

## Towards a European Geographic Information Infrastructure: The contribution of the GI & GIS Project of the Joint Research Centre

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### 1. Introduction and background

The aim of this paper is to present a general overview of the main activities performed by the Geographic Information and Geographic Information Systems (GI & GIS) Project within the European Commission's Fifth Framework Programme (FP5). The GI & GIS Project activities are performed by the Space Applications Institute (SAI) of the Joint Research Centre (JRC) in close cooperation with other Services and Directorate Generals of the Commission, and also with a large number of external institutions, both private and public.

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The ultimate goal of the GI & GIS Project is the creation of the European Geographic Information Infrastructure (EGII). The same concept also applies at national level in the case of creation of National Spatial Data Infrastructure (NSDI) where the topics covered and the activities performed are similar.

The enlargement of the European Union (EU) and transnational disasters, such as floods for example, have demonstrated to the Commission and the Member States the importance of harmonised data not limited by national boundaries (coherent databases describing fundamental resources, such as soil, meteorological information, land cover, demography, protected sites, etc.) and the need for an adequate technology to access and process distributed geographic data.

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The Joint Research Centre's experience with GIS, combined with its independence and neutrality results in an interesting position for providing not only the skills needed to assemble and manage such data bases, but also a technical co-ordination point supporting the development of GIS use in Europe.

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The operational use of spatial databases requires that geographically distributed catalogues are interoperable, and thus accessible to distributed users. SAI participates in the technical work aiming to establish GI metadata standards, to adopt a common European Spatial Reference System as well as to define a harmonised GI data policy for access and dissemination. This will not only contribute to the creation of EU wide databases, but will also ensure that Europe maintains a cutting edge position concerning the evolution of GIS techniques. The GI & GIS Project also supports both the European Environment Agency (EEA) and the Eurostat activities linked to thematic databases.

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The recent evolution of GIS technology with the development of Internet or web based services is an opportunity for European industry to re-enter the global market. Some international organisations, such as the Open-GIS Consortium (OGC), are currently defining new GIS interoperability criteria that might lead to de-facto standards for distributed geo-processing. The European presence is real but relatively weak compared to the US industry participation. The JRC's participation is thus related to publicising new development, impact quantification and options assessment, data storage, and to act as a focal point of co-operation for the promotion of European excellence.

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The GI & GIS Project aims to be considered as a European Reference Centre on Geographic Information. Regarding the European GI policy development, in addition to the draft GI2000 Communication from the Commission to the Council and Parliament, the GI & GIS Project is clearly involved in a wider debate, especially considering the Green Paper on Public Information and the eEurope initiative (An Information Society for All) launched by Directorate General Information Society.

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This article has been prepared on the occasion of the 20<sup>th</sup> International Cartographic Conference “Mapping the 21<sup>st</sup> Century” (Beijing, China, August 2001) as a contribution to the session on Spatial Data Infrastructure Policies. The European Union has been collaborating intensively with non E.U. Member States (mainly in Central and Eastern Europe, and the Mediterranean region) during the last 10 years, either at bilateral or multilateral levels. In some cases, projects funded by the European Commission were implemented in collaboration with the relevant Directorates General and the Space Applications Institute of the Joint Research Centre. The thematic fields covered are, for example, agricultural statistics and crop monitoring, development of agri-environmental indicators such as nitrate balance, forest fire risk assessment and forest monitoring, soil mapping, soil erosion and land degradation assessment, landscape characterisation, desertification monitoring, coastal zones monitoring, water resources management, karstic zones protection.

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Most of these projects, even in the case of a successful implementation, have faced a common difficulty regarding access to existing information, especially cartographic. Several months are often required in order to identify, collect and pre-process the necessary data (maps, satellite data, aerial photographs, statistics) that can exist in different formats or projections. As a result, the staff allocation available for data analysis and production of new information for management purposes is substantially reduced.

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The main concept of the GI-GIS Project is to consider GI as a common element to several thematic areas and thus to concentrate the work to build a GI infrastructure, GI being a multi-purpose layer in support to several thematic activities and projects.

