USING ARGOS FOR HYDROLOGICAL STUDIES OF COASTAL SWAMPS IN FRENCH GUIANA

by

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USE OF THE ARGOS SYSTEM FOR HYDROLOGICAL STUDY OF COASTAL SWAMPS IN FRENCH GUIANA

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1) Study Problematics

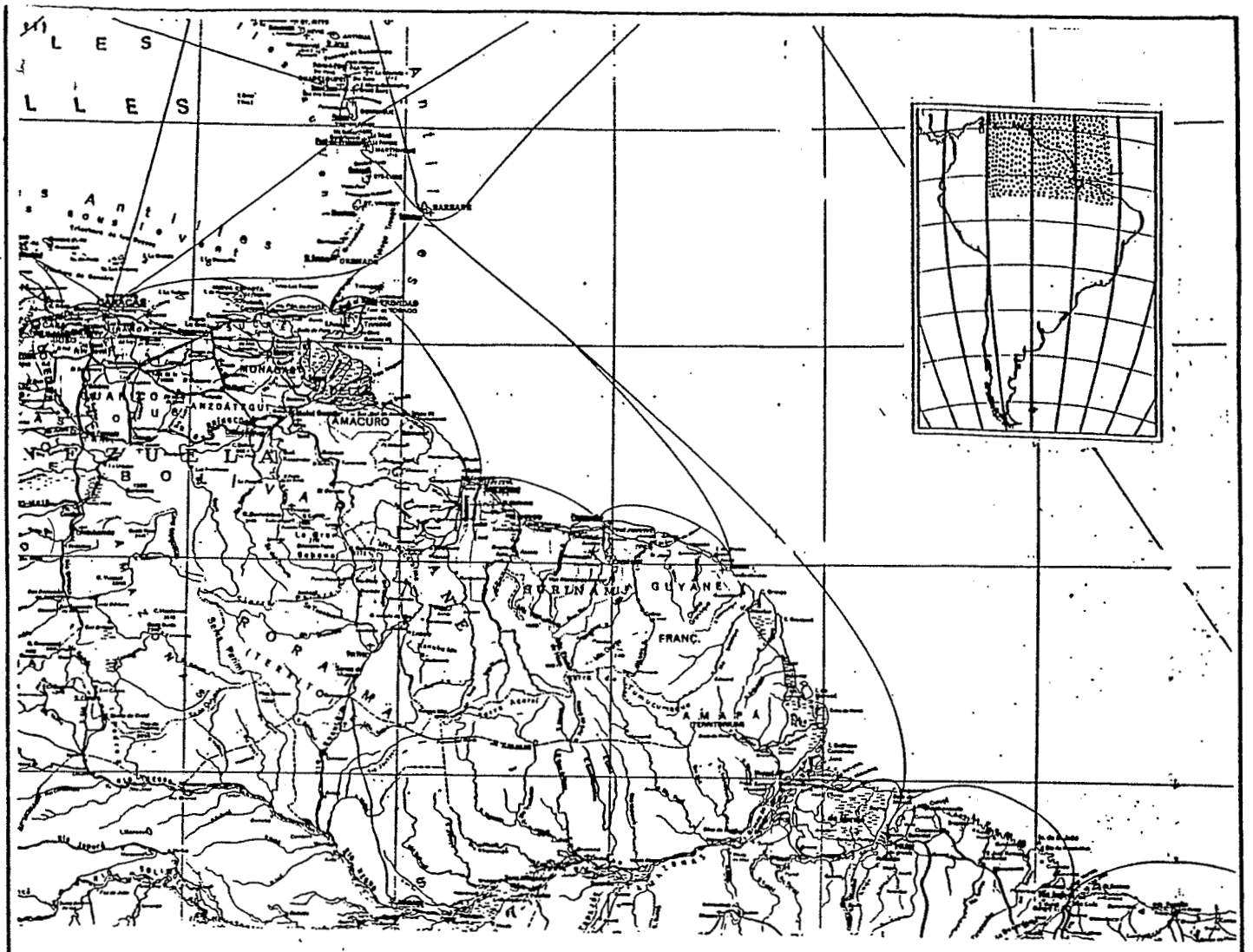
French Guiana, situated between 4° and 6° latitude in the northern hemisphere on the Atlantic coast of South America (fig.1), possesses approximately 500 km of lowland coasts mainly fringed with white and red mangroves (avicennia sp. and rhizophora sp.). The north equatorial sea currents load the coast with a flow of fine sediments thrown out by the Amazonian delta, thereby creating a situation of chronic and generalized silting . Nevertheless, the northward shifting dynamics of these mud-banks and the temporary appearance of mangroves within them, render a perpetually changing coastal outline, sometimes stretching over several kilometres within a given area in a matter of just à few years.

