



Computer Science
& Engineering
Department



High Performance Scientific Computing in Romanian Universities

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University Politehnica of Bucharest



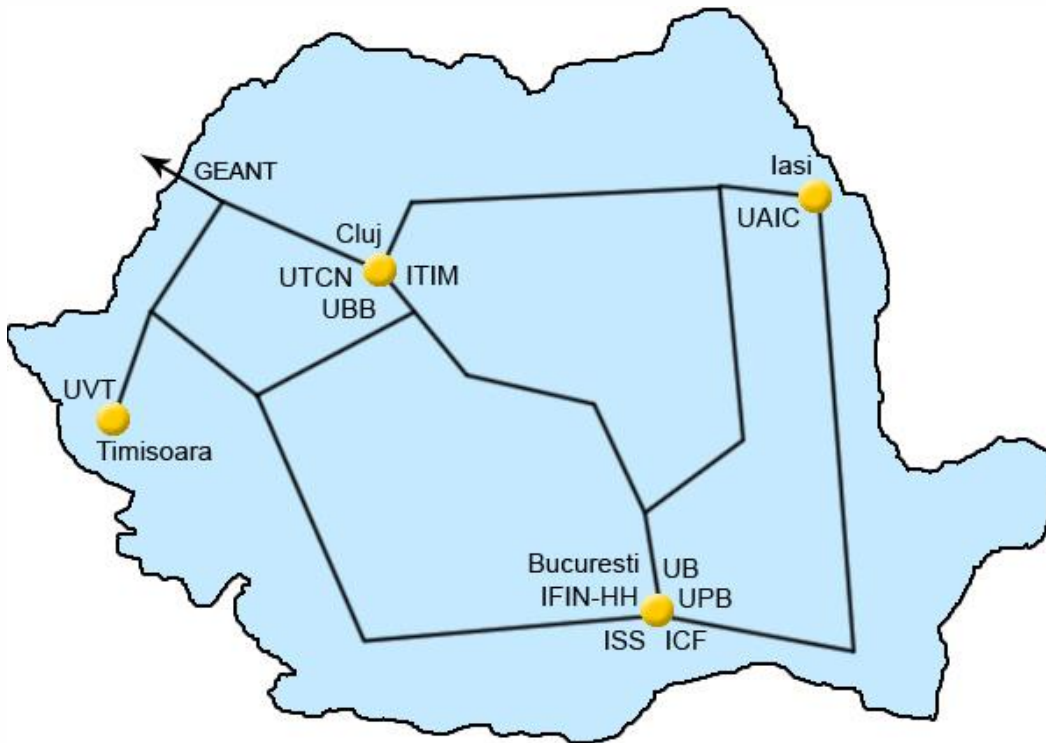
National Strategy for High Performance Scientific Computing

- Development of a national network of HPC centers
- Support of scientific domains requiring HPC:
 - Computational physics
 - Computational chemistry
 - Astronomy & Astrophysics
 - Meteorology
 - Seismology
 - Life Sciences & Bioinformatics
 - ...
- Support of R&D projects in the field of HPC
- Application evaluation and resource allocation of relevant HPC workloads
- Strengthening international HPSC cooperation



National HPSC Infrastructure

10 systems >200 cores totaling
over 7.700 cores & approx. 50 TFlops Rpeak
Uplink RoEduNet → GEANT2

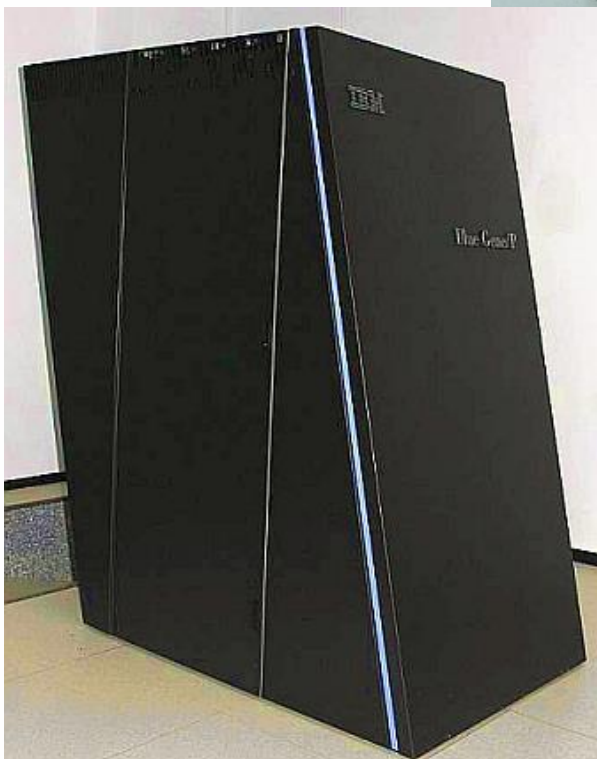


Nr.	Nume	Institutia	Cores
1	Blue Gene/P	UVT	4096
2	NCIT-Cluster	UPB	940
3	IFIN_BC BladeCenter	IFIN-HH	656
4	CMMCCC	UBB	560
5	RO-09-UTCN	UTCN	512
6	Blade Cluster – IBM	ICF 'Ilie G. Murgulescu'	512
7	InfraGRID	UVT	400
8	IFIN_Bio	IFIN-HH	256
9	Rospace	ISS	212
10	MDEO-Cluster	UB, Fac. de Fizica	208
11	Animal X16	UB, Fac. de Biologie	128

