

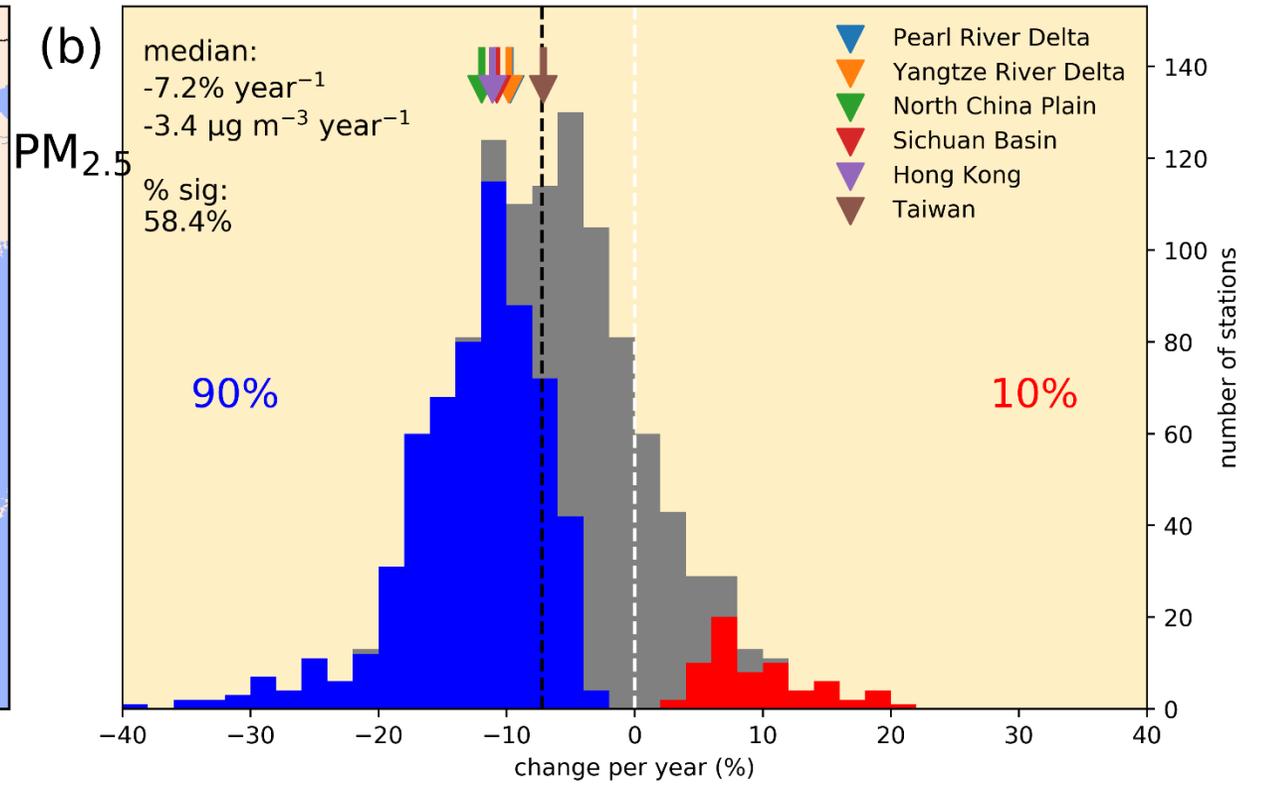
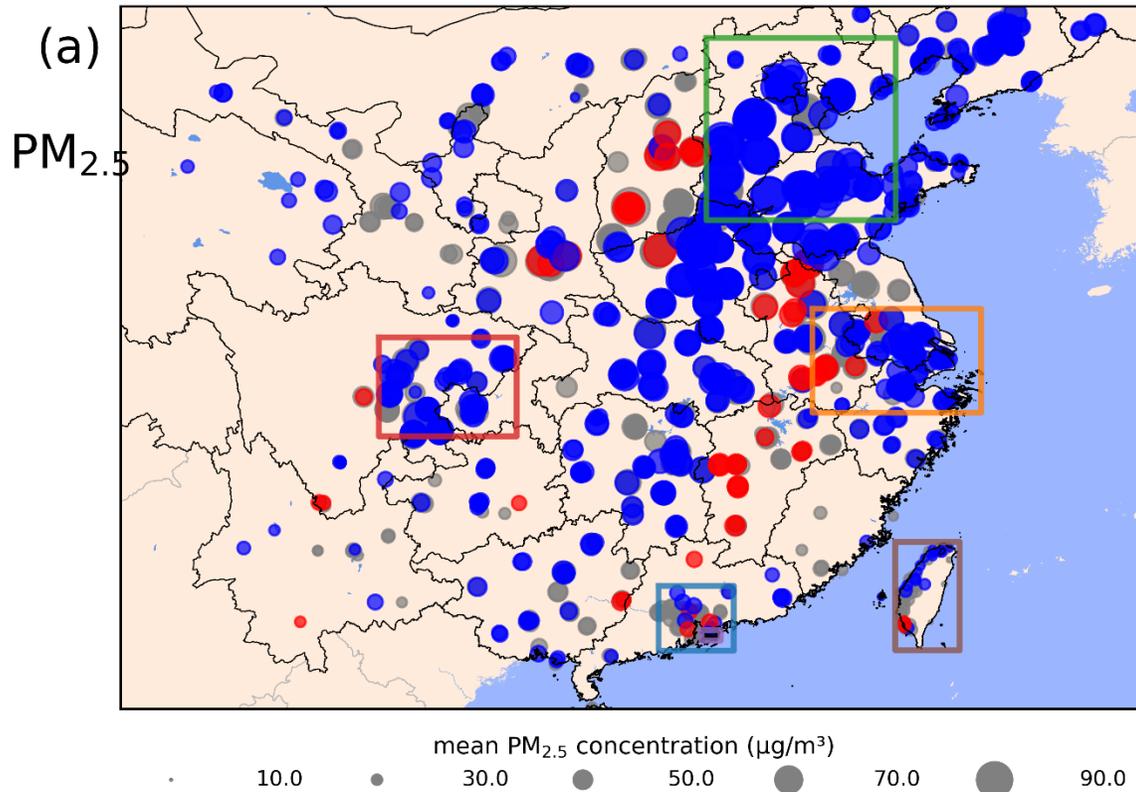
Chinese emissions reductions deliver reduced PM_{2.5}- caused mortality across China during 2015-2017

