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## Aim of This Work

- Applied a top-down Bayesian inversion framework with observations in Hong Kong to optimize prior HFC and HCFC emissions.
- Elaborated spatial distributions of HFC-134a and HCFC-142b emissions over South to East China (SE China).
- Quantified regional and provincial emissions of HFC-134a and HCFC-142b in 2022–2023 using Bayesian inversion.

## Method & Model

### Bayesian Inversion Framework

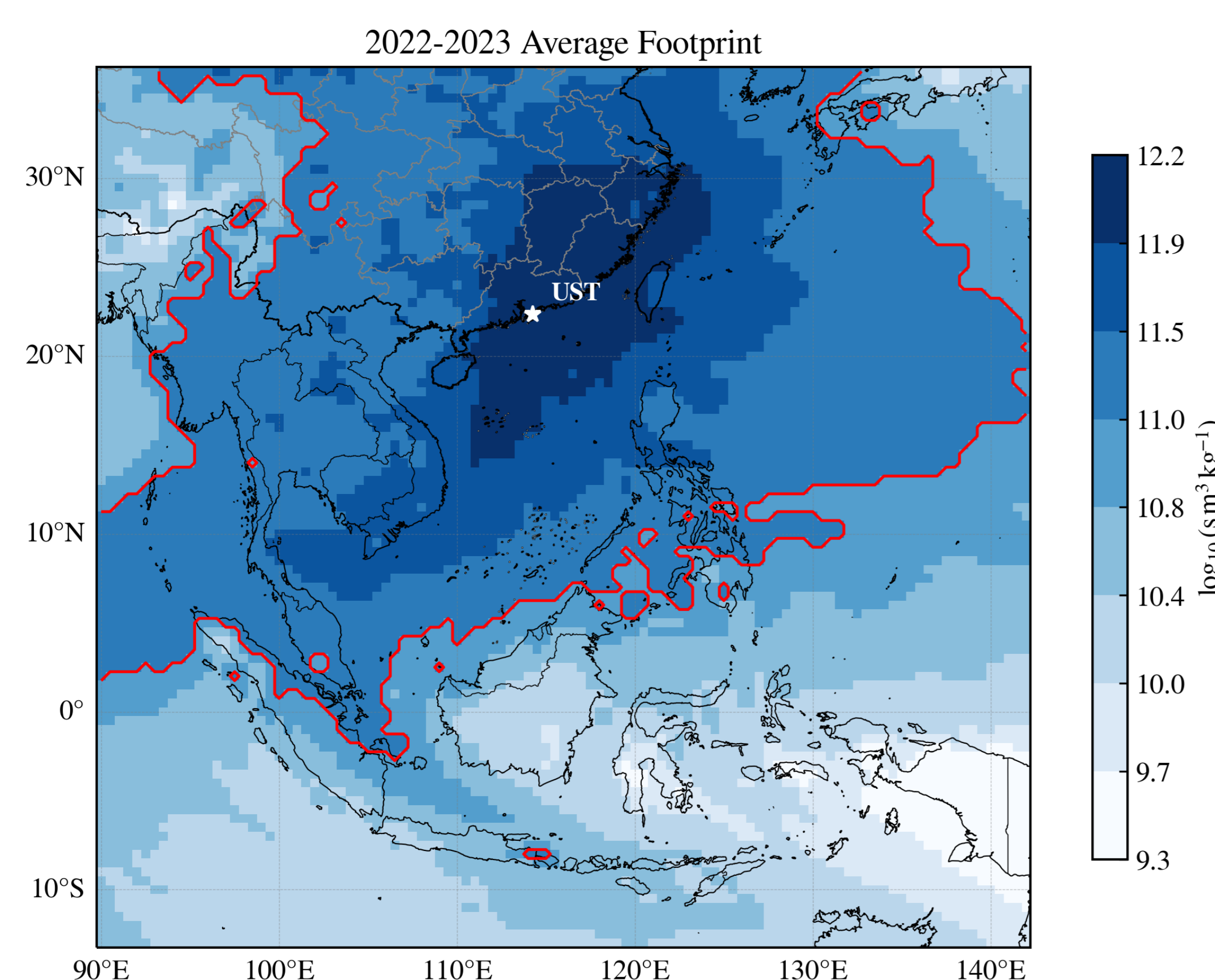
$$\mathbf{x}_a = \mathbf{x}_b + [\mathbf{G}^T \cdot \mathbf{R}^{-1} \cdot \mathbf{G} + \mathbf{B}^{-1}]^{-1} \cdot \mathbf{G}^T \cdot \mathbf{R}^{-1} \cdot (\mathbf{y} - \mathbf{G} \cdot \mathbf{x}_b)$$