In some places, beyond the mangrove and protected by a sandy bar can be found specific aquatic ecosystems of brackish waters, covered with herbaceous vegetation or forming open water ponds.

These coastal swamps, streching over a few thousand hectares each, are connected to the sea by narrow "water gullies" or "creeks" which gash their way through the sandy bar and are fed upstream with continental fresh-water runoff as well as rainwater that falls directly on the swamps (from 2,000 to 3,500 mm. annually in French Guiana).

An intense biological activity is at work in the sea-waters of the continental shelf. Here one meets with massive concentrations of several shrimp species of the "Penaeus" family, a resource that has been commercially exploited since the early' 60 s. Depending on the period, between 50 to 100 trawler ships are scraping the "penaeus" inhabited beds, unloading every year from 3,000 to 5,000 tons of shrimp in Cayenne.

To reach adulthood, the principal species "penaeus subtilis" has to pass the first weeks of its life in brackish waters. Once in their post-larval stage the 15 day-old shrimps leave the sea where they are born to penetrate into the coastal swamps by travelling up the creeks mostly when the tides are strong. Two months later, these young shrimps return to open sea and into the fishing zone. In 1972, a hydrobiological study of one such swamp situated at the N.W. extremity of French Guiana close to the Mana township, was undertaken. The conclusions that emerged could indicate the specific importance of this site as a major contributor to the stock of shrimp caught.



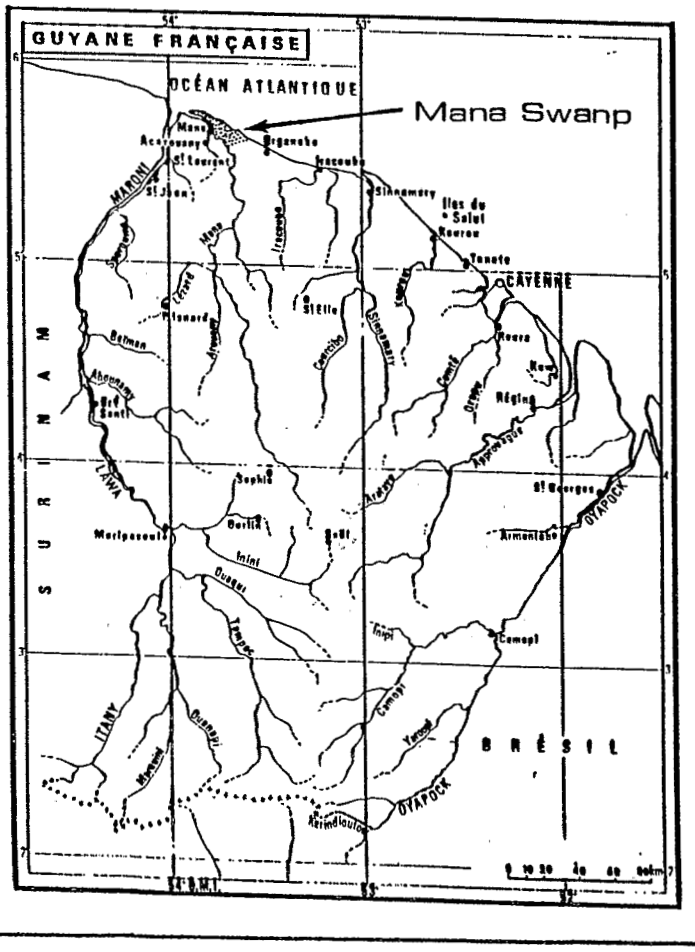


FIG:1. Location of the study area

Since over two years, a significant drop has been noted in the quantity of the catches. Several explanations have been offered concerning these poor fishing results : one of them points out their logical connection with a change in the quality and productivity of the on-shore nurseries due to natural conditions (rainfall deficit or silting) or man-made causes (extension of rice polders adjacent to these swamps.

