

National Technical University of Athens  
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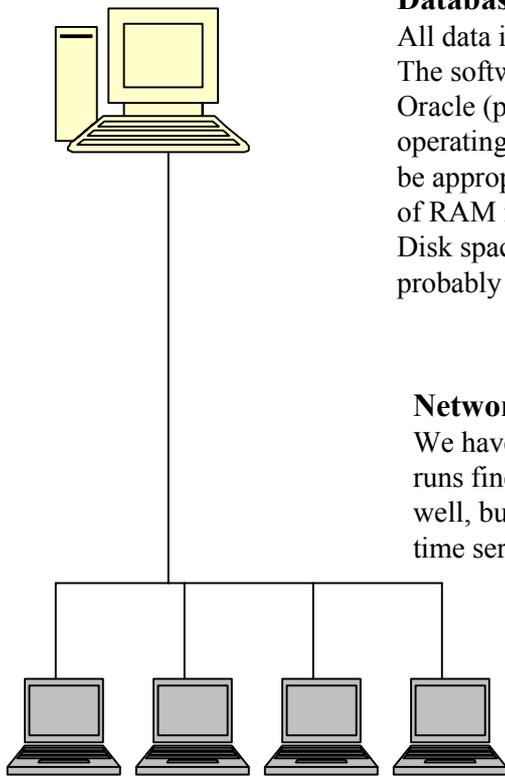
## Software for the management of measuring stations and time series

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**Foreword**

The software presented in the following pages is part of a large system being developed in order to assist the management of the 4000 km<sup>2</sup> hydrosystem from which Athens, Greece, is supplied with water. The software development is being funded by the Water Supply and Sewerage Company of Athens. It embodies experience from the Hydroscope project (1992-1993), but makes use of the latest technology in relational databases and software development tools.



### **Database server**

All data is stored here. The software is developed specifically for Oracle, thus an Oracle (preferably 8.1) server must be provided. Any operating system on which the Oracle server can run should be appropriate. The machine had better be powerful; 512 MB of RAM is recommended on a processor at least 500 MHz. Disk space depends on the amount of data, but a few GB are probably enough.

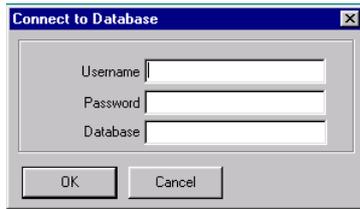
### **Network**

We have tested the software on a 10 MBit network and it runs fine. It can probably run decently on slower lines as well, but this might cause long delays when fetching long time series from the database.

### **Clients**

The software runs on client machines, which connect to the database via the network. The client machines must be running any modern version of Microsoft Windows (95, 98, ME, NT4, 2000, XP). Existing machines can be used. The software only occupies 2 MB of disk space, but the Oracle Client must also be installed, which is around 40 MB. There are no special memory requirements; 32 MB of RAM are enough, unless the operating system needs more (this is true for ME, 2000 and XP).

If the database server runs Windows, then the software can also run on the server.



### **Connecting to the database**

Users connect to the database using their username and password (the “Database” field will normally contain the same value for all users). Different users have different permissions on the database. Some users have only read permission; others are able to add and modify data. Oracle’s software, such as the Oracle DBA Studio, which is provided with the server, must be used in order to add, remove, and assign permissions to users.

### **Languages**

The software is localizable and can easily be translated to other languages. It is distributed in a single version, containing all available languages. When run, it automatically determines which language to use; if a translation in the language set in Control Panel, Regional Settings, is available, it uses that language; otherwise, it uses English. Currently only English is available, with Greek soon to follow. It is easy to provide other localizations, at least for Western languages.

## Measuring stations

The data stored for a measuring station includes name, location, co-ordinates, service owning the station, type (meteorological, flow measuring, etc.), functioning period, whether it is still active, and whether it is telemetric.

## Database field languages

Database fields are available in two languages (as seen, for example, in the station name above). This is especially useful if the database is to be accessed through a bilingual web site. All fields are in two languages, although some do not show in the above form; for example, only Greek shows up in the station prefecture above, because the names of the prefectures are accessed through another form:

id	Name (Greek)	Name (English)	Abbrev (Gr)	Abbrev (En)
1	Αιτωλοακαρνανίας	Aitolokarnanias	Αιτωλοακαρ	Aitolokarna
2	Αττικής	Attikis	Αττικής	Attikis
3	Βοιωτίας	Viotias	Βοιωτίας	Viotias
4	Εύβοιας	Evias	Εύβοιας	Evias
5	Ευρυτανίας	Eviritanias	Ευρυτανίας	Eviritanias
6	Φθιώτιδας	Fthiotidas	Φθιώτιδας	Fthiotidas

The same is true for all drop-down boxes.

