Archival Management and Preventive Conservation

PREVENTIVE CONSERVATION

MONITORING

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LESSON CONTENTS:

DEFINITION OF PREVENTIVE CONSERVATION

To introduce this lesson I give the definition of Preventive Conservation, defined by the International Council for Museums – Committee for Conservation (ICOM – CC):

«All measures and actions aimed at avoiding and minimizing future deterioration or loss. They are carried out within the context or on the surroundings of an item, but more often a group of items, whatever their age and condition. The measures and actions are indirect - they do not interfere with the materials and structures of the items. They do not modify their appearance».

MATERIAL STABILITY

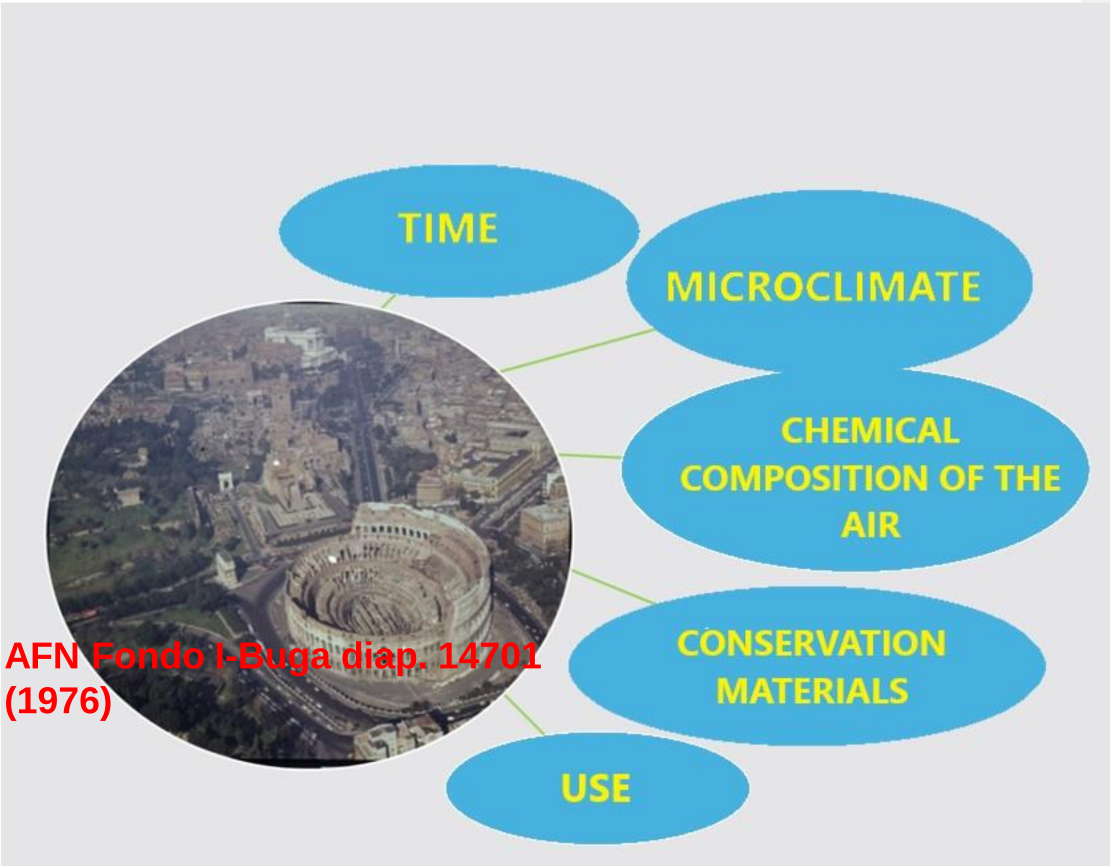
The definition refers to deterioration and loss. Deterioration consist in structural and/or chemical modifications of an artifact.

The current state of conservation and the aging process of an artifact are the result of its balance with the surrounding environment:

ENVIRONMENT ⇄ ARTIFACT

The balance involves:

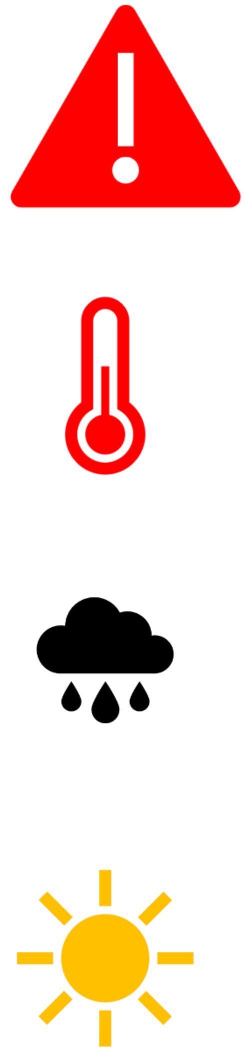
- **ENERGY EXCHANGES** (mechanical, thermal, electromagnetic)
- **EXCHANGES of MATTER** (chemical reactions, absorption of water and/or other substances from the environment)



