Urban ambient mixing ratios of hydrochlorofluorocarbons in China

Xuekun Fang, Jing Wu, Yehong Shi, Jianbo Zhang, Jianxin Hu

College of Environmental Sciences and Engineering,
Peking University, Beijing, China

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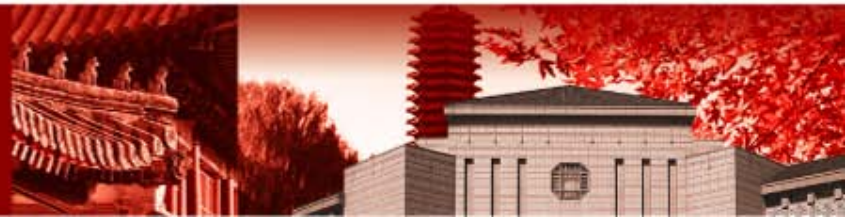
Peking University, China



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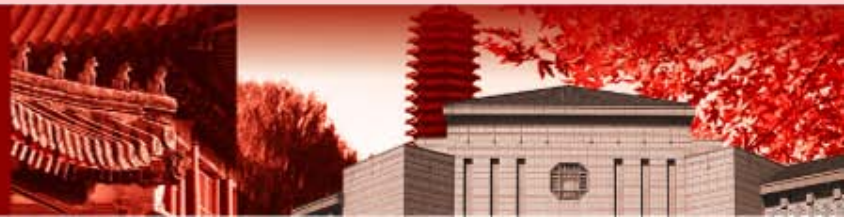


1.Introduction

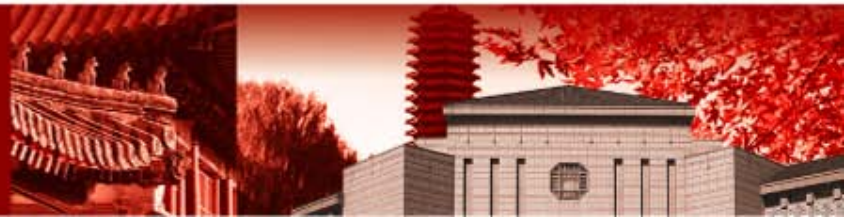
- CFCs were manufactured since 1930s, but forbidden due to ODP

  ($ODP_{CFC\text{-}11}$=1.0, ODPCFC-12=1.0) Montreal Protocol (UNEP, 2009)

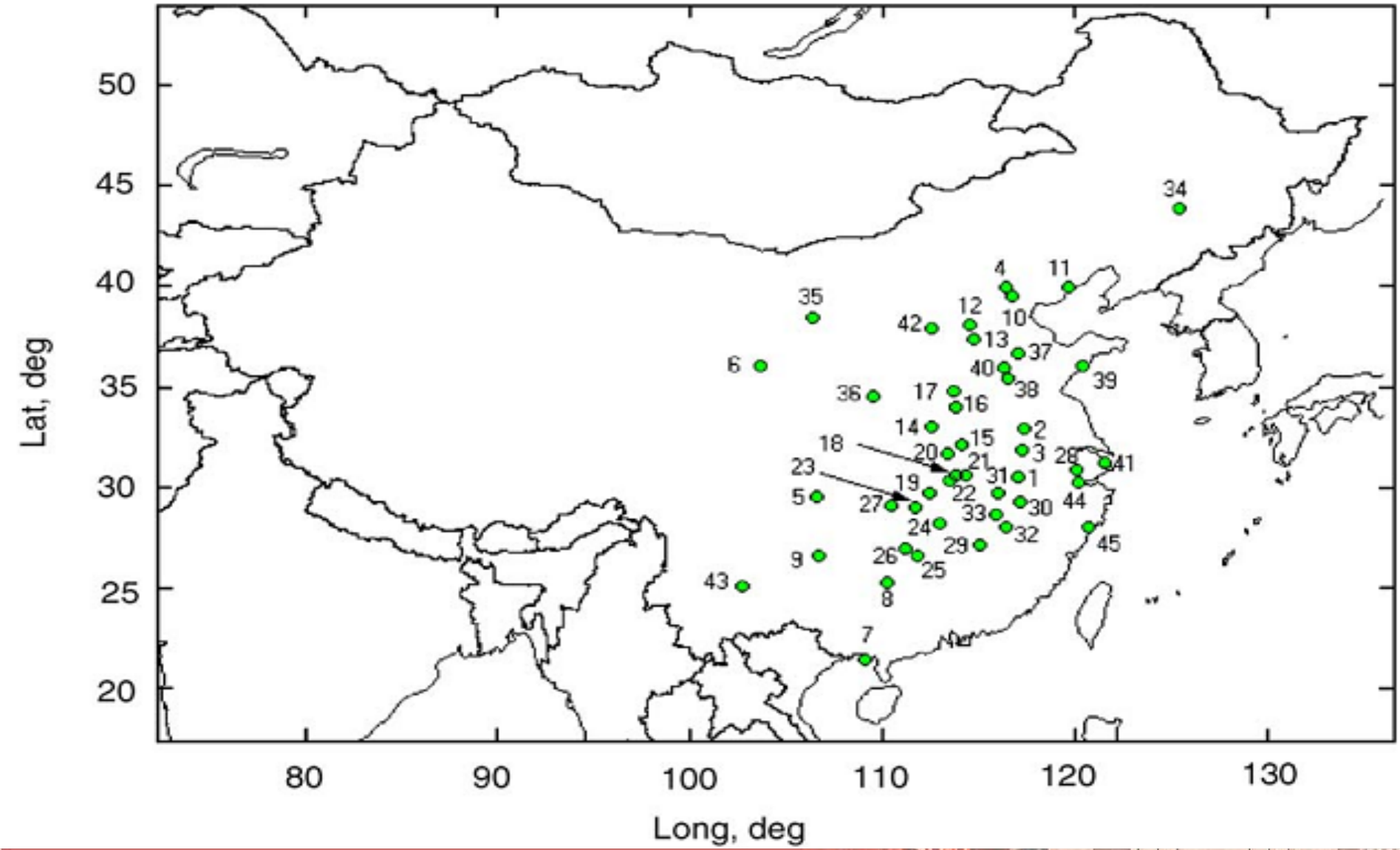
- HCFCs and HFCs came to use, but with high GWP

