Reconstruction of Late Pleistocene Mountain Glaciation and Climate in the Great Basin, Western U.S.A.

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ICE-D informal cosmogenic-nuclide exposure-age database ALPINE

NSF

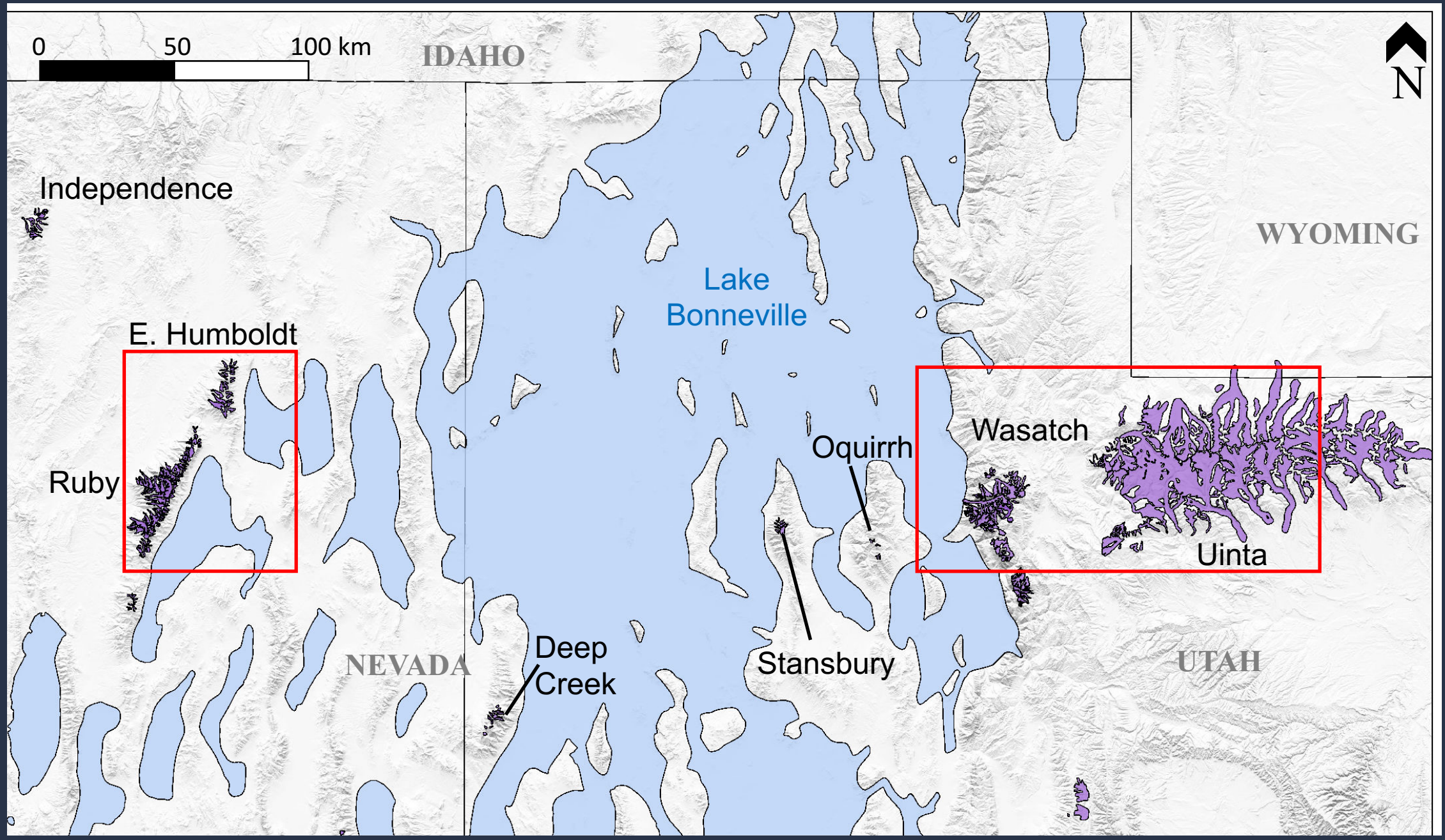
Pleistocene mountain glaciers and lakes of the Great Basin

Glacial record summarized by Osborn and Bevis (2001, QSR)