- $\mathbf{x}_a$ : posterior emissions
- $\mathbf{x}_b$ : prior emissions
- $\mathbf{G}$ : concentration model output
- $\mathbf{y}$ : observations
- $\mathbf{R}$ : covariance matrix for the observational errors
- $\mathbf{B}$ : covariance matrix for the emissions errors

### FLEXPART & FlexInvert

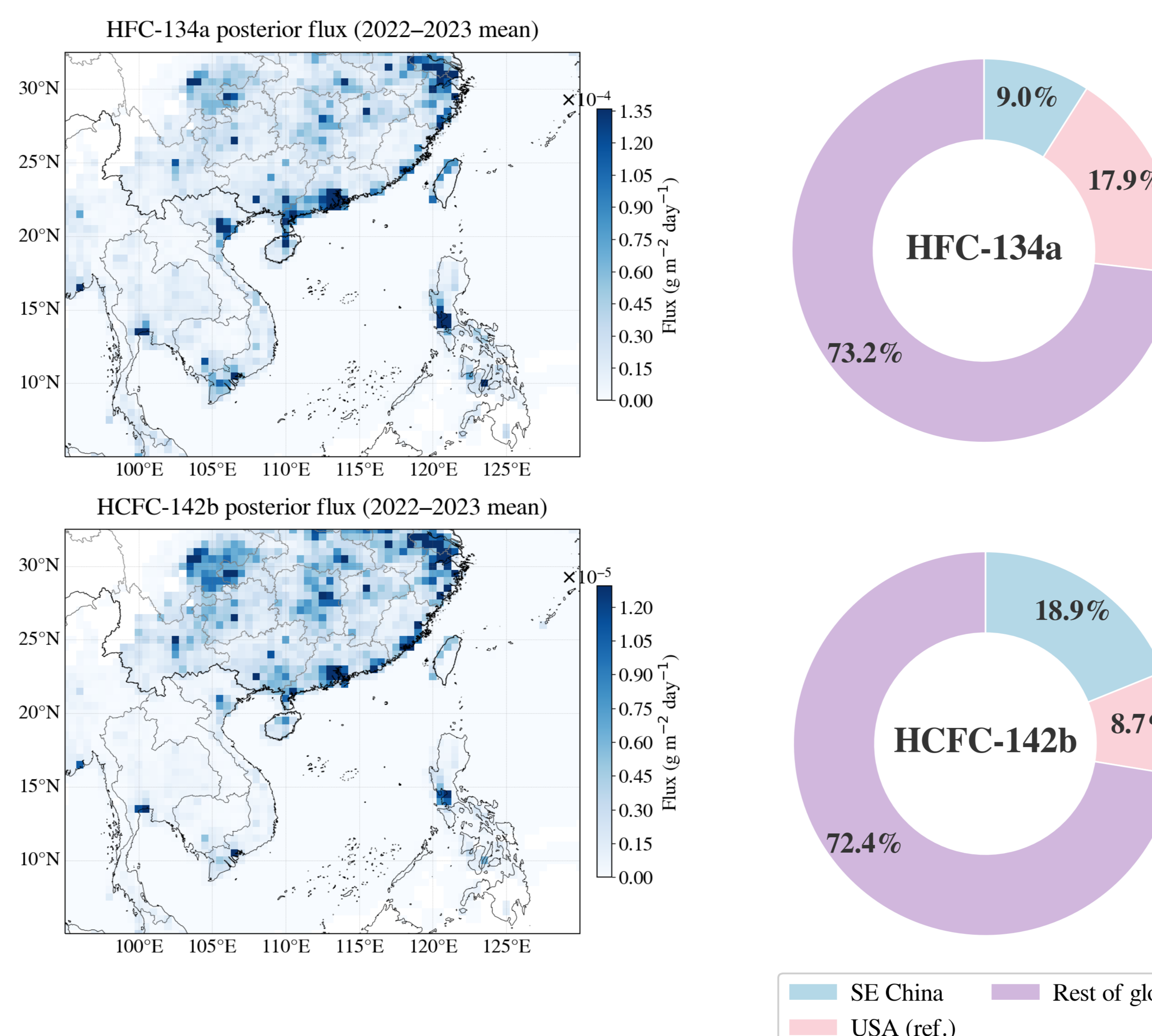
FLEXPART was conducted in 0.5° x 0.5° resolution, with 40,000 particles released in UST and backtracking 20 days.

