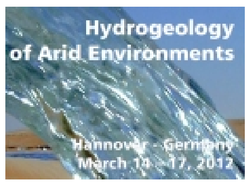

FAD: A computer based system for Frequency Analysis of Droughts

Abstract

Decision support systems are widely developed to assist water resources engineers, water managers and hydrologists in the design, operation and management of water resources structures. Unfortunately most decision support systems based on frequency analysis are not accepted by their projected users. The user's conceptual representation of certain situations does not often correspond to the hydrological frequency analysis model representation as applied by most decision support systems. The main purpose of this paper is to present a software for hydrological frequency analysis with historical information. The FAD software (acronym for Frequency Analysis of Droughts) developed in a Windows platform and compiled by MATLAB 6.5, represents a user friendly tool that can be used by practitioners for solving frequency analysis problems in the field of hydrology in arid and semi-arid regions. The software represents also a decision support system for experts to assist water resources engineers and hydrologists and a didactic tool for students who approach this kind of problem for the first time.

FAD System Development

The chosen technical platform drew upon our development experience, in the area of graphical user interface (GUI) and decision support systems. The system is constructed with the use of pre-developed toolkits of MATLAB (Matlab 6.5). The system components such as toggle and push buttons, menus, edit texts, list boxes, popup menus, axes, etc., are all pre-programmed in MATLAB. The sole source for all program features and some tools is our development. MATLAB functions are not the only base for all graphical features of the system. The system is constructed in a modular fashion, comprising of a number of components, including hypertext, database, data graphing facilities, selected fitted drought frequency distributions and probability plotting position for all distributions available in the software. The FAD software objectives were to create a computer system that would support multidisciplinary decision making by water resources managers, ecologists, environmentalists and economists.

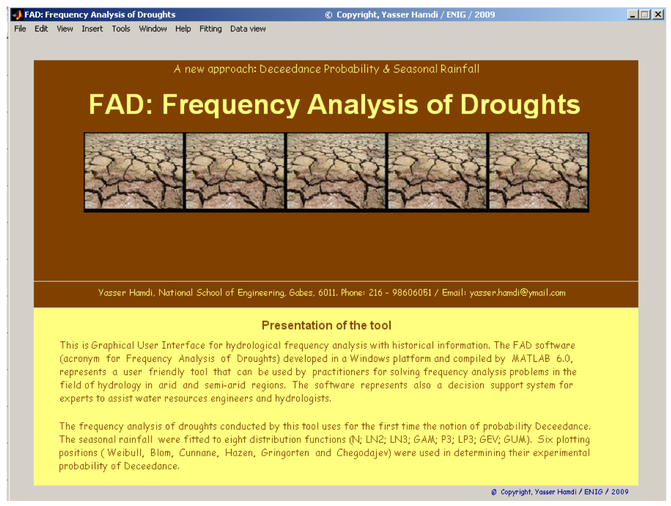

Fig. 1: Screen capture of the FAD front page

The advantage of a such computer program is that many different scientific and hydrological disciplines can be involved. The user can use it for drought frequency analysis, precipitation frequency analysis, etc., The resources and the input data of the system included gauged systematic records, Annual rains whose magnitudes can be accurately estimated such as most systematically gauged precipitation data, a second type of historical information to be considered is the annual rainfall whose magnitudes cannot be determined but which are known to have not exceeded an upper threshold and finally, all the rainfall values whose magnitude is known to be within a range described by an upper and a lower bound. To achieve these objectives, ease of system use, low platform costs, low maintenance costs and flexibility of the system components were key design priorities.

Data required by the developed system

The FAD project is characterized by comprising various aspects connected to hydrological and water resources management. Another advantage of developed product that a big number of hydrological sites can be involved in the same application and by choosing the site number in the corresponding GUI, the user can easily make the hydrological frequency analysis that concerns solely that site. This causes that a wide range of data is to be used and many different hydrological components and water sectors in different locations can be involved. Figure 2 is a screen display of the proposed data file format.

This includes obviously a systematic period of data and the three types of historical information mentioned earlier in this paper (historical known values, upper thresholds and range rainfall estimates). Each type of information can vary, in term of length of period, from a site to another one. This gives more flexibility to the developed tool.

