

Estimating Arctic Holocene precipitation seasonality and amount using proxies & forward models

Elizabeth K. Thomas

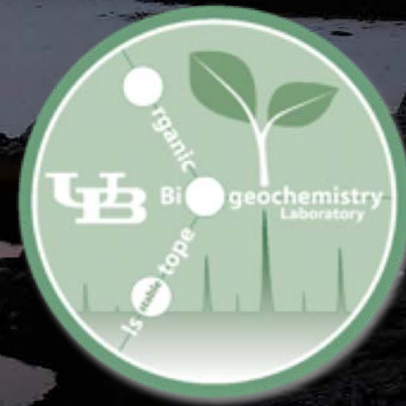
Water Isotopes and Climate Workshop

October 1-3, 2019

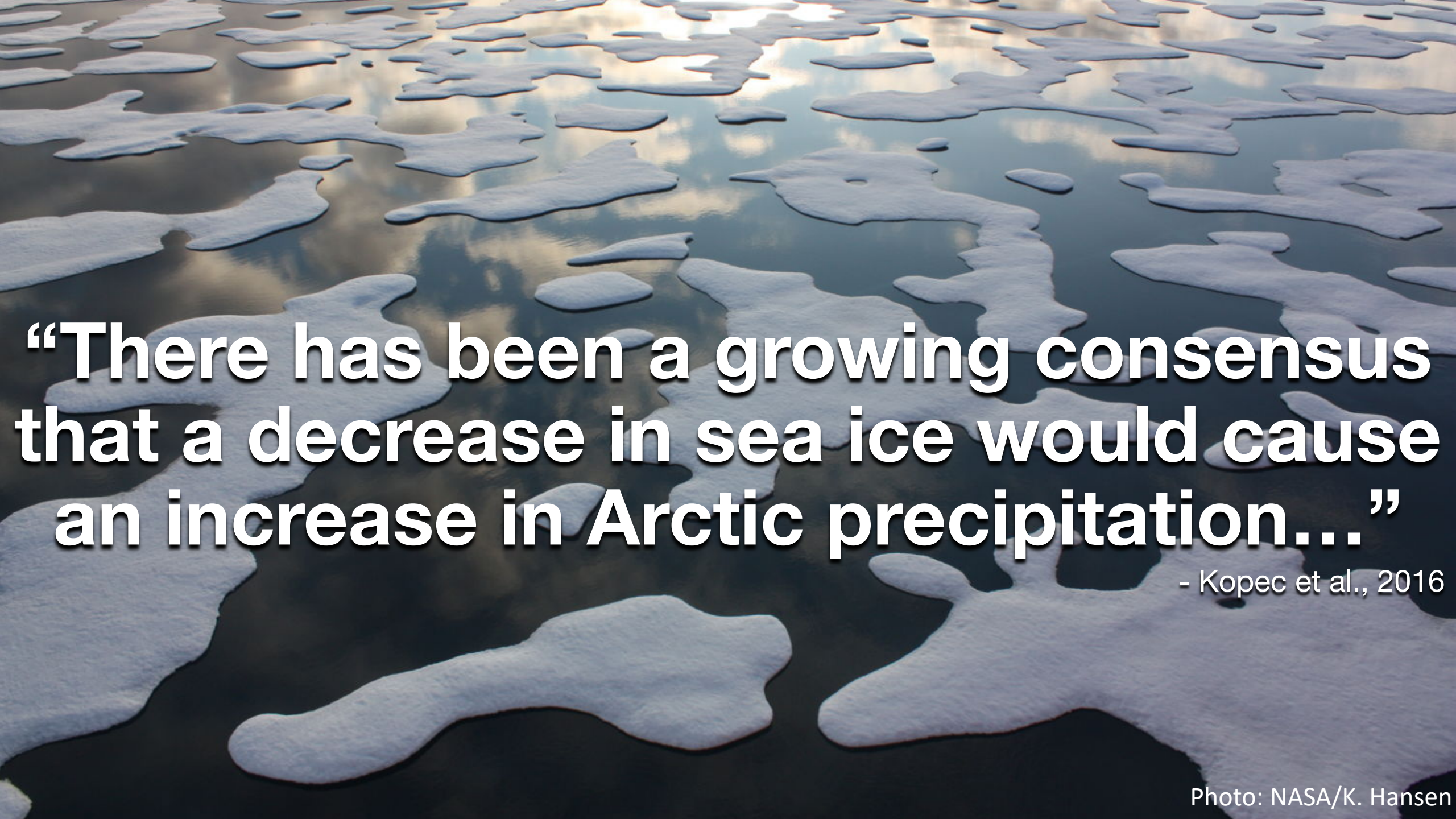


with

Megan C. Corcoran^{1,2}, Allison A. Cluett¹, Kayla V. Hollister¹, John J. Ryan-Henry³, Amy L. Grogan¹, Owen C. Cowling¹, Jason P. Briner¹, Sylvia Dee⁴, Carrie Morrill⁵

