New electronic thermometers for the Cooperative observation network

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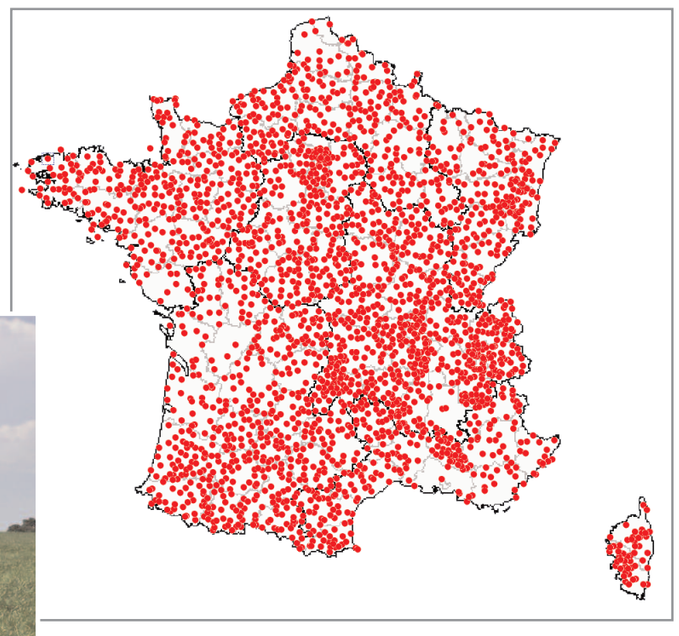
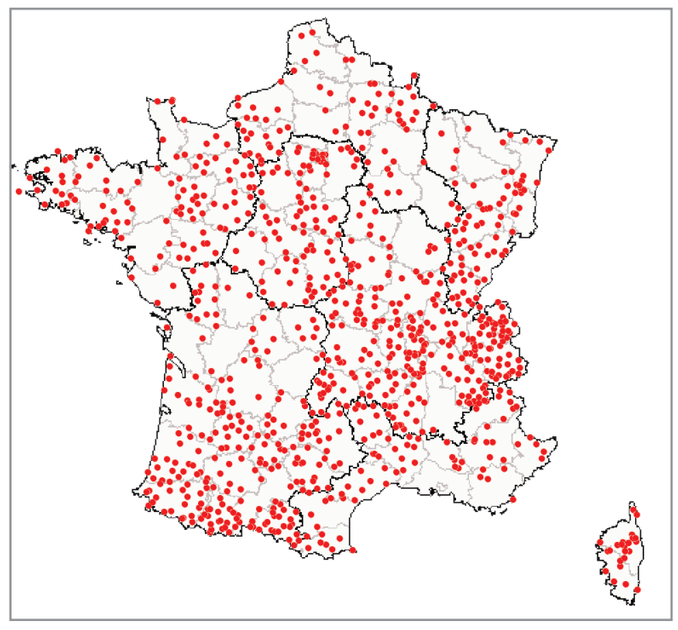
The Cooperative Climatological Stations Network

In France, about 3000 cooperative observers measure daily quantity of precipitation and about 1000 of them measure also the daily extremes of the air temperature. They are currently using liquid in glass thermometers, with mercury for the measurement of the maximum temperature. Each morning, around 6 hour local time, the observer measures the quantity of precipitation from a manual rain gauge and reads the daily maximum temperature (Tx). The minimum temperature (Tn) should be read around 18 hour local time, but in reality, it is very often also read in the morning, to avoid two daily visits.



Cooperative network for daily precipitation



Cooperative network for temperature

The selected solution

We received several proposals. Some of them were on the shelf products, which were not well adapted to our needs : high power consumption and high price.

Others proposed small “classical” AWS, with a local display and a transmission of data either by a SD memory card or a radio transmission to the observer’s house.

We have selected a French company, Cimel (http://www.cimel.fr)

The proposal was quite original, compared to other proposals.

