

Assessing the Influence of Climate Forcing Data Resolution on Simulations of Glacier and Freshwater Dynamics for the Flade Isblink Ice Cap, Northeast Greenland

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Introduction

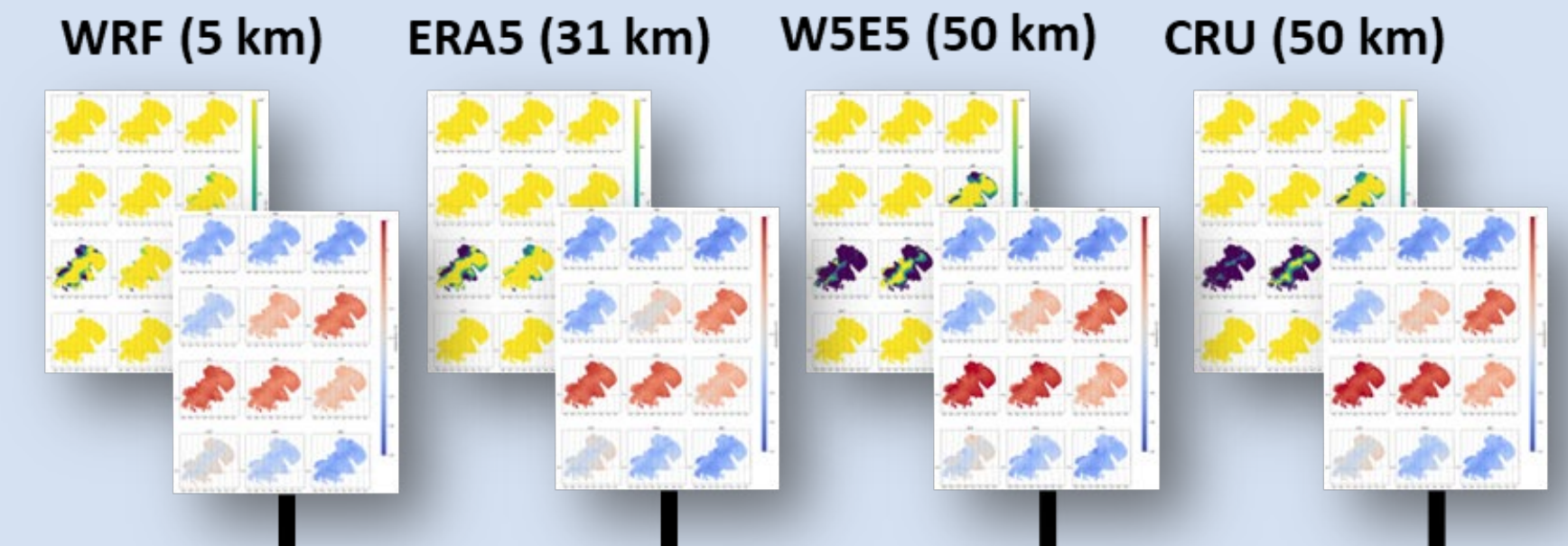
Discover how high-resolution climate data is key for accurate glacier & freshwater runoff modeling and how even coarse datasets can yield accurate simulations with proper regional scaling.

Global Scale Climate Datasets

vs.

Regional Scale Climate Datasets

Methodology

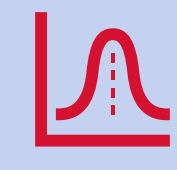


OGGM modeling combined with regional scaling.

Mass balance

Simulated mean mass balances match observations across datasets and model settings.

Equifinality risk: similar outcomes from different model settings could affect runoff accuracy.



