RESMA

ITALIAN AIR FORCE – METEOROLOGICAL SERVICE

W.M.O.

Field Rainfall Intensity Intercomparison
ET/IOC SIIB-3 MEETING

"Little Goodwill Men for great projects"

QUALITY ASSURANCE
RESMA PROPOSAL

Mj Fabio MALASPINA – Cap. *Emanuele VUERICH*

Vigna di Valle, 26.02 – 02.03.2007

SUBJECTS:

- Brief history of meteorological measurements;
- Brief history of “quality management”;
- Good quality data in measure activity;
- Control quality data
- Quality in intercomparison : from the data control to the process quality assurance;
- Conclusions

Even if we often believe:

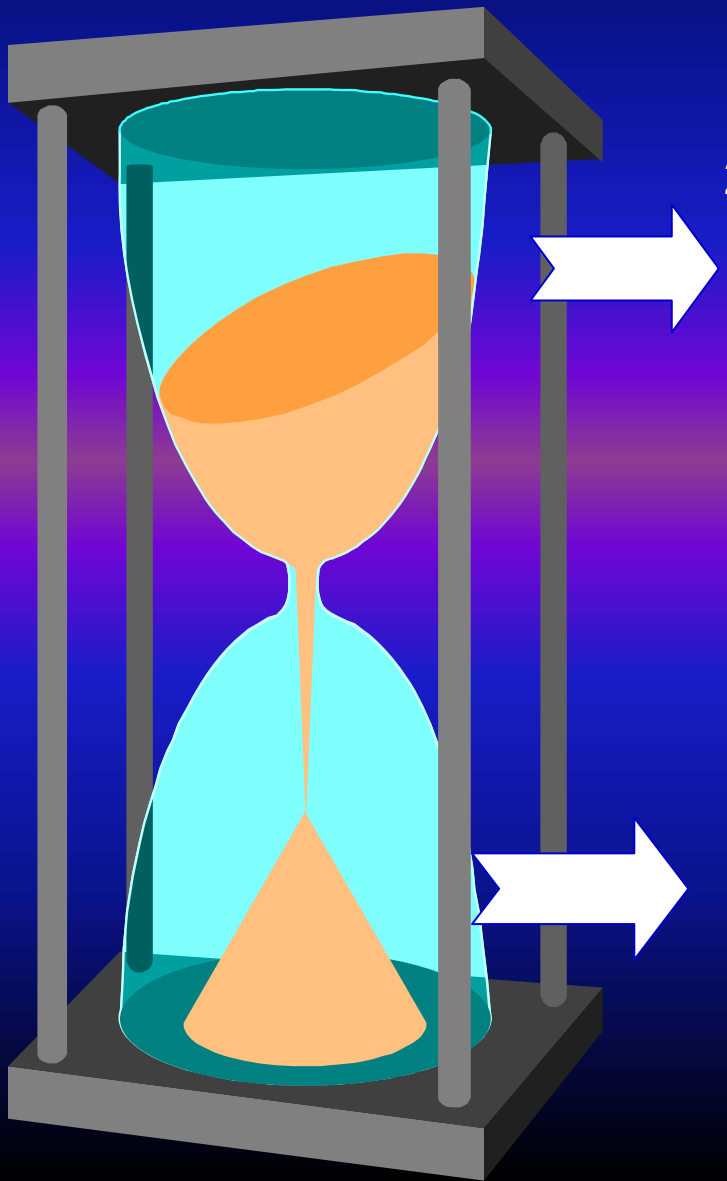
"Natural phenomena are written in this big book that it is always opened in front of our eyes ... *It is written in mathematical language*, and the characters are triangles, circles, and other geometric figures... without these it is a vainly wandering for a dark labyrinth."

Galileo Galilei, Il Saggiatore (1623)

Important facts have to be consider:

1. Instrument measurements produce numerical values. The purpose of these measurements is to obtain physical or meteorological quantities representing the state of the local atmosphere;
2. "NOT ALL NUMBERS ARE DATA";
3. "EVEN IF INPUT INSTRUMENTS ARE THE SAME, IT ISN'T SURE THAT THE RESPONSE IS THE SAME".

“Quality Management” in general organization



1. When products were less than needs: only customer was interested to test products/service (produzione parte azienda fondamentale)
2. When products became more than needs and very sofisticated and expensive:

Control quality: It consists of examination by factory’s personnel of only product. The goals is diveded production in “the first choice”, “the second choice”, etc.

