

# PRELIMINARY RESULTS OF COMPARISON BETWEEN DATA COLLECTED FROM AWOS AND THOSE COLLECTED FROM MANUAL OBSERVING INSTRUMENTS

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## Abstract:

*In 2004, 8 new automatic weather stations had been integrated in the national meteorological observation network of Morocco to strengthen observation made by the existing manned station. This automatic stations made by TELVENT are currently operating in different working conditions. Three of them are installed in the south of the country in desert and sandy area. One is working in mountainous region at 1600 m above sea level.*

*In order to validate the data collected and to assess the impact of the local climate, comparison was conducted for the 8 stations while confronting the data recorded with those collected from analogical sensors.*

*The paper describes the working environment of each weather automatic station and the preliminary results gotten for some meteorological parameter measurements.*

## 1. Introduction:

As a result of an ambitious program launched by the end of the 90's aiming the acquisition of 10 AWOS each year, the National Meteorological Service of Morocco account at present more than 40 weather automatic stations implemented in several parts of the country sometimes in extreme working conditions (desert region, coastal area and mountainous zone)

AWOS installed in airports include, in addition to the standard sensors of climatologic stations, transmissometers and laser ceilometers.

The following table resumes the marks of the AWOS forming the national AWOS network:

<b>Mark</b>	<b>Type</b>	<b>Number</b>	<b>Date of installation</b>
<b>THIES CLIMA</b>	CLIMATIC	9	1999 and 2001
<b>DEGREANE</b>	CLIMATIC and AERO	10	Since 1991
<b>TELVENT</b>	CLIMATIC and AERO	8	2004
<b>CIMEL</b>	CLIMATIC	12	2001
Other: QUALIMETRICS, SEAC, IMPULSPHYSIC			

In order to value the climate changes effect and to measure the influence of local climate on digital sensors installed, an intercomparison may be achieved using conventional data collected from the synoptic stations where the AWOS are installed.

For this purposes, the 8 Automatic stations TELVENT acquired and implemented in 2004 have been chosen for this study.

Intercomparative measurements is made using hourly data collected from classic instruments enclosure and the automatic station related to the following meteorological parameters: Pressure, Temperature, Humidity, precipitation and also wind speed and direction at 10 meters above ground.

## 2. Localisation:

The map and the table below present the sites where the automatic stations are implemented and also the local environment of this sites.

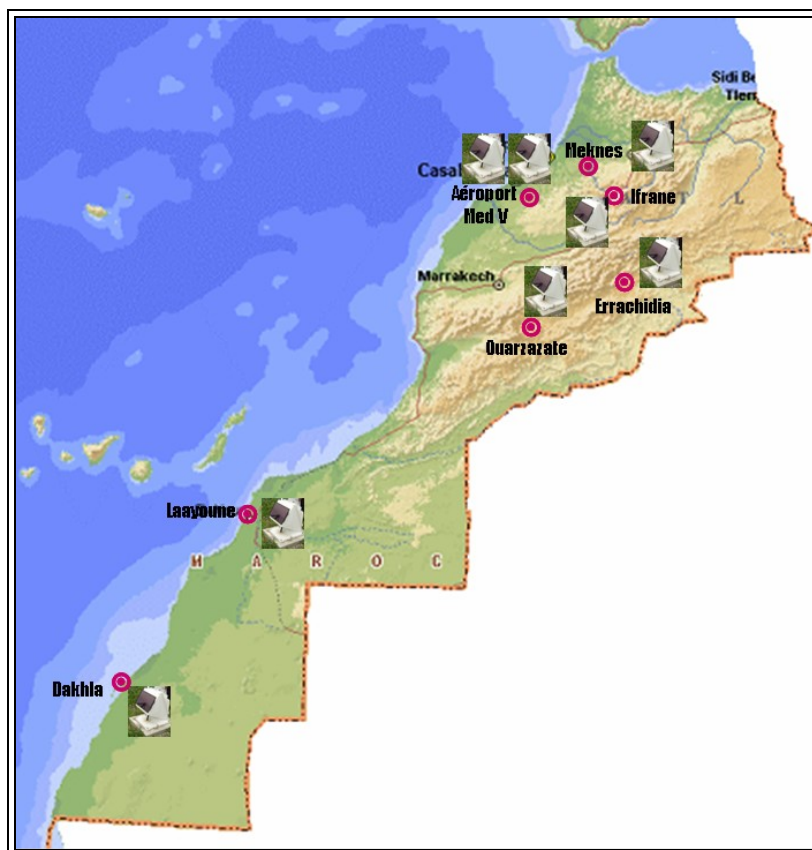


Fig 1. TELVENT Automatic weather stations sites

<i>Stations</i>	<i>latitude</i>	<i>longitude</i>	<i>altitude</i>	<i>Observations</i>
LAAYOUNE	27°10' N	13°13' W	064 m above sea level	- Desert area (sandy soil), 25 km from Atlantic coasts - Extreme temperatures recorded for the station : Tmax=+46.8°C Tmin= +4.6°C
DAKHLA	23°43' N	15°56' W	011 m	- Desert and coastal area (sandy soil) - Extreme temperatures recorded for the

