

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

Stéphanie Arcusa

PhD Candidate Climate and Environment Change

Northern Arizona University

**NAU**  
NORTHERN  
ARIZONA  
UNIVERSITY

School of Earth  
and Sustainability

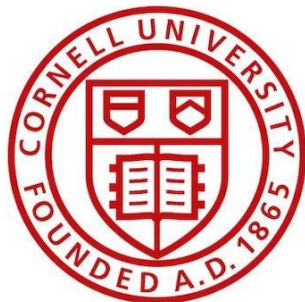
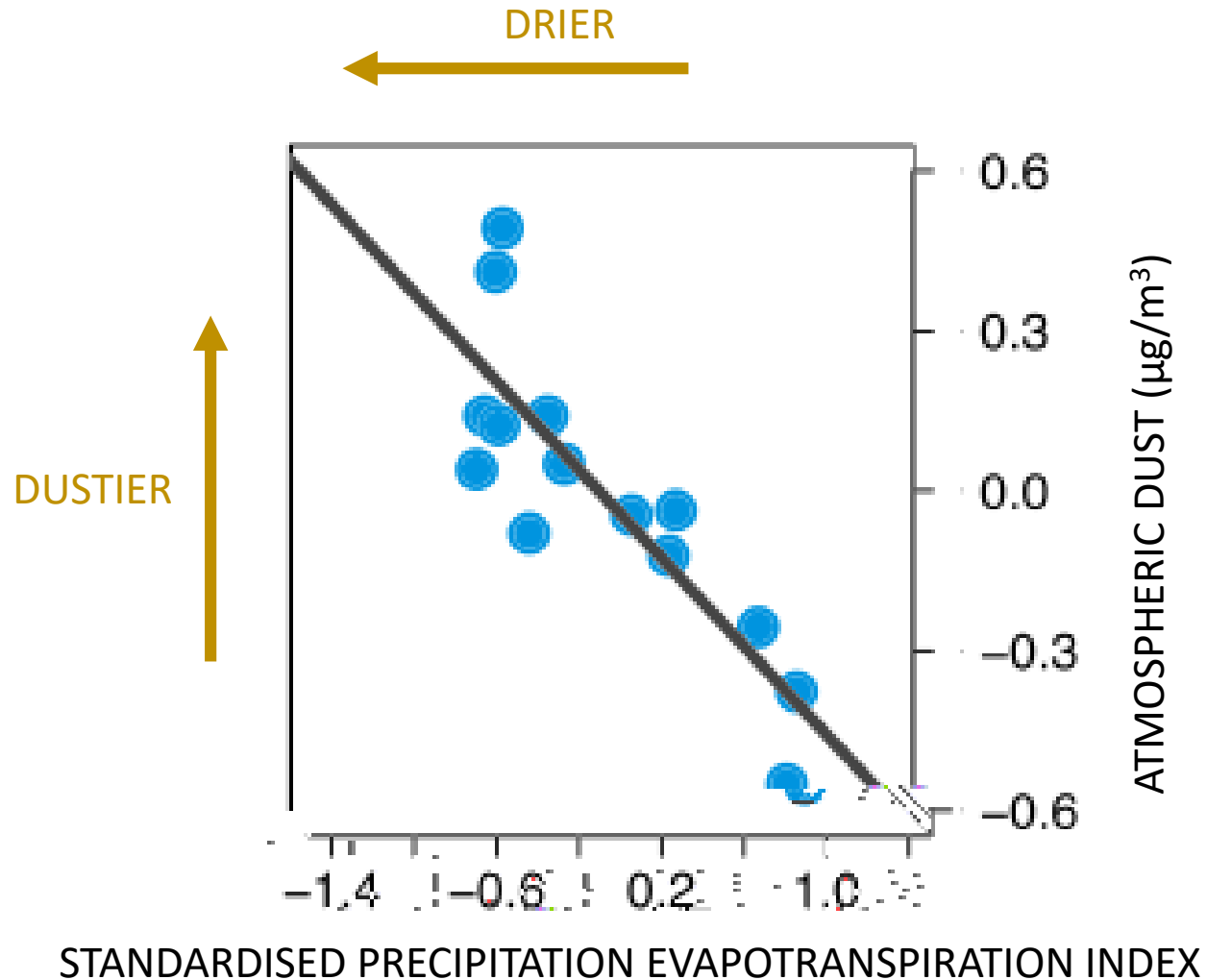


