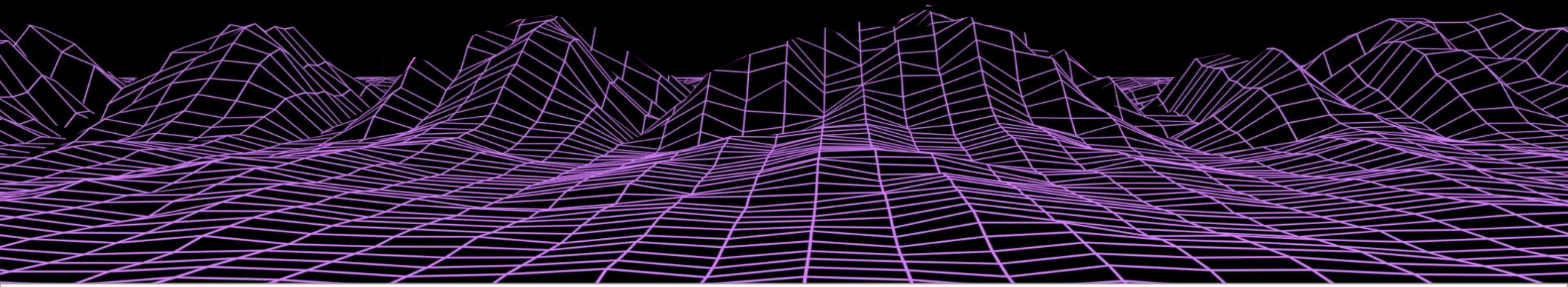
How would the propagation of surface uplift in the Alps affect regional climate and isotopic composition of precipitation?

Daniel Boateng, Sebastian G. Mutz, Todd A. Ehlers

Department of Geoscience, University of Tübingen



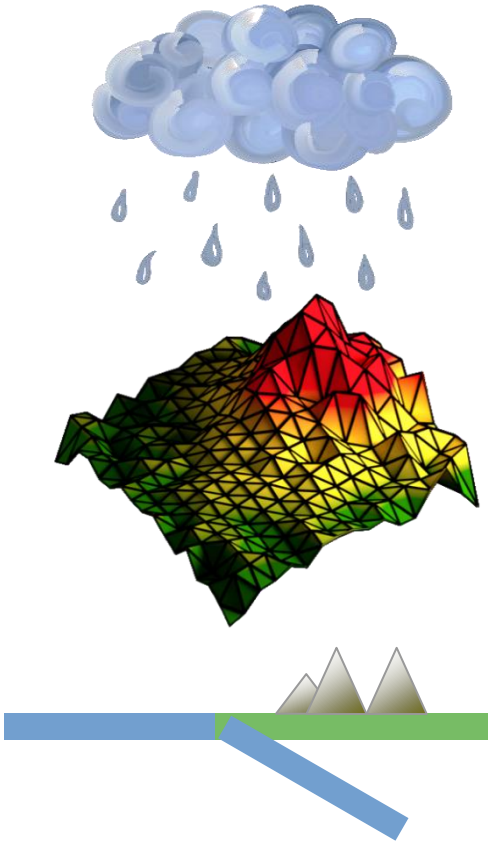
EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Mountain Building Processes in 4D