Ben Silver, Luke Conibear, Carly Reddington, Christophe Knote,
Steve Arnold, and Dominick Spracklen

Measured PM_{2.5} trends (2015-2017)



Median trend: $-7.2\% \text{ year}^{-1}$ or $-3.4 \mu\text{g year}^{-1}$



● significant positive trend ● significant negative trend ● insignificant trend

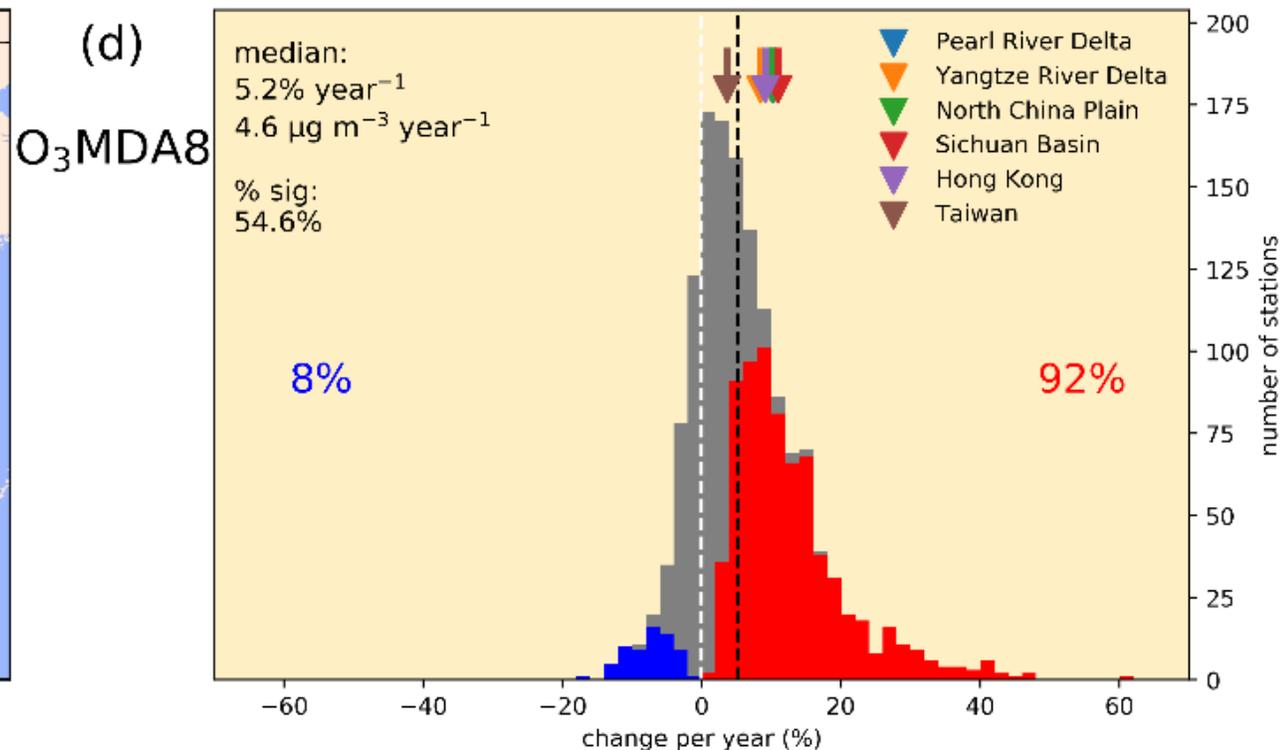
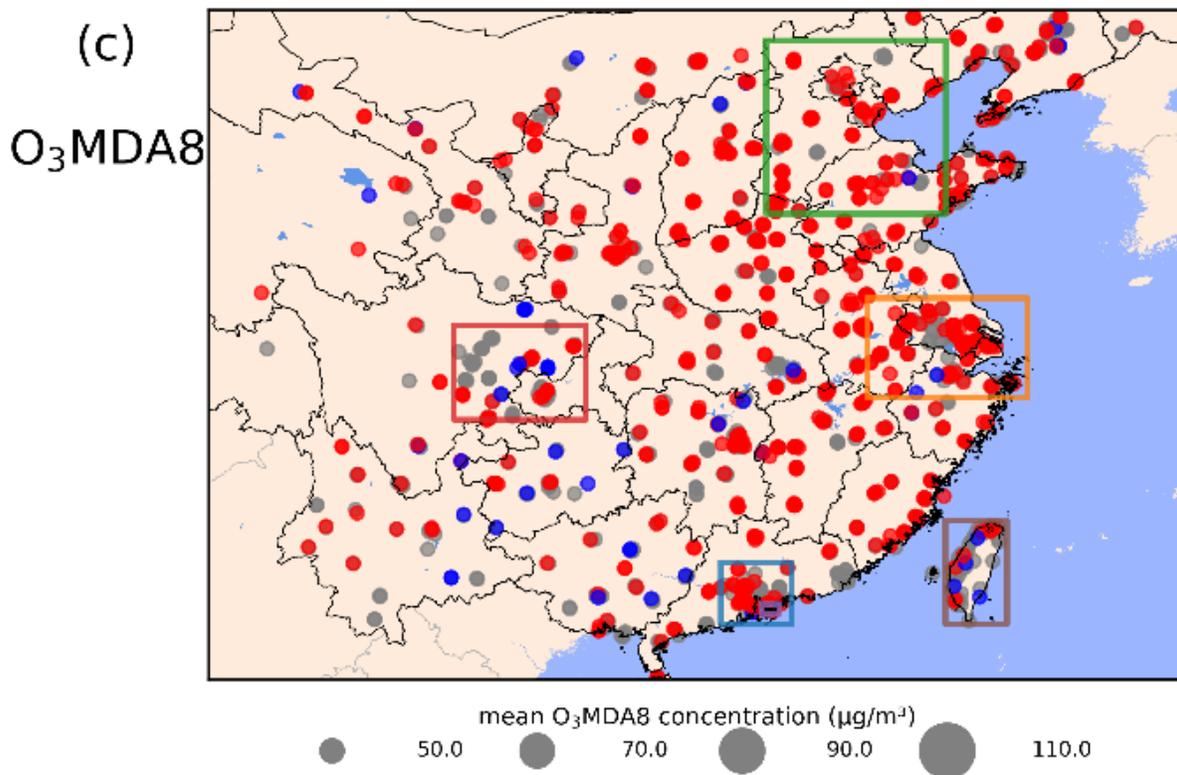
--- median significant trend - - - - zero