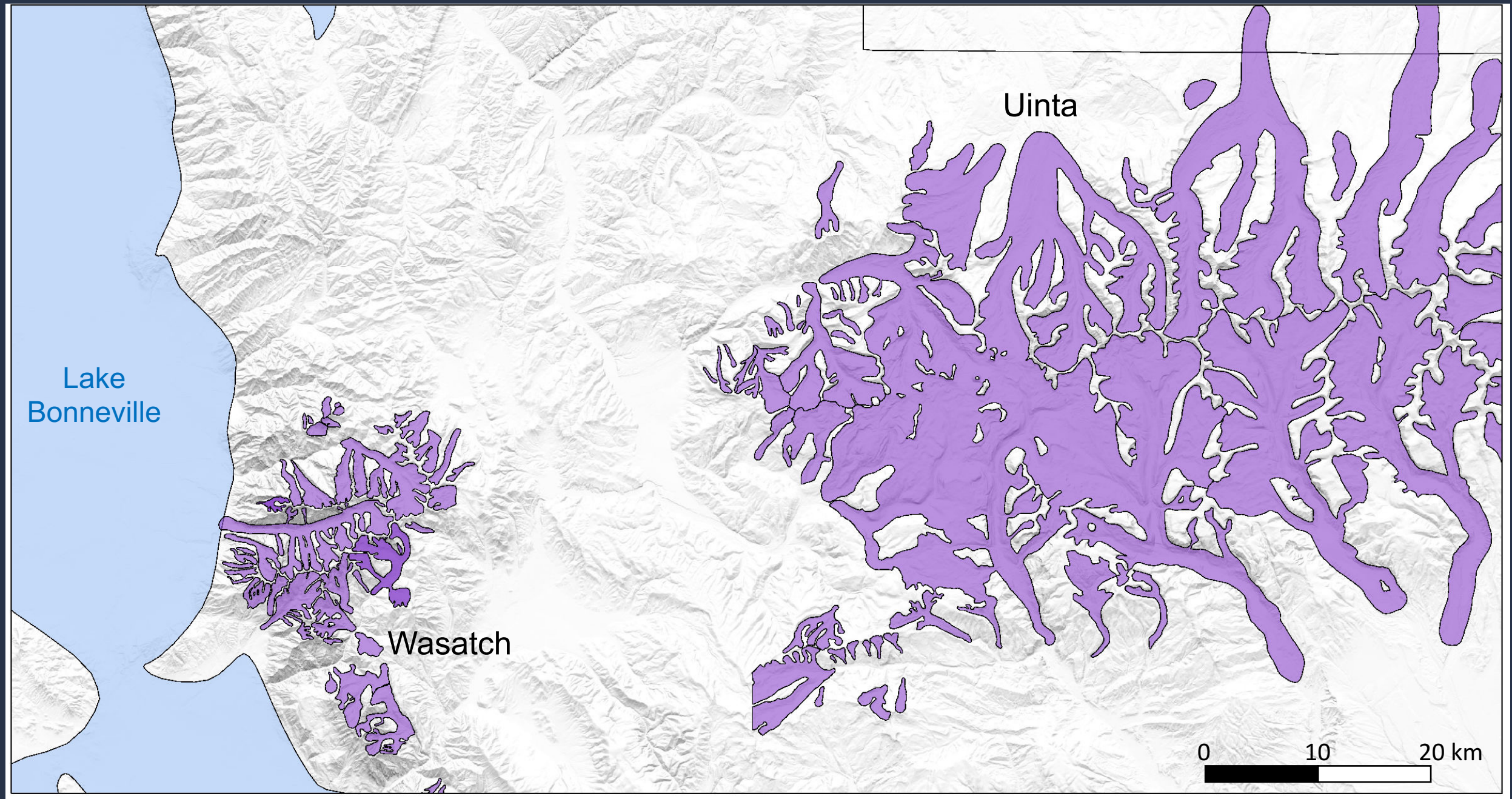
Geomorphic record of multiple glacial episodes

