ECF-200W-18-0028
Revision 0

Evaluation of Three-Dimensional Extent of Carbon Tetrachloride and Nitrate in Groundwater for 200-West for Calendar Years (CYS) 2015 and 2017

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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ENVIRONMENTAL CALCULATION COVER PAGE

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Evaluation of Three-Dimensional Extent of Carbon Tetrachloride and Nitrate in Groundwater for 200-West for Calendar Years (CYS) 2015 and 2017

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ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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Terms

3D	three-dimensional
AOI	area of interest
CDF	cumulative distribution function
COI	contaminant of interest
CTET	carbon tetrachloride
ECF	environmental calculation file
GIA	groundwater interest area
HEIS	Hanford Environmental Information System
P&T	pump and treat
RF	random function
SGSIM	Sequential Gaussian Simulation
SRL	standard reporting limit

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1 Purpose

This report serves as the environmental calculation file (ECF) describing the data, methodology and implementation for development of multiple alternate three-dimensional (3D) distributions depicting the extent of carbon tetrachloride and nitrate contamination at the Hanford 200 West site using Sequential Gaussian simulation (SGSIM), implemented using the SGSIM software (Deutsch & Journel, 1998, *GSLIB: Geostatistical Software Library and User's Guide*) developed for this purpose. The aim of SGSIM is to generate a set of statistically equiprobable realizations of the 3D distribution of each contaminant of interest (COI). The set of equiprobable simulated distributions can then be used to quantify certain aspects of the uncertainty present in the extent and concentration of these plumes. This document outlines the methodology and parameters used throughout the SGSIM process such that the procedure is transparent and reproducible. The simulated realizations are further constrained to best estimate through the use of weighted mass recovery data. That process is described in an additional ECF.

2 Background

Carbon-tetrachloride and nitrate concentrations have been sampled on a regular basis at the Hanford Site to provide understanding of the subsurface extent of contamination for characterization and remediation purposes, to help design and evaluate the performance of groundwater remedies. In addition to other common variants of ordinary kriging used to depict the contaminant plumes, SGSIM was also used in support of the preparation of Revision 0 of the 200-ZP-1 Remedial Design/Remedial Action Work Plan (DOE/RL-2008-78, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan* and DOE/RL-2009-38, *Description of Modeling Analyses in Support of the 200-ZP-1 Remedial Design/Remedial Action Work Plan*), The volume and mass of carbon tetrachloride present in the initial conditions (plumes) generated using the “best estimate” initial condition using the expected-average (E Type-average) derived from SGSIM was considered to over-state the actual volume and mass of carbon tetrachloride present in groundwater. This was due to difficulties encountered in constraining the multiple realizations to obtain a best-estimate. The intent this application of SGSIM is to build upon the previous work undertaken using SGSIM, and to use subsequent post-processing methods and data that were not available in the previous study to help evaluate the results obtained using SGSIM to develop a more constrained best-estimate from the multiple realizations.

3 Methodology

This section describes the methods used, and the acquisition of the data used as inputs.

3.1 Data Acquisition

The Hanford Environmental Information System (HEIS) was queried by William D. Webber on February 8, 2018 for all groundwater constituent concentration measurements collected between October 7, 1951 and January 31, 2018 and the table of the database snapshot was saved in HEIS as GW_REPORT_CY2017_GWSR. This dataset includes concentrations of chemical constituents and physical parameters in groundwater, measured across the Hanford site, in wells and aquifer tubes.

Spatial coordinates, location type, groundwater interest area (GIA) assignments, and construction information for all chemical concentration measurement locations were queried from HEIS database. GIA assignments were further refined using a set of polygons to define the appropriate interpolation dataset for each GIA. This information, together with the chemical concentration data and additional information described above, were reduced and compiled into separate files comprising a comprehensive database of all information required for the plume mapping procedure described later in this document.

Data selection rules consist of the following criteria to determine the appropriate interpolation dataset for each COI and GIA:

1. Monitoring locations were removed from the master chemical concentration table if the screened interval is outside the aquifer zone of interest.
2. Rejected samples (measurements flagged with qualifiers "R") were removed from the dataset. Samples submitted for review (Request for Data Review) or identified as erroneous were excluded from the dataset per input from the project scientist.
3. For measurements flagged with the "U" qualifier or any combination including the "U" qualifier, the reported value represents (or is replaced by) the associated minimum detectable activity, for radionuclides, or the standard reporting limit (SRL), for all other COIs. If the SRL field is blank, the standard value reported (STD_VALUE_RPD) is used.
4. Selected measurements for monitoring wells without screen elevations were excluded from the dataset as not representative of the contaminant distribution pattern in the aquifer.
5. For each measurement location, a single representative concentration is determined depending on:
    a. Available data (Calendar Year 2017 only, 2014-2015);
    b. Type of monitoring location (monitoring well, extraction/injection well);
    c. Collection purpose (e.g., routine sample vs characterization sample)

If the well had characterization data instead of mid screen elevation, sample depth and calculated sample elevation is used. Because of monitoring wells lack of spatial coverage in 200 West area, concentration data from some extraction wells were included in one interpolation data set with exception of extraction wells with carbon tetrachloride concentration values less than neighboring monitoring wells. Data used for the interpolation are listed in the Appendix to this ECF. Sample data from monitoring well 299-W11-33Q were excluded from calculations because unknown screen information.

3.2 Data Sets Used in Calculations

The datasets evaluated using SGSIM are summarized below in Table 3-1.

For carbon tetrachloride, multiple datasets are evaluated in this study. First, carbon tetrachloride data collected in 2014 and 2015 are summarized into two contrasting datasets: the first is a calculated average concentration for each sampled location, while the second is the maximum value from each sampled location. Each of these datasets is used to generate a separate (i.e., independent) geostatistical model of the plume. Additionally, a third carbon tetrachloride geostatistical model was generated using the 2014-2015 data along with data from three of the operating extraction wells of the 200-ZP-1 pump and treat (P&T) remedy that exhibit higher concentrations than the surrounding monitoring wells. Fourthly, the most current data from 2017 is used to generate an additional geostatistical model.

For nitrate, the data available for 2014 and 2015 are summarized into average and maximum values and each dataset evaluated separately.

Table 3-1. Data Sets Used to Develop Geostatistical Models

Year(s)	Type	Comments
2014-2015	Carbon tetrachloride	Average
2014-2015	Carbon tetrachloride	Max
2014-2015	Carbon tetrachloride	Average, 3 Pumping wells included
2017	Carbon tetrachloride	Average
2014-2015	Nitrate	Average
2014-2015	Nitrate	Max

3.3 Data Preparation

Two primary steps were taken in the data preparation. These are: data declustering and normal-score transformation. These are described here.

With regard to declustering: when data to be evaluated are not sampled on a regular grid, declustering of the data can be used to generate a weighting scheme that provides a more representative scheme for combining and evaluating the data. For this calculation, cell declustering is implemented. This simple approach to declustering will discretize the area of interest (AOI) into cells and calculate a weight for each sample data value within each cell. For this analysis, this was accomplished using a cell size of 645 meters x 645 meters in the X and Y directions respectively. If a cell contains a single data value, the declustering weight for that sample is 1. Two samples in a single cell are each given a weight of 0.5. Note that in this simple declustering method, some data values in sparsely sampled areas can be given a weight greater than 1. Depictions of data locations, summary stats of clustered and declustered data are provided in Figures A-1a and A-1b.

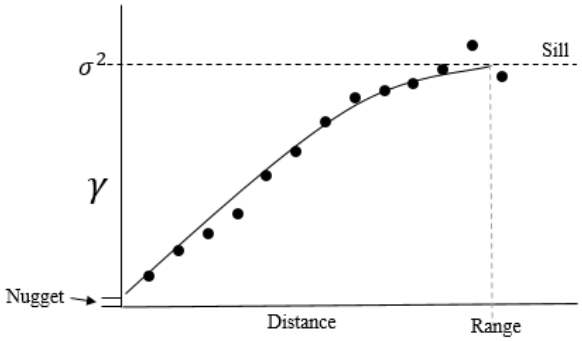
With regard to data transformation: Gaussian based geostatistical methods, such as implemented in SGSIM, assume the input data form a Gaussian distribution. This is rarely the case in practice. For this reason, the declustered sample data distributions are transformed to a standardized Gaussian distribution (i.e., with a mean of zero and standard deviation of one). Prior to undertaking this transformation which is commonly referred to as a normal-score transformation, each of the datasets is “despiked” to provide a continuous sequence of data values. Despiking is often referred to as “breaking the ties”: it implies that equal data values that are in close proximity will be separated by adding a very small random value to distinguish them. Following this process, the normal scores (aka Gaussian) transformation is performed by mapping quantiles of the declustered and despiked distribution to quantiles of the Gaussian distribution. Mapped values used in the non-parametric transformation are retained for later use in back transforming from the Gaussian space to data values in the original units of measurement.

3.4 Variogram Analysis

The semivariogram, colloquially known as the variogram, is a function used to quantify the spatial relationship between sample results obtained at different locations within the AOI. As shown in Equation 3.1, the variogram (2γ) is defined as the average of the squared difference between two points (Z_u, Z_{u+h}) separated by a lag distance (h), depicted over n lags (Journel and Huijbregts, 1978, *Mining Geostatistics*).

$$2\gamma = \frac{1}{n(h)} \sum_{n(h)} (z_u - z_{u+h})^2 \qquad \textbf{Equation 3.1}$$

The idealized (model) variogram is derived from the sample data by first constructing an experimental variogram from the Gaussian transformed data. Next, a parametric function is used to model the experimental variogram. This parametric variogram model, fit to the experimental variogram, will ultimately be used in SGSIM for purposes of kriging. An example variogram is given below: the experimental variogram represented by points, and the variogram model shown as a solid line along with key components labeled.



Data from two locations are considered spatially correlated when the value of the variogram is less than the sill, which is equal to the (total) variance of the data. With SGSIM, experimental variograms are calculated and modeled in Gaussian space: therefore, the variance is equal to one. The lag distance at which the variogram reaches the sill is called the range: beyond this distance, data are considered uncorrelated. The contaminant plumes considered are 3D, and hence the variogram is defined in horizontal and vertical directions. The plumes were determined based on initial analyses to be essentially isotropic (specifically, not materially differentiable) in the horizontal plane which implies a single variogram can be used to model the spatial continuity in the XY plane while a second variogram model is required to represent the vertical direction. Though separate experimental variograms were calculated for all four datasets, a single variogram model was chosen for each contaminant. Variogram plots are given in the Appendix, while a summary of variogram models is listed in Tables 3-2 and 3-3.

Table 3-2. List of Variogram Model Set 1

	CTET 2014-2015 (Average and Max)		**Nitrate 2014-2015 (Average and Max)**	
	Horizontal	**Vertical**	**Horizontal**	**Vertical**
Nugget Effect	0.01	0.01	0.01	0.01
Structure 1	Spherical	Spherical	Spherical	Spherical
Contribution	0.99	0.99	0.4	0.4
Range (m)	2500	80	200	50
Structure 2	N/A	N/A	Spherical	Spherical
Contribution	N/A	N/A	0.59	0.59
Range (m)	N/A	N/A	1500	50

N/A = not applicable

Table 3-3. List of Variogram Model Set 2

	CTET 2014-2015 (Average w/ Wells)		CTET 2017 (Average)	
	Horizontal	**Vertical**	**Horizontal**	**Vertical**
Nugget Effect	0.01	0.01	0.01	0.01
Structure 1	Spherical	Spherical	Spherical	Spherical
Contribution	0.25	0.25	0.25	0.25
Range (m)	2800	18	2500	25
Structure 2	Spherical	Spherical	Spherical	Spherical
Contribution	0.74	0.74	0.74	0.74
Range (m)	2800	200	2500	250

CTET = carbon tetrachloride

3.5 Simulation Process

Sequential Gaussian simulation was used to generate 100 statistically equiprobable realizations, conditioned to the input data, for each of the six datasets. Each set of realizations is generated on the same spatial grid described in Table 3.4.

Table 3-4. Stochastic Simulation Grid

	# Of Cells	Cell Size (m)	Origin (m)
Easting	120	60	565205
Northing	100	60	133045
Vertical	20	5	40

The general methodology for SGSIM begins by selecting a random node in the grid and simple kriging is performed to estimate a distribution of possible values at that location. A random value from this distribution is chosen. Next, another random location in the grid is selected and again simple kriging is performed, this time simulated values already generated may be included in the kriging process if they fall within the search radius. Again, a random value from the estimated local distribution is selected. This process is repeated for each location in the grid to generate a single realization. One hundred realizations of the contaminant plume are generated for each set of data.

SGSIM parameters are constant for each of the six datasets modeled, except for the input conditioning data and variogram model. Parameters are chosen to minimize bias while still reproducing the input distribution. Up to 40 nearby data values (actual sampled locations) are included in each kriging and up to 12 simulated values, permitted they fall within the search radius. The search radius is determined to be longer than the variogram range such that all spatially correlated data are included. Once simulation is complete, the full set of 100 realizations is back transformed from Gaussian units, to original units of the data by the same quantile to quantile mapping (and interpolation where necessary) used for the original normal scores transform.

3.6 Geostatistical Model Checking

An important aspect of any geostatistical modeling exercise is to validate the geospatial model. Two steps were undertaken to validate the geostatistical model:

1. Variogram reproduction: the set of realizations should reasonably demonstrate the same spatial continuity as the original data by reproducing the variogram (a result termed ergodicity).
2. Histogram reproduction: a valid set of simulated realizations ought to reasonably reproduce the input declustered distribution within acceptable tolerance limits.

No single realization is expected to perfectly match the input histogram and variogram, but the set of realizations ought to reproduce the mean and variance of the input data while replicating the shape of the original histogram (or cumulative distribution function) with some reasonable variability.

To perform the variogram validation, the average horizontal omni-directional variogram and the vertical variogram were extracted from each realization prior to back transforming. This set of one hundred variograms extracted is visually compared to the input variogram model. Variogram validation plots are provided in Appendix A, Figures A-4a, A-4b and A-4c.

Histogram reproduction is checked in a similar fashion. After back transforming to original units, a single cumulative distribution function (CDF) was generated for each realization and visually compared with the declustered input distribution. This is depicted in the Appendix, where Tables A-1 through A-6 give summary statistics comparing the simulated models and the input distribution they are intended to replicate.

3.7 Postprocessing

The large set of realizations generated through SGSIM can be cumbersome to manipulate and analyze: partly as a consequence, it is not common practice to evaluate the performance of a P&T remedy on the basis of one hundred possible models. Instead, a variety of post processing methods allows for the practitioner to summarize the variability and uncertainty quantified by the set of realizations, and to obtain a single “best” depiction from the ensemble of realizations by a variety of methods. Common post processing options include:

- Calculating a single Expected Value or “E-Type” average model,
- Calculating a map of the conditional variance highlighting areas of uncertainty in the AOI; and,
- Extracting a subset of the realizations models – such as representing best and worst-case scenarios – and subjecting those realizations to further analysis.

Initial post-processing efforts conducted for this analysis focused on evaluation of the “E-Type” model along with a set models at set percentiles (i.e., the p10, p25, p50, p75, p90). Ultimately, as detailed in a companion ECF to this ECF (i.e., ECF-200W-16-0092, *Calculation of Three-Dimensional Groundwater Concentration Plumes for 200-West for Calendar Year (CY) 2015*, Revision 1) a weighting scheme was developed based upon historic data and deterministic groundwater flow and contaminant transport modeling to obtain a single weighted-average best depiction for use in later calculations.

4 Assumptions and Inputs

The goal of geostatistical modeling is to estimate a value, or distribution of possible values, for each unsampled location across a gridded domain using sampled values obtained at intermediate locations.

There are assumptions that underlie the strict application of geostatistical techniques. However, even in instances when these are not fully adhered to, the methods prove beneficial for developing an understanding of the spatial distribution of a quantity of interest and preparing inputs to subsequent analyses such as fate-and-transport modeling.

Geostatistical modeling employs the use of random functions (RF) for regionalized variables across the domain of interest (Deutsch and Journel). Carbon tetrachloride and nitrate contaminant plume data are location dependent and therefore can be considered regionalized variables. Furthermore, the Random Function must be stationary across the domain or AOI. Stationarity implies that the mean and covariance function for a given variable are invariant throughout the AOI. The decision of stationarity refers to the RF for that variable, rather than the data being considered and therefore must be based on knowledge of the study area and natural phenomena being predicted (Leuangthong, Khan, and Deutsch, 2008, *Solved problems in Geostatistics*).

