



Neutral and Ionic Per- and Polyfluoroalkyl Substances (PFASs) in the Atmosphere: Occurrence and Distribution Associated with Particulate Matter

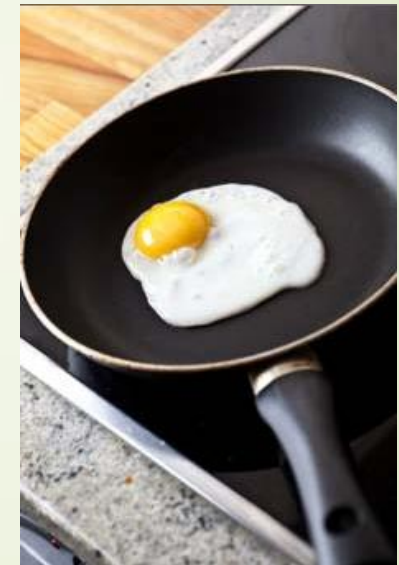
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PFASs-Property and Application

- Property: Hydrophobicity/Lipophobicity
- Surfactivity
- Chemical Stability

- Application: Chemical production
- Textile
- Leathering
- Packaging
- Firefighting foams

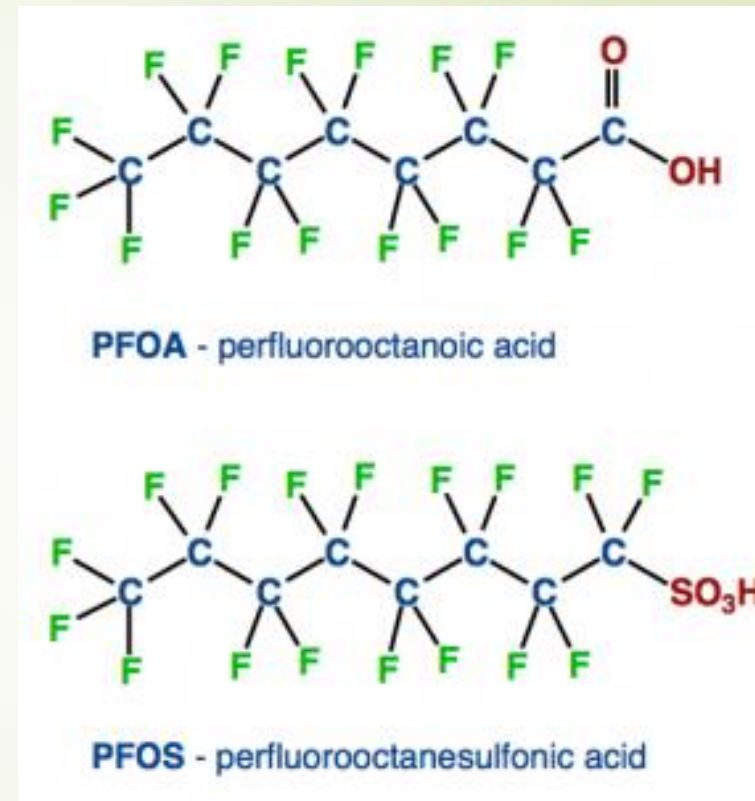


PFASs-Risk and management

- **Risk: Persistence**
- **Bioaccumulation**
- **Ecological and human toxicity**