AFN Fondo I-Buga diap. 14701 (1976)

In the history of photography, very different materials have been used, with different nature and chemical structure.
Each one of these materials has its own stability, according to specific environmental conditions. So if these conditions are present, it can be preserved in time: in the picture we see the factors which are responsible for the stability of photographs (time, microclimate, chemical composition of the air, conservation materials, use).
Each one of these factors contribute to physical, chemical and morphological changes that characterize the aging of an artifact. In this lesson we'll focus on microclimate.

D.S. Palazzi, family archive
Gelatin silver print/silver salt,(1931)



We talked about exchanges of matter and energy: the parameters registering those exchanges are:

- temperature
- humidity
- illuminance

RELATIVE HUMIDITY

We consider air to be a blend of perfect gases composed by dry air and water steam. Perfect gases are composed of punctiform molecules, which do not interact between each other and move with random motion.

- We define SPECIFIC HUMIDITY (US) as the quantity (in grams) of steam contained in 1 kg of dry air;
- We define HUMIDITY SATURATION (USat) the maximum quantity of steam that 1 kg of air can contain. When temperature raises, steam solubility raises, and so Usat raises
- We define RELATIVE HUMIDITY (UR):

$$UR = US/Usat * 100$$

UR varies from 0 % (dry air, lack of humidity) to 100% (condensation of H_2O from vapor to liquid)

High UR (relative humidity) value:

- Creates favorable environment for the proliferation of mould and biodeteriogens
- Favours the absorption of humidity by hygroscopic materials (for example gelatin), causing distortion in the stratified structures, due to the different behaviour of the support and of the image layer
- Provoques hydrolysis reactions, in presence of acidity, to the polymeric materials (both natural and synthetic)
- Hydrolysis breaks up the polymeric chain structure, causing serious damages to the artifacts
- In the photo-types on metallic support they cause corrosion
- Favour deterioration of the silver image

Low UR (relative humidity) value:

- Causes shape distortions and fragility, due to the loss of H_2O in the hygroscopic material, possible detachment of emulsion from support

THE TEMPERATURE

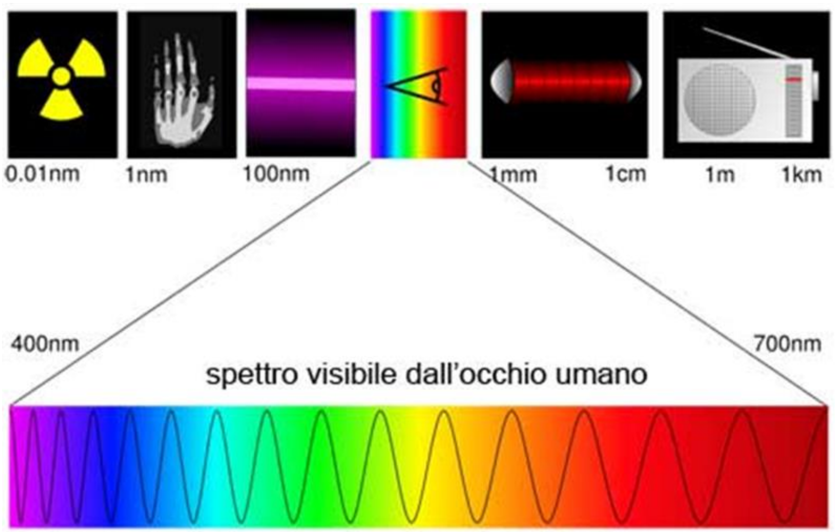
- With raising temperature, the speed of chemical reactions and deteriorating reactions increases
- An increase of temperature alters the water content in hygroscopic materials (for example paper, gelatin…)
- Environmental temperature variations cause relative humidity variations
- That can favour the reproduction of damaging microbiological and/or entomologic species

WE HAVE TO CONSIDER “T” AND “UR” TOGETHER

We repeatedly underlined the fact that different material constituting photographs respond differently to “T” and “UR” variations. Their chemical nature gives them different stability under the same environmental conditions: for this reason, to define the adequate conditions for a long-lasting conservation we need to talk about:

- Pairs of values “T”, “UR” (not isolated values of “T” or “UR”)
- Conditions that represent a good compromise for the stability of the different layered materials

THE LIGHT



The parameter to be monitored is illuminance, expressed in Lux

< Wavelength (λ), > Frequency (v), > Energy.