				station : Tmax=+39.6 °c Tmin=+6.6 °c
OUARZAZATE	30°56' N	06°54' W	1136 m	- Dry climat and Fohen effect - Extreme temperatures recorded for the station : Tmax=+45.2 °c Tmin=-8.4°c
ERRACHIDIA	31°56' N	04°24' W	1037.2 m	- Dry climat and Fohen effect - Extreme temperatures recorded for the station : Tmax=+43.0 °c Tmin=-6.2°c
MEKNES	33°53' N	05°32' W	556 m	- Plain with intense agricuktural activity - Extreme temperatures recorded for the station : Tmax=+45.2 °c Tmin=-6.4°c
IFRANE	33°30' N	05°10' W	1663 m	- Mountain (snow) - Extreme temperatures recorded for the station : Tmax=+36.2 °c Tmin=-16.0°c
Med V Airport	33°22' N	07°35' W	200 m	- in the center of the country. 30 km from atlantic coasts - Extreme temperatures recorded for the station : Tmax=+46.1 °c Tmin=-4.8°c

Tab 1. Stations coordinates and climatic features

### 3. Instrumentation:

#### Manned synoptic stations:

<i>Measured parameter</i>	<i>Classical instruments</i>	<i>Instrument location</i>
Air temperature	- Mercury thermometer - Temperature recorder - bimetal. Mark JULES RICHARD . accuracy: $\pm 0.5^{\circ}\text{c}$	In instrument screen, 2m above ground
Air minimum temperature	Alcohol thermometer	In instrument screen, 2m above ground
Air maximum temperature	Mercury thermometer	In instrument screen, 2m above ground
Relative humidity	- Wet bulb thermometer – dew point - Hair hygrometer - JULES RICHARD accuracy: $\pm 5\%$	In instrument screen, 2m above ground
Air pressure	- Mercury barometer - TONNELOT , PRECIS MECANIQUE - Pressure recorder, LAMBRECHT - vacuum capsule	In station office
Wind direction and velocity	Diffrential sensors with TAVID 87 recorder	10 m above ground
Precipitations	- raingauge – 200 cm <sup>2</sup> - Tipping bucket raingauges recorders 200 cm <sup>2</sup> , PRECIS MECANIQUE	1m above ground



Thermometers and recorders in stevenssen screen      Lambrecht atmospheric pressure recorder

Tipping bucket raingauges recorder      Wind sensors for TAVID 87 recorder

**Automatic weather station TELVENT:**

Automatic station type SAIMET; mark TELVENT

<i>Measured parameter</i>	<i>Sensors</i>	<i>sensor location</i>
Air temperature and humidity	VAISALA probe WAA151	On arm and in screen at 2m above ground
Air pressure	VAISALA PB220	In station logger
Wind direction and velocity	VAISALA WAA151 for velocity VAISALA WAV151 for direction	At 10 m above ground
Precipitations	- Tipping bucket raingauges THIES	At 1.6m above ground