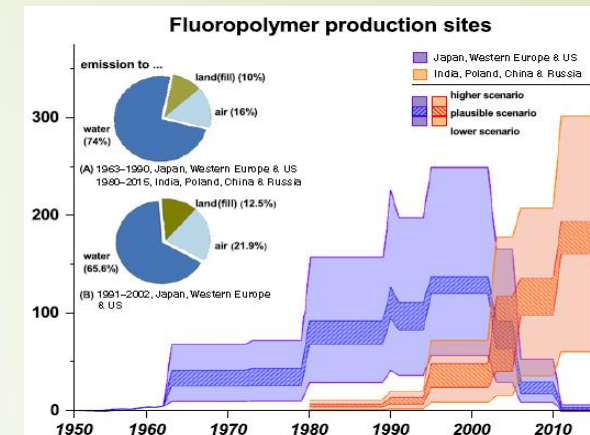
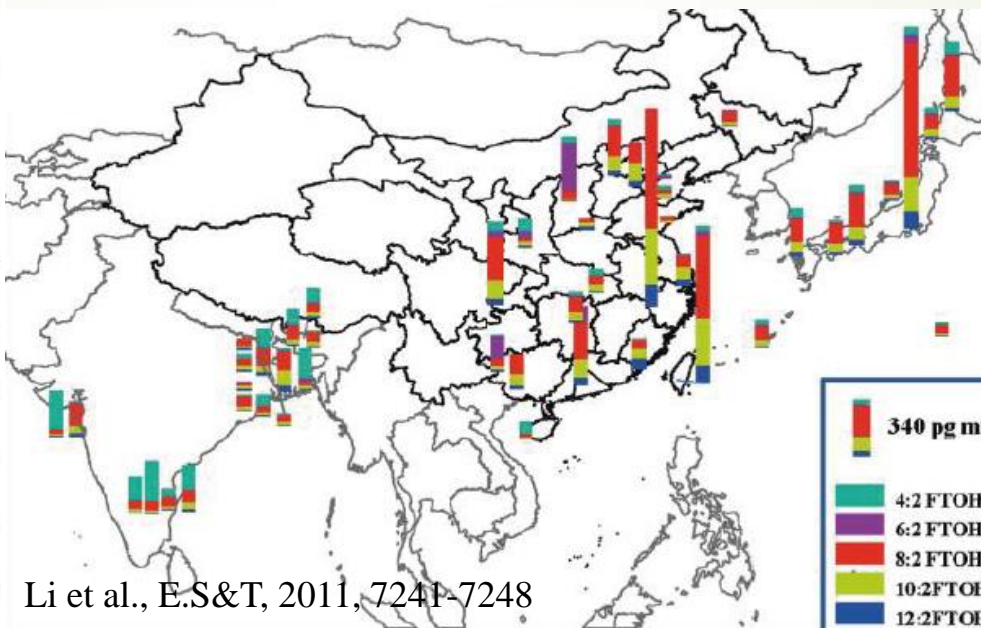
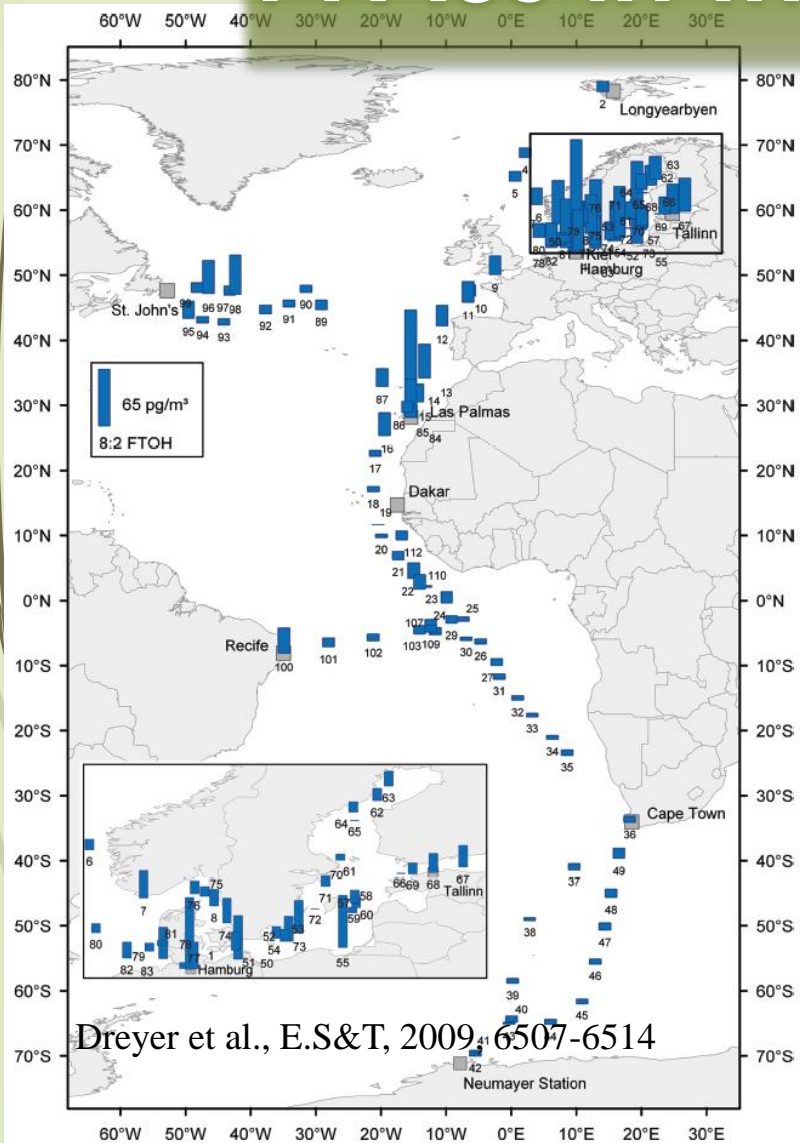
- **Management:**

- 2002: Phase-out of POSF by 3M
- 2006: PFOA Stewardship Program
- 2008: PFOS and its derivatives banned by EU
- 2009: PFOS listed in Stockholm Convention