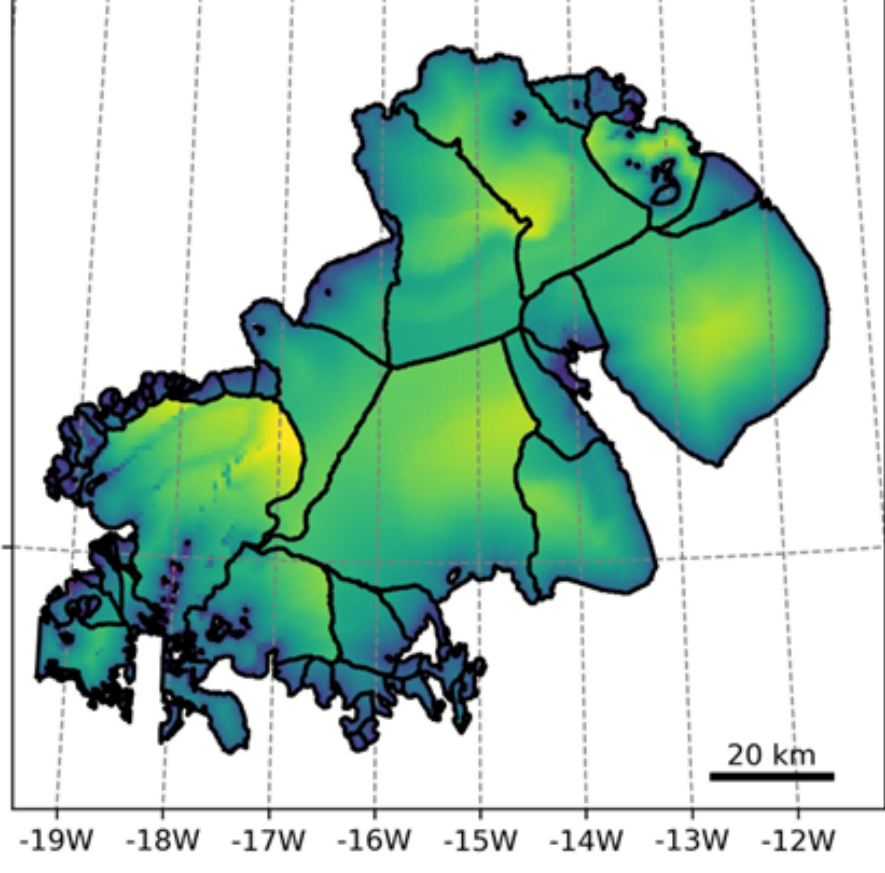
Glacier thickness and volume

High-resolution WRF closely matches reference glacier volume; low-resolution models improved with scaling.

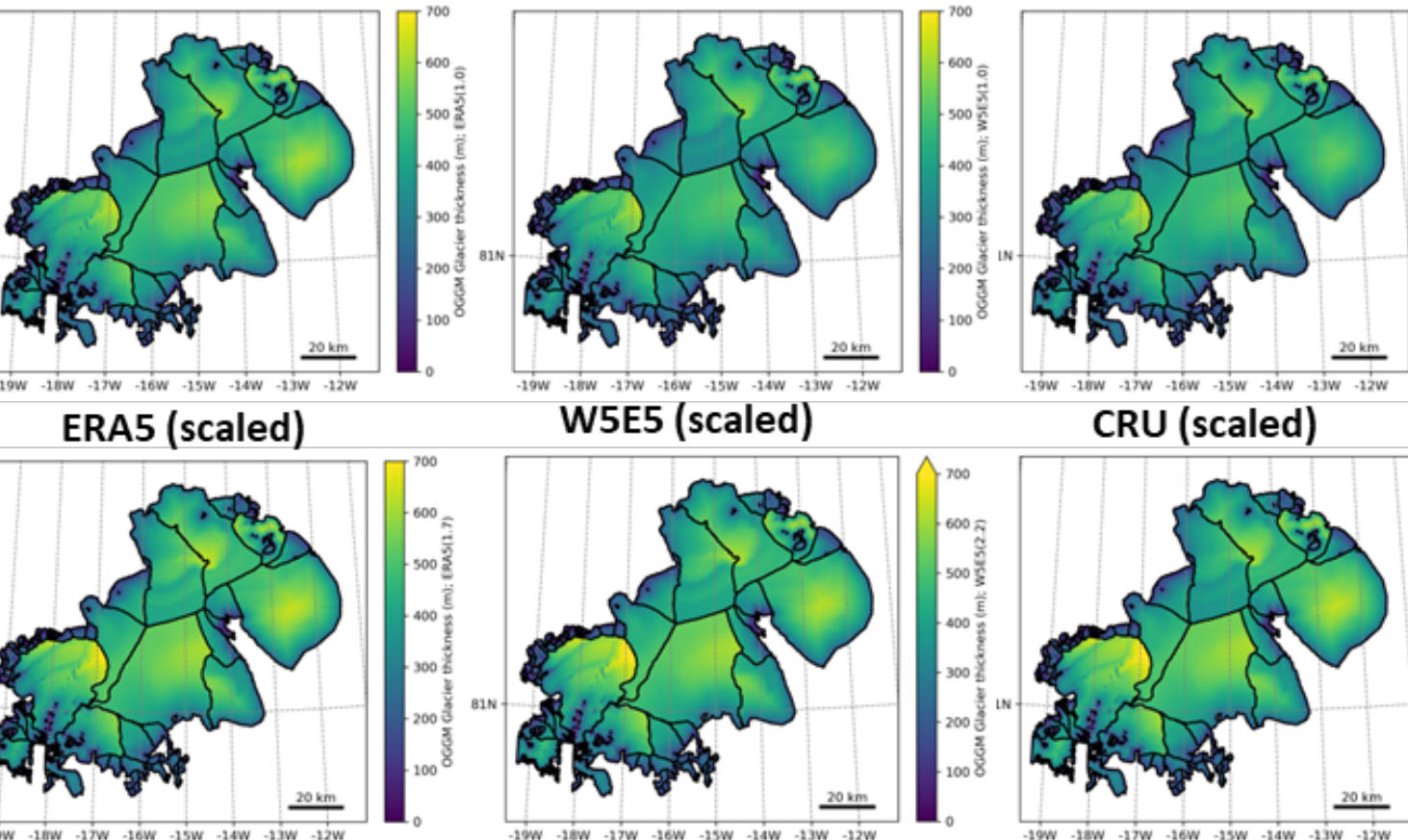
Sensitivity analysis: volume increases with precipitation and decreases with temperature.

