LONGITUDINAL GRADIENTS OF OXYGEN ISOTOPES AS INDICATORS OF HYDROCLIMATE CHANGE IN EURASIA

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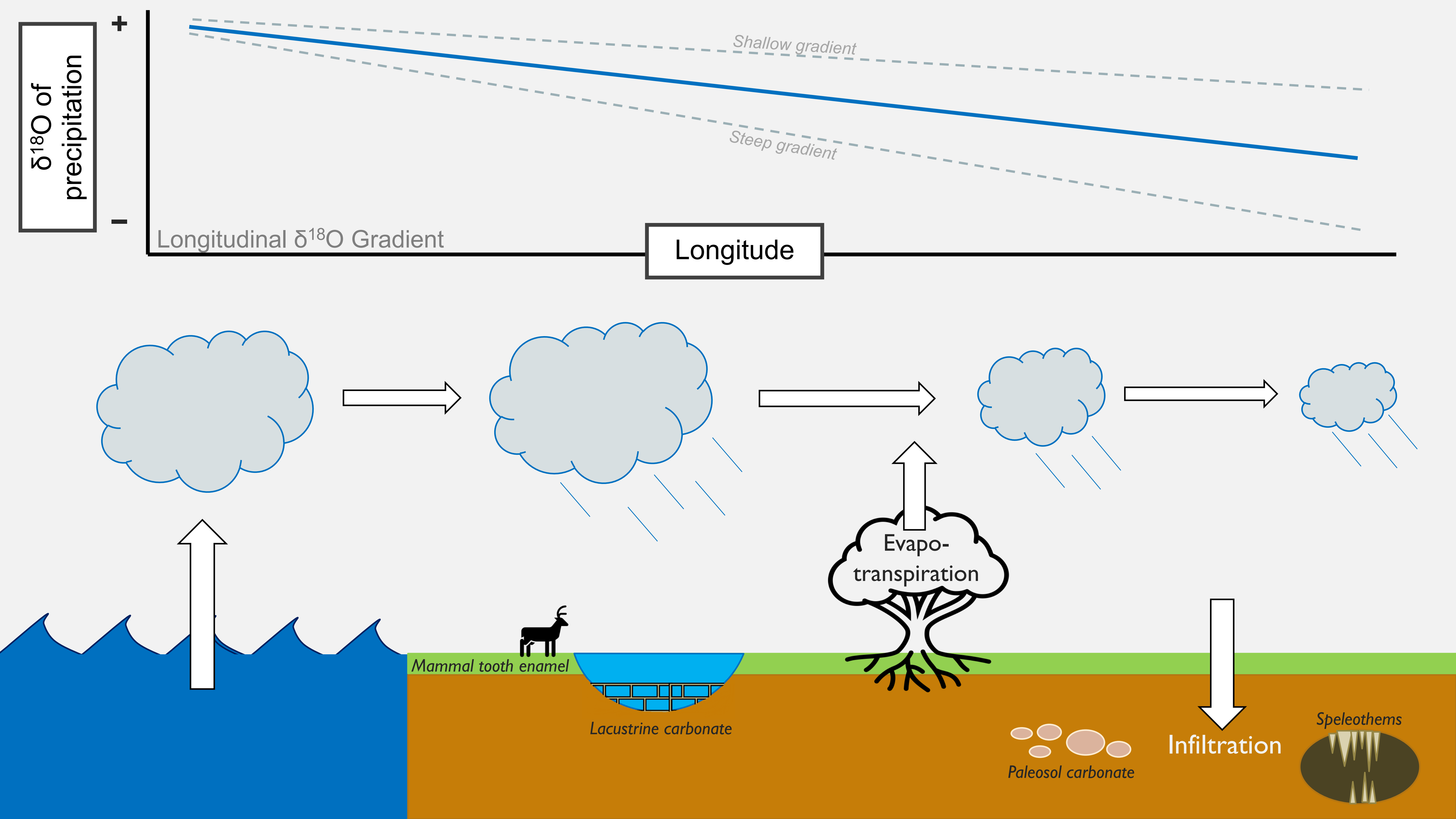
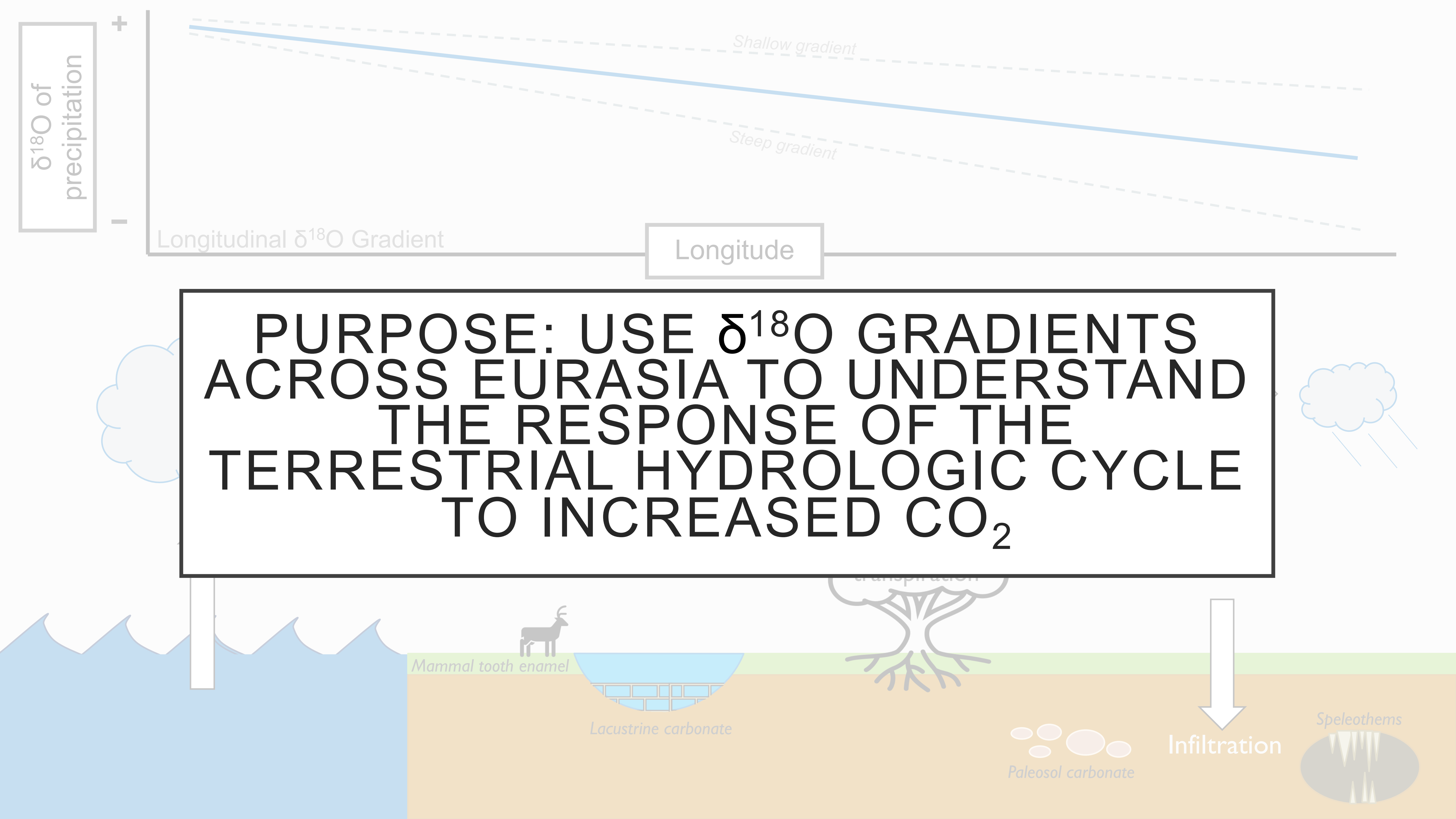