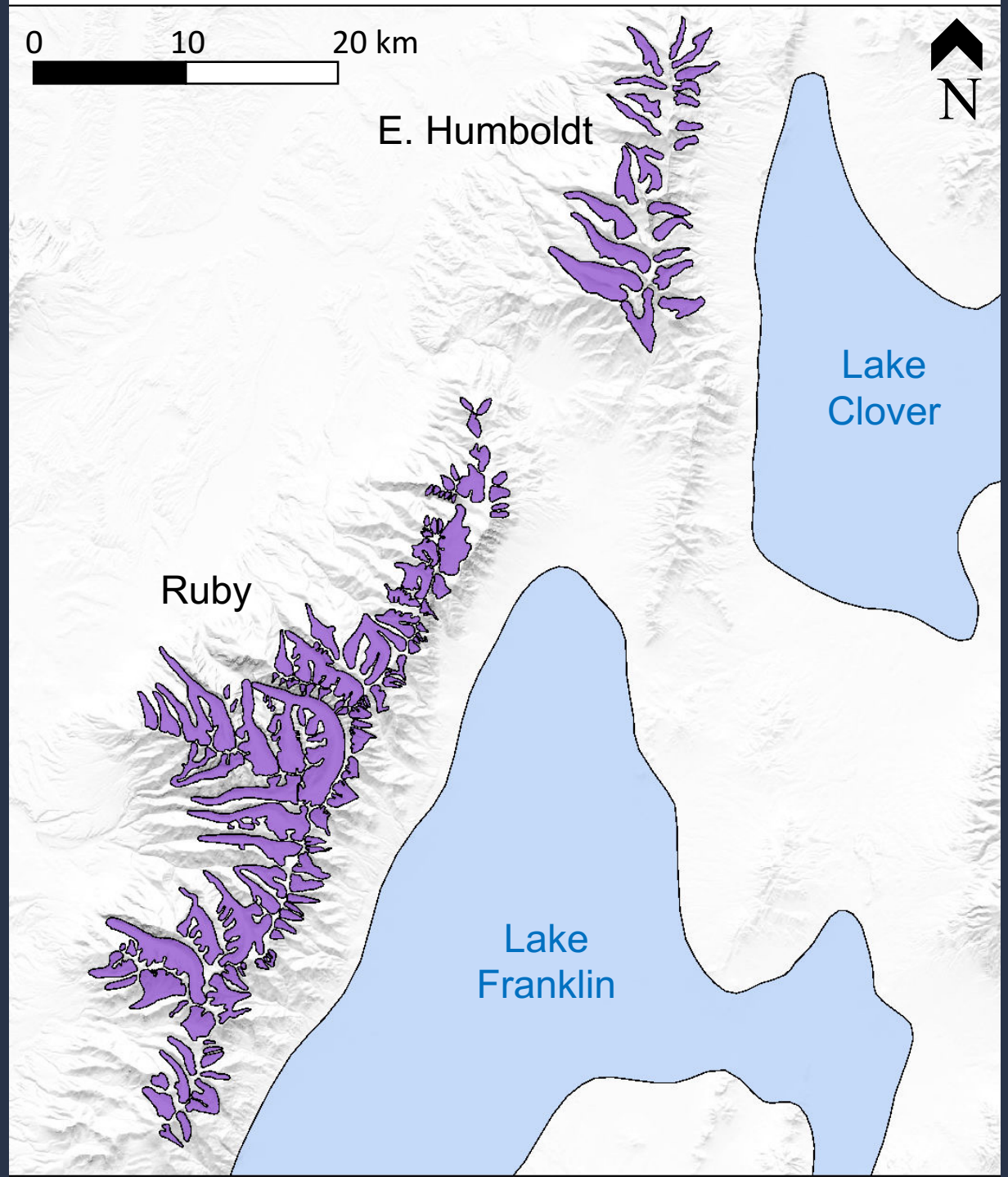
Glacier outlines from Pierce (2003), lakes from Reheis (1999)

Pleistocene mountain glaciers and pluvial lakes in the northeast Great Basin



Mountain glaciers in the Wasatch and Uinta Mountains (Munroe and Laabs, 2009)

