Supplement of

Dramatic increase in reactive volatile organic compound (VOC) emissions from ships at berth after implementing the fuel switch policy in the Pearl River Delta Emission Control Area

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Table S1. More information during sampling.

| NO | Sampling temperature (°C) | Power (kW) | Amount | Condition | Engine loads (%) | Fuel consumption rate(t*d⁻¹) |
|----|---------------------------|------------|--------|-----------|-----------------|-----------------------------|
|    |                           |            |        |           |                 |                             |
|    | Coastal vessels (before IFSP) |            |        |           |                 |                             |
| A  | 17                        | 1760       | 2      | Off       | -               | 3.0                         |
|    |                            | 1320       | 1      | On        | 53              |                             |
| B  | 32                        | 2045       | 2      | Off       | -               | -                           |
|    | 2045                      | 2          | 1      | On        | 40              | 4.1                         |
| C-1| 34                        | 1760       | 2      | Off       | -               | -                           |
|    | 1320                      | 1          | 1      | On        | 55              | 4.0                         |
| D-1| 29                        | 660        | 1      | Off       | -               | -                           |
|    | 660                       | 2          | 1      | On        | 34              | 2.2                         |
|    |                           |            |        |           |                 |                             |
|    | Coastal vessels (after IFSP) |            |        |           |                 |                             |
| E  | 25                        | 200        | 1      | Off       | -               | -                           |
|    |                            | 200        | 1      | On        | 39              | 0.4                         |
| F  | 21                        | 200        | 2      | Off       | -               | -                           |
|    |                            | 200        | 1      | On        | 50              | 0.5                         |
| C-2| 29                        | 1760       | 2      | Off       | -               | -                           |
|    | 1320                      | 1          | 1      | On        | 52              | 3.5                         |
| G  | 31                        | 500        | 2      | Off       | -               | -                           |
|    |                            | 500        | 1      | On        | 65              | 1.8                         |
| D-2| 31                        | 660        | 1      | Off       | -               | -                           |
|    | 660                       | 2          | 1      | On        | 37              | 2.4                         |
|    |                           |            |        |           |                 |                             |
|    | River vessels             |            |        |           |                 |                             |
| H  | 25                        | 76         | 1      | Off       | -               | -                           |
|    |                            | 144        | 1      | Off       | -               | -                           |
|    |                            | 144        | 1      | On        | 40              | 0.3                         |
| I  | 32                        | 73.5       | 2      | On        | 40              | 0.3                         |
| J  | 38                        | 58         | 1      | Off       | -               | -                           |
|    | 58                         | 1          | 1      | On        | 32              | 0.1                         |
| K  | 35                        | 58.8       | 1      | Off       | -               | -                           |
|    | 58.8                      | 1          | 1      | On        | 35              | 0.1                         |
Table S2. The percentage of the top 25 VOC species in EFs.

