* RBF-FD is new method
* Scaling RBF research to large problems
  + Global RBF problems have some large problems
    - Cite Knepley for interpolation
    - Other papers
  + Limited work on RBF-FD for large problems
* Leveraging modern architecture
  + Future of HPC is in accelerators
  + RBF research on GPU is limited
    - Cite Schmidt
* Challenges in RBF-FD
  + Conditioning
  + Stencil size
  + Support
* Grand Applications
  + Toward Mantle Convection
  + Need building blocks for applications
* All RBF Literature
  + Global Methods
* Define RBF (Introduction)
* Define RBF interpolation
* Related Methods
  + Global
  + Compact
  + Other
* Define the RBF-FD method
  + History
  + Computing weights
    - Direct solve
    - Stable algorithms that are known
  + Choosing epsilon
    - Contours
    - Related work: what functions did they use?
* Customized Weights
  + Direct compute
  + Linear combinations
  + Projections
* Neighbor queries
* Solving PDEs with RBF-FD
  + Derivative as stencil evaluation
  + All Derivatives as SpMV
  + Assemble system
* Hardware architecture
  + Memory layout
  + Processing cores
  + Trends in hardware since 2006 (additions and benfits)
* Optimization
  + SpMV memory layout
  + Scheduling threads
  + Reductions
* OpenCL
  + Why?
    - Cross platform support
    - Asynchronous Queuing with Dependencies
  + Implementations details
    - Kernel
    - Work-Item
    - Work-Group
    - NDRange
    - Queue
    - Etc.
  + How does it compare to CUDA? Phi
  + Latest trends
    - Phi: bind against MKL for optimized CPU and MIC
    - CUDA-MPI
    - CUDA Sub-Kernel calls
    - CUDA uptake
      * E.g., Matlab (MEX compiled kernel wrappers)
* Conclusions on GPGPU
  + Benefits are good
    - Cheap to purchase < $1K
    - superior performance 1.2 TFLOPs possible in one card
    - was a trending technology (major uptake in supercomputing and national labs)
  + Downsides were varied
  + Overall Impression is that
    - Uptake was wide-spread for research projects
    - Focus was on determining limits of the hardware
      * Many studies focused on optimization of primitives which allow general use in applications such as RBF-FD without recreating the wheel when it comes to optimal algorithms. Allows researchers to concentrate on other investigations into application, preconditioning, data analysis, etc.
* Newcomers to the field are interested USING gpgpu applications, rather than writing them
* Peak throughput
  + CPU
  + GPU
* Achieved throughput
  + CPU
  + GPU
* Scalability
  + Weak
  + Strong
* Time reduction
  + Neighbor
* Conditioning Impacts
  + Interleaving?
  + Node order for GPU?
  + Node order LSH?
* Preconditioners Tested
  + ILU0
  + ILUP
  + MG
  + AMG
  + Etc.
* Mask for Stokes
  + All blocks of non-interleaved
  + Diagonal blocks of non-interleaved
  + Etc.