Limited glacier advances and modest glacial cooling on the Tibetan Plateau revealed by glacial geology and glacier modeling

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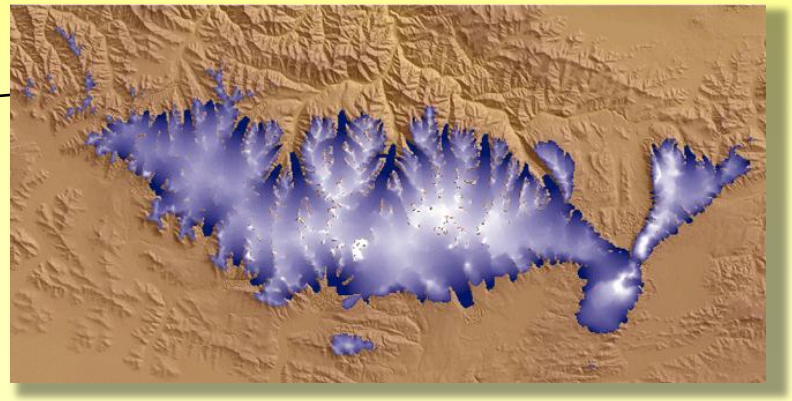
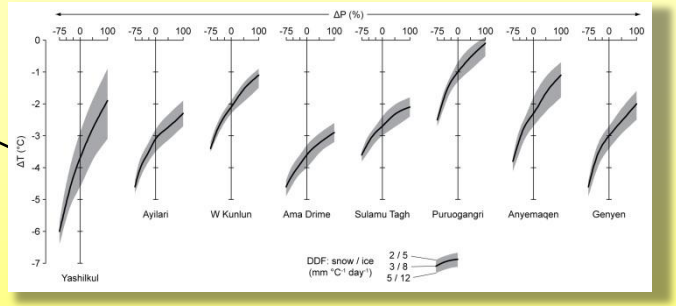
Outline

Introduction



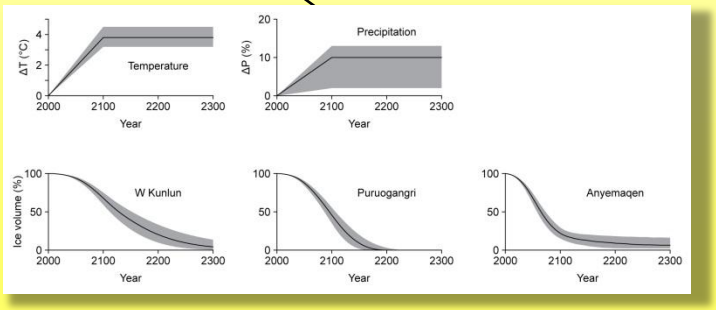
Methods

Glacial paleoclimate

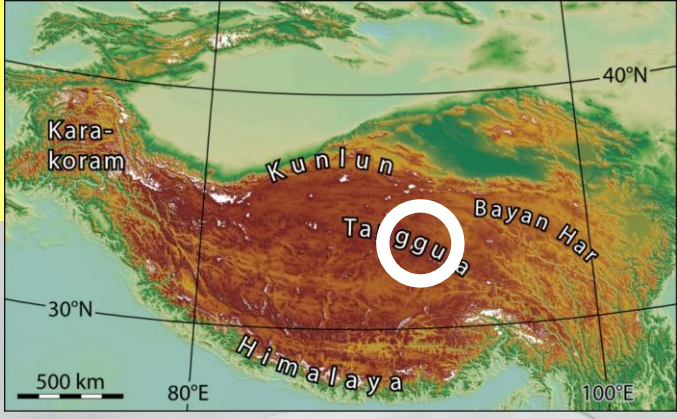


Projection

Conclusions



Limited glaciation of Tibet



Exposure age data: Schäfer et al. (2002)
Owen et al. (2005)
Colgan et al. (2006)

