Five hundred years of anthropogenic mercury: Spatial and temporal release profiles

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1.0 Methodology for Estimating Time-Varying Emission Factors

This section is adapted from previous published documentation [1,2] of the methods used for the determination of sector-specific Hg emission factors over time (shown here from 1850 to the present). Figure 1 presents a conceptual diagram of the methodology used to estimate the time variation of Hg emissions to the environment for source types that involve combustion or metal-extraction techniques. The total Hg that is released in the combustion of a ton of coal or the production of a ton of silver, for example, is constrained by the Hg content of the raw coal or the silver ore. The relationship between these parameters determines an upper bound on the amount of Hg that can have been released in the all-time combustion of coal or the production of silver.

Figure 1. Conceptual diagram of the methodology used to estimate the time-varying composition of Hg releases to air and land/water per unit of fuel combusted or metal produced, as a function of the Hg content of the raw material (gray dashed line), the increased penetration of emission control technologies and waste treatment systems over time (solid blue line), and the recent trend toward capturing and re-using Hg (solid red line).
The partitioning of emissions between air, land, and water is driven largely by the implementation of emission control technology. Before 1900 there were few attempts to limit air pollution, and so the release of Hg to the air was at a maximum per unit of activity. As time went on, there was a transition from old, small-scale, uncontrolled processes to modern, large-scale industrial processes with emission controls, and therefore the air emissions per unit of coal combusted or silver produced declined (Figure 1). Consequently, more Hg was released to land and water. The production of desirable materials has increased continuously, but at the same time process technology has improved and pollution controls have been adopted, so the resulting level of Hg releases at any given time is determined by competition between production growth and technology improvement. The partitioning between air and land/water is similarly determined.

We use the following transformed normal distribution function to estimate the change of air emission factors over time and hence the boundary between air and land/water emissions, as shown in Figure 1:

\[ y_{r,p,t} = (a_{r,p} - b_{r,p})e^{(r^2/s_{r,p}^2)} + b_{r,p} \]

where

- \( y_{r,p,t} \) = air emission factor in region \( r \) for process \( p \) in year \( t \) (g Mg\(^{-1}\));
- \( a_{r,p} \) = pre-1850 emission factor (g Mg\(^{-1}\)) in region \( r \) for process \( p \);
- \( b_{r,p} \) = best emission factor achieved in region \( r \) for process \( p \) today (g Mg\(^{-1}\)); and
- \( s_{r,p} \) = shape parameter of the curve for region \( r \) and process \( p \).

The use of such sigmoid curves to simulate the dynamics of technology change has been previously applied to energy and emission control technology, carbon sequestration, and automobile technology. By selecting values of the parameters \( a, b, \) and \( s \) to correspond to the known or inferred time development pathway of relevant technologies, we can estimate the value of emission factor \( y \) at any point in time \( t \).

Figure 1 shows that the Hg not directly released to air is composed of Hg remaining in the waste left over from the extraction and processing of the raw coal or ore, Hg left in discarded bottom ash and slag during the combustion/smelting process, and Hg contained in fly ash that is collected at the facility. Historically, and still today to some extent, these waste products have
accumulated at sites contaminated by Hg such as waste piles, storage ponds, and adjacent rivers. In recent years, greater efforts have been taken to secure these wastes in controlled landfills, to recycle the Hg and to re-use the collected wastes (in products such as cement, gypsum, and sulfuric acid), as indicated in Figure 1. The total Hg released to land/water can be calculated by subtraction of the air emissions from the total Hg content of the raw or processed material, by direct calculation of the amount of collected fly ash, or by the ratio of air to land/water releases.

Figure 2 illustrates the use of this technique for estimating atmospheric Hg emission factors for copper smelters (the solid blue line in Figure 1). We have divided the world regions into five distinctive types to represent different emission factor trajectories. Each world region is comprised of countries with similar levels of technology development, ranging from most developed (Region 1) to least developed (Region 5). Emission factors for each world region were determined from a review of reported emission rates in representative countries and used to anchor each trajectory [1]. The Supporting Information for Reference 1 presents and documents emission factor ranges for each industrial activity for 1850, 1930, and 2008 and provides citations for the studies used in the development of the emission factor curves.

