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Supplementary Material

SECTION I) DATA EXPLORATION

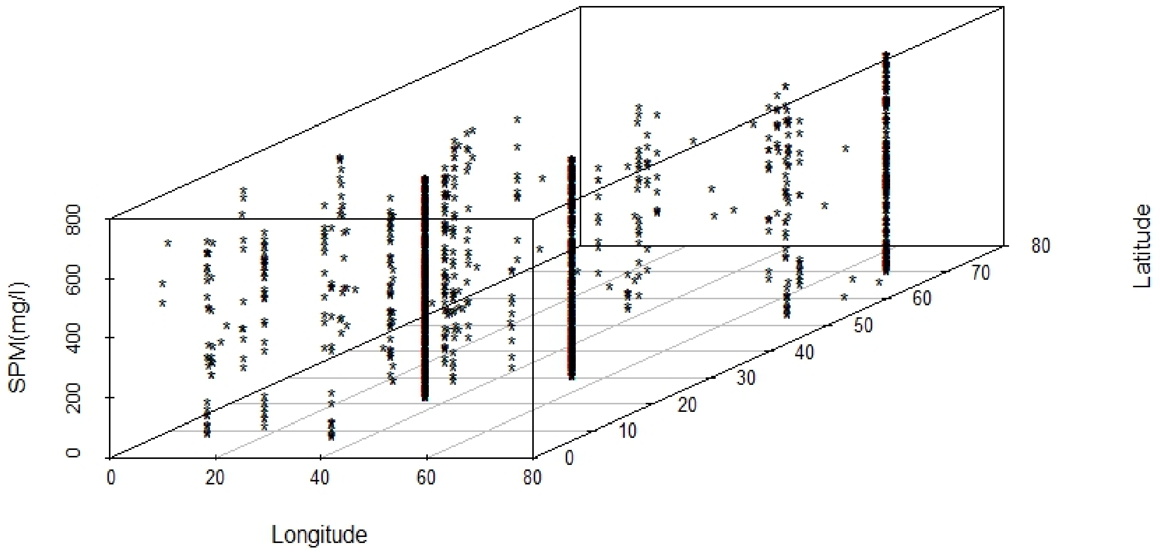


Figure S1 : Scatter plot of Suspended Particulate Matter (SPM) values in different station points in Potter Cove. This plot shows the difference on sampling within the cove among the two decades SPM sampled years (1992-2012). The number of measurements at the three long term locations of Carilini Satation are clear with a high density of points.

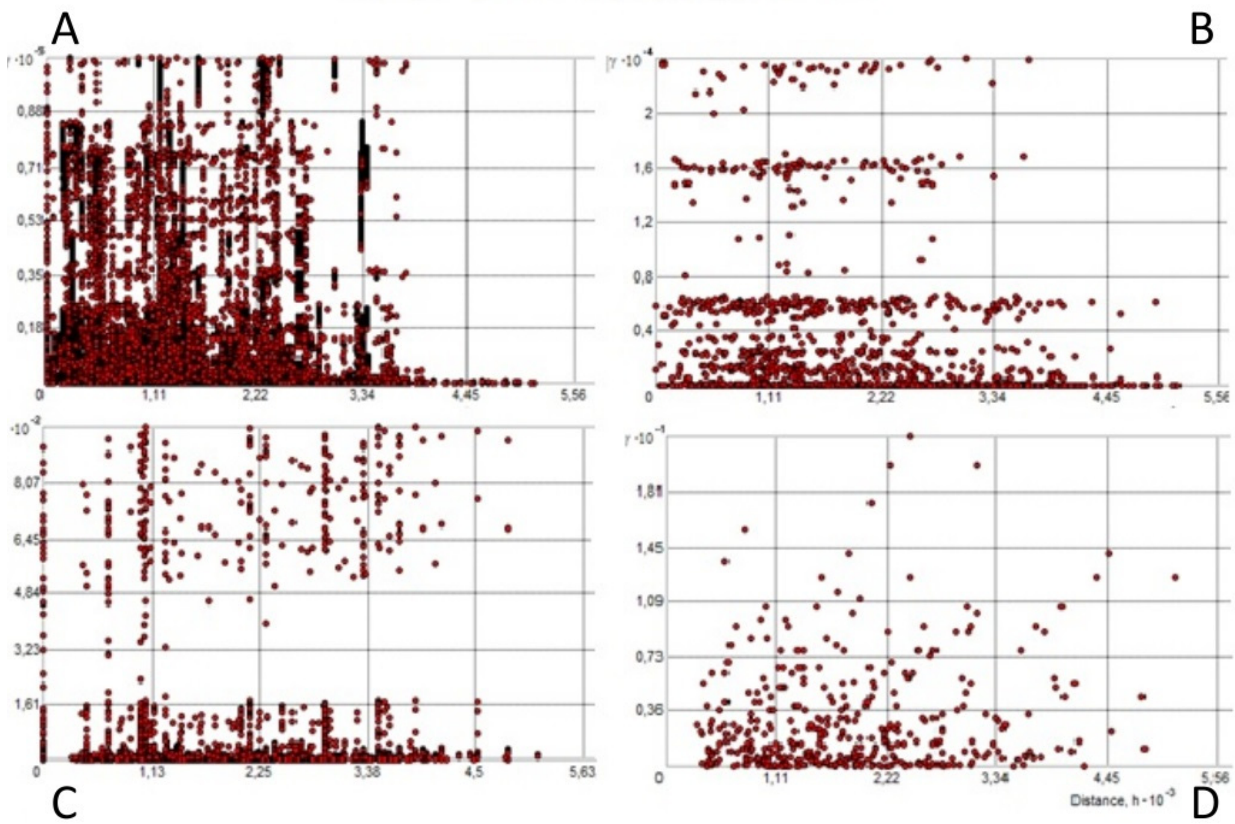


Figure S2: Semivariogram cloud plots of SPM data partitioning. **(A)** Data set 1.0-Two decades SPM data- Semivariogram cloud SPM 1992-2012 all values, stations and depth. **(B)** Data set 1.1.-Two decades shallow depth SPM data

Semivariogram SPM 0-5 m depth mean summer 1992-2012 values for station excluding the outlier. **(C)** Data set 2.0 – One-summer SPM data. Semivariogram summer SPM 2010-2011. **(D)** Data set 2.1.- One-day SPM data without meltwater streams (MWS) Semivariogram SPM 09/02/2011 0-5 m depth.

