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Overview

Overview of Presentation:
- Introduction
- Seismology VO Specific Info (Seismology Data)
- Applications
- Current: Statistical Seismology Science Gateway (SCIBUS Project)
SEE-GRID-SCI: Development of virtual organizations, applications and services for earth science on grid e-Infrastructures for South Eastern Europe

SEE-GRID-SCI was coordinated by GRNET/Greece 2008-2010
Introduction to Seismology VO

- Construction of highways, bridges, dams and factories, Insurance premiums, Renovation of risky structures, Construction standards
- Emergency response after earthquakes

- Insurance companies, Municipalities, Governmental Institutes, Civil engineering, Seismology / Earthquake Departments in Universities

- Knowledge workers, Engineers, Researchers

- Decision Support Systems Software

- Massive Seismology Data and Computational Power

- Grid (e-Science Platform for Seismology)

- Many Users

- Software Costs, Realistic Models

- Interested Organizations

- Investments worth billions of euros

- Construction of highways, bridges, dams and factories, Insurance premiums, Renovation of risky structures, Construction standards
- Emergency response after earthquakes
Main Objectives, Approaches and Motivation for the Grid

- Gridify useful seismology applications
- Serve regional historical seismic data provided by partner national seismology centres using a high level interface that is easy to use/adapt.
- Collaborate with other seismology related organizations (ORFEUS, EMSC) and provide high level interface to data collections of these organizations
- Avoid duplicate work and contribute complementary work:
- Seismology VO added value:
  - The grid platform
  - Performance aspects – (HPC, high performance access to massive data)
  - High-level user friendly interface to data – no need to:
    - learn a lot of new tools
    - write data location dependent code
    - modify existing applications drastically
    - learn web services programming when accessing NERIES and EMSC
Introduction to Seismology VO

Applications

Programming Tool (Data Iterators)

Distributed storage and indexing of data on grid using AMGA

- Earthquake and seismic waveform data
  - SEE Country 1
- Earthquake and seismic waveform data
  - SEE Country 2
- Earthquake and seismic waveform data
  - SEE Country n
- NERIES/ORFEUS Datacenter
- EMSC Datacenter

European Countries
<table>
<thead>
<tr>
<th>Size of Continuous Waveform Data</th>
<th>3.3 TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of stations</td>
<td>93</td>
</tr>
</tbody>
</table>
Seismology VO Main Achievements

- Massive regional seismic data collected and made available to VO users
- Diverse set of seismology applications deployed
- Special care was taken to develop high level tools that are easy to use by seismologists
- Successful collaboration and use of JRA1 applications services (SDSAS, AWT, PGRADE)
- Extensive use of grid services mainly for storage (AMGA, LFC)
- Successful international collaborations (e.g. with ORFEUS/NERIES)

Scientific dissemination output:
- Newsletter articles: 1
- Posters: 8
- Presentations: 4
- Training Events: 3
- Conference /User Forum Papers: 10
- Journal Articles: 3
Seismic Risk Assessment - SRA

Main Developer: Cevat Şener, Middle East Tech. Univ., Turkey

Description
- A framework that allows embedding of assessment models and produces seismic hazard maps for the SEE region
- Useful for determination of earthquake insurance premiums

Objectives
- Gridify the SRA application and provide P-GRADE Portal platform based interface.

Motivation for the Grid
- Data intensive
- Can also be compute intensive depending on parameters.