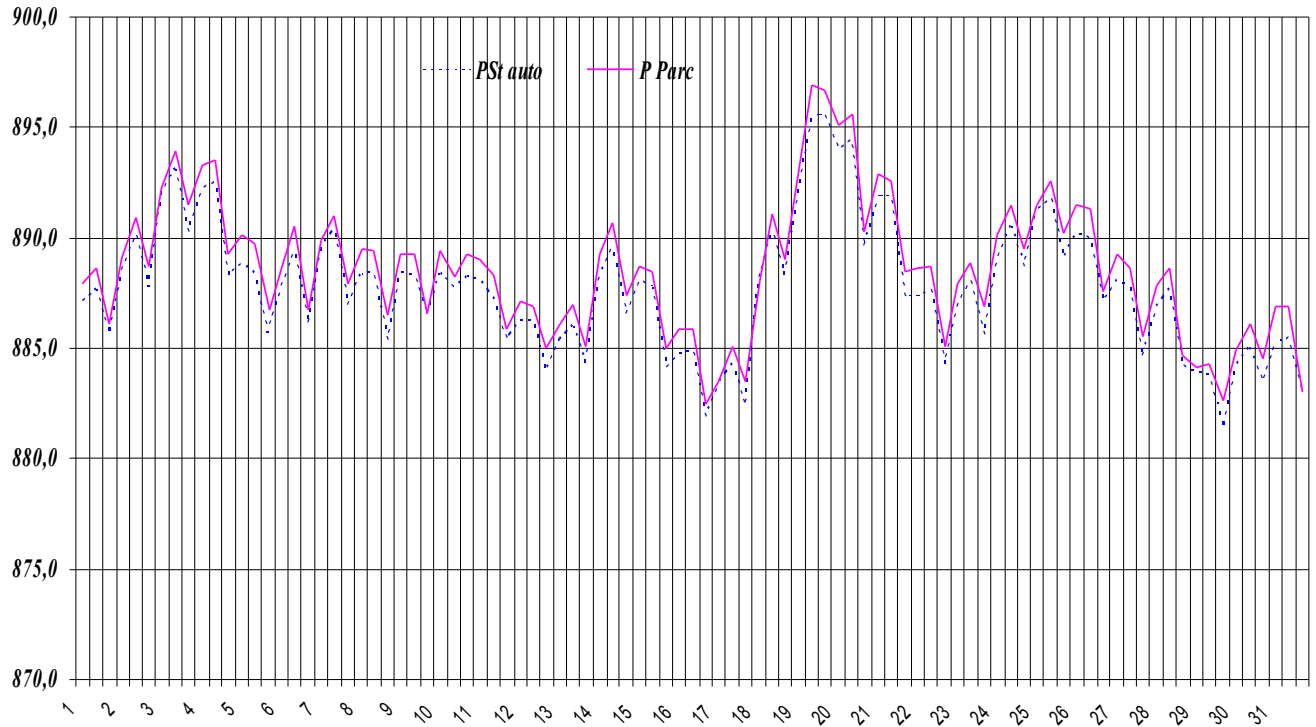
SAIMET sensors on arm



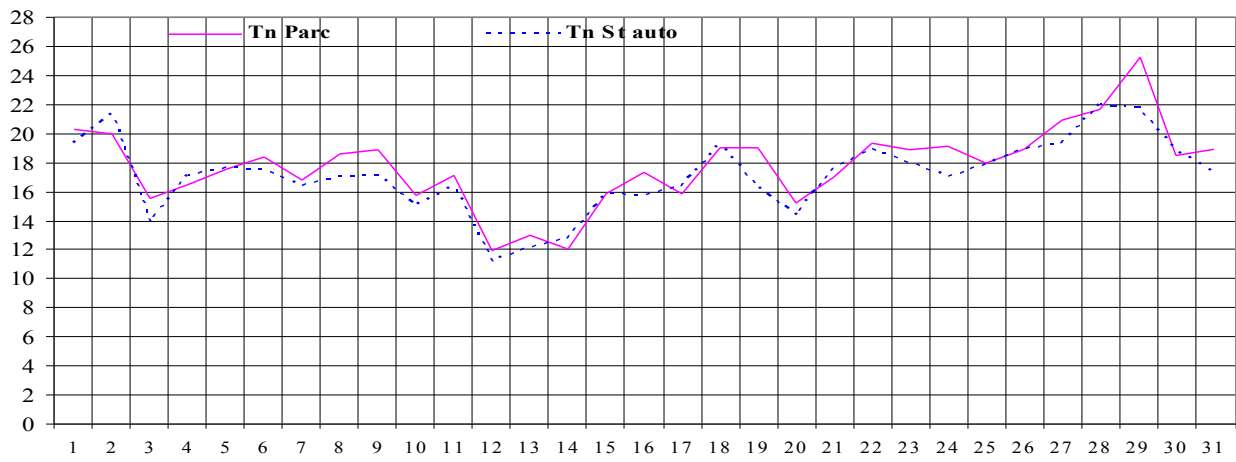
Wind transmitters at 10m above the ground

