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An Observational Study on Air Quality in Lanzhou China

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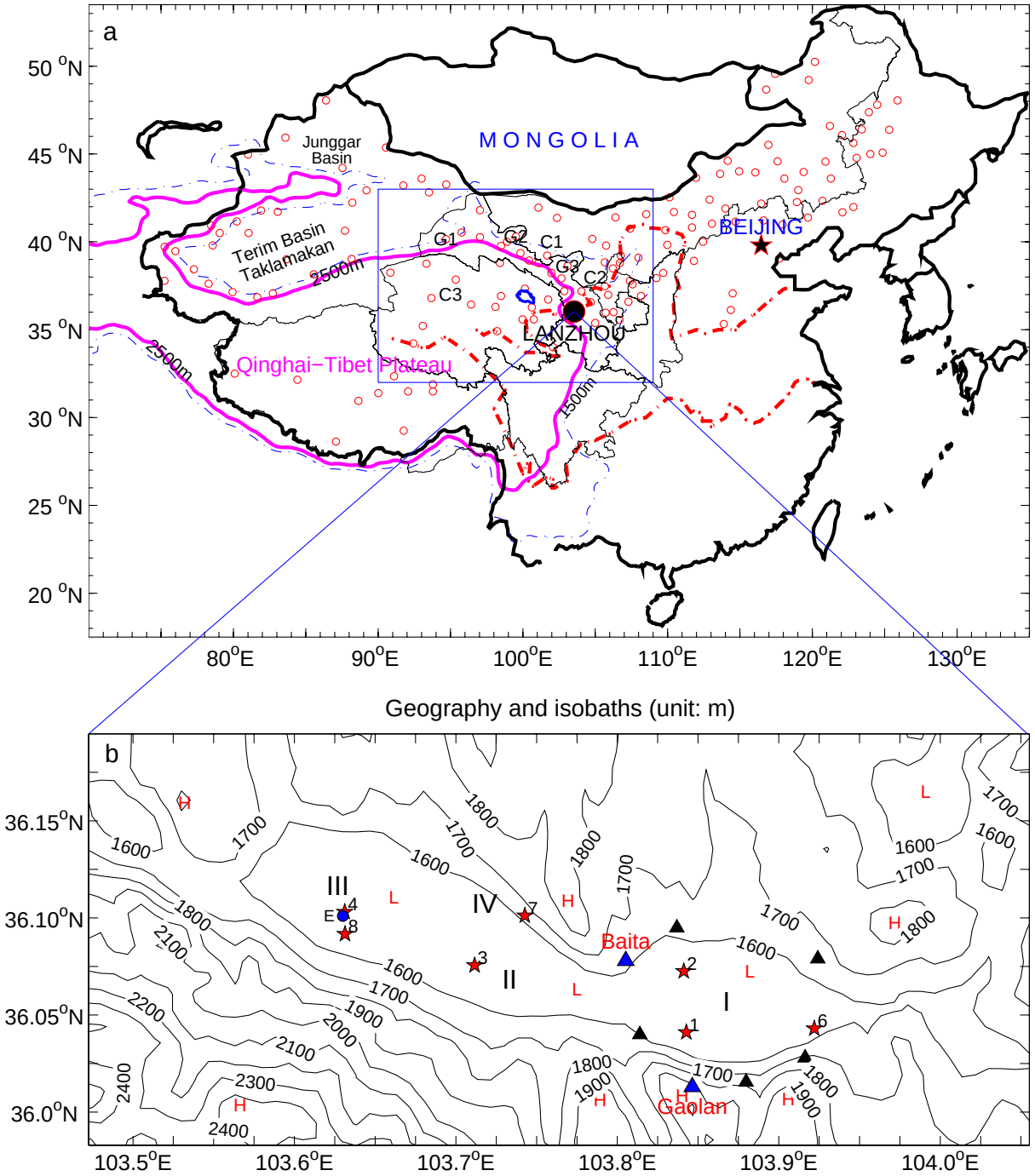
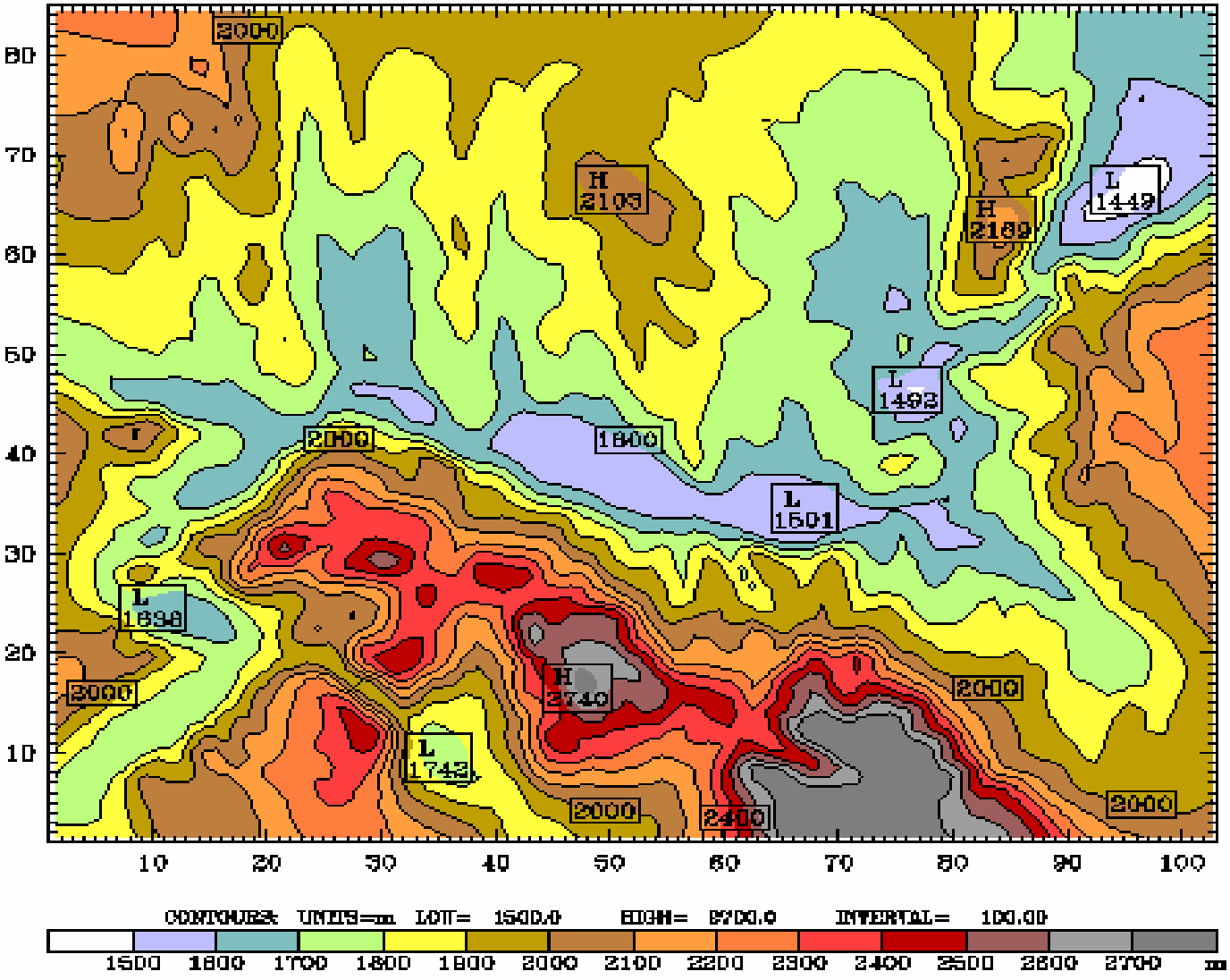
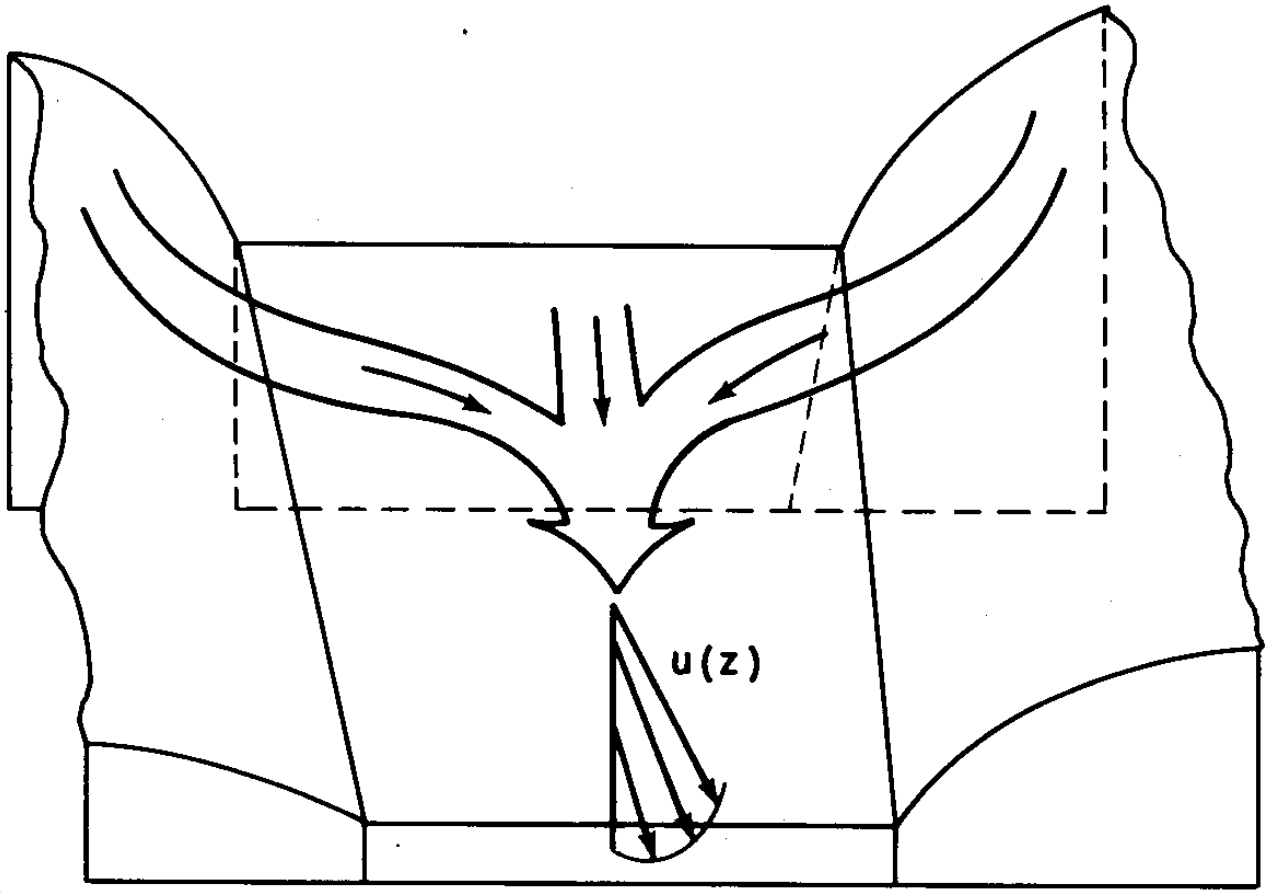