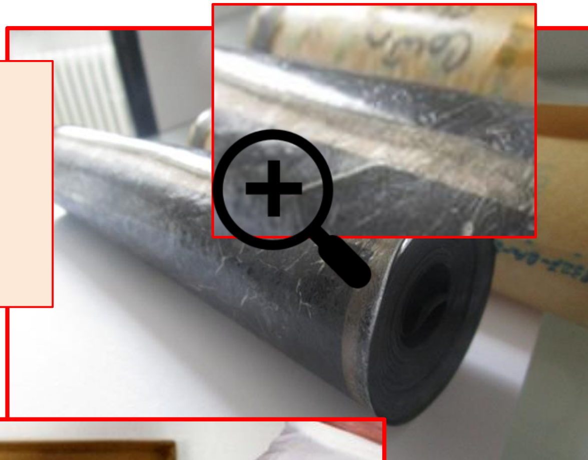
As you see in the diagram, radiations increase their energy from right to left.

UV radiations and the closer radiation in the visible spectrum are the most energetic present in the sources of light (also natural light!).

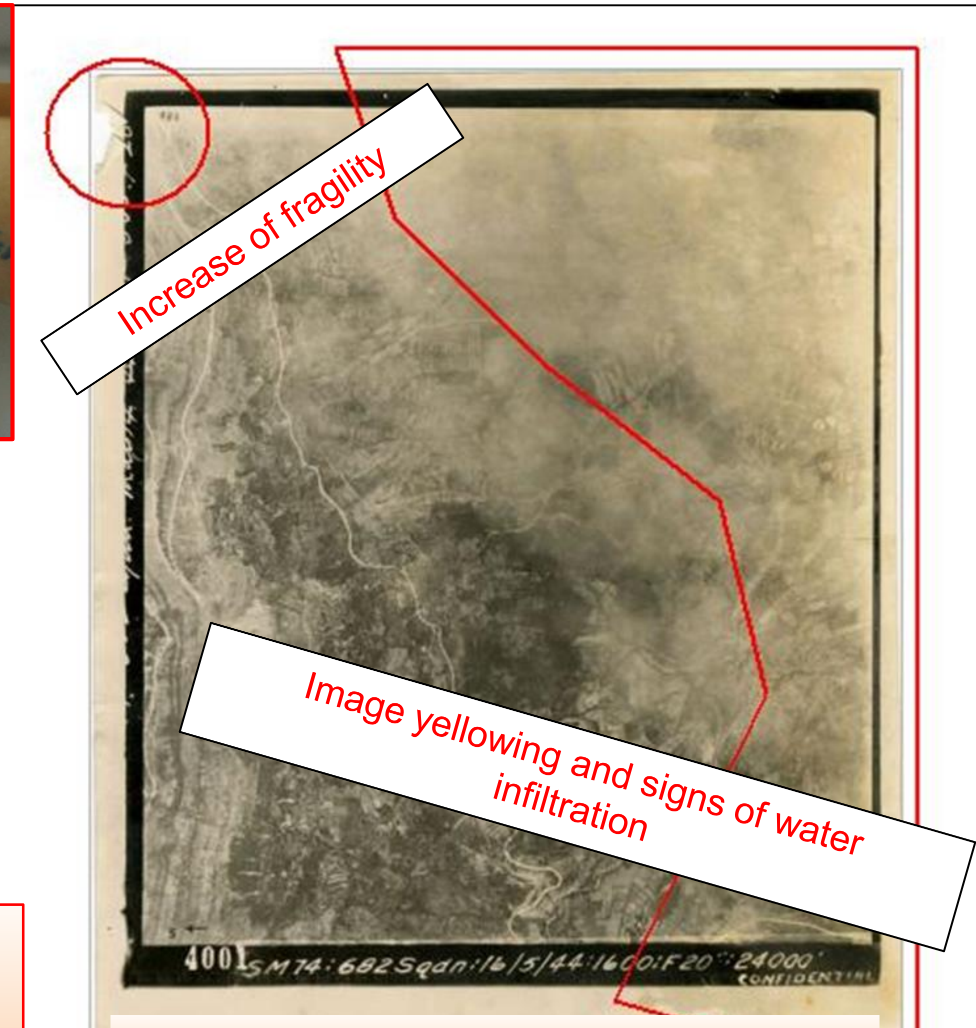
They can cause deterioration such as photo-oxidation (which is an oxidation reaction caused by the energy of radiations).

Just like infrared rays, lower energy radiations can increase their energy while interacting with materials and therefore warm them up. This interferes with the hygrometric balance of the objects and dehydrates them, distorting them, and making them fragile.