Photo credit: Mike Olbinski



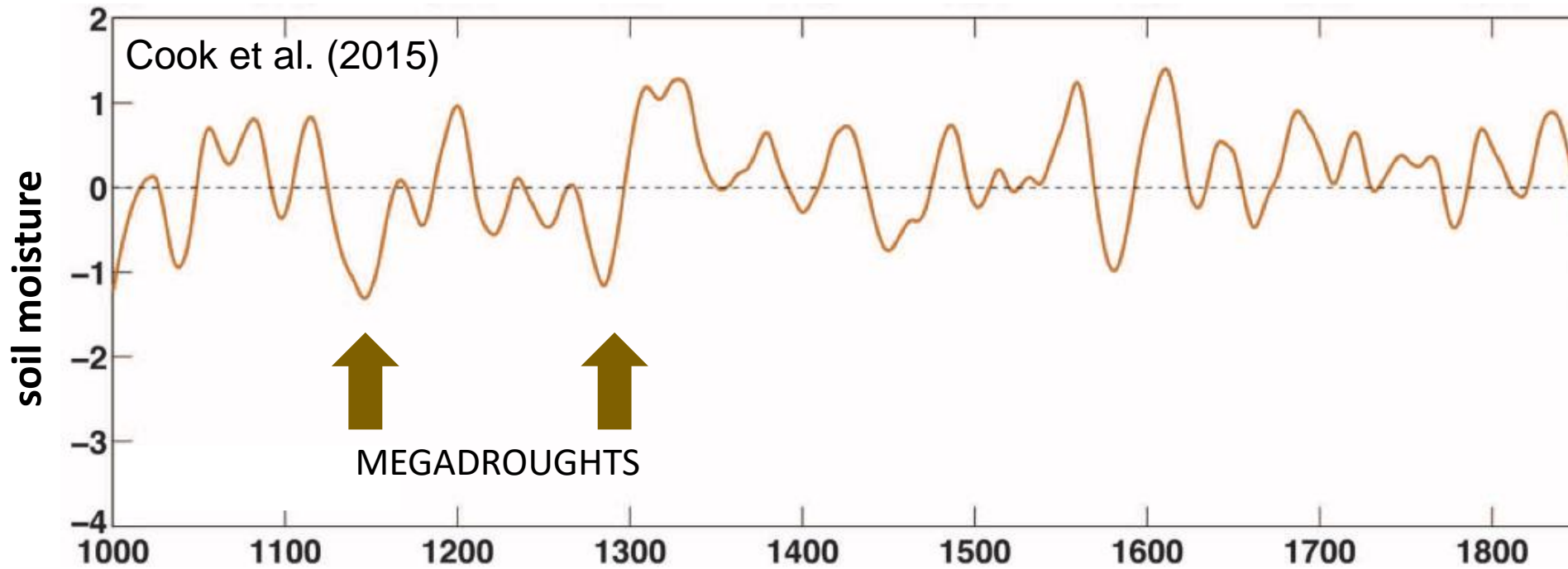
# DUST-DROUGHT NEXUS

# More dust with drier conditions today



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

# Unprecedented 21<sup>st</sup> 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

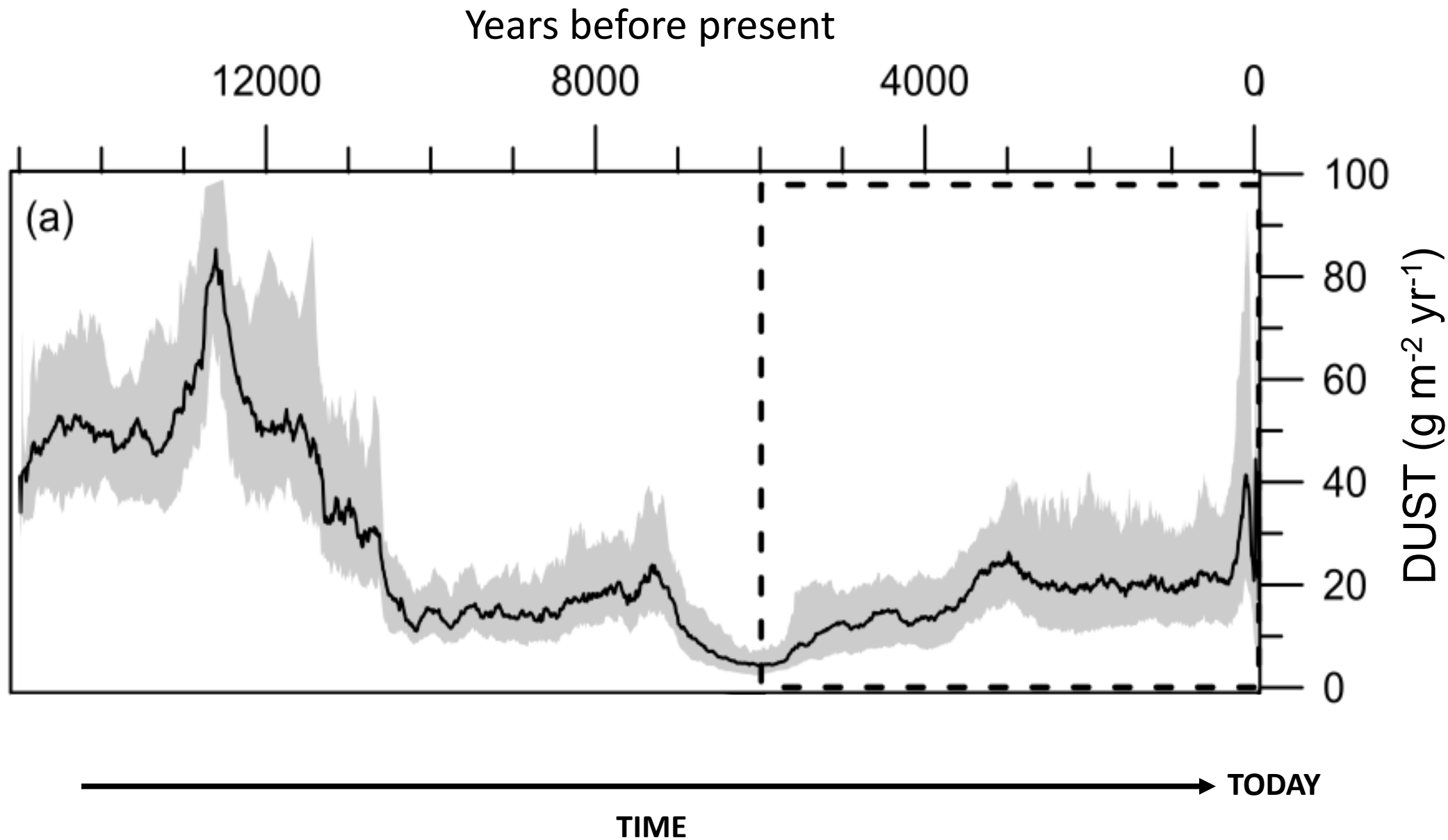
### Paleo model analysis

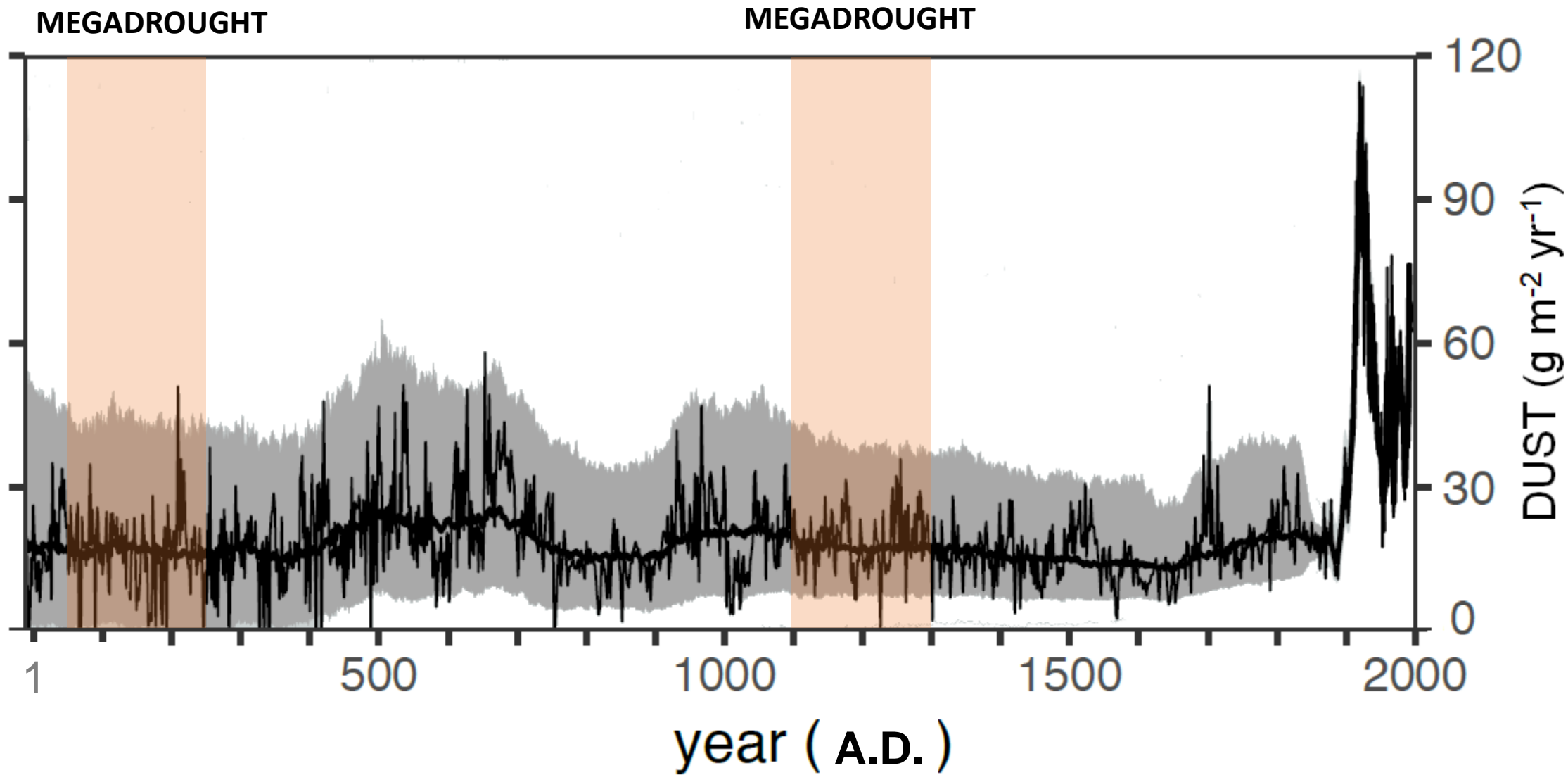
- Community Earth System Model
- Last Millennium Experiment
- Dust module
- Megadroughts
- Role of age uncertainty

