

Climate sensitivity of Tibetan Plateau glaciers

past and future implications

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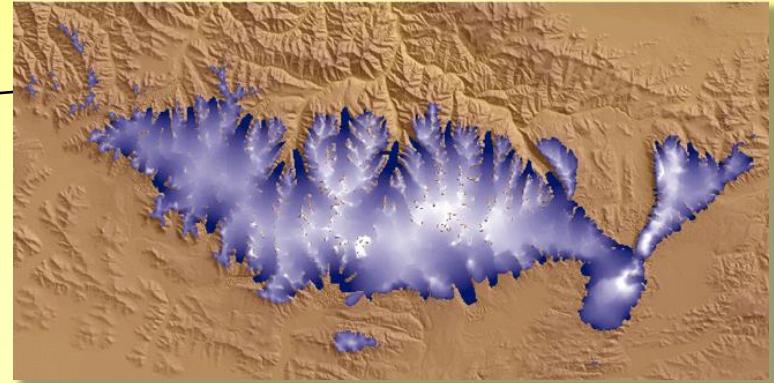
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Outline



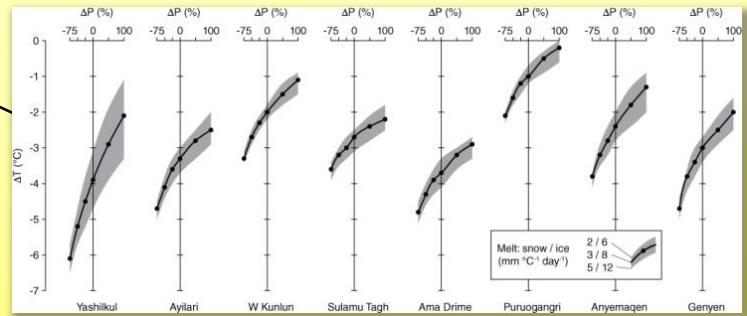
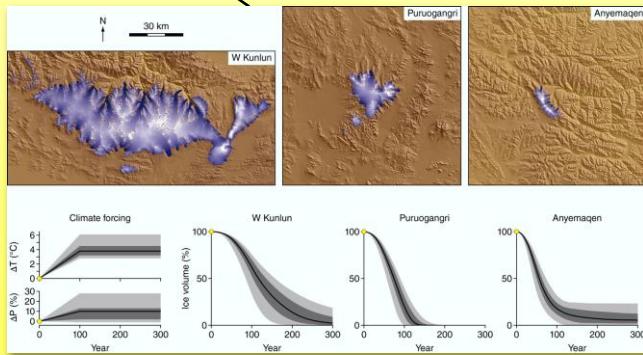
Introduction



