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Fractional solubility of aerosol iron during winter at a coastal city in northern China

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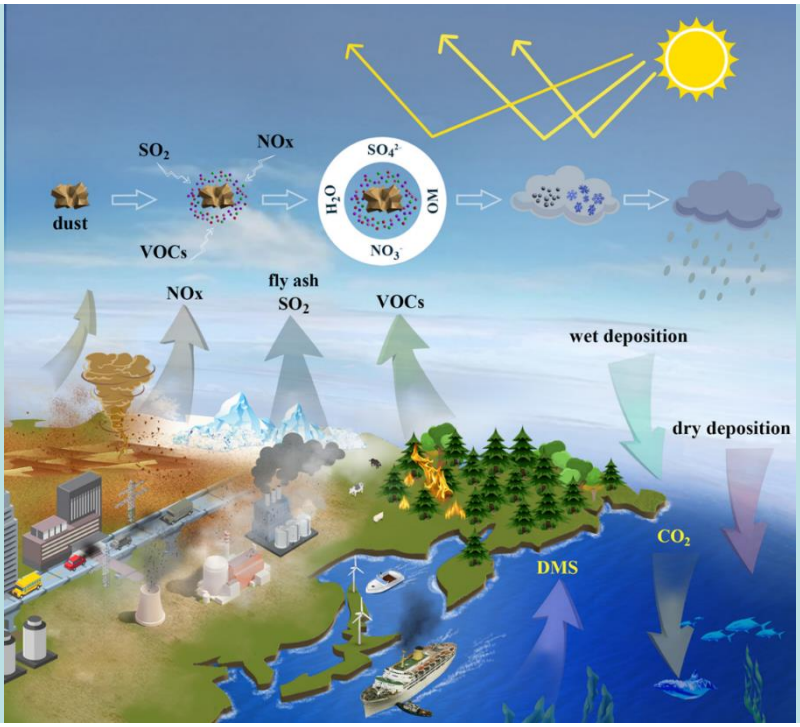
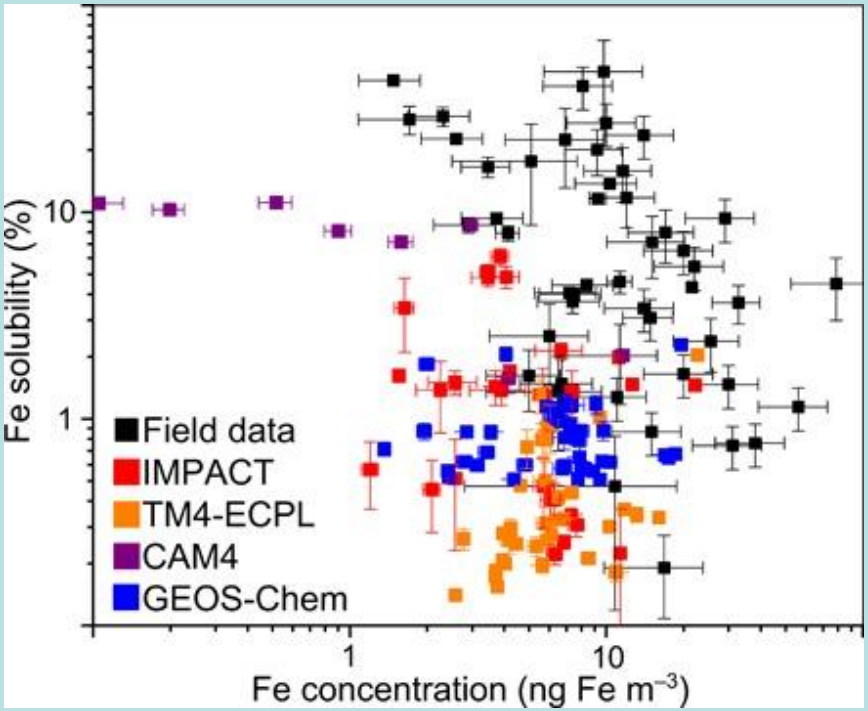
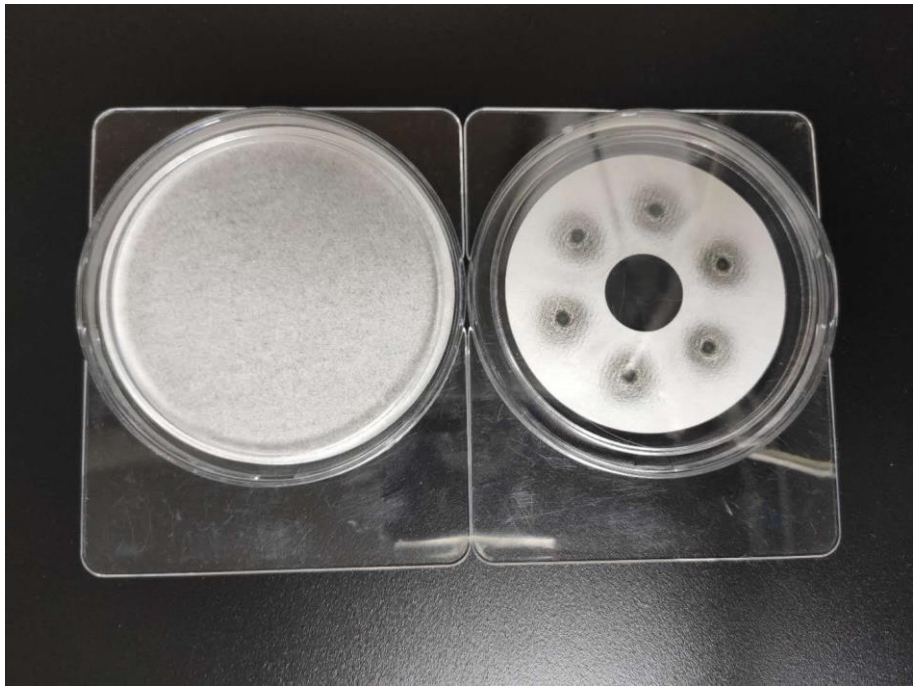
Aerosol Fe solubility is underestimated

