

Our Computer cluster is formed from three functional components.

- The computing cluster that is responsible with the calculations, and it's equipped with 1344 computing cores. The equivalent of approximative 700 new laptop computers.
- The visualization cluster, responsible with the parallel display of the data on a wall of screens mounted as shown in the picture.
- The GeoWall, is a way to present the results to a larger audience. It consists from a 3d TV, with glasses, connected to a PC as a secondary display. Using this hardware in combination with specific software, the presenter will be able to display it's work in a new exciting way.

High Performance Computing Cluster



- 5 Air-cooled Racks
- 28 Dell Power Edge R815 compute nodes
- 2 Dell Power Edge R715 master nodes
- 40Gb/s Infiniband QDR Qlogic interconnect
- 40 TB Panasas storage unit
- 2.9 TB RAM
- Operating System: Linux CentOS

This is our main processing unit, 30 Computers distributed in 5 air-cooled racks. The master nodes are configured in fail-over mode, which means that if one server is malfunctioning, the second is taking over automatically. The heart of the cluster is the Infiniband switch, capable to transfer 40 Gigabits per second. This speed is reflected directly in ability of the supercomputer to do the calculations faster. The 40 Terra Bytes Panasas unit is useful to store the large data files resulted from the runs. The Linux operating system is used to glue all the hardware together, and what we “see” when we work with it is a single linux box.

Compute nodes



- Dell Power Edge R815
- 4 CPU x 12 AMD Opteron™ 6172 @ 2.01 GHz Cores
- 96 GB RAM
- 500 GB Seagate HDD

The 28 compute nodes are all identical, each has the equivalent computing power of 24 “usual” laptops. The 500 GB HDD is used only to store the operating system and temporary files. Also the high amount of RAM is useful for the calculations.



Master nodes

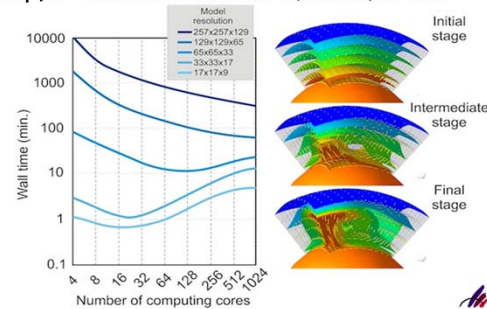
- Dell Power Edge R715
- 2 CPU x 12 AMD Opteron™ 6174 @ 2.20 GHz Cores
- 64GB RAM
- 500 GB Seagate HDD

The master node manages the scheduling system, that assigns the jobs to the “worker” nodes. Also it’s monitoring the entire system for malfunctions. It’s a bit slower than worker nodes, containing the computing power of only 12 usual laptops.

HPCC performance

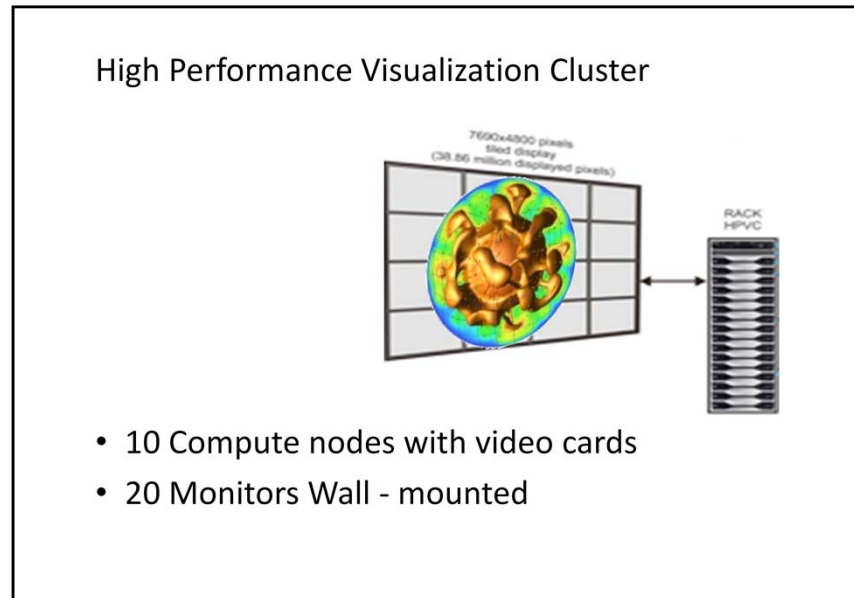
- HP Linpack test
 - Theoretical 12 TFlop/s
 - Achieved 7.8 TFlop/s - would have been in the top 100 of year 2005

