**Silicate Correction for Years 2007 – 2017**

**Joseph Linguanti**

**February 21, 2018**

**Updated December 8, 2021** (see note on page 2)

**Introduction**

Roy Hourston asked me to apply the silicate data correction, described by Tamara Fraser in her email of January 18, 2018 (see Tamara’s email at the end of this document), to the files in the Ocean Science Division’s Cruise Data Archive (CDA).

I wrote a program “Silicate\_correction.for” to search through the CDA for any files containing silicate data and apply the correction where applicable.

**Methodology**

Silicate is measured from samples drawn from a bottle or the loop system, therefore the program looks only at bottle or loop files.

As mentioned in Tamara’s email the cruises affected are between 2007 and 2017, excluding all the Arctic cruises and several others mentioned in the email. The program contains the code to bypass the excluded cruises. The following table lists the excluded cruises.

|  |  |
| --- | --- |
| **Year** | **Excluded cruises** |
| < 2007 | All cruises |
| 2007 | All cruises except for 2007-12, 2007-14, 2007-15 and 2007-26. |
| 2008 | 2008-01, 2008-02, 2008-04, 2008-29 and 2008-30 |
| 2009 | none |
| 2010 | 2010-05 |
| 2011 | 2011-18 |
| 2012 | 2012-44 |
| 2013 | 2013-06 |
| 2014 | none |
| 2015 | none |
| 2016 | none |
| 2017 | none |

The correction equation is a function of salinity, where salinity is 25 psu or less. The program first looks to use bottle salinity and if not available than the programs looks to use CTD salinity. If neither the bottle nor the CTD salinity is available, than the correction is not applied. Bottle salinity is not available for one of two reasons; either no salinity sample was taken with the silicate sample, or the salinity value has assigned one of the quality flags 3, 4 or 5 designating a questionable salinity value.

A new data file, with the characters “ \_New” appended to the file extension name, is created only if any corrections were applied to the silicate data. Two additional channels called “Silicate:Corrected” and “Flag:Silicate:Corrected” are added to the file. Channel Silicate:Corrected contains the corrected silicate values when available, otherwise the original silicate value is copied over. Channel Flag:Silicate:Corrected is just a copy of the Flag:Silicate channel.

The program creates a DOS script file “Movren.txt” containing commands for moving the original file to the .History subdirectory within the cruise directory and renames the corrected ,\*.\*\_New, files back to the original file names. Before executing the script file in the DOS command rename file Movren**.txt** to Movren.**bat**. The Movren file initially has the extension .txt so that it cannot be executed accidentally by clicking on it.

The program creates a CSV file called “Silicate Report.csv” containing information on silicate value acted on including, filename, station, sample number, bottle and ctd salinity values, old and new silicate values and comments on the actions taken or not taken. I have converted the .csv file to an Excel spreadsheet (.xlsx) file with rich text and formatting and the addition of the excluded cruises table.

All the files used and created, including this report, are stored in folder **OSD\_Data\_Archive\Cruise\_Data\Documents\ Silicate Correction Feb 20, 2018.**

**Silicate Correction for Years 2018– 2021**

**Joseph Linguanti, December 8, 2021**

Lu Guan requested that the same corrections get applied to the 2018, 2019, 2020 and 2021 data. As in February 2018, the Arctic cruises are to be excluded. A search of the IOS Data Archive didn’t find any Arctic cruises with silicate data for the years 2018 to 2021 inclusive.

Following is the Correction Summary table produced by Mark Belton:

|  |  |  |
| --- | --- | --- |
| ***Water Properties Salinity Correction Summary 2018-2021, and Ongoing*** | | |
|  |  |  |
| **Year** | Cruises to Correct | Method |
| **2018** | All | Joe Linguanti Script or other equivalent method from the data processing group - Astoria Correction Factor |
| **2019** | All | Joe Linguanti Script or other equivalent method from the data processing group - Astoria Correction Factor |
| **2020** | All except 2020-083 (see below) | Joe Linguanti Script or other equivalent method from the data processing group - Astoria Correction Factor |
| **2020** | 2020-083 | Manually applied by Nutrient Analysis Group and resubmitted - AA3 correction factor (includes NO3 + NO2 correction) |
| **2021** | Archived as of 25Nov2021 (2021-001, 004, 005, 006, 020, 021, 024, 032, 069) | Joe Linguanti Script or other equivalent method from the data processing group - Astoria Correction Factor |
| **2021** | Not Archived (2021-008, 012, 022, 025, 033, 034, 036, 153) | Manually applied by Nutrient Analysis Group and resubmitted - Astoria Correction Factor |
| **2022-ongoing** | All | Applied by Nutrient Analysis Group prior to submission - Instrument Specific Correction Factor |