Financed by ANCS & EU through CEEEX, Nucleu, PN II & POSCCE,
FP7 programs

Supercomputer
IBM BlueGene/P
4096 cores, 13 TFlops

HPC in Cloud
IBM Blade Center
400 cores, 11 TFlops



UVT / IEAT

Numerical and Symbolic
Computing

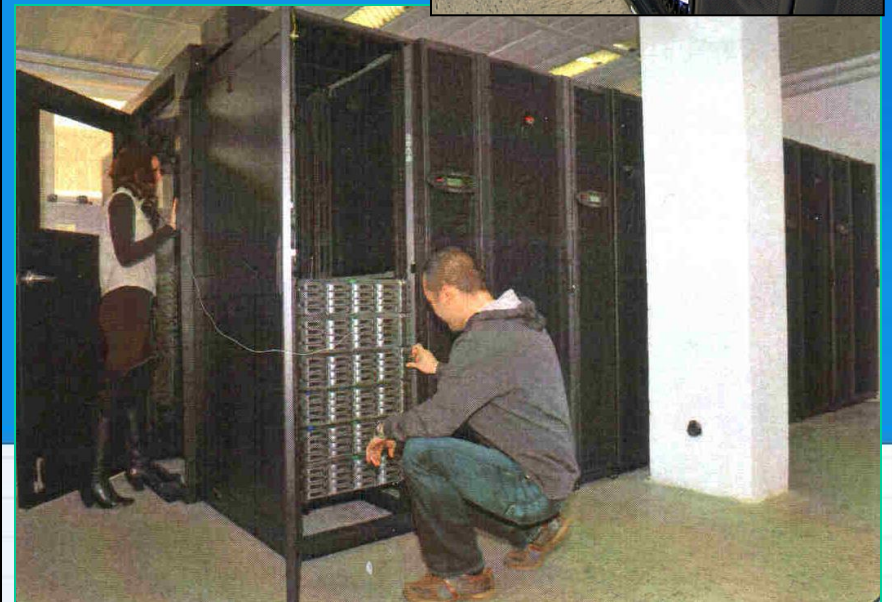
Evolutionary Computing

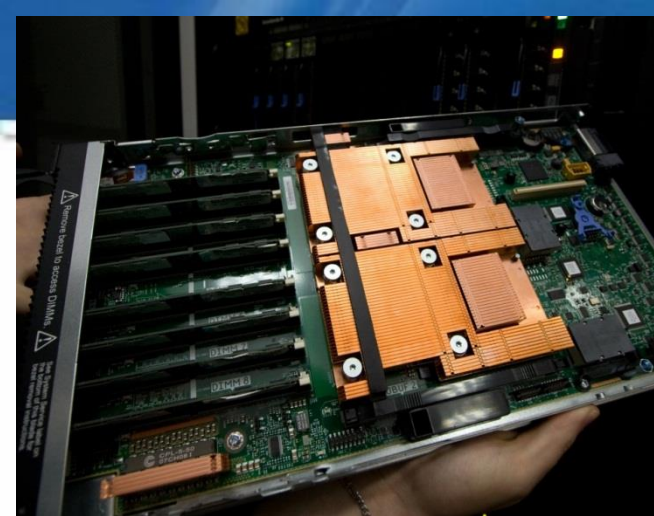
Image Processing & Computer
Graphics

Expert and multi-agent
systems



CTI / DPETI





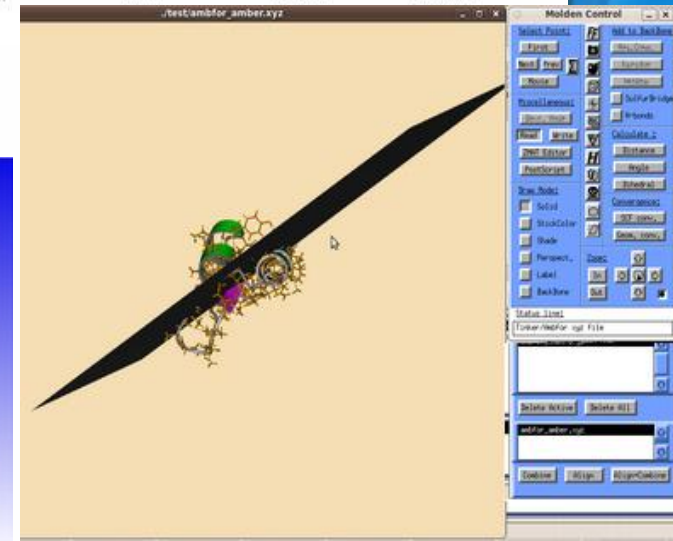
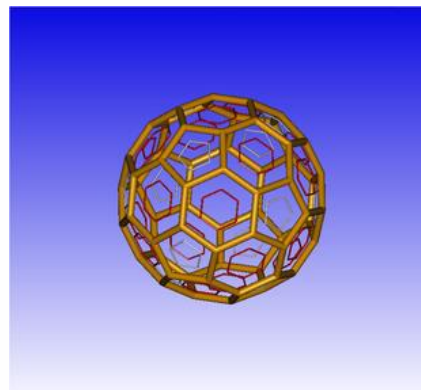
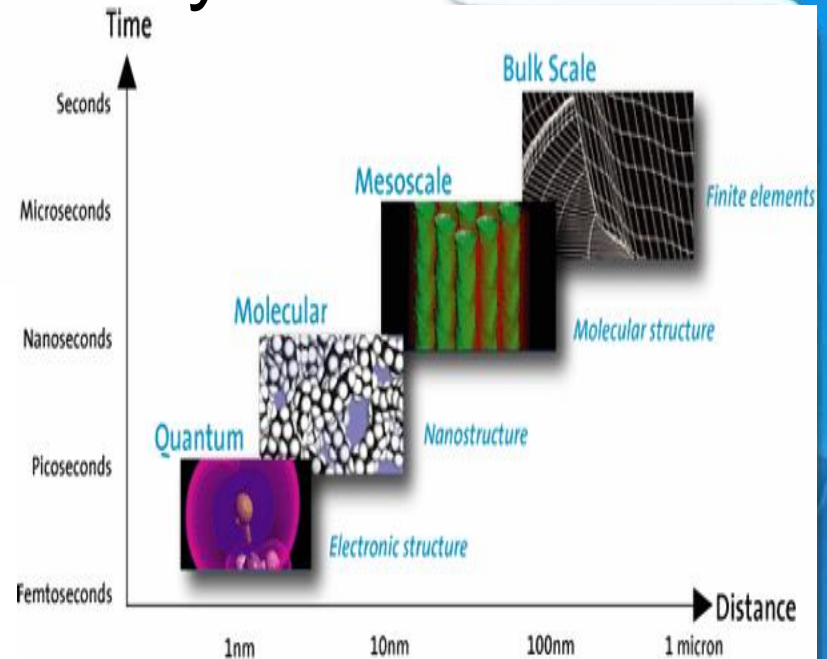
UPB





