

FUTURE OF THE MED-HYCOS

*How to Improve the Project
by
Developing Information System*

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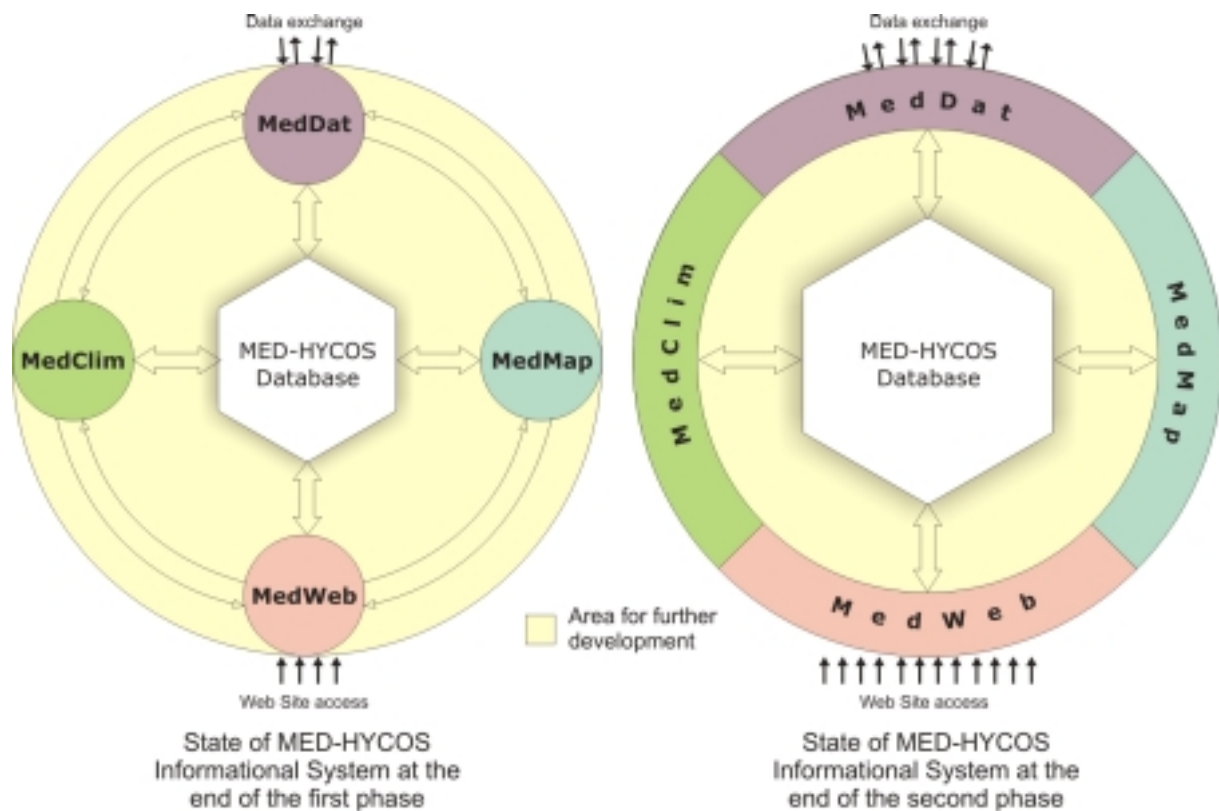
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How to improve the Project



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FUTURE OF THE MED-HYCOS

How to improve the Project by Developing Information System

Foreword

This Report of the **FUTURE OF THE MED-HYCOS** has a clear purpose contained in the first part of the subtitle: “*How to improve the Project*”. The second part of the subtitle gives a clear answer: “*By developing Information System*”. The document was prepared during the author’s expert mission (November 9th till December 9th, 2000) in the MED-HYCOS Regional Pilot Centre (RPC) situated at the Institute for Research and Development (IRD, Montpellier, France). Report contains general description of HYCOS intentions in the light and experiences collected during the first phase of the MED-HYCOS project realisation. Some points from the state of water problems, policy and important actions proposed in the document of Global Water Partnership: “Water for the 21st Century: Vision to Action – The Mediterranean” are also considered. Proposal for MED-HYCOS future work is made according to the decisions of the ICG (MED-HYCOS Initial Co-ordination Group: Final Report of ISG 5th meeting, Tunis, June 2000).

After general discussions, list of groups of possible tools, which can be developed, was done. Only short description (resume) of tools purpose and their application has been made. Also, some guide instruction for tools preparation and advantages of tools presentation through Internet.