PFASs in the atmosphere

- Focus on source region
- Ionic PFASs



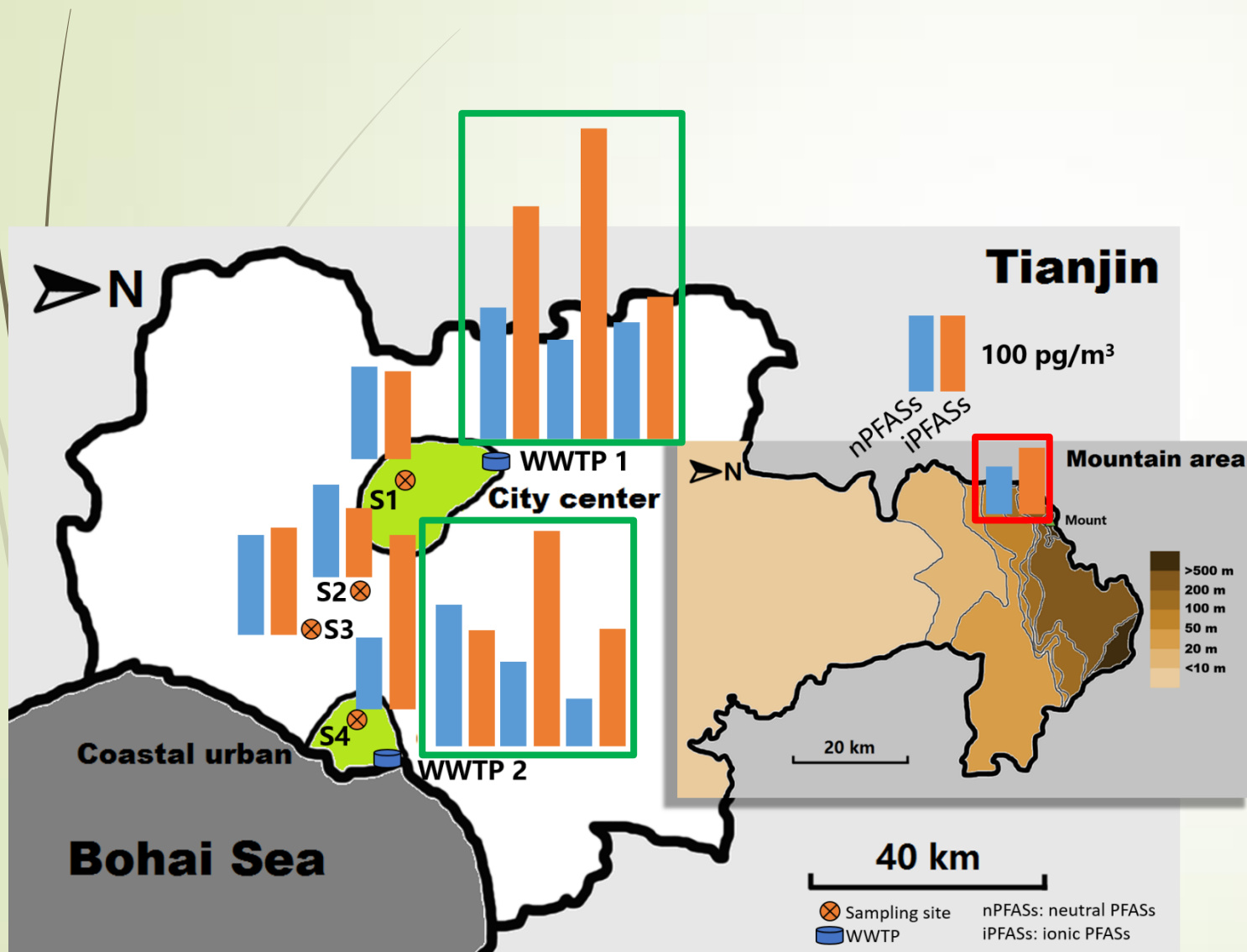
- Shift to Asia
- Insufficient data

PFASs in dry deposition

- A pathway for PFASs removal
- A reason for increasing levels in surface runoff



