Assessing CeO2 and TiO2 nanoparticle concentrations in the Seine River and Its Tributaries Near Paris.

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**Supporting information**

Table S1: Water chemistry of the sampling site on the Seine River campaign.

Table S2: Elemental concentrations in the conventional dissolved fractions (i.e., <0.22µm).

Table S3: Water flows, Suspended Matter Concentrations et total Ti, Ce, Al, La, V and Y concentrations of the Seine River and its tributaries at the sampling points on 11th of May, 2015, from http://www.hydro.eaufrance.fr/ (N.A. = not available).

Table S4: Ti/Al elemental ratios measured by ICPMS after acid digestion of engineered nanoparticles (industrial powders).

Figure S1: Ce concentrations in water samples.

Figure S2: Ti concentrations in the different sampling points.

Figure S3: Principal component analysis of total Ce concentration with the water chemistry.

Figure S4: Principal component analysis of total Ti concentration with the water chemistry.

Figure S5: Principal component analysis of total Ce concentration with the total concentrations of rare earth elements.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Sampling site | pH | Conductivity | Dissolved O2 | Temperature | Ionic Strength | Alkalinity | [NPOC] |
|  |  | (µS cm-1) | (mg L-1) | (%) | (°C) | (mmol L-1) | (meq L-1) | (mg L-1) |
| SR1 Marnay sur Seine | 8.03 | 523 | 8.87 | 89.7 | 16.4 | ± 0.6 | 5.9 | 9.70 | 2.72 |
| TR1 Savigny sur Orge | 8.04 | 724 | 9.98 | 104.8 | 17.9 | ± 0.1 | 9.1 | 8.76 | 5.20 |
| SR2 Alfortville | 7.90 | 532 | 10.02 | 102.8 | 17.0 | ± 0.3 | 6.0 | 8.41 | 3.70 |
| TR2 St Maurice | 8.04 | 544 | 9.95 | 102.1 | 17.0 | ± 0.3 | 6.2 | 9.14 | 2.61 |
| SR3 Paris | 8.35 | 527 | 9.70 | 101.2 | 17.4 | ± 0.2 | 5.8 | 8.67 | 3.58 |
| SR4 Argenteuil | 8.30 | 520 | 9.41 | 99.0 | 18.0 | ± 0.3 | 5.8 | 8.33 | 3.68 |
| SR5 Bougival | 8.14 | 508 | 9.38 | 98.5 | 17.9 | ± 0.1 | 5.6 | 8.17 | 3.81 |
| SR6 Conflans Ste Honorine | 8.23 | 513 | 9.33 | 97.7 | 17.5 | ± 0.3 | 5.6 | 8.22 | 3.58 |
| TR3 Neuville sur Oise | 8.20 | 610 | 9.38 | 96.8 | 16.9 | ± 0.1 | 7.1 | 9.10 | 4.13 |
| SR7 Triel sur Seine | 7.85 | 528 | 8.86 | 91.6 | 17.1 | ± 0.1 | 5.9 | 8.26 | 4.47 |
| *Average in the Seine River* | *8.11 ± 0.20* | *522 ± 9* | *9.37 ± 0.42* | *97.2 ± 4.8* | *17.3 ± 0.5* | *5.8 ± 0.2* | *8.54 ± 0.54* | *3.65 ± 0.51* |

Table S1: Water chemistry of the sampling site on the Seine River campaign.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** |  | **SR1 Marnay sur Seine** | **TR2 Savigny sur Orge** | **SR2 Alfortville** | **TR2 St Maurice** | **SR3 Paris** | **SR4 Argenteuil** | **SR5 Bougival** | **SR6 Conflans Ste Honorine** | **TR3 Neuville sur Oise** | **SR7 Triel sur Seine** |
| **Concentration (µmol/L)** | Al | 0,186 | 0,267 | 0,279 | 0,470 | 0,509 | 0,448 | 0,460 | 0,557 | 0,229 | 0,450 |
| +/- | 0,002 | 0,003 | 0,003 | 0,005 | 0,005 | 0,004 | 0,005 | 0,006 | 0,002 | 0,005 |
| Ca | 2498 | 2585 | 2281 | 2345 | 2230 | 2208 | 2141 | 2149 | 2433 | 2175 |
| +/- | 25 | 26 | 23 | 23 | 22 | 22 | 21 | 21 | 24 | 22 |
| Fe | 0,093 | 0,143 | 0,116 | 0,035 | 0,124 | 0,175 | 0,166 | 0,272 | 0,101 | 0,256 |
| +/- | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,002 | 0,002 | 0,003 | 0,001 | 0,003 |
| K | 45,81 | 204,30 | 92,30 | 62,81 | 66,37 | 75,55 | 72,76 | 77,57 | 142,74 | 98,08 |
| +/- | 0,46 | 2,04 | 0,92 | 0,63 | 0,66 | 0,76 | 0,73 | 0,78 | 1,43 | 0,98 |
| Mg | 131,2 | 489,9 | 153,9 | 280,7 | 218,3 | 188,9 | 174,3 | 180,3 | 304,4 | 204,4 |
| +/- | 1,3 | 4,9 | 1,5 | 2,8 | 2,2 | 1,9 | 1,7 | 1,8 | 3,0 | 2,0 |
| Na | 174,3 | 1134,4 | 371,5 | 265,0 | 267,9 | 289,8 | 271,0 | 289,3 | 536,8 | 365,9 |
| +/- | 1,7 | 11,3 | 3,7 | 2,6 | 2,7 | 2,9 | 2,7 | 2,9 | 5,4 | 3,7 |
| SiO2 | 48,79 | 101,85 | 64,54 | 50,44 | 54,77 | 60,56 | 58,96 | 60,51 | 74,97 | 63,39 |
| +/- | 0,49 | 1,02 | 0,65 | 0,50 | 0,55 | 0,61 | 0,59 | 0,61 | 0,75 | 0,63 |
| Sr | 2,720 | 12,23 | 2,810 | 4,325 | 3,464 | 3,269 | 2,942 | 3,132 | 5,172 | 3,706 |
| +/- | 0,027 | 0,12 | 0,028 | 0,043 | 0,035 | 0,033 | 0,029 | 0,031 | 0,052 | 0,037 |
| F- | 3,637 | 10,43 | 4,430 | 5,907 | 5,643 | 4,988 | 5,720 | 5,413 | 6,678 | 4,964 |
| +/- | 0,036 | 0,10 | 0,044 | 0,059 | 0,056 | 0,050 | 0,057 | 0,054 | 0,067 | 0,050 |
| Cl- | 280,1 | 1301 | 464,7 | 344,1 | 351,4 | 363,0 | 351,9 | 364,5 | 725,1 | 455,4 |
| +/- | 2,8 | 13 | 4,6 | 3,4 | 3,5 | 3,6 | 3,5 | 3,6 | 7,3 | 4,6 |
| NO3- | 223,2 | 311,1 | 327,1 | 279,3 | 286,7 | 291,0 | 289,5 | 292,3 | 350,9 | 319,5 |
| +/- | 2,2 | 3,1 | 3,3 | 2,8 | 2,9 | 2,9 | 2,9 | 2,9 | 3,5 | 3,2 |
| PO43- | 1,865 | 2,522 | 2,927 | 2,372 | 3,149 | 2,486 | 2,939 | 3,586 | 2,280 | 3,653 |
| +/- | 0,019 | 0,025 | 0,029 | 0,024 | 0,031 | 0,025 | 0,029 | 0,036 | 0,023 | 0,037 |
| SO42- | 143,7 | 727,8 | 241,2 | 223,7 | 211,1 | 219,4 | 205,0 | 217,4 | 351,7 | 261,5 |
| +/- | 1,4 | 7,3 | 2,4 | 2,2 | 2,1 | 2,2 | 2,0 | 2,2 | 3,5 | 2,6 |

