WMO / OMM

Volta-HYCOS Project

Training module on Hydrological Expertise and IWRM

Management and valorisation of hydrological data for IWRM

2iE (Ouagadougou) - March 2007

IRD - Unite OBHI (*Observatoires hydrologique et Ingenierie***)**

Management and valorisation of hydrological data for IWRM

Introduction : importance of hydrological data for IWRM

1. From collection of data to dissemination of hydrological information : The role and functioning of a hydrological services
2. Quality of hydrological data
3. Management and exchange of hydrological data for IWRM

Introduction : Importance of hydrological data for IWRM

- Hydrological data (hydrometric data , piezometric data and water quality data) constitute a knowledge base which is fundamental to water resources assessment and subsequent decisions.

- It is essential that policy makers appreciate the importance of reliable and representative data, create the necessary institutional responsibilities and make appropriate allocations of financial and human resources reflecting local needs.

Introduction : Importance of hydrological data for IWRM

Hydrological data are essential for :

The assessment of water resources

- Evaluation of water resources in relation to a reference frame (quality and quantity of resources)
- Evaluation of the dynamics of water resources in relation to human impacts (e.g. increase in water demand, pollution, change in land use) or climatic impacts

The planning of water resources:

- Estimation of current water availability in relation to demand
- Generation of scenarios of development related to water : can the availabe resource meet the long-term future demand?
- Definition of objectives for water quantity, quality, and allocation

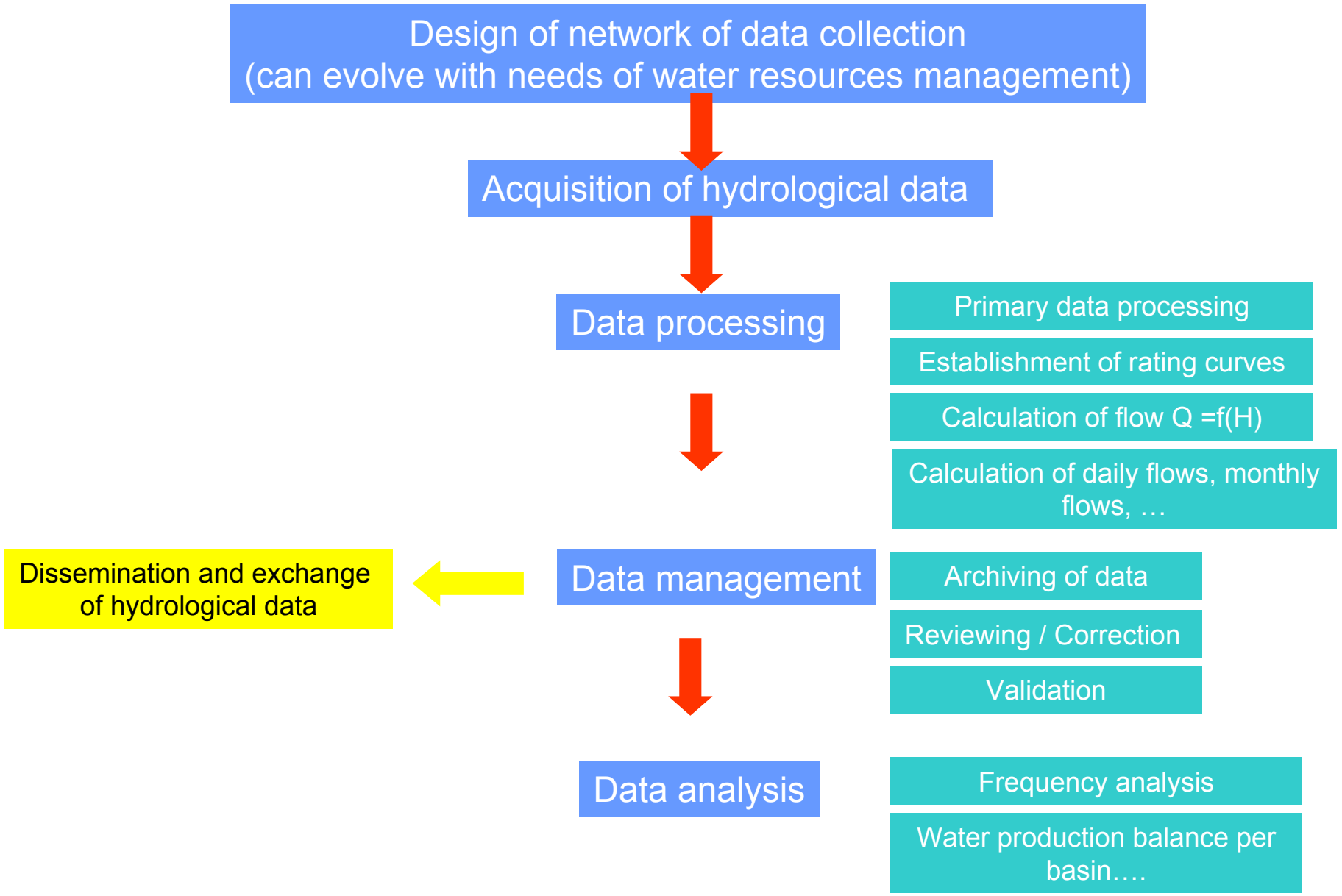
… Hydrologicals data are essential for :