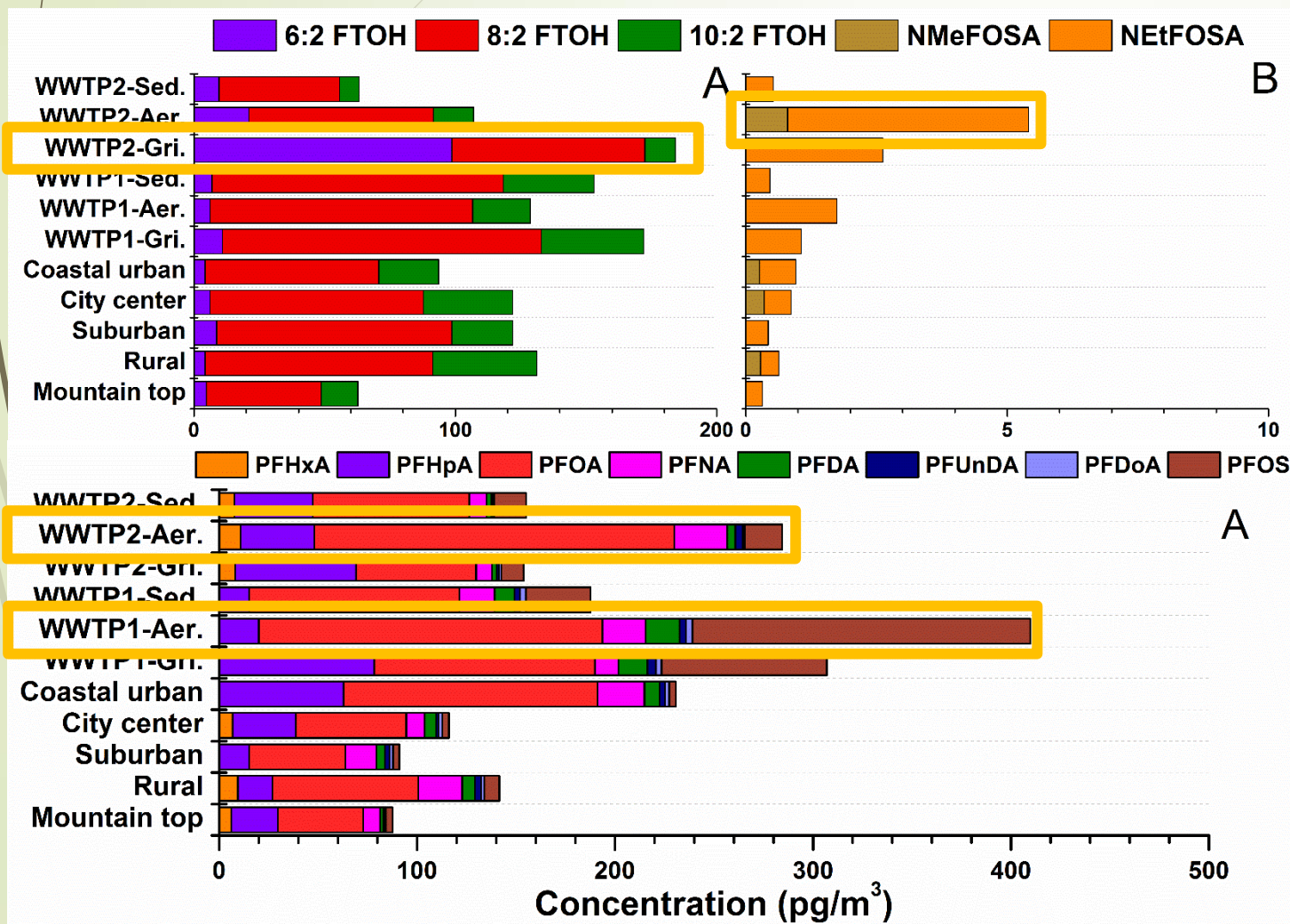
PFASs in the atmosphere of Tianjin



- Comparative levels between neutral and ionic PFASs
- Higher ionic PFASs at the mountain top
- Different release profiles over stages at WWTPs