77 ka
71 ka
66 ka
62 ka
47 ka
43 ka

Distance to glacier: 7.8 km

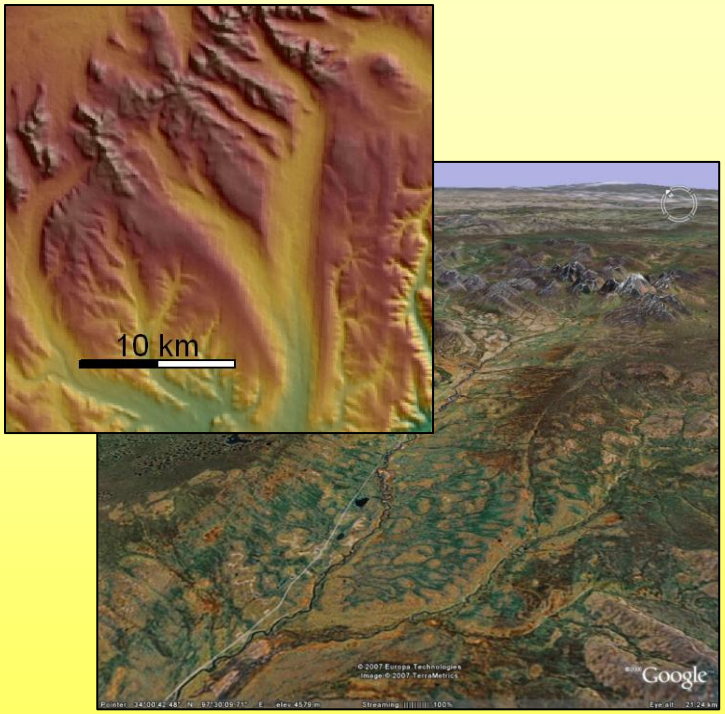
34 ka Distance to glacier: 3.1 km

Paleo-climate implications? **Glacial geology + glacial modeling**

Glacial landform mapping

Detailed mapping of glaciers, glacially eroded valleys, and moraines

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