Trend Analysis for Data set 2.1

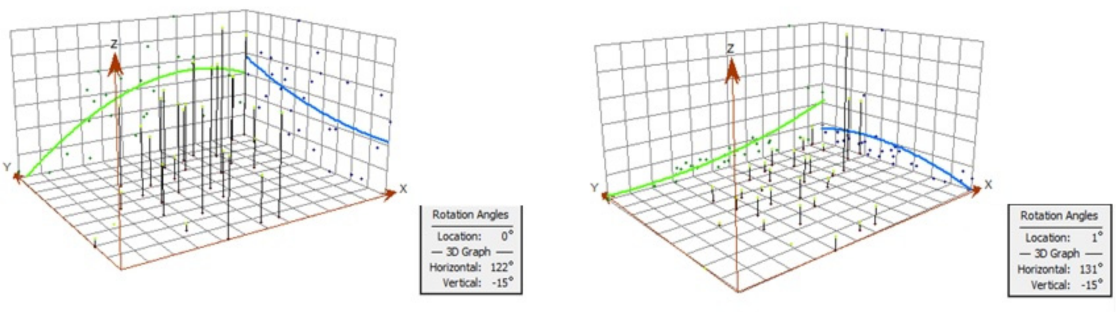


Figure S3: Trend analysis for One-day SPM data without meltwater streams input (left) and with (right).

SECTION II) DETAILED PROCEDURE CONFIGURATION AND STATISTICAL DIFFERENCES BETWEEN GEOSTATISTICAL MODELS

Default values were configured following automatic options indicated by Geostatistical Wizard of ArcGIS 10.4.1 applying the three methods Simple Kriging (SK0), Ordinary Kriging (OK0) and Empirical Bayesian Kriging (EBK0). For the Tuned models, different configurations have been applied. Since semivariogram conditions the output, the optimized option was chosen. For Simple and Ordinary Kriging was optimized with a nugget and partition sill calculation as 'true' factor and anisotropy as 'false'. In the case of Empirical Bayesian Kriging, the model was optimized as default by a simulation of 100 semivariograms and one overlap factor, with a semivariogram type 'power' except when transforming the data (Fig. S.4 single variogram per model, whit a better fit for EBK algorithm). Simple Kriging maps and Ordinary Kriging (SK1, SK2 and OK3) have been configured by the optimized tool, then the maximum radio was configuring by default. Empirical Bayesian Kriging was configured with the variation of the neighborhood: mean far away distance divided by the mean of nearest neighbor distance (EBK4 and EBK5), half of the faraway neighbor mean divided by the nearest neighbor distance (EBK7) and mean of faraway neighbor distance divided by half of the furthest away neighbor mean (EBK8). EBK5 data was log-empirical transformed regarding on the trend graph, semivariogram was configured as 'exponential' and EBK6 model has avoided the neighborhood configuration due to its smooth factor. Whenever was possible for EBK, radio was configured as the sum of the most faraway distance for each point. EBK6 was smooth of EBK4 modeling, so configurations might be corresponding. However, when EBK6A was defined, a radio of 144,15 was not allowed to configure. Then, it was determined by default.

When EBK4A and EBK8A were configured with Empirical Bayesian Kriging model, a defined search neighborhood in one sector with 5 maximum neighbors and 1 minimum neighbor, and a radius of 144.15 which is the sum of the Euclidean distance of the furthest away neighborhood; the interpolation it is similar to a Voronoi map. A possible explanation is that to search in one direction only (one sector), with a specific radio as the furthest away neighbor and a neighborhood ratio which considers the minimum distance where a neighbour can be found; could result in single triangulation to interpolate as in a Voronoi.

Table S1. Detailed numbers of the configuration of the different parameters applied.