It is also assumed that the input data comprise a representative distribution of valid concentration values. Measurement error and possible sources of data uncertainty are not considered as they fall outside the scope of this study. It is assumed that proper QA/QC controls and field sampling procedures have been followed to provide a valid dataset used for simulation across the AOI.

5 Software Applications

All calculations presented in this ECF were undertaken using the GSLIB SGSIM software, with attendant pre- and post-processing utilities. All software used for this calculation was used in accordance with a PRC-PRO-IRM-309, procedure that implements the requirements of DOE O 414.1d, *Quality Assurance*.

5.1 Approved Software

No approved calculation software, as defined in CH2M HILL Plateau Remediation Company (CHPRC) procedure, was used in these calculations.

5.2 Scripting Software

Calculations were performed using publicly available GSLIB software (Deutsch & Journel). The GSLIB software is executed via BASH scripting (GNU bash, version 4.4.12: available from https://www.gnu.org/software/bash/). BASH is a shell and command language for Unix and Windows operating systems. BASH is a command processor that typically runs in a text window where the user types commands that cause actions; however, it can also read and execute commands from a file, called a shell script.

Plotting, additional calculations and data manipulation are performed using the Python programming language (version 3.6.3, Anaconda distribution: available from https://www.anaconda.com/download/). Python is an open source, freely available programming language and can be run on a variety of operating systems. The functionality of the Python programming language can be extended through the use of packages designed to support specific needs such as statistical programming or plotting of numerical data. GSLIB software and Python packages used are outlined in Tables 5-1 and 5-2.

Table 5-1 GSLIB Software

Software	Description
Declus	Cell declustering for either minimum or maximum mean value
Despike	Despiking or "breaking ties" by adding small random values to equal data within a defined neighborhood
Nscore	Normal score transformation by Q-Q transform
SGSim	Sequential Gaussian Simulation
BackTr	Back transform from Gaussian units to original units via Q-Q transform
ClipGrid	Clip extraneous values from model grid based on X and Y coordinates
PostSim	Summarize simulated realizations through a variety of methods (e.g. E-Type)

Table 5-2 Python Packages

Python Package	Package Description	Version
Matplotlib	Plotting histograms, line charts etc.	2.1.0
NumPy	Numerical calculation and manipulation	1.14.2
Pandas	Data management, manipulation and numerical calculations	0.20.3
Seaborn	High level plotting and styling	0.8.0

The Python and GSLIB routines were independently checked and verified by detailed review as part of the preparation of this calculation. Development of software quality assurance documentation for this set of routines under CHPRC's controlled software management procedure would permit this process to be handled through software acceptance testing, rather than by detailed review and verification of each application of these routines. Accordingly, preparation of software quality assurance documentation is recommended to support efficient future applications of these routines.

6 Calculations

Calculations were performed in a batch sequence using the scripting environment as detailed above. Appendix B provides the input file contents for the full sequence of calculations made for both carbon tetrachloride and nitrate. Input files for five carbon tetrachloride workflows are included: the first provide parameters for simulating the plume based on different datasets considered (average values from 2014-2015, average values from 2014-2015 with three pumping wells included in the dataset, maximum values from 2014-2015 and average values of 2017 data). Two workflows are described for simulating the nitrate plume based on average and maximum data values collected in 2014 and 2015. The results of the calculations are provided in Section 7.

7 Results and Conclusions

Results from simulated realizations as well as E-type summaries of those realizations are provided in the appendix (Tables A-1 through A-6) for comparison with original and declustered data for each model. Tabulated results suggest that carbon tetrachloride simulations effectively reproduce the input data with a minor amount of variation. Nitrate simulations are not as effective in reproducing the summary statistics of the input data. This discrepancy is likely related to outliers present in the nitrate data, which stand out on the probability plots included in the appendix. There are a variety of strategies that could be implemented for effective outlier management, but each would involve some iteration and additional data preparation which is considered outside the scope of this study.

In addition to reproducing the summary statistics of the input data the shape of the CDF for realizations, original distribution and the E-Type model is compared in a series of plots included in the appendix. This allows for a visual comparison of the shape of the distribution. In all instances the E-type model shown in blue is a departure from the set of simulated realizations shown in black. This is an expected result. The expected value, otherwise known as the E-Type, of a set of simulated realizations smooths a distribution and reduces its variance. In most cases the E-Type model will not effectively reproduce the very highest and lowest values of the input distribution considered and can be seen in the tabulated summary statistics for each model.

Spatial variability of the simulated realizations can be quantified by the variogram. This is the same process used to calculate the experimental variogram initially. The omni-directional horizontal variogram and the vertical variogram are calculated and plotted for each of the 100 realizations per each model generated. Variogram validation figures in the appendix show variograms calculated from realizations in black with the original variogram model in red. A visual comparison suggests that the range has increased in some cases. This implies that realizations may be too continuous. This is a common issue and though some iteration of variogram parameters may help it, a discrepancy of this scale is unlikely to impact conclusions.

8 References

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Appendix A

Supporting Information for ECF-200W-18-0028

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Figures

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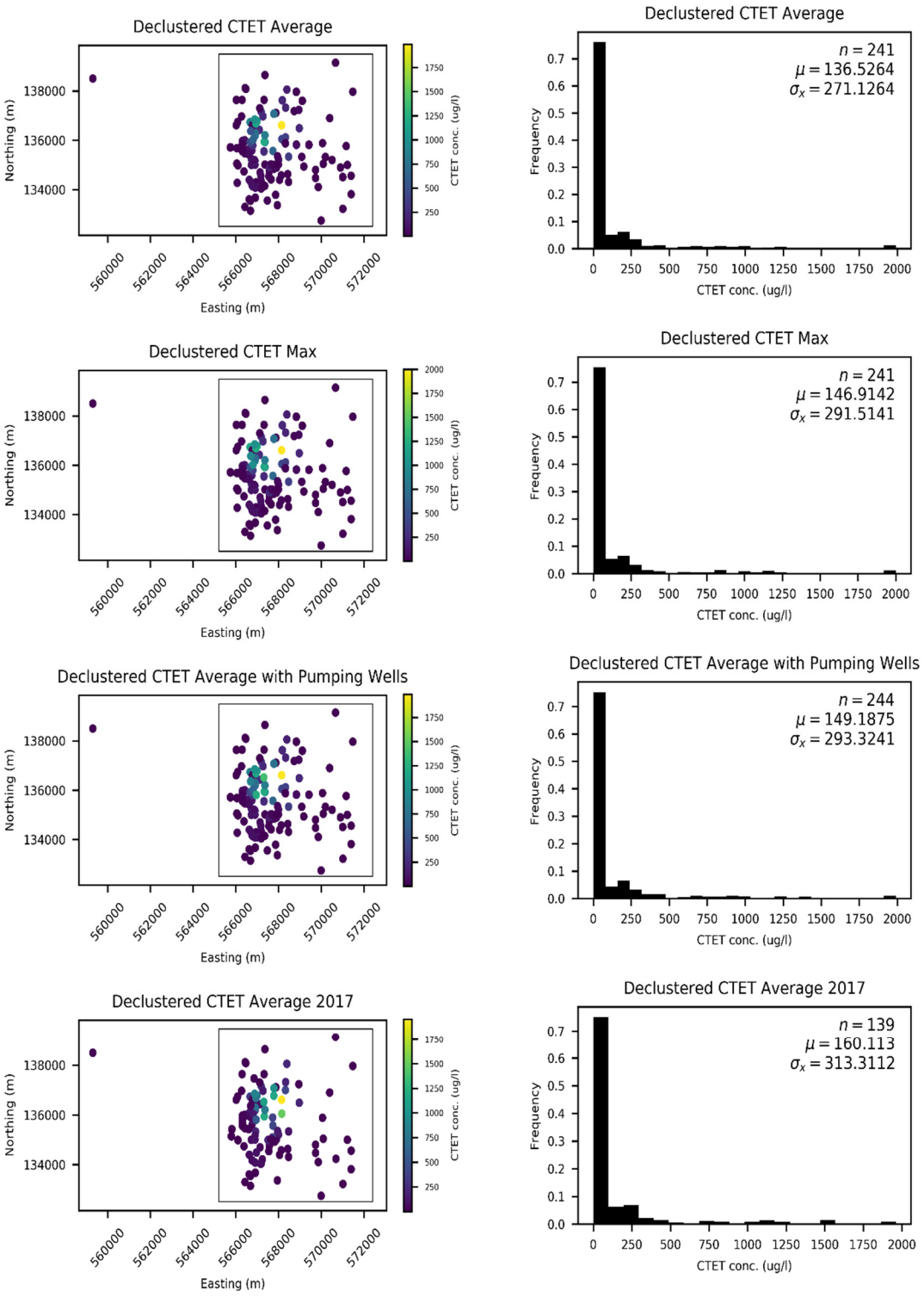


Figure A-1a. Locations, Histograms and Summary Statistics of Declustered CTET Data

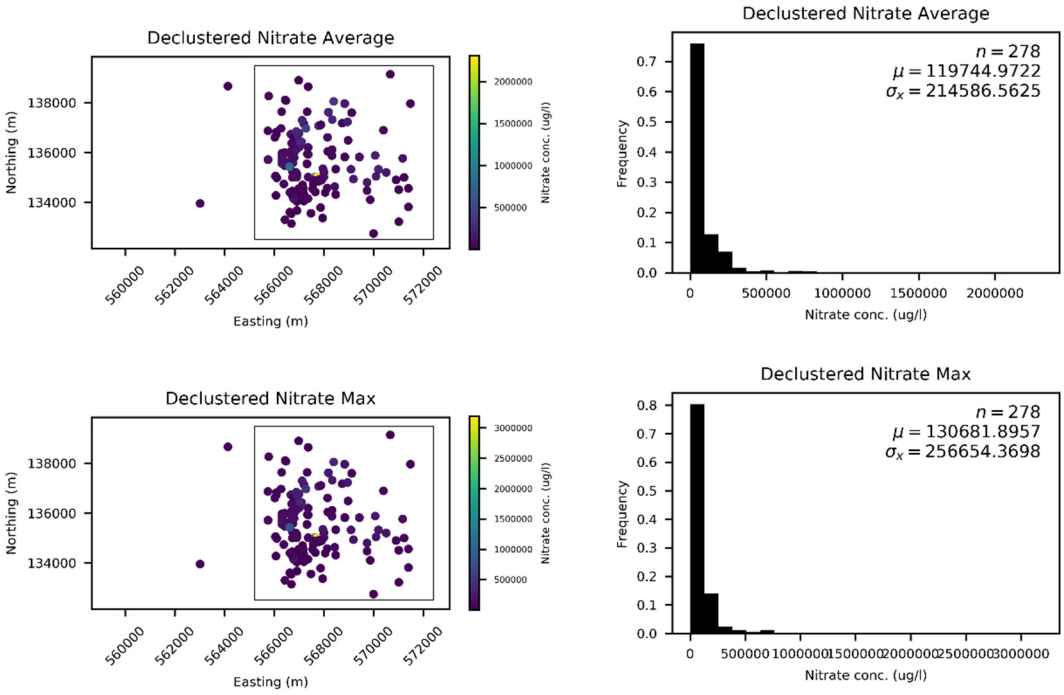


Figure A-1b. Locations, Histograms and Summary Statistics of Declustered Nitrate Data

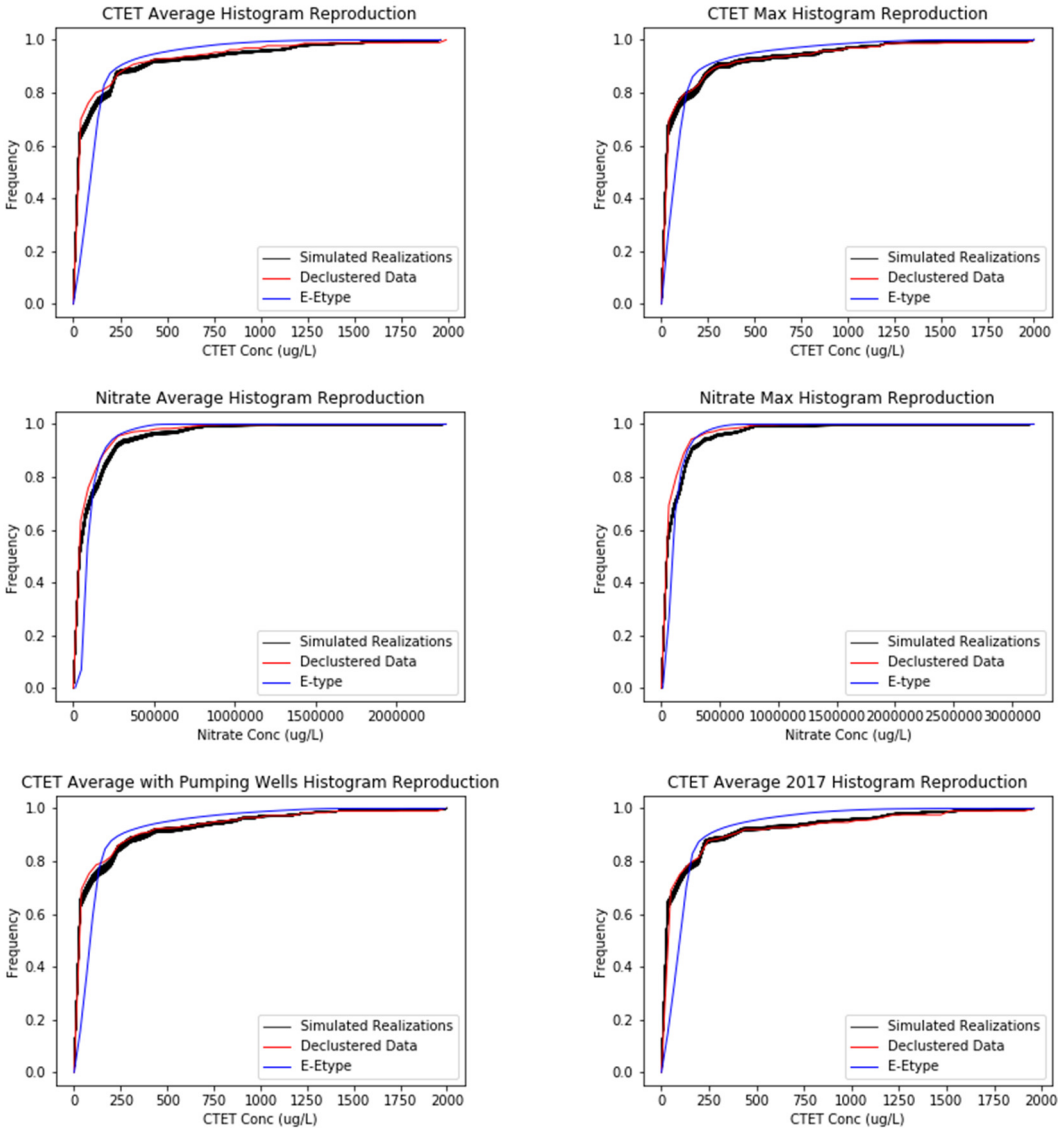
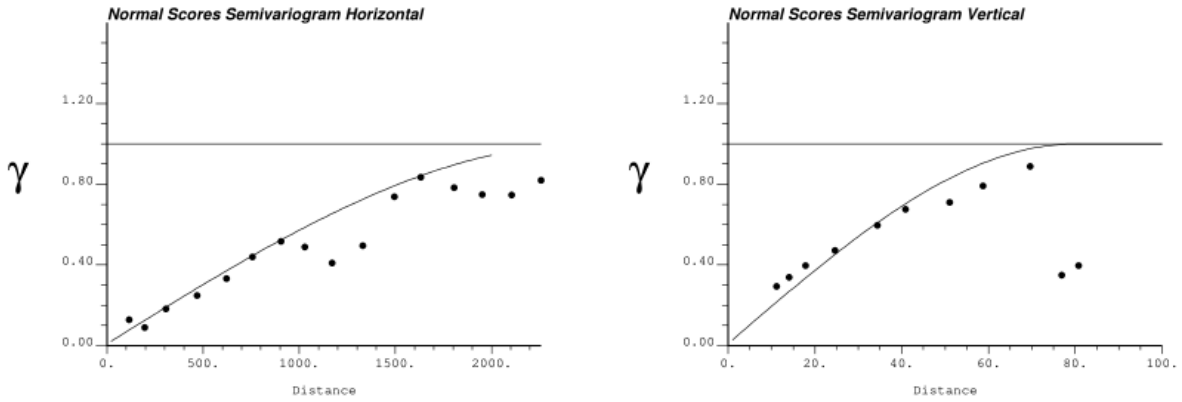