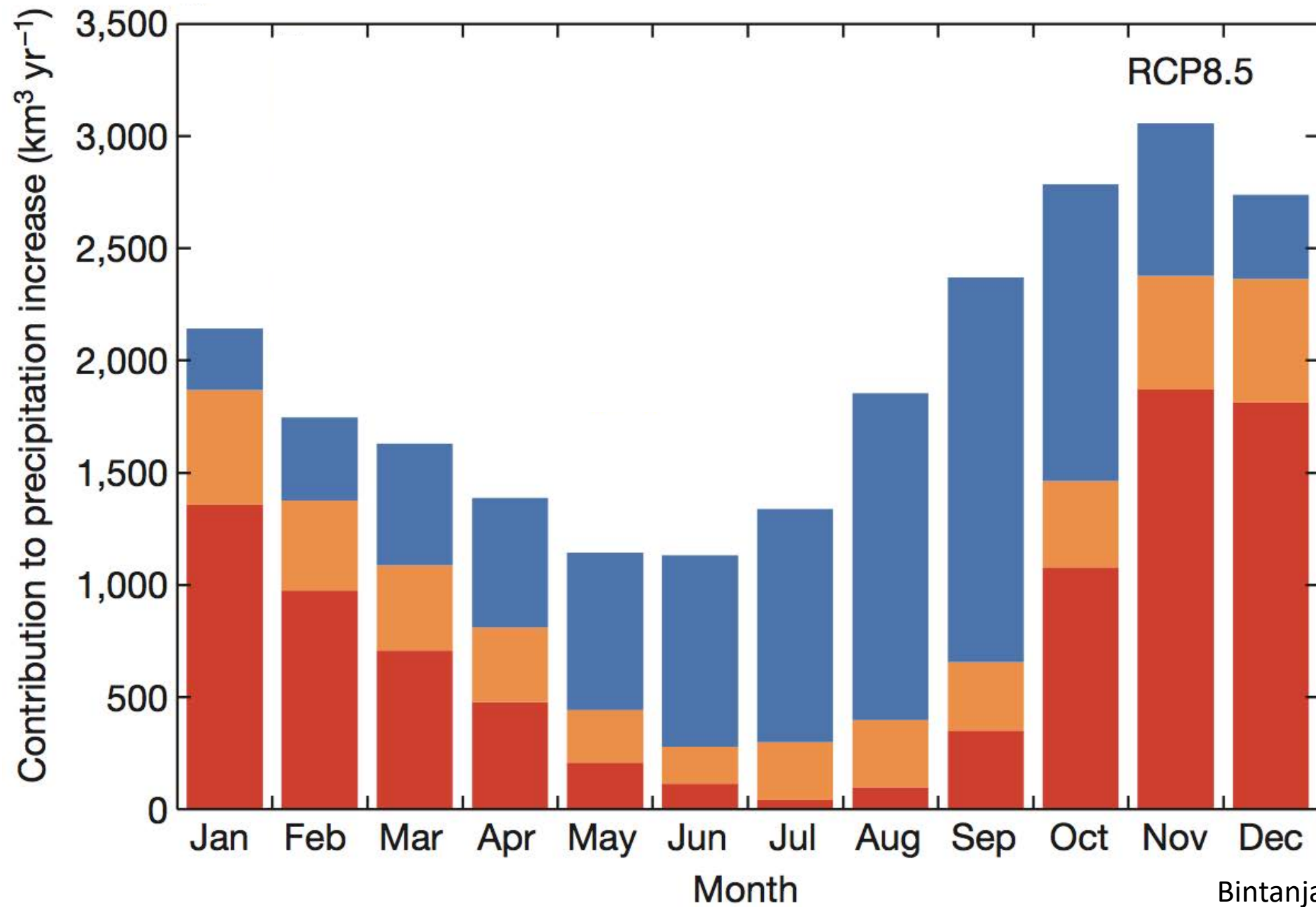


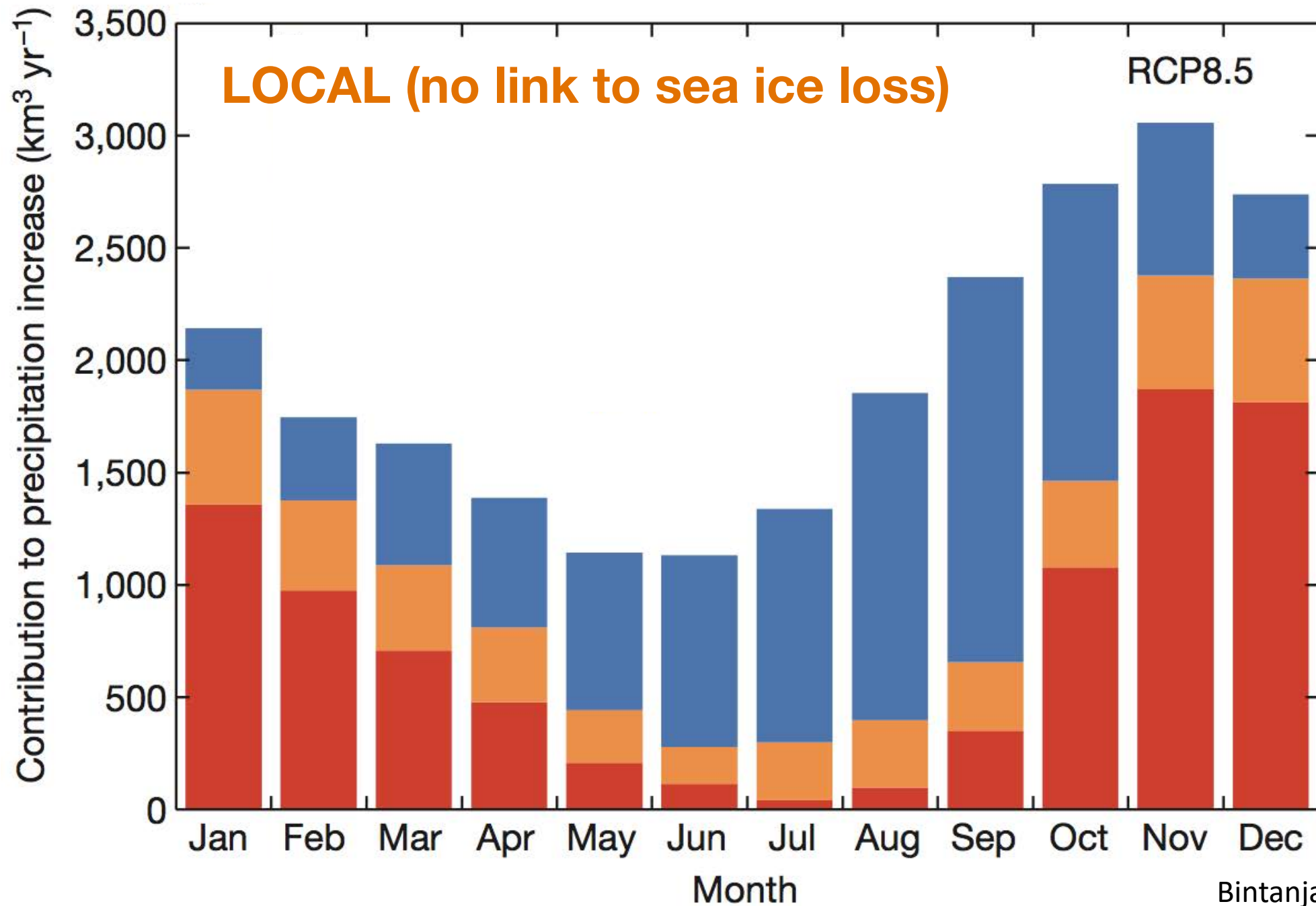
¹University at Buffalo Dept. of Geology, ²University of Cincinnati Dept. of Geology, ³Brown University and Coastal States Organization, ⁴Rice University Dept. of Earth, Environmental, and Planetary Sciences, ⁵Cooperative Institute for Research in Environmental Sciences (CIRES) University of Colorado at Boulder, and NOAA's National Centers for Environmental Information (NCEI)

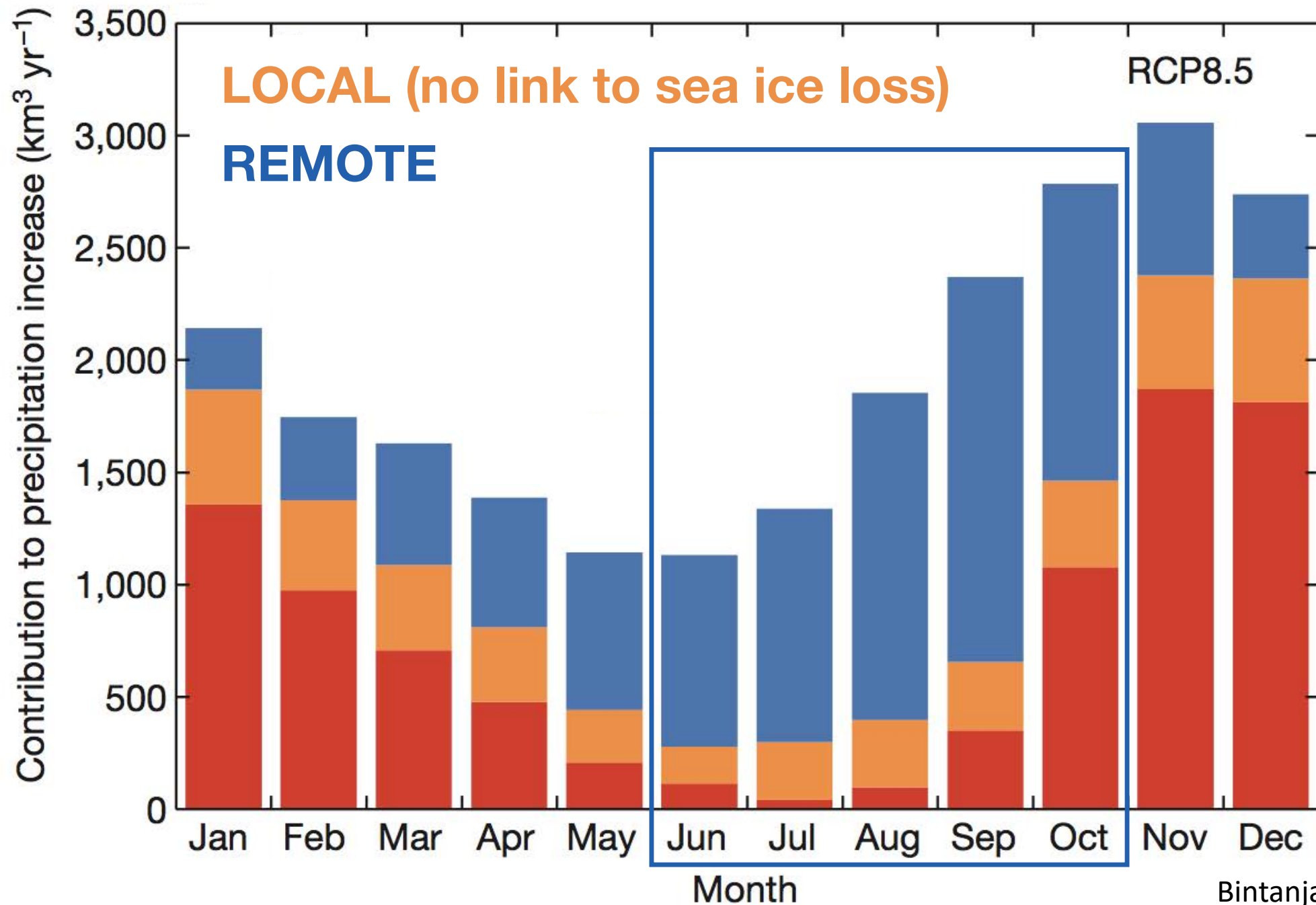
An aerial photograph of a vast expanse of sea ice. The ice consists of numerous irregular, light blue and white floes of varying sizes, separated by dark, open water. The sky is reflected in the water, showing soft, golden light from a low sun, likely during sunrise or sunset. The overall scene conveys a sense of a cold, remote environment.

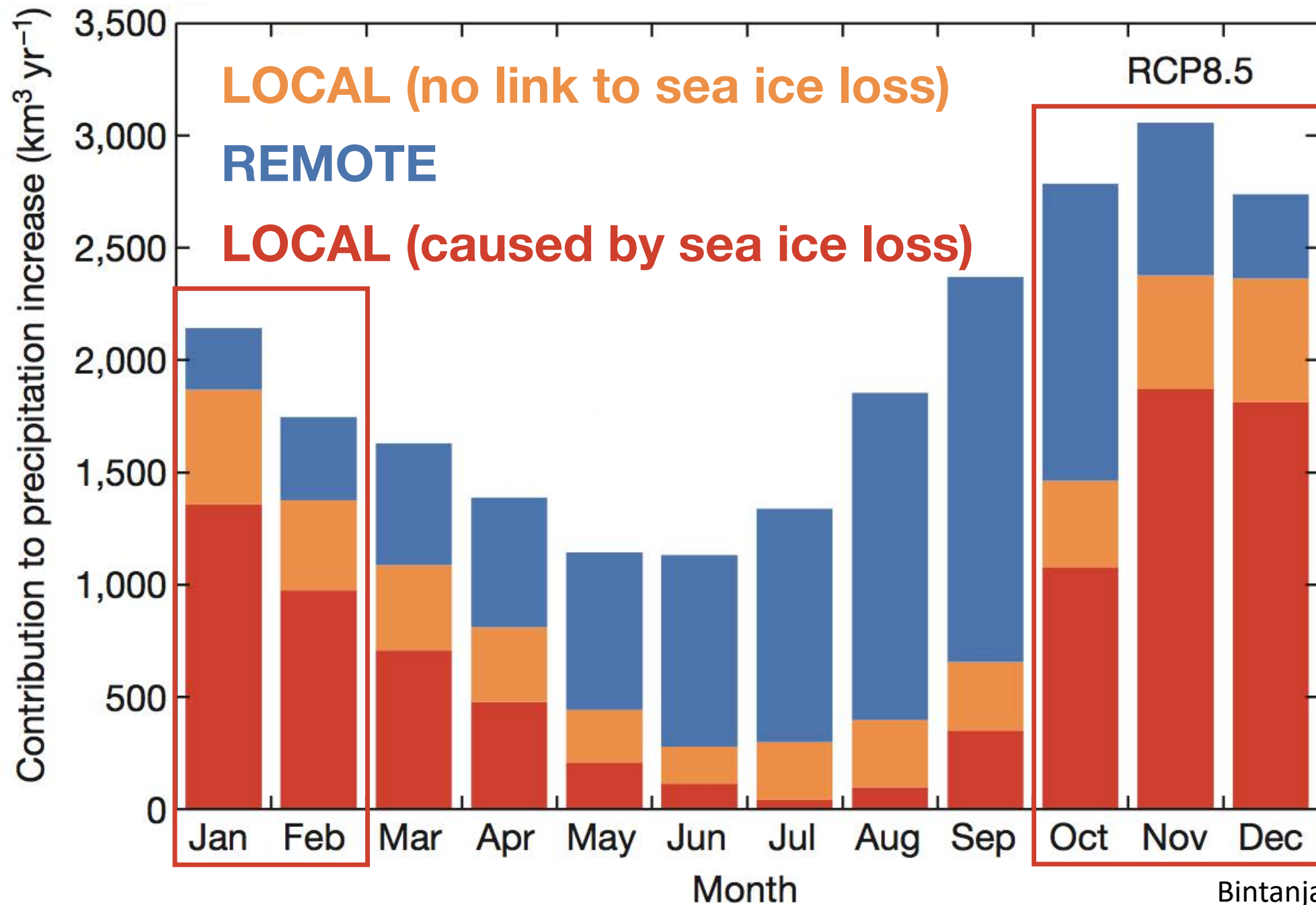
**“There has been a growing consensus
that a decrease in sea ice would cause
an increase in Arctic precipitation...”**