Annex Table	Code	Data used	Absolute value MS	1-RMSS	Absolut value RMSS	Neighbour	Radio	Trend I	Ratio numbers of Neighbours	Radio	Transformation	Smooth	Trend	Optimized	%Improvement in Mean Standard	%Improvement in Root Mean Square Standard	Performance Index (Factor 0,7 RMSS)	Performance Index (Factor 0,5 RMSS)	Comment
0.Simple Kriging	SK0.A	09.02.2011	0,021	-0,007	0,007	Default (4 and 45º)	Default	Default No removed	5/2 (4 and 45º)	3149,917	YES Normal Score	NO	NO	NO			0,011	0,014	Default
	SK0.B	09.02.2011 + MWS	0,036	0,099	0,099					4710,17							0,080	0,068	
0.Ordinary Kriging	OK0.A	09.02.2011	0,043	0,003	0,003	Default (4 and 45º)	Default	Default No removed	5/2 (4 and 45º)	default from semivariogram	NO	NO	NO	NO			0,015	0,023	
	OK0.B	09.02.2011 + MWS	0,002	0,001	0,001					3166,99							0,001	0,002	
0.Empirical Bayerian Kriging	EBK0.A	09.02.2011	0,014	0,020	0,020	Default (full sector)	Default	Default No removed	15/10 (full sector)	default from semivariogram	NO	NO	NO	NO			0,018	0,017	
	EBK0.B	09.02.2011 + MWS	0,026	0,036	0,036					2176,52							0,033	0,031	
1.Simple Kriging	SK1.A	09.02.2011	0,014	-0,006	0,006	MFAN / MCN (4 and 45º)	Default	Corrected with section neighbour (4 and 45º)	5/2 (4 and 45º)	3694	NO	NO	NO	YES	33,600	8,045	0,008	0,010	Optimized
	SK1.B	09.02.2011 + MWS	0,101	-0,188	0,188				31/2 (4 and 45º)	3866,17					-181,407	-89,489	0,162	0,144	Standard neighbour (no Stantard circular) generates a smoothy surface
2.Simple Kriging (tendence removed)	SK2.A	09.02.2011	#¡VALOR!	######	######	MFAN / MCN (full sector)	----	YES	5/1(full sector)	----	NO	NO	YES	YES	----	----	----	#¡VALOR!	Trend remove and optimized is not possible because it's required an
	SK2.B	09.02.2011 + MWS	0,015	-0,269	0,269		Default		31/1 (full sector)	3866,178					58,846	-171,521	0,193	0,142	
3.Ordinary Kriging	OK3.A	09.02.2011	0,038	0,010	0,010	MFAN / MCN (4 and 45º)	optimized	Corrected with section neighbour (4 and 45º)	5/1 (4 and 45º)	1138,32	NO	NO	NO	YES	11,370	-219,677	0,018	0,024	Optimized variogram(in this case the number of lag is near to the summatory
	OK3.B	09.02.2011 + MWS	0,003	-0,021	0,021				31/1 (4 and 45º)	optimized (2853,16)					-10,937	-1840,531	0,015	0,012	optimized
4.EBK(mean furthest away/ mean closest neighbour)	EBK4.A	09.02.2011	0,017	0,071	0,071	MFAN / MCN (full sector)	∑FAN	NO	5/1 (full sector)	144,15	NO	NO	NO	NO	-19,077	-251,415	0,055	0,044	28 samples. Equal to EBK5 but in this case a map is possible
	EBK4.B	09.02.2011 + MWS	0,018	0,057	0,057				31/1 (full sector)	1004,9					31,423	-180,342	0,045	0,037	
5.EBK(transformed data)	EBK5.A	09.02.2011	0,002	0,009	0,009	MFAN / MCN (full sector)	Default	NO	5/1(full sector)	2174,52	YES(Empirical)	NO	NO	NO	88,863	53,605	0,007	0,005	Transformation Empirical because log transformation is not posible due to
	EBK5.B	09.02.2011 + MWS	0,018	-0,036	0,036				31/1 (full sector)	2174,52	YES (log empirical)				31,735	-77,682	0,030	0,027	
6.EBK(smooth)	EBK6.A	09.02.2011	0,001	0,018	0,018	Default by smooth	Default	NO	changed by default when is	2174,52	NO	YES (0,2)	NO	NO	94,396	9,185	0,013	0,010	Radio default. When radio is determine as summatory of far away neighbourg any station is included in the model. The
	EBK6.B	09.02.2011 + MWS	0,010	0,032	0,032				changed by default when is smooth	2174,52					60,978	-57,210	0,025	0,021	30 Samples, one has an unestable estimation (Number 27)
7.EBK(1/2 mean furthest away neighbour / mean closest & radio)	EBK7.A	09.02.2011	0,024	0,057	0,057	(1/2MFAN) / MCN (4 and 45º)	∑FAN	NO	2/1 (4 and 45º)	144,15	NO	NO	NO	NO	-68,109	-181,329	0,047	0,041	28 samples. Semivariogram power
	EBK7.B	09.02.2011 + MWS	0,013	0,062	0,062				15/1 (4 and 45º)	1004,9					47,842	-208,080	0,048	0,038	31 samples. Semivariogram power
8.EBK(mean furthest away/1/2 mean furthest away neighbour)	EBK8.A	09.02.2011	0,013	-0,002	0,002	MFAN / (1/2MFAN) (full sector)	∑FAN	NO	5/2 (full sector)	144,15	NO	NO	NO	NO	10,342	89,142	0,005	0,007	28 samples. Similar to EBK3 but full sector and radio of sumatory
	EBK8.B	09.02.2011 + MWS	0,001	0,005	0,005				31/15 (full sector)	1004,9	YES (log empirical)				97,114	74,923	0,004	0,003	31 samples. Similar EBK 12 but trasformed