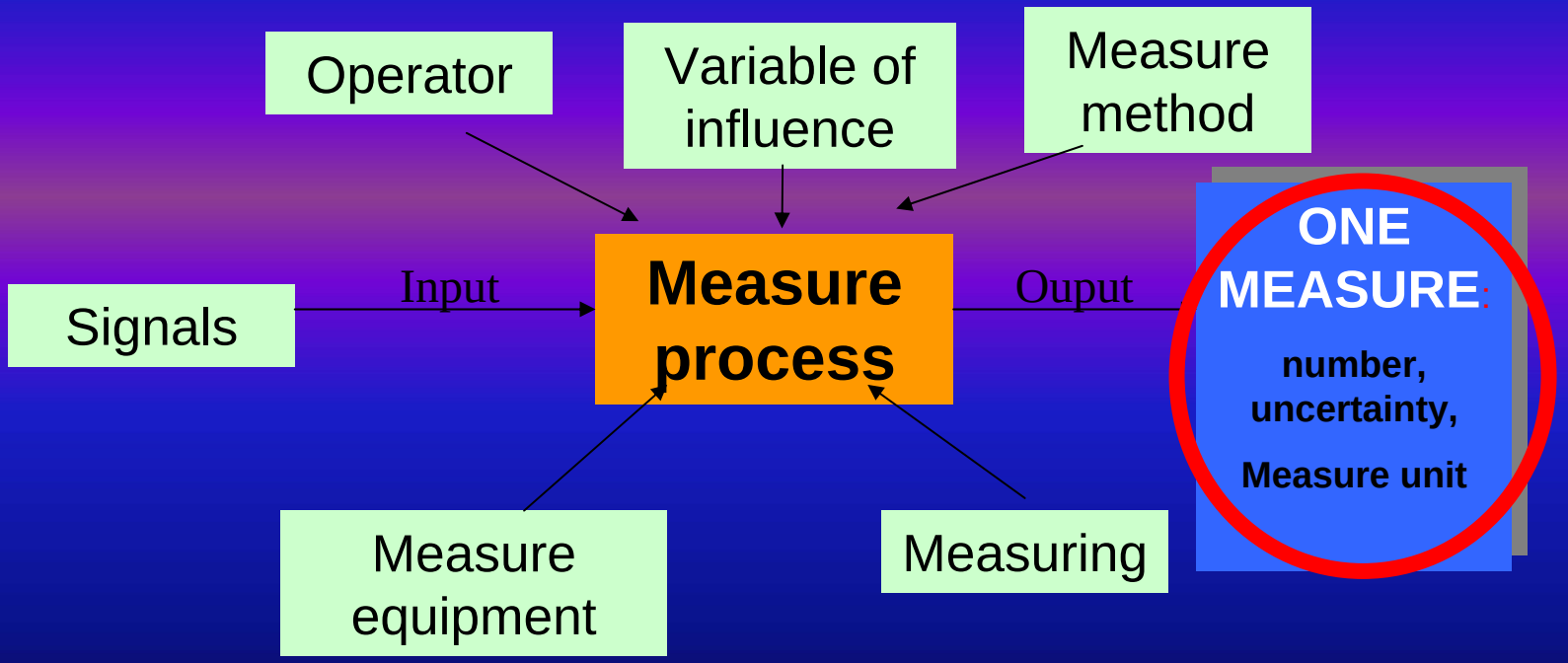
Quality Assurance: The quality systems operate continuously at all point in the whole production process (ISO 900n)

Total Quality: when all production process is known and controlled, process can be easily modify for Marketing needs (Vision 2000,, just in time)

What means “Quality Control”?

It consists of examination of final data

Quality Control is the best known component of quality management system, and it is the irreducible minimum of any system. It consists of examination of data in stations and in data centers to detect errors so that the data may be either corrected or deleted. (Guide n. 8 WMO- 1996)