The document presents author’s personal view and it can be the matter of discussion with RPC, ASG and General Project Coordinator. For the better future of the project opinions about this document from the all National Hydrological Services from the Mediterranean are welcome too. I really hope that after these discussions the best and optimal solution for the MED-HYCOS project development future can be found. Also, a hope that other HYCOS projects can also make some profit out of this proposal, and maybe even WMO co-ordinating group for HYCOS regional projects.

Zoran M. RADIC,
December 8th 2000,
Montpellier, France

1. GENERAL VIEW OF HYCOS INTENTIONS

According to the Secretary-general Mr. Obasi*, *an essential goal of WMO is to assist its Members in maintaining and improving their information systems. The Organisation uses such means as:*

- *technology transfer and training,*
- *collaboration among meteorological and hydrological services, and*
- *International exchange of data and information.*

The World Hydrological Cycle Observing System (WHYCOS) has been developed to contribute to this goal.

WHYCOS will provide a vehicle not only for disseminating high quality information, but also for promoting international collaboration. It will build the capacity of national Hydrological Services (NHSs), so that they are ready to face the demands of the 21st century. It will provide a means for the international community to monitor more accurately water resources at the global level, and to understand the global hydrological cycle.

WHYCOS **objectives** are to:

- Strengthen the technical and institutional capacities of hydrological services to capture and process hydrological data, and meet the needs of their end users for information on the status and trend of water resources;
- Establish a global network of national hydrological observatories which provide information of a consistent quality, transmitted in real time to national and regional databases, via the Global Telecommunication System (GTS) of WMO; and
- Promote and facilitate the dissemination and use of water-related information, using modern information technology such as the World Wide Web and CD-ROMs.

WHYCOS has two **components**:

- *a support component, which strengthens cooperative links among participating countries; and*
- *an operational component, which achieves "on the ground" implementation at regional and international river basin levels.*

An important product of WHYCOS is regional data sets that are of consistent quality and can be used in preparing products for water resources assessment and management. However, WHYCOS has been conceived, perhaps more importantly, as a vehicle for:

* For more information about WHYCOS see WMO site <http://www.wmo.ch>

- technology transfer,
- training, and
- capacity building.

By providing a framework of common guidelines and standards, WHYCOS enables the use of information from the regional HYCOS for larger scale applications, such as research into the global hydrological cycle. Hence, WHYCOS can make an important contribution to the work of other WMO and international scientific programmes which require water-related information.

Nine (9) **key steps** in establishing a regional HYCOS include:

- 1) *Reaching agreement among participating countries to proceed with establishing a HYCOS*
- 2) *Defining the needs which are to be met*
- 3) *Installing a real-time data collection and transmission system*
- 4) *Upgrading national data processing and archiving systems*
- 5) *Establishing distributed regional databases*
- 6) *Establishing a regional telecommunication network*
- 7) *Preparing and disseminating hydrological information of national and regional interest*
- 8) *Staff training*
- 9) *Performance monitoring and follow-up*

Study of these key steps is of great help to proper implementation of the HYCOS intentions.

Beside of W-HYCOS contained explanation of these key steps, author's understanding of meaning of some steps is explained in details in the following text.

2. MED-HYCOS AS A FIRST HYCOS COMPONENT

Mediterranean Observing Hydrological Cycle program is established as a first World HYCOS Regional Project. All objectives and intentions of MED-HYCOS project are strictly defined and described in the Project Document (see <http://medhycos.com>).

During the first phase of MED-HYCOS project implementation (1995-2000) serious attempts were made and results were obtained. It can be concluded those HYCOS key steps 3,4,5 and 6 were strictly followed. In the ICG 5th meeting (Tunis, June 2000) careful monitoring of performance against defined objectives is maintained and difficulties that can be avoided are identified, so, key step 9 is also implemented.

Main **objectives** of the MED-HYCOS Project proposed for the first phase were:

- DEVELOPMENT OF THE DCP NETWORK
- DEVELOPMENT OF THE MED-HYCOS Information System (IS)
- IMPROVEMENT OF NATIONAL HYDROLOGICAL SERVICES
- DEVELOPMENT OF THE COOPERATION INFRASTRUCTURE

For the **future work** participants on the ICG 5th meeting (see Final Report) agreed that the emphasis should be on:

- ◆ REGIONAL APPROACH WITH FOCUS ON WATER ASSESSMENT AND MANAGEMENT
- ◆ REAL-TIME DATA FOR FORECASTING AND WARNING
- ◆ TECHNOLOGY TRANSFER
- ◆ INTERNET ORIENTED PRODUCTS AND TOOLS

For the full implementation of proposed objectives, wider understanding and implementation of HYCOS key steps 1,2,7 and 8 are necessary.