a
MONGOLIA
Junggar Basin
Terim Basin
Taklamakan
2500m
Qinghai−Tibet Plateau
BEIJING
LANZHOU
G1
G2
C1
G3
C2
C3
1500m
50 °N
45 °N
40 °N
35 °N
30 °N
25 °N
20 °N
80°E
90°E
100°E
110°E
120°E
130°E
Geography and isobaths (unit: m)
b
Baita
Gaolan
I
II
III
IV
E
36.15°N
36.10°N
36.05°N
36.0°N
103.5°E
103.6°E
103.7°E
103.8°E
103.9°E
104.0°E

Topography around Langzhou, China



Mountain-Valley Wind (at Night or in Winter)



Factors Affecting Air Quality

- Meteorological Conditions

  Stable stratification especially Inversion

  Low Winds

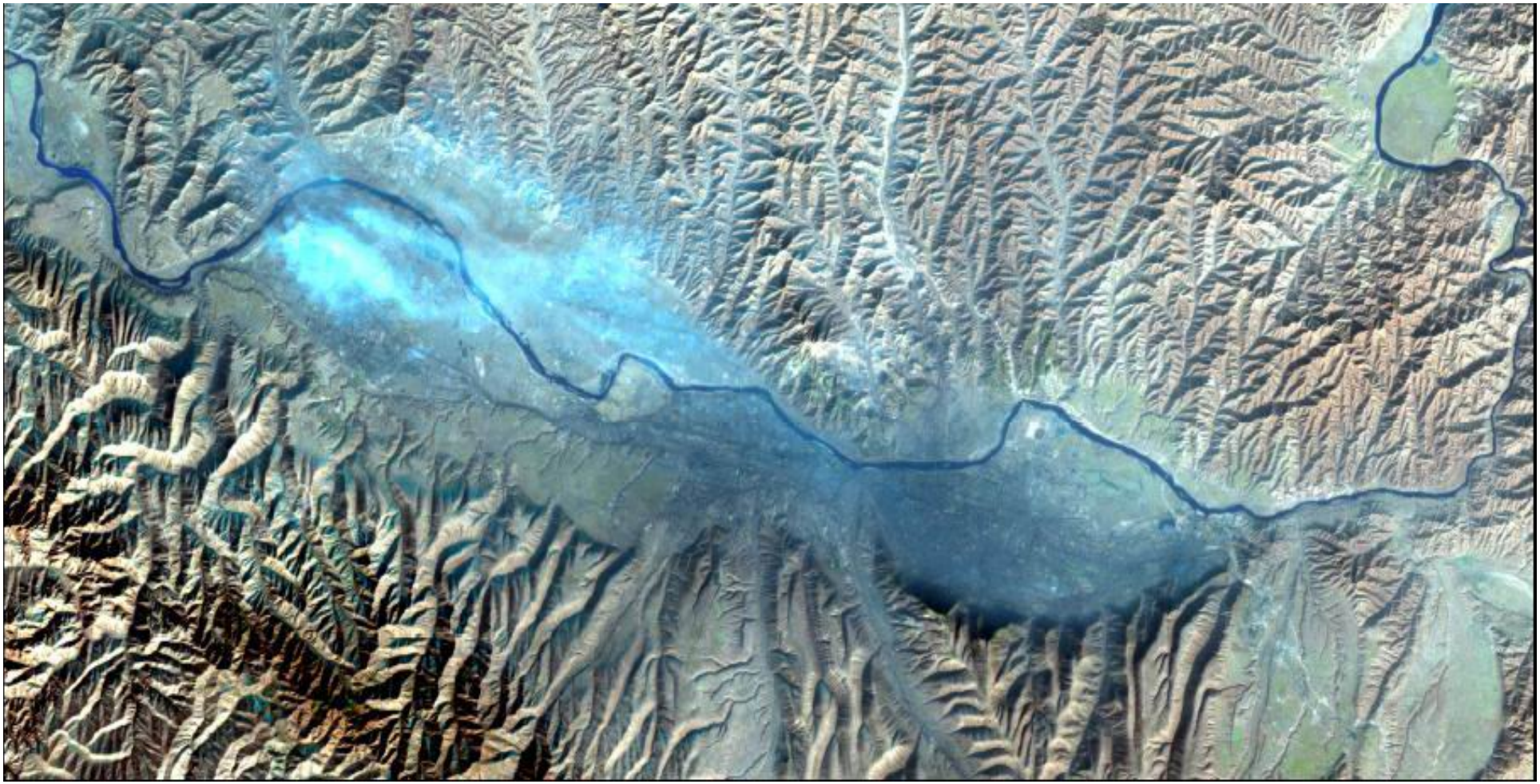
  Mountain-Valley Circulation

  Dust Storms

- Pollution Sources

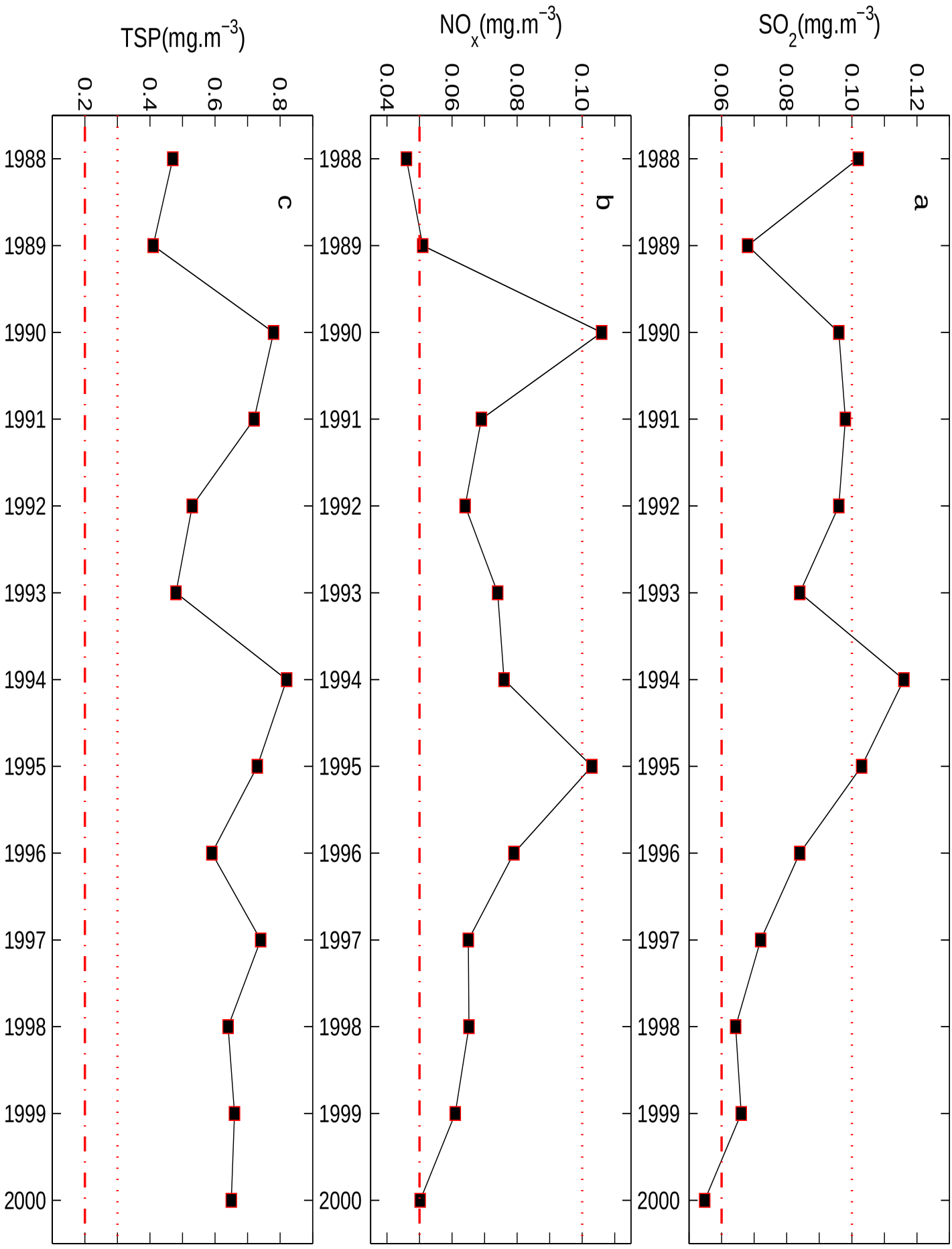
Lanzhou – One of the Most Polluted Cites in China

