



**Hydrometeorological Data Acquisition,
Transmission and Dissemination
through the MED-HYCOS Project**
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Introduction

Water resources management and assessment are based on a coherent analysis of various series of observations over a long period and the provisioning of information in real time or slightly later. To reach this target, the World Meteorological Organisation (WMO) -, in association with the World Bank -, launched in 1995 the World Hydrological Cycle Observing System (WHYCOS), based on a global network of reference stations with real-time satellite data transmission, to contributing to the development of consistent, high-quality and constantly updated and distributed national, regional and international data bases on river flow, water quality and certain climatic variables.

In the Mediterranean Basin, the MED-HYCOS project (Mediterranean Hydrological Cycle Observing System) contributes to water resources assessment and management by helping the national Hydrological Services to strengthen their capacities level of competence and by promoting the exchange of information and skills among the countries participating in the project.

The MED-HYCOS project is structured aroundon the following main activities :

- implementation of a network of Data Collecting Platforms (DCPs) sited on the main rivers of the participating countries and transmitting data via the European meteorological satellite METEOSATMeteosat ;
- development and implementation of an Information System connected to the World Wide Web of Internet ;
- and organisation of relevant training activities.

The MED-HYCOS project concerns the Mediterranean countries ; the Black Sea countries are involved in co-operation activities :

- Mediterranean Sea Basin : Albania, Algeria, Bosnia-Herzegovina, Bulgaria, Cyprus, Croatia, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, FYR Macedonia, Malta, Morocco, Palestinian Territories, Portugal, Slovenia, Spain, Syria, Tunisia, Turkey, Yugoslavia (24).
- Black Sea Basin : Georgia, Moldova, Romania, Russia, Ukraine (5).

At pPresently, twenty five countries are collaborating and participating in the MED-HYCOS project at different levels of commitment.

The initial phase (May 1995 - December 1999) is being executed by the partner countries with the help of WMO and with the financial support of World Bank.

The Institute of Research for Development (IRD ex ORSTOM) is hosting in Montpellier (France) the MED-HYCOS Pilot Regional Centre (PRC) which is in charge of co-ordinating and leading the project with the support of Regional Task Forces with experts from participating countries.

The Initial Co-ordinating Group (ICG) assistshelps the PRC in the operation of the project. ICG is presently composed of Bulgaria, Cyprus, France, Italy, Malta, Romania, Slovenia, Spain, Tunisia, WMO, World Bank, regional organisations concerned (FRIEND-AMHY and MEDIAS-France), and IRD.

Hydrometeorological Data Acquisition and Transmission

The first immediate objective of the project consists to of collecting hydrometeorological data in order to fulfil different goals including :

- to survey the evolution of resources on main rivers and ground water tables
- to contribute to the evaluation of certain terms of the hydrological cycle at different watershed scales (rainfall, runoff, evapotranspiration),
- to monitor the management of dams and the transfer of water between different areas
- to contribute to the water sharing between users
- to evaluate pollution flows from the catchments to the coastal zones of the Mediterranean sea,
- to face the International and transboundary water issues, etc.

The designation of the sites to be equipped with the MED-HYCOS Data Collecting Platforms (DCP) is the responsibility of each of the countries according to their own prioritiesinterest. However, it is recommended thato choose their location be choosen among the existing stations according to the stability of their gauging and the length of their observation series.

The DCP are designed to measure different parameters related to :

- Water quantity
- Water quality
- Meteorology
- and Maintenance

At present, the MED-HYCOS platforms are equipped with :

- Water level sensor,
- Water and Air temperature sensors
- Rainfall recorder

However the DCP stationsbut are able to accommodate up to twelve until twelve additional sensors - this willcan be the case for equip the DCP stations as themto be shortly shortly provided to the countries (pH, Conductivity, Turbidity, Dissolved Oxygen, Solar radiation, Relative humidity, Wind speed and direction, Atmospheric pressure, etc.).

The main characteristics of these DCPs are : METEOSATMeteosat transmission (or GOES/GMS, ArgosRGOS, InmarsatNMARSAT, modem), self power supply with solar panels and battery, additional capacities for meteorology or water quality monitoring (17 sensors), easy installation and maintenance, and data storage on site byon flash memory.