  ($GWP_{HCFC\text{-}22}$=1780, $GWP_{HFC\text{-}134a}$ =1410) Special Report (IPCC/TEAP, 2005)

- China has phased out CFCs (mid-2007), but usage of HCFCs and HFCs are growing fast



1.Introduction



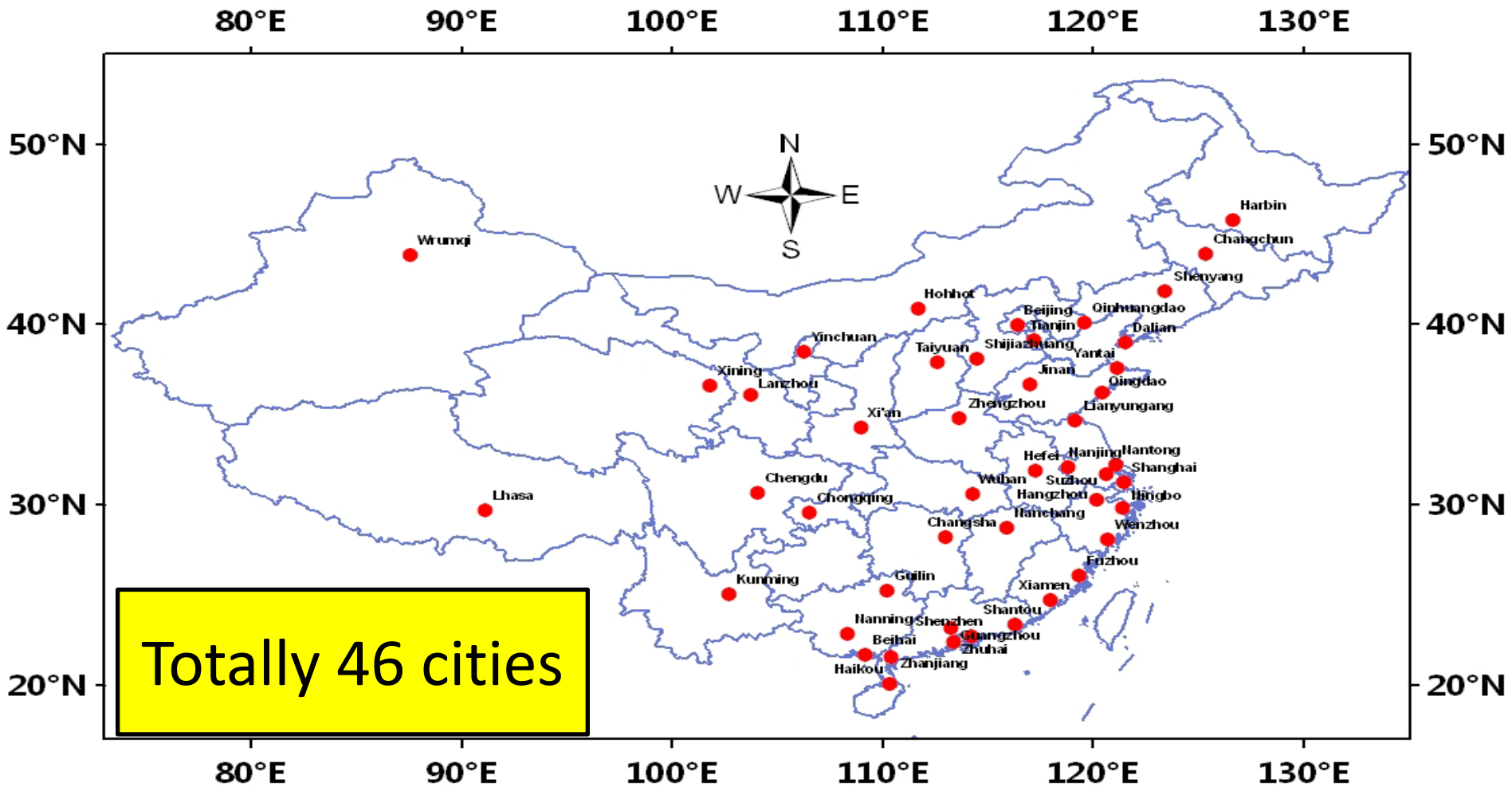
1.Introduction

- China, the most populated country with 1.33 billion in 2009 (NBSC, 2010)
- One of the fast growing economies (>10% per year, NBSC, 2010);
- Ten years have passed, things changed.

HCFCs, How is now ?

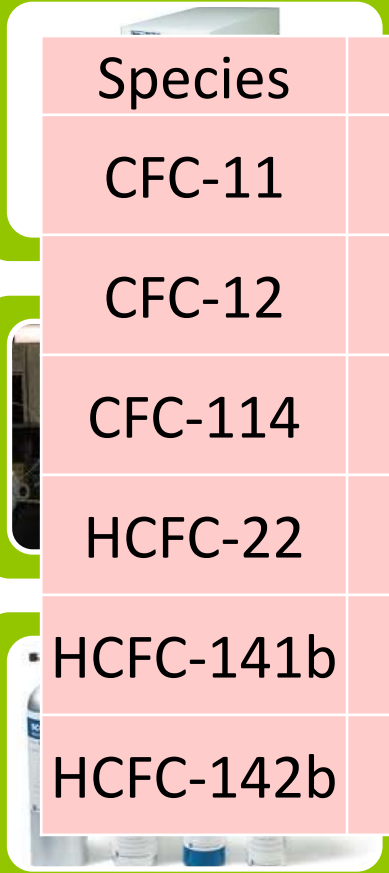
2. Experiment

Map of population density and sampling sites

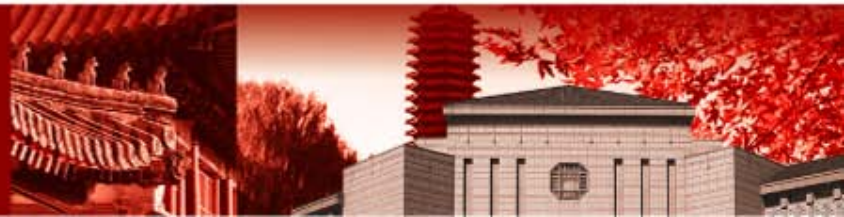


2. Experiment

Species	R	RRF	LOD (pptv)	RSD
CFC-11	0.999	0.395±0.003	6	5.09%
CFC-12	0.997	0.421±0.012	8	6.82%
CFC-114	0.999	0.494±0.004	7	6.17%
HCFC-22	0.999	0.111±0.004	18	3.84%
HCFC-141b	0.997	0.051±0.004	4	5.35%
HCFC-142b	0.998	0.054±0.001	6	7.90%



3. Results and discussion



3.1 General features

- Variability of ozone depleting substances is an important indication of emissions

(Chang et al., Atmospheric Environment, 2010)

