EC/OC Emissions in China: Current Understanding & Relevant Issue

ZHANG, Xiao-Ye; Qiu, J H; Gong, S L; Cao, G L; Zhou, L X; Sun, J Y; Wang, H; Wang, Y Q; Xu, D; Zhang, H; Ma, J Z; Liu, Y; Li, Yang; Che, H; Ding, Y

Centre for Atmosphere Watch & Services (CAWAS), CMA

Emission Inventory of EC & OC in China

Carbonaceous aerosol emission source

Fuel types considered in this work

Residential

- Agriculture residues
- Fuelwood
- Rural residential-coal
- Rural residential-oil
- Urban residential coal
- Urban residential-oil

Biomass burning

- agriculture waste
- Forest fire
- Grassland fire

Industry

- Urban industry-coal
- Urban industry-oil
- Rural industry-coal
- Rural industry-oil
- Biofuel

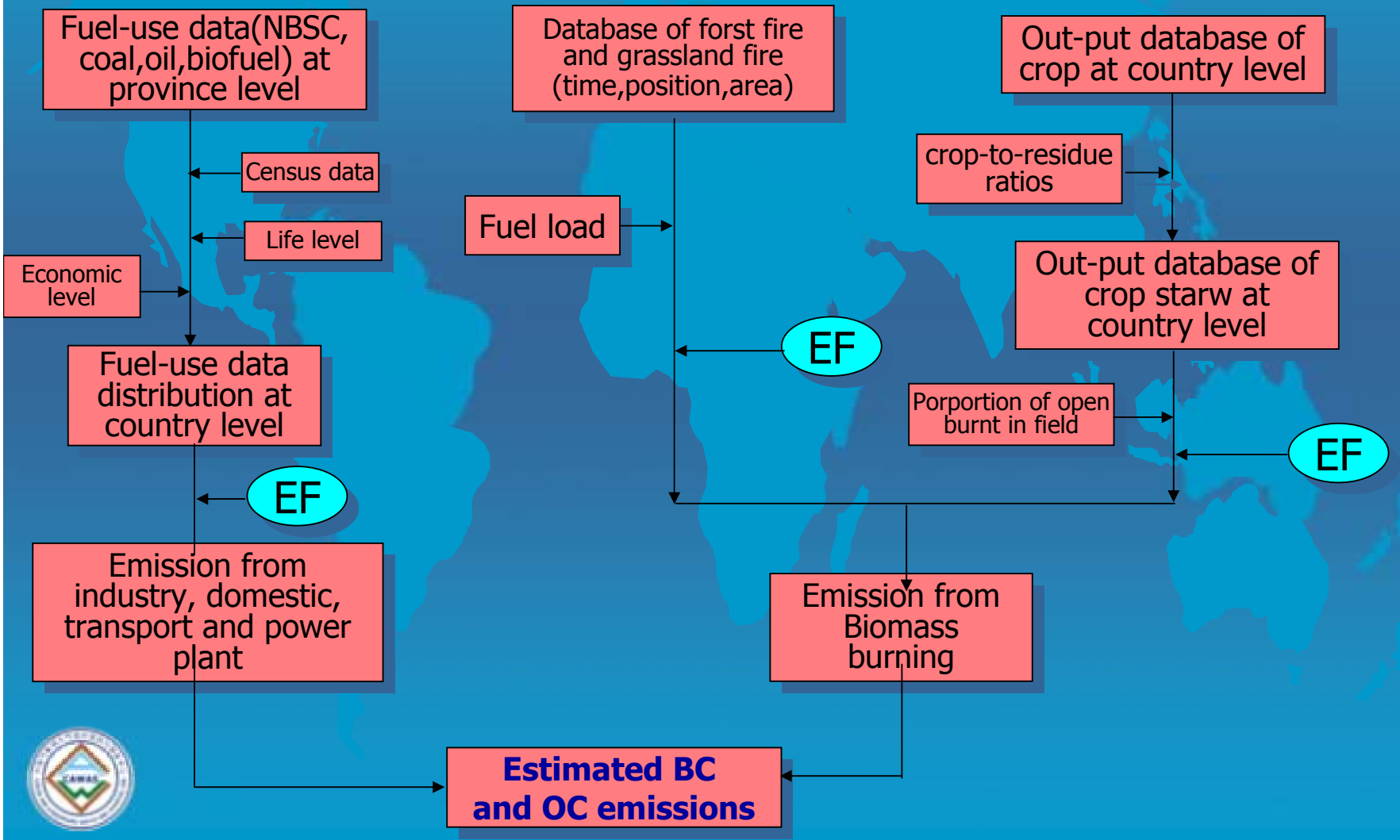
Power Plant

- Coal
- Oil

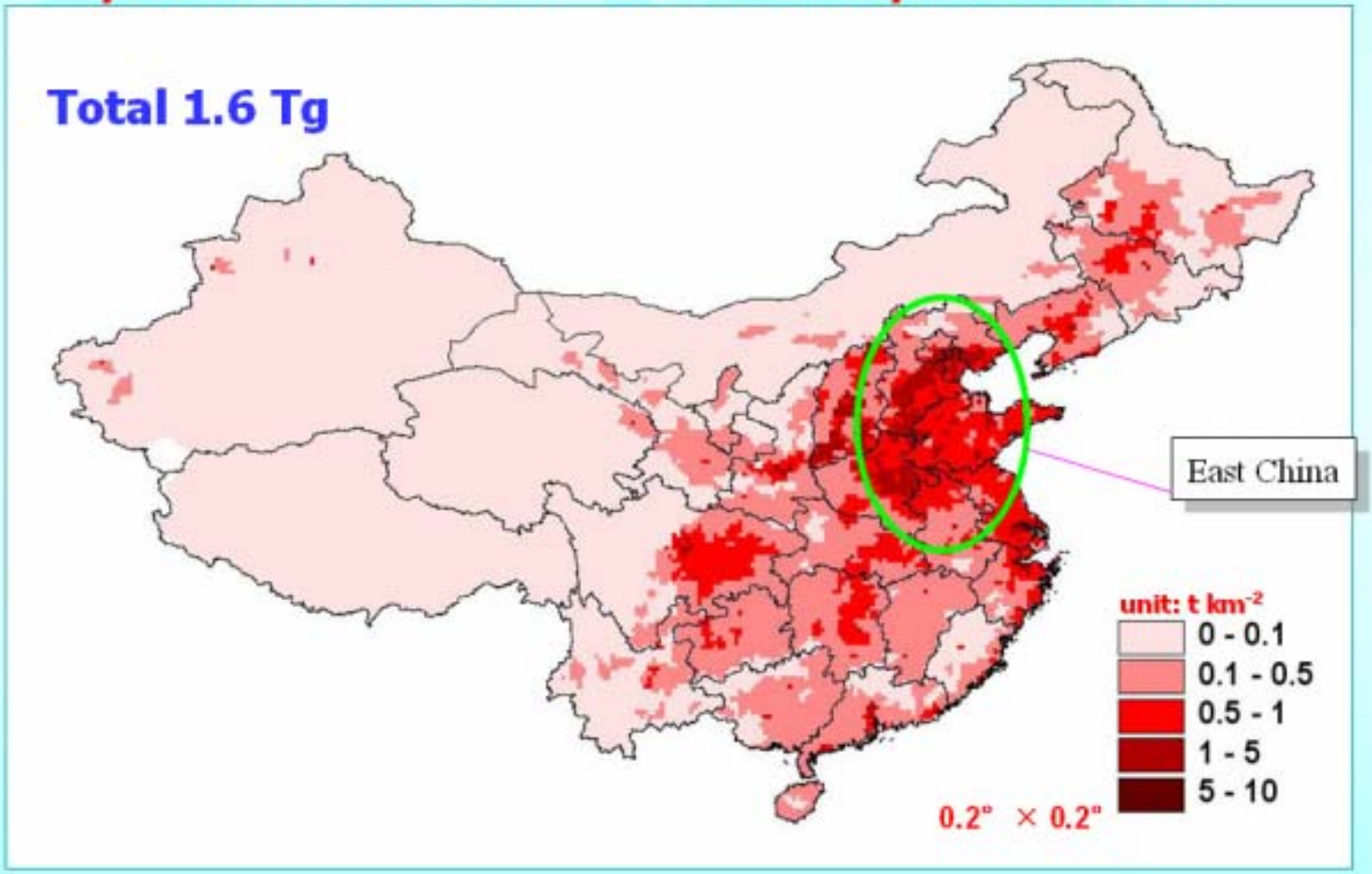
Transportation

- diesel
- gasoline

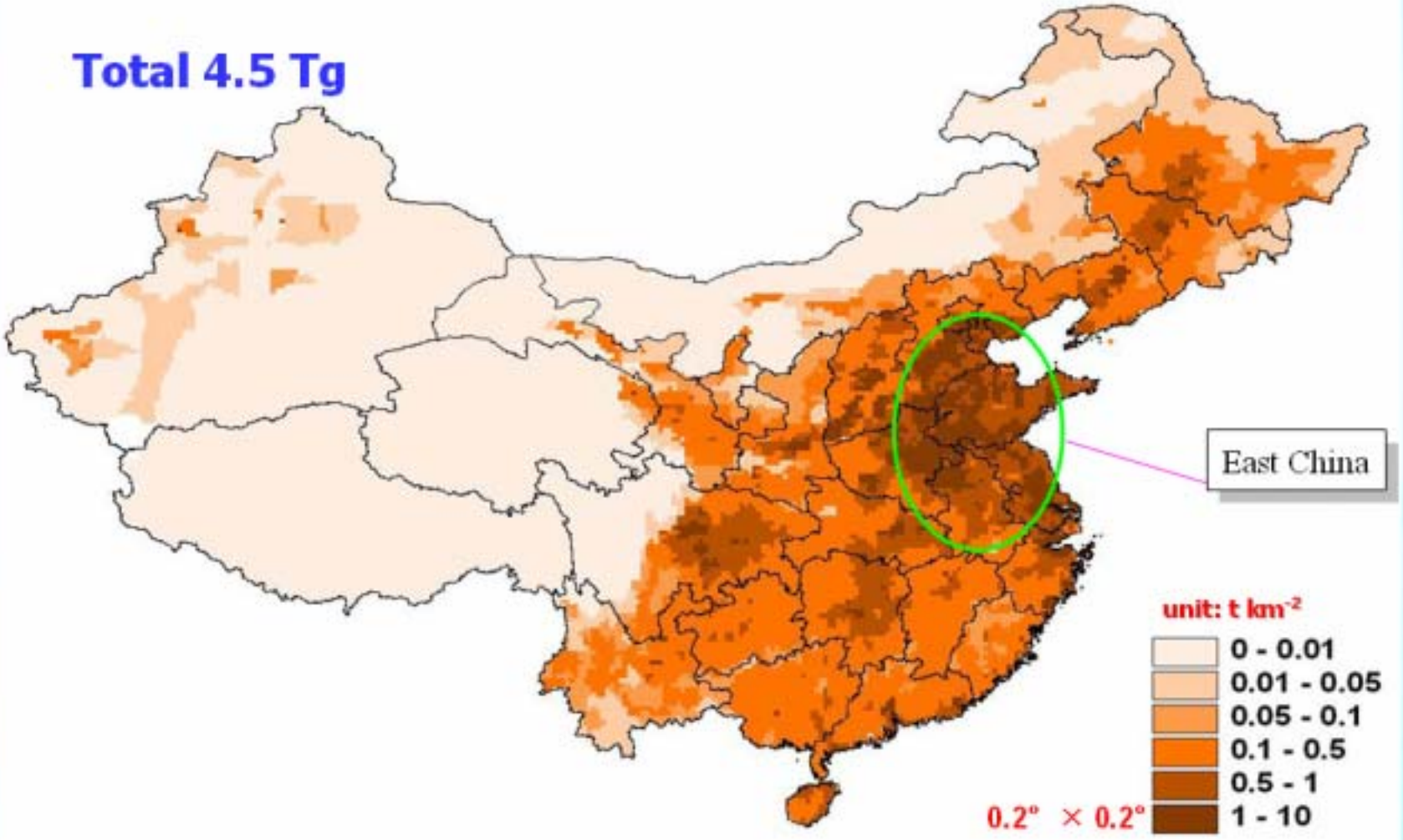
Methodology



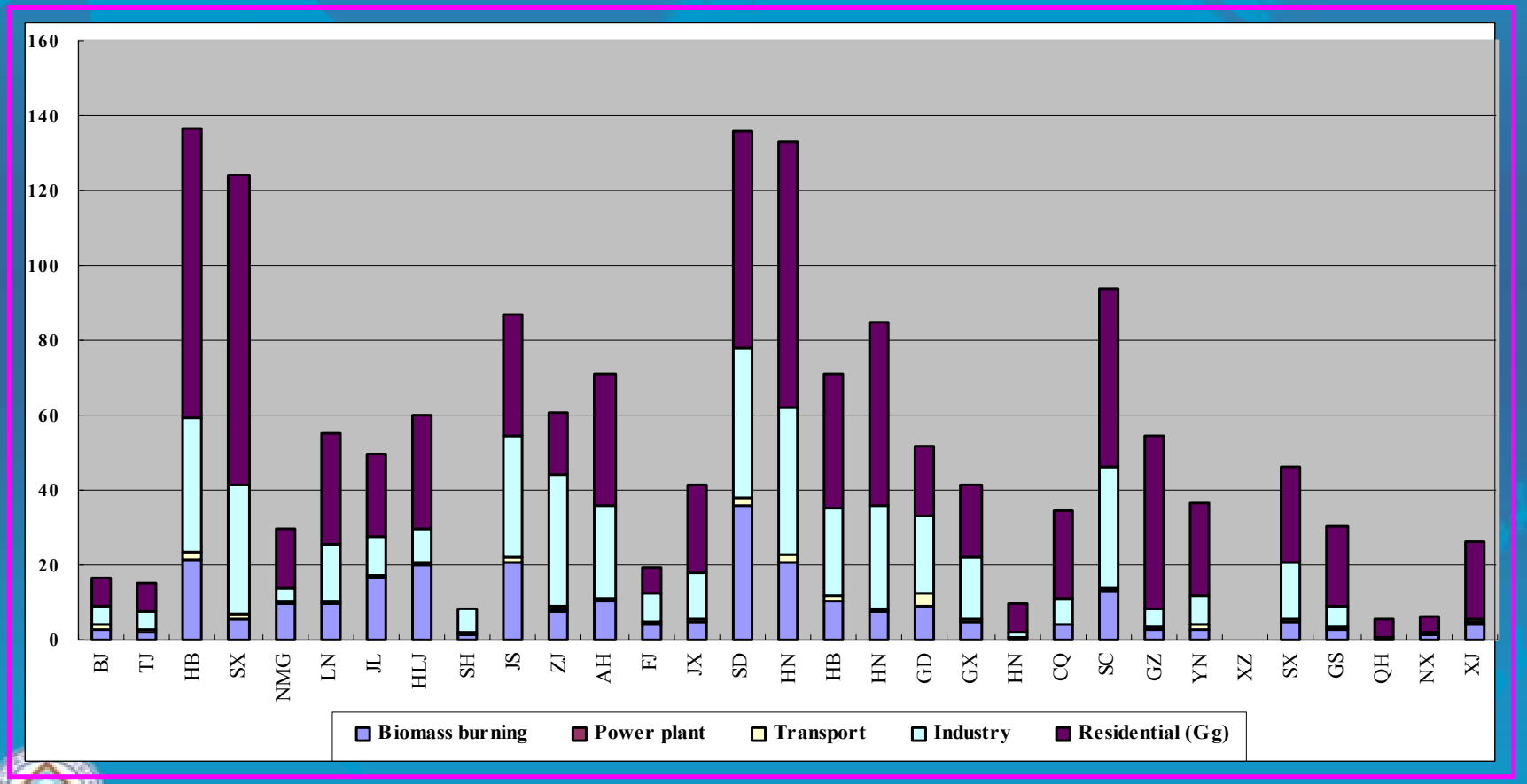
Estimated BC emission for the year 2000 in China by CAWAS



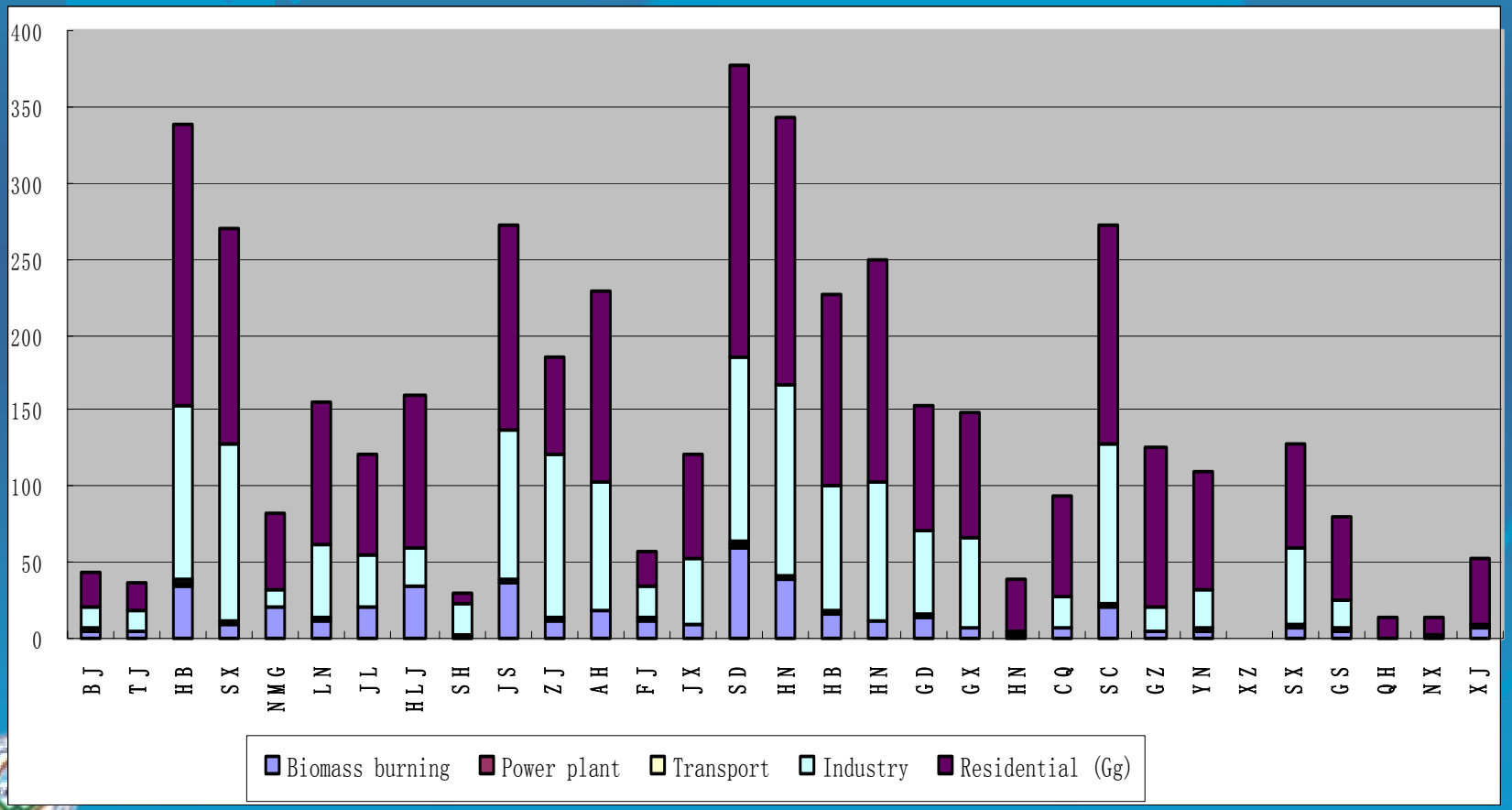
Estimated OC emission for the year 2000 in China by CAWAS