**Figure 2.** Time development of Hg emission factors for copper smelters in five world regions. Each world region is comprised of countries with similar levels of technology development.
[1] Streets, D.G., Devane, M.K., Lu, Z., Bond, T.C., Sunderland, E.M., Jacob, D.J., 2011. All-time releases of mercury to the atmosphere from human activities. *Environ. Sci. Technol.* **45**, 10485–10491

[2] Streets, D.G., Horowitz, H.M., Jacob, D.J., Lu, Z., Levin, L., ter Schure, A.F.H., Sunderland, E.M., 2017. Total mercury released to the environment by human activities. *Environ. Sci. Technol.* **51**, 5969–5977
### 2.0 Decadal Mercury Emissions Data by Major Source Regions, 1510–2010

#### (A) 1510–1600

| Region          | Long-term regional Hg releases (Mg Hg) | 1510 | 1520 | 1530 | 1540 | 1550 | 1560 | 1570 | 1580 | 1590 | 1600 |
|-----------------|---------------------------------------|------|------|------|------|------|------|------|------|------|------|
|                 |                                       |      |      |      |      |      |      |      |      |      |      |
| **North America** |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.0                                   | 0.0  | 0.4  | 0.7  | 1.0  | 1.3  | 1.6  | 1.8  | 2.1  | 2.4  |      |
| Land/Water      | 0.0                                   | 0.0  | 10.1 | 20.0 | 29.9 | 39.8 | 49.7 | 59.6 | 69.5 | 79.4 |      |
| Total Hg        | 0.0                                   | 0.1  | 10.5 | 20.7 | 30.9 | 41.1 | 51.2 | 61.4 | 71.6 | 81.8 |      |
| **South America** |                                      |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.0                                   | 0.0  | 1.3  | 5.1  | 7.8  | 42.0 | 46.1 | 50.3 | 54.5 | 58.9 |      |
| Land/Water      | 0.0                                   | 0.0  | 3.1  | 11.2 | 18.2 | 36.4 | 41.5 | 48.0 | 54.3 | 60.7 |      |
| Total Hg        | 0.0                                   | 0.0  | 3.3  | 11.7 | 18.9 | 39.7 | 46.3 | 53.0 | 59.5 | 66.4 |      |
| **Europe**      |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 26.9                                  | 30.9 | 35.0 | 39.4 | 43.9 | 44.6 | 45.3 | 45.9 | 44.9 | 41.6 |      |
| Land/Water      | 78.3                                  | 87.9 | 98.2 | 109.1| 120.7| 122.4| 124.2| 125.9| 125.1| 120.9|      |
| Total Hg        | 105.2                                 | 118.8| 133.2| 148.5| 164.6| 167.0| 169.4| 171.8| 170.0| 162.5|      |
| **Former USSR** |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| Land/Water      | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| Total Hg        | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| **Africa/Middle East** |                              |      |      |      |      |      |      |      |      |      |      |
| Air             | 1.5                                   | 1.5  | 1.4  | 1.4  | 1.4  | 1.4  | 1.3  | 1.3  |      |      |      |
| Land/Water      | 2.2                                   | 2.2  | 2.2  | 2.1  | 2.1  | 2.1  | 2.0  | 2.0  |      |      |      |
| Total Hg        | 3.7                                   | 3.6  | 3.6  | 3.5  | 3.5  | 3.4  | 3.3  | 3.3  |      |      |      |
| **Asia**        |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 5.1                                   | 5.5  | 5.8  | 6.2  | 6.6  | 6.9  | 7.3  | 7.7  | 8.0  | 9.3  |      |
| Land/Water      | 7.7                                   | 8.2  | 8.8  | 9.3  | 9.8  | 10.4 | 10.9 | 11.5 | 12.0 | 13.9 |      |
| Total Hg        | 12.8                                  | 13.7 | 14.6 | 15.5 | 16.4 | 17.3 | 18.2 | 19.1 | 20.0 | 23.1 |      |
| **Oceania**     |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| Land/Water      | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| Total Hg        | 0.0                                   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |      |
| **Global**      |                                       |      |      |      |      |      |      |      |      |      |      |
| Air             | 33.5                                  | 37.9 | 44.1 | 52.8 | 60.7 | 96.2 | 101.6| 107.1| 110.9| 113.4|      |
| Land/Water      | 88.2                                  | 98.4 | 150.9| 253.1| 344.5| 529.4| 604.3| 679.5| 752.5| 823.7|      |
| Total Hg        | 121.7                                 | 136.3| 195.0| 305.9| 405.2| 625.6| 705.9| 786.6| 863.4| 937.1|      |
### (B) 1610–1700

