**University "Ss. Cyril and Methodius"**
**Faculty of Computer Science and Engineering**

## Proceedings of the Ninth International Conference on Informatics and Information Technology

# CIIT 2012

**April 19-22, 2012, Molika, Bitola, Macedonia**

**Editors:**
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**Dejan Gjorgjevikj**

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# Preface

The Conference of Informatics and Information Technology was held for the ninth time, traditionally in Bitola, Macedonia during April 19-22, 2012. This year, for the first time it was organized by the Faculty of Computer Science and Engineering (FCSE). FCSE is the result of the unification of the two largest institutions in the area of informatics and computer technologies in Macedonia – the Institute of Informatics at Faculty of Natural Sciences and Mathematics and the Institute of Computer Techniques and Informatics at Faculty of Electrical Engineering and Information Technologies. The previous eight conferences were organized by the Institute of Informatics at the Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius in Skopje. Now, FCSE continues the tradition of giving the opportunity to researchers to present their latest results in the field of Informatics and Information Technologies.

During the three days of the conference 81 presentations were given in 13 regular sessions. One project meeting and special student session were also held. On the student session 15 student projects were presented and the best one (chosen from the student participants) was awarded.

Professor Vedran Mornar from Faculty of Electrical Engineering and Computing in Zagreb gave the invited lecture “State Matura and National Information System for Application to Higher Education Institutions”.

The rich variety of topics covered by the presentations provided a setting for numerous fruitful discussions on different concepts, methods and technologies for the benefit of advancing these research areas.

As editors we hope that the CiiT conference will continue its growth toward becoming an influential international conference with great impact to ICT research and development.

The Editors,

Verica Bakeva, PhD

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# eWorld – eWork, eCommerce, eBusiness, eLearning

# DATA WAREHOUSE DESIGN FOR CLIMATE CHANGE PREDICTION IN REPUBLIC OF MACEDONIA

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## ABSTRACT

This research paper presents an overview of key points, which in the future will help to build a system for a solution of the climate problems in this country. For this purpose, we inspected the situation in Macedonia, analyzed previous tests, and made a review and comparison with organizations in the world. Our main goal is to describe the system (Data Warehouse) which will be a blend between such organizations, and will enable researchers to analogously import data, conduct monitoring - as a key tool for research and observation. In parallel, the system will digitally take the results obtained from the organizations; it will analyze, process, and filter to eventually allow users to monitor the outcome of that research.

## I. INTRODUCTION

Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological elemental measurements in a given region over long periods. Climate can be contrasted to weather, which is the present condition of these elements and their variations over shorter periods. A region's climate is generated by the climate system, which has five components: atmosphere, hydrosphere, cryosphere, land surface, and biosphere. Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO).

Over the years there have been many climate changes: warming of specific surface areas and reduction of water surface, change in the amount of atmospheric greenhouse gases, which lead to a state of global warming, or global cooling, atmospheric and oceanic circulation… Such climate changes have a negative effect on human activities, causing destruction of fauna, catastrophic results in agriculture, animal husbandry, even extreme events, such as floods, droughts, heat waves, hurricanes etc.

Such organizations, today, are spread all around the world: WMO- World Meteorological Organization, GCOS - system for global climate observations, Climate Institute, C2ES - Center for Climate and Energy Solutions, EPA, GEOSS - Global systematic observation of the country etc. This research is indeed dedicated to these organizations, respectively to create a digital system that will take the already processed data from these organizations and will enable researchers to import analog data that can't be monitored with sensors or satellites. The creation of such a system would be a repository of all gathered information, and will provide improvement of climate predictions and researches. The system's main goals will be: collecting local information, collecting information from satellites and sensors, collecting information from inquisitive stations and organizations, systems analysis etc.

