

EARTHWATCH

GLOBAL ENVIRONMENT MONITORING SYSTEM

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**TOWARDS THE DESIGN FOR A META-DATABASE
FOR THE HARMONIZATION OF ENVIRONMENTAL
MEASUREMENT**

Report of the Expert Group Meeting, July 26-27, 1990



UNITED NATIONS ENVIRONMENT PROGRAMME

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1. INTRODUCTION

The Mission of UNEP-HEM is as follows :

"The Harmonization of Environmental Measurement (HEM) project is to promote the improved collection and management of data, and thereby to enhance the quality and compatibility of information on the state of the environment worldwide."

HEM long-term goals include:

- the establishment of a meta-database as part of a HEM Information System
- the development of environmental classification schemes
- the development of strategies for quality control
- the establishment of international guidelines for specimen banking

Short-term goals include the feasibility of the meta-database, and case studies on environmental classification, quality assurance, and specimen banking. Current activities include an update of the "Inventory of Internationally Active Organisations in the Area of Environmental Measurement" and the development of a "Survey of the International Environmental Monitoring and Information Management Programmes of International Organisations".

The purpose of assembling the Expert Group was to address the first of the identified long-term goals, that is, the establishment of a HEM meta-database. The discussion paper, "A Metadatabase for Harmonization of Environmental Information", which was prepared in advance of the Expert Group Meeting, provides the background in more detail. The Discussion Paper also identified a number of key questions which the experts were expected to address, as follows:

- 1) Is there a clear need for a HEM meta-database?
- 2) What should be the scope and initial priorities?
- 3) Should there be one integrated meta-database or 2 or 3?
- 4) Is the project feasible technically?
- 5) Is the project feasible administratively, and what administrative arrangements are recommended?
- 6) What are the principal sources of data to populate the metadatabase?
- 7) What is the rough configuration needed to do the job?
- 8) What should be the first concrete steps to be taken by HEM towards realizing the database?

The Expert Group consisted of the following individuals (see annex A for the complete address and affiliation):

- Dr. Suad Alagic, Yugoslavia;
- Dr. David M. Clark, USA;
- Dr. Ian Crain, Canada;

Mr. William Garetz, USA;
Dr. Hein van Gils, The Netherlands;
Dr. Michael Matthies, Germany;
Dr. Jürgen Lamp, Germany;
Mr. Jef Maes, Belgium;
Dr. Harry Miles, United Kingdom;
Mr. Jan Mousset, Belgium;
Dr. Ron Witt, Switzerland.

The eleven experts were selected to cover a broad range of the expertise required to effectively advise on such an undertaking - including computer science, spatial information systems, management of large databanks, environmental science, remote sensing. The experts came from academia, government and international agencies in eight different countries.

The meeting was hosted by Dr. Hartmut Keune, Director of UNEP-HEM at their offices on the campus of the Gesellschaft für Strahlen- und Umweltforschung (GSF) in Neuherberg near Munich. Additional assistance was provided by HEM staff and consultants:

Mrs. Gerda Beckers (Administration)
Mrs. Jenny Graham (Secretary)
Mr. Jan-Stefan Fritz (Researcher)
Mr. Heiner Benking (Consultant)

Thus the Expert Group was well fortified by appropriate expertise, administrative and technical support.

2. PRESENTATIONS OF HEM-STAFF

See the agenda (annex B) for further information.

Introductory remarks on scope and mission of the HEM project and the expert group meeting were given by the director of UNEP-HEM.

- Mr. Fritz presented the draft of the UNEP-HEM "Survey of ENVIRONMENTAL MONITORING & INFORMATION MANAGEMENT PROGRAMMES of International Organisations". The draft was thoroughly reviewed after the presentation and considered as a possible first step for the data-collection phase.
- Mr. Benking outlined preliminary design considerations in a short presentation called "Information about Environmental Information". Later on he introduced the invited presentations as follows:

