Republic Hydrometeorological Service of Serbia

PERFORMANCE ANALYSIS of REGIONAL Eta MODEL

installation, running and optimization on different hardware/software platform

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Outline

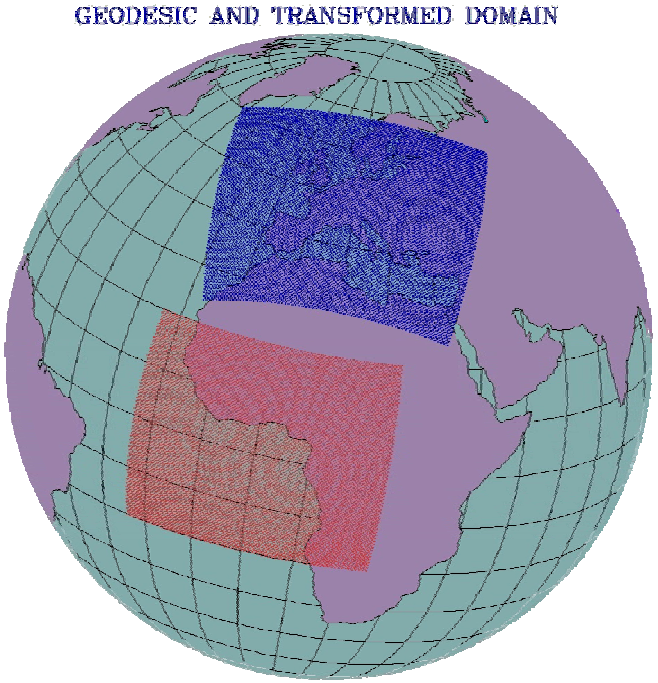
- NWP in Serbia -The Eta model characteristics
- Historical overview and description of present operational system
- Latest efforts in installation and running the Eta model on different platforms
- Conclusion

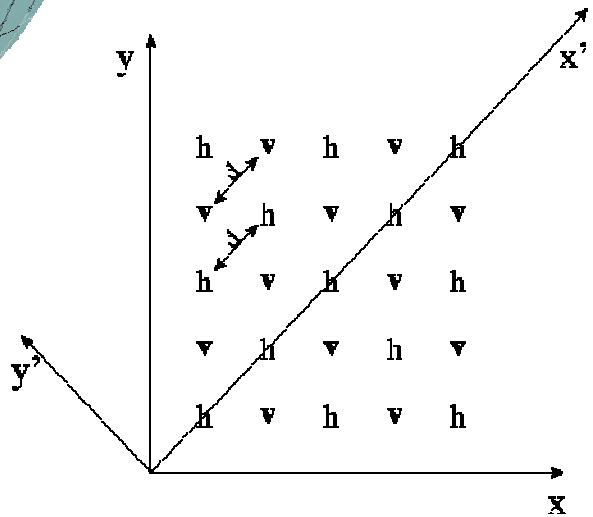
Development of NWP in Serbia

- In 1972 Belgrade University professors Zaviša Janjić and Fedor Mesinger developed the first version of regional NWP model in cooperation with the Federal Hydrometeorological Institute of Yugoslavia(HIBU)
- NWP model has been used operationally in Belgrade since 1979
- After its unique vertical coordinate was defined by prof.Mesinger in 1984, the model was named the Eta model
- Several model components were developed in National Center for Environmental Prediction (NCEP), Washington and Geophysical Fluid Dynamics Laboratory (GFDL), Princeton