Figure A-2. Posterior Cumulative Distribution Functions (CDFs) from SGSIM Realizations Compared with Variogram Models

CTET Average 2014-2015



CTET Max 2014-2015

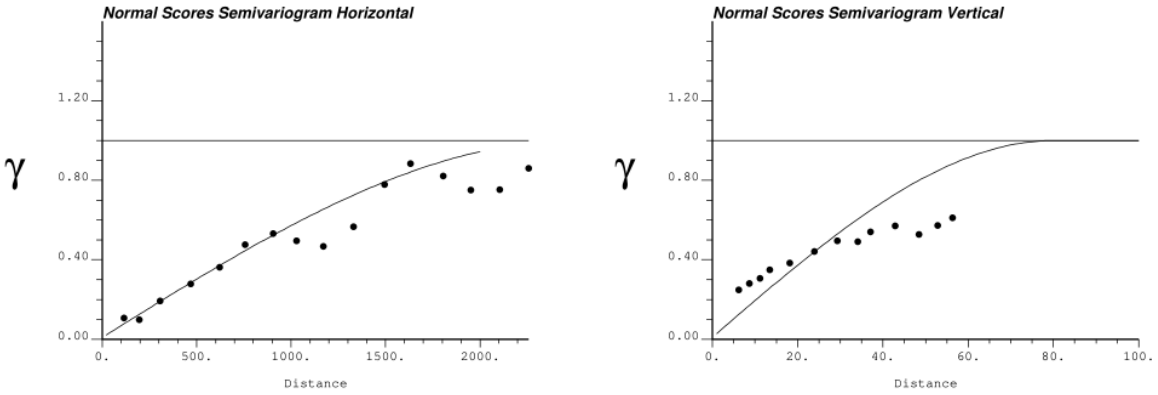
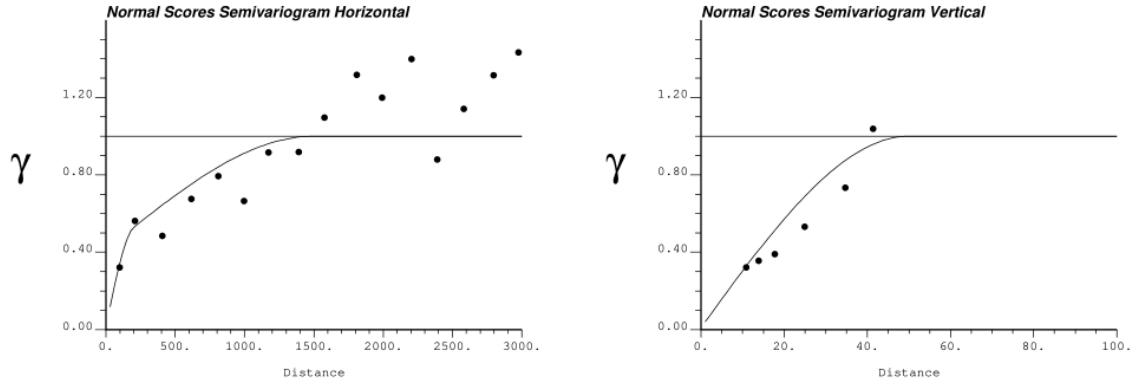


Figure A-3a. Experimental Variograms and Associated Variogram Models

Nitrate Max 2014-2015



Nitrate Average 2014-2015

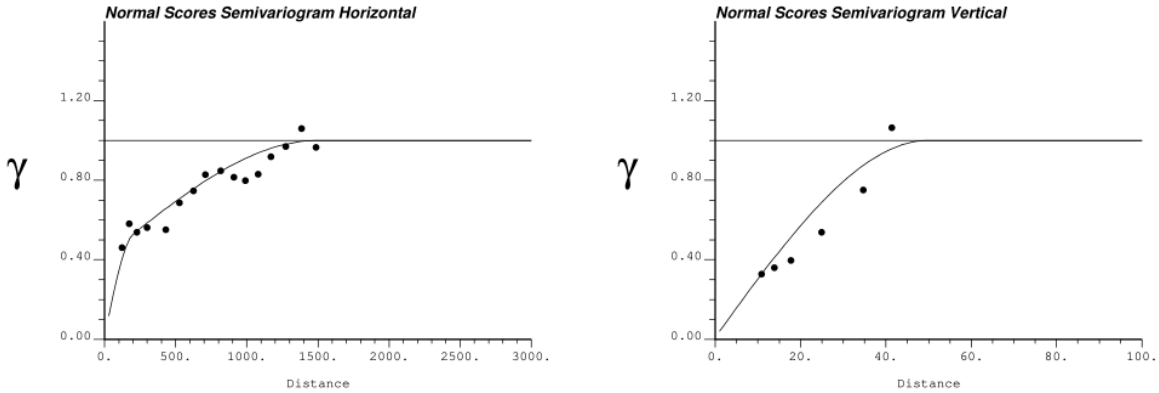
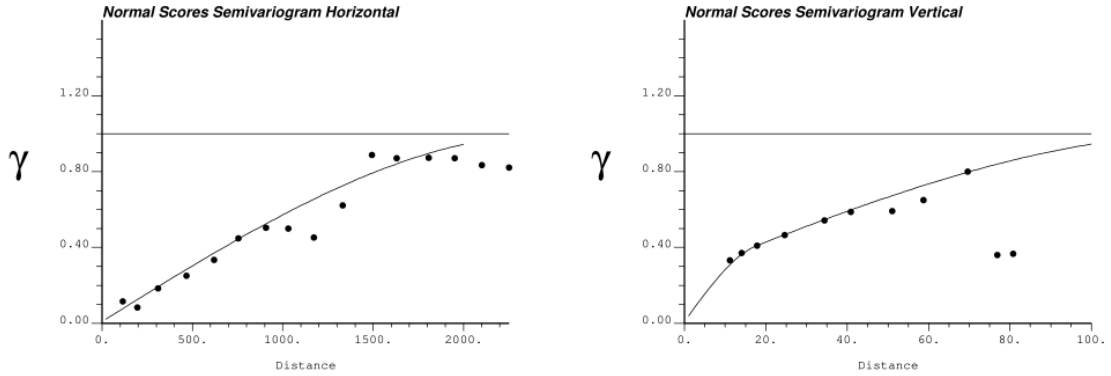


Figure A-3b. Experimental Variograms and Associated Variogram Models

CTET Average with Pumping Wells



CTET Average 2017

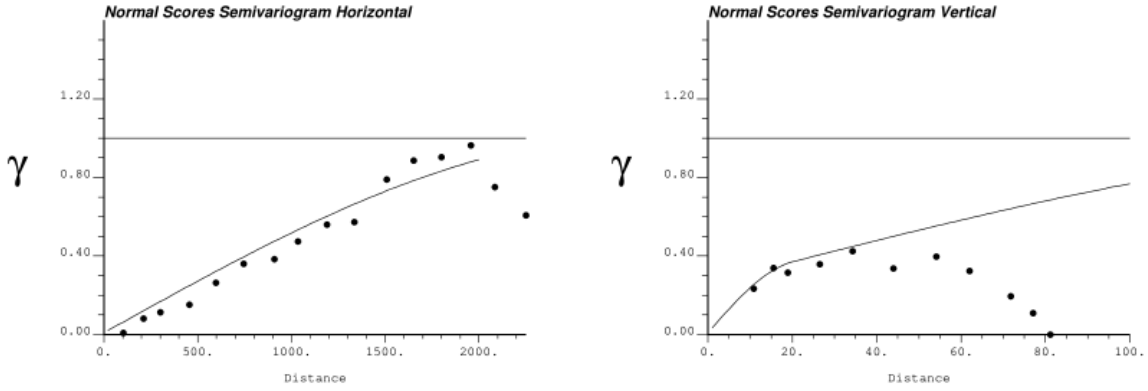


Figure A-3c. Experimental Variograms and Associated Variogram Models

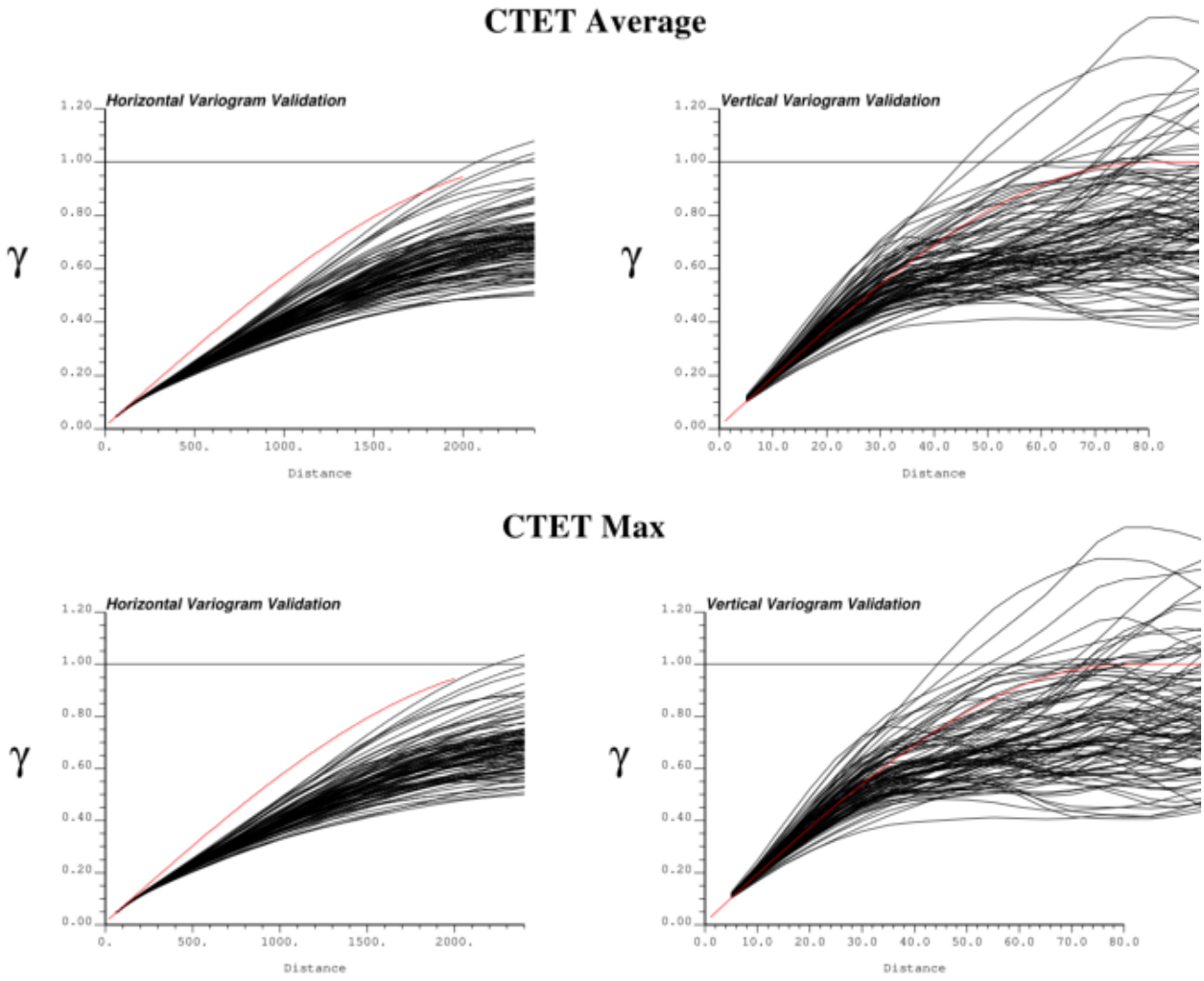


Figure A-4a. Posterior Simulated Variograms Compared to Original Variogram Models

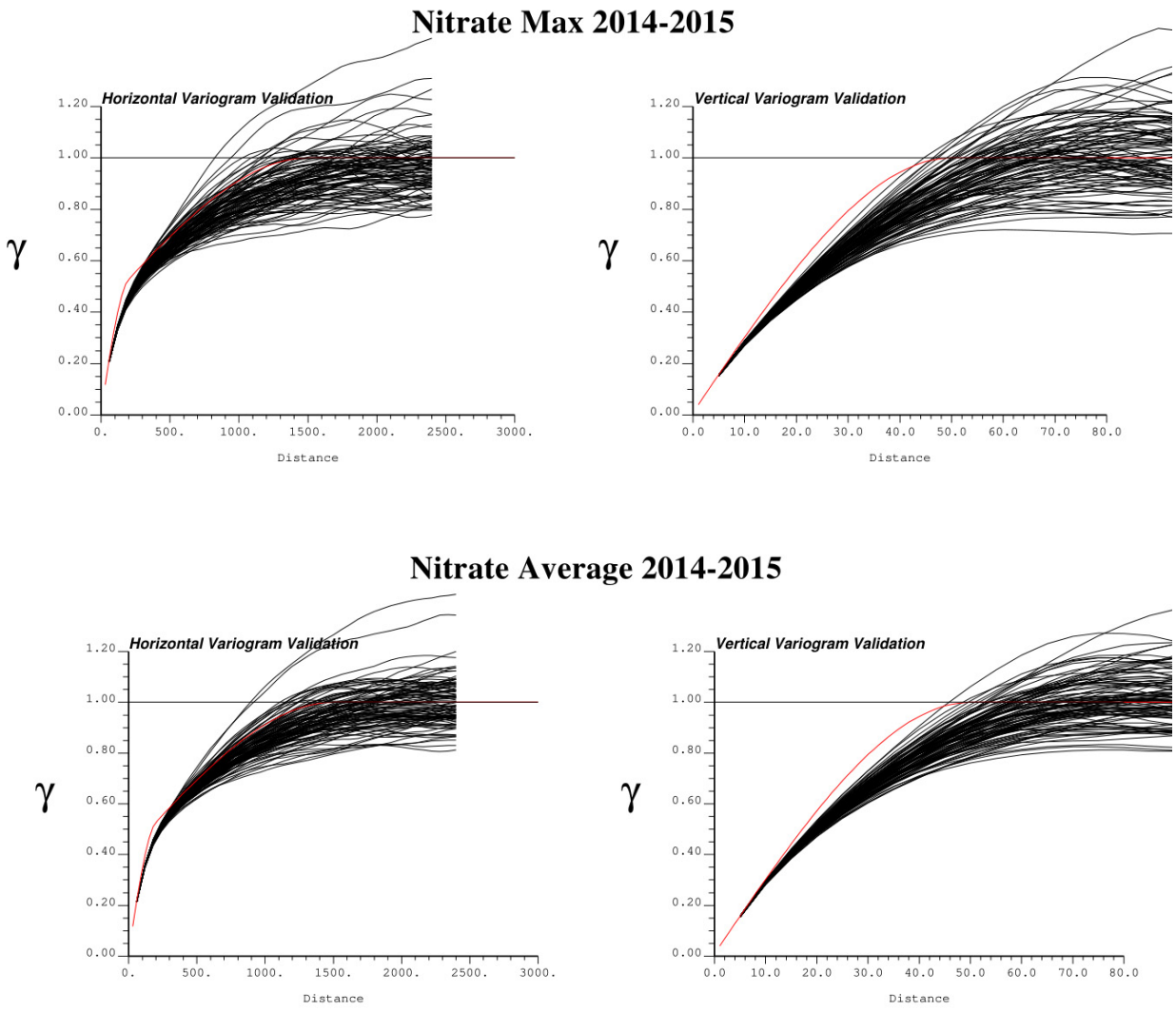


Figure A-4b. Posterior Simulated Variograms Compared to Original Variogram Models

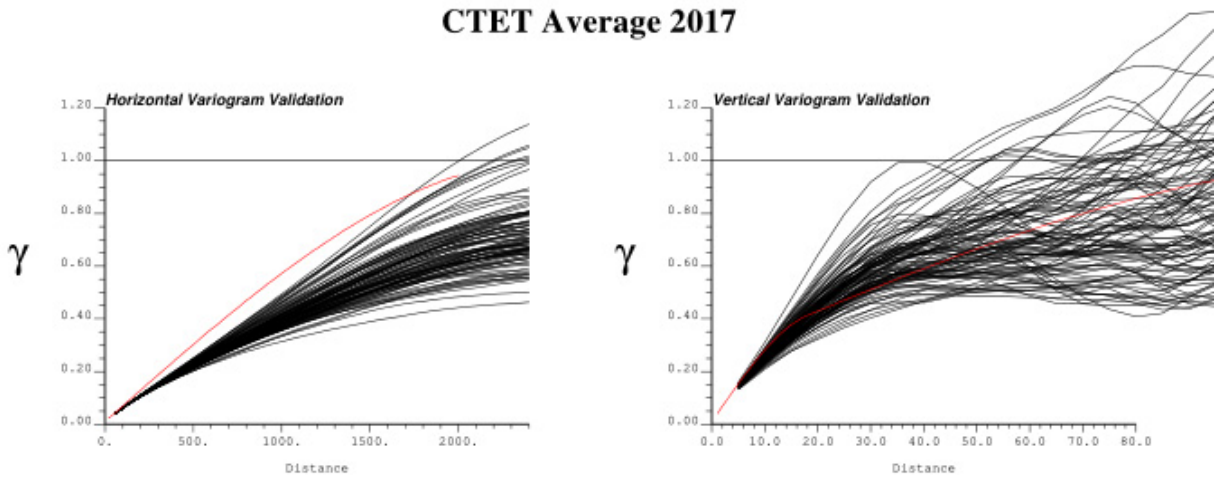


Figure A-4c. Posterior Simulated Variograms Compared to Original Variogram Models