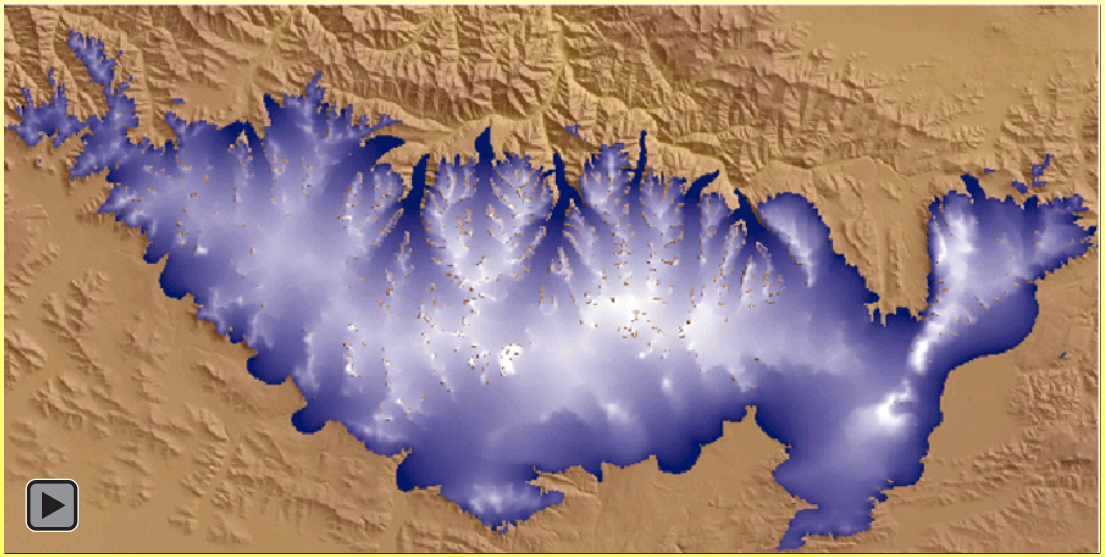


Glacier model

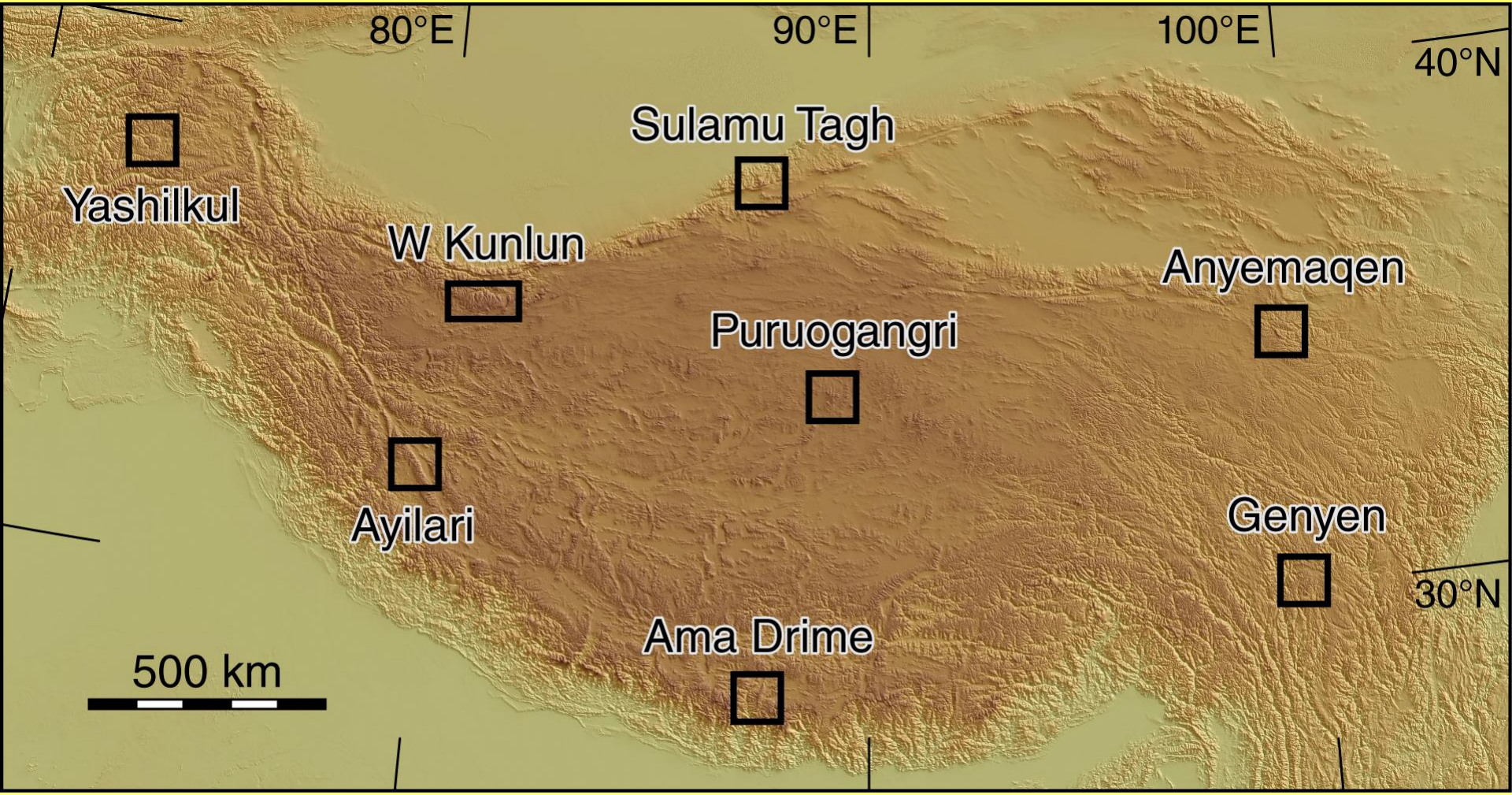
<u>Higher order 3D ice flow model</u>
Resolution: 250 m

<u>Degree day mass balance model</u>
DDF_{snow}: 3 mm $°C^{-1}$ day^{-1}
DDF_{ice}: 8 mm $°C^{-1}$ day^{-1}

<u>Input</u>
SRTM topography
Mean monthly temperature and precipitation (WorldClim)