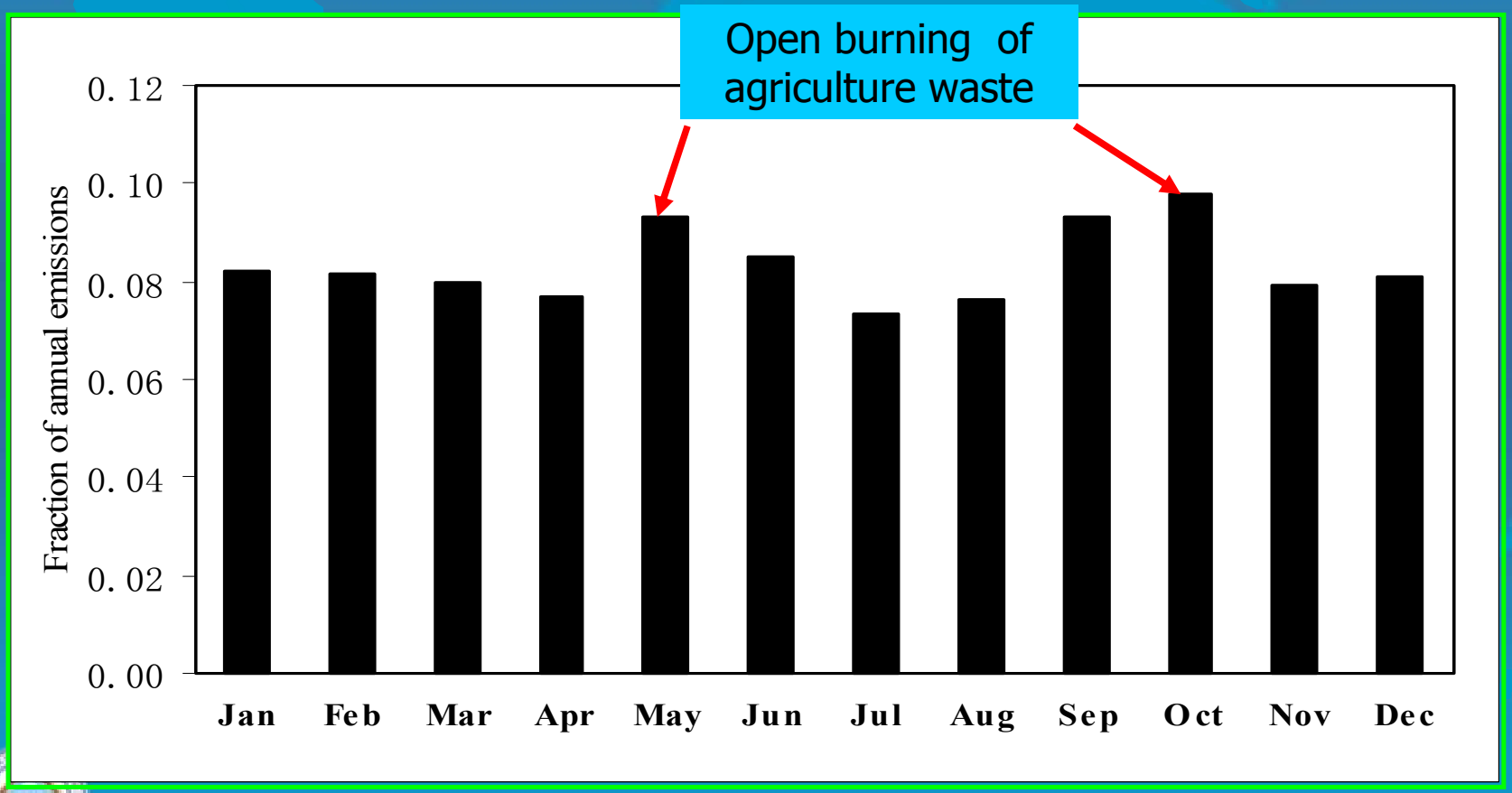
Regional BC Sources



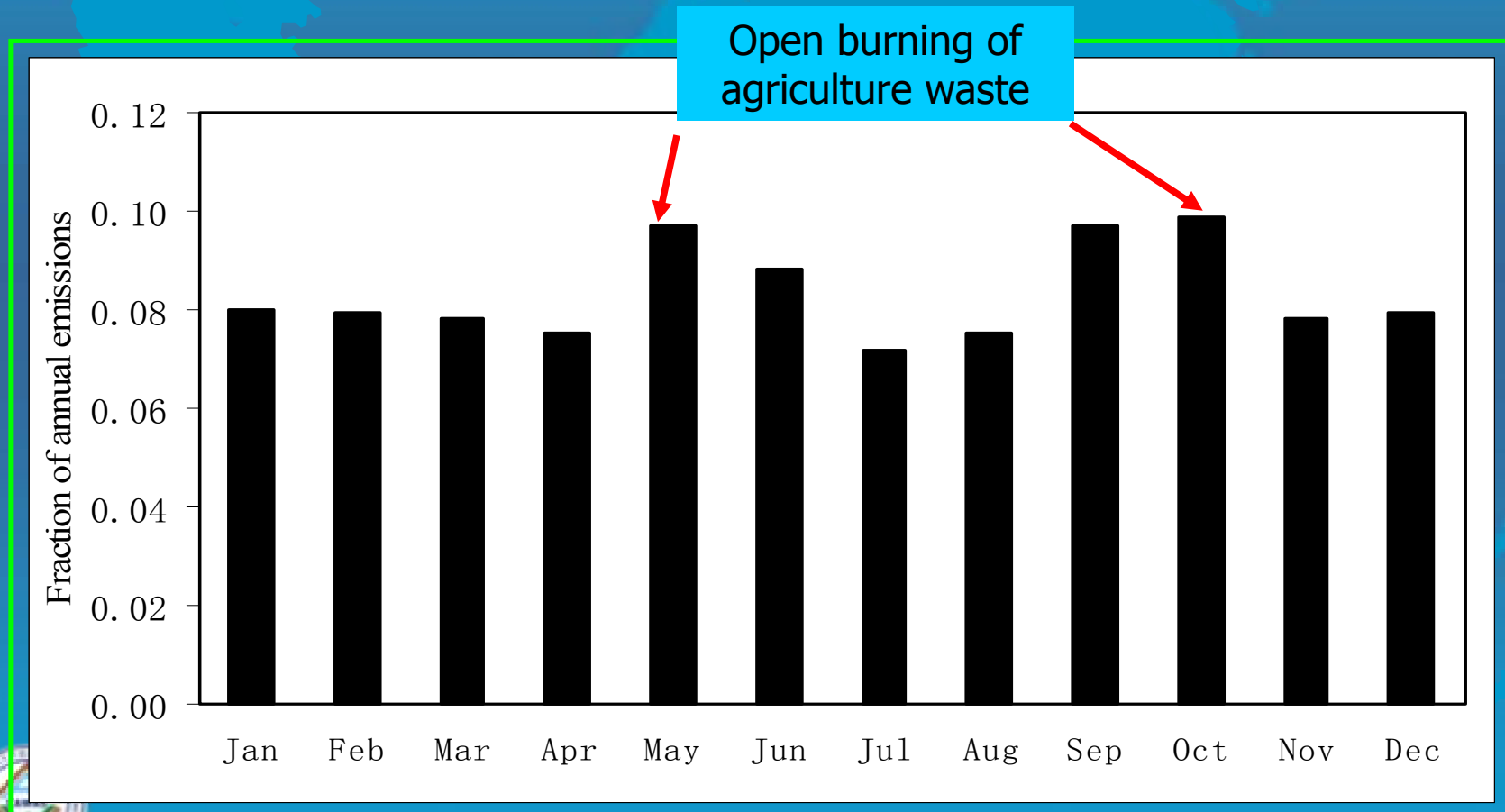
Regional OC Sources



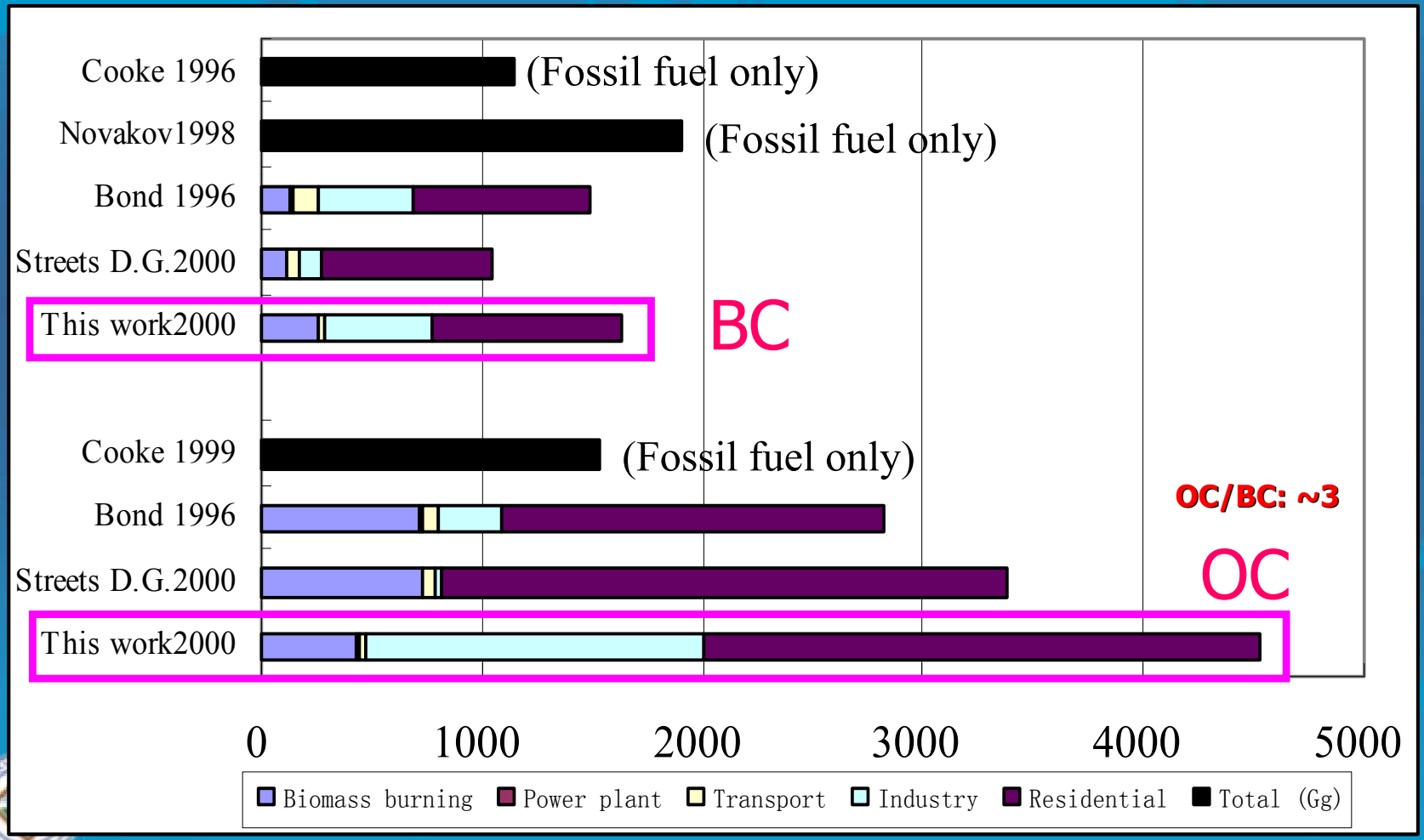
Monthly fractions of total BC emission



Monthly fractions of total BC emission



Emission inventory Comparisons (China)



Fuel types considered in this work

Residential

- Agriculture residues
- Fuelwood
- Rural residential-coal
- Rural residential-oil
- Urban residential coal
- Urban residential-oil

BC: .556 Tg
OC: .848 Tg

Biomass burning

- agriculture waste
- Forest fire
- Grassland fire

BC: .259 Tg
OC: .402 Tg

Industry

- Urban industry-coal
- Urban industry-oil
- Rural industry-coal
- Rural industry-oil
- Biofuel

BC: .356 Tg
OC: 1.23 Tg

Power Plant

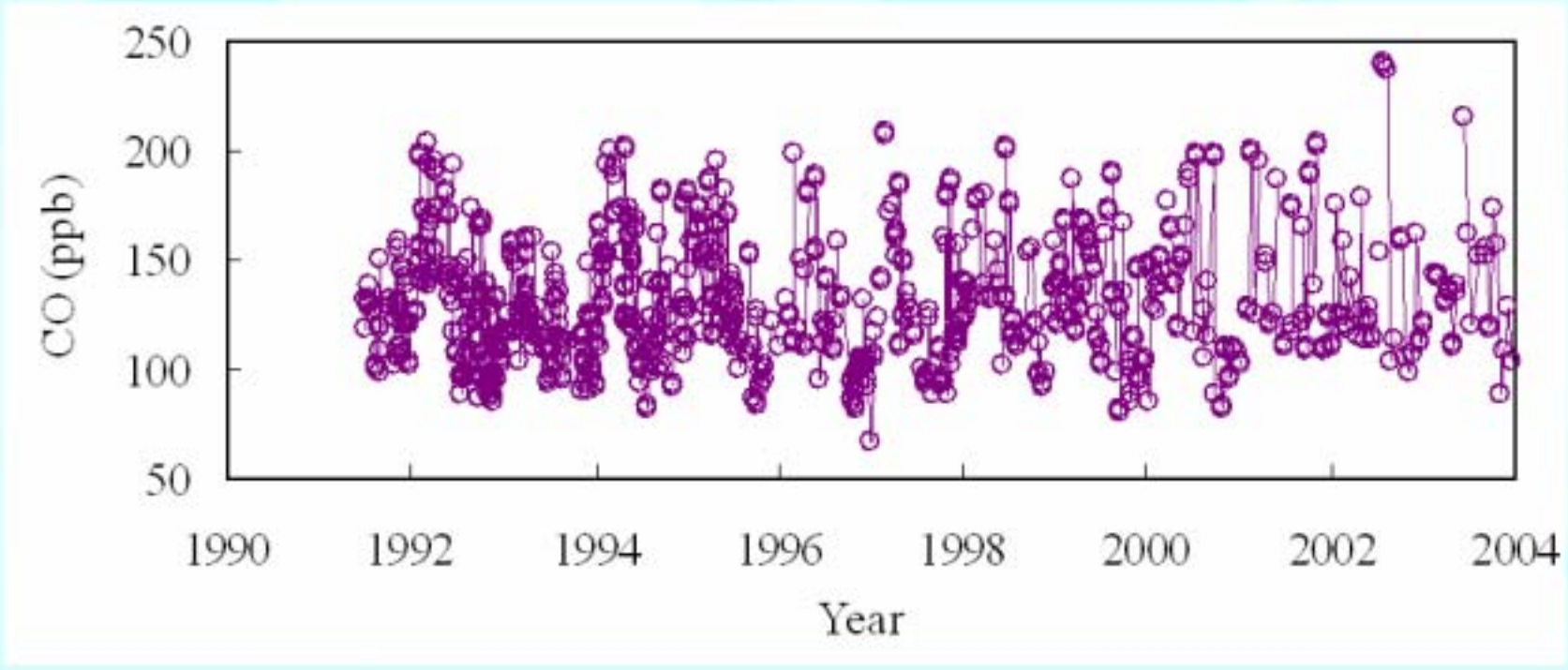
- Coal
- Oil

Transportation

- diesel
- gasoline

Some OC-EC Observations in China

CO, Waliguan


250
200
150
100
50
CO (ppb)
1990
1992
1994
1996
1998
2000
2002
2004
Year

Global & Regional GAW Stations, CAWAS, CMA

Akdala
(47° 06′N, 87° 58′E, 562m asl)

Shangdianzi
(117.07° E, 40.39° N, 293.9 m asl)

Longfengshan
(127.6 ° E, 44.73 ° N, 310 m asl)

Waliguan
(36.3° N, 100.9° E , 3810m asl)

Zhuzhang
(27° 30′N, 99° 0.5′E, 3580 m asl)

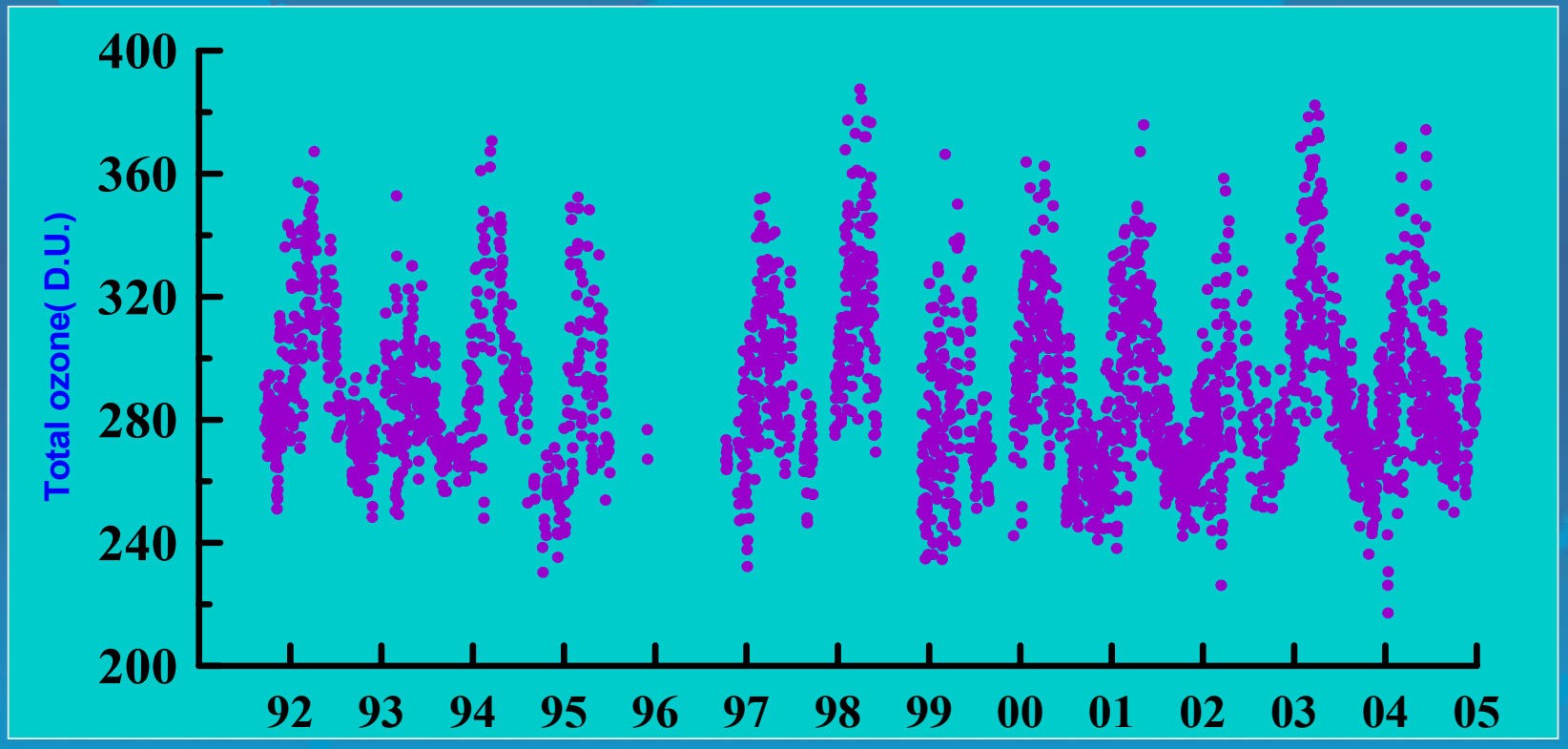
Xianning (31° 24.5′ N, 112° 59.5′ E , 862 m asl)

LinAn
(119.73 ° E, 30.3 ° N, 138m asl)