Statistical significance confirmed the impact of resolution and scaling on volume simulations.

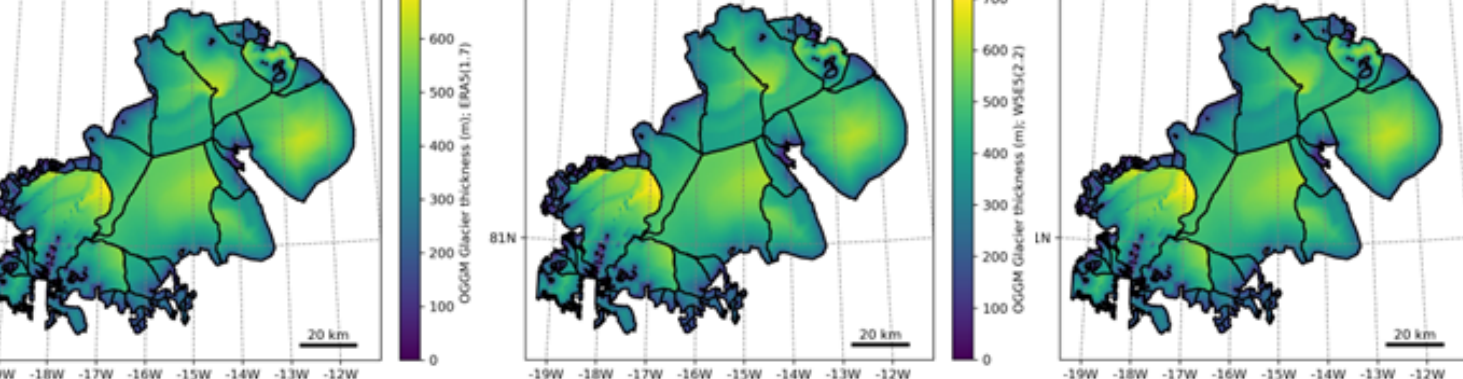
Glacier thickness WRF (unscaled)