PFASs in the atmosphere of Tianjin



Higher level of FTOHs over influent

Higher levels of ionic PFASs over aeration tanks

Water turbulence



Aerosol formation

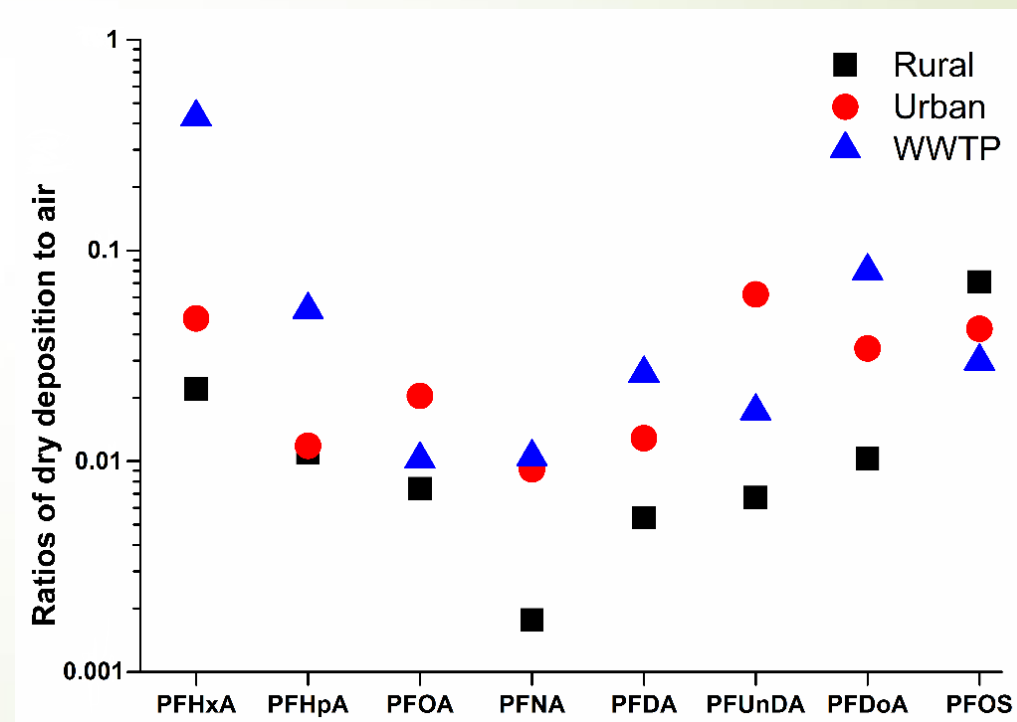
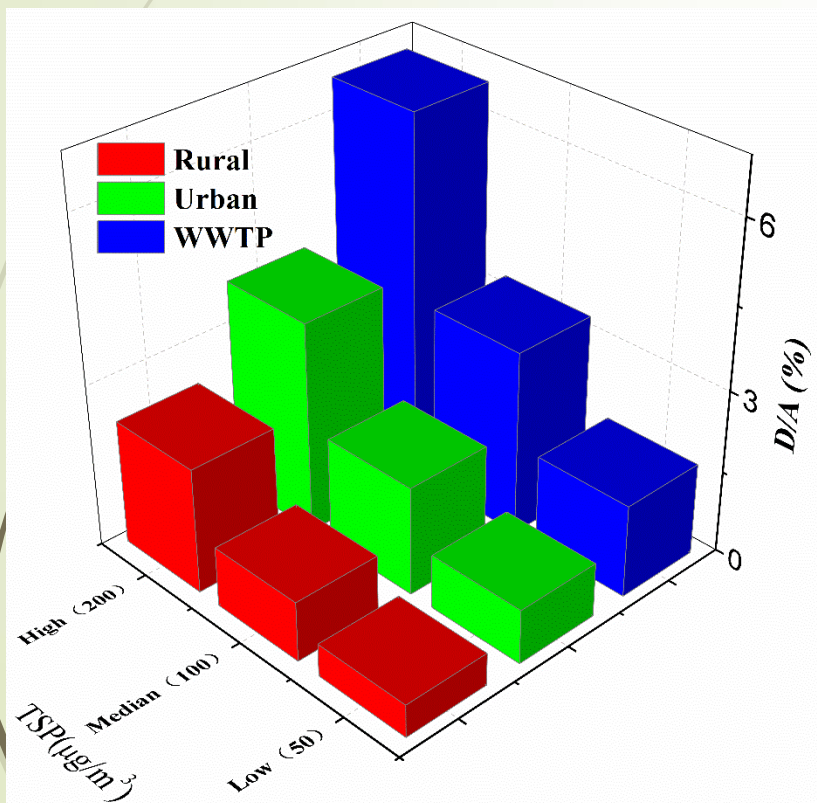