A Pt100 (1/10 Din) will be connected to an acquisition device, that acquires the temperature every minute, and calculates and records the hourly and daily values. The 32 Mb internal memory will allow to record more than 10 years of data. The device will be powered by small batteries

Data will be transferred to a handheld portable terminal, via a short range (a few m) radio link . The radio link will be actived only during the transmission time, thus saving the use of power.

terminal

This portable terminal will give access to data through its display. A SD-card will allow to transfer all the data to a local or distant micro-computer, by a physical transfer of the SD-card. All data may also be transferred to a local micro-computer via radio, with the help of a dedicated interface to be connected on a USB port of the PC.

The advantages of this system, compared to other proposals, are multiple:

- It is not necessary to move the acquisition device connected to the temperature probe to get the data or to look at a local display. This will preserve the connector between the temperature probe and the acquisition device.
- The small size of the acquisition device installed in the screen reduces its thermal influence inside the screen
- The data transfer to the portable terminal will request a very short opening of screen doors, this reducing potential disturbance of the measurements.
- The display on the portable terminal can be consulted at any place, not necessarily in the field.
- If used, the SD-card can be removed indoor rather than in the field (thus avoising the risk of loosing it in the grass or the snow!).
- The power consumptions are kept very low, an autonomy of a few years is expected on both devices under normal usage.
- The portable terminal could also be used to manually input other information, such as the daily amount of precipitation data could be stored on the SD-card, which could then be sent by post mail. The design of the portable terminal will also allow the connection to an automatic rain gauge (such as a tipping bucket rain gauge).

The need for modernization

In view of modernizing the equipment and of stopping the use of mercury, Météo-France defined technical specifications for an electronic device to replace the current liquid in glass thermometers. A tender was issued last year and interesting technical proposals were received. The main objectives of the modernization are:

- To stop the use of mercury thermometers
- To homogenize cooperative network equipment
- To alleviate the constraints of observers (currently daily measurements)
- To improve the accuracy of the measurements
- To allow an electronic transfer of data if the observer has an access to Internet.

Previous investigations

Low or medium cost electronic systems were evaluated in 2006-2008. Some of them fulfill the requirement in term of announced uncertainty, but the two main drawbacks were:

They are not designed to be calibrated nor even controlled. Therefore, the metrology cannot be under control.

The method of resetting the period of calculation of minimum and maximum temperature doesn’t fit the need of meteorological purposes.

Technical specifications

To have a very good stability during years, the temperature probe must be a thermo-resistance based on platinum: Pt100 is preferred, but any other value at 0°C is accepted.

The overall uncertainty requested for the probe and the acquisition system is 0.25°C over a range of – 40 to + 60°C.

The preferred sampling period is 1 minute, though a maximum of 6 minutes was accepted.

The period of calculation of Tn (daily minimum) and Tx (daily maximum) can be individually selected.

Calculated daily values and hourly values of temperature and its extreme over the one hour period are recorded by the device.

The device can be used in two modes :

- The daily Tn and Tx can be displayed with the corresponding date on a local display. The observer read the values and continue to send them monthly by post mail. If he has an Internet access, he can transmit them via Météo-France dedicated Web pages.
- Recorded daily and hourly values are transmitted to a PC belonging to the local observer. The media to transfer the data from the electronic thermometer was not defined and was left to the imagination of the industry.

The device can be installed in the numerous existing Stevenson type screens, but must also allow the use of smaller multi-plates screen. The screen might be mounted on a pod allowing to adjust the height above snow level, if any.

The device must use its own battery, with a minimum life duration of 12 months. To stay as simple as possible, a solar panel was not allowed.

The stability of the internal clock must be better than 1 minute per month and 6 minutes per year.

The cost objective was about 500 € per device (including its temperature probe).

A specific version with hourly humidity measurement was also requested. The hygrometer was not part of the tender.

Schedule

We will receive at the end of 2010 2 prototypes of the temperature model (Type_T) and 2 prototypes of the model for temperature and relative humidity (Type_T&U). After testing and approval by the technical teams of Météo-France, 25 Type_T models and 5 Type_T&U models will be delivered in 2011, for field tests with the cooperative observers in real conditions and various operational conditions. We consider this phase as important to check the ergonomic features with non-professional observers. This period will also be used to set all the operational procedures which will changed compared to the actual “old” system.
The “massive” installation (1000 systems) will be done in 2012-2014.

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