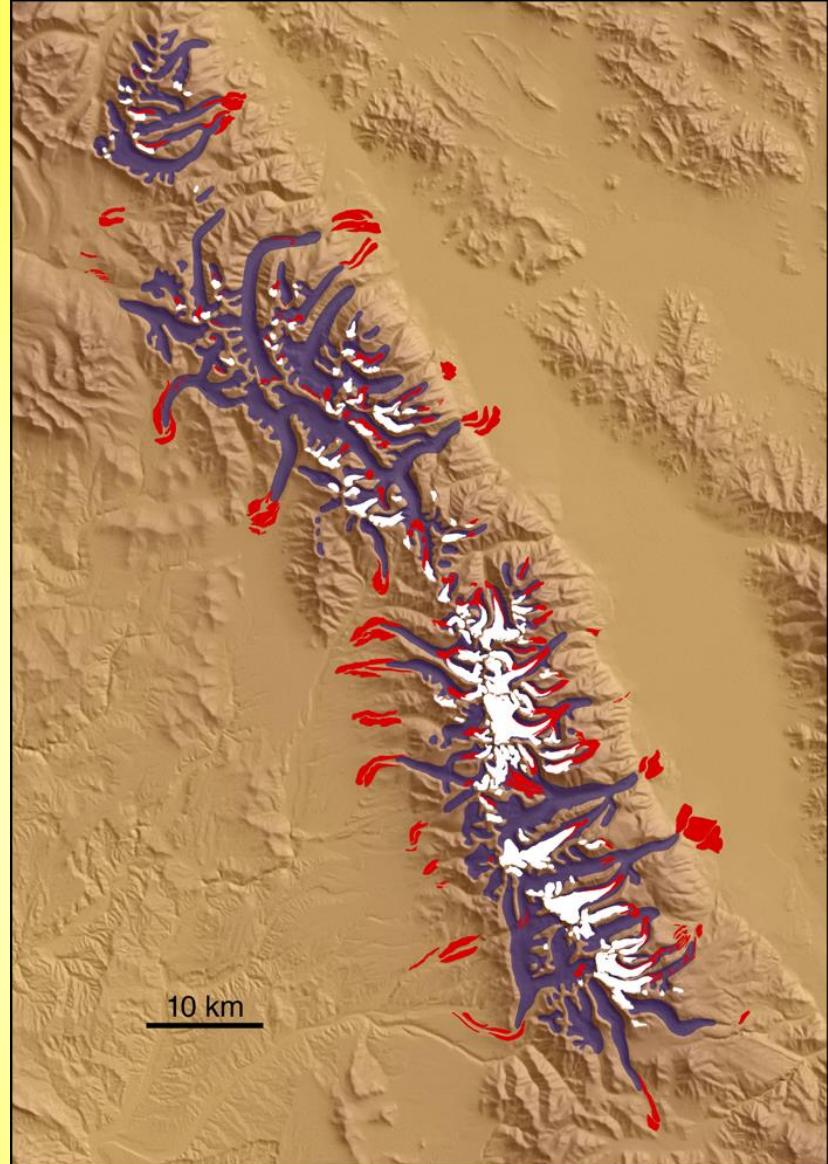
Methods

Glacial paleoclimate

Projection



Limited glaciation of Tibet

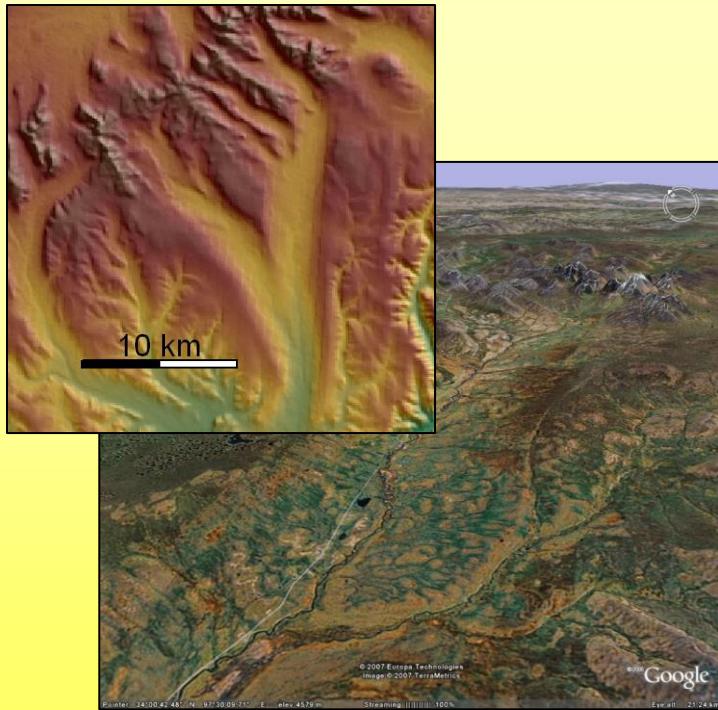


Paleo-climate implications?

Glacial landform mapping

Detailed mapping of glaciers, glacially eroded valleys, and moraines

- SRTM elevation model
- Landsat ETM+ images
- Google Earth



Glacier model

Higher order 3D ice flow model

Resolution: 250 m

Temperature index mass balance

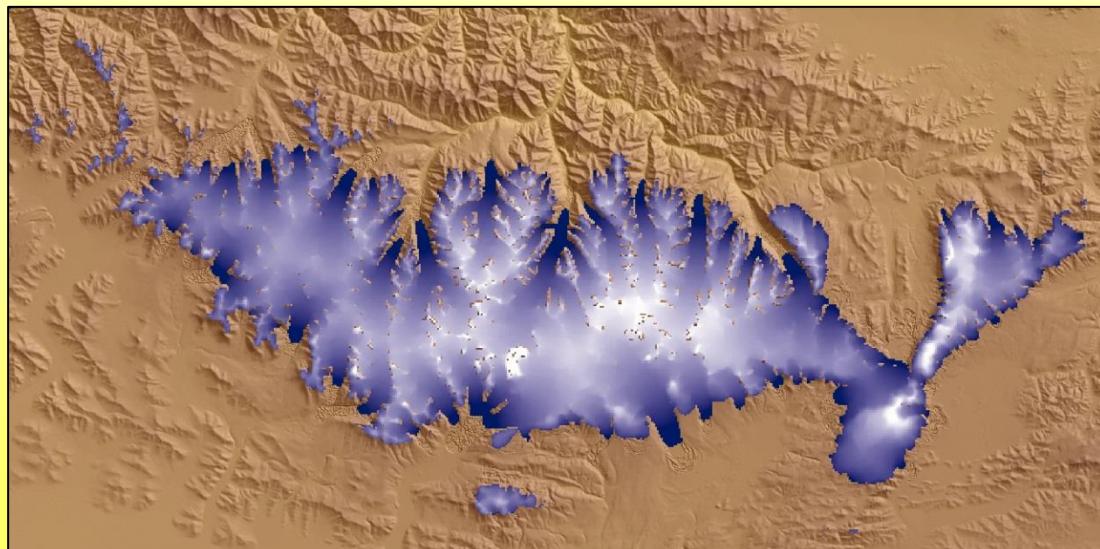
Snow melt: $3 \text{ mm } ^\circ\text{C}^{-1} \text{ day}^{-1}$

