Overview

P2

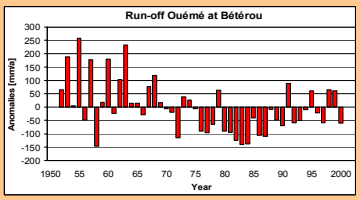
IMPETUS WEST AFRICA

An Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa

- Case Studies for Selected River Catchments in Different Climatic Zones -

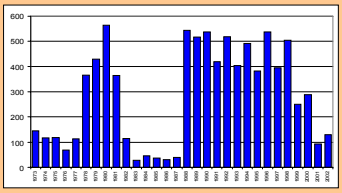
Past and Present Situation

Since the early 1970s tropical West Africa has suffered from a prolonged drought that reached two peaks in the early 1970s and mid-1980s. The average rainfall deficit over 1971-1990 was on the order of 180 mm/year compared with the interval 1951-1970. All climatic zones, from the semi-arid Sahel and the sub-humid Sudanese zone down to the humid Gulf of Guinea, have been affected. The prolonged West African drought has already brought about a profound deterioration in the economic and social development of the West African countries. For example, river discharges in West Africa have decreased by about 40-60% in recent decades, causing shortages in river water available for domestic and agricultural purposes. For instance the figure below shows the decrease in run-off of the Ouémé at Bétérou which reflects the integral for the southern part of the upper Ouémé catchment. This has led to extensive migrations in the past. During the rain-rich fifties, water power stations were built in the Guinea Coast zone to supply a substantial amount of energy to Ivory Coast, Ghana, Togo, Benin, and Nigeria.



Annual run-off anomalies of the Ouémé river at Bétérou for the period 1952 through 2000. Units are in mm/year, thereby taking into account the size of the upstream catchment area.

Moroccan precipitation is strongly related to the large-scale atmospheric circulation over the subtropical and extratropical North Atlantic and the Mediterranean Sea, with the bulk of precipitation occurring in winter (November - March). Since the late 1970s, Morocco has experienced a number of extremely dry winter seasons. Due to the orographic barrier of the High Atlas mountains long-term precipitation trends in south-eastern Morocco have not always been in phase with the northern parts of the country, the causes of which have been enlightened in the course of the present project. Against this background, the development of sustainable water resource management is even more a necessity. The considered wadi Drâa possesses two main tributaries which drain the south-eastern and south-western parts of the Atlas and meet near the city of Ouarzazate. This is also the site of the Mansour Ed Dahbi dam that was built in 1968 and whose reservoir has a storage capacity of 530 million m³. Approximately half of this amount is released in normal years. An effective and sustainable management of water in the Drâa valley is essential to enable the competing users (water power generation, irrigation, domestic consumption) to have adequate supplies, and to prevent social tensions related to water resources. The figure just below shows the sharp decrease in the filling levels of the reservoir in recent years.



1st April-filling levels of the "Mansour Ed Dahbi" reservoir near Ouarzazate, Morocco (in Mill. m³) since construction in 1972.

Methods

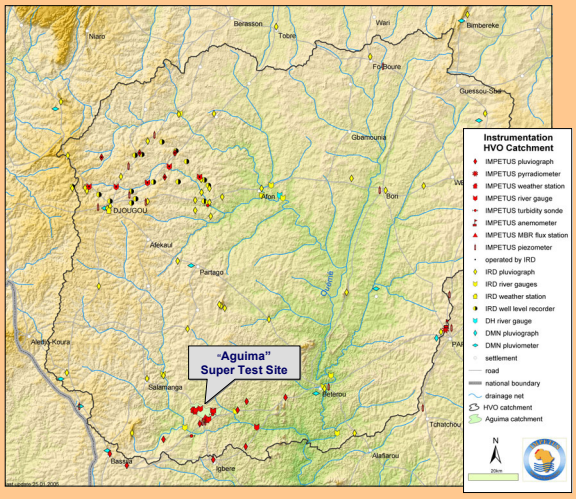
A measurement network of necessary parameters has been set up in data sparse areas of each catchment under consideration.