## II. CLIMATE RESEARCH AND MONITORING

Monitoring is a tool to synchronize all data with standard which is adopted global, and provides access to data, no matter whether tests are performed in Europe or America. Climate monitoring concerns the monitoring of the atmosphere and of other components of the earth system as well as the monitoring of global climate indicators (e.g. global mean earth surface temperature and precipitation). Satellite measurements appear to satisfy the need for global measurements.
Reason for monitoring is the following:
Too much data coming from too many sources that use too many different computer systems can be downright confusing. That's happening with the numerous programs observing events that affect the Earth's health. The complex programs—developed by governments and organizations involved in environmental research—capture all sorts of data along with the geographic coordinates of the places where each measurement is made. These coordinates are then used to map the data. This may sound simple enough, but it's not.
The reason is that not everyone uses the same coordinate system, and maps cannot simultaneously display data with mixed coordinates. But this is just one of the problems faced by research groups, which are usually happy to share the information they collect to advance the development of knowledge. Each group may also use its own native language, scientific terms, and technical protocols, as well as those geographic coordinates. The result: It may take weeks to sift through conflicting information to build a model that simulates a drought, for example.

### II.I CLIMATE RESEARCH AND MONITORING - REPUBLIC OF MACEDONIA

Climate changes in Macedonia until 2006 were analyzed through their main parameters: air temperature and precipitation. Analyses of the existing data were made in the period of 1971 - 2000 for 34 meteorological stations. Information on climate variations are based on comparative analysis of two series for a period of 30 years, i.e. 1961 to 1990 and 1971 to 2000. Studies that have been carried out in

Macedonia are based as a result of the 15 selected meteorological stations that belong to different climate types and subtypes. Simple tests of quality were applied (eg: Tavg> Tmin, Tavg <Tmin, Tavg ≈ (Tmin + Tmax) / 2) to detect errors in data. It was discovered that, the provided data, often has errors, such as the absence of the negative sign of winter temperatures, 10 ° C to low or high value, etc.

Improper data can greatly risk the estimated observed trends, as well as the developed empirical models that describe the relationship between climate variability on a global and local scale. In consequence of problems with the trends in Macedonia, the results are based on simulations made with the GCM (general model of circulation).

Long-term effects of climate changes in Macedonia are estimated in the most vulnerable areas: agriculture, forestry, water resources, biodiversity and health. These estimates are made, considering scenarios of climate change on sub-regions in the country. In order to mitigate adverse effects of climate change on the above sectors, it must meet the priorities for adaptation within the cross-national plan.

Macedonia has not achieved significant results related to climate conditions and changes. Moreover, it doesn't have special application that would constantly monitor the situation in the country and its connection with world organizations. Heretofore, it has made several monitoring projects which were supported by the Government of Macedonia, Hydrometeorology, National Institute of Health and several international organizations.

The previously mentioned facts are the main reason for implementation of such system that could function in the same way as the applications worldwide. Implementation of such system requires a good technical and financial infrastructure.

### II.II CLIMATE RESEARCH AND MONITORING - INTERNATIONAL ORGANIZATIONS

**GEOSS – euroGEOSS**

The Global Earth Observation System of Systems (GEOSS) is being developed to overcome such incompatibilities. This Earth-monitoring network brings together data gathered by thousands of sensors, buoys, weather stations, and satellites on conditions across the land, water, and atmosphere. The network created to monitor the Earth contains data collected by thousands of sensors, weather stations and satellites that are placed on the coordinates in: the earth, water and atmosphere.GEOSS is supported by all the major industrialized nations and many scientific organizations, including IEEE through its Committee on Earth Observation. The European Commission is one of the leading players in the development of GEOSS and supports it through several research projects. One such project is EuroGEOSS, which allows scientists and funding agencies to access information from a variety of shared infrastructures without having to install special software or learn new applications—and to do it via the Web. "We are trying to create an environment in which scientists in different specialties can collaborate with a shared perspective to address different chunks of the same environmental problem," he continues. "By making the process more open and available on the Web, potentially millions of people can use it and understand the science better."