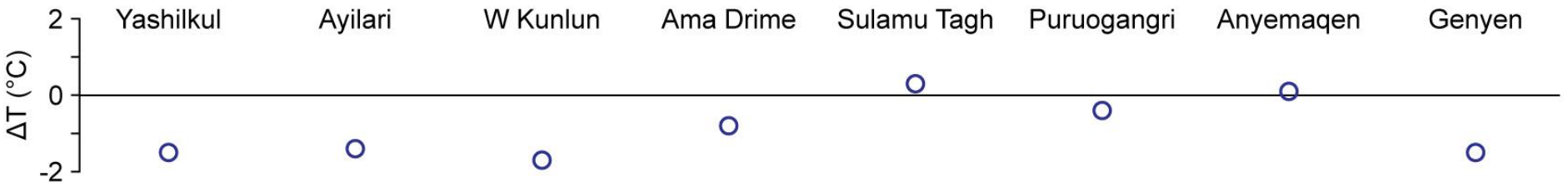
Glacier model domains

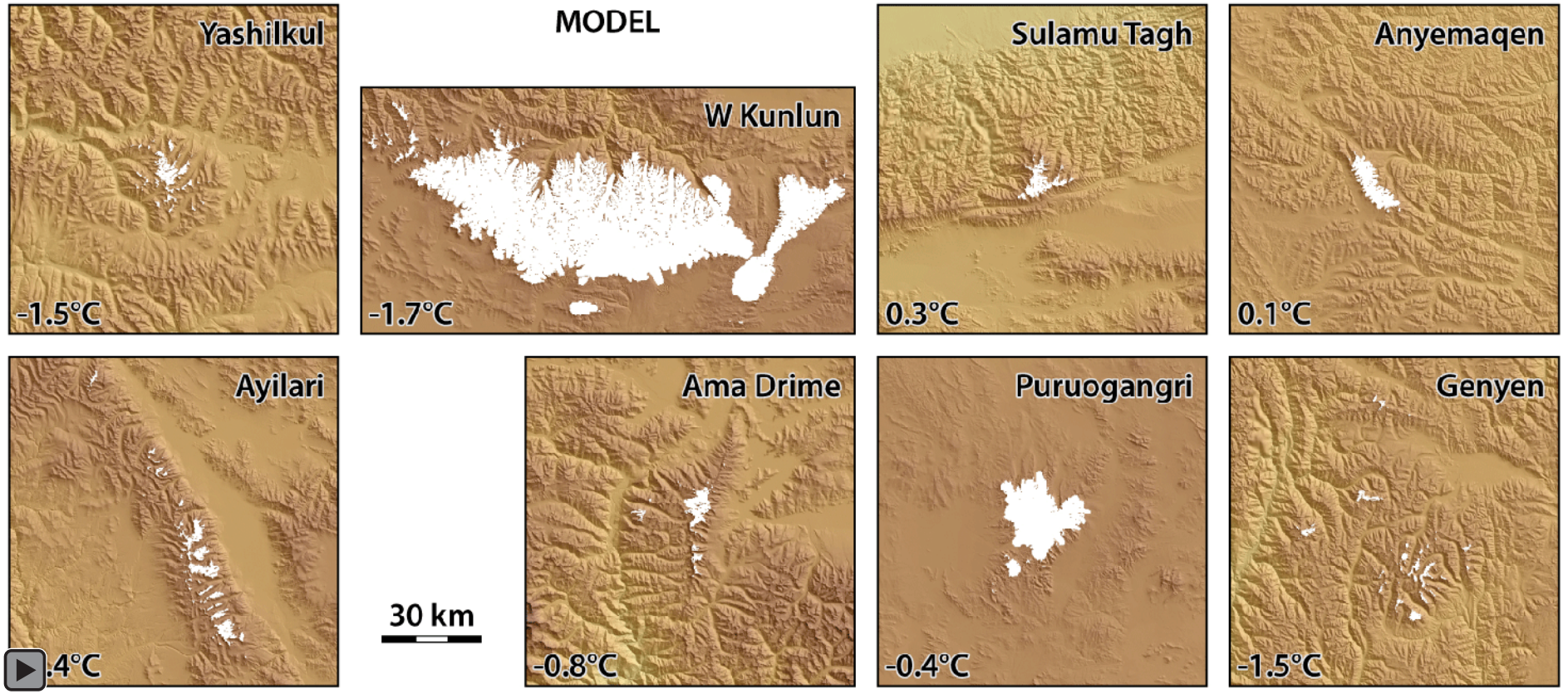


All model domains have present-day glaciers