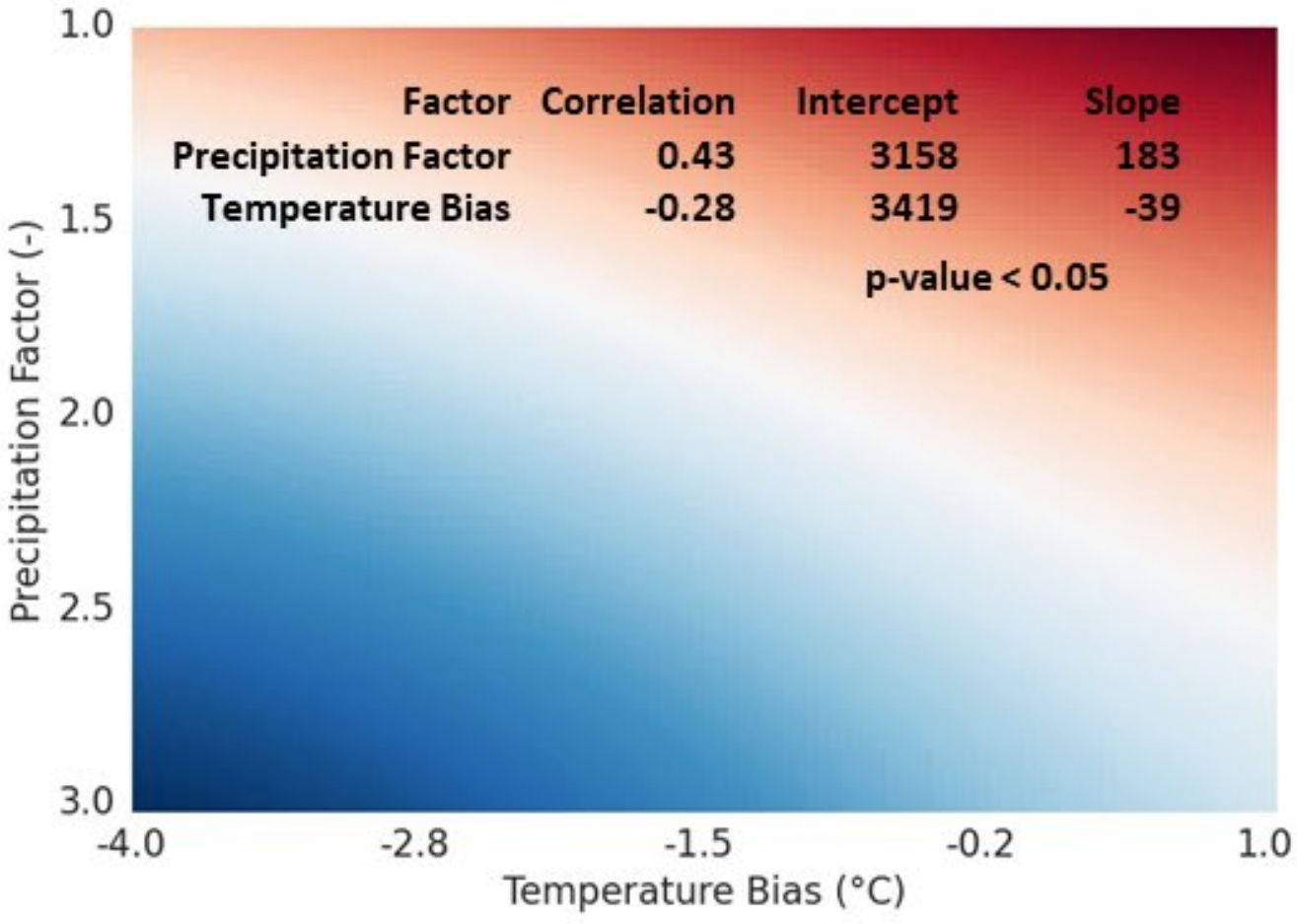
ERA5 (unscaled) W5E5 (unscaled) CRU (unscaled)