Link: CatMDEdit http://catmdedit.sourceforge.net/
PDF: www.eurogeoss.eu/Documents/D-5.2 a_ EuroGEOSS_guidelines_updating_metadata_in_catalogue.pdfg

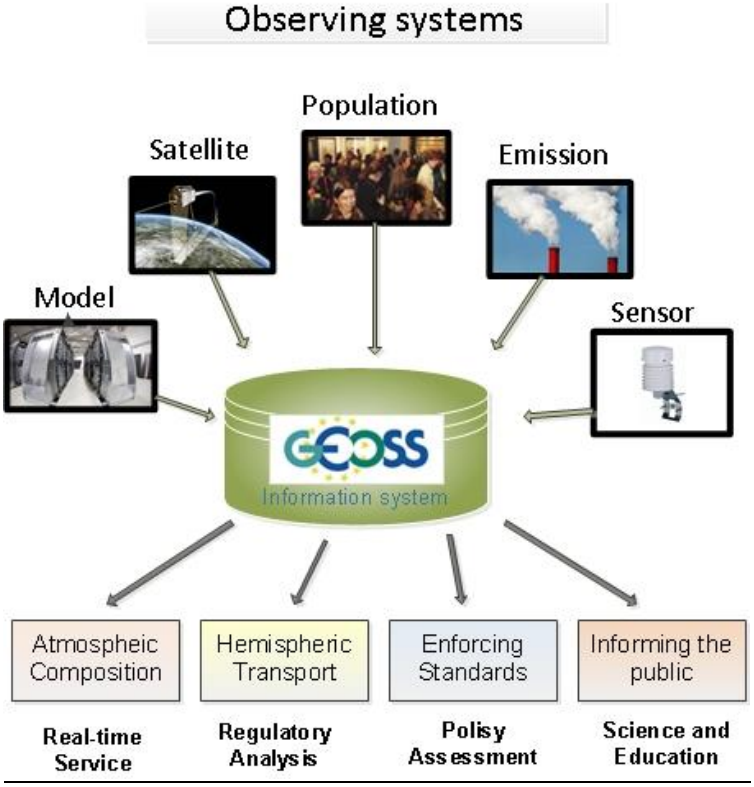


Figure 1:Geoss Observing systems.

EuroGEOSS has zeroed in on linking forestry, drought, and biodiversity systems. By focusing on specific areas, EuroGEOSS can create a template with linkages across multiple systems and enable them to work together as one—not only in accessing data but also in providing models, forecasts, and possible scenarios. EuroGEOSS builds on the achievements of the Infrastructure for Spatial Information in Europe (INSPIRE), a European directive providing the legal framework, technical guidelines, and specifications for shared data infrastructures that deal with environmental issues. The legislation requires all 27 nations of the European Union to "ensure that the spatial data infrastructures of the member states are compatible and usable in a community and transboundary context."

**WMO – World Meteorological Organization**

The World Meteorological Organization (WMO) is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the

climate it produces and the resulting distribution of water resources. WMO has a membership of 189 Member States and Territories. WMO facilitates the free and unrestricted exchange of data and information, products and services in real- or near-real time on matters relating to safety and security of society, economic welfare and the protection of the environment.
The vision of WMO is to provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources and related environmental issues and thereby contribute to the safety and well-being of people throughout the world and to the economic benefit of all nations. In the specific case of weather-, climate and water-related hazards, which account for nearly 90% of all natural disasters, WMO's programmes provide vital information for the advance warnings that save lives and reduce damage to property and the environment.