Difficulties appeared during the first phase of MED-HYCOS project implementation, such as:

- DCP's installation, real-time data collection and transfer,
- Number and dynamic of near-real time data exchanges,
- Dynamic of observing network completing etc.,

discussions made during the ISG 5th meeting are clearly showed that:

- ◆ *Developed components of Information System highly contributed to the global project success during the first phase of MED-HYCOS development,*
- ◆ *Information System is the heart of the MED-HYCOS and none of the four main objectives can be successfully realized out of it!*

By developing IS other problems such as:

- *How to reach agreement among participating countries to proceed with establishing a HYCOS (key step 1)?*

will be easily overcome if new products are oriented to solve the problem contained in the HYCOS key step 2:

- *By defining the needs that are to be met!*

3. EXPECTED HYCOS PRODUCTS

What are the products in a sense of HYCOS intentions?

The products in a sense of HYCOS intentions are explained in to the key-step 7 as:

“ A wide range of information products, which meet specific user needs, can be prepared from the data provided by the observing system. This includes forecasts, hydrological statistics, information on trends on the state of the water resource, or "yearbooks" in electronic format. Products are designed to meet specific needs of users and are widely disseminated via the regional telecommunication network and other, more traditional methods.”

Preferred MED-HYCOS products

Following HYCOS intentions and MED-HYCOS needs it is clear that different products must be developed for the potential users. Potential users of MED-IS products are:

- National Hydrological Services, and
- Regional centres for global studies.

The needs for the global studies are of common interest of all citizens living in the Mediterranean, but sometimes some NHS cannot recognise that need. NHS has some specific needs also. They are often under pressure with the current activities and problems, and they don't have time nor interest in international activities and global studies.

But,

- ◆ *If products contained in the MED-HYCOS Information System can solve same or most actual NHS needs,*

it can be supposed that global needs can be easily solved too.

So, optimal solution can be found for both interests (national and international one),

- ◆ *If new MED products can be used on both National and International level.*

In practice, it is impossible to use all products in different time and scale steps, but some of the components (or modules) can be easily applied in different macro tools. That means:

- ◆ *All MED tools must be developed as compatible (using the same standards and principles).*

Standardisation of product opens new important possibilities:

- *Continuous development of tools possibilities,*
- *Application of same components or modules separately and*
- *Distribution of some tools to the NHS before completing macro modules.*

Other advantages of this approach will be presented later.

Two main groups of MED tools

New tools and MED-HYCOS products are divided in to two groups:

- *Tools strictly dedicated to the National Hydrological Services, and*
- *Tools of common interest.*

Tools dedicated to the National Hydrological Services can be divided in to three sub-groups:

- *Simple tools for every day NHS activities,*
- *Modules for solving main problems at the sub-regional level (droughts, floods etc.),*
- *Internet oriented macro-tools, which improve NHS activities in the relations to the external users and at the national level.*

By introducing this kind of products MED-HYCOS also (partly) satisfies HYCOS objective contained in key step 7(Staff training), which means:

“ Training in the use of the newly introduced technology is, of course, essential, but the opportunity can also be taken to provide refresher training in more conventional hydrological skills, as well as in non-technical areas such as administration, public relations, marketing and customer service“.

Products from the group three can be developed and presented in demo versions. When their applicability is seen, it is expected that NHS will be stimulated to participate not only in sharing data and products but also financially.

Tools of common interest are dedicated to the water balance and water regime studies, as well as for the improvement of water assessment and management in Mediterranean. For study of global process:

- non-standard methods can be applied,
- data from wider area are necessary, and
- high level of scientific knowledge must be introduced.

It is highly optimistic expectation that NHS in Mediterranean has resources to study problems such as:

- Structural analysis of hydrologic series,
- Developing methods for study of the influence of global climatic changes on hydrological regime,
- Influence of human activities on runoff process at the catchment scale,
- Developing and introducing new technologies as GIS (Geographic Information System) or RS (Remote Sensing).

All cited problems are of great NHS interest, and MED-HYCOS must be on help. According to the WMO:

“...A major contribution of WHYCOS, then, will be to provide a means for incorporating information about the global water cycle into efforts to understand the global environment...”

It is clear that to understand the global environment:

- *Hydrological data*, and
- *Methods for their analysis*

Should be available.

Internet oriented MED products

In the HYCOS program Internet is seen as:

- “A key element for promoting data exchange and scientific co-operation is the establishment, using the Internet and other modern data transmission technologies, of a "global hydrological information system". It will provide a medium for easy, fast dissemination and exchange of water-related data and information, which has become a prerequisite for efficient and cost-effective operational hydrology, and
- “World Wide Web will be used for discussing results, obtaining feedback, expressing needs, and sharing ideas and views. Electronic communication will be supplemented by face-to-face meetings, for such purposes as fine tuning programme outputs to meet the precise needs of end users.”

