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Air quality — Meteorology — Siting classifications for surface observing stations on land

Qualité de l'air — Météorologie — Classifications des sites pour les stations terrestres d'observation

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO 19289 was prepared by ISO/TC 146, *Air quality*, Subcommittee SC 5, *Meteorology,* and the World Meteorological Organization (WMO) as a common ISO/WMO Standard under the Agreement on Working Arrangements signed between the WMO and ISO in 2008. This International Standard is identical to the "Siting Classifications for Surface Observing Stations on Land", published in the WMO Guide to Meteorological Instruments and Methods of Observations (WMO-No. 8), 2014 Edition, Part I, Chapter 1, Annex 1B.

Introduction

Environmental conditions of a site[1)] might influence the measurement results. A careful analysis of the site environmental conditions is to be associated to the knowledge of the instrument characteristics to avoid quantities of influence to distort measurement results affecting their representativeness, particularly when a site is supposed to be representative of a large area (i.e. 100 km^2 to 1 000 km^2).

1) A “site” is defined as the place where the instrument is installed.

Air quality — Meteorology — Siting classifications for surface observing stations on land

1 Scope

This International Standard indicates exposure rules for various sensors, but what should be done when these conditions are not fulfilled? There are sites that do not respect the recommended exposure rules. Consequently, a classification has been established to help determine the given site's representativeness on a small scale (impact of the surrounding environment). Hence, a class 1 site can be considered as a reference site. A class 5 site is a site where nearby obstacles create an inappropriate environment for a meteorological measurement that is intended to be representative of a wide area (at least tens of km^2). The smaller the siting class, the higher the representativeness of the measurement for a wide area. In a perfect world, all sites would be in class 1 but the real world is not perfect and some compromises are necessary. A site with a poor class number (large number) can still be valuable for a specific application needing a measurement in this particular site, including its local obstacles.

The classification process helps the actors and managers of a network to better take into consideration the exposure rules and thus it often improves the siting. At least, the siting environment is known and documented in the metadata. It is obviously possible and recommended to fully document the site but the risk is that a fully documented site might increase the complexity of the metadata, which would often restrict their operational use. That is why this siting classification is defined to condense the information and facilitate the operational use of this metadata information.

A site as a whole has no single classification number. Each parameter being measured at a site has its own class and is sometimes different from the others. If a global classification of a site is required, the maximum value of the parameters' classes can be used. The rating of each site should be reviewed periodically as environmental circumstances can change over a period of time. A systematic yearly visual check is recommended: if some aspects of the environment have changed, a new classification process is necessary. A complete update of the site classes should be done at least every five years.

In this International Standard, the classification is (occasionally) completed with an estimated uncertainty due to siting, which has to be added in the uncertainty budget of the measurement. This estimation is coming from bibliographic studies and/or some comparative tests.

The primary objective of this classification is to document the presence of obstacles close to the measurement site. Therefore, natural relief of the landscape may not be taken into account, if far away (i.e. >1 km). A method to judge if the relief is representative of the surrounding area is the following: Does a move of the station by 500 m change the class obtained? If the answer is no, the relief is a natural characteristic of the area and is not taken into account.

Complex terrain or urban areas generally lead to high class numbers. In such cases, an additional flag "S" can be added to class numbers 4 or 5 to indicate specific environment or application (i.e. 4S).

2 Air temperature and humidity

2.1 General

Sensors situated inside a screen should be mounted at a height determined by the meteorological service (within 1,25 m to 2,0 m as indicated in Reference [1]). The height should never be less than 1,25 m. The respect of the higher limit is less stringent, as the temperature gradient versus height is decreasing with height. For example, the difference in temperature for sensors located between 1,5 m and 2,0 m is less than 0,2 °C.

The main discrepancies are caused by the following unnatural surfaces and shading:

a) Obstacles around the screen influence the irradiative balance of the screen. A screen close to a vertical obstacle might be shaded from the solar radiation or "protected" against the night radiative cooling of the air by receiving the warmer infrared radiation from this obstacle or influenced by reflected radiation;

b) Neighbouring artificial surfaces might heat the air and should be avoided. The extent of their influence depends on the wind conditions, as wind affects the extent of air exchange. Unnatural or artificial surfaces to take into account are heat sources, reflective surfaces (for example, buildings, concrete surfaces, car parks), and water or moisture sources (for example, ponds, lakes, irrigated areas). Shading by nearby obstacles should be avoided. Shading due to natural relief is not taken into account for the classification (see above). The indicated vegetation growth height represents the height of the vegetation maintained in a "routine" manner. A distinction is made between structural vegetation height (per type of vegetation present on the site) and height resulting from poor maintenance. Classification of the given site is therefore made on the assumption of regular maintenance (unless such maintenance is not practicable).