The Eta model characteristics

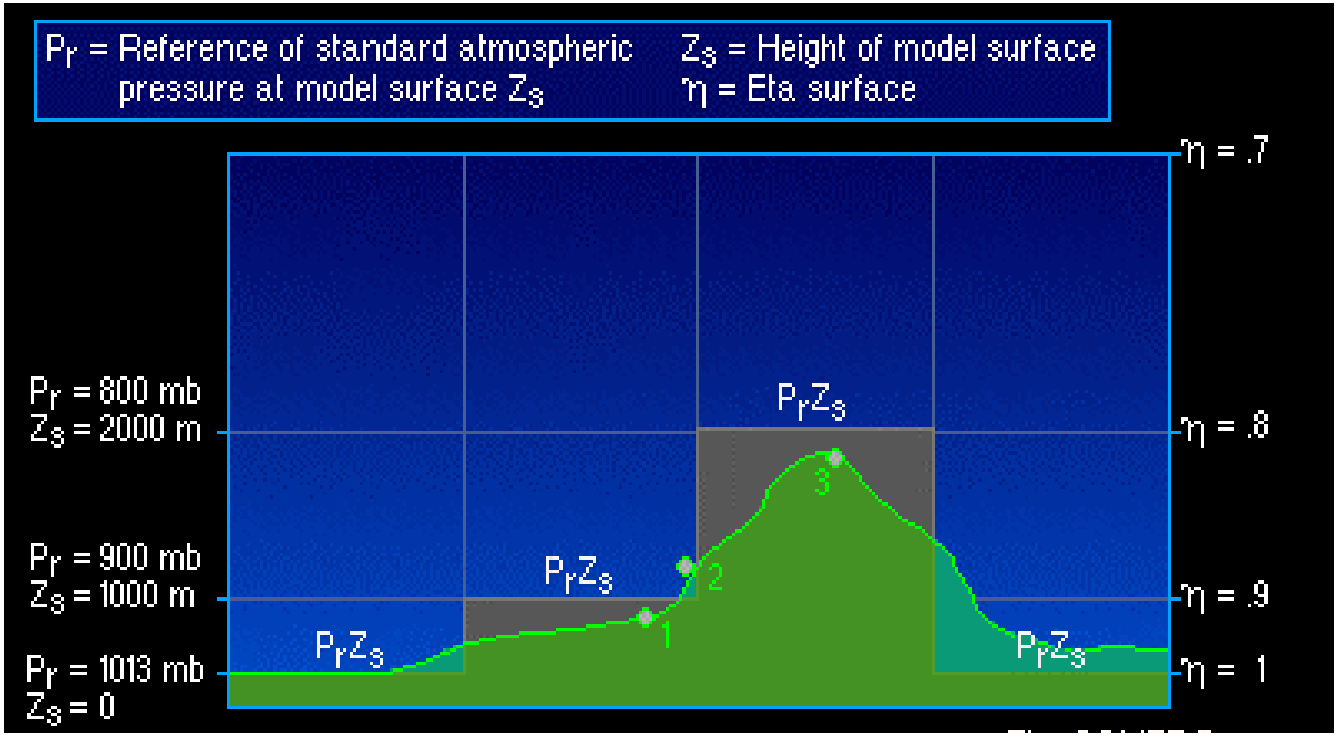
- Limited area grid point model based on finite differences numerical methods
- The horizontal grid is Arakawa semi-staggered E grid defined in a transformed lat/lon coordinate system
- h points carry surface pressure, cloud water temperature, specific humidity, vertical velocity, turbulent kinetic energy and passive substances
- v points carry u and v components of the horizontal wind





