

Technology of the provision of aviation with radar meteorological information using BUFR code

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Abstract. The WMO and ICAO provide for the migration to the FM-94 BUFR code for radar data exchange. In this paper results of a pilot project are presented on the adjustment of a new technology of collecting and transferring data that has been carried out since April 2003 in Russia, Ukraine and Byelorussia. At present, in exchanging with radar data using BUFR code, eight meteorological radars MRL-5 participate equipped with the “MeteoCell” Radar Control and Display Workstation. The configuration of the meteorological radar system is presented in Fig. 1. Five of them are located in Russia (the Northern Caucasus region), two of them are in Ukraine and one – in Byelorussia. Each of the radar transmits the following standard set of 13 obligatory products, meeting the requirements of aviation as the main user:

- meteorological phenomena and types of cloudiness;
- radioecho top level;
- 11 CAPPIs in the layer from 0 to 11 km with a step of 1 km.

A radar product is sent in the matrix (100×100) form. Values of the matrix element are related to the center of the cell with a size of 4×4 sq. km. The time resolution of the radar products is 10 min, and that of the composite maps is 30 min.

For radar data exchange, the channels of the Global Telecommunications System (GTS) are used. The routing of messages is performed in the GTS nodes. Each radar product is transmitted as a separate message in BUFR code. For radar data given in BUFR code, the indices of data are given in the form of IPRNii, where ii is the radar product code. Each of the radar has a unique four-letter identifier for forming the shortened headline of WMO GTS. The construction of composite maps is accomplished at a user workstation. The customer can choose the necessary set of products from those radars that are of interest. The use of GTS communication channels for data transferring also allows us to get the

whole volume of necessary meteorological information at a workstation from regional and world centers for its complex analysis.

The main problem of the realization of such technology is the absence of a code table in the BUFR code for meteorological phenomena and cloud types derived from radar data. In this connection, for the regional exchange Table B of BUFR code class 21 was complemented with a new descriptor 0 21 022 and with a corresponding code table. The code table contains 32 values (no data, no radar echo, and three gradations of cloudiness form without precipitation, continuous precipitation, shower-type precipitation, thunderstorms, hail, and squall).

The verification of this new technology within the framework of the pilot project has shown that its main advantage is a significant extension of the number of potential users of radar information, the reduction of the costs on its delivery, and the data unification of radar systems produced by various providers.

1 Introduction

The WMO and ICAO provide for the migration to the FM-94 BUFR code for radar data exchange. In this paper results of pilot project are presented on the adjustment of a new technology of collecting and transferring data that has been carried out since April 2003 in Russia, Ukraine and Byelorussia.

2 Configuration of radar network of the pilot project

At present, in exchanging with radar data using BUFR code, eight meteorological radars MRL-5 participate equipped with the “MeteoCell” Radar Control and Display Workstation. Five of them are located in Russia (the Northern Caucasus region), two of them are in Ukraine and one – in Byelorussia. Each of the radar transmits the following

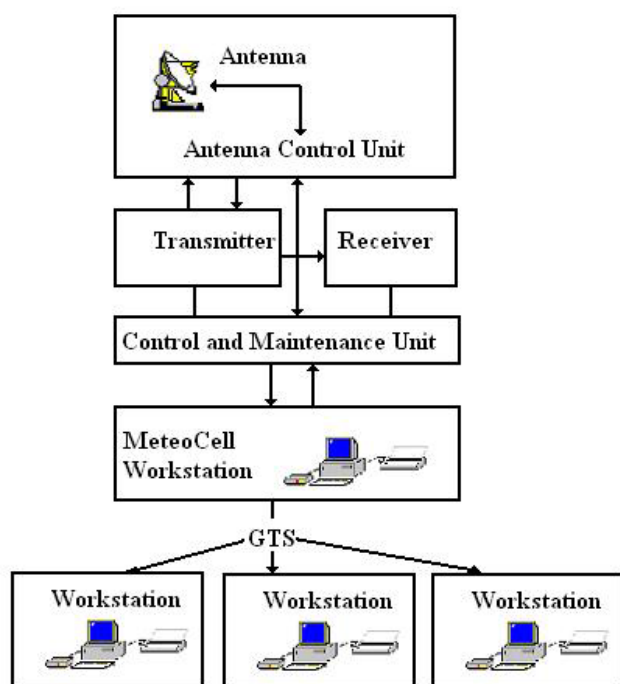


Fig. 1.