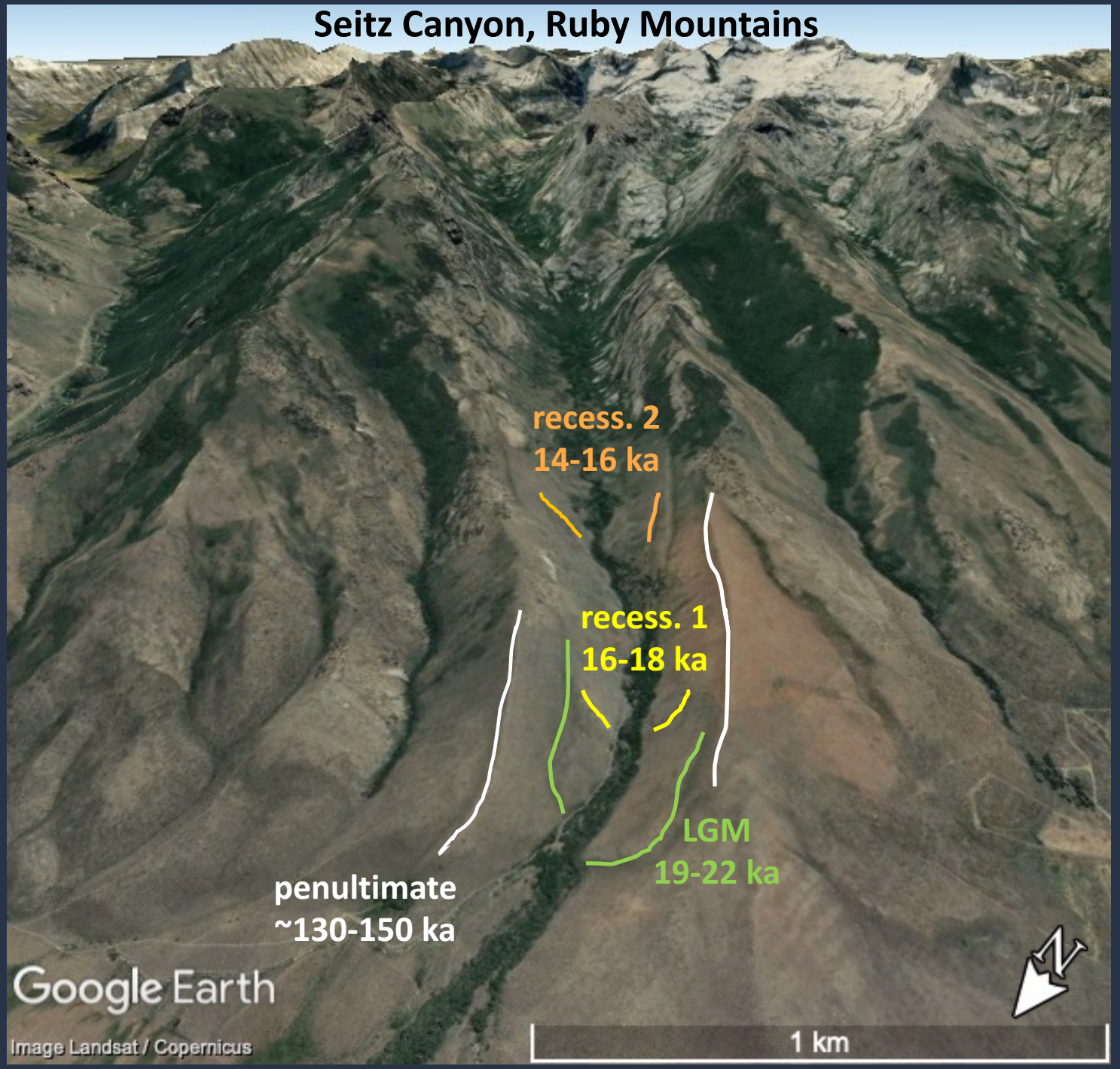


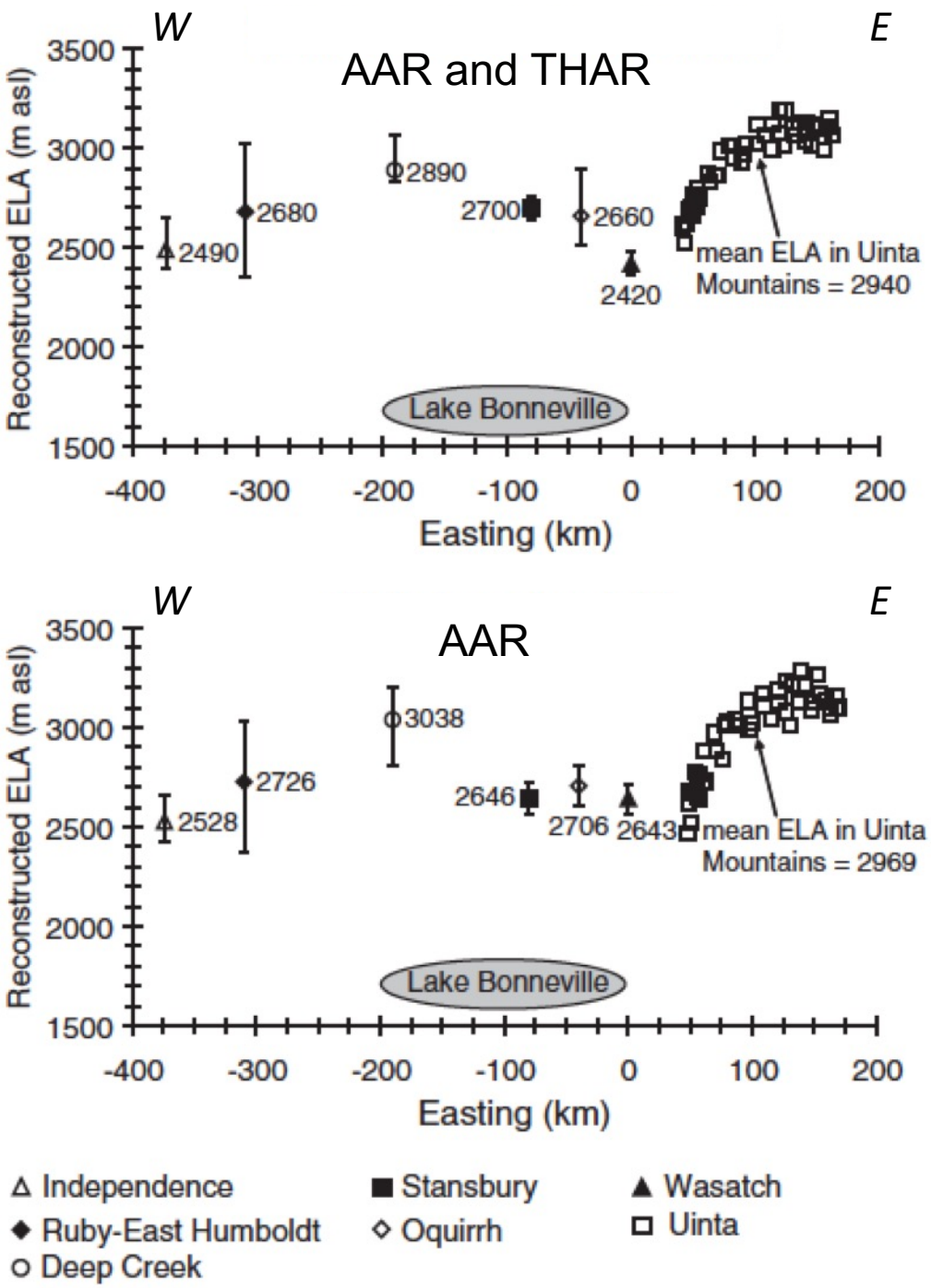


Mountain glaciers in the Ruby and East Humboldt Ranges (Laabs et al., 2011)

Includes **Angel Lake** and **Lamoille,** type locales for the last and penultimate glaciations

Moraine record and cosmogenic chronologies