AFN –A.M. Fund. cellulose acetate negative, visible *craquelures* and edge waving



Curve of a «block» of gelatin silver prints, pasted together due to extreme humidity which favoured gelatin biodeterioration and melting. The curve is caused by the decrease of Relative Humidity and by the different reaction of paper and gelatin to humidity variation



AFN –MAPRW fund, 1944, positive n.4001, gelatin silver print/silver salt on paper

Material	Temperature	Relative humidity (%)
Gelatin silver print/Silver salt	+18°C	30 – 50%
Silver plate on glass	+18 °C	30 – 40%
Negatives on acetate support, gelatin emulsion/Silver salt	+5°C +2°C	20 – 40% 20 – 50%
Color photographs	-5 °C– +2°C	25 – 35%

This chart shows as an example some suggested values for photographs conservation*

*Data coming from
“Chimica e biologia applicate alla conservazione degli archivi” («chemistry and biology applied to archive’s conservation»), Edited by State Archive, MiBAC-DGA, 2002

Portable thermo-hygrometer: useful for instant measurement only

As we saw, if we want to preserve photographs at best, we need to know the environmental microclimatic values. To get a quick measure we can use a portable thermo-hygrometer like the one in the picture. We'll get an instant value that will reassure us (or warn!) on the current environment situation, but we'll not get any information on the situation at different times of the day, and in different seasons.
To understand if the environment is adequate for conservation and to know if it's possible to adjust its microclimate, we need CONTINUOUS measurements during LONG PERIODS (at least a year).

THAT'S WHY MONITORING IS IMPORTANT

THERMO-HYGROGRAPH

It continuously registers on paper the T and the UR values:

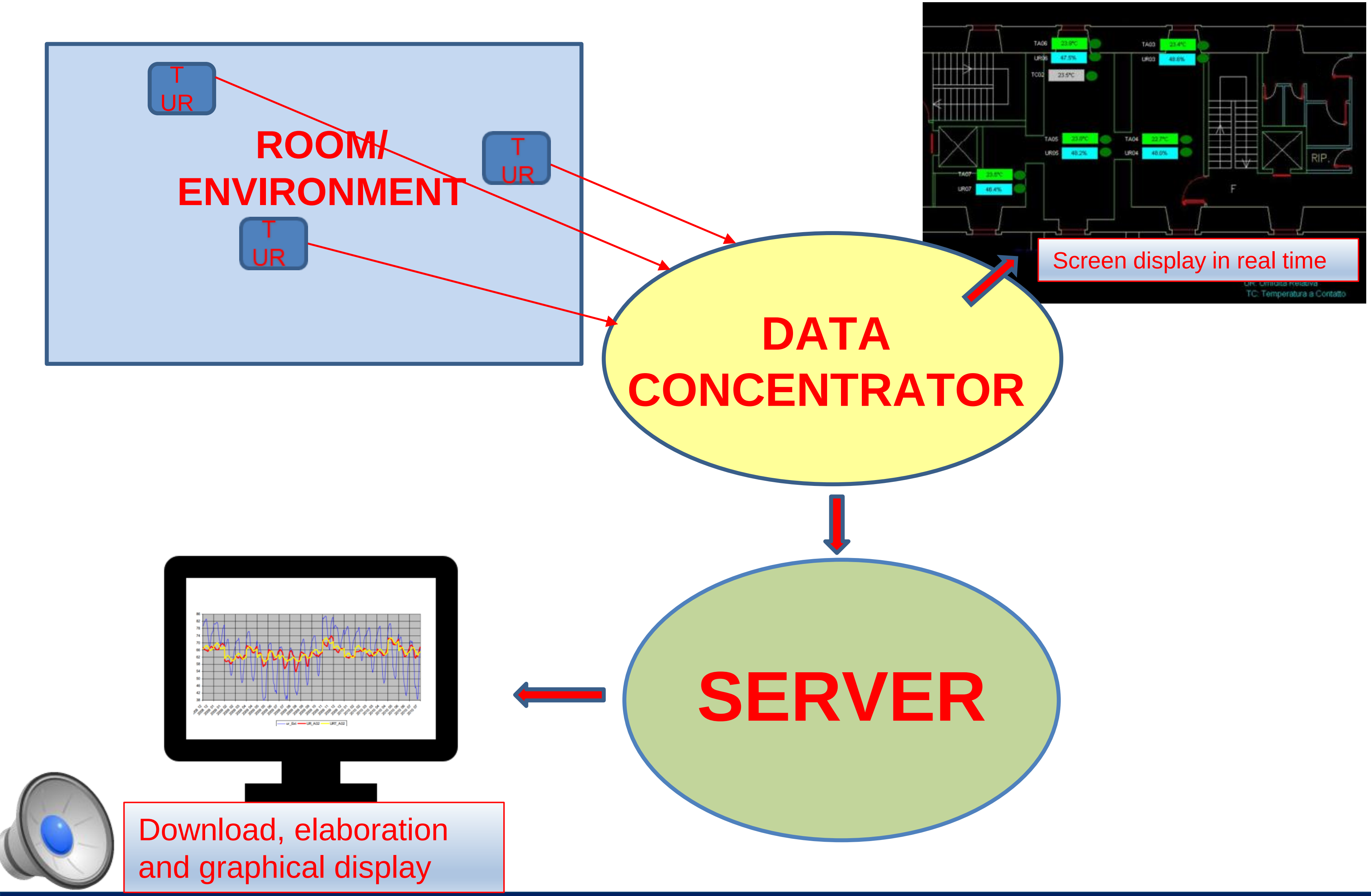
- We need to calibrate it and check paper and ink consumption
- No digital data register