Requested by SEDETOM (State Secretariat for Overseas Departements and Territories), studies of selected coastal swamps were started in 1985, by IFREMER, dedicated to the so-called biological aspects with ORSTOM taking over the environnement's physico-chemical parameters.

2) Data collection

The physico-chemical conditions in the canals linking the swamps to the sea are changing very rapidly (fig. 2). The twice a day tide rhythm being distorted, sea-water enters into the swamps during two to four hours, whereas ebbing occurs for about seven to ten hours. During this period, the water level and salinity vary in the space of a few minutes. Added to this is the monthly variation originating from the lunar cycle of the tides, and an annual rather problematic one governed by the advent of the rainy and dry seasons.

Apart from the volume of water entering and leaving these swamps, some minimum data, relating to the level temperature and salinity of the water, is needed for a biological follow-up.

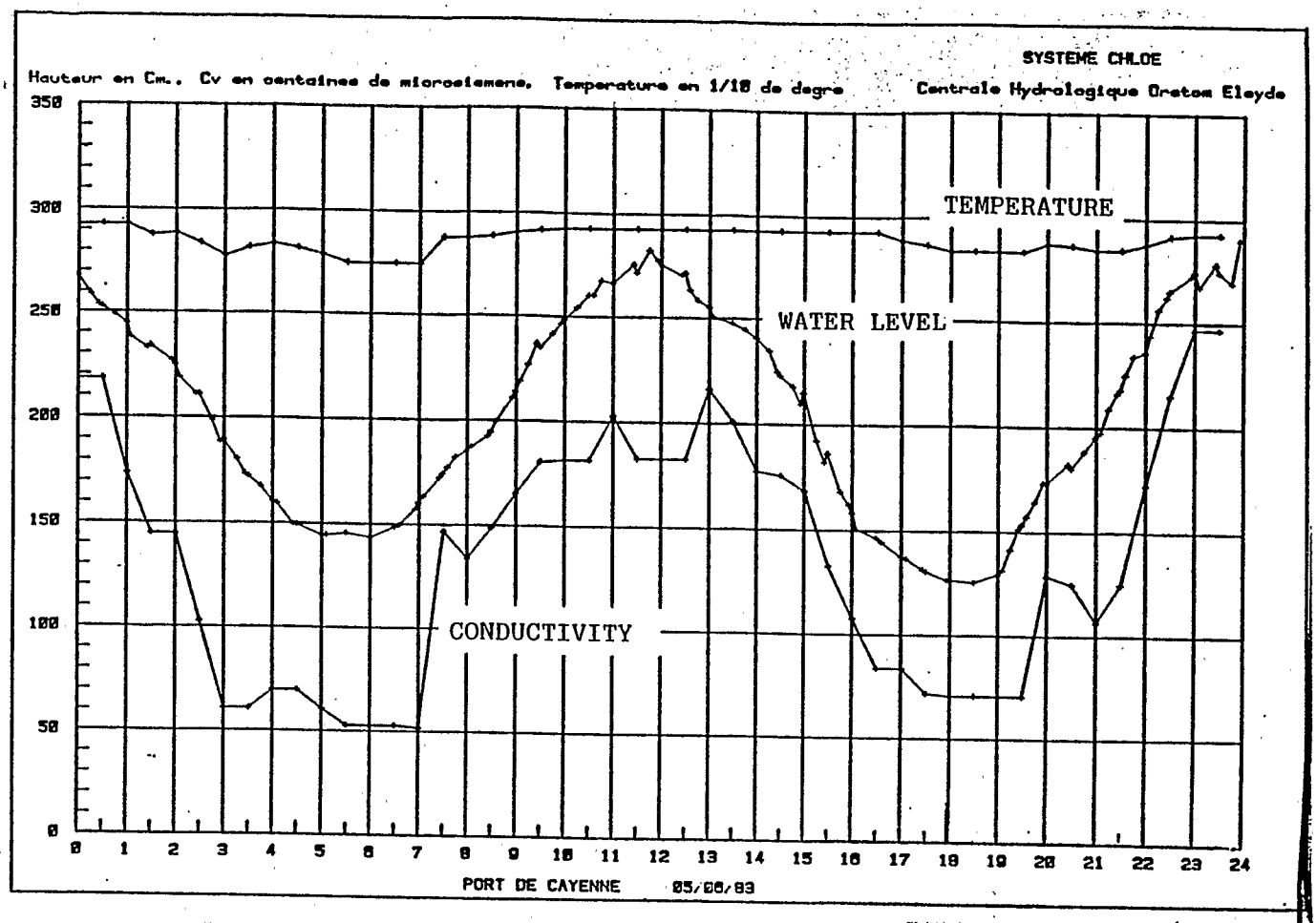
These parameters are measured by an automatic CHLOE unit, initially developed for ORSTOM by the ELSYDE company. This unit uses an immersed piezo-resistive sensor (SPI) for measuring the level and the temperature, and a salinity sensor PONSELLE CTS 10. The sensor data are processed by a centralizing module, assuring the following functions :