LANDSAT-TM imagery representing air pollution on 3 January 2001.

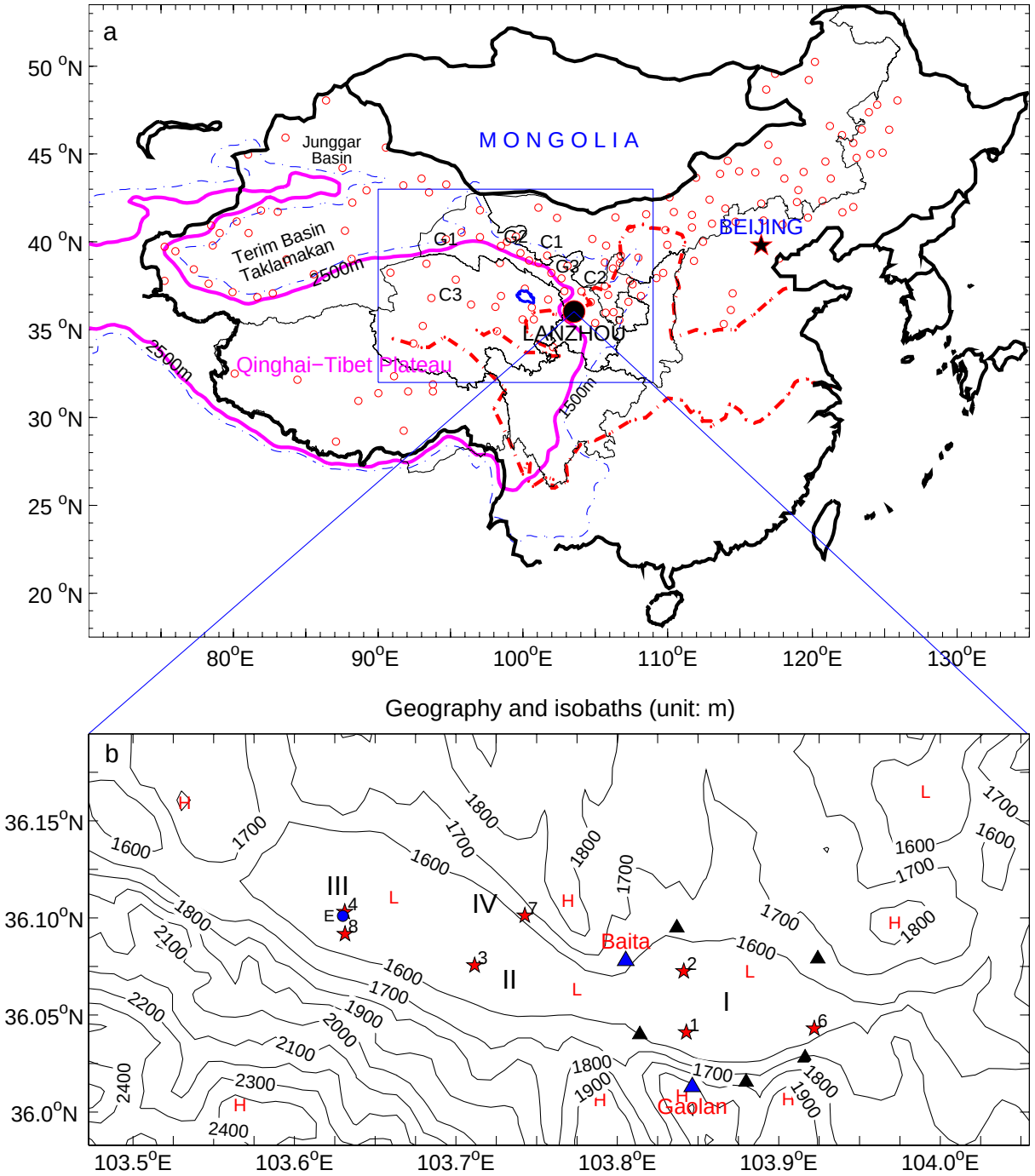


Criteria for Annual Mean Concentrations (mg/m^3) – Chinese EPA

Level of Criterion	SO_2	NOx	NO_2	TSP	PM_{10}
1	0.02	0.03	0.02	0.08	0.04
2 commercial /Residential	0.06	0.05	0.04	0.2	0.10
3 Industrial	0.10	0.10	0.08	0.3	0.15


TSP(mg.m^{-3})
NO$_x$(mg.m^{-3})
SO$_2$(mg.m^{-3})
0.2
0.4
0.6
0.8
0.04
0.06
0.08
0.10
0.06
0.08
0.10
0.12
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
c
b
a

Intensive Observation
Oct 1999 – Apr 2001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103.6°E
103.7°E
103.8°E
103.9°E
104.0°E

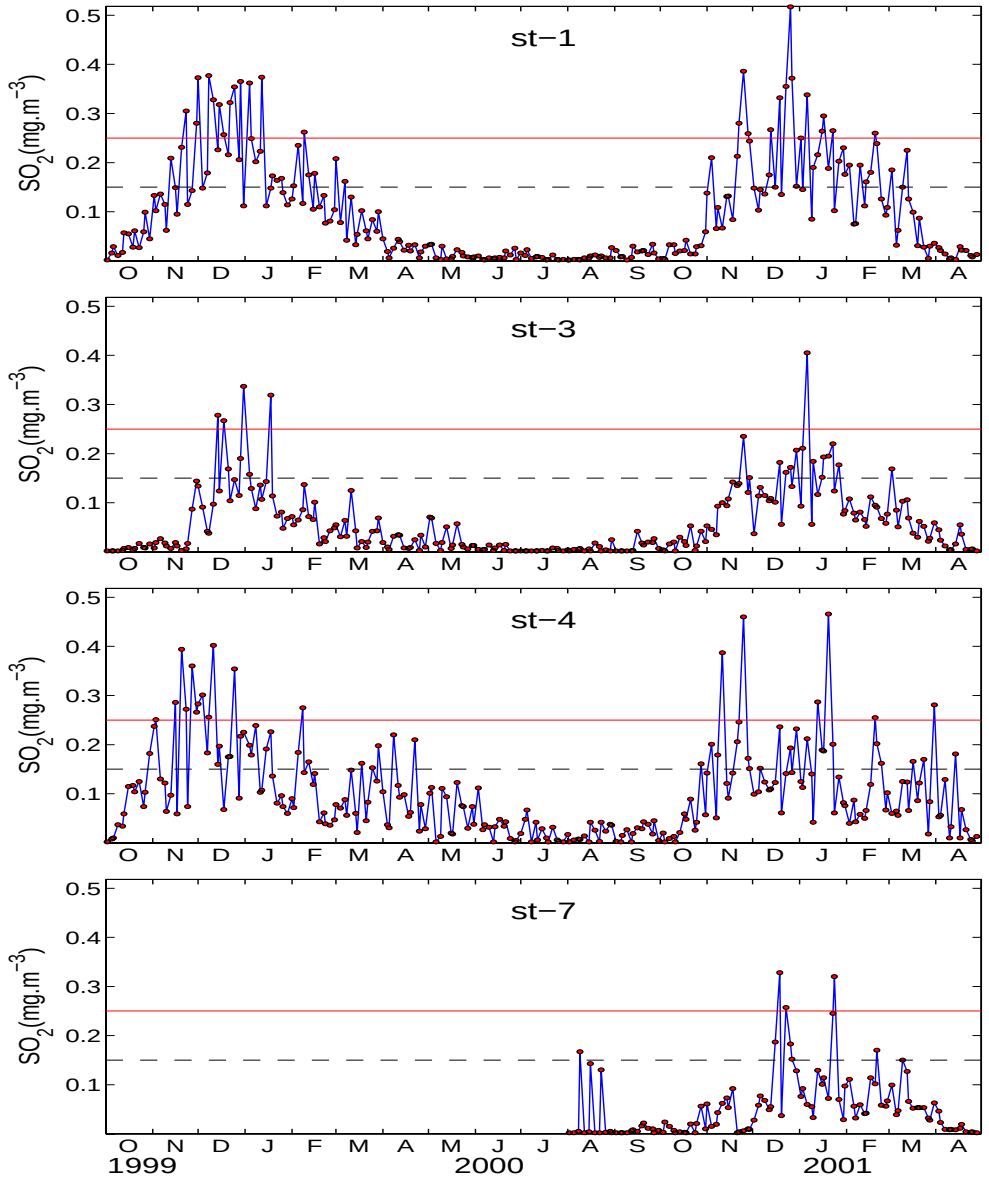
Location of observational stations and mean concentrations (mg m^{-3})