## 2. Objective of the GI & GIS Project

The main objectives of the GI & GIS Project (1999-2002) are:

- To assist the creation of the European Geographic Information Infrastructure collaborating with the main European actors (GISCO, EEA, EUROGI, Eurogeographics, etc.).
- To conceive, create or harmonise Pan-European databases to be used to support and monitor the EU policies mainly through the support, co-ordination or technical cooperation with thematic networks such as the European Soil Bureau, EEA European Topic Centres, Eumetnet, etc.
- To develop integrating spatial models (to assess the impact and to help in the definition of the EU policies).
- To develop methods and tools to contribute to the definition of the future European geostatistical system (in co-operation with Eurostat-GISCO).
- To provide scientific and technical support on GI&GIS Interoperability to develop common European position and to operate as GI communications facility (web, discussion lists, etc.).
- To create link and synergies to EU space activities; for example, in the field of earth observation, telecommunications and positioning.

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### 3. Presentation of the GI & GIS Project activities

This paper presents the GI & GIS Project activities, especially as a Geographic Information European Reference Centre in relation to:

- Assist the creation of the European Geographic Information Infrastructure (EGII)
- Geographic Information Data Policy (access and dissemination, GI economy and pricing, etc.)
- Standardisation on GI Metadata
- Standardisation on Reference Systems
- Technical Support on GI for the Services of the European Commission.

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#### 3.1 Geographic Information Reference Centre

##### 3.1.1 Assist the creation of the European Geographic Information Infrastructure (EGII)

The creation of an EGII certainly follows the recommendations produced by technology watch but it also takes into account other issues such as:

- policy decision for a distributed network or a centralised facility,
- identification and analysis of the constraints due to the data to be managed,
- user requirements analysis,
- overall system architecture.

The GI & GIS Project is therefore proposing to:

- Provide recommendations to the policy making process on the Infrastructure to be created and help in the formalisation of the user requirements for the EGII.
- Help in identifying the technological constraints due to the nature and properties of the GI to be managed, operating as a test environment for investigating different models for data access and data integration.
- Demonstrate and test the benefits of interoperability. Promote interoperability through specific initiatives (e.g. GIPSIE and PREANVIL Projects).
- Help in the definition and creation of new thematic networks (e.g. Water-GIS) in collaboration with relevant organisations.
- Establish a GI Pan-European network (e.g. PANEL-GI) through links with Central and Eastern European Countries and Mediterranean countries in the future, supporting the development of National Geographic Associations and National Geographic Infrastructures.
- Contribute to set-up of an interoperable European GeoStatistical System.

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##### 3.1.2 Geographic Information Data Policy

GI data policy is a complicated matter, both from political and technical viewpoints but it is essential for the definition of a Geographic Infrastructure. Typical questions that are addressed are: “may citizens use the basic GI datasets that governments have compiled with their tax money?”, or “who has the copyright of value-added data?”. “Is Geographic Information to be considered in the same category as environmental information?” In the last year’s debate about a GI data policy, different positions emerged.

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In order to discuss and agree on a common vision, a Workshop on "Geographic Information Policies in Europe: National and Regional Perspectives" was organised in collaboration with EUROGI (European Umbrella Organisation for Geographic Information). This meeting reflects the effort of the JRC and the Information Society Directorate to give the opportunity to National Organisations, in charge of defining National Policies, to know, compare and discuss topics of common interest and to help the Commission in understanding how to formulate a European Policy compliant with on going and emerging National initiatives. The meeting was hosted by RAVI, the Dutch national organisation for Geographic Information, on the 15th November 1999 in Amersfoort.

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The main objective of the Workshop was to identify, firstly, similarities and differences in data policy initiatives taking place across Europe, and, secondly, key issues that may need addressing at the international level. Further efforts were put into highlighting gaps in current knowledge where additional information is required, and in suggesting ways in which these gaps could be filled. In addition, light was shed on policy frameworks relating to the dissemination and conditions of access to digital data.