**4. Preliminary Results:**

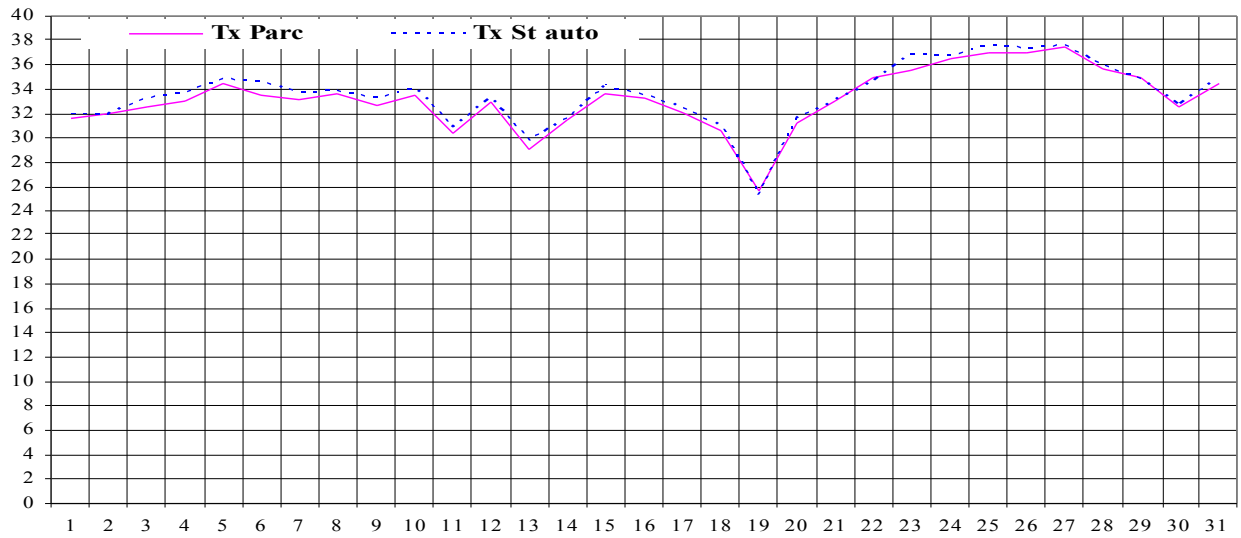
- **Synoptic station of OUARZAZATE:**



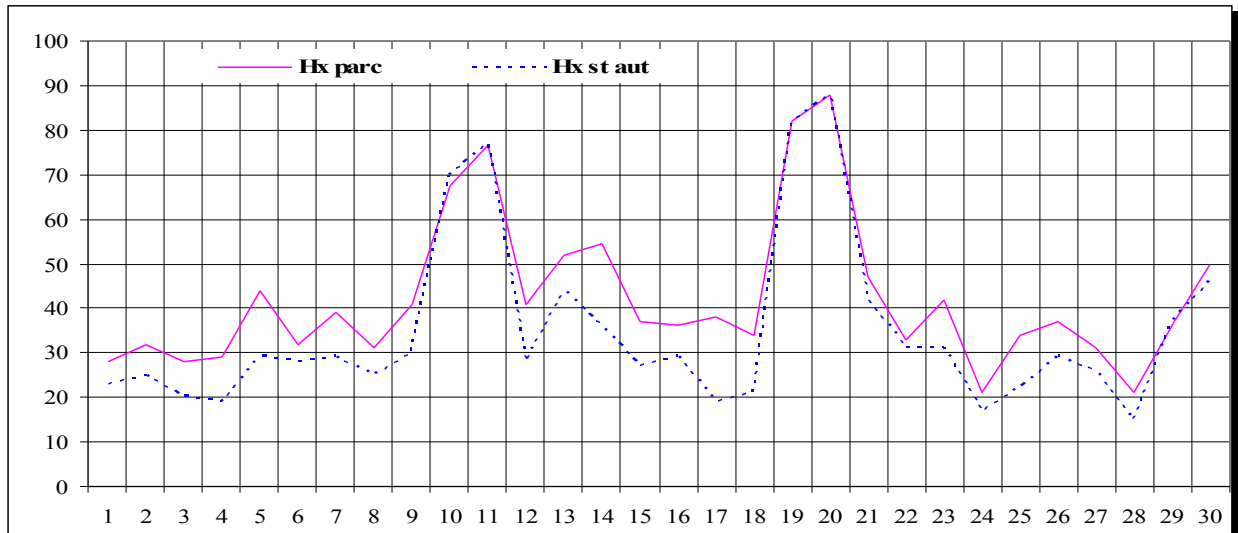
Graph of pressure level (hPa) at the station : MAY 2005



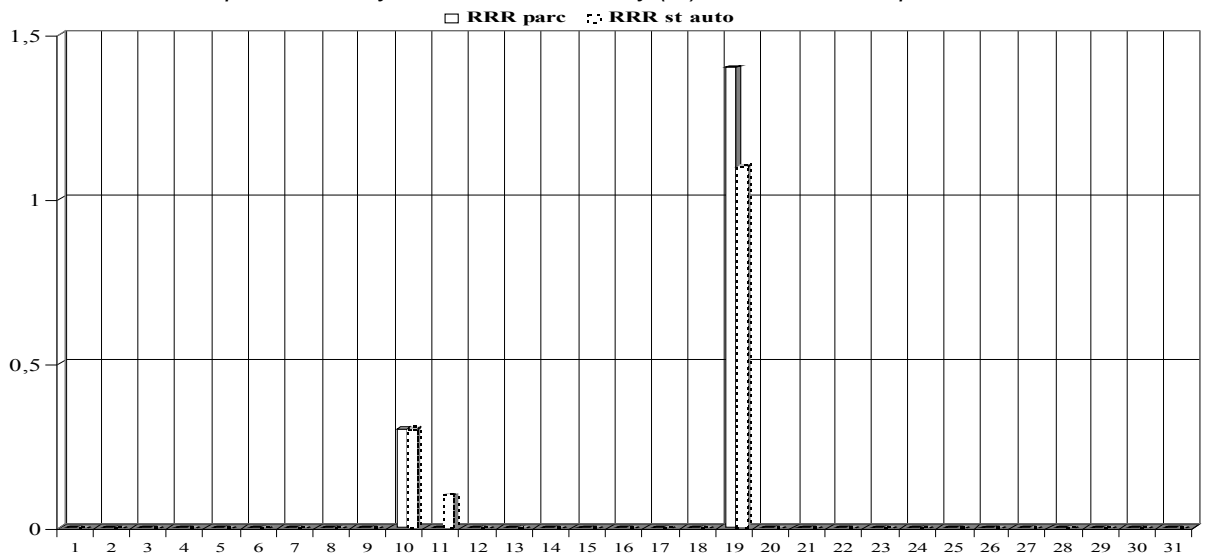
Graph of daily extreme temperature (°C) at the station : T min - MAY 2005



