SELECTIVE PARAMETRIC SPECIFICITY OF CLUJ-NAPOCA METEOROLOGICAL STATION ACCORDING TO ANNEX 1B OF WMO NO. 8 GUIDE

G.-S. TUDORACHE[1,2]

ABSTRACT – Selective parametric specificity of Cluj-Napoca meteorological station according to Annex 1B of WMO No. 8 Guide. Meteorological metadata are required to be used for all types of measurements. Metadata is information about when, where, how and by whom the meteorological data was measured. Detailed metadata are important to understand the characteristics and limits of measurements, especially for climatology. But detailed metadata, due to their complexity, can greatly reduce their operational use. In the usual practice, the measurement characteristics and limits of a sensor are taken into account at the expense of the environmental conditions in which the measurement of a meteorological parameter takes place. W.M.O., based on the Meteo-France`s proposals (M. Leroy, 1998), has defined a classification for some base surface variables to document the environment near a site. Site classification requires assigning a class number for each measured parameter, which varies from 1 to 5. By convention, a class 1 location complies with WMO regulations. In this paper, the classification criteria set out in Annex 1B of wmo Guide No. 8, are adapted and applied for Cluj-Napoca meteorological station. As a result of applying the classification for Cluj-Napoca Automatic Weather Station, a class number is assigned for the air temperature-humidity, precipitation and wind sensor. The application proposals for the site classification based on results can then be applied to the rest of the meteorological network taking into account the characteristics of the location of a meteorological platform.

Keywords: site classification, metadata, meteorological measurement, sensors

1. INTRODUCTION

When installing a meteorological station, site selection is a very important task, largely reflected in the quality of the data obtained and implicitly of the climate assessments carried out in the research activity. Internationally, the issue of the respresentativeness and quality of meteorological data is treated with maximum interest, trough the World Meteorological Organisation`s (W.M.O.) specialized committees. The main negative aspects are related to the appearance of high-rise buildings near the meteorological station, the sensor`s specifications and the experience of the personnel.

[1] Faculty of Geography, University of Bucharest, 1 Nicolae Bălcescu Blvd., Sector 1, 010041, Bucharest, Romania, e-mail: tudorache.george86@yahoo.com

[2] Romanian National Meteorological Administration, 97 Bucuresti-Ploiești St., Sector 1, 013686, Bucharest, Romania, e-mail: george.tudorache@meteoromania.ro

Since it is impossible to maintain a very dense meteorological network, knowing that the measurements are thus punctual, the quality of the data and their ability to express extensible values on large areas of territory is the essence and condition for the quality of studies and climatological research.

Understanting the mechanisms generating certain types of weather, the occurence and evolution of meteorological phenomenas, some of them with a high risk character, variation of the climate, climate change, can only be achieved by processing an important volume of quality data, ensures the elimination of any suspicions.

Theoretically these issues are regulated by *W.M.O. - Guide to Meteorological Instruments and Methods of Observation - Sixth edition - WMO-No. 8 – 1996 (WMO, 2008)*, which sets out the general conditions necessary for the normal operation of a meteorological station. It also regulates the way the instruments are exposed, this being a determining factor in the measurement of some meteorological elements. In order to maintain the representativeness and, implicitly, the quality of the meteorological data, the Commision for Observing Intruments and Methods recommends that periodic inspections of the meteorological stations are carried out regularly. Internationally, it is noted that both methodological norms and equipment vary from one country to another. Thus, meteorological data must be thoroughly analysed when comparing them. For short periods of 20 years, for example, an increase in the average air temperature may be due to replacement of the sensor, from a higher precision class, sensor errors, observer change, the evelation of some constructions near the meteorological station, but also a realt heating or trends. An increase in the average air temperature of 0.3 – 0.6 °C over the past 100 years can not be supported by climatologists unless the data used are rigorously accurate without any of the above mentioned errors.

