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THE USE OF GEOGRAPHIC INFORMATION SYSTEMS IN CLIMATOLOGY AND METEOROLOGY, COST719

ZASTOSOWANIE GEOGRAFICZNYCH SYSTEMÓW INFORMACYJNYCH W KLIMATOLOGII I METEOROLOGII, COST719

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SUMMARY: The COST Action 719 has started in 2001 and presently 20 European countries are participating. There are manifold objectives of the Action, however, the main aspects such as establishing interfaces between GIS and meteorological data, assessing the availability, contents and accessibility of meteorological and climatological data sets,, encouraging and fostering European co-operation should be mentioned.

The tasks are carried out within three working groups concentrated on tasks such as data access and availability, methods of spatial interpolation and developing recommendations for standardised GIS applications.

The applications which have been already adopted are mainly focusing on three parameters, i.e. precipitation, temperature and energy balance for which three so-called Demo projects have been formulated.

It is expected to achieve better and more cost-effective production of state of the art meteorological and climatological information. Also an improvement of the co-operation between European countries in the application of GIS in the field of meteorology, climatology and environmental sciences should be achieved together with better trained personnel within the operational and scientific divisions of National Meteorological Services.

Additionally some tasks such as the development of a visualisation system for climate data sets for Internet application are under preparation. The paper provides the information concerning the work progress on demo projects made within COST 719.

KEY WORDS: Geografical Information Systems, meteorology, climatology, COST, temperature, precipitation, energy balance

1. OBJECTIVES

The COST Action 719 started in 2001 with 18 European countries participating. Presently 20 countries have signed the Memorandum of Understanding. The Action has several objectives including establishing interfaces between GIS and meteorological data in close co-operation with the GIS industry; assessing the availability, contents and accessibility of meteorological and climatological data sets; encouraging and fostering European co-operation in the development of operational applications of GIS in meteorology and climate research and finally strengthening the links between the National Meteorological Services, the research community as well as the GIS industry.

2. WORKING GROUPS

The tasks are carried out within three working groups.

Working Group 1 – DATA ACCESS AND DATA AVAILABILITY is focusing on putting pointers to existing and potential GIS data sets and on the conversion and standardisation of climatological, meteorological and other relevant environmental data in view of data exchange. In particular, the Action will keep pace with the advancing state-of-the-art of applicable GIS tools (software/hardware) and developments in progress; document the availability, contents and accessibility of climatological, meteorological and environmental data sets, including metadata, and relevant future developments therein. In its responsibilities are also: to establish standardized interfaces between GIS systems and climatological and meteorological databases, when possible in close co-operation with GIS system providers and to define and/or develop filter tools as appropriate in order to improve the exchange of data between research institutes, NMS(National meteorological Services) and the rest of the user community.

Working Group 2 – SPATIAL INTERPOLATION is responsible for establishing an inventory of interpolation functionality already present in GIS and statistical software and the recognition of gaps. In particular to study the potential and limitations of existing GIS (interpolation) functionality for spatialisation of meteorological and climate data; compare with other spatialisation algorithms and set up recommendations/specifications for future GIS tools for spatialisation, suitable for meteorological and climate applications, and take these up with industry.

Working Group 3 – GIS APPLICATIONS is developing standardised GIS applications aimed at climatological, meteorological and relevant environmental users. In particular the Action has established an inventory of the present use of GIS applications in meteorology and climate research. Also the perceived potential, as well as the

limitations for future development, will be considered, taking into account the requirements of interested parties. The identification of a set of useful applications of GIS in the fields of meteorology and climate research, e.g. with respect to visualization and mapping is being examined. Furthermore WG3 will develop the specifications for such applications; encourage joint development, for example with European Climate Support Network, of such applications to be shared between the participants of the Action.

3. DEMO PROJECTS

The applications which have been already adopted are mainly focusing on three parameters, i.e. precipitation, temperature and energy balance for which three so-called Demo projects were formulated.

Demo A – "Mapping the Precipitation Using Combined Information from Satellite Data, Mesoscale Forecast Models and Ground Measurements (Synoptic and Climatologic)" – is focused on precipitation. This demo project has been started in the Satellite Research Department in Institute of Meteorology and Water Management in Poland as a result of experience gained during the research on application of satellite microwave images from NOAA K, L, M series. The satellite data together with standard synoptic and climatic measurements as well as radar and Numerical Weather Prediction analysis are merged together for precipitation analysis. The system allows to display the rain field forecasted by the numerical weather prediction model and the precipitation observed with other ancillary information through a unique front-end software interface. Figure 1. Presents the workflow of the project.