Computational Chemistry

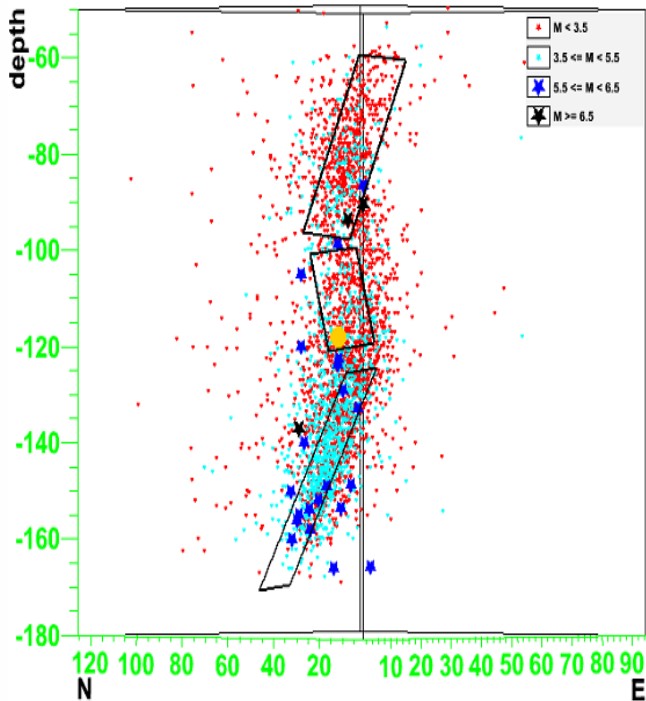
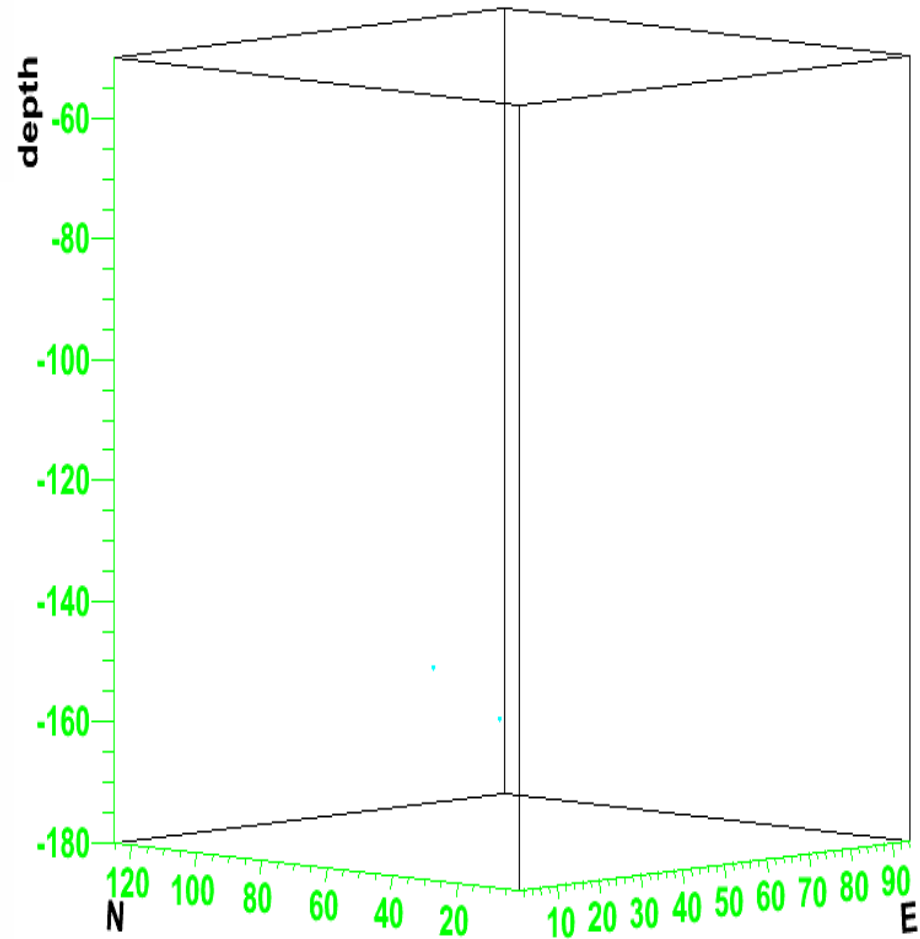
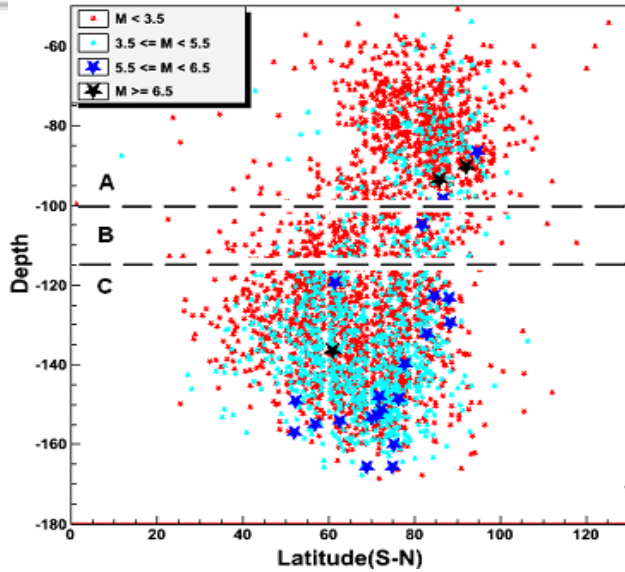
- Paramagnetic materials simulation
 - OpenMP CS parallelization:
Speedup 8.3x on 8 procs – **superlinear** due to improved cache performance
- GAMESS
 - MPI parallelization
- MOPAC
 - Parallelization scheme for modern multi-core architectures
- NAMD / GROMACS / Gaussian / CPMD
 - Scale to production systems