Ozone

地基臭氧总量在瓦里关山的观测

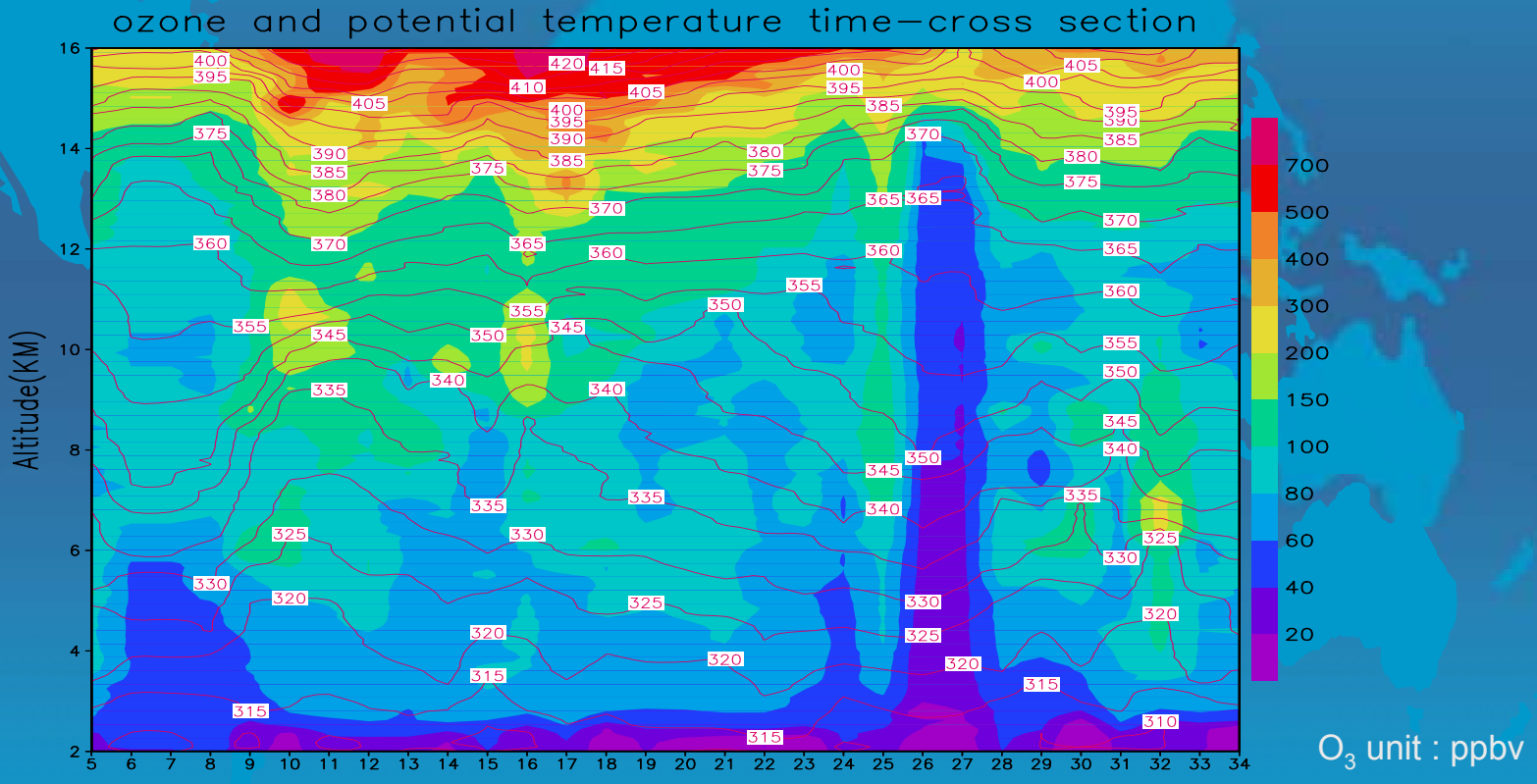
Surface O_3 (1991-2004)



臭氧垂直分布的变化(从地面到18公里)

Column Ozone (surface to 18 km)

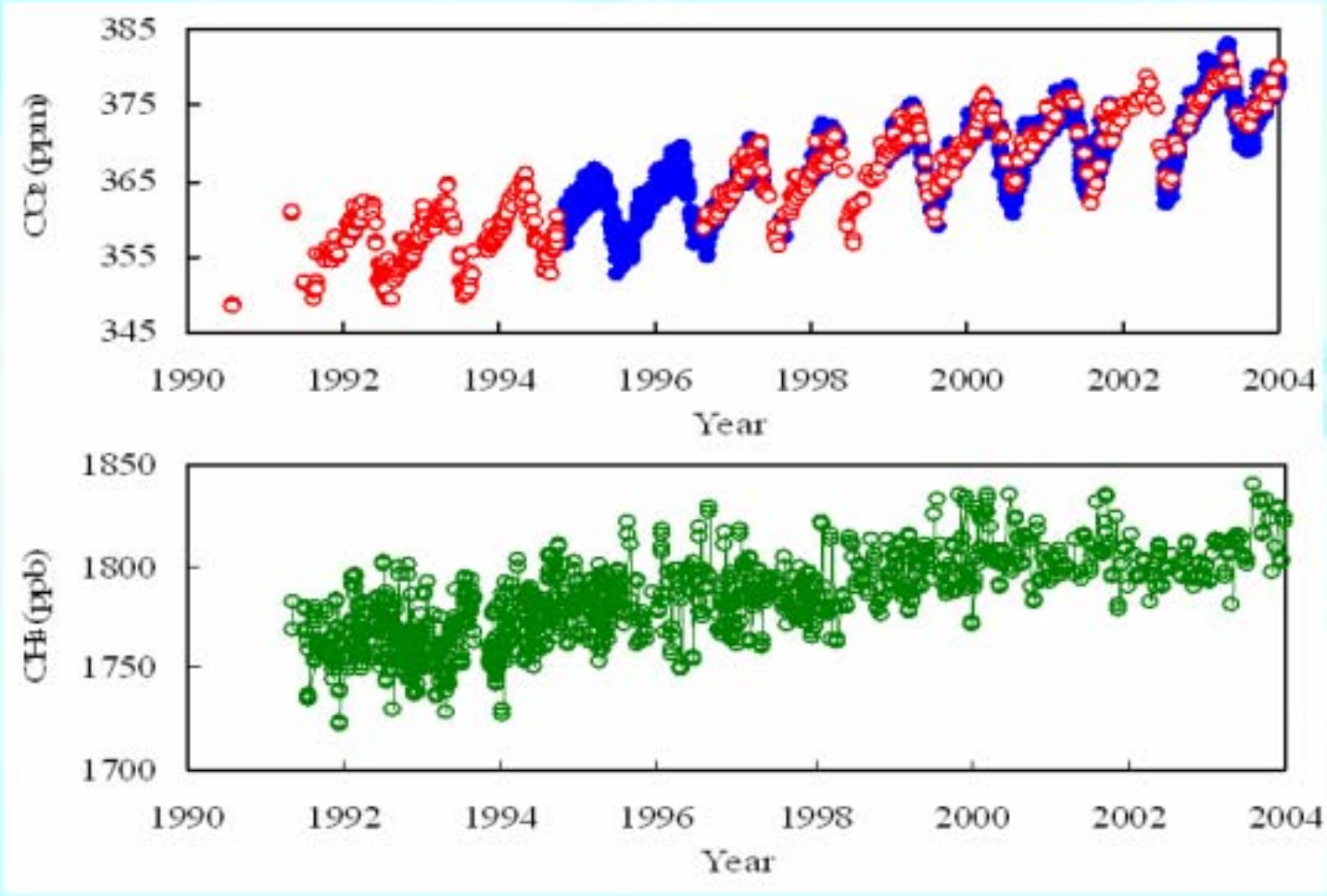
(7 July – 3 August 1996, Xi-Ning)



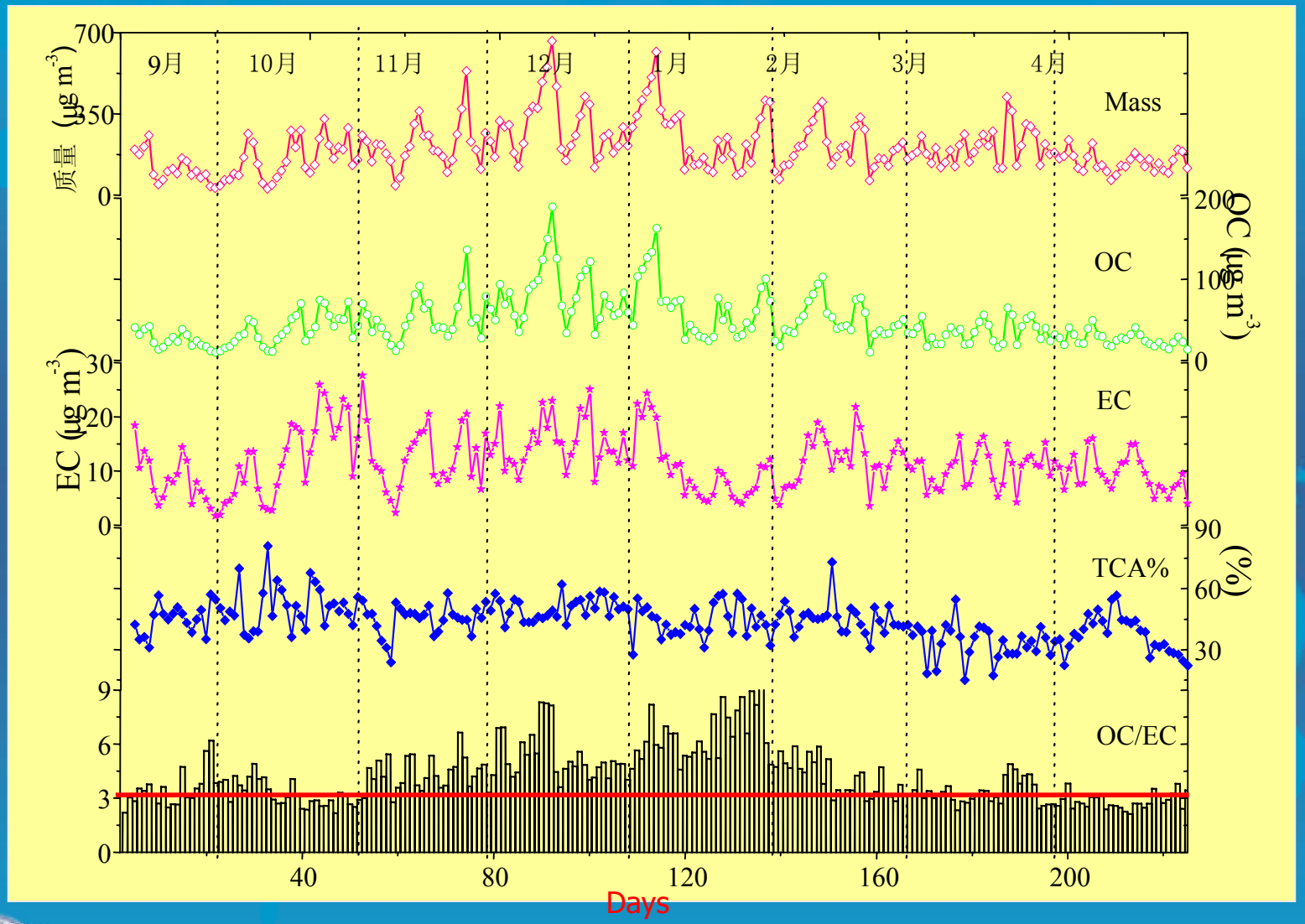
O_3 unit : ppbv

(对流层臭氧,位温在天气尺度的垂直演变过程)

GHGs, Waliguan



Some BC (EC) & OC Results



2003年9月13日至2004年4月30日西安（总观测日223天）

13 Sept. 2003 – 30 April 2004 XiAn (Total observation days: 223)


阿克达拉
哈密
塔中
敦煌
额济纳旗
民勤
锡林浩特
朱日和
龙凤山
大连
惠民县
榆社
西安
拉萨
绵阳
大洪山
合肥
福安
全球本底站（1个）
已建区域本底站（3个）
拟建区域本底站（3个）
沙尘暴一期站点（10个）
中韩合作沙尘暴站点（4个）
新建站点（9个）