Demo B – "Spatial interpolation of temperature in Alpine Regions" is setting its focus on Temperature measurements. Since this demo project has only been started within this Cost Action and is therefore not based on a currently running project within one of the participating institutes it has only got started so there can not be presented any results yet. It was the aim to use one set of data to start out with which would be accessible by all the group members. Therefore it was proposed to apply the data set of MAP (Mesoscale Alpine Project), which is accessible on the Internet. The proposed structure of the project is shown on Figure 2.

Demo C – "Prediction of Road Surface Temperature" – COST 719 Working Group 3 are participating in a trial to test the application of new road ice prediction software across the EU. The software "IceMiser" was developed at the University of Birmingham, UK and predicts Road Surface Temperatures (RST) across the road network. Coded in Visual Basic as an extension of ArcGIS, the model combines Geographical GIS data with forecast Meteorological data to produce a 24 hour forecast of RST.

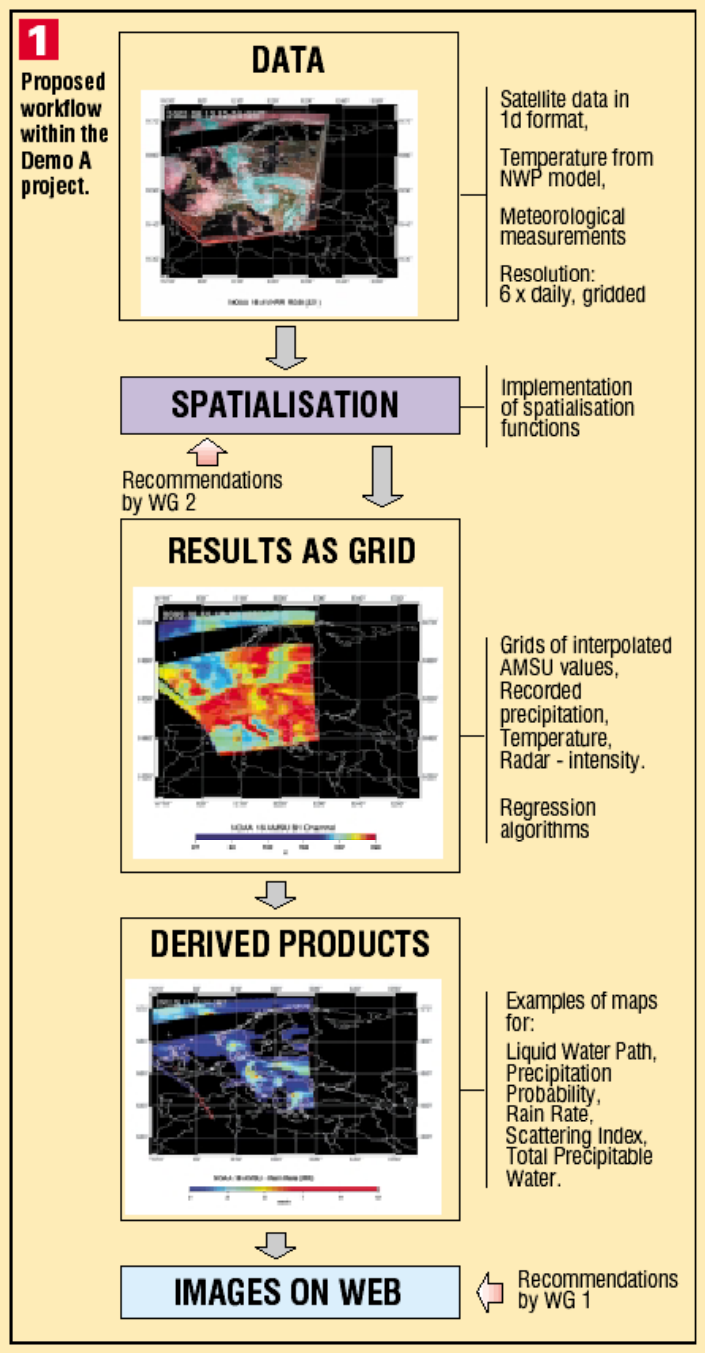

Fig. 1. Proposed workflow within the Demo A project

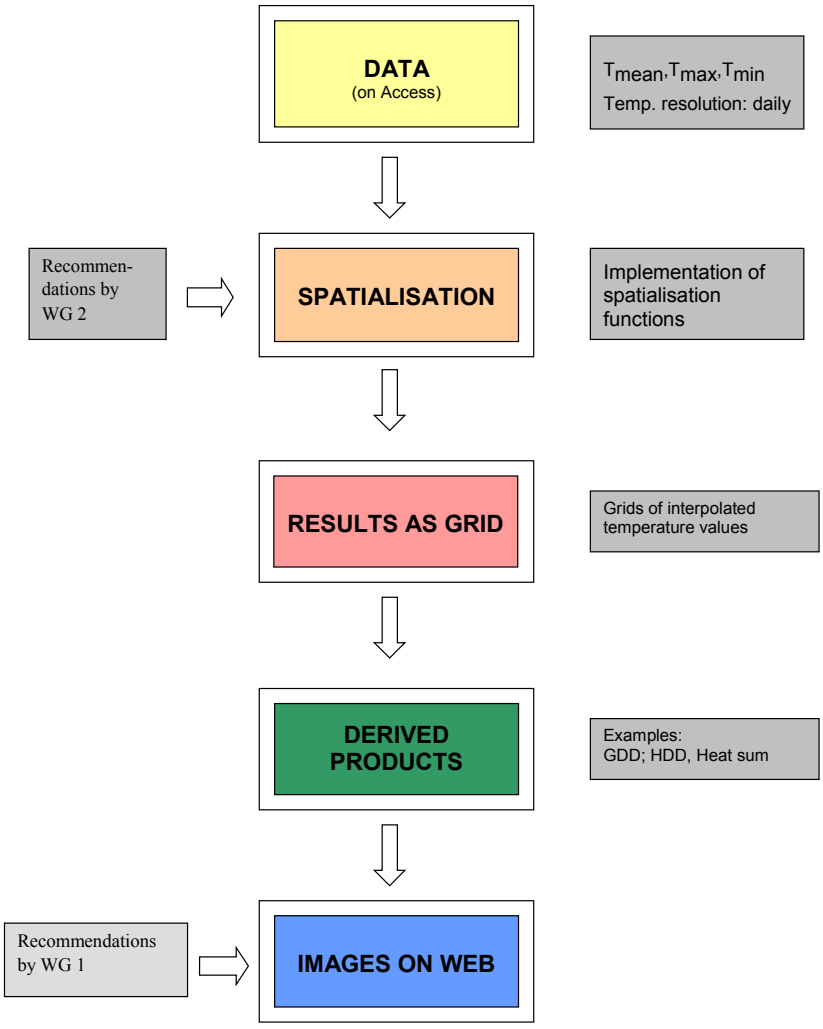

Fig. 2. Proposed workflow within the Demo B project

Several GIS layers are required (Fig. 3). These include raster data in the form of a Digital Elevation Model, Cold Air Pooling algorithm, Aspect, Slope and Landuse and Line data showing the road network and the Sky-View Factor as point data (calculated from fish eye images: Fig 3. lower right)

The GIS data is then combined with meteorological forecast data and entered directly into the model. The result is a dynamic forecast of RST around the road network at temporal and spatial resolutions of 20 minutes and 20 metres respectively. These are displayed immediately in ArcGIS, but can also be viewed in ArcExplorer.