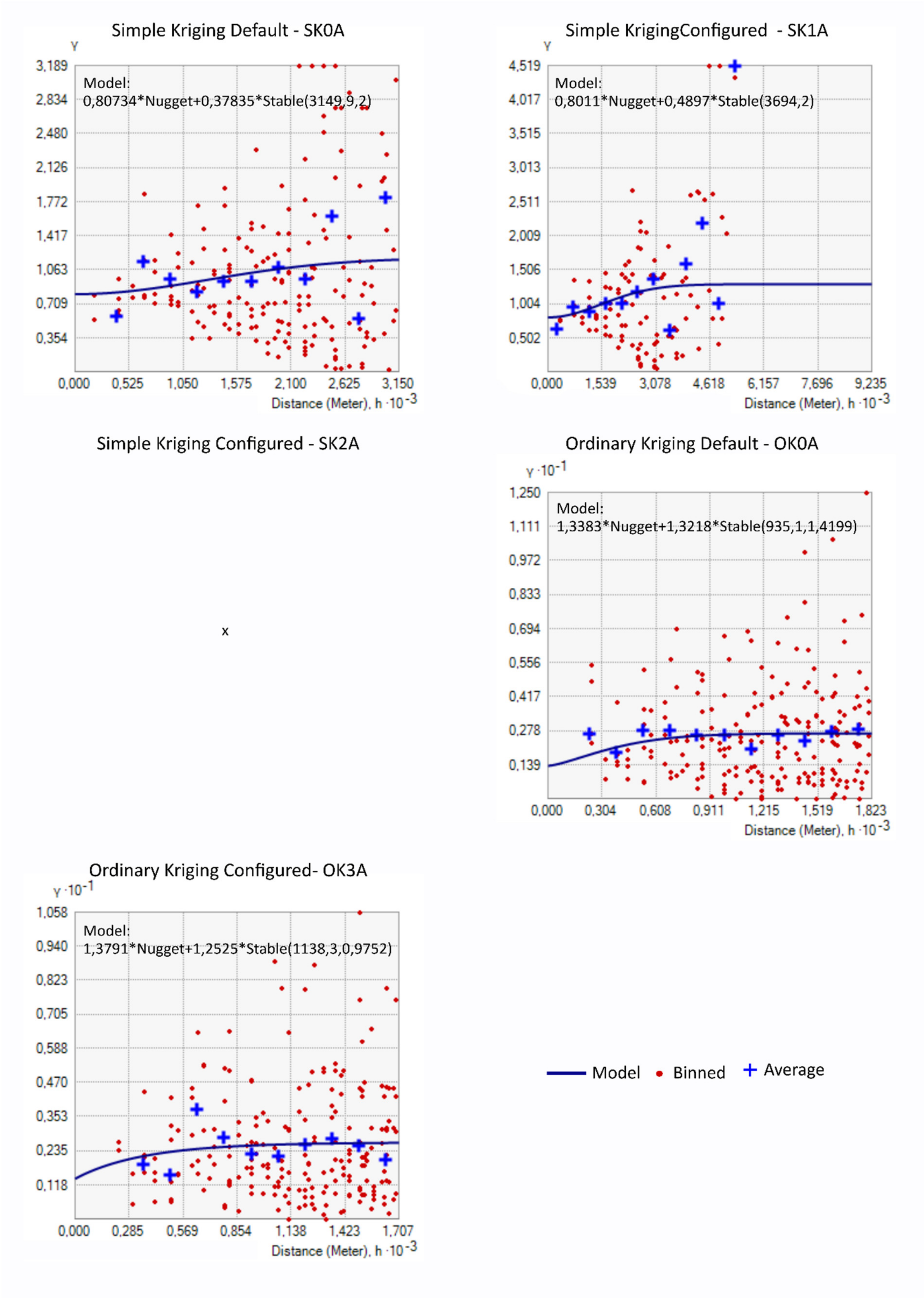


Figure S4(I): Semivariogram and semivariogram model of each Simple Kriging (SK) and Ordinary Kriging (OK) by default and configured of suspended particulate matter data without meltwater streams input (SPM data A, without MWS). SK2 model was not performed Continue in Figure S.4b for SPM data with MWS input.