## PART 3

### Paleo model/data comparison

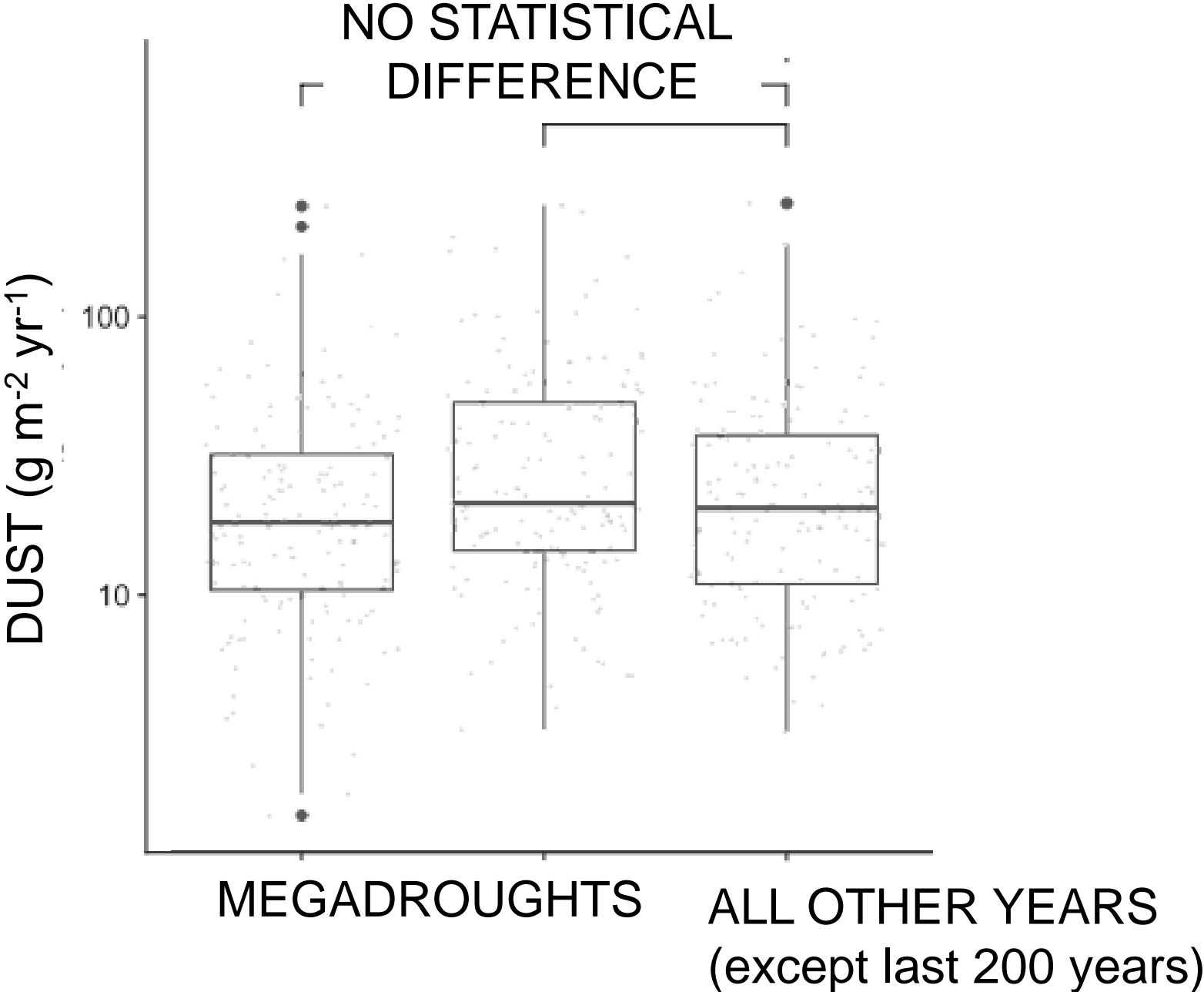
- Spatiotemporal comparison
- Dust during megadroughts







Dust from lake sediment  
Drought from tree-rings



### **PART 1**

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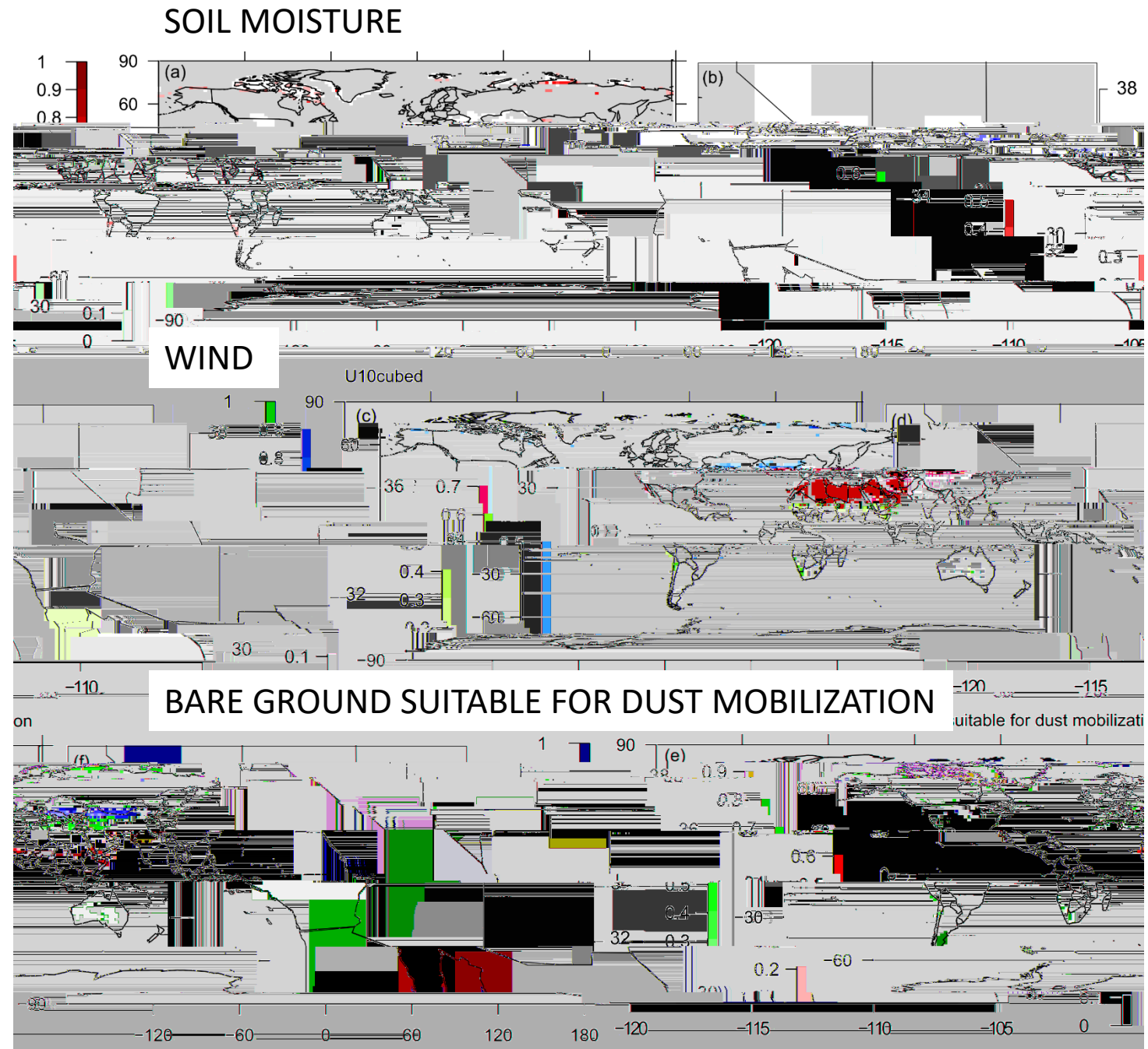
**DUST = WIND + SOIL MOISTURE + BARE GROUND**