The overview of data policy initiatives presented (see Workshop proceedings) highlights a number of issues:

- There are many national initiatives across Europe concerned with the development of data policies in general, and GI policy in particular. In some cases, the GI dimension is very strong, as is the case in Portugal and the Netherlands for example. In others, such as France, GI is recognised as an important element of public sector information, which highlights the potential conflicts between economic and social objectives.

- Whilst in most countries the emphasis is on the national level, it is important to recognise that in other countries the regional/local dimension is particularly important, as in the case of Germany, Italy, and Belgium.

- Whilst some countries display a higher level of awareness than others, there is a sense to which the very rapid developments brought about by technology and the Internet are forcing governments to come to terms with the opportunities and challenges that these developments create. At the present time, most countries seem to have adopted policies in respect to access to public sector information. These may in some cases take the form of Freedom of Information legislation. There is however, quite a different set of policies that need developing in respect to a pro-active dissemination of public sector information. The Mandelkern report in France is a good example of the difference between access and dissemination.

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- Disseminating information has major implications in respect to the organisation of work in the public administration, intellectual property, metadata (i.e. the first step in active dissemination is to declare what is available), relationships with the private sector, and pricing.

- In respect to pricing, there are significant variations among the countries analysed above. In some cases there is a distinction between essential data free of charge (i.e. paid for through general taxation), and value added data charged for. In others, a policy has yet to emerge, and individual organisations act independently. Where a policy exists, a general principle that seems to emerge is that whatever the pricing policy, price should not deter use of data but on the contrary should encourage it.

- Whilst in the last few years there has been an tendency within the GI community to argue for the development of GI policies and infrastructures, it seems increasingly clear that these cannot be pursued in isolation, but need to be inserted in a broader debate about data access and dissemination policies. For this reason, the forthcoming Communication of the European Commission to the European Parliament and Council on Green Paper on Public Sector Information is of strategic importance for the development of this field.

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Areas where further action is needed are:

- Continue monitoring, documenting, and disseminating data policy developments occurring at national/regional level in Europe, and in the international arena. This may include, for example, National Spatial Data Infrastructure developments outside Europe, the discussions in the framework of the Global Spatial Data Infrastructure, and policies on access to remotely sensed data, such as those formulated by the UN. These policies may become particularly important as the impact on data supply of very **high-resolution** remote sensing satellites and the operational earth observation programme increases.

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- Contribute to the debate not only by observing practice but also through theory-informed discussions on appropriate legal and economic frameworks to the dissemination of digital information. A useful discussion on data pricing took place in the GI2000 discussion list, while CERCO (Comité Européen des Responsables de la Cartographie Officielle) Working Group 1 on legal and economic issues will discuss "Public Information vs. Privacy Protection". Research in this area is also taking place at different locations (e.g. Technical University of Vienna), and EC-funded projects (e.g. MADAME).

- Link GI policy initiatives to the wider debates on data policy (e.g. Green Paper) and other major policy initiatives at the EU level such as enlargement, agricultural policy, spatial development perspective, so that a stronger case for European action can be developed.

A Joint European Commission/EUROGI Workshop has also been organised in November 2000 in Brussels in order to review the role and usefulness of Geographic Information for the Enlargement of the European Union, with participants from Central and Eastern Europe and from the Mediterranean region (Craglia et al., 2001). The report includes a description of the "acquis communautaire" per country and a description of the main players in the field of GI, a review of the status of Spatial Data Infrastructures set-up at national level and of the creation of local Geographic Associations.

### 3.1.3 Standardisation: Metadata

The generation, **and** provision of access to multidisciplinary databases of harmonised and coherent geographical data implies different levels of interoperability. A wider use of metadata is extremely important since, for many users, the lack of data documentation or its poor quality is an obstacle resulting in a lower efficiency of the activity considered. There is presently a variety **of** sometimes confusing emerging standards, de facto standards or official standards in the GI field.