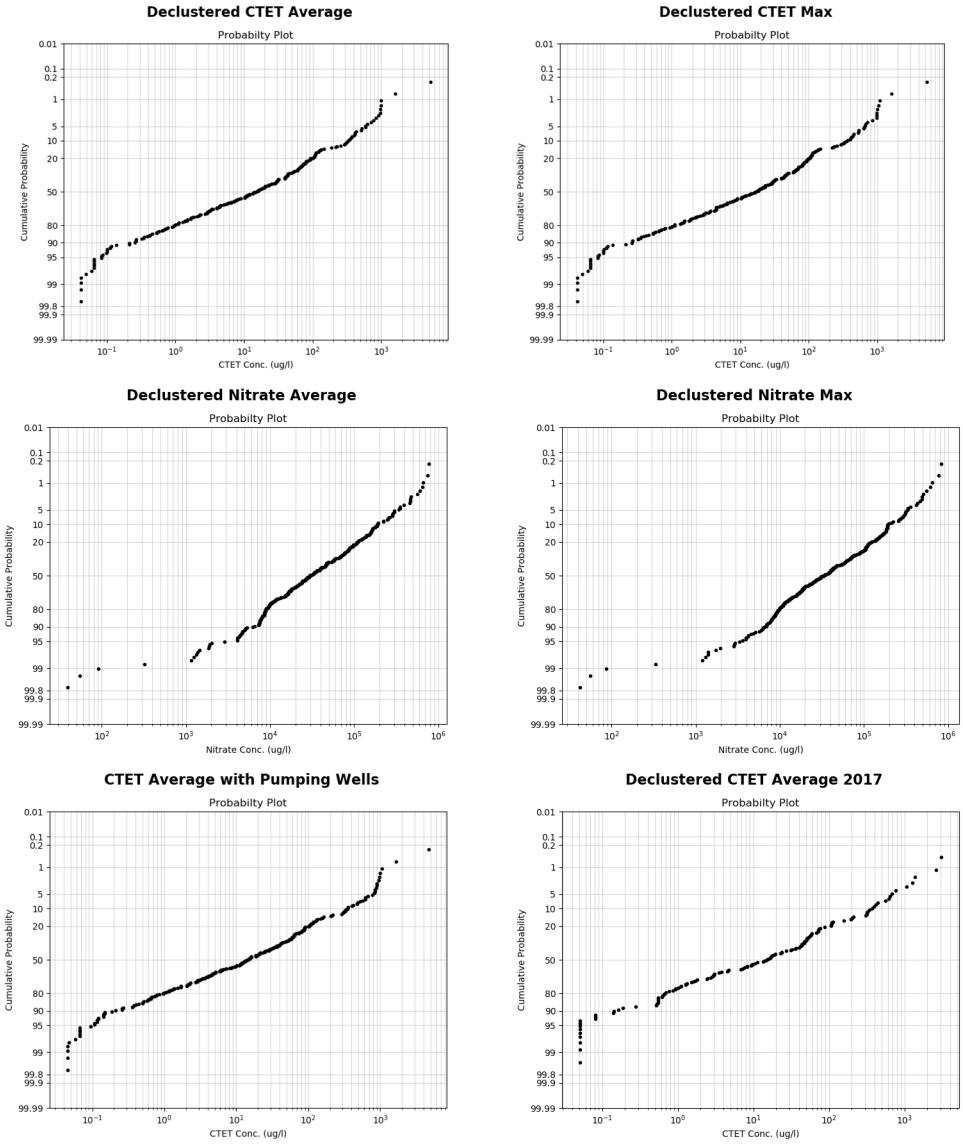


Figure A-5. Probability Plots of Declustered Data

Table A-1. CTET Average 2014-2015 Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	241.00	241.00	168720.00	16872000.00
MIN	0.13	0.04	0.30	0.00
P50	21.78	15.16	96.30	8.09
AVERAGE	136.53	117.13	134.17	134.17
MAX	1990.00	5246.08	1960.00	1960.00
STD DEV.	271.69	394.52	164.09	305.35

Table A-2. CTET Max 2014-2015 Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	241.00	241.00	168720.00	16872000.00
MIN	0.13	0.04	0.80	0.00
P50	24.10	16.94	74.89	11.00
AVERAGE	146.91	124.82	123.36	123.36
MAX	2000.00	5272.44	2000.00	2000.00
STD DEV.	292.12	402.82	188.63	283.80

Table A-3. Nitrate Average 2014-2015 Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	278.00	278.00	168720.00	16872000.00
MIN	124.00	39.32	11345.00	124.00
P50	46500.00	29921.75	84346.08	35390.24
AVERAGE	119744.97	78514.54	108040.00	108040.00
MAX	2307500.00	771799.35	2307500.00	2307500.00
STD DEV.	214973.55	124275.32	74463.54	189011.18

Table A-4. Nitrate Max 2014-2015 Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	278.00	278.00	168720.00	16872000.00
MIN	124.00	42.43	11800.00	124.00
P50	48050.00	33303.93	88565.36	40358.48
AVERAGE	130681.00	83323.67	118783.65	118783.65
MAX	3190000.00	826167.32	3190000.00	3190000.00
STD DEV.	257117.23	125794.15	90109.01	225974.42

Table A-5. CTET Average 2014-2015 with Pumping Wells Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	244.00	244.00	168720.00	16872000.00
MIN	0.13	0.05	0.45	0.00
P50	21.95	14.51	86.74	12.59
AVERAGE	149.19	124.41	133.37	133.37
MAX	1990.00	4704.82	1990.00	2000.00
STD DEV.	293.93	376.27	183.71	293.59

Table A-6. CTET Average 2017 Pre-Post Processing Summary

	Clustered	Declustered	E-Type	Simulated
COUNT	139.00	139.00	168720.00	16872000.00
MIN	0.18	0.05	0.30	0.00
P50	23.00	15.17	96.30	8.09
AVERAGE	160.11	137.93	134.17	134.17
MAX	1960.00	3046.86	1960.00	1960.00
STD DEV.	314.44	396.90	164.09	305.35

Table A-7. Interpolation Dataset for the 2017 200-ZP-1 Carbon Tetrachloride Plume

Well Name	Easting	Northing	Z	CTET Average	Type
299-W18-42	565788	135139	47.6	0.2	Characterization
299-W18-42	565788	135139	72.1	2.3	Characterization
299-W18-42	565788	135139	77.9	0.2	Characterization
299-W18-42	565788	135139	98.6	3.9	Characterization
299-W18-42	565788	135139	114.5	0.6	Characterization
299-W18-42	565788	135139	120.7	0.2	Characterization
299-W18-42	565788	135139	126.5	0.2	Characterization
299-W18-44	565812	135421	50.5	0.2	Characterization
299-W18-44	565812	135421	79.8	0.2	Characterization
299-W18-44	565812	135421	101.3	0.5	Characterization
299-W18-44	565812	135421	101.7	2.7	Characterization
299-W18-44	565812	135421	116.5	0.2	Characterization
299-W18-44	565812	135421	125.7	0.2	Characterization
299-W18-44	565812	135421	131.7	0.2	Characterization
299-W19-123	567512	134988	81.1	65.0	Characterization
299-W19-123	567512	134988	87.6	245.0	Characterization
299-W19-123	567512	134988	91.2	85.0	Characterization
299-W19-123	567512	134988	101.2	110.0	Characterization
299-W19-123	567512	134988	105.9	280.0	Characterization
299-W19-123	567512	134988	110.0	240.0	Characterization
299-W19-123	567512	134988	119.5	230.0	Characterization
299-W19-123	567512	134988	124.1	230.0	Characterization
299-W19-123	567512	134988	126.9	200.0	Characterization
299-W19-125	567720	135091	93.0	200.0	Characterization
299-W19-125	567720	135091	102.1	97.0	Characterization
299-W19-125	567720	135091	111.0	69.0	Characterization
299-W19-125	567720	135091	120.3	260.0	Characterization
299-W19-125	567720	135091	125.2	390.0	Characterization
299-W6-16	566853	137469	69.1	0.2	Characterization
299-W6-16	566853	137469	78.6	2.2	Characterization
299-W6-16	566853	137469	87.5	0.2	Characterization
299-W6-16	566853	137469	108.7	16.0	Characterization
299-W6-16	566853	137469	123.5	0.2	Characterization
299-W6-16	566853	137469	130.2	2.8	Characterization
699-36-63B	570684	134229	113.9	0.8	Characterization
299-W11-90	567307	136520	100.2	1123.8	PW
299-W11-92	566693	136352	106.3	207.0	PW
299-W11-96	567775	136772	105.0	1167.5	PW
299-W12-3	568322	136998	103.0	419.0	PW
299-W14-20	566909	136284	105.4	717.0	PW

Table A-7. Interpolation Dataset for the 2017 200-ZP-1 Carbon Tetrachloride Plume

Well Name	Easting	Northing	Z	CTET Average	Type
299-W14-21	567722	135890	93.6	388.0	PW
299-W14-73	567359	136205	97.6	806.0	PW
299-W15-225	566657	136109	105.8	107.5	PW
299-W17-2	566952	135806	110.0	562.7	PW
299-W17-3	566926	135325	106.3	198.3	PW
299-W19-114	567902	135013	116.7	63.1	PW
299-W22-90	566961	134483	125.5	80.2	PW
299-W22-92	567168	134030	125.6	69.7	PW
299-W5-1	568330	137321	105.9	194.8	PW
299-W6-15	567782	137076	102.1	984.5	PW
299-W10-1	566663	136735	137.4	340.0	Monitoring
299-W10-14	566017	136609	80.4	0.2	Monitoring
299-W10-27	566844	136442	132.2	210.0	Monitoring
299-W10-30	566083	136739	131.7	15.1	Monitoring
299-W10-31	566266	136968	131.2	7.5	Monitoring
299-W10-33	566773	136610	83.3	0.3	Monitoring
299-W11-13	567099	136424	106.8	93.0	Monitoring
299-W11-18	567182	137161	137.0	340.0	Monitoring
299-W11-43	567270	136971	85.0	137.0	Monitoring
299-W11-45	566993	136776	124.9	725.0	Monitoring
299-W11-47	566934	136681	121.4	780.0	Monitoring
299-W11-48	566882	136846	110.6	880.0	Monitoring
299-W11-87	568141	136609	104.2	1960.0	Monitoring
299-W11-88	567875	137113	79.4	6.8	Monitoring
299-W13-1	568149	136049	98.3	1500.0	Monitoring
299-W14-11	566902	136288	123.1	695.0	Monitoring
299-W14-13	566902	136282	133.0	560.0	Monitoring
299-W14-14	566898	136181	133.1	256.0	Monitoring
299-W14-71	567733	135568	91.2	412.0	Monitoring
299-W14-72	567328	135941	87.2	1200.0	Monitoring
299-W15-11	566412	136001	134.2	70.2	Monitoring
299-W15-152	566309	135550	132.1	5.0	Monitoring
299-W15-17	566307	135719	78.9	2.6	Monitoring
299-W15-33	566433	135967	135.1	60.0	Monitoring
299-W15-46	566752	135587	127.4	21.0	Monitoring
299-W15-49	566307	135973	131.2	25.1	Monitoring
299-W15-50	566793	135791	123.0	110.0	Monitoring
299-W15-7	566676	135920	122.3	50.6	Monitoring
299-W15-763	566809	136029	132.3	131.0	Monitoring
299-W15-765	566697	136373	132.1	32.0	Monitoring

Table A-7. Interpolation Dataset for the 2017 200-ZP-1 Carbon Tetrachloride Plume

Well Name	Easting	Northing	Z	CTET Average	Type
299-W15-83	566305	135826	132.0	28.0	Monitoring
299-W15-94	566308	135640	132.1	8.9	Monitoring
299-W18-1	566422	135465	113.8	4.8	Monitoring
299-W18-15	566380	134733	139.3	10.0	Monitoring
299-W18-16	566605	135426	131.1	23.0	Monitoring
299-W18-21	566098	134979	140.1	0.3	Monitoring
299-W18-22	566089	134990	72.6	1.0	Monitoring
299-W18-40	566723	134996	130.9	67.0	Monitoring
299-W19-105	567565	134745	129.8	34.8	Monitoring
299-W19-107	567998	135206	119.7	160.0	Monitoring
299-W19-34A	567674	135012	113.3	40.3	Monitoring
299-W19-34B	567663	135011	87.6	81.2	Monitoring
299-W19-36	567635	135017	133.4	23.0	Monitoring
299-W19-4	567950	135351	98.3	150.0	Monitoring
299-W19-41	566897	135005	133.4	99.9	Monitoring
299-W19-47	566895	135162	131.0	86.8	Monitoring
299-W19-48	567823	134926	126.9	6.8	Monitoring
299-W19-6	567133	134694	89.8	41.1	Monitoring
299-W21-2	568124	134574	129.5	25.0	Monitoring
299-W22-47	566909	134076	130.5	97.4	Monitoring
299-W22-72	567237	134207	129.8	46.9	Monitoring
299-W22-86	567187	134041	129.8	12.8	Monitoring
299-W22-87	567542	134540	129.7	14.0	Monitoring
299-W22-88	568046	134391	128.3	7.2	Monitoring
299-W23-19	566759	134167	133.6	71.8	Monitoring
299-W23-4	566628	134392	129.8	58.0	Monitoring
299-W26-13	566424	133294	132.1	0.5	Monitoring
299-W26-14	566683	133539	131.3	3.0	Monitoring
299-W27-2	566908	133670	81.2	3.7	Monitoring
299-W6-3	567118	137299	87.0	0.7	Monitoring
299-W6-6	567319	137639	87.3	0.3	Monitoring
299-W7-3	566292	137639	65.4	0.7	Monitoring
699-30-66	569991	132739	90.8	0.4	Monitoring
699-32-62	571010	133216	122.8	0.2	Monitoring
699-32-72A	567943	133363	110.2	0.6	Monitoring
699-32-76	566684	133138	129.4	0.4	Monitoring
699-33-75	566908	133662	129.6	5.4	Monitoring
699-33-76	566621	133600	130.2	3.2	Monitoring
699-34-61	571396	133810	125.4	0.4	Monitoring
699-35-66A	569858	134099	131.2	0.7	Monitoring

Table A-7. Interpolation Dataset for the 2017 200-ZP-1 Carbon Tetrachloride Plume

Well Name	Easting	Northing	Z	CTET Average	Type
699-36-61A	571395	134557	123.4	0.2	Monitoring
699-36-66B	569731	134469	125.5	2.3	Monitoring
699-36-70A	568467	134309	132.1	2.7	Monitoring
699-36-70B	568428	134626	128.6	8.4	Monitoring
699-37-66	569730	134797	125.2	1.5	Monitoring
699-38-61	571219	134997	122.4	0.2	Monitoring
699-38-65	570090	135040	137.7	1.1	Monitoring
699-38-70B	568469	135331	95.6	115.0	Monitoring
699-40-65	570057	135881	124.1	7.7	Monitoring
699-43-69	568967	136488	99.2	200.0	Monitoring
699-44-64	570391	136897	121.6	14.0	Monitoring
699-45-69C	568947	137234	107.5	22.0	Monitoring
699-47-60	571474	137969	120.8	0.3	Monitoring
699-48-71	568388	138057	128.4	210.0	Monitoring
699-48-77C	566469	138087	114.5	0.3	Monitoring
699-48-77D	566433	138119	137.2	0.3	Monitoring
699-49-100C	559304	138503	135.3	0.2	Monitoring
699-50-74	567360	138647	127.2	0.2	Monitoring
699-51-63	570664	139148	123.5	0.3	Monitoring