Regional collaborators and their roles
- Collaborate on developing testing: Geophysical Institute of BAS (BG)
- Collaborate on developing models/testing: Inst. of Geo. and Seismo. of ASM (MD)
- Collaborate by supplying data and SDSAS: Boğaziçi University (TR)
Seismic Risk Assessment – SRA

- Application Architecture
  - SRA uses JRA1 SDSAS and P-GRADE Portal.
  - AMGA is used to store results

- Results / Refereed Publications
  - 4th EGEE User Forum Poster Presentation, Catania, Sicily, Italy (March 2009)
  - Seismic Hazard Assessment for Turkey: A GRID-Based Approach", (to be submitted soon to Computational Geosciences Journal).
Earthquake Location Finding - ELF

Main Developer: Mehmet Yılmazer, Boğaziçi University, Turkey

Description
- A HYPO71 based application that finds earthquake locations and magnitudes from continuous waveform data files reported by stations.
- After an earthquake, the location of an earthquake needs to be reported to various authorities for necessary actions to be taken.

Objectives
- Gridify by partitioning stations among the worker nodes and expressing the application as a parallel JDL workflow.

Motivation for the Grid
- Reads waveform files from many stations.
- Not computational intensive but data intensive.
- Parallel file access by utilizing multiple pathways of network can improve performance.

Regional collaborators and their roles
- Collaboration in usage: METU – TR, Armenia
- Collaboration by data supplying: U. of Ss Cyril and Methodius (MK)
Earthquake Location Finding - ELF

- Application Architecture
  - Application uses continuous waveform data archived by the JRA1 SDSAS
  - Results are stored in AMGA tables that can be visualized using SDS web interface

- Results/Refereed Publications
Massive Digital Seismological Signal Processing with the Wavelet Analysis- MDSSP-WA

- **Main Developer:** Ljupco Jordanovski, U. of Ss Cyril and Methodius (MK)

- **Description**
  - Computes various earthquake parameters needed in seismic hazard and risk analysis
  - Does mapping of the given earthquake prone regions in terms selected parameters

- **Objectives**
  - Application will be parallelized by making use of a workflow toolkit

- **Motivation for the Grid**
  - Application is compute intensive and take several hours. Parallelization will speed it up
  - Application will be able to use data provided by other countries

- **Regional collaborators and their roles**
  - Supply data via SDSAS : Boğaziçi University (TR)
  - Exch. of various data/parameters/research results: Geophysical Inst. of BAS (BG)
  - Exch. of various data/parameters/research results : Seismological Survey of Serbia (RS)
  - Various studies of Valandovo, Strumica and Skopje regions : Institute of Geodesy, BAS (BG)
Massive Digital Seismological Signal Processing with the Wavelet Analysis- MDSSP-WA

- Geomagnetic field/data/research: Inst. Nuclear Res. & Nuclear Energy, BAS (BG)

Application Architecture
- Uses JRA1 SDSAS, ULMON, Work Binder and AWT

Results/Refereed Publications
- Poster Presentations at the Annual Meeting of the NERIES Project, Utrech, the Netherlands (June 29-July 1, 2009)
Fault Plane Solution - FPS

- **Main Developer:** Mehmet Yılmazer, Boğaziçi University, Turkey
- **Description**
  - Computes source parameters and moment magnitude of an earthquake
  - Inputs a crust model and actual seismic waveform data.
  - Outputs fault parameters of the earthquake.
  - Results obtained can help in risk analysis
- **Objectives**
  - Parallelize the application by expressing the application as a parallel workflow.
- **Motivation for the Grid**
  - This application is computational intensive. Therefore, parallelization will speed-up the application.
- **Regional collaborators and their roles**
  - Computer and Automation Res. Inst. (SZTAKI) of HAS (HU) is helping in the development of a workflow and PGRADE port for the application.
Fault Plane Solution - FPS

Application Architecture
- Uses continuous waveform data archived by the JRA1 SDSAS
- Parallelized by JDL workflows
- PGRADE version was also developed

Results / Refereed Publications
  - Earth Science Informatics
  - VOAS Journal special issue
Main Developer: Bálint Süle, Hungarian Academy of Sciences, Hungary

Description
- Provides model of the thermal convection in the Earth's mantle
- Solves numerically the equations of thermal convection
- The mantle convection is the driving force of the plate tectonics
- Results will help us to understand better the dynamics of the Earth

Objectives
- Port to the grid as a Parameter Study application

Motivation for the Grid
- Computational intensive application
- Can be parallelized easily using the P-GRADE Portal

Regional collaborators and their roles
- Collaboration in testing of the application and interpretation of the results: Boğaziçi University (TR)
**Application Architecture**

- The gridification process included developing a specialized web interface extension to P-GRADE Portal, specifically tailored for the application's needs.
- An interface suitable for this was developed using the Application Specific Module of P-GRADE Portal 2.7.

