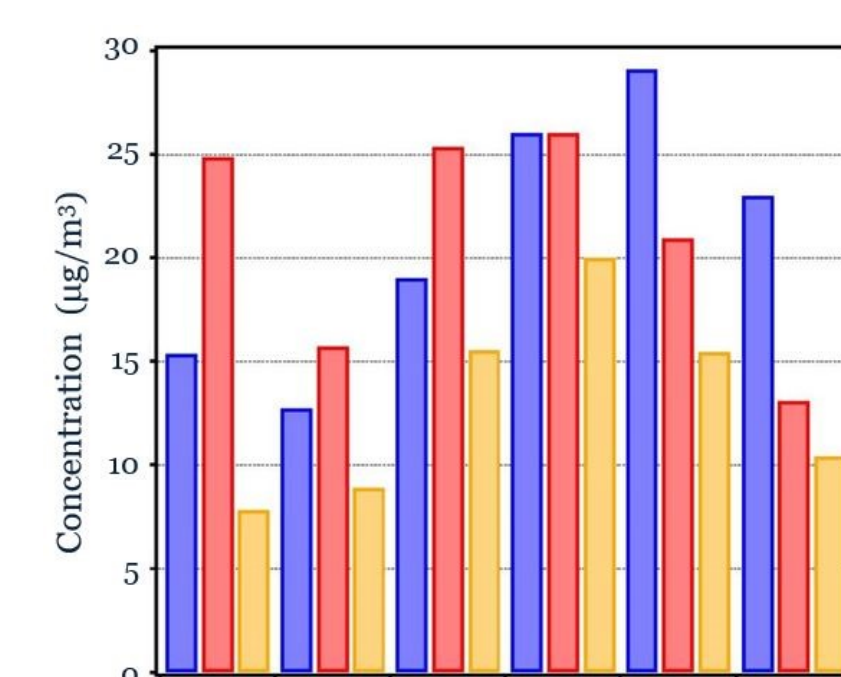


I. BACKGROUND

➤ Stubborn particulate nitrate pollution in China



High concentration

Figure 1. Major constituents in $PM_{2.5}$ observed in Beijing during winter from representative articles (Xie et al., 2020).