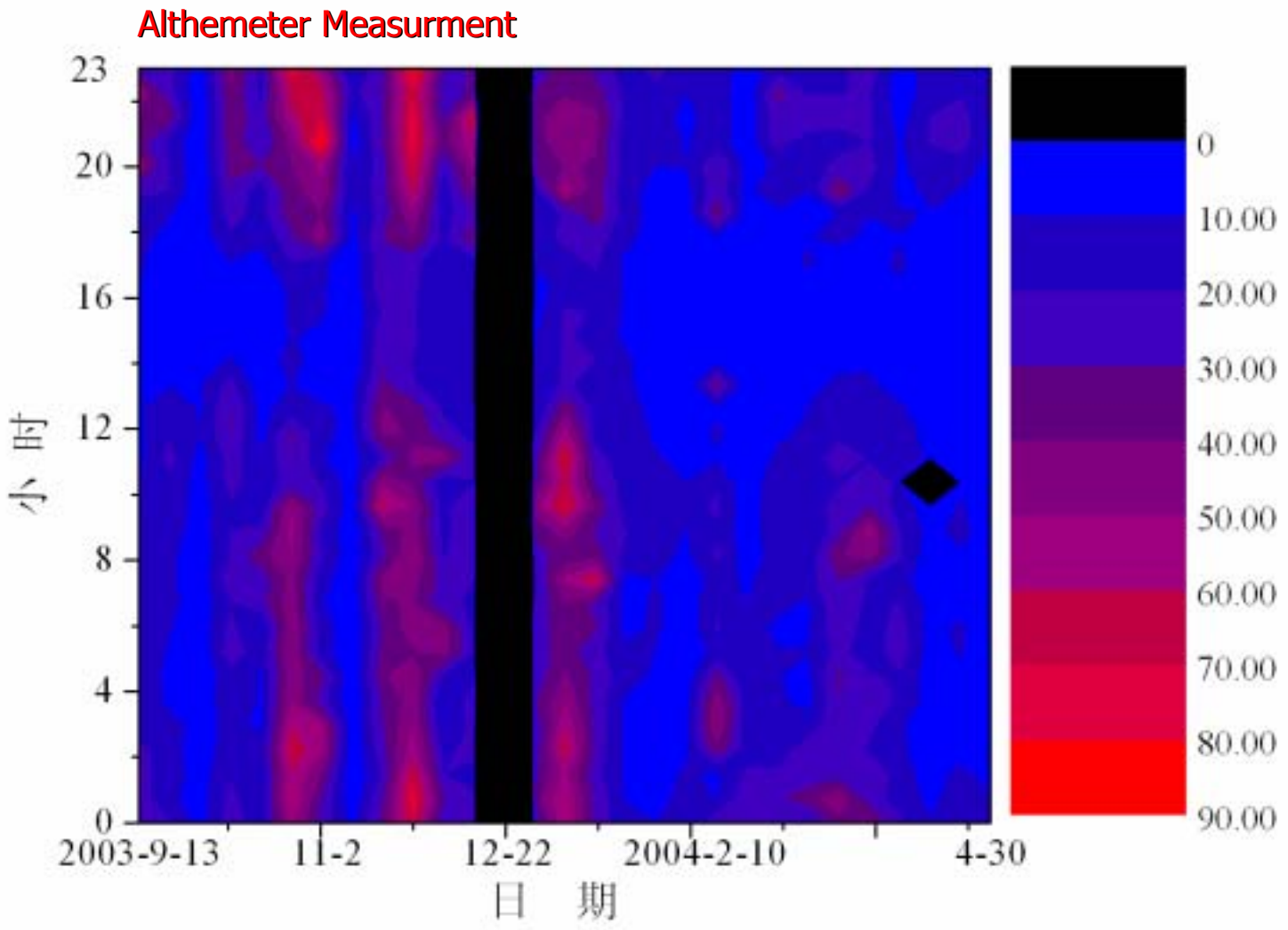
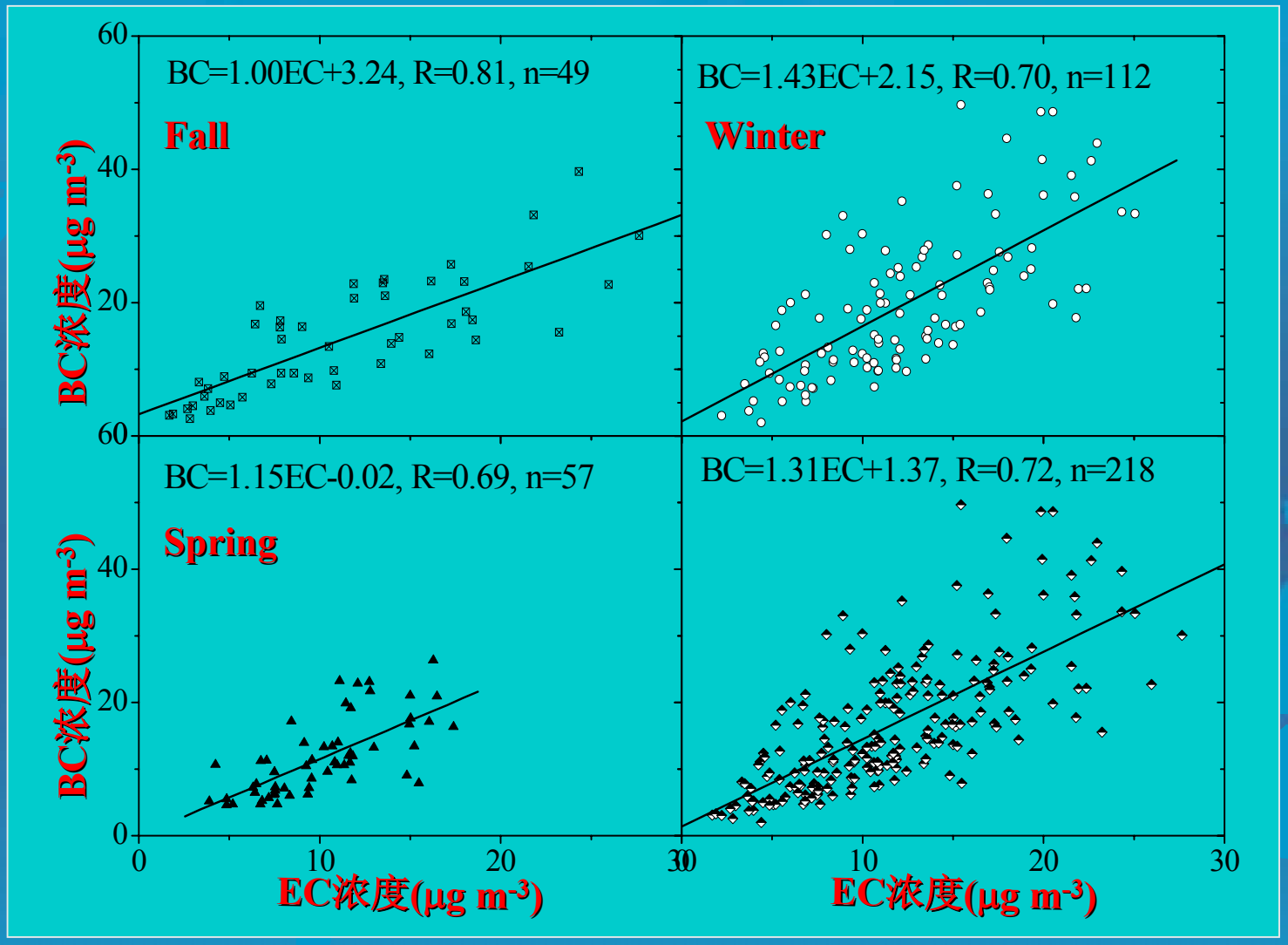


图3-1 2003年9月13日-2004年4月30日每5分钟的BC浓度变化序列图

（BC浓度单位μg m^{-3}）

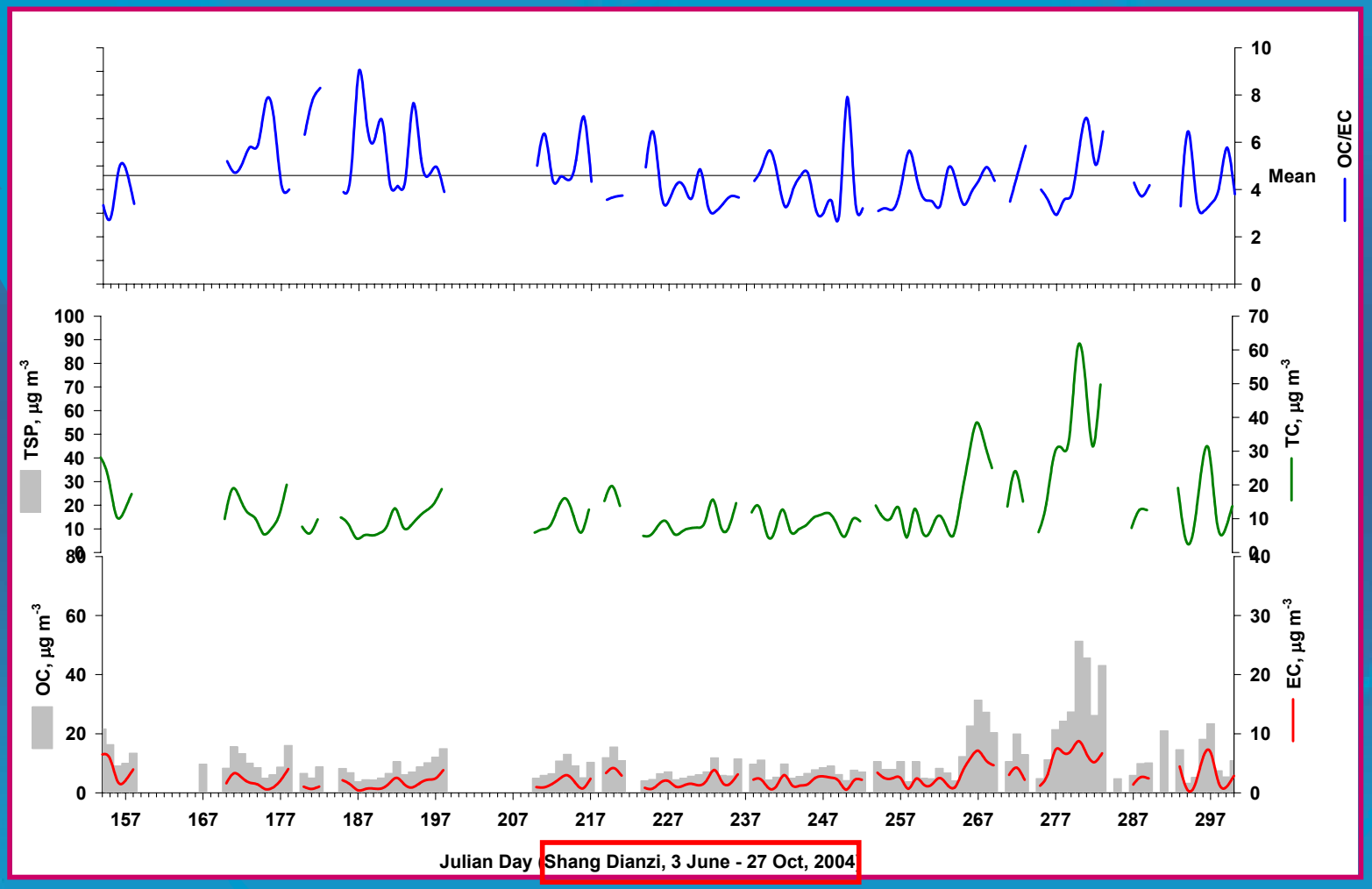
(5 min-averaged BC variations at XiAn (13 Sept., 2003) – 30 April, 2004)



EC vs BC

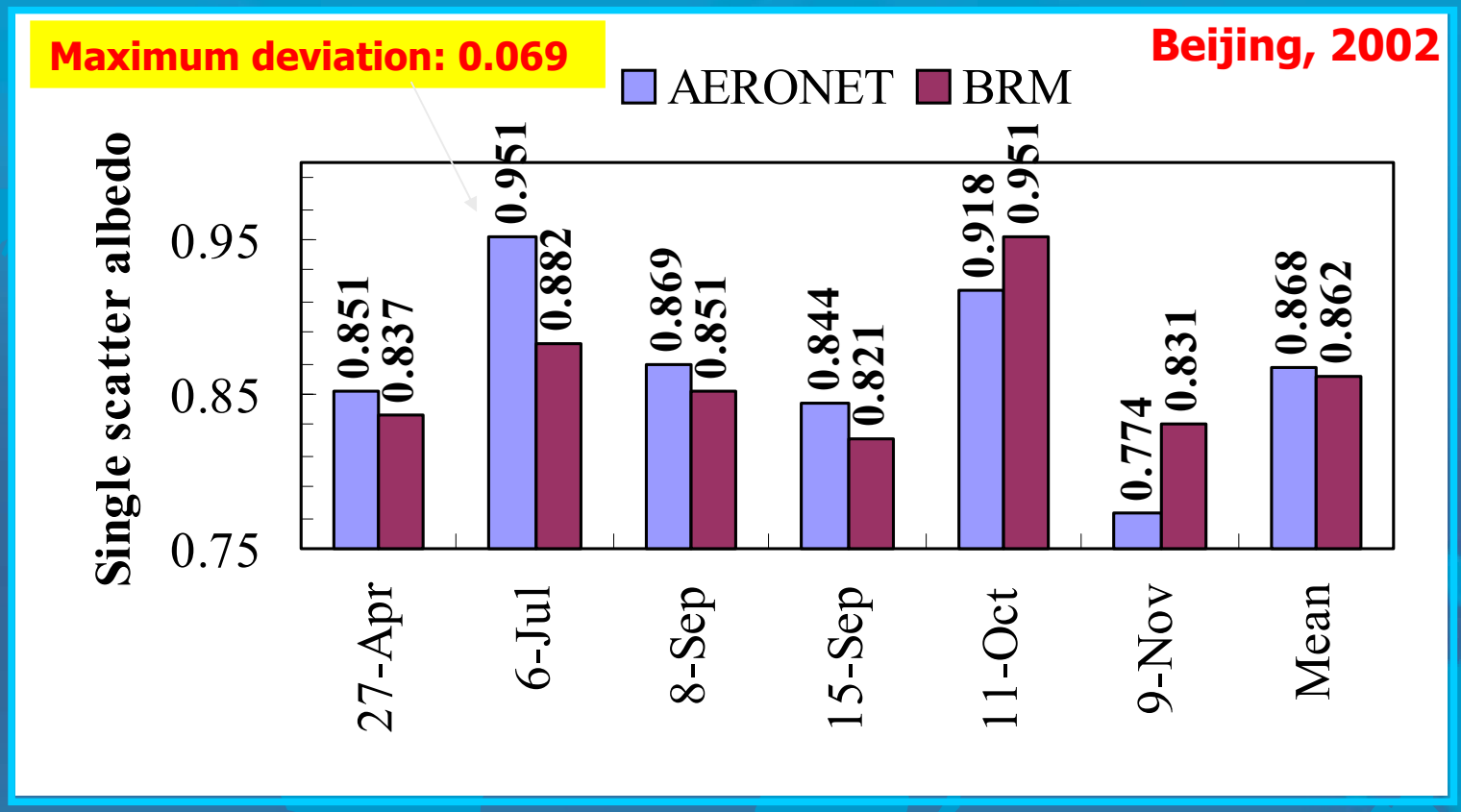
(XiAn, Fall of 2003 to Spring of 2004)

OC-EC (Shang-Dian-Zi)



CMA Aethalometer Network (2005)