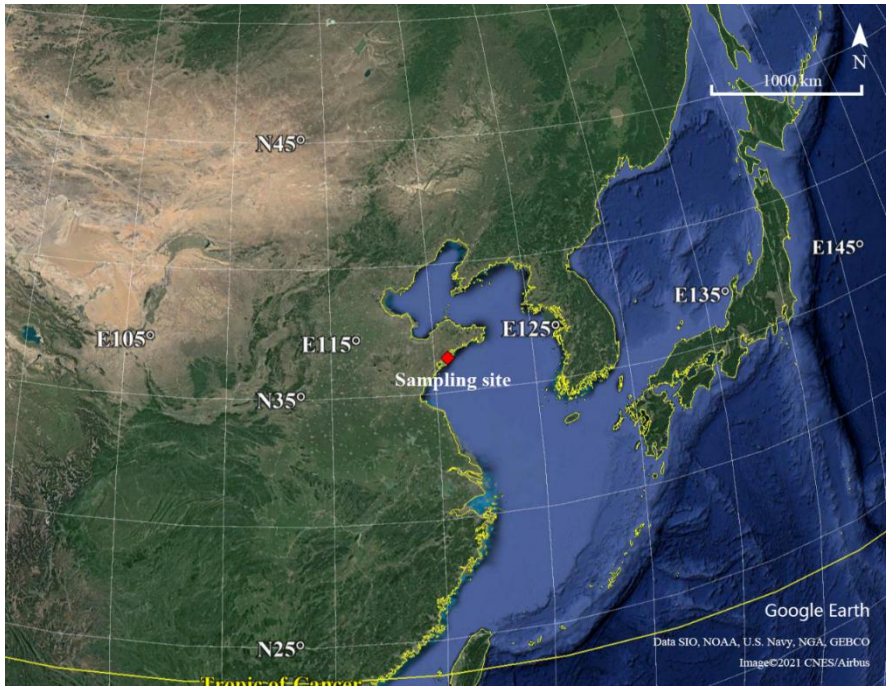




- Aerosol deposition is the major source of soluble Fe in the open ocean
- Modelling work significantly underestimates aerosol Fe solubility
  - Combustion may emit aerosol particles with higher Fe solubility
  - Atmospheric chemistry processes could enhance aerosol Fe solubility