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The actions performed in this work package aim to:

- Monitor the emergence and consolidation of standards aimed at the interoperability of GI and GIS (e.g. ISO, CEN, OGC, **etc.**).

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- Monitor Information Technology development in relation to GIS.

- Study the applicability of technology and/or protocol to the interoperability of geographical information, and prototype and demonstrate the feasibility of technology and/or protocol.
- Promote the synergy between emerging and/or consolidated GI interoperability standards and earth observation interoperability standards.

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Specific attention is given to the improvement of the metadata documentation of EC databases and to the usefulness of Discovery Metadata such as Dublin Core.

One of the barriers to European interoperability is the cultural and linguistic diversity of European countries. This element appears to be common with other Spatial Data Infrastructures (SDI) such as, for example, the Asia-Pacific SDI (PCGIAP) or the African initiative (DIGSA).

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### 3.1.4 Standardisation: a Reference System for Europe

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Regarding GI interoperability at data level, exact knowledge, understanding, management and subsequent processing of the coordinates of GI datasets is one of the central aspects of cross-border interoperability. The GI&GIS Project, together with MEGRIN (Consortium of European Mapping Agencies for the production of Pan-European data), organised the "European Spatial Reference System" Workshop in Paris, 29-30 November 1999, with a panel of leading experts. With this Workshop, the organising committee sought to advise the EC on data specification related to spatial referencing systems; to assess, at European level, the issues involved; to identify the relevant actors; and eventually to draft an initial action-plan. Some of the topics addressed were: a common Spatial Reference System for Europe; a survey/collection of the Spatial Reference Systems used in Europe; transformations from national co-ordinates to the common system, and vice versa; specification, validation or certification of software embedded transformation modules.

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A common reference system for geographic information is needed, as a first step, to ensure that data is compatible across Europe. A suitable candidate already exists: ETRS89 (European Terrestrial Reference System). There is consensus amongst the experts that this is the system to adopt at European level and several countries have already done so. It is thus considered that adopting this system would a priori be uncontroversial. For this reason, the Workshop recommended that the European Commission adopt ETRS89 as the geodetic datum for the geo-referenced co-ordinates of its own data and promote the wider use of ETRS89 within all Member States.

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It is not realistic to require all existing data in the Member States to be transformed into this new system – not even in the medium term. However, it could be required for all new data collected and for updates to existing data. In addition, there is also a need for Mapping Agencies to make public the transformation algorithms and parameters for transforming data between national systems and ETRS89. Low precision transformations (2-10m) should be offered at no cost in the public domain.

### 3.1.5 Technical Support/Concertation for the Services of the European Commission

The activities performed to support the Services of the Commission aim to:

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- Provide technical expertise to the EC Internal Committee on Geographic Information (COGI). Provide technical expertise to the follow-up of the High Level Working Group of GI2000 or similar initiatives for a European GI policy. Contribute to the definition of reference/base data and thematic data required at a European level for several applications or policies implementation.

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- Establish and co-ordinate links with other related national and international initiatives, in particular EUROGI and AGILE (Association of GIS Laboratories).
- Author strategic documents relating to GI research in close collaboration with GI actors and researchers (as input for Information Society Technologies Programme work-plan and research agendas).
- Operate GI communication facilities such as the EC GIS WEB site (<http://www.ec-gis.org/>) and be a neutral platform between projects (see Proceedings of the Sixth EC-GIS Workshop, Lyon, June 2000). Set up and maintain a database of EU projects with a high GI/GIS component.

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- Act under specific request of the Services of the Commission in order to provide technical support on GI and GIS (e.g. revision of GISCO architecture), follow GIS related projects, make available infrastructure and intellectual input for conference participation and manage targeted studies on specific topics.