2.2 Class 1

a) Flat, horizontal land, surrounded by an open space, slope less than 1/3 (19°);

b) Ground covered with natural and low vegetation (<10 cm) representative of the region;

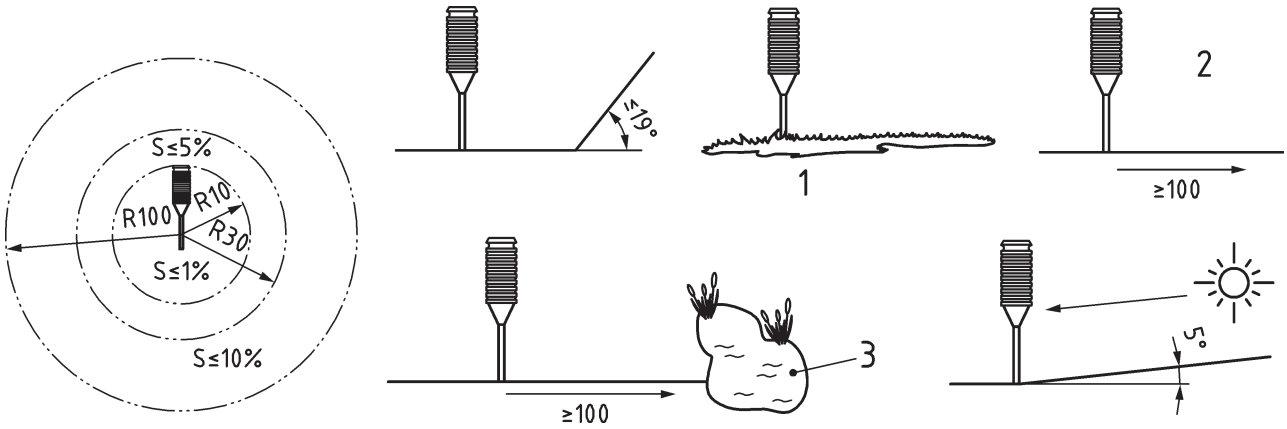
c) Measurement point situated

1) at more than 100 m from heat sources or reflective surfaces (buildings, concrete surfaces, car parks, etc.),

2) at more than 100 m from an expanse of water (unless significant of the region), and

3) away from all projected shade when the sun is higher than 5°.

A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10 % of the surface within a radius of 100 m surrounding the screen, makes up 5 % of an annulus of 10 m to 30 m, or covers 1 % of a 10 m radius area.



Key

1 low vegetation (<10 cm)
2 heat sources (building, car parks, concrete surface)
3 lake
S surface of heat sources

Figure 1 — Schematic showing criteria for air temperature and humidity for class 1 sites (numbers are given in metres unless otherwise indicated)

2.3 Class 2

a) Flat, horizontal land, surrounded by an open space, slope inclination less than 1/3 (19°);

b) Ground covered with natural and low vegetation (<10 cm) representative of the region;

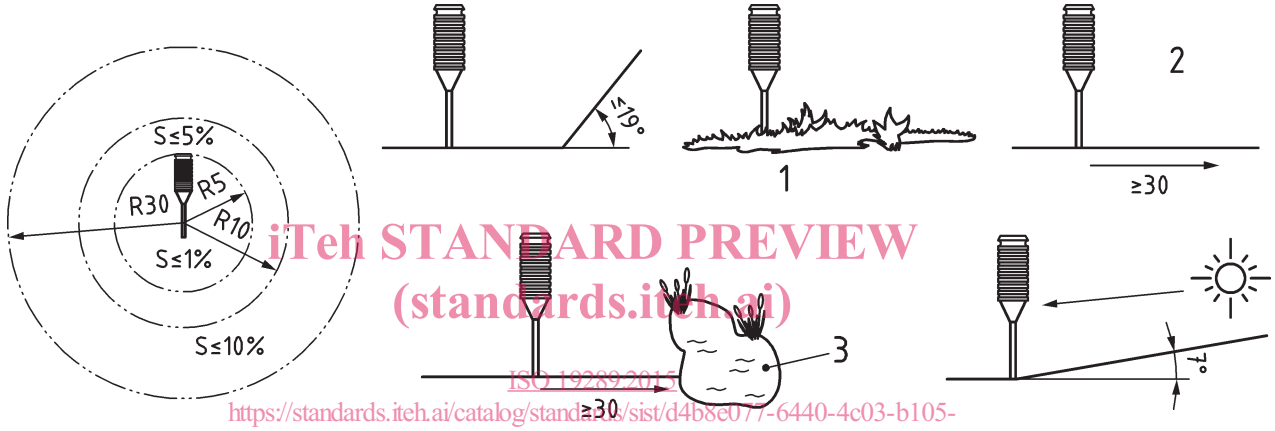
c) Measurement point situated

1) at more than 30 m from artificial heat sources or reflective surfaces (buildings, concrete surfaces, car parks, etc.),

2) at more than 30 m from an expanse of water (unless significant of the region), and

3) away from all projected shade when the sun is higher than 7°.