Release to the atmosphere

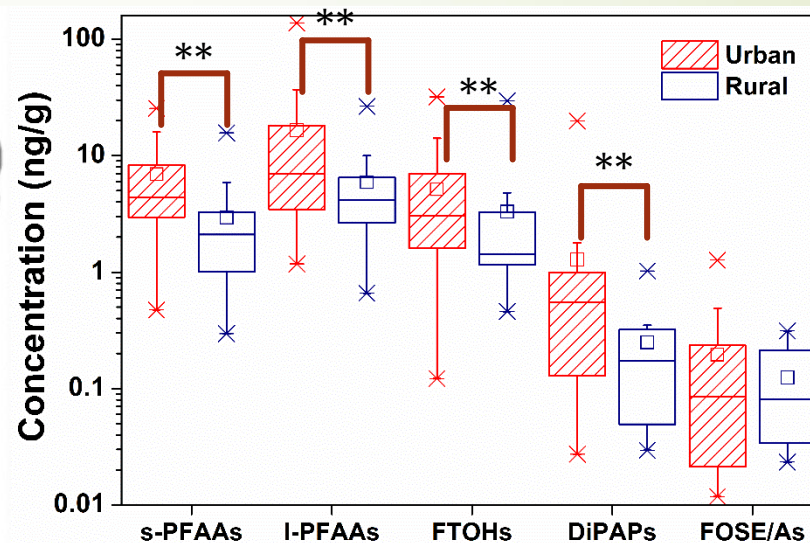
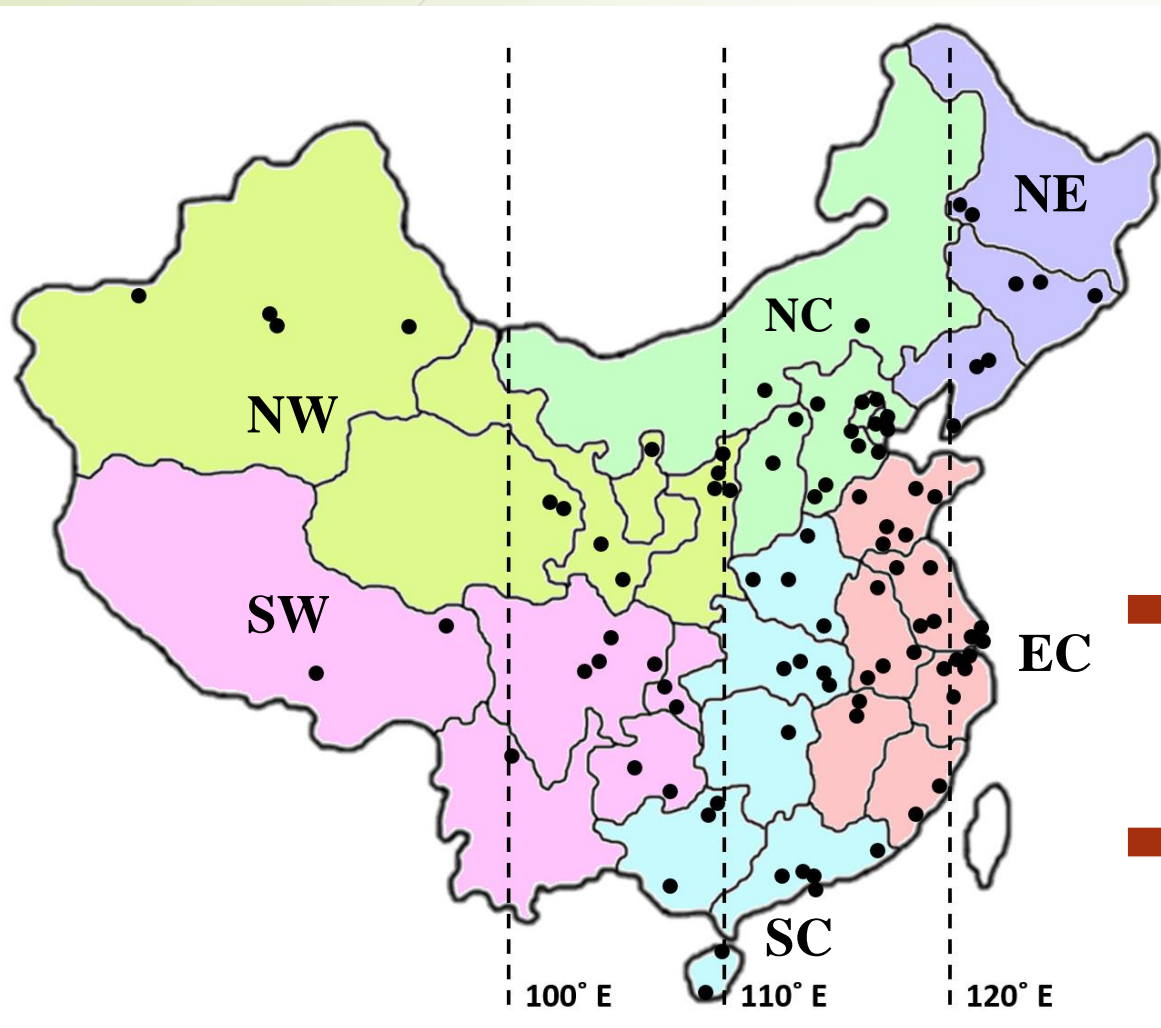
PFASs-Partitioning to dry deposition

$$\text{Ratio} = C_{\text{dry deposition}} \times TSP / C_{\text{air total}}$$

- Removal for 1-5% ionic PFASs in total
- U-shape along PFCA chain length



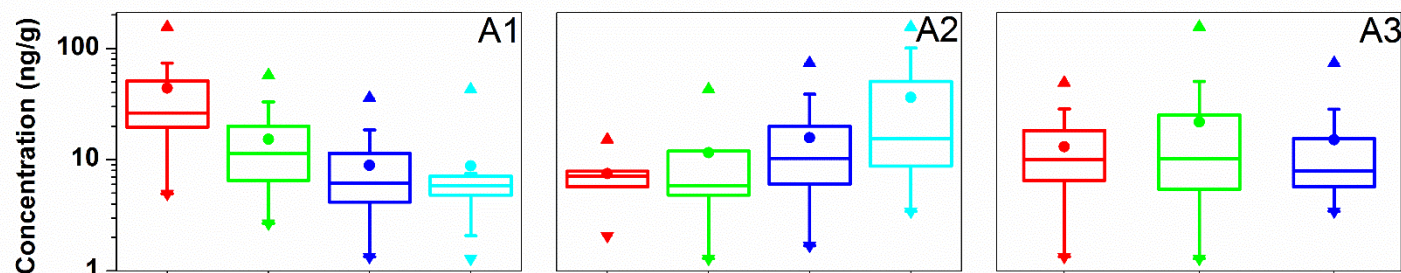
PFASs-Nationwide distribution in outdoor dust