- CitcomS tests

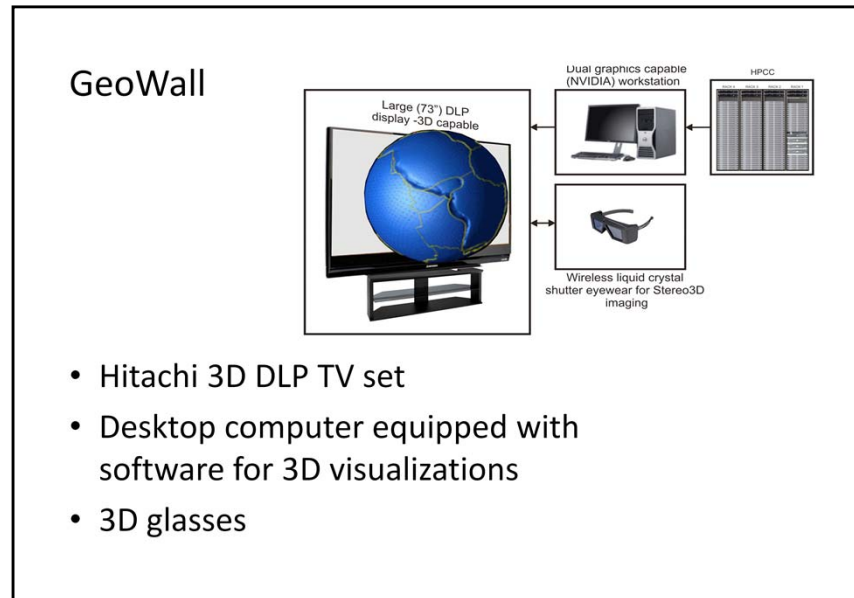


We put the system to some speed-tests.

- The Linpack test is a standard speed test used to rank supercomputers. From the time took to compute a series of matrix transformations, results the speed in Floating Point operations per second. With seven point eight terraflops our computer would have made the top 100, actually top 50 list, of year 2005 (two thousand and five). Now probably is situated somewhere on rank 3000.
- Below is a part from a research we did in order to find the optimal resolution of the CitcomS models capable of being run on Cyberdyn supercomputer. We used the same mantle convection model with different resolutions, and we plotted the time took to solve the problem against the number of cores used to solve it. The color of the curves represent the complexity of the model, the higher the complexity, the darker the line. It shows that when using a large amount of computing cores, the time required to solve a complex problem could decrease from several days to hours. You can see in the right images that represent the different stages of the model. In the second and third stage you can see the convection onset. Plots were drawn with openDX

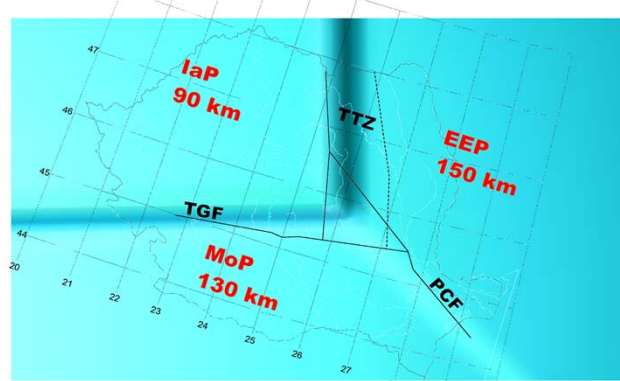


The visualization cluster is designed to be a subset of the “main” computing cluster. As such, a third of the nodes have video cards capable to operate two monitors. The models seen by their authors on this wall of monitors will be examined in greater detail, and this will help improve them.



Another way to look at the models is through the 3D glasses. This is a system designed for conferences and student sessions. Hopefully the new technology will be attractive to the younger audience.