Silver *et al.*, *ERL* (2018)

Measured O₃ (MDA8) trends (2015-2017)



Median trend: 5.2% year⁻¹ or 4.6 μg year⁻¹



● significant positive trend ● significant negative trend ● insignificant trend

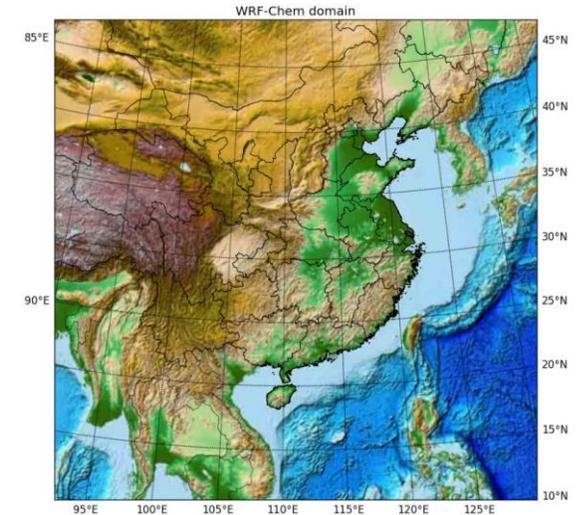
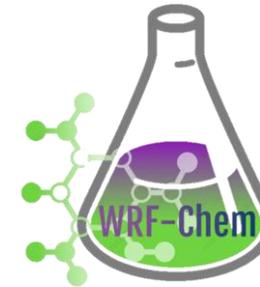
--- median significant trend - - - - zero

Silver *et al.*, *ERL* (2018)

Are the trends driven by emissions or meteorology?

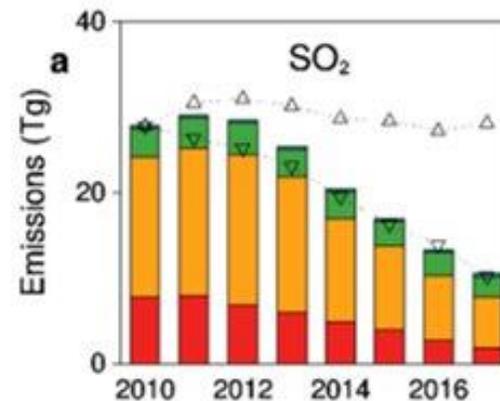


- Using WRF-Chem, we simulate air quality over China during 2015-2017
- ECMWF ERA-Interim fields used for initial and boundary conditions, and to nudge the meteorology.
- MOZART-4 chemistry with MOSAIC 4-bin aerosol scheme
- Multiresolution Emission Inventory for China (MEIC) 2015