DATA LOGGER

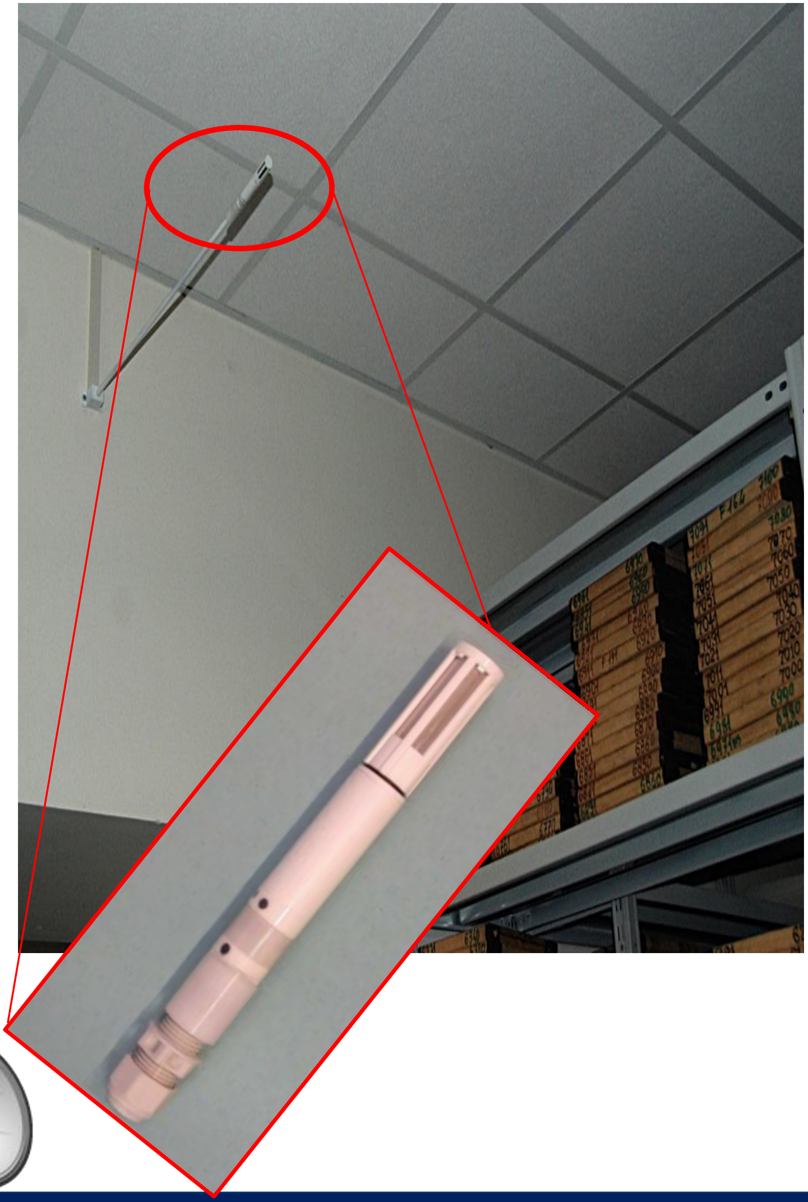
It can continuously register T, UR and Lux (illuminance), storing data in the memory

- Small volume (few centimetres)
- Interface to download data on the computer for its elaboration

Both these tools can be used for monitoring, but they have some practical limits if the rooms are very big or if there are many rooms. One or more measure points could be insufficient for a more complex situation. Managing a high number of tools like these can be dispersive and complicated