Линк:
http://www.wmo.int/pages/index_en.html

## III. Climate change monitoring: Organizations and ICT tools

Climate change organisations are currently typified as having three distinct "personalities" based on their functions in climate change action – monitoring, mitigation and adaptation. Generally, this type of organization (GEOSS, WMO, EPA) gathers and distributes key data. With this information, organisations stress the potential and use of accurate indicators to increase the possibilities of mitigating climate change and of helping developing countries in particular to adapt to weather events. Access to high quality, timely data is central to facing the challenges of climate change and ICT has been considered as key to achieving this. At the moment, ICTs are used in monitoring. This organisational element confers authority, attracts attention and provides resources for the utilisation of ICTs in climate change and development policy implementation.( (Richard Heeks and Angelica Ospina),)

## IV. Building Data Warehouse for climate change in Republic of Macedonia

Our main goal is to build a system that will store the information and will be used for analysis and reporting. Data will be kept in the warehouse, or database that will include all the research, analysis and significant events. To preserve the correctness and value of information, additional operations will be performed before using it for reporting DW. The process of this repository will include the following activities: data collection, analysis and filtration of data, data storage, display data, conclusions and predictions obtained from the results.

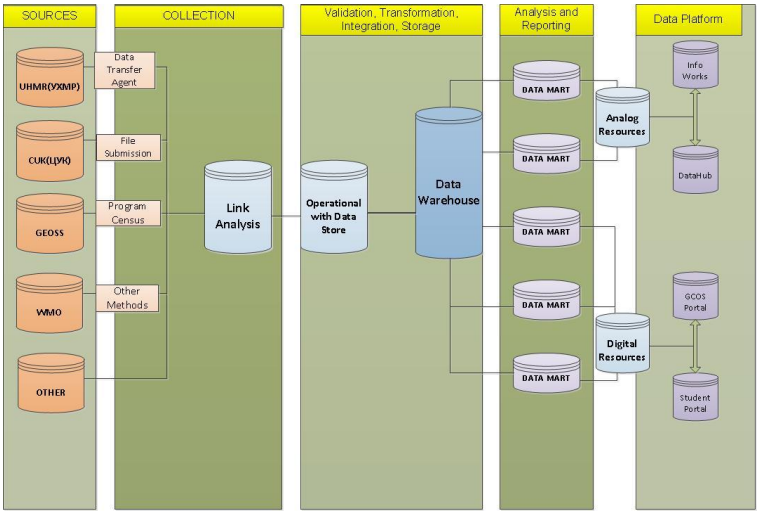


Figure 2: Data Warehouse.

This system will allow us:

1. Register of all data and historical monitoring of the same;
2. Integration of data from multiple source systems, that allow central review;
3. Improving data quality by providing standard codes;
4. Analog and digital input data;
5. Electronic display of results and research;

The system will include monitoring of several important areas including: meteorological changes, biodiversity, forestry, water resources and climatic disasters (droughts, floods, fires ...). The application will integrate the two systems that will perform collection and data analysis. One system is for analog (manually) input data, and other system for digital data entry. The main goals of the system will be: Collecting local information, information from satellites and sensors, gathering information from inquisitive stations and organizations, systems analysis etc.

### IV.I System for analogue (manual) input of data

Conduct of tests and analysis at local level (depending on location and climate).

These tests are based on results that are obtained from researches throughout many years. They are a consequence of daily changes, and should occur in the future, caused by a planned and implemented action. Organizations involved in this process are: Hydrometeorology, Ministry of Agriculture, Forestry and Water Management, CMC - Center for Crisis Management, Ministry of Environment and Urban Planning and all other organizations directly or indirectly monitor changes in the environment.
This system will store data from everyday activities that cannot be followed by technical tools, and still are one of the key areas related to climate problems. As we mentioned, the system will make analogical introduction of activities like: reforestation, planting of seedlings of species, water resources (reduction or increase of water levels), drying of water

resources, flood, biodiversity, migration, forest fires, termination of certain organizations, health and human factors.
The system will contain all the changes that have occurred and all activities carried out, to give a full picture of the accomplished action in the end. For example, if in 2011 were planted approximately 100,000 trees in the vicinity of East Macedonia, but no disaster happens (fire, drought, disease of seedlings), that action will improve the cleanliness of the air particles for XX%.
Also there will be an integrated application that will make analysis of events and changes that occurred during the period of one week, month and finally- annual analysis. Analysis per year will give a picture of the annual events and will allow the relevant authorities to review the events of that particular year, as well as the reasons for the action and the opportunity for future prevention of side effects. The received results will be available to the public, so that all users would have a clear image of all events in the country and directly follow all the activities.