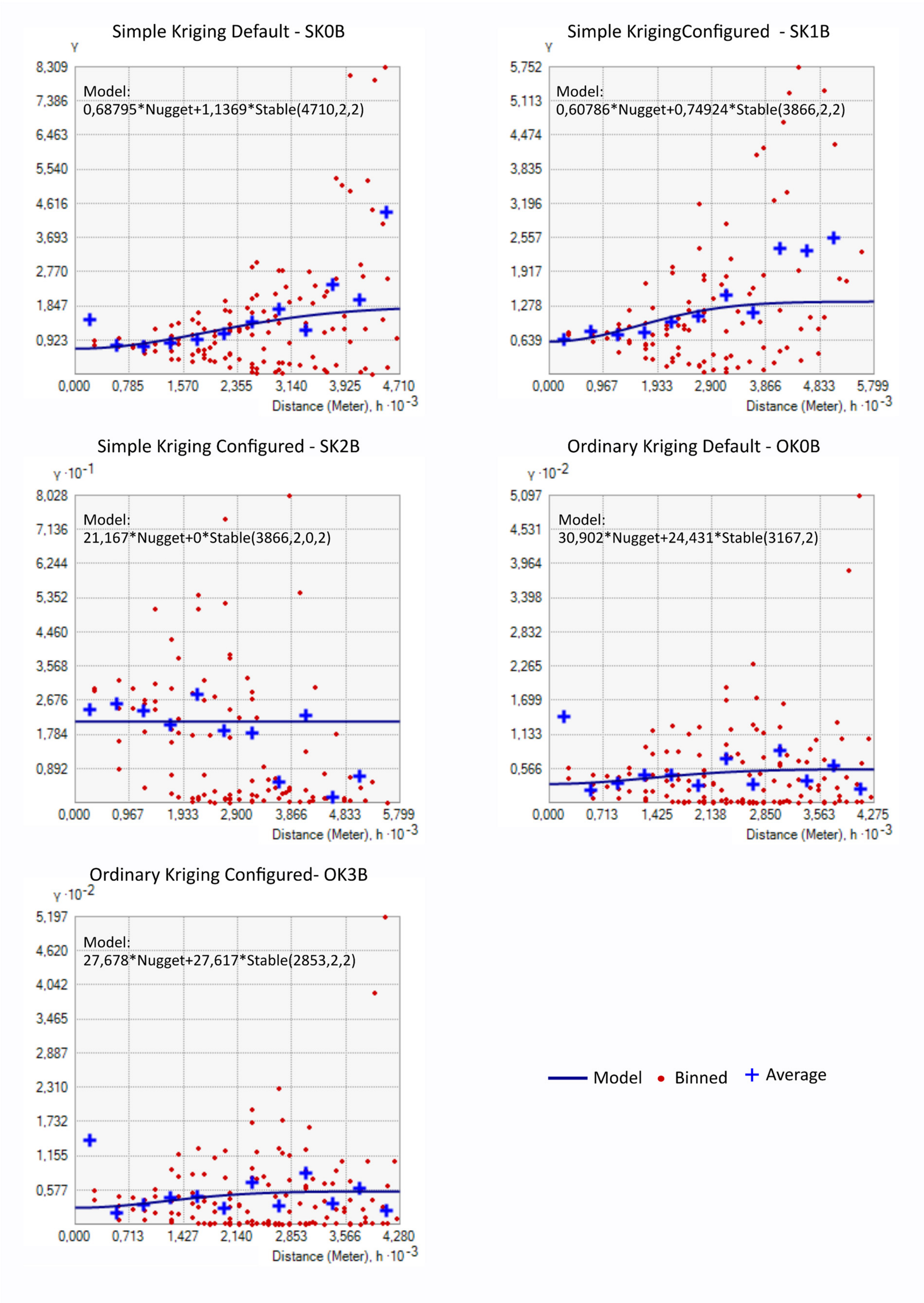


Figure S4II: Semivariogram and semivariogram model of each Simple Kriging (SK) and Ordinary Kriging (OK) by default and configured of suspended particulate matter data without meltwater streams input (SPM data A, without MWS). Continution of Figure S4(I).

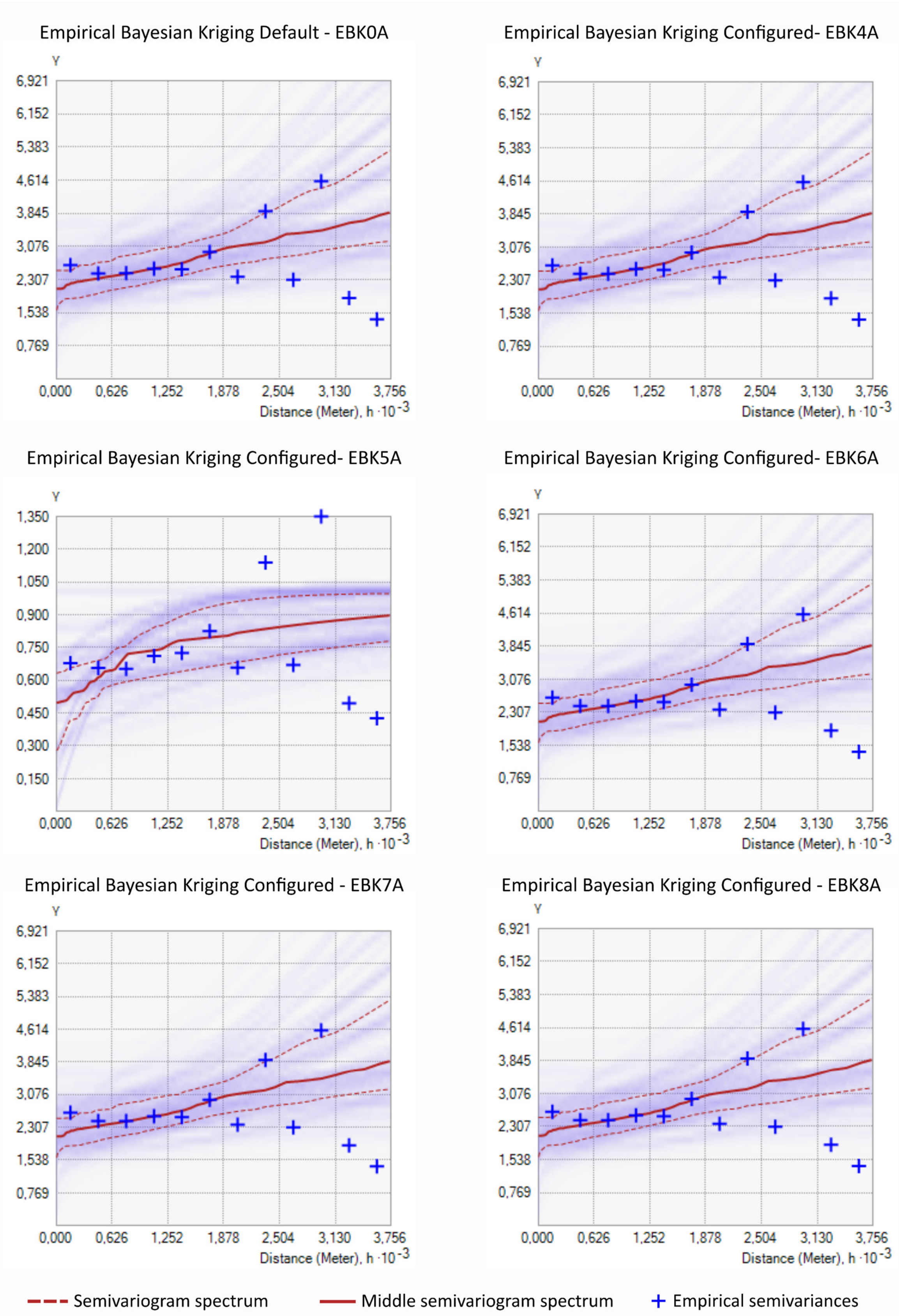


Figure S5 (I): : Semivariogram and semivariogram model of each Empirical Bayesian Kriging (EBK) by default and configured of suspended particulate matter data without meltwater streams input (SPM data A, without MWS. Continue in Figure S.5(II) for SPM data with MWS input. Clear differences can be visualized in semivariogram of transformed data (EBK5) compare to others