Previous glacier and equilibrium-line altitude (ELA) reconstructions (Laabs et al., 2011)

ELAs estimated from planimetric accumulation areas (AAR) and toe-headwall altitude ratios (THAR)

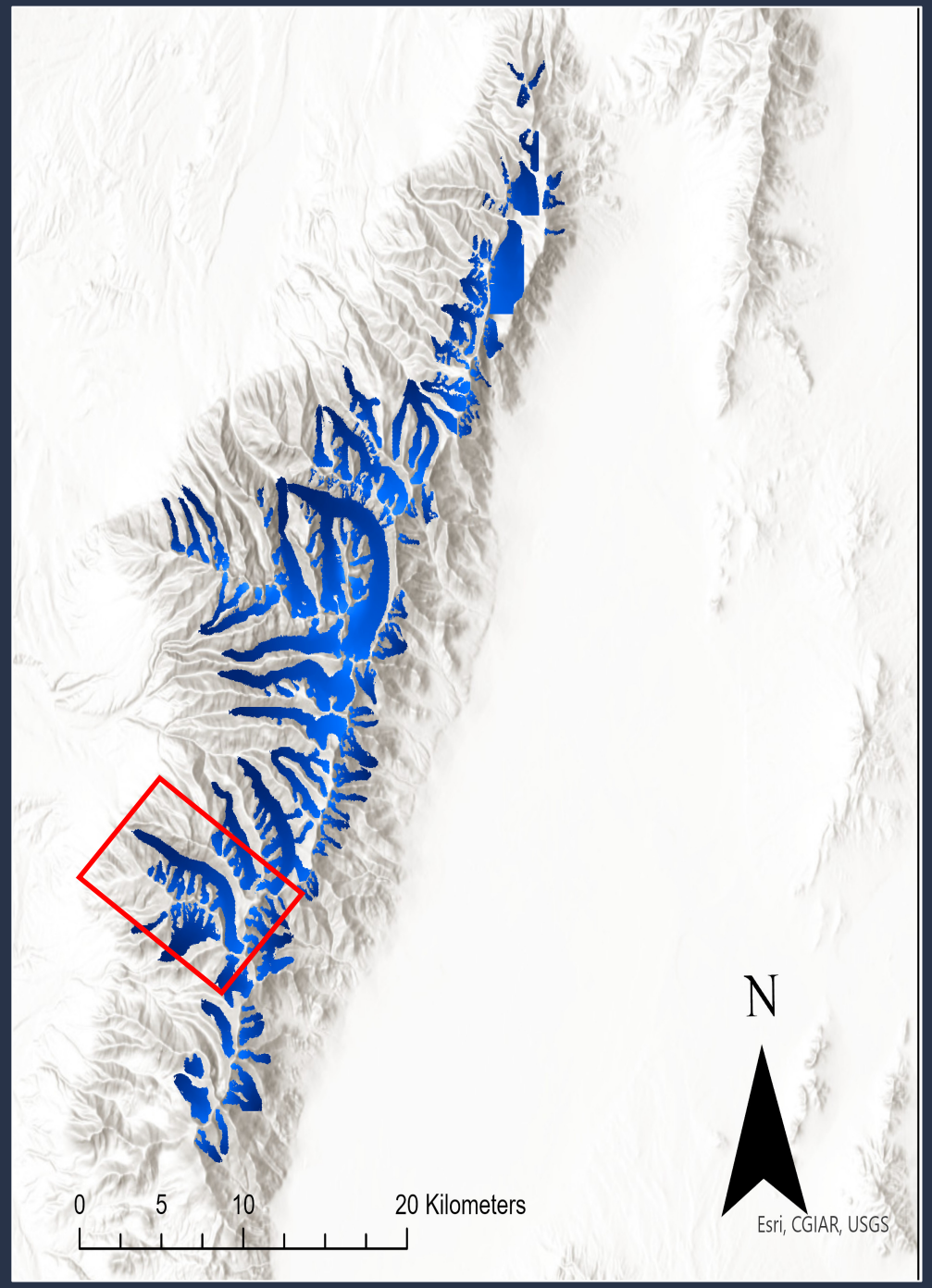
ELAs generally rise from west, except in the area around Lake Bonneville