Photo credit: Mike Olbinski

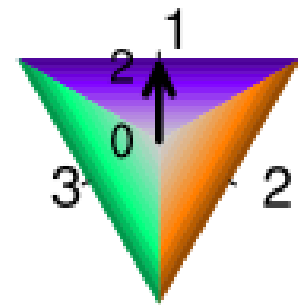
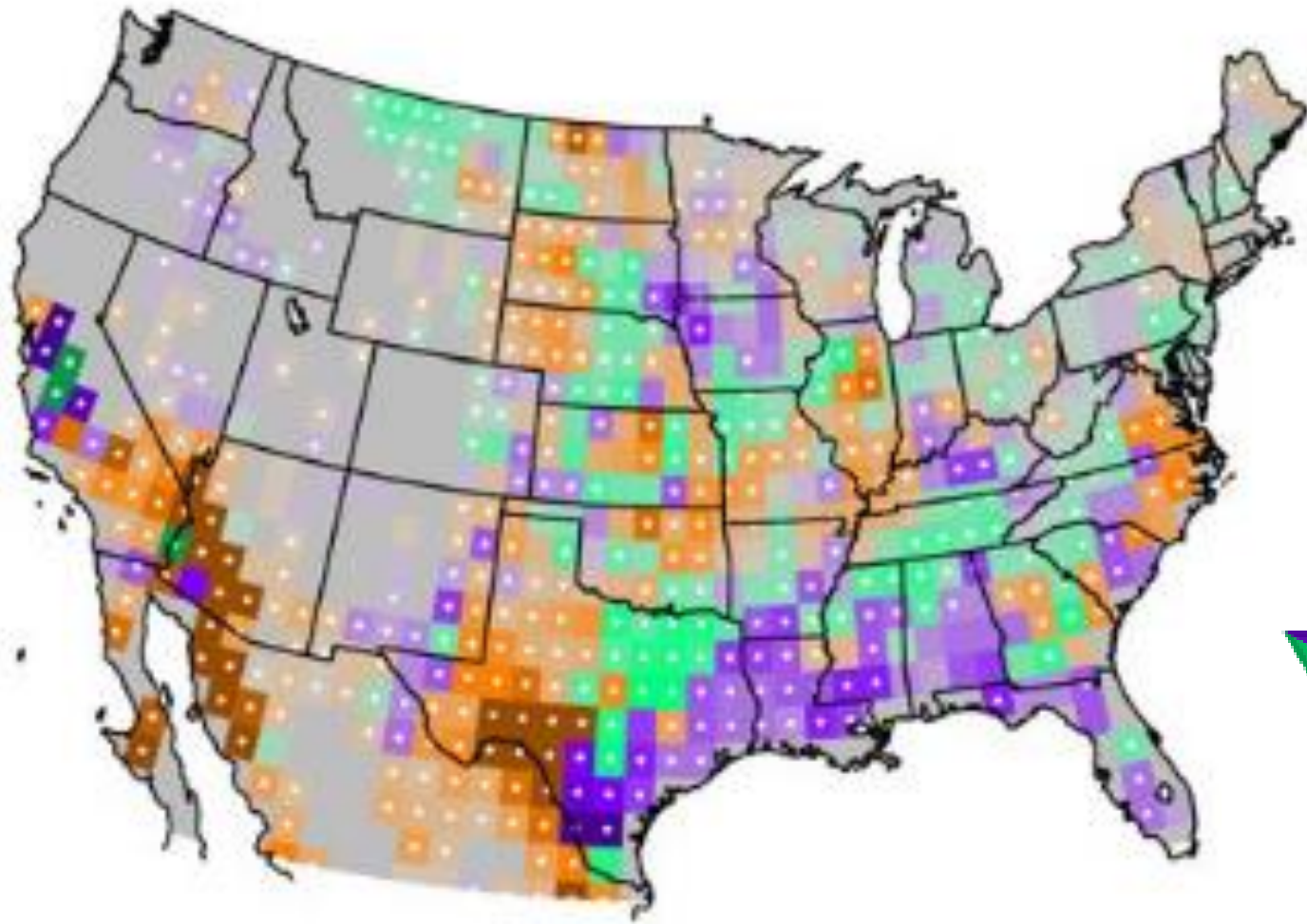
# Paleo model

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

RELATIVE IMPORTANCE



# SPRING



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

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#### **Paleo model analysis**