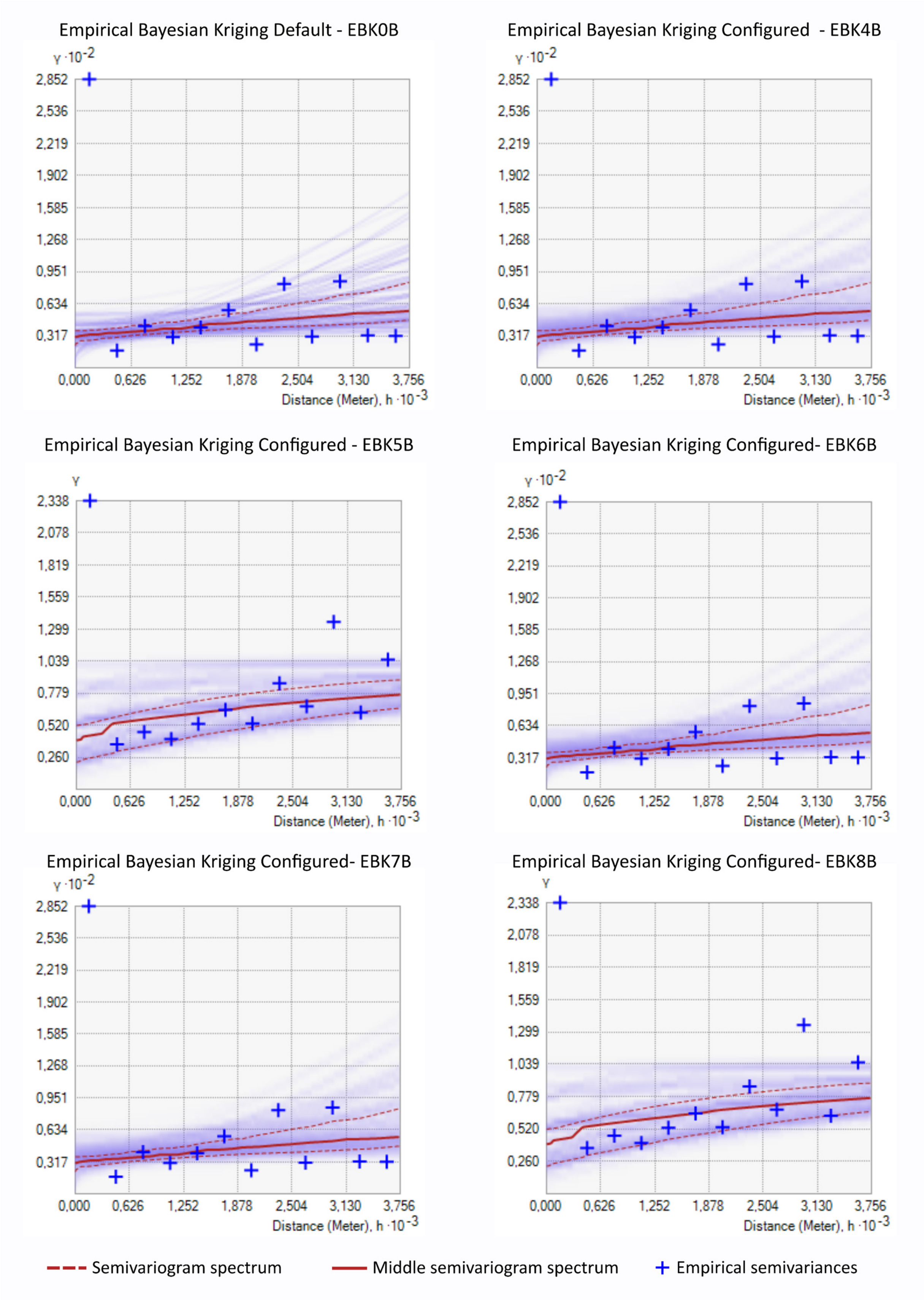


Figure S5(II): : Semivariogram and semivariogram model of each Empirical Bayesian Kriging (EBK) by default and configured of suspended particulate matter data with meltwater streams input (SPM data B, with MWS. Clear differences can be visualized in semivariogram of transformed data (EBK5 and EBK8) compare to others.