The prior emissions were derived from China's bottom-up inventory and then redistributed by population ratio.

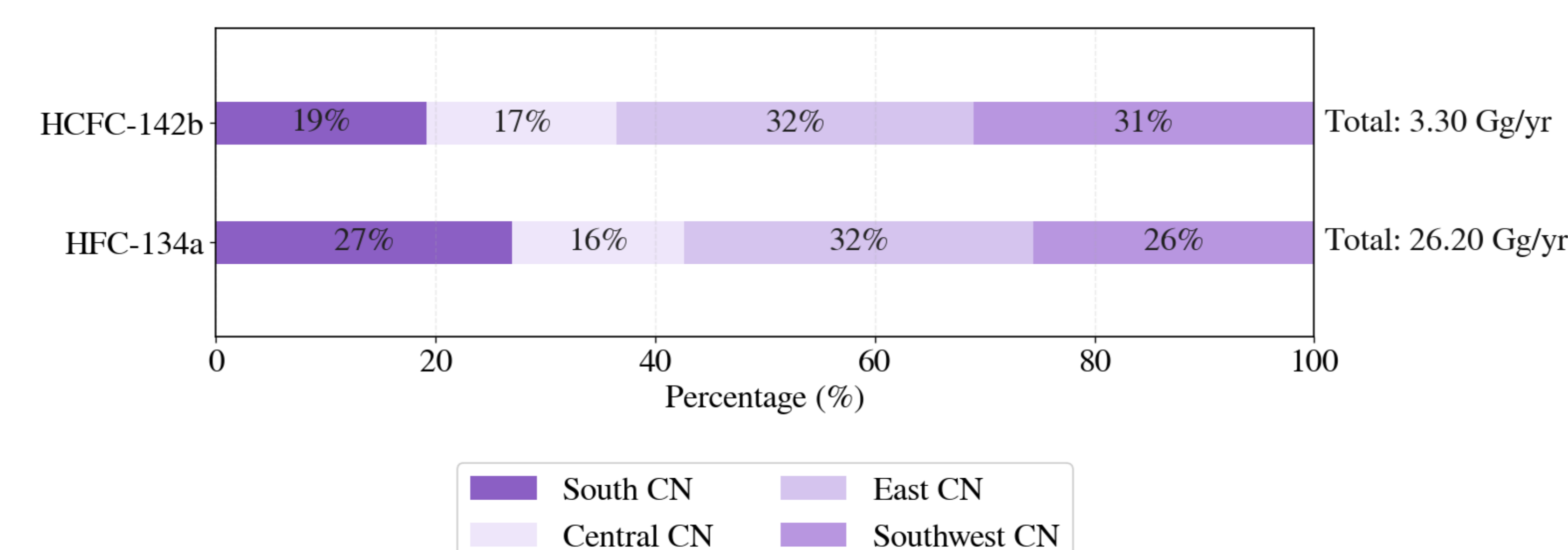


- **Observed data:** January 2022 – December 2023
- **Climate data:** NCEP FNL (Final) Operational Global Analysis data, 1° x 1°