δ18O of precipitation
+
−
Shallow gradient
Steep gradient
Longitudinal δ18O Gradient
Longitude
Evapo-
transpiration
Mammal tooth enamel
Lacustrine carbonate
Paleosol carbonate
Infiltration
Speleothems

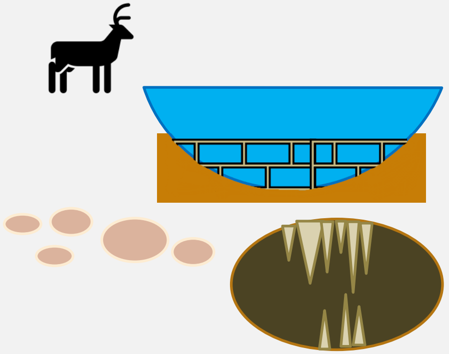


PURPOSE: USE $\delta^{18}O$ GRADIENTS ACROSS EURASIA TO UNDERSTAND THE RESPONSE OF THE TERRESTRIAL HYDROLOGIC CYCLE TO INCREASED CO_2

Why Eurasia?

- Largest continental area on Earth
- Dominated by a single air mass, with moisture flux from Europe to Asia driven by the Westerlies
- Much of the precipitation that falls over Asia is sourced from evaporated or transpired continental moisture from Europe
  - Isolate the effects of higher CO_2 on the terrestrial water cycle and the role of the land surface in driving changes in hydroclimate by nearly eliminating influence from marine moisture sources

METHODS: RESPONSE OF LONGITUDINAL $\delta^{18}O$ GRADIENTS OVER EURASIA TO VARYING CO_2 CONCENTRATIONS



Proxy $\delta^{18}O$ data

Proxy longitudinal $\delta^{18}O$ gradients

Quaternary - Eocene

Reactive Transport Model

(Kukla et al. 2019)