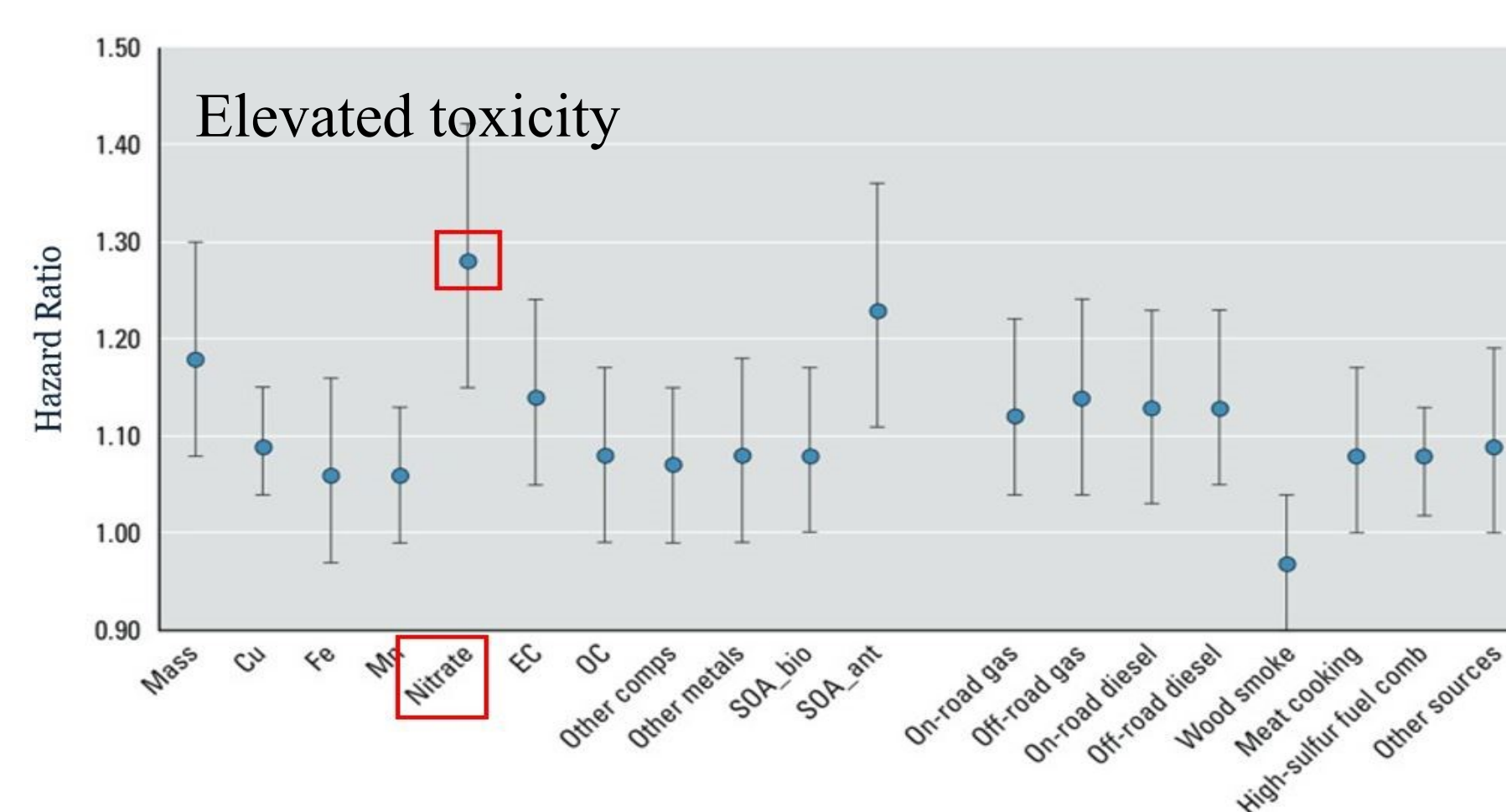


Figure 2. Association of $PM_{2.5}$ constituents and sources with ischemic heart disease mortality (Ostro et al., 2015).

II. DATA AND METHOD

➤ Machine learning + Ground measurements + Satellite data

Study period: 2005-2018

Machine learning model: Random forest

Spatial resolution: 10-km

Temporal resolution: Daily

Model input:

- MISR fractional AODs
- Available ground observational records of nitrate
- Meteorological conditions from GEOS reanalysis
- Atmospheric compositions from CAMS reanalysis
- Other supporting information (i.e., land type, road length)