These DCPs are manufactured by CEIS-TM (Toulouse France) according to the specifications requested by MED-HYCOS project, especially for remote monitoring.

Data Collecting Platforms (DCP) are functioning operational in the following countries : Albania, Bulgaria, Croatia, Cyprus, Malta, Slovenia, Tunisia, and Turkey. Others will be operational in 2000

in Algeria, Bosnia-Herzegovina, Greece, Italy, Jordan, Lebanon, FYR Macedonia, and Morocco. Every three hours, the DCPs already installed transmit hourly data on water level, water temperature, air temperature and rainfall using the METEOSAT facilities. These real time data are available on the Web Site of Eumetsat only for all the participating countries and for the Pilot Regional Centre on the Web Site of EUMETSAT.



Installation of a hydrometeorological data collecting platform in Croatia

Development and Implementation of the MED-HYCOS Information System

The MED-HYCOS Information System (MHIS) is made up of two main parts :

- the first one is composed of information related to the National Hydrological Services and to MED-HYCOS activities.
- the second part is comprised of the Regional Database (RDB) and a toolbox in order to deal with the data managed in the RDB.

The regional database

The Regional Database is composed of the data collected in real time from DCPs, data coming from near real time sites and historical data (especially daily and monthly discharges) from other sites chosen by the countries representatives. The data collected by the DCP are automatically downloaded from the EUMETSAT Web Site and checked in the Pilot Regional Centre before putting them inside the database. The water levels are calculated in discharges.

Every week, certain data come from "near real time sites" chosen by the countries. Besides, at last, historical data concerns generally the DCP's sites or the near real time sites.

The Regional Database is managed by the Data Base Management System OracleRACLE interfaced with Internet. Thus, the MED-HYCOS Web site presents hydrological data on more than sixty stations ; for about two thirds of them, data isare updated every week.

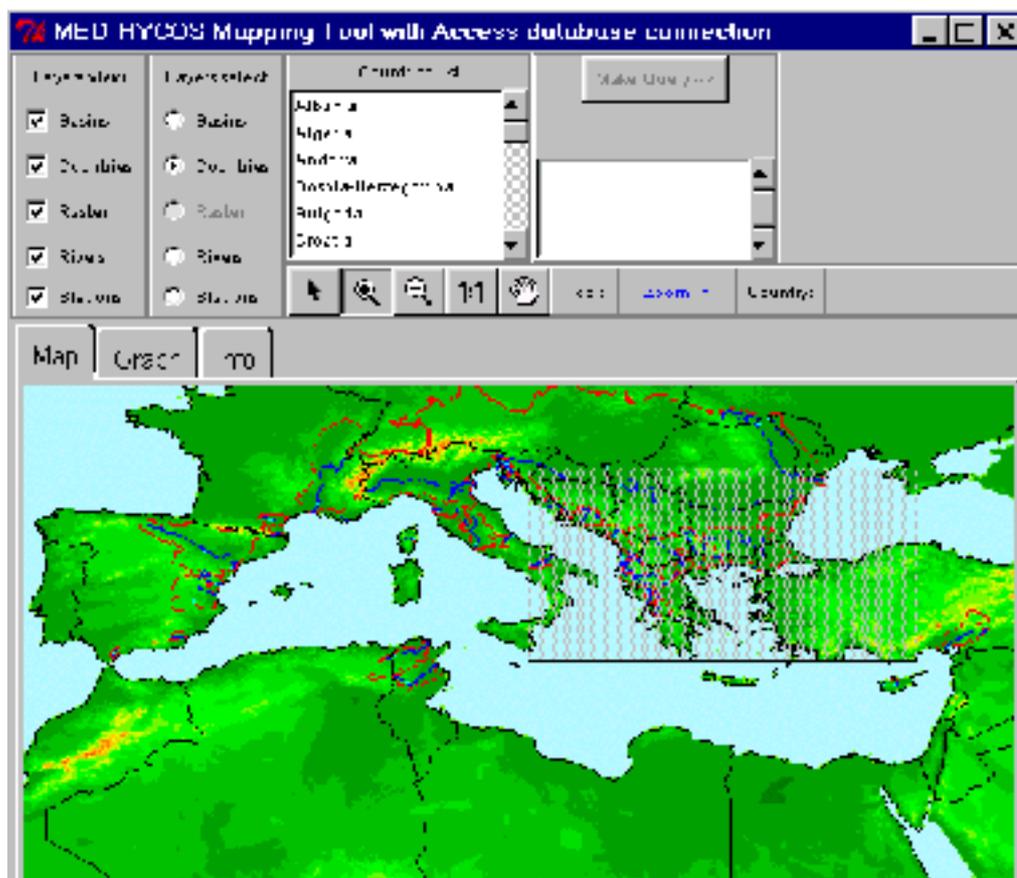
At this step, information and the most part of the data are available on the web site by in free accessAccess. However, the providers belong to their owners and, for any use, the agreement of the concerned National Hydrological Service every one must is required the agreement of the concerned National Hydrological Service.