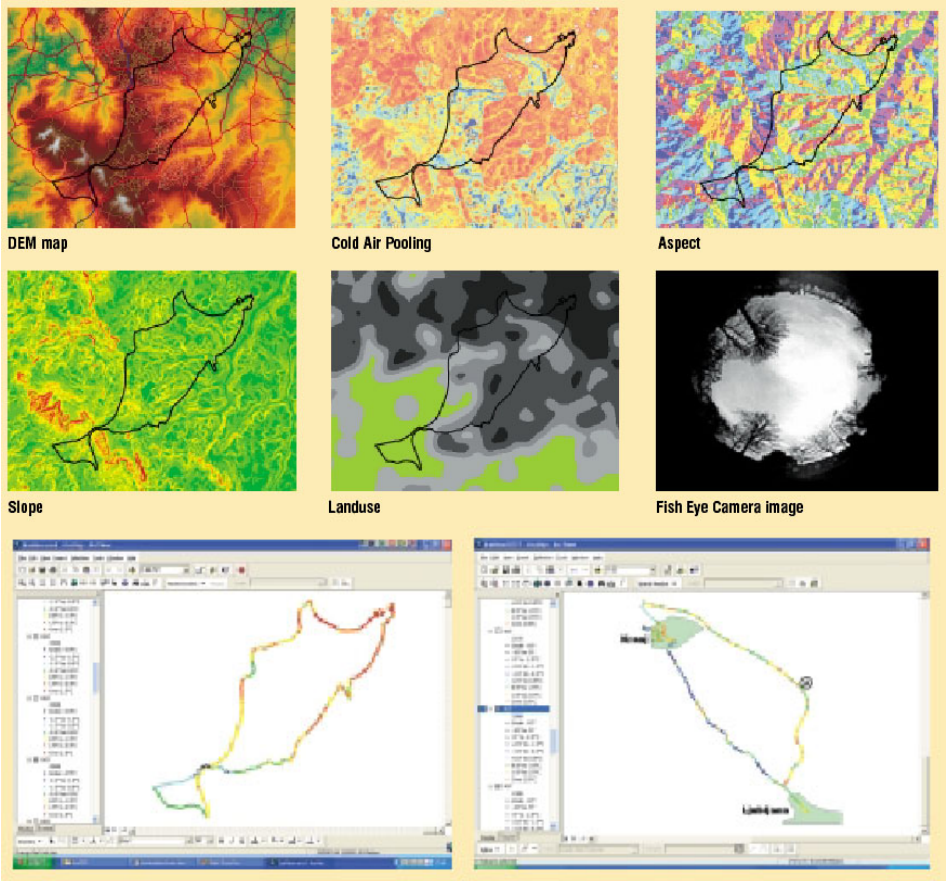

Fig. 3. Proposed workflow within the Demo C project

Successful trials have already been carried out in the UK and it is hoped that the model can be tested, refined and ultimately used across the EU. An initial trial in Slovenia was undertaken in Slovenia in December 2002 (below).

Additionally some tasks such as the development of a visualisation system for climate data sets for Internet application are under preparation. For the demonstration projects, an Internet Map Server will operate in Foundation of Applied Meteorology web sites. In particular we will use a technologies developed to serve GIS data on the Internet, in a form of a map. The WIM (Web Internet Map server) used is SISTERIMS (*www.sister.it*) that allows the display and query the maps with the usual browser without any plug-in installed on the client PC. The system uses the same of ARC-INFO software as data format (shape file, coverage, BIL, BSQ, ECW, IMG, TIFF etc).

4. EXPECTED BENEFITS

There several benefits expected of the international co-operation within COST719. These include better and more cost-effective production of state of the art; meteorological and climatological information, improvement of the co-operation between European countries in the application of GIS in the field of meteorology, climatology and environmental sciences and better trained personnel within the operational and scientific divisions of NMS.

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ZASTOSOWANIE GEOGRAFICZNYCH SYSTEMÓW INFORMACYJNYCH W KLIMATOLOGII I METEOROLOGII, COST719

S t r e s z c z e n i e

Akcja COST 719 rozpoczęła się w 2001 roku i obecnie zrzesza 20 krajów europejskich. Na szczególną uwagę zasługują zadania Akcji takie jak: Określenie dostępności i zawartości baz danych meteorologicznych oraz klimatologicznych, wzmacnianie współpracy europejskiej w rozwijaniu zastosowań GIS w badaniach meteorologicznych i klimatologicznych oraz zacieśnienie kontaktów pomiędzy Narodowymi Służbami Meteorologicznymi, środowiskiem naukowym a przemysłem GIS.

W wyniku działania Akcji spodziewane jest sprawniejsze przygotowanie i prezentacji informacji meteorologicznej, a także klimatologicznej z wykorzystaniem nowoczesnych metod GIS, rozwijanie europejskiej współpracy w zakresie zastosowań GIS w meteorologii, klimatologii i innych dyscyplinach badania środowiska oraz dobrze wyszkolony personel w operacyjnych i naukowych komórkach służb narodowych.

Zadania te realizowane są w ramach trzech grup roboczych. Grupa pierwsza zajmuje się określeniem dostępności i osiągalności wszelkich danych, monitoringiem rozwoju technologii GIS. Druga grupa robocza koncentruje się na badaniach metod interpolacji przestrzennej. Natomiast trzecia grupa robocza opracowuje rekomendacje standardowych zastosowań GIS. W przygotowywanych zastosowaniach skoncentrowano się na trzech parametrach meteorologicznych, tj. opad, temperatura i bilans energetyczny. Sformułowano trzy przykładowe projekty: „Rozkład przestrzenny opadu na podstawie danych satelitarnych, numerycznych i naziemnych (synoptyczne i klimatologiczne)", „Rozkład przestrzenny temperatur w rejonie Alp" oraz „Bilans Energii: Prognoza temperatury nawierzchni dróg".

Dodatkowo opracowywane są systemy umożliwiające internetową wizualizację danych klimatologicznych. Praca prezentuje stan zaawansowania projektów demonstracyjnych w ramach Akcji COST 719.

SŁOWA KLUCZOWE: geograficzne systemy informacyjne, meteorologia, klimatologia, bilans energii

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