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# PRESENT SITUATION ABOUT THE UTILIZATION OF THE ARGOS SYSTEM BY THE HYDROLOGICAL UNIT OF ORSTOM FOR HYDROMETRIC DATA COLLECTION.

By G. Rabbia - Hydrologist O.R.S.T.O.M.

## 1- Utilization of low orbiting satellite (Argos System) by the hydrological unit of ORSTOM.

From 1978 to 1982 the hydrological unit of ORSTOM has tested the efficiency of the remote sensing technical and management procedures of hydrometric networks utilizing this system.

- in 1978-79, testing of the system at KAOLACK (Republic of Senegal) hydrometric station on the SALOUM River. A Sigtaycod digital incoder had been installed inside a OTT X limnigraph;

- in 1979-80 technical assistance provided for testing the system in Canada (Quebec province) the hydrometric station was MALBAIE on the Malbaie River, a left bank tributary to the Saint Laurent. The LEUPOLD and STEVENS pneumatic limnigraph was equipped with a Memomark incoder, same brand. It should be noted that this is the same electronic system (platform n°50) built by the firm Electronique Marcel Dassault that has been used for those two tests.

- in 1980, installation of three stations in the inland White Nile Delta (Sudd) in SUDAN for a single measuring operation. The Neyrtec incoder was directly actuaded by a float-counterweight device;

- in 1980 a similar apparatus was installed in two hydrometric stations on the Faleme River, a tributary of the Senegal

- in 1981 the hydrological unit of ORSTOM has contributed as advisor to the testing of the Argos System in view of improving the management of the Seine Basin hydrometric networks. We have reached the point of defining a new type of signal electronic equipped with a memorizing system. In this system, the limnigraph is questioned every 30 minutes period; The incoder was a CSEE Sigtaycod installed inside a OTT X limnigraph.

- in 1982 a test was made in BRAZIL. An hydrometric station on the Paraiba do Sul was modified for remote sensing through the Argos System. A sigtaycod was easely installed inside a Hydrologia S.A. type LNG-9 limnigraph. The station was in operation from april to october 1982.

In september a second station was installed at Boa Vista, on the Rio Branco. There was a limnigraph there : the water level reading was entered to platform manually by means of a key-board actuated twice daily by the hydrometric station watcher.
Finally, a direct receiving station was installed for two weeks in the Federal Hydrological Service Headquarters (DCRH) at Brazilia.

That station, that ORSTOM bought after its return from Brazilia has been installed on 14 february 1983 in the hydrological unit offices in Bondy (France) and receives, of course in a more or less irregular manner taking distance into consideration (more than 6,000 Kms), signal broadcasted by the platforms installed in Senegal.

## 2- Common factors about those tests.

All those tests were conducted using transmitter electronics (also called plat. form) made by the firm Société électronique Marcel Dassault. It should be noted that the same platform (with a transmission code 50) has been operating successfully and successively in Senegal (1978), Canada (1979), France (1981) and Brazil (1981) without any failures.

The antenna is generaly of the AV 402 type made by C II Alcatel ; it is a well designed compact structure.

The power supply requires a 24 volts-DC current for an average consumption of 72 mw (a peak amperage of 700 mA during 0.3 s). Usually a set of dry cells having 700 Ah capacity would furnish an autonomy exceeding two years ; The Brazilian experience has evidenced the requirement of eliminating the utilization of car type batteries : such an electrical power supply looses all efficiency in three months.

In addition, the remote sensing equipment is of sufficient reduced size, in most cases, to enable its installation in existing structures, without noticeable modifications.

In most of the cases, rainfall gauge readings were made simultaneously - A tipping bucket apparatus with a contactor generates an impulse registered by a meter it is this binary value of the meter that is remote sensed.

3- Results.

The Argos Agency had foreseen a ratio of daily readings that was rather pessimistic. As a matter of fact, we have collected

- for a 07° latitude : 8.6 collect/day
  against 7.5 forecasted by Argos service
  resulting in a 15% increase.

- for a 23° latitude : 10.4 collect/day
  against 8.5 forecasted (20% increase)

- for a 49° latitude : 13 collect/day corresponding to the forecasts.

The rate of exact collections is really high. For a 32 bits message, it varies between 98,8 and 99,9%. For a 256 bits message it is 97,6%. It should be noted that most of the wrong collections are resulting from transmissions made in adverse conditions (i.e when the satellite is very low at the horizon).

This is an explanation for the collection/day exceeding the Service Argos forecasts : these forecasts were planned for satellites having more than 5° tilt above the horizon.

These results, associated to the fact that the Argos System is utilizing two satellites, simultaneously (one being able to insure alone the collection in case of unforseen breakdown of the other), the Argos system is perfectly operational in spite of some design or operational short comings.

4- Return of data to the Users.

