

## FOR A BETTER DIRECTION OF THE DEVELOPMENT OF GLOBAL ENVIRONMENTAL DATABASES

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### ABSTRACT

This paper is a review of the activity of the ISPRS WG IV/6 which aims to find better direction of the development of global database. There are some problems in developing global databases for mapping and monitoring the environment. Though there are many projects or studies to develop global/continental environmental variables such as IGBP, GLOBE, Global Mapping, AFRICOVER, G3OS, AARS, there is no common table to discuss barriers for the development of global /continental datasets/databases. In this paper, these barriers are described. To cope with this situation, the WG started virtual workshop on the internet which provides the opportunity to discuss these common problems. In addition to the virtual workshop, the WG plans to have a real(physical) workshop in 1999, and plans to conclude the direction of the development of global database by the Amsterdam Congress in 2000. As one of problems, when we want to use global environmental data, it is difficult to access it. Furthermore, it is sometimes difficult even to know the existence of the data. To cope with this problem, the WG started to build metadata database of global/continental environmental variables on the internet.

### 1 WHAT IS A GLOBAL ENVIRONMENTAL DATABASE?

A global environmental database is a database of environmental variables covering global area. An environmental variable may be physical one or socio-economic one. A physical environmental variable may be terrestrial, oceanographic, or atmospheric one. Table 1 shows examples of environmental variables. An environmental data may be given in grid form, vector form, or as irregularly distributed points. In this paper, a single dataset of global environmental variable is also treated.

### 2 WHY DO WE NEED GLOBAL ENVIRONMENTAL DATABASE?

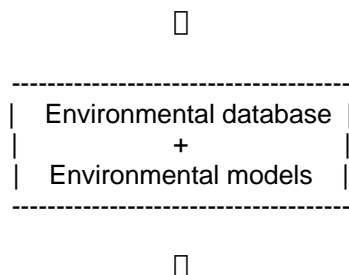
We need global environmental database for research community, for political decision-makers, and for general people especially for young people as materials of education and enlightening of environmental problems. Global environmental dataset shows global environment at a certain time from the view point of one variable, and temporal datasets or change datasets show environmental change from the view point of one variable. One of the most important necessities of global environmental database in research community is that they are input of environmental models including climate model, water circulation model, land use/land cover change model, etc. In the symposium by UNDP and UNEP, held in Bangkok, Thailand in 1994, the most important variables for environmental assessment and sustainable development strategies were identified.. Figure 1 is simplified schematics of an environmental simulation. If we have enough global environmental database and reliable environmental models, which describes environmental mechanism well enough, we can simulate environmental change due to human activities.

**Table 1 Examples of environmental Variables**

Field	Variables
Physical	Terrestrial elevation, land cover
	Oceanographic surface temperature
	Atmospheric aerosol
Socio-economic	human population

Such a system provides reliable information for policy makers to decide the direction of human activities. However it is a challenging task to develop enough global environmental database, and it is much more difficult to understand environmental mechanism completely. The ISPRS WG IV/6 pursues to solve problems in the former challenging task.

Hypothetical data of environmental variables  
(human activities)



Change of other environmental variables  
(effect to global change)

**Figure 1 Simplified schematics of an environmental simulation**

### 3 WHO PRODUCE GLOBAL ENVIRONMENTAL DATABASE/DATASET?

Various groups listed below have been producing global environmental database/dataset.

- International projects  
IGBP-DIS for land cover, GLOBE for elevation, GTOS for in-situ terrestrial ecosystems data
- Organization  
CIESIN for population, GRDC for river run-off data
- Space agencies  
Planning to develop global environmental variables using earth observation satellites such as EOS series and ADEOS series
- Individual researchers  
ETOPO5 for elevation

### 4 WHAT ARE PROBLEMS FOR BETTER GLOBAL DATABASES/ DATASETS? HOW CAN WE SOLVE THEM?

#### 4.1 Mechanism to collect local data for the production of global data

When we think land cover as an example, many local land cover data have been produced by various research projects and by individual researchers as a final product or a by-product. However, in most cases, these data are

used only in the project group or in a limited people. Usually other researchers do not know even the existence of the data. These local data has a value as a secondary ground truth for global land cover mapping. What we need to do to solve this problem is to have meta-database accessible by any person. A good example of this meta-database is the Asian Wide Land use and Cover(AWLC) meta-database initiated by the Japan national committee of the International Geosphere Biosphere Program(IGBP) /Data and Information System(DIS) sub-committee. The AWLC meta-database was started in summer 1998, and it has a function to collect meta-data of land use and land cover data and any related land surface data in Asia.

