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Preface

Welcome to the International Workshop on Environmental Applications and Distributed Computing – EADC 2006. The workshop is a two-day combined event where environmental application researchers meet with grid researchers: workshop with invited lectures, plenary discussions, accompanied by induction and grid application developer course, which is in the scope of the MEDIgRID project 2004-2006, FP6-2003-Global-2-004044. The MEDIgRID project addresses the challenge of providing a modular decision support framework for assessing multiple hazards, based on Grid-enabled applications and distributed data architecture.

The topics of the workshop are:

- Grid and Cluster Computing
- Web Distributed Computing
- High Performance Distributed Computing and Large Scale Simulation
- Environmental Modelling, Simulation, and Optimization
- Environmental Risk Assessment, Planning, and Policy Making
- Landscape Analysis, Hydrological and Climatological Studies
- Environmental Pollution, Waste Management
- Remote Sensing and GIS
- Conservation Security (of soil, water, air, energy, plant and animal life)
- Use of Knowledge and Semantics in Environmental Applications and Risk Management

The important goal of the workshop is to pursuit construction of an international grid initiative having in mind the intention to enable a Grid accessible for environmental applications. This could help improve and promote research and development of environmental applications, using advanced grid technology.

The workshop on Environmental Applications and Distributed Computing – EADC 2006 has attracted paper contributions and active participations from numerous countries: Greece, Portugal, Russia, Spain, Sweden, Taiwan, Turkey, UK and Slovakia.

Many people have assisted in the success of this workshop. I would like to thank all members of the Program and Organizing Committees and the workshop Secretariat for their work and assistance in the workshop. I would like to express my gratitude to all authors for contributing their research papers as well as for their participations in the workshop that made our cooperation more fruitful and successful.

Ladislav Hluchý
October 2006
Bratislava, Slovakia

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Invited lecture

CFD and Mesoscale Air Quality Models Integration for Urban Air Quality Applications: Spain Case Study

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Abstract. The increased interest on carring out air quality impact applications in real complex urban environs has increased substantially during the last years. This contribution presents the results of different experiments carried out in Madrid (Spain) with a CFD model (MIMO, University of Karlsruhe, Germany) and the well-known MM5-CMAQ air quality modeling system, which is a representative of the third generation of air quality dispersion models. An adapted version of EMIMO (Technical University of Madrid (UPM), 2003) is used for emission data and finally a cellular automata model (CAMO) is used to describe in detail the complex urban traffic emissions. Different traffic scenarios are used such as normal traffic conditions, decreasing on 30 % the total number of private cars and increasing on 15 % the total number of public buses. The results shows that these tools are providing a considerable level of detail and the results can be used for decision makers on air quality issues.

Keywords: CFD, air quality, MM5, CMAQ, turbulence, fluid dynamics, software tools.

1 Introduction

Considerable interest exists on investigations related to detailed air quality exposure doses in highly dense urban environs in large world cities. The advances on the capability of Computational Fluid Dynamics models and Air Quality Modelling Systems during the last decade have been quite substantial. The increase on computer capabilities and on the knowledge of turbulence parameterization and numerical schemes has also been very important during the last ten years. On the other hand, there is a considerable public interest on information related to the “real” pollution they are exposure on when they are walking in the street going to work or even during the period they are driving a car from/to work or other daily activities. At street level the differences in the concentration values at both sides of a street can be important, particularly, for instance, on relation to photochemical production during

Section 1
HPCN Environmental Modelling and Simulation

Animation of Forest Fire Simulation

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Abstract. New dynamic 3D visualization technique for forest fire spread simulation and fire behaviour modeling is described. It is demonstrated on the reconstruction of a concrete forest fire in the Slovak Paradise National Park in 2000 during which six people died because of extreme fire behaviour. The developed technique utilizes outputs of FARSITE fire simulator tested under Central European conditions using original fuel models developed for forest fire simulation in Slovakia.

Keywords: forest fire simulation, fire behaviour modeling, dynamic 3D visualization, forest fire spread animation

1 Introduction

Every year, forest fires cause enormous damage of vegetation, fauna, environment and property, and block significant human resources. Particularly in national parks and natural reservations, unique areas of high degree of protection can be devastated by fire. For instance, during the destructive forest fire in the Slovak Paradise National Park (Slovakia) in 1976, very unique vegetation was destroyed in the Kyseľ Gorge, where the recovery into the former state will last 200 years [8]. Till now (thirty years after the fire), this locality is closed for tourists because of the vast damages.