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
299-W10-1	566663.1	136734.6	137.4	886.7	1200	Monitoring
299-W10-14	566017.2	136608.9	80.4	0.1	0	Monitoring
299-W10-27	566844.0	136441.8	132.2	185.0	230	Monitoring
299-W10-30	566082.8	136739.3	131.7	7.1	7	Monitoring
299-W10-31	566266.4	136968.3	131.2	20.0	20	Monitoring
299-W10-33	566772.8	136610.2	83.3	0.3	0	Monitoring
299-W11-13	567099.4	136424.0	106.8	260.0	260	Monitoring
299-W11-18	567181.9	137161.5	137.0	297.0	297	Monitoring
299-W11-43	567269.7	136971.0	85.0	240.5	250	Monitoring
299-W11-45	566992.8	136775.6	124.9	996.7	1100	Monitoring
299-W11-47	566933.8	136680.7	121.4	1160.0	1220	Monitoring
299-W11-48	566882.0	136846.2	110.6	1000.0	1000	Monitoring
299-W11-49	567361.5	135924.7	112.4	880.0	880	Monitoring
299-W11-87	568141.1	136608.7	104.2	1990.0	2000	Monitoring
299-W11-88	567874.7	137113.1	79.4	0.4	1	Monitoring
299-W13-1	568148.7	136048.6	98.3	410.0	450	Monitoring
299-W14-11	566901.7	136287.6	123.1	1415.0	1510	Monitoring
299-W14-13	566901.7	136282.4	133.0	805.0	1000	Monitoring
299-W14-14	566898.4	136181.0	133.1	681.5	834	Monitoring
299-W14-20	566909.2	136284.5	105.4	720.0	720	Monitoring
299-W14-22	568324.7	136117.3	97.5	390.0	390	Monitoring
299-W14-71	567733.4	135567.8	91.2	654.0	680	Monitoring
299-W14-72	567328.4	135941.3	87.2	1200.0	1200	Monitoring
299-W14-73	567359.0	136204.6	97.6	835.0	840	Monitoring
299-W15-11	566412.3	136000.7	134.2	103.0	103	Monitoring
299-W15-152	566309.4	135550.0	132.1	7.3	10	Monitoring
299-W15-17	566306.9	135719.0	78.9	1.5	2	Monitoring
299-W15-33	566433.3	135966.7	135.1	101.0	120	Monitoring
299-W15-37	566716.5	135248.3	132.7	143.8	175	Monitoring
299-W15-42	566581.8	135627.0	129.4	104.0	120	Monitoring
299-W15-46	566752.2	135586.7	127.4	105.0	140	Monitoring
299-W15-49	566307.2	135972.9	131.2	73.6	74	Monitoring
299-W15-50	566793.5	135790.7	123.0	285.0	360	Monitoring
299-W15-7	566675.9	135920.2	122.3	461.0	546	Monitoring
299-W15-763	566809.2	136028.8	132.3	660.0	1000	Monitoring
299-W15-765	566697.0	136373.1	132.1	530.3	948	Monitoring
299-W15-83	566304.5	135826.2	132.0	15.1	21	Monitoring
299-W15-94	566307.6	135640.3	132.1	12.0	13	Monitoring
299-W18-1	566421.5	135465.2	113.8	8.6	11	Monitoring
299-W18-15	566380.0	134733.5	139.3	18.2	18	Monitoring

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
299-W18-16	566605.1	135425.7	131.1	58.0	58	Monitoring
299-W18-21	566097.7	134978.7	140.1	0.7	1	Monitoring
299-W18-22	566088.6	134990.2	72.6	1.1	1	Monitoring
299-W18-40	566723.3	134996.4	130.9	116.0	116	Monitoring
299-W19-101	567939.1	135014.1	128.7	18.6	24	Monitoring
299-W19-105	567565.2	134745.4	129.8	25.9	34	Monitoring
299-W19-107	567997.9	135205.7	119.7	82.0	82	Monitoring
299-W19-18	567360.6	135012.4	124.8	10.0	10	Monitoring
299-W19-34A	567673.6	135012.2	113.3	91.6	92	Monitoring
299-W19-34B	567662.9	135010.7	87.6	135.0	135	Monitoring
299-W19-35	567992.1	135015.2	135.2	42.0	42	Monitoring
299-W19-36	567634.7	135017.1	133.4	34.5	59	Monitoring
299-W19-39	567901.7	134886.7	131.5	63.4	70	Monitoring
299-W19-4	567949.9	135350.8	98.3	45.5	48	Monitoring
299-W19-41	566896.5	135004.5	133.4	99.0	99	Monitoring
299-W19-43	567699.2	135004.0	130.5	42.4	57	Monitoring
299-W19-46	567782.7	134842.5	130.3	13.2	17	Monitoring
299-W19-47	566895.3	135161.9	131.0	211.7	240	Monitoring
299-W19-48	567822.9	134926.0	126.9	49.8	59	Monitoring
299-W19-49	567568.0	134894.4	129.0	152.2	243	Monitoring
299-W19-6	567133.3	134693.8	89.8	45.7	46	Monitoring
299-W21-2	568124.4	134573.8	129.5	28.4	32	Monitoring
299-W22-113	566904.5	134192.8	128.2	85.3	97	Monitoring
299-W22-24P	567648.2	134410.9	44.0	0.3	0	Monitoring
299-W22-24S	567648.2	134410.9	101.1	0.3	0	Monitoring
299-W22-45	566945.2	134292.5	137.3	25.0	38	Monitoring
299-W22-47	566908.7	134076.3	130.5	114.0	121	Monitoring
299-W22-49	566904.4	134201.6	133.7	20.0	20	Monitoring
299-W22-69	567179.6	134347.8	129.4	38.0	42	Monitoring
299-W22-72	567237.4	134207.1	129.8	41.0	41	Monitoring
299-W22-83	567009.1	134092.5	132.0	101.4	130	Monitoring
299-W22-86	567186.7	134041.3	129.8	19.7	27	Monitoring
299-W22-87	567541.8	134539.9	129.7	19.0	20	Monitoring
299-W22-88	568046.5	134390.5	128.3	9.1	9	Monitoring
299-W22-95	567170.5	134549.1	126.0	70.3	93	Monitoring
299-W22-96	567351.9	134145.6	129.2	6.8	7	Monitoring
299-W23-15	566794.0	134127.2	137.6	74.8	92	Monitoring
299-W23-19	566759.1	134166.7	133.6	93.6	98	Monitoring
299-W23-21	566707.7	134294.0	132.1	86.0	88	Monitoring
299-W23-4	566628.2	134391.9	129.8	79.0	80	Monitoring

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
299-W26-13	566424.4	133293.6	132.1	0.6	1	Monitoring
299-W26-14	566682.7	133539.2	131.3	2.6	3	Monitoring
299-W27-2	566908.3	133670.4	81.2	5.6	6	Monitoring
299-W5-1	568329.7	137321.2	105.9	210.0	210	Monitoring
299-W6-3	567118.2	137299.1	87.0	0.1	0	Monitoring
299-W6-6	567318.7	137638.7	87.3	0.7	1	Monitoring
299-W7-3	566292.0	137638.6	65.4	0.6	1	Monitoring
699-30-66	569991.0	132739.2	90.8	0.5	1	Monitoring
699-32-62	571009.6	133215.9	122.8	0.1	0	Monitoring
699-32-72A	567942.7	133362.6	110.2	1.0	1	Monitoring
699-32-76	566683.9	133137.7	129.4	0.4	0	Monitoring
699-33-74	567472.7	133552.2	129.0	18.5	20	Monitoring
699-33-75	566907.8	133662.5	129.6	6.8	8	Monitoring
699-33-76	566621.2	133600.4	130.2	3.7	4	Monitoring
699-34-61	571395.9	133809.9	125.4	0.9	1	Monitoring
699-34-72	567860.0	133785.3	128.4	1.1	1	Monitoring
699-35-66A	569857.9	134099.2	131.2	0.9	1	Monitoring
699-35-78A	566063.6	134271.3	139.5	19.5	21	Monitoring
699-36-61A	571395.5	134557.1	123.4	0.5	1	Monitoring
699-36-66B	569731.3	134469.0	125.5	2.5	3	Monitoring
699-36-70A	568466.7	134308.8	132.1	3.2	4	Monitoring
699-36-70B	568427.8	134626.0	128.6	13.5	14	Monitoring
699-37-66	569730.3	134797.2	125.2	1.4	2	Monitoring
699-38-61	571219.1	134997.3	122.4	0.6	1	Monitoring
699-38-65	570090.2	135039.8	137.7	1.0	1	Monitoring
699-38-68A	569180.3	134931.6	132.0	4.4	7	Monitoring
699-38-70B	568469.1	135331.0	95.6	354.0	390	Monitoring
699-38-70C	569084.1	135325.6	103.0	21.8	28	Monitoring
699-40-62	571164.3	135764.4	125.0	0.8	1	Monitoring
699-40-65	570057.5	135881.2	124.1	4.4	5	Monitoring
699-43-69	568967.0	136488.5	99.2	220.0	220	Monitoring
699-44-64	570390.7	136897.4	121.6	8.9	10	Monitoring
699-45-69A	568729.3	137182.7	132.2	8.5	13	Monitoring
699-45-69C	568947.1	137233.8	107.5	46.3	52	Monitoring
699-47-60	571474.4	137968.7	120.8	0.7	1	Monitoring
699-48-71	568387.9	138056.9	128.4	172.5	174	Monitoring
699-48-77C	566469.0	138086.8	114.5	0.5	1	Monitoring
699-48-77D	566433.3	138119.3	137.2	0.5	1	Monitoring
699-49-100C	559303.7	138503.2	135.3	0.4	2	Monitoring
699-50-74	567359.5	138646.7	127.2	0.2	0	Monitoring

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
699-51-63	570664.4	139148.4	123.5	0.7	1	Monitoring
299-E11-1	571003.1	134505.3	105.3	0.2	0	Characterization
299-E11-1	571003.1	134505.3	111.4	0.1	0	Characterization
299-E11-1	571003.1	134505.3	117.5	0.4	0	Characterization
299-E11-1	571003.1	134505.3	120.6	0.1	0	Characterization
299-E20-1	570503.0	135199.8	112.3	0.1	0	Characterization
299-E20-1	570503.0	135199.8	115.4	0.1	0	Characterization
299-E20-2	570897.9	134895.8	110.2	0.1	0	Characterization
299-E20-2	570897.9	134895.8	116.2	0.1	0	Characterization
299-E20-2	570897.9	134895.8	119.3	0.1	0	Characterization
299-W11-97	568317.6	135875.9	59.9	0.1	0	Characterization
299-W11-97	568317.6	135875.9	66.2	1.2	1	Characterization
299-W11-97	568317.6	135875.9	72.3	2.0	2	Characterization
299-W11-97	568317.6	135875.9	78.6	1.1	1	Characterization
299-W11-97	568317.6	135875.9	84.8	11.0	11	Characterization
299-W11-97	568317.6	135875.9	90.5	565.0	570	Characterization
299-W11-97	568317.6	135875.9	98.2	590.0	590	Characterization
299-W11-97	568317.6	135875.9	103.1	180.0	180	Characterization
299-W11-97	568317.6	135875.9	110.4	110.0	110	Characterization
299-W11-97	568317.6	135875.9	121.4	13.0	13	Characterization
299-W13-2	568832.6	135819.2	66.4	75.0	75	Characterization
299-W13-2	568832.6	135819.2	72.8	73.0	79	Characterization
299-W13-2	568832.6	135819.2	79.3	93.0	93	Characterization
299-W13-2	568832.6	135819.2	85.6	100.0	100	Characterization
299-W13-2	568832.6	135819.2	92.4	150.0	150	Characterization
299-W13-2	568832.6	135819.2	98.1	140.0	140	Characterization
299-W13-2	568832.6	135819.2	105.1	60.0	60	Characterization
299-W13-2	568832.6	135819.2	110.7	54.0	54	Characterization
299-W13-2	568832.6	135819.2	116.8	54.0	54	Characterization
299-W13-2	568832.6	135819.2	123.0	68.0	68	Characterization
299-W15-228	565745.4	135711.5	49.7	0.3	0	Characterization
299-W15-228	565745.4	135711.5	75.5	3.8	4	Characterization
299-W15-228	565745.4	135711.5	81.6	5.9	6	Characterization
299-W15-228	565745.4	135711.5	87.7	5.8	6	Characterization
299-W15-228	565745.4	135711.5	93.8	7.6	8	Characterization
299-W15-228	565745.4	135711.5	100.0	5.7	6	Characterization
299-W15-228	565745.4	135711.5	105.8	3.6	4	Characterization
299-W15-228	565745.4	135711.5	112.0	7.6	8	Characterization
299-W15-228	565745.4	135711.5	118.3	4.8	5	Characterization
299-W15-228	565745.4	135711.5	123.8	3.9	4	Characterization

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
299-W15-228	565745.4	135711.5	130.5	1.0	1	Characterization
299-W15-229	566049.3	135678.8	74.8	17.0	17	Characterization
299-W15-229	566049.3	135678.8	99.3	1.7	2	Characterization
299-W15-229	566049.3	135678.8	132.2	0.4	0	Characterization
299-W18-260	566862.5	135196.9	106.2	271.0	271	Characterization
299-W18-260	566862.5	135196.9	112.2	272.0	272	Characterization
299-W18-260	566862.5	135196.9	118.2	250.0	250	Characterization
299-W18-260	566862.5	135196.9	124.3	195.0	195	Characterization
299-W18-260	566862.5	135196.9	129.8	72.4	72	Characterization
299-W18-41	566045.1	135048.5	56.7	0.1	0	Characterization
299-W18-41	566045.1	135048.5	75.1	0.3	0	Characterization
299-W18-41	566045.1	135048.5	80.5	6.3	6	Characterization
299-W18-41	566045.1	135048.5	86.7	11.0	11	Characterization
299-W18-41	566045.1	135048.5	92.7	14.0	14	Characterization
299-W18-41	566045.1	135048.5	98.8	2.2	2	Characterization
299-W18-41	566045.1	135048.5	105.1	0.1	0	Characterization
299-W18-41	566045.1	135048.5	111.0	0.1	0	Characterization
299-W18-41	566045.1	135048.5	120.5	1.7	2	Characterization
299-W18-41	566045.1	135048.5	126.5	0.3	0	Characterization
299-W18-41	566045.1	135048.5	132.5	0.1	0	Characterization
299-W19-111	567313.0	135547.0	87.9	260.0	260	Characterization
299-W19-111	567313.0	135547.0	94.0	730.0	730	Characterization
299-W19-111	567313.0	135547.0	100.1	190.0	190	Characterization
299-W19-111	567313.0	135547.0	106.0	190.0	190	Characterization
299-W19-111	567313.0	135547.0	112.1	290.0	290	Characterization
299-W19-111	567313.0	135547.0	118.2	295.0	300	Characterization
299-W19-111	567313.0	135547.0	124.3	240.0	240	Characterization
299-W19-113	567689.6	135008.2	109.2	120.0	120	Characterization
299-W19-113	567689.6	135008.2	115.4	26.0	26	Characterization
299-W19-113	567689.6	135008.2	121.4	160.0	160	Characterization
299-W19-113	567689.6	135008.2	127.1	32.0	32	Characterization
299-W19-114	567901.9	135013.2	94.8	130.0	130	Characterization
299-W19-114	567901.9	135013.2	103.9	76.0	76	Characterization
299-W19-114	567901.9	135013.2	110.1	34.0	34	Characterization
299-W19-114	567901.9	135013.2	116.3	43.0	43	Characterization
299-W19-114	567901.9	135013.2	122.4	55.0	55	Characterization
299-W19-114	567901.9	135013.2	126.8	4.2	4	Characterization
299-W5-2	568175.4	137621.1	81.2	200.0	200	Characterization
299-W5-2	568175.4	137621.1	87.0	225.0	230	Characterization
299-W5-2	568175.4	137621.1	91.0	290.0	290	Characterization