Traditionally, instruments characteristics are taken into account more than the environment around the platform. Meteo-France proposes a classification of the obstacles in a 100 m area around the measuring point (M. Leroy, 1998). Based on this proposal W.M.O. establishes the criteria for the meteorological site classification. The site classification implies assignment of a class number between 1 and 5 (where 1 is the most appropriate) for each sensor. A class 5 site where nearby obstacles create an inadequate measurement environment meteorological and which is intended to be representative of a wide area (at least tens of km^2), is a location where measurements should be avoided.

For some classes, an estimate of possible associated errors or disturbances was indicated. This estimate results from bibliographic studies and/or from comparative tests. In this paper the classification criteria according to Annex 1B are adapted and applied in order to establish a class number according to the environment in which Cluj-Napoca meteorological station is installed. To apply the classification, simple but effective methods are developed based on W.M.O. criteria to avoid high costs and to shorten the execution time.

2. DATA AND METHODS

In order to obtain the classification of the Cluj-Napoca meteorological platform in accordance with W.M.O. Annex 1B regulations, it is necessary to identify the existing obstacles in the 100 m area around the Automatic Weather Station pole.

Thus, using Google satellite imagery, all obstacles have been mapped into the following main categories: buildings, high vegetation, small vegetation and asphalt/concrete surfaces (but in the case of Cluj-Napoca no significant asphalt/concrete surfaces were identified). As a suggestion, if there is a poor image clarity of Google images, orthofotoplan images can also be used (this is not the case here). Following the vectorising in a GIS software, a map results (Fig. 1) which will be the basis in obtaining the necessary information for the classification. As can be observed in Fig. 1 distances from the center of the meteorological platform to the existing obstacle are important and have been measured and noted, they will be part of the analysis criteria for certain meteorological parameters included in the classification.

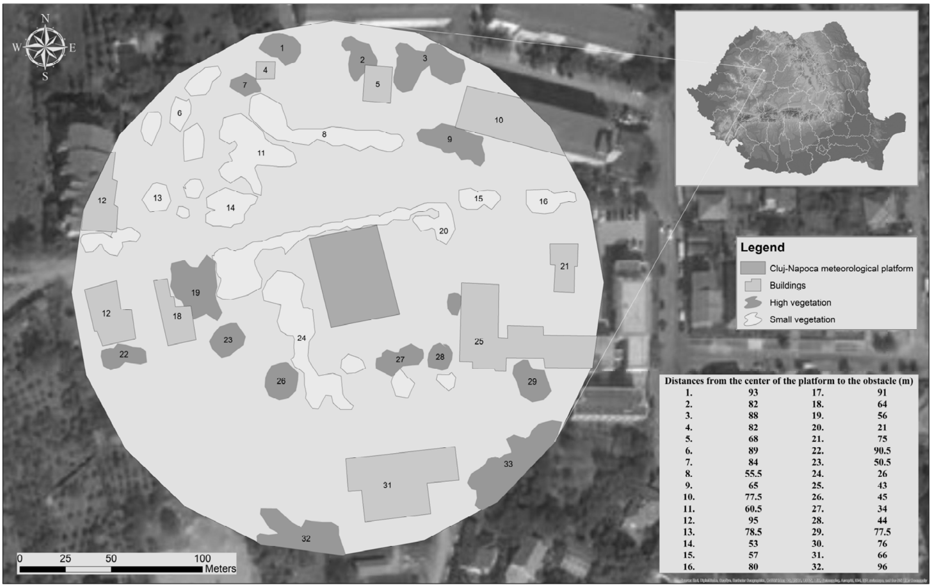


Fig. 1. ***The obtained image with the vectorized obstacles for Cluj-Napoca meteorological station using GIS software***

In Fig. 2 on-site images are presented with the sides of the Cluj-Napoca meteorological platform for exemplifying the horizontal visibility from the center of the platform. These images are documented and stored together with the classification charts done in accordance with the Annex 1B regulations.

Obstacle identification is necessary but not sufficient to analyze the classification of a meteorological parameter, additional information is essential to determine whether the obstacle infuses the measurements or can be ignored.