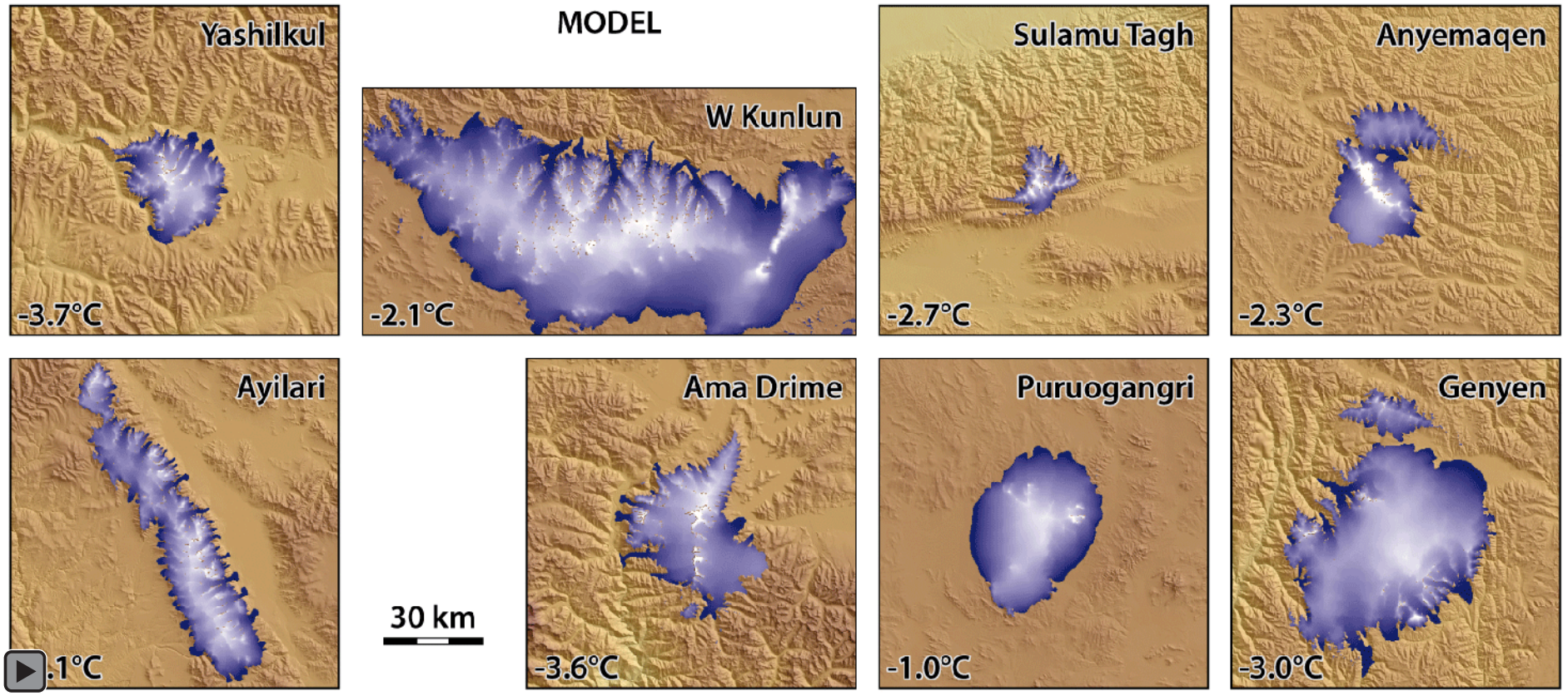
For six domains there are cosmogenic exposure ages for past glaciations (>50 ka)