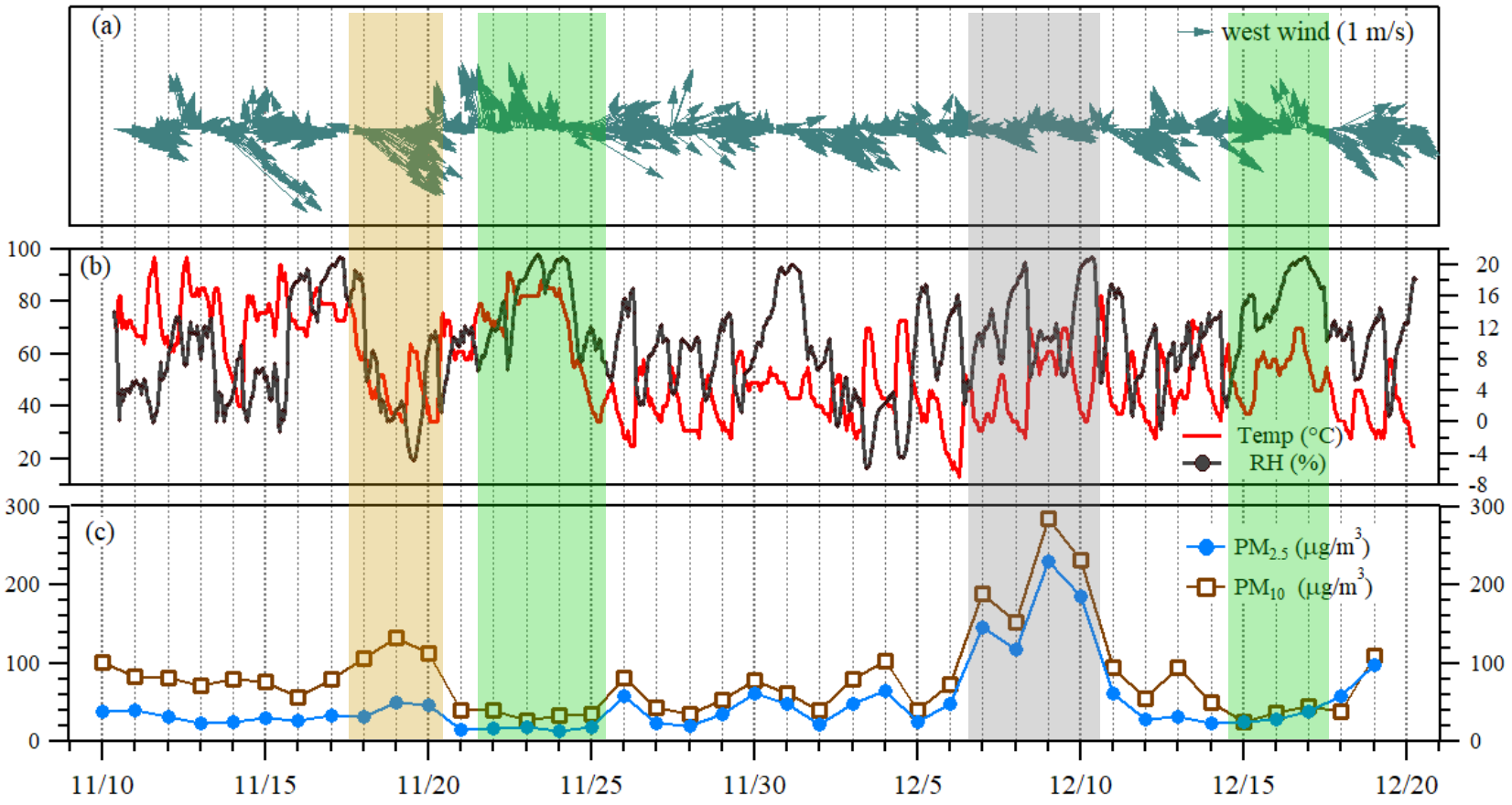
Aerosol sampling: how and where





- Simultaneous collection of fine (<1 μm) and coarse (>1 μm) particles
  - **coarse particles:** enriched with desert dust; **fine particles:** enriched with combustion particles
- Aerosol sampling carried out at Qingdao, a coastal city in northern China
  - Frequently affected by Asian outflow of desert dust and anthropogenic aerosols