Reanalysis Longitudinal $\delta^{18}O$ Gradients

Modern

CESM-output Longitudinal $\delta^{18}O$ Gradients

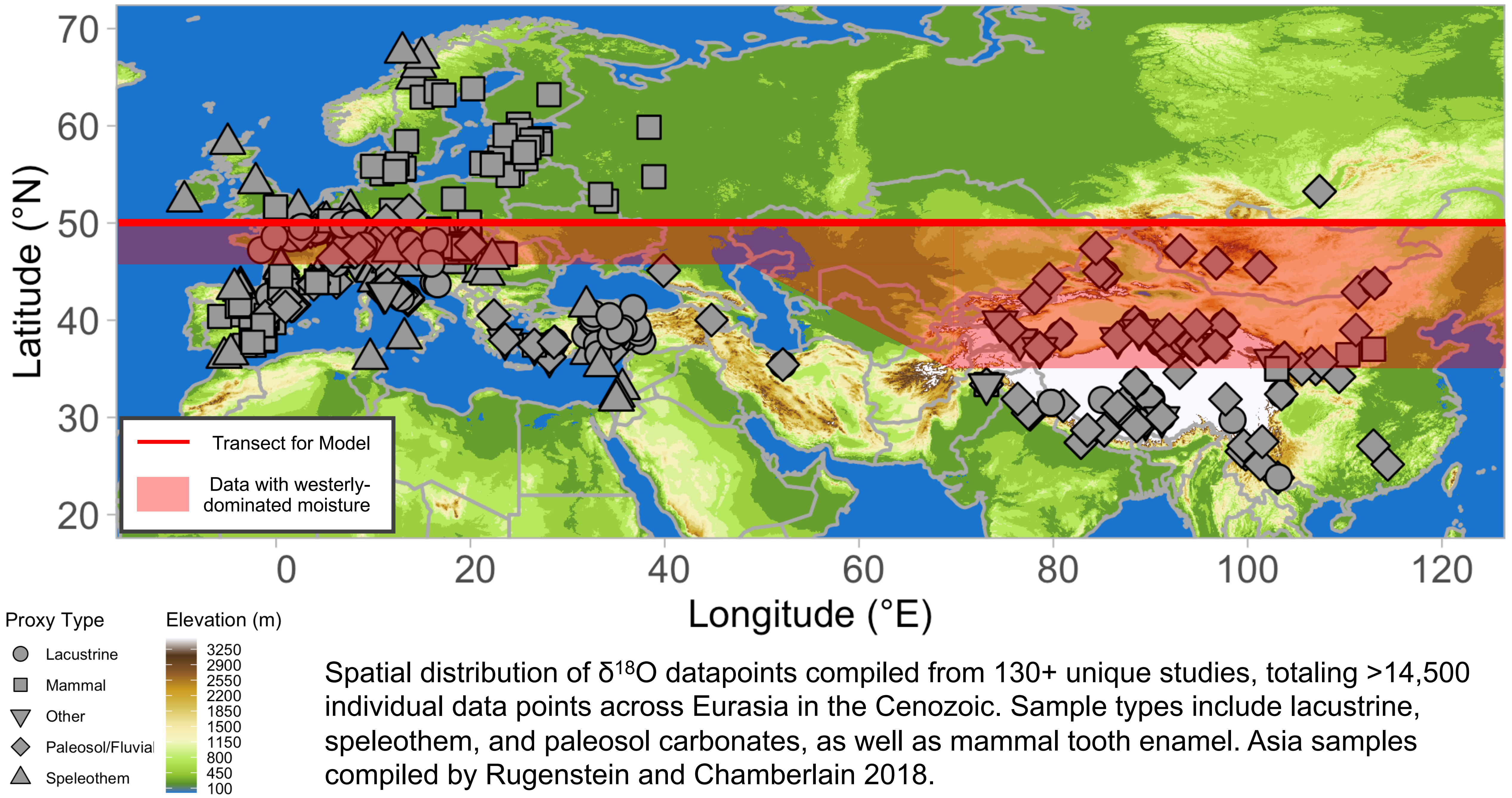
Pre-industrial CO_2, $2xCO_2$, $4xCO_2$

(relative to 280 ppm)