Ice melt: $8 \text{ mm } ^\circ\text{C}^{-1} \text{ day}^{-1}$

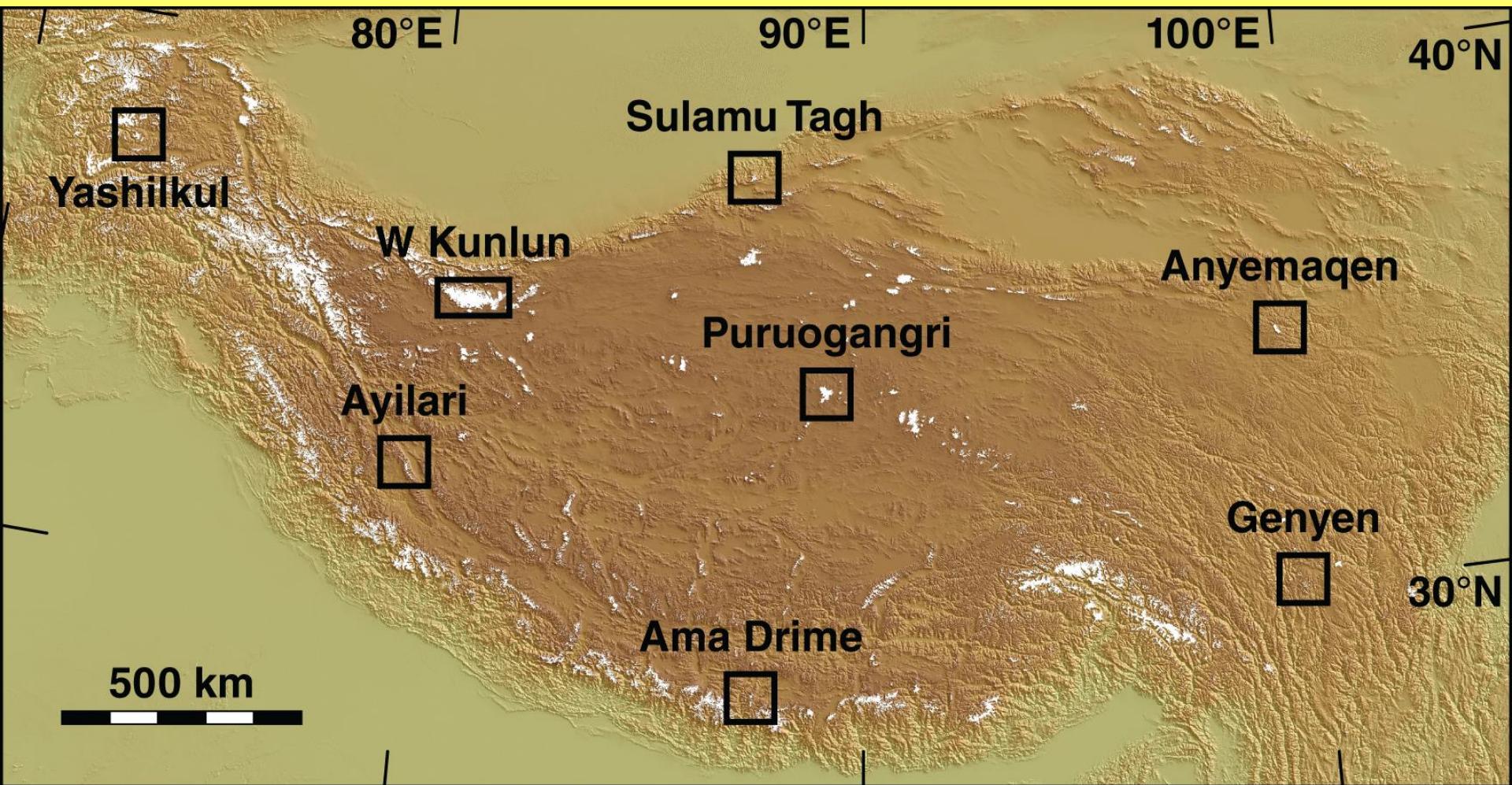
Input

SRTM topography

Mean monthly temperature and precipitation (WorldClim)