## Navigating in the database

The controls on top are used in order to move to the next or the previous station, or to add, remove, and edit stations. Rather than moving to the next or previous station, the “Go to” field can be used in order to move to a specific station, provided the user remembers its id. Alternatively, a synoptic table is provided which displays all stations in alphabetical order.

The screenshot shows the 'Stations' software interface. On the left is the 'Data entry form' for station ID 334. It includes fields for Name (Πολυτεχνειούπολη Ζωγράφου), Prefecture (Αττικής), Location (Πολυτεχνειούπολη Ζωγράφου, Αθήνα), and coordinates (37° 58' 26" N, 23° 47' 16" E). On the right is the 'Synoptic table' showing a list of stations with columns for id, Name, and Prefecture. Station 334 is highlighted in blue.

### Station codes

Stations are identified by their id, which is automatically assigned by the software when a new station is entered in the system. However, additional fields are provided in order to store alternative ids, such as already existing ids given by the owning service or by WMO.

### Remarks and multimedia

Any information which does not fit into the rest of the fields, from short notes to reports of unlimited length, can be entered in the “Remarks”. In addition, photographs and videos of the station can be entered or accessed through the “Multimedia” button.

The screenshot shows two windows from the 'Stations' software. The 'Stations: Remarks' window on the left has two text areas: 'Remarks (Greek): Δεν έχει εγκατασταθεί ακόμα.' and 'Remarks (English): Not installed yet.' The 'Stations: multimedia' window on the right shows a table of media files:

s/n	Type	Date
1	Φωτογραφία	05/01/1998
2	Φωτογραφία	05/01/1998
3	Φωτογραφία	05/01/1998
4	Φωτογραφία	05/01/1998
5	Βίντεο mpeg	

Buttons for 'Show...' and 'Load from file...' are visible at the bottom of the multimedia window.

Stations

Data entry form | Synoptic table

id: 334 Go to: 334 [Go there](#)

Name: Πολυτεχνειούπολη Ζωγράφου (Greek) NTUA University Campus of Zografou (English)

Prefecture: Αττικής Municipality: Ζωγράφου (Greek) Zografou (English)

Location: Πολυτεχνειούπολη Ζωγράφου, Αθήνα (Greek) NTUA University Campus, Zografou, Athen (English)

Co-ordinates: phi 37 d 58 m 26 s N lambda 23 d 47 m 16 s E X 481360 Y 4202939 Altitude 219

Service: ΕΜΠ-ΤΥΠΥΒΕ

Type: Μετεωρολογικός Subtype:

Functioning period: 01/10/1993  Active  Telemetric

Various codes: Service:  Miet:  Hydroscope:  WMO:  Other:

Instruments... Data format... Time series... Events... Remarks... Multimedia...

## Events

The “Events” is a kind of electronic logbook. Any event, such as malfunction, servicing, or extreme weather event, can be entered there. By clicking on an event, the details are shown in the remarks fields. These details can be short comments or reports of unlimited length.

Events

s/n	Date	Type
6	10/12/1998	Αλλαγή στο configura
3	18/03/1999	Παρατήρηση καιρού
4	01/05/1999	Βλάβη σταθμού
5	03/01/2000	Βλάβη σταθμού

Greek remarks: Από 12:20 ως 14:00 EET δεν υπάρχουν δεδομένα, λόγω προβλήματος του λογισμικού. Στο διάστημα αυτό παρατηρήθηκε μικρή χιονόπτωση.

English remarks: From 12:20 to 14:00 EET there is no data, due to software malfunction. During this period there was weak snowfall.

### Instruments

Clicking on the “Instruments” button shows the instruments for the station being viewed. Again, there is a synoptic table showing all the instruments in alphabetical order, and each instrument has its own remarks and events.

### Time series

Clicking “Time series” on the instruments form shows the time series for the current instrument. Clicking “Time series” on the stations form shows all the time series for the current station; this includes the time series for all its instruments, in addition to time series that are not tied to specific instruments (for example, evapotranspiration derived by a method such as Penman).

For each time series, general information is stored, such as variable name, time series name, step (10-minute, hourly, daily, monthly, yearly and others), remarks and events.

It is also possible to store time series that are not tied to stations, but to other geographical entities, such as water basins; this is particularly useful for areal rainfall.

### Time series data

This is the button that actually shows the time series.

Time	Value
23/10/2001 08:00	246
23/10/2001 08:10	47.36
23/10/2001 08:20	45.97
23/10/2001 08:30	50.27
23/10/2001 08:30	195.38
23/10/2001 08:40	1901.51
23/10/2001 08:50	198.60
23/10/2001 09:00	2059.90
23/10/2001 09:10	305.65
23/10/2001 09:20	218.40
23/10/2001 09:30	177.88
23/10/2001 09:40	354.69
23/10/2001 09:50	349.28

## Time series data

A special form has been designed for the easy and effective viewing and management of time series data.