Above all, several useful tools available byin free accessAccess on the Web Site have been developed in order to check, to examine, to visualise and to download the hydrometeorological data.

Mapping application

The mapping application, running as a plug-in through the browser or as a standalone module, is platform independent application developed in Tcl/Tk. This application allows user to accessAccess the hydrometeorological data and related information through the display of maps.

The picture below shows the data accessAccess and visualisation possibilities through the standalone module. After choosing the country, the basin or the river, the user can select the station from the list produced by queringquerying of the database.



Mapping application : selection of a hydrometeorological station

The maps used for the mapping application were produced from already existing digitised maps of the Mediterranean region in DCW format : political limits, hydrographic networks, etc. In order to

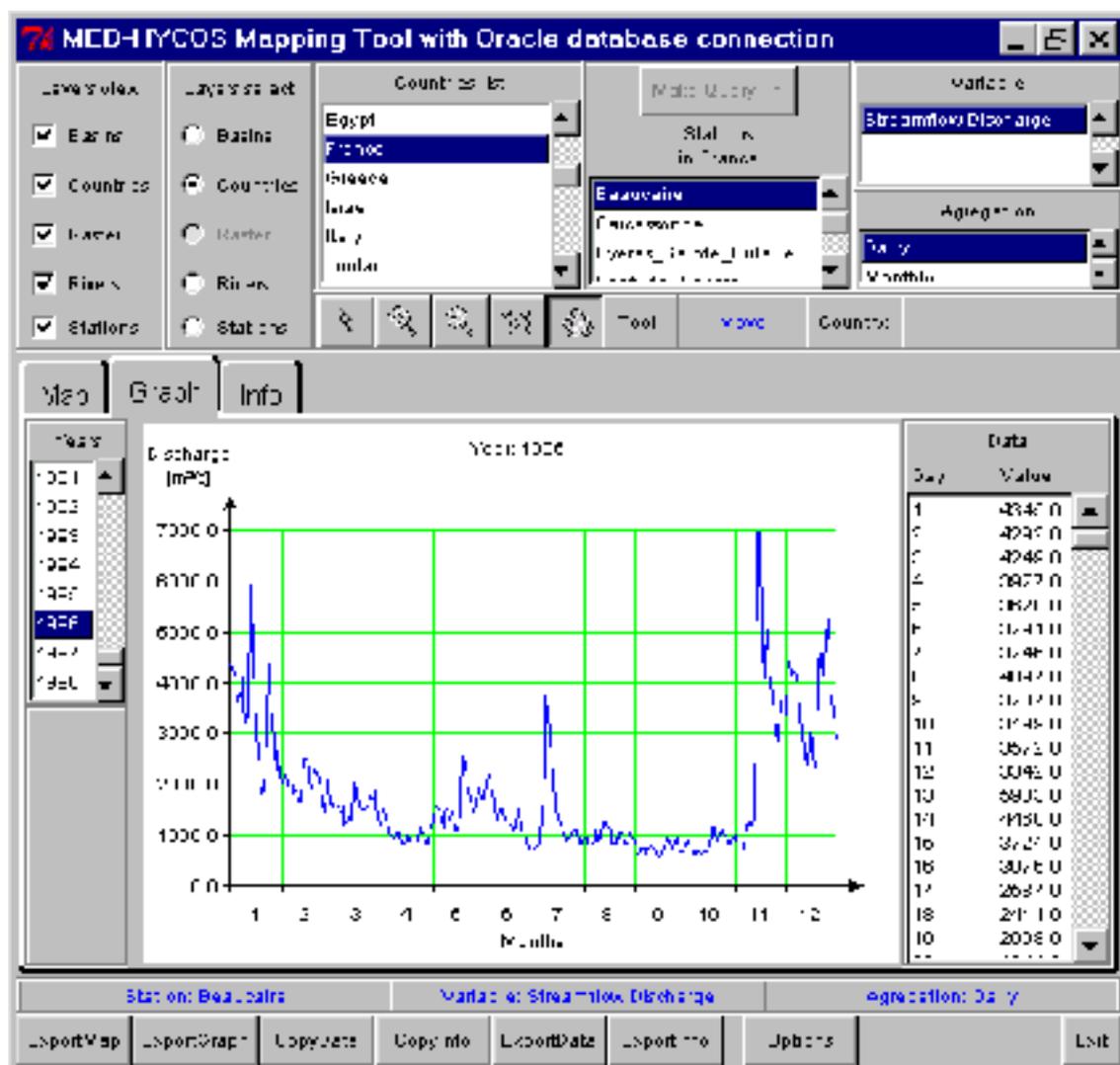
reduce their size a "point/file-size reduction" was carried out using several GIS oriented software packages such as Map Info.