An Inter-Service Committee for GI (COGI) has been established within the EC and the Director General of EUROSTAT chaired its first meeting on the 16th November 1999. COGI helps the Commission to develop an internal policy for GI acquisition, use, and dissemination. In addition, it stimulates the use of geographic information within the Commission services and improves the efficiency and cost effectiveness of the monitoring and impact assessment of European policies that require spatial analysis at a European scale. The draft proposed mandate, to be reviewed on a yearly basis, has yet to be made public and concerns:

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- improve the availability of GI within the Commission services mainly by proposing joint acquisition of basic GI complying with common specifications and needs,
- improve the level of awareness amongst middle and higher management within the Commission of the power of this technology and how it can contribute to the excellence and increased efficiency of European public service,
- project a coherent image of the Commission's GI activities to the outside world,
- develop a data policy applicable to all Commission services to better share existing in-house GI and facilitate its dissemination to outside users at the lowest possible price, thereby stimulating the market for value added services building on this data,
- reduce duplication of effort through better co-ordination between individual activities,
- exchange best practice and experience between departments and thereby contribute to extending and maintaining an in-house expertise and know-how on GI/GIS.

The establishment of COGI is viewed as an important development with potential benefits for the GI sector throughout Europe. A 1997 study on GI-policy funded by former DGXIII clearly indicated the extent to which developing a clear policy within the Commission, which still is the major user of pan-European GI, was a pre-requisite for discussing the implementation of European-wide GI policies with member states and national organisations. It should also be noted that the GI & GIS Project has been invited to participate in the United Nations Working Group on Geographic Information.

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In addition to its institutional activities, the GI & GIS Project is also participating in some competitive activities. An example is the ETEMII Project (Accompanying measure to support the set-up of a Territorial Management Infrastructure). Its main activities are related to building a consensus on such issues as European reference data, interoperability and standardisation. The

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Project also supports European participation in such initiatives as Open GIS Consortium, ISO and GSDI (Global Spatial Data Infrastructure).

### 3.2 Pan-European databases development

This component of the GI & GIS Project is related to the set-up of harmonised and coherent multidisciplinary databases for an enlarged EU. The following activities deal with the conception, creation and/or harmonisation of various Pan-European databases to be used to support and monitor EU policies: Land Cover, Agro-Meteorology, Protected areas, Catchments, etc. (themes in which the spatial component plays an important role). Most of these activities are support and co-ordination of thematic networks such as, for example, the EEA European Topic Centres. A new network is being created with Eumetnet for meteorological aspects.

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#### 3.2.1 Catchment based Information System (CIS).

Within recent years environmental issues have become an increasingly important concern to a wider public. The Common Agricultural Policy (CAP) is shifting towards sustainable agriculture, taking into account environmental aspects. The impact of EU policies as well as assessing environmental hazards and supporting environmental protection has to be addressed. The processes involved are closely linked to the hydrological cycle within catchment areas, rather than administrative or regular geometric units.

In response to the demands for interrogating agri-environmental issues, in 1998, the Space Applications Institute initiated the development of a Catchment-based Information System (CIS).

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The purpose of the CIS is to provide a quantitative response to agri-environmental queries in the framework of an operational activity. In order to achieve its purpose, the following objectives were identified:

- Assessing the impact of European Union policy on agriculture and environment.
- Monitoring environmental changes.
- Evaluating detrimental effects to the environment.
- Supporting environmental protection.

The CIS uses the catchment as a spatial unit of the system and a statistical entity in the analysis and processing steps.

The CIS is based on the following principal design characteristics: multi-scale catchment data set, an integrated data storage structure and linked environmental applications .

#### 3.2.2 Land Use/Land Cover.

The updating of the European-wide CORINE Land Cover database started in 1999 as a joint JRC/EEA project. It is split into two phases, IMAGE2000 (the collection and processing of satellite imagery) and CLC2000 (the actual updating). The satellite images that are the basic input source for updating the land cover database will provide a common reference between national and European demands. Therefore IMAGE2000 is an EU-wide mosaic of ortho-rectified satellite imagery in both European and national projections, dated 2000 with the maximum allowed deviation of one year (1999-2001). Although IMAGE2000 is primarily designed for CLC 2000 production, it can be seen as a multipurpose product that can be used for different topics demanding spatial information within the Commission. The GI&GIS staff are responsible for IMAGE2000, in co-operation with EEA. CLC2000 is under the responsibility of EEA and it is jointly co-ordinated by the JRC and EEA.