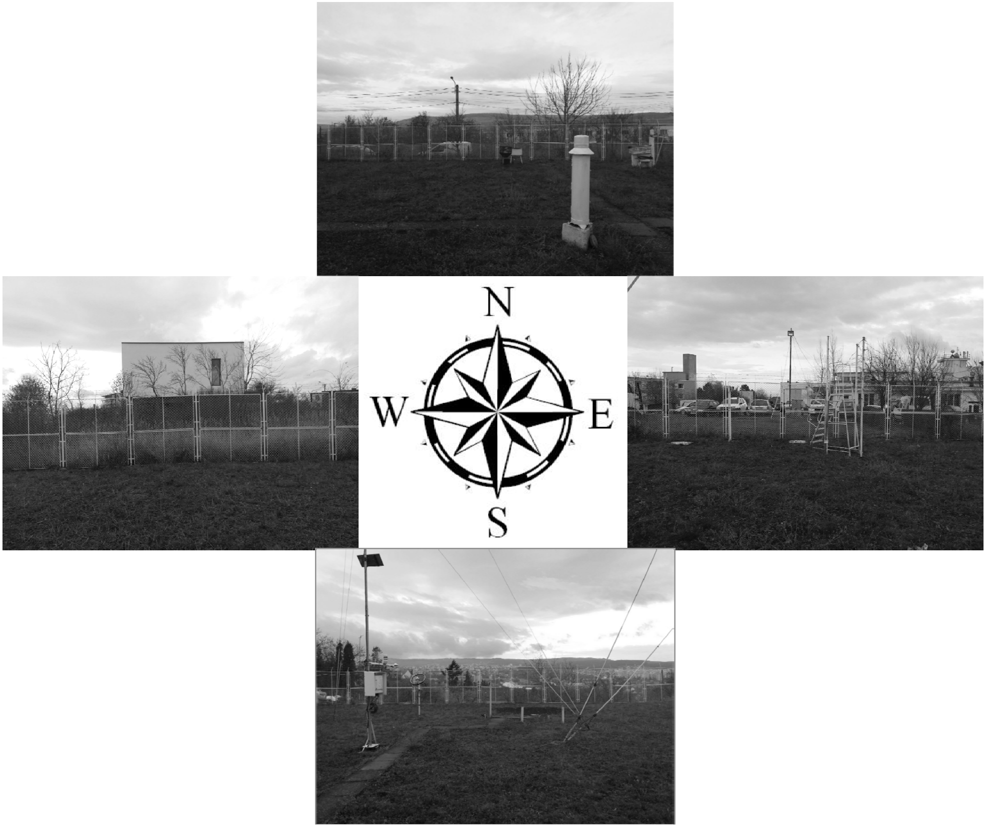


Fig. 2. ***On-site images of Cluj-Napoca meteorological platform sides (2017)***

In the second phase of the classification, after identifying the visible obstacles using satellite imagery, a table was compiled and filled on site with measured information about the nearby obstacles. The table contains columns regarding the obstacle height, length and width, the material from which the it is built/the type of the vegetation and other observation regarding the slope of the land, soil type, heat sources and asphalt or concrete surfaces (Tab. 1). Filling the table with the above mentioned information was done on site by measuring, assessing and documenting the materials from which the nearby obstacles are built of.

Table 1. ***Cluj-Napoca meteorological station – required information table resulted from obstacle vectorization and filled with the neccesary details***

