A hydrometeorological telemetric network for the water resources monitoring of the Athens water supply system

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Elements of the Athens water recourse system

4 reservoirs

Marathon, Yliki, Mornos, Evinos

100 boreholes

Mainly at B.Kifissos-Yliki and N. Parnitha areas

3 major water transfer works
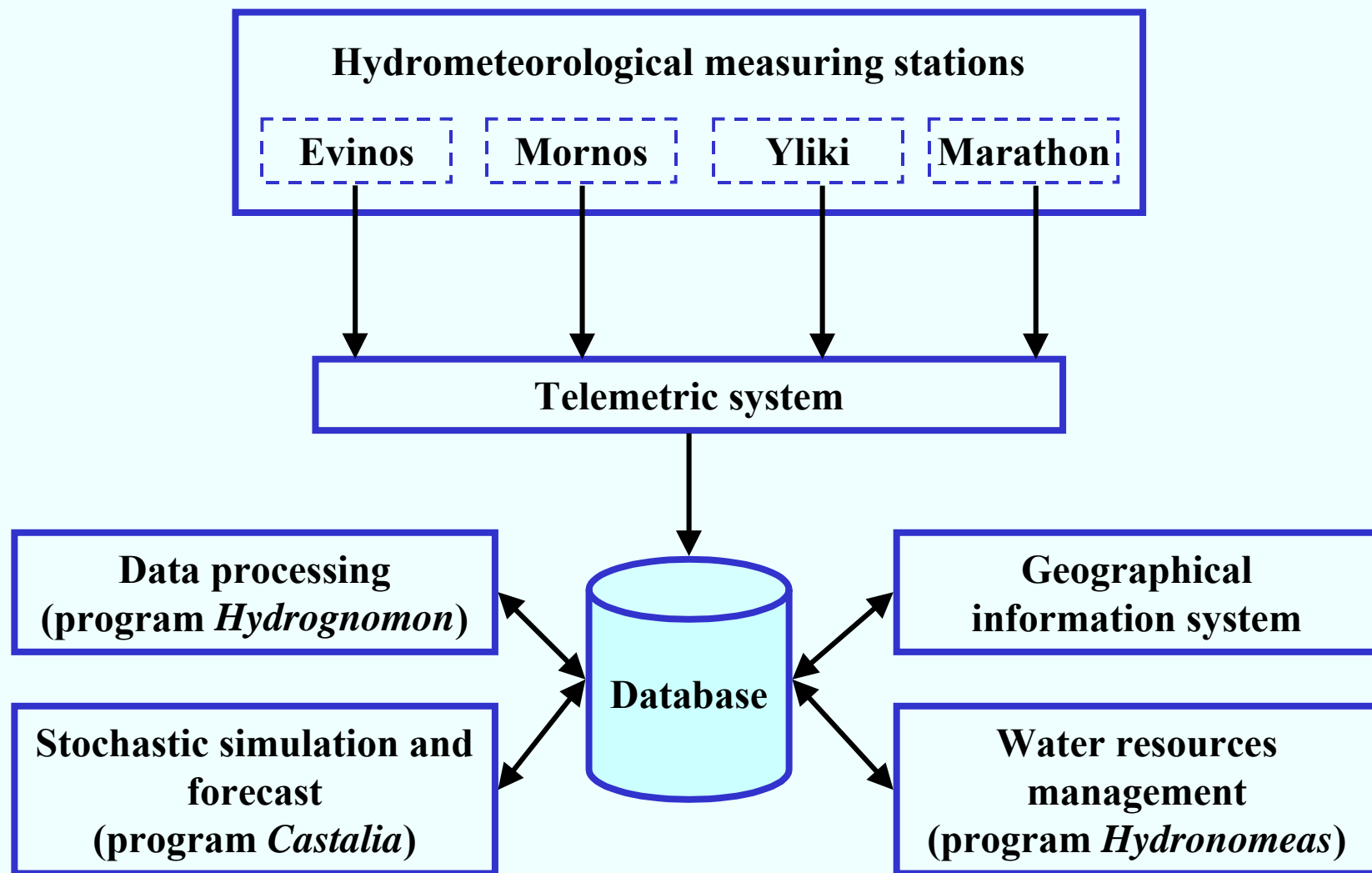
Mornos aqueduct (about 190 km long)
Yliki aqueduct (about 70 km long)
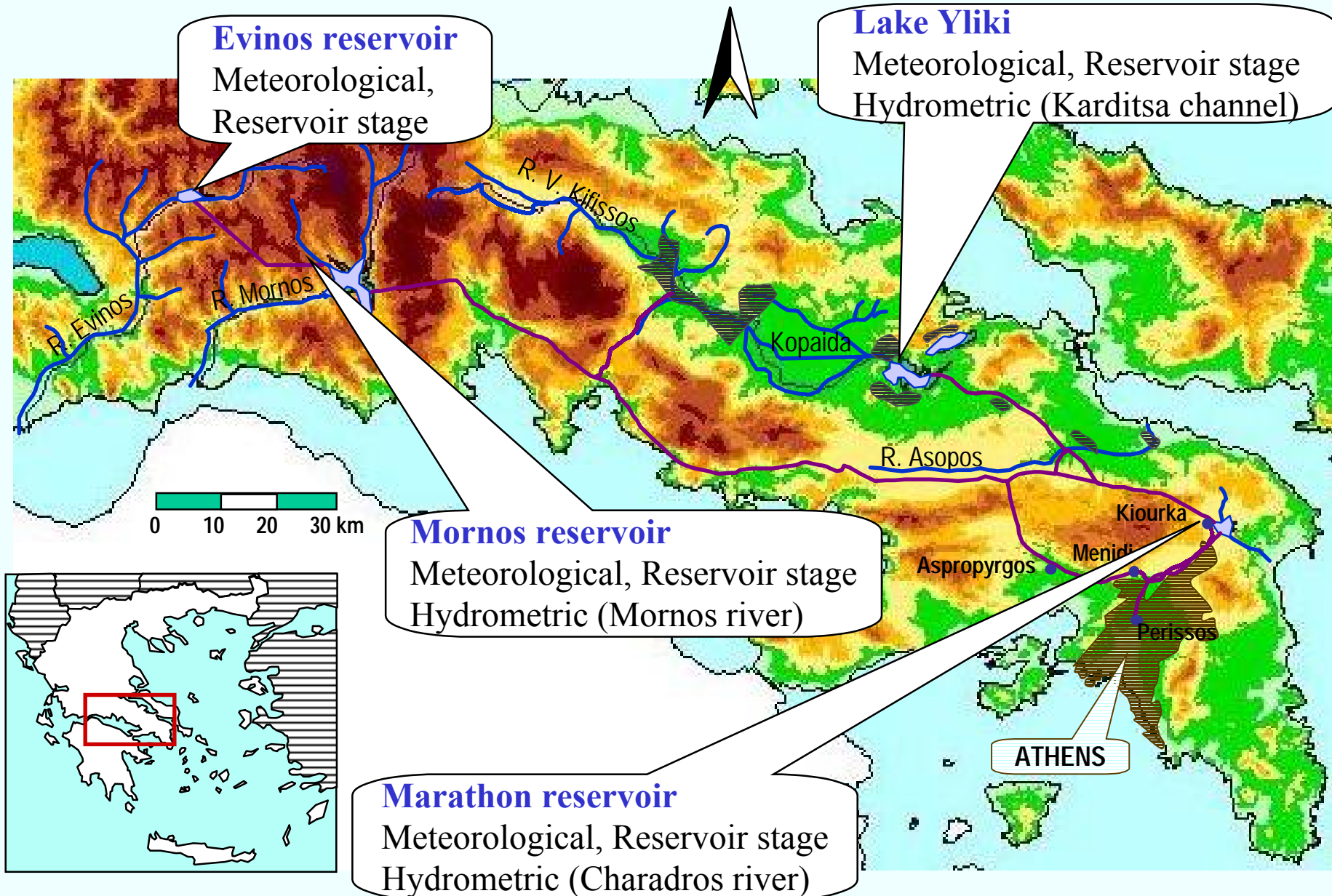Evinos-Mornos tunnel (about 30 km long)