Temperature perturbations to reproduce present-day glaciers





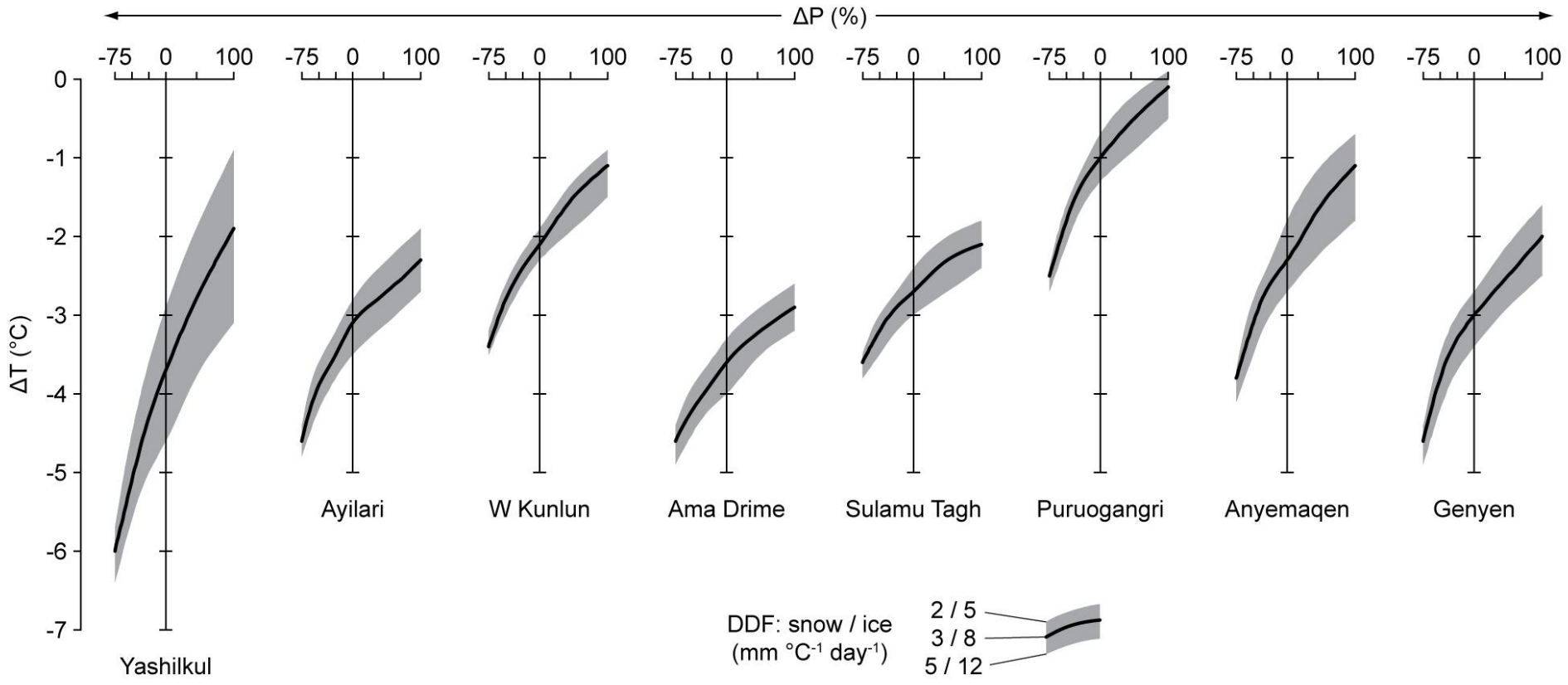
Climate perturbations for paleo-glaciation targets