- Kopec et al., 2016

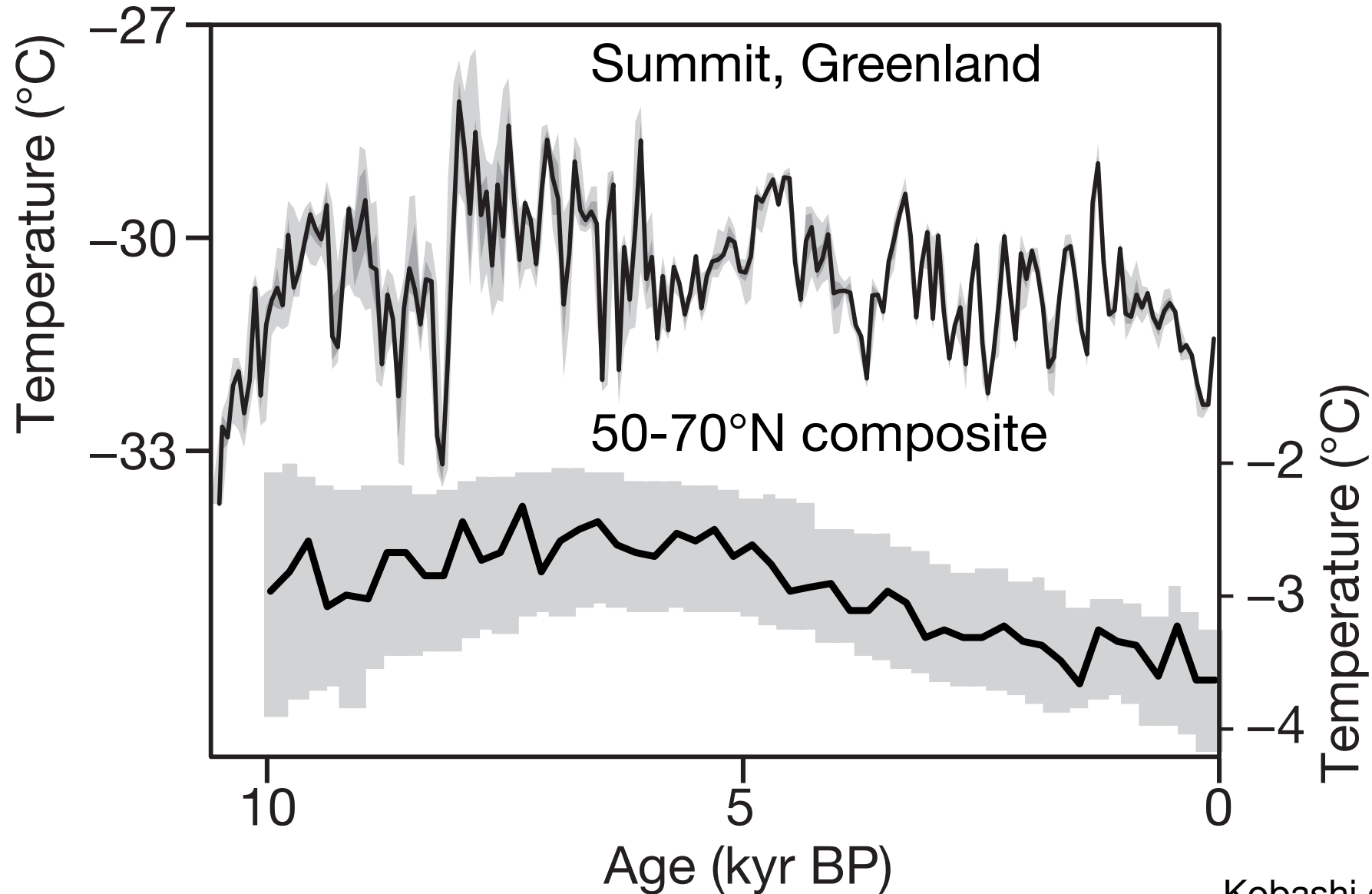


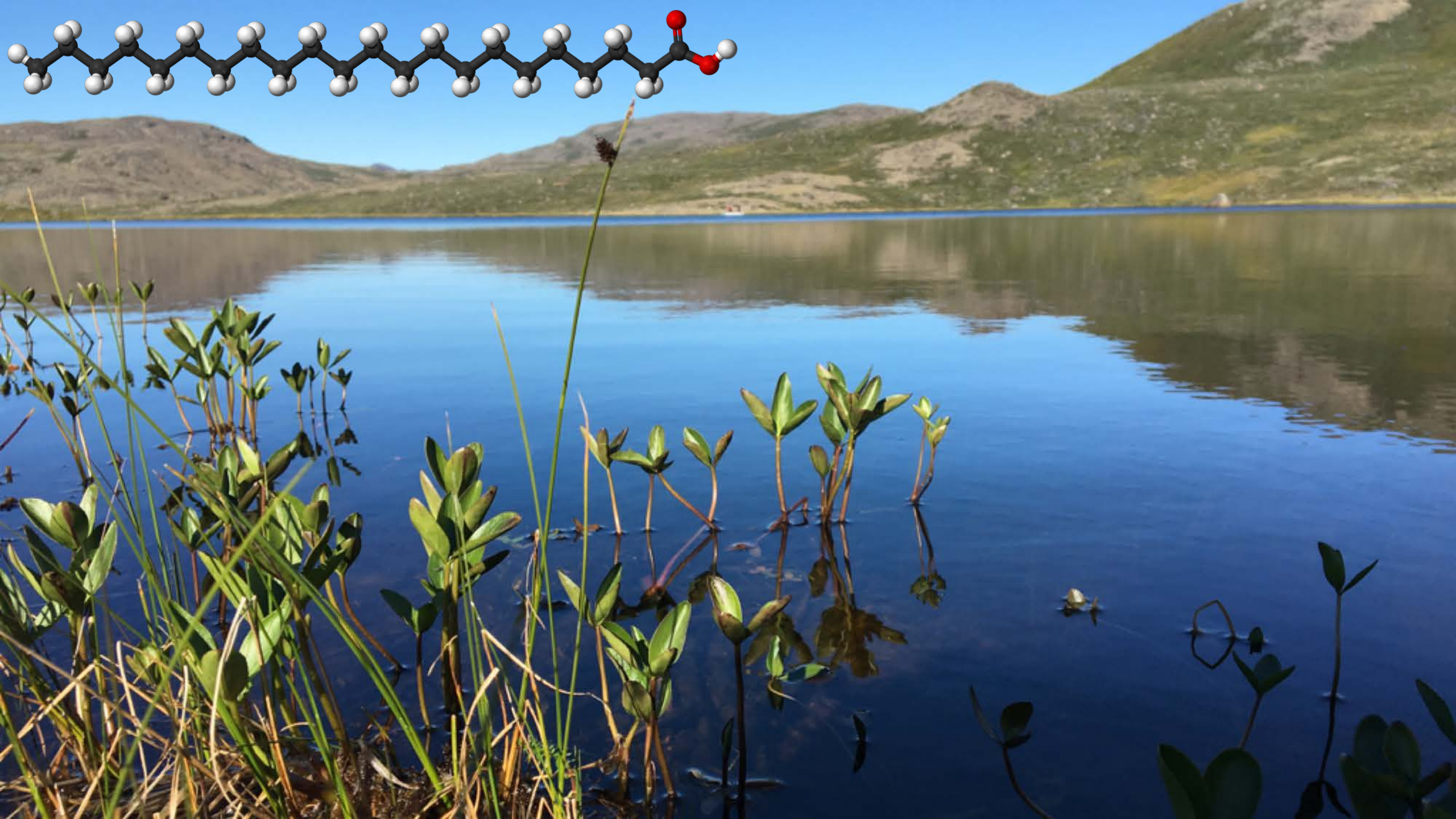
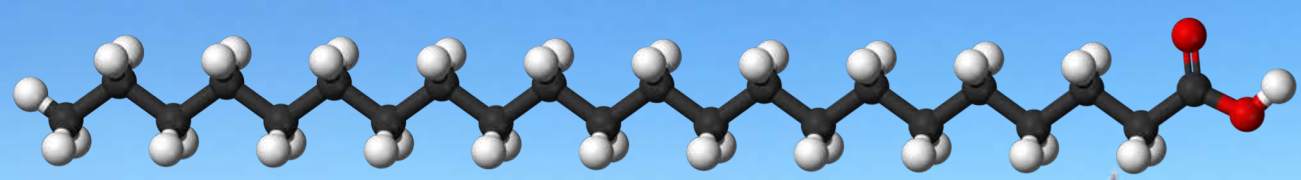






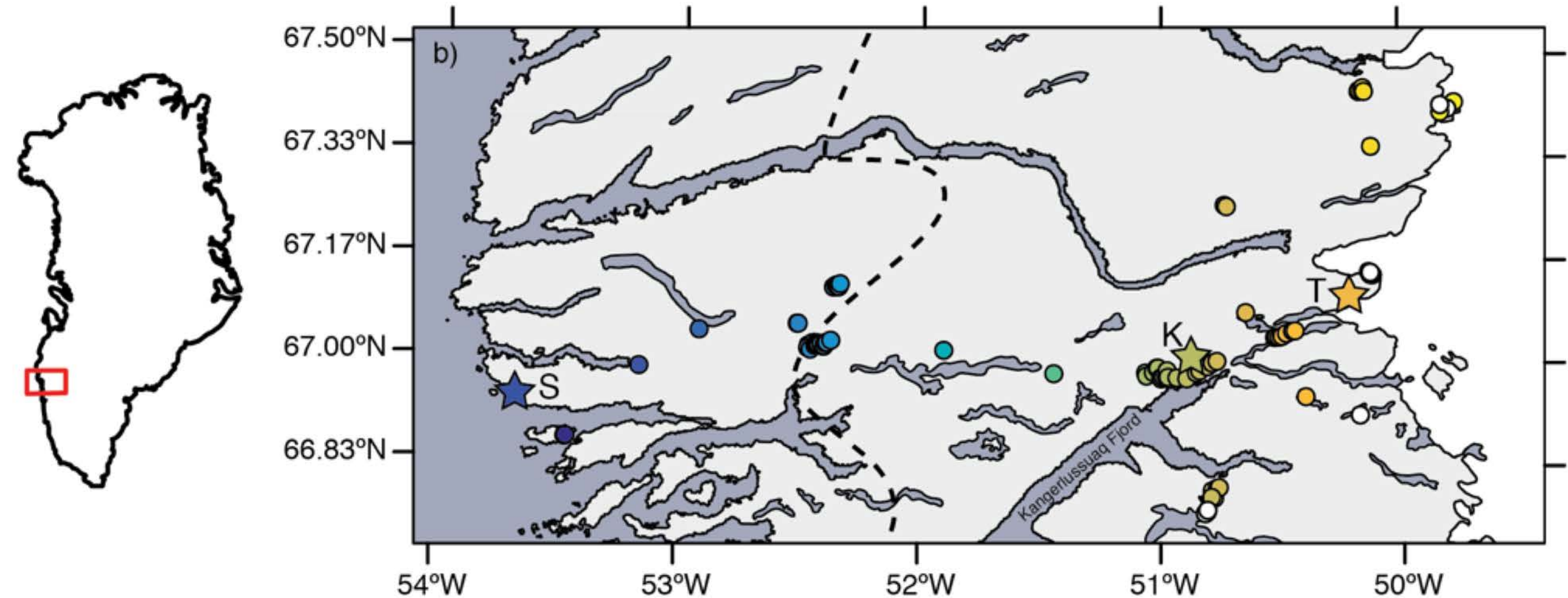
HOW DID PRECIPITATION CHANGE DURING HOLOCENE WARMTH?