Advances in computers and information technologies in the last decades stimulate the development of various useful program systems for fire fighting. Particularly, fire behaviour predicting systems can be directly used for specific purposes of fire management, or they can be included in more complex decision support systems (e.g. pre-suppression planning systems). The fire behaviour predicting systems are capable to simulate the forest fire front growth after the fire detection. They describe not only the spatial and temporal behaviour of forest fires (fire spreading rate and direction), but can quantify and often even display various fire characteristics (e.g. fire intensity, flame length, etc.), which can be useful for the purposes of fire effects analysis. They can be used for simulation of various fire scenarios in a certain region under different conditions to test the fire management response for the fire event (prevention). Most suppression decision support systems are based on fire behaviour prediction and make it possible to test the effectiveness of different types of suppression strategies and tactics, taking into account the existing fire fighting infrastructure and specific

Operational Application of a Decision Support Tool in Fire Management in Portugal

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Abstract. In the scope of a private initiative (Project PREVINFL) from a Portuguese group of companies (COTEC – Enterprise Association for the Innovation) related to Forest Fire Prevention, several decision support systems (DSS) were installed in some of the SNBPC (National Firefighters and Civil Protection Service) decisions centres (CDOS – Rescue Operations District Centre). One of the tools used was a Fire Simulator, developed by ADAI, called FireStation. FireStation is an integrated system that simulates fire spread and wind properties over complex topography. It implements mathematical models that describe fire characteristics such as fire rate of spread, linear intensity, flame length and energy released. Like for other fire simulators, the inputs used describe topography (geometry, slope and orientation), forest fuels (physical characteristics, moisture content and spatial distribution) and wind (velocity and direction). Wind field simulation is based on local (point) measurements taken from meteorological stations or from numerical predictions. FireStation was developed under a graphic interface that makes its use in operational conditions, as well as the interpretation of the results very easy. The main objective of this component of the PREVINFL project was to give assistance in the process of taking decisions by the officers involved in firefighting coordination, during the fire seasons of 2004 and 2005. A description of the fire simulator, FireStation, is given, as well as the main achievements of this component of PREVINFLOR project.

Keywords: Decision Support System; Fire Management; Fire Simulation

1. Introduction

Knowledge of fire behaviour is an important component in fire management decision-making, as it allows managers to predict fire potential with a certain level of confidence. Fire behaviour information can be used in fire management activities

Parallel High Performance Computer Simulations of Eulerian 4D Air Quality Modeling Systems

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Abstract. Progress on performance of different computer platforms has increased substantially during the last decade. Although the speed per processor has progressively approached to its physical limit, the performance by using shared and/or distributed memory platforms has increased substantially the performance of different applications. In parallel, substantial work has had to be done on the consequent parallelization of the different codes to obtain the maximum efficiency on the speed results. Air quality modeling systems have also progress substantially during the last decade. Nowadays, these sophisticated models are complex numerical tools which are parallelized (mostly) and are used in real-time. Air quality forecasting applications require the maximum accuracy, speed and reliability and these features can be reached by using modern shared and distributed memory computer platforms. In this contribution we have used the MM5 mesoscale meteorological model (PSU/NCAR) and the CMAQ air quality dispersion model (EPA) – which are both parallelized – to test the performance on different processors and platforms focusing on the 32/64 bits new platforms. The results show that the potential improvement in speed of the new 64 dual core computer platforms is very high.

Keywords: air pollution, parallel platforms, meteorological modelling.

1 Introduction

There is a substantial demand from the general public, air quality authorities and scientific bodies on producing reliable, robust, quick and efficient air quality forecasting tools which can be used to take measures on pollution reduction in advance to protect the human health and environment. In this contribution we have used the MM5 meteorological mesoscale model developed by Pennsylvania State University (USA) and NCAR (National Centre for Atmospheric Research, USA) [1]. The CMAQ model is the Community Multiscale Air Quality Modelling System

Neural Networks Approach Towards Medico-demographical Factors Investigation

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Abstract. The theoretical outcomes and experimental results of applying of Artificial Neural Networks towards mortality structure examination in Russian Federation are presented in the article. The most influencing Classes of Diseases are selected by sensitivity analysis. It is proved that Neural Network Models appear to be an adequate tool for mortality structure examination. Some interesting results for Males and Females Total Mortality are discussed. Proposed technology can be used for support in decision making in social sphere.

1 Introduction

Rapid technology growth and its numerous real-life applications lead to some contradictory tendencies which appear in demography and ecology. Adequate forecasts of medical and demographical processes are to be of a great importance, as they are necessary as a foundation for environmental risk evaluation and welfare systems planning and are used as a basis of decision-making support systems.

Statistical methods and special indexes represent a traditional tool for demographic forecasting and include such methods as micromodelling, regression analysis, component and variance analysis and some specially evaluated indicators. These methods are being used for a long time, thought they can not be used as an adequate tool for demographic parameters forecasting from the system approach positions.

