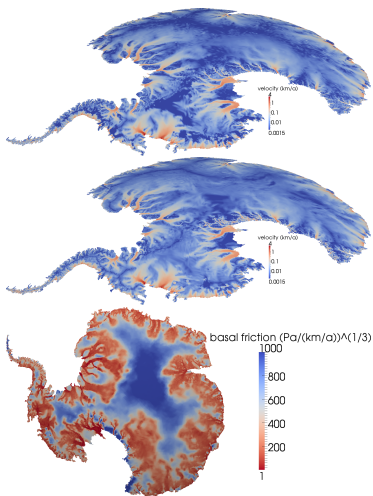


# Tobin Isaac's Research

Large scale Bayesian inversion and Uncertainty Quantification for critical ice sheet modeling parameters, . . .



Inverting for unobserved basal friction field from InSAR satellite data, with quantified uncertainty (in preparation):

- Nominally  $> 400K$  parameters: high-dimensional inverse problem
- MAP point calculated using Newton's method, adjoint-based gradients and Hessian-vector products
- Posterior covariance via scalable low-rank approximation algorithm
- Propagation of uncertainties to predicted quantities of interest

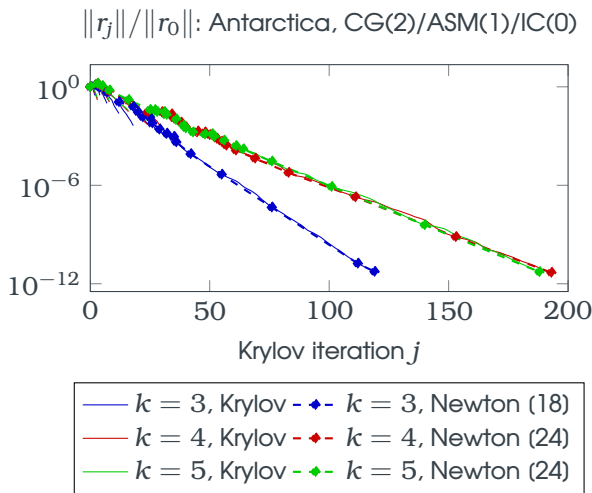
## Tobin Isaac's Research

. . . built on scalable, efficient solvers for high-order, inf-sup stable discretizations of nonlinear PDEs, . . .

Solver presented in

[arXiv:1406.6573](https://arxiv.org/abs/1406.6573):

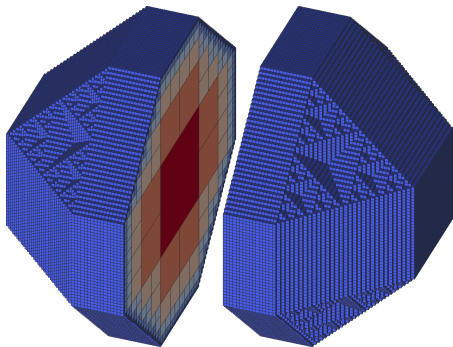
- Newton-Krylov method,
- $Q_k \times Q_{k-2}^{\text{disc}}$  discretizations,
- Matrix-free matvecs,
- block/multigrid preconditioning,
- efficient at high aspect ratios



## Tobin Isaac's Research

. . . built on extremely scalable parallel adaptive mesh refinement algorithms.

Illustration of 2:1 balance kernel from  
[doi:10.1109/IPDPS.2012.57](https://doi.org/10.1109/IPDPS.2012.57).



Scalability to 458K cores from  
[arXiv:1406.0089](https://arxiv.org/abs/1406.0089).

$L_{\text{nodes}}$  runtime in seconds