*Graph of daily extreme temperature (°C) at the station : T max- MAY 2005*

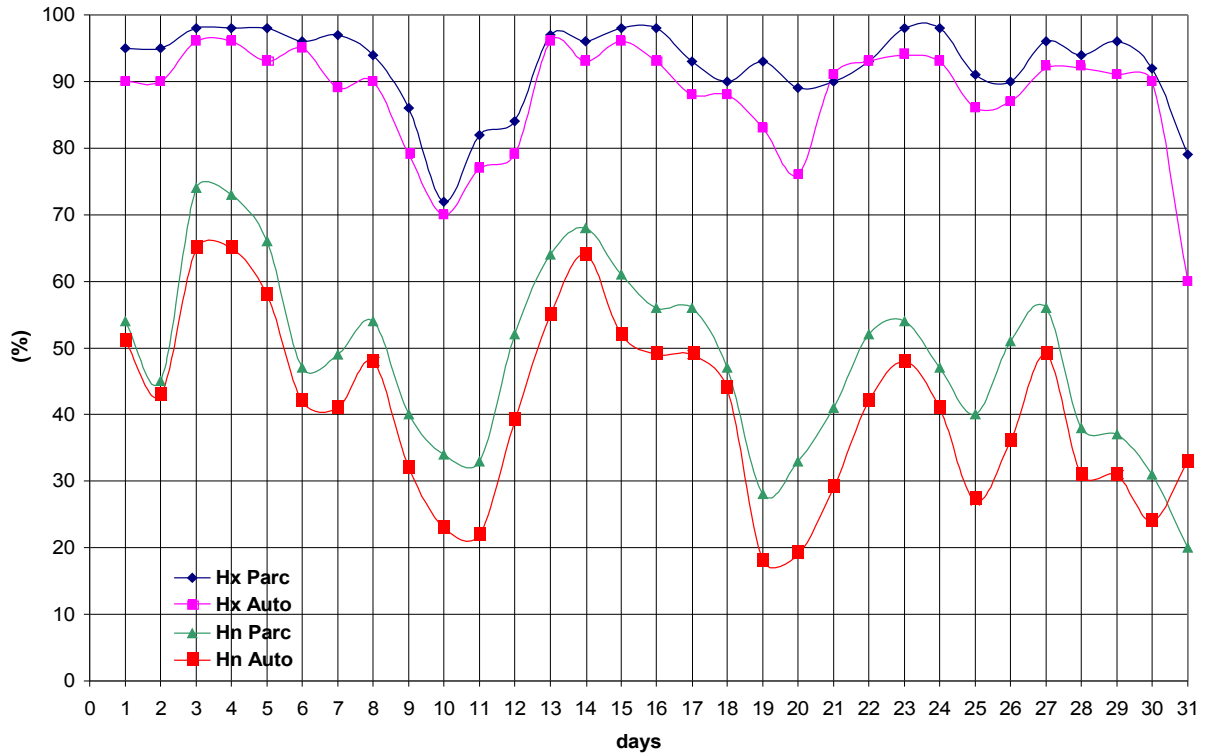


*Graph of the daily maximum of humidity (%) at the station : April 2005*

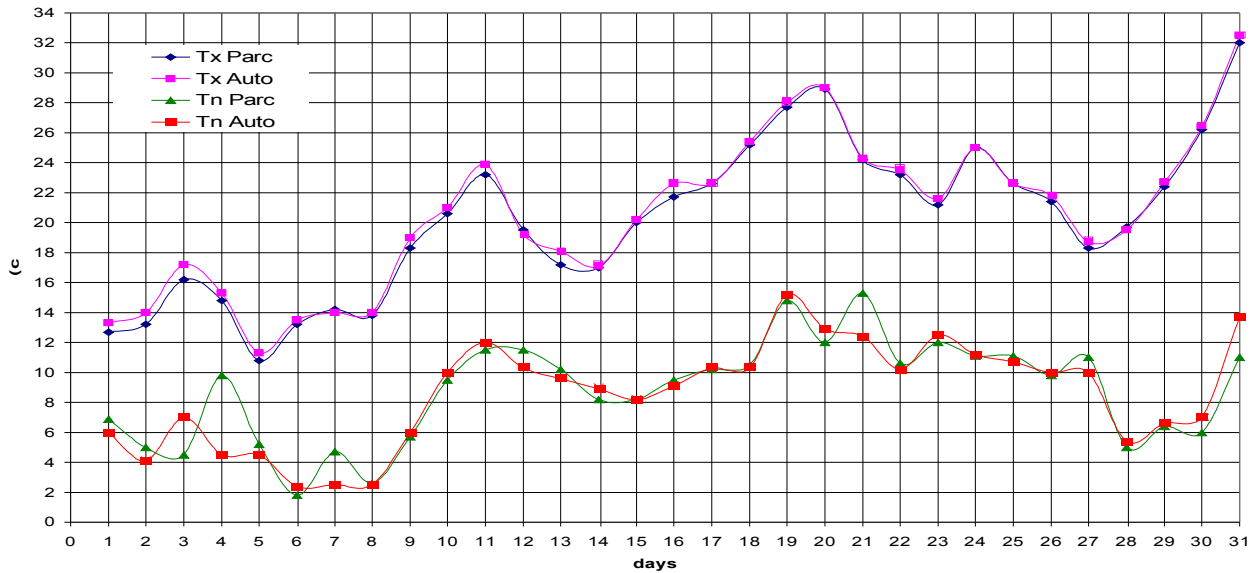