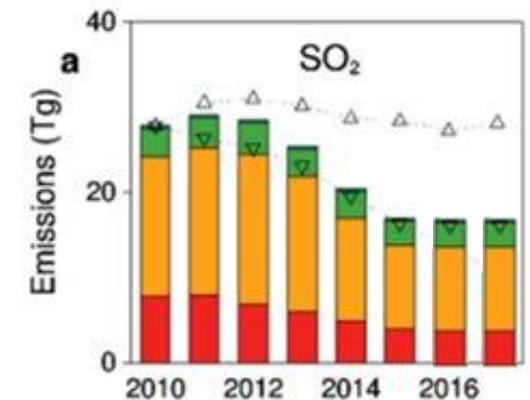
Control simulation

Varying emissions using MEIC 2015 scaled by Zheng *et al* (2018) for 2015-2017

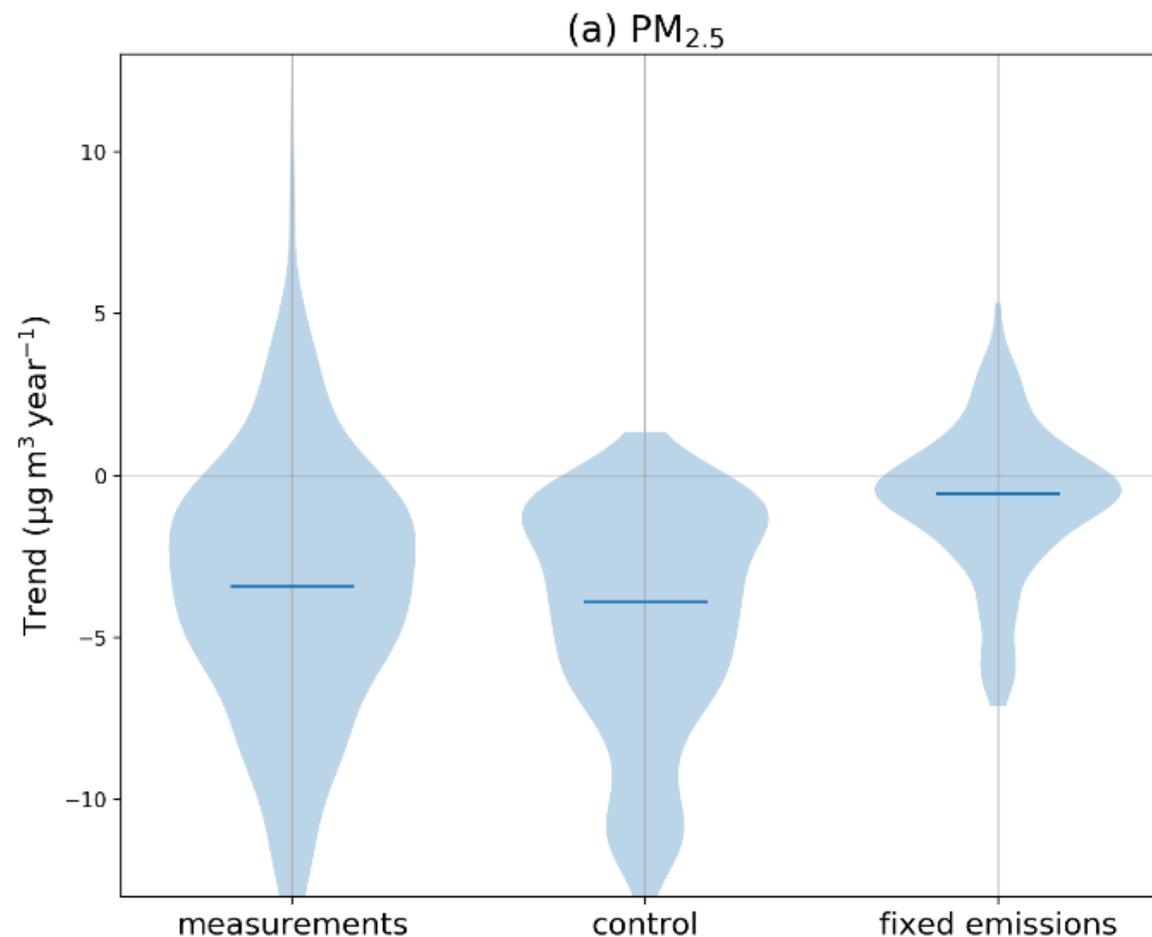


Fixed emissions simulation

MEIC 2015 emissions used for all simulation years



- At the location of each measurement station, the trend in the **measurement data**, **control**, and **fixed emissions** simulations are calculated
- The **control** run matches the **measurement** run reasonably well
- There is no overall trend in the **fixed emissions** run
- This suggests that the trend in PM_{2.5} was primarily driven by changes in emissions, with little overall contribution from meteorology
- Using GBD 2017, we calculated that between 2015 and 2017 annual premature mortalities decreased by 150 000 (129 000 – 170 000)