## Flags

Time series records have flags in order to signal error conditions or other noteworthy circumstances. Numerous flags are available in order to signal out of range values, suspect values, snow, values that were originally missing but were calculated by infilling, and so on. There are also generic flags, without any special meaning, for general use. There are 30 flags in total, and each record can have any combination of those.

Time series can be displayed with or without flags, as shown above and on the right.

Time	Value	Flag
23/10/2001 08:00	246	
23/10/2001 08:10	47.36	
23/10/2001 08:20	45.97	
23/10/2001 08:30	50.27	
23/10/2001 08:30	195.38	LOGNOISY
23/10/2001 08:40	1901.51	LOGOUTSIDE
23/10/2001 08:50	198.60	
23/10/2001 09:00	2059.90	LOGOUTSIDE
23/10/2001 09:10	305.65	
23/10/2001 09:20	218.40	LOGNOISY
23/10/2001 09:30	177.88	
23/10/2001 09:40	354.69	LOGNOISY
23/10/2001 09:50	349.28	

Define filter

Only display records such that:

The value is greater than 360

or

The flag COMMENT is on

Buttons: OK, Cancel

## Filtering

Filters can be used to hide some of time series records, so that only those records that pass through the filter are displayed.

	246	
22/10/2001 16:10	406.26	LOGNOISY
22/10/2001 16:30	450.46	LOGNOISY
22/10/2001 17:30	402.11	LOGNOISY
22/10/2001 18:10	497.19	LOGNOISY
22/10/2001 19:50	387.38	LOGNOISY
22/10/2001 20:10	376.67	LOGGOVERRUN
23/10/2001 08:40	1901.51	LOGOUTSIDE
23/10/2001 09:00	2059.90	LOGOUTSIDE
23/10/2001 10:10	2063.58	LOGOUTSIDE
23/10/2001 10:30	2063.58	LOGOUTSIDE
23/10/2001 10:40	2059.90	LOGOUTSIDE
23/10/2001 14:40	1890.46	LOGOUTSIDE

**Filters**

Once a filter has been defined, it can be toggled on or off with this button.

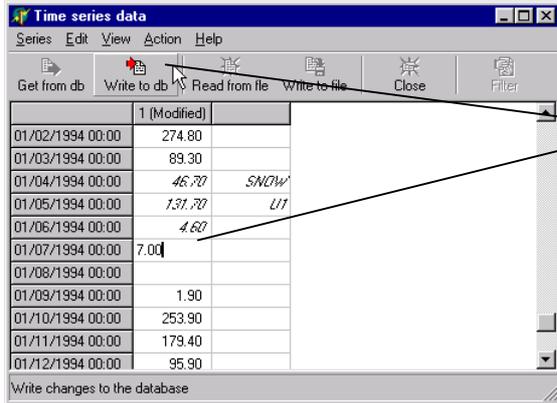
**Multiple time series**

More than one time series can be displayed at the same time. Records with the same time stamp are shown on the same row. Time stamps existing on one time series but not on the other are indicated by diagonal lines.

	1	2
01/05/1997 00:00	20.40	8.00
01/06/1997 00:00	7.00	5.50
01/07/1997 00:00	0.60	
01/08/1997 00:00	17.40	7.40
01/09/1997 00:00	2.60	0.60
01/10/1997 00:00		
01/11/1997 00:00		44.10
01/12/1997 00:00		142.40
01/01/1998 00:00		22.70
01/02/1998 00:00		20.40
01/03/1998 00:00		141.30

An unlimited number of time series can be shown side by side, with or without the flags.

	1	2	3	4	6	7
01/02/1994 00:00	274.80	204.50	81.80	374.40	184.20	183.30
01/03/1994 00:00	89.30	37.80	8.00	84.30	25.60	76.30
01/04/1994 00:00	45.70	33.30	83.00	78.10	IN FILLING	139.70
01/05/1994 00:00	129.70	49.80	40.00	193.00	69.10	43.20
01/06/1994 00:00	2.60	0.50	5.40	6.30	26.30	43.40
01/07/1994 00:00	7.00	36.20	18.00	65.20	110.90	6.30
01/08/1994 00:00		1.50	2.10	21.00	33.20	20.00
01/09/1994 00:00	1.90		2.40		7.40	
01/10/1994 00:00	253.90	146.30	90.60	290.90		177.30
01/11/1994 00:00	179.40	83.60	120.00	151.20		137.10
01/12/1994 00:00	95.90	83.90	118.30	150.90		90.40