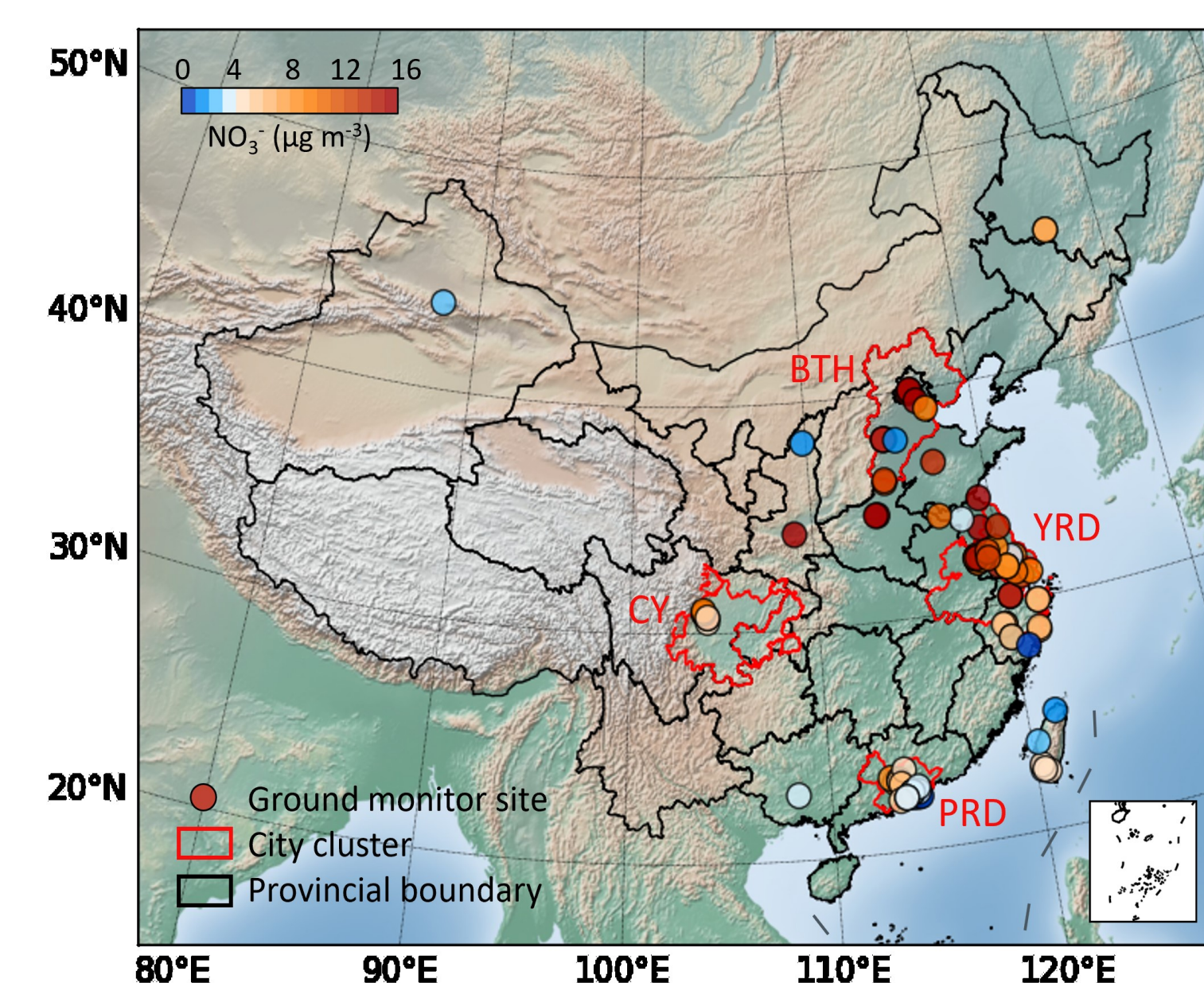


Figure 3. Map of study domain, the spatial distribution of ground monitoring sites, and averaged daily mean nitrate concentrations (Hang et al., 2022).