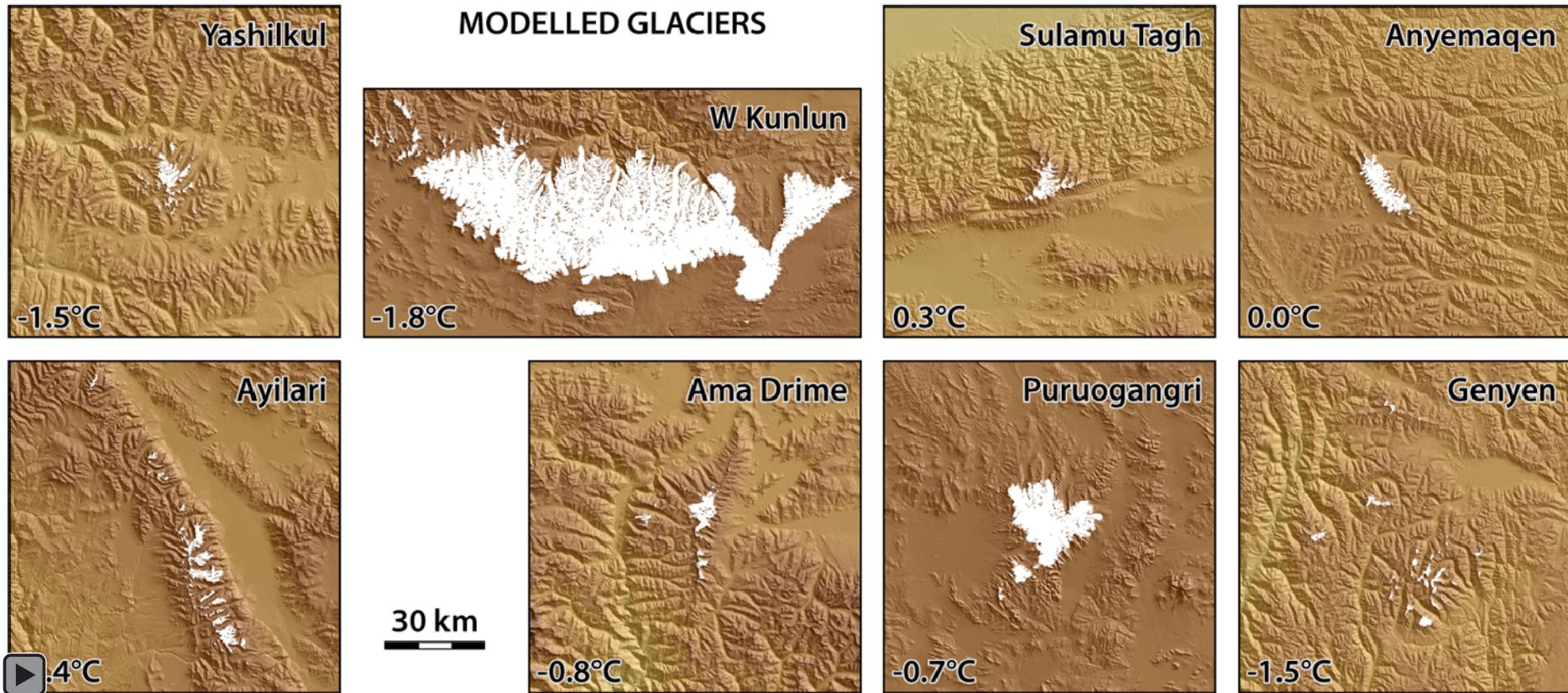
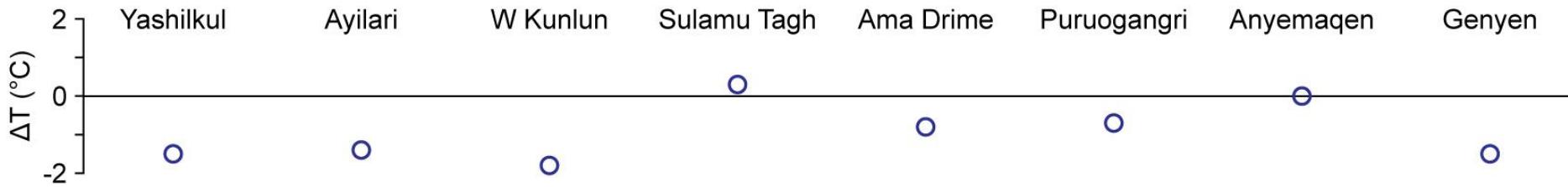
Glacier model domains



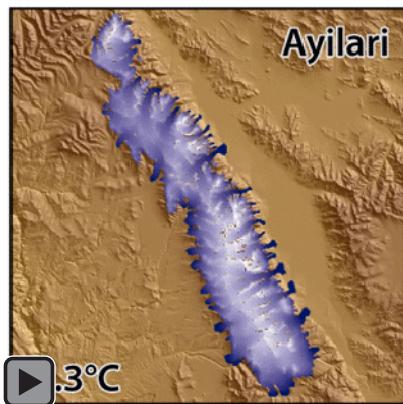
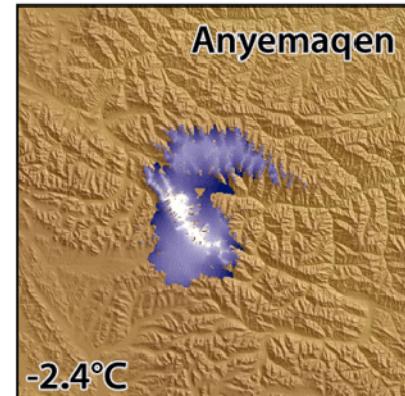
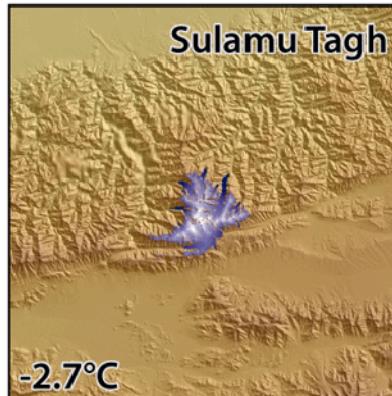
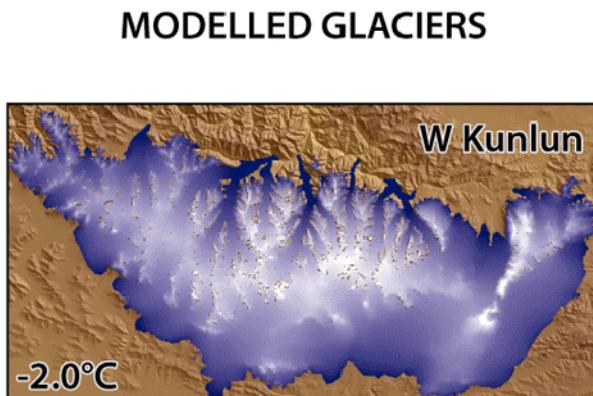
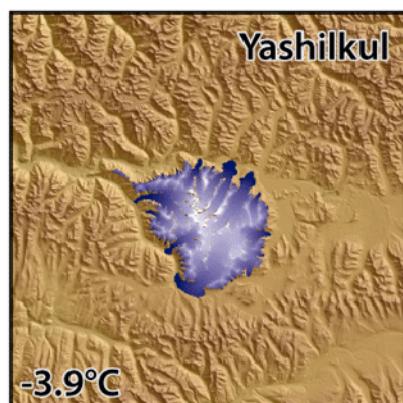
All model domains have present-day glaciers