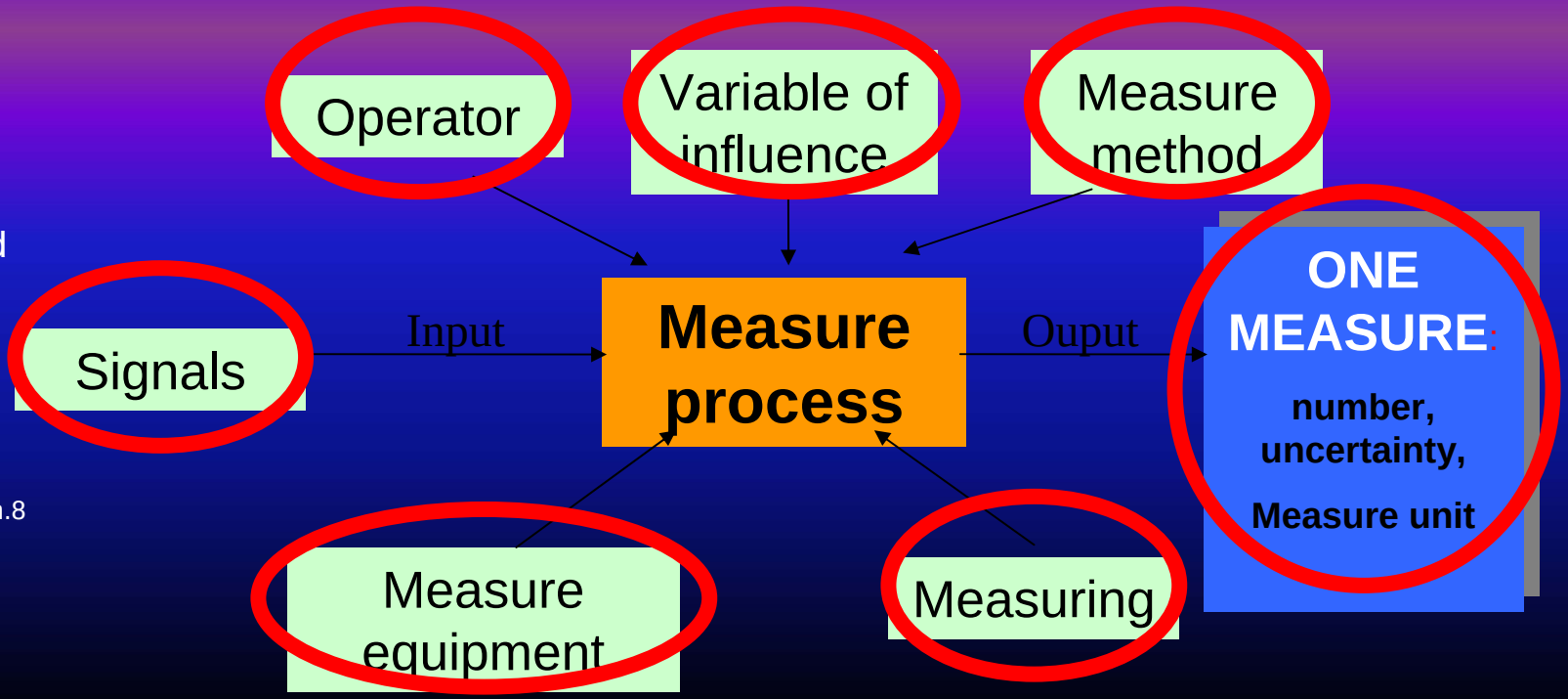
NB:An organization can work in “quality” without to take a certification

What means “Quality Assurance”?

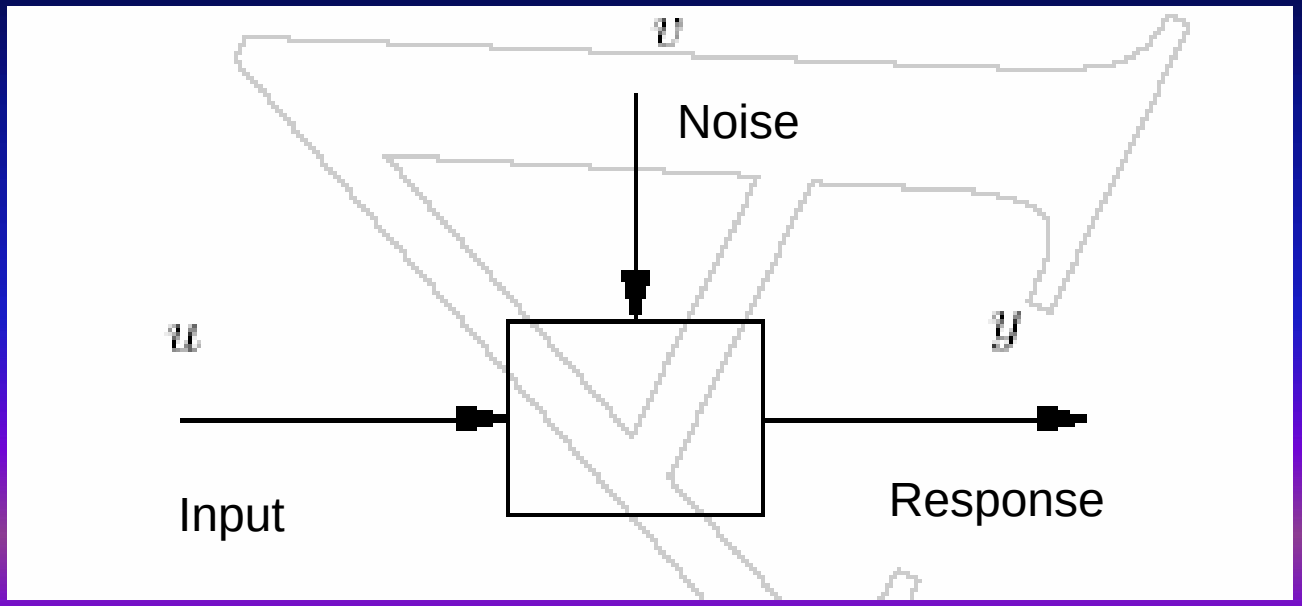
It consists of examination in the whole process

The provision of good quality meteorological data is not a simple matter, and it is impossible without a quality management system. The best quality systems operate continuously at all point in the whole observation system, from network planning and training, through installation and station operations to data trasmission and archiving, and they include feed-back and follow-up provisions on time scales from near-real time to annual reviews.

