Supplementary material for “Climate and health implications of future aerosol emission scenarios”

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\textbf{Figure S1.} Annual mean effective radiative forcing of anthropogenic and biomass burning aerosols relative to the year 1850 a) for 4.5AER in 2005 (note that scenarios start diverging in 2001), b) for 4.5AER in 2100, c) for LOW in 2100, and d) for HIGH in 2100. Note that the scale of the colorbar is different in (a).
Figure S2. a) Anthropogenic annual mean PM$_{2.5}$ surface concentration in year 2000 calculated as the difference between the simulation for year 2000 and the reference simulation for year 1850 without anthropogenic aerosol emissions. b) Same as a), but including anthropogenic aerosol emissions for year 1850. c) Annual mean PM$_{2.5}$ surface concentration in 2005 for 4.5AER.
Figure S3. Difference in a) PM$_{2.5}$-caused premature mortality and b) organic carbon emissions from biomass burning between the aerosol emissions in LOW for year 2100 and in the reference simulation for year 1850 without anthropogenic aerosol emissions.
Table S1. Annual global PM$_{2.5}$-induced premature mortality using the methodology of Burnett et al (2014). The first number is based on ensemble mean relative risk and the numbers in parenthesis represent the high and low estimates by using 2.5th and 97.5th percentiles. The numbers are rounded to nearest 100.

| Year | LOW    | 2.6AER | 4.5AER | 8.5AER | HIGH    |
|------|--------|--------|--------|--------|---------|
|      | (1,349,500 - 2,957,800) | (1,322,900 - 2,919,500) | (1,329,300 - 2,925,200) | (1,320,300 - 2,906,800) | (1,349,500 - 2,957,800) |
| 2005 | 2,399,500 | 2,358,500 | 2,399,500 | 2,354,100 | 2,399,500 |
| 2010 | 2,226,700 | 2,424,400 | 2,371,800 | 2,231,800 | 2,501,400 |
| 2020 | 1,612,700 | 2,270,000 | 2,290,900 | 2,231,800 | 2,659,200 |
| 2030 | 299,900  | 1,849,500 | 2,062,700 | 1,967,700 | 2,780,800 |
| 2040 | 292,500  | 1,392,800 | 1,746,900 | 1,601,400 | 2,760,300 |
| 2050 | 257,600  | 1,109,900 | 1,337,700 | 1,306,600 | 2,556,300 |
| 2060 | 190,400  | 940,400   | 1,085,300 | 1,134,900 | 2,260,900 |
| 2070 | 104,400  | 820,700   | 839,500   | 1,005,100 | 1,818,900 |
| 2080 | 25,700   | 688,800   | 615,200   | 940,300   | 1,150,900 |
| 2090 | 22,400   | 548,700   | 569,100   | 751,800   | 1,186,700 |
| 2100 | 22,900   | 475,400   | 525,700   | 678,000   | 1,231,200 |
Table S2. Annual global PM$_{2.5}$-induced premature mortality. The first number is the central estimate and the numbers in parenthesis represent the high and low estimates by using upper and lower bound of 95% confidence interval for the coefficient $\beta$ (Ostro 2004). The numbers are rounded to nearest 100.

| Year | LOW         | 2.6AER       | 4.5AER       | 8.5AER       | HIGH         |
|------|-------------|--------------|--------------|--------------|--------------|
| 2005 | 2,787,300   | 2,737,600    | 2,787,300    | 2,730,700    | 2,787,300    |
|      | (1,072,100 – 4,314,000) | (1,050,700 – 4,314,000) | (1,049,500 – 4,229,400) | (1,072,100 – 4,314,000) |
| 2010 | 2,571,100   | 2,819,200    | 2,753,400    | 2,577,700    | 2,918,000    |
|      | (985,800 – 3,991,100) | (1,085,700 – 3,994,000) | (1,059,100 – 3,994,000) | (1,125,600 – 4,503,900) |
| 2020 | 1,839,900   | 2,626,000    | 2,657,200    | 2,577,700    | 3,129,200    |
|      | (698,000 – 2,885,100) | (1,010,500 – 4,261,300) | (990,400 – 3,994,000) | (1,214,500 – 4,803,000) |
| 2030 | 346,200     | 2,123,600    | 2,381,300    | 2,577,700    | 3,291,900    |
|      | (127,200 – 559,400) | (810,200 – 3,705,700) | (910,500 – 3,849,300) | (1,279,300 – 4,803,000) |
| 2040 | 337,200     | 1,597,000    | 2,016,600    | 2,577,700    | 3,274,900    |
|      | (123,900 – 545,200) | (602,300 – 3,544,100) | (765,300 – 3,705,700) | (1,271,500 – 5,045,200) |
| 2050 | 299,000     | 1,275,900    | 1,551,200    | 1,520,400    | 3,040,900    |
|      | (109,800 – 483,700) | (478,200 – 3,544,100) | (583,800 – 3,849,300) | (1,279,300 – 5,045,200) |
| 2060 | 224,400     | 1,079,500    | 1,256,600    | 1,326,900    | 2,674,000    |
|      | (82,300 – 363,500) | (403,100 – 1,996,500) | (470,000 – 2,087,200) | (1,027,200 – 4,142,800) |
| 2070 | 124,600     | 938,600      | 971,300      | 1,177,800    | 2,131,000    |
|      | (45,700 – 201,600) | (349,400 – 1,552,200) | (361,100 – 1,854,400) | (809,500 – 3,336,500) |
| 2080 | 31,900      | 784,500      | 712,200      | 1,103,000    | 1,333,800    |
|      | (11,900 – 50,800) | (291,000 – 1,144,800) | (263,200 – 1,734,100) | (498,300 – 2,121,400) |
| 2090 | 28,500      | 623,600      | 659,100      | 870,700      | 1,372,100    |
|      | (10,700 – 45,200) | (230,500 – 1,060,800) | (243,300 – 1,380,800) | (512,900 – 2,181,400) |
| 2100 | 29,000      | 541,900      | 608,500      | 783,800      | 1,420,800    |
|      | (10,900 – 46,000) | (199,900 – 980,500) | (224,300 – 1,244,300) | (531,400 – 2,257,700) |
Text S1 Alternative methodology for calculating relative risk

To estimate how the choice of concentration-response function affects the PM$_{2.5}$-induced premature mortality, we re-calculated our mortality estimates by using the methodology by Ostro (2004), as done for example by Partanen et al (2013).

We calculated the relative risk for cardiopulmonary diseases (cardiovascular diseases and chronic obstructive pulmonary disease) or lung cancer (trachea, bronchus, and lung cancers) using the following formula:

$$RR_j = [(z + 1)/(z_{cf}+1)]^\beta,$$  \hspace{1cm} (S1)

where $z_{cf}$ is the PM$_{2.5}$ concentration (in μg m$^{-3}$) in the reference scenario or a minimum threshold of 5.8 μg m$^{-3}$ (Apte et al 2015) (whichever is larger); $z$ is the PM$_{2.5}$ concentration in a given year in a given aerosol emission scenario or the previous minimum threshold (whichever is larger); $\beta_j$ is a constant with a value of 0.23218 (95% confidence interval: 0.08563–0.37873) for lung cancer and 0.15515 (95% confidence interval: 0.0562–0.2541) for cardiopulmonary diseases (Ostro 2004). We calculated the premature mortality with relative risk from Equation S1 by summing the contributions from cardiopulmonary diseases and lung cancers using the Equation 1 for a single age group of people with an age over 30 years. We calculated the 95% confidence interval for our mortality estimates by evaluating Equation S1 with the low and high estimates of $\beta_j$. 