中国气象局微粒吸收计网

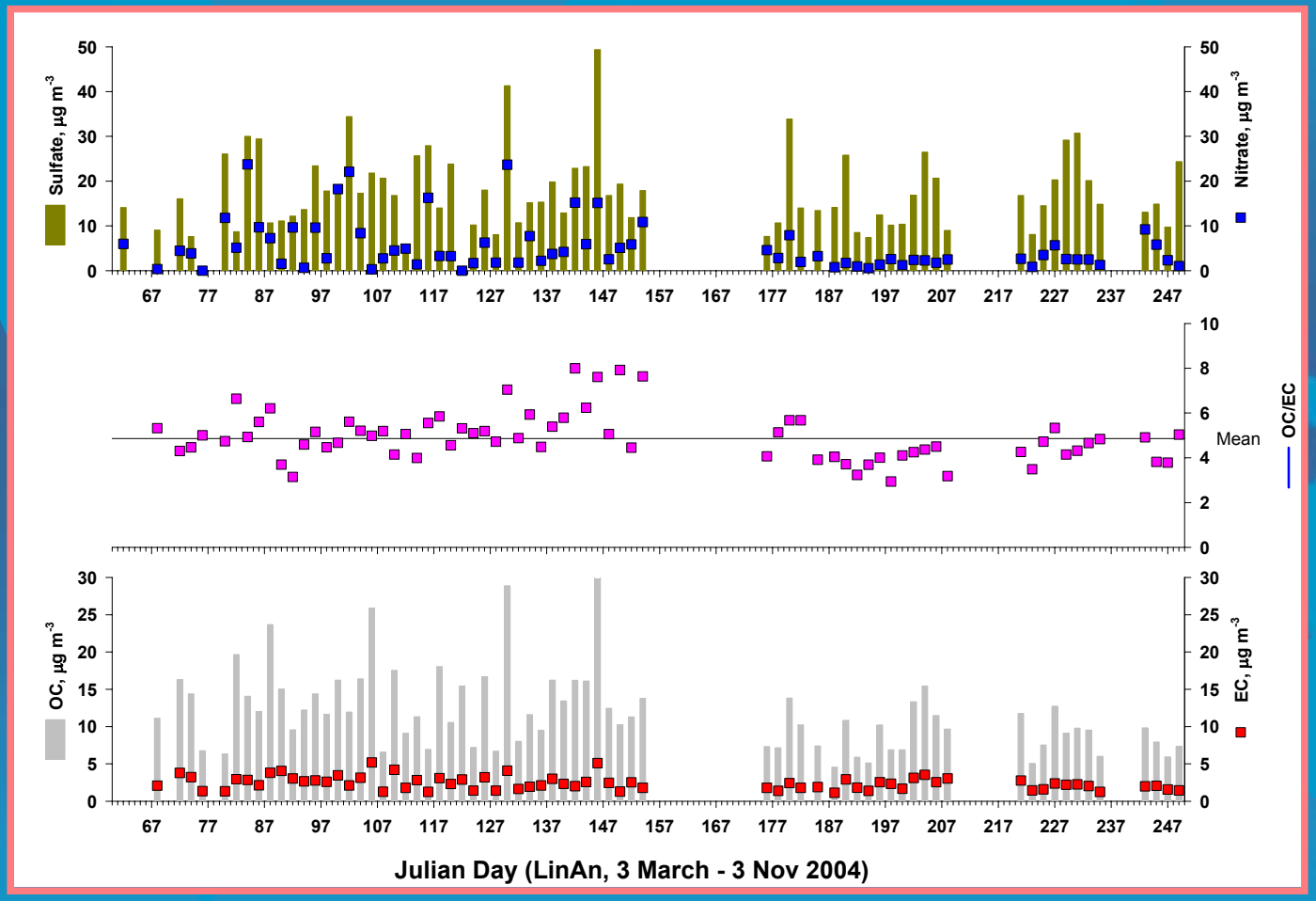


Comparisons between daily-mean SSA from AERONET (Nakajima's method) and SSA from BRM (Qiu et al's method)

Deviation of total-mean SSAs: 0.006!

Qiu's group

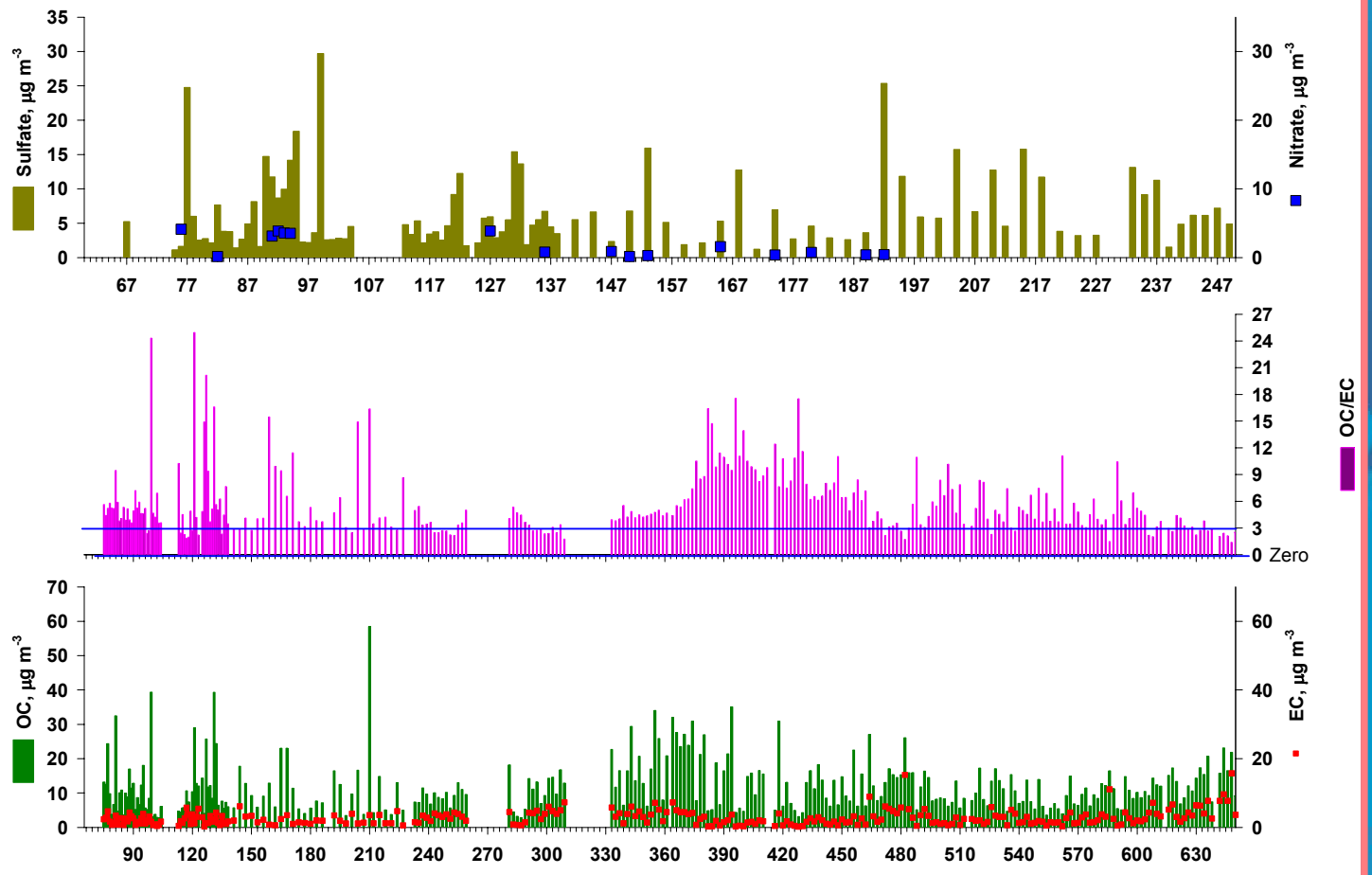
OC-EC-Sulfate-Nitrate (LinAn)



CMA Aethalometer Network (2005)

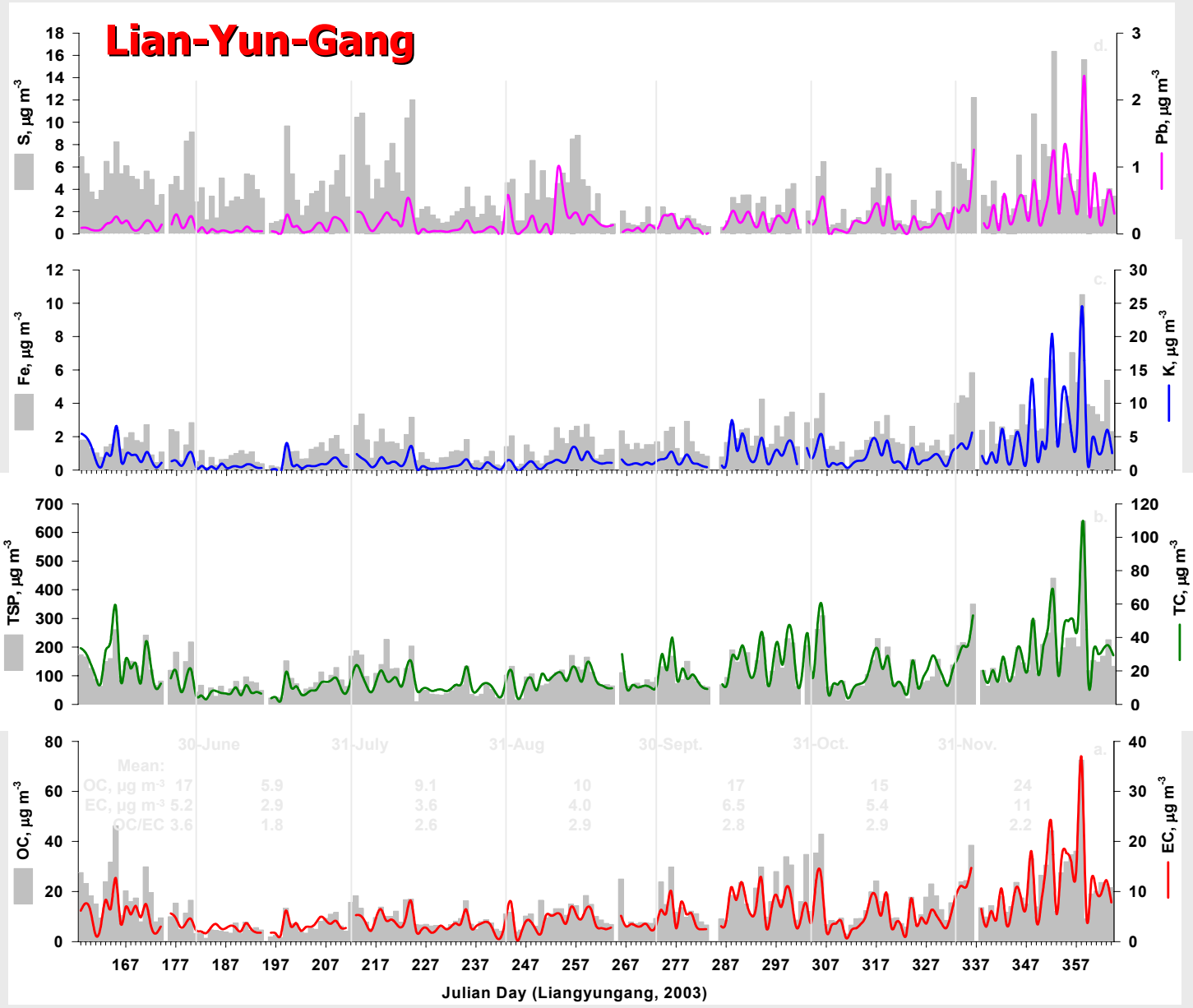
中国气象局微粒吸收计网

OC-EC-Sulfate-Nitrate (Yulin)

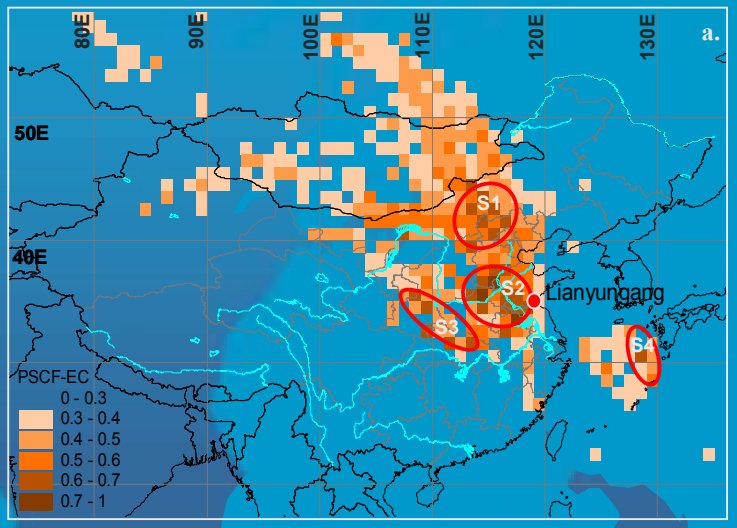


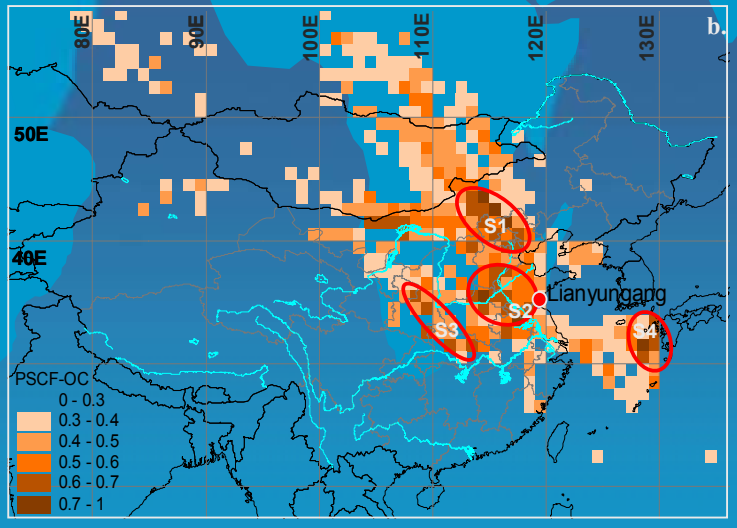
CMA Aethalometer Network (2005)