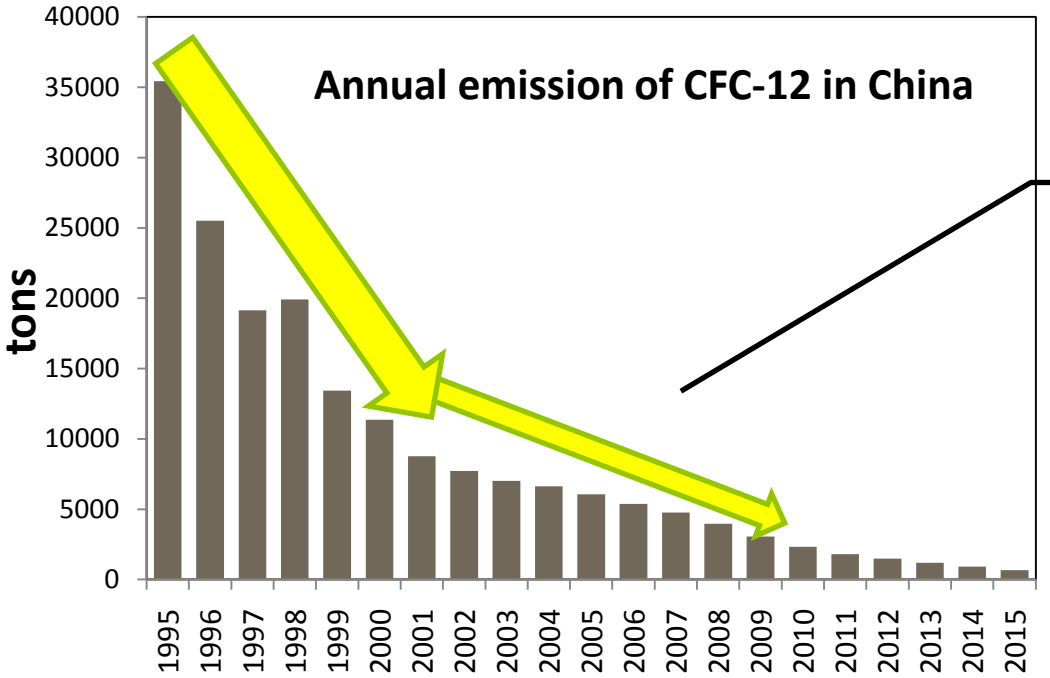
- the smaller variability is,

→ the smaller emission source will be,

→ the much closer its concentration will be to the global background value.

3.1 General features

Common	Mean	RSD	Median (pptv)	Min (pptv)	Max (pptv)



(Hu et al., Atmospheric Environment, 2009)

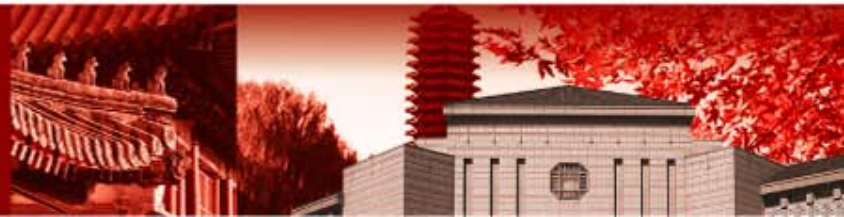
Negligible emission sources of CFCs existed in China

to calculate mean and relative standard

3.1 General features

Common Name	Mean (pptv)	RSD (%)	Median (pptv)		
HCFC-22	585	39	493		
HCFC-141b	47	47	39		
HCFC-142b	60	68	42	24	223

Much larger emission sources of HCFCs existed in China



3.2 Compared to NH background

Common Name	Mean (pptv)	RSD (%)	M (I			NH Background (pptv)
HCFC-22	585					211[a]
HCFC-141b	47	47	39	26	293	22[a]
HCFC-142b	60	68	42	24	223	21[a]

Surpassed the background to a large extent

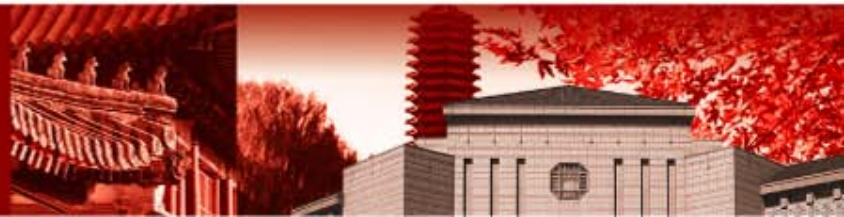
[a]Insitu monthly average Data (October 2010) from the NOAA/ESRL halocarbons in situ program (ftp://ftp.cmdl.noaa.gov/hats). Data of HCFC-141b from flask program (July 2010)

3.2 Compared to NH background

Reason——a big proportion of Global emissions

Compound	China Emissions (kt/a)				Glabal Emissions
	Kim et al., [2010] for 2008	% to Global	Vol al.[2		
HCFC-22	83 (64-109)	23	165(140-213)	79.3	365
HCFC-141b	15 (12-21)	25		12.1	60
HCFC-142b	10 (7.6-13)	24	12(10-18)		41