The data and the maps produced as an export file from MapInfo software are stored as a compressed set of characters inside the database. The maps are stored in three different ways, inside Oracle for Internet access, inside Microsoft Access database and also as ASCII files. The mapping application includes the possibility of viewing bitmaps as well as vector objects.

The browser application (requiring Tcl/Tk plug-in) allows users to access through the MED-HYCOS Web Site the hydrometeorological data which are contained in the Oracle database.

The standalone application includes viewing of raster images and the connection with the local Access database and also with a locally stored ASCII files (necessary for CD version). In the standalone version users have the possibility to export/copy data and graphs to the local file system.

The following picture shows that after selecting a station, user can choose the type of the available variable, its aggregation time step, and the period for which the graphical or textual representation of data will be displayed.



Mapping application : data and graphical display

The browser application (requires Tcl/Tk plugin) allows user to access the hydrometeorological data which are in the ORACLE database on the MED-HYCOS Web Site.

The main and most important module of the Mapping application is a Tcl/Tk script used for building a graphical user interface (GUI) as well as for making providing several ways for manipulating the displayed maps in addition to the . vVery common mapping tools such as zooming, moving, and selecting., etc. are working available. Also,T the GUI of this application provides a simultaneous representation of graphical objects in textual form. A graphical interface was built for simple graphical representation (line charts) of selected data. In the future, tools will be implemented to show hydrological information inside maps.

Retrieving and managing tools

The second main stand-alone tool which was developed for the needs of the MED-HYCOS project, contains "Data retriever " and "Data Manager" computer programs.

Both programs are written in Visual Basic and can be used in Windows95 and higher environment. They are using the commonly used in PC-programming graphic user interface and are user-friendly.

The first one - "Data retriever " - is used to automatically (with a given time-step) retrieve data messages from DCPs, which are collected and stored by the Meteosat service. This retrieval is made using the "http protocol". As the messages from the last five days are stored at the Meteosat web site, the program first has to make a daily connection, gives the right user password and then retrieves specified data messages from the Eumetsat web site.

Then these messages are unpacked, data is checked for logical and syntactic errors and stored in an Access database. After the data checking and the update of the database, the operator has the possibility to verify all the history of that process from several "log" files. There is also the possibility to manually make changes to data messages when errors can not be repaired without user intervention (usually satellite transmission errors).

The program maintains a file archive of the received data files and another one with the corrected data files for the last three months of working.

It can be used as well from the Pilot Regional Centre and from national hydrological services to retrieve automatically their data collected by the DCP and transmitted by the Meteosat service.