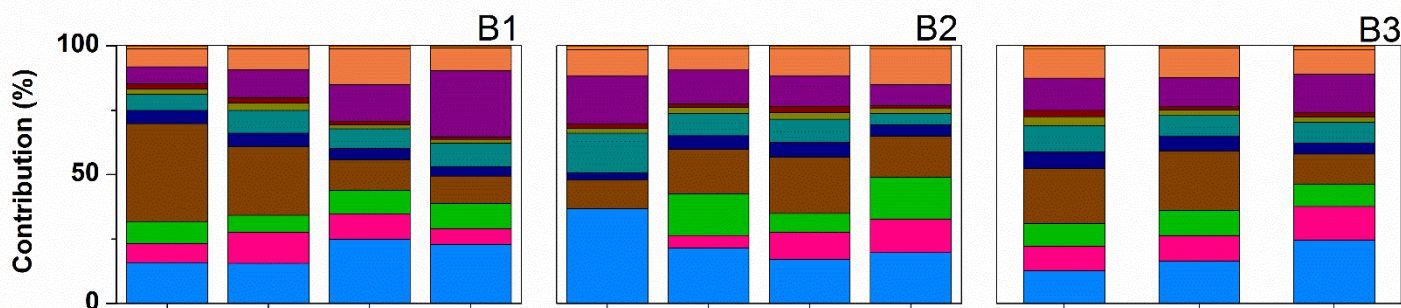
➤ Neutral and ionic PFASs detected

➤ Highly related to urban activities

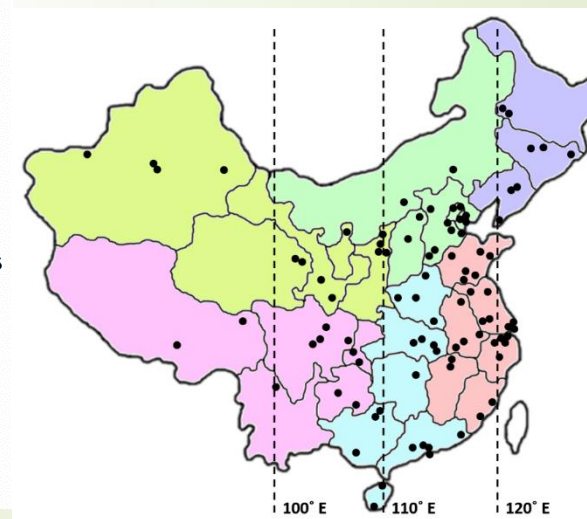
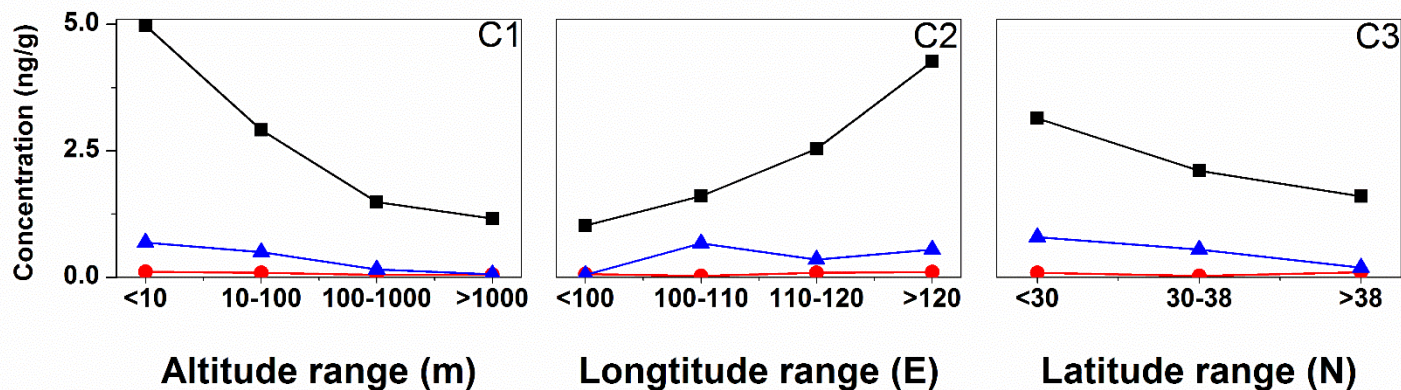
PFASs-Nationwide distribution in outdoor dust