III. RESULTS

➤ High-performance nitrate concentration model

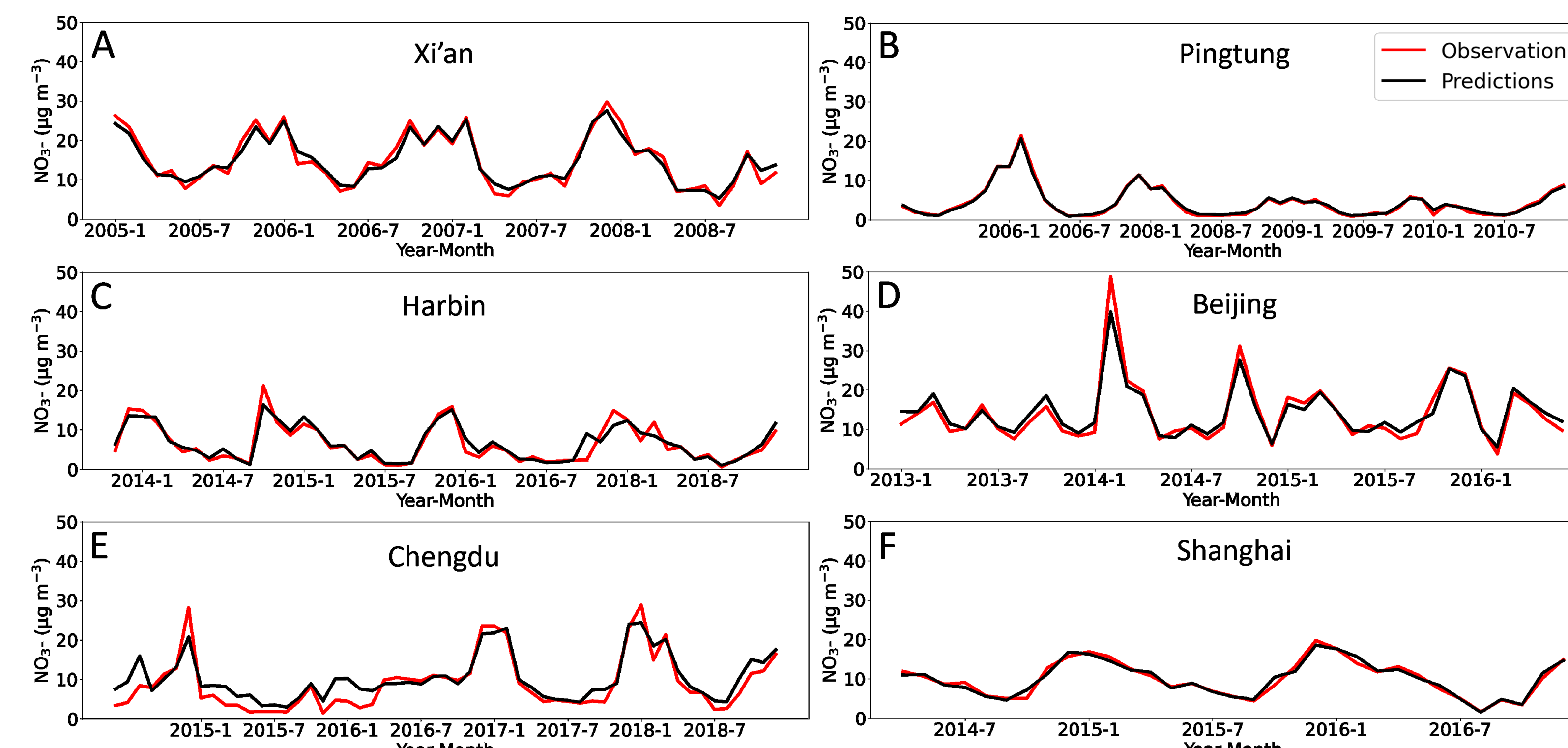


Figure 4. Predicted and observed monthly mean nitrate concentrations at six monitoring sites of different geographical regions in China: (A) Xi'an in the Northwest, (B) Pingtung in the South, (C) Harbin in the Northeast, (D) Beijing in the North, (E) Chengdu in the West, and (F) Shanghai in the East (Hang et al., 2022).

➤ Spatial contrast of nitrate

Areas with high nitrate level:

- Major traffic corridors
- Regions with many coal-fired power plants and extensive industry facilities
- Cities with high vehicle usage and dense road networks

