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PARAMETRIC CLASSIFICATION OF IAȘI AND BOTOȘANI METEOROLOGICAL STATIONS SITES ACCORDING TO W.M.O. REGULATIONS

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Key words: site classification, metadata, meteorological platform, data quality

Abstract: Selecting a meteorological platform siting is established according to World Meteorological Organization (W.M.O.) regulations so that the measurements are done in optimal conditions, thus ensuring a high quality meteorological data. The environmental characteristics of a meteorological platform can sometimes generate measurement errors that exceed the automatic meteorological station (A.W.S.) sensors tolerances. Due to the urban development in the vicinity of the meteorological station the measurement conditions of a meteorological parameter may suffer adverse changes due to the emergence of large obstacles or heat sources. At the Technical Conference of W.M.O. regarding the Observing Instruments and Methods in 2013, meteorological platform classification criteria was established, regulated by Annex 1B of W.M.O. No. 8 Guide. The classification uses the detailed documentation of the obstacles in a 100 m around the A.W.S. and assigning a class number for each measured meteorological parameter. The classification has been established to help standardize the representativeness of a meteorological platform at a small scale. Among the results of the site classification include the user's knowledge of the conditions for measuring the meteorological parameters in the initial phase of the use or implementation of a data string. The site classification needs to be applied for all weather stations in Romania's national network and in this paper a proposal for the implementation method is presented for two meteorological stations located in Moldavia, Iași and Botoșani.

Introduction

Siting determination of a meteorological platform is established by W.M.O. regulations (WMO, 2007; WMO, 2008; WMO, 2001). The

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meteorological measurements need to be done by standardized conditions ensuring a high quality of the meteorological data (Raliță, 2005).

To ensure the quality of the data string the conditions in which the data was measured need to be known and noted, so that later if needed these metadata will help determine if the data can be used in studies or reasearches. Managing a complete metadata database helps maintain the quality of the data the user needs for his applications.

The environmental characteristics of a meteorological platform can sometimes generate measurement errors that exceed the automatic meteorological station (A.W.S.) sensors tolerances. Due to the anthropogenic development near the meteorological platform, the conditions for measuring a meteorological parameter may suffer adverse changes because the appearance of large obstacles or heat sources. Usually, a high importance is granted to the measuring instrument properties to the detriment of the environmental characteristics in which the measuring took place, influencing the quality of the data, especially when a meteorological platform is assumed to be representative for a large area (100 km^2-1000 km^2). Based on these aspects, at the Technical Conference of W.M.O. regarding the Observing Instruments and Methods in 2013, meteorological platform classification criteria was established, regulated by Annex 1B of W.M.O. No. 8 Guide (Zahumensky, 2015).

The classification uses the detailed documentation of the obstacles in a 100 m around the A.W.S. and assigning a class number for each measured meteorological parameter (M. Leroy, 2010). A class 1 meteorological platform cand be considered as reference, while a class 5 is a platform where obstacles create a inadequate environment for meteorological measurements, but can still be valuable for a specific application.

This paper presents the proposal for the implementation of the site classification for Botoșani and Iași meteorological stations. In the study are presented the proposed stages of the documentation of the obstacles in the 100 m^2 area near the Iaşi and Botoşani meteorological platforms using methods of satellite images vectorization, the transposition of the information related to these obstacles in 3D, the elaborateing a classification sheet and assigning a class number for every measured meteorological parameter (from 1 to 5) in accordance with WMO requirements of Annex 1B. The two meteorological stations were chosen on the criterion of importance in Romanian`s national network of meteorological stations, both of which are county stations within the Regional Meteorological Center of Moldova. Iaşi meteorological station is also a county and international meteorological station, being included in the Regional Basic Synoptic Network (RBSN) and the Regional Basic Climatological Network (RBCN). This proposal lacks the classification for the two meteorological stations of the radiation parameter, the implementation methodology being still under discussion. Thus, in the classification sheet class numbers will be assigned for temperature and humidity, atmospheric precipitation and wind parameters.

Siting classification of weather station is a WMO regulation and must be implemented by all Member States. In the documentation paper, only the criteria for class number assignment is presented, the implementation method is not covered. Thus, at national level, each Member State is free to use its own methods to apply the classification to its own network.

This paper proposes methods for documenting obstacles inexpensive (using free software packages) and providing a quick and accurate classification method.

1. Data and methods

The first stage of applying the classification of Iaşi and Botoşani meteorological platforms according to WMO criteria in Annex 1B of Guide No. 8 involves identifying and documenting obstacles around the pillar of the Automated Weather Station (AWS) over a 100 m radius.