But, real advantages of Internet will be achieved with the *development of hydrological tools in Internet environment.*

As a first HYCOS project MED-HYCOS must be the first in this new area of development and implementation of new technology in Hydrology.

WHY new tools?

The best way for the realisation of cited MED-HYCOS objectives No.2 to No.4 is development of new tools.

In addition, tools application on MED-HYCOS data can prove the need for:

- The future data base development,
- More historical and near real time data,
- More real-time hydrological data,

In that way, the needs for DCP network system and their development will be improved. It means that objective No.1 of the MED-HYCOS project can be easily realized with the help of IS and developing of the new IS products.

During the training courses, users from different countries were asking for the extension of the existing product (MED-DAT and MED-MAP) capability.

WHICH type of tools can be developed?

The main WMO roles are:

- Changing the experiences between NHS, and
- Improving NHS practice.

It can be done in different way. Therefore, products exchanged through the WMO programs must have two components:

- Applicative, and
- Educative.

The same characteristics must have MED-HYCOS products. Two groups of new tools can be developed:

- Teaching tools, and
- Applicative tools.

Teaching tools must have two specific characteristics:

- *They must be written in a form of electronic books, and*
- *Instead of simple teachings, it must contain expert knowledge too.*
-

Applicative tools instead of application program must have:

- *Full help support, and*
- *Characteristics of program type “know-how”,*

which means that instruction of type:

- *Why?*,
- *When?*,
- *What?*,
- *How?* ,

must be Included. Of special interest, for users in the NHS’s are the answers to the questions like:

- ◆ *“When-Yes”*,
- ◆ *“When-No” and*
- ◆ *“What Now”* .

It is clear that this type of preferred tools could be made by the *highly skilled experts* with the knowledge both in *Hydrology* and in new *Information technology*.

4. IMPROVEMENT OF MED-HYCOS INFORMATION SYSTEM

During the next phase of MED-HYCOS project development, several changes of MED-DAT can be proposed.

Some of proposed tools are very simple and oriented to make database more efficient and useful. Other simple tools present a base for the development more sophisticated modules.

Some of the tools can be useful for solving some specific problems at national service level, local or regional level and others for the studies and presentation of water cycle (water balance and hydrological regime studies) in the whole Mediterranean area. The last purpose is connected with the future development a new MED-MAP or MED-CLIM tools.

Suggested tools are grouped and presented with existing MED-DAT, MED-MAP and MED-CLIM components of Information system.

Grouping and categorization of tools is made logically:

- *simple,*
- *more complicated,* and
- *complex.*

For some tools additional features are included. They are, more or less, important for other hydrological applications. They are separated and underlined.

4.1. DATA BASE IMPROVEMENT

UPGRADE OF EXISTING TOOLS:

- **Station elevation and catchment area must be added as a minimum**
- **Tools for the general presentation data base content**
Including: - Data types, ganthograme and tabular presentations for all or selected data types and period of time
- **Graphical presentations must query which will permit selection of the first and the last date of data which can be drawn for one or more selected years**
- **Tools for duration curves can be added with query for the selection data time step and the period of data which can be analyzed**

- More statistical characteristics can be added and selection of the period of data can be defined by the users

*Including: - confidence interval and standard errors, and
- recursion estimation techniques*

DATA RETRIAL AND EXTRACTION TOOLS:

- Tools for data selection according to the defined keys are, for example existing data type, data step, geographical location (between specified latitudes and longitudes), selected elevations, common or selected period of data sets etc.
- Tools for data sorting in order acceptable for publishing the hydrological year-books
- Extraction of yearly extreme values from daily data sets

*Including: - Duration selection for daily minimum values
- Automatic derivation of the statistics,
- Test for independence and stationarity,
- Test for homogeneity and stationarity and
- Test for detection of outliers*

- Extraction of yearly extremes over/under threshold values (threshold selection can be made using duration curves, or selected by the user)

*Including: - Automatic derivation of the statistics
- Independency test (absence of correlation)*

- Extraction of water volumes, and their duration from daily data sets

*Including: - Automatic derivation of the statistics
- Independency test*

- Hydrograph separation methods (direct and base flow component) using different automatic procedures (constant interval method, moving interval method, and modified L'Vovich method)

Including: - Automatic procedure for base flow index (BFI) calculation

STATISTICAL (or frequency analysis) TOOLS :