DFG Deutsche Forschungsgemeinschaft German Research Foundation

EGU European Geosciences Union

Motivation - climate and tectonics interaction



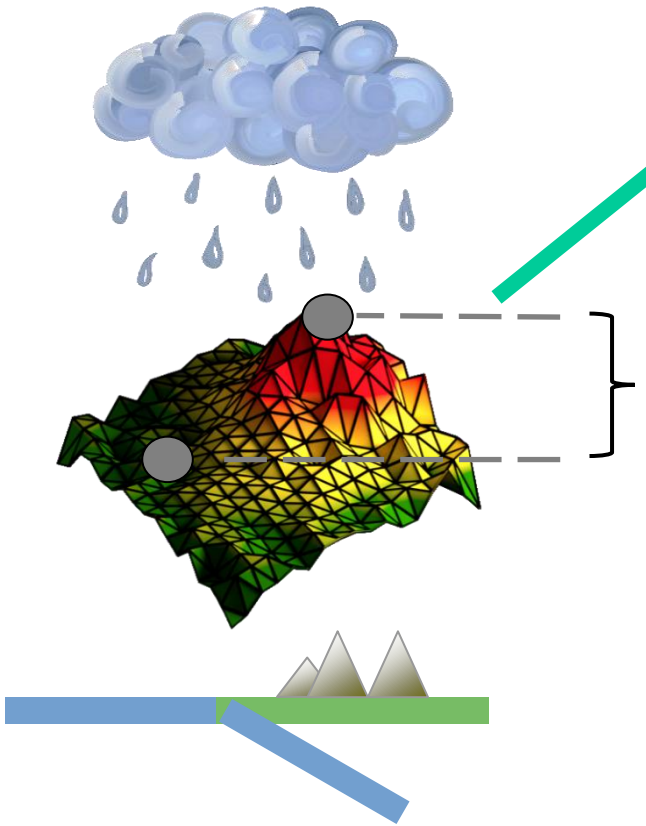
$\Delta\ \delta^{18}O$

Δ Elevation

Δ Geodynamics

Causal chain

Motivation - climate and tectonics interaction



$\Delta\ \delta^{18}O$

Paleoaltimetry

Inference

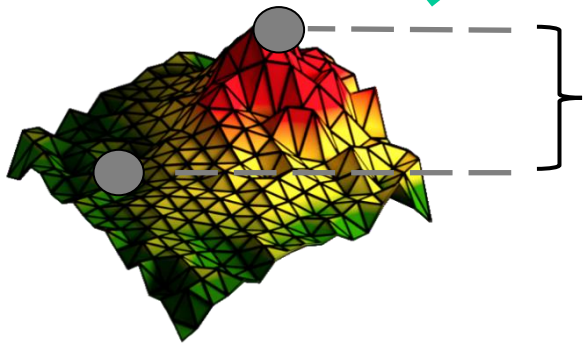
Δ Elevation

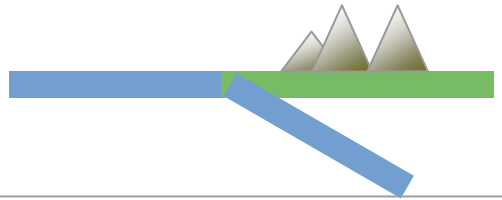
Δ Geodynamics

Motivation - climate and tectonics interaction

$\Delta\ \delta^{18}O$

