OBSERVING AND CALIBRATING SYSTEMS OF THE NATIONAL METEOROLOGICAL SERVICE OF MOROCCO– ACHIEVEMENTS AND CURRENT STATUS

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Abstract:

The paper briefly describes the architecture of the national meteorological observing infrastructure, the progresses made by the NMS during the last few years and provides the current status and modernization perspectives. It presents efforts done, in collaboration with Meteo-France, to renovate equipments and standards of the calibrating and standardization laboratory.

This laboratory is proposed to be of sufficient standard and staffing to act as the country's national standard for meteorological observations and to assess countries of the AR-I by calibrating their standards and by holding special training.

Introduction:

High quality meteorological data are essential to the needs of climatology, weather numerical modeling and forecast activities.

The National Meteorological Service (NMS) of Morocco had, all the time, taken in consideration the standardization and the homogenization of the whole chain of measure fulfilling to WMO requirements. To this effect, some specific actions were achieved including the unification of the measurement environment by opting for a specific design of the enclosure and sensors. Unique manufacturer had been also chosen for each conventional instrument. Otherwise, necessary test chambers and standards for calibration operation have been installed in 1989 as a first stage of the setting up of standardization laboratory.

Since 1994, the NMS started a modernization program concerning the establishment of Numerical Weather Prediction models and the acquisition of automatic observing and transmission tools. The program leads to the setting up of a national Radar network, national Lightning Detection Network, Satellite receiving systems and AWOS network.

More then 40 automatic weather stations of different marks have been installed sometimes in areas with extreme working conditions (desert region, coastal area and mountainous zone). The facilities of the laboratory don't allow validating the reliability of the instruments in exploitation so an upgrade project is planned for the two coming years.

1. National surface observation network

1.1 Manned Observations

The Moroccan national synoptic network includes 42 stations; most of them are installed in the north part of the country (cf fig 1.1). The oldest station provides meteorological observations for more than 105 years.

Within this network, the NMS account 5 marine stations, three upper air stations and 2 stations for ozone and pollution measurement.

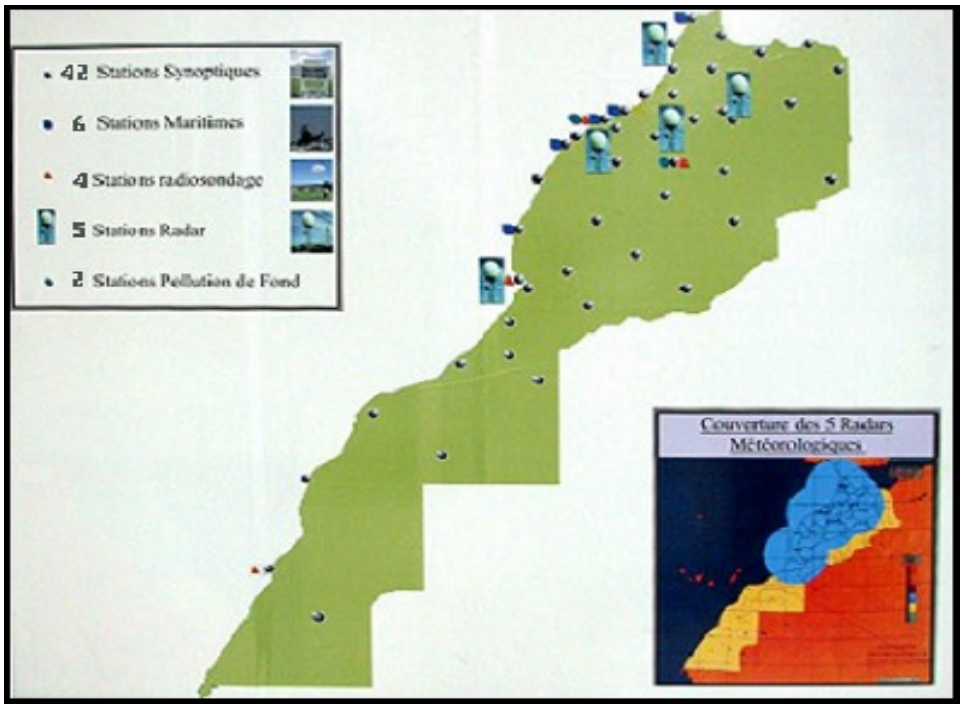

Fig 1.1 synoptic stations locations

For all the synoptic stations a unique and specific design of classic instruments enclosure (cf fig 1.2) had been approved and applied before the year 1960. This enclosure named *solvent 29* have the advantage of respecting exposure and minimal distances between sensors.