- Probability distribution derivation using yearly extremes method (flood and low flows statistical analysis including tabular and graphical presentations of quintiles and plotting position for empirical data sets)

*Including: - Automatic procedure for distribution selection according to the time series statistical values and distribution properties
- Goodness of fit test
- Derivation of confidence limits for distribution
- Probability plots on probability graph paper (quintiles)*

for theoretical distribution and plotting positions derived for empirical values)

- **Yearly extremes analysis using POT (or PUT) method**
Including: - Goodness of fit test
- Probability plots on probability graph paper
- **Floods and droughts analysis (statistical analysis of deficit volumes and deficits duration)**
Including: - Automatic procedure for distribution selection
- Goodness of fit test,
- Probability plots on probability graph paper

TIME SERIES STRUCTURAL ANALYSIS TOOLS :

- **Time series stochastic characteristics (ACF, PACF, Periodogramme)**
- **Structural analysis of long yearly or monthly series using TIPS approach (or global changes study)**
Including: - Tendency (trend analysis and jumps in data),
- Intermittency,
- Periodicity (seasonal and cyclical),
- Stochasticity study
- **Structural analysis of daily data sets and improving methods for flow prediction and forecasting (based on TIPS approach smoothed statistical functions and probability of 365 distribution of daily flows)**
- **Simulation techniques (or synthetic series simulation)**

MULTIVARIATE HYDROLOGICAL SERIES ANALYSIS TOOLS :

- **Missing data derivation using regression and correlation techniques**
Including: - Two variable linear correlation with confidence level
and different quality measures
- Different types of non-linear regression curves fitting
- **Regional analysis and equations**
Including: - Multiple linear, non-linear and canonical correlation
- Space correlation method
- Cluster analysis of data

FLOOD AND DROUGHTS SIMULATION AND MITIGATION:

- **Continuous base flow simulation model (suggested for the catchment with dominant underground flows, and for drought period prediction)**
Including: - *Hydrograph separation techniques based on IH method for BFI determination,*
- *Model identification tools*
- *Different methods for model quality control*
- **Self teaching model for real-time flow forecasting**
Including: - *Binary presentation of state,*
- *Model with seasonally changed parameters*
- *Forecasts probability*
- *Lead-time of 5 days*
- **Reservoir simulation program for the management of water in extreme situations (flood and droughts)**
Including: - *Possibility for reservoir volume control*
- *Different strategy analysis*
- *ICOR method for optimal solution determination*

INTERNET ORIENTED REGIONAL PRESENTATION TOOLS:

- **Flow probability presentation in Internet environment. The same system can be used for flood flows, mean flows, or low flows with different duration's,**
Including: - *Searching through the map or query*
- *Presentation of the main catchment characteristics*
(useful for regional studies)
- *Probability table*
- *Probability plots on probability graph paper*
- *Data base or recursion parameter estimation*
- **Water balance component presentation in Internet environment (or: aerial presentation of drought condition)**

GIS ORIENTED RAINFALL RUNOFF MODELING TOOLS:

- **GIS oriented distributed model for simulation of runoff from the moving rainstorms:**
Including: - *Connection with meteorological radar data*
- **GIS oriented, physically based, distributed water balance simulation model**

- Including:
- Penman method for PET simulation according to the land use map
 - Philip model for infiltration simulation according to the soil map (with different initial and boundary conditions)
 - DTM model for surface flow direction determination and flow speed simulation according to the land-use map
 - Direct and base flow hydrograph component Simulation
 - Continual simulation of soil moisture content

4.2. MED-MAP IMPROVEMENT:

Existing MAP component of MED-HYCOS information system contains state boundaries, catchment boundaries, station locations and rivers from which data are included in data base. For new applications and graphical presentation in Internet environment, new layers must be included.

Having in mind that Internet oriented product of MED-HYCOS are most important, development of MAP tools must be connected with development of other IS component (i.e., with new MED-DAT and MED-CLIM tools), connected with GIS oriented models and Remote sensing satellites data collection system.

More thematic data from the national services can be supplied only if demo map tools prove the products usable.