China emissions were relative large emissions



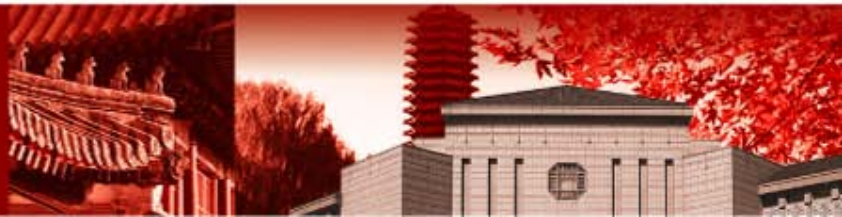
3.3 Compared to year 2001

Mixing ratios have increased rapidly since 2001

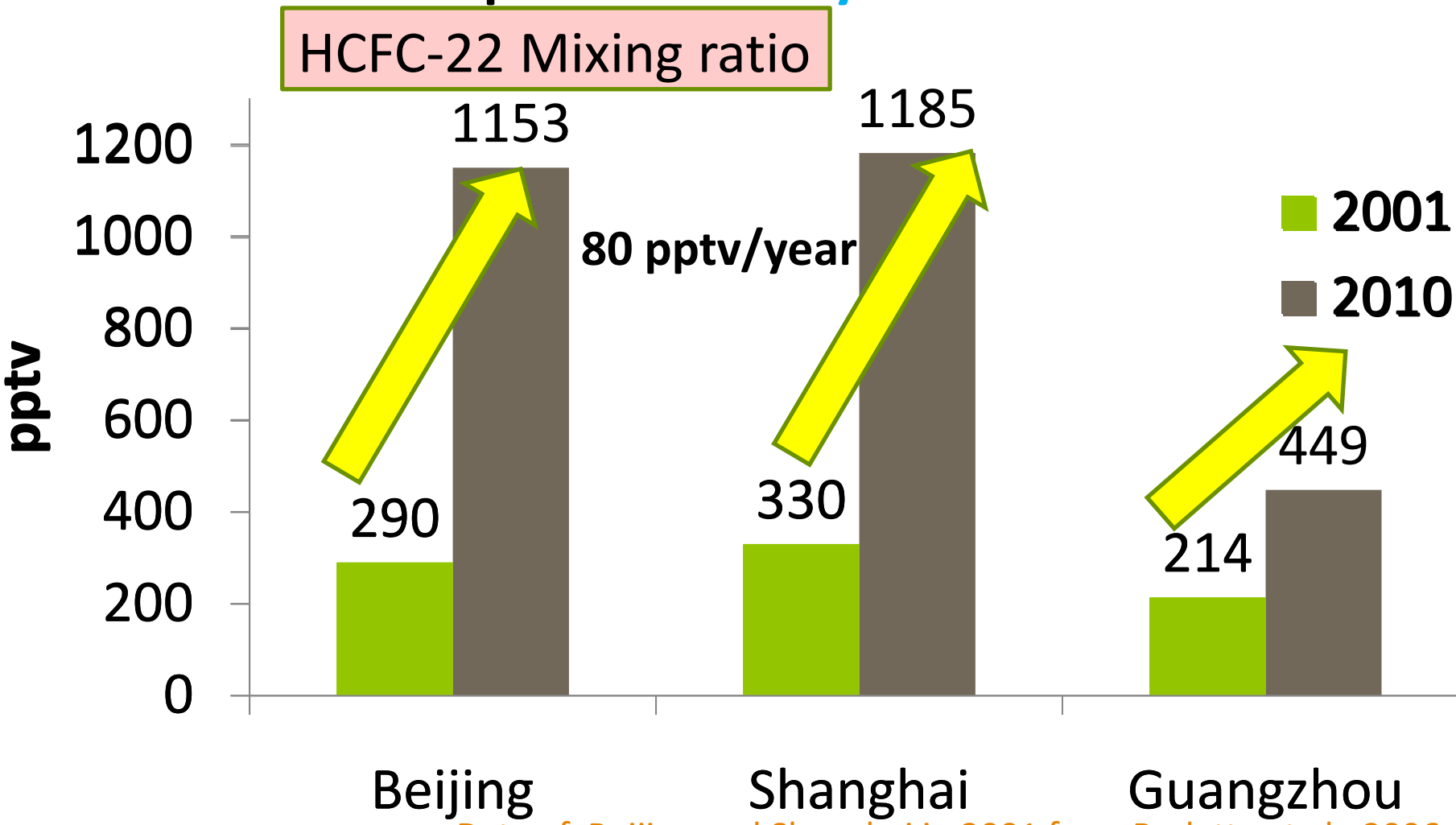
Common Name	Mean	RSD (%)	Me				45 cites in 2001[d]
HCFC-22	585	3	493	269	4541	211[a]	220(71)
HCFC-141b	47	47	39	26	293	22[a]	20(9)
HCFC-142b	60	68	42	24	2169	21[a]	19(5)

[a]Insitu monthly average Data (October 2010) from the NOAA/ESRL halocarbons in situ program (ftp://ftp.cmdl.noaa.gov/hats)

[d](Barletta et al., Atmospheric Environment. 2006).