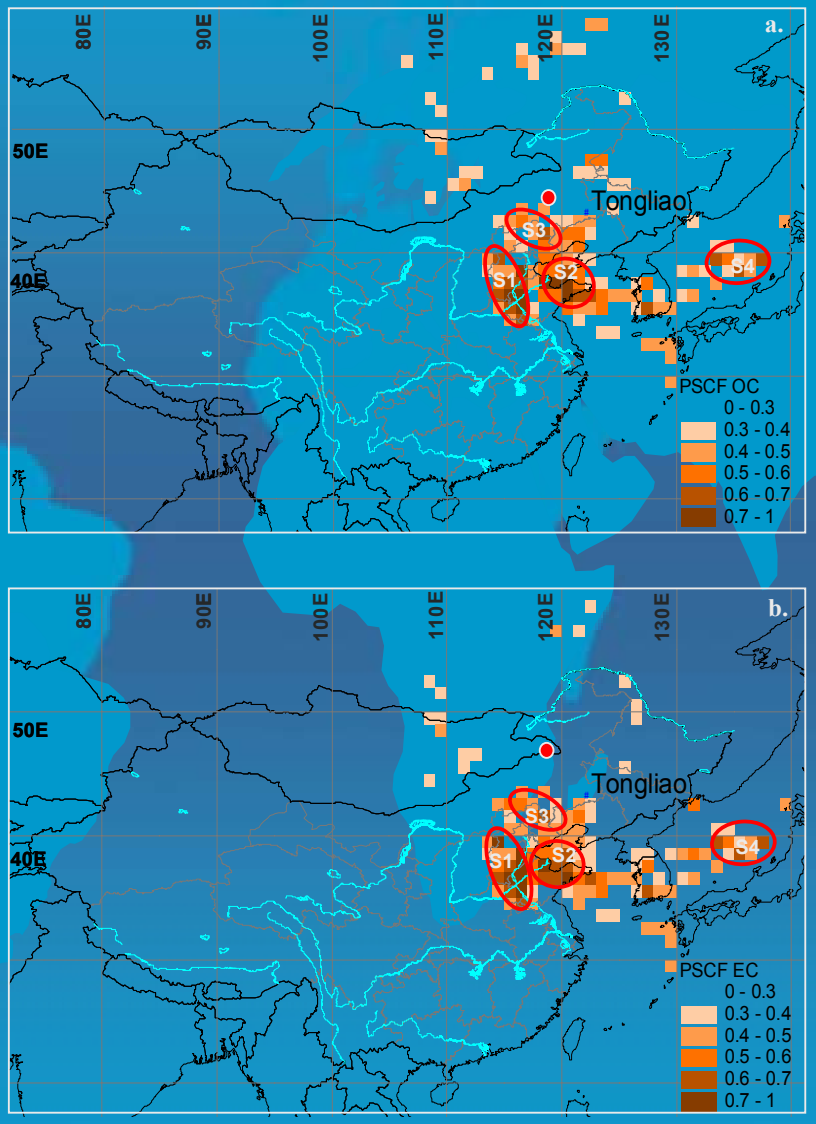
中国气象局微粒吸收计网

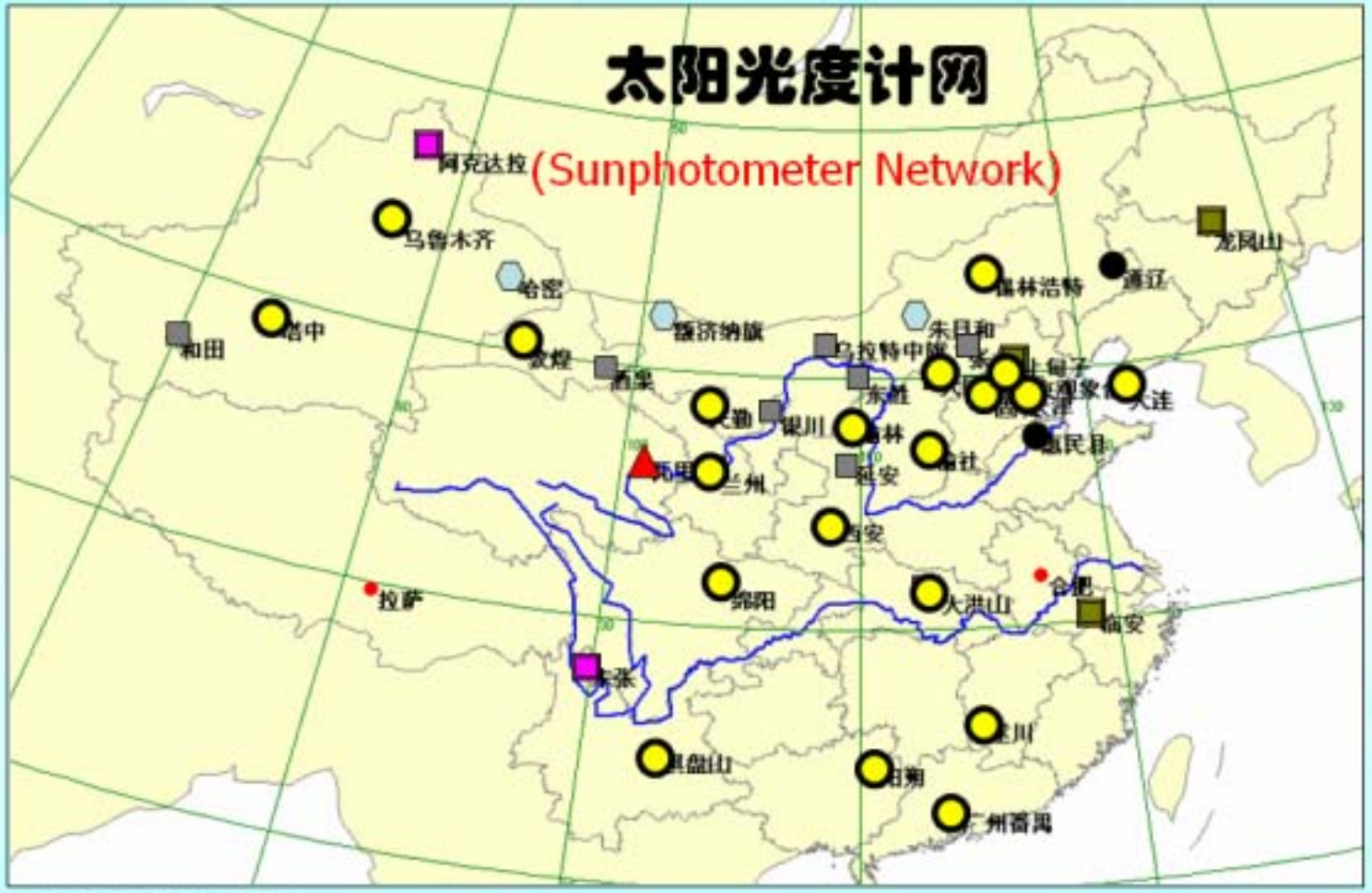

Lian-Yun-Gang
d.
S, μg m-3
Pb, μg m-3
c.
Fe, μg m-3
K, μg m-3
b.
TSP, μg m-3
TC, μg m-3
a.
OC, μg m-3
EC, μg m-3
30-June
31-July
31-Aug
30-Sept.
31-Oct.
31-Nov.
Mean:
OC, μg m-3 17 5.9 9.1 10 17 15 24
EC, μg m-3 5.2 2.9 3.6 4.0 6.5 5.4 11
OC/EC 3.6 1.8 2.6 2.9 2.8 2.9 2.2
Julian Day (Liangyungang, 2003)

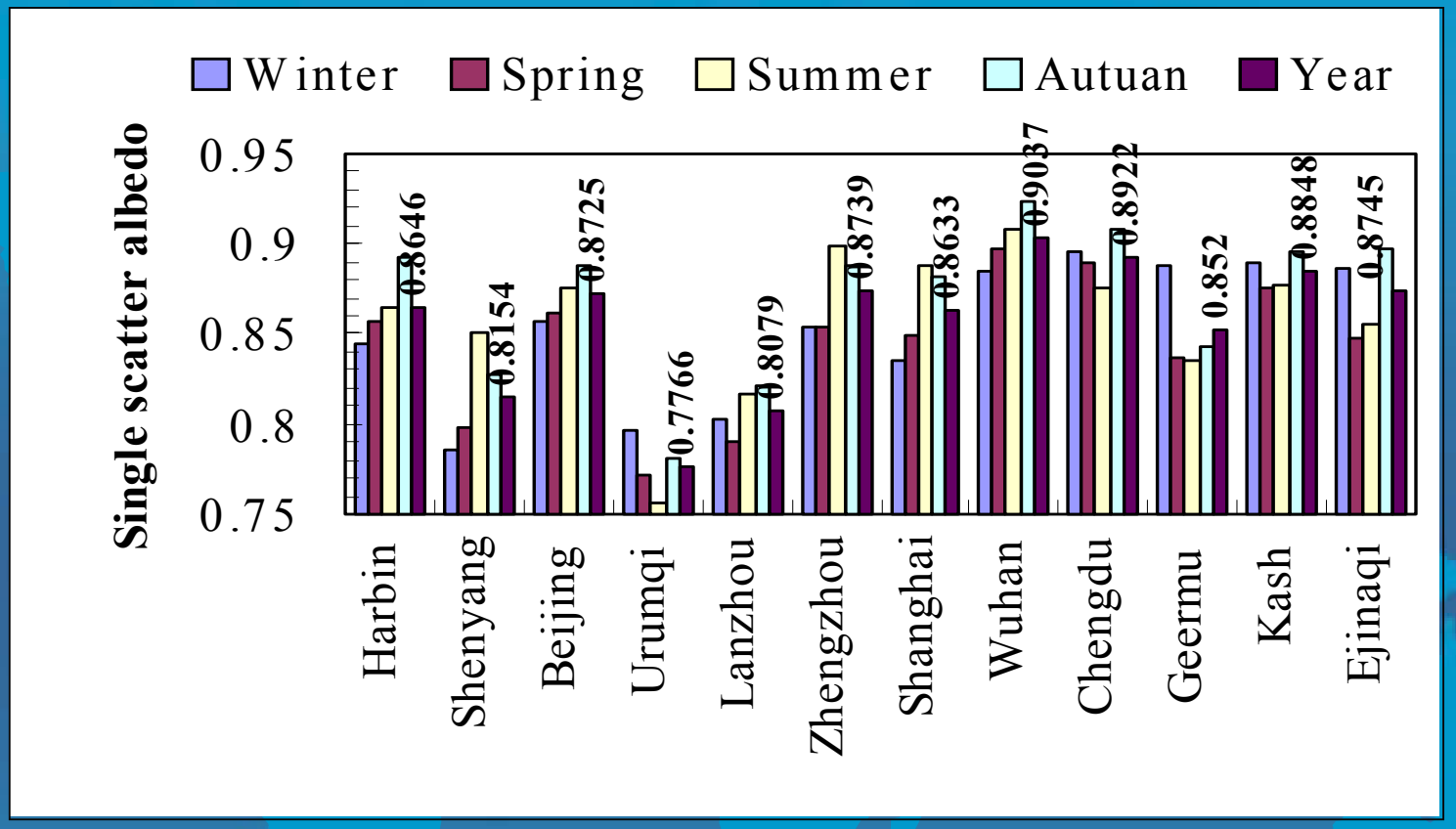

全球本底站（1个）
已建区域本底站（3个）
拟建区域本底站（3个）
沙尘暴一期站点（10个）
中韩合作沙尘暴站点（4个）
新建站点（9个）
阿克达拉
哈密
塔中
额济纳旗
敦煌
民勤
乌里雅
拉萨
绵阳
大张
棋盘山
西安
榆林
榆社
木日和
大连
龙凤山
大洪山
合肥
福安
遂川
阳朔
广州番禺


a.
80E
90E
100E
110E
120E
130E
50E
40E
S1
S2
S3
S4
Lianyungang
PSCF-EC
0 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 1


b.
80E
90E
100E
110E
120E
130E
50E
40E
S1
S2
S3
S4
Lianyungang
PSCF-OC
0 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 1


a.
80E
90E
100E
110E
120E
130E
50E
40E
Tongliao
S1
S2
S3
S4
PSCF OC
0 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 1
b.
80E
90E
100E
110E
120E
130E
50E
40E
Tongliao
S1
S2
S3
S4
PSCF EC
0 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 1


太阳光度计网
(Sunphotometer Network)
阿克达拉
乌鲁木齐
哈密
和田
若中
敦煌
额济纳旗
酒泉
银川
兰州
西安
绵阳
拉萨
大洪山
合肥
临安
龙凤山
通辽
朱日和
乌拉特中旗
大连
延安
太阳光度计站点
(Sunphotometer Stations)



- Total mean SSA：**0.864**
- **Beijing ： 0.872**
- **Shenyang：0.815； Urumqi：0.777**
- **Small SSA during winter over some sites such as Shenyang**