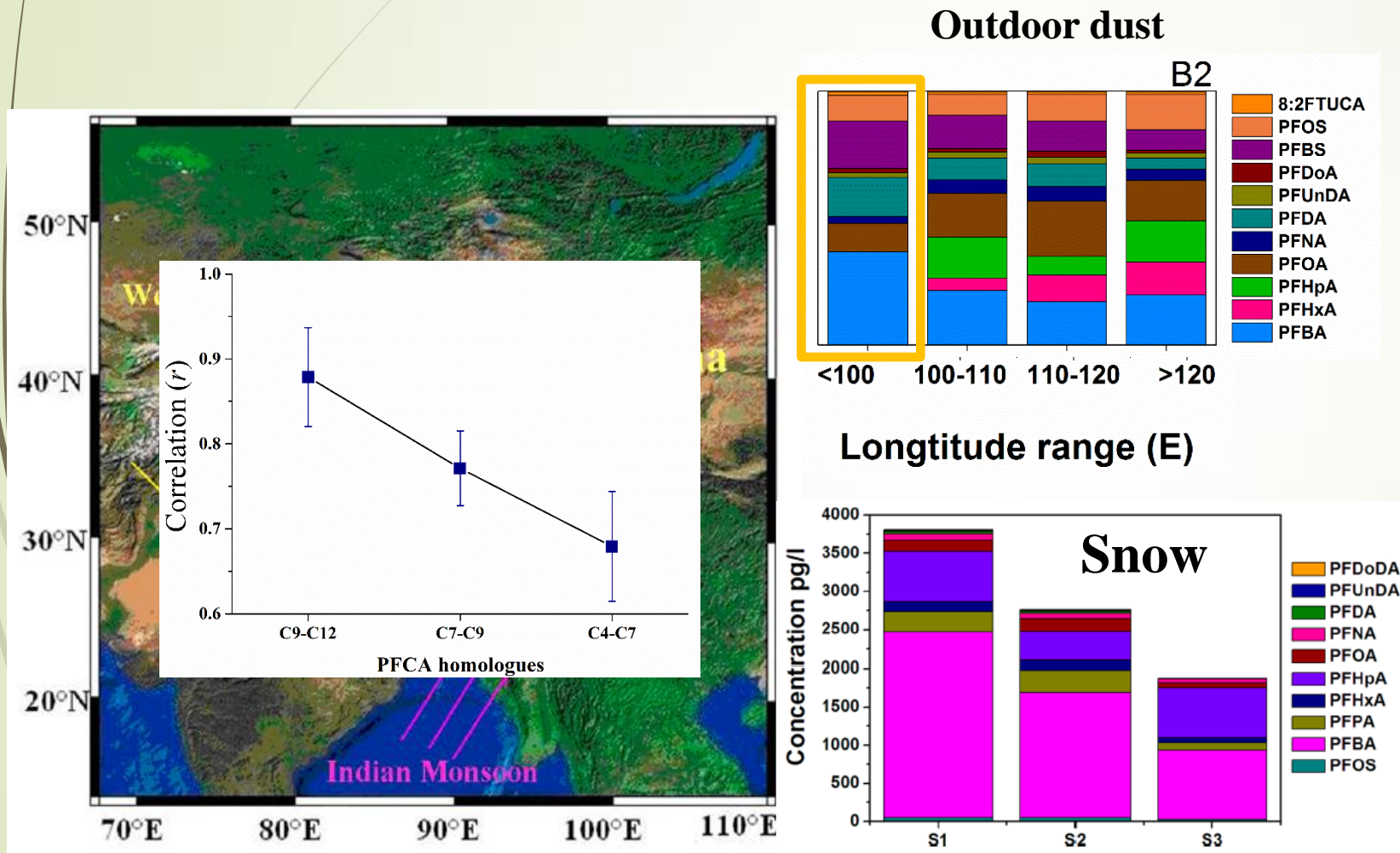
Level decreased with increasing altitude



Level increased with increasing longitude



PFASs-Comparison with Namco snow



➤ Similarly high contribution of PFBA

➤ Common sources are involved

➤ Input from India could be a reason (4:2 FTOH)

Implications

- Both neutral and ionic PFASs can be directly released into the atmosphere
- Ionic PFASs have different affinities with particulate matter along carbon chain length
- The ubiquitous occurrence of PFASs in outdoor dust demonstrated atmospheric transport involving particulate matter
- Towards the high western areas, the atmospheric transport of PFASs from the eastern was limited

Acknowledgement

- National Science foundation of China
- Ministry of Education of China

Thank you for your attention