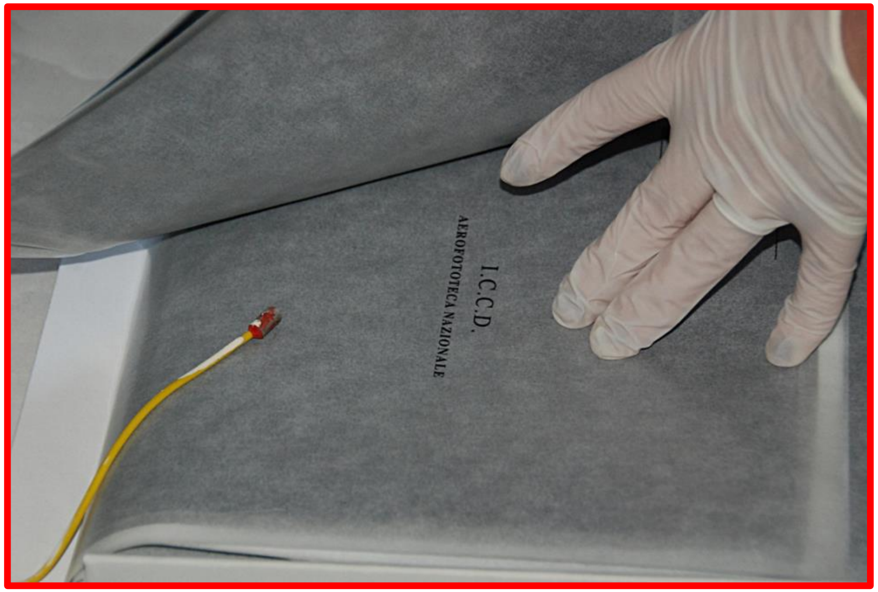

T
UR
T
UR
T
UR
ROOM/
ENVIRONMENT
DATA
CONCENTRATOR
Screen display in real time
SERVER
Download, elaboration
and graphical display

SYSTEM PROBES



The picture, taken in an AFN archive, shows a fixed thermo-hygrometric probe, located in an environment

SYSTEM PROBES

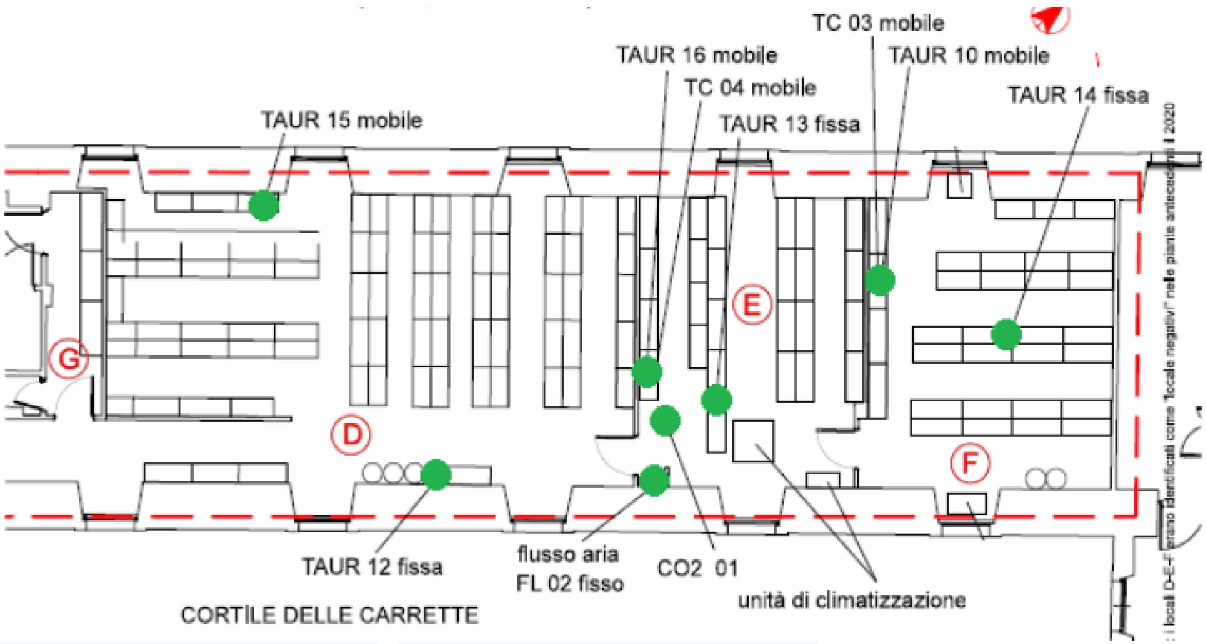


A monitoring system can use contact probes for measuring temperatures on surfaces. For example, a wall, a window or, like it's displayed in the photo, the probe can be installed inside a container, to get information on the difference between the container and the room's temperatures

SYSTEM PROBES

Moreover, it can be useful to have mobile thermo-hygrometric probes that can be located in different places, according to our needs. In the AFN sample the mobile probe has a long electric cable but there are also wireless probes.

