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CHANGES OF HISTORICAL METADATA REFLECTED IN THE WIND PARAMETERS AT IAȘI METEOROLOGICAL STATION

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Abstract. The metadata are defined as the informations behind the data. The purpose of the metadata in meteorological activity is to represent where, when, how and by whom meteorological data has been obtained, colected and recorded. Ideally, a comprehensive metadata base should contain records of all changes that have occured throughout the entire period in which the meteorological station has functioned, the so called „station history". This paper renders the preliminary results of the analysed wind parameter values (percentages of wind calm and wind frequency) for the time period between 1961 and 2015 at Iași meteorological station. The data were analysed based on various historical metadata information (e.g. the emergence of new construction(s) around the station, relocation of the station, changes in the equipment used to measure the wind etc.), information that may influence the wind parameters measured at Iași weather station.

Introduction

The purpose of the metadata in meteorological activity is to represent where, when, how and by whom one meteorological data has been obtained, colected and noted. Internationally, the methodology for handling metadata is regulated by guides published under the auspices of the World Meteorological Organization: *Guidance on Metadata and Homogeneization* (Aguilar E. et al. 2003), *Guide to meteorological instruments and methods of observation* (W.M.O. 1983) and *Maintenance of Accurate Metadata for all Automatic Weather Station Installations* (Zahumensky, I 2004).

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Regarding climatological studies, the certainty that the variations identified in the time series is exclusively due to intrinsic variations and changes of the

climate taking into account the station history, achieving a high level of confidence in the statistical processing of meteorological data.

The lack of homogeneity of data can be prevented to a great extent by applying specific control procedures using metadata. The study of wind characteristics is of very high importance especially in the light of violent manifestations it can trigger: blizzards (Ciurlau, D. and Ionac N. 2013, Costache R. and Fontanine I. 2013, Ciurlau D. and Sasu M. 2015, Ciurlau D. 2016) and even tornadoes (Oprea I. C. and Bell A. 2009, Rauhala, J. and Schultz D. M. 2009). For this reason wind characteristics, like direction and frequency, is a issue tackled in many paper in the specialty literature (Smedman-Högström A. S. and Högström U. 1978, Jaramillo O. A. and Borja M. A. 2004, Rajabi M. R. and Modarres, R. 2008).

The description of Iași meteorological station

Iaşi is the county capital and the main urban center in Northeast Romania. According to the census of 2011, Iași city had a population of 263.410 inhabitants and thus was the fourth largest city in Romania. Iaşi is the cultural, economic and academical center of Moldavia. Over 60,000 students enroll in universities in the city. Here there was founded and operates the first university in Romania, "Alexandru Ioan Cuza" University, representing one of the most prestigious academic institutions in the country.

The meteorological platform of Iași meteorological station is currently located at 30 Marginii St., Iasi, at an altitude of 74 meters, at the geographical coordinates: 47° 09' 48" norh latitude and 27° 37' 38" east longitude.

Iași meteorological station is currently using a Vaisala Automated Weather Station for measuring meteorological parameters. Iași meteorological station is a plain station and the meteorological platform is oriented on the north-east direction, at 65 m away from the station building, in line with the World Meteorological Organization standard sizing of 26 x 26 m.

Changes of Iași meteorological station locations

The first meteorological observations made ati Iasi station were made by Ghe. Asachi in 1839 and were regularly published starting with January 1839 in *Albina Românească* newspaper. Other observations, but this time systematically collected, will be made and published by the scientist Petru Poni between 1877 and 1882.November and December 1877 observations were published in Volume 8 of the journal led by P.S. Aurelian and Grigore Ștefănescu. In 1938, at Iași Airfield, is founded a station with a synoptic character serviced by the aviation fleet staff, which operates in parallel with the one from the Boarding High School (now C. Negruzzi High School, 4 Toma Cozma St.) till March 1944. Since November 1944 the observations have been resumed in the building next to the National Theatre

(16 Mai 9 St.), the platform beein located in the yard of No. 4 Army Corps. On July 15, 1951 the meteorological station is moved again on Iași Airfield (now 1 Aeroportului St.) where operated until June 23, 2011, with synoptic, climatological and aerological activities. Since June 23, 2011 Iași meteorological station is relocated to 30 Marginii St.. The last two site location are taken into consideration beeing included in the analyzed 1961-2015 period (Fig. 1). Analyzing the atmospheric calm values, by comparing them with the known metadata regarding the two periods in which Iași meteorological station functioned in different locations, have not resulted in changes. Relocation of the meteorological platform had no influence on the atmosferic calm regime, the only influences observed came form the changes of the wind measuring equipment.

