Comparison between the data collected from AWOS and that collected from manual observing instruments

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1-INTRODUCTION

IT was noticed since we started in automating of our observations and, our surface observing systems in Egypt, that there were some differences between the values of weather parameters that collected from accurate and calibrated automatic observing sensors and that were collected from accurate and calibrated manual observing instruments.

Also It was noticed that with regarding to these observations, that there are limitations in the quality and quantity of data made by human observers. The main cause of this is the lack of definitions for the variables required. Although some definitions and thresholds for parameters are available at national levels, it is almost impossible for them to be applied objectively due to the limitations in, the performance of both the instruments and sensors.

The WMO alphanumeric codes currently in use also do not make provision of all measurements presently already available. This lead to the conclusion that several of the "present weather" observations could not be performed neither in a qualitative nor quantitative manner and, therefore, not be made available as reliable data sets.

It was agreed by the working group of the Egyptian meteorological authority that users' needs have to be reviewed in the light of present and future requirements and precise definitions have to be developed for the variables/parameters required.

The ultimate aim should be to define these parameters, as much as possible, in a quantitative manner, which would significantly facilitate the automation of observations.

2-Background

During the last ten years Egypt has deployed about 23 surface automatic observing stations and put them operationally in the assigned different locations to measure and determine surface observations beside the traditionally manual observing stations

-7 of these AWOS were operated for the purpose of aviation
-2 of these AWOS were operated for the purpose of agro meteorology
-14 of these AWOS were operated for the purpose of synoptic application.

During operating of these automatic observing stations some problems arises. The most important one that faced us was that reported differences between the Variables values that collected from these automatic observing stations and that values collected from traditionally manual observing instruments.

A workgroup was established from the department of instruments in our service to watch the performance of these automatic observing stations. All regarded sensors and instruments were calibrated to minimize the differences in variables values.

The workgroup started to apply a quality control system and examined the data at both of the stations and at the main data center in our service to detect errors so that data may be either corrected or approved.

The applied quality control included procedures for returning to the source of data to verify them and to prevent recurrence of errors.

We have applied this quality control at real time at both of the stations and the main data center.

Also this quality control was performed at near real time and at non real time at the main data center of our service to examine the performance of the observing system and to prescribe changes that may happened to the equipments.

Also to get the best of our study we have established two work teems of our workgroup , one for the regular maintenance and calibrations procedures and one for the monitoring of the data to get rapid response to failure reports from Monitoring system .

Our real time quality control included checks for each of the following:-

a- completeness of observations at the stations
b- completeness and timeliness of the collections of observations at data center.
c- quality of data

As a result of these above mentioned procedures we have collected different statistics on observational error of individual variables and we have generated hourly , daily, and monthly summaries for each of the following :

a- total number of observations scheduled for each variable
b- total number of observations that failed the quality control check
c- the percentage of failed observations
d- error and threshold values for each failed observation
e- check on both maximum and minimum variability of an instantaneous values

We have succeeded by applying these procedures to minimize the differences between the data of the automatic observing stations and that of manual observing instruments to the lowest values which meet with our requirements in the light of the observing regulations

3-Instrumental aspects

The working group that established in the Egyptian meteorological authority to watch the performance of these automatic sensors and equipment’s presently available for measuring or determination of "present weather" and which are currently in operation in the various Services discussed their advantages and limitations compared with human observers.

It was found that single and multi-sensor solutions and the application of various combinations of sensors already meet a great range of data according to users' needs, as well as they could be determined presently.

The development of new and the improvement of existing automatic sensors and algorithms should be reconsidered to make the values of data collected from these automatic observing systems becomes as same as the values of data that collected from manual observing instruments

4-Procedures and algorithms

It was noticed that the procedures and algorithms used for the determination of "present weather" are crucial for the data generated. Several algorithms for single or multi-sensor solutions are already in application, although they still have limitations.

Some of our working group in the Egyptian meteorological authority presented details of algorithms developed in our service to correct some reports or to overcome deficiencies in the ability of instruments to report certain phenomena, mainly related to "present weather" observations.

It was generally accepted that these were valuable additions to the process of making a representative observation. However, we recognized that these procedures have been developed, in many cases, from climatological records specific to the region in which they are being applied.