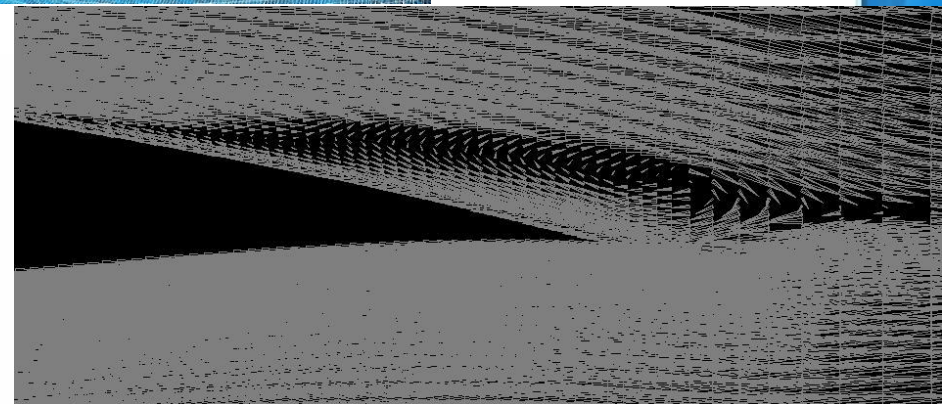
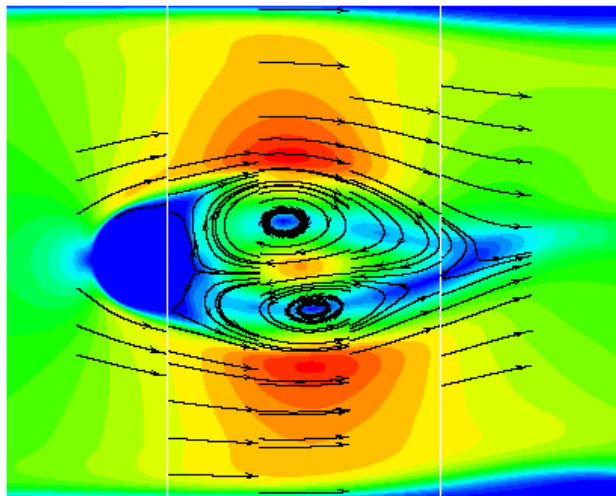
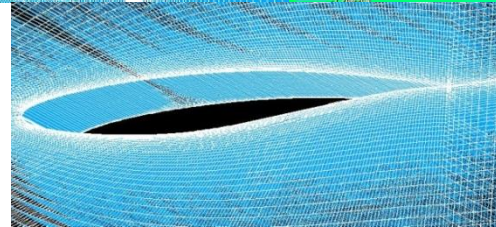
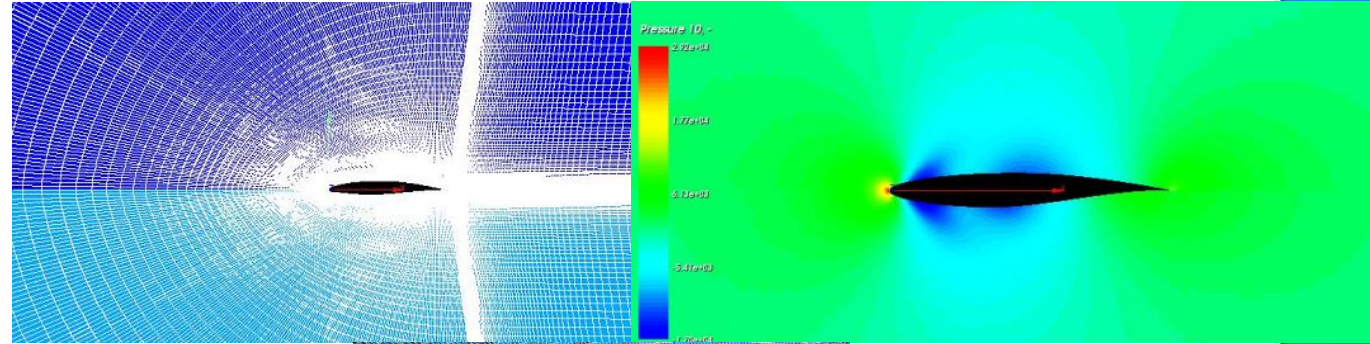
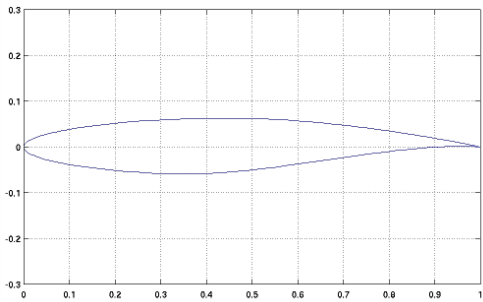
Seismology

1/1974 - 6/1974





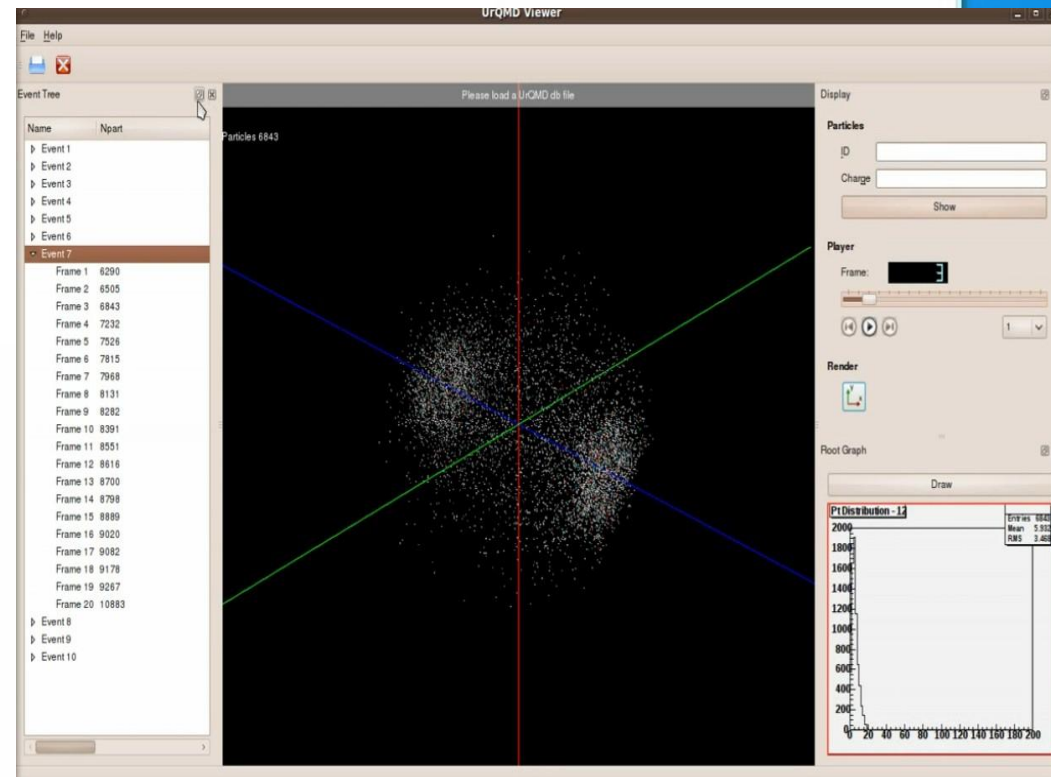
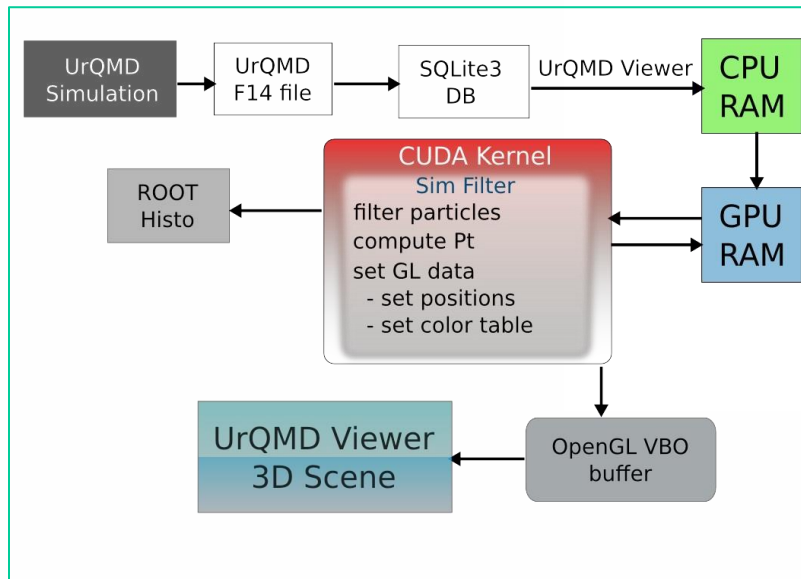
Modeling and Simulation of Aerodynamic Phenomena