*Precipitations (mm) at the station – May 2005*

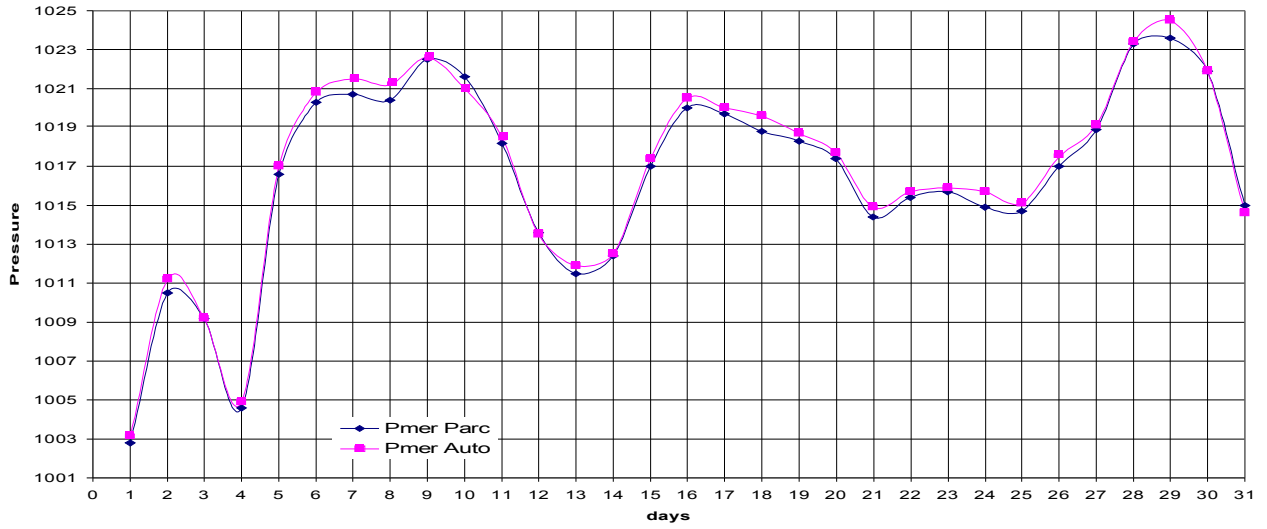
▪ ***Synoptic station of Meknes:***



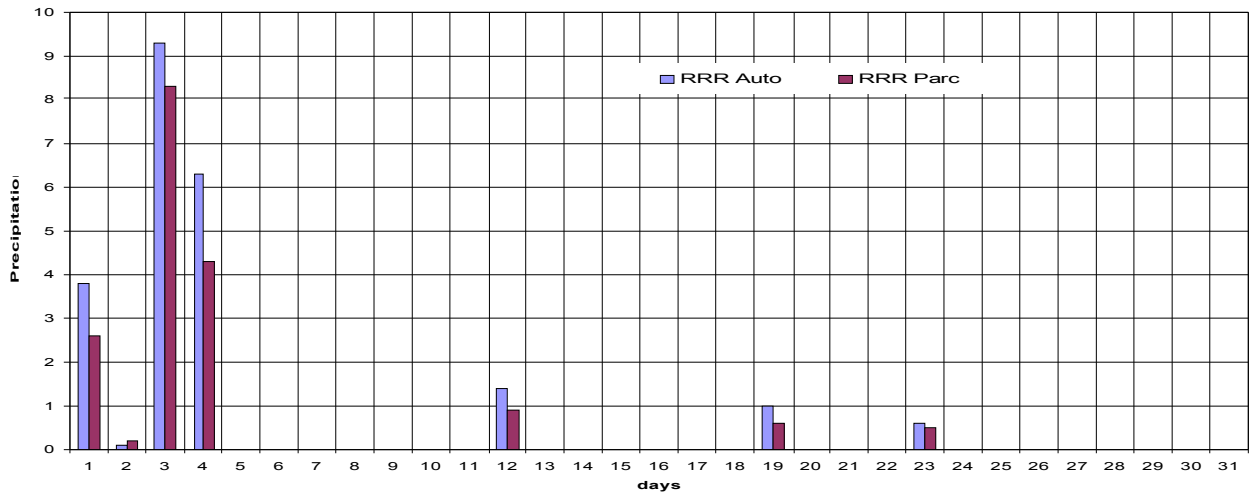
*Evolution of daily maximum humidity (%) at the station - Mars 2005*