Without a quality system, the data must be regarded as being of uncertain or unknown quality, and their usefullness is diminished (Guide n.8 WMO 1996)



Make a measure: y is different from u?



How can I identify measurement system? Input

I can measure some instrumental characteristics, but what can I say about error when input is unknown?

Once measurements are made and converted to a legible form of “true” values for analysis, the next step is to determine how well the measurements represent the “true value” of the parameter being measured.

Deviations from the “true value”, is generally due to sensitivity, precision, systematic error (static calibration) and response time (dynamic calibration), exposure.

Control Quality and Monitoring Data

According decisions about data-acquisition and data-elaboration, it will be made routine “ad hoc” which will be able to find out in real-time “strange data” or “strange situation”. These routine can only help “quality management” to individuate problems and remove them.

“Truth proceeds faster from error than from confusion” (Francis Bacon)

In fact, there are some problems when results of “control quality” is not real-time and it is not used to improve process:

- Lost data are irrecoverable and not used data cost as well;
- Generally the Statistical description of the past is not the probability evaluation of future (David Hume) we can exclude the most meaningful data;
- Data absence during a period makes **the historical series** not representative

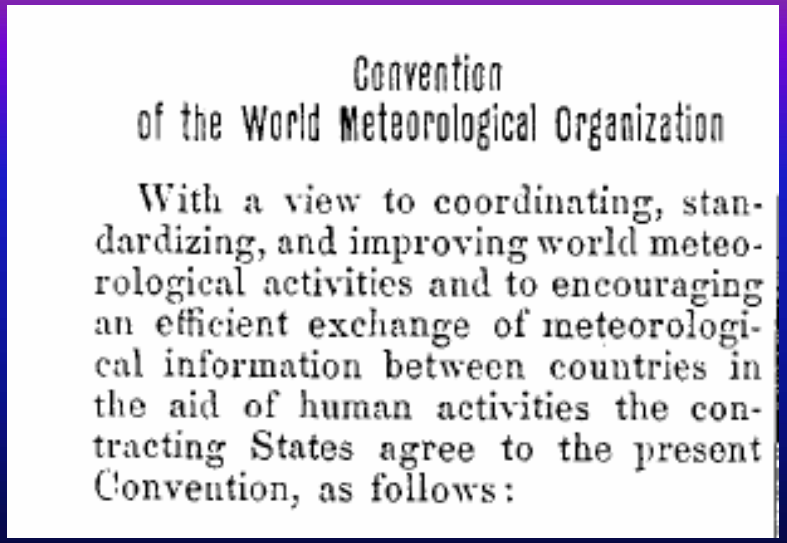
Machine can not completely replace man

From: "Guide to the expression of uncertainity in measurement"
International Organization for Standardization 1993

"Although this guide provides a framework for assessing uncertainity, it cannot substitute for critical thinking, intellectual honesty, and professional skill. The evaluation of uncertainity is neither a routine task nor a purely mathematical one; it depends on detailed knowledge of the nature of the measurand and of the measurement. The quality and the utility of the uncertainty quoted for the result of the measurement therefore ultimately depend on the understandig, critical analysis, and integrity of those who contribute to the assignement of its value."

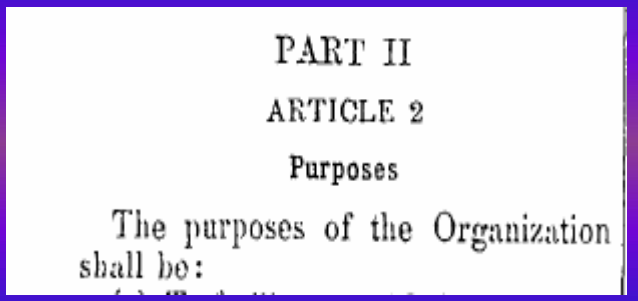
Field intercomparisons are used to verify performance of sensors in the field since laboratory calibrations, while, essential, are not always reliable predictor of field performance.

On 23 March 1950, WMO emerged as a new intergovernmental organization and a specialized agency of the United Nations.



Convention
of the World Meteorological Organization

With a view to coordinating, standardizing, and improving world meteorological activities and to encouraging an efficient exchange of meteorological information between countries in the aid of human activities the contracting States agree to the present Convention, as follows:

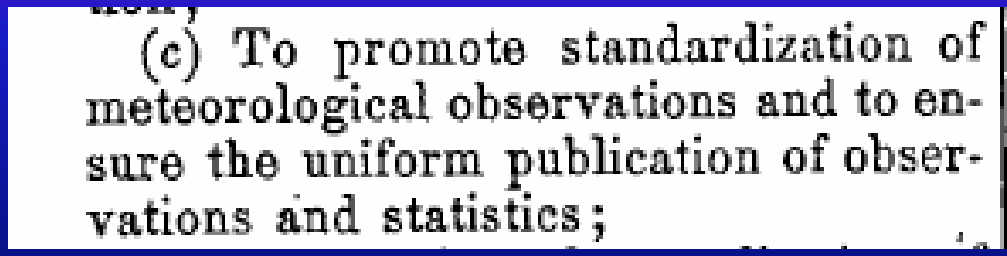


PART II

ARTICLE 2

Purposes

The purposes of the Organization shall be:



(c) To promote standardization of meteorological observations and to ensure the uniform publication of observations and statistics;

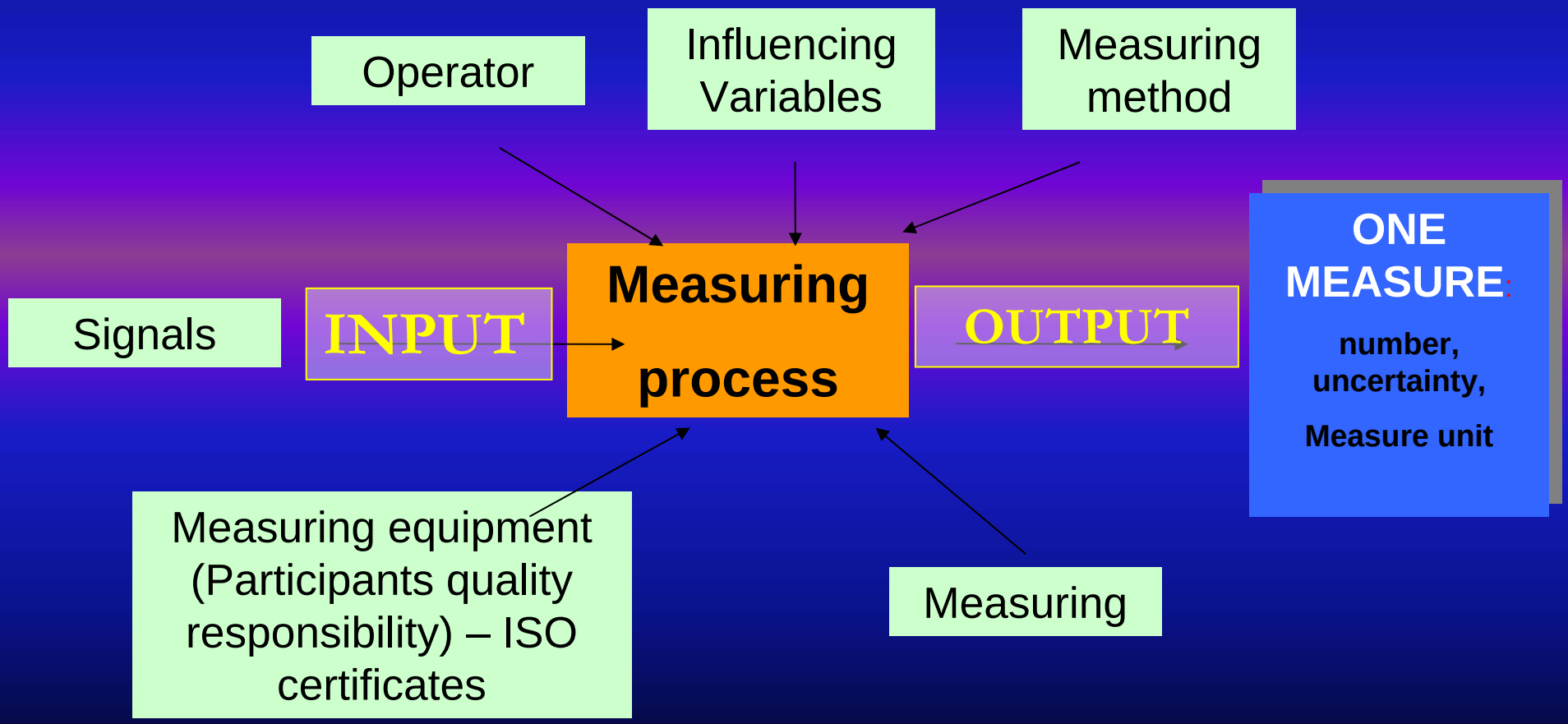
Field Intercomparisons

Departure Axioms:

1. Instant by instant, Input is the same for every instruments;
2. By Instruments characteristics and sampling-time we are able to sample input without lost information (Shannon theorem)

In Intercomparison process, we are not interested into the “true value”, but only into a comparison and related evaluations. Instruments in pit gauges in the center of the field, give only a “reference value” and not the “true value”.

“Quality Assurance” in the whole “field intercomparison process”



If QA is perfect, performing a QC after is useless: we already have good quality data!

Why is the continuous observing presence important?

