Supplemental Material

Discrepancies in ozone levels and temporal variations between urban and rural North China Plain: implications for agricultural impact assessment

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**Table S1.** Annual and seasonal change rates of AOT40 levels at GC, BD, BJ, SJZ and CNEMC NCP sites during 2013-2019.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sites | Rates (ppm h yr-1) | Annual | Spring | Summer | Autumn |
| BD | GC | -3.8 | -0.0 | -2.9 | -0.3a |
| Urban/Suburban | **7.9** | **2.7** | **4.3** | 0.9 |
| BJ | North | **2.5** | 0.6 | 1.4 | **0.5** |
| Urban | 2.3 | 0.6 | 1.22 | 0.5 |
| West | **2.3** | 0.4 | **1.2** | 0.7 |
| SJZ | Suburban | 2.9 | 0.7 | 1.6 | 0.5 |
| Urban | **5.4** | **1.6** | **3.1** | 0.6 |
| Rural | -2.0 | -0.4 | -1.1 | -0.3 |
| NCP | p<0.05 | upward | **4.5****(1.9 to 10.2)**# | **1.8****(1.3 to 2.9)**# | **2.7****(1.0 to 5.6)**# | **0.2****(0.0 to 1.4)**# |
| downward | **-1.7****(-1.9 to -1.4)**# | **-** | **-** | **-** |
| NDown/NAll-s \* | 6/51 | 0/15 | 0/38 | 0/39 |
| p>0.05 | upward | 0.0 to 2.0# | 0.5 to 1.6# | 0.2 to 4.6# | 0.0 to 1.0# |
| downward | -0.4 to 0.0# | -0.6 to -0.0# | -0.6 to -0.2# | **-** |
| NDown/NAll-n \* | 38/78 | 33/58 | 11/35 | 0/79 |

Notes:

1. Bold numbers are rates that passed the 95% significant test.

2. \* NDown represents the number of sites with downward AOT40, while NAll-s and NAll-n are the total numbers of sites with significantly and non-significantly change rates of AOT40, respectively.

3. a represents change rates calculated for 2013 to 2018

4. # variation range of the AOT40 change rates observed at distinct sites in the NCP.

**Table S2.** Monthly average (± standard deviation) of O3 mixing ratios at GC during 2013-2019 (Units: ppb).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Jan. | 2.6±4.9 | 5.3±8.4 | 5.5±8.2 | 7.7±10.5 | 7.0±10.2 | 7.3±8.8 | 7.0±8.9 |
| Feb. | 8.6±9.4 | 11.2±12.7 | 13.8±14.1 | 10.7±12 | 11.4±12.7 | 13.8±11.8 | 13±13.8 |
| Mar. | 11.5±11.7 | 19.9±20 | 22.1±19.8 | 14.3±13.3 | 17.1±14.9 | 17.1±15.4 | 23.5±18.2 |
| Apr. | 15.7±14.7 | 34.4±24.1 | 35.6±25.7 | 24.1±16.9 | 22.2±17.5 | 26.6±19.3 | 28.3±19.4 |
| May | 28.6±22.8 | 44.9±28.6 | 48.4±33.7 | 34.3±24.7 | 43.1±32.3 | 32.9±22.1 | 37.4±24.8 |
| Jun. | 44.3±32.7 | 49.9±31.3 | 57.3±35.9 | 46.1±30.5 | 61±38 | 49.6±31.3 | 46.5±30.9 |
| Jul. | 43.7±30.7 | 45.9±31.4 | 58.8±37.8 | 39±28.8 | 52.4±38.6 | 34.5±23.6 | 31.6±25.4 |
| Aug. | 39.3±30.7 | 41.2±30.6 | 46.6±36.4 | 28.9±24.6 | 27.8±21.3 | 28.4±21.5 |  |
| Sep. | 25.8±25.5 | 25.9±26.1 | 36.1±34.8 | 30.9±30.7 | 26.9±29.2 | 20.2±20.3 |  |
| Oct. |  | 16.1±20.5 | 20.2±26.8 | 10.4±15.6 | 9.8±11.3 | 13.6±16.7 |  |
| Nov. |  | 9.5±11.6 | 11.1±13 | 6.5±9 | 8.7±9.5 | 7.4±11.2 |  |
| Dec. |  | 8.4±9.4 | 5.4±7.6 | 3.3±5 | 6.9±8.5 | 5.4±7.5 |  |

**Table S3.** Annual AOT40 for wheat, maize and soybean during the growing seasons at GC from 2013 to 2019.

|  |  |  |
| --- | --- | --- |
| Year | AOT40wheat (ppm h) | AOT40soybean/maize (ppm h) |
| 2013 | 6.9 | 27.9 |
| 2014 | 22.6 | 31.2 |
| 2015 | 26.0 | 48.5 |
| 2016 | 12.4 | 25.0 |
| 2017 | 18.5 | 34.0 |
| 2018 | 12.7 | 15.8 |
| 2019 | 14.0 | 11.7 |

**Table S4.** The locations and types of the observation sites at GC, BD, LF, BJ, SJZ.

|  |  |  |
| --- | --- | --- |
| City | Type | Location |
| GC | Rural | 39.15°N, 115.73°E |
| BD | Urban | 38.86°N, 115.49°E |
| 38.90°N, 115.52°E |
| 38.91°N, 115.47°E |
| 38.84°N, 115.46°E |
| 38.88°N, 115.44°E |
| 38.87°N, 115.52°E |
| LF | Urban | 39.57°N, 116.77°E |
| 39.52°N, 116.68°E |
| BJ | Urban | 39.87°N, 116.37°E |
| 39.95°N, 116.43°E |
| 39.87°N, 116.43°E |
| 39.97°N, 116.47°E |
| 39.94°N, 116.36°E |
| 39.99°N, 116.36°E |
| 40.00°N, 116.41°E |
| 39.93°N, 116.23°E |
| Suburban | 40.29°N, 116.17°E |
| 40.14°N, 116.72°E |
| 40.39°N, 116.64°E |
| 40.20°N, 116.23°E |
| 40.29°N, 116.17°E |
| SJZ | Urban | 38.04°N, 114.61°E |
| 38.05°N, 114.52°E |
| 38.02°N, 114.53°E |
| 38.01°N, 114.46°E |
| 38.05°N, 114.46°E |
| Suburban | 38.14°N, 114.50°E |
| Rural | 37.91°N, 114.35°E |