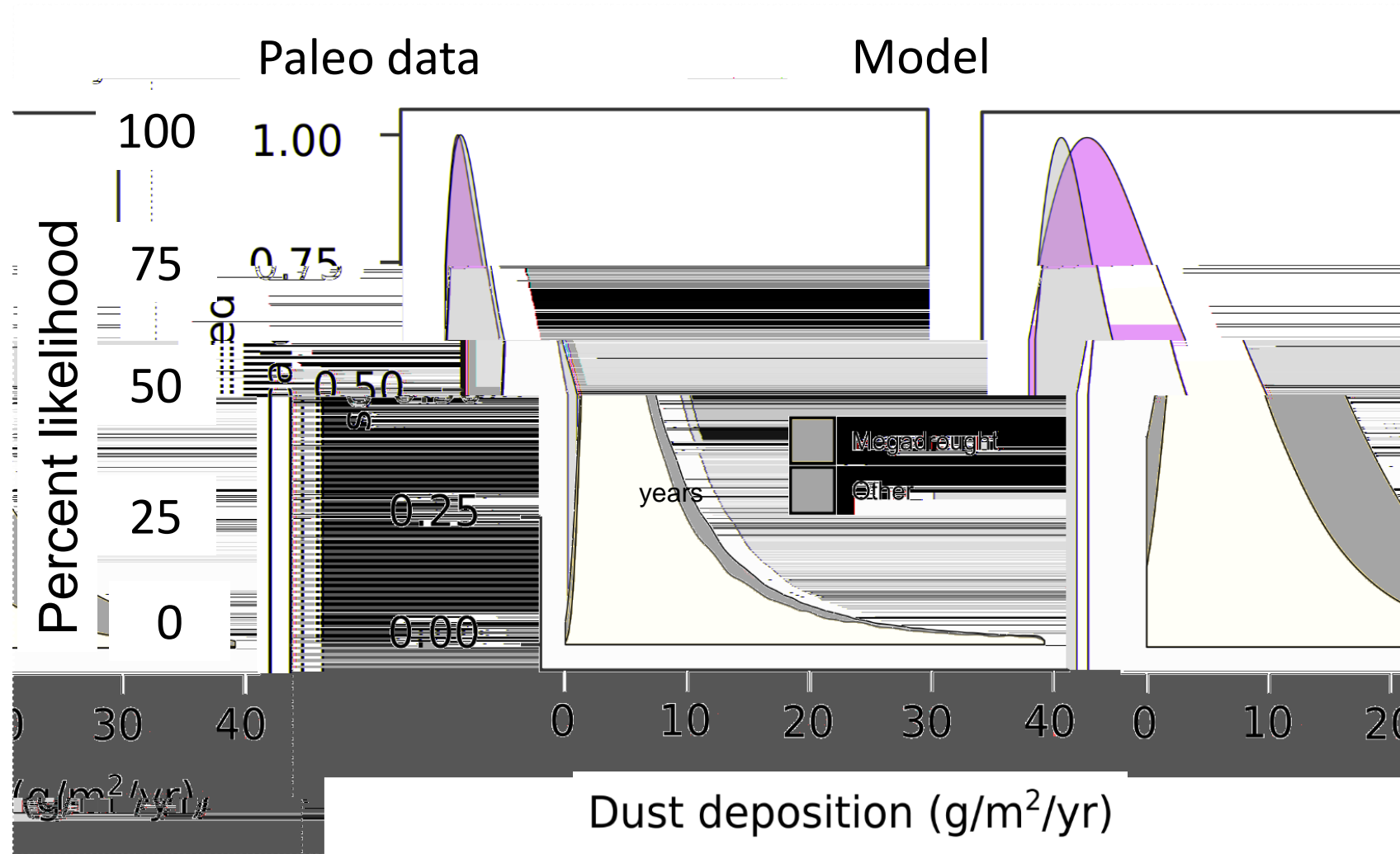
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### **PART 3**

#### **Paleo model/data comparison**

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# Paleo model and data agree



A wide, flat, cracked dry lake bed under a cloudy sky with mountains in the distance. The foreground is dominated by a dense pattern of irregular, polygonal cracks in the dry earth, creating a mosaic-like texture. The middle ground shows a flat, light-colored expanse that extends to a low horizon line. In the background, dark, silhouetted mountains range across the horizon under a heavy, overcast sky with patches of lighter clouds. The overall mood is desolate and somber.

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.



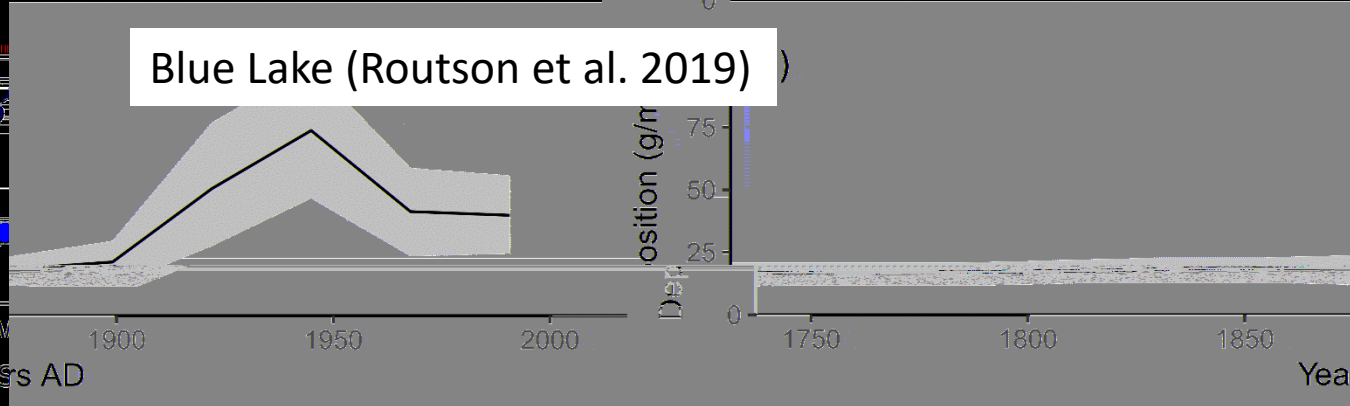
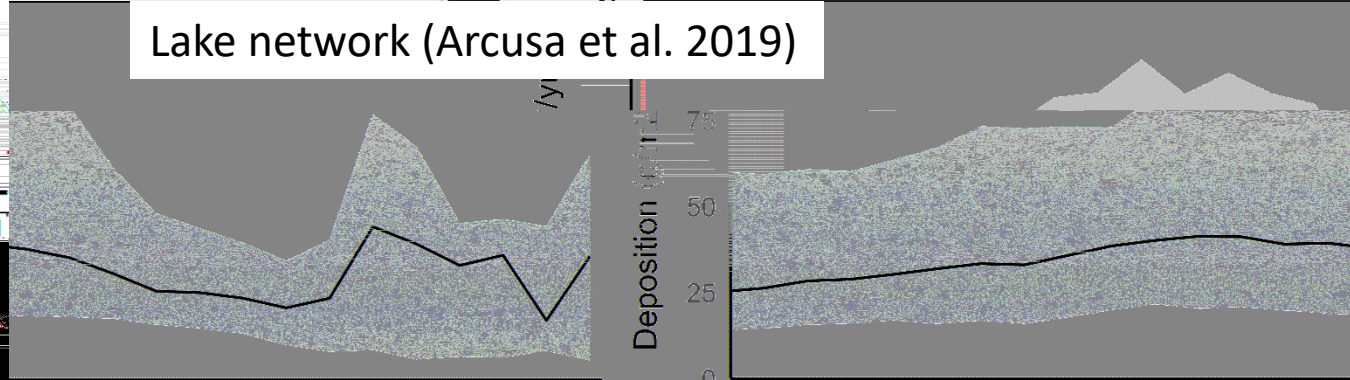
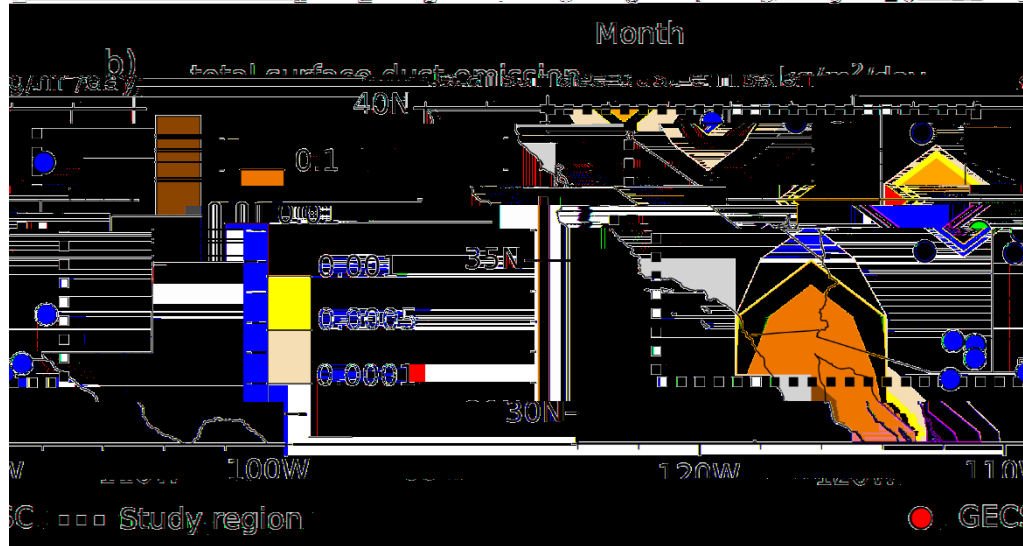
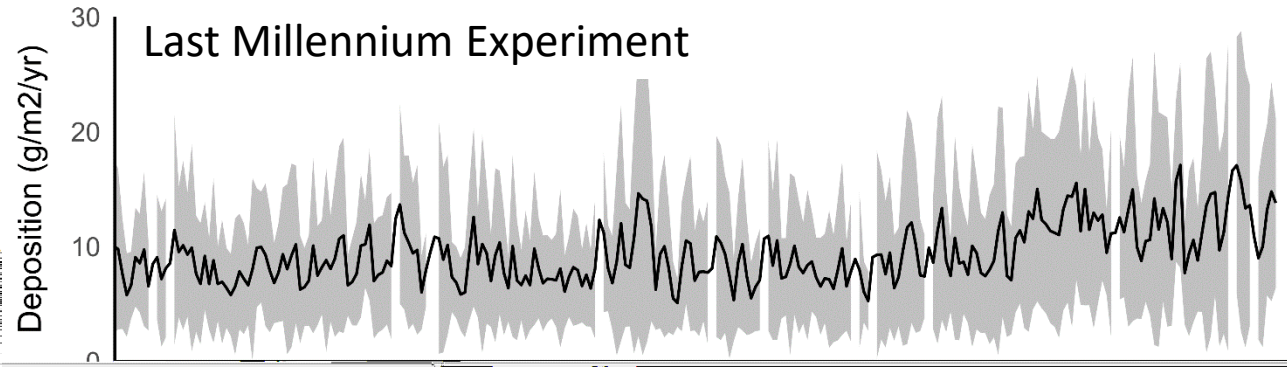
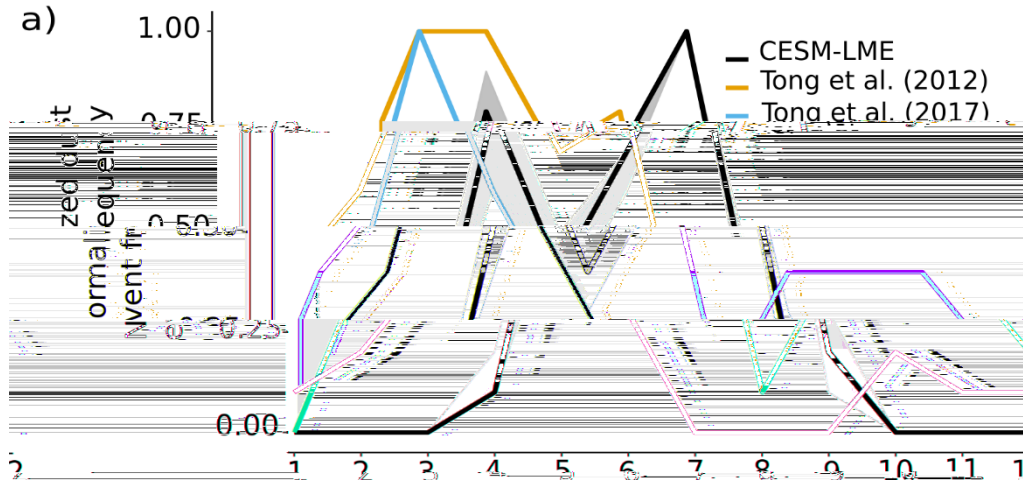
Thank you!

