

Moroccan lightning detection network, topology, performance and management of the network

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Abstract:

In 2006, the Moroccan Meteorological Service (DMN) has proceeded to the implementation of a lightning detection network composed of five Vaisala IMPACT-ESP sensors and covering the most part of the country with a high detection efficiency and precision. After the necessary calibration period, lightning data will be used in forecasting center to improve meteorological nowcasting forecasts by allowing the identification and the monitoring of thunderstorms development, strength and path. Data will be also used by the DMN costumers for civil security, aviation, electricity and defense.

Raw lightning data are concentrated, in real time, by two central processors LP2000 situated at Casablanca via a telecommunication leased lines. The LP2000 processor combines the Magnetic Direction Finding (MDF) and Time Of Arrival (TOA) technologies to perform efficient and accurate impact localization. LP2000 outputs are colleted in real time and stored by CATS software which is used, in addition to lightning database, to manage products for the users. The CATS workstation supplies real time data to the operational forecasting center using two PC-based display systems called JOBS. This system is also used to manage specific lightning alert tasks for the DMN costumers

To complete the lightning detection coverage over the country, a cooperation agreement is in preparation between DMN and the Spanish meteorological institute to interconnect their own lightning detection networks.

1. INTRODUCTION:

In 2006, the Moroccan Meteorological Service (DMN) has proceeded to the implementation of a lightning detection network covering the most part of the country with a high detection efficiency and precision. After the necessary calibration period, lightning data will be used in forecasting center to improve meteorological nowcasting forecasts by allowing the detection of thunderstorms at an early stage in their development. Data will be also used by the DMN costumers for civil security, aviation, electricity and defense.

To complete the lightning detection coverage over the country, a cooperation agreement is in preparation between DMN and the Spanish meteorological institute to interconnect their own lightning detection networks.

2. LIGHTNING NETWORK DESCRIPTION:

The Moroccan lightning 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. They are also able to measure and analyze a part of the very low frequency electromagnetic waves (VLF) associated to the electrical activity inside clouds. Each sensor measures time of arrival, direction, amplitude and sign of the lightning signal. The new generation IMPACT-ESP sensors are known to be more sensitive and robust with a high MTBF (> 50000 hours). A

well implemented IMPACT-ESP network can perform strokes localization with medium location accuracy of 500 meters and detection efficiency near 80 %. The choice of sensors sites was done according to Vaisala site survey recommendations (topographical and electromagnetic survey). All sensors are actually localized inside airports.

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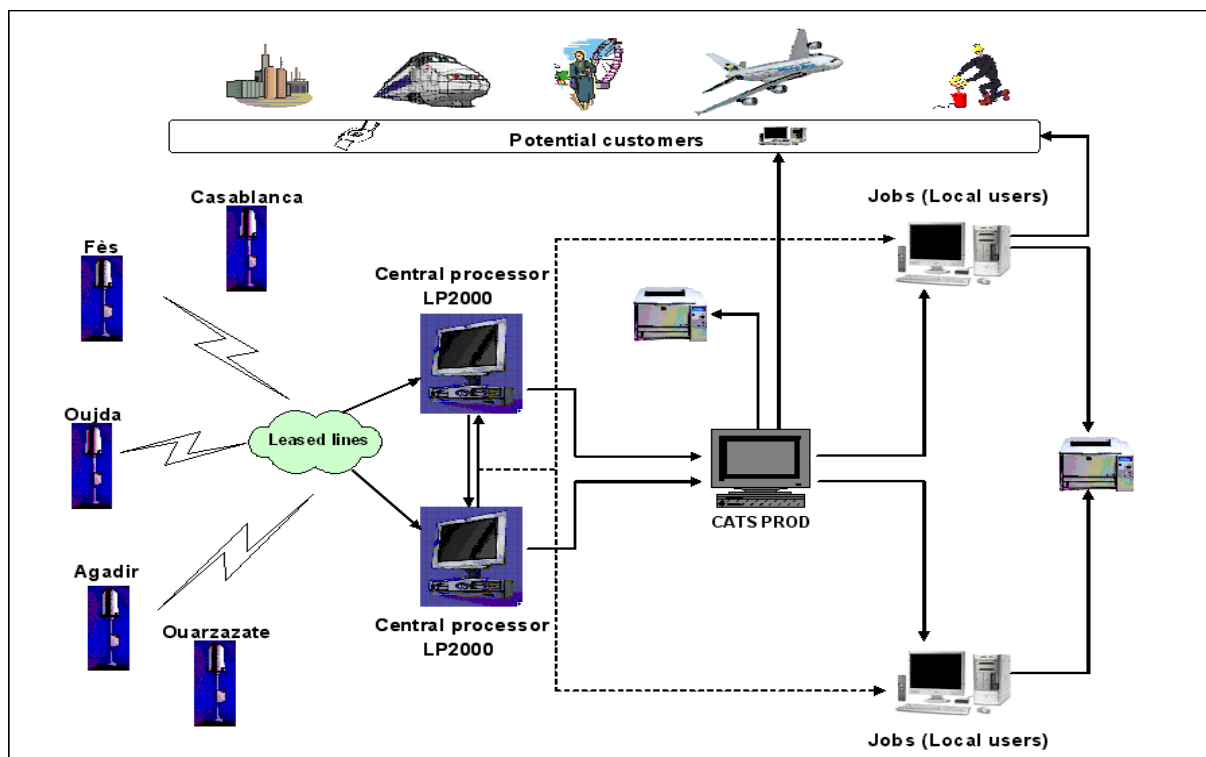


