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CRAFTING AN ENHANCED SEMANTIC GRID IN FLOODFORECASTING SIMULATIONS

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Abstract— During a Decade an advances in computer simulation and high performance computing have highly extended the possibilities in this field. This paved the way to deploy the novelty in natural disaster management system functional work. Herewith, the topic has turned to be more impressive to Researchers in the field of prediction, prevention, or minimization of the impact of natural disaster management. The objective of this paper is to design the proposed evolution system which incorporates the flood prediction application based on grid technologies. In other terms, the proposed system crafted as a unique approach in enhancing the Semantic Grids with the deployment of advanced Techniques.The application consists of a set of simulation models, visualization tools, to support a virtual organization of experts, developers and users. It also highlight the corresponding discovery and composition of services into work flows and semantic tools supporting the users in evaluating the results of the flood simulations. This paper also projects the challenges of the flood-forecasting application and corresponding design relevant to the development of the service-oriented model, based on the well known Web Service Resource Framework (WSRF). Finally, description of enhanced experience management solutions can help in the process of service discovery and user support.

Keywords: Grid services, Semantic Grids, Web Services, Web Service Resource Framework

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INTRODUCTION

Design and development of the service-oriented distributed system is quite common and there are several emerging WS initiatives, which try to automate the process of discovery, composition and invocation of services. As reviewed from numerous journals, some of the reliable open issues are discussed here. They are, A flood prediction system must provide accurate warning measurement to promote confidence. And also Flood-Forecasting systems must be reliable and designed to operate during severe floods. Herewith, Deploying a improved viable Flood-Forecasting system to overhead the Research challenge. The Proposed framework enhanced with a combination of data, forecast methods, tools, as well as trained forecasters. One such example is the Web Service Resource Framework (WSRF) [3], which extends the current WS technologies by modeling the grid services. In this paper focused on design and development of the enhanced Web Service-based Flood-Forecasting system, which can perform very accurate predictions by providing a complex support for the user interactions. In section 1 the paper gives the comparative study of existing grid services. In section 2 will present the process of design and development of the flood-prediction simulation system. In section 3 present the work flow model and mapping the work flow model to the semantic web services . In section 4 Different water flow forecasting and river simulation models and systems are analyzed. It extends heterogeneous data processing, hydro logical models for time scale modeling water flows and Geo-simulation, visualization and duly warning on flooding In section 5 the paper made a discussion of how to integrate the application with other geographical and meteorological tools and standards and the description of the virtual organization of hydro meteorological experts, users, data providers and customers supported by the application ,which are widely adopted and appreciated in the hydro-meteorological community. In section 6 The paper concludes with a proposed system flood-forecasting application scenario demonstrating the benefits of the system and description of related work.

I. LITERATURE STUDY

In the literature, there is a number of papers concerning grid services for flood forecasting application [1][10][12] and a few works correlated to the use of grid technologies and workflows for coping with Geo-science applications [8].Here is the literature study and comparative measures are taken . The Compartive study of all the existing grid services are shown in TABLE 1.1

TABLE 1,1 Compartive study of Existing Services

Grid service	Model	Workflow	Maintenance	Notify
Cross GRID	Series of grid	manual	Hard	No

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	jobs			
KWf-Grid	HSPF& NLC	Abstract workflow	Long running workflows unattended	Notes
WSRF	XML schema	High Level PetriNets	Easy	Done
GIS& Remote sensing	Data cluster, Filter	Data fusion Water depth map	GeoPortal	Done
MOSE	spatio-tempor al data	Graphical web interfacesin P2P	Visual Interface	done

Cross GRID belongs to the first framework supporting on grid environments. It supports the new technical specifications of WSRF and uses a GUI for composing distributed grid applications. The aim of flood animations in the CrossGrid project was to predicate, which parts of the modeled area would be endangered in case of a natural disaster. The most straightforward way of presenting such data is a map.Its application to geo-science problems and natural disaster would require integration with GIS, but it does not supply a dedicated portal and does not provide advanced 3D visualization services. One of the best-known workflow-based graphical problem solving is MOSE[7][5][4], permitting Grid jobs and Web services to be run. It supplies peer-to-peer services (also comprising bindings for web services) and a visual interface permits a user to run complex grid workflows. The GEO Grid project [2] integrates data, computing services and archives earth observation satellite for building an infrastructure to support the task of Global Earth Observation. The system permits one to cope with global problems such as environment conservation, natural disaster prevention and resource exploration. GEO Grid joins standard technologies such as OGSA (Open Grid Services Architecture), web service interface, and GSI (Grid Security Infrastructure) for secure, OWS-4 (OGC Web Services) enables the design of complex geoscience applications by means of BPEL [WS-BPEL] workflow based on the Open Geospatial Consortium (OGC) services. The OGC is an international, nonprofit making, voluntary organization that develops standards for geospatial and location based services. However, it does not provide any database mechanism, In particular for Web databases, which isfundamental owing to the large scale of Internet.