## Posterior Emissions

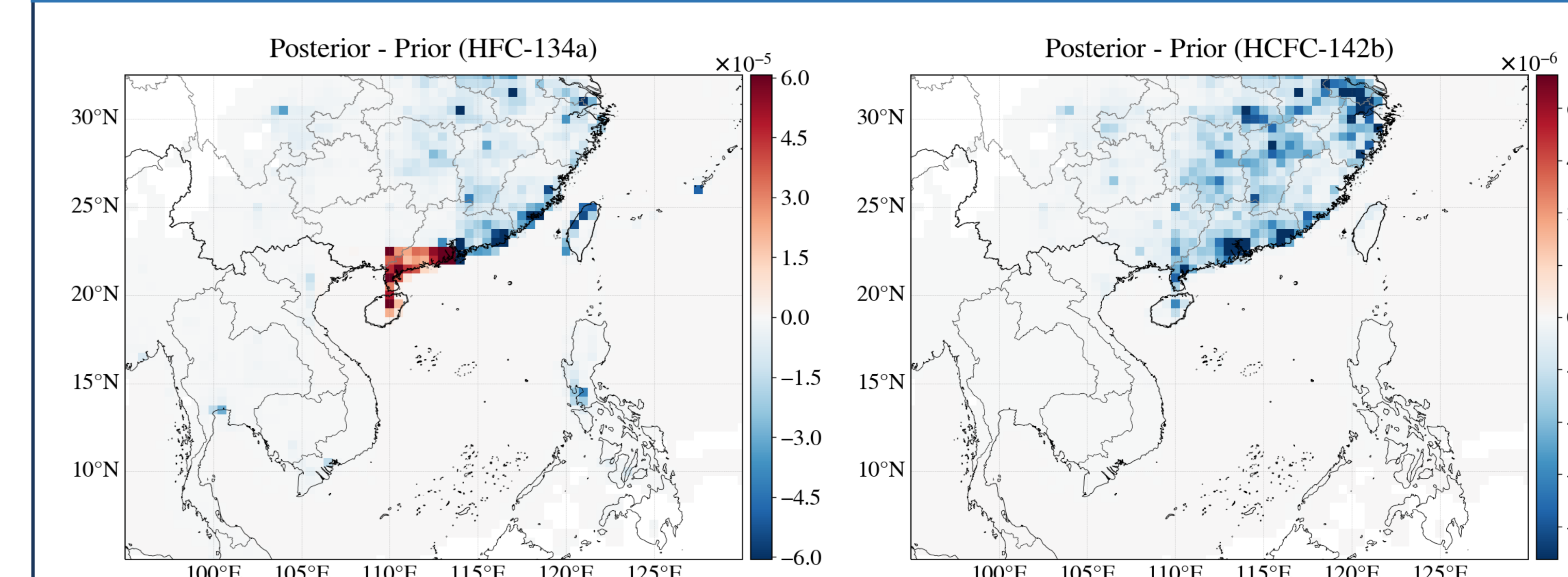


- Pearl River Delta (PRD), Yangtze River Delta (YRD), and Sichuan basin were main hotspots for both species, while HFC-134a was high around Guangdong coastal region.
- SE China's HCFC-142b still contributed significantly to the world.



- In terms of total numbers, HFC-134a far exceeds HCFC-142b.
- East CN is the largest contributor to both HFC-134a and HCFC-142b, following South CN (HFC-134a) and Southwest CN (HCFC-142b), suggesting that more attention is needed in the Sichuan-Chongqing basin.

## Prior Comparison



- We displayed differences between prior emissions and posterior emissions for HFC-134a and HCFC-142b, respectively.
- Posterior emissions of HFC-134a are higher in western Guangdong, while lower in other regions.
- HCFC-142b's posterior emissions were lower throughout almost SE China regions, suggesting lower emissions than previously estimated.

## Summary

- We performed a top-down Bayesian inversion model to estimate HFC-134a and HCFC-142b emissions in SE China.
- SE China contributes 9.0% of global HFC-134a and 18.9% of global HCFC-142b, suggesting the need for continuous monitoring of HCFCs in China.
- Emissions lower than bottom-up inventories (e.g., EDGAR) by ~20%, indicating overestimation of current inventories.
- In the future, we plan to estimate detailed provincial emissions and use longer observations to analyze trends of different species.

## Acknowledgement

This research was substantially supported by the Research Grants Council of the Hong Kong SAR, China (Project No. C6001-24Y, 16306224).

**Reference:** X. Cao, D. Gu, et al. Top-down Estimates of HFC-134a and HCFC-142b Emissions in East Asia in 2022 and 2023 Using a Bayesian Inversion Framework. (Under review)