- periodical interrogation of sensors (user may program the intervals),

- parameter selection if their variation appears signifiant (user may program the sensitiveness),

- result memorized onto a removable EPROM cartridge,

- output message generation in ARGOS format.



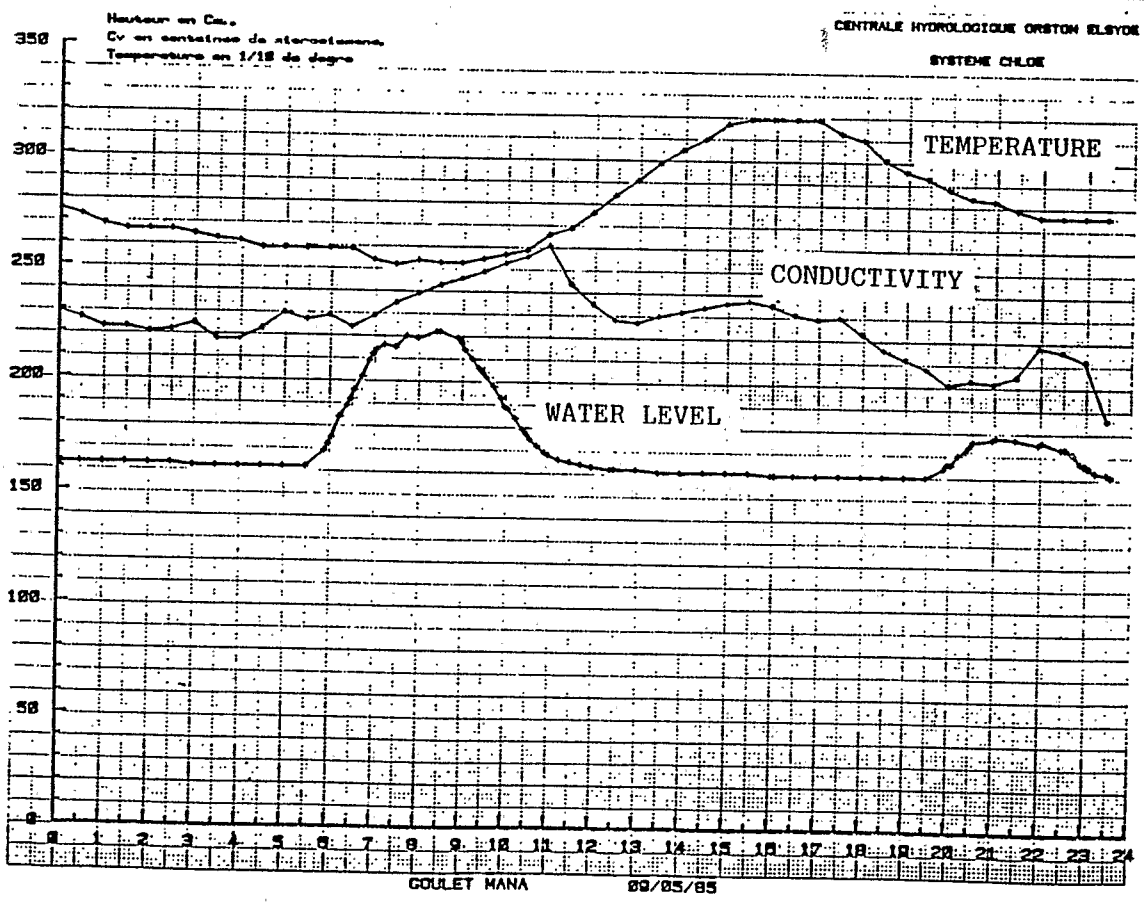


Fig. 2 : Sensors variations - in estuaries (up) and in swanp output (down) during big tide period -

water level in cm ; conductivity in micro-siemens x 100 ; température in Celsius degrès x 100 -