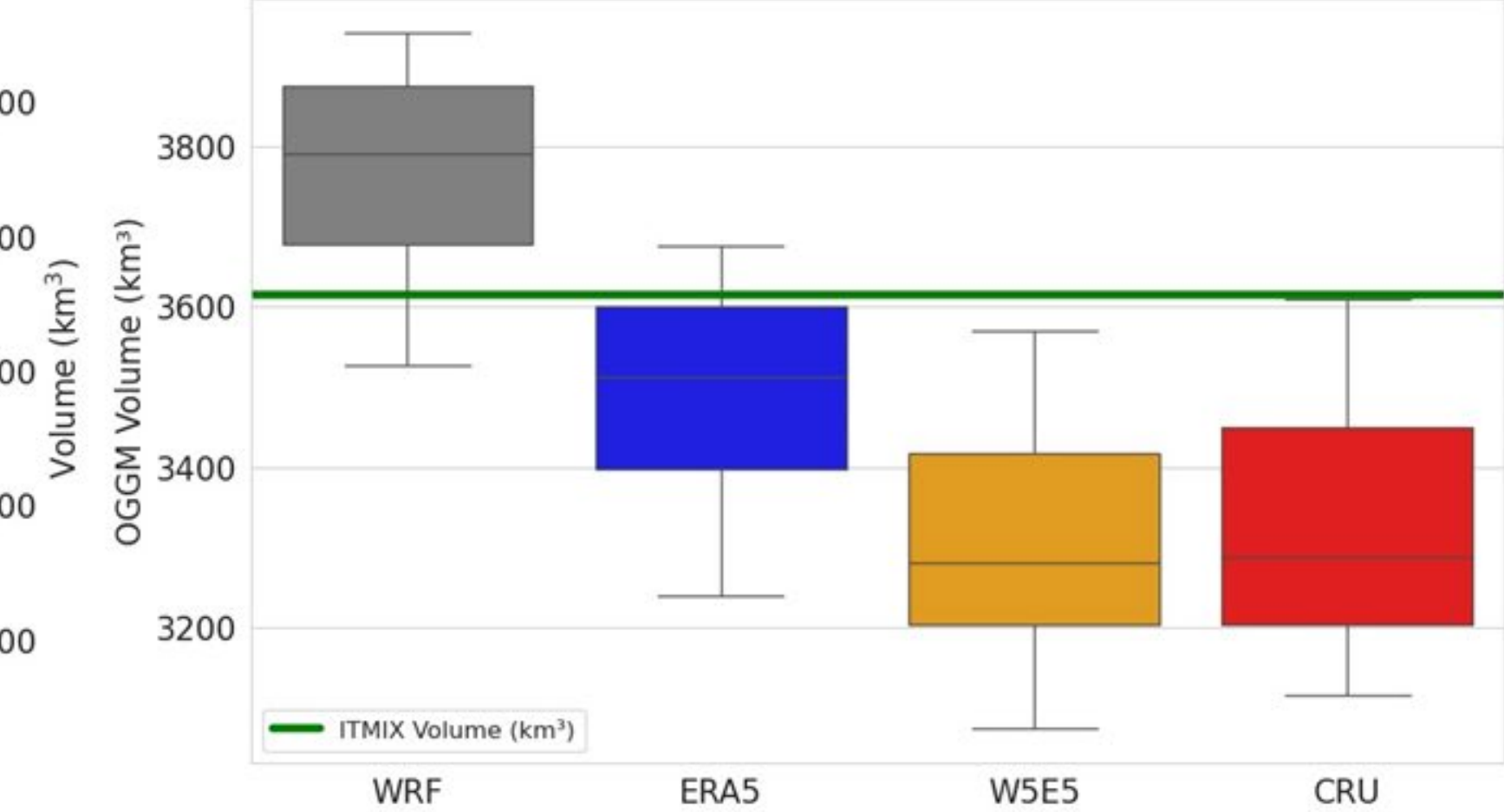
ERA5 (scaled) W5E5 (scaled) CRU (scaled)