In accordance with system approach, system of medical and ecological parameters (including demographical parameters) represent a complex system. It is known that a complex system can not be studied with statistical methods as we do not obtain full information about it, its structure and all its connections with environment. Statistical methods construct internal model structure and in case we do not take into account all the factors of such a model, we will not receive an adequate one. Eliminating from or adding factors into the created model also cardinally change it, which would lead to wrong forecasting and wrong decision.

That is why a “black box” principle is applied for analysis of complex systems. In accordance with this principle, we do not know an internal model structure, but we create a model of systems reaction to different

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Section 2
Usage of Knowledge and Semantics in Environmental Applications

Promoting Sustainable Human Settlements and Eco-City Planning Approach: Southeastern Anatolia Region and Southeastern Anatolia Project(GAP) in Turkey As a Case Study

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ABSTRACT

In the recent years, there have been many opportunities flourishing through the development of Turkey. One of these is unvalued rich agricultural and hydro-sources in the Southeastern Anatolia Region. The Southeastern Anatolia Project (GAP), one of the most important projects to develop the remarkable natural resources of the world, is considered as a chance to make use of rich water and agricultural resources of the Southeastern Anatolia Region.

In the recent years, the concept of promoting sustainable human settlements and eco-city planning approach have been included into the GAP Project. And by applying these concepts in real projects caused remarkable results through development of the region.

The aim of this study is analyze the concepts of promoting sustainable human settlements and eco-city planning approach in the GAP Project that has been still processed.

In the first section, the region of Southeastern Anatolia and the GAP Project will be introduced briefly. In the second section, the stages of GAP Project and the project existing will be analyzed. In the third section, the projects and sub-projects used for promoting sustainable human settlements will be introduced.

In the last and fourth section, a series of policies and strategies for providing the process of settlements which is optimal and harmonizes with eco-system will be given.

Keywords: **Promoting Sustainable Human Settlements and Eco-City Planning Approach, Land Use, Southeastern Anatolia Region and Southeastern Anatolia Project(GAP), Regional Development and Human Resources.**

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Workflow-based Flood Forecasting in K-Wf Grid*

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Abstract. In this paper we describe the design, implementation and usage scenarios of the Flood Forecasting Simulation Cascade application of the K-Wf Grid project. The application uses a set of meteorology-related simulations in order to predict possible flood hazard in target areas. The application also takes advantage of several features of K-Wf Grid middleware. Its simulation models are instantiated as grid services, are enacted using K-Wf Grid's workflow management engine, and are accessible through its unified web portal. Its application components are ontologically annotated, which is crucial for any K-Wf Grid application. We also show how the application benefits from various other features of K-Wf Grid middleware, how users can share experience, or access the application through highly customized and domain-specific interfaces, despite the fact that the structure of the web portal interface is unified for all applications. We also describe the development and integration steps of this application into K-Wf Grid middleware.

Keywords: Grid, Web Services, Workflow, Flood, Knowledge.

1 Introduction

Prediction, prevention, and mitigation of natural disasters is an important field of research, and the development of computers, simulations, and information technologies in general in the last ten years has made it an even more relevant topic for IT engineers and scientists. More advanced simulation models, running of global-scale computational grids, enable to predict natural events before they happen. It applies also to prediction of floods.

This paper describes a flood prediction system, based on a cascade of simulation models, and running in a grid environment, using state-of-the-art knowledge management, workflows of loosely-coupled services and sophisticated data management to deliver predictions of possible floods before they can do damage. The following chapter first describes the context in which this flood prediction application runs – the EU IST 6th FP project K-Wf Grid. Then the description of the application itself follows – its architecture, capabilities and potential are described.

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Section 3
Environmental Risk Assessment

Assessment of Radioactive Pollution

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Abstract. IMS Model Suite is a complex software system developed primarily for environmental pollution assessment and prediction of consequences of nuclear accident or radiological emergence. It provides users with a comprehensive set of services (local, regional or continental scale dispersion and deposition modelling, data processing and visualization) as well as outputs (particle trajectories, surface and volume concentrations, calculations of the effective and equivalent doses). The architecture of the system, computational complexity and existing or potential interfaces to other systems and services make this application well suited for the Grid and virtual organization environment.

Keywords: Environmental modelling, environmental risk assessment, large scale simulation.

1 Dispersion Modelling

Earliest modern studies and theories of atmospheric dispersion originate in the first half of the 20th century [1]. The modelling and simulation of the dispersion of the pollutants in the atmosphere as a method of research became more feasible in 1970s with developments in computer area. The importance of this subject increased significantly since Chernobyl accident in 1986. The models of radioactive pollution and the assessment of the accident consequences became essential for the civil protection, planning and crisis management.