Site	Longitude E	Latitude N	Height (m)	Region	SO_2	NO_x	TSP
St-1*	103.84	36.04	25	Chengguan (District-1)	0.08	0.06	0.69
St-2	103.84	36.07	11	Chengguan (District-1)	0.03	0.04	0.57
St-3*	103.71	36.08	15	Qilihe (District-3)	0.05	0.05	0.74
St-4*	103.63	36.10	22	Xigu (District-2)	0.08	0.06	0.68
St-5	104.09	35.84	4	Yuzhong County	0.01	0.01	0.28
St-6	103.92	36.04	19	Chengguan (District-1)	0.02	0.03	0.56
St-7*	103.74	36.10	15	Anning (District-4)	0.04	0.05	0.52
St-8	103.63	36.09	4	Xigu (District-2)	0.06	0.05	0.54

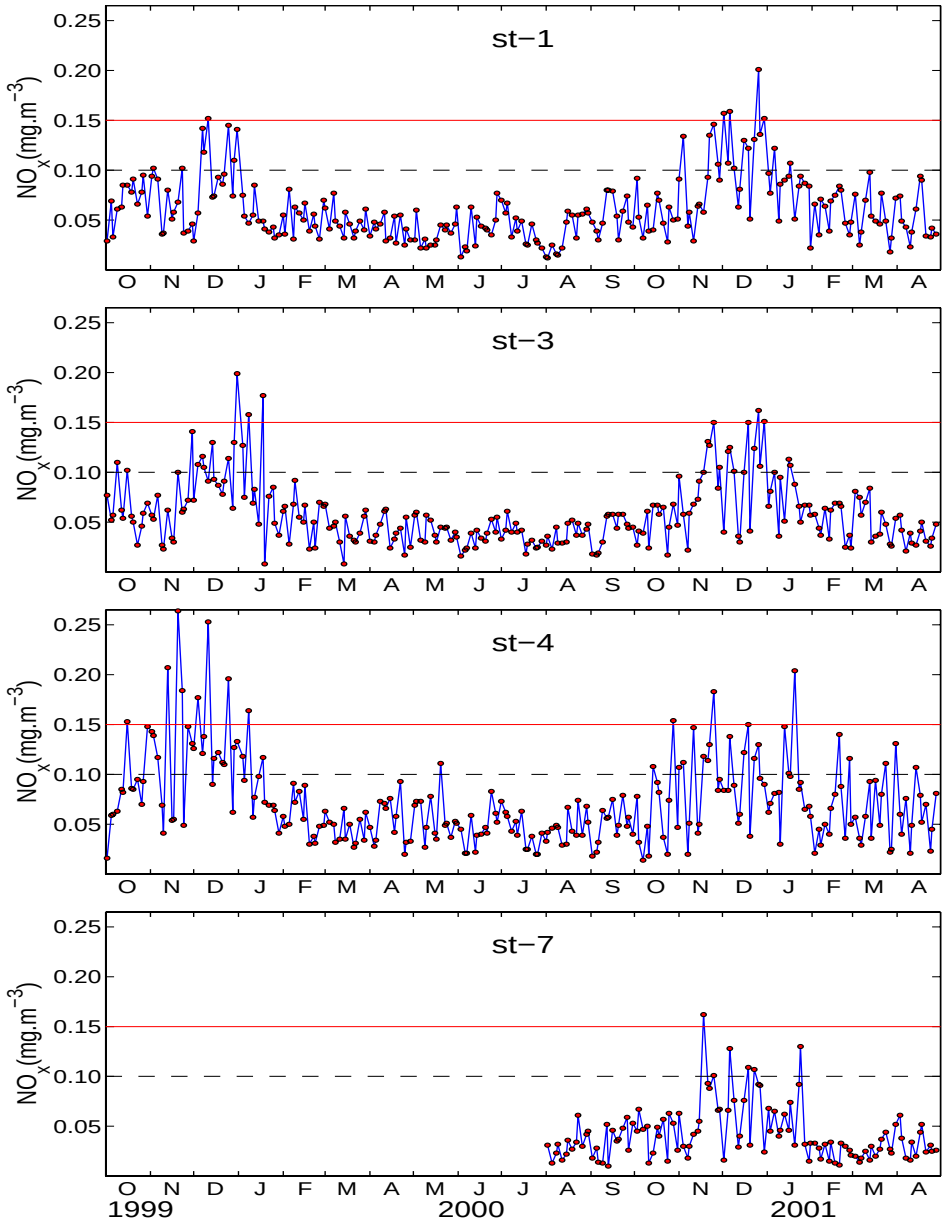
Criteria for Daily Mean Concentrations (mg/m^3) – Chinese EPA

Level of Criterion	SO_2	NOx	NO_2	TSP	PM_{10}
1	0.05	0.05	0.04	0.12	0.05
2 commercial /Residential	0.15	0.10	0.08	0.3	0.15
3 Industrial	0.25	0.15	0.12	0.5	0.25