Obstacole	**Obstacle height (m)**	**Obstacle leght (m)**	**Obstacle width**	**Material type**	**Observations**
4.	6/0	6.5	5.7	Brick	Beneath the platform
5.	7/1	12.7	9.6	AAC	Partial beneath the platform
10.	12/4	55	18	AAC	Partial beneath the platform
12.	6/6	13.5	11.5	Brick	Partial beneath the platform
18.	7/6	24	11	AAC	Partial beneath the platform
21.	6/5	18	9	AAC	Partial beneath the platform
25.	5/5	29	13	AAC	Partial beneath the platform
30.	3/3	6.5	3	AAC	Partial beneath the platform
31.	6/0	40	23	AAC	Beneath the platform
Vegetation	**Vegetation height (m)**	**Vegetation lenght (m)**	**Vegetation width (m)**	**Vegetati on type**	**Observations**
1.	5/0	10	6.5	Tree	Beneath the platform
2.	5/0	8.1	5.6	Tree	Beneath the platform
3.	6/0	6.5	5	Tree	Beneath the platform
6.	1/1	6	4	Bush	Beneath the platform
7.	5/4	5.8	5	Tree	Partial beneath the platform
8.	1/1	43	3	Tree	Partial beneath the platform
9.	5/5	7	4	Tree	Partial beneath the platform
11.	1/1	8	8	Tree	Partial beneath the platform
13.	1/1	3	3	Tree	Partial beneath the platform
14.	1/1	2	2	Tree	Partial beneath the platform
15.	1/1	3	3	Tree	Partial beneath the platform
16.	1/1	8	8	Tree	Partial beneath the platform
19.	5/5	8	8	Fir	
20.	1/1	37	2	Tree	
22.	4/3	4	4	Tree	Not seen from the platform
23.	5/4	9	9	Tree	
24.	1/1	40	4	Bush	They were partially cut (about 60%)
26.	3/3	8	8	Tree	
27.	5/4	6	3	Tree	
28.	5/4	6	6	Tree	The peaks are visible
29.	5/5	9	9	Tree	The peaks are visible
32.	4/0	10	10	Tree	Beneath the platform
33.	4/4	10	10		Beneath the platform
The angle (inclination) of the platform field			0º		-----------------------------
Soil type meteorological platform			Brown forest		
Surse de căldură			Distance to the meteorological platform		Type of heat source
Parcare			40 m		Concrete over which asphalt was poured

After completing the table with the identified obstacles in the first stage, knowing height, obstacle length and width, in order to have a better virtual view of the platform and obstacles, shapefiles are loaded into Google Earth and 3D images are generated (Fig. 3).

Images that can also be stored alongside other files and images that complement the classification of the meterological platform location.

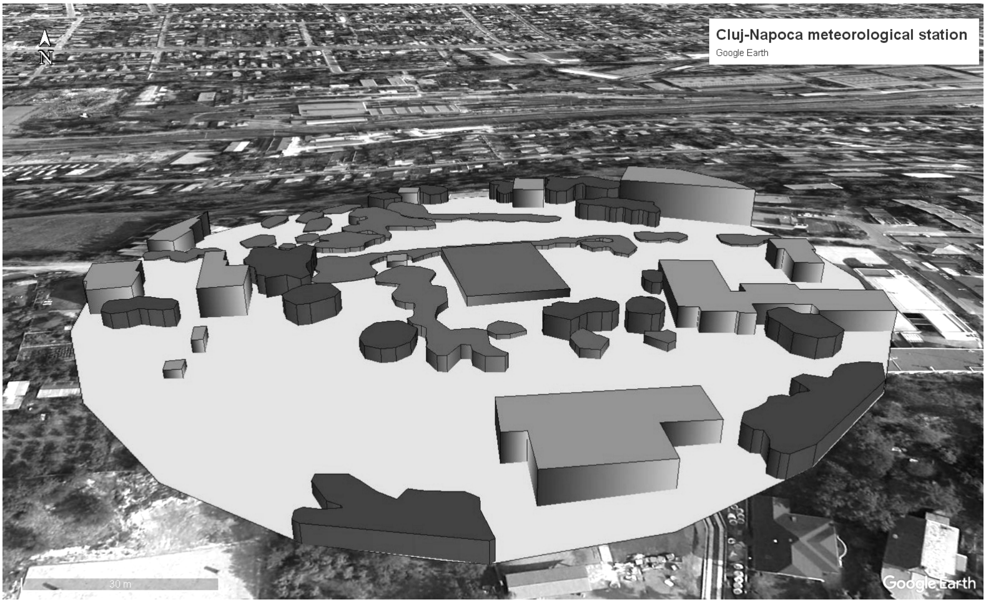


Fig. 3. ***The obstacle image with the vectorized obstacles for Cluj-Napoca meteorological station transposed in 3D using Google Earth***

The last step of the siting classification after obtaining all the information on the obstacles is to compile classification sheet for the station where class numbers are assigned for each meteorological parameter classified using Annex 1B regulations. These classification sheet represent a summary of the classes attributed to the meteorological parameters measured at the station, supported by the image with the vectorized obstacles and other special observations. The classification sheet can be stored in the metadata database and provide a quality flag for the meteorological data requested by the user.