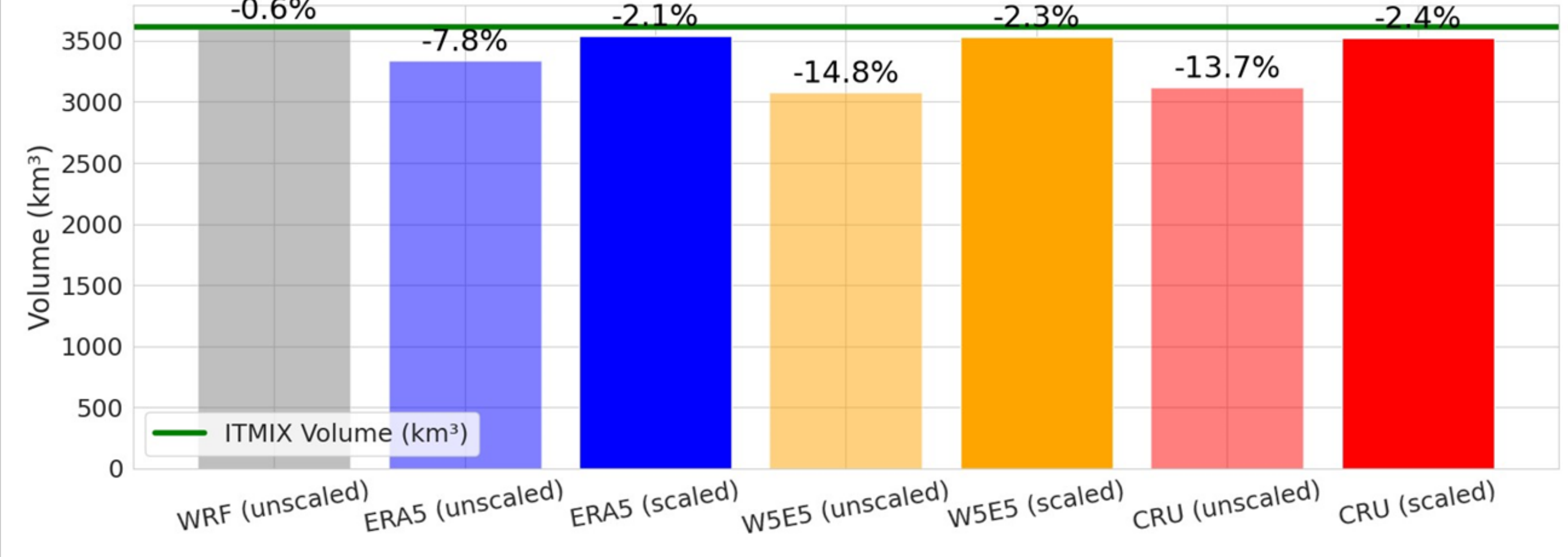
Sensitivity of glacier volume to scaling factors



