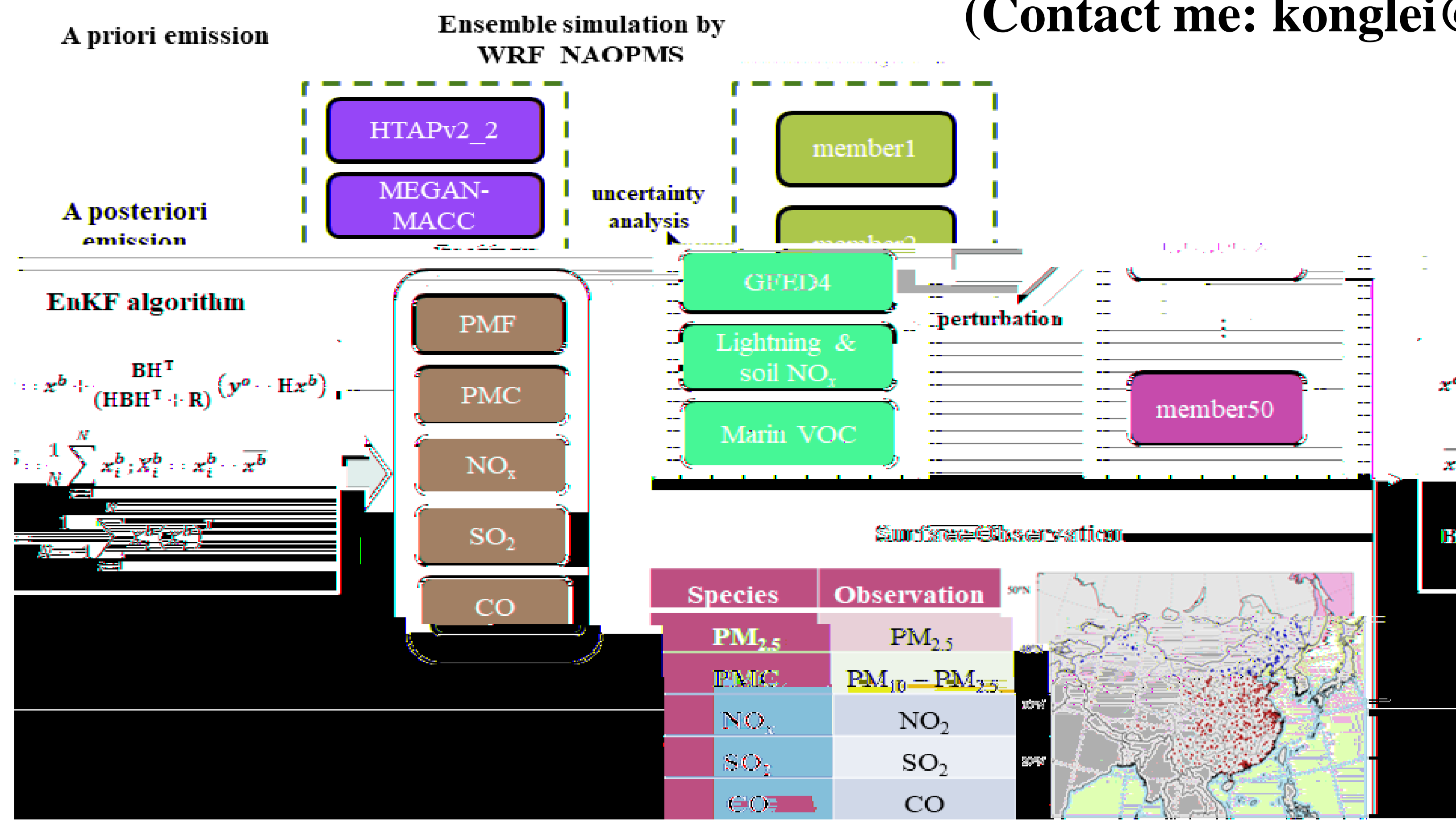


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■ We developed a high-resolution multi-air pollutant inversion system to estimate the daily emissions of NO_x, SO₂, CO, PM_{2.5} and PM₁₀ in China during the COVID-19 restrictions. This system uses the WRF-NAQPMS (Nested Air Quality Prediction Modelling System) model as the forecast model and the EnKF with the state argumentation method as the inversion method. The assimilated observations include surface observations obtained from the China National Environmental Monitoring Centre (CNEMC).