3. PRESENTATIONS OF OBSERVERS

- Mr. Schilling presented the LARS System from MIDAS GmbH, Frankfurt, as a library, archiving and retrieval system available on PC and various other platforms. It is installed and used within HEM and GSF and is considered as a very flexible and broadly used system. The latest version also includes the possibility of handling scanned documents.
- Mr. Sittard from ESRI in Kranzberg presented the ARC/INFO System as it is used for a variety of environmental projects. He covered topics such as interfacing, data-conversion procedures, the World Database II, including geo-referencing possibilities on workstations and PCs.
- Mr. Hilmar Zock from GSF-MEDIS explained the plans of WHO to develop and establish a meta-database for health-related subjects within GSF, with substantial support of the Federal Ministry of Environment.
- Dr. Ulrich Kampffmeyer from Project Consult, Hamburg, described the HYPARCHIVE system he has designed. He focused on classification, multi-lingual thesaurii development and other concepts related to the task of meta-database development.
- Mrs. E.M. Forster from GSF (in the group of Dr. Matthies), presented a meta-database design concept developed for environmental monitoring projects in Germany. She explained in her presentation the actual work and definition problems encountered, was well received. Topics were: data-set definitions, classification issues, and the exchange between various projects. She invited the Expert Group for a demonstration of the system under development.

The above presentations provided information on available technology related to meta-databases for environmental information and therefore an excellent background and stimulus for the formal discussions which followed.

Other observers were:

Mr. Dostalek, MIDAS; Dr. H.Dürbeck, KFA (for UBA);
Mr. Smith, SIEMENS; Mrs. Wehling, IBM.

The observers left the Expert Group Session after the first half day.

4. FORMAL EXPERT GROUP SESSIONS

The formal discussion beginning on Thursday afternoon was introduced by Dr. Ian Crain, the technical convenor of the meeting. Making reference to the discussion paper, this opening statement emphasized the need for the Expert Group to address the question of the **feasible** scope of the proposed HEM meta-database, and to recommend **concrete steps** which Dr. Keune as Director of HEM could undertake in the immediate future.

Following this introduction, David M. Clark of the NOAA World Data Centre in Boulder, Colorado was chosen to chair the subsequent discussions.

Note on Terminology:

Terminology in the fields relating to environmental information systems is inconsistent and confusing. The area bridges a number of disciplines in which the terminology has evolved independently. It was natural therefore that this diverse group of experts would use diverse terminology. Of particular note were words such as dataset, databank, database, data file and so on. "Database" has an exact meaning to a computer scientist, but is used very broadly in other fields to refer to data collections which may not be associated with a database management system. Similarly, "dataset" has a very circumscribed meaning in the context of certain computer operating systems (as a subdivision of a file) but is used in the general sense of "environmental datasets" which can refer to national statistical collections, i.e. equivalent to the term "databank". Other overlapping terms include layer, coverage, map, file (or datafile), assemblage, etc. During discussion this created little problem as the meaning was always clear from the context, however, in report writing this may be less so. For purposes of this report the terms data set, database and databank will be used in the following manner:

Databank: The most general term for a significant collection of data involving large or multiple data files, databases or datasets which may not be in digital format.

Database: This is used in the computer science sense of a large integrated digital data collection with an associated database management system.

Dataset: A sub-unit of collected data, usually part of a database (if digital) or databank. This would usually be more local or project oriented data than a database, for instance, water quality measurements in a specific lake.

The recommendations reflect this terminology.

5. DISCUSSION

General

Under the chairman's guidance, discussion at the Expert Group Meeting was vigorous and constructive. The agenda items were not always approached in strict chronological order, but rather in clusters of interrelated topics. Similarly, the "Key Questions" were used as a summary review tool towards the end of the meeting. For these reasons, this report does not constitute chronological "minutes", but rather a summary of discussions under the general headings of the agenda. No attribution of particular opinions is made to individuals.

Scope and Content of the Meta-database

It is obvious that the scope of the meta-database could not be extremely comprehensive or very narrow and this decision in detail will be depend on defining:

- 1) Who the users are
- 2) What the level of ambition (and funding) of HEM is

Primary users were identified in priority order as follows

- 1) The GEMS system, that is the GEMS components, such as GEMS/Water, GEMS/Atmosphere, and affiliated functions such as GRID, MARC and WCMC
- 2) The UN System, particularly those agencies active in environmental measurements such as WMO, WHO, FAO, UNDP
- 3) International Scientific Organisations such as the ICSU family, IUCN, etc.
- 4) The general scientific community, including government agencies

An important reminder was made that the needs of the national governments (especially FRG) and private companies who support the HEM project must be considered.