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
299-W5-2	568175.4	137621.1	93.2	280.0	280	Characterization
299-W5-2	568175.4	137621.1	101.7	0.1	0	Characterization
299-W5-2	568175.4	137621.1	108.3	230.0	230	Characterization
299-W5-2	568175.4	137621.1	111.4	200.0	200	Characterization
299-W5-2	568175.4	137621.1	118.8	200.0	200	Characterization
299-W5-2	568175.4	137621.1	123.7	230.0	230	Characterization
299-W6-15	567781.7	137076.4	81.1	210.0	210	Characterization
299-W6-15	567781.7	137076.4	86.6	420.0	420	Characterization
299-W6-15	567781.7	137076.4	92.7	580.0	580	Characterization
299-W6-15	567781.7	137076.4	111.0	1200.0	1200	Characterization
299-W6-15	567781.7	137076.4	123.1	750.0	750	Characterization
299-W7-13	566024.4	137636.3	80.6	3.7	4	Characterization
299-W7-13	566024.4	137636.3	107.9	17.0	17	Characterization
299-W7-13	566024.4	137636.3	128.8	4.7	5	Characterization
699-38-64	570189.6	135318.8	66.5	0.1	0	Characterization
699-38-64	570189.6	135318.8	71.7	0.1	0	Characterization
699-38-64	570189.6	135318.8	78.8	0.1	0	Characterization
699-38-64	570189.6	135318.8	85.4	0.1	0	Characterization
699-38-64	570189.6	135318.8	91.3	0.1	0	Characterization
699-38-64	570189.6	135318.8	116.2	1.3	1	Characterization
699-38-64	570189.6	135318.8	122.7	1.9	2	Characterization
699-40-67	569420.3	135815.7	67.3	1.2	1	Characterization
699-40-67	569420.3	135815.7	74.5	2.1	2	Characterization
699-40-67	569420.3	135815.7	80.3	1.0	1	Characterization
699-40-67	569420.3	135815.7	86.9	1.0	1	Characterization
699-40-67	569420.3	135815.7	92.6	16.5	17	Characterization
699-40-67	569420.3	135815.7	98.8	22.0	22	Characterization
699-40-67	569420.3	135815.7	118.8	40.0	40	Characterization
699-40-67	569420.3	135815.7	124.2	32.0	32	Characterization
699-46-68	569109.8	137600.9	83.9	29.0	29	Characterization
699-46-68	569109.8	137600.9	91.8	44.0	44	Characterization
699-46-68	569109.8	137600.9	98.8	20.0	20	Characterization
699-46-68	569109.8	137600.9	105.9	57.5	64	Characterization
699-46-68	569109.8	137600.9	124.9	1.0	1	Characterization
699-49-69	568829.7	137966.5	87.5	16.4	16	Characterization
699-49-69	568829.7	137966.5	93.8	21.9	22	Characterization
699-49-69	568829.7	137966.5	99.9	31.9	32	Characterization
699-49-69	568829.7	137966.5	105.9	30.0	30	Characterization
699-49-69	568829.7	137966.5	110.8	29.3	29	Characterization
699-49-69	568829.7	137966.5	118.3	11.9	12	Characterization

Table A-8. Interpolation Dataset for the 2014-2015 200-ZP-1 Carbon Tetrachloride

Well Name	Easting	Northing	Z	CTET Average	CTET Max	Type
699-49-69	568829.7	137966.5	124.2	12.8	13	Characterization
299-W17-2	566951.6	135806.2	110.0	1230.0	1230	PW
299-W11-90	567306.8	136519.7	100.2	1388.9	1389	PW
299-W11-92	566692.9	136351.8	106.3	880.0	880	PW

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-E11-1	571003	134505	105.3	17700.0	17700.0	Characterization
299-E11-1	571003	134505	111.4	8410.0	8410.0	Characterization
299-E11-1	571003	134505	117.5	22600.0	22600.0	Characterization
299-E11-1	571003	134505	120.6	20400.0	20400.0	Characterization
299-E20-1	570503	135200	112.3	177000.0	177000.0	Characterization
299-E20-1	570503	135200	115.4	186000.0	186000.0	Characterization
299-E20-1	570503	135200	118.6	167000.0	167000.0	Characterization
299-E20-2	570898	134896	110.2	33100.0	33100.0	Characterization
299-E20-2	570898	134896	116.2	20600.0	20600.0	Characterization
299-E20-2	570898	134896	119.3	37500.0	37500.0	Characterization
299-W11-97	568318	135876	59.9	124.0	124.0	Characterization
299-W11-97	568318	135876	66.2	26700.0	26700.0	Characterization
299-W11-97	568318	135876	72.3	23900.0	23900.0	Characterization
299-W11-97	568318	135876	78.6	23500.0	23500.0	Characterization
299-W11-97	568318	135876	84.8	20600.0	20600.0	Characterization
299-W11-97	568318	135876	90.5	25300.0	25300.0	Characterization
299-W11-97	568318	135876	98.2	30900.0	30900.0	Characterization
299-W11-97	568318	135876	103.1	27500.0	27500.0	Characterization
299-W11-97	568318	135876	110.4	27800.0	27800.0	Characterization
299-W11-97	568318	135876	115.3	32200.0	32200.0	Characterization
299-W11-97	568318	135876	121.4	56700.0	56700.0	Characterization
299-W13-2	568833	135819	66.4	24300.0	24300.0	Characterization
299-W13-2	568833	135819	72.8	24550.0	24800.0	Characterization
299-W13-2	568833	135819	79.3	26100.0	26100.0	Characterization
299-W13-2	568833	135819	85.6	27000.0	27000.0	Characterization
299-W13-2	568833	135819	92.4	21700.0	21700.0	Characterization
299-W13-2	568833	135819	98.1	23500.0	23500.0	Characterization
299-W13-2	568833	135819	105.1	27400.0	27400.0	Characterization
299-W13-2	568833	135819	110.7	25700.0	25700.0	Characterization
299-W13-2	568833	135819	116.8	29700.0	29700.0	Characterization
299-W13-2	568833	135819	123.0	24800.0	24800.0	Characterization
299-W15-228	565745	135711	49.7	146.0	146.0	Characterization
299-W15-228	565745	135711	75.5	13300.0	13300.0	Characterization
299-W15-228	565745	135711	81.6	12700.0	12700.0	Characterization
299-W15-228	565745	135711	87.7	11800.0	11800.0	Characterization
299-W15-228	565745	135711	90.9	35400.0	35400.0	Characterization
299-W15-228	565745	135711	93.8	24300.0	24300.0	Characterization
299-W15-228	565745	135711	100.0	73000.0	73000.0	Characterization
299-W15-228	565745	135711	105.8	96100.0	96100.0	Characterization

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-W15-228	565745	135711	112.0	33600.0	33600.0	Characterization
299-W15-228	565745	135711	118.3	80600.0	80600.0	Characterization
299-W15-228	565745	135711	123.8	106000.0	106000.0	Characterization
299-W15-228	565745	135711	130.5	103000.0	103000.0	Characterization
299-W18-260	566863	135197	106.2	4400.0	4400.0	Characterization
299-W18-260	566863	135197	112.2	35300.0	35300.0	Characterization
299-W18-260	566863	135197	118.2	43400.0	43400.0	Characterization
299-W18-260	566863	135197	124.3	53100.0	53100.0	Characterization
299-W18-260	566863	135197	129.8	57100.0	57100.0	Characterization
299-W18-41	566045	135049	45.7	26100.0	26100.0	Characterization
299-W18-41	566045	135049	52.8	37600.0	37600.0	Characterization
299-W18-41	566045	135049	56.7	292.0	292.0	Characterization
299-W18-41	566045	135049	75.1	33900.0	33900.0	Characterization
299-W18-41	566045	135049	80.5	52700.0	52700.0	Characterization
299-W18-41	566045	135049	86.7	25700.0	25700.0	Characterization
299-W18-41	566045	135049	93.0	25200.0	25200.0	Characterization
299-W18-41	566045	135049	99.1	68200.0	68200.0	Characterization
299-W18-41	566045	135049	105.1	72600.0	72600.0	Characterization
299-W18-41	566045	135049	111.0	76100.0	76100.0	Characterization
299-W18-41	566045	135049	120.5	83700.0	83700.0	Characterization
299-W18-41	566045	135049	126.5	38300.0	38500.0	Characterization
299-W18-41	566045	135049	132.5	36700.0	36700.0	Characterization
299-W19-111	567313	135547	87.9	15900.0	15900.0	Characterization
299-W19-111	567313	135547	94.0	7970.0	7970.0	Characterization
299-W19-111	567313	135547	100.1	7530.0	7530.0	Characterization
299-W19-111	567313	135547	106.0	7530.0	7530.0	Characterization
299-W19-111	567313	135547	112.1	3720.0	3720.0	Characterization
299-W19-111	567313	135547	118.2	2685.0	2690.0	Characterization
299-W19-111	567313	135547	124.3	2470.0	2470.0	Characterization
299-W19-113	567690	135008	109.2	27000.0	27000.0	Characterization
299-W19-113	567690	135008	115.4	166000.0	166000.0	Characterization
299-W19-113	567690	135008	121.4	633000.0	633000.0	Characterization
299-W19-113	567690	135008	127.1	1250000.0	1250000.0	Characterization
299-W19-114	567902	135013	94.8	30500.0	30500.0	Characterization
299-W19-114	567902	135013	103.9	203000.0	203000.0	Characterization
299-W19-114	567902	135013	110.1	677000.0	677000.0	Characterization
299-W19-114	567902	135013	116.3	549000.0	549000.0	Characterization
299-W19-114	567902	135013	122.4	660000.0	660000.0	Characterization
299-W19-114	567902	135013	126.8	68200.0	68200.0	Characterization

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-W23-236	566799	134128	120.2	7880.0	7880.0	Characterization
299-W23-236	566799	134128	130.2	7750.0	7750.0	Characterization
299-W5-2	568175	137621	81.2	664000.0	664000.0	Characterization
299-W5-2	568175	137621	87.0	708000.0	708000.0	Characterization
299-W5-2	568175	137621	91.0	753000.0	753000.0	Characterization
299-W5-2	568175	137621	93.2	753000.0	753000.0	Characterization
299-W5-2	568175	137621	101.7	97400.0	97400.0	Characterization
299-W5-2	568175	137621	108.3	708000.0	708000.0	Characterization
299-W5-2	568175	137621	111.4	443000.0	443000.0	Characterization
299-W5-2	568175	137621	118.8	620000.0	620000.0	Characterization
299-W5-2	568175	137621	123.7	239000.0	239000.0	Characterization
299-W6-15	567782	137076	81.1	169000.0	169000.0	Characterization
299-W6-15	567782	137076	86.6	216000.0	216000.0	Characterization
299-W6-15	567782	137076	92.7	289000.0	289000.0	Characterization
299-W6-15	567782	137076	111.0	395000.0	395000.0	Characterization
299-W6-15	567782	137076	123.1	289000.0	289000.0	Characterization
699-38-64	570190	135319	66.5	25200.0	25200.0	Characterization
699-38-64	570190	135319	78.8	37200.0	37200.0	Characterization
699-38-64	570190	135319	85.4	40300.0	40300.0	Characterization
699-38-64	570190	135319	91.3	46500.0	46500.0	Characterization
699-38-64	570190	135319	116.2	258000.0	343000.0	Characterization
699-38-64	570190	135319	122.7	212000.0	212000.0	Characterization
699-40-67	569420	135816	67.3	14800.0	14800.0	Characterization
699-40-67	569420	135816	74.5	28300.0	28300.0	Characterization
699-40-67	569420	135816	80.3	31300.0	31300.0	Characterization
699-40-67	569420	135816	86.9	35600.0	35600.0	Characterization
699-40-67	569420	135816	92.6	29350.0	29900.0	Characterization
699-40-67	569420	135816	98.8	28700.0	28700.0	Characterization
699-40-67	569420	135816	118.8	97400.0	97400.0	Characterization
699-40-67	569420	135816	124.2	113000.0	113000.0	Characterization
699-46-68	569110	137601	83.9	240000.0	240000.0	Characterization
699-46-68	569110	137601	91.8	245000.0	245000.0	Characterization
699-46-68	569110	137601	98.8	248000.0	248000.0	Characterization
699-46-68	569110	137601	105.9	211000.0	213000.0	Characterization
699-46-68	569110	137601	124.9	30900.0	30900.0	Characterization
699-49-69	568830	137967	87.5	122000.0	122000.0	Characterization
699-49-69	568830	137967	93.8	131000.0	131000.0	Characterization
699-49-69	568830	137967	99.9	188500.0	190000.0	Characterization
699-49-69	568830	137967	105.9	186000.0	186000.0	Characterization

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
699-49-69	568830	137967	110.8	184000.0	184000.0	Characterization
699-49-69	568830	137967	118.3	174000.0	174000.0	Characterization
699-49-69	568830	137967	124.2	165000.0	165000.0	Characterization
299-W10-1	566663	136735	137.4	77300.0	97800.0	Monitoring
299-W10-14	566017	136609	80.4	22000.0	22000.0	Monitoring
299-W10-24	566885	136799	132.6	168666.7	170000.0	Monitoring
299-W10-26	566843	136401	133.2	275000.0	465000.0	Monitoring
299-W10-27	566844	136442	132.2	238166.7	370000.0	Monitoring
299-W10-28	566702	136710	132.1	140500.0	151000.0	Monitoring
299-W10-29	566083	136829	131.6	31150.0	31900.0	Monitoring
299-W10-30	566083	136739	131.7	32250.0	35900.0	Monitoring
299-W10-31	566266	136968	131.2	46500.0	48700.0	Monitoring
299-W10-33	566773	136610	83.3	15000.0	15400.0	Monitoring
299-W11-13	567099	136424	106.8	303000.0	303000.0	Monitoring
299-W11-18	567182	137161	137.0	109000.0	109000.0	Monitoring
299-W11-39	566908	136780	131.8	98050.0	112000.0	Monitoring
299-W11-40	566927	136710	131.8	256250.0	456000.0	Monitoring
299-W11-41	566936	136678	132.2	257000.0	332000.0	Monitoring
299-W11-42	566920	136746	132.7	175750.0	193000.0	Monitoring
299-W11-43	567270	136971	85.0	462500.0	478000.0	Monitoring
299-W11-45	566993	136776	124.9	244500.0	265000.0	Monitoring
299-W11-47	566934	136681	121.4	207250.0	257000.0	Monitoring
299-W11-48	566882	136846	110.6	277000.0	283000.0	Monitoring
299-W11-49	567362	135925	112.4	27000.0	27000.0	Monitoring
299-W11-87	568141	136609	104.2	69300.0	73500.0	Monitoring
299-W11-88	567875	137113	79.4	35233.3	44100.0	Monitoring
299-W13-1	568149	136049	98.3	16650.0	16800.0	Monitoring
299-W14-11	566902	136288	123.1	508250.0	735000.0	Monitoring
299-W14-13	566902	136282	133.0	415000.0	536000.0	Monitoring
299-W14-14	566898	136181	133.1	120875.0	159000.0	Monitoring
299-W14-15	566900	136231	132.3	171000.0	205000.0	Monitoring
299-W14-16	567001	136318	132.1	273500.0	443000.0	Monitoring
299-W14-17	567007	136218	132.1	128000.0	132000.0	Monitoring
299-W14-18	566897	136344	132.5	300000.0	345000.0	Monitoring
299-W14-19	566899	136135	131.4	112250.0	127000.0	Monitoring
299-W14-22	568325	136117	97.5	32300.0	32300.0	Monitoring
299-W14-72	567328	135941	87.2	28200.0	28200.0	Monitoring
299-W14-73	567359	136205	97.6	73050.0	79700.0	Monitoring
299-W15-11	566412	136001	134.2	101000.0	101000.0	Monitoring