#### 4.2 Integration of in-situ observation

In-situ observation data is the most reliable data and is used as ground truth in the production of global data. A good example of this action is the Terrestrial Ecosystems Monitoring Sites(TEMS) meta-database by Global Terrestrial Observation System(GTOS) which was established in 1996 by FAO, ICSU, UNESCO, UNEP and WMO

#### 4.3 Cultural bias

The cultural bias is a bias of contribution or input to the production of global data, between developing countries and developed countries. This bias creates a bias of data quality between two regions. Most developing countries have interest in environmental monitoring in the territory of their country, but less interest in continental/global monitoring. However, local observation or mapping can contribute to global dataset production.

#### 4.4 Description about data

Just data without any description about the data is no use. Usually, most data have insufficient description about the method to develop the data, accuracy of the data, map coordinate of the data, limitation of the data. More description of the data makes better use of the data. Good example of the description of the data is the global elevation data, GLOBE, which has an enough description about the data.

#### 4.5 Information of data availability

One of problems for the use of data is that there has been less method to know the existence of data. Development of meta-data is necessary to promote the use of the data. Some organizations, for example United Nations Environmental Program(UNEP) Global Resource Information Database(GRID), summaries a list of available global datasets. The Global Change Master Directory(GCMD) by NASA provides simple meta-data for earth science data on the internet. It includes not only global datasets but also regional and local one. The development of the GCMD is a worthwhile effort to promote the use of the earth science data. For more efficient survey of global/continental dataset/database, ISPRS WG IV/6 begins a new meta-database on the internet, which is Global/Continental Environmental

Variables(GCEV) meta-database.

#### 4.6 Needs for new dataset

Datasets of some global variables are not developed. For example, data needs is one of the main agenda of the Land Use and Land Cover Change(LUCC) Data Requirements Workshop(Barcelona, 11-14 November 1997). There is a lack of global socio-economic data. On the other hand, many physical variables are expected to be developed in the coming decades by earth observation satellites.

#### 4.7 Global base map

Digital global base map of seashore lines, rivers, national boundaries are necessary when some global data including satellite data are geometrically corrected. Commonly used global base maps are the Digital Chart of the World(DCW), the World Vector Shoreline(WVS) data, and World Data Bank II(WDBII). The DCW consists of 17 attributes including seashore lines, rivers, national boundaries, and the source information is the Operational Navigation Chart(ONC) with the scale of 1:1,000,000. The WVS has only seashore line data as its name, and the source information is the Joint Operation Graphic(JOG) with the scale of 1:250,000. The source information of the WDBII is a map with the scale of 3,000,000. From these characteristics, the DCW is the most widely used digital global base map. Since the geometric accuracy of the DCW is about 400 - 600 meters at the examined points(Tateishi 1998), the DCW can be used only for the data with a resolution of 1 km or larger. There is a plan to produce a better digital global base map by National Imagery and Mapping Agency(NIMA) which is VMAP1. However, since we cannot know the time of the completion and its availability, another option to produce a digital global base map should be pursued. It is a production of digital global base map by satellite images with a resolution of about 100 meters and Global Positioning System(GPS). This map will be based on World Geodetic System 84(WGS84), and consists of seashore lines, large rivers and lakes. National boundaries can be added from other sources.

### 5 REMARKS

The importance of the development of global environmental variable datasets is recognized by scientists internationally. What we need now is to recognize problems and find the way for us to go for the better development of global database. For this purpose, ISPRS WG IV/6 initiated the Virtual Workshop on Spatial Environmental Data Issues and plans to have a workshop in fall 1999 and in-depth workshop at the Amsterdam Congress in 2000.

Web site of ISPRS WG IV/6 (The Virtual Workshop on Spatial Environmental Data Issues is linked from this site):  
<http://www.ngdc.noaa.gov/seg/tools/gis/isprs46.html>

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