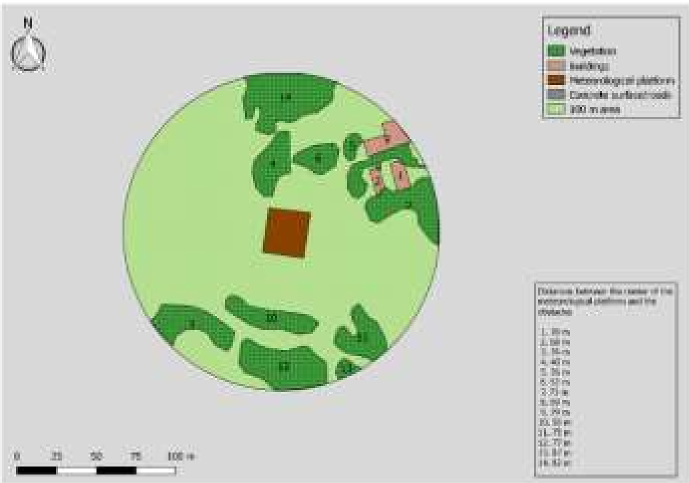


Fig. 1 – The obtained image with the vectorized obstacles for Botoșani meteorological station using Qgis software package

In order to achieve the implementation of the classification, as far as possible freeware methods have been used, from which good results have been obtained and a method of application of the classification has been attempted. In the case of the two meteorological stations the obstacles were identified and vectorized using the Qgis software package, (GIS - Geographic Information Systems), using as a "basemap" the Google Satellite maps (Figures 1 and 2).

Using this method, for each station, images were created showing the obstacles in the area, the type of obstacle (that could be determined) and the distance between the obstacle and A.W.S. pole (Fig. 1 and 2). This image can be saved and stored in the metadata database taking into account that the classification should be reviewed at a maximum period of 5 years.

Vectorizing and identifying obstacles using satellite imagery is inappropriate in order to be able to apply the criteria for assigning class numbers to measured parameters at a weather station. Thus, the next step proposed in the classification process is to draw up a table to be completed with the necessary details of the identified obstacles.

Thus, in the table the columns regarding the height of the obstacle, the length and width of the obstacle, the material from which it is made / the type of vegetation and other observations regarding the slope of the land, the type of soil, heat sources in the area and surfaces asphalt or concrete were completed.

Fig. 2 – The obtained image with the vectorized obstacles for Iași meteorological station using Qgis software package

Vectorizing and identifying obstacles using satellite imagery is inappropriate in order to be able to apply the criteria for assigning class numbers to measured parameters at a weather station. Thus, the next step proposed in the classification process is to draw up a table to be completed with the necessary details of the identified obstacles.

Tab. 1 - Iaşi meteorological station - table example completed with information necessary to achieve the classification of the site

Obstacole	**Obstacole height (m)**	**Obstacle length (m)**	**Obstacle width (m)**	**Material type**	**Observations**
1	11	13.5	10	Hebel	
2	6	6	4	Hebel	
3	6	6	4	Hebel+adobe	
4	8	6	5	Hebel+adobe	
5	5	5	4	Adobe	
6	6	6	4	Adobe	
8	4	2	2	Adobe	
9	6	6	4	Adobe	
10	8	8	5	Brick	
Vegetation	**Vegetation height (m)**	**Vegetation length (m)**	**Vegetation width (m)**	**Vegetation type**	**Observations**
23	14	30	20	Tree spruce	
24	20	12	5	Poplars	
25	13	8	6	Chestnuts tree	
26	15	8	3	Tree spruce (acacia, maple tree. poplar, walnut)	
27	14	13	13	Poplars spruce	
29	11	10	10	Tree spruce	
30	-	-	-	-	**Cut trees**
31	12	20	10	Trees (walnuts, poplars)	
32	15	13	10	Poplars	
33	17	13	10	Poplars	
34	-	-	-		**Cut trees**
The angle (inclination) of the platform surface			0^0		
Soil type of the meteorological platform			Sandy loam		
Heat sources					
48 Bitumen surface					
49 Concrete surface					

Thus, in the table the columns regarding the height of the obstacle, the length and width of the obstacle, the material from which it is made / the type of vegetation and other observations regarding the slope of the land, the type of soil, heat sources in the area and surfaces asphalt or concrete were completed.

Table 1 shows an example of a completed table for Iasi meteorological station, where the above mentioned information can be observed.