Table S2: Elemental concentrations in the conventional dissolved fractions (i.e., <0.22µm).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | *Flow (m3/s)* | *[SPM] (mg/L)* | *Total Ti (µmol/L)* | *Total Ce (nmol/L)* | *Total Al (µmol/L)* | *Total La (nmol/L)* | *Total V (nmol/L)* | *Total Y (nmol/L)* |
| *SR1 Marnay sur Seine* | 184 | 9,25 | 0,15 | 1,40 | 5,69 | 0,76 | 18,41 | 1,08 |
| *TR1 Savigny sur Orge* | 2.87 | 16,65 | 0,33 | 3,35 | 12,36 | 1,78 | 36,77 | 2,81 |
| *SR2 Alfortville* | 474 | 12,58 | 0,46 | 4,35 | 16,81 | 2,20 | 28,76 | 3,19 |
| *TR2 St Maurice* | 193 | 51,95 | 2,28 | 17,27 | 72,14 | 8,37 | 73,55 | 9,62 |
| *SR3 Paris* | 657 | 28,12 | 1,05 | 8,48 | 38,93 | 4,31 | 46,70 | 5,41 |
| *SR4 Argenteuil* | *N.A.* | 28,44 | 0,75 | 5,35 | 26,53 | 2,82 | 38,26 | 4,08 |
| *SR5 Bougival* | *N.A.* | 36,85 | 1,49 | 10,98 | 52,49 | 5,74 | 59,29 | 7,08 |
| *SR6 Conflans Ste Honorine* | *N.A.* | 36,18 | 1,23 | 8,87 | 41,13 | 5,24 | 51,22 | 5,75 |
| *TR3 Neuville sur Oise* | 109 | 13,59 | 0,49 | 4,30 | 15,40 | 2,06 | 32,50 | 2,68 |
| *SR7 Triel sur Seine* | 853 | 31,73 | 1,78 | 13,61 | 58,29 | 6,71 | 66,50 | 12,48 |
| *R2Water flow* | *-* | *-* | 0,176 | 0,177 | 0,067 | 0,062 | 0,047 | 0,231 |
| *R2[MES]* | *-* | *-* | 0,880 | 0,843 | 0,886 | 0,881 | 0,853 | 0,598 |

Table S3: Water flows, Suspended Matter Concentrations et total Ti, Ce, Al, La, V and Y concentrations of the Seine River and its tributaries at the sampling points on 11th of May, 2015, from http://www.hydro.eaufrance.fr/ (N.A. = not available).

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| --- | --- | --- |
| *Powder origin* | ***Ti/Al*** | ***ΔTi/Al*** |
| *Kobo* | 5.25 | 0.09 |
| *Tayca MT 01* | 4.08 | 0.11 |
| *Tayca MT 100 TV* | 8.01 | 0.11 |

Table S4: Ti/Al elemental ratios measured by ICPMS after acid digestion of engineered nanoparticles (industrial powders).



Figure S1: Ce concentrations in water samples.



Figure S2: Ti concentrations in the different sampling points.

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Figure S3: Principal component analysis of total Ce concentration with the water chemistry.

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Figure S4: Principal component analysis of total Ti concentration with the water chemistry.

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Figure S5: Principal component analysis of total Ce concentration with the total concentrations of rare earth elements.

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Figure S6: Principal component analysis of total Ti concentration with the total concentrations of trace elements.