For six domains there are cosmogenic exposure ages for past glaciations (≥ 49 ka)

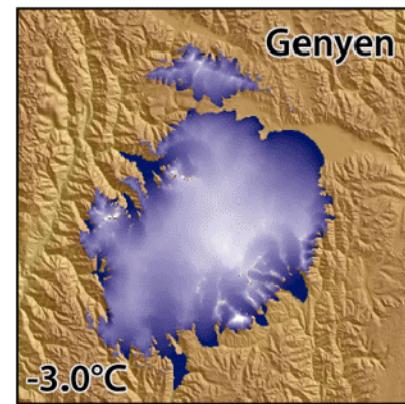
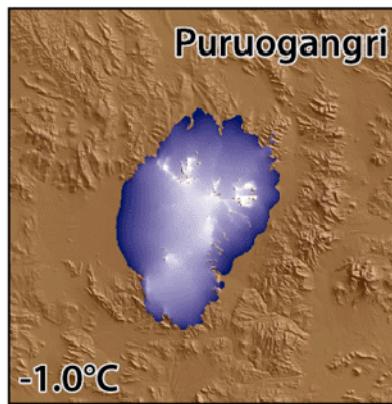
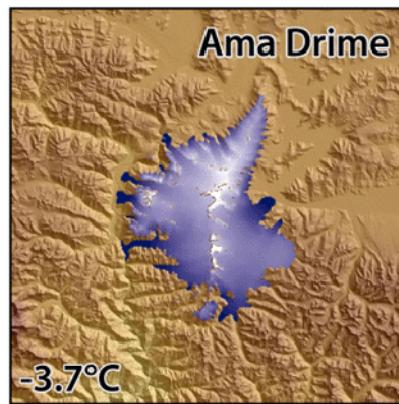
Temperature perturbations to reproduce present-day glaciers