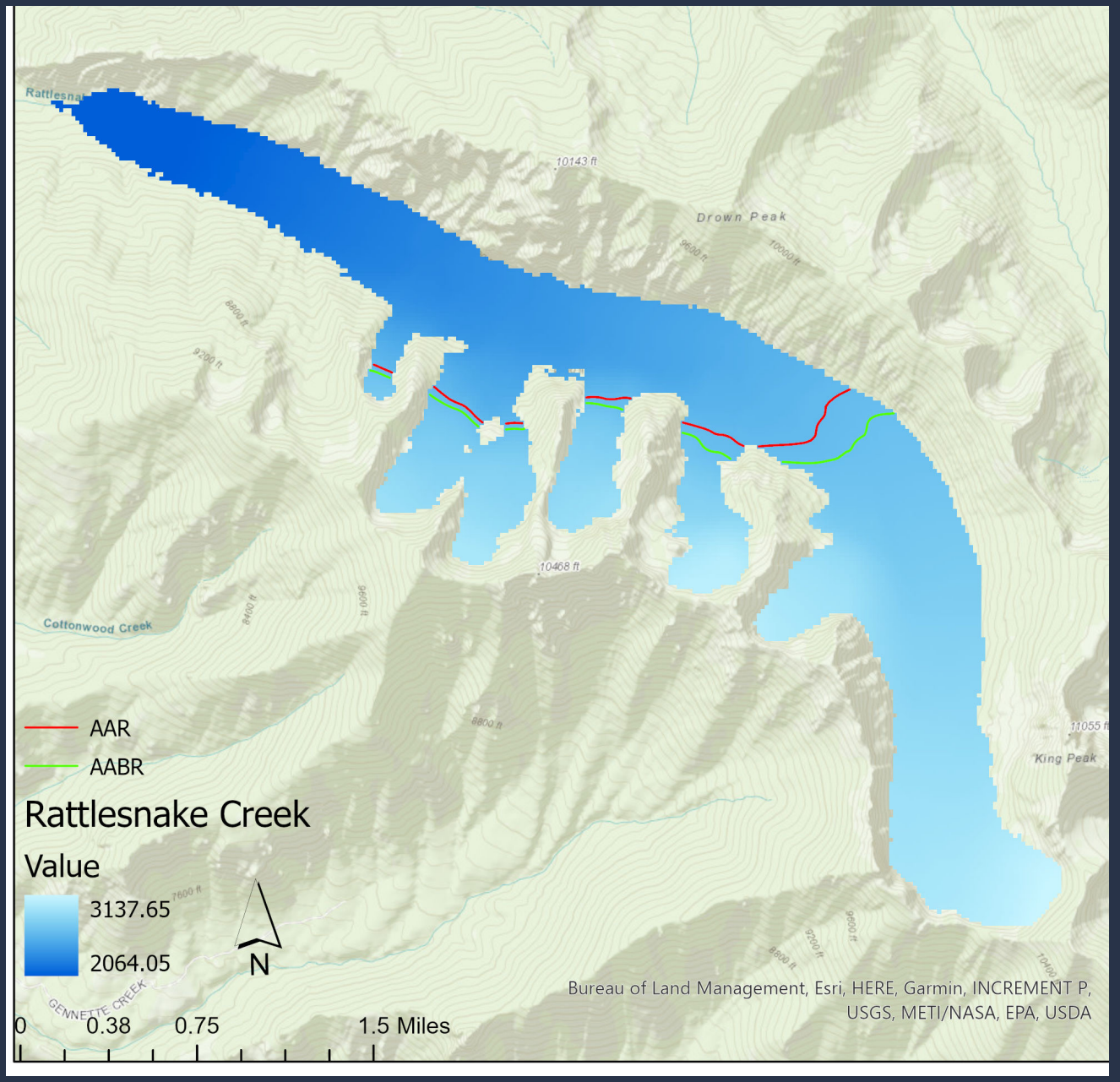
Reflects strong orographic effects and/or moisture sourcing from Lake Bonneville