Meteorological conditions

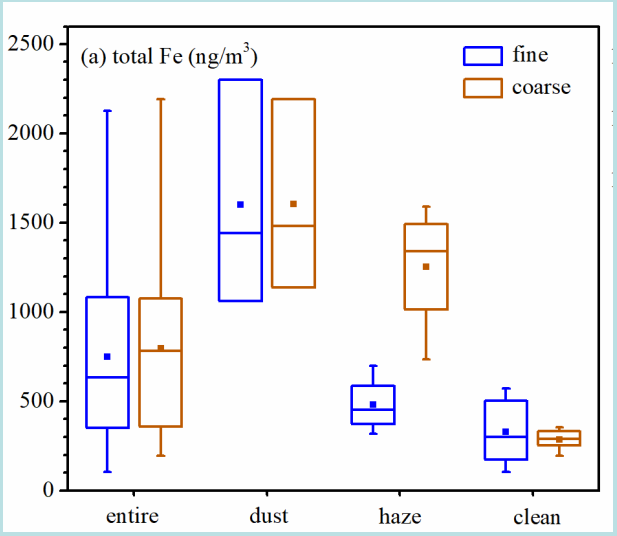


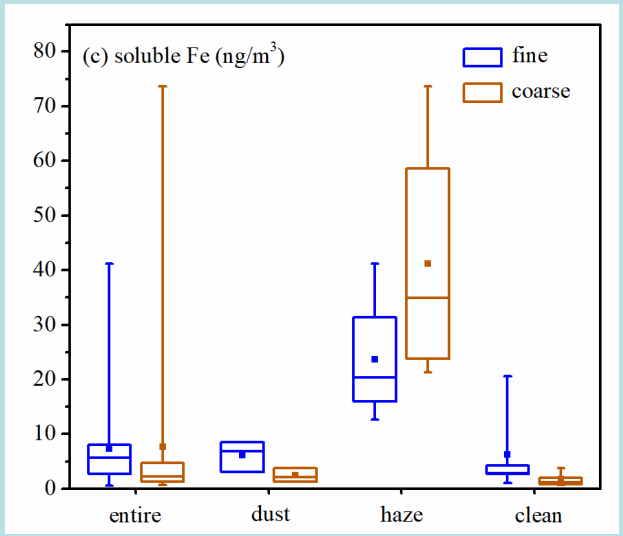
wind direction: mostly northwest; wind speed: mostly <6 m/s

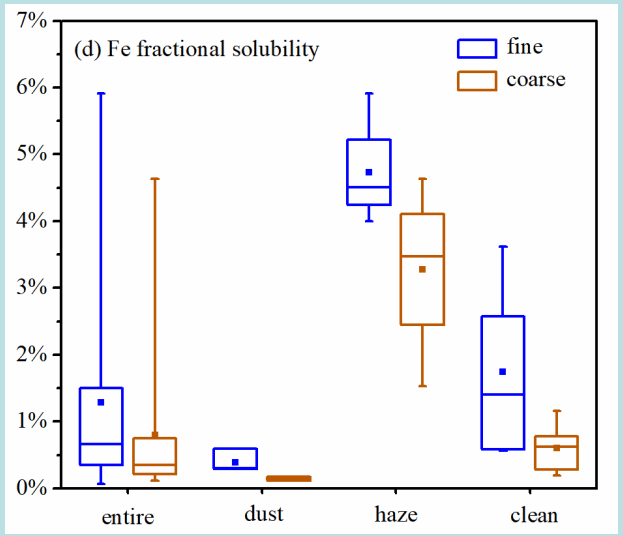
dust: 11/18-11/20; haze: 12/07-12/10; clean: 11/22-11/25 and 12/15-12/17

Fe solubility under different weather

- Compared to clean days, total Fe concentrations were much higher in both fine and coarse particles during dust days and haze days.
- Although total Fe concentrations were higher in dust days than haze days, soluble Fe concentrations were much lower in dust days.