Modelling past maximum glacier extent

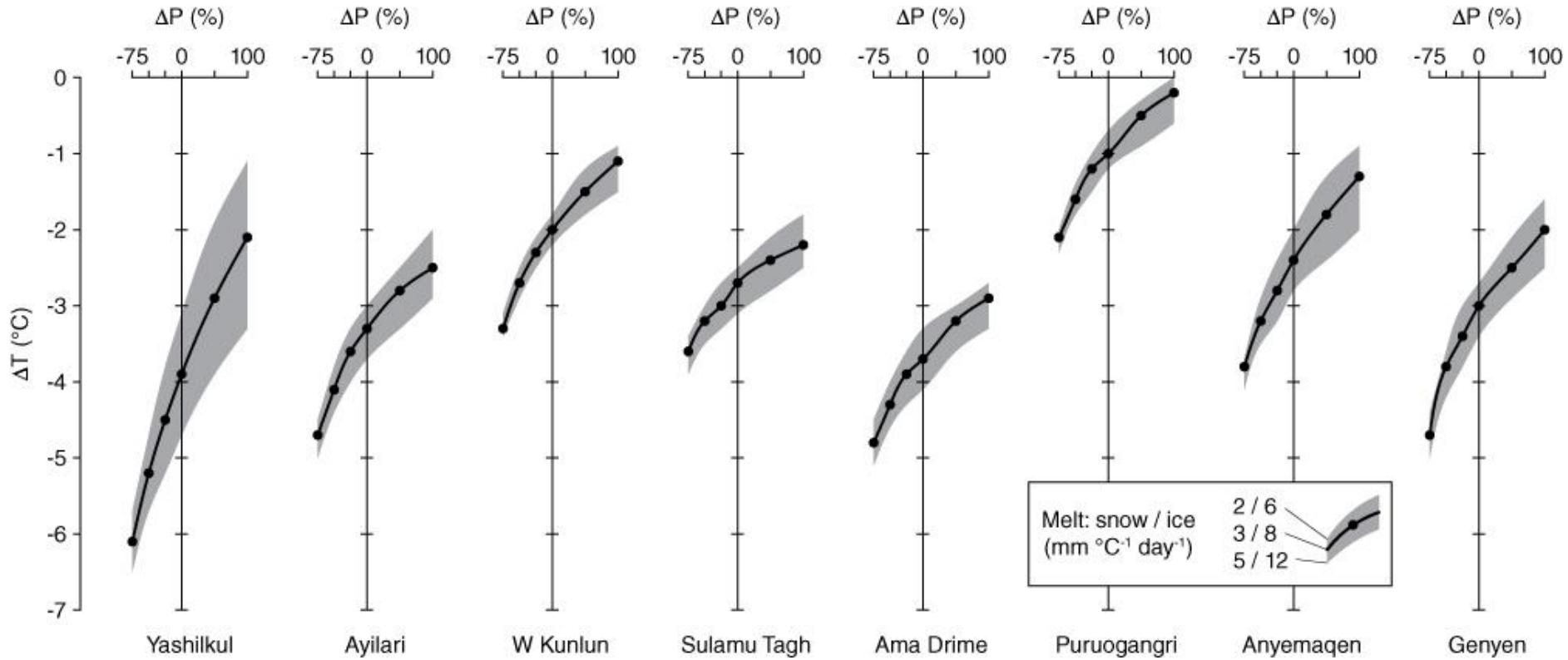


30 km

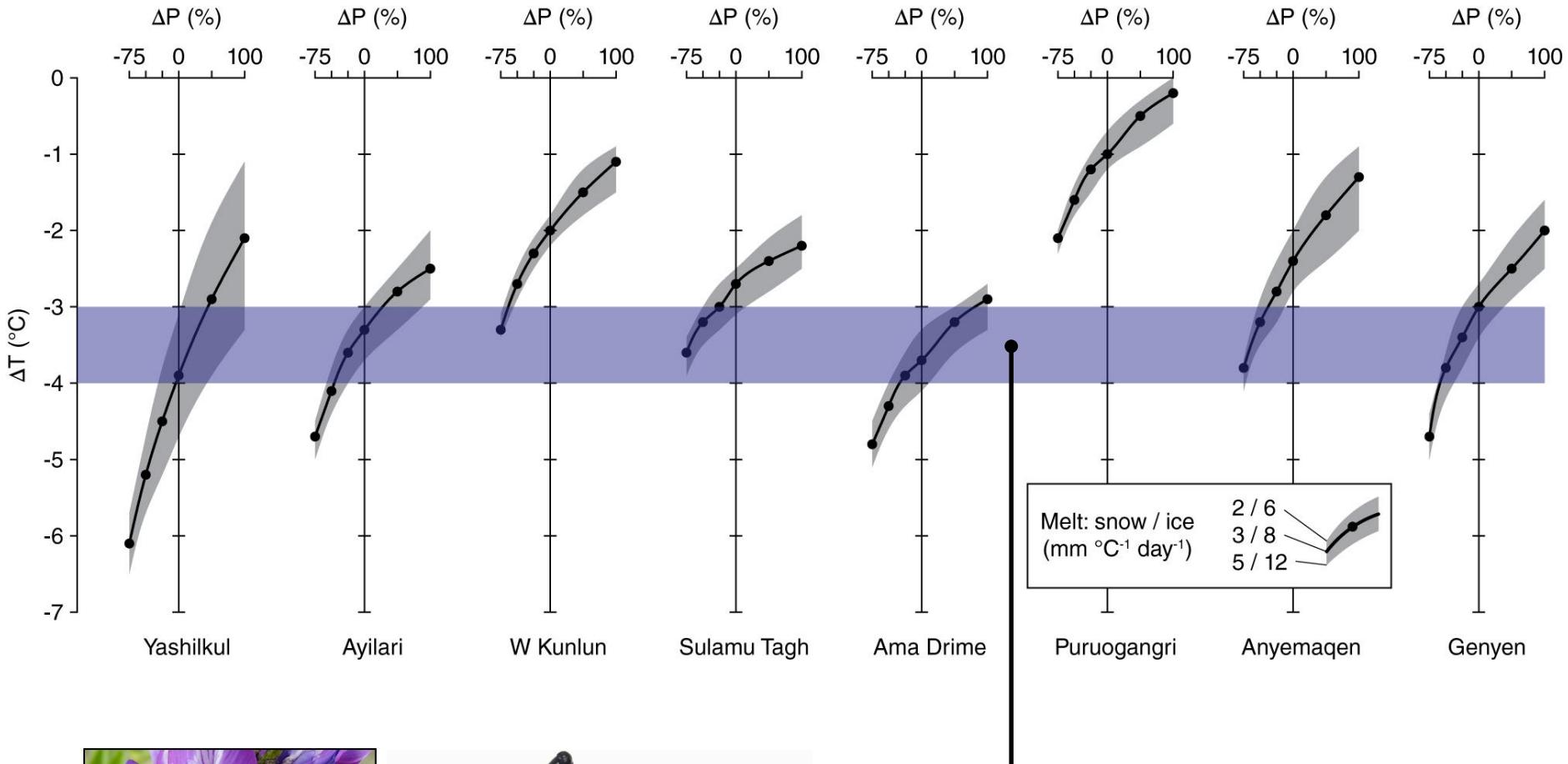


Modelling 5000 years forward with static temperature
and precipitation perturbations