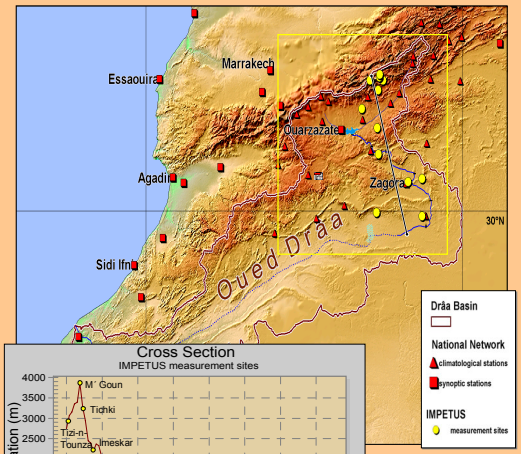
For the Ouémé catchment special emphasis is put on the Upper Ouémé Valley where the existing national and IRD hydro-meteorological networks have been enforced. In addition a high number of different measurements have been carried out on the super test site 'Aguima' near Doguè (cf. figure on the right). In the Drâa catchment 12 climate stations and 10 fenced vegetation plots were installed along a height gradient from the High Atlas to the pre-Saharan desert (cf. figure below) and operated permanently .

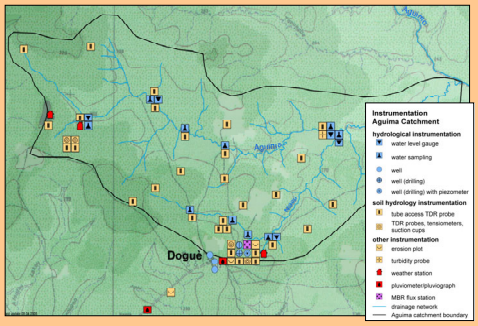
In an integrated approach a sequence of existing models for the individual components of the hydrological cycle have been adapted in the first project phase.

The focus of the on-going second phase is set on the analysis of possible future developments. This is done primarily on the basis of coupling suitable models.

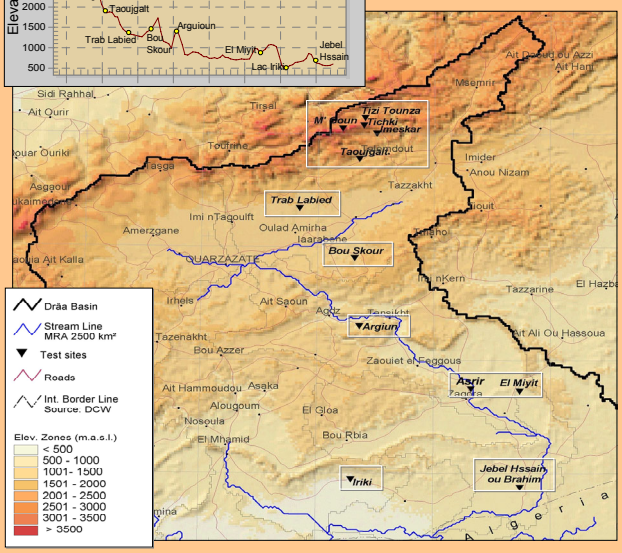
Since construction of a unified coupled system seems not feasible, different system components (i.e. individual disciplinary models) are coupled via







The Aguima catchment (30 km²) has been selected as a super test site of IMPETUS. It is situated in the south of the upper Ouémé basin (ca. 14.000 km²). The catchment (ca. 250-320 m above sea level) is part of a large plain and is dominated by savannah vegetation and farm land close to villages.



The upper figure shows existing Moroccan stations - and recently installed IMPETUS measurement sites. The latter ones are located along a north- south height gradient (see overlaid figure in the middle) and concentrated in the upper Drâa catchment (cf. lower figure).

data exchange and not dynamically. The choice of models to be coupled varies and depends on the specific problem.

Due to the uncertainties arising from model parameterizations future development cannot be forecast precisely. To cope with these uncertain-ties a set of future development paths is considered. Scenario analysis (cf. posters P3 and P4) is a suitable tool for this exercise. Embedded within the scenarios will be "problem clusters" (cf. poster P5) which combine the underlying processes and complex interactions of a certain water-related problem. Coupled numerical or conceptual models form the core of such a problem cluster, thereby enabling the development of suitable management options by assessing the system's response indicators in a quantitative manner.

Examples of such problem clusters are given on individual posters (posters P6 to P9 for Benin and posters P10 to P13 for Morocco) .

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