Fig1: Moroccan lightning detection network implementation

¹ French private company which installed and operating the French Lightning Detection Network

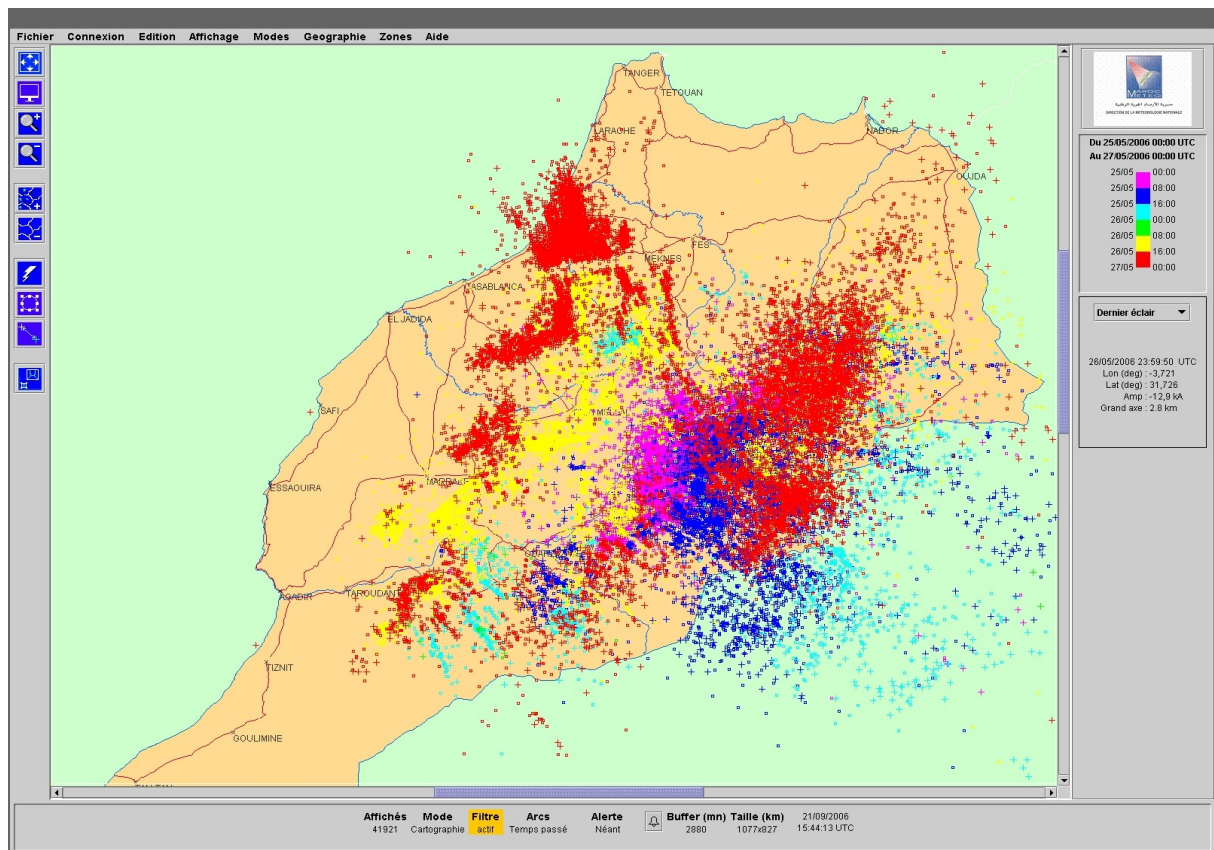


Fig2: cloud-to-ground lightning impacts from 25 to 27 may 2006

Lightning data are subject to several quality control checks. Firstly, sensors perform continuous self test (verification of sensors and communications links) and automatically report status to the central processor. Results are analyzed continuously to minimize sensors dead time. To ensure a continuity of the localization function, we have at DMN two LP2000 workstations. Both stations receive and analyzed lightning data.

CATS software holds tools to perform new site error corrections. This operation is performed, generally, each year by using the lightning database.

3. LIGHTNING DATA USE AT DMN

The primary use of lightning data is to help DMN 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 forecasters needs, CATS 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. SYNERGIE 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.