A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10 % of the surface within a radius of 30 m surrounding the screen, makes up 5 % of an annulus of 5 m to 10 m, or covers 1 % of a 5 m radius area.



Key

1 vegetation (<10 cm)
2 heat sources (building, car parks, concrete surface)
3 lake
S surface of heat sources

Figure 2 — Schematic showing criteria for air temperature and humidity for class 2 sites (numbers are given in metres unless otherwise indicated)

2.4 Class 3 (additional estimated uncertainty added by siting up to 1 °C)

a) Ground covered with natural and low vegetation (<25 cm) representative of the region;

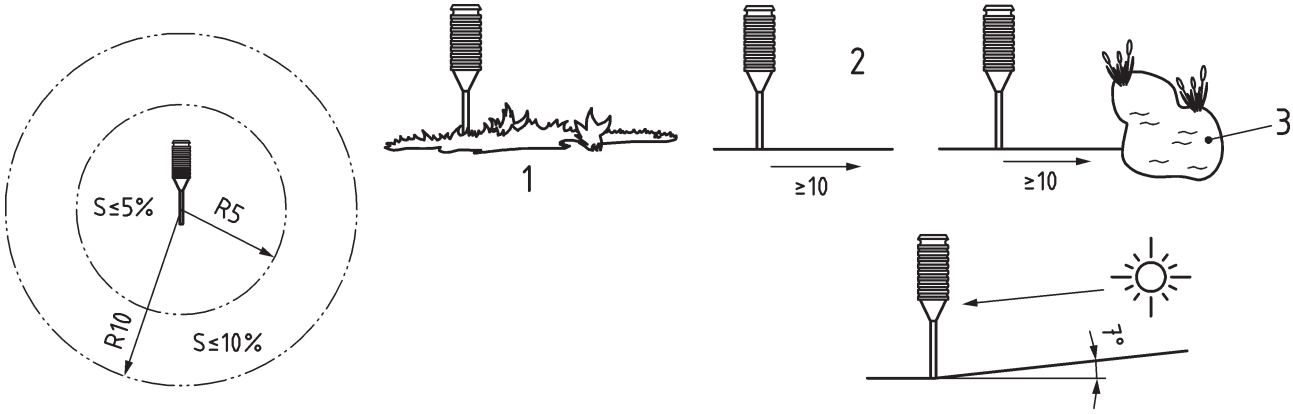
b) Measurement point situated

1) at more than 10 m from artificial heat sources and reflective surfaces (buildings, concrete surfaces, car parks, etc.),

2) at more than 10 m from an expanse of water (unless significant of the region), and

3) away from all projected shade when the sun is higher than 7°.

A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10 % of the surface within a radius of 10 m surrounding the screen or makes up 5 % of a 5 m radius.



Key

1 vegetation (<25 cm)
2 heat sources (building, car parks, concrete surface)
3 lake
S surface of heat sources

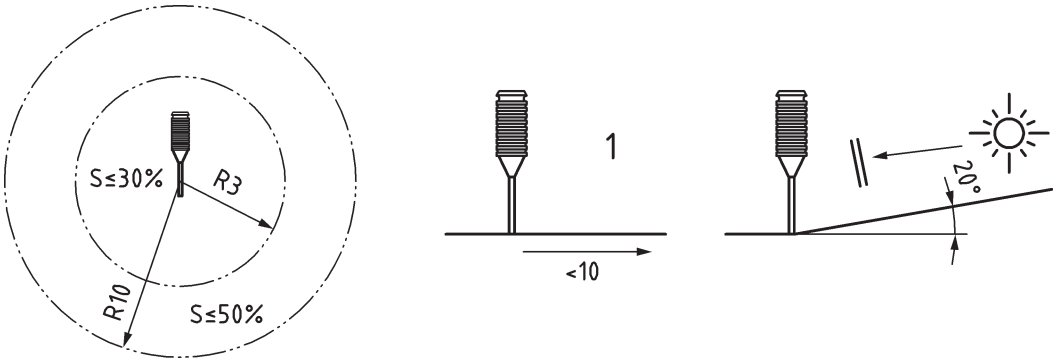
Figure 3 — Schematic showing criteria for air temperature and humidity for class 3 sites (numbers are given in metres unless otherwise indicated)

2.5 Class 4 (additional estimated uncertainty added by siting up to 2 °C)

a) Close, artificial heat sources, and reflective surfaces (buildings, concrete surfaces, car parks, etc.) or expanse of water (unless significant of the region) occupying

1) less than 50 % of the surface within a circular area of 10 m radius around the screen, and
2) less than 30 % of the surface within a circular area of 3 m radius around the screen.

b) Away from all projected shade when the sun is higher than 20°.