Fig.1 Basic flow of the emission inversion

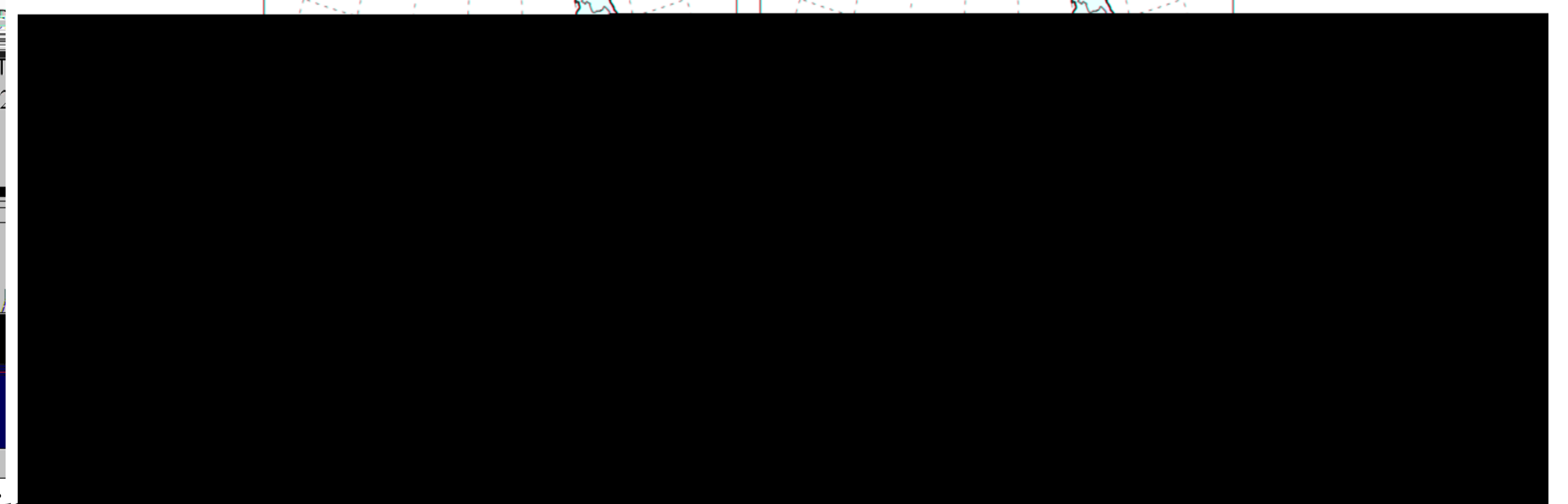
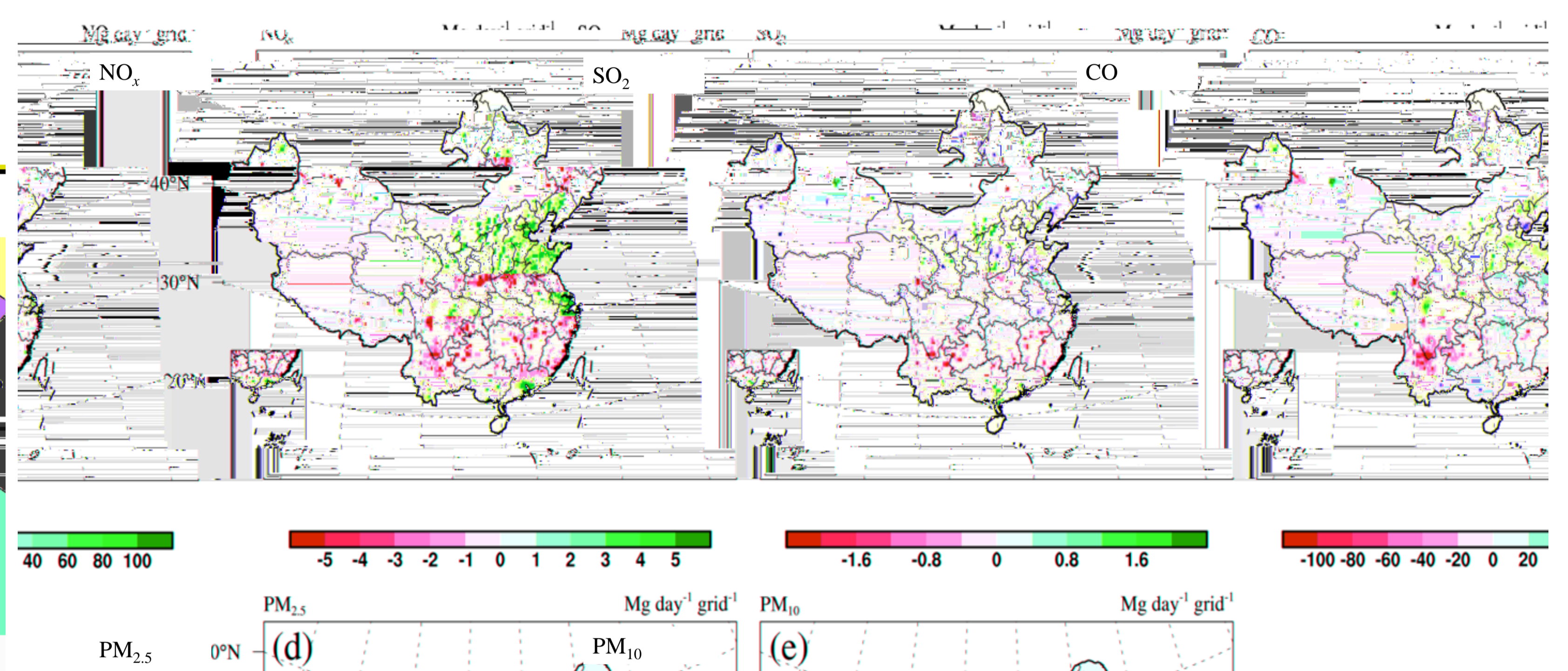