| Species (before IFSP) | Coastal vessels Mean ± 95% C.I. | Species (after IFSP) | Coastal vessels Mean ± 95% C.I. | Species | River vessels Mean ± 95% C.I. |
|-----------------------|---------------------------------|----------------------|---------------------------------|---------|-----------------------------|
| n-Hexane              | 0.67 ± 0.25                     | Ethane               | 1.16 ± 0.50                     | Ethane  | 0.94 ± 0.30                 |
| n-Octane              | 0.60 ± 0.15                     | Propane              | 0.81 ± 0.39                     | n-Butane| 1.18 ± 2.25                 |
| n-Nonane              | 2.74 ± 1.65                     | n-Butane             | 2.59 ± 2.89                     | n-Octane| 0.60 ± 0.27                 |
| n-Decane              | 7.40 ± 6.48                     | n-Pentane            | 0.61 ± 0.61                     | n-Nonane| 2.57 ± 1.12                 |
| n-Undecane            | 16.20 ± 10.34                   | n-Nonane             | 2.37 ± 2.57                     | n-Decane| 4.15 ± 1.95                 |
| n-Dodecane            | 15.78 ± 9.90                    | n-Decane             | 6.27 ± 6.87                     | n-Undecane| 2.93 ± 1.38                |
| Isopentane            | 1.61 ± 0.69                     | n-Undecane           | 2.61 ± 2.92                     | Isobutane| 15.99 ± 5.25               |
| 3-Methylhexane        | 0.79 ± 0.41                     | n-Dodecane           | 2.90 ± 5.59                     | Isopentane| 1.96 ± 0.51                |
| TM224PE\(^a\)         | 2.30 ± 1.16                     | Isobutane            | 8.47 ± 3.68                     | 3-Methylhexane| 0.61 ± 0.20            |
| Ethylene              | 2.85 ± 1.50                     | Isopentane           | 1.65 ± 0.82                     | TM224PE\(^a\) | 0.82 ± 0.24          |
| Propene               | 5.36 ± 2.34                     | Ethylene             | 23.88 ± 11.66                   | Ethylene| 23.85 ± 7.17               |
| 1-Butene              | 1.90 ± 1.11                     | Propene              | 10.89 ± 2.94                    | Propene | 12.38 ± 3.51               |
| Trans-2-butene        | 0.51 ± 0.26                     | 1-Butene             | 2.64 ± 0.69                     | 1-Butene| 2.30 ± 0.17                |
| 1-Pentene             | 2.66 ± 1.83                     | 1-Pentene            | 1.63 ± 0.40                     | 1-Pentene| 1.90 ± 0.17                |
| 1-Hexene              | 5.88 ± 5.01                     | 1-Hexene             | 1.09 ± 0.37                     | 1-Hexene| 1.58 ± 0.31                |
| M4PE1ENE\(^b\)        | 0.64 ± 0.38                     | Acetylene            | 7.87 ± 10.50                    | Acetylene| 6.90 ± 2.99                |
| Acetylene             | 0.85 ± 0.55                     | Benzene              | 3.82 ± 2.92                     | Benzene | 3.04 ± 0.32                |
| Benzene               | 13.24 ± 11.47                   | Toluene              | 2.10 ± 1.28                     | Toluene | 1.74 ± 0.18                |
| Toluene               | 5.91 ± 2.92                     | Ethylbenzene         | 0.67 ± 0.31                     | Ethylbenzene| 0.66 ± 0.25          |
| Ethylbenzene          | 1.29 ± 0.27                     | m/p-Xylene           | 1.93 ± 1.03                     | m/p-Xylene| 1.34 ± 0.59                |
| m/p-Xylene            | 1.80 ± 0.25                     | o-Xylene             | 0.97 ± 0.55                     | o-Xylene | 0.73 ± 0.31                |
| o-Xylene              | 0.70 ± 0.12                     | m-Ethyltoluene       | 1.09 ± 0.99                     | m-Ethyltoluene| 1.27 ± 0.68          |
| m-Ethyltoluene        | 0.54 ± 0.21                     | o-Ethyltoluene       | 0.68 ± 0.64                     | o-Ethyltoluene| 0.60 ± 0.25          |
| TM123B\(^c\)          | 0.91 ± 0.38                     | TM123B               | 0.86 ± 0.82                     | TM123B  | 0.81 ± 0.41                |
| TM124B\(^d\)          | 1.47 ± 1.05                     | TM124B               | 1.79 ± 1.79                     | TM124B  | 1.94 ± 0.84                |

\(^a\)2,2,4-Trimethylpentane; \(^b\)4-Methyl-1-pentene; \(^c\)1,2,3-Trimethylbenzene; \(^d\)1,2,4-Trimethylbenzene.
Figure S1. The fuels used by ship at berth.
Figure S2. Typical total ion chromatographs of VOC species in fuel oils.
Figure S3. VOCs grouping according to their carbon numbers.
Figure S4. Comparison of $R_{O3}$ (g O$_3$ g$^{-1}$ VOCs) and $R_{SOA}$ (g SOA g$^{-1}$ VOCs) based on VOCs source profiles with calculated results from previous studies.
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