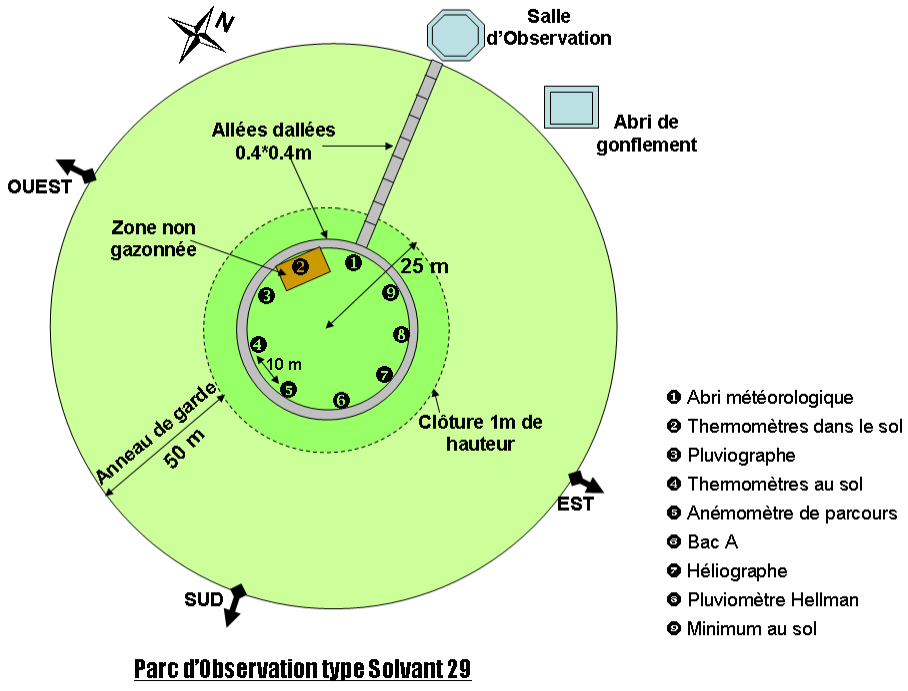

Fig 1.2 Layout of Solvant 29 enclosure

The NMS use for the synoptic network one type of instruments for each meteorological parameter observed. For example, all stations are equipped for more than 30 years by PRECIS MECANIQUE instruments: Fortin and Tonnelot barometers and tipping bucket raingauges recorders, CASSLLA instruments for sunshine recorders and Class A evaporimeter hook gauges and still wells …

The data collected are transmitted hourly to the central service and through out to the GTS.

During the few last years, the surrounding environment of instrument enclosure had changed for several stations. In fact, due to the cities extension, industrial constructions and building appears affecting sometimes the quality of observations made.

The actual preoccupation of the NMS is to resolve such problems and to renovate the observatory park for training, field acceptance and sensors intercomparison purposes. This park was operating for more then 35 years from 1960 to 1996.

1.2 Automatic Weather Observations Stations

The first automatic weather station was installed in 1992 and by the end of the 90's, the NMS launched an ambitious program aiming the acquisition of 10 AWOS each year. Until now more then 40 automatic stations were implemented in several parts of the country. All principal national airports are equipped by automatic observing systems including transmissometers and laser ceilometers (cf fig 1.3).