MicroStep-MIS develops, deploys and markets monitoring and information systems in the fields of meteorology and radiation monitoring. The product range covers measurement, real-time data collection, data processing, archiving and tools for analysis and decision support. The IMS Model Suite together with the data collection systems, database systems and numeric weather prediction models form a product line for the large scale monitoring and data processing centers.

This paper describes the Lagrangian dispersion model integrated within the IMS Model Suite and the possible gridification of this application[1].

[1] The gridification of the IMS Model Suite is supposed to be performed in cooperation with the Institute of Informatics, Slovak Academy of Sciences within the project "Interactive European Grid" EU 6FP RI-031857 (int.eu.grid).

Modelling Shallow Landslides within the context of a Distributed Framework for Multi-Risk Assessment of Forest Fire Hazards

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Abstract. The MEDIGRID project aims to use distributed GRID technology to integrate natural hazard models, maintained independently at different centres in Europe, into a single system, accessible to users over the internet. As an example, the SHETRAN hydrology, soil erosion and landslide model can receive input from a separate fire propagation model and in turn can provide data to a vegetation regeneration model. The individual models are located at process nodes while data relevant to forest fire impact modelling are provided at data storage nodes. Each node has been fitted with the Globus Toolkit, which provides the shared, specific computing environment required for the system construction. Users access the system through a series of portals and portlets, which provide a personalised interface to the Grid. Integration of the individual models required them to be modified so as to be run remotely over the internet as web services. As the models have different data characteristics, a common data format was created to allow exchange of data between the models. The MEDIGRID system marks an advance in the integration of independently constructed models to provide improved hazard assessment technology.

Key words: Shallow landslides, GRID, Multi-risk Assessment

1 Introduction

It has long been known that forest fires can significantly affect river basin response through their elimination of the hydrological and soil protection functions of the vegetation cover. Impacts can range from increased runoff, flashier runoff and accelerated soil erosion in the short term to increased landslide and debris flow incidence in the longer term (e.g. [13] [16]). Mediterranean-type environments are especially vulnerable to fire and there is interest therefore in the post-fire management of Mediterranean landscapes. However, while there is extensive

Fire Hazard Assessment: Mapping Using Fuzzy Concepts

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Abstract— The processes involved in fire ignition are complex. Hazard indexes generally focus on meteorological ignition and spreading factors, as they are the critical operational point. We consider human and physical factors of fire ignition, to first determine the most relevant factors and then, model their respective contribution to the ignition hazard. Through the means of a fuzzy approach, we try to integrate the knowledge and the opinion of experts. In this study, fuzzy concepts are used to gather the large knowledge accumulated on fires in order to describe ignition mechanisms.

Index Terms— Fire hazard, fuzzy concepts.

Introduction

Fire hazard is a complex phenomenon to model, as it includes physical, meteorological and human factors. The multiplicity of factors and the complexity of the mechanisms are difficult things to model with simple rules. Fire risk assessment is generally computed as an index, mainly based on meteorological data which is considered as the most critical variable for fire ignition and spread. These indexes are reviewed in [1]. The other hazard factors are less considered, even if they are important as well; physical and human factors are also relevant in fire ignitions ([2],[3],[4] and [5]).
Fuzzy concepts ([6]) provide appropriate tools to describe this complex reality and offer a realistic fire hazard assessment. A fuzzy approach conveys knowledge stemming from literature and experts and inserts some uncertainty, some reservations where rich and complex processes or contradictions can be taken into account. Even qualitative data can be introduced in computations to upgrade the knowledge database

This work was supported by the French government in the frame of PAREFEU project.

Land mouvement hazard

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Abstract: Land movements can bring together several phenomena and present different shapes. Indeed, according to several parameters such as for example land origin and type but also volumes involved and movement mechanics, several types of mechanics can be observed.
Several mass movements can be accentuated by fire occurrence due to the destruction of the vegetation ecosystem.

I. Erosion

Erosion is one of the land movements the most prone to being aggravated by fires because when plant cover disappears, it leaves leaves bare soils, whose elements are much more sensitive to transport by runoff water.