The same methodology was used as in February 2018. The only change was a minor modification to the FORTRAN program “Silicate\_Correction.for” to insert the current month and year into the first remark added to the Comments section. In version 1.0 of the program, developed in 2018, the date was hard coded. The new version of the modified program is 1.1.

All the files used and created, including this report, are stored in folder **OSD\_Data\_Archive\Cruise\_Data\Documents\ Silicate Correction Dec 8, 2021.**

**Tamara Fraser’s email**

**From:** Fraser, Tamara   
**Sent:** Thursday, January 18, 2018 1:43 PM  
**To:** Hourston, Roy; Robert, Marie; Yelland, Doug; Chandler, Peter; Johannessen, Sophia; Wright, Cynthia; Belton, Mark; Gatien, Germaine; Romaine, Stephen; Hannah, Charles; Scozzafava, Kenny; Young, Kelly; Ianson, Debby; Wietzke, Jasmine  
**Subject:** Silicate data correction 2007 to present

Hello interested readers

There is a phenomenon known as the “salt effect” that occurs on nutrient continuous flow analysers.   Lower salinity samples exhibit a temporary baseline deflection in the phosphate channel.  However, the only real effect is on silicate concentration determination in the same samples.  No response abnormalities  are observed in the silicate or nitrate channels.  Accuracy of phosphate and nitrate concentration determination are not affected.

Each salt correction factor must be developed for specific chemistry configurations on specific analysers.   We have now determined the salt correction factors for the Astoria Pacific analyser and for the Seal AA3 in the Water Properties Group.  The Arctic group has their own salt correction factor for their AA3.  Data produced outside or previous to the timeline given below cannot be corrected because that instrument no longer exists and no correction factor was or can be determined.

The WPG’s AA3 has only been used for test samples and method development so far and any data generated by this instrument will include the salt correction and will be documented in the header of these data files.  The Astoria Pacific has been used by the WPG since 2007 so we need to update data produced by this instrument to improve the accuracy of the silicate information.  The correction requires the salinity correction factor for the instrument, the salinity in PSU for the sample, and the “old” silicate concentration in micromoles/litre.  See also the equation below.  In our tests uncorrected silicate data was no more than 10% higher than it “should” be.  Corrected data was within normal instrumental variability limits (~1.5% for silicate).

I have spoken with Roy about this correction and his is able to write code to do the following correction in affected bottle files (thank you so very much Roy!)  We will also ensure that a note is made in the header files:

1. Apply the Astoria Pacific silicate correction equation to the following data where salinity is 25 psu or less:
   1. 2007-12, 2007-14, 2007-15, and 2007-26 but no other 2007 data
   2. All 2008 silicate data except 2008-01
   3. All silicate data between 2009 and 2017
2. Equation: Ncorrected = Nuncorrected [1+((-0.003)\*(32-S))]

Ncorrected = corrected silicate concentration in micromoles/litre

Nuncorrected = uncorrected silicate concentration in micromoles/litre

-0.003 = salt correction factor

32 = salt concentration of artificial seawater used by the WPG Astoria Pacific continuous flow analyser

S = salinity of the sample

1. Roy will also produce a list of samples adjusted with their cruise number, station and cast (and sample number).
2. Loop sample data and QF files will also be updated – can’t recall if “we” can do that in an automated way or not but it will happen.

My many thanks to Jasmine Wietzke and Nicole Davies for conducting the correction factor experiments with me.  Thanks also to Roy and Germaine and Marie for providing advice and help.

Tamara Fraser

IOS Nutrient Analysis Laboratory

Institute of Ocean Sciences

Fisheries and Oceans Canada

9860 West Saanich Road

PO Box 6000

Sidney, BC    V8L 4B2

Phone: 250-363-6801

Fax: 250-363-6807

Email: [tamara.fraser@dfo-mpo.gc.ca](mailto:tamara.fraser@dfo-mpo.gc.ca)