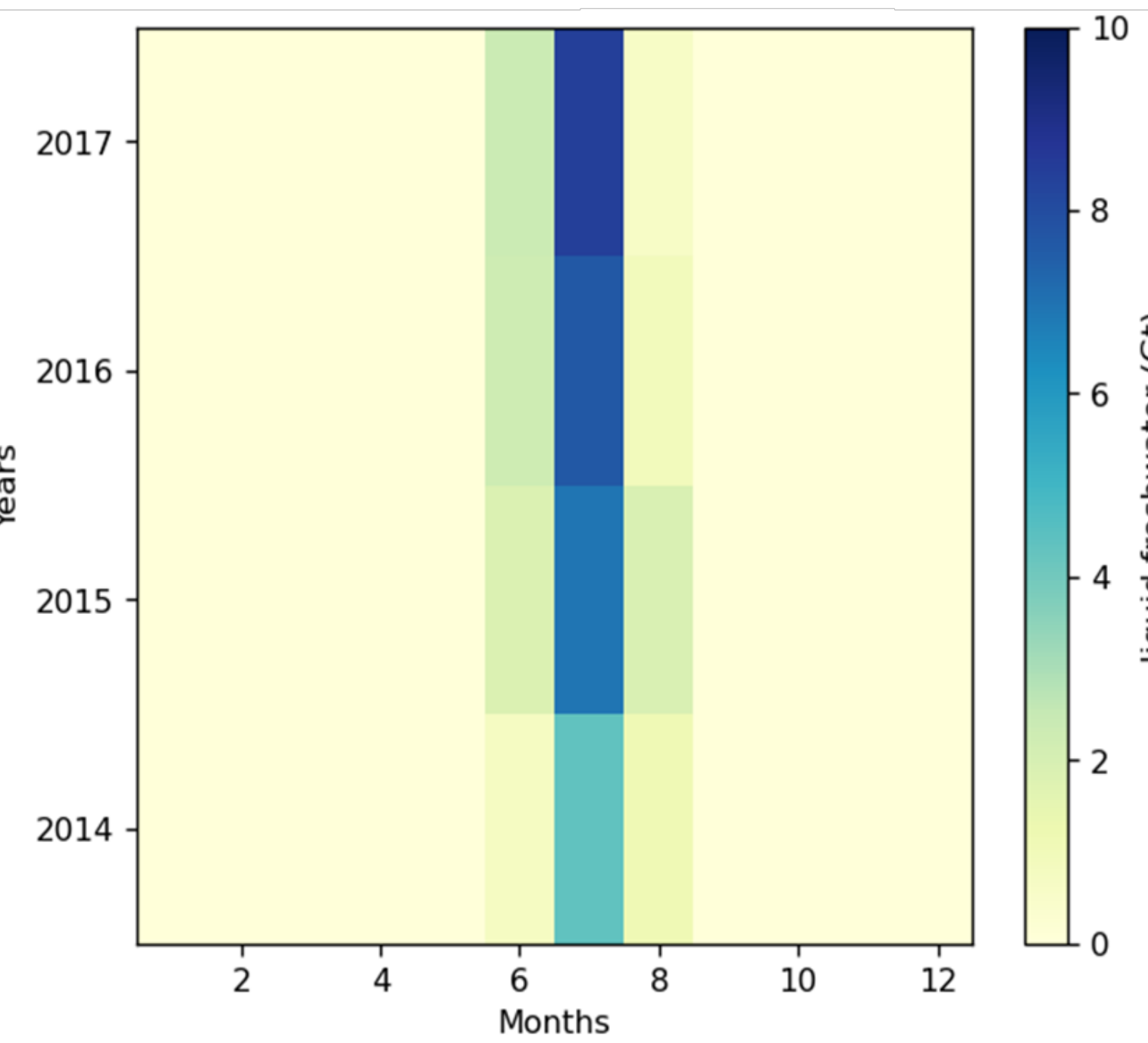
Sensitivity of glacier volume to spatial resolution