3.3 Compared to year 2001

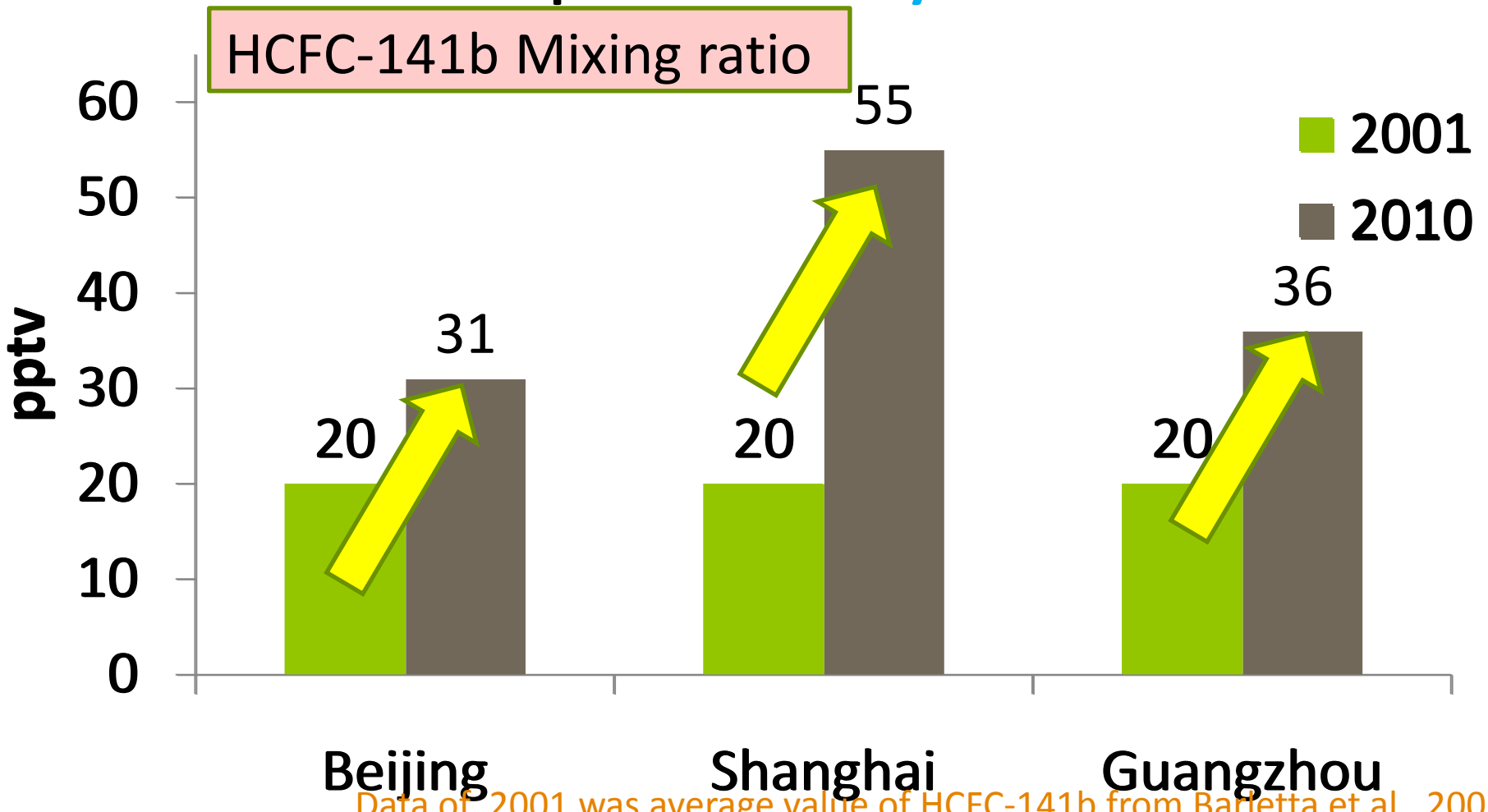


Data of Beijing and Shanghai in 2001 from Barletta et al.,.2006

Data of Guangzhou in 2001 from Chan and Chu, 2007

Case study

3.3 Compared to year 2001

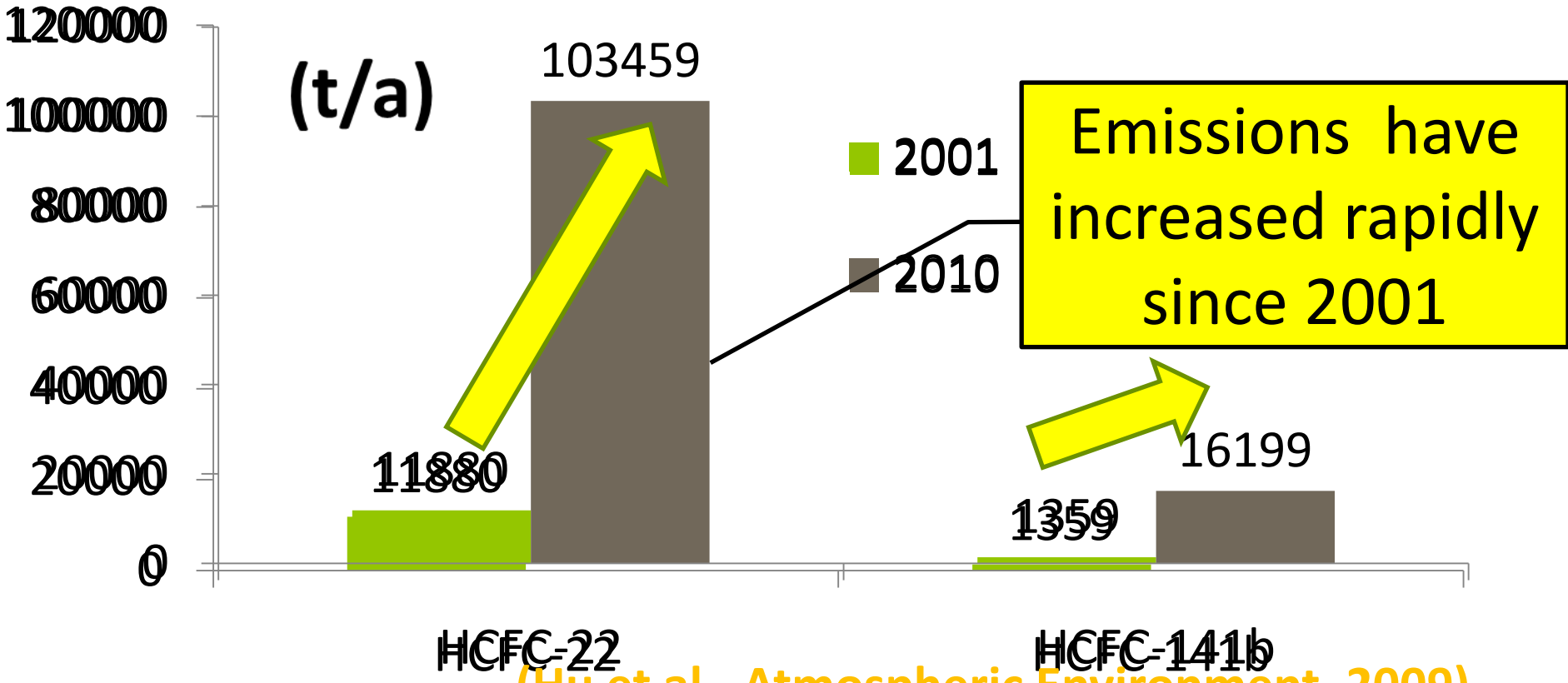