| Long-term regional Hg releases (Mg Hg) | 1610 | 1620 | 1630 | 1640 | 1650 | 1660 | 1670 | 1680 | 1690 | 1700 |
|----------------------------------------|------|------|------|------|------|------|------|------|------|------|
| **North America:**                     |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 3.1  | 3.1  | 3.3  | 3.3  | 3.6  | 3.6  | 3.9  | 3.9  | 4.2  | 4.2  |
| Land/Water                             | 102.9| 102.9| 111.7| 111.7| 120.6| 120.7| 129.4| 129.4| 139.6| 139.7|
| Total Hg                               | 105.9| 106.0| 115.0| 115.1| 124.2| 124.3| 133.2| 133.2| 143.8| 143.8|
| **South America:**                     |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 58.4 | 58.0 | 57.7 | 57.3 | 56.9 | 55.8 | 54.8 | 53.7 | 52.7 | 51.7 |
| Land/Water                             | 579.8| 552.0| 524.3| 496.6| 469.0| 438.6| 408.6| 378.5| 348.5| 318.5|
| Total Hg                               | 638.2| 610.1| 582.0| 553.9| 526.9| 494.6| 463.4| 432.2| 401.2| 370.2|
| **Europe:**                            |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 44.3 | 48.5 | 58.3 | 70.2 | 76.0 | 62.0 | 52.9 | 45.4 | 39.1 | 33.9 |
| Land/Water                             | 137.9| 159.9| 193.9| 236.2| 251.6| 206.6| 173.3| 146.4| 124.0| 105.4|
| Total Hg                               | 182.2| 208.4| 252.2| 305.4| 326.7| 267.6| 226.2| 191.8| 163.1| 139.3|
| **Former USSR:**                      |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Land/Water                             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Hg                               | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| **Africa/Middle East:**                |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 1.2  | 1.2  | 1.1  | 1.0  | 1.0  | 0.9  | 0.8  | 0.7  | 0.7  | 0.7  |
| Land/Water                             | 1.9  | 1.8  | 1.7  | 1.6  | 1.5  | 1.4  | 1.2  | 1.1  | 1.1  | 1.1  |
| Total Hg                               | 3.1  | 2.9  | 2.8  | 2.6  | 2.4  | 2.3  | 2.1  | 2.1  | 2.1  | 2.1  |
| **Asia:**                              |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 10.5 | 11.8 | 13.0 | 14.3 | 15.5 | 16.8 | 18.0 | 19.3 | 20.6 | 21.7 |
| Land/Water                             | 15.7 | 17.6 | 19.5 | 21.4 | 23.2 | 25.1 | 27.0 | 28.8 | 30.7 | 32.6 |
| Total Hg                               | 26.3 | 29.4 | 32.5 | 35.6 | 38.7 | 41.9 | 45.0 | 48.1 | 51.2 | 54.3 |
| **Oceania:**                           |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Land/Water                             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Hg                               | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| **Global:**                            |      |      |      |      |      |      |      |      |      |      |
| Air                                    | 117.6| 122.6| 133.4| 146.2| 152.0| 139.1| 130.4| 122.9| 117.2| 112.3|
| Land/Water                             | 838.2| 834.2| 851.0| 866.4| 885.9| 791.5| 739.5| 684.3| 644.0| 597.2|
| Total Hg                               | 955.8| 956.8| 984.5| 1012.6|1018.0| 930.6| 869.9| 807.2| 761.2| 709.5|
### Long-term regional Hg releases (Mg Hg)