After obtaining the details regarding the obstacles in the first and second stage, for a better viewing of the meteorological platform siting, the obstacles are transposed in 3D using Google Earth freeware software. This method is not a must in the process of the siting classification, but sometimes can be useful especially in those situations where on-site movement is not possible, but it is necessary to analyze the influence of obstacles. Once the information is transposed in 3D, we obtain a view of the site from multiple angles and even a visual perspective from ground level (Fig. 3 and 4).

All the information collected, documented and analyzed for this classification should be stored in a historical metadata database since this classification should be analyzed at least 5 years. Thus, the user also benefits from a history of urban development, location changes, or other changes that occur, in addition to information about the environmental conditions in which the measurements were made.

The last step for siting classification after obtaining all the information on the obstacles is to compile classification sheets for the analised stations where class numbers were assigned for each meteorological parameter classified using Annex 1B regulations. These classification sheets 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.

2. Objectives and results

The main objective of the classification of the meteorological platforms is to ensure the quality of the meteorological data and to inform the user about the conditions in which it was measured. 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 AWS locations. Within a national meteorological network, for all meteorological station will be compiled a classification sheet (Figures 5 and 6).

Figure 5 shows a printscreen of Botosani meteorological station platform classification sheet. The Botoşani meteorological station is situated at an altitude of 161 m, with the geographical coordinates: 47° 44` 08`` latitude N and 26° 38` 44`` longitude E.

Fig. 3 – The obstacle image with the vectorized obstacles for Botoșani meteorological station transposed in 3D using Google Earth

Fig. 4 – The obstacle image with the vectorized obstacles for Iași meteorological station transposed in 3D using Google Earth

The temperature and humidity sensor is appropriately located at a height of 2 m and protected by a shelter. The meteorological platform is installed on a

Staţia meteorologică: Botoșani **Actualizată:** 01.01.2015

Altitudinea: 161,00 m **Latitudine:** 47° 44' 08" **Longitudine:** 26° 38' 44"

0 200 m

Platforma meteorologică

Clădiri

Vegetatie înaltă (copaci, pomi fructiferi)

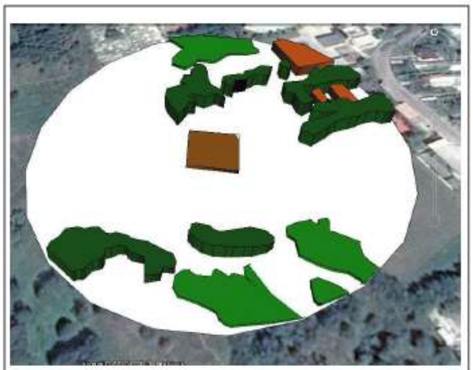
Vegetatie măruntă (ierboasă, arbuşti)

Suprafeţe de asfalt (beton, şosele etc.)

Suprafeţe apă

(12) Înălţimea (m) obstacolelor

Conturul altitudinii



Orizontul radiaţiei

Temperatura şi umiditatea: Înălţimea de instalarea a sezorului: 2,00 m

Ventilaţie artificială? NU

Acoperirea suprafeţei sub adăpost: Vegetaţie ierboasă

Tipul solului platformei meteorologice: Cernoziom

Precipitaţii: Înălţimea la gura pluviometrului: 1,5 m

Vânt: Înălţime traductorului/giruetei: 10 m Permanent? DA

(dacă "nu" deasupra: înălţimea clădirii ,lăţimea ,lungimea .

Clasa de rugozitate a terenului: catre N ,catre E ,catre S ,catre V .

Observaţii:

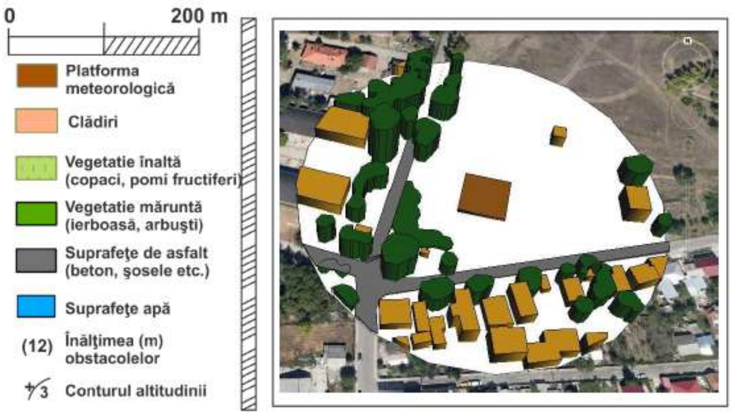
	Temperatura/umiditate	Precipitatii	Vânt	Radiaţie
Clasa	1	1	2	