Data of 2001 was average value of HCFC-141b from Barletta et al., 2006).

Case study

3.3 Compared to year 2001

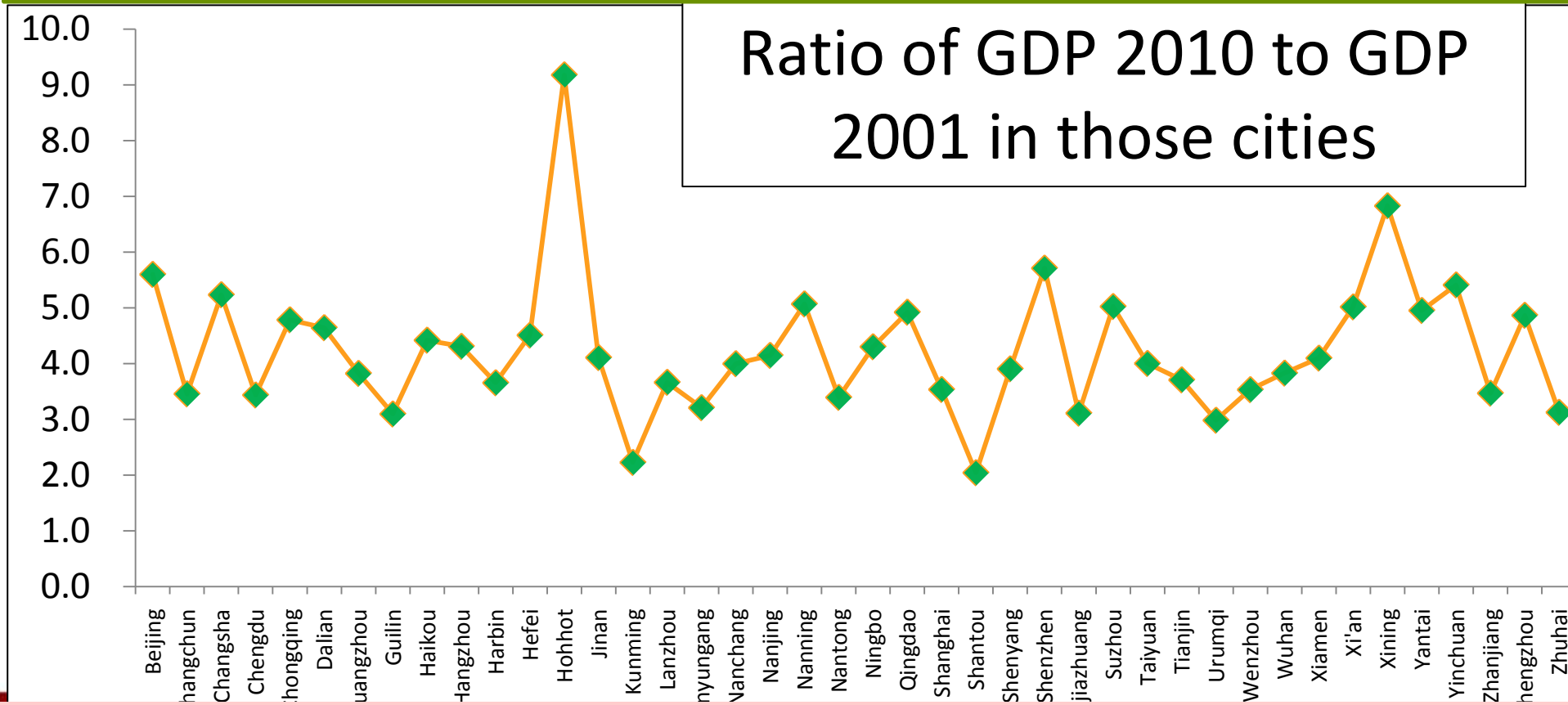
Reason—— Annual emissions increase



(Hu et al., Atmospheric Environment, 2009)