Δ Elevation





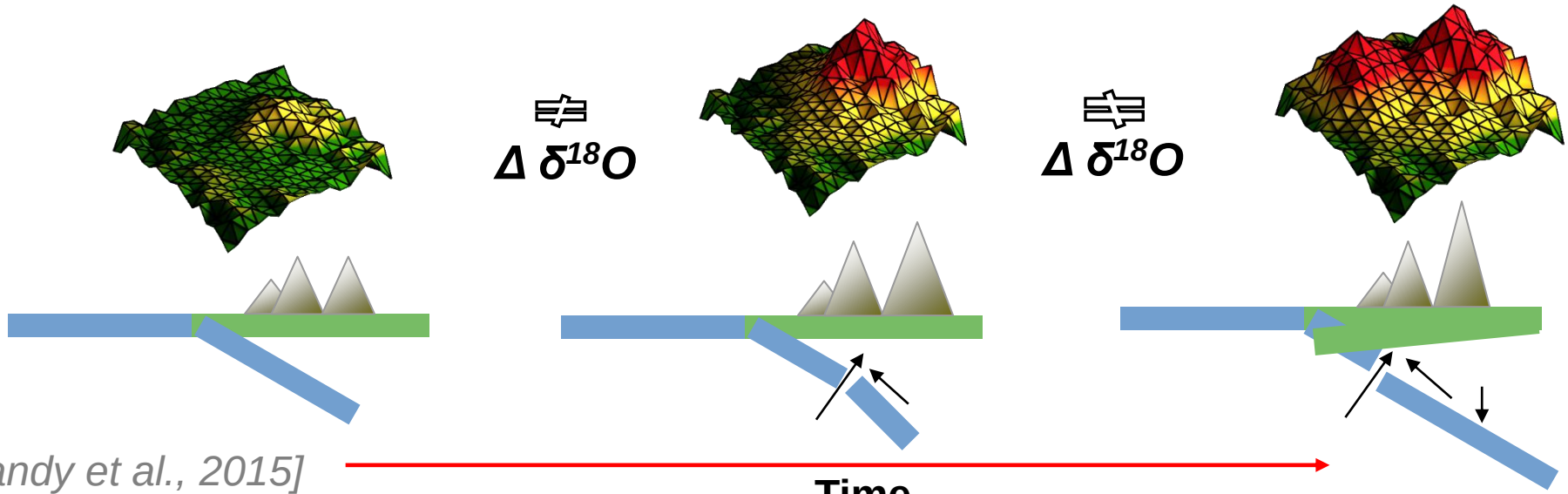
Paleoaltimetry

Inference

Complication

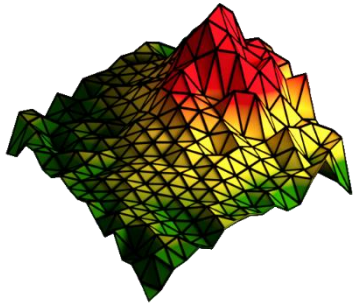
Motivation – Diachronous surface uplift of the Alps

- Hypothesis tested: Different topographic scenarios would result in different $\delta^{18}O_p$ and regional climate patterns



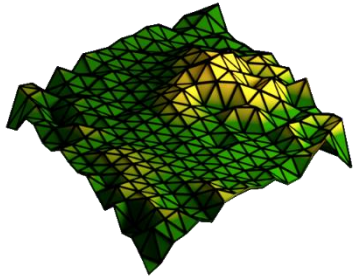
Method – Topographic sensitivity experiments

- AGCM (ECHAM5-wiso) to quantify topographic signal in isotopic record

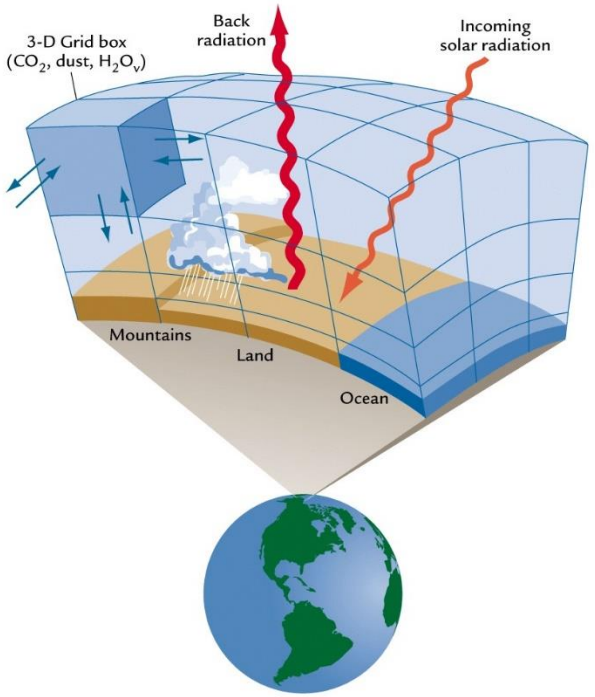


Topography changes:

- West-Central Alps



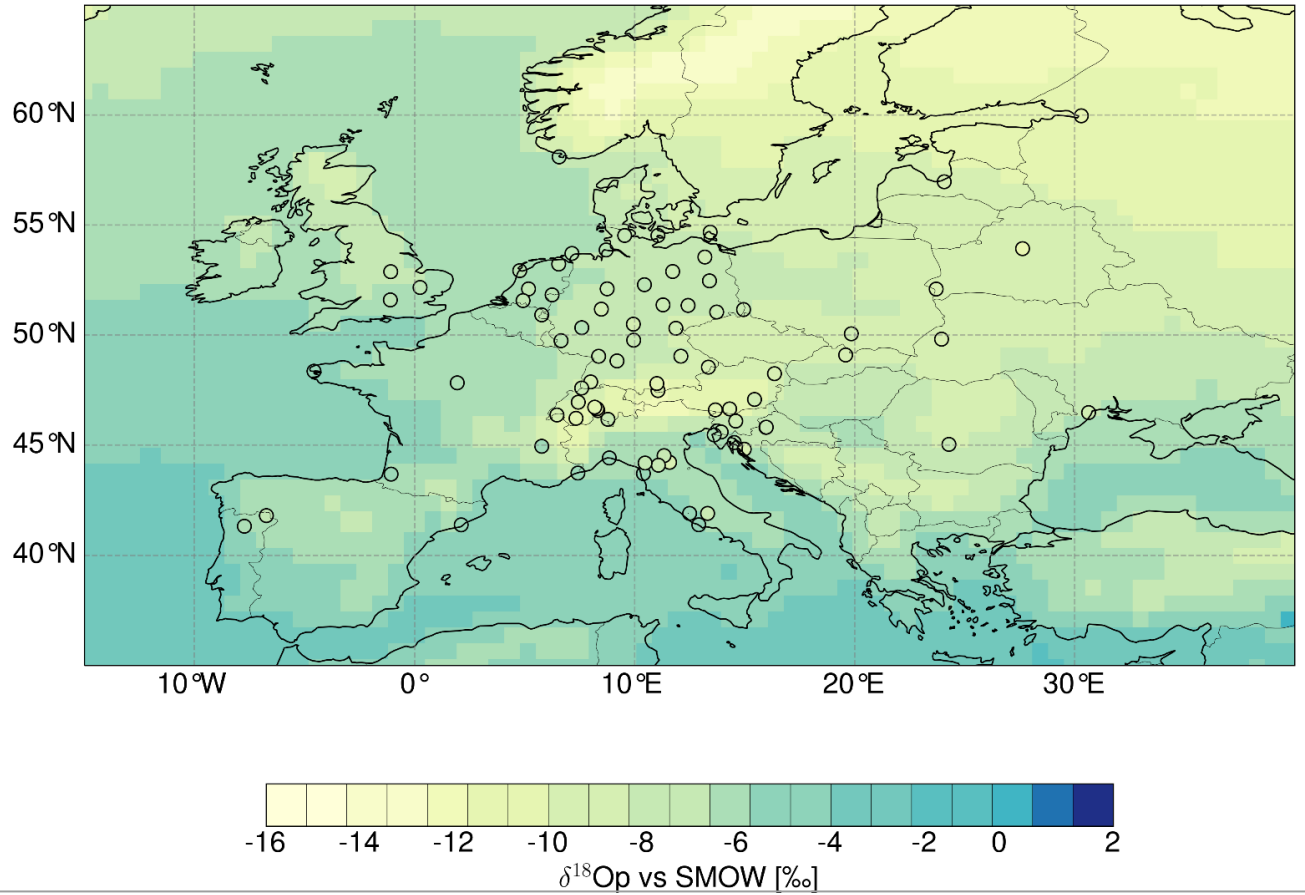
- Eastern Alps



[W. F. Ruddiman, 2001, Earth's climate: Past and Future]