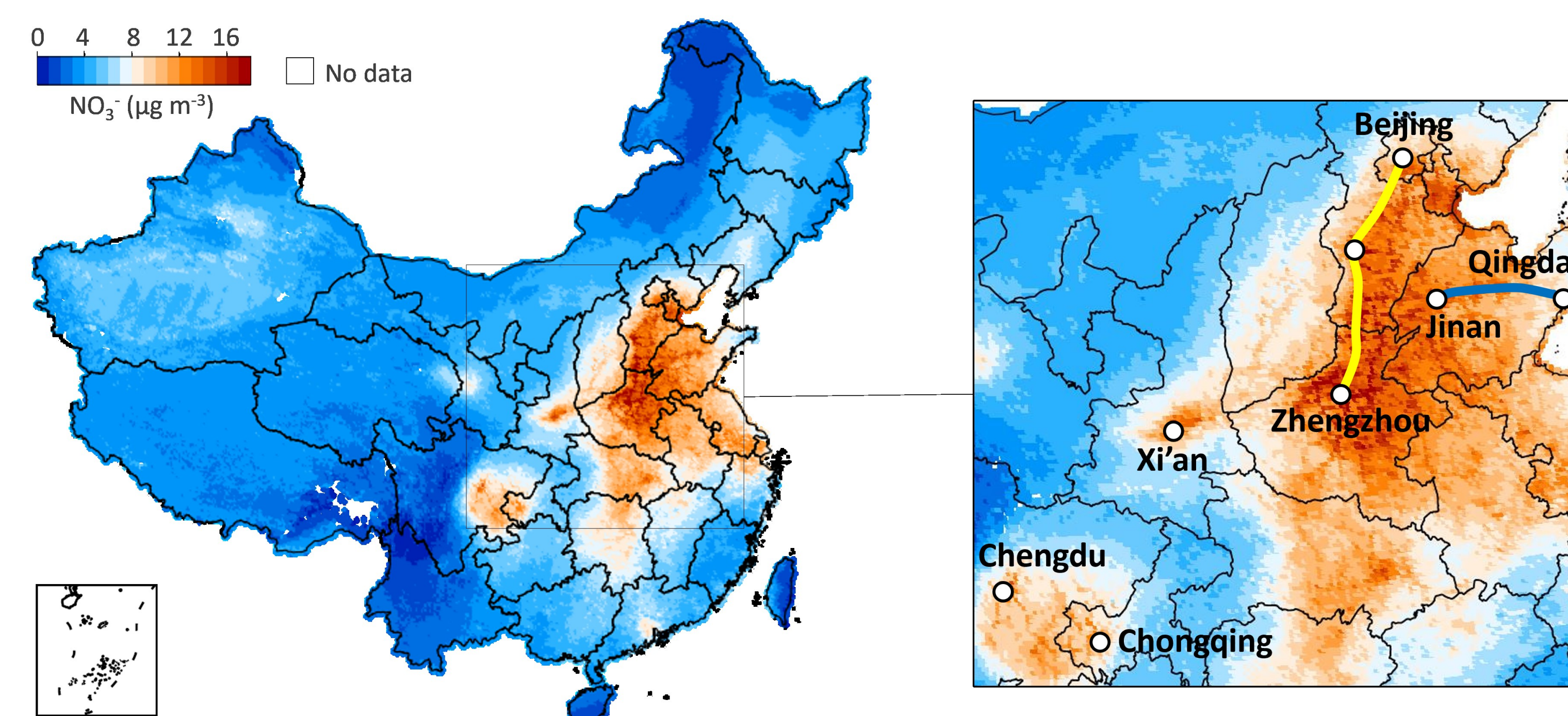


Figure 5. Spatial distribution of annual mean nitrate concentrations in China, 2005-2018. The thick lines in the right-side figure refer to the section of G4 Beijing-Hong Kong and Macau Expressway (yellow) and G20 Qingdao-Yinchuan Expressway (blue) (Hang et al., 2022).

➤ Mortality burden attributable to long-term nitrate exposure

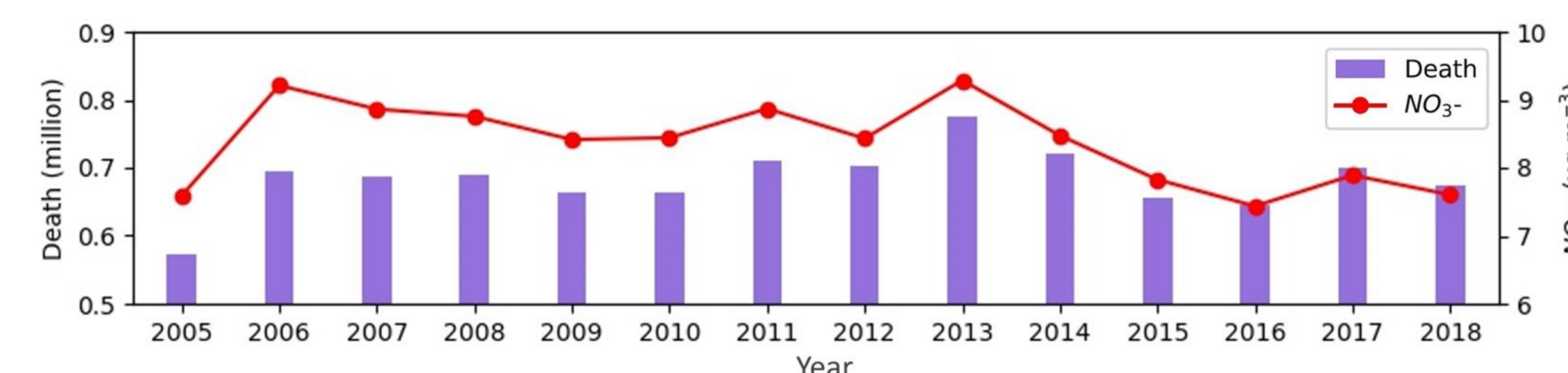


Figure 6. National mean annual nitrate concentration and its corresponding premature death number from 2005-2018 (Hang et al., 2022).

- The first estimate of long-term mortality burden from nitrate in China
- In 2018, the national mortality burden attributable to nitrate was about 0.68 million

IV. SUMMARY

- Existing air pollution control policies are effective, but increased nitrate of traffic emissions offset reduced nitrate of industrial emissions
- Targeted regulations on vehicle emissions are needed to control nitrate pollution in China