In discussing potential users, a round-table review indicated that to the best knowledge of experts, no existing database or inventory met the likely user needs.

Four major subject matter areas were identified as follows, in priority order:

- 1) Environmental databanks
- 2) Global environmental activities
- 3) Environmental classification systems
- 4) Analytical Methods and Models

There was considerable discussion on the latter two items including the question of what meaningful parameters could be stored to describe or typify classification systems or analytical methods in a way which could be useful for the identified users. No agreement was reached on this, except for recognition of the need for some sort of inventory in such items, and that this need should be kept in mind during system design.

The second subject matter area, that of identifying and recording environmental activities was recognized as a monumental task which potentially overlapped with UN system functions, such as INFOTERRA and SWMTEP. It was agreed that existing sources should be used as much as possible in an integrated manner, and the scope should be kept to the largest activities of global significance. A "Survey of the International Environmental Monitoring and Information Management Programmes of International Organisations" was currently being compiled by the HEM office. A draft version was tabled at the meeting and it was recognized as a useful starting point for providing information to the proposed meta-database.

In terms of data content, it was generally agreed that there must be a balance between data content and the cost and difficulty of obtaining and updating the information. All agreed that the initial meta-database should begin with a minimal set of descriptors, which could be augmented later. For the environmental databanks component the following minimal list was identified:

NAME OF DATABASE

GEOGRAPHIC SCOPE

DATA CONTENT KEYWORDS

DATE OF INCEPTION

UPDATE FREQUENCY

MEASUREMENT TECHNIQUES

CLASSIFICATION STANDARDS

ACCURACY/QUALITY CONTROL

LEVEL OF DETAIL/GEOGRAPHIC REFERENCING

RESPONSIBLE ORGANIZATION

CONTACT NAME

CONDITIONS OF ACCESS

DURATION OF OBSERVATION

ASSOCIATED PERSONNEL AND BUDGET

DATABASE TECHNOLOGY

SELECTED SIGNIFICANT PUBLICATIONS

In terms of **geographic scope** it was agreed that **global significance** was important and that would normally exclude databanks of sub-national scope. Emphasis should be on databanks and activities of global, continental, multi-national and national scope (when national data are of global significance).

The existence was noted of significant non-digital databanks, such as national environmental statistics. As a result it was agreed that the meta-database should encompass significant manual databanks.

Relevant recommendations: 1, 2, 3, 4, 5, 7.

6. ALTERNATE STRATEGIES

The previous discussion had concentrated on what the meta-database should contain. This latter discussion emphasized the alternative strategies of **how** to achieve the meta-database. A number of general principles emerged to guide the development of the meta-database:

- 1) A phased approach should be taken starting with a narrow-scope directory of environmental databanks and a catalogue of environmental measurement activities.
- 2) In spite of a phased approach the development must be viewed as an integrated whole. Formal data modelling techniques are recommended and the **entire** concept of four components should be modelled even if implementation of parts could be delayed.
- 3) It was premature to define exactly the hardware and software required, however, the consensus was that off-the-shelf technology should be employed and that PC level technology should be sufficient for initial phases.
- 4) A conventional system life cycle methodology should be used. This Expert Group Meeting could be considered an early phase of

such a development process, and should act as a review committee as the project progresses. Such a methodology (using varying terminology) normally encompasses:

- a) Definition of Requirements (consultation with users)
- b) Functional Design (including data modelling)
- c) Technical Design
- d) Development (may involve pilot studies and prototyping)
- e) Implementation

The a) component above was seen as underway and consultation with primary users was the next obvious step.