UPGRADE OF EXISTING TOOLS:

- **Boundary of all continental parts from which water reach the Mediterranean Sea, including subdivision to the regional seas contributing area (as the Adriatic sea, the Aegean sea, the Ionic sea etc.). This subdivision is important for the countries where national water quantities are divided and flowing to the different directions (as in Turkey, Bulgaria, Yugoslavia, Italy, France, Spain etc.)**
- **Complete river network for all rivers included in MED-HYCOS data base according to the generally accepted scale (only the most important tributaries should be added)**
- **River network and catchment boundaries for all basins connected to the Mediterranean sea**

NEW LAYERS:

- **Digital maps for complete river network and hydrological stations in national level**
- **New catchments characteristics in digital form (DEM, Soil map, Land use map, Vegetation map, etc.)**
- **Water works and water use maps at the catchments scale**

NEW MAP TOOLS DEVELOPMENT:

- **New graphical and tabular presentation connected with new features included in MED-DAT with corresponding queries (such as tools for Internet presentation of flood statistics etc.)**
- **New tools for Water balance aerial presentation**

Including: - Options with the different level of available data sets

for drought indices presentation

- *Aerial presentation of rainfall drought indices*
- *Aerial presentation of potential and actual evapotranspiration*
- *Aerial presentation of soil moisture*
- *Aerial presentation of runoff indices etc.*

4.3. MED-CLIM IMPROVEMENT

Existing MED-CLIM tools contain sufficient number of stations and representative data sets for developing demo for meteorological droughts presentation and for long series structural analysis. Also, drought rank and severity of past droughts can be studied.

For better data presentation and recognising of dry and wet seasons and Aerial presentation of dry and wet years additional tools must be developed.

UPGRADE OF EXISTING TOOLS:

- **Rainfall and Temperature data analysis and map presentation on relative scale**
- **Improving rainfall and temperature aerial interpolation tools including influence of elevation (DEM data) and other parameters (station orientation etc.)**

NEW MAP TOOLS DEVELOPMENT

- **Tools for points potential evapotranspiration calculation (using meteorological parameters and land use map) and aerial interpolation and PET presentation**

- **Tools for meteorological droughts analysis, prediction and Aerial presentation**

Including:

- Structural analysis of long series
- Droughts indices introduction and
- Severity of droughts studies
- Study of global changes in Mediterranean

5. EXPECTED FINAL PRODUCTS AT THE END OF THE SECOND PHASE

Careful monitoring of performance against defined objectives at the end of the first phase of MED-HYCOS show that all other objectives are highly connected and correlated with the results obtained through IS development.

At the beginning, hydrological services expressed the greatest interest for the database development and its application on the national scale, and then, for the application of the mapping tools. So, MED-DAT and MED-MAP tools were fully justified. At the end of phase one, many suggestions and conclusions were collected in order to improve these tools for the future. New tools will cover these suggested changes.

During the first phase, representative climatic data sets were collected. Air temperature and monthly and yearly rainfall data sets cover all the Mediterranean and contain long series, but MED-CLIM tools has not yet confirmed its usefulness.

Actual topic as:

- *Detection of order of global climatic changes in some regions, and*
- *Drought monitoring*

are the most important and the most attractive topics for water management. Therefore, more serious as well as attractive MED-CLIM tools must be developed. Proposed tools are fully oriented to cited subjects.

Having in mind local changes (i.e., human influences on catchment scale) such as:

- *Changes on land-use* (introduced by the processes like deforestation and urbanization),

- *Changes of water regime* (influenced by intensive irrigation, water supply and sewage systems, river regulations, reservoir building etc)

it is clear that water assessment and management, or real-time flow forecasting and warning system can be developed only by using distributed rainfall-runoff models. For this purpose serious analysis of area distribution of meteorological parameters are necessary. Therefore, for the water balance, simulation and modeling on the catchment scale the most important are the tools for aerial presentation of rainfall and potential evapotranspiration should be included in the list of new CLIM-tools.

At the end of the second phase of MED-HYCOS developing program several macro-tools in Internet environment should be developed:

1. Number of simple but very *useful tools for all day activities of National Hydrological Services*,
2. *Macro-tools for the statistical analysis* including teaching tools and Internet presentation of the statistical products by maps,
3. *Macro-tools for time-series structural analysis* and simulations including teaching tools for The TIPS method. This can be applied on global climatic change studies, as well as on structural analysis of daily flow series or rainfall episodes. Mapping presentation of results will be also included,
4. *Macro-tools for drought monitoring* in the national and regional scales. They include different indicators for meteorological, agricultural or hydrological drought conditions; as well as mapping tools,
5. *Macro-tools for water balance study and water management on the catchment scale*. Different modules will be developed including GIS oriented rainfall-runoff distributed model, Remote Sensing data, base flow (low flow prediction) and flood simulations and forecasting. The influence of different water use strategies and water allocation schemes and reservoir regulation will be included. Effects and influence of catchment characteristic changes (land-use and urbanization) will be simulated as well.
6. *Macro tools for mapping* and studies of point and aerial distribution of *water quality indicators, suspension and solid transport*. Using this tools connection of water quantity with water quality parameters or solid

transport production will be more easily studied. Those tools will be with the developing of real-time water quality data collection system.