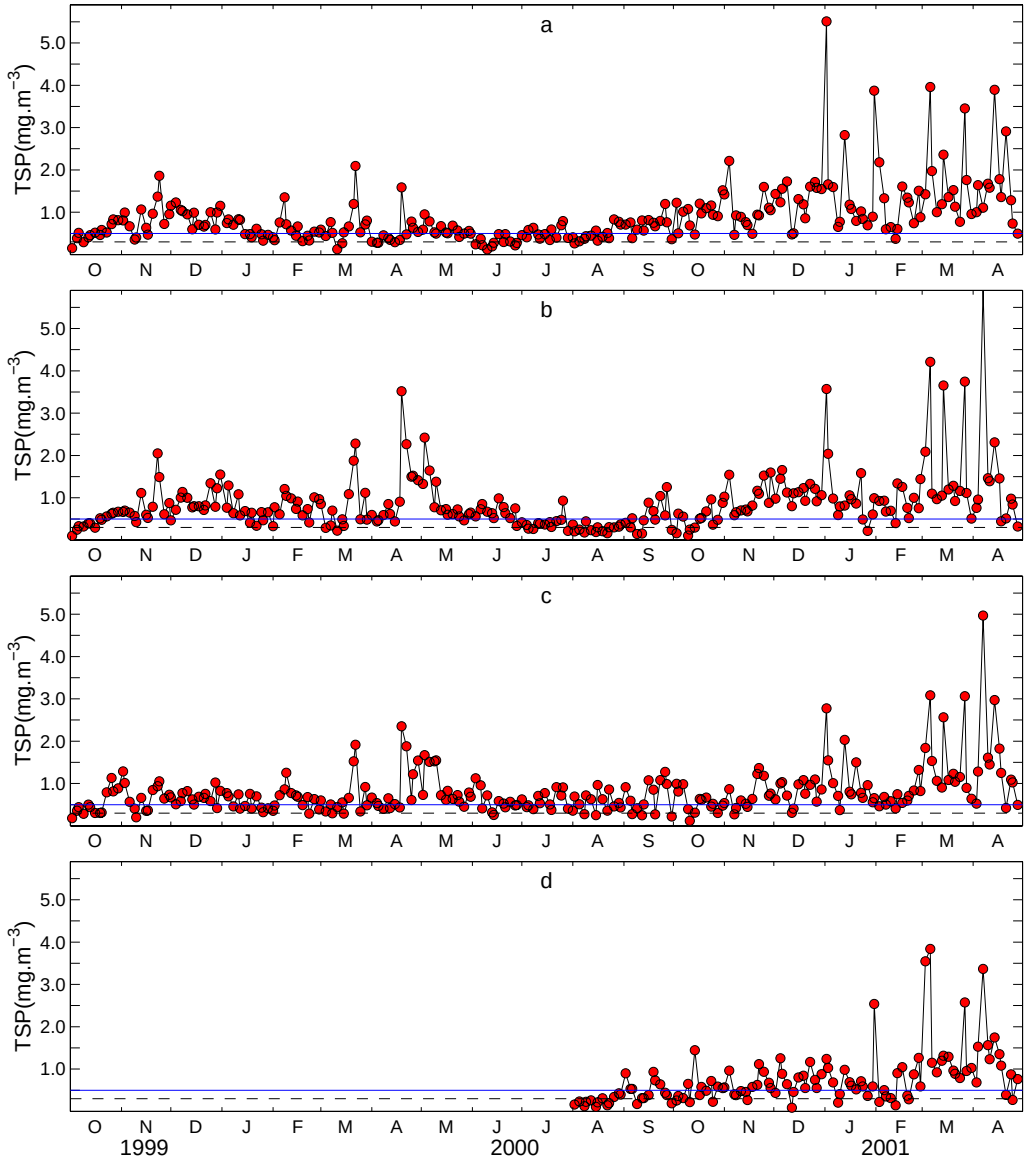
Daily mean SO_2 concentration



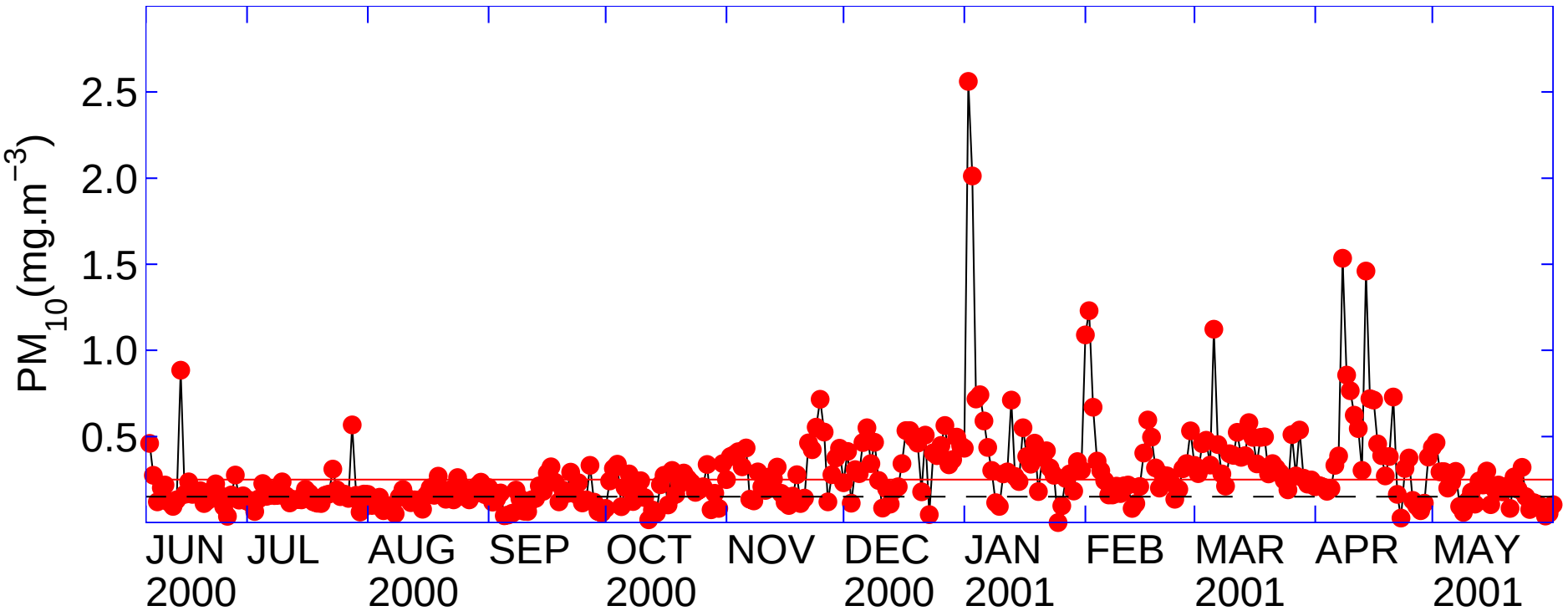
Daily mean NO_x concentration



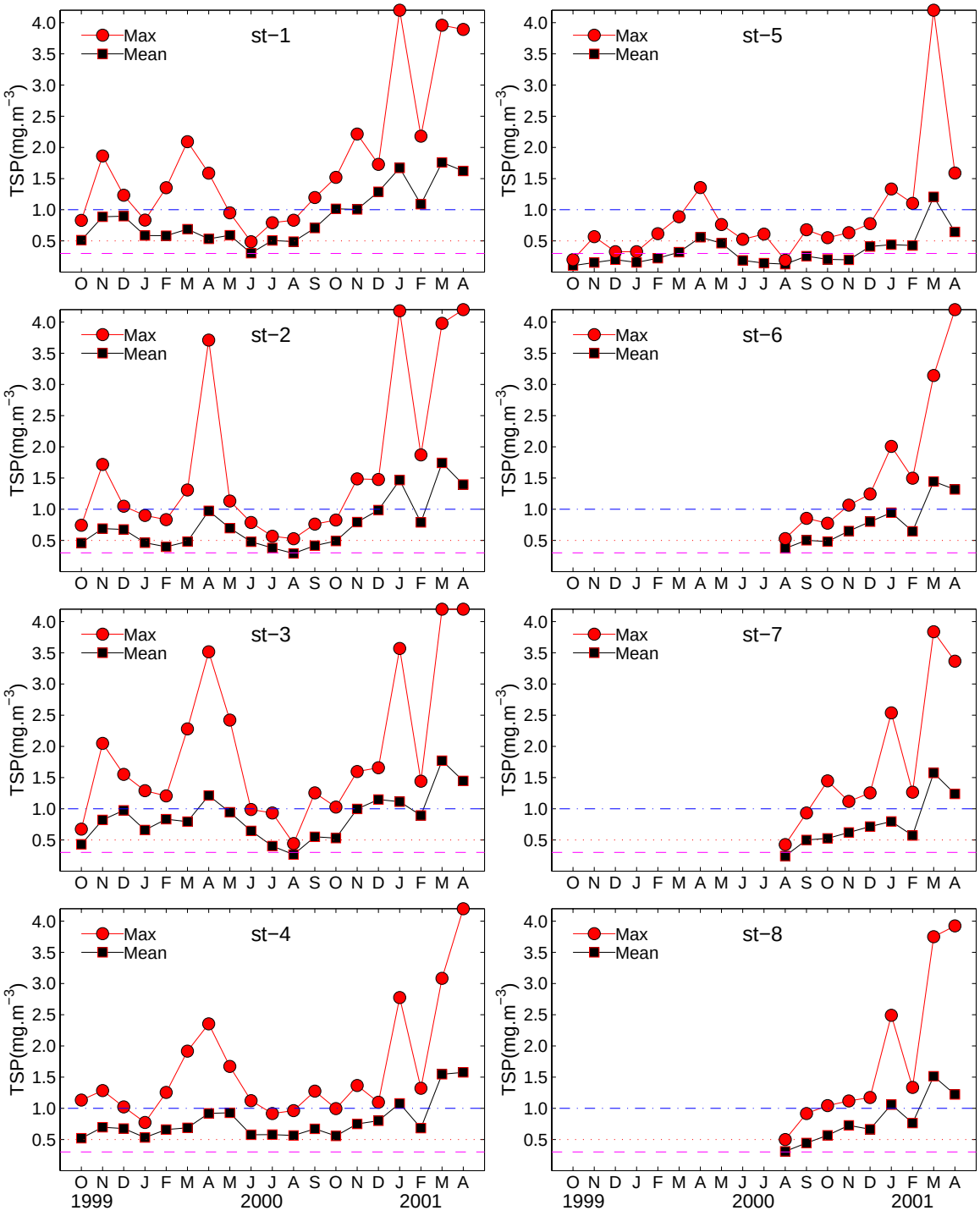
Daily mean TSP concentrations



Daily mean PM_{10} concentration



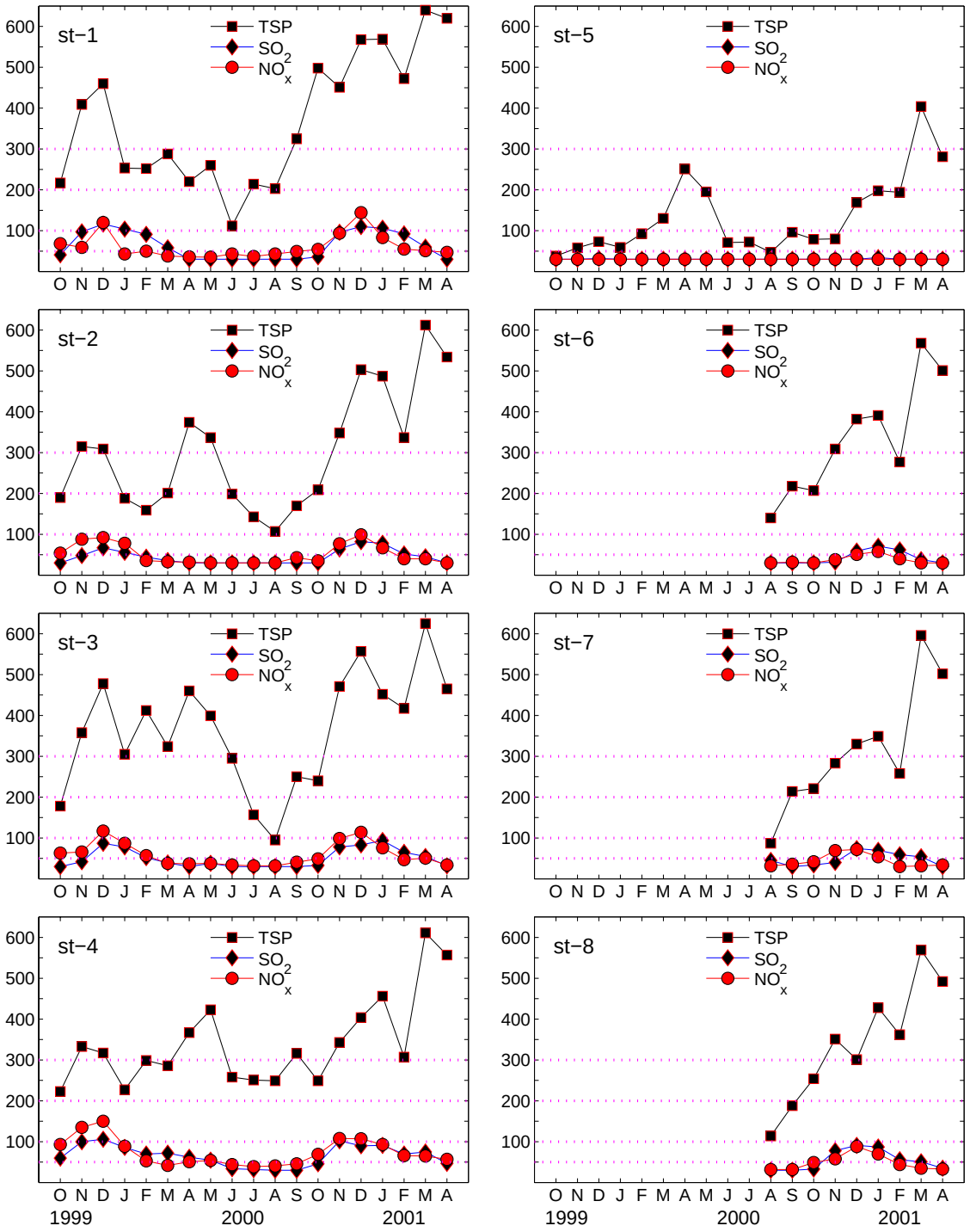
Monthly mean(■) and maximum(●) Concentrations (mg m^{-3}) of TSP at St-1 to St-8.



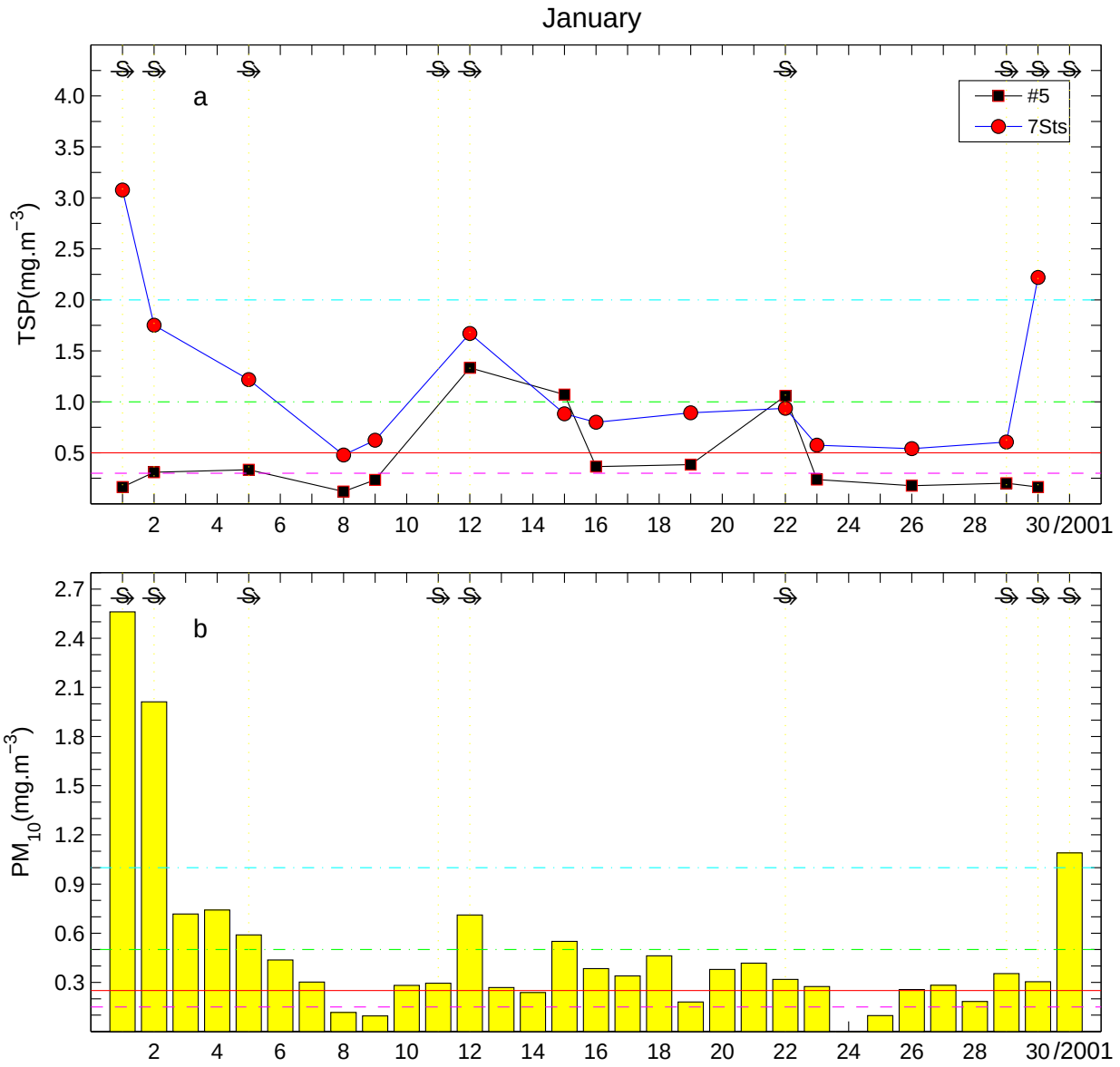
Air Quality Management

Air Pollution Index	Air Quality Classification		Air Quality Description and Management
< 50	I	Clean	No action is needed.
50-100	II	Good	No action is needed.
100-200	III_1 III_2	Low-level pollution	Persons should be careful in outdoor activities.
200-300	IV_1 IV_2	Mid-level pollution	Persons with existing heart or respiratory illnesses are advised to reduce physical exertion and outdoor activities.
>300	V	High-level pollution	Air pollution is severe; The general public is advised to reduce physical exertion and outdoor activities.