This part of the stand-alone tool is operational at the PRC of MED-HYCOS project and give good results from the month of March'99.

The second program – "Data manager" - has several important functions:

To maintain the structure of both Oracle and Access MED-HYCOS databases. As the structures of the databases are similar, user can interactively transfer the structure of Oracle database to an Access database. The user has also the possibility to add new variables with the corresponding aggregation levels to his Access database. This gives the user great flexibility to store in his own local database different kind of time series related to hydrometeorology. To transfer the information coming from DCPs (flat Access table) to the variable oriented Access and Oracle tables.

To export from both databases (local user database) and to remote PRC – Oracle database, time series for a given period in several formats (ASCII file, Windows clipboard, graphic representation).

To edit, to update, to add and to delete particular records in both databases using a developed graphic interface.

To import any data received in ASCII format, like "near real time" data series.
To visualise data series from both databases in graphic and tabular format. This visualisation permits to find easily some errors not yet discovered at the previous steps of data acquisition. This gives also the user the possibility to compare two or more data series in the time, to make scatter representations of two series, to calculate and to visualise averaged (daily, monthly, yearly) or cumulated values of data series.

To automatically update PRC - Oracle database with newest data coming from the DCPs.

For the project members (National Hydrologic Services) which are remote users of the PRC Oracle database, the main advantage of these tools is to have the possibility to view and to import all the data stored in MED-HYCOS database, which is open to external users. The second advantage is the possibility to use local database with user's data not coming from PRC, but related with the MED-HYCOS project (like flash memory data from DCPs and so on). In the future, MED-HYCOS tools will give the user the possibility to export this kind of data to the PRC Oracle database, using the same tool. By this way the data stream will become bi-directional and more efficient for the both sides of the relationship.

The main advantage for the MED-HYCOS PRC is the automatic data retrieval from Eumetsat server in Darmstad (Germany) and also the automatic update of Oracle database which is connected to the web-site. So, now the people who connect the MED-HYCOS web-site can view data coming from DCPs one day after the measurements have been made.

On the other hand, the objective of MED-HYCOS project is to implement a collection of program modules, which permit the Pilot Regional Centre team :

- to retrieve automatically data coming from the DCP every three hours and stored in the Eumetsat server in Darmstad (Germany). These data are present there for the last five days only, so the program has to retrieve files every day.

- to validate the data coming from the DCP data before putting them in an ACCESS database.