The picture shows an anemometer, useful to study air movements in the environment.



TA 10 (°C)	21.19
UR 10 (%)	47.87
TC 03 (°C)	21.28

Mobile

TA 16 (°C)	20.6
UR 16 (%)	50.79
TC 04 (°C)	20.48
CO2 (ppm)	446.6
TA 13 (°C)	20.76
UR 13 (%)	47.89

Scaffale

TA 15 (°C)	19.12
UR 15 (%)	57.29

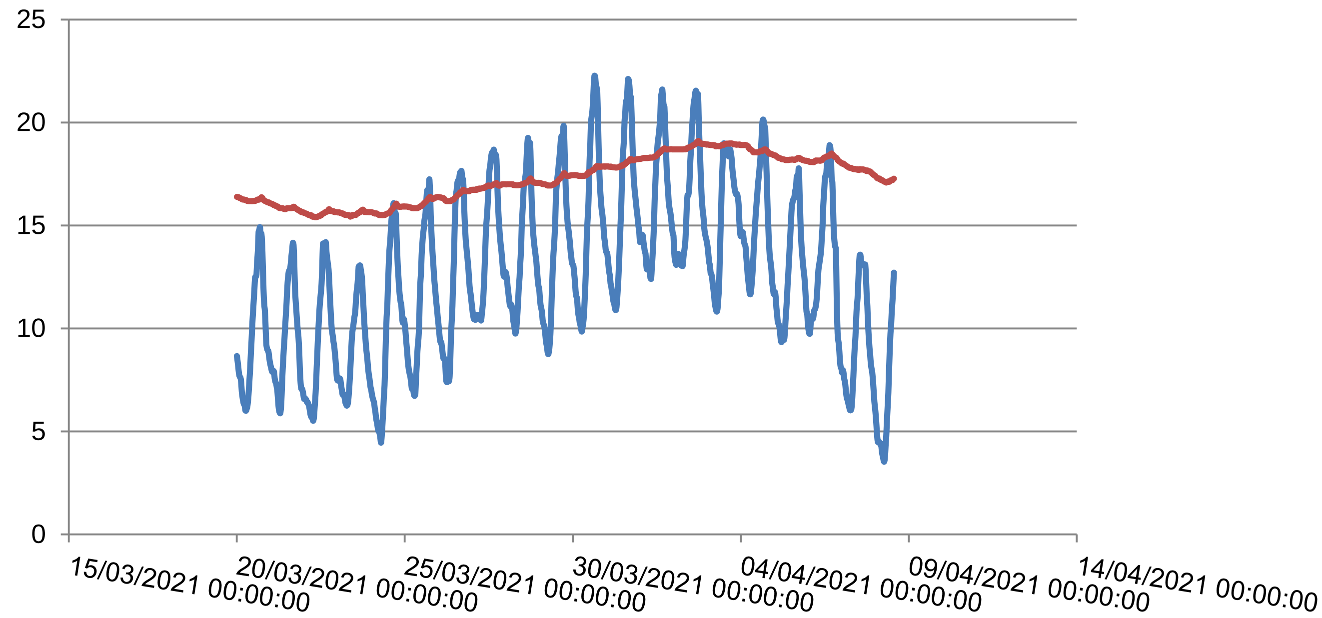
Ambiente

TA 12 (°C)	19.3
UR 12 (%)	57.21

Ambiente Sala

TA 14 (°C)	21.15
UR 14 (%)	46.83

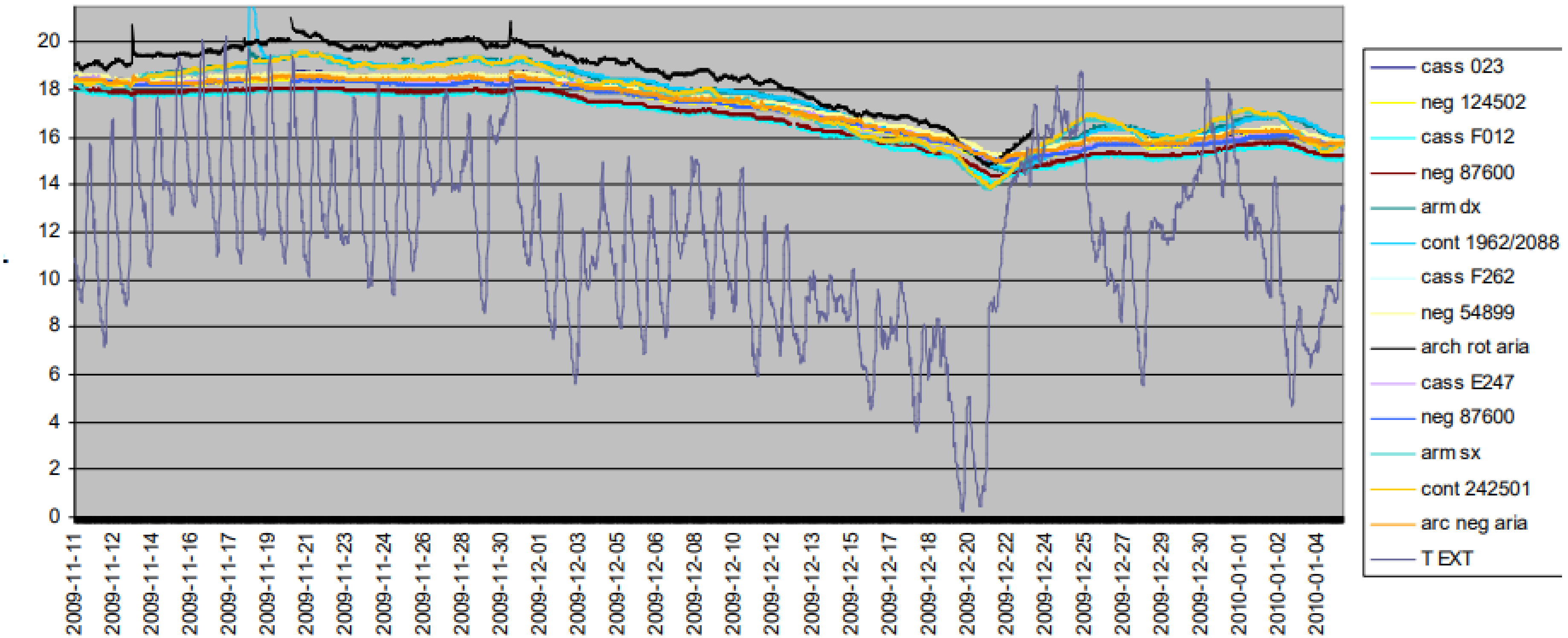
COMPARISON BETWEEN EXTERNAL AND INTERNAL TEMPERATURE EVOLUTIONS. THE INTERNAL VALUES COME FROM A PROBE LOCATED INSIDE THE ARCHIVE



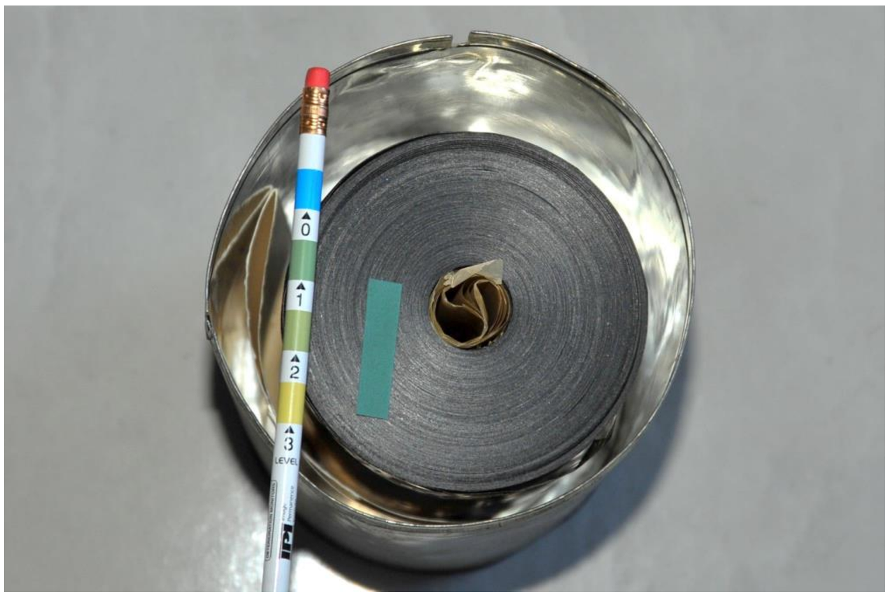
In this diagram we see the temperature variation in the conservation room (red diagram), whose walls mediate and moderate the external temperature range (blue diagram)

This diagram shows the relative humidity variations in three adjacent rooms. The room with higher relative humidity values (until 70%) is the bigger one, and the closest to the stairwell, which is cold and humid. They are compared with the external relative humidity values

EXAMPLE OF GRAPHIC DISPLAY



OTHER TYPES OF MONITORING



Monitoring vinegar syndrome on cellulose acetate film. The colour acquired by the paper indicates the level of acid hydrolysis reaction on the cellulose acetate film, giving useful information to improve conservation conditions

Traps for entomologic monitoring

Thank you for your attention!