In terms of data sources, the Group noted with interest the existence of the U.S. Master Directory of "Global and Regional Data Sets Supporting Global Change Research". It was recognized that this directory had a strong bias towards remotely sensed data, but was a potential valuable data source. As well, the associated format for the directory, the "Directory Interchange Format" (DIF), was of interest. An initial inspection of documentation provided indicated it did not meet the minimal data content list, but could be expanded. As a result it was proposed that HEM should as a trial measure implement the Master Directory to more fully examine its potential (hence Recommendation 6).

Other identified data sources included the IGU Working Group on Global Digital Database Directories "Directory of Directories", INFOTERRA, the UN's SWMTEP (for activities) and inventories of FAO, WMO, MARC, development banks and international organizational.

The existence of meta-databases of large regional environmental databases (such as CORINE and EDC in Europe) were noted. The design of the meta-databases must exhibit downward compatibility with those existing meta-databases. As well experienced practitioners in the field emphasized the need for administrative integration and linkages to ensure automatic and continuous update of the information. Volunteer input via periodic questionnaires was seen as unreliable (hence Recommendation 5)

As the next concrete step, the Group felt that HEM should form a Design Group of contracted experts and employ appropriate in house staff for data administration. It was a strong consensus that this data administrator should be in place and participate in the design phase. The task of the Design Group and Data Administrator are reflected in Recommendations 3.1 to 3.6 and Recommendation 4.

The Group identified as an open issue the need for spatial and temporal referencing in the meta-database, and that the approach to an inventory of analytical methods and models had not been discussed in detail. Much further analysis and design work was needed in these areas.

Reviewing the "Key Questions" the Group consensus was that all had been addressed except 7) "What is the rough configuration needed to do the job?" This question, it was agreed, would best be referred to the Design Group.

7. RECOMMENDATIONS

- 1) The group determined that no other organization currently records coordinated information on environmental databases, programmes and analytical methods worldwide, and so fully supports the goals of the UNEP Harmonization of Environmental Measurement office. It recommends proceeding expeditiously to implement the steps necessary to establish a HEM meta-database.
- 2) The priorities for a HEM meta-database are as follows:
 - 2.1.) Develop a **directory of environmental databanks** concentrating initially on the major global digital databases of the GEMS system including GRID, MARC, and WCMC, other UN specialized agencies and international organisations like WHO, WMO, FAO, OECD, and adding as a second priority regional and national databases of global relevance. Given that some significant environmental data are held manually, consideration should be given to including manual databanks of particular global relevance.
 - 2.2) Develop a **catalogue/inventory of global environmental activities**. (The group preferred "activities" to "programmes", because of potential confusion of the latter with programmes in the computer science sense.)

The United Nations System-Wide Medium Term Environmental Plan (SWMTEP), and the recent HEM Survey of Environmental Monitoring and Information Management Programmes of International Organisations were considered to be preliminary sources of information. Additional information should be sought from major international projects such as IGBP, MAB, and the international development banks.
 - 2.3) Develop an index to significant **classification systems** in use for international environmental data.
 - 2.4) Develop a database of information on **analytical methods** (including models) which are applied to the datasets of (2.1) above.

Note: It was the view of the group that priorities 2.3 and 2.4 required further elaboration by HEM as to scope, level of ambition and anticipated application.

- 3) HEM should proceed as soon as funding is available to design the meta-database, employing a small contracted Design Team of database experts (2 - 3 people). The team should be selected from a mixture of the academic, private and government sectors.

The Design Group should be specifically commissioned to:

- 3.1) consult with UNEP-GEMS officials, especially GRID, MARC, and WCMC, and with other representative future users of the meta-database in the international scientific community;
- 3.2) design a fully integrated system including the four elements described in recommendation 2.1 to 2.4, even though implementation of 2.3 and 2.4 may be part of a later phase;
- 3.3) take note of the advice and comments on the scope and data content for the database given in the Expert Group Report, including the identification of primary users of the HEM meta-database in the following order:
 - GEMS-system,
 - UN system in general,
 - ICSU and other scientific NGO's,
 - Other sponsors, e.g. the Economic Summit Nations,
 - Other governments, including Developing Nations,
 - International scientific community;
- 3.4) note that a number of meta-databases currently exist and to consider how to employ these as sources of data, and how to ensure compatibility with lower level meta-databases. In particular the Expert Group draws attention to the Global Change Master Directory, and the CORINE project;
- 3.5) consider the need for and design issues of incorporating spatial and temporal relationships in the data model;
- 3.6) review the appropriate geographic and thematic scope of the meta-database in light of the Expert Group Report, consultations with representative users and HEM's level of ambition.