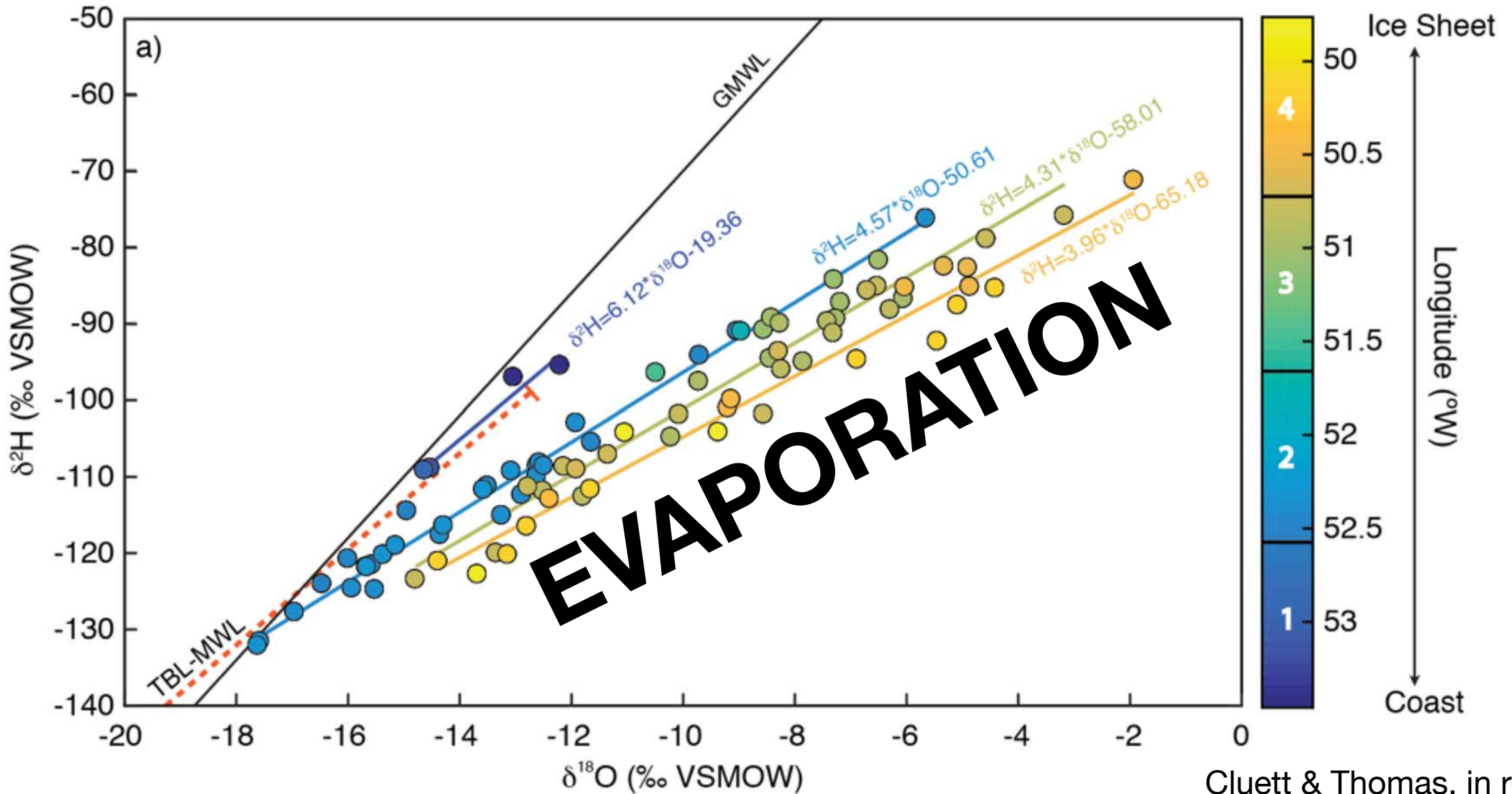




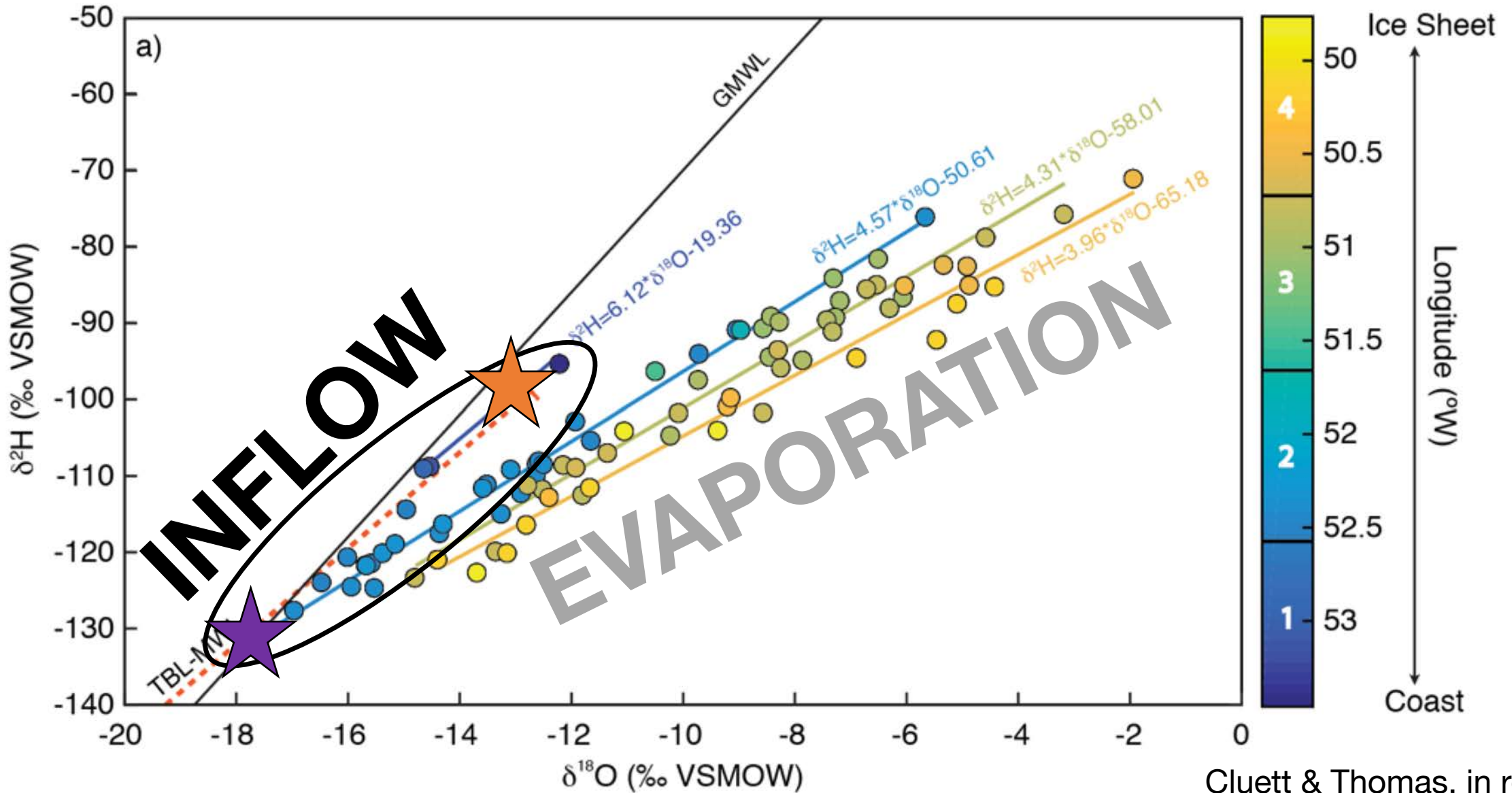
W. Greenland lake water, July 2016



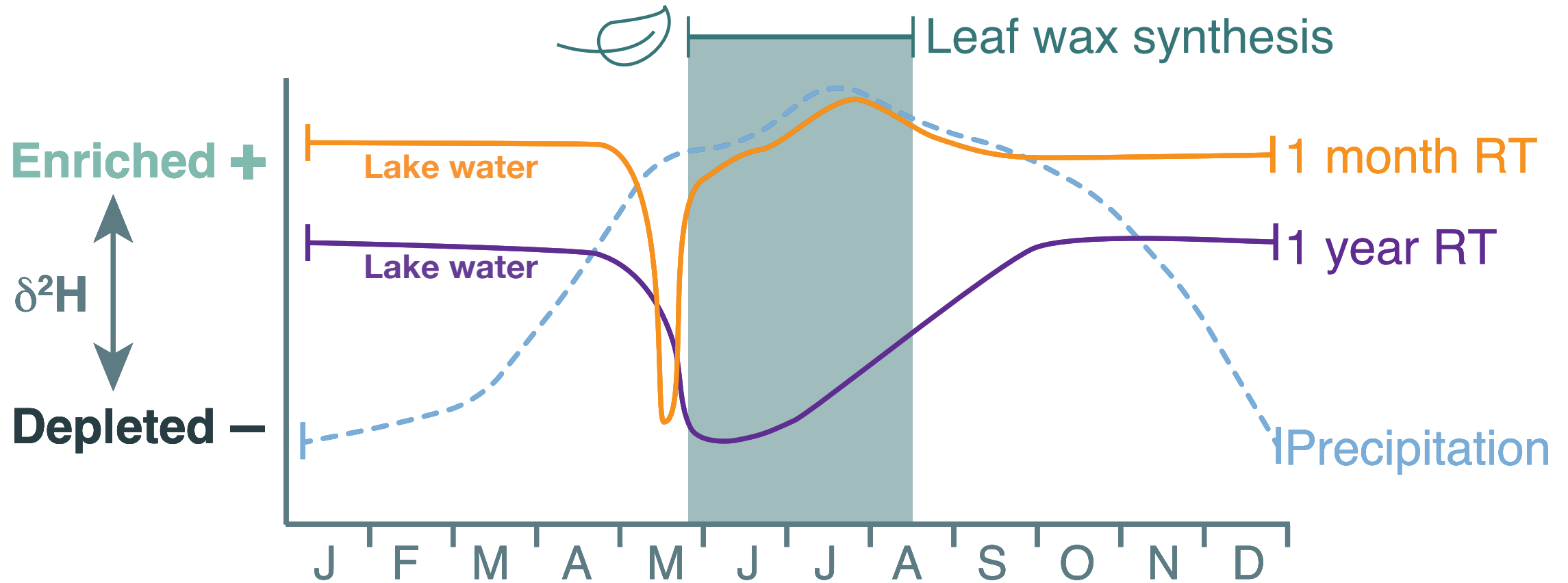
W. Greenland lake water isotopes



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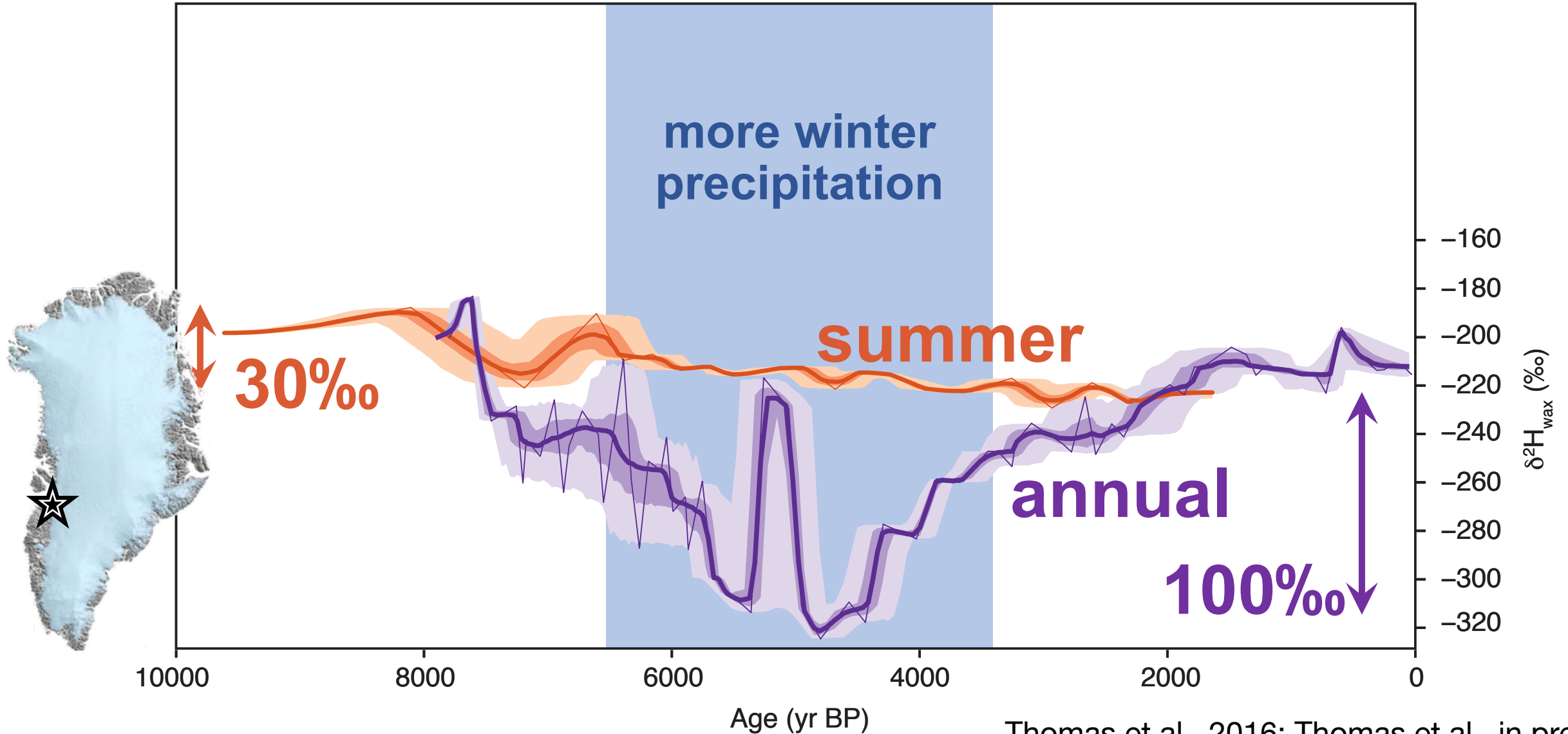


CONCEPTUAL MODEL: LAKE WATER ISOTOPE SEASONALITY



RT = residence time