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The challenge for updating the CLC data will be to bridge the national and European user requirements, which stress the need for a compatible more detailed inventory at local level. The multi-scale approach for the implementation of CLC2000 better fits the diversity of user requirements. A number of issues regarding the operational use of the CLC2000, namely access to the database, compatibility with other data, harmonisation of metadata and distribution policy are carefully examined.

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The process of updating existing land cover databases is an issue of great strategic importance with respect to the storage and access of existing and valuable information. For this reason, a Land Cover Updating methodology has been defined by SAI. Specific research activities are performed in the area of automatic change detection, aiming at a complementary use of image processing and pattern recognition techniques.

In order to fully exploit the data collected during the past activity on Land Cover changes on coastal zones (LACOAST), a dissemination plan has been set-up. To improve the dissemination activities, a new data model will be designed and a Geo-Data Server technology must be adopted. On this basis it will be possible to: develop environmental and economic indicators (eventually crossing information with other databases), link information to EU regulations, and more easily extend the database to other regions.

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### 3.2.3 Protected Areas.

Natura 2000 is a European network of areas, proposed under the Birds Directive and the Habitats Directive, where human activity must be compatible with the conservation of sites of natural importance. The Natura 2000 network comprises two types of areas: those designated directly by the Member States under the Birds Directive; and those proposed by the Member States under the Habitats Directive and then subjected to a Community selection procedure. Natura 2000 covers large areas of agricultural land. Contrary to a widely held belief in rural areas, the idea behind the Natura 2000 network is not to set up full nature reserves or freeze all human activity on the proposed sites. This would be both impossible and undesirable since the Natura 2000 network could eventually cover 12% of the EU territory. Apart from a few exceptions (intact natural forests and underwater caves), Natura 2000 sites are managed through productive activity. Natura 2000 could therefore become a clear sign of the multi-functionality of agriculture in the third millennium. DG Environment co-ordinates the activities related to the establishment of this network, in collaboration with the European Topic Centre on Nature Conservation of the EEA.

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The development of the Geographic Information System for Natura 2000 is part of the activities carried out by the JRC under the agreement between DG JRC and the DG Environment. The components of this system will play two key roles – firstly, in providing a mechanism for harmonising and validating incoming data from the Member States, each of which has different approaches, and secondly, to provide analytical tools to model, monitor, visualise and publish data relating to the Natura 2000 sites.

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A thorough analysis of the characteristics of the data provided by Member States was undertaken in mid-1999, resulting in the specifications and subsequent development of tools to ensure the establishment of a consistent, pan-European spatial database for Natura 2000. In parallel, work has begun in identifying and analysing requirements for the analytical aspects of the system. Such an information system will be vital to the successful management of the Natura 2000 network, which is a huge organisational task requiring the efficient and reliable flow of information related to the sites between all the actors at local, national and European level.

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### 3.2.4 Agro-Meteorology.

Since 1988, the Joint Research Centre has been participating in the MARS Project (Monitoring Agriculture with Remote Sensing) that provides information to Eurostat and Directorate General Agriculture on the acreage and yield of selected crops of the European Union. Some of the MARS techniques have been transferred to other regions of the world, including the Mediterranean Basin. Agro-meteorology is thus an important component of the MARS Project.

The algorithms implemented to provide interpolated meteorological parameters for the MARS project have gone through extensive research and the elaborated agrometeorological products have now reached a level of possible standardisation. This action aims to organise the elaboration and provision of standard (agro-) meteorological products on a regular basis and the provision of new parameters related to new applications through the collaboration with Eumetnet.

The GI & GIS Project is also participating at the Joint Research Centre Cluster on Agri-Environment.