| Region          | 1710 | 1720 | 1730 | 1740 | 1750 | 1760 | 1770 | 1780 | 1790 | 1800 |
|-----------------|------|------|------|------|------|------|------|------|------|------|
| **North America** |      |      |      |      |      |      |      |      |      |      |
| Air             | 6.1  | 6.2  | 8.6  | 8.7  | 11.3 | 11.3 | 13.7 | 13.8 | 20.9 | 20.9 |
| Land/Water      | 207.5| 207.5| 292.3| 292.4| 381.3| 381.3| 464.1| 464.1| 712.1| 712.2|
| Total Hg        | 213.6| 213.7| 300.9| 301.0| 392.5| 392.6| 477.8| 477.9| 732.9| 733.1|
| **South America** |     |      |      |      |      |      |      |      |      |      |
| Air             | 49.7 | 48.0 | 46.5 | 45.2 | 44.2 | 48.6 | 53.3 | 58.4 | 63.8 | 56.7 |
| Land/Water      | 324.4| 331.4| 339.2| 347.9| 357.3| 385.7| 415.1| 445.8| 477.8| 466.0|
| Total Hg        | 374.1| 379.3| 385.7| 393.1| 401.5| 434.3| 480.5| 504.2| 541.6| 522.7|
| **Europe**      |      |      |      |      |      |      |      |      |      |      |
| Air             | 44.8 | 59.1 | 77.7 | 102.4| 135.1| 152.2| 171.1| 192.3| 214.1| 218.9|
| Land/Water      | 140.6| 187.3| 249.5| 332.6| 443.8| 499.7| 562.5| 632.9| 709.2| 726.3|
| Total Hg        | 185.4| 246.4| 327.3| 436.0| 579.0| 651.9| 733.6| 825.2| 923.3| 944.2|
| **Former USSR** |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.6  | 1.2  | 1.9  | 2.6  | 2.9  | 3.2  | 3.5  | 3.9  | 4.2  | 4.5  |
| Land/Water      | 0.9  | 1.9  | 2.9  | 3.9  | 4.3  | 4.8  | 5.3  | 5.7  | 6.2  | 6.7  |
| Total Hg        | 1.4  | 3.1  | 4.8  | 6.4  | 7.2  | 8.0  | 8.8  | 9.6  | 10.4 | 11.2 |
| **Africa/Middle East** |    |      |      |      |      |      |      |      |      |      |
| Air             | 0.7  | 0.7  | 0.7  | 0.7  | 0.6  | 0.6  | 0.6  | 0.6  | 0.6  | 0.6  |
| Land/Water      | 1.1  | 1.0  | 1.0  | 1.0  | 0.9  | 0.9  | 0.9  | 0.9  | 0.9  | 0.9  |
| Total Hg        | 1.8  | 1.7  | 1.7  | 1.7  | 1.6  | 1.6  | 1.6  | 1.6  | 1.6  | 1.6  |
| **Asia**        |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.8  | 0.8  | 0.8  | 0.8  | 0.9  | 0.9  | 0.9  | 0.9  | 0.9  | 0.9  |
| Land/Water      | 1.2  | 1.2  | 1.2  | 1.2  | 1.2  | 1.2  | 1.3  | 1.3  | 1.3  | 1.3  |
| Total Hg        | 2.0  | 2.0  | 2.0  | 2.0  | 2.1  | 2.1  | 2.2  | 2.2  | 2.2  | 2.2  |
| **Oceania**     |      |      |      |      |      |      |      |      |      |      |
| Air             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Land/Water      | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Hg        | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| **Global**      |      |      |      |      |      |      |      |      |      |      |
| Air             | 102.8| 116.0| 136.3| 160.4| 195.0| 216.8| 243.2| 269.3| 304.5| 302.6|
| Land/Water      | 675.8| 730.3| 886.0| 978.9| 1188.9|1273.7|1449.1|1550.8|1907.6|1912.3|
| Total Hg        | 778.4| 846.3|1022.3|1139.3|1383.9|1490.5|1632.4|1820.6|2212.1|2215.0|
## Long-term regional Hg releases (Mg Hg)

