

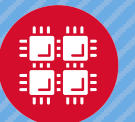
# Xpert Network Panel: Boosting RSE Productivity

Karen Tomko

Ohio Supercomputer Center

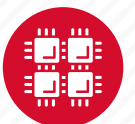
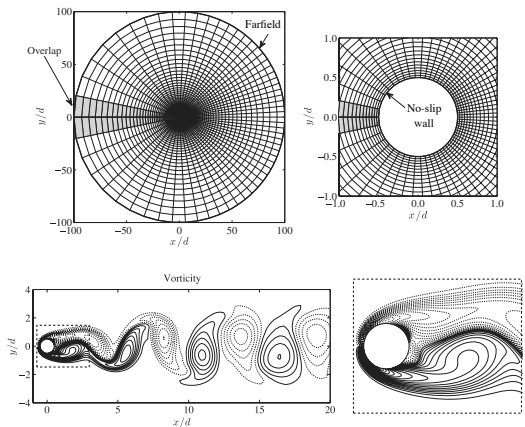
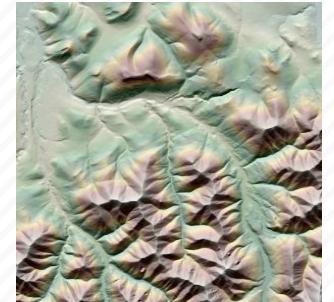
Email me: [ktomko@osc.edu](mailto:ktomko@osc.edu)

RSE Team: Samuel Khuvis, Evan Danish, Shameema Oottikkal



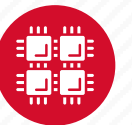
# Current RSE Projects

- **SETSM Terrain Generation Code**
  - C/C++, MPI+OpenMP
  - Code is in active development and used in a production environment
  - Software engineering, performance improvement
- **FDL3Div2 CFD software**
  - Fortran, MPI+OpenMP
  - Performance improvement, modernize for new architectures
- **Soil Spectroscopy**
  - R
  - Software engineering, parallelization
- **MVAPICH2 MPI**
  - C/C++, Fortran, CUDA, new programming models (PGAS, tasks ), Python
  - Performance analysis, case studies



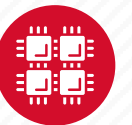
# Tools we use

- Git / Gitlab, Cmake/make
- Compiler reports and diagnostics: Intel, Gnu, PGI, Cray
- Debuggers: gdb, DDT
- Memory Debuggers: Valgrind, ASan(via gcc)
- Performance Analysis: Intel Advisor & ITAC, ARM Map, Tau, HPCtoolkit, mpiP
- Manual Instrumentation: timing, dumping variables, checking memory use
- Reframe test framework, test scripts



# Challenges

- Choosing the right tool
  - Many tools with overlapping functionality
  - Varying language support
- High learning curves, limited documentation and varying robustness
- Tool overheads (feasibility of completing a run)
  - How much extra memory?
  - What is the multiplier in runtime?
  - Can't profile every run
- Gaps
  - I/O – support full range of filesystems
  - Hot data structures (those with highest access times)
  - Process and thread placement, NUMA memory
  - Lack of standards for instrumentation (i.e. specifying code region to profile)



# Introducing Student to Tools

- CS Students
  - Many students now have exposure to source code control
  - Some have used a debugger: gdb or within an IDE
  - Few have used memory debug tools
  - Very few have used performance profilers
  - Almost none have created tools
- Non-CS students
  - Generally have very limited exposure to tools