Photo credit: Mike Olbinski

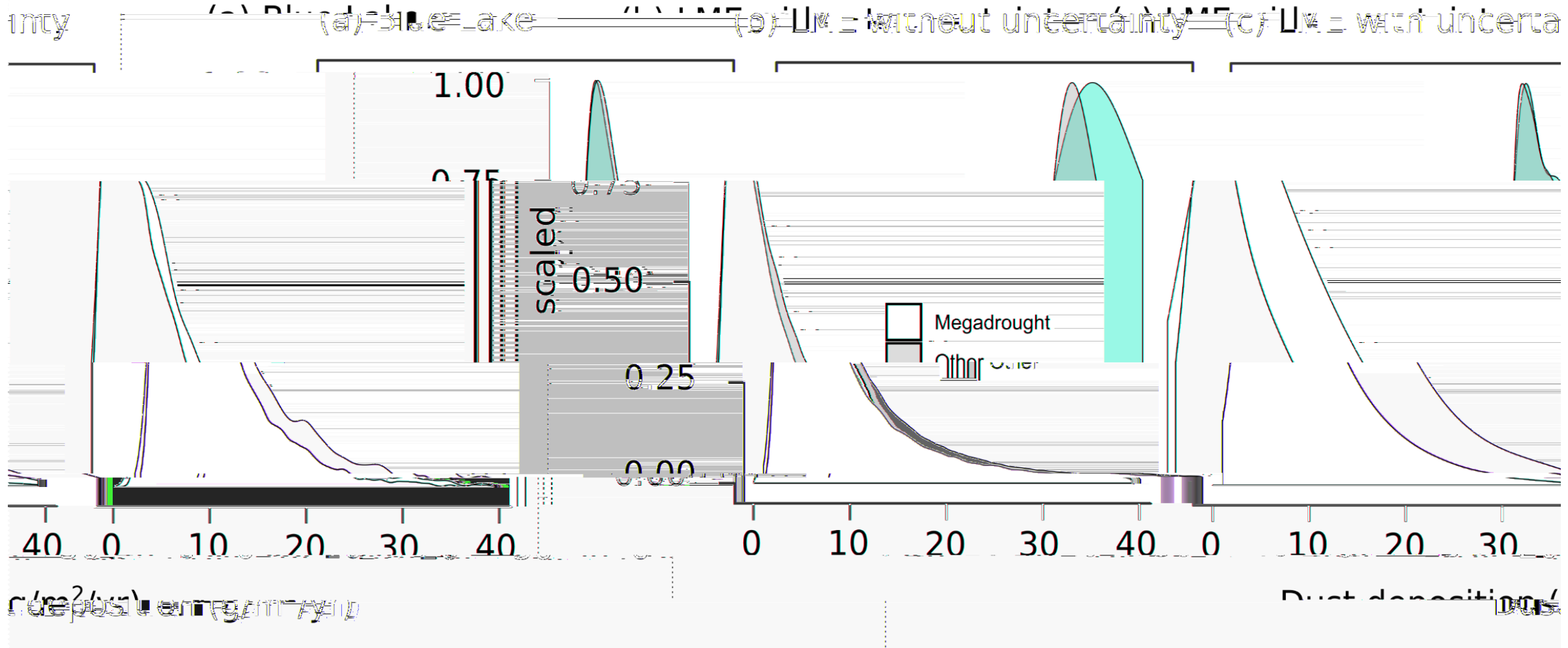


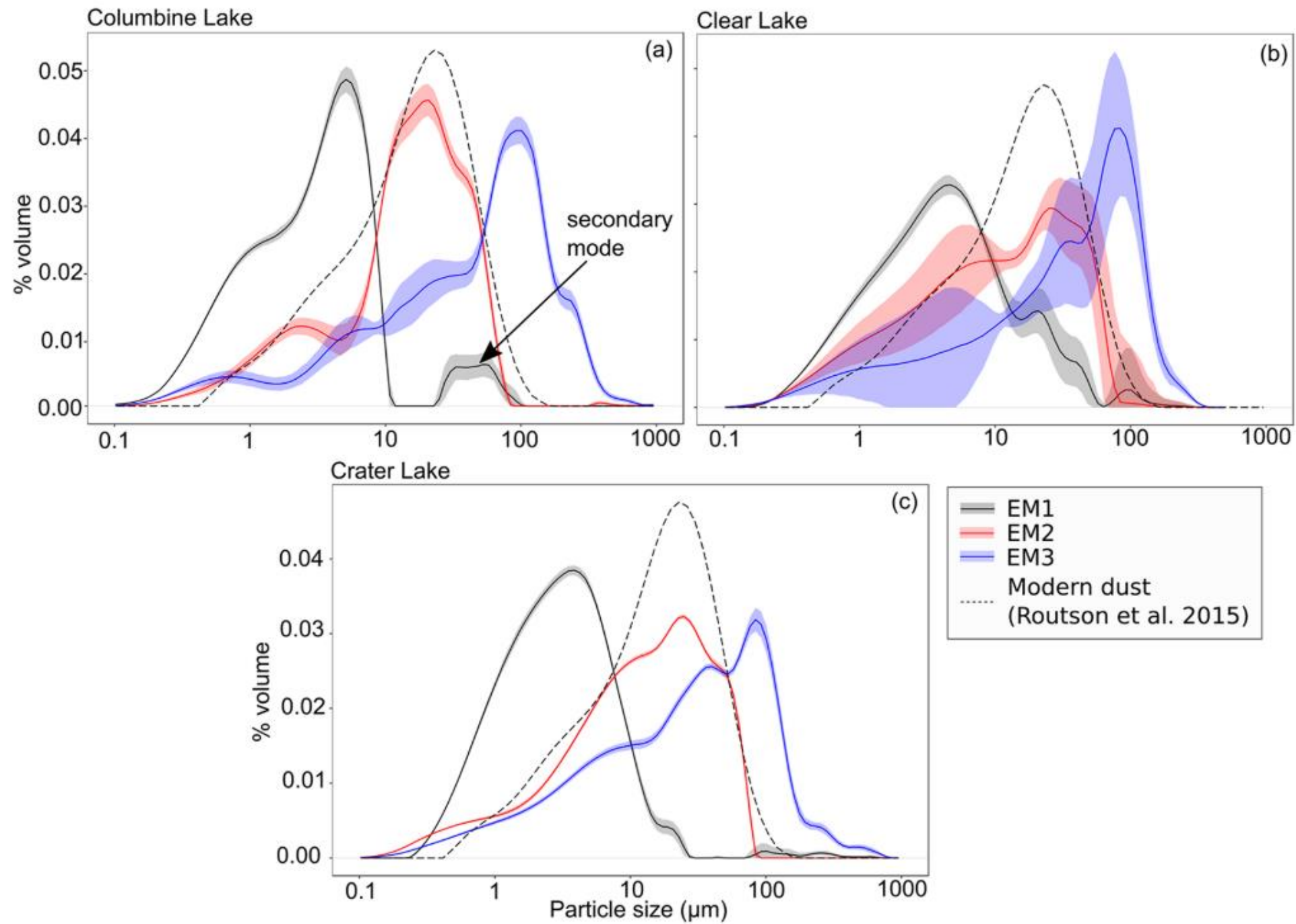


# Paleo model dust

