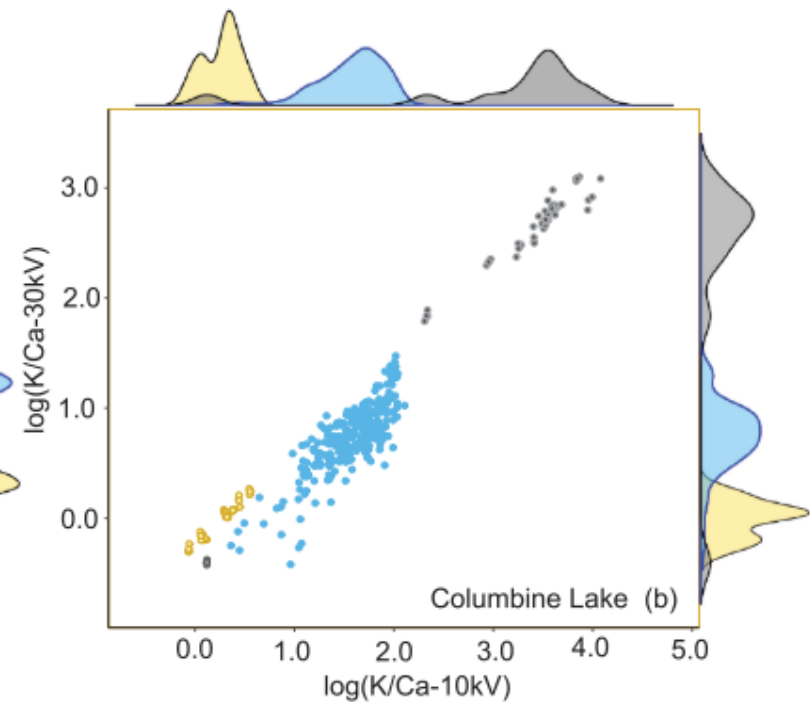
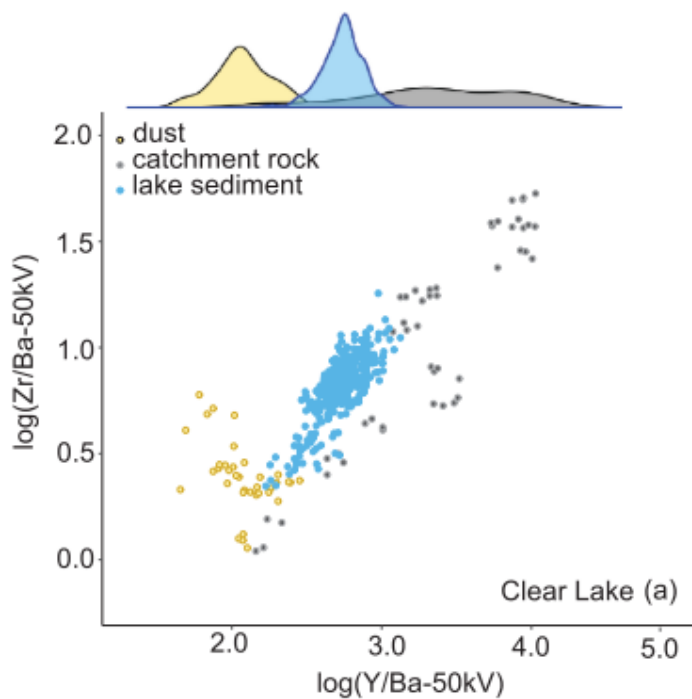
Paleo model dust



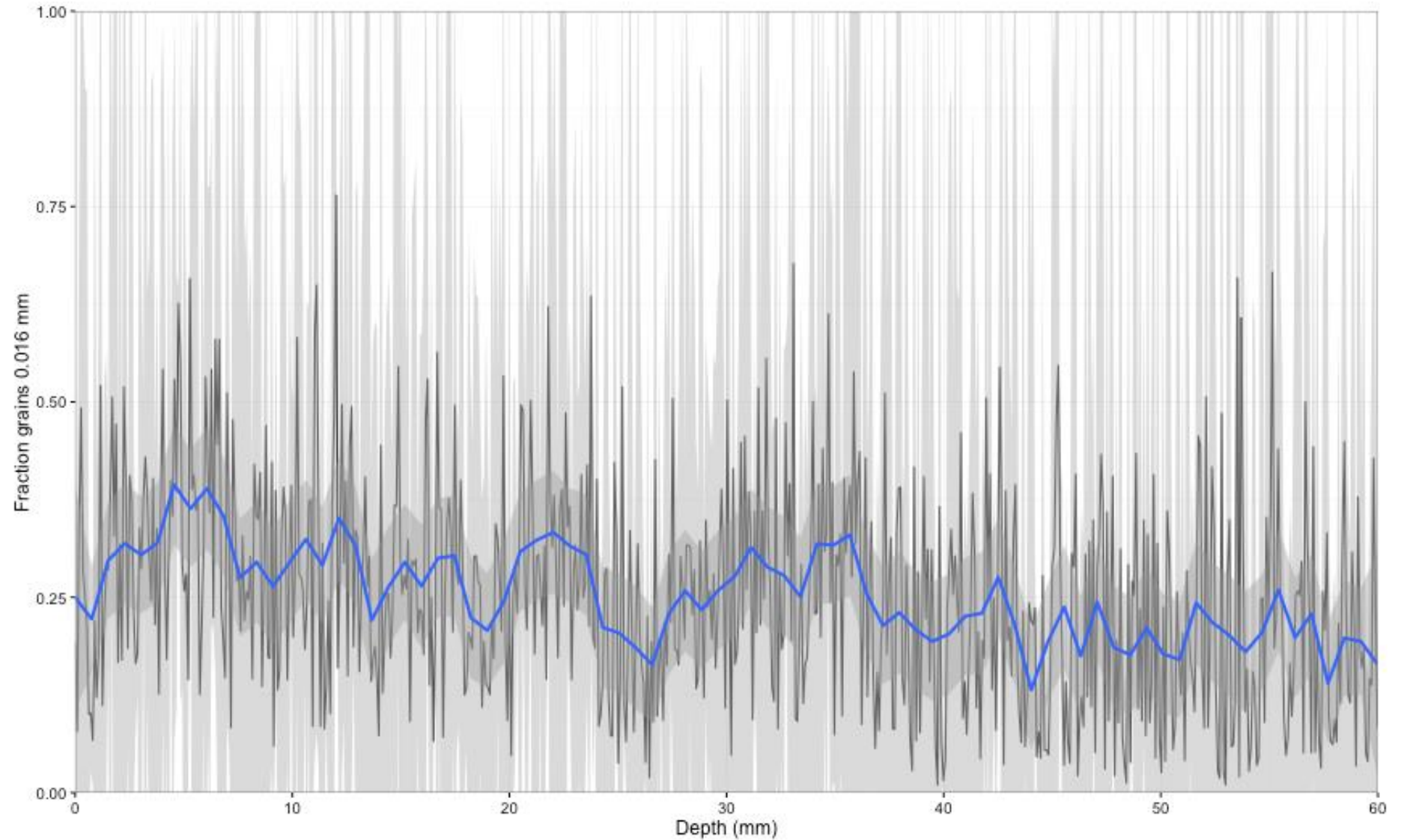
Community Earth System Model Last Millennium Experiment







Annual reconstruction



2017

1906