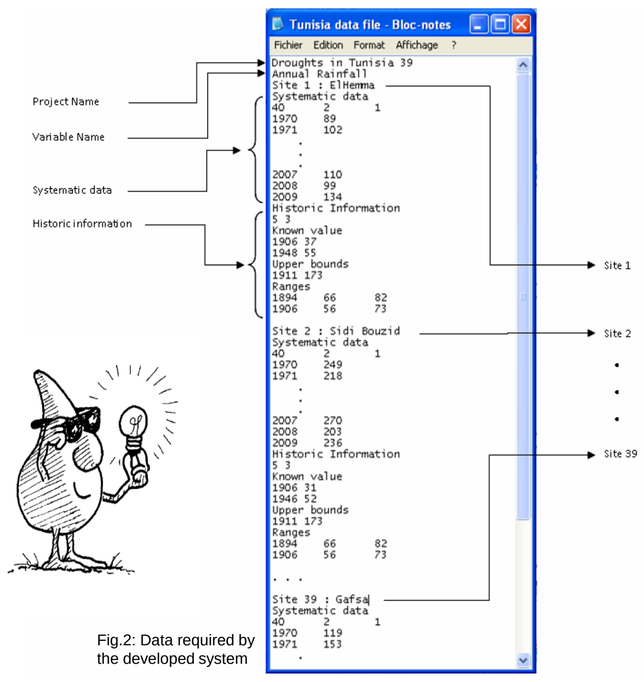

Fig.2: Data required by the developed system

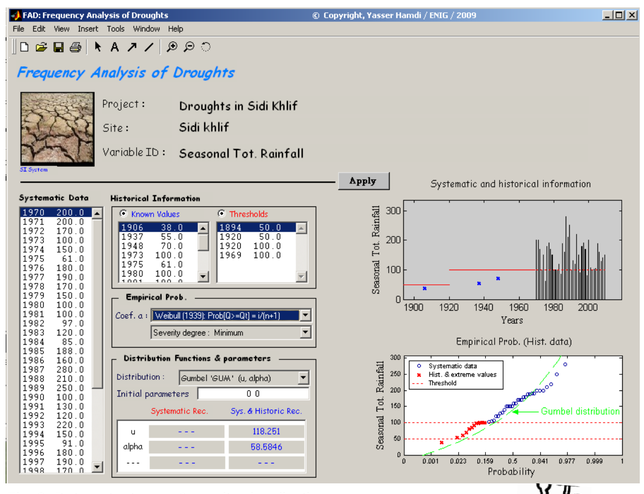

Fig. 3: Data output page & results visualization

Analysis of the developed system

FAD system successfully creates a technical hydroinformatics system that it is attractive and easy to use by the noncomputer expert. As noted earlier, the system uses a proprietary GUI. Although this interface is well designed, it inevitably incurs an additional knowledge burden upon the user. This need for additional knowledge arises because the user has no prior experience with the interface and consequently no prior knowledge base to draw upon. The software successfully demonstrates the suitability of hydroinformatics system to modular development. Additional modules have been added to FAD at various points, to meet additional user requirements. In a next step of the project, to make a strategy to continuously improve the software. Ideally, the feedback of information from the user to the designer must be the basic element of the strategy. A phased implementation of a module can allow the system to provide an operational service. Once in this module, valuable feedback can be obtained from the end users. We will use this information to continuously improve the system.

A computer package was developed to facilitate drought frequency analysis using information from different sources including: systematic gauged records and different types of historical drought data. The software calculates the probability plotting position. Data processing and manipulation tools are required for current tasks in the field of hydrological frequency analysis especially when historical information is included. The FAD product could be mentioned as one of the simple family of such software packages. Lot of algorithms for data validation, data import, data filling and analysis is included there. The system has got a lot of main features, such as flexible systematic and historical data imports, internal consistency checking, advanced graphics, sophisticated analytical tools, etc. We actually use this system in the Hydro-Science Research Unit projects, it successfully demonstrated the suitability of a hydroinformatics system in hydrology problems. For this reason, continuous improvements are supported and encouraged. As an essential feature, plotting positions graphics for both, gauged systematically data and historical information can be displayed by the software and this for a selected number of fitted distributions.

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