Reconstructing paleoglacier surfaces – GlaRe Tools

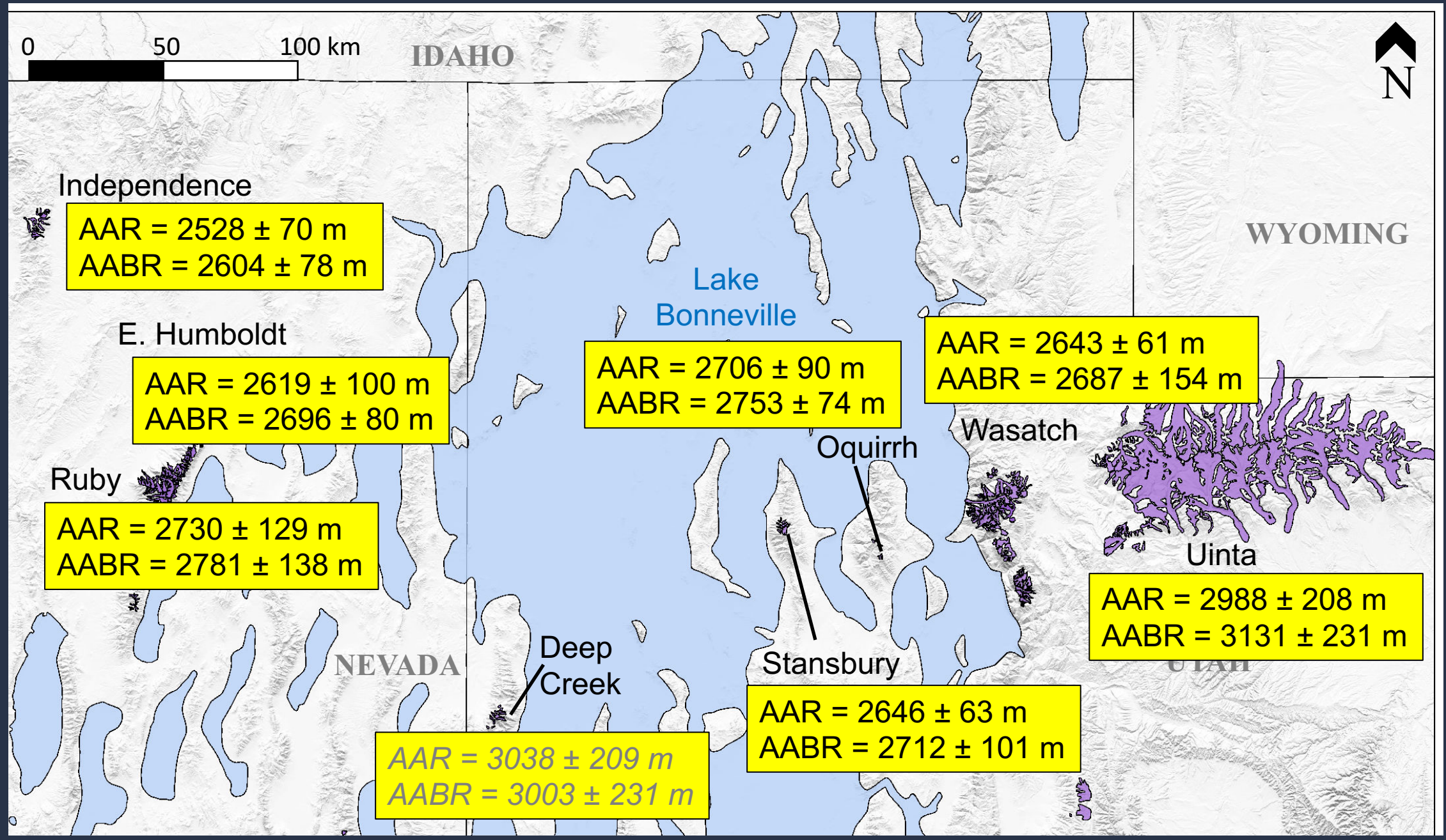
- Semi-automated modeling of paleoglacier surfaces (Pellitero et al., 2015, 2016)
- Inputs
  1. DEM and glacier flowlines
  2. User defined basal shear stress (50-150 kPa along flowlines)
  3. Terminus position and geometry of the glacier tongue
- Outputs
  1. Interpolated paleoglacier surface → enables estimates of ice volume
  2. Paleo-ELAs from AAR and AABR