Computational Physics using GPU Computing

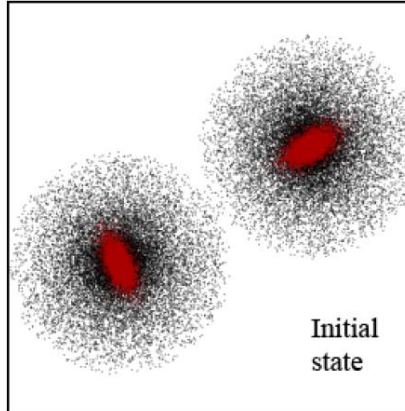
Online 3D analysis of elementary particles generated from UrQMD simulations (Ultra relativistic Quantum Molecular Dynamics)



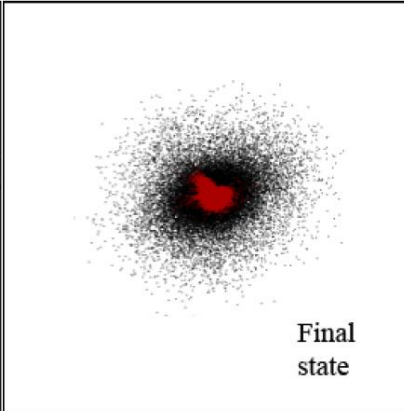
CERN, FAIR-GSI



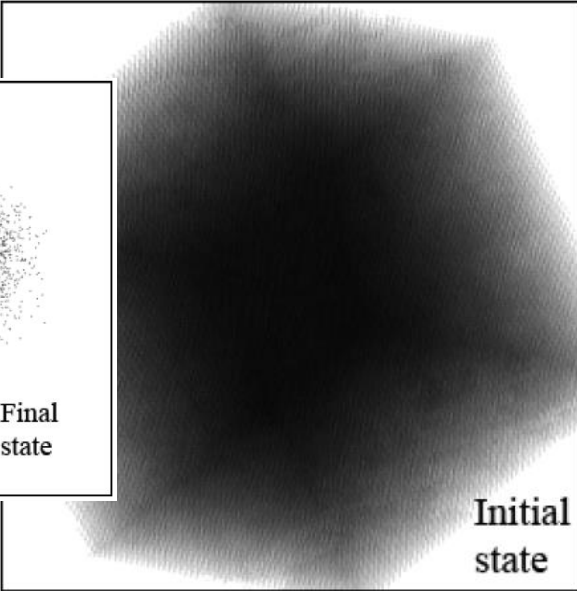
Astrophysics



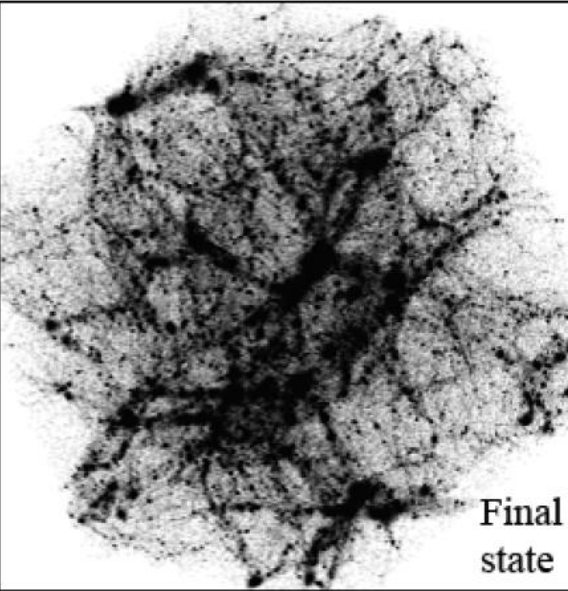
Initial state



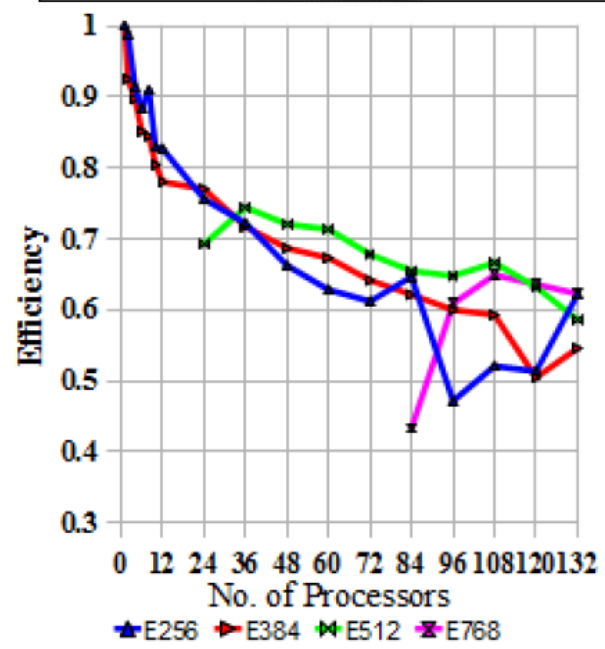
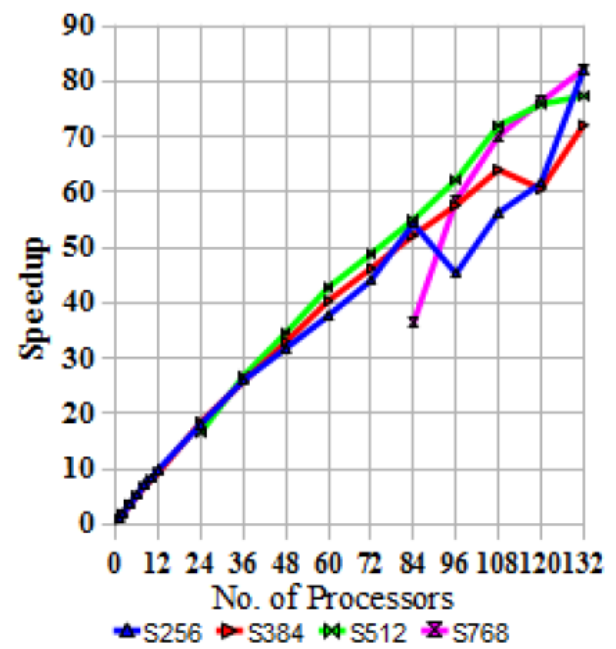
Final state