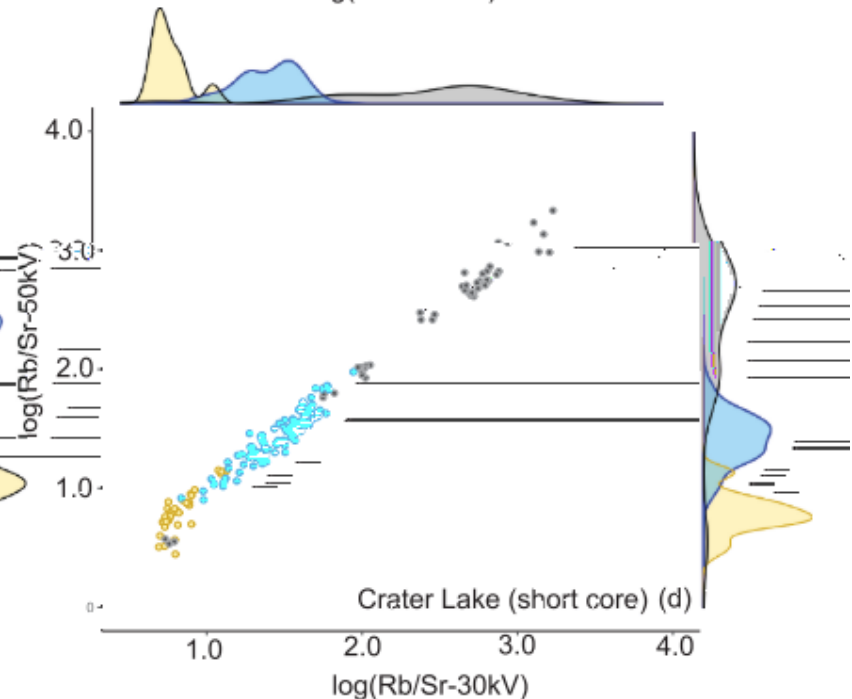
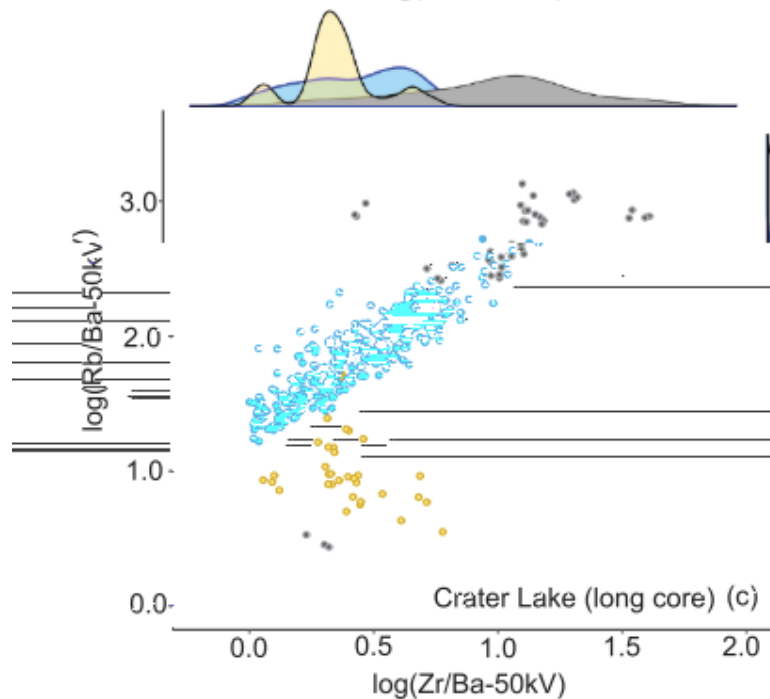
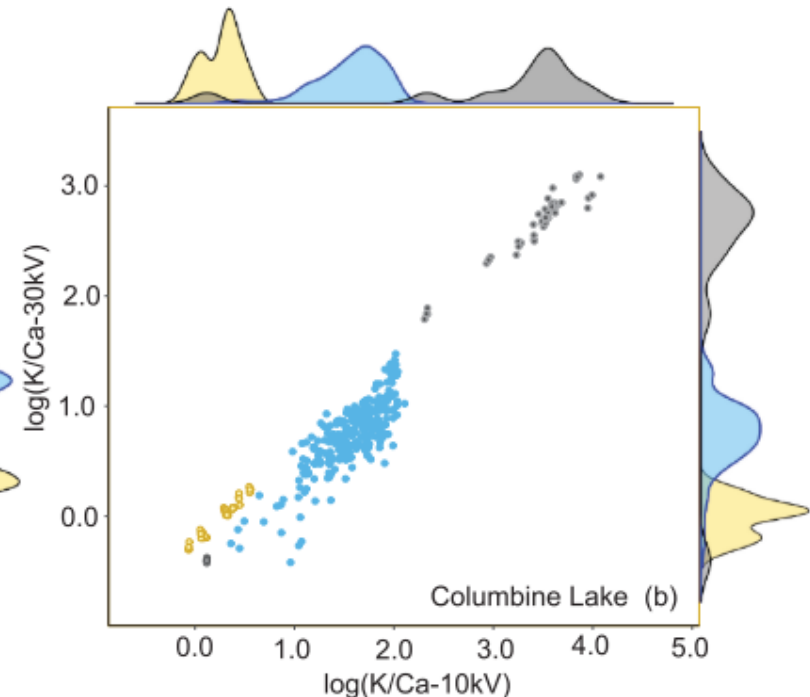
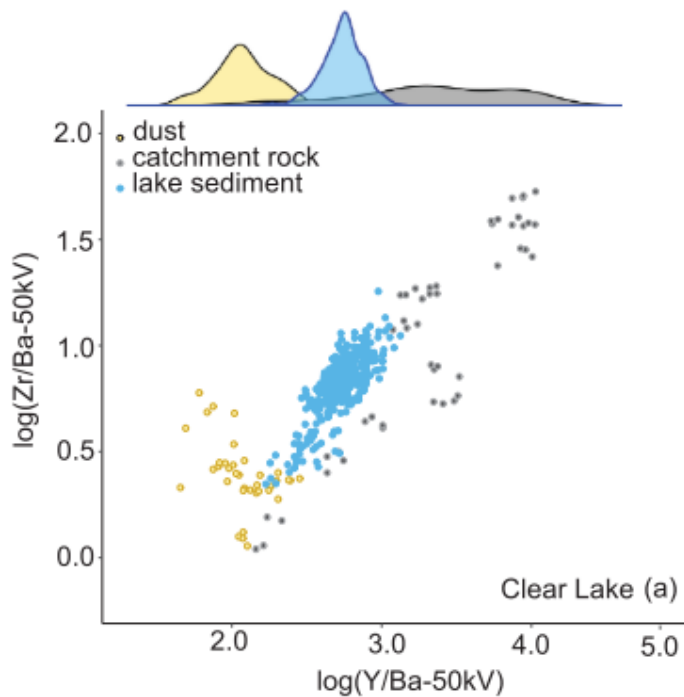