Eta coordinate

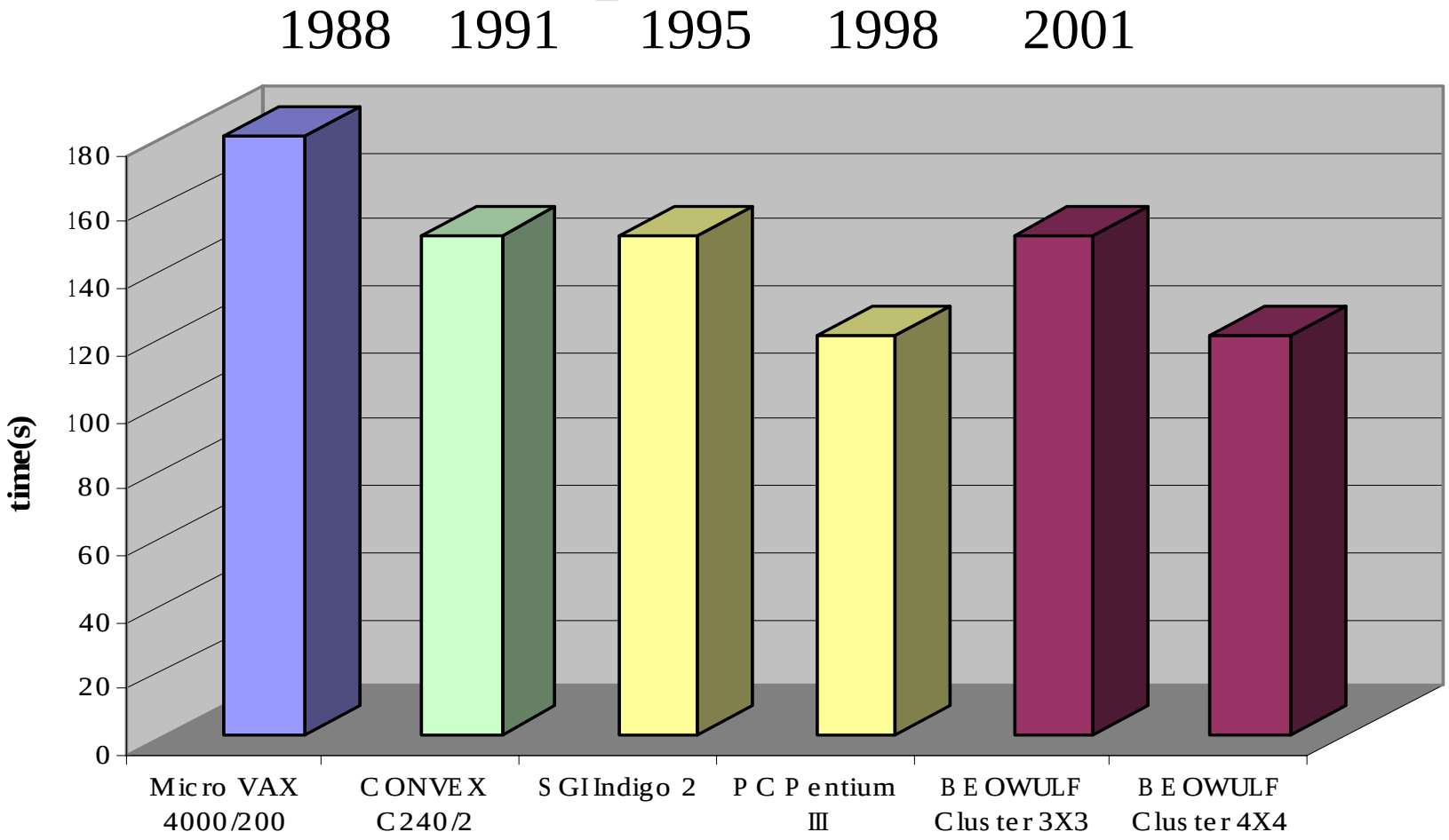
$$\eta = \left(\frac{p - p_T}{p_s - p_T} \right) \eta_s$$



Computer resources

Computers / year	NWP Eta model
Micro VAX / 1988	Resolution 1.1º; 36 hour forecast; 16 vert.levels; time step 120s, 759 numerical points
CONVEX -two processors / 1991	Resolution 0.4º; 48 hour forecast; 16 vert.levels; time step 120s, 6385 numerical points
Sgi Indigo2 / 1995	Resolution 52 km; 48 hour forecast; 32 vert.levels; time step 120s, 8773 numerical points
Pentium III CPU 600MHz / 1998	Resolution 52 km; 48 hour forecast; 32 vert.levels; time step 120s; (AVN LBC), 8773 numerical points
BEOWULF cluster 3X3 and 4X4 CPU 1.4MHz / 2001	Resolution 18km; 5 days forecast; 32 vert.levels; time step 45s; (DWD LBC), 70000 numerical points