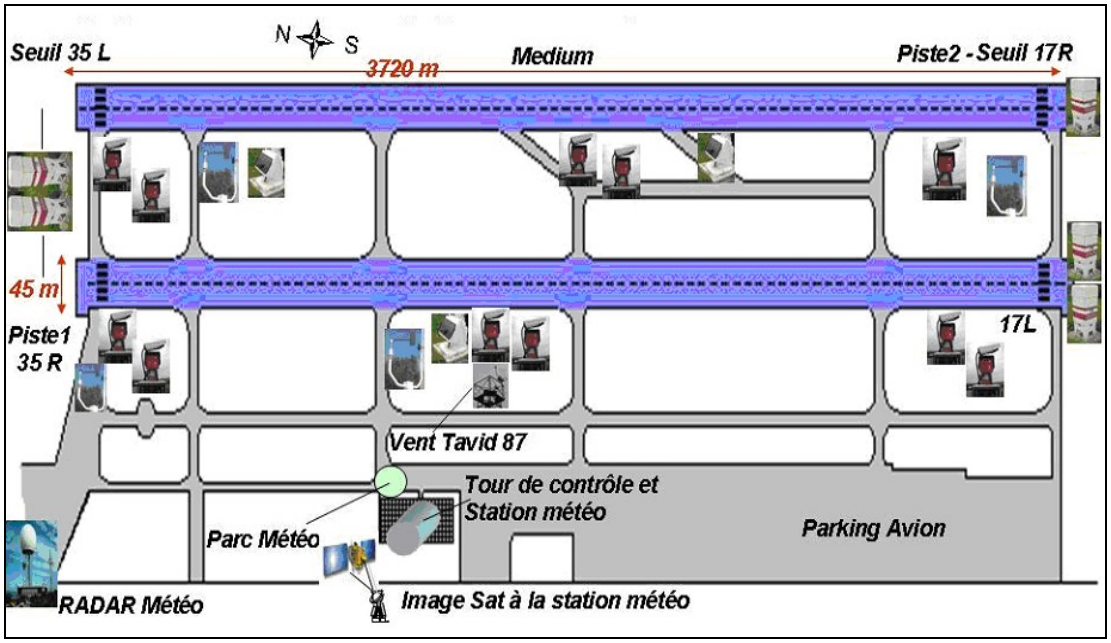

Fig 1.3 Meteorological automatic observing systems implemented in Mohamed V airport

The AWOS were installed sometimes in areas with extreme working conditions (desert region, coastal area and mountainous zone). Increasing efforts are made to improve their maintenance.

The NMS takes also in charge more then 50 climatologic automatic stations.

2. Radar Network

The NMS radar network, operational since 1995, is composed of five Doppler radars installed respectively in Casablanca, Khouribga, Fes, Agadir and Larache. During the last ten years radars data contributed to the enhancement of now-casting forecasts by the prevention against dangerous meteorological phenomena. By the end of this year, the radar network will be subject of a major upgrade operation in order to have access to the last stat of art in radar technologies. Upgraded radars will be equipped with fully digital signal processor and command modules. The software suite will contain several interesting modules such as flood warnings.
New EEC Doppler radar is being to be installed near Marrakech region. This new radar is fully digital (signal processor and command modules). It will be interconnected to the upgraded radar network.

Fig2.1 Moroccan radar network after the acquisition of the new Doppler radar

3. National Lightning Detection Network

In 2006, the NMS has proceeded to the implementation of a lightning detection network covering the most part of the country with a high detection efficiency and precision. The network is composed of five Vaisala IMPACT-ESP sensors localized in Casablanca, Fés, Oujda, Agadir and Ourazazat. Sensors measure and analyze the low frequency electromagnetic waves (LF) generated by cloud-to-ground lightning strokes.