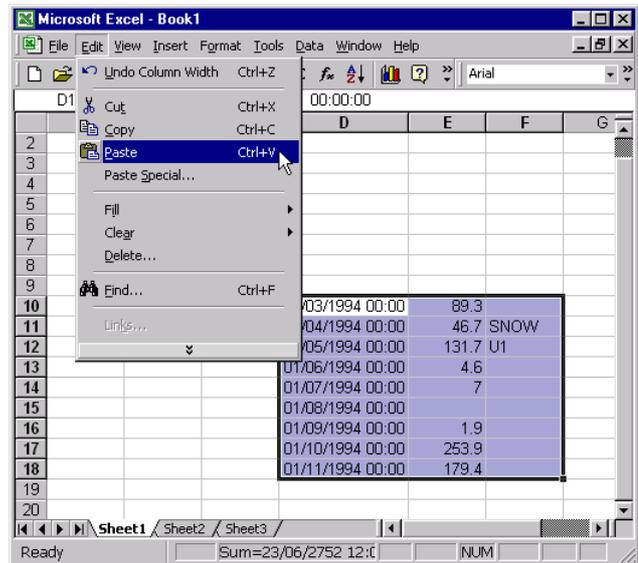
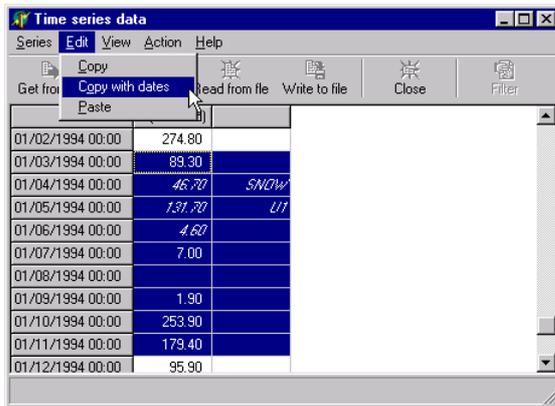


### Editing data

Users can manually alter a time series, values and flags. Altered records appear in italics. Users can write the changes to the database, provided, of course, they have permission to do so.

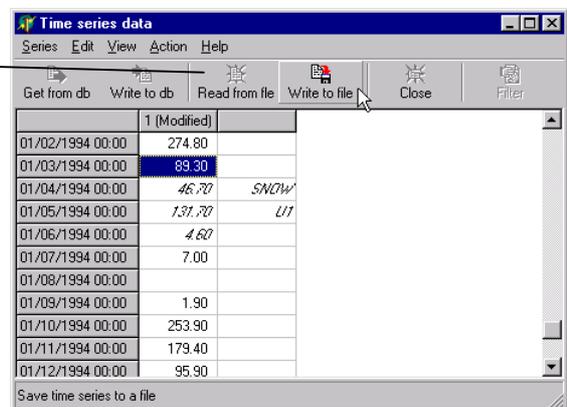
### Exchanging data

It is possible to copy and paste time series data to and from other applications.



### Storing in files

Time series can be written to files. This is especially useful for users who want to alter time series but do not want or do not have permission to store them in the database. The files are in a simple ASCII format so that they can be viewed with any text editor.



### **Importing data**

Importing already existing time series is a matter of fundamental importance. Although, as seen in the previous page, the application can read ASCII files, these must be in a specific predefined format. Existing data is expected to be in many different formats. The application does not provide any tool for converting. Thus, two suggested ways for importing data are: (1) Read the data into Microsoft Excel using the Text Import Wizard, then copy and paste into the time series form; (2) Create a simple program in order to convert existing data to the predefined format.

Why does the application not provide text conversion? The reason is that if it did, it would have to provide a tool such as Excel's Text Import Wizard. We avoid adding functionality which is already provided by existing software. Excel's Text Import Wizard is a fine tool, and it would be pointless to duplicate its functionality at this stage, when other more important issues need to be addressed.

### **Data processing**

Currently the software only provides a simple range check facility. Time stamp correction (determination and elimination of irregularities) and infilling of missing values of time series (using linear regression) is under development, and time series aggregation will follow. After that, a system to assist the construction of stage-discharge curves will be developed, including a method of calculating discharge time series.

### **Time table**

The screen shots shown in the previous pages are all from actual running software. Though it works well, some functionality is still missing (for example, it is not possible to manually add a record to a time series). The software will be operational, including time stamp correction, infilling, and aggregation, by the end of January 2002. No documentation or help files will be provided at this stage, although this report is probably enough to get one started.

Stage and discharge utilities, graphs, printing, and help files will be ready by the end of 2002.