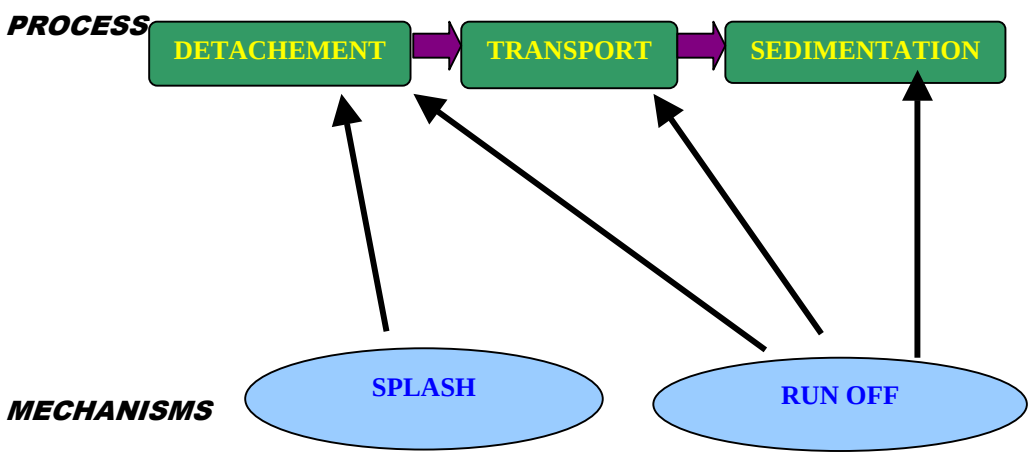

Figure 1. Diagram of the processes and mechanisms of hydric erosion (Source: PERSOONS E. et al, 2002)

Some authors show that the quantity of moved elements (water from run off and sediments) is ten times higher than on a non burned area. The first year after a fire occurrence, this factor is multiplied by 35. On the experimental site of the watershed of Collobrier in the Maures massif which burned in 1990, a 25 % increase of the run off compared to the preceding years can be observed. (PUECH *et al.* 1991 and LAVABRE, 1992).

This increase modified the hydrological cycle. Usually we can differentiate annual floods, ten years occurrence and extreme floods which occur every hundred or thousand years. Nevertheless, after a fire occurrence, we have observed an

Geovisualizations in Medigrid

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Abstract. The visualization of georeferenced data is a challenging task. This paper describes the Visualization Service, a tool for visualizing the simulation results developed as a part of the Medigrid project. After a short overview of the Medigrid project, the most popular mapping engines are compared. In the next part, the architecture of the Visualization Service is described, together with the supported data formats.

Key words: Visualization Service, Medigrid, GIS, MapServer

1 Introduction

Georeferenced data are data that have defined their location in physical space. They are commonly used in the field of GIS and other cartographic applications. Points, lines, polygons, images, 3D structures, raster imagery – all those are examples of data that can be georeferenced.

While the GIS technology has been around for some time, working with georeferenced data is still considered a challenge. The formats used to store georeferenced data are many; the efforts for standardization began taking place only very recently to be mature enough. The need for data format converters is only a simple consequence of this unpleasant situation.

However, despite the awkwardness of working with georeferenced data, many excellent cartographic applications have been developed. These applications serve as the basis for building more advanced systems that use them to provide the users with the exact location of the information the system deals with.

This paper describes Visualization Service, a tool for visualizing the simulation results developed as a part of the Medigrid project. In the beginning, a short overview of the whole project is given. The next parts of the paper describe the Visualization Service, beginning with a comparison of different mapping servers, continuing with a description of supported cartographic data formats, and dealing with the actual architecture of the service at the end.

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Use of remote sensing data and GIS technologies for environmental modeling: The AIRSAT project

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Abstract. The present paper provides information about the rationale and implementation of the AIRSAT application. AIRSAT is an integrated, web-based satellite environmental information system. It provides to users environmental spatial data about meteorological parameters (temperature, humidity, pressure, wind speed, precipitation), atmospheric variables (O_3, NO_2, aerosols), and ocean geophysical variables (chlorophyll, sea surface temperature). Further, it provides online tools for covariance spatial data analysis for the geophysical variables included. AIRSAT thus provides for monitoring and studying the natural ecosystems, with focus on the atmospheric and oceanic environment, using remote sensing data, geographical information systems (GIS) and web databases and interfaces. The data that will be presented in AIRSAT are freely available for public access in internet and derive from various space agencies like ESA, DLR and NASA. AIRSAT, in its current configuration, is focusing on two geographical areas, one over Greece (local scale, with high resolution data) and one over Europe (continental scale, with lower resolution data). In the future, land data

Keywords: Remote sensing, GIS, Environmental Risk Assessment, ESA

1 Introduction

The last two decades, the atmospheric environment of Greece is under study not only in operational level with the creation of monitoring stations in urban and industrial environments for pollutants whose levels are controlled by directives and law, but also with research measurements of non-regulated pollutants from several Universities [1,2,3,4]. According to research of the last five years, transboundary pollution plays a significant role in Greek background concentrations (O_3, SO_2, aerosol) [5,6,7].

Currently, no operational monitoring of the background concentration (i.e. outside of urban and semi-urban locations) of pollutants in country level exists. On the Northern gateway to Greece, emissions from Central Europe and industrial installations in Balkans enter through Thrace. The contribution to local air pollution

Grid-based flood application on EGEE

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In this paper, we present Grid-based system for flood forecasting comprising advanced simulation models (meteorological, hydrological and hydraulic), distributed data and heterogeneous computing resources. Grid technology enables to obtain the computation power needed for numerical modeling, provide infrastructure for secure data management and sharing, and to create collaborative tools that seamlessly connect together the experts, data and computing resources needed for flood forecasting.