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-W15-152	566309	135550	132.1	113600.0	120000.0	Monitoring
299-W15-17	566307	135719	78.9	23966.7	24900.0	Monitoring
299-W15-224	566308	135926	131.2	101300.0	108000.0	Monitoring
299-W15-30	566305	135749	136.7	110000.0	113000.0	Monitoring
299-W15-33	566433	135967	135.1	101500.0	103000.0	Monitoring
299-W15-37	566716	135248	132.7	71050.0	76100.0	Monitoring
299-W15-42	566582	135627	129.4	102500.0	105000.0	Monitoring
299-W15-44	566685	136066	132.9	81925.0	93000.0	Monitoring
299-W15-46	566752	135587	127.4	104000.0	107000.0	Monitoring
299-W15-49	566307	135973	131.2	77500.0	77500.0	Monitoring
299-W15-50	566793	135791	123.0	100450.0	104000.0	Monitoring
299-W15-7	566676	135920	122.3	76400.0	105000.0	Monitoring
299-W15-763	566809	136029	132.3	103580.0	124000.0	Monitoring
299-W15-765	566697	136373	132.1	49000.0	90300.0	Monitoring
299-W15-83	566305	135826	132.0	107733.3	114000.0	Monitoring
299-W15-94	566308	135640	132.1	109250.0	114000.0	Monitoring
299-W18-1	566422	135465	113.8	100500.0	120000.0	Monitoring
299-W18-15	566380	134733	139.3	55100.0	58400.0	Monitoring
299-W18-16	566605	135426	131.1	810000.0	810000.0	Monitoring
299-W18-21	566098	134979	140.1	35400.0	42500.0	Monitoring
299-W18-22	566089	134990	72.6	15170.0	20600.0	Monitoring
299-W18-260	566863	135197	127.4	64600.0	70800.0	Monitoring
299-W18-40	566723	134996	130.9	68600.0	68600.0	Monitoring
299-W19-101	567939	135014	128.7	34500.0	39300.0	Monitoring
299-W19-105	567565	134745	129.8	11345.0	14600.0	Monitoring
299-W19-107	567998	135206	119.7	112000.0	112000.0	Monitoring
299-W19-12	566897	135059	135.6	85750.0	88500.0	Monitoring
299-W19-18	567361	135012	124.8	58400.0	58400.0	Monitoring
299-W19-34A	567674	135012	113.3	34000.0	34000.0	Monitoring
299-W19-35	567992	135015	135.2	100000.0	100000.0	Monitoring
299-W19-36	567635	135017	133.4	899000.0	1010000.0	Monitoring
299-W19-39	567902	134887	131.5	61875.0	66400.0	Monitoring
299-W19-4	567950	135351	98.3	109950.0	165000.0	Monitoring
299-W19-41	566897	135005	133.4	30720.0	36000.0	Monitoring
299-W19-42	566897	135123	133.0	52420.0	57500.0	Monitoring
299-W19-43	567699	135004	130.5	2307500.0	3190000.0	Monitoring
299-W19-44	566897	135042	131.1	64275.0	68600.0	Monitoring
299-W19-45	566898	135088	132.0	106200.0	111000.0	Monitoring
299-W19-46	567783	134842	130.3	30175.0	34600.0	Monitoring

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-W19-47	566895	135162	131.0	66940.0	68200.0	Monitoring
299-W19-48	567823	134926	126.9	67180.0	73900.0	Monitoring
299-W19-49	567568	134894	129.0	37300.0	39000.0	Monitoring
299-W19-6	567133	134694	89.8	3720.0	3720.0	Monitoring
299-W21-2	568124	134574	129.5	40650.0	41000.0	Monitoring
299-W22-113	566905	134193	128.2	50300.0	53100.0	Monitoring
299-W22-115	566939	134292	127.9	70800.0	70800.0	Monitoring
299-W22-116	566901	134140	127.2	70800.0	70800.0	Monitoring
299-W22-24P	567648	134411	44.0	311.0	311.0	Monitoring
299-W22-45	566945	134293	137.3	107000.0	108000.0	Monitoring
299-W22-47	566909	134076	130.5	11532.5	16000.0	Monitoring
299-W22-49	566904	134202	133.7	63700.0	63700.0	Monitoring
299-W22-50	566904	134140	135.4	73500.0	73500.0	Monitoring
299-W22-69	567180	134348	129.4	21550.0	21700.0	Monitoring
299-W22-72	567237	134207	129.8	34400.0	37300.0	Monitoring
299-W22-80	566843	134126	132.1	11900.0	12400.0	Monitoring
299-W22-81	567000	134354	131.5	29300.0	30800.0	Monitoring
299-W22-82	567005	134167	131.9	64850.0	68200.0	Monitoring
299-W22-83	567009	134093	132.0	75100.0	103000.0	Monitoring
299-W22-84	566979	134548	131.7	26200.0	28100.0	Monitoring
299-W22-85	566903	134261	132.2	45275.0	47400.0	Monitoring
299-W22-86	567187	134041	129.8	28175.0	32800.0	Monitoring
299-W22-87	567542	134540	129.7	11605.0	14400.0	Monitoring
299-W22-88	568046	134391	128.3	7790.0	7790.0	Monitoring
299-W22-89	566907	134032	129.8	12850.0	13700.0	Monitoring
299-W22-93	566949	134486	127.0	53100.0	53100.0	Monitoring
299-W22-94	567010	134430	127.8	15632.5	21200.0	Monitoring
299-W22-95	567171	134549	126.0	47611.1	53100.0	Monitoring
299-W22-96	567352	134146	129.2	22200.0	23200.0	Monitoring
299-W23-15	566794	134127	137.6	8010.0	8100.0	Monitoring
299-W23-19	566759	134167	133.6	142916.7	199000.0	Monitoring
299-W23-20	566718	134446	132.1	11450.0	11800.0	Monitoring
299-W23-21	566708	134294	132.1	82466.7	87200.0	Monitoring
299-W23-4	566628	134392	129.8	27200.0	27200.0	Monitoring
299-W26-13	566424	133294	132.1	28400.0	30500.0	Monitoring
299-W26-14	566683	133539	131.3	5060.0	5310.0	Monitoring
299-W27-2	566908	133670	81.2	5685.0	6060.0	Monitoring
299-W5-1	568330	137321	105.9	235000.0	235000.0	Monitoring
299-W6-3	567118	137299	87.0	243000.0	243000.0	Monitoring

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
299-W6-6	567319	137639	87.3	30350.0	36800.0	Monitoring
299-W7-3	566292	137639	65.4	16033.3	18100.0	Monitoring
299-W9-2	565742	136873	131.7	26300.0	26600.0	Monitoring
699-19-88	563131	129414	166.9	1625.5	1950.0	Monitoring
699-26-89	562779	131375	139.5	3110.0	3110.0	Monitoring
699-30-66	569991	132739	90.8	21625.0	22600.0	Monitoring
699-32-62	571010	133216	122.8	20500.0	20500.0	Monitoring
699-32-72A	567943	133363	110.2	17300.0	17300.0	Monitoring
699-32-76	566684	133138	129.4	11740.0	12300.0	Monitoring
699-33-74	567473	133552	129.0	12250.0	13700.0	Monitoring
699-33-75	566908	133662	129.6	5372.0	5750.0	Monitoring
699-33-76	566621	133600	130.2	7095.0	7530.0	Monitoring
699-34-61	571396	133810	125.4	18800.0	19300.0	Monitoring
699-34-72	567860	133785	128.4	34100.0	34300.0	Monitoring
699-34-88	563012	133950	144.4	34200.0	34200.0	Monitoring
699-35-66A	569858	134099	131.2	23525.0	26200.0	Monitoring
699-35-78A	566064	134271	139.5	8410.0	8410.0	Monitoring
699-36-61A	571395	134557	123.4	17700.0	17700.0	Monitoring
699-36-66B	569731	134469	125.5	51090.0	54000.0	Monitoring
699-36-70A	568467	134309	132.1	26766.7	29100.0	Monitoring
699-36-70B	568428	134626	128.6	91425.0	93400.0	Monitoring
699-37-66	569730	134797	125.2	148400.0	160000.0	Monitoring
699-38-61	571219	134997	122.4	24500.0	25200.0	Monitoring
699-38-65	570090	135040	137.7	181500.0	190000.0	Monitoring
699-38-68A	569180	134932	132.0	181000.0	181000.0	Monitoring
699-38-70B	568469	135331	95.6	20750.0	23400.0	Monitoring
699-38-70C	569084	135326	103.0	157500.0	178000.0	Monitoring
699-40-62	571164	135764	125.0	128000.0	128000.0	Monitoring
699-40-65	570057	135881	124.1	215000.0	216000.0	Monitoring
699-43-69	568967	136488	99.2	31800.0	31800.0	Monitoring
699-44-64	570391	136897	121.6	61050.0	63700.0	Monitoring
699-45-69A	568729	137183	132.2	45550.0	67300.0	Monitoring
699-45-69C	568947	137234	107.5	199666.7	207000.0	Monitoring
699-47-60	571474	137969	120.8	40550.0	41300.0	Monitoring
699-48-71	568388	138057	128.4	363000.0	363000.0	Monitoring
699-48-77C	566469	138087	114.5	562.6	664.0	Monitoring
699-48-77D	566433	138119	137.2	2711.4	3010.0	Monitoring
699-49-79	565771	138271	136.1	46900.0	46900.0	Monitoring
699-50-74	567360	138647	127.2	7770.0	8010.0	Monitoring

Table A-9. Interpolation Dataset for the 2014-2015 200-ZP-1 Nitrate Plume

Well Name	Easting	Northing	Z	Nitrate Average	Nitrate Max	Type
699-50-85	564130	138669	66.4	22500.0	22500.0	Monitoring
699-51-63	570664	139148	123.5	24300.0	24500.0	Monitoring
699-51-75	566978	138906	131.8	4230.0	4230.0	Monitoring
699-55-76	566723	140226	128.0	12400.0	12400.0	Monitoring
699-55-89	562887	140199	128.3	5800.0	5800.0	Monitoring

Appendix B

Software and Parameter Information for ECF-200W-18-0028

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1 Software and Parameters

This appendix outlines the inputs prepared to the software used to implement the workflow described for simulating carbon tetrachloride and nitrate concentrations. Calculations were performed using publicly available GSLIB software (Deutsch & Journel, 1998). GSLIB software is executed via BASH scripting (GNU bash, version 4.4.12). Plotting, additional calculations and data manipulation is performed using the Python programming language (version 3.6.3, Anaconda distribution).

Six workflows are outlined in the tables that follow. The first three provide parameters for simulating the CTET plume based on four different datasets considered: average values from 2014-2015, average values from 2014-2015 with three pumping wells included in the dataset, maximum values from 2014-2015 and average values of 2017 data. Two nitrate workflows are described for simulating the nitrate plume based on average and maximum data values collected in 2014 and 2015. The name of each program is provided in bold, followed by their parameters.

1.1 Carbon Tetrachloride Average 2014-2015

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
ctet_average.dat                        -file with data
1   2   0   4                           -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                      -  trimming limits
declus.sum                              -file for summary output
declus.out                              -file for output with data & weights
1   1.0                                 -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                       -0=look for minimum declustered mean (1=max)
699  1.0  700.0                         -number of cell sizes, min size, max size
5                                       -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                              -file with data
1  2  3  4  0                           -columns for X, Y, Z, Var, and rock type
0  0  0                                 -number valid RTs and their integer codes
-1.0e21   1.0e21                        -trimming limits
10                                      -number of NN for local average
dspk_declus.out                         -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                       -file with data
6   5                                 -  columns for variable and weight
-1.0e21   1.0e21                      -  trimming limits
0                                     -1=transform according to specified ref. dist.
../histsmth/histsmth.out              -  file with reference dist.
```

```
1   2                                   -  columns for variable and weight
nscore.out                              -file for output
nscore.trn                              -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                              -file with data
1  2  3  7  0  0                        -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                       -  trimming limits
0                                       -transform the data (0=no, 1=yes)
sgsim.trn                               -  file for output trans table
0                                       -  consider ref. dist (0=no, 1=yes)
histsmth.out                            -  file with ref. dist distribution
1  2                                    -  columns for vr and wt
0.0    15.0                             -  zmin,zmax(tail extrapolation)
1       0.0                             -  lower tail option, parameter
1      15.0                             -  upper tail option, parameter
0                                       -debugging level: 0,1,2,3
junk.junk                               -file for debugging output
sgsim.out                               -file for simulation output
10o                                     -number of realizations to generate
120    565205.0    60.                  -nx,xmn,xsiz
100    133045.0    60.                  -ny,ymn,ysiz
20    40    5.0                         -nz,zmn,zsiz
69069                                   -random number seed
2     40                                -min and max original data for sim
12                                      -number of simulated nodes to use
1                                       -assign data to nodes (0=no, 1=yes)
1     3                                 -multiple grid search (0=no, 1=yes),num
0                                       -maximum data per octant (0=not used)
4500.0  1800.0  20.0                    -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                        -angles for search ellipsoid
121    101    21                       -size of covariance lookup table
0     0.60   1.0                        -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                       -  file with LVM, EXDR, or COLC variable
4                                       -  column for secondary variable
1    0.01                               -nst, nugget effect
1    0.99  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
     2500.0   2500.0  80.0              -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                               -file with data
1                                       -  column with Gaussian variable
-1.0e21   1.0e21                        -  trimming limits
sgsim_backtr.out                        -file for output
../02_nscore/nscore.trn                 -file with input transformation table
0.0 1960.0                              -minimum and maximum data value
1    0.0                                -lower tail option and parameter
1   60.0                                -upper tail option and parameter
```

clipgrid.exe

```
                  Parameters for CLIPGRID
                  ***********************

START OF PARAMETERS:
sgsim.out                                 -input  grid file
sgsim_clipped.out                         -output grid file
 80   5205.0   10.0                       -nx, xmn, xsiz
 90   3605.0   10.0                       -ny, ymn, ysiz
23                                        -Number of vertices
5410. 3800.                               -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                  Parameters for POSTSIM
                  **********************

START OF PARAMETERS:
sgsim_clipped.out                     -file with realizations
100      2                            -   number of realizations, column number
-0.0001   1.0e21                      -   trimming limits
120   100   20                        -nx, ny, nz
postsim_p100.out                      -file for output array(s)
3   1.00                              -output option, output parameter
3  10 11 12                           -if 7,  number of categories, categories
kt3d.out                              -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

1.2 Carbon Tetrachloride Max 2014-2015

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
ctet_max.dat                          -file with data
1   2   0   4                             -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                        -  trimming limits
declus.sum                                -file for summary output
declus.out                                -file for output with data & weights
1   1.0                                   -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                         -0=look for minimum declustered mean (1=max)
699  1.0  700.0                          -number of cell sizes, min size, max size
5                                         -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                                -file with data
1  2  3  4  0                            -columns for X, Y, Z, Var, and rock type
0  0  0                                   -number valid RTs and their integer codes
-1.0e21   1.0e21                          -trimming limits
10                                        -number of NN for local average
dspk_declus.out                           -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                         -file with data
6   5                                   -  columns for variable and weight
-1.0e21   1.0e21                        -  trimming limits
0                                       -1=transform according to specified ref. dist.
../histsmth/histsmth.out                -  file with reference dist.
1   2                                   -  columns for variable and weight
nscore.out                              -file for output
nscore.trn                              -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                            -file with data
1  2  3  7  0  0                      -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                     -  trimming limits
0                                     -transform the data (0=no, 1=yes)
sgsim.trn                             -  file for output trans table
0                                     -  consider ref. dist (0=no, 1=yes)
histsmth.out                          -  file with ref. dist distribution
1  2                                  -  columns for vr and wt
0.0    15.0                           -  zmin,zmax(tail extrapolation)
1       0.0                           -  lower tail option, parameter
1      15.0                           -  upper tail option, parameter
0                                     -debugging level: 0,1,2,3
junk.junk                             -file for debugging output
sgsim.out                             -file for simulation output
10o                                   -number of realizations to generate
120    565205.0    60.                -nx,xmn,xsiz
100    133045.0    60.                -ny,ymn,ysiz
20    40    5.0                       -nz,zmn,zsiz
69069                                 -random number seed
2     40                              -min and max original data for sim
12                                    -number of simulated nodes to use
1                                     -assign data to nodes (0=no, 1=yes)
1     3                               -multiple grid search (0=no, 1=yes),num
0                                     -maximum data per octant (0=not used)
4500.0  1800.0  20.0                  -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                      -angles for search ellipsoid
121    101    21                      -size of covariance lookup table
0     0.60   1.0                      -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                     -  file with LVM, EXDR, or COLC variable
4                                     -  column for secondary variable
1    0.01                             -nst, nugget effect
1    0.99  0.0   0.0   0.0            -it,cc,ang1,ang2,ang3
     2500.0   2500.0  80.0            -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                             -file with data
1                                     -  column with Gaussian variable
-1.0e21   1.0e21                      -  trimming limits
sgsim_backtr.out                      -file for output
../02_nscore/nscore.trn               -file with input transformation table
0.0 1960.0                            -minimum and maximum data value
1    0.0                              -lower tail option and parameter
1   60.0                              -upper tail option and parameter
```

clipgrid.exe

```
                 Parameters for CLIPGRID
                 ***********************

START OF PARAMETERS:
sgsim.out                               -input  grid file
sgsim_clipped.out                       -output grid file
 80   5205.0   10.0                     -nx, xmn, xsiz
 90   3605.0   10.0                     -ny, ymn, ysiz
23                                      -Number of vertices
5410. 3800.                             -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                 Parameters for POSTSIM
                 **********************

START OF PARAMETERS:
sgsim_clipped.out                     -file with realizations
100      2                            -   number of realizations, column number
-0.0001   1.0e21                      -   trimming limits
120   100   20                        -nx, ny, nz
postsim_p100.out                      -file for output array(s)
3   1.00                              -output option, output parameter
3  10 11 12                           -if 7,  number of categories, categories
kt3d.out                              -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

