An Update to the Quality Control Thresholds of the Conventional Observing System for Global Data Assimilation

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The set of quality control (QC) thresholds used for global data assimilation by the Japan Meteorological Agency (JMA) was updated on November 10, 2008. This update improves the performance of operational global forecasting by the Global Spectral Model (GSM). Since the results of QC are also utilized for global/regional (Region-II) surface and upper-air observation monitoring by JMA, the thresholds were carefully modified so that the QC results for each observed quantity would be consistent with the previous results in their rejection rates.

1. An update to the QC thresholds used for JMA global data assimilation

A QC procedure named Dynamic-QC (Onogi, 1998) was adopted for the JMA global data assimilation system in March 1997. The temporal tendency and horizontal gradient of each physical quantity around an observation, which are estimated from a first guess (a short-term forecast), are used as predictors to determine QC thresholds. The procedure is applied to the quality control of geo-potential height, zonal and meridional wind speed, temperature, relative humidity and surface pressure reported by conventional observation contributors (SYNOP, SHIP, TEMP, AIREP and so on). Since this adoption, the same set of QC threshold coefficients had been used, while a number of developments in GSM and the global data assimilation system (including the Semi-Lagrangian dynamic scheme and 4D-Var) have been made.

In 2008, the QC thresholds were thoroughly reviewed to ascertain suitable levels for the current global NWP system. The dependencies of each threshold on the temporal tendency and horizontal gradient of each physical quantity were also re-evaluated. These dependencies were found to be quite different depending on latitude and height, and the thresholds for observed physical quantities are not necessarily dependent on such predictors. Figure 1 shows (a) the correlation coefficient and (b) the reliability of the Student's t-test of a linear regression between the QC threshold for temperature and the temporal tendency of temperature. It suggests that the temperature's QC threshold should be significantly dependent on its temporal tendency only below 100 hPa in the mid-latitudes of both hemispheres, but otherwise elsewhere. QC threshold coefficients (linear trends, interceptions and so on) for observed physical quantities without significant dependencies on the predictors were replaced with fixed QC thresholds.

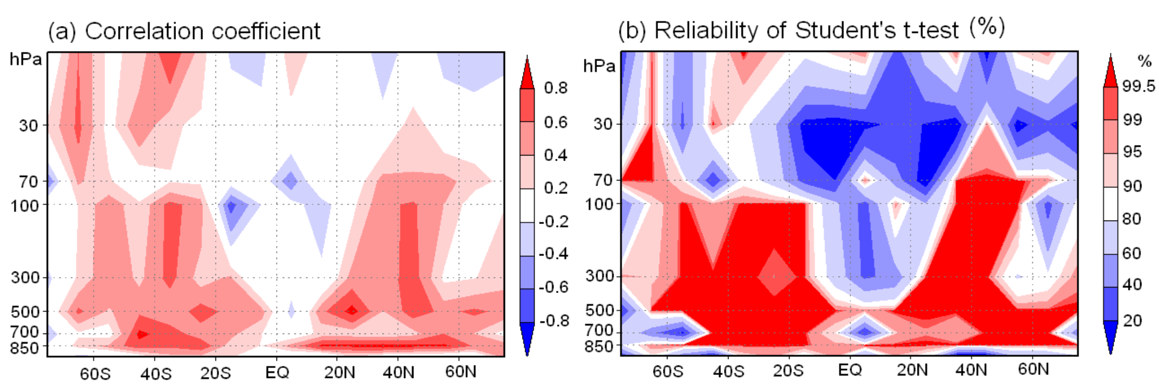

Figure 1. (a) Correlation coefficients and (b) reliabilities of the Student's t-test when a linear regression between the temperature's QC threshold and the temporal tendency of temperatures is performed. For the temperature's QC threshold, see Table 1.

An important application of the QC results is in observation data monitoring reports (see http://qc.kishou.go.jp/). These reports are utilized for observation quality improvements at each observation station. Accordingly, consistent QC results for each observed quantity are required.