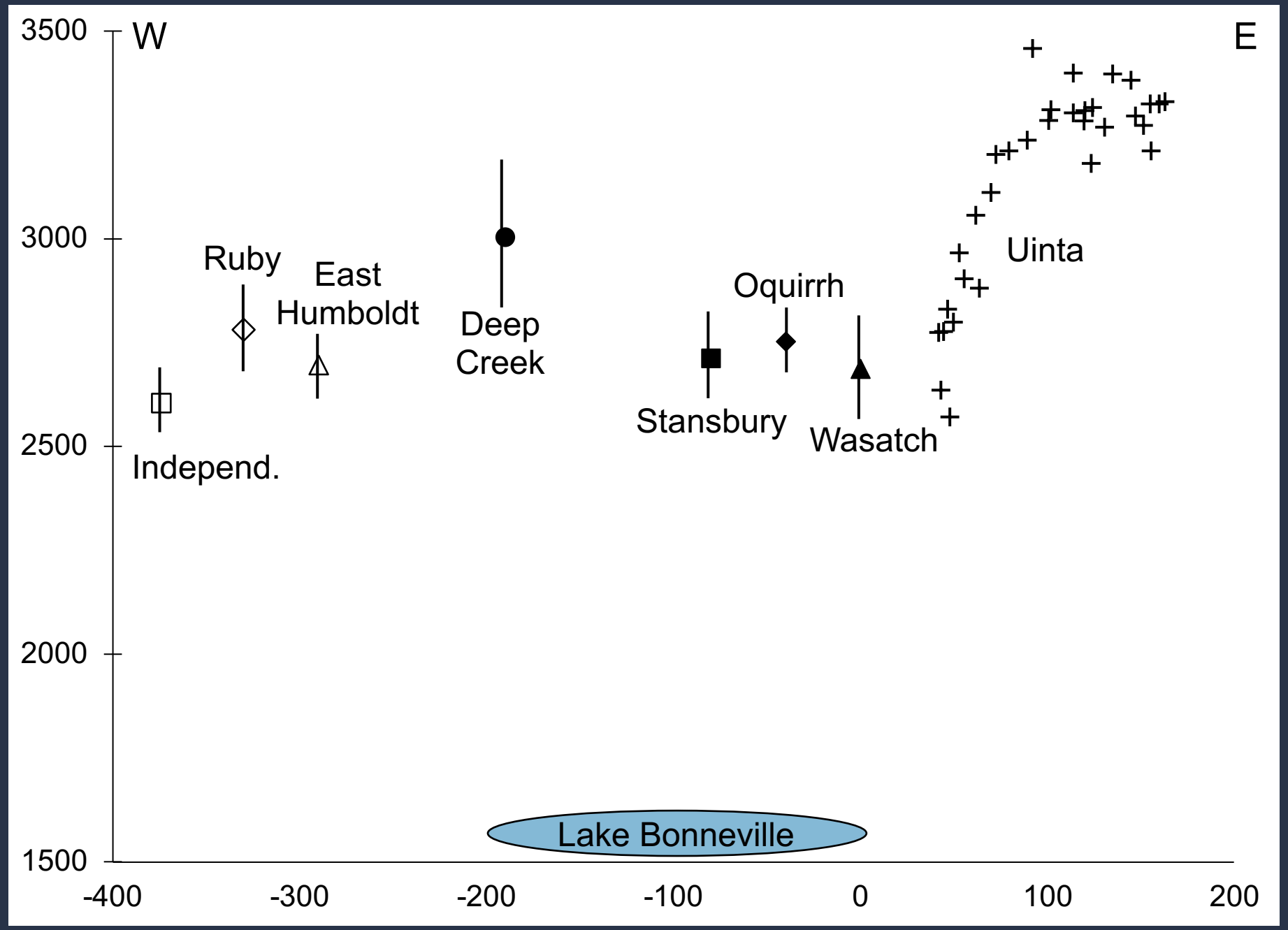
Paleoglacier surfaces in the Ruby Mountains





Paleoglacier ELAS – planimetric areas (AAR) and 3D surfaces (AABR)




3500
3000
2500
2000
1500
W
E
Ruby
East
Humboldt
Deep
Creek
Oquirrh
Uinta
Independ.
Stansbury
Wasatch
Lake Bonneville
-400
-300
-200
-100
0
100
200

Great Basin paleoglaciers and ELAs

- Modeled 3D surfaces closely match map-based glacier shapes
- ELAs of 3D surfaces are 30-150 m higher than ELAs inferred from polygons
- Paleoclimate and hydrology:
  - ΔT at ELAs = 9-11℃ with modern precipitation
  - Ice volume in the Lake Bonneville basin = 244 km^3, ~3% of lake volume

Conclusions

- GlaRe tools of Pellitero et al. (2016) accurately reproduce paleoglacier geometry in the Great Basin, can be applied elsewhere
- Paleoglacier surfaces afford more accurate estimates of ELAs and ice volumes

- Reconstructions of western U.S. paleoglaciers need updating!
- Interested? Join or follow the **Western U.S. Paleoglaciers Working Group**

https://sites.google.com/ndsu.edu/western-us-paleoglaciers

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