Case-study regarding seismic Vrancea zone

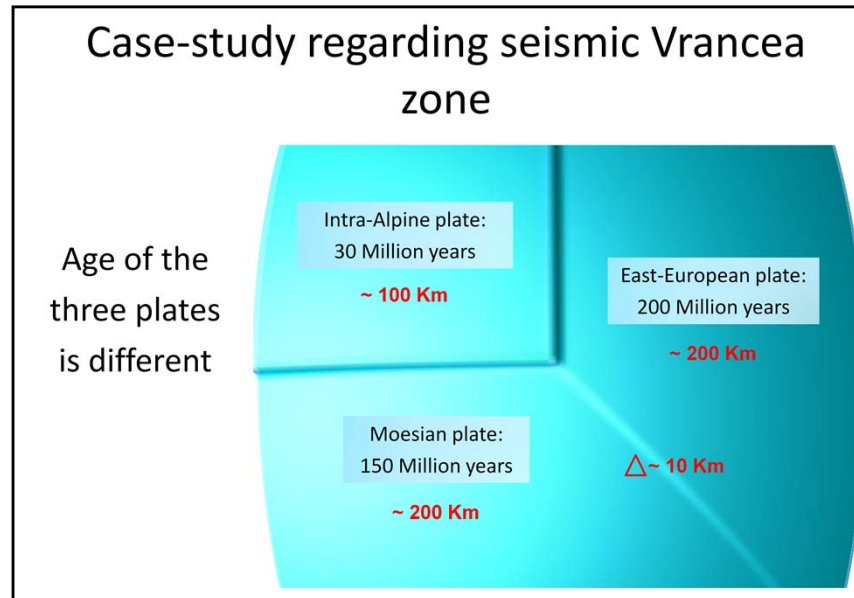


Construct a model with three lithospheric compartments similar with Vrancea area

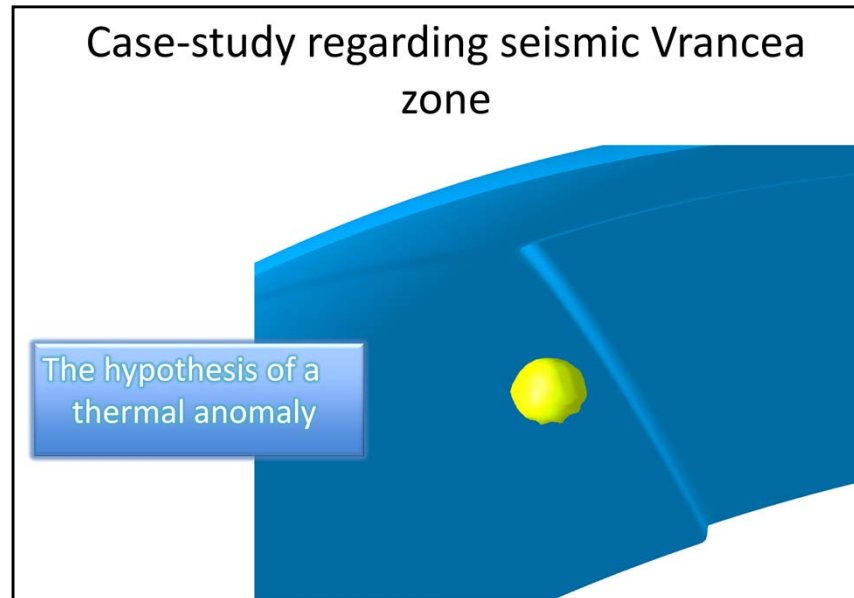
We began to study the Vrancea seismic zone, with constructing a model to recreate the plates meeting in that area. Here we see the correspondence between the model and the three plates:

- East European Plate – one hundred and fifty kilometers
- Moesian Plate – one hundred and thirty kilometers
- Intra-Alpine Plate - ninety kilometers