HOLOCENE PRECIPITATION $\delta^2\text{H}$



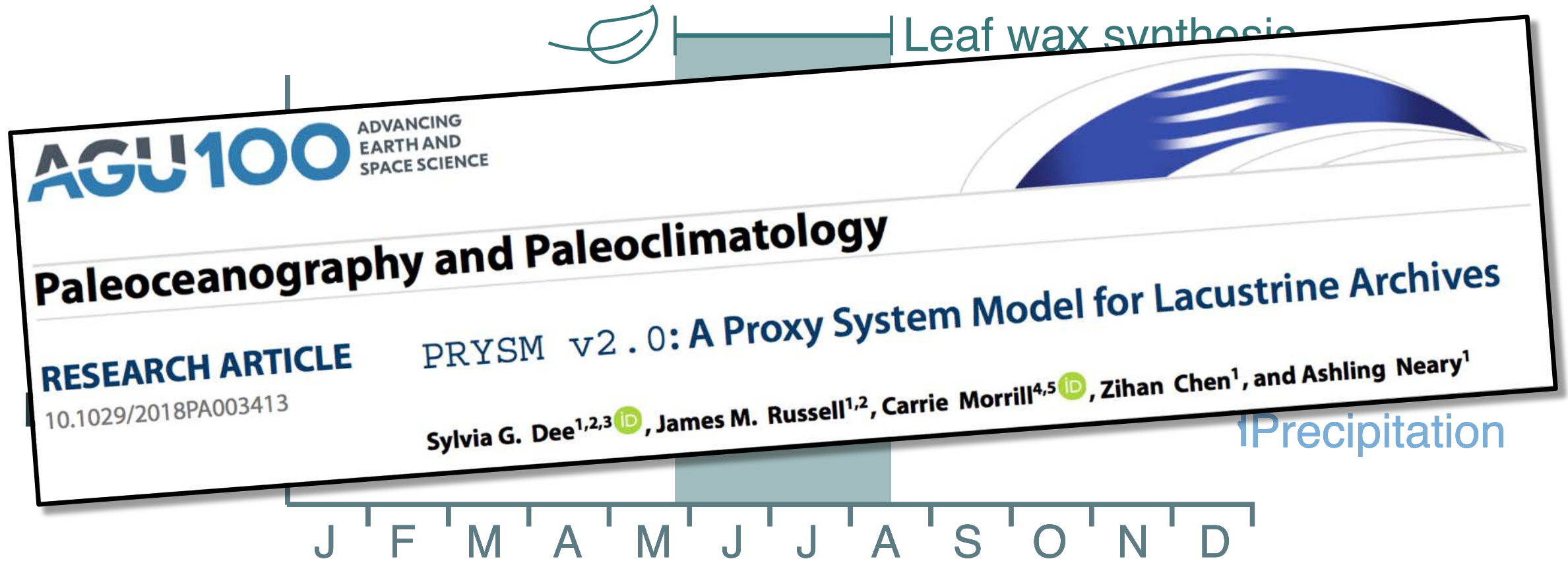
HOW DID PRECIPITATION CHANGE DURING HOLOCENE WARMTH?

On western Greenland:

- Greater winter precipitation during middle Holocene:
 - sea ice @ minimum & ocean heat transport @ maximum
 - ^2H -depletion of summer precipitation throughout Holocene:
- stronger latitudinal temp. gradient