**Results achieved / Refereed Publications**

- 4th EGEE User Forum Poster Presentation, Catania, Sicily, Italy (March 2009)
- Earth Science Informatics Journal VOAS special issue
Seismic Data Server SDS web interface

Main Developer: Can Özturan, Boğaziçi University, Turkey

Description
- Web interface to seismic data archive organized by the JRA1 SDSAS
- Let the users visually display various kinds of information about the seismology waveform data files, earthquakes and stations

Objectives
- Present a visual interface (by utilizing Google Earth API browser plug-in) to seismology data

Motivation for the Grid
- This application is useful for disseminating visually seismic data to everyone.

Regional collaborators and their roles
- Collaboration in usage: Ss Cyril and Methodius University of Skopje (MK) METU, (TR), Armenia
Seismic Data Server SDS web interface

- **Application Architecture**
  - Records of seismology data are kept in AMGA server
  - Invokes programs that utilize JRA1 SDSAS to retrieve information about earthquakes, stations and waveform files as a Google kml file and display them in browser window

- **Results /Refereed Publications**
  - Earth Science Informatics Journal VOAS special issue
International Cooperation Activities

- Cooperated with EGEE Earth Science Cluster
  - Participated in EGEE Oct/2008
  - SEE-GRID-SCI ES VOs at the EGEE Earth Science Cluster Workshop Jan/2009
  - EGEE SSC questionnaire Survey to Earth Science, March/2009
  - GEO European Projects Workshop /8, Istanbul Oct./ 2009

- Cooperation with ORFEUS/NERIES
  - Attended ORFEUS Annual Observatory Coordination Meeting, Erice, Italy May 2009
  - Attended the Third Annual Meeting of the NERIES Project, Utrecht, the Netherlands, June 2009
  - Development of SEE-GRID-SCI NERIES client interface
  - As suggested by Torild Van Eck from ORFEUS, SRA developers contacted with:
    - NATO Project "Harmonization of the Seismic Hazard Maps for the Western Balkan Countries" Funded for 2007-2010.
    - EC FP7 Project "SHARE: Seismic Harmonization in Europe" Funded for 2009-2011.
  - A Tutorial on Neries Web services was jointly organized during ISPDC 2010, Istanbul Turkey, July 2010 (http://hasandagi.cmpe.boun.edu.tr/ispdc2010/)

- Cooperated with Earth Science Informatics Journal / Springer to prepare a special issue on “Virtual Organizations and Application Services (VOAS) for Earth Science on Grids” devoted to SEE-GRID-SCI User Forum
As a continuation of the SRA efforts, Statistical Seismology Science Gateway is being developed under the FP7 SCI-BUS project.

Aims to provide the seven foremost statistical seismology functions from “integration of multi-source data” to “statistical calculations for seismic risk” to the international seismology community.

Supports three service levels:
- Simple
  - Via GUI
- Advanced
  - Via Code
- Expert
  - Via Embedded Workflow

Contact
- sss-gateway@sci-bus.eu
Conclusions

- Open access to data is important
- Seismology VO is operational and is supported by TUBITAK ULAKBIM, Turkey
- Current Countries on Seismology VO: Bulgaria, Greece, Georgia, Macedonia, Moldova, Serbia, Turkey
- TUBITAK ULAKBIM is operating Turkish National Science e-Infrastructure (TRUBA), (formerly known as TR-GRID).
- We are eager to participate in future collaborative projects