It appears that the return of data towards the user is the weakness of the remote sensing process (either for a low orbiting or geo-stationnary satellite). Taking the Argos system, even using a direct access to the files, timing is often exceeding what had been forecasted by Service Argos. Using the direct access, at the occasion of the Seine operation, has demonstrated that in the morning, about 0900 hr, it was not possible to obtain more recent collection than the ones of the preceeding day about 2100 hr (resulting in a 12 hr delai) Morcover, this procedure is relatively expensive because, in addition to TWX charges, the yearlyrental per platform is quite high.

The solution with the International Meteorological telephone network (GTS) may be used for only a few stations. If the charge is free, the timing however may sometimes exceed 24 hours.

In utilizing a direct receiving station (receiving directly the immediate transmission by the satellite of the platforms broadcasts) delais are eliminated as messages are caught at each passage. This type station, equipped with a omnidirectional stationnary antenna is entirely automatic. A connection RS232G enables for a possible connection with a computer. It is the ideal solution when the hydrometric network designed with remote sensing exceeds ten stations. We have tested it in Paris and Brazilia and were able to check that the operational range of the station was 3.000 Kms for a maximum 5.500 Kms.

The utilization of a direct receiving station will however, result in a decrease of the number of collect/days : the satellite being in direct vision field with the platform and the receiving station is a must.

Finally we also have used the "off-time" return of files made at Toulouse by the service Argos (disposition file). Once a month we obtain a magnetic tape including the entire collection. The system is specially excellent for the establishment of water levels files. Just one remark to regret that the format had not been designed for better "collection data" operations. In addition, the utilization of a pseudo Julian date calendar is specially uneasy.

5- Present and future projects.

In France : The modernization project of the hydrometrical networks of the Seine Basin is started. A first group of twenty hydrometrical stations should be installed in 1983 as well as the direct receiving station. The equivalent is under may for the Loire Basin.

In Africa : An important project to include the entire Niger Basin is also being accomplished : ten hydrometrical stations and a direct receiving station will be installed in 1983. The remainder (fifty five hydrometrical stations and seven other direct receiving stations) will be installed between 1984 and 1985.

In Brazil : A first project to include twenty three hydrometrical stations and one or two direct receiving stations is scheduled.

In French Guiana : Two hydrometrical stations will be installed.

A pilot project : This project includes height hydrometrical stations and a direct receiving station to be started in March 1984. It will concern a portion of the World Health Organization hydrographic network, as a contribution to the antionchocerciasis campaign.

Remote sensing should contribute, through immediate knowledge of the flow of rivers, to have a more accurate management in the utilization of planes and copters spreaders of insecticide.
Let us inform too of other programmes under study concerning Bolivia (Amazone Basin) Cameroun (national hydrometrical network), Indonesia (rain-fall data collection) and Senegal (Agency for improvement of the Senegal River valley).

6- Conclusions.

The utilization of the low-orbiting remote sensing system seems specially well adapted, in most of the cases, to the requirements of the hydrometrical networks. In only very few cases, it would be necessary to use the geo-stationnary wich would result in creating handi-caps on the field (checking of the clocks) and a cost of equipment largely higher.

Presently, the only really operational system in Africa and South America (for low orbiting satellite indeed) is Argos system. Such as it exists, it is giving valuable services in spite of the fact that hydrologists must cope with an

organization wich evidently, has never been designed neither for data collection neither for hydrology (i.e 24 V power supply for master data collection platform). It is also discouraging that any suggestion for minor modifications be acknowledged as a dismissed case. However, those criticisms are small in regards to a system fullfilling its mission and a perfectly operational service.

We are now taking the opportunity to emphasize the efficiency of the Argos system organization from wich we have always received cooperative support in view of developing our field operations (in particular through the loan of equipment).

As we can see, the number of hydrometrical stations utilizing the low orbiting satellite technique is increasing. There will be 57 for the sole concern of ORSTOM in 1983. For the period 1986-90 a prospective evaluationshould indicate a number of 500 for all the project we are cognizant of. It is reasonable to think that about 1992, year of phase out for the Argos system, a minimum of 1000 platforms will be used for the collection of hydrological data.

By that time, may we wish that the hydrologists be consulted in order that the post Argos system be designed according to their needs. Unless the hydrologists consider themselves capable of managing their own satellites network. Let us mention at this occasion, the interest that a low equatorial orbiting system would represent for the coverage of the intertropical zone (3.000 Kms on each side of the equator, allowing for a data collection each two hours with a single satellite). This would be interesting for a good portion of latin America, Central Africa and Indonesia.

Already, at the present time, Brazil is about to launch a similar type satellite that will contain a receiving channel adapted to the Argos system. We know that the interafrican committee for Hydrauliques studies is also interested in this project.

Let us wish the best results for this project.