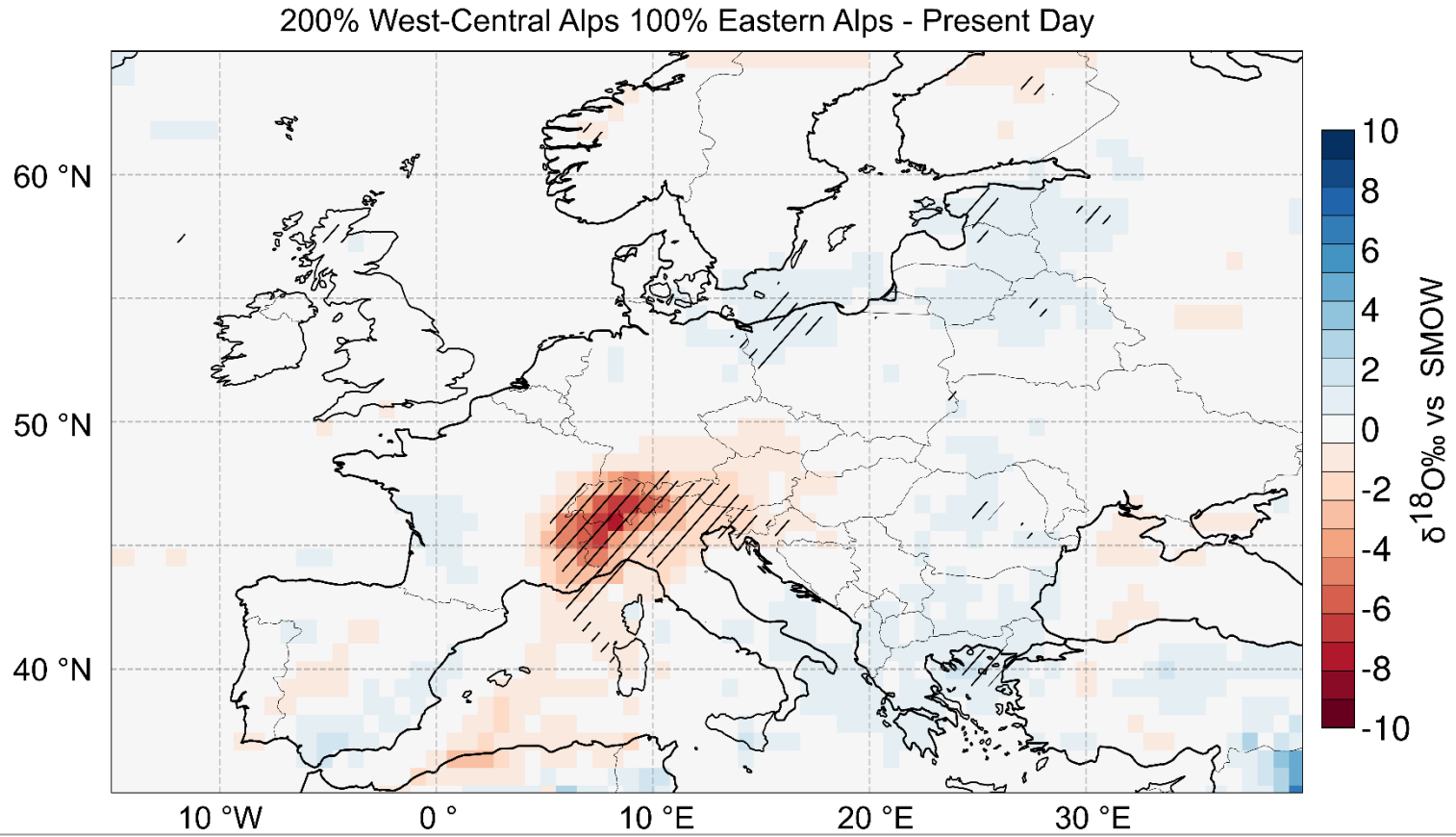
Model Validation

- $\delta^{18}O_p$ of GNIP stations are highly comparable to PD simulation with slight deviation within the range of 1-2 ‰