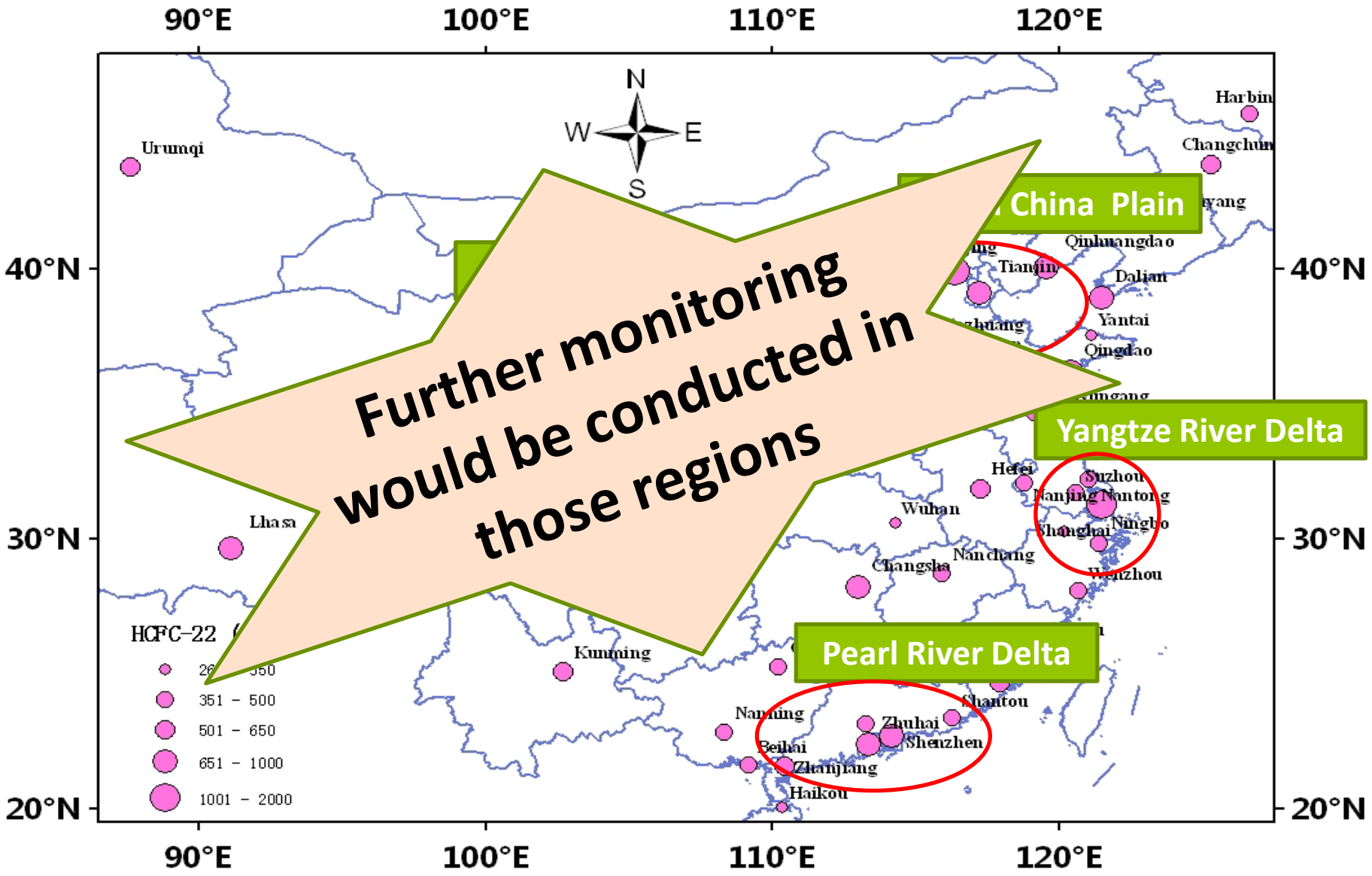
3.3 Compared to year 2001

Why emissions increased?



but CFC phased out, so production and consumption of HCFCs grew gradually.

3.4 Regions with high levels of HCFC-22



4. Conclusion

- Larger Variability of HCFCs than CFCs in China;
- Levels of HCFCs surpassed NH background to a large extent, especially for HCFC-22 (585 pptv and 211 pptv, respectively);
- Levels of HCFCs have increased rapidly since 2001;
- Regions with high levels of HCFC were distinguished.

Thank you for your attention!

Welcome to Peking University, China

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