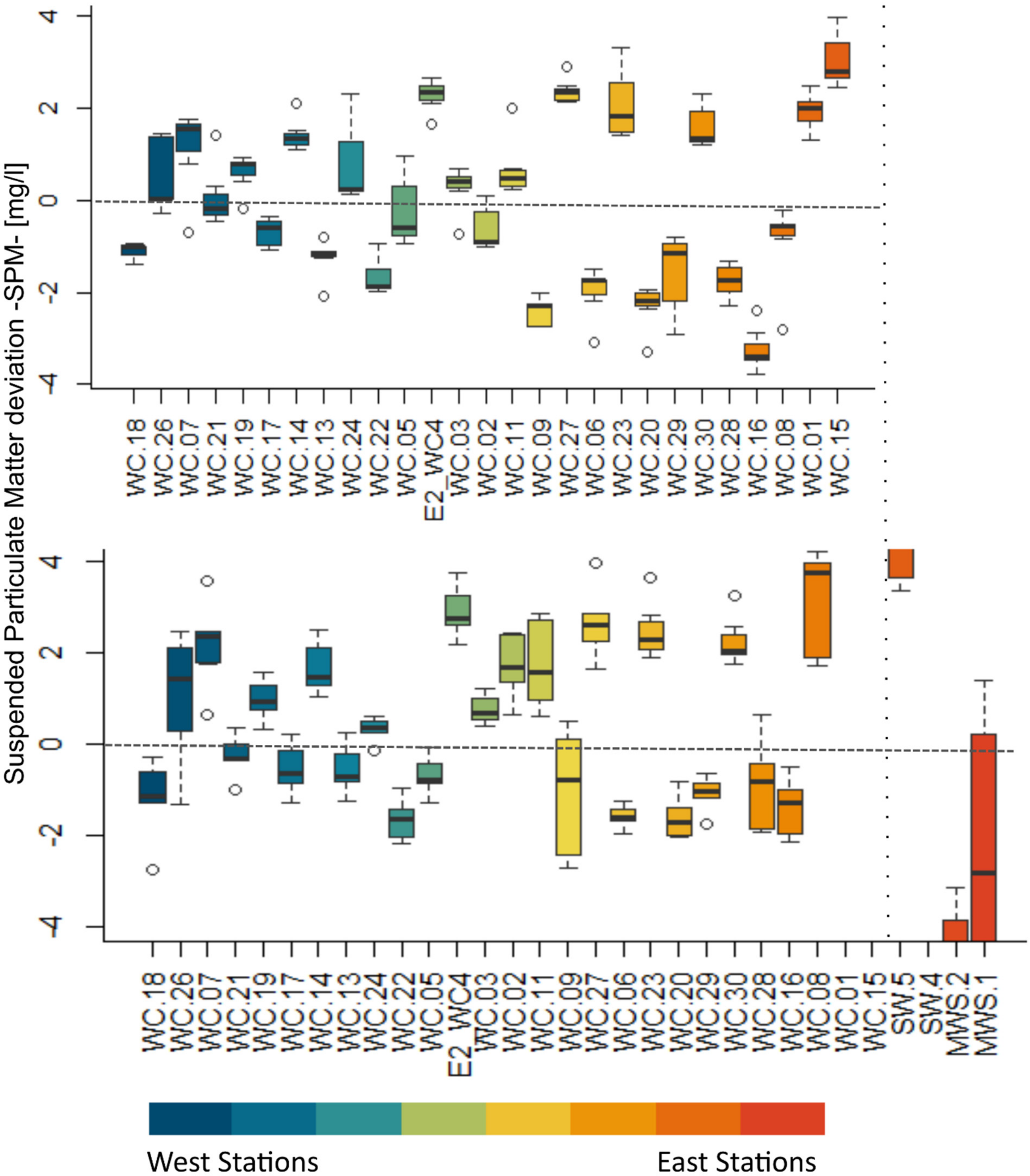
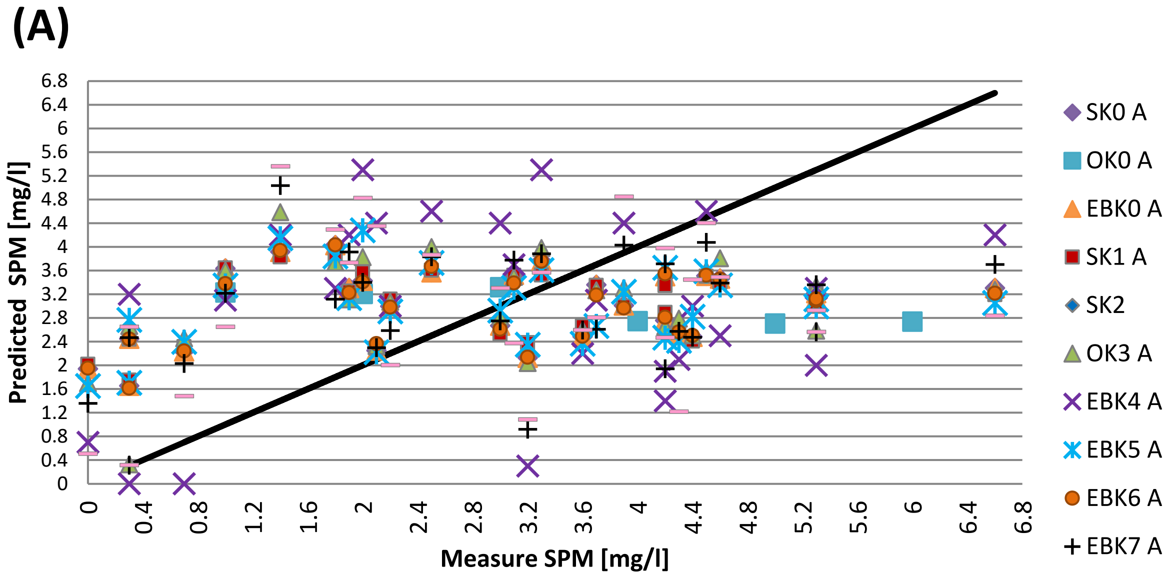


Fig. S.6: Zoom of Statistical error variation among the different interpolation methods applied delineated by station location sorted from west to east. **Up:** without meltwater streams input**. Down:** with meltwater streams input. The deviation value is the difference between the interpolated SPM value and the SPM measurements. West orientation from the coast has a higher distance to SPM input points, meanwhile to the east coast, the stations are closer to run-off meltwater rivers. Dashed line at zero means the threshold where the predicted value is equal to those interpolated. Same scaled to visualize differences of each interpolation method. It is a higher misclassification from the west to the east of the cove.