V. FUTURE WORK

➤ Predict and evaluate other $PM_{2.5}$ constituents

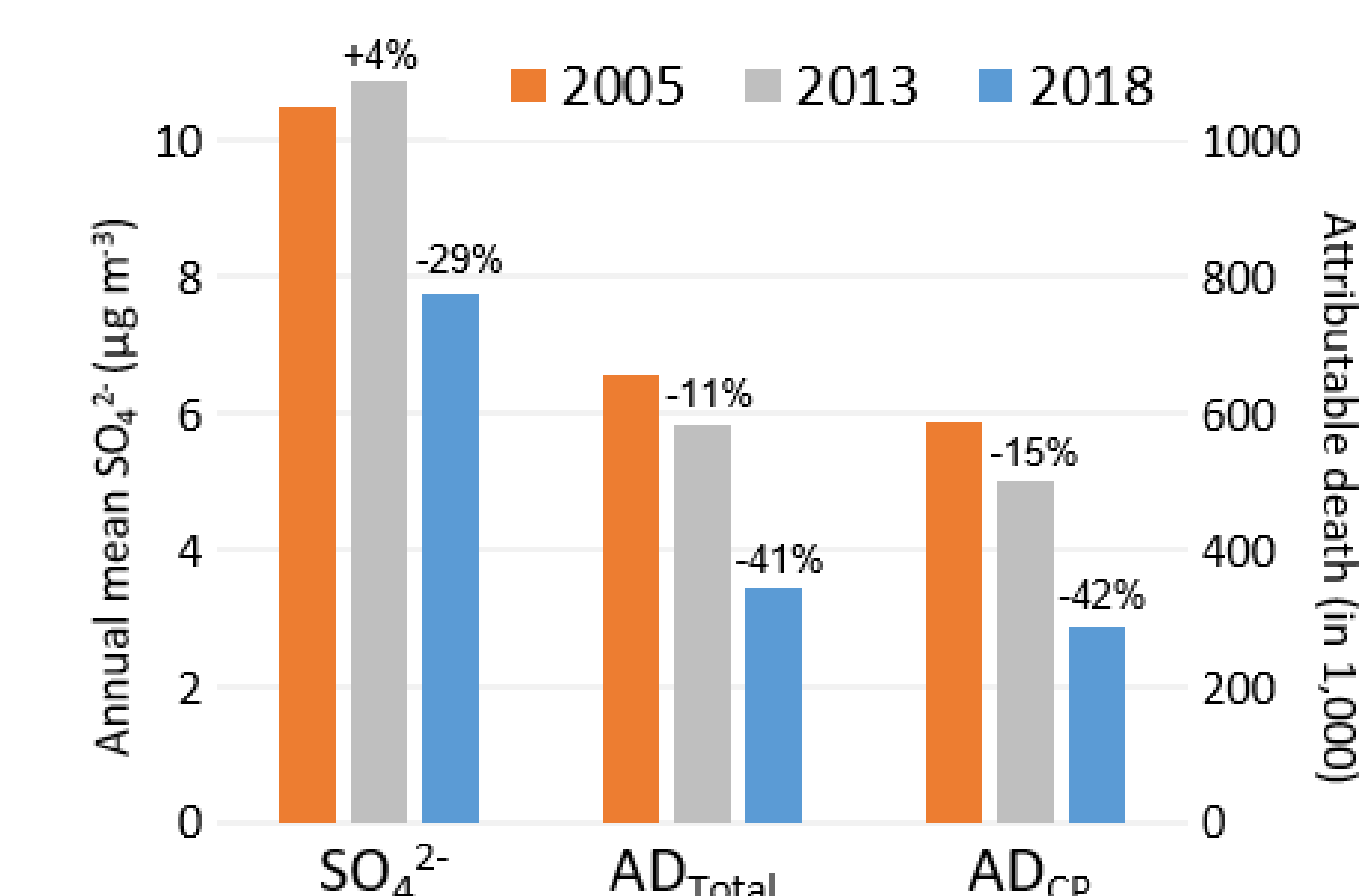


Figure 7. Population-weighted national annual mean sulfate concentrations (SO_4^{2-}) of selected years, total non-accidental (AD_{Total}) and cardiopulmonary (AD_{CP}) mortalities attributable to the sulfate exposure (Hang et al., 2022, submitted).

VI. REFERENCES

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Ostro, B., Hu, J., Goldberg, D., Reynolds, P., Hertz, A., Bernstein, L., & Kleeman, M. J. (2015). Associations of mortality with long-term exposures to fine and ultrafine particles, species and sources: results from the California Teachers Study Cohort. *Environmental health perspectives*, 123(6), 549-556.

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VII. ACKNOWLEDGEMENT

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