The JRC has launched the concept of clusters to group various projects targeting the same policy relevant issues in order to achieve critical mass, efficiency and visibility. This allows an integration of institutional activities, a clear identification of the points of contact for policy-makers and avoids duplication of activities. In the case of the JRC Agri-Environmental Cluster, the themes selected are: water, soil, atmosphere, land cover and the horizontal activities include geo-information, regulation verification, socio-economy, future orientation and information exchange.

GI & GIS Project activities in the field of agrometeorology (or related to agrometeorology) also include:

- participation at the EC Agri-Environment Working Group (DG Agriculture, Eurostat, DG Environment, EEA) on "Indicators integration in the Common Agricultural Policy"
- delivery of meteorological data and expertise for the "Fast Track Carbon Budget Estimation" for Community reporting on the Kyoto Protocol.
- delivery of the climatological part of the Unit meteorological database to Eurostat-GISCO for medium term implementation in the common geographic dataset for the services of the Commission. Test of the transfer procedure, metadata definition, dissemination policy, users requirement and feed-back.

The European public and policy-makers are paying increasing attention to the relationship between agriculture and environment. Without doubt, the Common Agricultural Policy (CAP) has favored the modernisation of agriculture in Europe. However, sustainable development and environmental friendly production methods are now major issues in European Union policies. Therefore there is a clear need for assessing, quantifying and monitoring the evolution of agricultural and environmental policies. This could be done with appropriately developed Agri-Environmental indicators. It will be important that these indicators are valuable in interpreting trends in agriculture and in environmental conditions and that they improve transparency, accountability and provide relevant monitoring, control and evaluation tools. However, the relationship between Agriculture and Environment is complex and can only be assessed through an integrated approach to understand processes and interactions and to derive relevant indicators. Geo-spatial information, such as pan-European homogeneous environmental data will be key input. Among the environmental indicators, the importance of activities related to soil (pollution, suitability / potentiality, erosion) and to Land resources are needed at Community level in order to fulfill the information needs in terms of conception, implementation and monitoring sustainable agricultural development. Likewise, water as a dominant theme of the future is underlined in respect to its quality and its use (in agriculture). Global climate and carbon cycle aspects should also be examined for their long-term interactions with agriculture and the environment.

The tasks to be carried out, consist in defining:

- The agri-environmental models and methodologies that are being or can be used to (a) generate environmental information and/or (b) through integrating Agri-Environment Indicators, simulate the future impacts of current agri-environment policies or changes in these policies.
- Data and their availability and quality. The data should reflect for example the physical, chemical and biological state of the environment, as well as the driving forces and pressures on the environment.
- The time and spatial coverage of available data.

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### 3.3 Applied research

Research or research/development is also needed to address specific European topics and the GI & GIS Project is mainly focusing on spatial analysis. The two examples of research activities presented below refer to the use of CORINE Land Cover data to map population density and rural areas, and to the definition of landscape diversity indicators in the European Union.

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#### 3.3.1 Using CORINE Land Cover to map population density and rural areas.

Statistical data are generally available for administrative regions at a certain aggregation level. For the European Union, the standard hierarchical nomenclature is known as NUTS (“Nomenclature des Unités Territoriales Statistiques”). For example, the NUTS 0 level corresponds to the countries, NUTS 3 corresponds, depending on the countries, to the provinces, counties, “départements”, “kreise”, etc. The NUTS 5 level corresponds to the communes.

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For many applications, data with this aggregation level is insufficient for analysis, in particular when geographical and spatial issues are important. We can mention, for example, studies on the environmental impact of agriculture: knowing the area of a particular crop for each region is not enough and some information is needed about the location of crops related to the hydrological catchment structure, soil type, slope, etc.

Population density data can be computed from available data in GISCO at the level of the municipality (NUTS 5). However, the territory of a municipality may be rather heterogeneous, and this level of spatial resolution may be insufficient for planning or modelling purposes. CORINE Land Cover provides information that is geographically more detailed on main types of land cover. A certain municipality may contain, for example, one part of dense urban nucleus, agricultural land with some sparse population, and natural vegetation areas with virtually no population. The main target of this activity is thus to disaggregate population data, imputing different densities to different land cover categories. The method developed for this particular problem still needs some improvement and assessment but can already be applied to more general cases of disaggregation of official statistics with ancillary georeferenced information. It can be useful for problems such as the spatialization of crop area or livestock statistics as an input for models to assess their environmental impact.