The design of various hydraulic structures (dams, irrigation schemes etc.)

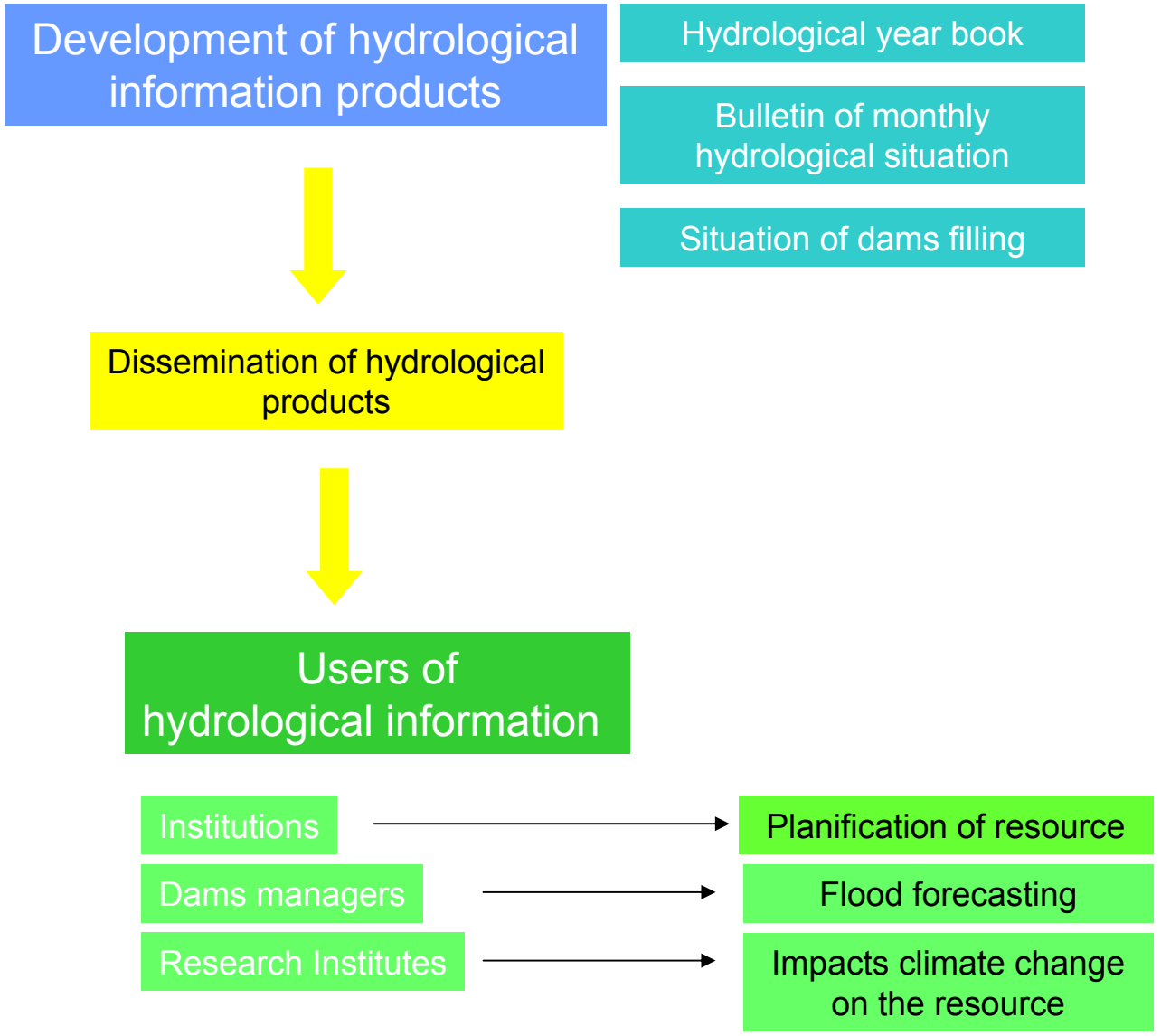
Forecasting of extreme events:

Analysis of probability of extremes events, such as droughts or floods

1. From collection of data to dissemination of hydrological information: The role and functioning of a hydrological services



1. From collection of data to dissemination of hydrological information : role and functioning of a hydrological services



2. Quality of hydrological data

2.1 S**ources of errors** in the process of data acquisition and processing

2.2 Reviewing and critic of data

2.3 Gaps and reconstitution of hydrological data

2.4 Validation of hydrological data

2. Quality of hydrological data

2.1 S**ources of errors** in the process of data acquisition and processing :

- Acquisition of data on the field :
  - Water level measurement :
    - Errors in de staff gauge reading (or inversion of value)
    - Errors linked to the recording on from the water level recorder (badly established gauge zero, mal-functioning of cable-float-poullyt system etc)
    - *Derive des capteurs* electronic sensors (e.g. the pressure sensor)
  - Errors linked to flow measurements operation
    - flow measuring equipment effective
    - Number of verticals insufficient,
    - …

2. Quality of hydrological data

2.1 S**ources of errors** in the process of data acquisition and processing :

- Primary data processing:
  - Extracting data from the the water level recorder chart
  - Entry of data in to the computer
  - Calculation of flow measurements: use of a wrong formula for current meter
  - Deriving flows from water level data using a rating curve not updated, or wrongly extrapolated
  - …

2. Quality of hydrological data

2.2 Reviewing and screening of data

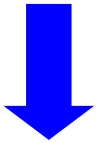
This step requires a good knowledge of the field and the station, and to have access to all the informations concerning eventual modifications on the site (see station file)

- Graphical visualisation of data :
  - Control des hauteurs instantanees
    - Superposition des limnigrammes de la station for un même mois sur differentes annees
    - Superposition et comparaison des limnigrammes à 2 stations proches
  - Control and screening of flow measurements : visualise the flow data plotted on the rating curve
    - Discrepancy of points of flow measurements can come from erroneous flow measurements or the rating curve is not valid
  - Compare the hydrograph of the flood and the hyetograph for the basin (unit hydrograph chracteristics

2. Quality of hydrological data

2.2 Reviewing and critic of data

- Comparative discharge evaluation
  - **Double mass curve method:** graph of the cumulative values of daily discharge for **station Y** (that you want to evaluate) against the corresponding cummulative values for 3 reference **stations X1,X2,X3**



  - **A change in slope** in the curve is a sign that station Y underwent a sudden or progressive change at a certain date (diversion, rating curve changed etc.

2. Quality of hydrological data

2.2 Reviewing and critic of data

- Importance of revision and valorisation of historical data taking advantage of the latest computer and graphic technology

- Erroneous historical values in a long series will, if not adjusted, undermine statistical hydrological variables.