4 water treatment plants

Galatsi, Menidi, Kiourka, Mandra

General scheme of the Decision Support System

Hydrometeorological measuring stations

Evinos | Mornos | Yliki | Marathon

Telemetric system

Data processing (program *Hydrognomon*)

Stochastic simulation and forecast (program *Castalia*)

Database

Geographical information system

Water resources management (program *Hydronomeas*)

Sites of hydrometeorological stations

Evinos reservoir
Meteorological,
Reservoir stage

Lake Yliki
Meteorological, Reservoir stage
Hydrometric (Karditsa channel)

R. V. Kifissos

R. Evinos

R. Mornos

Kopaida

R. Asopos

Kiourka

Menidi

Aspropyrgos

Perissos

Mornos reservoir
Meteorological, Reservoir stage
Hydrometric (Mornos river)

0   10   20   30 km

Marathon reservoir
Meteorological, Reservoir stage
Hydrometric (Charadros river)

ATHENS

Main purposes of the telemetric system

★ Feeding of the Decision Support System with reliable data

★ Quantitative inspection of the water resources of the catchments that contribute to the water supply of Athens

★ Improvement of the estimation of the parameters involved to reservoirs' water budget

★ Exploration of the hydrological and climatic characteristics of the study area after compilation of reliable time series of hydrometeorological variables

★ Supply of hydrometeorological and water availability data in real time on the Internet for public awareness

Existing infrastructure
Disadvantages of conventional networks

★ In many cases the measurements are not as reliable and accurate as needed

★ The temporal scale of measurements is inappropriate (too coarse) for several applications

★ There is significant delay in the availability of the measurements

★ The malfunctions of the instruments may not be detected in time

★ Conventional networks have high installation and operation costs

Existing infrastructure
Experience from the 10-year operation of the telemetric station at Zograpfou Campus

★Current conditions   ★Last 24-hour statistics   ★Pictures
★Last 24-hour charts   ★Historical data   ★What's new
★General information ★Links ★Freq asked questions
★Contact info - Project team

Stations and variables of the telemetric network

Meteorological stations

Measured variables

precipitation
temperature
relative humidity
wind speed-direction-gust
solar radiation
sunshine duration

Derivative variables

evaporation

Reservoir stage stations

Measured variables

reservoir stage

Derivative variables

storage of the reservoir
area of the reservoir

River stage stations

Measured variables

river stage
sporadic stage-discharge measurements

Derivative variables

river discharge

Positioning of the stations
General criteria

★ The sites should be hydrologically appropriate and fulfilling the WMO specifications

★ The sites must be near to facilities (dams or water pumping stations) in order to ensure the safety of the station and the availability of electricity and telephony

★ The sites of meteorological stations must be close to the maximum reservoir elevation in order to be as representative as possible for the variables that take part to the reservoir's water budget

★ The reservoir stage stations must be installed to the deepest point of reservoir (but above the dead storage)

★ The flow measuring stations must be as close to the dams as possible (above maximum reservoir elevation) in order to measure the maximum portion of inflow to the reservoir

Positioning of the stations
Procedure

★ **Bibliographical review**
- using previous reports for candidate sites
- using WMO specifications

★ **Visits to the candidate sites**
- ensuring the participation of experts and local personnel
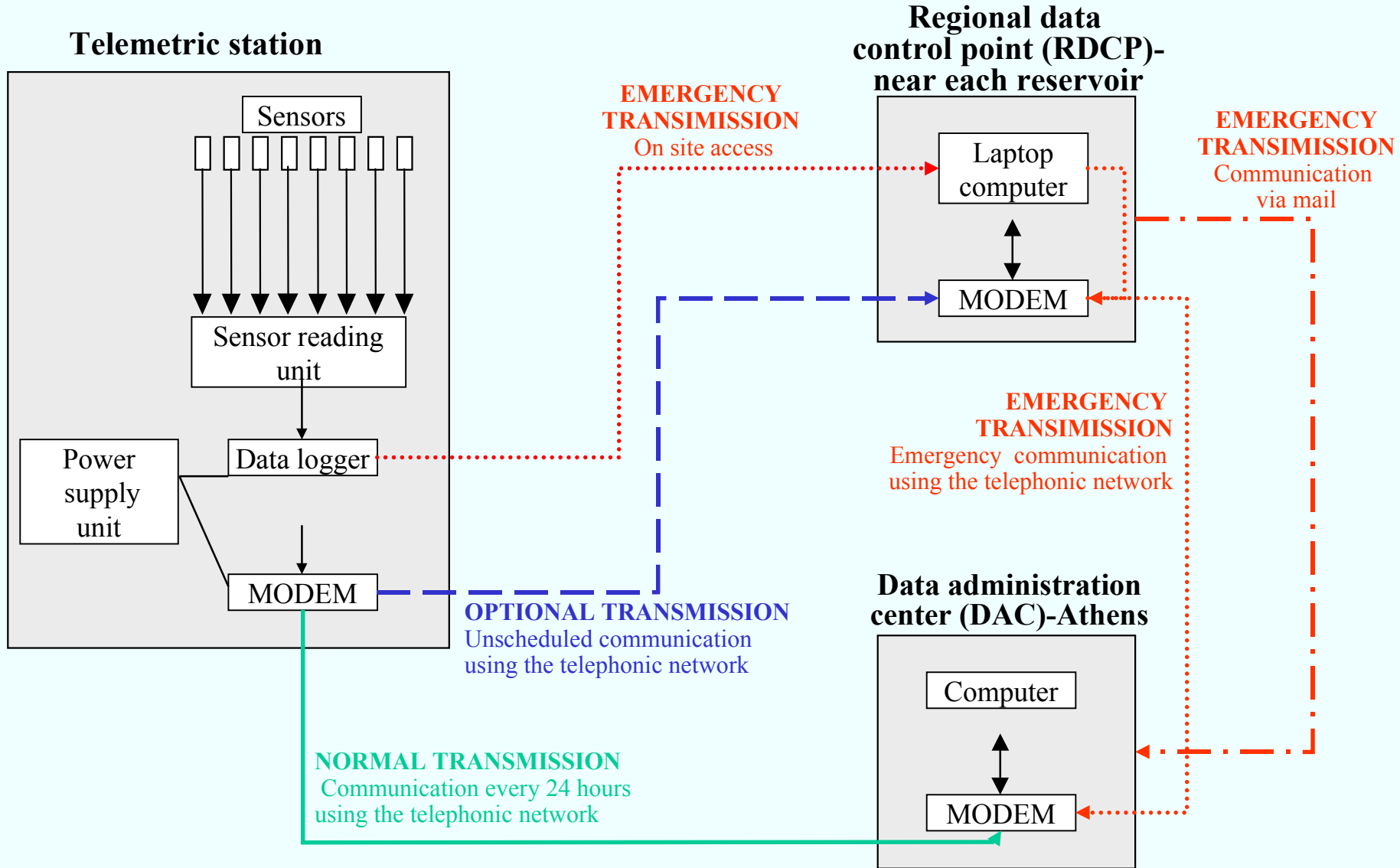- making record of specific site characteristics
- taking photos and videos