II. Flood Forecasting Simulations

Flood-forecasting application aims at providing current and accurate predictions of the water level and possible flood scenarios for the given river basin or its part. The Semantic Services Grid in Flood Forecasting 449 grid-based model of the forecasts for the basins of the major Slovak rivers was successfully developed and deployed during the project Cross-GRID. Christo Ananth et al. [6] discussed about Reconstruction of Objects with VSN. By this object reconstruction with feature distribution scheme, efficient processing has to be done on the images received from nodes to reconstruct the image and respond to user query. Object matching methods form the foundation of many state- of-the-art algorithms. Therefore, this feature distribution scheme can be directly applied to several state-of- the-art matching methods with little or no adaptation. The future challenge lies in mapping state-of-the-art matching and reconstruction methods to such a distributed framework. The reconstructed scenes can be converted into a video file format to be displayed as a video, when the user submits the query. This work can be brought into real time by implementing the code on the server side/mobile phone and communicate with several nodes to collect images/objects. This work can be tested in real time with user query results.This schema is also used in the K-Wf Grid project[14], where it is further expanded with work flow management and knowledge management tools. A sample work flow showing all the stages of the flood-forecasting is shown in Figure 2

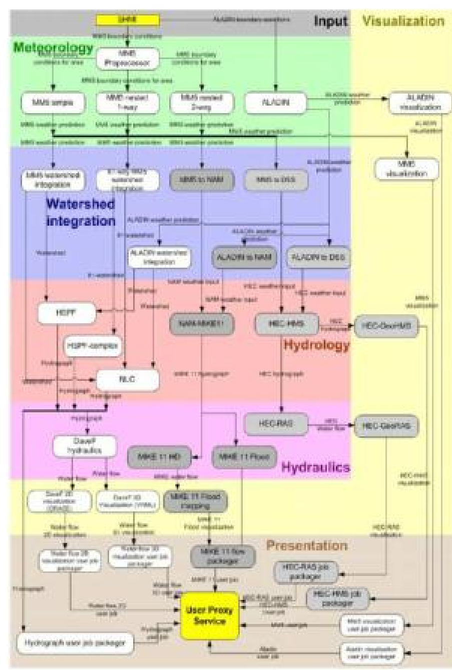

Fig. 2: Service-based flood prediction application.

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A. Pitfals

Although the model has provided many innovative ideas, it has also introduced new problems and obstacles:

- The model was based on the series of grid jobs, which were hard to maintain and with growing number of methods the complexity of inter-connections due to the heterogeneity of the methods has become an issue
- The user had to compose and run the work flow manually without the possibility to store the work flows or re-use the work flows run by other users. Such feature is quite important since many flood-forecasting work flows have the tendency to be repeated many times to get many different possible scenarios, which can then be evaluated and integrated.
- Although the model introduced a portal-based user interface, it was very complex and users were many times confused with the large number of different options
- There was no notification mechanism, which would allow the users to interact with long running work flows and take decisions during the run time of the work flow. There was also no possibility to discuss the results of the work flows and suggest new ideas for the future runs.