From Claudio Rafanelli Cnr- Isac, Roma

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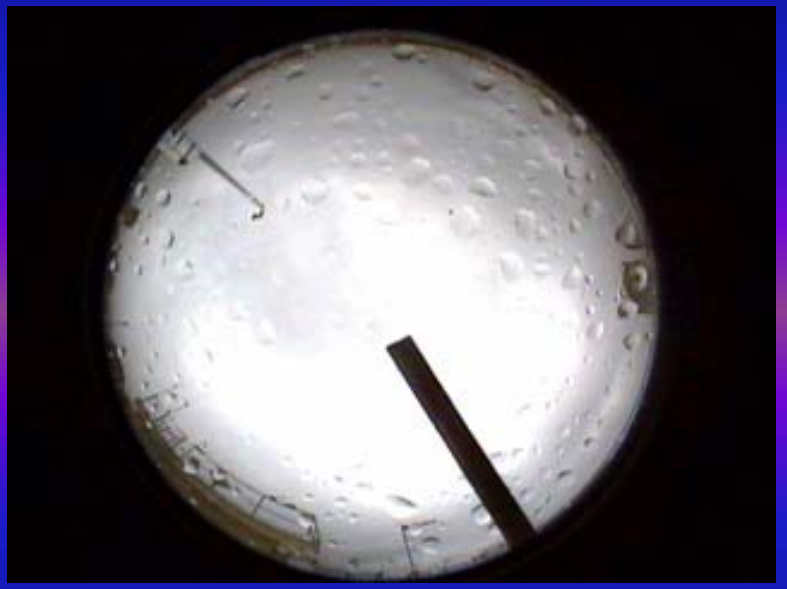
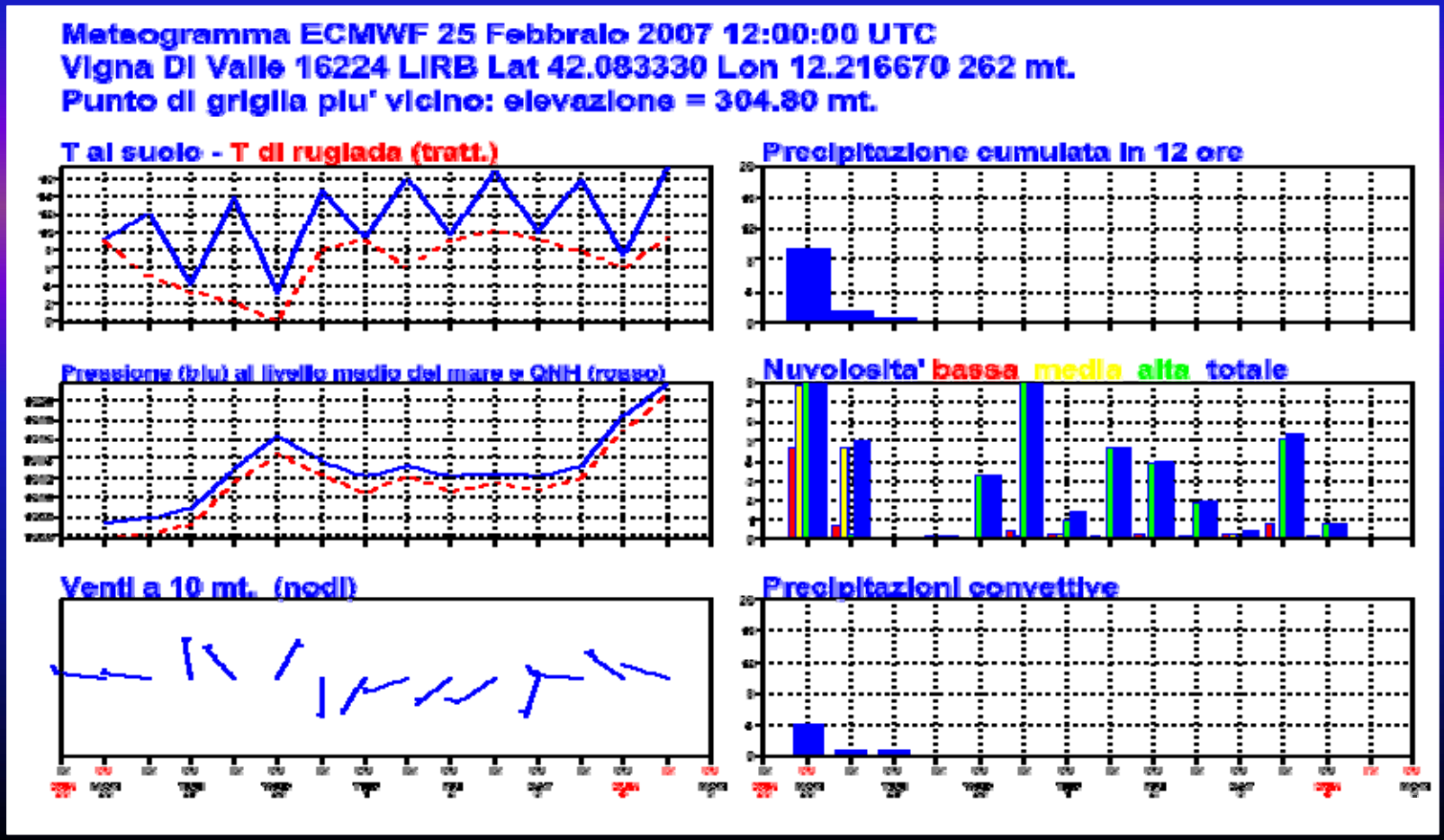