Spatial changes of $\delta^{18}O_p$ in response to changes in topography

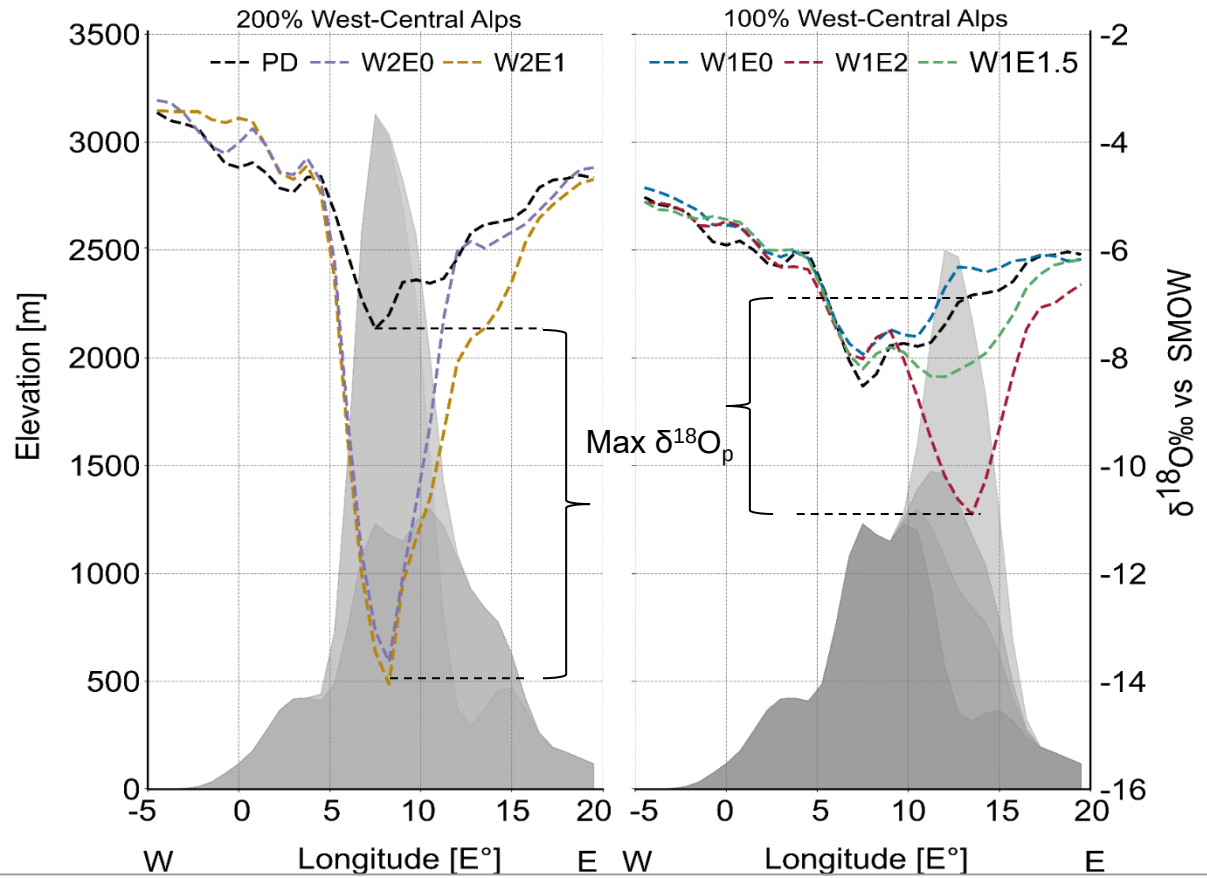
- Significant depletion of up to -8 ‰ across the Alps in response to increase in topography in the West-Central Alps