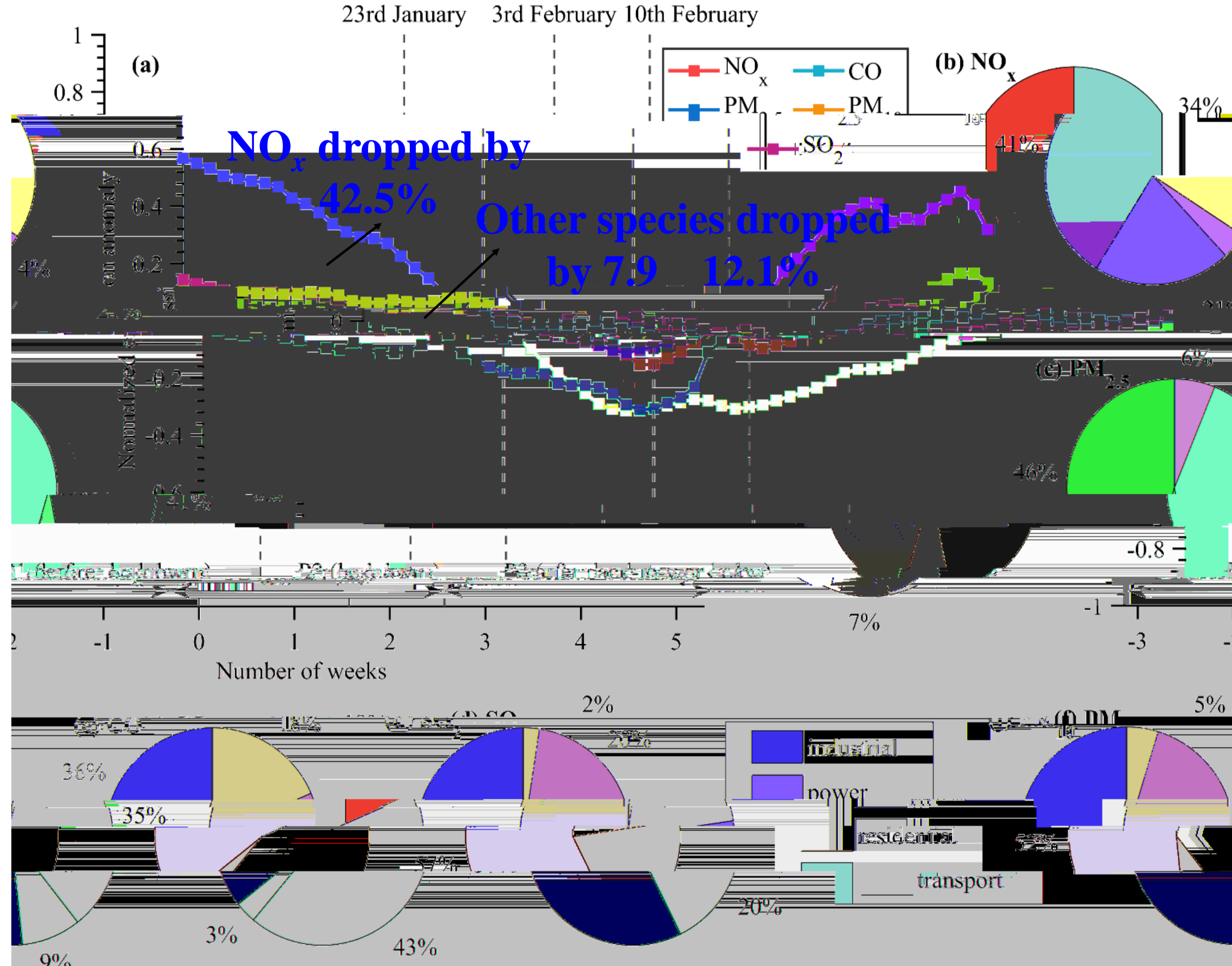