6. PROPOSAL FOR MED-HYCOS ORGANISATIONAL CHANGES

Considering that:

- Completing of MED-HYCOS network observing system is still in progress,
- With existing DCP network it is not possible to obtain real-time data from all key stations and sub-catchments in Mediterranean,
- Number of station with near real-time data is also limited,

it is necessary to make mechanism to initiate National Hydrological Services to cooperate.

This can be achieved in three ways:

- *By developing new attractive tools,*
- *By organization changes within MED-HYCOS, and*
- *By introducing the principle of reciprocity.*

New tools and products, for cited reason, are divided in two groups:

- Tools strictly dedicated to the National Hydrological Services, and
- Tools for common interest.

Organizational changes mean spreading of responsibility between:

- Pilot Regional Center (PRC),
- Regional Sub-Centers (RSC), and
- National Hydrological Services (NHS).

Principle of reciprocity in international cooperation is desirable and acceptable.

It can be applied by introducing some rules as for example:

- The contract between PRC and NHS (connected with DCP installation) must strictly include the exchange of near-real time data for at least 3 or 5 stations,
- The same rule must be applied to hardware, software and tools distribution through PRC,
- In case the local law prevents free data exchange specific hydrological products may be accepted too. Compatibility can be achieved by using MED-HYCOS proposed methodology.

- In reverse PRC or RSC can make an obligation to supply some product for NHS as compensation for wide real time or near real-time data exchange.

All obligations must be included in the contract with specified duration.

7. THE ROLE OF MED-HYCOS REGIONAL SUB-CENTRES

Legislative basis for RSC establishment already exists (see MED-HYCOS Project Document, points 52, 57 and 63 for example). On the first MED-HYCOS Technical Report (WMO and WB, Montpellier, 1995) some proposals for Sub-regional Center was already made. This idea was already discussed during The 5th ISG meeting (Tunis, 2000). The idea was to establish some pilot basins in order to study “problems common to several countries...” (see point 7 in ‘Proposals for future work’).

MED-HYCOS RSC can be established as:

- ***Developing***, which means new tools development,
- ***Educational***, meaning new technology training like GIS application in hydrology, Remote Sensing techniques application, or programming in Internet environment for example,
- ***Applicative***, meaning the implementation of certain tools in national hydrological services of the certain sub-region,
- ***Technical***, meaning DCP installation, equipment control, checking of rating curves etc.

The decision to form MED-HYCOS Sub-Centers should fulfill as many above-mentioned functions as possible. Activities of RSC should be completely controlled by PRC.

RSC establishment would make the work of PRC easier. The application of tools on the national services level would be transferred from RPC to RSC. RPC would:

- Coordinate RSC activities,
- Develop DCP network,
- Collect real-time and near real-time data,
- Improve IS capabilities,
- Implement tools in all Mediterranean, and
- Intensify the collaboration with other comparative programs and international projects in Mediterranean.

RSC should be established within NHC, but in order to develop tools that are more sophisticated and education in new technology, which requires scientific knowledge, it is necessary to make direct or indirect contract with the universities or the research institutes.

8. STRATEGIE AND PLAN FOR TOOLS DEVELOPMENT

GENERAL REMARKS

It is known that adequate planning is the most important part for successful work done. The MED-tools development plan must have several phases and components:

- *General, strategic plan* for the whole period of project (in this case second phase of the program implementation),
- *Overall plan* for developing and implementation of macro-tools,
- *Detailed plan* for developing main components for macro-tools and their inclusion in MED-Information System,
- *Dynamic plan* for developing partial tools (modules),
- *Short period plan* for the most urgent actions.

In this Report the list of a great number of new tools is given, as well as their incorporation into several macro-tools that can be the final products of MED-HYCOS project at the end of the second phase. In the following text, some suggestions are given about the priority (according to the general project strategy), but general plan for tools dynamic development should be made after summing opinions of NHS's. Common interest can be found by sending:

- *Questionnaire* and
- *A list of possible products*

to the NHS. That list should also contain short explanations of each of the suggested tools*.

Having in mind that the development of the new MED products contains three main ideas:

- *To make products for hydrological observations, regime and water balance presentation on the Mediterranean;*
- *To stimulate NHS to collaborate in bilateral, sub-regional and international level, and*
- *To stimulate other (non-participating) countries to participate in MED-HYCOS project,*

* Unfortunately, during the short period of this visit it was impossible to make them.

planning of new tools presentation and popularisation of MED product, would be of special importance.