2. Quality of hydrological data

2.3 Gaps and reconstitution of hydrological data

- Reconstitution of missing or doubtful values

- Sources of gaps
  - Momentary stop in data collection campaign
  - Equipment overflooded during floods
  - Stilling well of water level recorder is chokedcolmate
  - Battery failure for electronic stations
  - Vandalism (theft of solar pannel…)
  - …

- Pb of gaps in extreme situation (knowledge of extreme events high flows or low flows)

2. Quality of hydrological data

Some practical technics for filling gaps

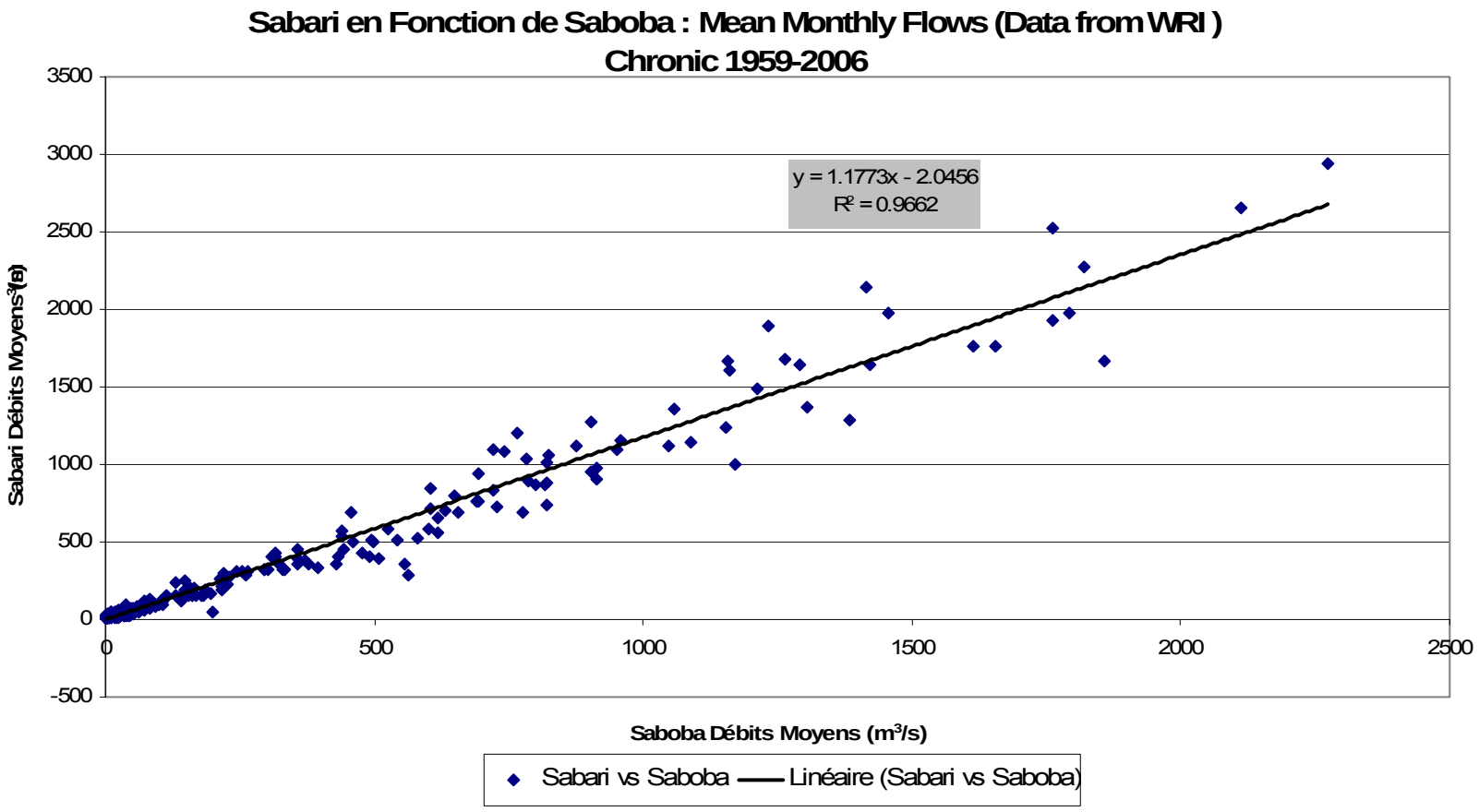
- What types of data can be reconstituted ?
  - Reconstitution of instantaneous, daily, monthly o annual flows