Different spatial profiles of $\delta^{18}O_p$ for the topography scenarios

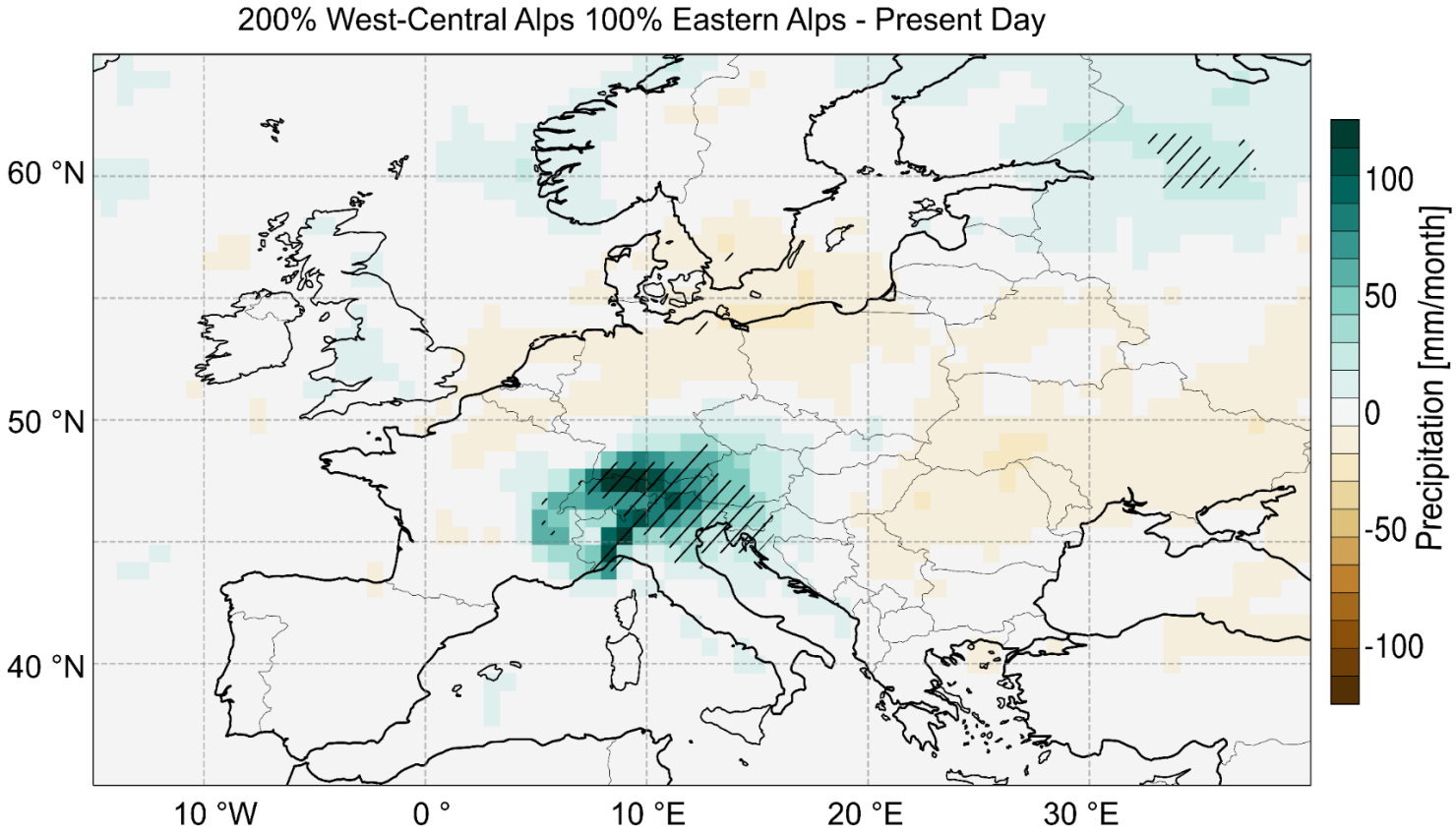
- $\Delta\delta^{18}O_p$ of < -2 ‰ in low elevation adjacent regions
- $\Delta\delta^{18}O_p$ of up to -7 ‰ in high elevation regions