Considering its latitudinal position, one must admit that Franch Guiana is not ideally situated for performances of polar orbit satellites such as those used in the ARGOS program. In fact only 4 groups of passages, 2 in the morning and 2 in the afternoon can be counted (fig. 3). However, one may infallibly stake on the visibility of the same satellite during the two successive orbits. Thus, at best, 256 data bytes per day (8 x 32) and per PTT identification number could be transmitted, provided a satellite passage time-table be maintained at ground level.

Hence, an ARGOS recording of all the data required for our study appears entirely improbable. In effect, a laboratory reading of the EPROM memory cartridge with a Hewlett Packard HP 85 computer leads to the creation of magnetic files which daily store more than 1,000 bytes of unpacked data ; in other words, 5 to 10 times the maximum possibility offered by the ARGOS system. Besides, the storing capacity of an EPROM (64 K bytes) cartridge covers several months' data and electrical autonomy of the collecting unit is supplied by a solar cell panel with an 8 watts peak power. Although the methodology of this study does not require real-time data availability, the use of the ARGOS system has all the same proved precious in satisfying the following objectives :

1) controlling the memory address of the cartridge, in order that it may be changed at the right time,

2) verifying the proper functionning of the sensors,

3) deciding on field jobs to be undertaken, should the transmitted parameters show certain readings (concerning the water's hyper-salinity, its exceptionally high level, etc...).

The ARGOS message is transmitted by a programmable LAMD 82-type P.T.T., manufactured by CEIS-ESPACE, which uses the 32 available bytes (fig. 4). 28 hexadecimally coded bytes are reserved for data, i.e. 14 sensor values, sampled at regular intervales. 2 BCD coded bytes are used to memorise local time of the latest sensor value sampled, and the last two bytes are reserved for general purposes (parity check, battery voltage, etc...)