They may therefore not be applicable without modification in other climatic regions. Although they may only be pertinent to specific instruments or combinations of instruments, a continued development of these algorithms could make them applicable for more general use in the future.

So it is needed that:

- The development and use of such algorithms must be encouraged;
- Members should always record details of the algorithms adopted;
- Members should make details on algorithms available to data archivists and researchers;
- Data archives should record original as well as amended (reported) data.

5-Present deficiencies

It is well known generally that an AWOS cannot report "present weather" or, more general, visual observations, in a manner as it is done by a human observer nor should an AWOS be expected to do so since an AWOS observes and reports weather differently. It was noted that AWOS provide consistent information while human observers characteristically show significant subjectivity, uncertainty, and variation especially when the parameters to be observed are not well defined.

As already stated above, it was found that in many cases no clear and agreed to definitions of "present weather", visual, or subjective observations exist so far. Even more significant, there is presently no clear statement available on the actual and future requirements of data users. In considering this unfortunate situation and noting that many of the "present be significantly reviewed in the light of present and future needs.

So individual sensors, multi-sensor systems, combination of available information or measurements, and sophisticated algorithms are already available or can be developed if there is a need for observing relevant parameters.

As already stated above, the automation of visual and subjective observations has to be reconsidered within the light that automated systems perform differently from human observers (i.e. it has to be based on a more objective and well defined basis). If this can be done, widely homogeneous observations can be achieved.

6-USED TECHNOLOGIES FOR THE AUTOMATION OF METEOROLOGICAL OBSERVATIONS

According to the common understanding of all of us, visual or subjective observations were more urgently needed in the past than nowadays (or even in future) due to the previously insufficient or generally missing measurements of various variables in the atmosphere.

That is to say, the subjective observations were in several cases used as indirect means for characterizing the status of the atmosphere, especially for forecasting purposes (such as the type, coverage, and height of clouds).

In addition, quantitative measurements were not sufficiently available or generally not yet possible at this earlier stage so that qualitative information had to be provided instead.

These mainly subjective observations were, especially if they were not well defined, very unreliable and subjective (such as the characterization of precipitation as "drizzle", "slight", "moderate", and "heavy").

7-Sensors and algorithms

It is understood that improvements of presently available automatic observing systems are ongoing and there are some individual sensors, multi-sensor systems, and sophisticated algorithms already available, in testing, or in development which may widely meet future needs. However, before further efforts will be undertaken in this regard, the future requirements have to be defined clearly.

8-Use of the composite observing systems

We have all noticed the progress made in recent times on measuring and observing meteorological variables by the application of direct and remote surface and space based techniques. It further noticed that the various types of instruments and equipment applied for these observations are already operated in automatic networks either on national or regional levels.

We have all recognized the significant work on examining approaches and benefits of composite observing methodologies which is being carried out in NAOS (North American Observing System) and within EUMETNET (Europe).

This approach enables the possibility that data obtained from different sources can be combined with the objective of achieving more complete and objective information on the status of the atmosphere.

9-APPLICATION OF WMO CODES FOR TRANSMISSION OF "PRESENT WEATHER" DATA

With reference to the assessment on the possible application of the presently available WMO codes for transmission of automatically generated visual and "present weather" observations, it can be reiterated that the operational use of alphanumeric codes SYNOP, METAR, SPECI, and 4680 "wawa" significantly restricts, or does not allow, the complete distribution of all available information to users.

Having in mind that a general amendment or supplement of these codes is a long-lasting process before it can be introduced world-wide and will, in any case, not be capable of meeting all users' needs, it is needed to develop and propose minor amendments for these codes in order to deal with the most immediate requirements.

It is possible to fulfill all present and yet to be determined future requirements, especially regarding the application of AWOS, through the application of BUFR and CREX, which allow, by nature of their flexibility, the ability to adapt to future needs.

The global introduction of BUFR / CREX will be a long process due to several issues in their application, namely:

- limitations in the capacity of telecommunication channels needed for data transmission,
- required software development, and
- due to the fact that most of various AWOS (which are in operation or are planned to be deployed in the next few years both within and outside NMHSs) cannot yet cope with these codes.

This calls for the development and introduction of an interim solution based on the currently available alphanumeric codes.