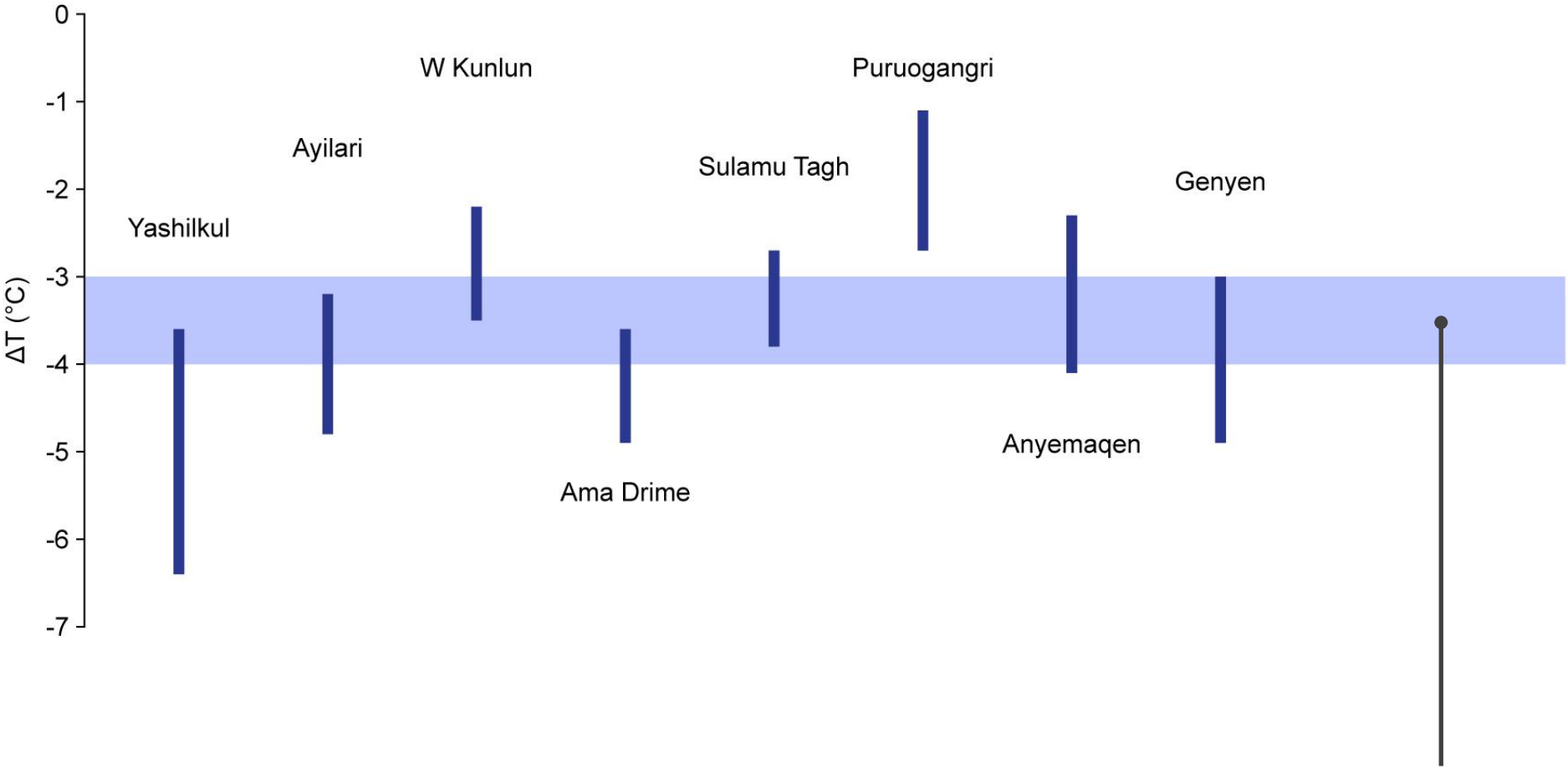
Modeling 5000 years forward with static temperature