The Design Group is to deliver a high level database design, perhaps including formal devices such as an entity-relationship diagram, and make concrete recommendations on required software and hardware. This should take into account the Expert Group Report especially with regard to keeping the technology to the "PC" level if possible.

- 4) It is strongly recommended that the HEM office rapidly employ the full time staff required to give on-going support and continuity to the HEM meta-database. As a minimum, an experienced database administrator, who is familiar with environmental data, and a computer-related clerk/technician are required. The database administrator should be in place during the design and implementation phases in order to provide continuity and capability to fully support the ongoing functions.

- 5) To ensure continued up-date of the meta-database, HEM should be organizationally linked to the UN-system processes, which generate information on environmental activities, such as SWMTEP, INFOTERRA, and UN Project Documents. HEM should seek administrative agreements with primary data collecting agencies to ensure a steady flow of up-to-date information.
- 6) Noting that the U.S. Global Change Master Directory is soon to be implemented at GRID-Geneva, the Group recommends as an interim measure the implementation of this directory at the HEM office as soon as possible. This will allow for examination of the relevance of its data content, "Directory Interchange Format (DIF)" and potential for assisting HEM clients in the short term.
- 7) It is recommended that HEM seek feed-back on priorities and proposed data content from primary users as soon as possible, such as by circulating a copy or abstract of the Expert Group Report.

8. REFERENCES

Report of UNEP Expert Meeting on Improvement and Harmonization of Environmental Measurement, Munich 9-11 December, 1987, GEMS Meeting Reports, No.2

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Munich, 26/27 July 1990

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LARS: A database management tool to be used for the design of meta-databases.

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Title:
ESRI's profile and experience in regard to thematical applications.

Mr. Hilmar Zock
MEDIS, GSF Neuherberg

Title:
A meta-database for "environment and health"

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Title:
Archiving, Classification and Retrieval using multi-lingual thessaurii and multi-media window software. How to get started?

Mrs. E.M. Forster
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Title:
A meta-database for environmental monitoring programs

Demo at the institute

PROGRAMME

**Munich Expert Group Meeting
on HEM meta-database design
Munich, 26./27. July 1990**

Wednesday, July 25

Arrival at Hotel Lechner Hof, Unterföhring (see att. plan)
Eichenweg 4 tel.: 089- 9506141 fax.: 089- 9506966

20:00 Get together (no host bar)

Thursday, July 26

8:00 Departure Hotel (bus transfer to GSF)

8:30 **Opening of the meeting** (GSF conference room)
Welcome address by Professor Levi,
Scientific Director of GSF
Introduction by Professor Ian Crain

9:00 **Presentation of HEM**
Dr. H. Keune, J.-S. Fritz, H. Benking

9:30 **Presentations, demonstration and discussions**

10:45-11:00 Coffee Break

11:00 Continuation of presentation and discussion

12:00 Lunch (GSF cafeteria)

13:00 **Presentation and discussion**
of the Background Paper by professor Ian Crain

13:30 Selection of Chairman

13:30	Expert Group Discussion
13:30-14:40	Principal needs and users of HEM meta-database
14:40-15:00	Coffee Break
15:00-17:30	Scope and data content <ul style="list-style-type: none"> - data sources (global, regional national) - initial priorities - quality control/verification
17:30	Summing up of the discussions
18:00	Bayrische Brotzeit (Invitation by GSF)
ca. 21:00	Bus transfer to the Hotel

Friday, July 27

8:00	Departure Hotel (bus transfer to GSF)
8:30-10:00	Alternate strategies <ul style="list-style-type: none"> - package software - choice of site - on-line access - PC vs mini - geocoding
10:30-10:45	Break
10:45-13:00	Recommendation and future steps
13.00	Adjournment (possibility to have lunch in GSF cafeteria)