Table 1 shows the QC (rejection) threshold and related statistical metrics obtained from global data assimilation experiments performed with the current GSM and assimilation system. As shown in the table, each threshold is defined using the average of absolute values of departures from the first guess (AAD) and the standard deviation of the departure (SDD). These statistics were updated, but since the definitions of the rejection thresholds remain unchanged, there is no significant change in the rejection rate for each observed quantity.

Table 1. Related statistical metrics and QC (rejection) thresholds. The metrics are obtained from an experiment performed from July 20 to September 9 of 2006. The metrics for each observed quantity are indicated using all observations regardless of the temporal tendency and horizontal gradient.

Observed Physical Quantity	Average of Absolute values of Departures from the first guess (AAD)			Standard Deviation of the Departures (SDD)			Rejection Threshold
	20°N – 90°N	20°S – 20°N	90°S – 20°S	20°N – 90°N	20°S – 20°N	90°S – 20°S	
500 hPa geo-potential height	17 gpm	18 gpm	12 gpm	150 gpm	124 gpm	51 gpm	AAD + 3 × SDD
850 hPa temperature	1.3 °C	1.4 °C	1.4 °C	1.9 °C	2.0 °C	2.0 °C	AAD + 3 × SDD
Surface pressure	0.8 hPa	0.9 hPa	0.8 hPa	1.7 hPa	2.8 hPa	2.8 hPa	AAD + 3 × SDD
300 hPa meridional wind speed	2.8 m/s	2.9 m/s	2.6 m/s	4.5 m/s	3.9 m/s	3.5 m/s	AAD + 3 × SDD
850 hPa zonal wind speed	2.4 m/s	1.9 m/s	1.9 m/s	3.4 m/s	2.7 m/s	2.5 m/s	AAD + 3 × SDD
700 hPa relative humidity	17.2%	20.7%	16.8%	24.6%	28.0%	22.8%	AAD + 4 × SDD

2. Improvement of forecast results

Figure 2 shows anomaly correlations of geo-potential height at 500 hPa over the Northern Hemisphere (20°N – 90°N) derived from preliminary forecast experiments performed for January and August 2007. Compared with the forecast results using the former QC thresholds, the new thresholds seem to contribute to an improvement in the forecast performance up to 192 hours (8 days). These results are believed to stem from the suitable QC thresholds for the current NWP system, which prevent erroneous observational reports from contaminating the initial fields of global forecasts.

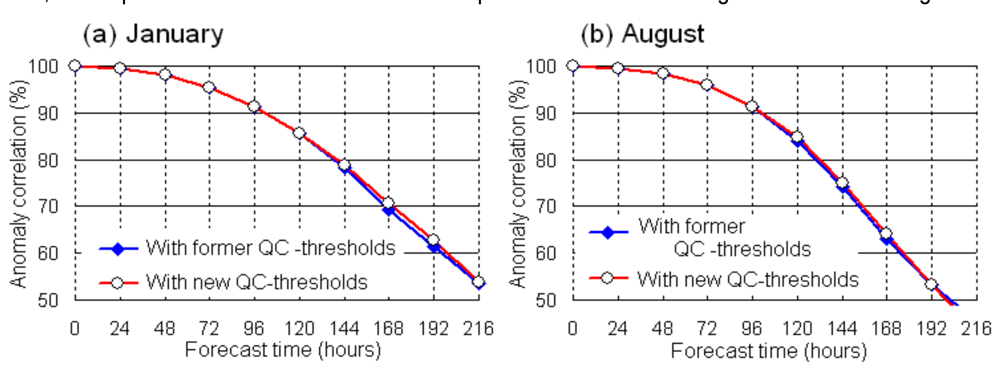

Figure 2. Anomaly correlations of geo-potential height at 500 hPa in the Northern Hemisphere (20°N – 90°N) against initial fields. The forecast results were examined for (a) January 2007 and (b) August 2007.

References

Onogi, K., 1998: A Data Quality Control Method Using Forecasted Horizontal Gradient and Tendency in a NWP System: Dynamic QC. *J. Meteor. Soc. Japan.*, 76, 497-516.