*Evolution of daily extreme temperature (°C) at the station - Mars 2005*



*Daily mean value of Sea level pressure at the station – Marsh 2005*

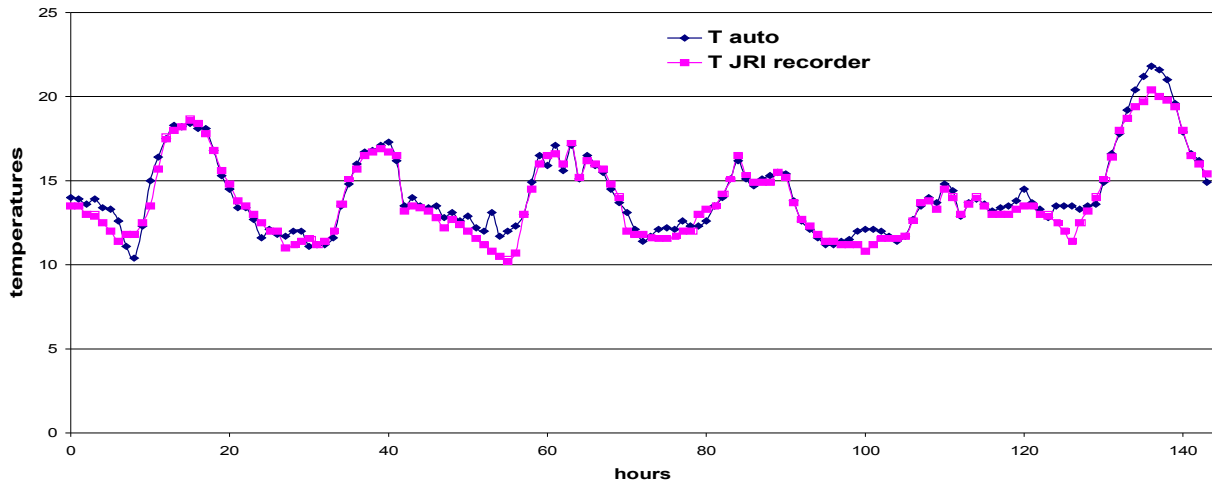


*Precipitations collected during March 2005 at the station*

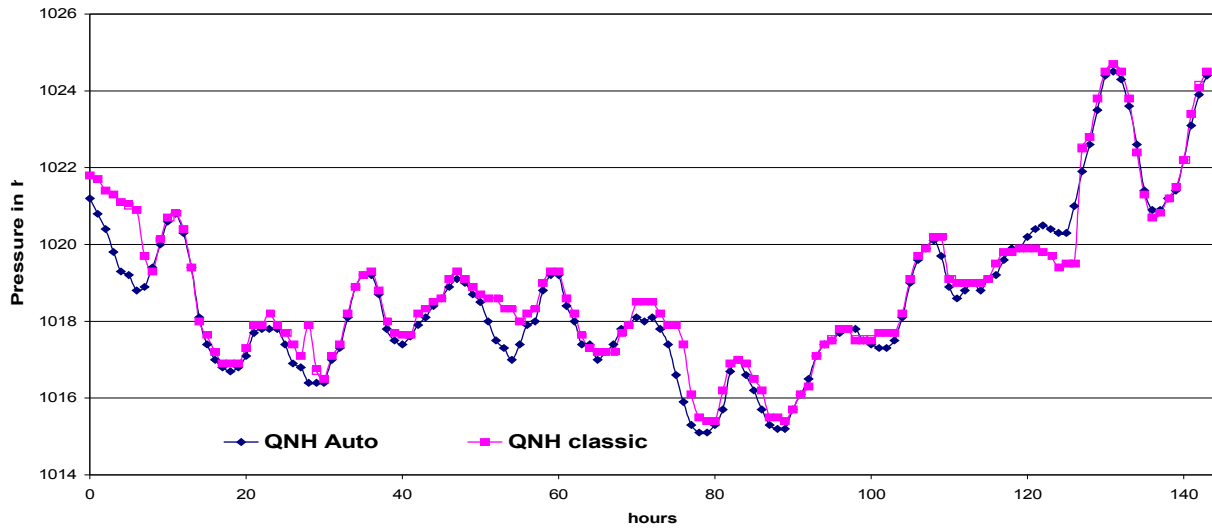
■ **Synoptic station of LAAYOUNE:**



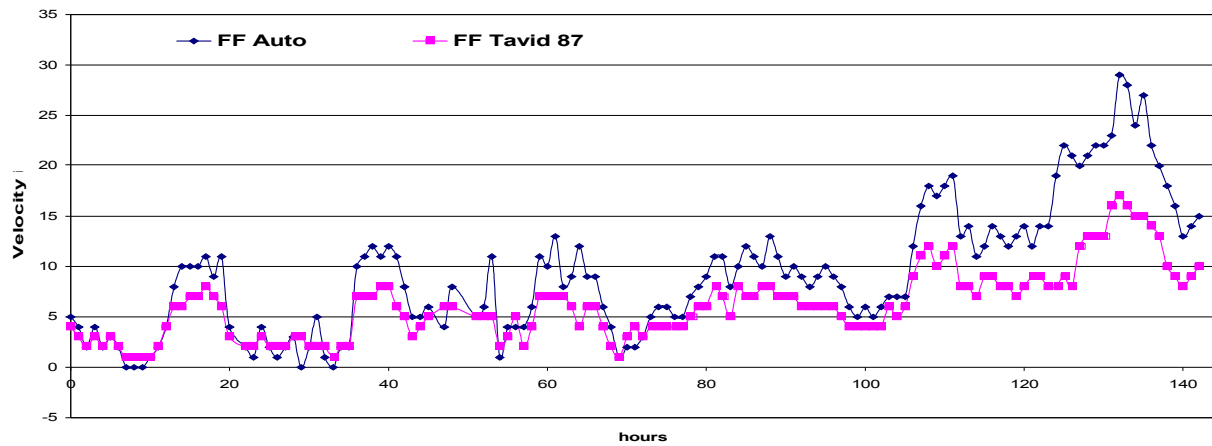
Hourly air temperature evolution for LAAYOUNE - Febrery 2005