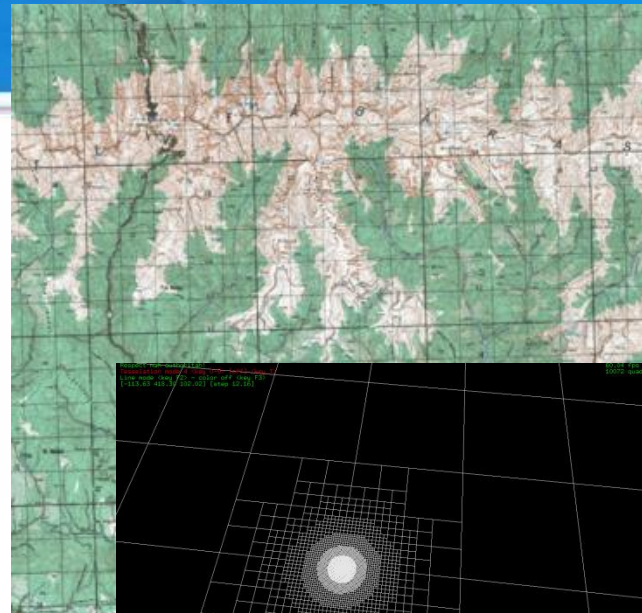
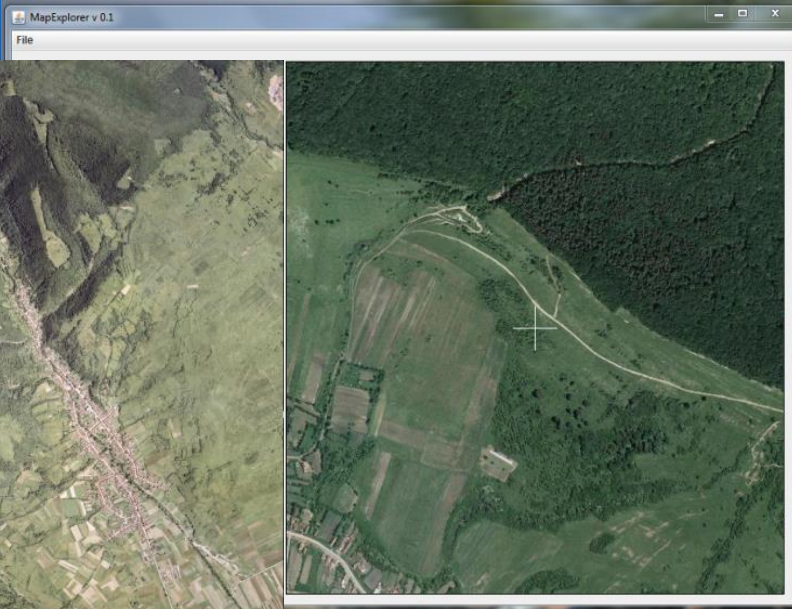