| Region          | 1810  | 1820  | 1830  | 1840  | 1850  | 1860  | 1870  | 1880  | 1890  | 1900  |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| North America   |       |       |       |       |       |       |       |       |       |       |
| Air             | 21.4  | 12.9  | 11.5  | 14.6  | 87.8  | 121.2 | 486.5 | 970.0 | 1374.2 | 1052.8 |
| Land/Water      | 703.0 | 398.2 | 339.4 | 424.0 | 304.1 | 466.6 | 2336.4 | 3139.5 | 2414.8 | 2008.6 |
| Total Hg        | 724.5 | 411.1 | 350.9 | 438.6 | 391.9 | 577.9 | 2831.9 | 4115.6 | 3789.0 | 3061.3 |
| South America   |       |       |       |       |       |       |       |       |       |       |
| Air             | 27.2  | 17.3  | 10.5  | 12.0  | 11.2  | 11.8  | 12.2  | 30.9  | 31.7  | 49.3  |
| Land/Water      | 355.3 | 314.5 | 292.7 | 276.1 | 301.5 | 302.2 | 311.3 | 659.2 | 709.4  | 1048.8 |
| Total Hg        | 382.5 | 331.7 | 303.2 | 298.0 | 312.6 | 314.1 | 323.5 | 690.0 | 741.0  | 1098.2 |
| Europe          |       |       |       |       |       |       |       |       |       |       |
| Air             | 207.7 | 199.1 | 196.9 | 226.0 | 260.8 | 316.5 | 411.6 | 631.1 | 749.6 | 605.9 |
| Land/Water      | 676.1 | 632.9 | 596.8 | 654.3 | 714.4 | 795.0 | 991.6 | 1593.8 | 1997.0 | 1476.5 |
| Total Hg        | 883.8 | 831.9 | 792.7 | 880.3 | 975.2 | 1111.6 | 1403.2 | 2224.9 | 2745.5 | 2082.4 |
| Former USSR     |       |       |       |       |       |       |       |       |       |       |
| Air             | 6.7   | 8.0   | 9.8   | 15.7  | 21.7  | 22.1  | 27.1  | 30.5  | 86.2  | 88.3  |
| Land/Water      | 9.8   | 11.6  | 14.3  | 23.0  | 32.0  | 32.9  | 40.2  | 44.9  | 234.7 | 239.5 |
| Total Hg        | 16.6  | 19.6  | 24.1  | 38.7  | 53.7  | 55.0  | 67.3  | 75.4  | 320.9 | 327.8 |
| Africa/Middle East |      |       |       |       |       |       |       |       |       |       |
| Air             | 0.6   | 0.5   | 0.3   | 1.2   | 0.1   | 0.2   | 0.7   | 2.7   | 16.7  | 22.9  |
| Land/Water      | 1.0   | 0.7   | 0.5   | 0.5   | 0.2   | 0.4   | 1.3   | 3.9   | 24.8  | 33.2  |
| Total Hg        | 1.6   | 1.2   | 0.8   | 1.7   | 0.2   | 0.6   | 2.0   | 6.6   | 41.5  | 56.1  |
| Asia            |       |       |       |       |       |       |       |       |       |       |
| Air             | 1.4   | 2.3   | 6.3   | 12.0  | 1.3   | 2.7   | 5.0   | 23.9  | 42.0  | 72.7  |
| Land/Water      | 1.5   | 2.5   | 3.4   | 4.3   | 2.4   | 5.2   | 9.9   | 36.6  | 63.2  | 104.3 |
| Total Hg        | 3.0   | 4.8   | 9.7   | 16.3  | 3.7   | 7.9   | 14.8  | 60.5  | 105.2 | 177.0 |
| Oceania         |       |       |       |       |       |       |       |       |       |       |
| Air             | 0.0   | 0.0   | 0.0   | 0.0   | 5.2   | 39.8  | 33.6  | 26.7  | 159.6 | 278.3 |
| Land/Water      | 0.0   | 0.0   | 0.0   | 0.0   | 7.7   | 59.4  | 50.0  | 39.6  | 238.3 | 410.5 |
| Total Hg        | 0.0   | 0.0   | 0.0   | 0.0   | 12.9  | 99.2  | 83.5  | 66.4  | 395.9 | 688.7 |
| Global          |       |       |       |       |       |       |       |       |       |       |
| Air             | 265.1 | 240.0 | 235.2 | 281.5 | 381.1 | 514.5 | 985.6 | 1721.8 | 2460.0 | 2170.2 |
| Land/Water      | 1746.8 | 1360.3 | 1246.0 | 1392.2 | 1362.3 | 1651.8 | 3740.7 | 6517.6 | 5680.2 | 5321.4 |
| Total Hg        | 2011.9 | 1600.3 | 1481.3 | 1633.7 | 1750.4 | 2166.3 | 4726.3 | 7239.4 | 8140.2 | 7491.5 |
### Long-term regional Hg releases (Mg Hg)