Fig.2 Time series of normalized emission anomaly for different species in China from 1st January to 29th February 2020, and Relative contributions of different sectors to the total anthropogenic emissions of different species

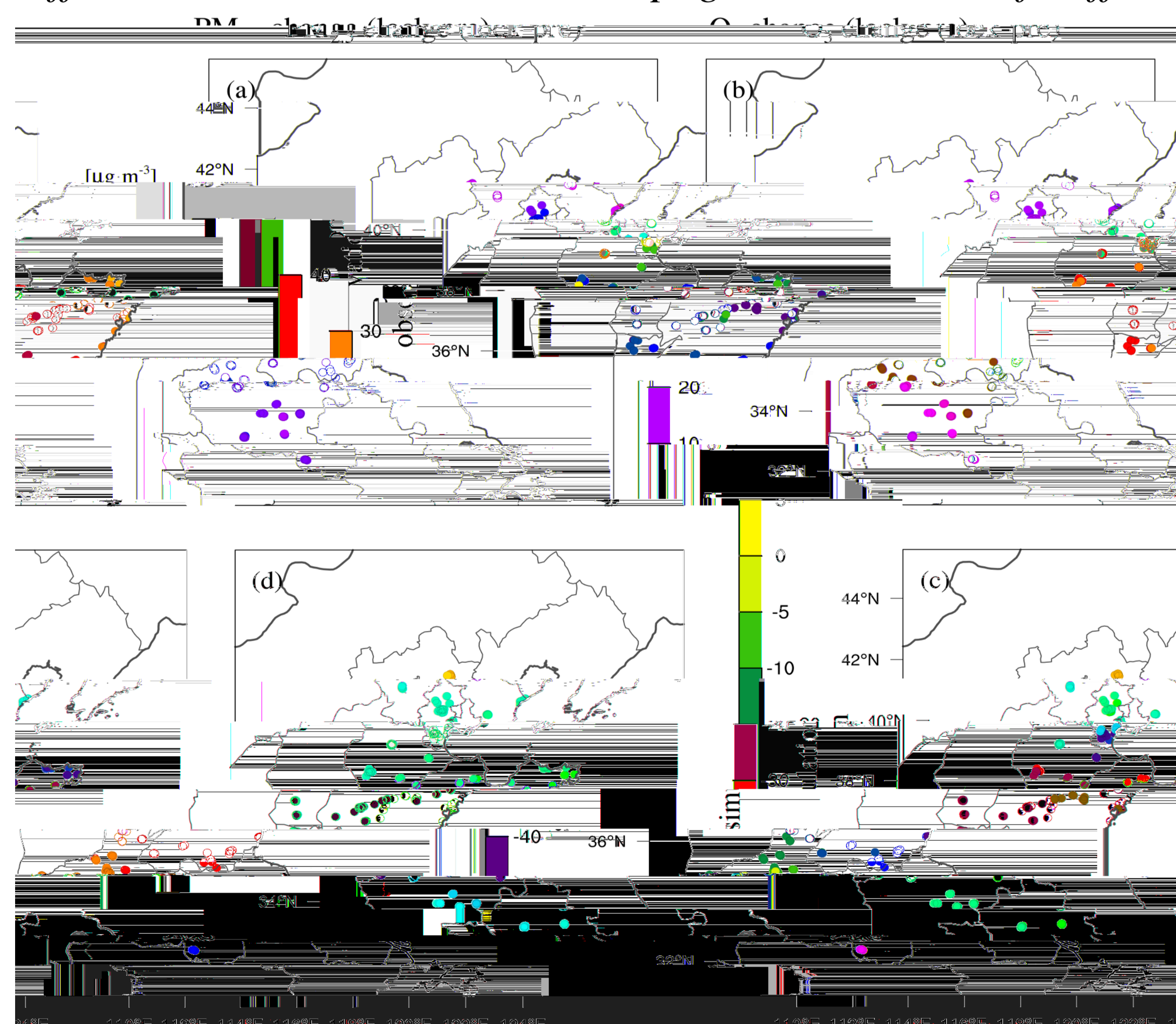


Fig. 4 Changes in the observed and simulated concentrations of PM_{2.5} and O₃ over the NCP region before and after lockdown

