WRF Software

John Michalakes, Dave Gill
Michael Duda, Thomas Henderson

Mesoscale and Microscale Meteorology Division
National Center for Atmospheric Research

\(^2\)NOAA GSD
Outline

- Version 3 software
  - New/enhanced features
  - Towards coupling
- High performance computing
  - Road to petascale
  - New architectures
Version 3 Software

• New, streamlined build mechanism
• Formalized code management & testing
• Platforms & compilers
  – Inte/AMD Linux (Intel, PGI, gfortran, g95, Pathscale)
  – MacOS (Intel, PGI, g95; xlf for ppc-based Macs)
  – NEC SX (thanks NEC, DKRZ, and U. Hohenheim, Stuttgart)
  – IBM Blue Gene (AIX)
  – Windows CCS (PGI)
  – GPU (experimental, more later)
• Benchmarks
  – V3 benchmarks page in progress, thanks Chris Eldred (CMU/PSC)
Towards Coupling

• Applications
  – Regional climate (ESM, NRCM, etc.)
  – Hurricane simulation and prediction (numerous)
  – Operations (NCAR/NASA/AFWA WRF/LIS coupling project)

• Supporting infrastructure
  – MCT and CPL7
  – ESMF
  – MCEL
Towards Petascale

- **WRF Nature Run**
  - 2-billion cell idealized 5km resolution over hemisphere
  - World record parallelism and U.S. record performance on 2-billion cell idealized hemisphere
    - Gordon Bell finalist SC07
- **Scalability enhancements in WRF Version 3**
  - Scalable data structures for LBCs
  - Parallel I/O

GPU Acceleration

- **GPUs**
  - SIMD fine-grained parallelism and multi-level concurrency
  - Very fast, peak 520 GF/s
  - Efficient in terms of flops / watt
  - Cheap (< $500) commodity plug-in coprocessor for ordinary desktop systems

- **Goal:**
  - Demonstrate GPU acceleration for large community weather model
  - First step: Microphysics
WSM5 Kernel Performance

- 2.4 GHz Opteron: 1616
- GPU: 12364
- GPU with xfer: 8772

Mflop/second
GPU Accelerated WRF

Accelerating < 1% of code provides > 20% speedup

Next steps:
- Tracer advection
- Chemistry

qp.ncsa.uiuc.edu
16 Dual dual-core 2.4 GHz Opteron nodes, each with Four NVIDIA 5600 GTX GPUs

Thanks: Wen-mei Hwu, John Stone, and Jeremy Enos
thanks