Initial state

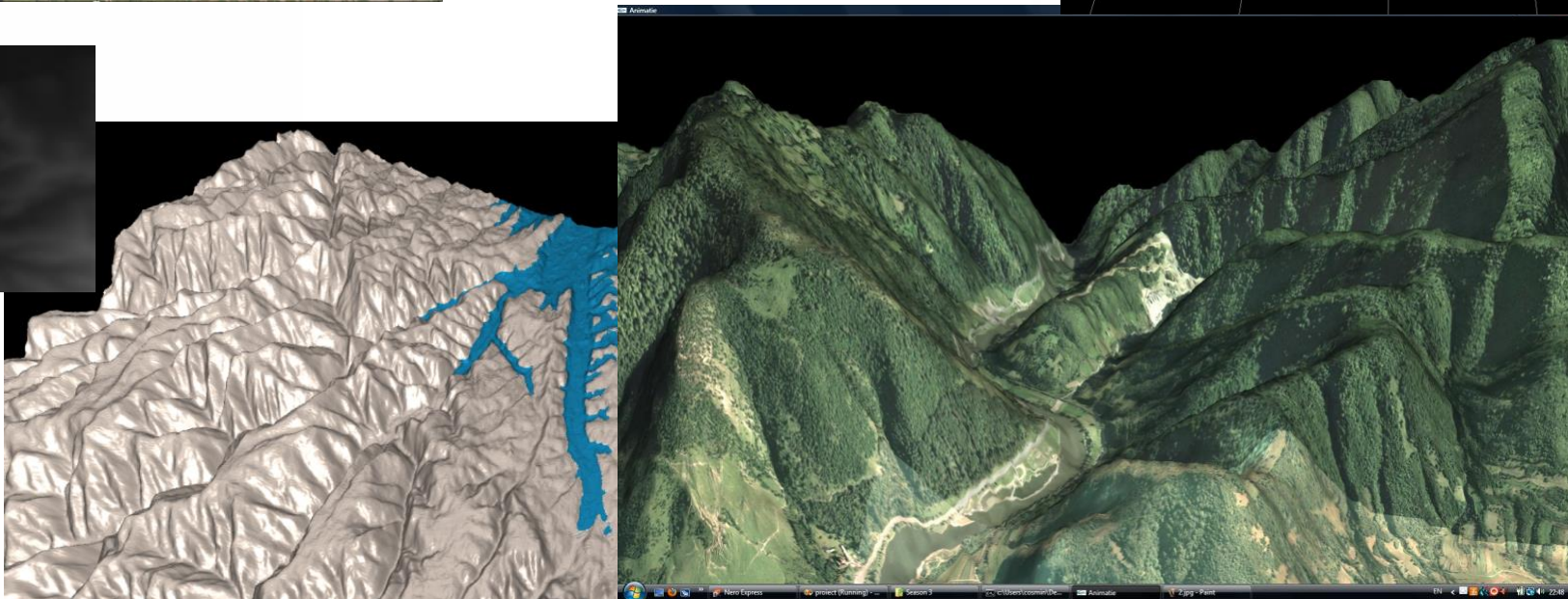


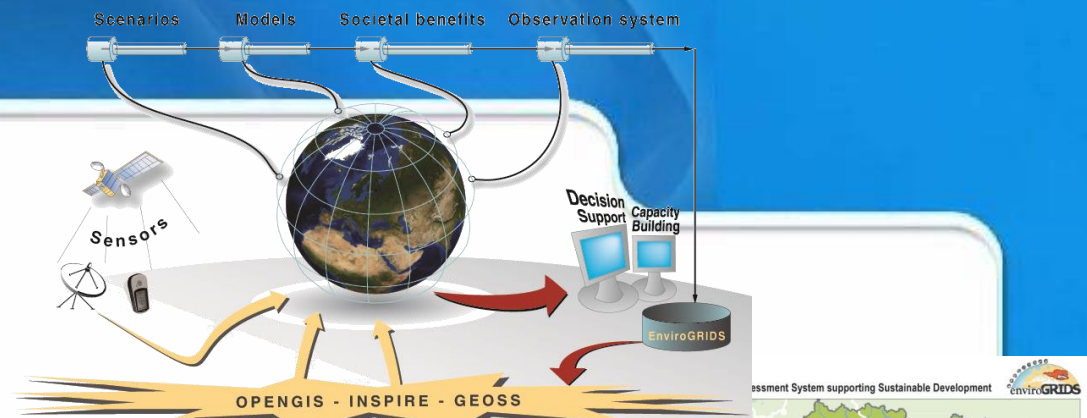
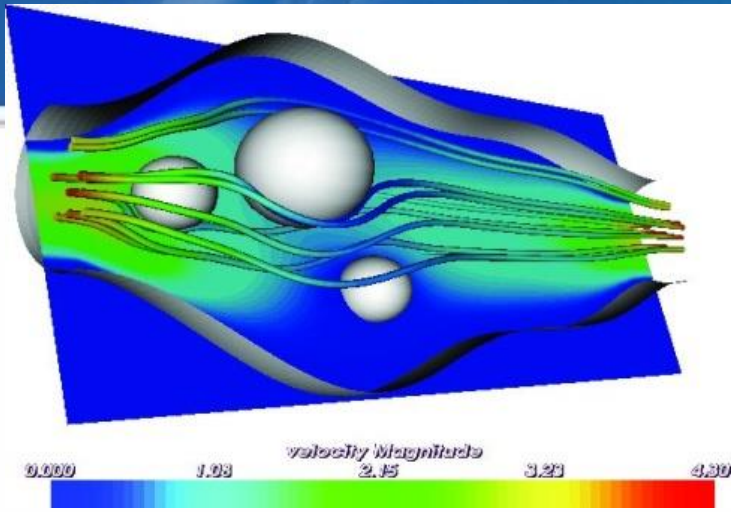
Final state



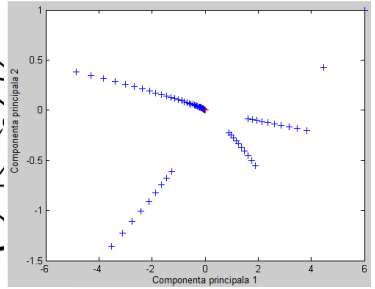
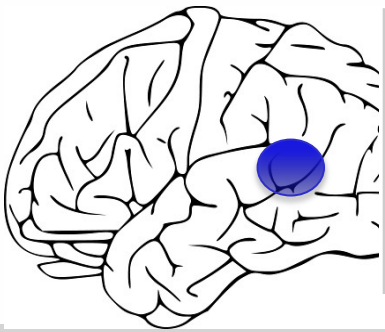
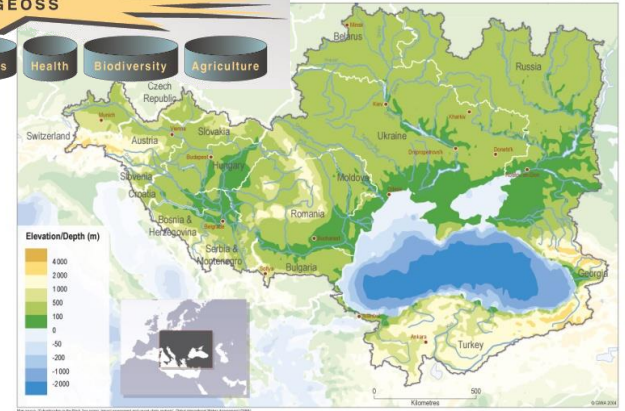


3D Romania





- Energy
- Disasters
- Climate
- Water
- Weather
- Ecosystems
- Health
- Biodiversity
- Agriculture



CFD
Climatology

Neuroscience

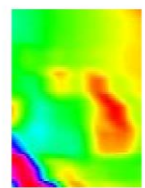
Processing information

Processing ID: 895

Last refresh: 5 September 2009, 15:00:47 (refresh every 50 seconds)

Change refresh time: 50 seconds

description	Node name	Start server time	End server time	Status	Options
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result6.tif	30_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:00:14	DONE	
result7.tif	27_FineToCoarse	2009-09-05 14:53:26			
result6.tif	24_FineToCoarse	2009-09-05 14:53:26			
result4.tif	18_FineToCoarse	2009-09-05 14:53:26			
result5.tif	21_FineToCoarse	2009-09-05 14:53:26			
result3.tif	15_FineToCoarse	2009-09-05 14:53:26			
result2.tif	12_FineToCoarse	2009-09-05 14:53:26			
result1.tif	9_FineToCoarse	2009-09-05 14:53:26			
result10.tif	3_FineToCoarse	2009-09-05 14:53:26			
result0.tif	6_FineToCoarse	2009-09-05 14:53:26			