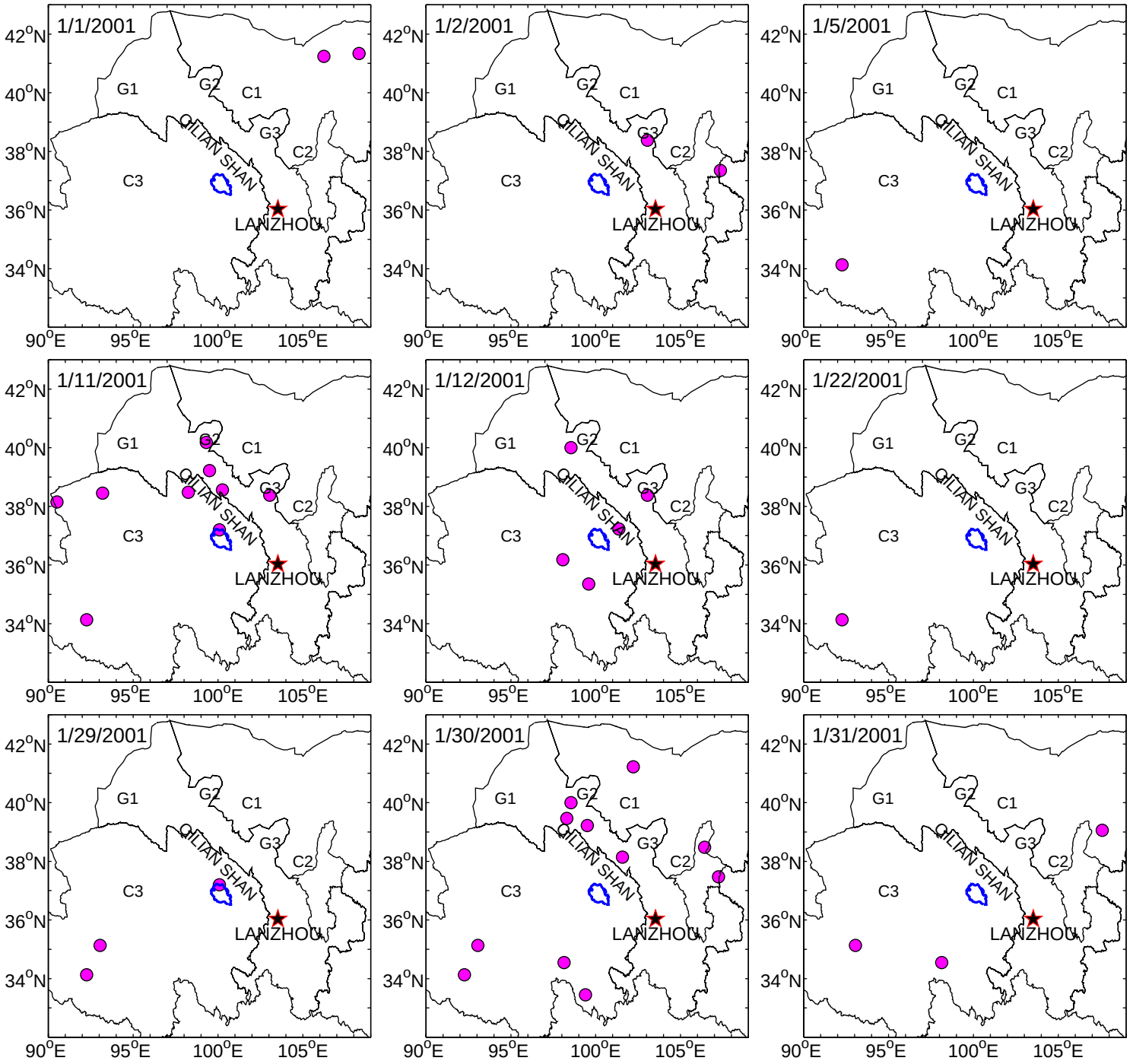
Monthly mean API at St-1 to St-8.



Dust Storms and (TSP, PM_{10}) in January 2001

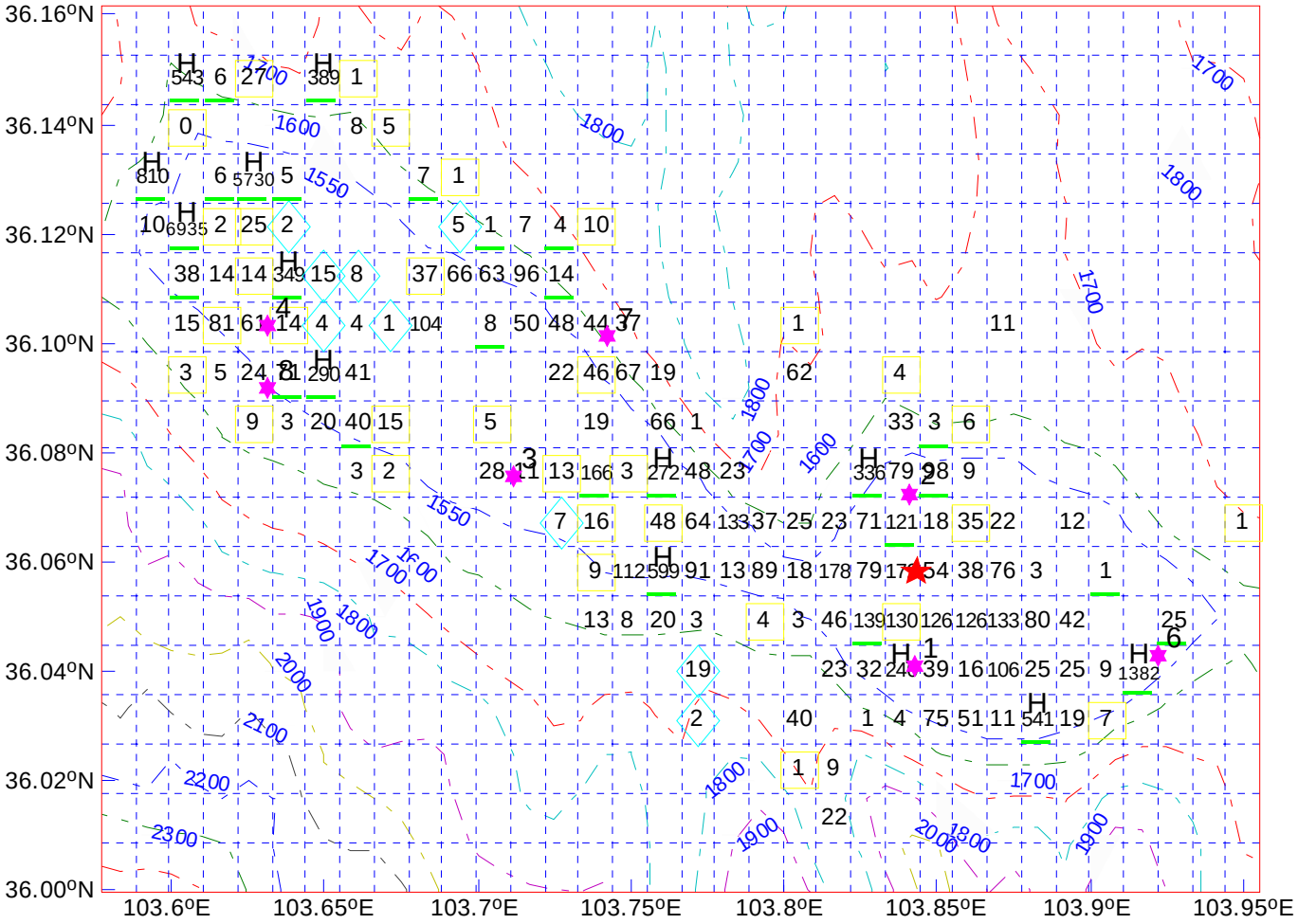


Dust Storms In Jan 2001



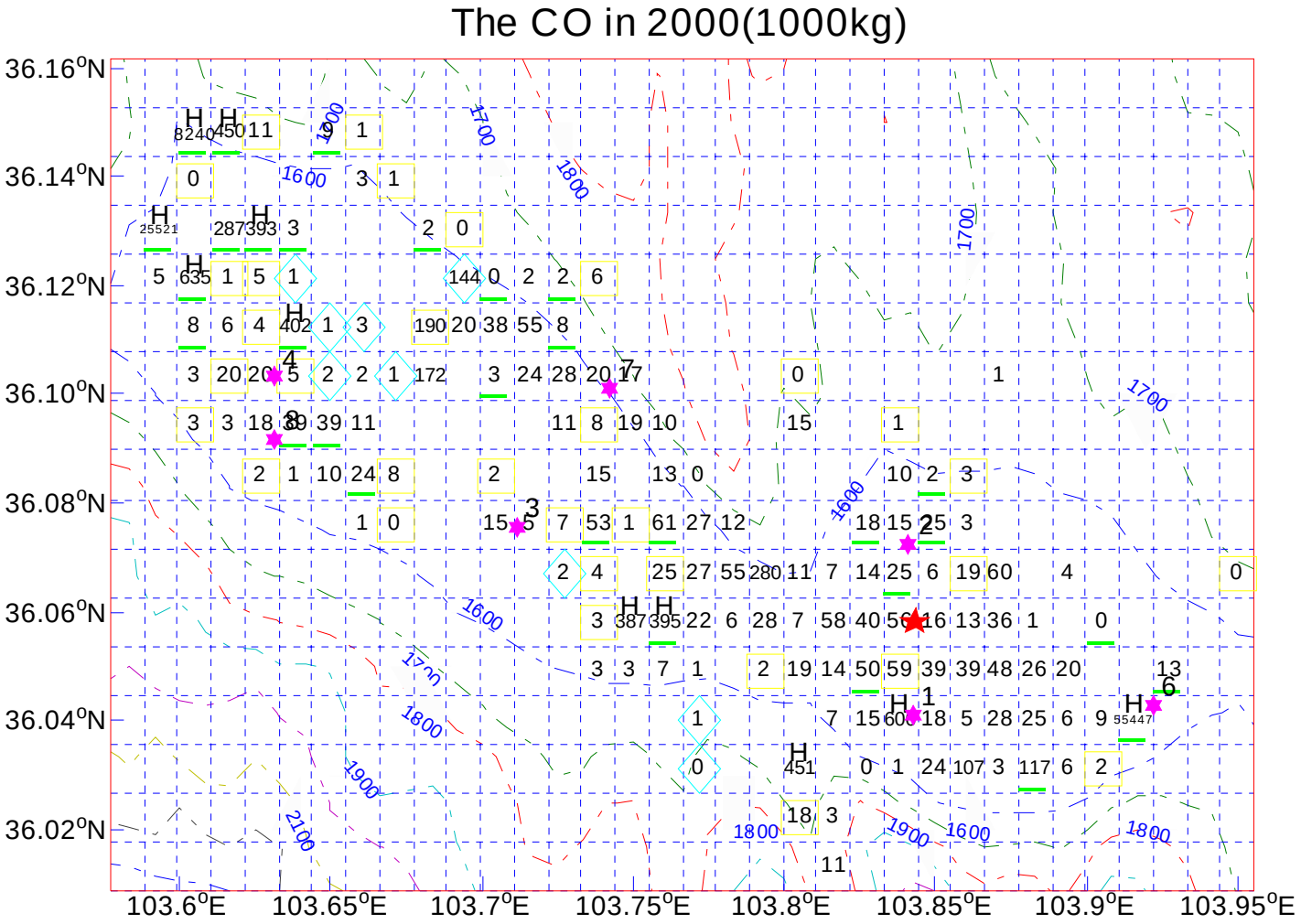
Dust Sources (1000 kg)

