NATIONAL UPPER-AIR NETWORK PERFORMANCE MONITORING, TASKS AND EXPERIENCE

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ABSTRACT

Discussed are tasks and summarized are ways and means of monitoring of national upper-air network to ensure operational performance and data quality.

Special attention is paid to a dedicated analysis of monitoring results, especially OB-FG statistics, aimed to indentifying reasons of data quality and performance degradation, as well as to presentation of monitoring results.

Also is presented the national upper-air network monitoring system and experience of its operation when numerous radiosonde and balloon types from alternative manufacturers are used on the network and ground station equipment is modernized or replaced by new systems.

Upper-air network performance is a multidimensional concept covering various aspects of the network operation quality: representativeness (spatial and vertical) and accuracy of observations, program of observation fulfillment, achieved heights, completeness, timeliness, proper reporting (especially adequate representation of vertical structure), archiving and safety etc /WMO 2007, WMO 2008/.

Special feature of radiosonde upper-air observations is that ground equipment is persistent factor while radiosondes, balloons and even chemicals used to produce hydrogen vary from one ascent to another. Production batch-to-batch variability, alternative manufacturers of consumables– everything plays role. As well, conditions of observations including observed variables themselves also influence observational errors and performance. Despite of all achieved progress in upper-air automation change of personnel generation and even shifts alternation may still affect performance. Altogether, plenty of factors affecting radiosonde observation result in high dimension of space of influencing quantities.

Performance of network is evidently wider than one of instrumentation and equipment. It is affected by human factor, procurement policy and delivery practices, maintenance and training activity, operators’ skill and motivation and so on.

Upper-air network performance monitoring is a part of multitier network operation management system aimed to ensure stable providing of upper-air data of appropriate quality (i.e. according to nominal accuracy and performance of used equipment under strict following to standards and procedures of observations and operational practices within limits of allocated resources) in real conditions of upper-air network operation.

Monitoring is based on ongoing composing, adjustment and expansion a set of qualitative and quantitative performance indicators. Namely performance indicators are subject to continuous assessment for significant changes.

Thus, technological purport of monitoring is a comparison of performance indicators or their components in various forms. Although majority of comparisons is performed in temporal domain under control as well must be variations of performance indicators across different stations, either within national or global network, different systems and so on.

The next level of monitoring is an analysis of found changes to determine sources of problems and undertake appropriate remedial measures.

To be effective such an analysis must be proactive and anticipatory. It should provide well-timed prevention of performance degradation down to critical levels. For that it requires quasi-daily evaluation on day-to-day basis.

Current posture analysis is nothing without providing bilateral feedback aiming towards improving performance through appropriate remedial actions: proper maintenance, necessary inspection and training, revising motivating factors, improving production or selection of alternative manufacturers etc.

For feedback to be effective performance indicator must be clear and evident, well documented /now only partially in WMO 1992/ and presented in obvious way. Web-based presentation was found to be one of most effective way.

Quality and reliability of used references are of critical importance therefore their validation and verification take important place. As FG field is used as the primary reference / Hollingsworth et al. 1986/ it's necessary to compare monitoring results with ECMWF and other NWP centers, direct radiosonde intercomparison /see Kitchen 1988/, other "references" such as satellites as well as other indirect methods

Monitoring has quite a close relation to operational QC, performed by NWP centers /see for example Collins 2001/, from one hand and from other hand – with postponed QC undertaken by climatologists /see for example Zurbenko et al. 1996, Alduchov et al. 2002/. The main difference task is not to detect error, but evaluate and monitor rate of errors of curtain type and identify a reason and remedy a defect.

There various source of information of use for monitoring. They are first and foremost data themselves as they come from GTS, decoded observations and found coding errors, results of quality control and FG field. There are lots of public Web-sites with upper-air data from GTS available, some of them provide decoded data – it will be demonstrated software for retrieving upper-air data from Internet and time-series analysis. There are many other sources of information that also may be useful, including statistics of radiosonde failures, ground equipment state etc.

There will be presented various methods of dedicated analysis of upper-air monitoring results, including those based of relationships used for derivation of geopotential and wind /following Hall, 1992/.

There will be presented recent progress in national upper-air network monitoring development in comparison with reported in /WMO 2005/ including used indicators, web representation, introducing yearly station review contest /similar to WMO 2000/.

Examples will be given to demonstrate influence of radiation errors, type of radiosonde and ground station, relative position of a radiosonde and other various factors.

Annex 1

Most sources of operational information used for national upper-air network monitoring in Russia were recently upgraded in comparison with reported in /WMO 2005/ and cover now the global upper-air network:

- results of upper-air data complex quality control[1] for data on standard pressure levels and significant points, performed operationally by the Hydrometeorological Centre of Russia data assimilation system;
- geopotential, temperature and wind first-guess (FG) fields, based on 6-h forecast, for all standard pressure levels from 1000 to 50 hPa and pressure at sea level, interpolated to the station's locations;
- 00 and 12 UTC de-coded radiosounding results from parts A, B, C and D of TEMP[2] messages, there were added sections 3, 4 and 7;
- time of arriving parts A, B, C and D of TEMP and PILOT messages to the Hydrometeorological Centre of Russia;
- NIL messages (the messages from Russian and some other stations use extended NIL code for providing additional information on reasons of absence for each missed radiosonde observation, such as routine maintenance, lack of consumables, failure of ground equipment, absence of energy, severe weather conditions, ATC ascent ban, communication problems etc).

All above information is received by FTP-protocol with dedicated software.

Some information is still collected off-line: quarterly statistics of radiosonde pre-flight and in-flight failures, monthly statistics of ascent heights (with separation of cases with balloon burst and all other cases). It is compiled on stations (in most cases so far manually) and regional administrations and is sent to CAO by e-mail.

[1] Developed by Dr. O. Alduchov following /Alduchov et al. 1996/

[2] PILOT messages are available as well.

Annex 2

To facilitate collection of necessary data it was developed the addition to code FM 35 TEMP that makes use of Section 10 (code groups to be developed nationally). Figure groups 61616 will be followed by information about reason for the ascent termination, additional information about used radiosonde, batteries and balloon, the free lift and overall tracking and telemetry performance. Figure 62626 (to be used for automated data-processing systems) will be followed by time and coordinates of the last ascent level, ground-check results, software version, percentage of missed/rejected/suspected telemetry and tracking data.

Amendments to code practice were reviewed by the upper-air network regional management and the program of migration to them is on development now that must foresees necessary upgrade of data processing, decoding and monitoring software.

In meantime under development is national template BUFR for transmitting upper-air data.

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