SlideShow: January 1961 - January 1961

Image title: 1961, January

Node name: 21_FineToCoarse

File name: 04082544-0073-42ff-9181-56722b4452b0\FineToCoarse_21_435.jpg

Start processing time: 2009-09-05 14:54:12

End processing time: 2009-09-05 14:57:33

SlideShow image position: 1 / 7

<< Prev Pause Next >>

Simulation Explorer View

X-Axis: 0.0 1.0 2.0 3.0 4.0

Y-Axis: 0.0 1.0 2.0 3.0

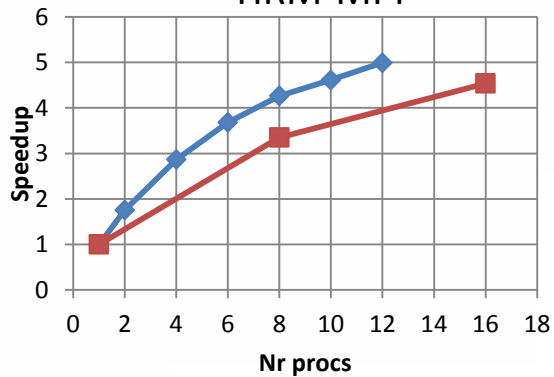
Z-Axis: 0.0 1.0 2.0 3.0



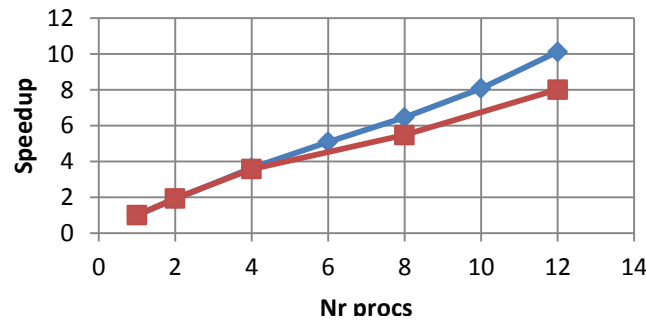


Weather Prediction Models

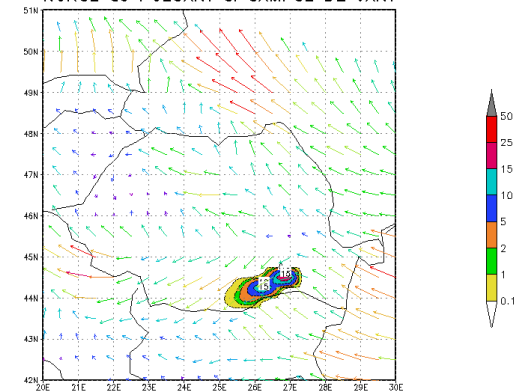
Quad vs Opteron for HRM-MPI



Quad vs Opteron for COSMO-MPI

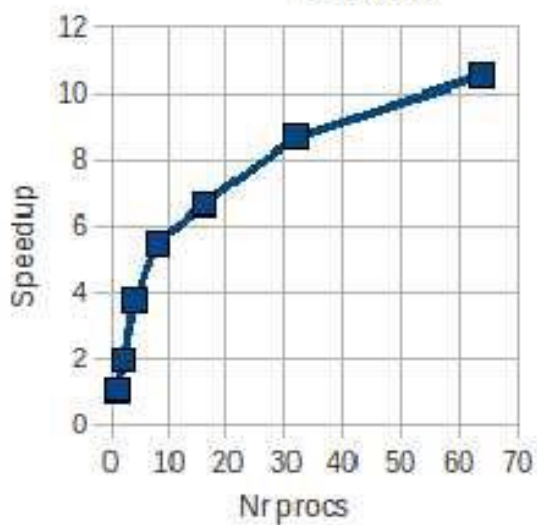


NORUL de POLUANT si CAMPUL DE VANT Date de vant din 18Z14JAN2008

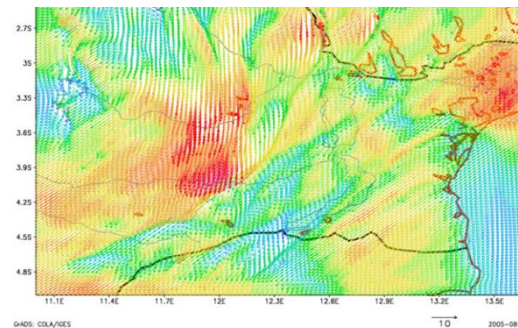
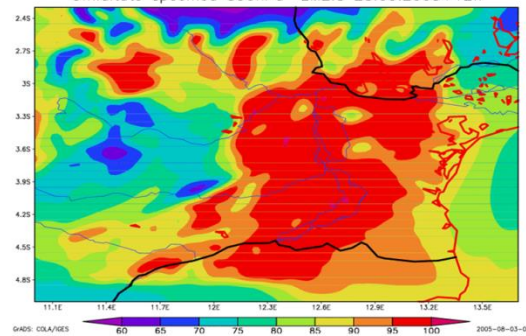


Prognoza narului de poluant la 24h Administratia Nationala de Meteorologie

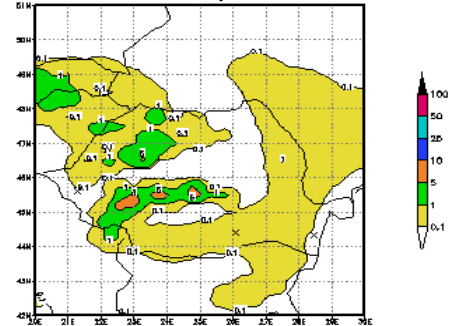
COSMO scalability



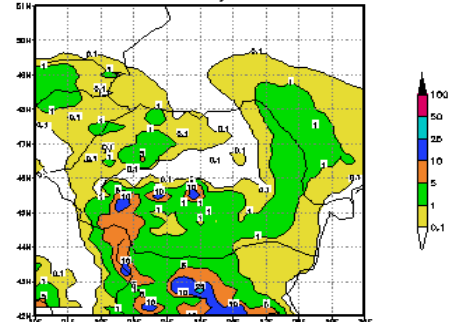
Umiditate specifica 850hPa LM2.8 28.05.2005+12h



HRM Precipitatie totala/24h (78-54) BASE 00Z14JAN2008+7Bore/VALD 06Z17JAN2008



HRM Precipitatie totala cumulata/78h BASE 00Z14JAN2008+7Bore/VALD 06Z17JAN2008



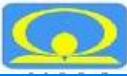


HPSC Related Lectures & Training

- HPC Summer school:
 - First Edition was in 2004
 - From 2008 the main focus is on developing HPC Applications using architectures with multicore processors
- Undergraduate Lectures:
 - Parallel Computing Algorithms and Data Structures, (Parallel) Computer Systems Architecture, Distributed Programming Languages
- Graduate Lectures:
 - Distributed Systems, Cluster & Grid Computing, High Performance Computing – Numerical Methods and Programming Techniques, Distributed Algorithms
- Extra-curricular training:
 - IBM (Cell) & Intel Multi-core Programming for Academia – 2007
 - Intel Parallelism Faculty – 2009
 - IBM BlueGene Programming – 2010
 - NVidia CUDA Programming – 2012

Acknowledgements

- **ANM** – Agentia Nationala de Meteorologie: Rodica Dumitrache, Cosmin Barbu, Doina Banciu, Victor Pescaru
- **IFIN-HH / INCD** – Fizica si Inginerie Nucleara “Horia Hulubei”: Mihnea Dulea, Octavian Carbutar, Ionut Vasile, Dragos Ciobanu-Zabet
- **INFP** – Institutul National de Fizica Pamantului: Mircea Radulian, Constantin Ionescu
- **Unibuc** – Universitatea din Bucuresti: Dan Mihailescu, Marian Ivan, Gh. Stefanescu
- **UTCB** – Universitatea Tehnica de Constructii Bucuresti: Alexandru Aldea, Cristian Ghindea
- **INCAS** – Institutul National de Cercetari Aerospatiale: Catalin Nae, Victor Mihai Pricop, Marius Gabriel Cojocaru, Claudiu Vadean
- **ICF** – Institutul de Chimie Fizica al Academiei Romane: Viorel Chihai, Gabriel Munteanu
- **AIRA** – Institutul Astronomic al Academiei Romane: Marian Suran, Dumitru Pricopi
- **UPB-IA** – Universitatea Politehnica Bucuresti, Facultatea de Inginerie Aerospatiale: Marius Stoia-Djeska
- **UPB-CS** – Universitatea Politehnica Bucuresti, Facultatea de Automatica si Calculatoare: Nicolae Tapus, Emil Slusanschi, Alexandru Herisanu, Razvan Dobre
- **UTCN** - Universitatea Tehnica din Cluj-Napoca: Dorian Gorgan, Rodica Potolea, Ioan Muntean, Marius Joldos
- **ISS** - Institutul de Stiinte Spatiale: Sorin Zgura, Mihai Niculescu





Thank you for your attention

Q & A

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