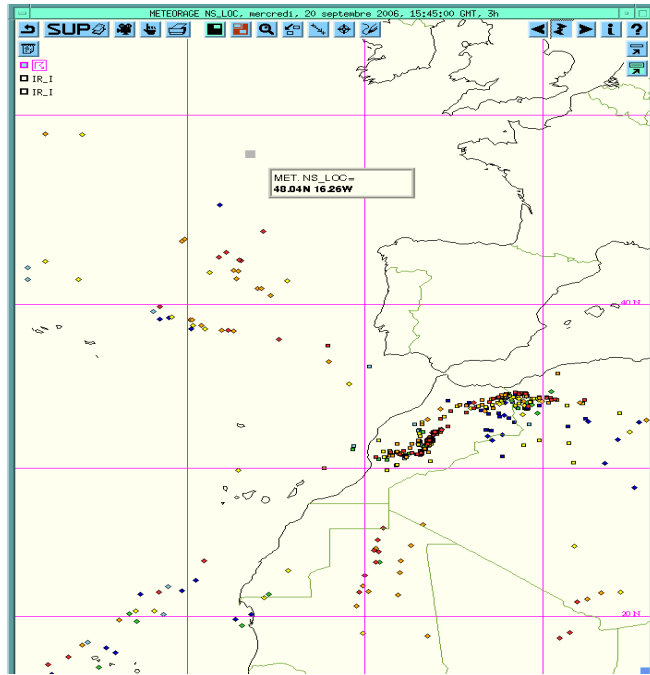


Fig3: Lightning data displayed on SYNERGIE

4. SPANISH AND MOROCCAN LIGHTNING NETWORKS INTERCONNECTION:

To improve data around borders area (in the north and the south of the Kingdom), a cooperation agreement is in preparation between the DMN and the Spanish meteorological institute to interconnect their own lightning networks. This agreement allows to the DMN to integrate data, trough LP2000, from three sensors localized in the south of Spain and five sensors in canaries isles. Data exchange will be done via internet or a leased line. The use of the exchanged data is limited to a national territory. DMN plans to propose the same interconnection agreement to Portugal lightning network operator.

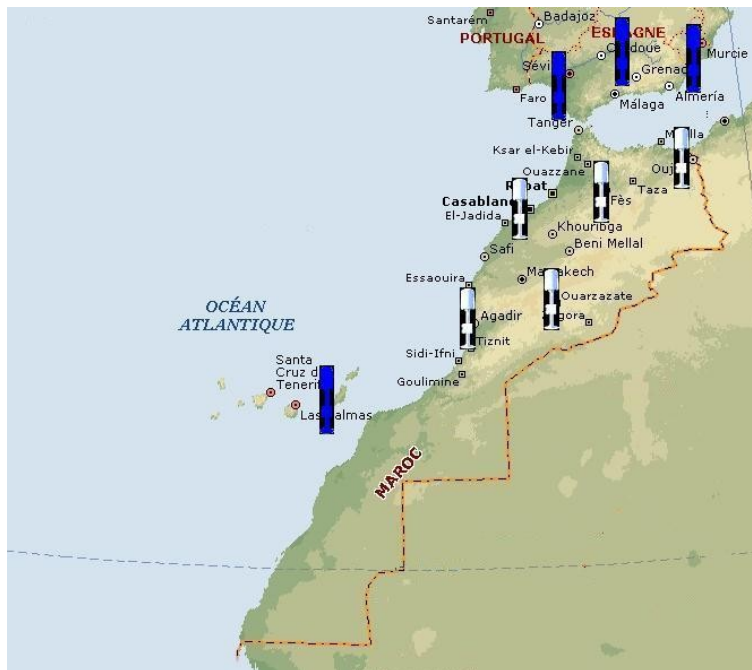


Fig4: Expected extension of the network by interconnection of Spanish borders sensors (in blue)

6. COMMERCIAL ISSUES

The DMN lightning network is recently implemented. The first site error corrections are being conducted after five months of continuous exploitation. After this necessary step, data will be suitable for use in commercial purposes. The DMN is seeking potential lightning customers to help funding a part of the maintenance and exploitation costs. Several clients are interested by this product such as Electricity Company, aviation and railroads office. The DMN plans to distribute real-time and archived data by means of several ways:

- Internet: The CATS software provides practical WEB tools for lightning distribution. Users can have a secure access to real-time and archived data via the DMN web portal.
- Fax and phone: lightning warnings can be sent by Fax or communicated to users via vocal messages.
- JOBS tool: For important users, the DMN can provide a complete solution to visualize real-time data with enabled warning functions. The solution is based on JOBS system developed by Meteorage. Within JOBS, data can be displayed on geographical information basis which depend on each user needs (for example high lines voltage for the Electricity Company).

7. CONCLUSION

The lightning detection network, recently implemented at Morocco, is expected to improve now-casting forecasts and fulfill DMN customers needs in lightning data. Actually, the use of lightning data is limited to forecasting center in order to perform the necessary first calibrations. The DMN is searching and preparing best ways to supply lightning services to actual and future interested customers.