Hourly QNH evolution for LAAYOUNE - Febrery 2005



Hourly Wind velocity evolution for LAAYOUNE - Febrery 2005



**5. Conclusion:**

Unfortunately, due to some problems related to the treating software of the automatic stations TELVENT, it was not possible to reach all the data archived since the date of setting up of these stations. Therefore, the study takes into account the months for which data are available. Following this comparative study, some first reports have been noted:

Temperature and pressure:

The mean difference between the hourly data of the two sets for air temperature and atmospheric pressure belongs weak (not exceeding 0.3 hPa in general for pressure and 0.25 °c for temperature - stations of Meknes and Laayoune and 0.9 hPa for Ouarzazate). However, the difference amplitudes for the whole stations are greater then 1° c and 1 hPa but remaining lower to 2°c and 2 hPa as maximum of deviation.

The barometric tendencies are well reproduced.

For the daily extreme temperatures, the difference between the two data sets is less important for the daily maximum of temperatures that for the minima of the day (as the data of the stations of Meknes and Ouarzazate testify it).

Precipitation:

The comparison takes in consideration only the stations where the distance between the conventional and the automatic instruments is weak.

It was noted, in general, an overestimate of the values of precipitations collected from the automatic station seeing those given by the conventional rain gauge recorder. The difference is accentuated in case of strong winds (station of Meknes) or in presence of sever storms (station of Ifrane).

For the case of Meknes, the company reinforced the stability of the metallic arm to avoid winds effect.



rain gauge of Telvent autamatic station at  
Meknes



Conventional and automated instruments at  
the station of Ifrane

In the station of Ifrane, we note some accumulated values of precipitation in presence of lightning and thunderstorms even if it's not a rainy storm (no rain observed) or an overestimate in case of rain falling. (for example: the lastest case observed of September 9<sup>th</sup>, 2006; automatic station give 4.4 mm as 12 hours cumulated precipitation and the Precis Mecanique Rain gauge recorder show 0.4mm. Wind exceeds 14 kt and thunderstorms are observed).

The same report was made at the station of Oujda endowed with DEGREANE automatic station.

Humidity:

The comparison of daily extreme values of humidity shows important difference amplitudes between the two data sets (more than 10%) with difference means about 5%. A detailed analysis must be conducted for a good appreciation

Winds:

Doubted data rises in case of strong winds, the software is suspected.

Difference amplitudes are important for wind direction and also wind velocity. A detailed analysis must also be conducted for this parameter.

For further and detailed comparison, a long term data sets must be used. Other factors should be integrated in the analysis like: apparatus design, calibration dates and methods, instrument location...

<b>Location</b>	<b>Type of AWOS</b>	<b>Mark</b>	<b>Date of installation</b>	<b>sensors</b>
AL-HOCIEMA	CLIMATIC	THIES CLIMAT	1999	Wind, P, T, Humidity, RR, solar radiation
BOUARFA	CLIMATIC	THIES CLIMAT	1999	Wind, P, T, Humidity, RR, solar radiation
ESSAOUIRA	CLIMATIC	THIES CLIMAT	1999	Wind, P, T, Humidity, RR, solar radiation
EL-JADIDA	CLIMATIC	THIES CLIMAT	1999	Wind, P, T, Humidity, RR, solar radiation
SAFI	CLIMATIC	THIES CLIMAT	2001	Wind, P, T, Humidity, RR, solar radiation
SIDI IFNI	CLIMATIC	THIES CLIMAT	1999	Wind, P, T, Humidity, RR, solar radiation
TAOURIRT	CLIMATIC	THIES CLIMAT		Wind, P, T, Humidity, RR, solar radiation
TAROUDANT	CLIMATIC	THIES CLIMAT		Wind, P, T, Humidity, RR, solar radiation
TIZNIT	CLIMATIC	THIES CLIMAT		Wind, P, T, Humidity, RR, solar radiation
AGADIR	AERO	DEGREANE	1991	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
FES	AERO	DEGREANE	2002	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
KENITRA	AERO	DEGREANE	2001	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
MERRAKECH	AERO	DEGREANE	2006	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
NADOR	AERO	DEGREANE		Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
NOUASSER	AERO	DEGREANE	1992	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
OUJDA	AERO	DEGREANE	2002	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
SIDI SLIMANE	AERO	DEGREANE	2002	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
TANGER	AERO	DEGREANE	1998	Wind, P, T, Humidity, RR, solar radiation, HBN, RVR
CASA-ANFA	CLIMATIC	DEGREANE	2001	Wind, P, T, Humidity, RR, solar radiation
DAKHLA	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
ERRACHIDIA	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
IFRANE	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
MEKNES	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
OUARZAZATE	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
LAAYOUNE	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
NOUASSER	CLIMATIC	TELVENT	2004	Wind, P, T, Humidity, RR, solar radiation
+ 12 automatic stations CIMEL implemented in 2001				

*Tab 1.1 the national AWOS network composition*