1.3 Carbon Tetrachloride Average (with Wells) 2014-2015

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
ctet_average_wells.dat                    -file with data
1   2   0   4                           -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                      -  trimming limits
declus.sum                              -file for summary output
declus.out                              -file for output with data & weights
1   1.0                                 -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                       -0=look for minimum declustered mean (1=max)
699  1.0  700.0                         -number of cell sizes, min size, max size
5                                       -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                              -file with data
1  2  3  4  0                          -columns for X, Y, Z, Var, and rock type
0  0  0                                 -number valid RTs and their integer codes
-1.0e21   1.0e21                        -trimming limits
10                                      -number of NN for local average
dspk_declus.out                         -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                        -file with data
6   5                                  -  columns for variable and weight
-1.0e21   1.0e21                       -  trimming limits
0                                      -1=transform according to specified ref. dist.
../histsmth/histsmth.out               -  file with reference dist.
1   2                                  -  columns for variable and weight
nscore.out                             -file for output
nscore.trn                             -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                              -file with data
1  2  3  7  0  0                       -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                       -  trimming limits
0                                       -transform the data (0=no, 1=yes)
sgsim.trn                               -  file for output trans table
0                                       -  consider ref. dist (0=no, 1=yes)
histsmth.out                            -  file with ref. dist distribution
1  2                                    -  columns for vr and wt
0.0    15.0                             -  zmin,zmax(tail extrapolation)
1       0.0                             -  lower tail option, parameter
1      15.0                             -  upper tail option, parameter
0                                       -debugging level: 0,1,2,3
junk.junk                               -file for debugging output
sgsim.out                               -file for simulation output
10o                                     -number of realizations to generate
120    565205.0    60.                  -nx,xmn,xsiz
100    133045.0    60.                  -ny,ymn,ysiz
20    40    5.0                         -nz,zmn,zsiz
69069                                   -random number seed
2     40                                -min and max original data for sim
12                                      -number of simulated nodes to use
1                                       -assign data to nodes (0=no, 1=yes)
1     3                                 -multiple grid search (0=no, 1=yes),num
0                                       -maximum data per octant (0=not used)
4500.0  1800.0  20.0                    -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                        -angles for search ellipsoid
121    101    21                       -size of covariance lookup table
0     0.60   1.0                       -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                       -  file with LVM, EXDR, or COLC variable
4                                       -  column for secondary variable
2    0.01                               -nst, nugget effect
1    0.25  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         2800.0   2800.0  18.0          -a_hmax, a_hmin, a_vert
1    0.74  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         2800.0   2800.0  200.0         -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                               -file with data
1                                       -  column with Gaussian variable
-1.0e21   1.0e21                        -  trimming limits
sgsim_backtr.out                        -file for output
../02_nscore/nscore.trn                 -file with input transformation table
0.0 1960.0                              -minimum and maximum data value
1    0.0                                -lower tail option and parameter
1   60.0                                -upper tail option and parameter
```

clipgrid.exe

```
                 Parameters for CLIPGRID
                 ***********************

START OF PARAMETERS:
sgsim.out                                -input  grid file
sgsim_clipped.out                        -output grid file
 80   5205.0   10.0                      -nx, xmn, xsiz
 90   3605.0   10.0                      -ny, ymn, ysiz
23                                       -Number of vertices
5410. 3800.                              -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                 Parameters for POSTSIM
                 **********************

START OF PARAMETERS:
sgsim_clipped.out                    -file with realizations
100      2                           -   number of realizations, column number
-0.0001   1.0e21                     -   trimming limits
120   100   20                       -nx, ny, nz
postsim_p100.out                     -file for output array(s)
3   1.00                             -output option, output parameter
3  10 11 12                          -if 7,  number of categories, categories
kt3d.out                             -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

1.4 Carbon Tetrachloride Average 2017

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
ctet_average2017.dat                      -file with data
1   2   0   4                            -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                        -  trimming limits
declus.sum                                -file for summary output
declus.out                                -file for output with data & weights
1   1.0                                   -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                         -0=look for minimum declustered mean (1=max)
699  1.0  700.0                           -number of cell sizes, min size, max size
5                                         -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                                -file with data
1  2  3  4  0                            -columns for X, Y, Z, Var, and rock type
0  0  0                                   -number valid RTs and their integer codes
-1.0e21   1.0e21                          -trimming limits
10                                        -number of NN for local average
dspk_declus.out                           -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                          -file with data
6   5                                    -  columns for variable and weight
-1.0e21   1.0e21                         -  trimming limits
0                                        -1=transform according to specified ref. dist.
../histsmth/histsmth.out                 -  file with reference dist.
1   2                                    -  columns for variable and weight
nscore.out                               -file for output
nscore.trn                               -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                              -file with data
1  2  3  7  0  0                       -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                       -  trimming limits
0                                       -transform the data (0=no, 1=yes)
sgsim.trn                               -  file for output trans table
0                                       -  consider ref. dist (0=no, 1=yes)
histsmth.out                            -  file with ref. dist distribution
1  2                                    -  columns for vr and wt
0.0    15.0                             -  zmin,zmax(tail extrapolation)
1       0.0                             -  lower tail option, parameter
1      15.0                             -  upper tail option, parameter
0                                       -debugging level: 0,1,2,3
junk.junk                               -file for debugging output
sgsim.out                               -file for simulation output
10o                                     -number of realizations to generate
120    565205.0    60.                  -nx,xmn,xsiz
100    133045.0    60.                  -ny,ymn,ysiz
20    40    5.0                         -nz,zmn,zsiz
69069                                   -random number seed
2     40                                -min and max original data for sim
12                                      -number of simulated nodes to use
1                                       -assign data to nodes (0=no, 1=yes)
1     3                                 -multiple grid search (0=no, 1=yes),num
0                                       -maximum data per octant (0=not used)
4500.0  1800.0  20.0                    -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                        -angles for search ellipsoid
121    101    21                       -size of covariance lookup table
0     0.60   1.0                       -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                       -  file with LVM, EXDR, or COLC variable
4                                       -  column for secondary variable
2    0.01                               -nst, nugget effect
1    0.25  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         2500.0   2500.0  25.0          -a_hmax, a_hmin, a_vert
1    0.74  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         2800.0   2800.0  250.0         -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                               -file with data
1                                       -  column with Gaussian variable
-1.0e21   1.0e21                        -  trimming limits
sgsim_backtr.out                        -file for output
../02_nscore/nscore.trn                 -file with input transformation table
0.0 1960.0                              -minimum and maximum data value
1    0.0                                -lower tail option and parameter
1   60.0                                -upper tail option and parameter
```

clipgrid.exe

```
                 Parameters for CLIPGRID
                 ***********************

START OF PARAMETERS:
sgsim.out                               -input  grid file
sgsim_clipped.out                       -output grid file
 80   5205.0   10.0                     -nx, xmn, xsiz
 90   3605.0   10.0                     -ny, ymn, ysiz
23                                      -Number of vertices
5410. 3800.                             -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                 Parameters for POSTSIM
                 **********************

START OF PARAMETERS:
sgsim_clipped.out                     -file with realizations
100      2                            -   number of realizations, column number
-0.0001   1.0e21                      -   trimming limits
120   100   20                        -nx, ny, nz
postsim_p100.out                      -file for output array(s)
3   1.00                              -output option, output parameter
3  10 11 12                           -if 7,  number of categories, categories
kt3d.out                              -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

1.5 Nitrate Average 2014-2015

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
Nitrate_average.dat                     -file with data
1   2   0   4                           -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                      -  trimming limits
declus.sum                              -file for summary output
declus.out                              -file for output with data & weights
1   1.0                                 -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                       -0=look for minimum declustered mean (1=max)
699  1.0  700.0                         -number of cell sizes, min size, max size
5                                       -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                              -file with data
1  2  3  4  0                           -columns for X, Y, Z, Var, and rock type
0  0  0                                 -number valid RTs and their integer codes
-1.0e21   1.0e21                        -trimming limits
10                                      -number of NN for local average
dspk_declus.out                         -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                       -file with data
6   5                                 -  columns for variable and weight
-1.0e21   1.0e21                      -  trimming limits
0                                     -1=transform according to specified ref. dist.
../histsmth/histsmth.out              -  file with reference dist.
1   2                                 -  columns for variable and weight
nscore.out                            -file for output
nscore.trn                            -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                              -file with data
1  2  3  7  0  0                       -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                       -  trimming limits
0                                       -transform the data (0=no, 1=yes)
sgsim.trn                               -  file for output trans table
0                                       -  consider ref. dist (0=no, 1=yes)
histsmth.out                            -  file with ref. dist distribution
1  2                                    -  columns for vr and wt
0.0    15.0                             -  zmin,zmax(tail extrapolation)
1       0.0                             -  lower tail option, parameter
1      15.0                             -  upper tail option, parameter
0                                       -debugging level: 0,1,2,3
junk.junk                               -file for debugging output
sgsim.out                               -file for simulation output
10o                                     -number of realizations to generate
120    565205.0    60.                  -nx,xmn,xsiz
100    133045.0    60.                  -ny,ymn,ysiz
20    40    5.0                         -nz,zmn,zsiz
69069                                   -random number seed
2     40                                -min and max original data for sim
12                                      -number of simulated nodes to use
1                                       -assign data to nodes (0=no, 1=yes)
1     3                                 -multiple grid search (0=no, 1=yes),num
0                                       -maximum data per octant (0=not used)
4500.0  1800.0  20.0                    -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                        -angles for search ellipsoid
121    101    21                       -size of covariance lookup table
0     0.60   1.0                       -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                       -  file with LVM, EXDR, or COLC variable
4                                       -  column for secondary variable
2    0.01                               -nst, nugget effect
1    0.4  0.0   0.0   0.0               -it,cc,ang1,ang2,ang3
         200.0   200.0  50.0            -a_hmax, a_hmin, a_vert
1    0.59  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         1500.0   1500.0  50.0          -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                               -file with data
1                                       -  column with Gaussian variable
-1.0e21   1.0e21                        -  trimming limits
sgsim_backtr.out                        -file for output
../02_nscore/nscore.trn                 -file with input transformation table
0.0 1960.0                              -minimum and maximum data value
1    0.0                                -lower tail option and parameter
1   60.0                                -upper tail option and parameter
```

clipgrid.exe

```
                 Parameters for CLIPGRID
                 ***********************

START OF PARAMETERS:
sgsim.out                               -input  grid file
sgsim_clipped.out                       -output grid file
 80   5205.0   10.0                     -nx, xmn, xsiz
 90   3605.0   10.0                     -ny, ymn, ysiz
23                                      -Number of vertices
5410. 3800.                             -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                 Parameters for POSTSIM
                 **********************

START OF PARAMETERS:
sgsim_clipped.out                     -file with realizations
100      2                            -   number of realizations, column number
-0.0001   1.0e21                      -   trimming limits
120   100   20                        -nx, ny, nz
postsim_p100.out                      -file for output array(s)
3   1.00                              -output option, output parameter
3  10 11 12                           -if 7,  number of categories, categories
kt3d.out                              -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

1.6 Nitrate Max 2014-2015

declus.exe

```
                  Parameters for DECLUS
                  *********************

START OF PARAMETERS:
Nitrate_max.dat                      -file with data
1   2   0   4                            -  columns for X, Y, Z, and variable
-1.0e21     1.0e21                       -  trimming limits
declus.sum                               -file for summary output
declus.out                               -file for output with data & weights
1   1.0                                  -Y and Z cell anisotropy (Ysize=size*Yanis)
0                                        -0=look for minimum declustered mean (1=max)
699  1.0  700.0                          -number of cell sizes, min size, max size
5                                        -number of origin offsets
```

despike.exe

```
                  Parameters for Despike
                  **********************

START OF PARAMETERS:
declus.out                               -file with data
1  2  3  4  0                           -columns for X, Y, Z, Var, and rock type
0  0  0                                  -number valid RTs and their integer codes
-1.0e21   1.0e21                         -trimming limits
10                                       -number of NN for local average
dspk_declus.out                          -file for output
```

nscore.exe

```
                  Parameters for NSCORE
                  *********************

START OF PARAMETERS:
dspk_declus.out                        -file with data
6   5                                  -  columns for variable and weight
-1.0e21   1.0e21                       -  trimming limits
0                                      -1=transform according to specified ref. dist.
../histsmth/histsmth.out               -  file with reference dist.
1   2                                  -  columns for variable and weight
nscore.out                             -file for output
nscore.trn                             -file for output transformation table
```

sgsim.exe

```
                  Parameters for SGSIM
                  ********************

START OF PARAMETERS:
nscore.out                              -file with data
1  2  3  7  0  0                       -  columns for X,Y,Z,vr,wt,sec.var.
-1.0       1.0e21                       -  trimming limits
0                                       -transform the data (0=no, 1=yes)
sgsim.trn                               -  file for output trans table
0                                       -  consider ref. dist (0=no, 1=yes)
histsmth.out                            -  file with ref. dist distribution
1  2                                    -  columns for vr and wt
0.0    15.0                             -  zmin,zmax(tail extrapolation)
1       0.0                             -  lower tail option, parameter
1      15.0                             -  upper tail option, parameter
0                                       -debugging level: 0,1,2,3
junk.junk                               -file for debugging output
sgsim.out                               -file for simulation output
10o                                     -number of realizations to generate
120    565205.0    60.                  -nx,xmn,xsiz
100    133045.0    60.                  -ny,ymn,ysiz
20    40    5.0                         -nz,zmn,zsiz
69069                                   -random number seed
2     40                                -min and max original data for sim
12                                      -number of simulated nodes to use
1                                       -assign data to nodes (0=no, 1=yes)
1     3                                 -multiple grid search (0=no, 1=yes),num
0                                       -maximum data per octant (0=not used)
4500.0  1800.0  20.0                    -maximum search radii (hmax,hmin,vert)
 0.0   0.0   0.0                        -angles for search ellipsoid
121    101    21                       -size of covariance lookup table
0     0.60   1.0                       -ktype: 0=SK,1=OK,2=LVM,3=EXDR,4=COLC
../data/ydata.dat                       -  file with LVM, EXDR, or COLC variable
4                                       -  column for secondary variable
2    0.01                               -nst, nugget effect
1    0.4  0.0   0.0   0.0               -it,cc,ang1,ang2,ang3
         200.0   200.0  50.0            -a_hmax, a_hmin, a_vert
1    0.59  0.0   0.0   0.0              -it,cc,ang1,ang2,ang3
         1500.0   1500.0  50.0          -a_hmax, a_hmin, a_vert
```

backtr.exe

```
                  Parameters for BACKTR
                  *********************

START OF PARAMETERS:
sgsim.out                               -file with data
1                                       -  column with Gaussian variable
-1.0e21   1.0e21                        -  trimming limits
sgsim_backtr.out                        -file for output
../02_nscore/nscore.trn                 -file with input transformation table
0.0 1960.0                              -minimum and maximum data value
1    0.0                                -lower tail option and parameter
1   60.0                                -upper tail option and parameter
```

clipgrid.exe

```
                 Parameters for CLIPGRID
                 ***********************

START OF PARAMETERS:
sgsim.out                                -input  grid file
sgsim_clipped.out                        -output grid file
 80   5205.0   10.0                      -nx, xmn, xsiz
 90   3605.0   10.0                      -ny, ymn, ysiz
23                                       -Number of vertices
5410. 3800.                              -x and y vertices
5382. 3900.
5400. 4000.
5460. 4032.
5490. 4080.
5480. 4180.
5390. 4380.
5390. 4420.
5420. 4450.
5600. 4440.
5840. 4460.
5863. 4400.
5965. 4200.
5955. 4160.
5840. 4104.
5800. 4040.
5800. 3940.
5860. 3895.
5875. 3860.
5863. 3800.
5800. 3760.
5660. 3725.
5520. 3750.
```

postsim.exe

```
                 Parameters for POSTSIM
                 **********************

START OF PARAMETERS:
sgsim_clipped.out                    -file with realizations
100      2                           -   number of realizations, column number
-0.0001   1.0e21                     -   trimming limits
120   100   20                       -nx, ny, nz
postsim_p100.out                     -file for output array(s)
3   1.00                             -output option, output parameter
3  10 11 12                          -if 7,  number of categories, categories
kt3d.out                             -if 10, kriged model to correct to


option 1 = E-type mean and conditional variance
       2 = prob and mean above threshold (par)
       3 = Z-percentile corresponding to (par)
       4 = symmetric (par) probability interval
       6 = prob to be within (par) % of the mean
       7 = summarize categorical variable realizations
      10 = correct to kriged model
```

2 References

Deutsch, C. V. and A.G. Journel, 1998, *GSLIB: Geostatistical Software Library and User's Guide*. New York: Oxford University Press.

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