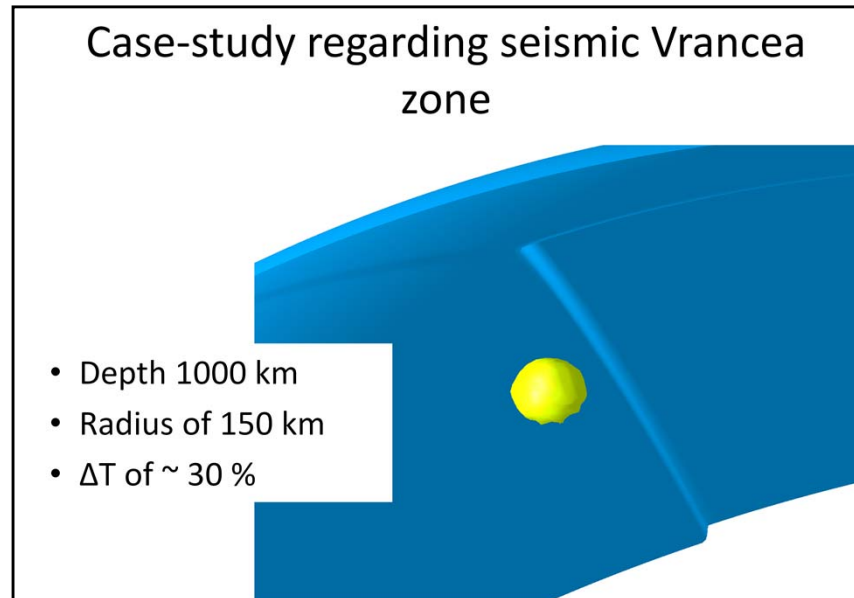
And also the thicknesses of the plates.



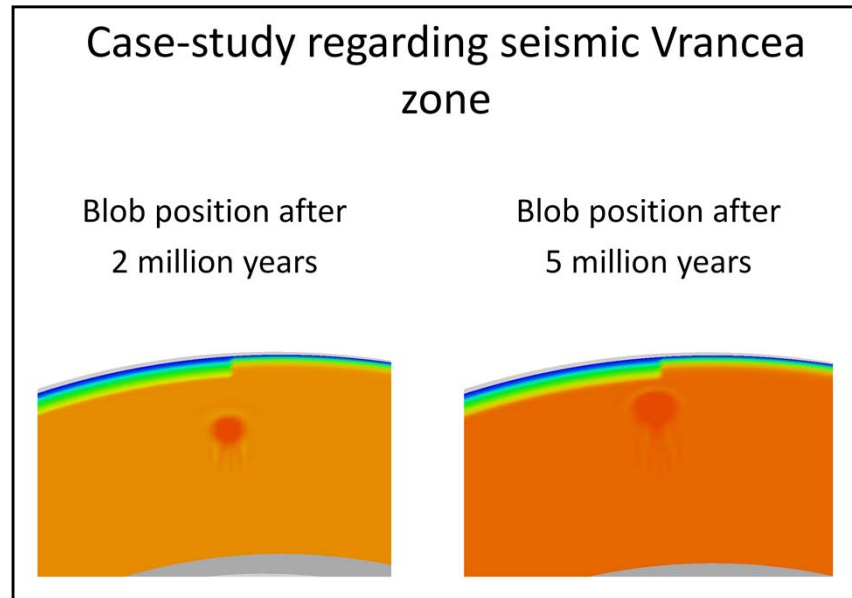
To emulate the difference in thickness we set different ages of the lithospheric compartments. Here we see the resulted approximate thickness from the modeled age difference. This is a preliminary version, we have to refine the model.



We considered a case with a thermal anomaly. The causes that would produce the anomaly could be many, one of them might be the heat resulted from the iron core convection.



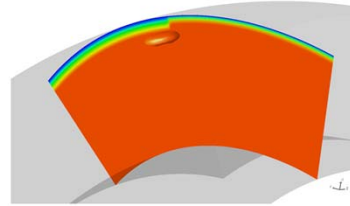
This is the setup for the anomaly, we also placed the anomaly right down the point where the three plates meet (a triple junction).



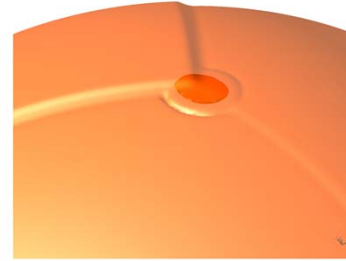
Here we see first steps of the evolution of the thermal anomaly. The model considers that the mantle has constant (not depth dependent) temperature. We see that the heat dissipates from the blob to the entire model.