1. Introduction

Over the past few years, floods have caused large damages throughout Europe. Therefore, the problem of flood forecasting and prevention has become imminent.

Flood forecasting requires quantitative precipitation forecasts based on the meteorological simulations of different resolution from mesoscale to storm-scale. From the quantitative precipitation forecast, hydrological models are used to determine the discharge from the affected area. Based on this information hydraulic models simulate flow through various river structures to predict the impact of the flood.

In this paper we present a collaborative problem solving environment intended to support a virtual organization for flood forecasting. The system employs the Grid technology to seamlessly interconnect the experts, data and computing resources needed for quick and correct flood management decisions. Main component of the system is a cascade of simulation models used to predict weather, hydrological river status and hydraulic events in flooded areas. The system also includes communication tools, enabling its users to cooperate.

This software was developed as a part of the CROSSGRID project [1], which finished in year 2004. In the EGEE project, the application is ported to EGEE middleware. Whole system is deployed on GILDA testbed and demonstrated during EGEE second review.

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Section 4
Grid and Cluster Computing

Data Management Services and Tools in MEDIgRID project

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Abstract. In this paper we describe grid data management system developed for the MEDIgRID project, which aims to solve several data management problems according to the requirements of environmental risk management community. The MEDIgRID project aims to create a distributed framework for multi-risk assessment of natural disasters. The project integrates in the grid framework models of forest fire behavior and effects, flash floods, erosion and land-slides. In the paper, we describe the requirements on the data management layer that include system heterogeneity, need for fine-grained data access policies and virtualization of distributed data from the users perspective. We present an overview of developed system and describe distinct components of data management layer including data transfer service, data resource management service and virtual directory system.

Introduction

Data management is one of the essential parts of the distributed systems, especially scientific Grids. In recent years, the intensive research and development effort in the field of grid computing enabled creation of production level grid infrastructure for the scientific communities. However, the data management tools and services in production grids are simple and do not reflect needs of many communities with extensive requirements on data organization and data security.

We present problems and challenges posed by MEDIgRID [1] project in the field of data management in grid environment. The MEDIgRID project aims to create a distributed framework for multi-risk assessment of natural disasters. The project integrates in the grid framework models of forest fire behavior and effects, flash floods, erosion and land-slides.

The simulation models have very different requirements in terms of computational performance and platform used. There are both fast and highly demanding sequential models running on Windows and there are fast sequential and demanding MPI parallel models running on Linux. That means that we have to support data and job

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Towards Transparent Distributed Execution in the Tornado Framework

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Abstract. Tornado is a new advanced kernel for modelling and virtual experimentation (*i.e.*, any evaluation of a model) in the water quality domain. Although primarily intended for use within this particular domain, the kernel is generic in nature and has a *plethora* of generally applicable features. Tornado often deals with elaborate models and many of its virtual experiment types are computationally intensive. In order to alleviate the computational burden, there is a strong need for distributed execution. However, since Tornado has a heterogeneous user community consisting of both expert and non-expert users, the distributed execution process should preferably be as transparent as possible. This article focuses on the initial steps that were taken along the road to transparent distributed execution. Main achievement so far is the ability to perform semi-automated distributed execution of workload on the Typhoon cluster and LCG-2 grid infrastructures. Our approach is based on the generation of generic job descriptions and has been shown to offer sufficient transparancy for non-expert users in the scope of a Monte Carlo simulation project that was run on a 16-node Typhoon / 40-node LCG-2 setup.

1 Introduction

In water quality research, the biological and/or chemical quality of water in rivers, sewers and wastewater treatment plants (WWTP) is studied. Research in this domain is facilitated by a number of models that have received a formal or *de facto* standardization status. Most notable are River Water Quality Model No.1 (RWQM1) [1] and the Activated Sludge Model (ASM) series [2].

Water quality models typically consist of large sets of non-linear Ordinary Differential Equations (ODE) and/or Differential-Algebraic Equations (DAE). These equations

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Project DEGREE: Bringing Grid into the Earth Science

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Abstract. Earth Science (ES) community have a big potential to exploit nowadays grid infrastructures like EGEE due to their heavy computational simulations. Several members of ES community created a project called DEGREE (Dissemination and Exploitation of GRids in Earth sciencE) which tries to help other ES application developers and users with using such infrastructures. DEGREE also seeks to address the barriers which stand in the way of a wider uptake of the technology, such as perceived complexity of the middleware, insufficient support for important ES functions and vital additional services. The results will provide feedback to the GRID community and dissemination in the ES community will increase awareness of and involvement with GRID developments. This paper brings an overview of the DEGREE project and its objectives. Other environmental applications can benefit from the roadmap, one of the DEGREE project results.