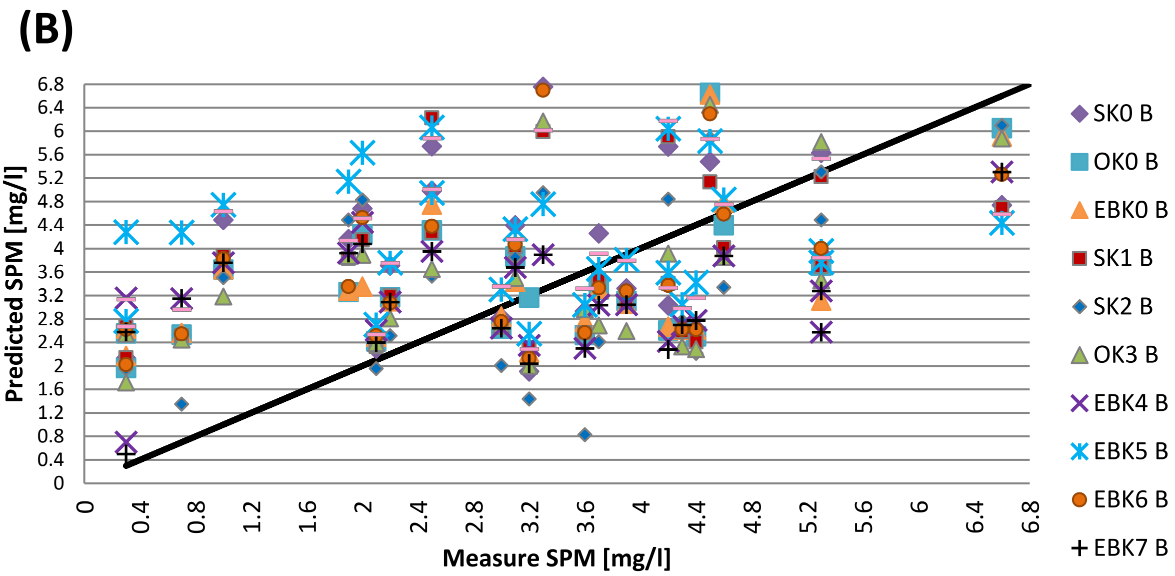


Figure S7(I): Scatter plot of observed vs predicted values for all interpolation methods of One-day SPM data **(A)** without and **(B)** with meltwater streams. Misclassification of SPM concentrations Summer day with mean weather conditions 09/01/2016. Comparable scale (continue Fig. S.7(II) for a scale view).

(B)

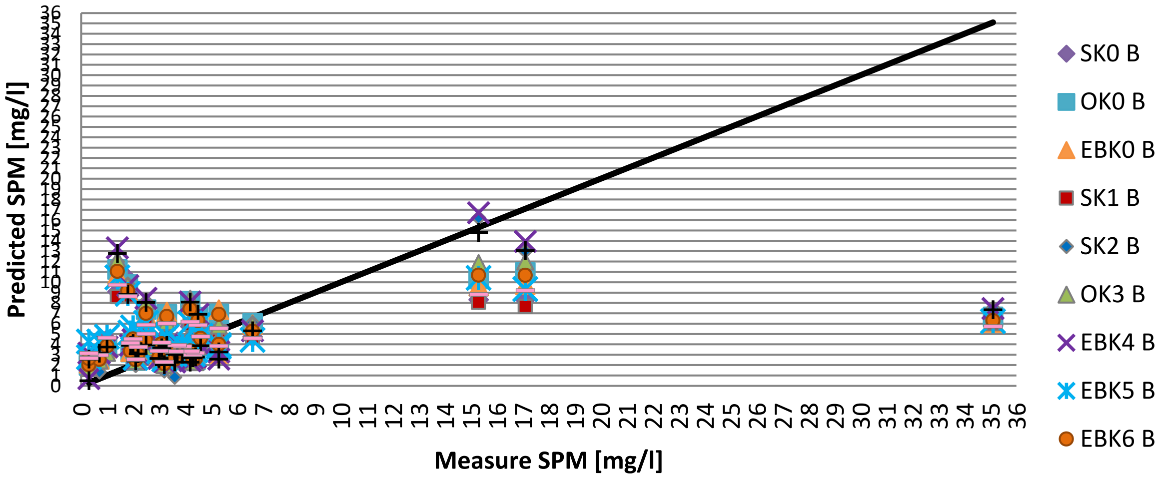


Figure S7(II): Scatter plot of observed vs predicted values for all interpolation methods of One-day SPM data with meltwater streams input. Full scale continued from Figure 3. Here it is shown the extreme measured concentrations from the SPM origin inputs (MWS stations).

Table S2: Order of the improvement in mean standardized (MS) and root mean squared standardized (RMSS) of the 22 geostatistical models configured. Performance of models evaluated with two weighted factors 0.7 (70% used in the present study) and 0.5 (50%). In *grey italics*, those models which diminish on MS or RMSS.

	Positive Improvement MS	**Positive Improvement RMSS**	**Absolut value DE One-day SPM data**	**Absolut value DE One-day SPM + MWS data**	**Performance Index factor RMSS 0,7**	**Performance Index 0,5**
1º	EBK8.B	EBK8.A	OK3	SK2	OK0.B	OK0.B
2º	EBK6.A	EBK8.B	EBK7	EBK7	EBK8.B	EBK7.A
3º	EBK5.A	EBK5.A	EBK6	OK3	EBK8.A	OK3.B
4º	EBK6.B	EBK6.A	EBK0	EBK4	EBK5.A	EBK6.B
5º	SK2.B	SK1.A	SK0	EBK6	SK1.A	EBK4.A
6º	EBK7.B	*EBK6.B*	SK1	SK1	SK0.A	EBK5.B
7º	SK1.A	*EBK5.B*	EBK5	EBK8	EBK6.A	EBK5.A
8º	EBK5.B	*SK1.B*	OK0	OK0	OK0.A	SK0.A
9º	EBK4.B	*SK2.B*	EBK8	EBK0	OK3.B	EBK0.A
10º	OK3.A	*EBK4.B*	EBK4	SK0	OK3.A	EBK8.A
11º	EBK8.A	*EBK7.A*		EBK5	EBK0.A	OK0.A
12º	*OK3.B*	*EBK7.B*			EBK6.B	SK2.B
13º	*EBK4.A*	*OK3.A*			EBK5.B	SK1.A
14º	*EBK7.A*	*EBK4.A*			EBK0.B	EBK0.B
15º	*SK1.B*	*OK3.B*			EBK4.B	EBK7.B
16º	*SK2.A*	*SK2.A*			EBK7.A	EBK4.B
17º					EBK7.B	EBK8.B
18º					EBK4.A	EBK6.A
19º					SK0.B	SK0.B
20º					SK1.B	OK3.A
21º					SK2.B	SK2.A
22º					SK2.A	SK1.B