BASIC SENSORS MAINTENANCE METHODS

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Maintenance is a non negligible part of MNS activities. As exposed in following, control and calibrating methods used in Météo-France network have been conceived to be simple and quick to carry out on sensors. For that, some of measurement components of sensors are more important than others

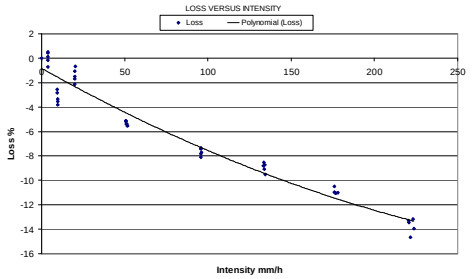
RAINGAUGES

To get measurement from tipping bucket raingauges as accurate as possible, we have to correct raw measured rain.

Each type of tipping bucket raingauge used in Meteo-France network is characterized by a specific error curve, loss versus rain intensity. When rain begins, a correction is calculated each minute. When correction accumulation reaches 0.05 mm, 0.1 mm is added to the minute rain accumulation and the accumulation counter is adjusted accordingly. After 1 hour without rain, the correction accumulation is reset to 0 by the AWS. So, in the field, rain gauges are adjusted to have a given loss for a given intensity.

SETTING SPECIFIC ERROR CURVE IN LABORATORY

Using a bench calibration (*water mass weighted, injected by pumping in the raingauge, is compared to rain gauge measurement*), we can set buckets loss, depending on intensities. For low intensities (< 50mmh), more points must be performed than for high ones, to draw a specific correction curve for each type of rain gauge.
Uncertainty on bench calibration is less than 1%.



The important quality for rain gauge is a good repeatability of the buckets' response, providing a stable error, easy to set when adjusting the rain gauge. A better repeatability is obtained using a large bucket capacity (20 g) rather than a small one. It allows a reduction of wetting losses, to enhance repeatability by enlarging cone nozzle.

ADJUSTING TIPPING BUCKETS IN THE FIELD

A shutter with trench is set in the bottom of the cone, limiting the mean intensity to 60mm/h when the cone is filled in with a water flask of 1 liter. A pocket computer PSION, easy to handle, is used to measure the duration of each tip (consequently mean tipping mass).Then buckets imbalance is calculated and corresponding corrections are deduced. This maintenance action is short, easy to carry out, and allows to adjust buckets, comparing to known intensity. This control is carried out every 6 months.

WIND SENSORS

Mainly, cup anemometers associated with a vane are used in Météo-France network. A few ultrasonic sensors, calibrated by his manufacturer, are used in some sites by Météo-France.

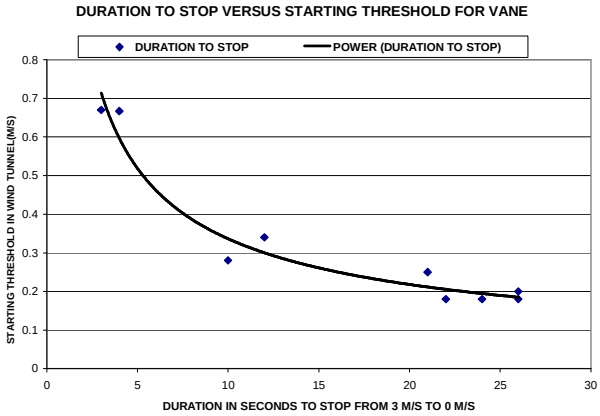
To get a measurement of cups wind sensors as accurate as possible, cups anemometer must have weak inertia. They are mounted on bearings whose friction must be minimal. It's the same for the wind vane.

The detection speed is an optoelectronic system added to a counter. Without any mechanical change of the cups, the only reason for a drift of the response is the aging of the bearings. So, only sensors bearings, which are subject to corrosion, are controlled. **For this kind of wind sensors, the bearings quality must be high.**

TESTING THE BEARINGS

To test the bearings' status, we have to know the tolerable friction. So, we have measured for a batch of sensors :
- the time used to rotate from an initiate value of 3 m/s to complete stop.
- in a wind tunnel, the value of the starting threshold for each sensor.

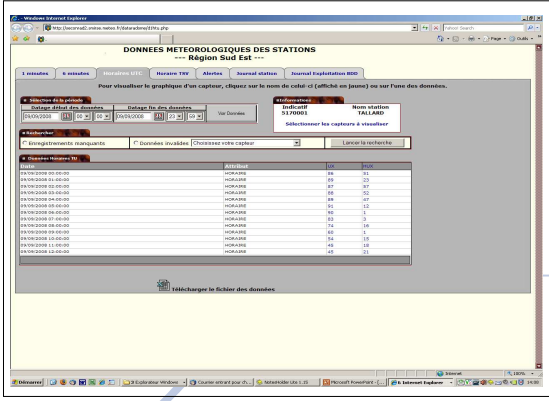
Then, we draw the associated curve :



A defined accepted starting threshold allows to provide a criterion duration. For example, for a given type of sensor used in Météo-France network, this duration must be greater than 22 s for anemometer, and 10 s for vane, for a starting threshold of 0.5 m/s.
It's to note that the time limit is less for vane than for anemometer. Wind on the vane generates a stronger couple than on the cups. For a same starting threshold (0.5m/s), the vane-bearings can have more friction.
In the field, the bearings control can be carried out with adequate software included in the pocket computer PSION.

It's also possible to have a very simple correct indication about the bearings status, by manually rotating the cups mounted on the anemometer or the vane and by measuring the time to stop. Even if the initial rotating speed is not accurately known, it doesn't change a lot the time to stop, as the initial speed's decrease is rapid, due to the aerodynamic friction.

The control of wind sensors' bearings is carried out once per year or if a measurement problem is detected.



HUMIDITY

Capacitive hygrometers sometimes drift, specially at high humidity. So, humidity sensors are calibrated every year to control the error magnitude of measurement and adjust them if necessary. An additional survey is done at high humidity values. During their operational use in the network, the raw (possibly > 100%) daily maximum measured value is recorded in a database and this value is controlled : oversaturation can be detected, as well as subsaturation.

CONCLUSION

Maintenance constraints must be greatly taken into account before purchase, in order to save time and money. Constraints may be subject to bring modifications on sensors.

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