- Reconstitution of data by regression between stations
  - Regression between hydrometric stations which are « comparables », that is to say :
    - Stations which are not very far apart
    - Area of basins have similar sizes,
    - Stations with a similar rainfall history
    - Basins have similar response time to equivalent rainfall (Concentration times)

2. Quality of hydrological data

Regression method

- Regressio between discharges taken from the **considered station** and those of a « reference » stations or stations :
  - $y = ax + b$ (regression based on one station)
  - $y = a_1x_1 + a_2x_2 + \ldots + a_nx_n + b$ (multiple regression, based on several stations)


Sabari en Fonction de Saboba : Mean Monthly Flows (Data from WRI)
Chronic 1959-2006
y = 1.1773x - 2.0456
R² = 0.9662
Sabari Débits Moyens (m³/s)
Saboba Débits Moyens (m³/s)
3500
3000
2500
2000
1500
1000
500
0
-500
0
500
1000
1500
2000
2500
Sabari vs Saboba
Linéaire (Sabari vs Saboba)

F3

- Reconstitution of peak discharge
  - Examination of high water marks on the field (application of Manning's formula)
  - Correlation between known peak discharges at the 'reference' station and those of the station in question

- What type of technique to use for reconstituting data, one should:
  - have a visual examination of the reconstituted hydrogragh
  - Indicate that the data has been reconstituted (attribute a specific code) and the method used for reconstitution

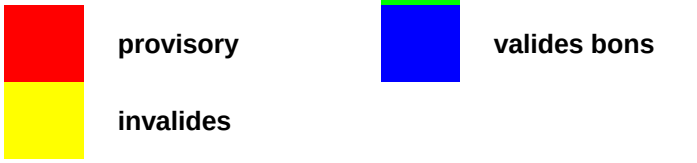
2. Quality of hydrological data

2.4 Validation of hydrological data

- Attribution of code of quality to the data: Give the level of confidence to the data

Legend :

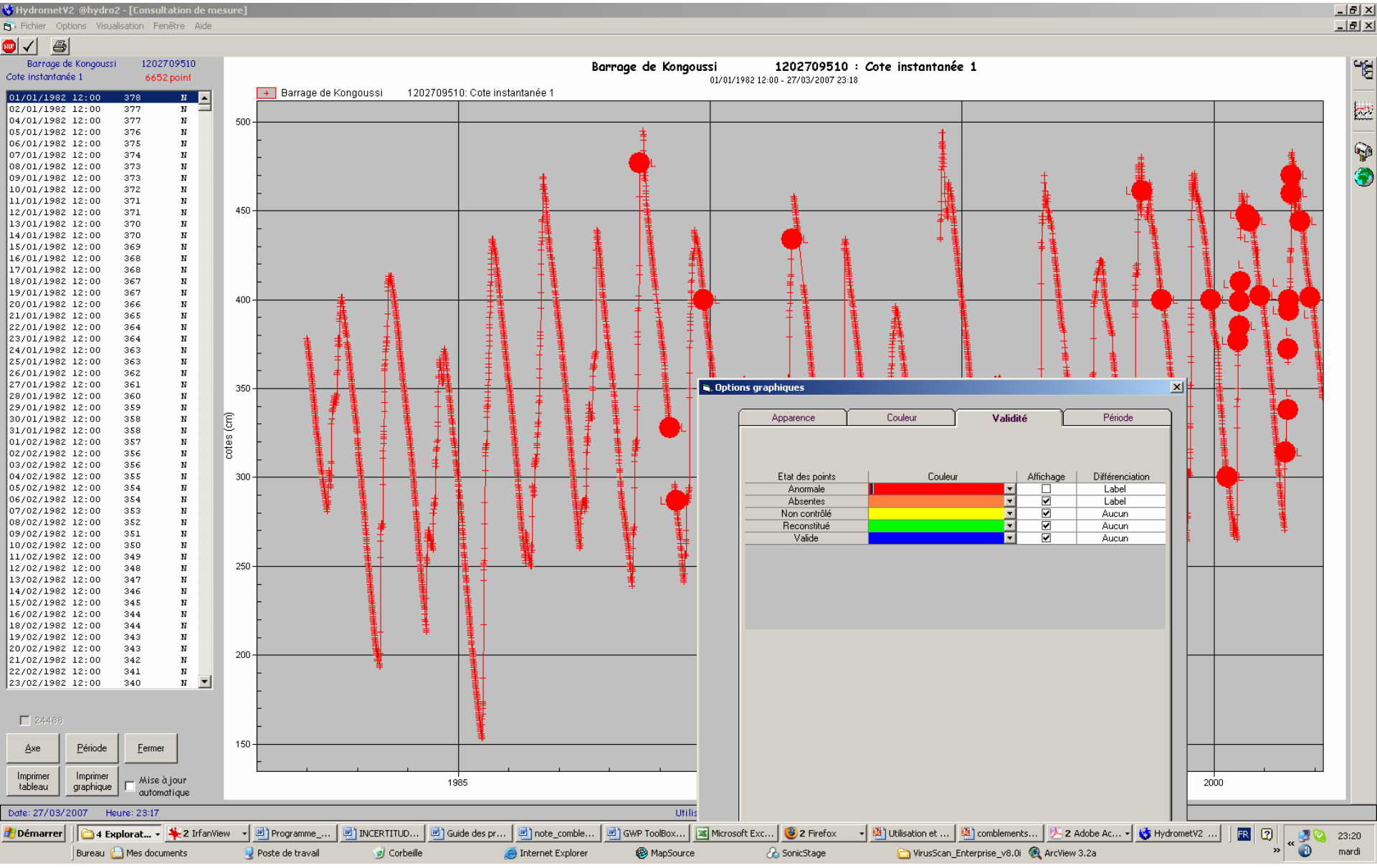
Flows :