★ **Comparison of different characteristics**
- hydrological suitability
- security
- availability of electricity
- availability of telephony
- ease of installation

Θέση	Είδος	Επικοινωνία	Τροφοδοσία	Ασφάλεια	Υδρολογική καταλληλότητα	Παρατηρήσεις
Φράγμα Ευήνου	Μ	ΤΓ	ΓΡ	8	8	Υπάρχον σταθμός, κόψιμο δένδρων
Υδροληψία Μόρνου	Μ	ΤΓ	ΓΡ	8	9	
Αντλ. Μουρικίου	Μ	ΤΓ	ΓΡ	10	9	Πιθανό κόψιμο δένδρων
Φράγμα Μαραθώνα	Μ	ΤΓ	ΓΡ	9	9	
Φράγμα Ευήνου	Σ	ΤΓ	ΓΡ	9	10	Με τροποποίηση κατασκευής
Φράγμα Μόρνου	Σ	ΤΓ	ΓΡ	10	10 και 8	Δύο πιθανές θέσεις
Λίμνη Υλίκη	Σ	ΚΤ ή ΤΓ	Μ ή ΓΡ	8	10	
Φράγμα Μαραθώνα	Σ	ΤΓ	ΓΡ	10	9	
Ποταμός Εύηνος	Σ	ΚΤ ή Ρ	Σ	3	5	Δεν θα εγκατασταθεί σε αυτή τη φάση
	Υ	ΚΤ ή Ρ	Σ	3	5	Δεν θα εγκατασταθεί σε αυτή τη φάση
Ποταμός Μόρνος	Σ	ΚΤ ή ΤΓ	Σ ή ΓΡ	6	9	
	Υ	ΚΤ ή ΤΓ	Σ ή ΓΡ	6	9	
Δ. Καρδίτσας	Σ	ΚΤ	ΓΡ	6	10	
	Υ	ΚΤ	ΓΡ	6	10	
Ποταμός Χάραδρος	Σ	ΚΤ ή ΤΓ	Σ ή ΓΡ	6	8	
	Υ	ΚΤ ή ΤΓ	Σ ή ΓΡ	6	8	

General scheme of data transmission

Telemetric station

Sensors

Sensor reading unit

Power supply unit

Data logger

MODEM

Regional data control point (RDCP)- near each reservoir

Laptop computer

MODEM

Data administration center (DAC)-Athens

Computer

MODEM

EMERGENCY TRANSIMISSION
On site access

EMERGENCY TRANSIMISSION
Communication via mail

EMERGENCY TRANSIMISSION
Emergency communication using the telephonic network

OPTIONAL TRANSMISSION
Unscheduled communication using the telephonic network

NORMAL TRANSMISSION
Communication every 24 hours using the telephonic network

Data management and processing

Applications:
Oracle data base
Hydrognomon application
PC208W (data logger support software)

System functions:
Automatic storage of telemetric data

Organised viewing and management of various information
- station-instrument characteristics
- time series
- multimedia

Data processing module
- range check facility
- fixing of time step
- filling of missing values
- time series aggregation
- construction of stage-discharge curves
- calculating derivative time series

Data management and processing
Hydrognomon application

System completion

★ Inspection and acceptance of all system components

★ Record of stations' and instruments' details

★ Comparison of telemetric and conventional data

★ Integration of the telemetric network within the DSS

★ Supply of the information on the Internet

★ Scheduling and execution of river discharge measurements