One hour forecast on different platforms



Agenda

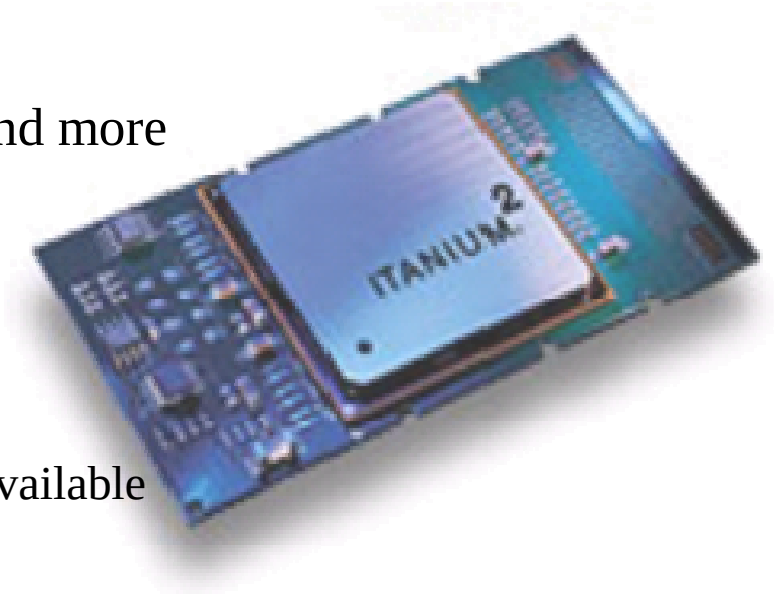
- Our Mission
- Hardware Platform
- OS Consideration
- Porting Adventure
- Achieved Results
- Yet to be done…

Our Mission

- Our goal is to speed up Eta model as much as possible, considering price/performance ratio
- 32bit platform is already exploited to maximum (PGA Compiler, SMP, Clustering)

Hardware Platform

- Itanium 2 is Our Platform of Choice
  - EPIC (Itanium) goes beyond simple GHz
  - Excellent Scalability
    - From 2 to 128 CPUs per box
    - Up to 84 CPUs per rack
  - Support all relevant OS platforms and more
    - SuSE and RedHat Linux
    - Windows
    - HP-UX
    - OpenVMS
  - Promising Platform
    - Dual Core 9M Itanium 2 Already available
    - Dual Core 12M Itanium 2 in 2005



OS Consideration

- HP-UX For Performance
  - HP Fortran Compiler
  - Mature Software Platform
- Linux For Price & Performance
  - Intel Linux Fortran Compiler
  - Proven Development Platform
  - User Friendly Environment
  - Portable Code

Porting Adventure (1 of 3)

- Starting environment
  - Linux IA32
  - PGA Compiler
- Two destination environments
  - HP-UX
  - Linux 64bit Itanium2

Porting Adventure (2 of 3)

- HP Fortran Compiler follows f90 standards (Easy to port)
- GRIB library requires minor modification since it supports HP-UX PA, but not HP-UX Itanium2
- Auto-parallelization and Itanium2 optimization led to significant performance boost
  - Without Itanium2 optimization - 19min per iteration (1h)
  - With Itanium2 optimization – 3min per iteration! (1h)

Porting Adventure (3 of 3)

- Intel Fortran Compiler – Faster but less compatible
- Code modification required for GRIB library and Eta model
- Different optimization options must be provided for different Eta model stages while compiling the model

Achieved Results

- We are at the beginning of porting journey
- Reference platform
  - Two-way rx2600 Itanium2 3M 900MHz
  - RedHat Linux AS
  - 4GB RAM
  - 5min per Iteration (1h of forecast)

Yet to be done…

- General directions
  - Optimize on single node
    - Modifying code and introducing Intel Fortran specific code
    - Introducing new Itanium2 processors
      - More cashe leads to more FPU performance
      - Dual core leads to higher density
  - Optimize for Cluster (MPI)
    - MPI – Intel Linux Fortran Compiler Issues?

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