Fig. 1 – Changes of Iași meteorological station locations (Google Earth)

Meteorological equipment history for wind measurements at Iași meteorological station

For wind measurements, Iași meteorological station, since its establishment until the installation of the Automatic Weather Station used the following classic equipment types: light plate and heavy plate wind vane, WILD type and an anemograph recording device. Since June 29, 2000 the Automatic Weather Station

is installed and the wind is measured using a ultrasonic sensor, WS425 model, produced by Vaisala.

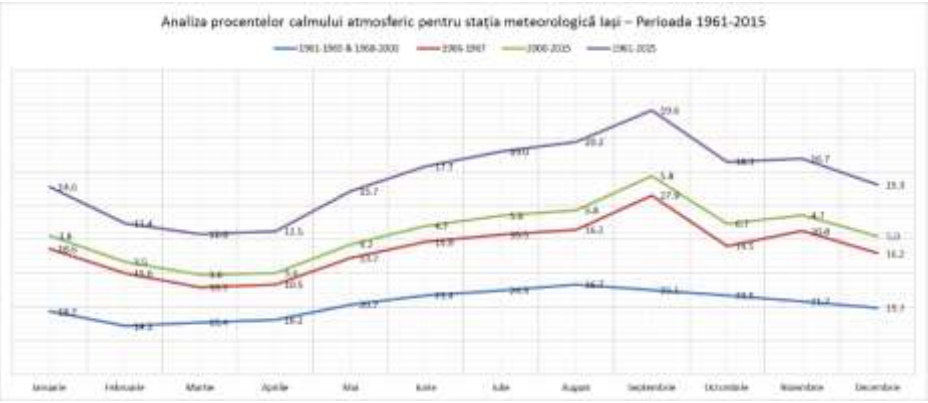
1. Case study

1.1. The influence of equipment changes on atmospheric calm at Iași meteorological station. In this paper, at Iași meteorological station, the atmospheric calm

percentages were analyzed during the 1961-2015 period by dividing this period into three distinct intervals, according to the equipment used to measure wind speed:

- In the 1961-1965 and 1968-2000 periods, when the light plate and heavy plate wind vane, WILD type were used;
- 1966-1967 period, when the anemograph recording device was used;
- 2000-2015 represents the period when the wind is measured using an ultrasonic wind sensor (WS425- Vaisala).

Opposed to the wind vane, the anemograph is a tool with a greater precision in measuring wind speed, as shown in Fig. 2, so that the multiannual means values recorded during the period when the anemograph was used were visibly below the multiannual means values of the period in which the wind vane was used.



Data source: A.N.M., 2015

Fig. 2 – The chart for the analysis of the atmospheric calm at Iași meteorological station

Analyzing the atmospheric calm regime for Iași meteorological station (Fig. 2) can be concluded that the multiannual atmospheric calm values for the wind sensor are well below the multiannual mean of the 1961-2015 period (with differences ranging between 9.1% and 16.4%).

Recorded high values can be observed during the 1961-1965 and 1968-2000 periods (the highest value being 26.7% and the lowest of 14.3%) compared to the 2 years period (1966-1967), when at the meteorological wind speed measurements were performed using the anemograph (the highest value being 27.9% and the lowest 10.5%).

The percentages values recorded during the period in which the Automated Weather Station functioned (2000-2015), have the highest value of 5.8%.

Large differences between the multiannual means occur due to the measurements systems used during the historical periods. The main tool used for measuring wind over a long period (aproximately 39 years) was the wind vane, which has a relatively low accuracy for assessing wind speed. The ultrasonic wind sensor used at Iași meteorological station is a quick response device that measures wind speed with a range of 0.0 to 65.0 m/s.

1.2. The influence of location and/or equipment changes on the wind direction frequency regime at Iași meteorological station. The 1961-2015 period was dedided into three intervals in which changes have occurred that could have an influence on the wind direction. Thus, 1961-2000 is the period in which the wind measurement were performed classically and NW was the predominant direction with values ranging between 27.17% (July – Fig. 3) and 19.73 (September – Fig. 4).