Community Earth System Model Last Millennium Experiment

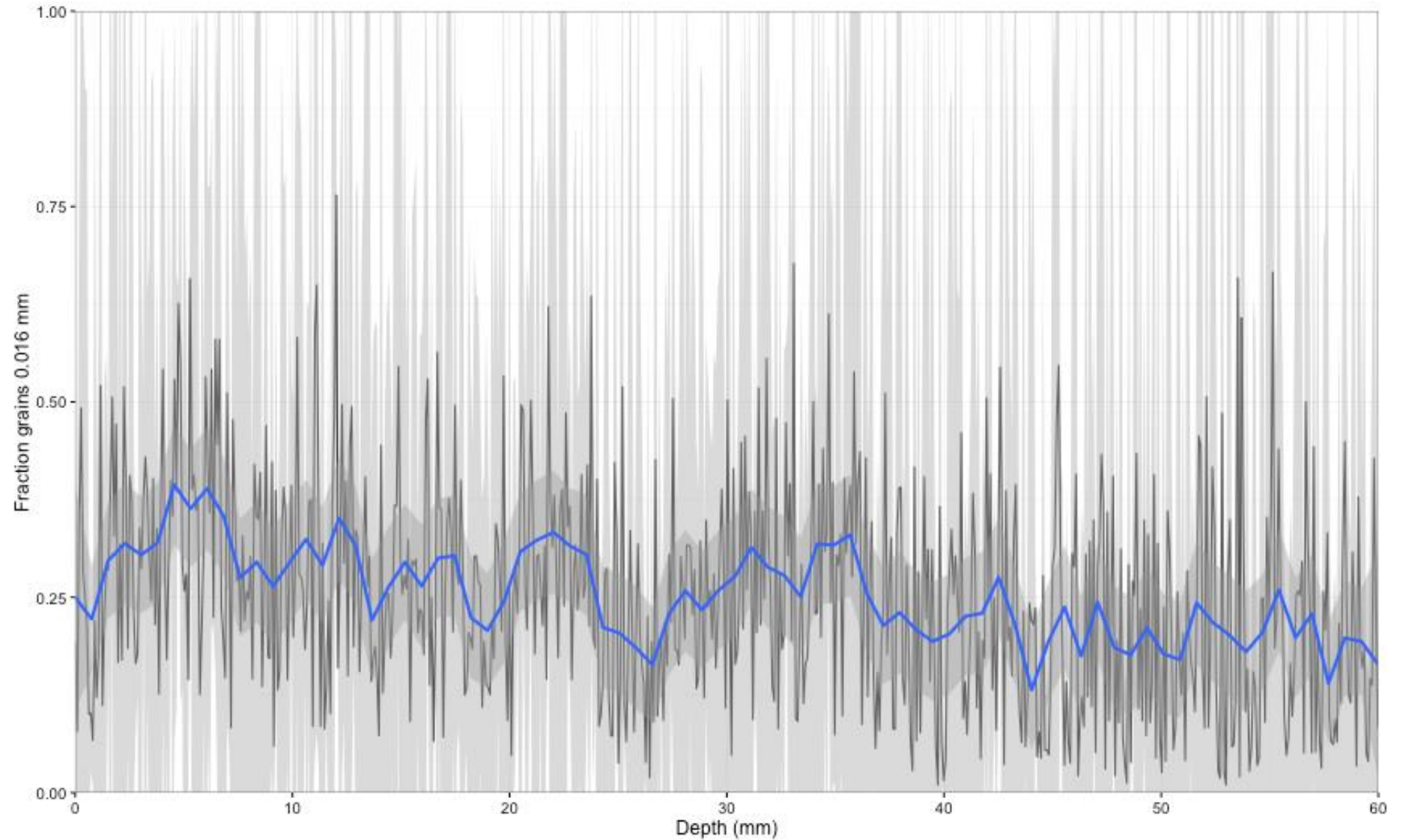








# Annual reconstruction



2017

1906