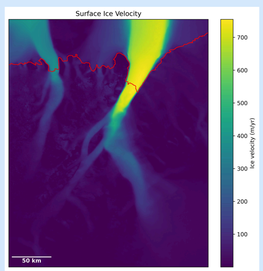
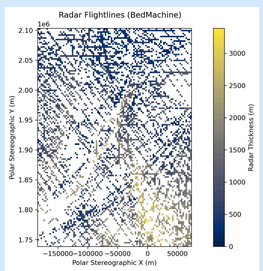
# Subglacial Bed Topography of Jutulstraumen Glacier Using MCMC-Geostatistical Simulation

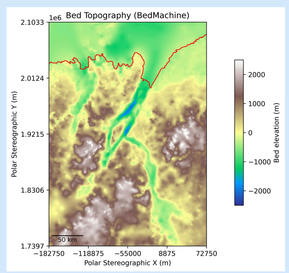
Apoorva Bangalore Raviprasad, Niya Shao, Emma "Mickey" MacKie
Department of Geological Sciences, University of Florida

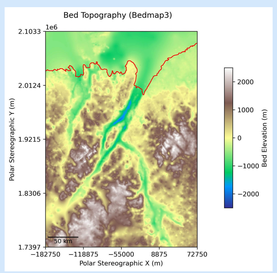



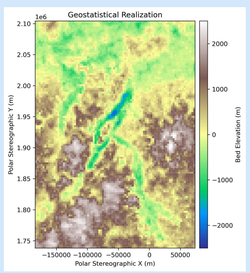



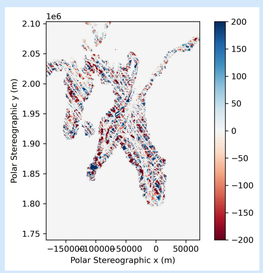

- Jutulstraumen Glacier (location below) is one of the largest fast-flowing outlet glaciers in Dronning Maud Land, channeling ice from the interior of East Antarctica toward the Fimbul Ice Shelf.
- Its wide, deep trough and strong shear margins make it highly sensitive to basal topography.
- Because radar coverage across Jutulstraumen is sparse and uneven, existing Antarctic bed products smooth over important small-scale features.
- These missing details impact modeled velocities and grounding-line stability, motivating a need for improved, uncertainty-aware bed reconstruction methods.

*Figures: Location of Jutulstraumen Glacier; Surface Velocity; Radar Flightlines (example from BedMachine) BedMachine, Bedmap 3, SGS Topographies; Difference between LargeScale and SmallScale Realizations*



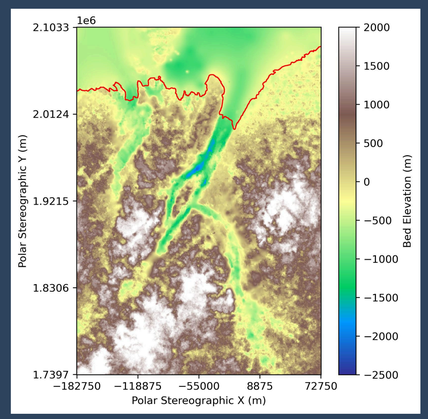




## Methods

- We start with a large-scale bed from BedMachine or Bedmap3 and preserve its major trough geometry while allowing small-scale uncertainty to vary.
- A subglacial roughness is added using statistical basis functions whose amplitudes are sampled to match realistic SGS-derived topography spectra and roughness distributions.
- An MCMC sampler is run that proposes random perturbations to the bed and accepts/rejects them based on how well they satisfy physical constraints (ice thickness, grounding-line position) and statistical priors.
- An ensemble of plausible beds is generated, from which we compute a most probable topography.




## Result

- The MCMC-derived bed for Jutulstraumen reveals deeper trough structure, sharper lateral ridges, and more realistic small-scale variability than both BedMachine and Bedmap3.
- Probabilistic bed inversion using MCMC is well-suited for large Antarctic outlet glaciers like Jutulstraumen, where interpolation-based bed products smooth out crucial topographic variability.

**Check out the GitHub repo here!**