and precipitation perturbations

Climate perturbations for paleo-glaciation targets



Assuming -25% to -75% ΔP

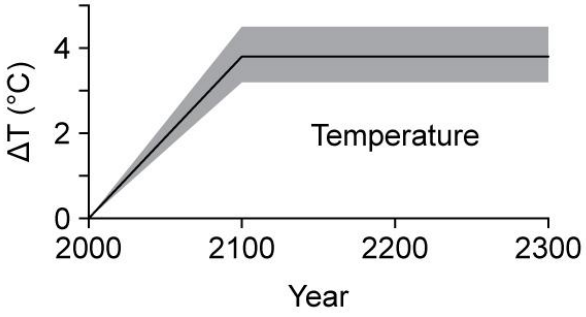


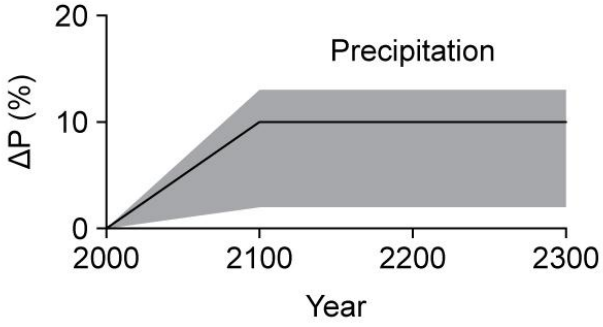
Max LGM summer cooling: 3-4°C

Schmidt et al. (2011): QSR

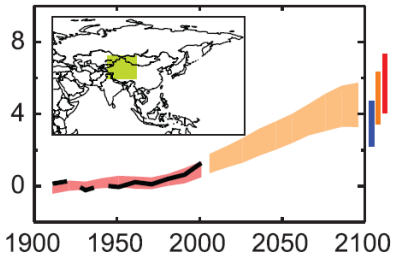
Miehe et al. (2011): QR

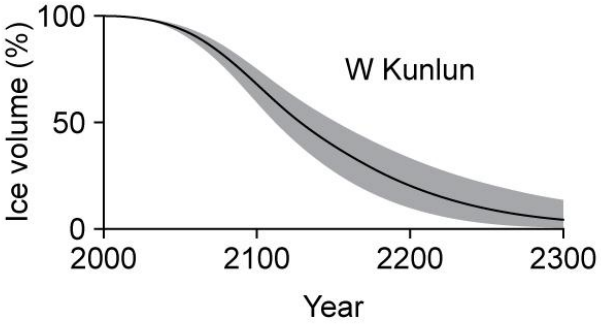
Glacier evolution with warming

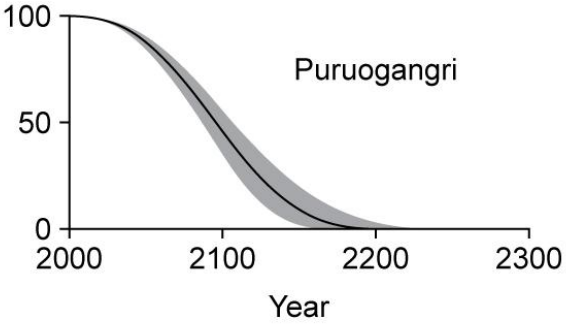


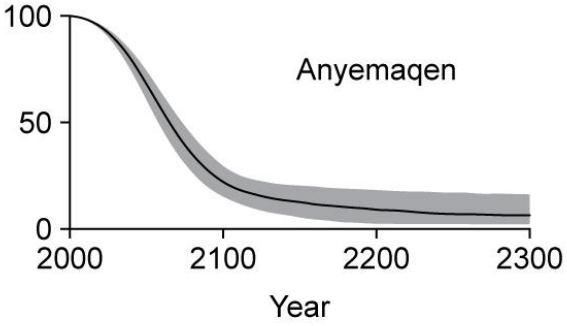


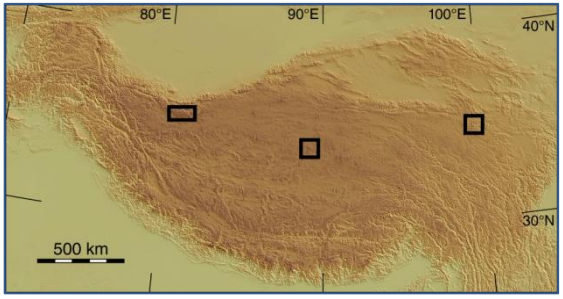
IPCC (2007) regional projection

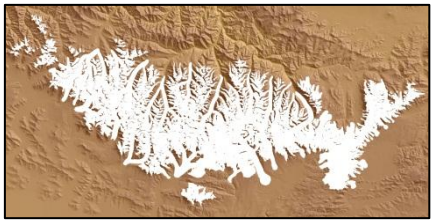


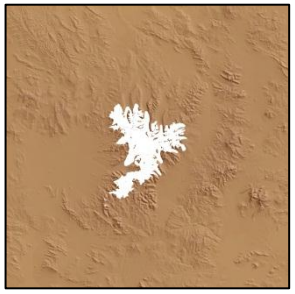












Conclusions

- **The Tibetan Plateau has experienced only limited cooling during the last few glaciations (max 2-6°C)**

- **Future warming of projected IPCC magnitude (3.2-4.5°C) would result in dramatic glacier loss**

Thank you!