3. OBJECTIVES AND RESULTS

The main objective of the classification is to inform the data user/beneficiary about the quality of the data by providing the necessary information about the measurement methods and conditions.

The metadata reconstruction process is important for ensuring the quality of the data string. Restoring the metadata is necessary and useful to meet the requirements of the INSPIRE Directive of the European Union (since May 2007), which includes the INSPIRE Metadata Regulation document. Siting classification is useful to document and analyze the impact of urban development on A.W.S.

locations. Within a national meteorological network, for all meteorological station will be compiled a classification sheet (Fig. 5).

To help the technician determine the classification of the meteorological parameters included in the site classification, synthesis files have been prepared that use in the background the calculation formulas and the criteria contained in Annex 1B (Fig. 4).

SINTEZA CLASIFICARII AMPLASAMENTULUI
PENTRU SENZORUL DE TEMPERATURA AERULUI

Data evaluării: 01/01/2017
Numele stației meteorologice: Cluj-Napoca
Indicativul O.M.M.: 15120
Coordonate geografice: Latitudine 46° 46'40"
Longitudine 23° 34'17"
Altitudine platformă meteorologică: 410,00 m
Numele tehnicianului: Tudorache George-Stelian

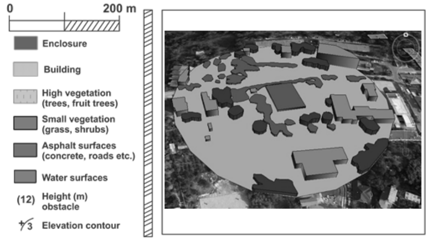
	Clasa 1	Clasa 2	Clasa 3	Clasa 4	Clasa 5	
T1) Acoperirea solului	Pe o rază de 10m vegetație <10cm	Pe o rază de 5m vegetație <15cm	Pe o rază de 5m vegetație <25cm	Vegetație <50cm	Vegetație >50cm	1
T2) Suprafața terenului/panta	Plată pe o raza de 10m Pantă <19°	Plată pe o rază de 5m, Pantă <19°	Plată pe o rază <5m, Pantă >19°	-	-	1
T3) Irigare in apropiere	La mai mult de 30m distanță	La mai mult de 10m distanță	La mai mult de 5m distanță	La mai puțin de 5m distanță	Lângă senzor	1
T4) Surse de căldură semnificative	La mai mult de 100m distanță	La mai mult de 30m distanță	La mai mult de 10m distanță	Mai puțin de 10 m distanță	-	2
T5) Infrastructura din apropiere	Subiectivă și la o distanță de 2:1 față de obiecte	Subiectivă și la o distanță de 2:1 față de obiecte	Subiectivă și la o distanță de 1:1 față de obiecte	Subiectivă	Afectează	1
T6) Avioane și/sau autostrăzi	La mai mult de 100m distanță	La mai mult de 50m distanță	La mai mult de 30m distanță	La mai puțin de 30m distanță	-	1
T7) Scut împotriva radiației sau carcasă	Da	-	-	-	Nu	1
T8) Inălțimea de instalare a sezorului față de sol	1.2m – 2.0m	1.2m – 2.5m	1.2 – 3.0m	1.0 – 3.5m	Peste limitele Clasei 4	1
T9) Grosimea maximă anticipată a stratului de zăpadă	La mai mult de 1m sub carcasă	La mai mult de 0.5m sub carcasă	Sub carcasă	Ventilația nu este obstrucționată	Ventilația ar putea fi obstrucționată	2
T10) Fară umbrire semnificativă	Orizont +5°. (umbrire la <10°)	Orizont +7°. (umbrire la <20°)	Orizont +10°. (umbrire la <30°)	Orizont +20°. (umbrire la <45°)	Peste limitele Clasei 4	1