B. Knowledge-Based Grid Computing in K-Wf Grid

The idea of the project K-Wf Grid is based in the observation, that users often have to learn not only how to use the grid, but also how to best take advantage of its components, how to avoid problems caused by faulty middleware, application modules and the inherent dynamic behavior of the grid infrastructure as a whole. This result is then further processed in the Hydrology stage, where two models – HSPF and NLC compute river levels for selected geographical points. These levels are then used to model water flow in the last, Hydraulic stage of the application. Concurrently all important results are optionally visualized, packaged and displayed to the user – if he/she requires it. Apart from the simulation models, preprocessor and associated tools, the data flow contains also several job packagers and a User Proxy Service. Additionally, with the coming era of resources virtualized as web and grid services, dynamic virtual organizations and widespread resource sharing, the variables that are to be taken into account are increasing in number

C. Need of webservices

- The semi-automatic composition of the services is enabled by the semantic description of the grid services, which is created and maintained by the Grid Organizational Memory (GOM) and supporting tools
- When parts of the workflow are ready to be executed on the Computing Grid, GWES asks the Scheduler for the optimal resource, due to some user-defined metrics. Then,the corresponding Web Service operation is invoked remotely on the Grid middleware using WSRF protocols.

III. SEMANTIC DESCRIPTION OF GRID SERVICES

WS-Resource Framework (WSRF) is a set of specifications, which are based on the concept of modeling state as statewide resource and codify the relationship between Web Services (WS) and statewide resource in terms of a set of conventions on current (i.e. stateless) WS technologies [13].OWL-S is an ontology-based approach to the semantic web services [11]. The structure of the ontology consists of a service profile for advertising and discovering services, a process model which supports composition of services, and a service grounding, which associates profile and process concepts with underlying service interfaces A statewide resource is defined as having specific state data expressible as an XML document and a well defined life-cycle. It can be acted upon by one or more statewide services, e.g. files in a file system or rows in a relational database are considered a state wide resource .Semantic description of user context and experience allows the system to determine similarity and relations among different contexts experienced by other users.This is the domain of the knowledge and experience management [9], where such functionality is defined as a capability to collect lessons from the past.

A. Workflow

Since workflow do not rely on the single service, but on the set of services, it is necessary to describe the application in terms of the work flow, which represents a control and data flow of the corresponding services. Web services have relied on the work flow model based on the High-level Petri Nets, which allows to compute the output tokens of a transition from the input tokens . Service operations are represented as transitions as shown in Figure 3. Each service operation is represented by the transition Ti, denoted by a thick vertical line. The variables of the formal parameters are represented as input, output places, Piin, Piout, shown as empty circles. Each place can hold a number of tokens, which represent the data items of the parameters. The input and output parameters of the operation are shown as input and output edge expressions, respectively. The paper can describe the complex work-flows by connecting the output places of one transition with input places of another transition. Additionally, it is possible to introduce more complex conditions to realize standard control flow structures such as conditions and loops. All of the mentioned concepts and relations are defined in the form of an XML-Schema as Grid Workflow Description Language (GWorkflowDL). Detailed description of the GWorkflowDL

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and High-level Petri Nets is beyond the scope of this document and can be found in [16].

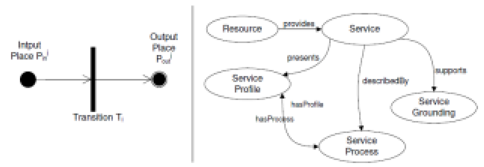

Fig. 3. Schema of the workflow model (left). Basic concepts of the OWL-S ontology (right)

IV FLOOD MONITORING AND FORECASING SYSTEMS

The real-time flood monitoring and forecasting system is developed within the above described approach and is based on the integrated use of ground-based and aerospace data. The system allows operational forecasting of the river water levels, discharges and inundation areas, and provides prior notification of the citizens on emergency situations at the GeoPortal and/or by using mobile devices.

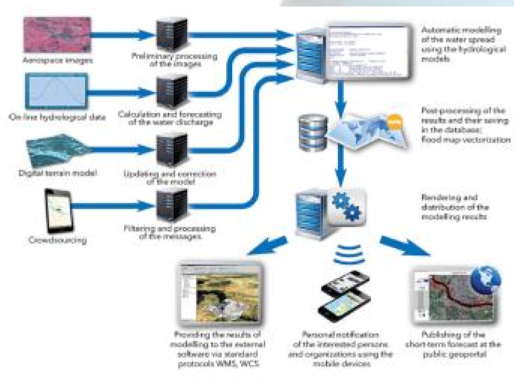

Fig 4.Flood monitoring and forecasting system

The system operates automatically and provides flood forecasts over 48 h ahead with hourly outlines of the potential flooded zones and objects and a water depth map, both available via standard protocols WMS, WCS. A high-resolution digital elevation model is required to provide a high accuracy of flood forecasts as shown in figure 4. Visualisation of the modelling results in 2D and 3D modes is performed. The flood forecasting results are provided as a web service on a remote basis. The modelling and forecasting results are automatically presented at the GeoPortal where data and information are continuously updated and available on-line for the end users.The users of the system are not required specific knowledge in modelling and simulation or programming skills.