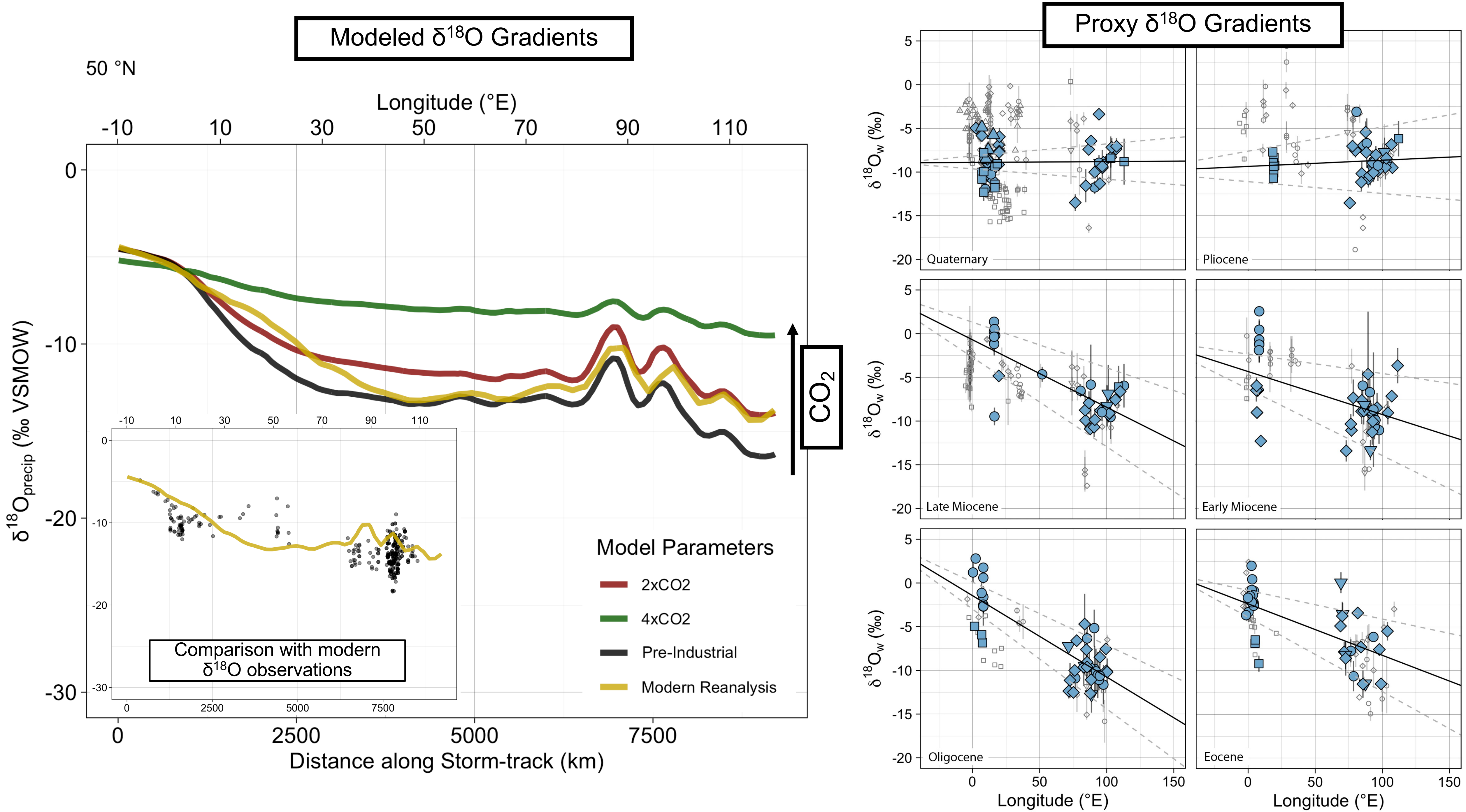
The PATCH Lab

Paleo Analysis of Terrestrial Climate and Hydrology

Full database of compiled N. America, Europe, and Asia $\delta^{18}O$ data available at: https://geocentroid.shinyapps.io/PATCH-Lab/



Spatial distribution of $\delta^{18}O$ datapoints compiled from 130+ unique studies, totaling >14,500 individual data points across Eurasia in the Cenozoic. Sample types include lacustrine, speleothem, and paleosol carbonates, as well as mammal tooth enamel. Asia samples compiled by Rugenstein and Chamberlain 2018.



Modeled δ18O Gradients
50 °N
Longitude (°E)
Distance along Storm-track (km)
δ18Oprecip (‰ VSMOW)
CO2
Comparison with modern δ18O observations
Model Parameters
2xCO2
4xCO2
Pre-Industrial
Modern Reanalysis
Proxy δ18O Gradients
δ18Ow (‰)
Quaternary
Pliocene
Late Miocene
Early Miocene
Oligocene
Eocene
Longitude (°E)

DISCUSSION

- Potential drivers for contradiction in slope between proxies and model:
  - Changes in paleogeography
  - Seasonality of proxy formation may change through time
  - Model incorrectly simulating land surface interactions

Oligocene *ca.* 25 Ma © Deep Time Maps 2020

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QUESTIONS?

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- **All references for compiled modern and proxy data are available upon request.**