Rezultatul clasificării amplasamentului platformei meteorologice pentru temperatura aerului: 1

Observații: Majoritatea obstacolelor sunt sub orizontul platformei meteorologice

Fig. 4. ***Printscreen of site classification synthesis file (in Romanian) for air temperature parameter for Cluj-Napoca meteorological station***

Station: **CLUJ-NAPOCA** Update: **01.01.2017**
Elevation: **410,00 m** Latitude: **46° 46' 40"** Longitude: **23° 34' 17"**



Radiation horizon

Temperature and humidity: Senzor height: **2,00 m**
Artificial ventilation? **NO**
Surface cover under screen: **Grass**
Soil under screen: **Brown forest**
Precipitation: Gauge rim height: **1,5 m**
Wind: Anenometer height: **10 m** Free-standing? **YES**
(if "no" above: building height - ,width - ,lenght - .
Terrain roughness: to N **1** ,to E **1** ,to S **1** ,to V **1** .
Remarks:

	Air temperature/humidity	Precipitations	Wind	Radiation
Class no.	1	1	2	

Fig. 5. ***Printscreen of site classification chart (in English) for Cluj-Napoca meteorological station according to Annex 1B – WMO No.8***

The classification sheet needs to be revised periodically at least 5 years, according to W.M.O. regulations. Due to the technological progress in building construction, the emergence of new big obstacles may occur within 1 year, so it is recommended that the changes in the surrounding environment of the platform to be analyzed annually at least visually.

In the case of Cluj-Napoca meteorological station following the application of the siting classification the temperature/humidity parameter received a class 1, the precipitation parameter received a class 2 and wind measurements received a class 2.

Classification methodology is in early stages trying to implement methods that are fast and efficient but not costly in order to compile the classification, this is the reason why for the radiation meteorological parameter, a class number could not be determined mainly due to the lack of a clear procedure.

4. CONCLUSIONS

The primary objective of the classification is to document the presence of the obstacles near the measuring site. By linking the measurements to their associated uncertaintly level, this classification can be used to define the maximum class assigned to a meteorological station so that it can be included in a particular network or used in a particular application.

The classifications main advantage is being simple and therefore easy to use. Unfortunately, siting classification as defined does not allow the measurements to be corrected. Correction methods remain possible but independent of the meteorological platform classification. There is a clear limitation, but this classification allows easy documentation of the "quality" of the meteorological network. The results of the classification are important and so are the methodology that resulted by applying different methods and intruments (software packages). In the end, the siting classification represents a "win-win" situation both for the meteorological network owner and for the data user.

In the case of the Cluj-Napoca meteorological platform, the parametric classification assigns a general class number of 1 (Fig. 4), meaning that the data measured at this location is in accordance with the W.M.O. regulations and the data user can apply the dataset in most of its studies or applications.

REFERENCES

1. Leroy, M., in WMO (1998), *Meteorological measurement representativity, nearby obstacles influence*, Papers Presented at the WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (TECO–1998), Instruments and Observing Methods Report No. 70, p. 51
2. Leroy, M., in: WMO (2010), *Sites Classification*, Papers Presented at the WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (TECO–2010), Instruments and Observing Methods Report No. 104
3. Raliță, I. (2005), *Criterii de reprezentativitate a platformelor stațiilor meteorologice*, ISBN-10 973-0-04655-7, ISBN-13 978-973-0-04655-7. București
4. Zahumensky, I., (2015), *Maintenance of Accurate Metadata for all Automatic Weather Station Installations*, CBS/OPAG-IGOS/ET AWS-3.
5. *** WMO (2008), *Guide to Meteorological Instruments and Methods of Observation,* WMO-No.8
6. *** WMO (2008), *Annex 1.B – Siting classifications for surface observing stations on land*, WMO-No.8, I.1-19
7. *** WMO (2001), *Automatic Weather Station MAWS 301*, User`s Guide - M10077en-A. Vaisala