Calculation of regional QC ranges of temperature and salinity for Korean waters

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Abstract

Establishment work of quality control procedures for the ocean data produced by a variety of national research projects was conducted in order to set up a national ocean data sharing system. We set up 12 QC procedures for physical, chemical, biological and geological ocean data items. At first, we had prepared draft version of QC procedures after analyzing existing international and domestic QC methods. The proposed procedures were reviewed and revised by experts in the field of oceanography. The QC procedure for temperature and salinity data was set up by referring the manuals published by GTSPP, ARGO and IOOS QARTOD. It consists of 16 QC tests applicable for vertical profile data and time series data obtained in real-time mode and delay mode. Three regional range tests to inspect annual, seasonal and monthly variations were included in the procedure and three programs were developed to provide regional ranges to data managers. The programs can calculate upper limit and lower limit of temperature and salinity at depth from 0 to 1550m by using statistical data of World Ocean Atlas 2013 released by NOAA NCEI. When users input location, time (season or month) and depth to the programs, they calculate regional ranges with three standard deviations and display regional ranges. Users can use different range from suggested range if users know well the regional characteristics of the area, because it is known that the sparse data can cause bias of the statistic data in some areas around Korean peninsula. We have plan to produce new statistical data and regional range by analyzing unpublished new data and reanalyzing existing data.

1. Introduction

To establish data management system for ocean data obtained by national research projects of Ministry of Oceans and Fisheries of Korea, KIOST(Korea Institute of Ocean Science and Technology) has being conducted standardization and development of quality control(QC) procedures. For this work, we first prepared standard proposals and draft version of QC procedures by reviewing and analyzing of existing international and domestic ocean-data standards and QC procedures. The proposed standards and QC procedures were reviewed and revised by experts in the field of oceanography and academic societies for documentation. A technical report on the standards of 25 data items was prepared as an output of this work. We also set up 12 QC procedures for physical, chemical, biological and geological ocean data items (Table 1).

Table 1. Data items for QC procedures.

Part	Data Item
Physical	TS, ADCP, Wave
Chemical	DO, CO_2, Nutrient
Biological	Phytoplankton, Algae, Fish
Geological	Surface Sediment, Core Sediment, Shallow Seismic Wave

2. QC Procedures for Temperature and Salinity data

There are some QC manuals for temperature and salinity data. GTSPP (Global Temperature and Salinity Profile Programme) published the first version of real-time quality control manual in 1990 and the revised version in 2010. ARGO Data Management Team and IOOS QARTOD (Quality Assurance of Real Time Ocean Data) also published QC manuals for TS data in 2007 and in 2014, respectively. In this study, the QC procedure for temperature and salinity data was set up by referring the manuals published by GTSPP, ARGO and IOOS QARTOD. It consists of 16 QC tests applicable for vertical profile data and time series data obtained in real-time mode and delay mode (Table 2). Three regional range tests to inspect annual, seasonal and monthly variations were included in the list. A document which describes the details and application of each QC tests was printed out for research data management.

ODSBP(Ocean Data Standards and Best Practices Project), whose objective is to achieve broad agreement and commitment to adopt a number of standards and best practices, adopted standard for QC flag in 2013 and published IOC Manual and Guide 54 to promote the usage of recommended standard. We decided to use the QC flag recommended by ODSBP for TS QC tests of this study (Table 3).

Table 2. List of QC tests for research data management

No.	Test	Required	Recommended	Suggested	Time Series	Vertical Profile
1	Observation time/Time interval	○			○	
2	Text syntax	○			○	○
3	Date/Time	○			○	○
4	Location	○			○	○
5	Moving speed		○			○
6	Annual regional range		○		○	○
7	Seasonal regional range			○	○	○
8	Monthly regional range			○	○	○
9	Time continuity		○		○	
10	Pressure increasing		○			○
11	Spike		○			○
12	Gradient		○			○
13	Stuck value		○		○	○
14	Density inversion			○		○
15	Consistency with other data			○	○	
16	Neighbor Test			○	○	

Table 3. QC Flag for TS data (from ODSBP)

Code	Short Name	Definition
1	Good	passed documented required QC tests
2	Not evaluated, not available or unknown	used for data when no QC test performed or the information on quality is not available
3	Questionable/suspect	failed non-critical documented metric or subjective test(s)
4	Bad	failed critical documented QC test(s) or as assigned by the data producer
9	Missing data	used as place holder when data are missing

3. Calculation of Reginal QC Range

Though the global range for TS data are suggested by several documents, it is not easy to determine regional ranges for QC test. Fortunately, World Ocean Atlas 2013 (WOA13) released by NCEI (NOAA National Centers for Environmental Information) provides statistical data in 3 kinds of grid systems (5° grid, 1° grid and 0.25° grid). It provides number of data, mean and standard deviation calculated from TS data quality controlled by NCEI at each grid point and each standard depth. Thanks to the WOA13, we could develop three console programs which can retrieve statistical data from WOA data set and calculate upper limit and lower limit of temperature and salinity at depth from 0 to 1550m. The spatial coverage of the programs are 117-142E and 27-52N. When user input location, time (season or month) and depth to the programs, the programs calculate regional ranges with three standard deviations. They display regional ranges at selected grid of 3 grid systems and finally provide recommendation ranges (Fig. 1).

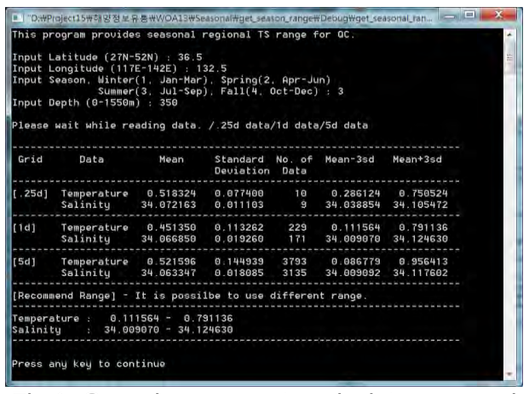

Fig 1. Console program to calculate seasonal regional QC range

4. Discussion

The programs were developed as an inception stage. Because there are sparse data in some areas around Korean peninsula (Fig. 2), statistical data can be biased. It is required to use this programs carefully and data managers can use different values instead of suggested values by programs. It is possible for the expert to suggest better regional QC range if he knows well Korean waters. We have plan to produce new statistical data and regional range by analyzing unpublished data and reanalyzing existing data.

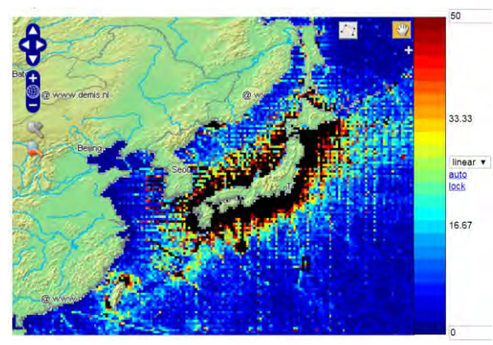

Fig 2. Distribution of temperature data around Korean peninsula (from NCEI website)

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