Qiu's group

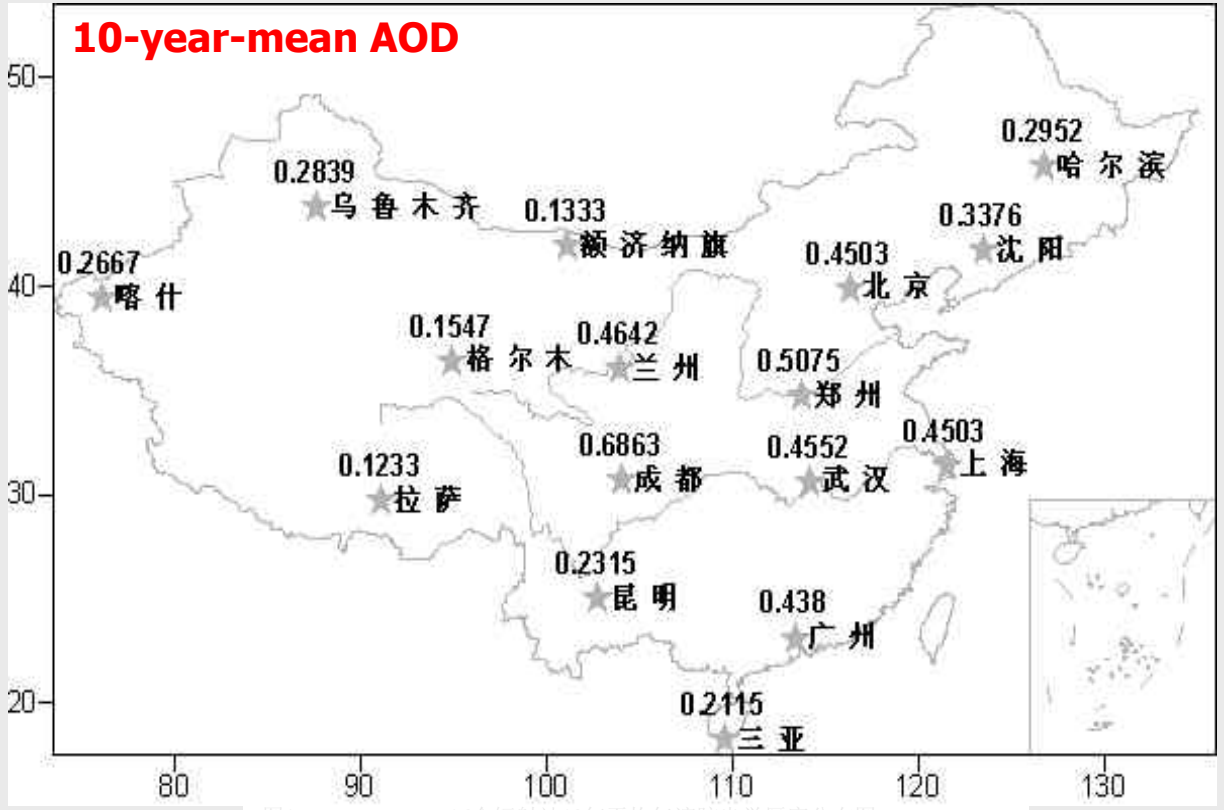


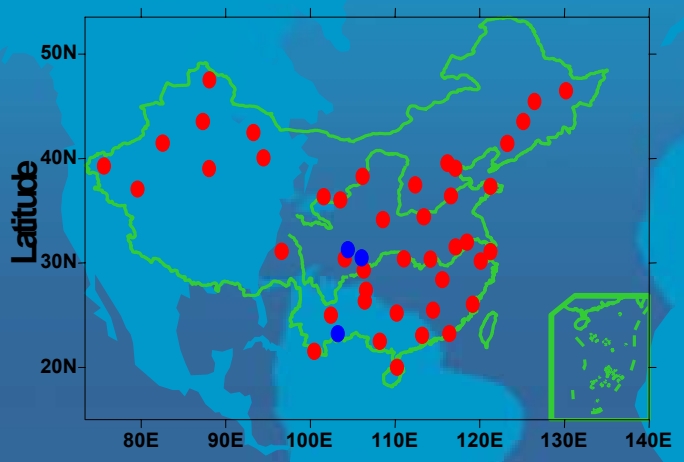
图1 16个辐射站10年平均气溶胶光学厚度分布图

年份	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AOD	0.363	0.336	0.320	0.354	0.341	0.331	0.339	0.364	0.338	0.345

16-site-mean yearly-mean AOD (750nm): 0.32～0.36

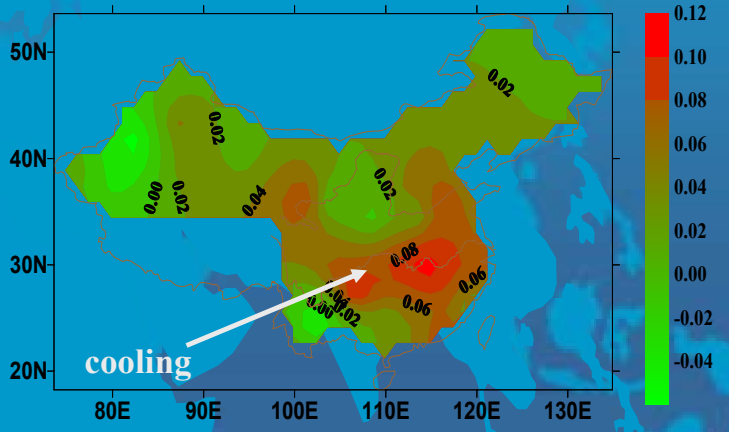
Qiu et al., 2001

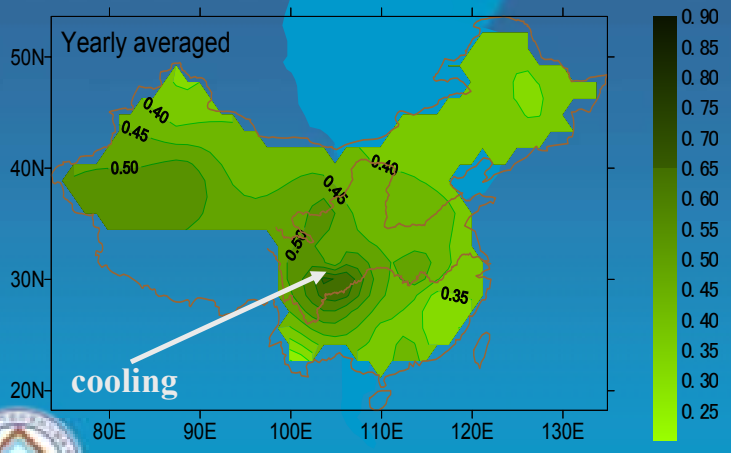
The distribution of yearly mean (1961-1990) aerosol optical depth over China



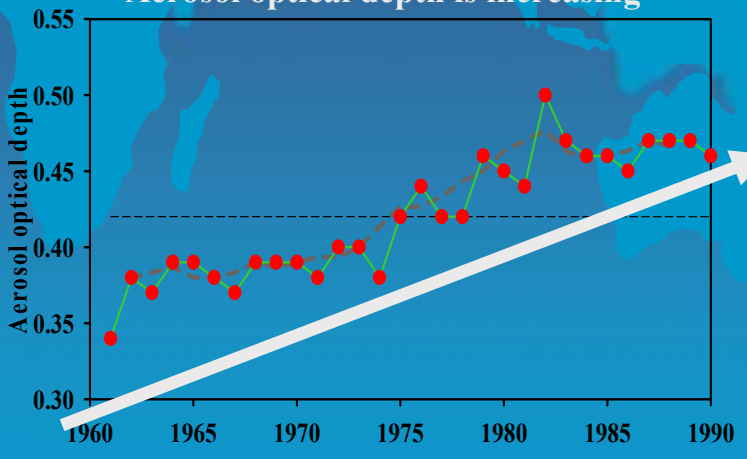
Luo et al. (2001)

The linear trend *10 (yr^{-1}) of AOD over China mainland



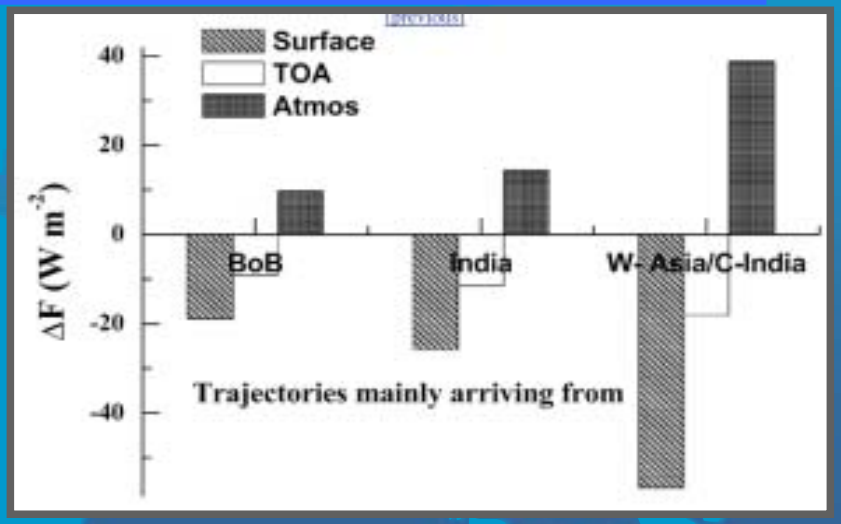


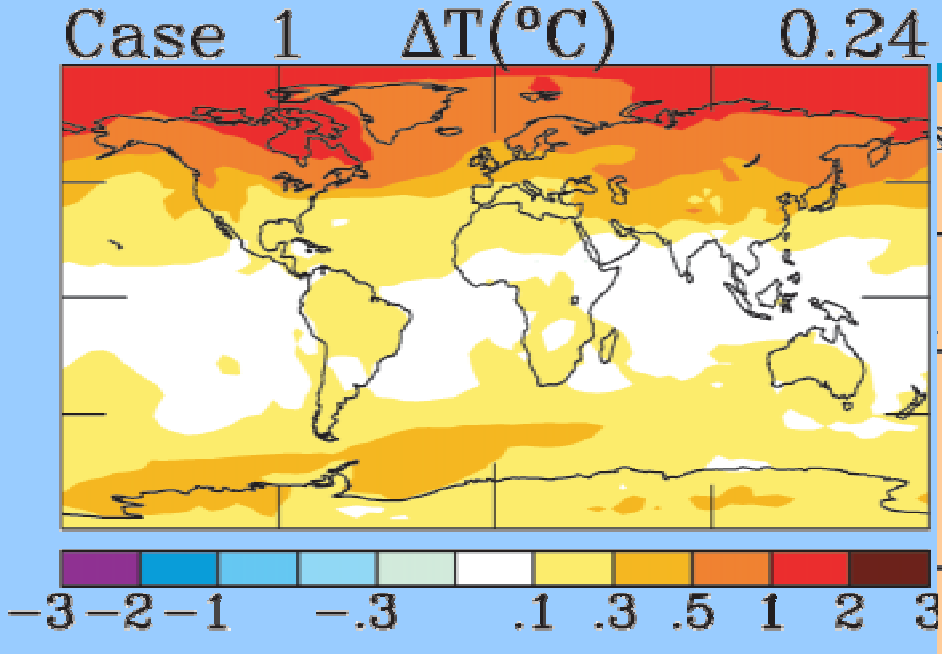
Aerosol optical depth is increasing



Long-range climate effects of Aerosols

Based on measurements during the inter-monsoon period over India (South-west coast) (Moorthy et al. 2005).



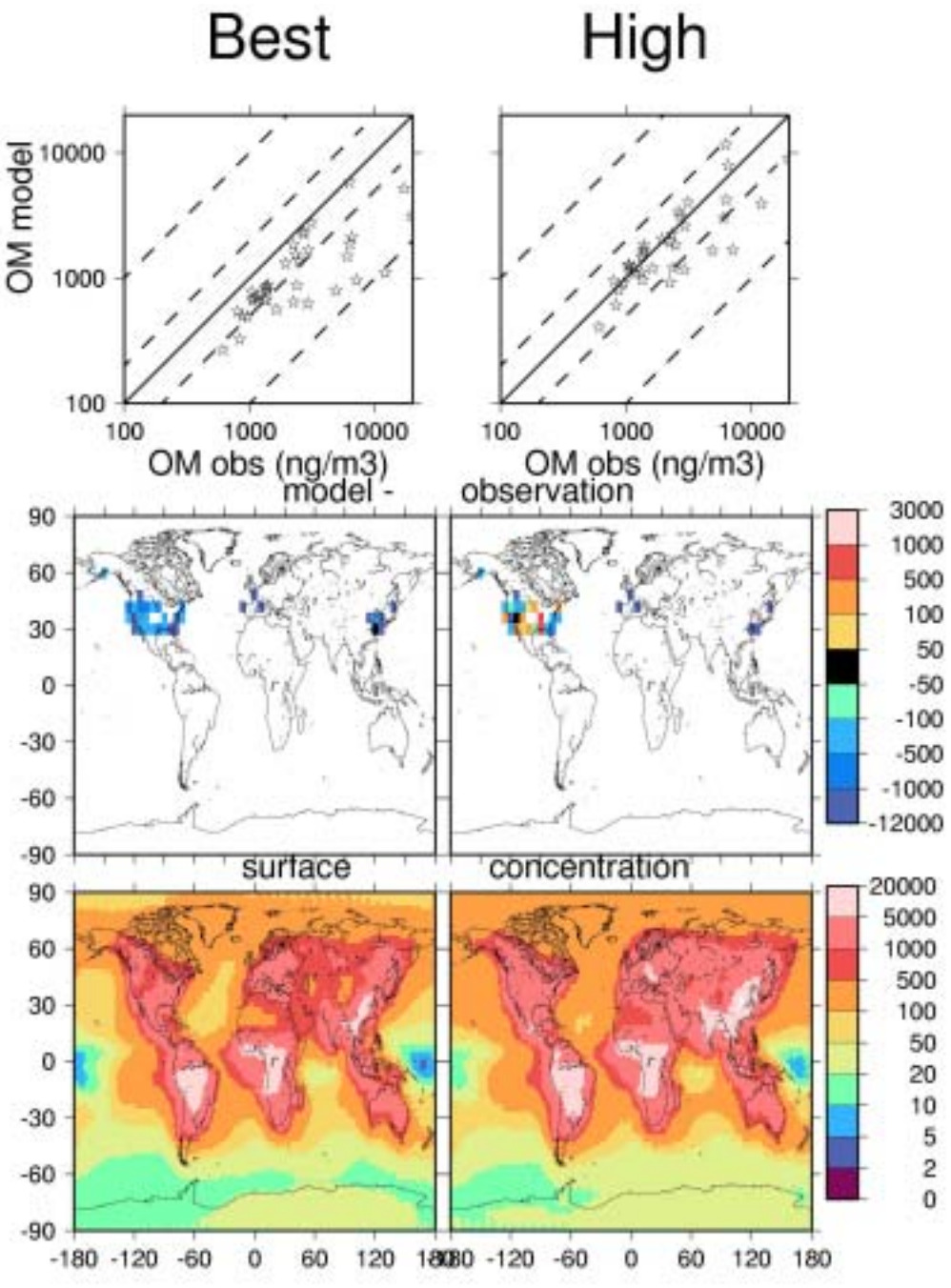


Hansen and Nazarenko (2004)

sions and Contribution

BC Emissions, %[a]	BC Arctic τ, %
44	30
10	14
8	11
4	12

(Koch and Hansen, 2005)



OC model performance

Model vs annual average surface concentration:

Model low by > factor of 2

Source: Dorothy Koch

Questions on Aerosol Issues

- Climate issue
- Environmental issue
- Secondary aerosol formation
- Natural and Anthropogenic Sources

Thank you!