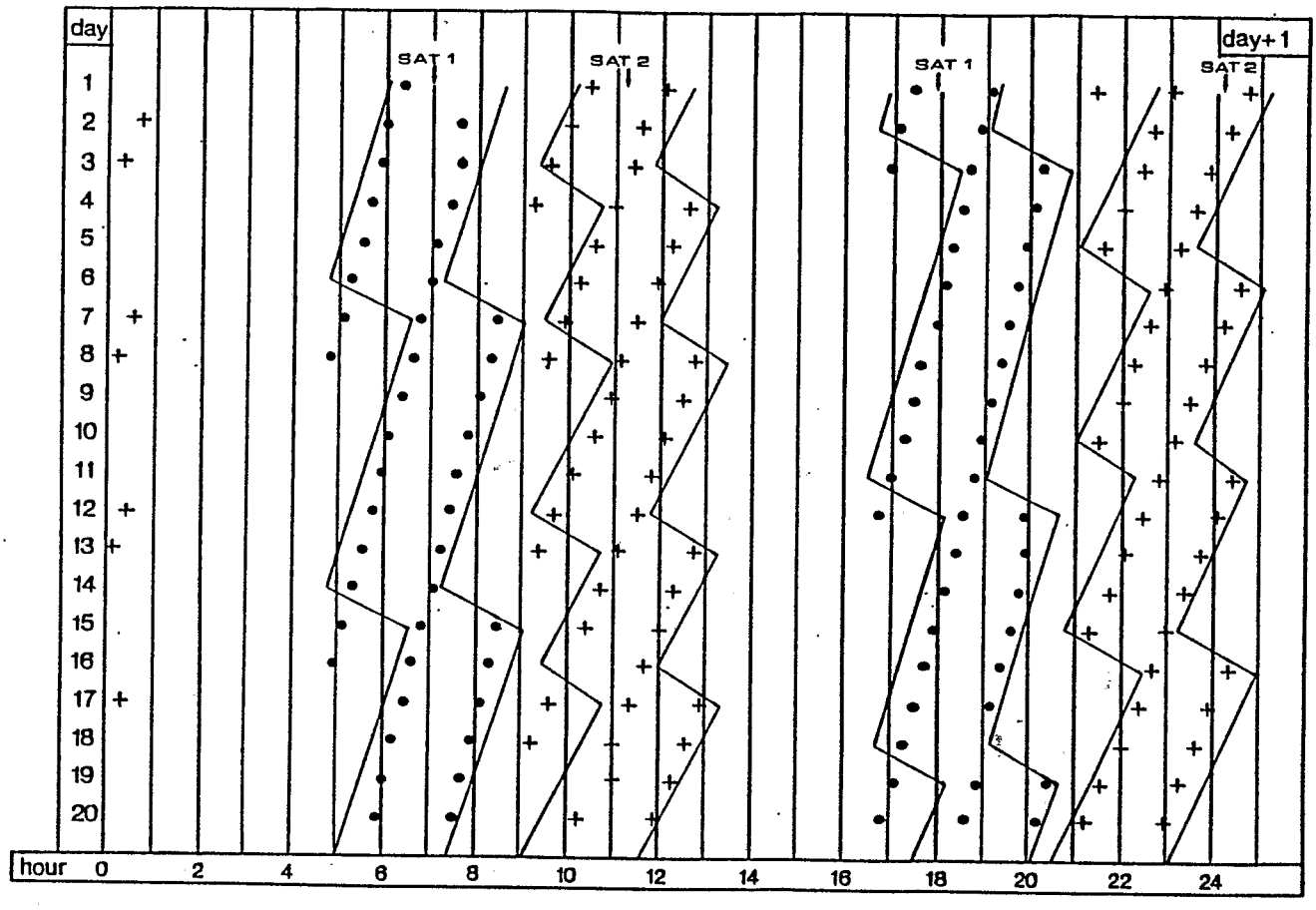


Fig. 3 : Occurence of messages present in DISPOSE file from 1 to 20 of july 1983.

P.T.T. was located in Cayenne - French Guyana - (T= 300 s)

Hours in Universal Time

Local Time = UT - 3

```
530255

ARGOS  530255 F
173 1314 0
ORSTOM 910608F65555
/// ARGOS SYSTEM READY  PLEASE LOGIN


LOGIN,

LOGIN  AT 173/1114

/


STAT


/
      //STATUS LABEL USER 0026  //

//N.EX//FILES //SIZE//REC.TIME//STAT//

PUBLIC FILE LAST UPDATE : 173/0605

ARGOS READY
/
 COM,          09150


/
 EXP 0299

 09150  NO LOCATION                                  172/2323Z-
  ( 2)  09          54          10          13
        00          90          09          27
        10          3F          00          05
        08          EB          10          83
        01          12          08          B8
        10          98          01          1C
        08          97          10          7F
        20          05          06          A5

ARGOS READY
/
 LOGOUT,
```

Fig. 4 : ARGOS message transmitted by CHLOE

CENTRALE D'ACQUISITION DE DONNEES HYDROLOGIQUES
DECODAGE MESSAGE ARGOS

Num. Message	Dernier Par. (h. locale)	Réception Sat. (T.U.)	Dispo. Message (T.U.)	Inter. Télex
78	172 / / 2005 L	172 / / 2323 Z	173 / / 0605 Z	173/ /1114 Z

Heure Paramètre (locale)	Données brutes messages (Hexa.)	Paramètre Physique	Donnée vraie grandeur	OBS.
20.05	0954	Adresse	2388	
19.35	1013	Cu	19	
19.05	0090	Ht	144	Ht : Hauteur d'eau en cm.
18.35	0927	Adresse	2343	
18.05	103 F	Cu	63	Cu : Conductivité en centaines de micro-Siemens
17.35	0095	Ht	213	
17.05	08 EB	Adresse	2283	
16.35	1083	Cu	131	
16.05	0112	Ht	274	
15.35	08 B8	Adresse	2232	
15.05	1098	Cu	152	
14.35	011 C	Ht	284	
14.05	0897	Adresse	2199	
13.35	107 F	Cu	127	