MARKETING ASPECTS

Popularization of project results must contain efforts oriented to marketing. It can be made continually, and in different phases:

- *Instant*, after completing some attractive component (new module which for improving NHS current activities),
- *Partial*, after completing important macro tools component (which connects several modules), and
- *Final*, when all products are completed (complex macro-tools).

Exchange of information on new products (completed or in development) is also an important part of the future of the project and performance. This can be done in different ways:

- *By Internet presentation* (using MED-WEB),
- *By mail or by fax* distributed memory-letters sent to the NHS and personally,
- *By organising demo-presentations* during ISG meetings,
- *By organising the visits* to some NHS.

The last mentioned way of information distribution on MED-HYCOS project and the demonstration of MED-products possibilities may be especially useful for the countries out of ISG.

For the countries out of HYCOS activities the best effects would be to have MED visiting group but also the representative from WMO. In that case, wider interest of national TV network and press can be expected and helpful in spreading general attitude of the HYCOS Program and its importance on the international level.

Wider distribution and proper presentation of MED-products possibilities by teaching component or demo version of future product should cause serious attention of some Hydrological Services and, may be their support too.

Way of preparation and proper presentation of teaching tools and help-supporting files, suggested in this report, is also very important:

- *If NHS realizes that some MED-product is more than just a simple program (because it contain know-how component too), it will accept these tools instead of similar tools (already available product with the same technical characteristics).*

SHORT-TERM PLAN AND STRATEGIE FOR THE BEAGINING OF SECOND PHASE

From the MED-HYCOS strategic point of view, three points are very important:

- At the beginning of the phase two, wider useful tools (more attractive for NHS) should be developed first,
- Acceptability of MED product will be achieved *if* NHS knows that already available MED-tools will coming soon as the part of some macro-tools,
- Especially, if *Internet oriented tools* are the final product (NHS can improve its status on national level), it will be certainly accepted.
- Even greater effect will be achieved if *mapping presentation tools* are included in the Internet presentation of products.

From the HYCOS point of view, such orientation is even more important. Internet oriented and mapping-supporting tools can be considered a final objective of HYCOS for two reasons:

- They enable adequate presentation of the hydrological cycle in all Mediterranean,
- Their application makes a new way of communications around WMO and with the hydrology product users, which means: instead of rough data even a hydrological products can be exchanged.

This possibility as a new style of communication between NHS on the international level can overcome existing problems and misunderstandings about the question:

- *Free data exchange yes or no?*

Declarative acceptance of free data exchanges on the WMO level and discrepancy of that in practice is evident on both national and international level. Very often, water assessment and water management improvement problems are the results of the lack of adequate or available hydrological data (including water quantity and water quality data). So:

- By introducing new tools into NHS we enable them to produce wider useful products, and support them to exchange them,
- Of course, first we must show them to the NHS and prove they are of both, national and international benefit.

If MED-HYCOS by developing new products, contributes in that area, automatically:

- ◆ Almost all HYCOS key steps will be completed,

- ◆ Main idea and objectives of HYCOS Programme will be achieved,
and, consequently:

- ◆ The improvement of MED-HYCOS project will be completed.

FINANSICAL ASPECTS

Developing hydrological tools on Internet environment is very attractive, but also, difficult and *highly specialised expert job*. This is especially true, if sophisticated “know-how” support and mapping tools are included.

Having in mind the importance of water in the new millennium, and the role of HYCOS as a support for water assessment and water management at the global level, all suggested macro tools contain characteristics of high technology products.

For that reasons, adequate financial support for product developing, tools presentation, and organization of teaching seminars and training courses, are necessary. Budget for this purpose must be planned and funds distributed according to the expected results and benefit for the Project.

9. FINAL REMARKS

Presented report is written in short form with short explanations. Extraction of main points is made by underlying, by italic/bold presentation of some points or combining cited forms.

For this reason all document can be seen as conclusion presentation and separate conclusions are not necessary.

May be even shorter document will be more appropriate for some reasons, and some explanations may be insufficient. The usage of this document through the MED-HYCOS will show all their advantages or insufficiency. However, before serious conclusions and critics of the document, the short period of its preparation must be taken into account.

From the author’s point of view of MED-HYCOS project history and main HYCOS ideas and objectives, presented document satisfy both. If NHS’s and Project leading groups (ISG and PRC) have the same opinion future of the project will be proved.

Realisation of suggested tools can be organized in different ways and realisation can be made by different dynamic. Therefore, definite judgment of this report will be possible only also at the end of the second phase of the MED-HYCOS.

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MED-HYCOS Project present and future symbolic presentation is on the front page of this report. It represents the development of all Information System and database. The result is better information exchange and number of Internet access to the MED-WEB.

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