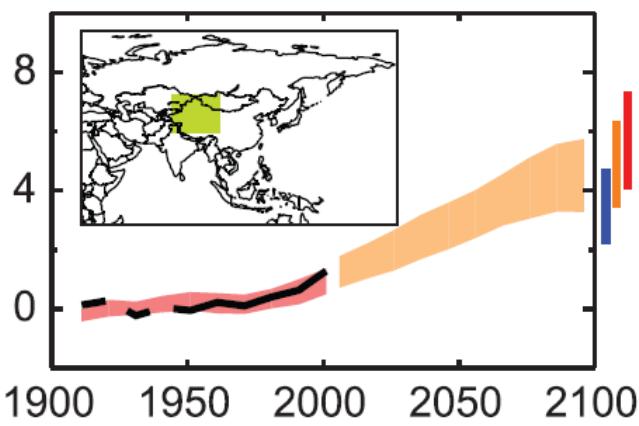
Climate perturbations for paleo-glaciation targets



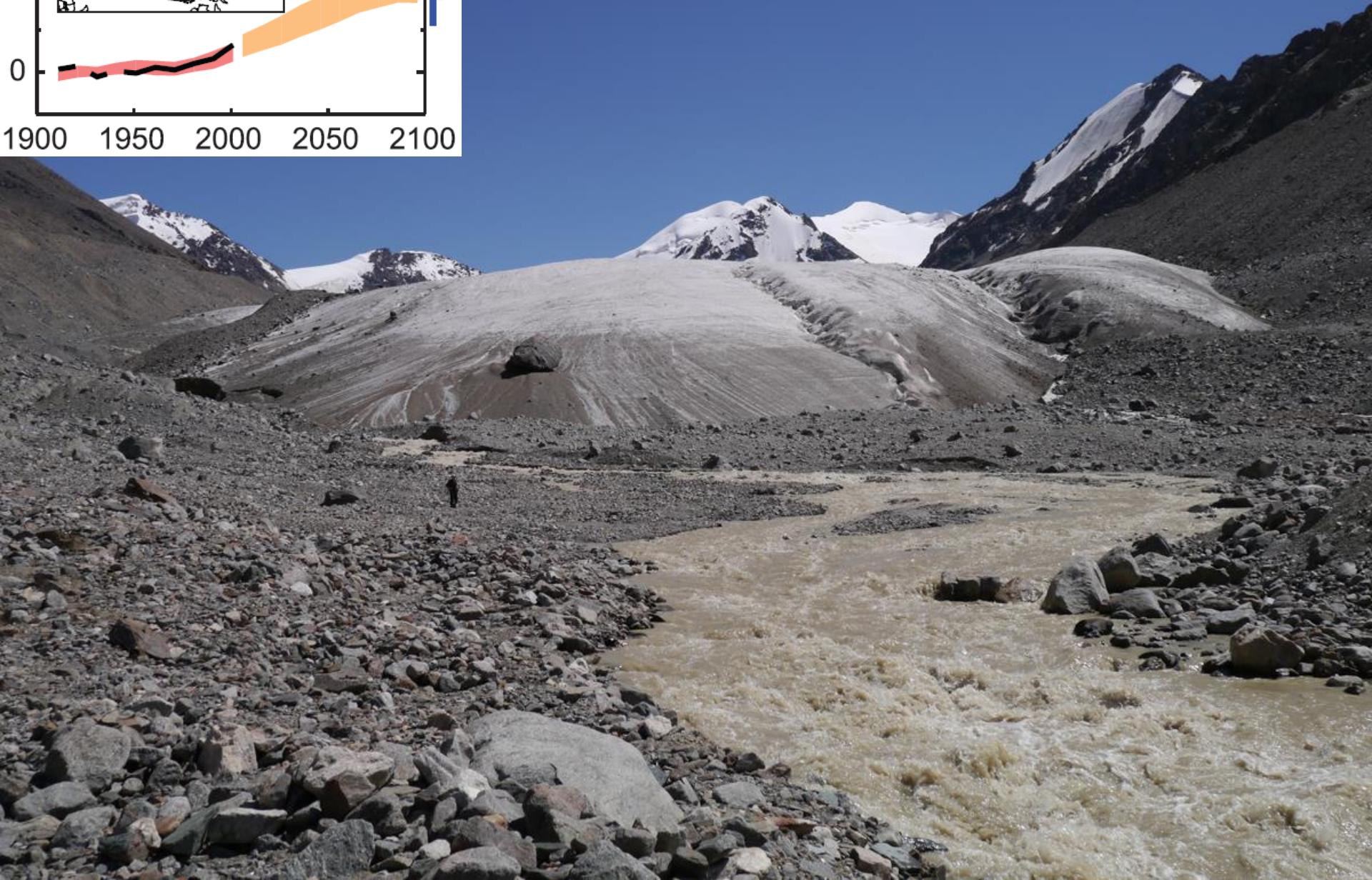
Climate perturbations for paleo-glaciation targets