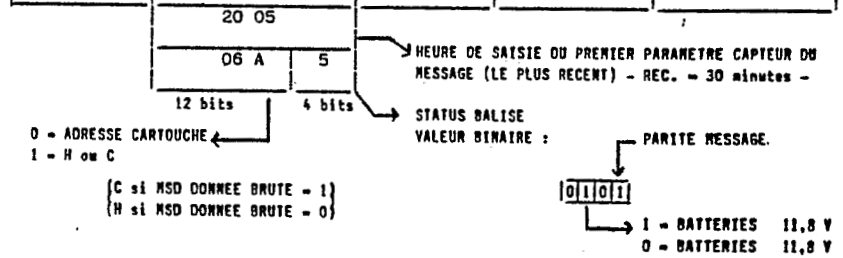


Fig. 5 : Logical design of ARGOS message transmitted 1 by CHLOE

The data are collected by PTT on a CHLOE unit output every 30 minutes, showing in alternation water level, conductivity and cartidge memory address (fig. 5). The ARGOS services include standard data collection and processing, without location calculations. Magnetic files are required only for telex consultations, which occur periodically (twice a week) to make sure that the unit is working properly and to control increasing of the EPROM cartridge memory address.

3) Considerations on data collection by ARGOS system

During the last few years, within the context of our work in a multi-disciplinary research centre, we have noticed that microprocessor technologies are becoming commonplace in field data collection (Geo-physics, Physics, Biology etc...). This penetration was partly done by automatic data collectors "ready for immediate-use" (such as meteorological stations), including sometimes an on-field data storage feature, and also by personnalized "fittings" designed by the user to suit his own needs, which can integrate sensors, portable "field computers" and peripheral devices such as magnetic cassette units.

Usually the scientist studying natural environment has a relatively limited budget and the portion reserved for measurements only barely allows him to hope to reach the industrial quality level. In practically no way will the integration of the system designed by him ever make it to spatial or military quality levels, even though certain elements or macro-components may separately be considered as such. Moreover, it is a scientific must that these devices be generally used in rigourously severe environmental conditions. Therefore, the user can rightly fear showings of a drop in performance, even a breakdown in his system, but he resigns himself to an intuitive realism which commands that absolute reliability become synonymous with infinite cost.

But, should he bring himself to accept the possibility of a mishap and the necessity of a motivated field intervention, it would be out of question for the average scientist to serenely accept gaps in his recording over long periods during which rare and freak phenomena could occur (floods, drought, seismic movements, exceptionally cold spells, etc...)

Remote monitoring of field digital equipement appears to be a very promising step forward, one not utilized to its full capacity by the ARGOS system. The typical P.T.T. that is ideal for this purpose, while remaining the simplest possible, should contain one single digital input, using the commonest communication standard (RS 232 connection). For the user, this transmittor would represent an ordinary peripheral device, which he could run at his convenience depending on the nature and form of data collected. On freeing itself of specificities related to each particular sensor and to each data storing system, this product could enjoy a wide promotion. It is pretty clear that the success of such a product is directly linked with its buying and annual functionning cost, which if not marginal, should at least be tolerable when compared to the total cost of a data collection unit. This frequently met-with situation can, in all probability, be further improved.

It is understandable that industrial firms should be reticent where it comes to supplying customers with one or a few transmittors, preferring large-scale projects with tens or hundreds of PTTs fully integrated with all the components necessary for data-recording (sensors, transmittors, power-supplies, direct reception, etc...). But they should also consider the fact that a diversification of ARGOS users is the best promotion this system could get for large-scale future projects.

Centre National d'Etudes Spatiales
French Space Agency

Commission Océanographique Intergouvernementale
Intergovernmental Oceanographic Commission

Organisation Météorologique Mondiale
World Meteorological Organization

ARGOS USERS CONFERENCE

SEPTEMBER 24 AND 25, 1985
NEW ORLEANS , LOUISIANA

CONFERENCE UTILISATEURS ARGOS

24 ET 25 SEPTEMBRE 1985
NOUVELLE ORLEANS , LOUISIANA