standard set of 13 obligatory products, meeting the requirements of aviation as the main user:

- meteorological phenomena and types of cloudiness;
- radioecho top level;
- 11 CAPPIs in the layer from 0 to 11 km with a step of 1 km.

A radar product is sent in the matrix (100×100) form. Values of the matrix element are related to the center of the cell with the size of 4×4 sq. km. The time resolution of the radar products is 10 min, and that of the composite maps is 30 min.

3 Telecommunication

For the purpose of the radar data exchange, the channels of the Global Telecommunications System (GTS) are used. The routing of messages is performed in the GTS nodes. Each of the radar products is transmitted as a separate message in BUFR code. For BUFR – encoded radar data, the indices of data are given in the form of IPRNii, where ii is the radar product code. Each of the radars has a unique four-letter identifier for forming the shortened headline of WMO GTS. The construction of composite maps is accomplished at a user workstation. The customer can choose the necessary set of products from those radars that are of interest. The use of GTS communication channels for data transferring also allows to get the whole volume of necessary meteorological information at a workstation from regional and world centers for its complex analysis.

Table 1. Meteorological phenomena. Code table 0 21 022.

code numeral	value
0	No echo
1	Upper and middle layer cloudiness
2	Stratus
3	Precipitation, light
4	Precipitation, moderate
5	Precipitation, severe
6	Cumulus
7	Shower, light
8	Shower, moderate
9	Shower, severe
10	Thunderstorm, probability 30–70%
11	Thunderstorm, probability 71–90%
12	Thunderstorm, probability >90%
13	Hail, light
14	Hail, moderate
15	Hail, severe
16	Squall, light
17	Squall, moderate
18	Squall, severe
19	Tornado
31	No data

4 Meteorological radar data for aviation

Meteorological radar data are used as aircraft take-off and landing aids and for provision of flights along the routes. Meteorological radar data are transmitted to the briefing workstations for flight personnel information. Information about meteorological phenomena in a airport traffic-control zone and in flight information region and visibility in precipitation and cloud icing is the most interesting. Thunderstorm, hail and squall coordinates and feature data are transmitted to aircraft boards as a part of ATIS report while providing aircraft landing.

Providing of the air traffic services with the meteorological radar data is performed by the Air Traffic Control (ATC) automated system. The workstation located in the ATC service receives the total set of necessary data as follows: meteorological radar data, OPMET data, GRIB – and BUFR – encoded forecasts. All communication channels are reserved for reliability ensuring. Incoming data are processed, and then the encoded reports are formed and transmitted into the ATC system using agreed protocol. The contours of thunderstorm and hail zones, actual weather and forecasts for controlled airspace, flight forecasts and other meteorological information required are visualized on the screens of air traffic controllers. Aviation forecasters are the main customer of meteorological radar information.

5 New code table

The main problem of the realization of such technology is the absence of a code table in the BUFR code for meteorological phenomena and cloud types derived from radar data. In this connection, for the purpose of regional exchange Table B of BUFR code class 21 was complemented with a new descriptor 0 21 022 and with a corresponding code table. The code table contains 32 values (no data, no radar echo, and three gradations of cloudiness form without precipitation, continuous precipitation, shower-type precipitation, thunderstorms, hail, and squall) and presented in Table 1.

6 Summary

The verification of this new technology within the framework of the pilot project has shown that its main advantage is a significant extension of the number of potential users of radar information, the reduction of the costs on its delivery, and the data unification of radar systems produced by various providers. By means of GTC those airports and Air Traffic Services which do not have their own meteorological radars may be supplied with the meteorological radar information without any additional expense for communication channels lease.