  - *e.g., PD- Present day, W2E1 – 200% West-Central Alps 100% Eastern Alps*



Spatial changes of precipitation in response to the changes of topography

- Significant increase of precipitation up to ~ 125 Mm/month across the Alps and expansion of drier patterns towards the north and east flanks



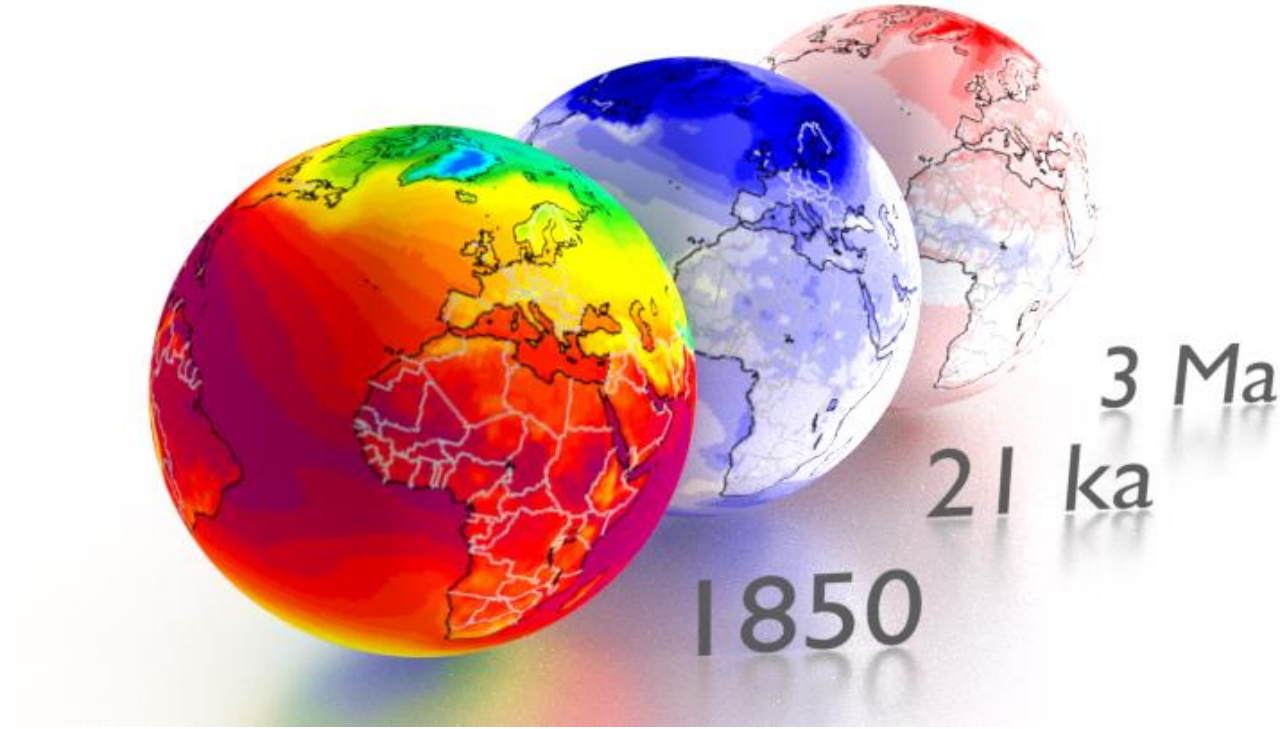
Take Home Messages

- Significant variation in $\Delta\delta^{18}O_p$ suggests preservation of isotopic signal in response to changes in topography across the Alps
- Significant influence of topography changes on regional climate patterns (e.g., precipitation)
- Results highlight the importance of sampling far-field and low elevation sites to discern between different uplift scenarios

Thank You for the attention !

@Dann-boat

daniel.boateng@uni-tuebingen.de



EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

MB 4D Mountain Building Processes in 4D

DFG Deutsche Forschungsgemeinschaft
German Research Foundation

EGU European Geosciences Union

Topographic configurations