Scenario simulation

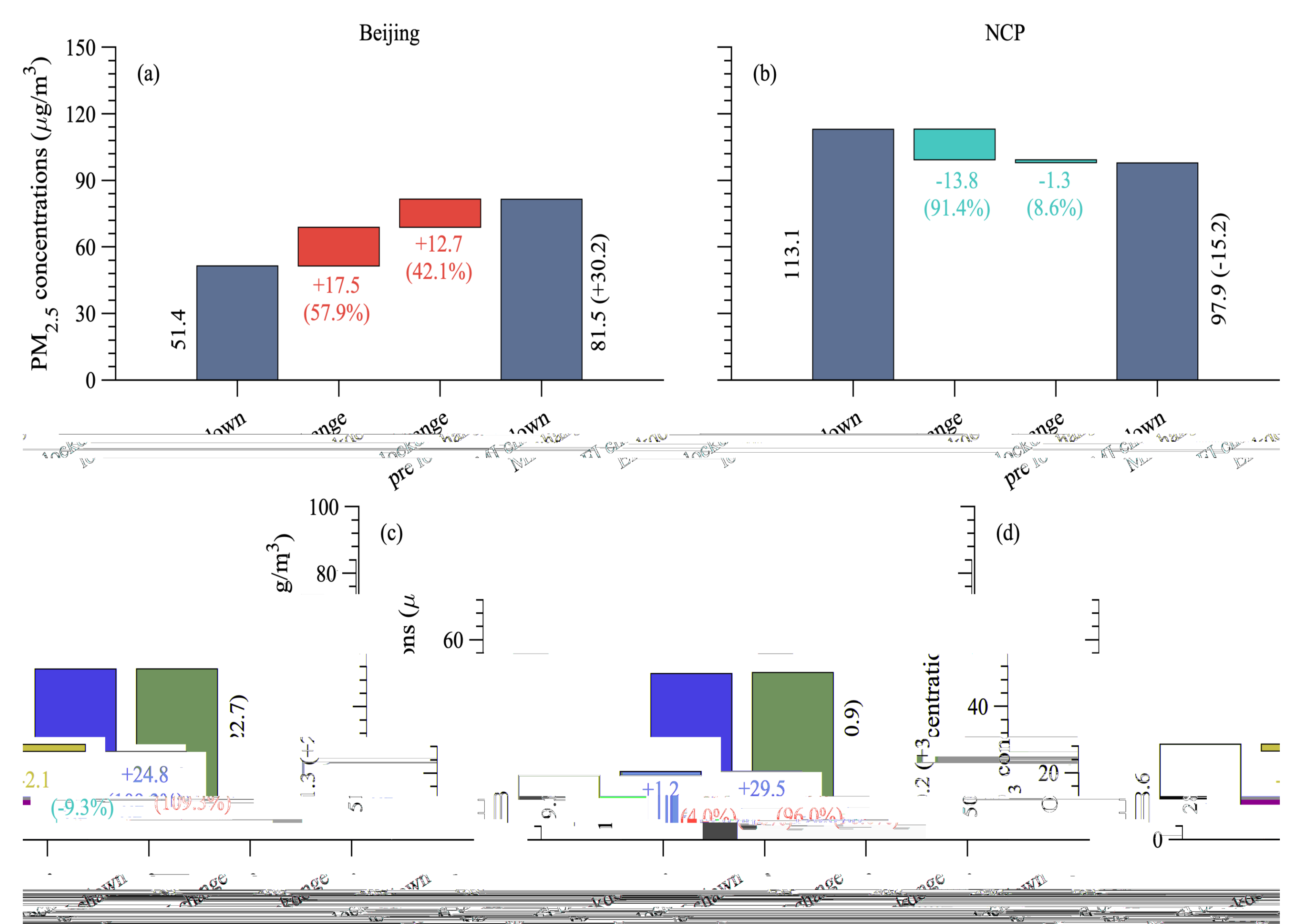
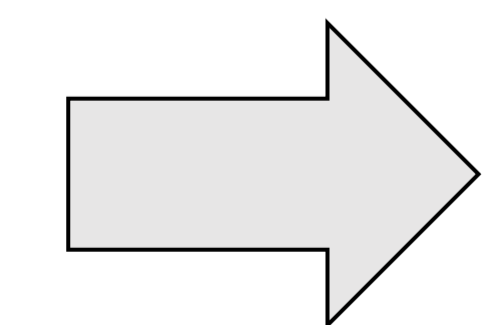


Fig.5 Contributions of the meteorological and emission changes to the PM_{2.5} and O₃ over Beijing and the NCP region before and after lockdown

Conclusions:

- The lockdown in China is largely a nationwide road traffic control measurement.
- The NO_x emission (by ~40%) decreased more substantially than other species (by ~10%)
- The lockdown only contributed 8.6% to PM_{2.5} reduction over NCP and led to significant increases in O₃
- The unexpected haze in Beijing is a combined effects of inefficient reductions in PM_{2.5} emissions and unfavorable meteorological conditions.