The Yan Chen in 2000(1000kg)



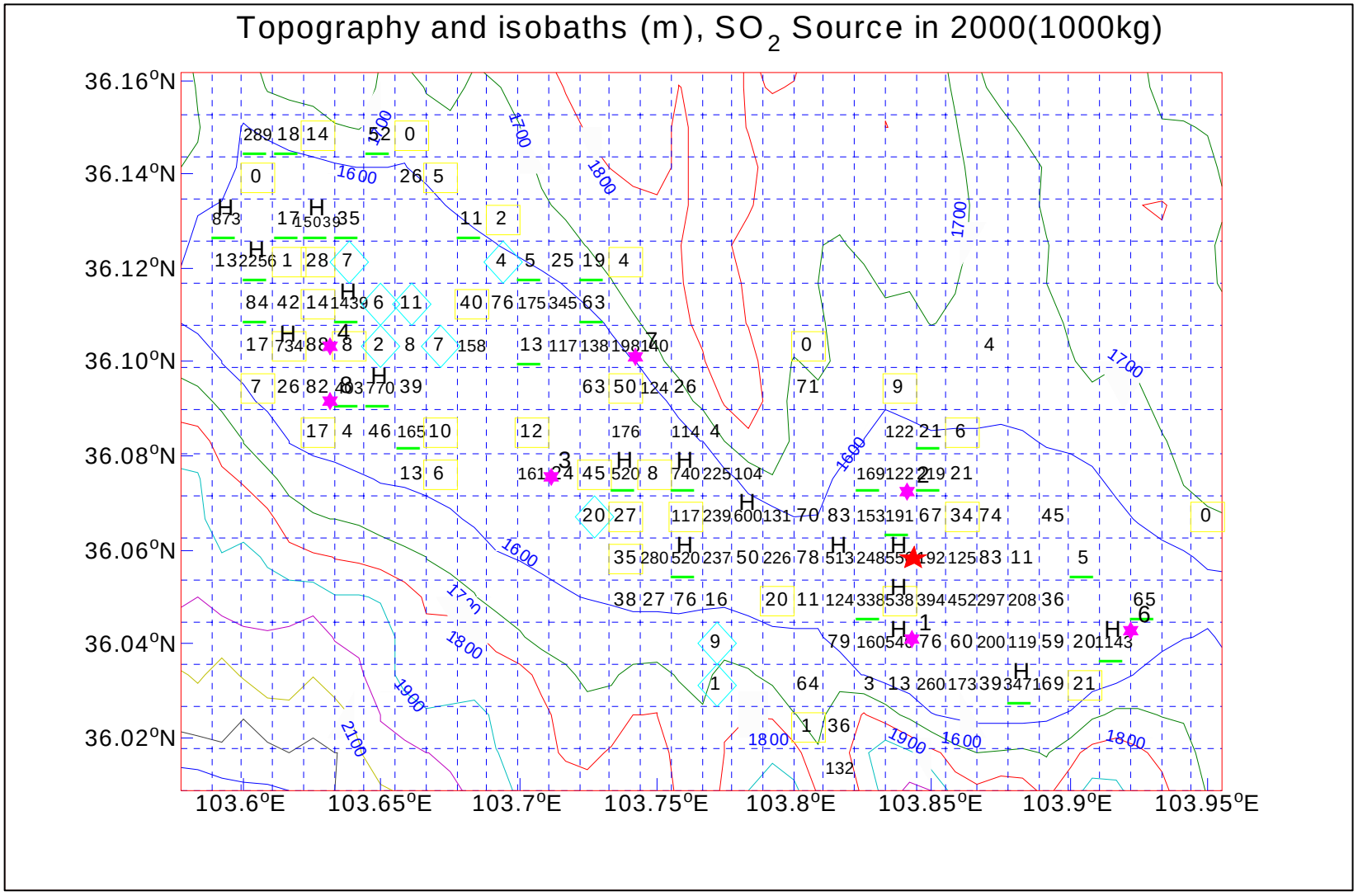
◇ Industrial ☐ Residential

CO Sources (1000 kg)



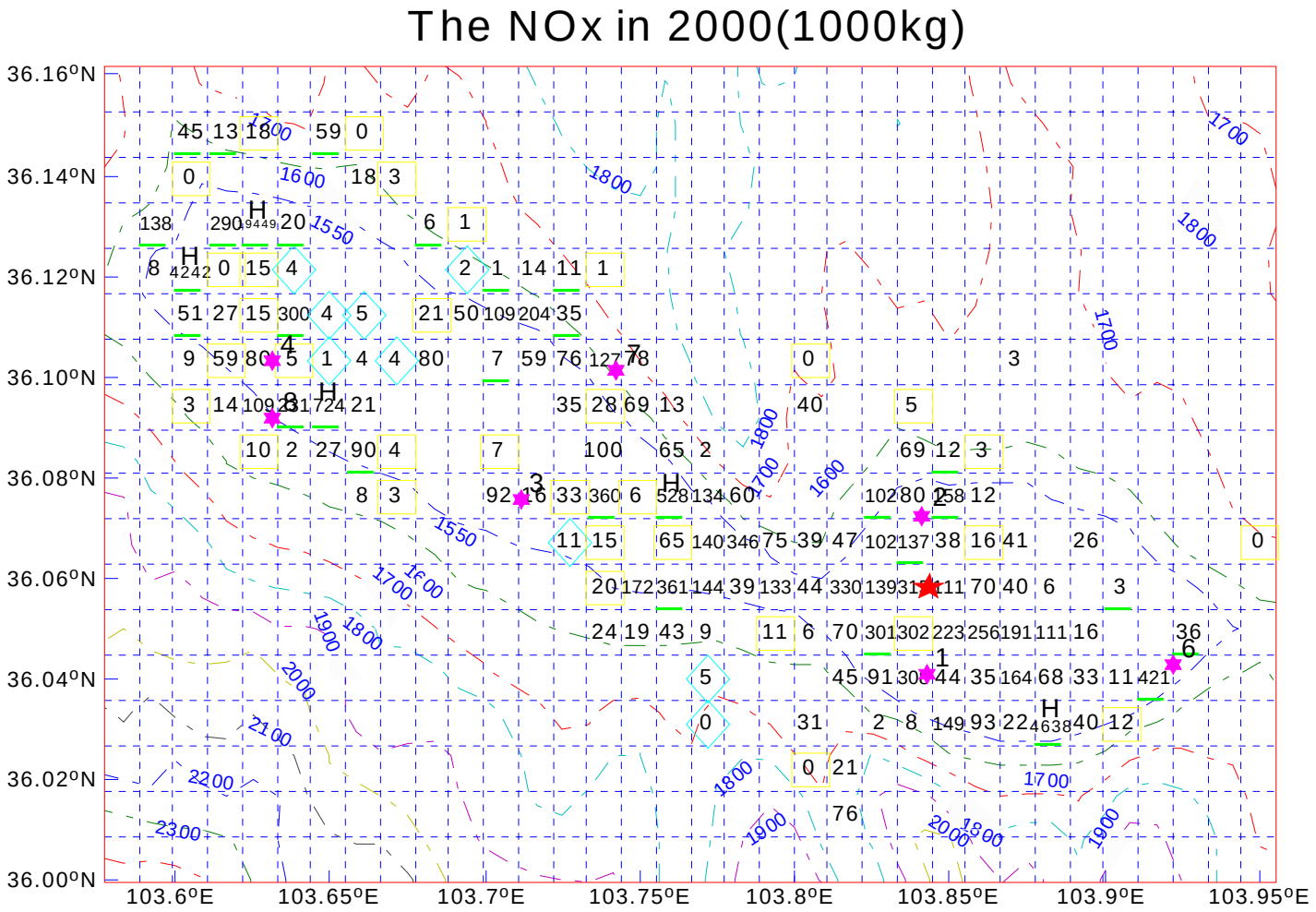
◇ Industrial ☐ Residential

SO_2 –Sources in 2000 (1000kg)



◇ Industrial □ Residential

NO_x Sources in 2000 (1000 kg)



◇ Industrial □ Residential

Conclusions

- Severe TSP pollution is caused by dust storms
- Meteorological conditions take important roles:
  - Inversion (Stable Stratification)
  - Mountain-Valley Wind
- Air quality improvement is an urgent task for Lanzhou.