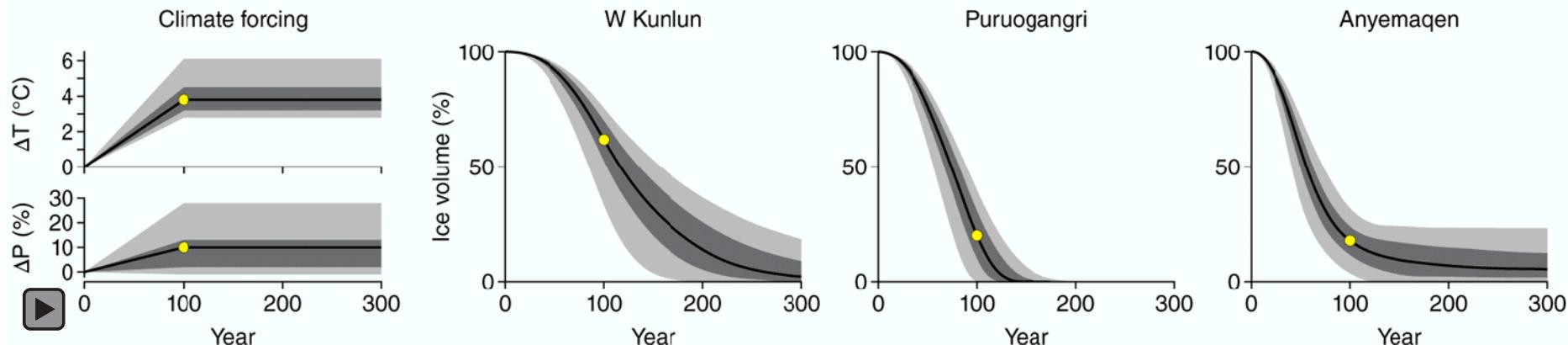
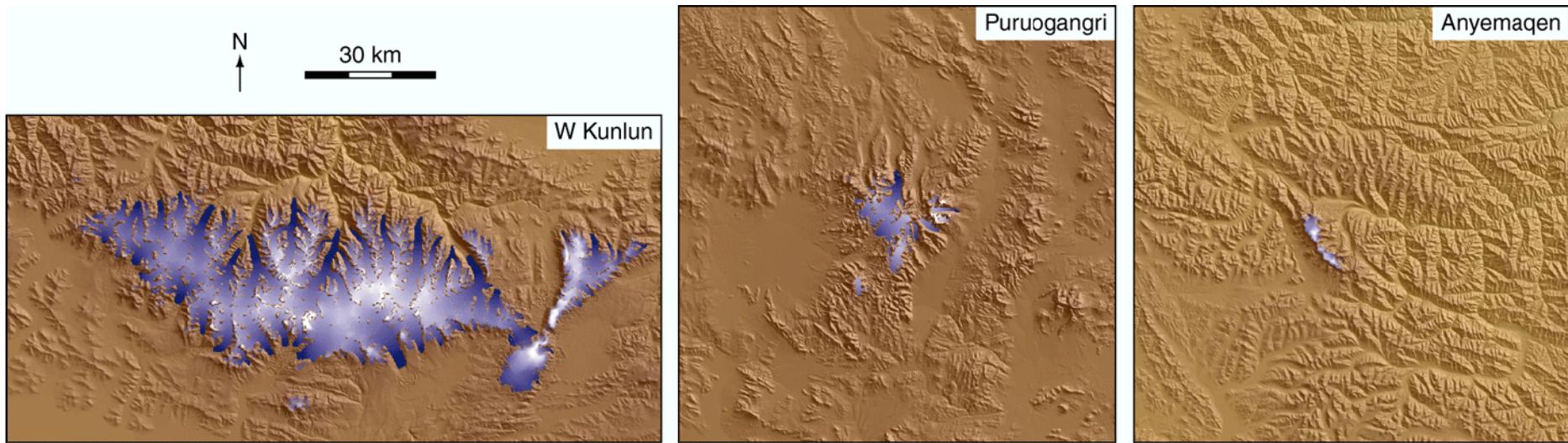
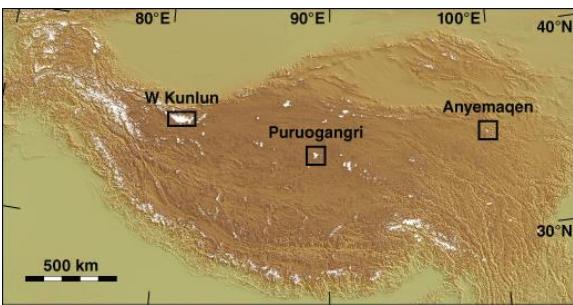
Max LGM summer cooling: 3-4°C
Schmidt et al. (2011): QSR
Miehe et al. (2011): QR



IPCC (2007) regional temperature projection



Glacier evolution in a warming climate



Conclusions

- The Tibetan Plateau has experienced only limited cooling during the last few glacial cycles ($<6^{\circ}\text{C}$)
- Future warming of projected IPCC magnitude ($2.8\text{-}6.1^{\circ}\text{C}$) would result in dramatic glacier reduction



Thank you!