| Region       | 1910  | 1920  | 1930  | 1940  | 1950  | 1960  | 1970  | 1980  | 1990  | 2000  | 2010  |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| North America|       |       |       |       |       |       |       |       |       |       |       |
| Air          | 632.3 | 381.1 | 400.0 | 447.6 | 371.3 | 502.8 | 782.2 | 432.4 | 324.2 | 172.6 | 109.3 |
| Land/Water   | 1281.5| 724.0 | 955.0 | 1415.9| 1050.0| 1313.1| 1805.5| 2092.2| 1776.2| 1247.3| 1033.7|
| Total Hg     | 1933.8| 1105.1|1354.9| 1863.7| 1421.4| 1815.9| 2587.1| 2584.6| 2100.4| 1420.1| 1143.0|
| South America|       |       |       |       |       |       |       |       |       |       |       |
| Air          | 223.1 | 132.3 | 97.6  | 113.4 | 58.6  | 104.1 | 62.4  | 74.2  | 154.6 | 239.0 | 263.6 |
| Land/Water   | 330.0 | 201.7 | 162.9 | 240.8 | 123.9 | 230.1 | 203.4 | 233.9 | 536.2 | 769.3 | 843.1 |
| Total Hg     | 553.1 | 334.0 | 264.6 | 364.2 | 182.5 | 334.2 | 265.8 | 308.1 | 609.2 | 1008.4| 1196.7|
| Europe       |       |       |       |       |       |       |       |       |       |       |       |
| Air          | 691.1 | 395.1 | 430.4 | 614.8 | 318.3 | 555.0 | 1036.6| 508.7 | 309.8 | 155.3 | 85.7  |
| Land/Water   | 1677.2| 909.5 | 915.6 | 1489.7| 723.2 | 1188.3| 2126.0| 1950.5| 1864.9| 895.3 | 597.6 |
| Total Hg     | 2368.3| 1304.6|1345.9| 2104.5| 1041.5| 1747.8| 3162.5| 2485.3| 2714.7| 1056.0| 683.3 |
| Former USSR  |       |       |       |       |       |       |       |       |       |       |       |
| Air          | 63.6  | 36.6  | 90.7  | 197.1 | 194.3 | 252.9 | 196.4 | 213.0 | 186.5 | 114.9 | 96.5  |
| Land/Water   | 101.1 | 70.6  | 216.0 | 452.6 | 485.8 | 584.0 | 551.3 | 646.5 | 799.0 | 520.3 | 427.1 |
| Total Hg     | 164.7 | 107.2 | 306.8 | 646.7 | 680.1 | 836.8 | 749.7 | 855.5 | 929.5 | 635.2 | 513.6 |
| Africa/Middle East | | | | | | | | | | | |
| Air          | 220.6 | 212.1 | 252.5 | 349.4 | 243.6 | 374.3 | 413.1 | 388.1 | 371.8 | 365.3 | 383.2 |
| Land/Water   | 336.7 | 345.3 | 466.9 | 728.2 | 547.6 | 962.4 | 1344.1| 1265.6| 1300.7| 1083.9| 887.4 |
| Total Hg     | 557.3 | 557.4 | 713.8 | 1073.6| 911.1 | 1336.7| 1757.1| 1633.7| 1672.5| 1449.2| 1270.6|
| Asia         |       |       |       |       |       |       |       |       |       |       |       |
| Air          | 137.2 | 169.6 | 219.6 | 435.5 | 130.6 | 624.1 | 516.5 | 314.5 | 585.2 | 886.9 | 1255.5|
| Land/Water   | 208.5 | 308.2 | 477.4 | 1102.6| 292.7 | 1778.0| 1757.1| 831.5 | 1623.2| 2217.2| 3170.6|
| Total Hg     | 345.7 | 477.8 | 697.0 | 1531.1| 423.2 | 2402.1| 2273.6| 1146.0| 2208.4| 3104.1| 4426.1|
| Oceania      |       |       |       |       |       |       |       |       |       |       |       |
| Air          | 210.1 | 28.1  | 23.7  | 28.7  | 12.9  | 13.3  | 15.3  | 11.7  | 25.4  | 28.5  | 25.6  |
| Land/Water   | 308.2 | 42.6  | 31.8  | 63.5  | 37.4  | 51.1  | 61.3  | 76.0  | 298.5 | 397.4 | 372.0 |
| Total Hg     | 518.2 | 70.7  | 55.5  | 92.2  | 50.3  | 64.4  | 76.6  | 87.7  | 325.0 | 425.9 | 397.6 |
| Global       |       |       |       |       |       |       |       |       |       |       |       |
| Air          | 2178.0| 1365.9|1514.4| 2186.4| 1329.6| 2430.4| 3024.4| 1982.4| 1960.6| 1962.7| 2209.4|
| Land/Water   | 4156.2| 2601.9|3224.5| 6493.2| 2269.6| 6107.5| 7840.7| 7105.4| 8198.7| 7130.6| 7331.4|
| Total Hg     | 6334.2| 3967.7|4738.9| 7679.6| 4590.2| 8530.0| 10873.1| 10098.0| 10159.3| 9093.6| 9540.9|