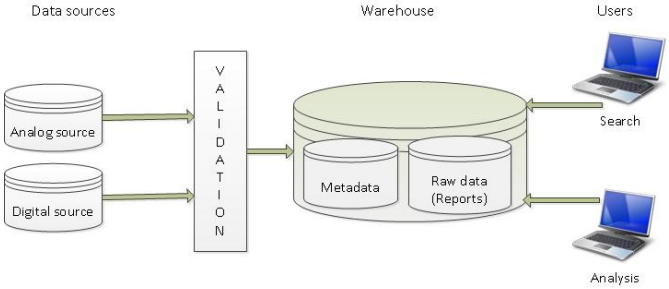


Figure 3: Validation of Data Warehouse.

## IV.II SYSTEM FOR DIGITAL DATA ENTRY:

Tests and analysis on a global level

This part will be connected with the existing organizations and institutions. The main goal is to integrate organizations locally and globally, providing a central review. The system will cover the same areas as well as the system for analog input data, where the centre of research will be the biodiversity, global climate changes, disasters, caused by drought, fires, floods and also the results from the technical infrastructure.
The system will take the already analyzed data from worldwide organizations such as Hydro and meteorological stations, Euro GEOSS and WMO. Integration into these organizations will give us a new look in our work, where researchers will directly be able to recognize the standards by which we performed analysis, conditions that we will have to accomplish for their disclosure; coordinate system and global terminology for publication of results globally.
Apart from the direct connection to their database, this section will include all publicly available applications that facilitate the work, and give precisely defined information to the researchers and other users. Connection with the brokers, (semantic broker), will allow all users to obtain information and opportunity to convert it by themselves. In that way the results will have the same referent systems, used for locating of geographical subjects and weather reports. If you are part of the working group in Europe, and travel to Africa for researching, you do not have to take all the files with you. Simply go to the Internet in Africa and do the same procedure that you performed in Europe. You can bring the editor CatMDEdit as an example, which is a tool that facilitates the documentation of resources, with particular focus on geographic information, where users are allowed to indicate different types of resources in accordance with ISO 19115/19119 standard.
Link: http://catmdedit.sourceforge.net/.

Direct connection with these applications will improve the knowledge about all the problems associated with the points above, and at the same time allow our country, which is a developing country, to accelerate and perfect measures for prediction and prevent adverse events. Leaving out digital input data is to provide program with information, in order to save peoples' lives and reduce damage of property and environment. It will also contribute to reduction of the harmful impacts from human disasters, such as those related to chemical and nuclear accidents, forest fire, volcanic ashes, etc.

## V. SUMMARY

Climate change has emerged as a key global issue, and increasing numbers of organisations are seeking to address this issue in various ways. These "climate change organisations" are found at different levels, from the international organisations of the UN system through national ministries and down to local government and community organisations. Monitoring is a tool to synchronize all data with standard which is adopted global, and provides access to data no matter whether tests are perform in Europe or America. EuroGEOSS is one of those organization who monitoring the Earth contains data collected by thousands of sensors, weather stations and satellites that are placed at the coordinates: earth, water and atmosphere. Macedonia has not achieved significant results related to climate conditions and changes, or organizations such as GEOSS. Also has no a special application that performs constant monitoring of the situation in the country and its connection with world organizations. For that reason creating a system that represents the data warehouse will help Macedonia which is a developing country, and will enable new ways to solve future problems. In this paper we reviewed and analyzed organizations and research locally and globally. We have seen benefits from such organizations as the predictions for the coming years. Finally, we gave a description of the system which will be according to the information and all its functionality, ranging from gathering information to their disclosure. The system will collect information from various sources (via analog and digital input), will analyze, filter, and then display the results. The main purpose and benefit of creating such a repository will be fast and simple overview of

information that will be guaranteed standard coded for accuracy and validity of information.

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