Water levels :

(incomplete years are represented by 'X')

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Flows												
Levels					XXX							


HydrometV2 @hydro2 - [Consultation de mesure]
Fichier Options Visualisation Fenêtre Aide
Barrage de Kongoussi 1202709510
Cote instantanée 1 6652 point
01/01/1982 12:00 378 N
02/01/1982 12:00 377 N
04/01/1982 12:00 377 N
05/01/1982 12:00 376 N
06/01/1982 12:00 375 N
07/01/1982 12:00 374 N
08/01/1982 12:00 373 N
09/01/1982 12:00 373 N
10/01/1982 12:00 372 N
11/01/1982 12:00 371 N
12/01/1982 12:00 371 N
13/01/1982 12:00 370 N
14/01/1982 12:00 370 N
15/01/1982 12:00 369 N
16/01/1982 12:00 368 N
17/01/1982 12:00 368 N
18/01/1982 12:00 367 N
19/01/1982 12:00 367 N
20/01/1982 12:00 366 N
21/01/1982 12:00 365 N
22/01/1982 12:00 364 N
23/01/1982 12:00 364 N
24/01/1982 12:00 363 N
25/01/1982 12:00 363 N
26/01/1982 12:00 362 N
27/01/1982 12:00 361 N
28/01/1982 12:00 360 N
29/01/1982 12:00 359 N
30/01/1982 12:00 358 N
31/01/1982 12:00 358 N
01/02/1982 12:00 357 N
02/02/1982 12:00 356 N
03/02/1982 12:00 356 N
04/02/1982 12:00 355 N
05/02/1982 12:00 354 N
06/02/1982 12:00 354 N
07/02/1982 12:00 353 N
08/02/1982 12:00 352 N
09/02/1982 12:00 351 N
10/02/1982 12:00 350 N
11/02/1982 12:00 349 N
12/02/1982 12:00 348 N
13/02/1982 12:00 347 N
14/02/1982 12:00 346 N
15/02/1982 12:00 345 N
16/02/1982 12:00 344 N
18/02/1982 12:00 344 N
19/02/1982 12:00 343 N
20/02/1982 12:00 343 N
21/02/1982 12:00 342 N
22/02/1982 12:00 341 N
23/02/1982 12:00 340 N
24488
Axe
Période
Fermer
Imprimer tableau
Imprimer graphique
Mise à jour automatique
Barrage de Kongoussi 1202709510 : Cote instantanée 1
01/01/1982 12:00 - 27/03/2007 23:18
Barrage de Kongoussi 1202709510: Cote instantanée 1
cotes (cm)
500
450
400
350
300
250
200
150
1985
2000
Options graphiques
Apparence
Couleur
Validité
Période
Etat des points
Couleur
Affichage
Différenciation
Anormale
Label
Absentes
Label
Non contrôlé
Aucun
Reconstitué
Aucun
Valide
Aucun
Date: 27/03/2007 Heure: 23:17
Démarrer
4 Explorat...
2 IrfanView
Programme_...
INCERTITUD...
Guide des pr...
note_comble...
GWP ToolBox...
Microsoft Exc...
2 Firefox
Utilisation et ...
comblements...
2 Adobe Ac...
HydrometV2 ...
FR
23:20
mardi
Bureau
Mes documents
Poste de travail
Corbeille
Internet Explorer
MapSource
SonicStage
VirusScan_Enterprise_v8.0i
ArcView 3.2a