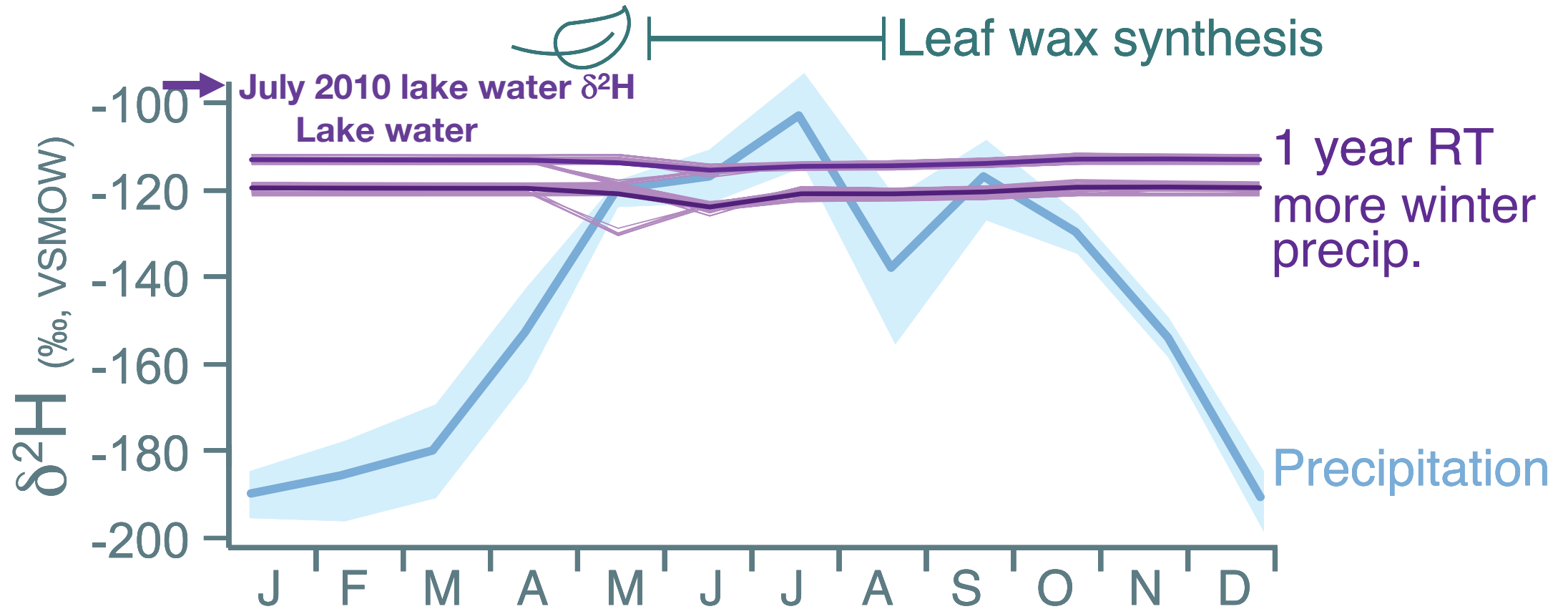


CONCEPTUAL MODEL: LAKE WATER ISOTOPE SEASONALITY



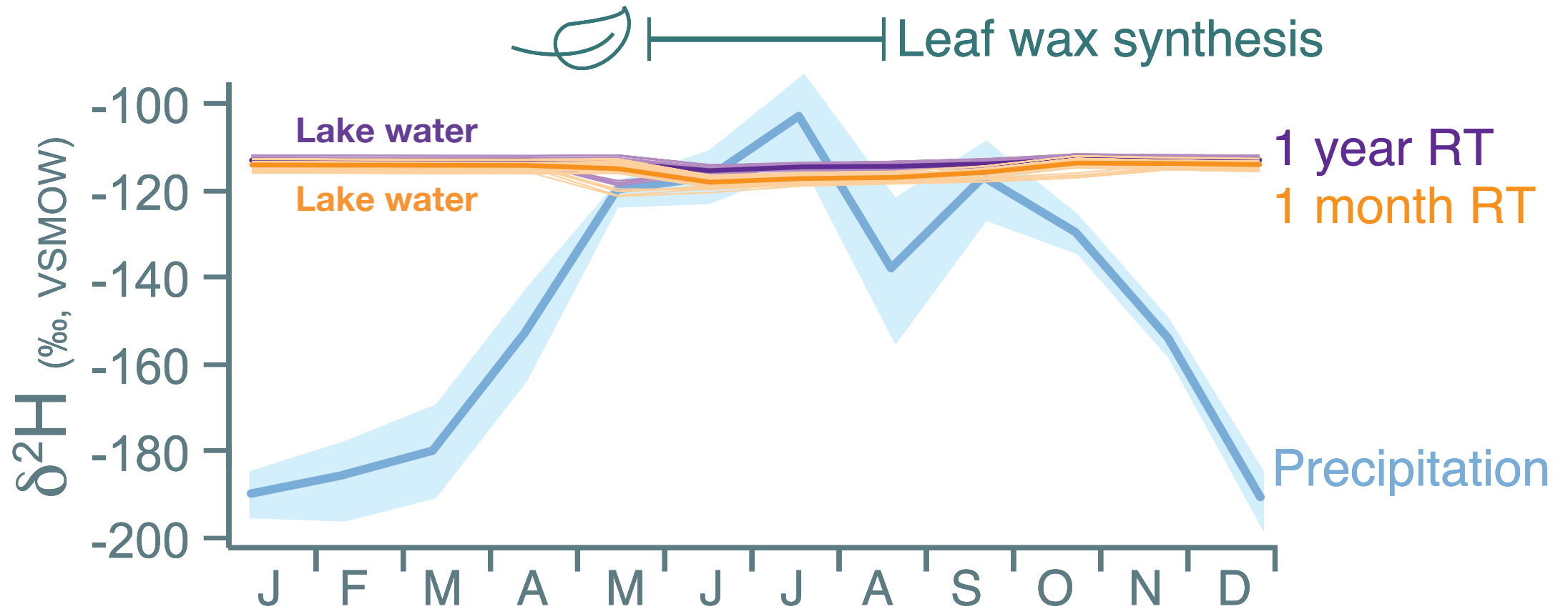
RT = residence time

FORWARD MODEL: LAKE WATER ISOTOPE SEASONALITY



RT = residence time

FORWARD MODEL: LAKE WATER ISOTOPE SEASONALITY

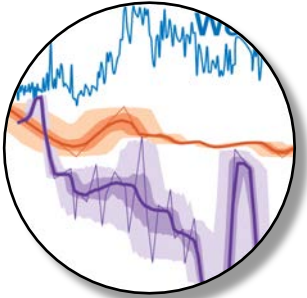


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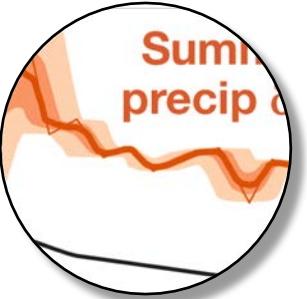
CONCLUSIONS



Proximal lakes with contrasting residence times: same climate, $\delta^2\text{H}_{\text{aq}}$ different seasons



Middle Holocene on western Greenland: wet winters

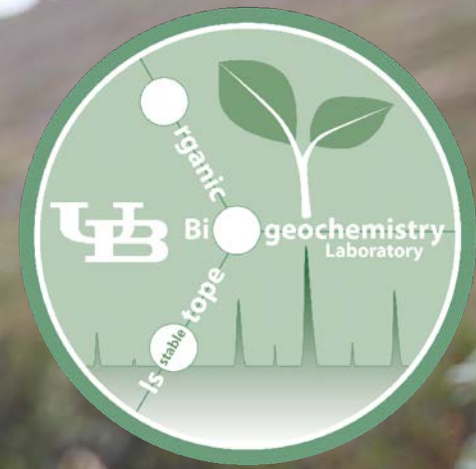


Late Holocene on western Greenland: ^2H -depleted summer moisture



Lake water isotopes in forward model $\neq$ lake water isotopes in conceptual model

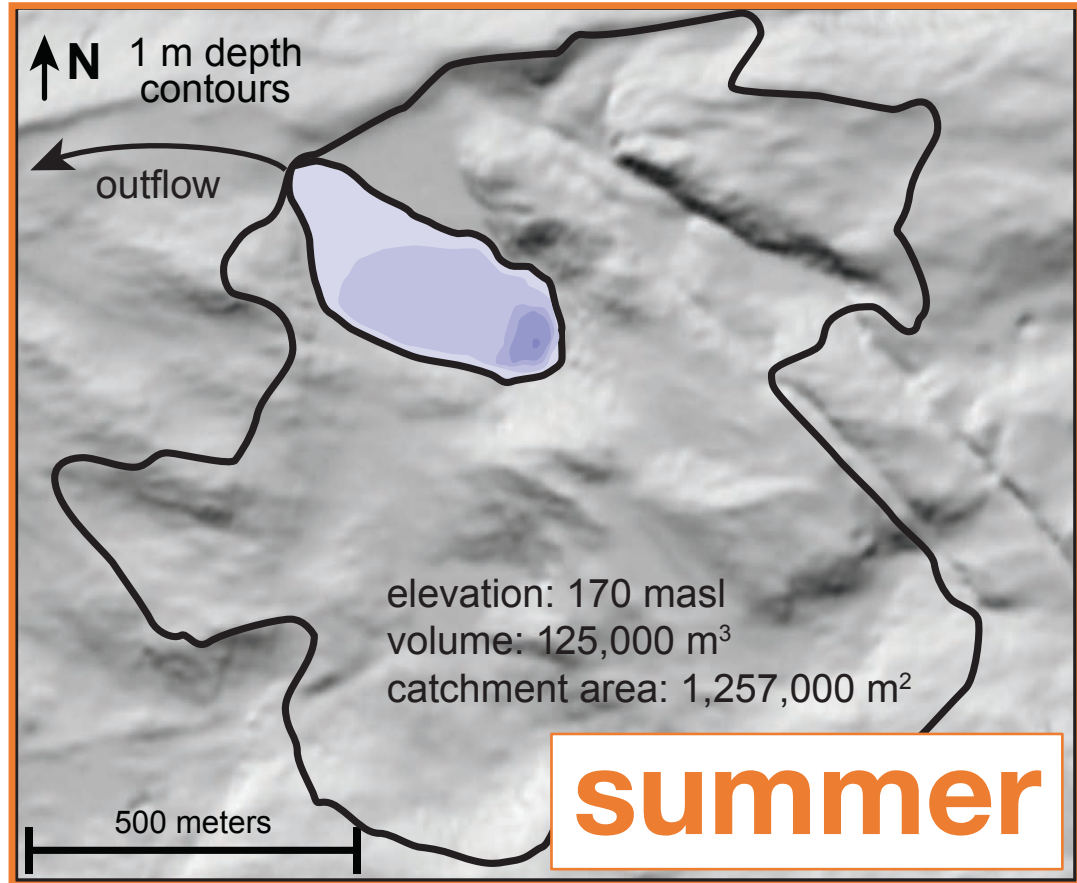
Thanks!