Gelöscht: —Seitenumbruch—  
 Gelöscht: CORINE

#### 3.3.2 Landscape diversity indicators in the European Union

There is an increasing concern in the European Commission on the role of the Common Agricultural Policy (CAP) in landscape diversity. Tools are needed to assess the impact that the CAP has had on landscape in the past or may have in the future. It is not easy to have homogeneous data to compare landscape diversity between regions or between two different dates. CORINE Land Cover is a spatial database that allows landscape diversity indicators to be computed and comparisons among European regions to be established, but it is not yet clear to which extent such indicators are robust and comparable.

Gelöscht: data base

For this reason, an activity has been initiated in order to assess to what extent the indicators are really homogeneous across different countries and which indicators are less dependent on the scale of the information. Additional questions appear linked with the existence of heterogeneous classes in CORINE Land Cover, that do not have the same meaning as “pure classes” such as arable land, forest or water bodies. The results suggest that landscape diversity comparisons among regions depend not only on the landscape itself, but also on the way the CORINE Land Cover methodology has been applied in each region. Comparing diversity in different regions can also give quite different results depending on the indicator selected. Calibrating diversity indicators would require detailed land cover data for a large sample in the EU, possibly from a ground survey with compatible specifications.

### 3.3.3 Carbon budget information system

The European Community is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and as such is committed to demonstrate progress in achieving the Kyoto Protocol target and to report emission and sink data. Council Decision 1999/296/EC for a monitoring mechanism of Community CO<sub>2</sub> and other greenhouse gas emissions calls for monitoring the policies and measures taken in the member states and EC<sub>2</sub> reporting by aggregating report data provided by the Member States. Development of an EC in-house monitoring capacity could lead to improved harmonization of methodologies within the Member States and would provide an independent check on data.

Gelöscht: CO2

Formatiert

In 2000, in a joint collaboration between the GI&GIS and the TREES projects, a Carbon Budget Information System (C<sup>BIS</sup>) was set-up to provide a harmonised estimate of carbon sinks in the forests of the fifteen Member States of the European Union (Smits 2000). C<sup>BIS</sup> is based on state of the art bio-geo-chemical carbon modelling, and makes use of unique pan-European geospatial databases such as land-cover, soil, and meteorological databases (Annoni et al. 1998). At present C<sup>BIS</sup> has entered a stage of validation, and the first results will be published in 2001 (Mollicone et al. 2001).

Gelöscht: like

Gelöscht: ¶

## 4. Conclusion

The authors of this paper consider that the set-up of Geographic Infrastructures (at local, regional, national or international levels) is a way to improve 1) the efficiency of ongoing activities and projects, and 2) the access of citizens to public information. Regarding the creation of National Geographic Information Infrastructures, it is interesting to note that, despite the specificity of each country, there is a high degree of similarity in the ongoing technical debate in the European Union Member States and in several EU Enlargement countries. The same issues (concept and definition of an Infrastructure, public mandate and private companies role, rules of competition, national mapping agencies activities, cost recovery and pricing policies, definition of reference data, copyrights, etc.) are discussed with varying issues of consensus in this phase of transition towards the Information Society.

Gelöscht: ...)

For this reason, it is considered by the authors of this paper that there are real fields of possible technical cooperation with non European Union Member States (Enlargement, Mediterranean and Asian countries), for example, on networking activities (support to the creation of National Geographic Associations, Geographic Information thematic networks, participation in European Topic Centres), on the support to the creation of pan-european or national databases (land cover, nature conservation, cadastre) or on the definition and set-up of National Spatial Data Infrastructures to be integrated in European or global initiatives. Such Project Proposals have a clear usefulness in order to manage the natural resources and to prepare our common integration in the Information Society.

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