From Claudio Rafanelli Cnr- Isac, Roma

Preventive Maintenance

Every day : checking instruments. Every operation will be recorded (“AD HOC” LOGBOOK). Operations will be performed with SM supervision. Preventive Maintenance will be done in particular when precipitation is “going to approach”

I.M.S. - Meteogram: “LOCAL MODEL” weather forecast



Signal: convective o “warm fronts” precipitation

POSSIBLE MET PRODUCTS AND METADATA (IMS-Resma)

- **Observer reports** (GCOS+GAW 24H Vigna di Valle Met Station)
- **Temperature of rain**
- **Sfuk (lightning)**
- **Nefodine (sat+clouds+water)**
- Precipitation typology (hail/snow..)

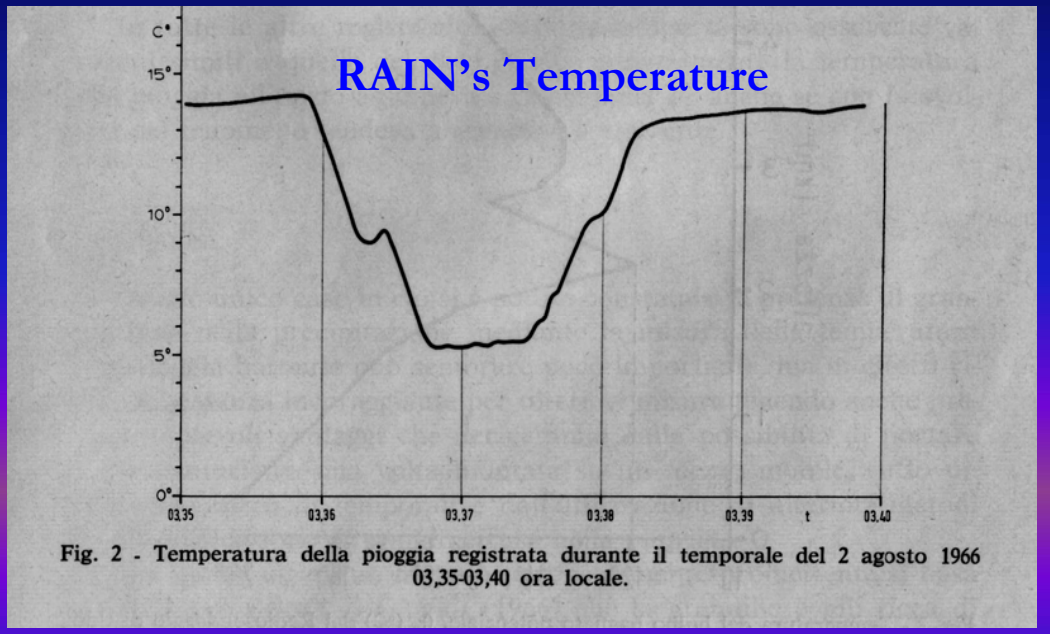
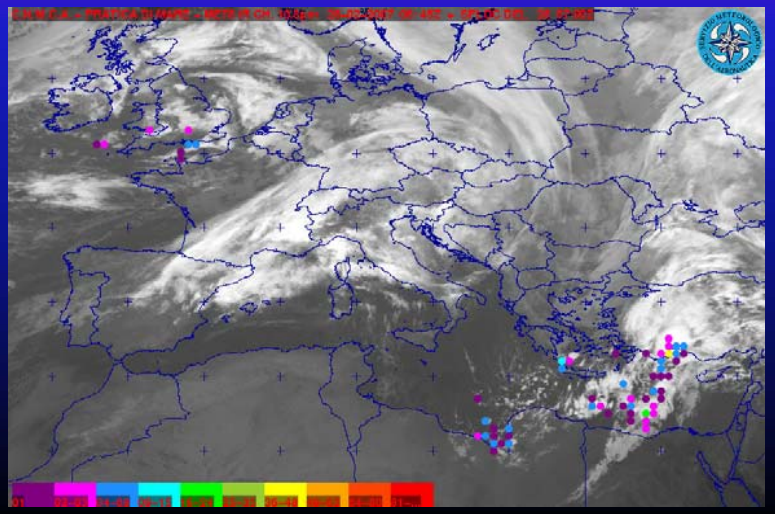
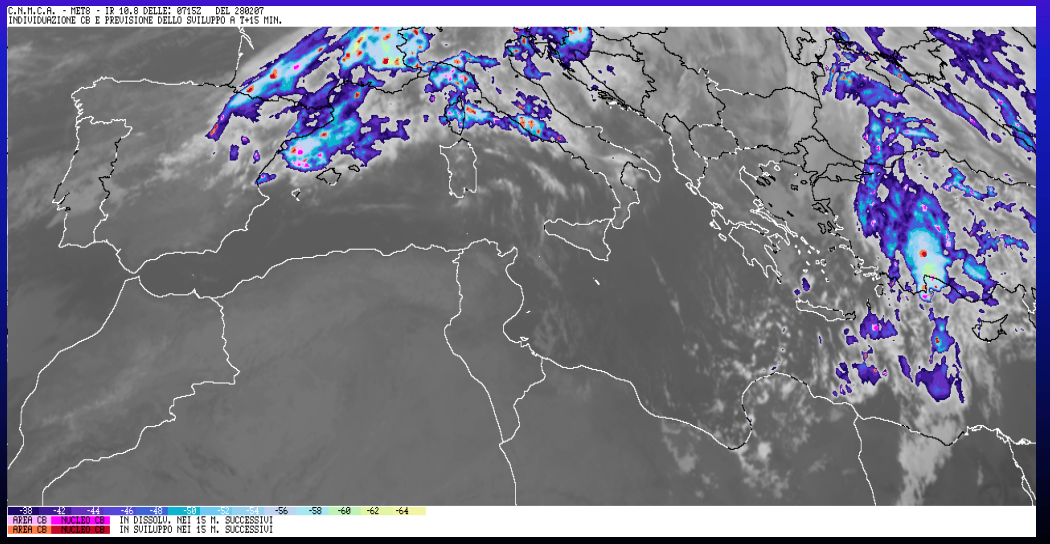