3. Management and exchange of hydrological data

Different scale of management and exchange of data:

- At the des National Hydrological Services (NHSs) level:
  - Many data bases data on different computers (Head office and regional offices
  - Many data base software utilises (with different data format)

➡ Pb for exchanging data between national and regional offices

- At the country level :
  - Differents institutions generating the data (eg :dam operators, data collection institutions water quality etc.) therefore multiple data bases

➡ Pb for exchanging data between the different organisms which produce data

- At the regional level (eg: transboundary basin)
  - All the national Hydrological Services and other institutions producing hydrological data
  - Basin organisation (eg. Volta Basin Authority) gaurantee the good management of water at the basin level

➡ Pb for exchanging data between countries (transboundary flows balances, transfert of polluants, …) and between countries and basin authority

3. Management and exchange of hydrological data

- When data needed for water resources assessment are collected by a number of different organisations or contries, their systems need to be compatible in terms of standards, quality assurance, electronic access and transfer.

- Quality assurance is basic to the usefulness of the knowledge base and in particular in transboundary situations where mutual confidence building and credibility is essential.

3. Management and exchange of hydrological data

- Difficulties of exchanging data are related to :
  - Multiplicity of data bases and of Management System of Data Bases softwares
  - Diversity of data format
  - Coding of data (use of different codes)
  - Reliability of exchanged data (confidence on quality of data)

- Some solutions :
  - Develop protocoles of communication between data bases
  - Unify / Normalise the data exchange formats
  - Unify / Normalise the systems of coding the information, in particular the codes for data quality
  - Ensure transparency in the protocols for acquisition and validation of data

- Better ensure the sharing of information to answer the needs for valorisation of data
- Guarantee the quality of data exchange
- Facilitate and accelerate the exchange of data

Water Information Systems : some reference Internet sites

- http://ffw.mrcmekong.org/ : Water Information System of the Mekong transboundary basin (Asia)
- http://www.eaufrance.fr/ : France Water Information System
- http://sierm.eaurmc.fr/ : Water Information System of Rhône-Méditerrannée Basin Agency(France)
- http://www.rdbrmc.com/hydroreel2/ : Real time hydrometric data server of Rhône-Méditerrannée Basin Agency (France)
- http://waterdata.usgs.gov/nwis/rt : USGS Web Water Data (U.S. Geolocical Survey – USA)
- …
-

Integrated Water Resources Management : some reference Internet sites

- http://www.gwpforum.org : Global Water Partnership site (THE reference site on IWRM, with many documents including the « ToolBox »)
- http://www.cap-net.org/ : Cap-Net is an international network for capacity building in IWRM (with many tutorial documents)
- http://www.oieau.fr/ : International Water Office site (French and English)
- http://www.rhone-mediterranee.eaufrance.fr/ : Rhône-Méditerrannée Basin Agency site (France)
- …