1 Introduction

DEGREE [1] is a Specific Support Action (SSA) project which aims to promote GRID throughout alarge and diverse Earth Science (ES) community, in order to increase the awareness and uptake of GRID technology and infrastructure by EU Earth Science Industry and Research communities. It aims to do this by developing ES approaches and solutions for using the GRID technology and driving home convincing arguments on the potential benefits for large scale ES processing, e-collaboration and research. Although several Earth Science applications have been ported to run on GRID infrastructures since 2000 ([4], [5], [6], [7], [8], [9]), the experiences gained so far have shown that GRID is a developing technology and the Earth Science community is reluctant to deploy their applications on it. DEGREE seeks to address the barriers which stand in the way of a wider uptake of the technology, such as increasing the ES GRID awareness and expertise, perceived complexity of the middleware, insufficient support for important ES functions and vital additional services.

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Interactive application support in the Int.eu.grid project

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Abstract. The consortium from 13 European countries is trying to improve functionality of Grid by developing and deploying an interoperable production-level e-Infrastructure for demanding interactive applications that will impact the daily work of researchers: distributed parallel (MPI) interactive computing and storage at the tera level, user friendly access through a Grid interactive desktop with powerful visualization, supporting virtual organizations at all levels - setup, collaborative environment, Grid enhancement of applications, execution and monitoring tools, discussion of results.
This paper brings an overview of the Interactive European Grid project and of one of its applications – Decision Support Tool for Environmental Assessment of Climate-Change driven Risks in Landscape.

1 Introduction

The Interactive European Grid (Int.eu.grid) project [1] started on 1 May, 2006 and will last for 24 months. The objective of the project is the deployment of an advanced Grid empowered infrastructure in the European Research Area specifically oriented to support the execution of interactive demanding applications. The consortium involves 13 leading institutions in 7 countries, with significant computing capacity and expertise in Grid technology.

While guaranteeing interoperability with existing large e-Infrastructures like EGEE [2] by providing basic common middleware services, the initiative will exploit the expertise generated by the EU CrossGrid project [3] to provide researchers an interactive and simultaneous access to large distributed facilities through a friendly interface with powerful visualization.

The Int.eu.grid project, while interoperable with EGEE, will focus on interactive use for medicine, environment, physics and other research areas (from robotics to archeology) where demanding interactive applications that can benefit from being grid-enhanced have been identified.

2 Project infrastructure

Grid infrastructure for the Int.eu.grid project will be based on Grid middleware developed in EGEE project [2] and will be interoperable with EGEE infrastruc-

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GRID DATA POOLING

Exploitation of the Grid System for Environmental Applications

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Abstract : The goal of this paper is the introduction to Grid Technology. The Grid is a unified source of distributed resources through a fast network. The Grid supplies its users with a network of computational and storage elements.

Our main goal is to create a single pool of reference for data that has been collected from the Internet that is of use to geoscientists and is available to them in a grid-like way. The catalogue involves items like GTOPO, ETOPO databases and even bigger datasets such as free ozone data. When data is registered to the Grid a unique file name is assigned to it, an lfn (logical file name). The catalogue contains these file names with which Grid users can access the data.

Key words: Grid, data pooling, LCG, EGEE

Introduction

The basic idea behind a Computing Grid architecture is that of the electric power grid; a variety of resources contribute power into a shared "pool" for many consumers to access on an as-needed basis [2]. The Grid concept goes well beyond simple communication between computers and aims ultimately to turn the global network of computers into one vast computational resource. Ultimately, Grid computing is a form of distributed computing that involves coordinating and sharing computing, application, data, storage, or network resources across dynamic and geographically dispersed organizations. The LCG/EGEE Grid is a service for sharing computer power and data storage capacity over the Internet [3].

Although the Grid was designed for the LHC experiment, the largest scientific instrument in the world which will begin operations at CERN in year 2007 and produce data at about 10 Petabytes per year [4]. Its use branches out into every field and science that needs great computing power. Theoretically, the grid can be used in any application that requires a computer, since essentially the grid is a very large computer; due to that it introduces itself over time to many more scientific groups. In reality, the first grid users are those with very demanding applications that cannot be implemented in simple computer systems. So today the Grid is being used in High Energy Physics, Astronomy, Biomedicine, Chemistry, Environmental Sciences and so on. Scientists form collaborating communities called Virtual Organizations, also

Calibration of Distributed Rainfall-Runoff Model with Genetic Algorithms and Shuffled Complex Evolution Approach

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Abstract. Three different automated methods, Shuffled Complex Evolution (SCE), Simple Genetic Algorithms (SGA) and Micro- Genetic Algorithm (μGA) are presented and compared in this study for the calibration of the grid-based distributed rainfall-runoff model (GBDM). The methods have been applied with two different objective/fitness functions for calibrating five historical storm events occurred in Yan-Shui Creek catchment, Taiwan. The results showed the three approaches can get similar simulated hydrograph, and demonstrated all of them are operative in the calibration of GBDM. The results further indicated that SCE is more robust and accurate than SGA and μGA, while μGA converge quicker than the other two approaches. Finally, the results further revealed the simulated hydrograph are affected by objective/fitness functions. The weighted root mean square error (WRMSE) is helpful to reduce the error of peak discharge.