Case-study regarding seismic Vrancea zone

Blob position after
10 million years

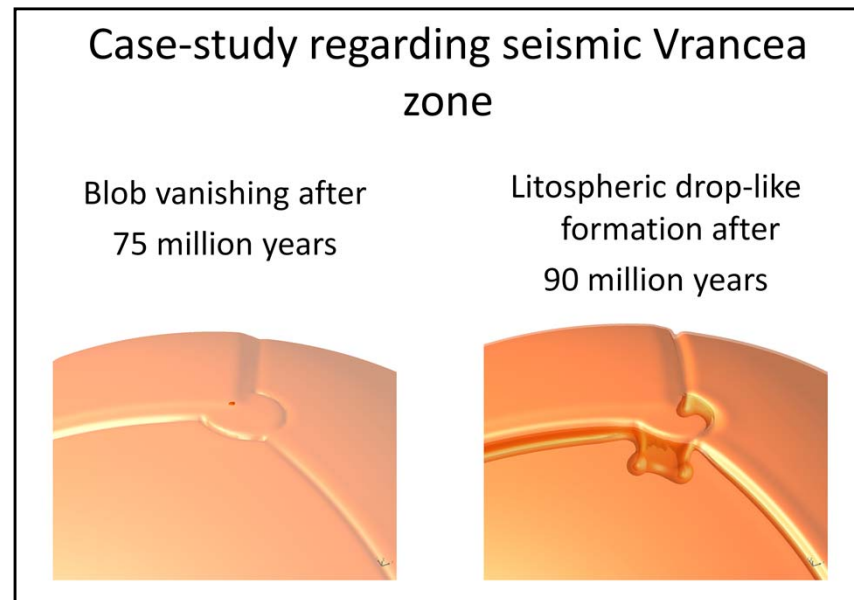


Blob position after
55 million years



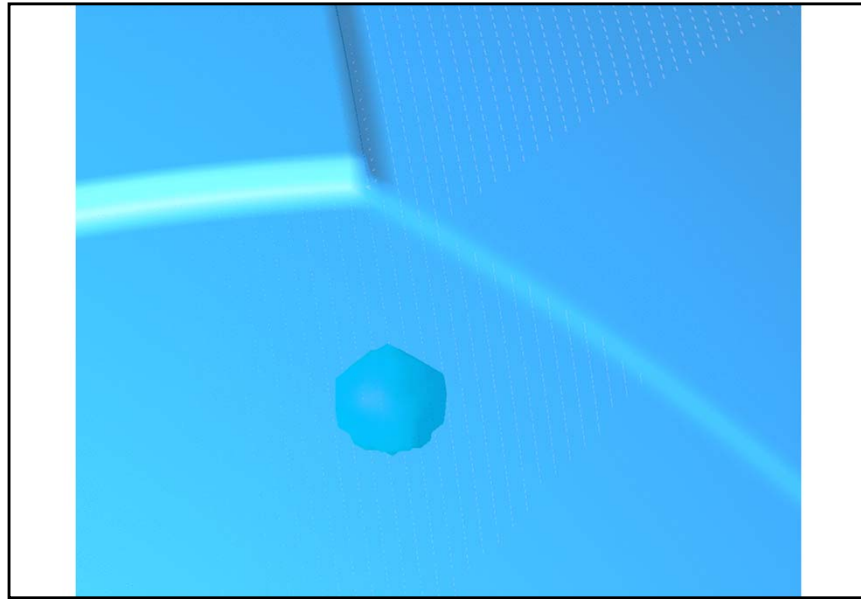
After 10 Million years the blob is risen to the bottom of the lithosphere. I switched from 2D because the color palette doesn't allow anymore to show the evolution of the anomaly.

After 55 Million years the changes of the lithosphere are visible, a colder formation is growing downwards.



At 75 million years, after another 20 Million years, (picture to the left) the colder layer advances, and the thermal anomaly dissipates all the heat.

In the picture to the right, we see the end of the simulation after 90 Million years. A drop-like formation formed. These are relative isotherms and the difference between the two isosurfaces depicted would be around 60 degrees Kelvin.



Here is a animation. It depicts what happens with the isotherms, from start to end. It is not very accurate in terms of velocity of the evolution but provides a glance at the kinematics of the model.