Key

1 heat sources (building, car parks, concrete surface)
S surface of heat sources

Figure 4 — Schematic showing criteria for air temperature and humidity for class 4 sites (numbers are given in metres unless otherwise indicated)

2.6 Class 5 (additional estimated uncertainty added by siting up to 5 °C)

Site not meeting the requirements of class 4.

3 Precipitation

3.1 General

Wind is the greatest source of disturbance in precipitation measurements due to the effect of the instrument on the airflow. Unless rain gauges are artificially protected against wind, for instance, by a wind shield, the best sites are often found in clearings within forests or orchards, among trees, in scrub or shrub forests, or where other objects act as an effective windbreak for winds from all directions. Ideal conditions for the installation are those where equipment is set up in an area surrounded uniformly by obstacles of uniform height. An obstacle is an object with an effective angular width of 10° or more.

The choice of such a site is not compatible with constraints in respect of the height of other measuring equipment. Such conditions are practically unrealistic. If obstacles are not uniform, they are prone to generate turbulence, which distorts measurements; this effect is more pronounced for solid precipitation. This is the reason why more realistic rules of elevation impose a certain distance from any obstacles. The orientation of such obstacles with respect to prevailing wind direction is deliberately not taken into account.

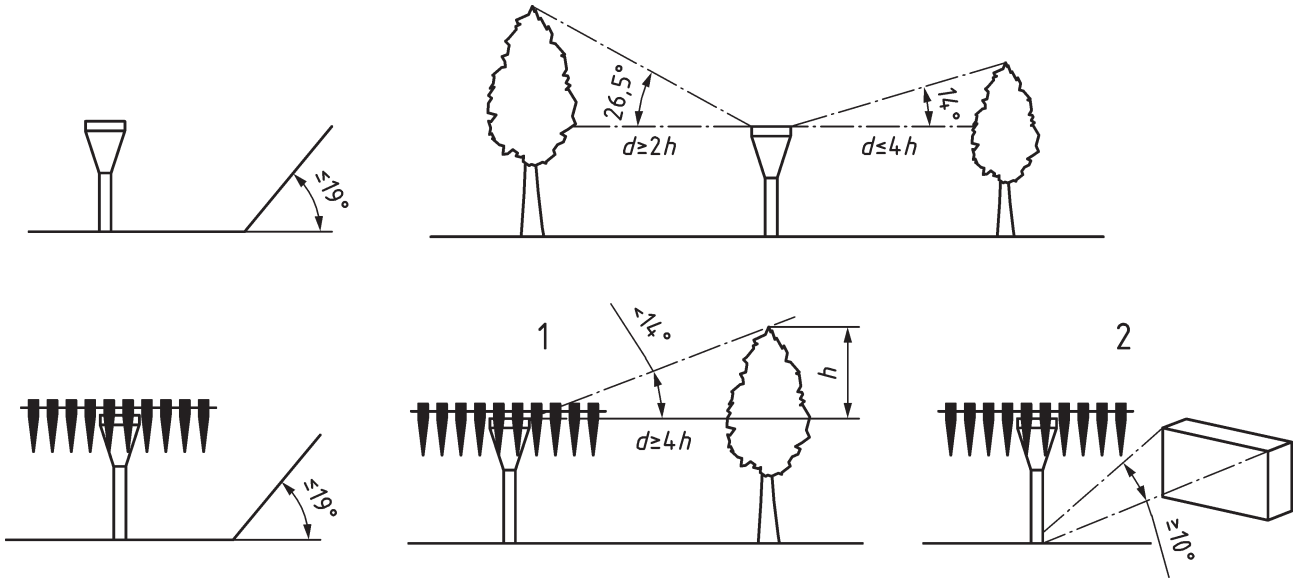
Indeed, heavy precipitation is often associated with convective factors, whereby the wind direction is not necessarily that of the prevailing wind. Obstacles are considered of uniform height if the ratio between the highest and lowest height is less than two.

Reference for the heights of obstacles is the catchment's height of the rain gauge.

3.2 Class 1

a) Flat, horizontal land, surrounded by an open area, slope less than 1/3 (19°). Rain gauge shall be surrounded by low obstacles of uniform height, that is, subtending elevation angles between 14° and 26° (obstacles at a distance between two to four times their height);

b) Flat, horizontal land, surrounded by an open area, slope less than 1/3 (19°). For a rain gauge artificially protected against wind, the instrument does not necessarily need to be protected by obstacles of uniform height. In this case, any other obstacles shall be situated at a distance of at least four times their height.



Key

1 site

2 obstacle

Figure 5 — Schematic showing criteria for precipitation for class 1 sites