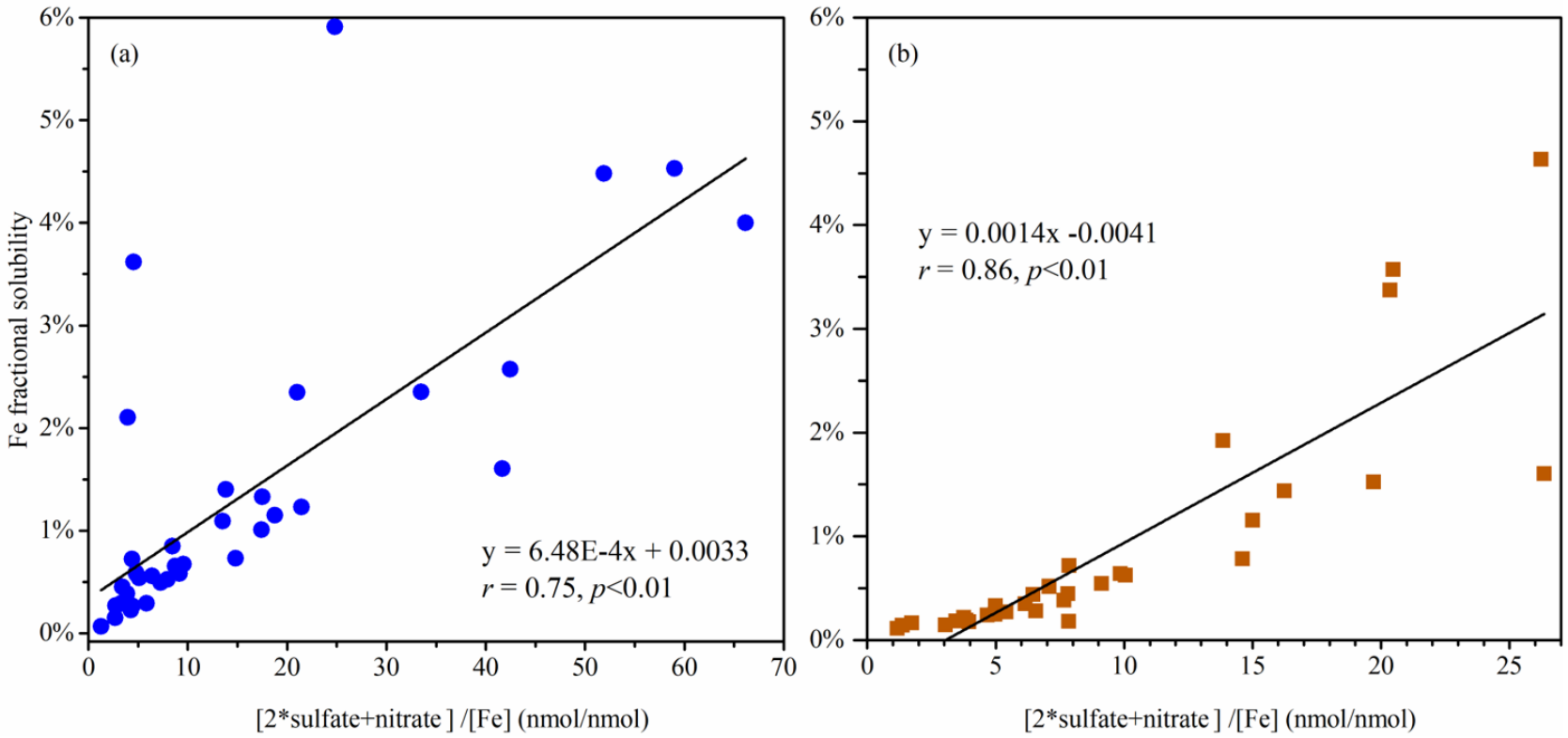




Total Fe **Soluble Fe** **Fe solubility**

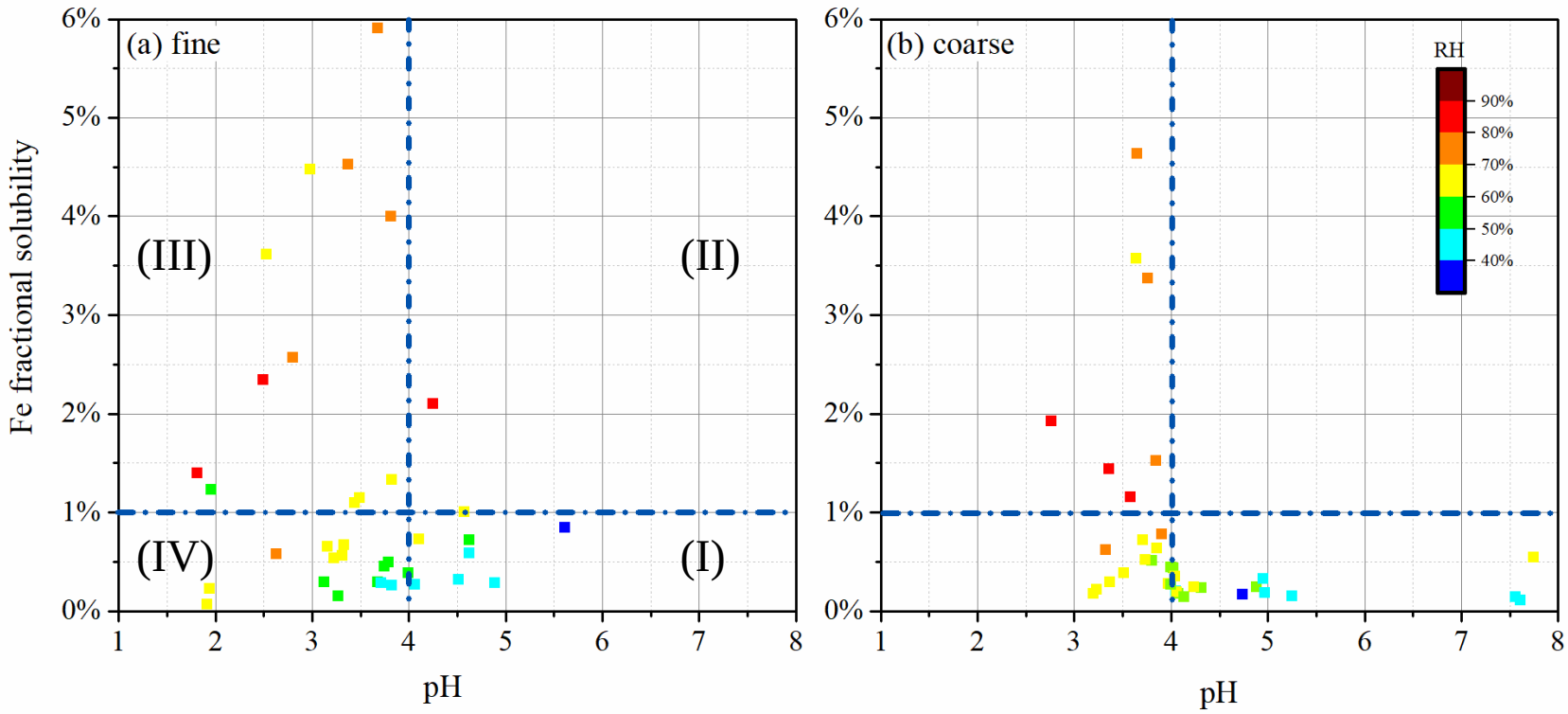
- Compared to clean days, iron solubility in fine and coarse particles was much lower in dust days and much higher in haze days.
- During the entire campaign, iron solubility was significantly higher in fine particles than coarse particles.

Fe solubility versus secondary acids



- Fe solubility was well correlated with sulfate and nitrate for both fine and coarse particles
- Chemical processing by secondary inorganic acids significantly enhance aerosol Fe solubility.

Fe solubility versus aerosol acidity



Aerosol water content and acidity play important roles in Fe solubility

- I : High aerosol pH (>4) and low Fe solubility (<1%)
- III: High Fe solubility (>1%) and low aerosol pH (<4)
- IV: Low aerosol pH (<4) but also low Fe solubility (<1%)

Thank you very much !