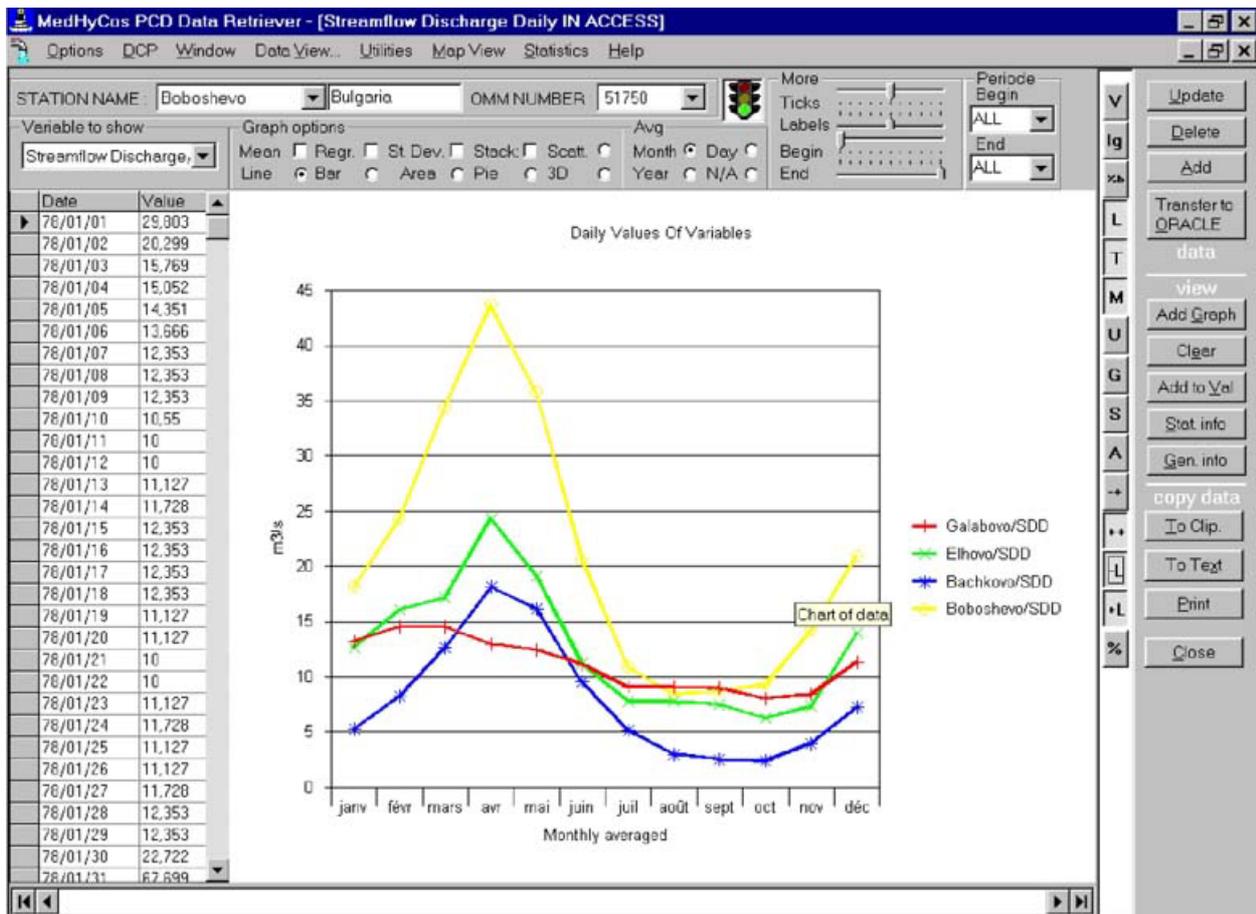
- to manage the bi-directional interface between regional ACCESS database and remote ORACLE database through the Net.

These tools are used at the PRC Centre and will be disseminated in the hydrological offices, which are involved in the MED-HYCOS project and have DCP stations.

- to implement a local for the user ACCESS database which will contain data coming from DCP, time series data from PRC MED-HYCOS which are open to public use and any user time series (national data) ,

- to give the user graphical and tabular possibilities to view, edit, import and export data, and also to print reports and graphics,

- to allows the MED-HYCOS partners to update the Oracle regional database possibilities according a very restrictive access policy.



Data Manager tool : graphical display

By this way, as the mapping application, the processing tools can access the Oracle database on the MED-HYCOS server, a local ACCESS database or files on CD-ROM.

Thus, the MH tools can be used by the PRC team to manage the regional database.

The National Hydrological Services can exchange data between the regional database and its own database. According to the application of the MED-HYCOS tools on an ACCESS database or on ASCII files, they can be applied to process national data outside MED-HYCOS regional context.

The *lambda* client can process hydrometeorological data through the Web Site or on CD-ROMs insofar as they are available in free access.

Besides, the data managed on the server have been transferred to CD-ROM while preserving maintaining their organisation. Thus, the MH tools are used to obtain and process data through the Web Site, or on CD-ROM, or on your own hard disk. The *lambda* client can process hydrometeorological data through the Web Site or on CD-ROMs insofar as they are available in free Access.

So, the MH tools can be applied to process data outside MED-HYCOS regional context.

Conclusion

The MED-HYCOS Project uses the newest acquisition and telecommunication technologies to collect and to disseminate the hydrometeorological data coming from the main rivers of the Mediterranean area.

One of the main challenge of MED-HYCOS Project is that these technologies adapted to the collection and the dissemination of data at international and regional levels will be adopted by the National Hydrological Services.

So, by promoting the use of modern technologies and, by promoting the exchange of information, data and skills among the countries participating in the project and by strengthening the capacities level of competence of their National Hydrological Services, MED-HYCOS wants is striving to be one of the initiatives which contribute to the improvement of water resources assessment and water management in the Mediterranean area.