A. *Virtual organization of Flood Forecasting*

The scheme of the virtual organization as shown in figure 5

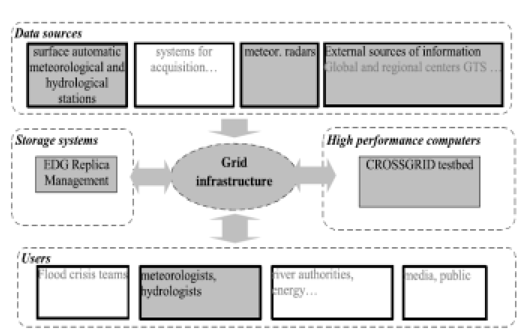

Fig. 1. Virtual organization for flood forecasting – architecture

Fig:5 Virtual organization for flood forecasting –architecture.

is responsible for supplying initial boundary conditions for the meteorological simulation (these come from an external source) and for radar measurements.Cycle providers to ensure interoperability with other grid testbeds. Storage providers – the storage space for computation output is provided by the Institute of Informatics of the Slovak Academy of Sciences (II SAS) Temporary storage space needed to locally store input and immediate ouput data for running simulations will be provided by testbed contributors, whose processing facilities will be used.Users – there are several groups of users in the Virtual Organization (VO) include-meteorological and hydro logical experts, developers and end users. Experts – the system will be used solely by meteorological and hydro logical experts from the SHMI and by trained staff from II SAS. These experts will provide configuration parameters for the simulations and they will decide which simulations need to be executed.

V METEROLOGICAL DATA MODELING

River flood monitoring and control require measurement and notification of the water level, velocity, and precipitation. Input data for precipitation forecast are meteorological data and weather forecasts as the most important components of a flood fore-casting and early warning system [10,12]. In practice, river flood forecasting is based on mining historical data and specific domain knowledge to deliver more accurate flood forecasts. Effective flood monitoring and control use space and ground-observed data received from satellites and terrestrial (meteorological, automatic rain gauge, and climatological) stations. These data maybe represented as images, terrain information, and environmental information, i.e., soil type, drainage network, catchment area, rainfall, and hydrology data.

A. *hydrological modeling*

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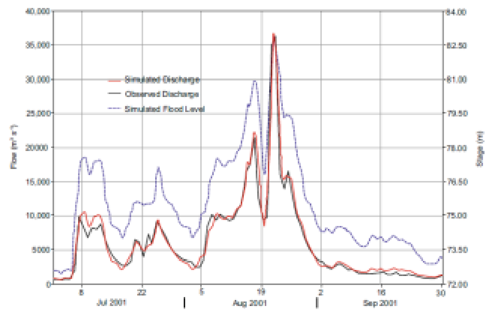
Real-time flood forecasting was given by continuous simulation of flood hydrographs using the real-time hydrometeorological data of the 2010 flood season. Subsequently, simulated discharges were compared with the field observed discharges at Perur and Koida at Godavari basin. Computed and observed flood hydrograph at Koida, the final outlet of the study area, is shown in Figure 5



Observed and computed flood hydrographs at Perur, Godavari Basin, India (2001)

stations that the model could not take into account. The model is more than 90 percent accurate in computing discharges when there is no floodplain inundation. The difference between the observed flood event time and simulated flood event time was less than two hours.

Flood forecast lead time is increased by 12 hours compared to the present conventional method. Due to the hydrological modelling technique, accuracy in discharge computations is improved. As the gauge-discharge function (relation) data is fed into the model for Perur and Koida Stations, the model can forecast the flood levels along with the discharges at these stations. Flood discharge at any river confluence can also be computed. This will help in forecasting flood discharges at intermediate river junctions. Discharge in any sub basin of the study area can be predicated separately with the adoption of this hydrological modelling approach.