The period between 2000 and 2011 is the period in which wind measurements were performed using a ultrasonic wind sensor, where can be observed that the predominant wind direction changed from NW to W, change mainly due to the increased precision of measuring wind, with values ranging between 28.95% (July - Fig. 3) and 20.40% (May – Fig. 5).

2011-2015 is the period preceding the change of the meteorlogical station location but without any major changes to its geographical location, the only difference between the old and the new position, the altitude of the station has changed from 102 m to 75 m. During this period, the predominant direction in most months remained W, according to the analyzed previous period.

In conclusion, after the analysis of wind direction frequency distribution for Iași meteorological station during the 1961-2015 period, can be observed a major change in wind direction from NW to W and the difference between the precision of a classic equipment (wind vane) and a recoding equipment (anemograph and Automatic Weather Station).

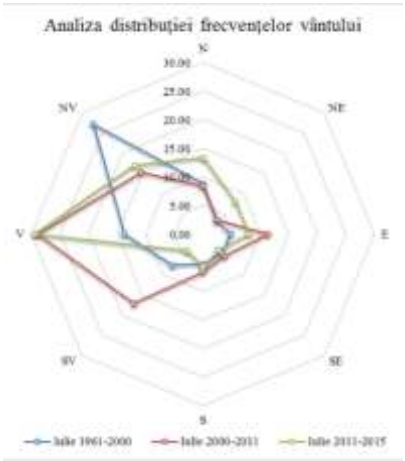


Fig. 3 – The analysis of wind direction frequency distribution - July

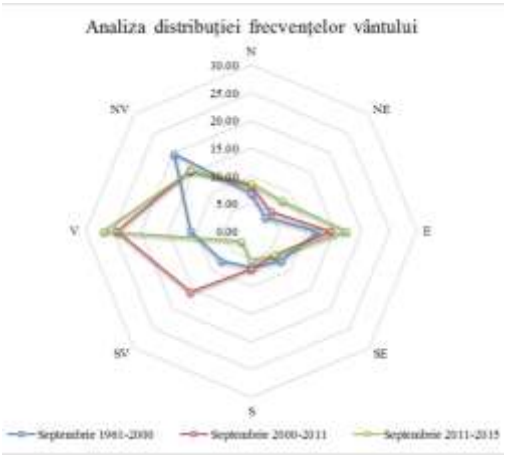


Fig. 4 – The analysis of wind direction frequency distribution - September

Data source: A.N.M., 2015

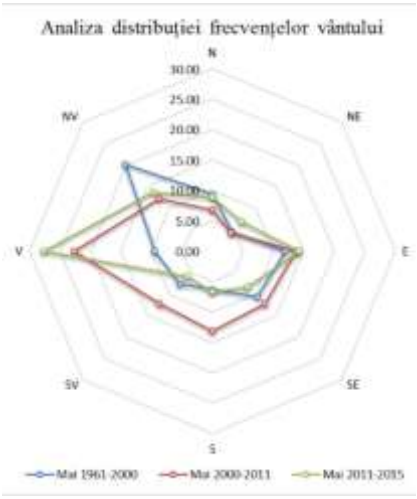


Fig. 5 – The analysis of wind direction frequency distribution – May (Data source: A.N.M., 2015)

Conclusions

The main conclusion of the presented study, on the frequency of atmospheric calm and the wind direction distribution, is that technology evolves and with it the equipement and instruments pecision. The changes can be considered to be

significant and as a result obtained in this study, especially for the wind parameter, the data requires to apply homogenization methods taking into account human and equipment errors. After analyzing the wind direction distribution for Iași meteorological station, the situation can be summarized as follows:

- 2011-2015 is the period preceeding the change of the meteorological platform location but without any major changes to its geographical location, the only difference between the old and the new position is the atitude of the station which changes from 102 m to 75 m. During this period the main direction was W in most months;
- During the 1961-2015 period, can be observed a major change in wind direction from NW to W and the difference between the precision of a classical instrument (wind vane) and a recording device (anemograph, Automatic Weather Station);
- The transition from classic wind measurements using a wind vane to using an ultrasonic wind sensor, can be observed a sharp decrease in atmospheric calm precentages;

Thedecrease in athmospheric calm values caused by using the Automated Weather Station leads to a redistribution of the wind direction frequencies.

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