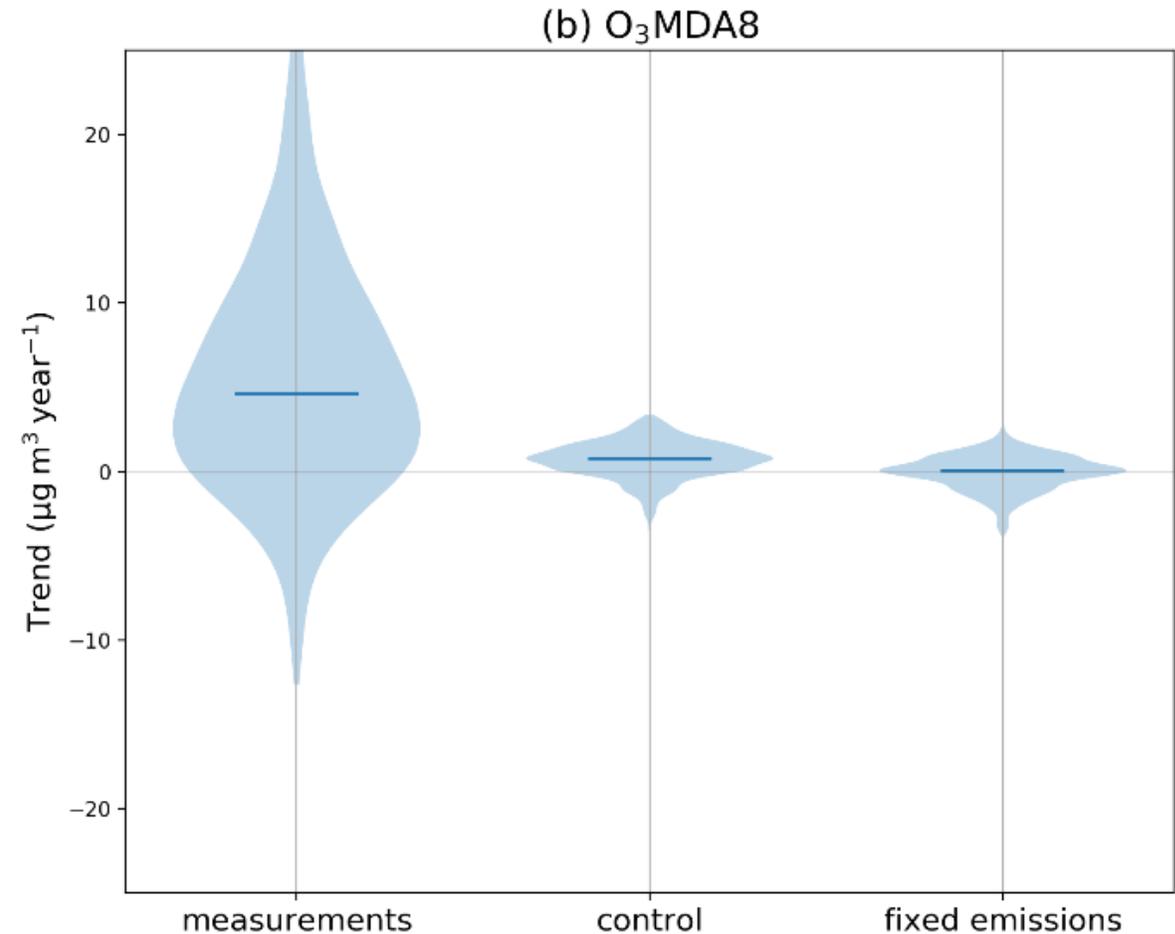


Median trend: - 3.4 $\mu\text{g m}^{-3} \text{ year}^{-1}$ - 3.9 $\mu\text{g m}^{-3} \text{ year}^{-1}$ - 0.6 $\mu\text{g m}^{-3} \text{ year}^{-1}$

O₃: Model underestimates the trend



- At the location of each measurement station, the trend in the **measurement data**, **control**, and **fixed emissions** simulations are calculated
- The **control** run records a median positive trend, but underestimates compared with the measurements
- There is no overall trend in the **fixed emissions** run
- Based on the measurement trend, we estimate an increase of 21 000 annual premature mortalities caused by O₃ between 2015 and 2017.



Median trend: 4.6 µg m⁻³ year⁻¹ -0.7 µg m⁻³ year⁻¹ 0.0 µg m⁻³ year⁻¹





Thank you for your attention

Contact: eebjs@leeds.ac.uk

References:

Silver, Ben, C. L. Reddington, S. R. Arnold, and D. V. Spracklen. "Substantial changes in air pollution across China during 2015–2017." *Environmental Research Letters* 13, no. 11 (2018): 114012.

Silver, B., Conibear, L., Reddington, C. L., Knote, C., Arnold, S. R., and Spracklen, D. V.: Pollutant emission reductions deliver decreased PM_{2.5}-caused mortality across China during 2015–2017, *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2019-1141>, in review, 2020.

Zheng, B., Tong, D., Li, M., Liu, F., Hong, C., Geng, G., ... & Yan, L. (2018). Trends in China's anthropogenic emissions since 2010 as the consequence of clean air actions. *Atmospheric Chemistry and Physics*, 18(19), 14095-14111.