Fig. 2 - Temperatura della pioggia registrata durante il temporale del 2 agosto 1966 03,35-03,40 ora locale.





For every significant precipitation observed, personnel will contribute to carry out a metadata record

It is important that should be kept not only the meteorological measurement values, but also the circumstances in which the measurements are made. Such information is known as **metadata** - data about data.

possible *record*

Campo	**contenuto**
00	n° sito
01	località
02	coordinate geogr. (GPS)
03	inizio precipitazione
04	fine precipitazione
05	quantità precipitazione
06	direzione vento
07	forza vento
08	fenomeni speciali
11	nuvolosità
12	tipo di copertura del suolo
13	fase vegetativa
14	tipo di nuvolosità
16	note
17	**ET decisions**

According to WMO n.622 – 1986, for every instrument, a book will be realized to archive every operation/problems on the instrument (“Italian history” of instruments)

INSTRUMENT STATISTICAL FORM

Issued, date .....

Kind of instrument on file: .....

File No.: ..... Store location: .....

Make, model, year of release: .....

Date of despatch to the station: ..... Station: .....

Name/grade of station personnel responsible for the instrument:

(1) ..... (2) .....

(3) ..... (4) .....

Major adverse environmental characteristics of the duty station (frost, strong winds, corrosive pollution, etc.): .....

.....

Instrument failure: nature/date/remedial action taken/observer on shift:

(1) .....

(2) .....

(3) .....

(4) .....

Instrument's periodic performance test date: results/staff member:

.....

.....

.....

Re-calibration corrections date: scale range/correction/staff member:

.....

.....

.....

Date of despatch: ..... Date of receipt: .....

Transit time: ..... Maintenance/repair/calibration time: .....

.....

Number and kind of spares used: .....

Maintenance personnel: .....

Calibration graph attached: YES/NO

REMARKS: .....

.....

.....

Number of statistical form sheets preceeding the last one dated: .....

Filing clerk: .....

Pre-calibration Phase

Sensor or system calibration is the first step in defining data validity. So, we propose a pre-calibration phase in Genoa laboratory and a traveling calibration system will be at ReSMA

It is also important to know if participants have a system quality management and if their products are certified

The Quality Assurance plan

The QA plan should describe the **purpose and design of the project**, and outline the **objectives**, **measurement and analysis method, and milestones of the project**. The QA plan should specify the **required accuracy, precision and completeness**. The plan should also contain a description of all instrumentation that includes even precaution to guard against **unwanted sensors inputs**, **sensor signal processing** and **recording methods**, **response times and sampling rates.**

The QA plan must contain a **detailed description of data validation** procedures and criteria including methods of handling missing data or will be considered questionable or invalid. The **monitor program** must not delete or in any way change data but set a **flag associated with each datum to indicate probable quality.**

The QA plan should also specify the **schedule** and content of the performance **reports** of the measurements system and **provide a quantitative information on the quality of the data produced by the program.**

CONCLUSIONS:

1. Not all the numbers are data
2. To guarantee the quality of the data of a station is necessary: a suitable instrument, a correct exposure, the calibration, a right choice of the sampling times, ability and motivation of the personnel;
3. Quality must be thought by the point of view of the purpose [calibration and meta-data are important];
4. For “field intercomparison a document about “QA plan”, which reports all “good practical actions” been used, and it can be realized according to ISO ed WMO document, for example:

ISO 10012:2003 Measurement management system- Requirements for measurement processes and measuring equipment.