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:

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

$\frac{\|r_j\|}{\|r_0\|}$: Antarctica, CG(2)/ASM(1)/IC(0)

$k = 3$, Krylov
- $k = 3$, Newton (18)
- $k = 4$, Krylov
- $k = 4$, Newton (24)
- $k = 5$, Krylov
- $k = 5$, Newton (24)
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.