www.glyfac.buffalo.edu/Faculty/ekthomas ekthomas@buffalo.edu

 **@IsotopeThomas**

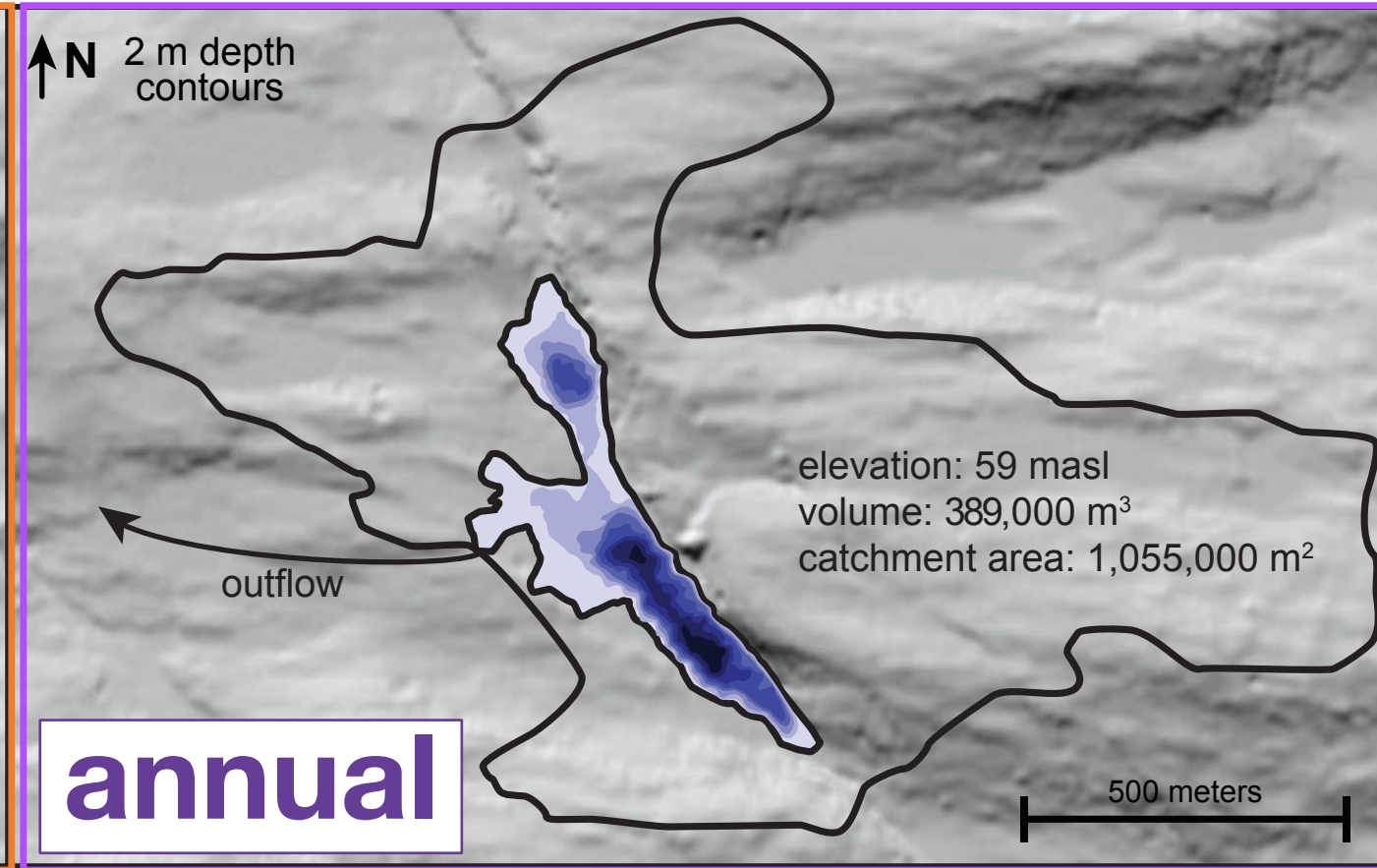
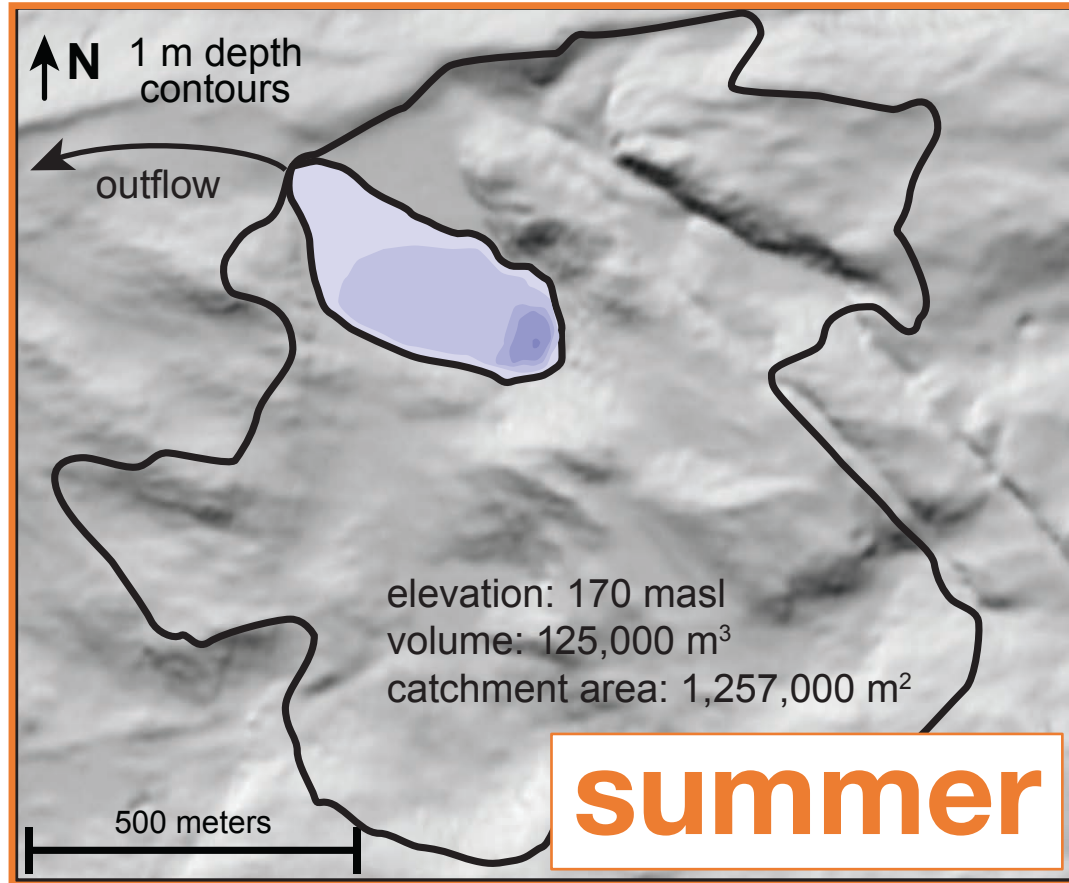
TWO LAKES, CONTRASTING RESIDENCE TIMES



PLUTO LAKE

fully flushed 2-3x each year

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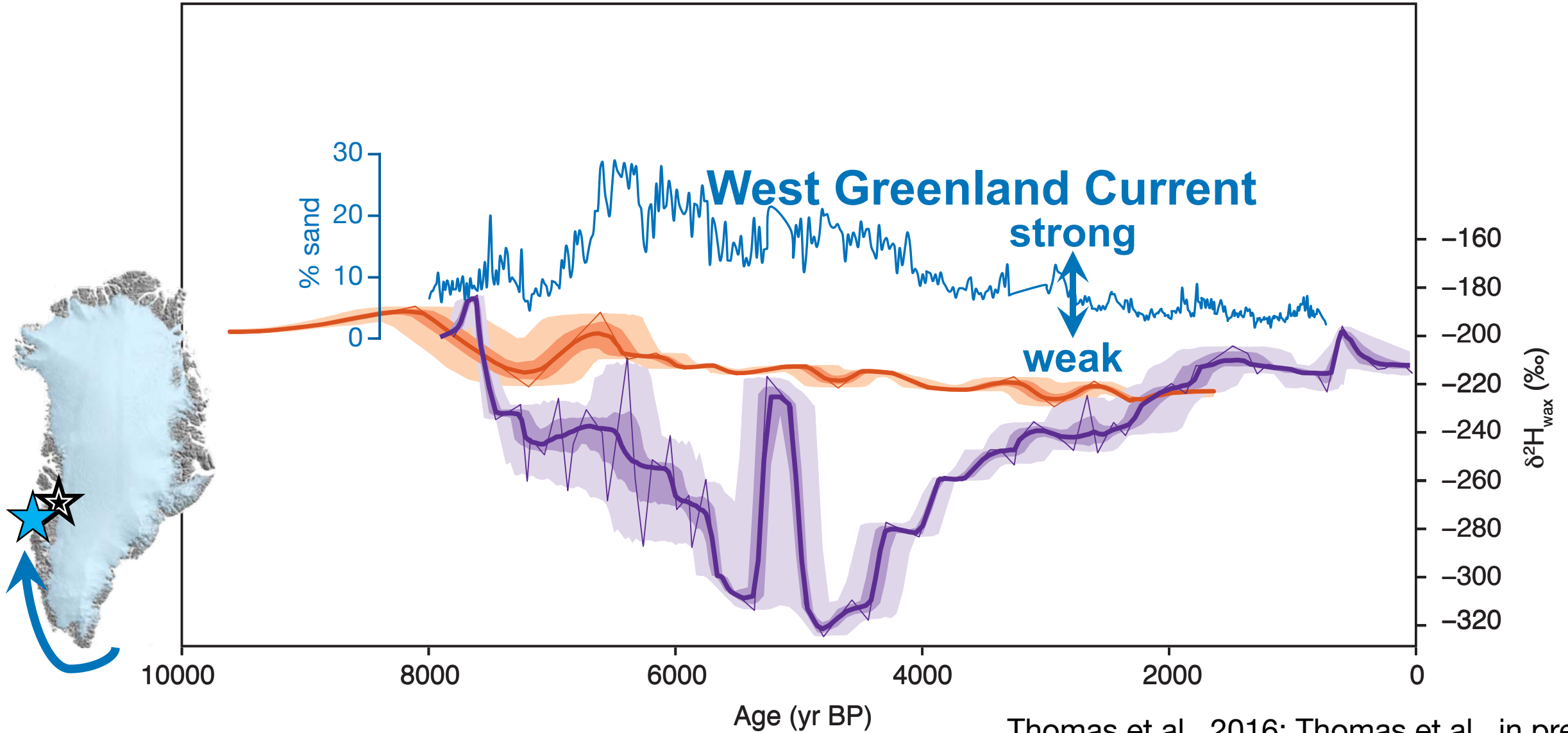
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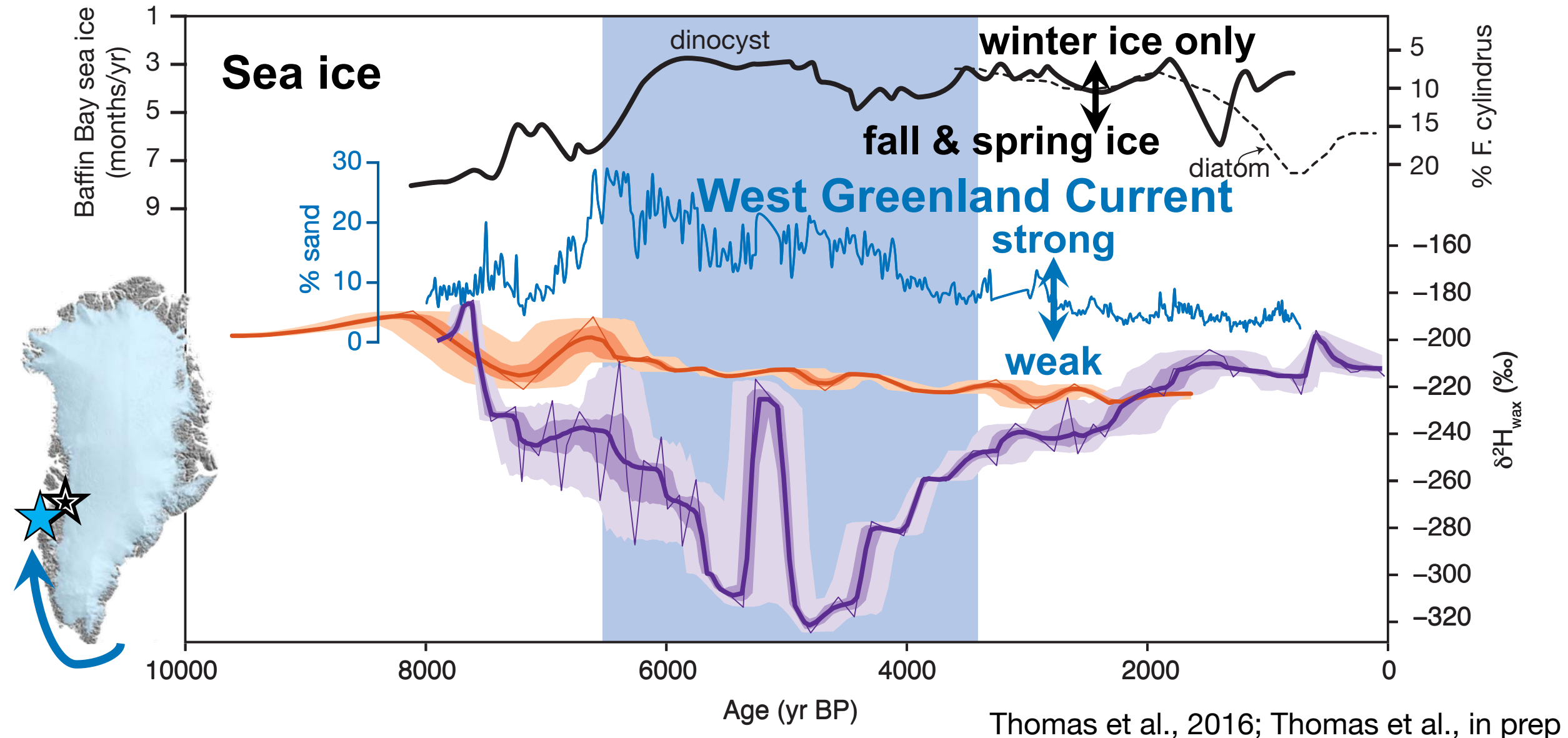
LAKE N3