B.Grid-based problem solving environment

A PSE presents the MOSE(Spatio-Temporal MO*delling of Environmental Evolutionary Processes by means of Geo*S*ervices*)system, for the developing of geoscience applications.MOSE is a PSE able to support the activities that concern the modeling and simulation and mining of spatio-temporal phenomena for analyzing and managing the identification and the mitigation of natural disasters like floods,wildfires, landslides etc. The activities managed by MOSE are characterized by the need to handle large amounts of spatio-temporal data and to support the interoperability among simulation models, distributed GIS, visualization systems, parameter estimation services, discovery of spatio-temporal patterns in pre-existing data, etc The main components of MOSE are simulation services, geographic information (GI) services, knowledge discovery services (KDS), visualization services, geographic data and repositories. MOSE enables the creation, execution and monitoring of geo-workflows in grid environments through high-level, graphical Web interfaces. Components of the workflows can be sequential, parallel and P2P applications. Each component is wrapped as Web/Grid Service for exploiting the potentialities of this architecture. Each Web service is semantically annotated and, consequently, domain specific ontologies support the user in building complex workflows, even without a deep knowledge of the domain itself.

VI PROPOSED APPROACH

A new approach to integrate different models and technologies for improving flood risk forecasting, based on analysis of heterogeneous data received from different information sources. The development of the flood monitoring and forecasting system is based on the recent progress in the sphere of spatial modeling and simulation, modern geo-information systems (GIS) and earth remote sensing technologies.

The traditional flood model-based fore-casting approach is advanced by integrating different models and technologies for improving flood risk output prediction such as input data clustering and filtering; digital maps of a relief and river terrain; datacrowd sourcing; forecasting models; different hydrological models for time scale modelling water flows; computer simulation for modelling the river behaviour; visualisation tools; geographic information systems (GIS); and techniques for flooding scenario generation and comparison .

Real-time flood monitoring [17] is based on the integration of heterogeneous data from both space and ground-based information sources (Fig. 1). Taking into consideration the floodplain width and the speed of flooding processes, satellite and aerospace monitoring allows regularly overlooking large areas and providing high efficiency information on the research object. Additionally, to get a holistic view of the current situation, remote sensing is supplemented by data obtained from ground-based monitoring devices. Clustering of dynamic historical data allows identifying typical dynamic flooding patterns in the real-life situations which have occurred in the past and might be expected in the future. A symbolic regression-based forecasting model is integrated into short-term forecasting of the river flow discharge and monitoring in a specific real-life situation like river belt is cut which causes flood. Here, the main challenges are a small number of input factors and a small set of flow measurements.

Layered architecture of short-term forecasting of the river flow discharge and monitoring

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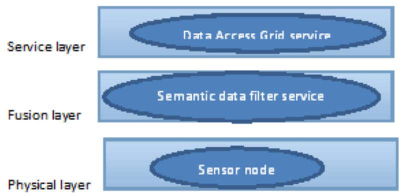

An exponential smoothing is applied to predict the water levels in the river. Hydrological models are advanced by realistic physical models that are derived from topological maps and represent geo information of the river and its neighbouring areas. Data crowd sourcing is used for calibration of a hydrological model based on comparison of the actual situation with forecasted. Additionally, regression-based meta models using river simulation results allow performing sensitivity analysis of input factors influencing the river water levels and inundation areas, and improving understanding of the model behaviour and interpretation of the flood forecasts .GIS and the earth remote sensing technology present the most powerful tools emerged in the hydrological field, which allow for the collection and analysis of environmental data as well as provide a platform for integrating space and ground-based data for flood monitoring and modelling. Observed data support the creation of information through modelling, and the information evolves into knowledge through visualisation and analysis of digital elevation pictures and finally supports analysis of flooded geographic areas. Finally, automatic generation and analysis of flooding scenarios will allow analyzing dynamics of the river floods and evaluating their potential effects in the near future to support preventive actions to mitigate impacts of floods.

CONCLUSION

This paper has discussed a working Flood-Forecasting system based on the semantic grid services. It also discuss about earlier techniques of how it compose and execute work flows while supporting complex user interactionsand assisting technologies. Real-time flood forecasting was given by continuous simulation of flood hydrographs using the real-time hydro meteorological data on the river basin of godavari. The paper also illustrate the future scope of Designing the Proposed Flood-Forecasting system with an objective to enhance as efficient and reliable model.

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