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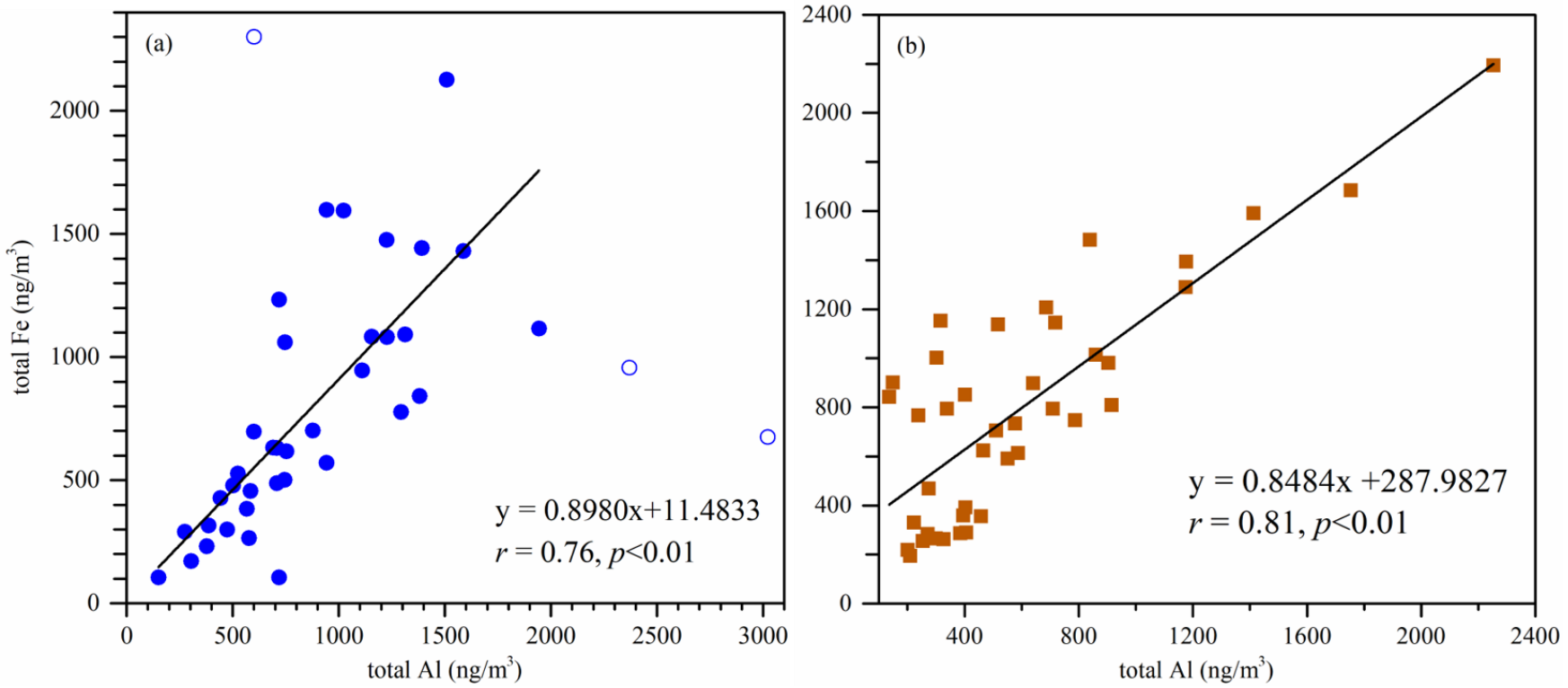
JGR Atmospheres

RESEARCH ARTICLE
10.1029/2021JD036070

Abundance and Fractional Solubility of Aerosol Iron During Winter at a Coastal City in Northern China: Similarities and Contrasts Between Fine and Coarse Particles

Huanhuan Zhang and Rui Li have contributed equivalently to this work.

Sources of total Fe



- [Fe] is well correlated with [Al] in fine and coarse particles
- suggesting desert dust as the major source of total Fe

- [Fe]/[Al]: 1.123 and 0.825 for coarse and fine particles (medium values)
- Slightly larger than desert dust in China (PM_{10}: 0.837; $PM_{2.5}$: 0.561)