Fig. 5 - Printscreen of Botoșani meteorological station site classification sheet according to Annex 1B, WMO No 8 (Romanian)

chernozem soil and covered with grassy vegetation. The wind is measured according to WMO requirements at 10 m and the height at the

Staţia meteorologică: Iasi **Actualizată:** 01.06.2014

Altitudinea: 74,29 m **Latitudine:** 47° 9' 48" **Longitudine:** 27° 37' 38"



Orizontul radiaţiei

Temperatura şi umiditatea: Înălţimea de instalarea a sezorului: 2,00 m

Ventilaţie artificială? NU

Acoperirea suprafeţei sub adăpost: Ierboasă

Tipul solului platformei meteorologice: Luto-nisipos

Precipitaţii: Înălţimea la gura pluviometrului: 1,40 m

Vânt: Înălţime traductorului/giruetei: 10 m Permanent? DA

(dacă "nu" deasupra: înălţimea clădirii ,lăţimea ,lungimea .

Clasa de rugozitate a terenului: catre N ,catre E ,catre S ,catre V .

Observaţii:

	Temperatura/umiditate	Precipitaţii	Vânt	Radiaţie
Clasa	1	1	2	

Fig. 6 – Printscreen of Iași meteorological station site classification sheet according to Annex 1B, WMO No 8 (Romanian)

mouth of the rain gauge is 1.5 m. Since these mandatory installation requirements are appropriate, from the analysis of the obstacles near the AWS`s pole and the application of the requirements set out in Annex 1B, results a class 1 for air temperature and humidity, class 1 for precipitation and a class 2 for wind measurements. In terms of radiation, a class number could not be established mainly due to the lack of an adaptation of the clear classification application procedures.

Iași meteorological station platform is installed at an altitude of 74,3 m, with the geographical coordinates: 47°09`48`` latitude N and 27°37`38`` longitude E. In the case of Iaşi meteorological station it should be mentioned that the meteorological platform has been moved in the past for representativeness reasons (29 June 2011 - the platform is relocated from 1 Airport St. to 30 Marginii St.).

Although in Figures 2 and 4 we can observe numerous obstacles around the platform and implicitly of the AWS, these obstacles are at an appropriate distance and do not exceed the tolerated heights according to the requirements of Annex 1B. This is another reason why the Iaşi meteorological station was chosen in this paper, to prove that although the obstacles in the area are numerous, this does not mean that it influences or prevents the measurements. After applying the classification, the weather station location receives a class 1 for air temperature and humidity, a class 1 for precipitation and a class 2 for wind measurements (due to the high vegetation in the area - generally poplars).

Conclusions

Site classification is intended to be a simple and easy to apply method, but differences in the conditions of a country may prevent the application of the criteria requiring adaptation of the application methodology. Unfortunately, the site classification as defined does not allow the measurement to be corrected. Correction methods remain possible but independent of platform classification. There is a clear limitation, but this classification allows easy documentation of the "quality" of the meteorological network. Another advantage is that it also represents a didactic approach for both network designers, funders and end-users.

Site Classification in accordance with Annex 1B of the WMO Guide No. 8 presents advantages for the direct user of the measured data by assigning a class number that reveals to the user in the initial phase if the data are appropriate for application in the study, the climatological analysis or in his application. Site classification can also be a tool for the owner of the meteorological station network to establish the condition of the network. As the classification is applied for each parameter, if the conditions for representativeness for one of the measured weather parameters are not met, obstacle removal measures may be applied and, if this is not possible, it should be taken in account platform relocation. Classification of the site can also be used in the start-up phase of a platform installation so that the future layout can be assessed if it complies with WMO regulations in vigy.

Botoşani and Iaşi meteorological stations received large class numbers, and therefore for the next 5 years, for temperature, humidity, precipitation and wind parameters, no obstacle removal or correction of measured data is necessary. Iași meteorological station was chosen because the meteorological platform was relocated prior to the publication of the criteria for site classification in Annex 1B. The result of the classification reveals that the chosen location was correct and appropriate according to the international standards of representativeness.

The current classification proposal will be applied and further adapted for all 158 national meteorological stations and the network condition will be presented in future studies. Implementation methods require improvements, adaptations and discussions, but bearing in mind that ease of implementation and minimization of enforcement costs should be maintained as much as possible.

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