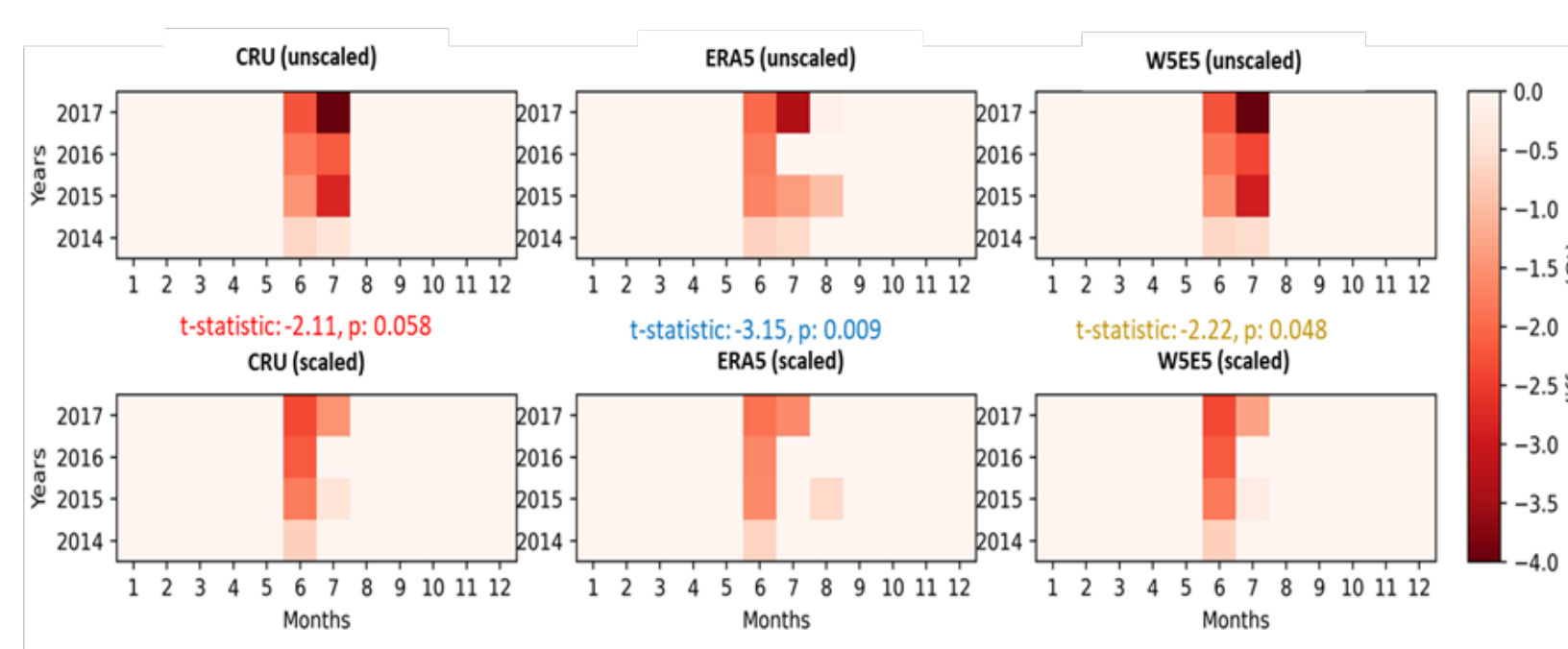
OGGM glacier volume



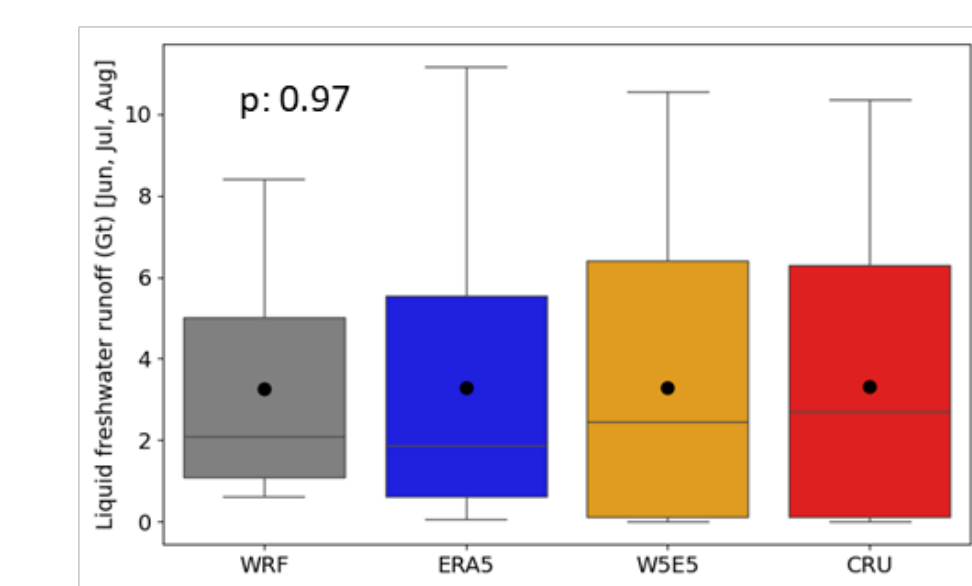
Freshwater runoff - WRF (unscaled)



Freshwater runoff - differences



Freshwater runoff sensitivity to spatial resolution



Freshwater runoff

- Pre-scaling: underestimation by 25-34% for coarser datasets compared to WRF (9.81 ± 2.39 Gt/yr).
- Post-scaling: discrepancies reduced to 0.5%-1.6%. Effectiveness increases with resolution (ERA5 vs CRU).
- Insignificant differences in runoff ($p=0.97$), highlighting role of regional scaling in standardizing runoff simulations.

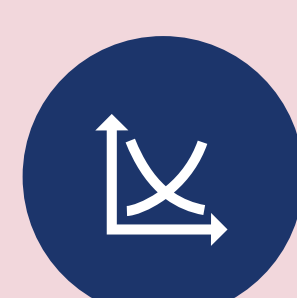
Conclusions



high-resolution climate data enhances accuracy & confidence



potential of regional scaling for cost-effective alternatives with coarse data



balancing model complexity with computational demands