Keywords: Distributed Rainfall-Runoff Model, Global Optimization, Shuffled Complex Evolution, Genetic Algorithms

1 Introduction

Rainfall-runoff models are important tools and have been extensively researched and applied in many water resource projects in the past decades. For example, hydrological forecasting, spillway design, climate change and landuse change effect studies normally need a good rainfall-runoff model to simulate floods resulting from rainfall input to a catchment. Hence, there is a continuing interest in the application of hydrological models to water resource projects and increasing attention to further improve performance of rainfall-runoff models. Besides the structure of the model, the successful performances of rainfall-runoff models significantly depend on the suitable choice of model calibration parameters. The calibration methods have been developed from manual toward automatic approaches since the computers have been widely used. The automatic calibration can be carried out by employing a search or optimization technique and an objective function to fit historical rainfall and runoff records. Some automatic optimization or search method such as downhill simplex method, pattern search, direction set method, and rotating directions (Yapo *et al.*,

Medigrid application portal[1]

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This paper presents the application portal that has been created in the context of the MEDIGRID project. The function of the portal is to provide a common graphical user interface to the grid services deployed in the Medigrid testbed – job submission, data transfer, replica location and metadata catalog – and allow easy interaction with these services. On the other hand it also tries to hide certain complexities of interaction with them by providing intuitive "point and click" interface.

Introduction

The aim of the MEDIGRID project is to create a distributed framework for multi-risk assessment of natural disasters that integrates models of forest fire behavior and effects, flash floods and landslides. The project joins six partners from Slovakia, Greece, Portugal, France, Spain and United Kingdom. It has three pilot areas in Spain, Portugal and France.
In order to achieve the project's aim we had to web-enable the simulation models, create distributed data warehouse containing data describing the pilot areas, fill the data warehouse with actual data, provide a nice user interface to all the services and make all this work in a secure manner.
Of course, we did not implement everything by ourselves. The services implemented are based on the Globus toolkit's [2] implementation of the WSRF standard [3] that in addition to the standard web services interface also provides X.509 certificates based authentication and message encryption and verification. The services are described in [1] together with their integration with Globus' Replica location service and third party metadata catalog [4]. The article [1] also describes the reasons for developing custom data and job services instead of using existing solutions. The portal is built on the Gridsphere [5] portal framework.

In this paper we describe the web based user interface – a MEDIGRID application portal – created in the project to enable easy and centralized interaction with MEDIGRID services. We describe the portal architecture, the portal framework it is

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Tutorial

P-GRADE
Parallel Grid Run-time and Application Development Environment

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Abstract. Over the last decades, by the introduction of massive computing power and advances in information and communication technology, the process of design in engineering and science has been incrementally transformed towards the complex computer modeling and simulations. Grid infrastructures, which support the sharing and coordinated utilizing of miscellaneous resources in dynamic multi-institutional virtual organizations, make possible to carry out very complex and high fidelity simulations of the enormous scope. Such endeavors require development of fully new latency-tolerant algorithms, as well as a new code framework which must be capable of fault tolerant and dynamic reconfiguration in response to rapidly changing computational resource conditions. One hypothetical scenario of the future presents *Problem Solving Environments*, a new approach which can support the entire assortment of development activities ranging from the problem formulation, algorithm selection to simulation execution and solution visualization. Computational portals are one such design. P-GRADE (*Parallel Grid Run-time and Application Development Environment*) provides a unique solution for development and execution of parallel applications on supercomputers, clusters, and Grid systems. It significantly accelerates the re-engineering procedure of sequential and legacy programs for parallel and Grid systems providing easy-to-use solutions even for non-professional programmers.

1 Introduction

Grids [1, 2] are a crucial enabling Information and Communication Technology for meeting the goal of the *Lisbon Strategy* of transforming the EU into the most competitive knowledge-based economy in the world by the 2010. Grid, Peer-to-Peer and other types of networked distributed computing and storage technologies, as well as emerging web-technologies, make it possible to conceive new paradigms exploiting distributed resources (IST Mission [3]).

Over the last decades, by the introduction of massive computing power and advances in information and communication technology, the process of design in

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Lecture

EGEE Grid Infrastructure

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