80% flushed each year

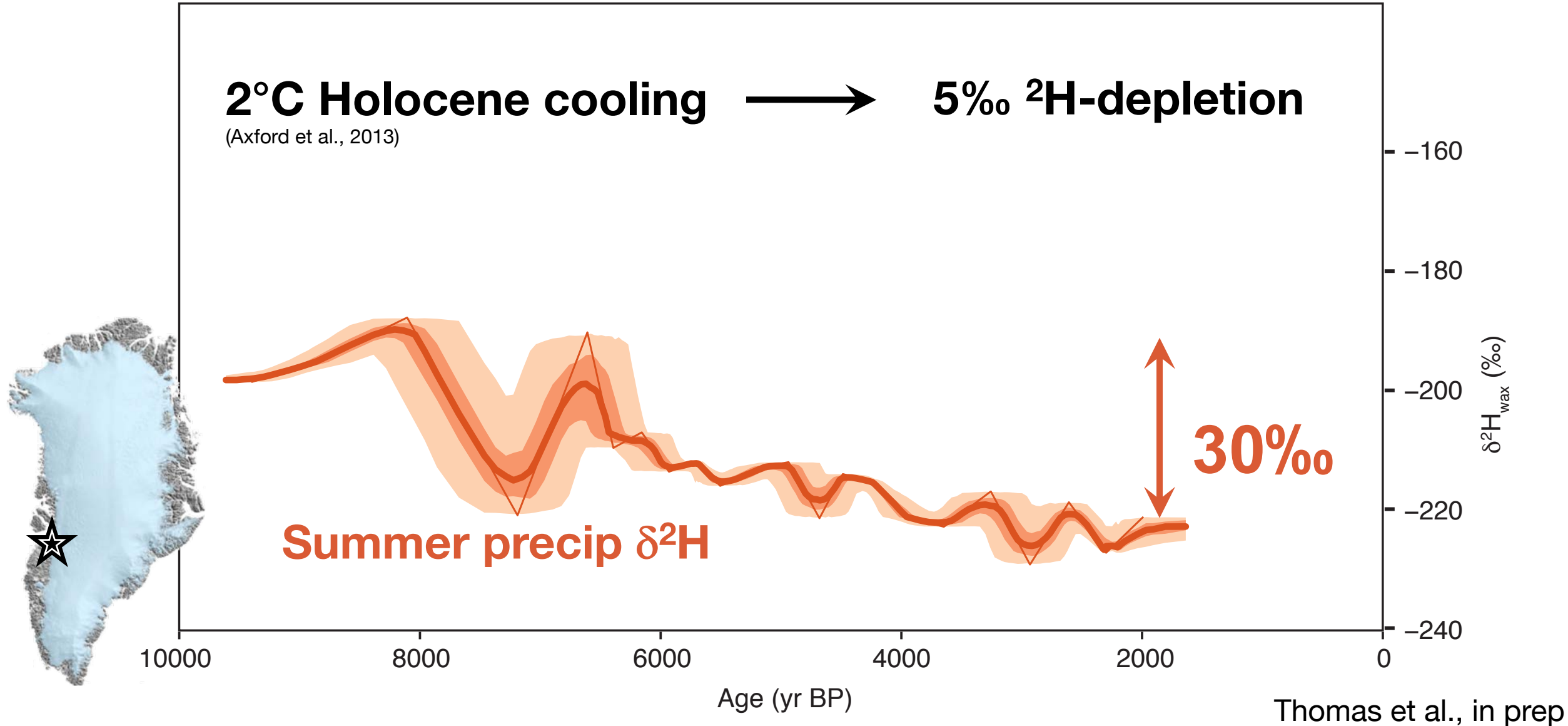
MORE WINTER PRECIP IN MID-HOLOCENE



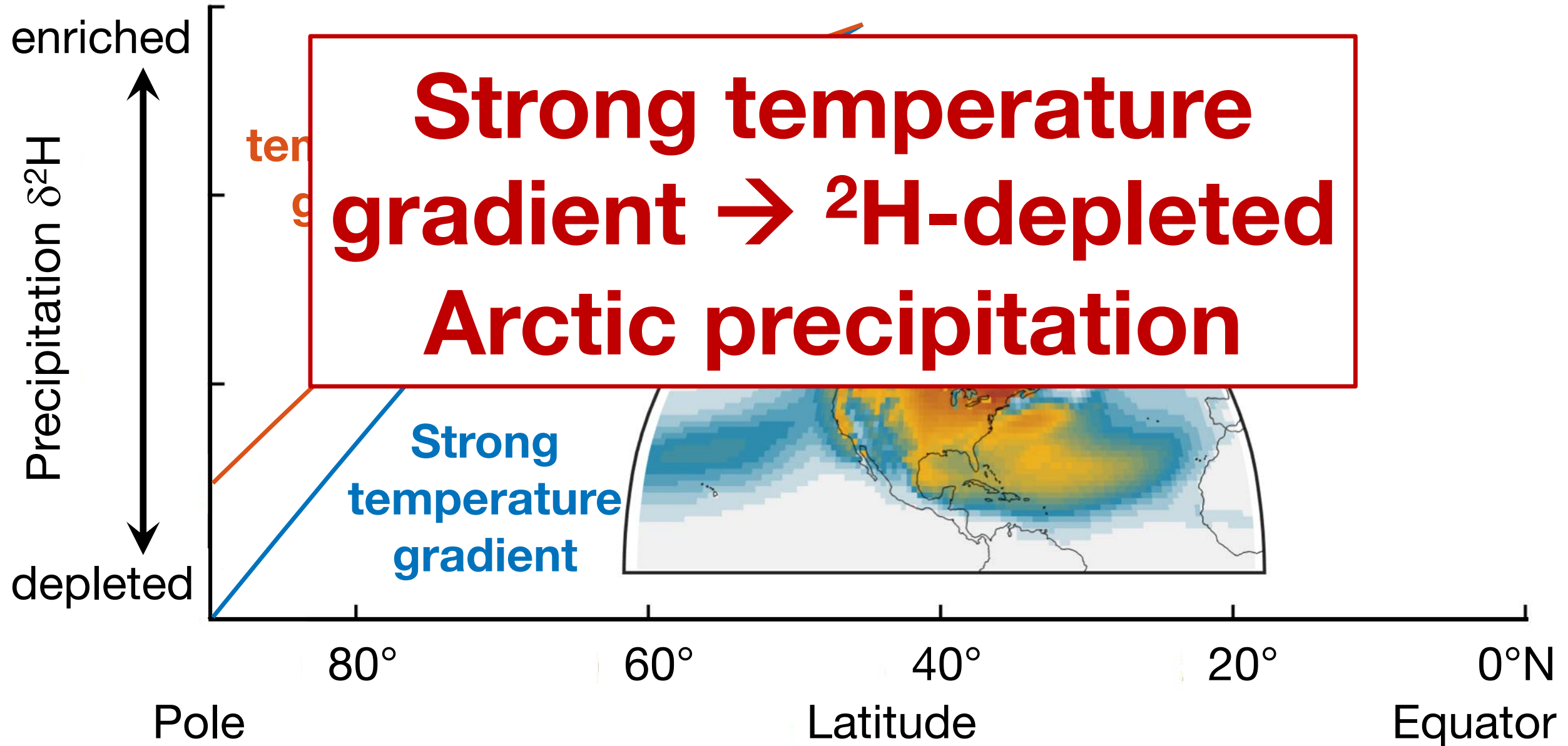
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HOLOCENE SUMMER PRECIPITATION $\delta^2\text{H}$



RAYLEIGH DISTILLATION: KEY @ HIGH LAT.



HOLOCENE SUMMER PRECIPITATION $\delta^2\text{H}$