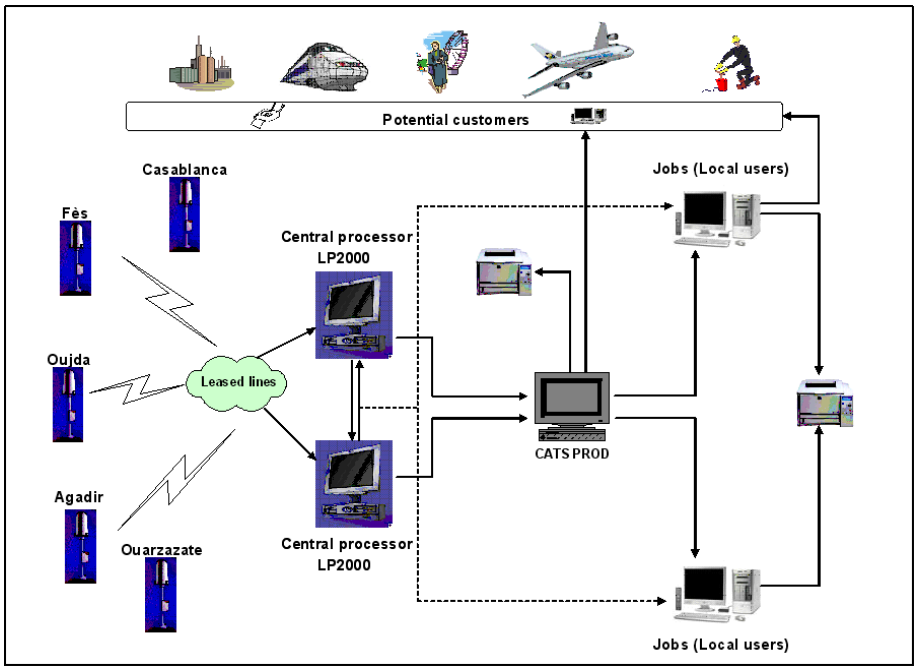

Fig 3.1 Moroccan lightning detection network implementation

The primary use of lightning data is to help NMS to improve now-casting forecasts by allowing the identification and the monitoring of thunderstorms development, strength and path. To achieve this, lightning data are combined to MSG satellite images and data from the Moroccan radar network. To fulfill forecaster's needs, CATS software supplies real-time lightning data to forecasting center at Casablanca and to regional forecasting units. At Casablanca, data are displayed via JOBS platforms and via SYNERGIE system. SYNEGIE is a powerful tool used to display and superimpose meteorological data (conventional and satellite observations and NWP products). At regional forecasting sites, lightning data is displayed thought MESSIR-AERO system which is similar to SYNERGIE.

4. MSG Receiving systems

Satellite data are a vital component of the Moroccan meteorological observing system. Satellite images are used, in addition to radar data and NWP model outputs, to produce accurate weather forecasts. Data from METEOSAT-8 satellite are received using two independent reception modes: HRIT and LRIT. The HRIT system receives satellite data with a high temporal and spatial resolution. It receives also some elaborated products such as SMT and DCP messages. The Low Rate reception LRIT system is used as a mobile solution to have access everywhere to satellite images.

5. Calibrating Laboratory

The NMS calibrating laboratory began its activities before 1960. In fact some calibrating equipments were working since 1953. In 1967 a test chamber SAPRATIN (cf fig 5.1) was implemented at the laboratory allowing calibration of meteorological instruments measuring pressure, temperature and humidity.

Fig 5.1 Test chamber SAPRATIN-1967

The principal equipments and standards of the laboratory have been acquired between 1979 and 1989 (cf tab 5.1 and tab 5.2).

Fig 5.2 Pressure Room containing mercury standard barometer, reference and working standard barometers (type FORTIN)

Even if this material is still well functioning, it doesn't fit with sensors of AWOS. So, an upgrade project is planned for the two coming years including training on metrology and the acquisition of digital standards for pressure, temperature and humidity, test chambers and rain gauges calibrating system.

Within this project, the laboratory is proposed to be of sufficient standard and staffing to act as the country's national standard for meteorological observations and to assess countries of the AR-I by calibrating their standards and by holding special training.

Domain	Type of standard	Type	Manufacturor	Range	Uncertainty	Tracability to	observation
Temperature	Working standard	mercury	Thermo Schneider	-3°C to 102°C	indeterminate	Manufacturer	Temperature Bath Theodore Frederics + Temperature test chamber Theodore Frederics with measuring feeler recorder Pt 100
Pressure	Secondary	mercury	Précis Mécanique	790 to 1090 hPa	indeterminate	Météo-France	+ Thodore Frederics Pressure chamber
Humidity	Working standard	psychrometer	Electrical hair hygrometer		Indeterminate	Manufacturer	humidity test chamber Theodore Frederics + Vaisala humidity meter calibrator HMK11
Solar	Working standard	Kipp & Zonen Pyranometer		310 - 2800 nm	indeterminate	Manufacturer	CFR Calibration facilities
Wind	Other	Tavid 87	R. Laumonier				control

Tab 5.1 Standards available at the laboratory

				
Pressure generator **Manufacturer:** Theodor Frederics **Operating range:** 40 to 1100 hpa **State:** Well functioning	**Humidity chamber** **Manufacturer:** Theodor Frederics **Humidifying product:** Water vapor **DeHumidifying product:** Silica Gel **Standard** Electric Hair psychrometer **State:** Well functioning	**Temperature test Chamber** **Manufacturer:** Theodor Frederics **Operating range** -25 to 100 degres c **Standard** Measuring feeler Pt 100 **State:** Well functioning 	**Temperature Bath** **Manufacturer:** Theodor Frederics **Operating range** -20 to +50 degres c **capacity** Up to 19 mercury thermometer **Standard** mercury standard thermometer **State:** Well functioning	**CFR Calibration Facilities** **Manufacturer:** Kipp & zonen **Standard** Pyranometer CM11b **Operating range** 310 - 2800 nm **Description** The Calibration Facility is meant for calibration of Pyranometers by comparison to a reference Pyranometer. **State:** New

Tab 5.2 Calibrating materials available at the laboratory