The influence which subsidence inversion in the spring had on aerosol over Beijing regian

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1、Introduction

Atmospheric aerosols have large impact on climate forcing by effecting global cloud albedo,radiative forcing,ozone layer,acid rain and visibility. Increasing number of aerosol particales may also cause significant health effects.Through the measurement from 12 aircraft flights over Beijing, China in the spring of 2005 and 2006, we found that the aerosol pollution in the Beijing region was very heavy when the subsidence inversion occurred in the spring. This paper analyzed the vertical distribution of aerosol concentrations of five cases under subsidence inversion in the spring. and discussed the influence which subsidence inversion in the spring had on aerosol concentration.

2、Instrumentation on the aircraft

Several instruments were mounted on the wingtip on an aircraft (Cheyenne IIIA) to measure the spectrum of particles over the Beijing region. Particles rang from 0.1 to 3.0 um in diameter with 15 unequally size bins were recorded at 1-s intervals by a particle measuring systems (PMS Inc., Boulder, CO ,USA).The airplane has multi-engines with flight speeds of about 100 ms^{-1}. Passive cavity aerosol spectrometer probe (PCASP) instrument throughout the flight .The In-site meteorological parameters such as ambient air temperature (T),relative humidity(RH), and air pressure(P) are

measured during flights. The instruments(PCASP) is calibrated using polystyrene latex spheres(PSL) by Particle Metrics Inc.(PMI) in the United States. The calibration is conducted every year before the measurements take place.

Fig.1. aircraft (Cheyenne IIIA)

Fig.2. Passive cavity aerosol spectrometer probe (PCASP) instrument (left)

3、Analysis of the result

Table 1 shown summary of five cases about aircraft measurement. We carried out the vertical measurement of aircraft in the spring of 2005 and 2006 over Beijing region. The site、time and maximal altitude of vertical measurement is the same by and large. The aircraft first climb to about 3.6 km, and then gradually descents to the ground with a descending time of about half an hour. During descending, vertical profile of aerosol particles is measured.

Fig.3,The measured vertical profiles of temperature and dew point of five cases during descending period are shown. The character of subsidence inversion In synoptic meteorology is that the different value of temperature and dew point is bigger in some altitudes, and the different value of temperature and dew

point increased with altitude increasing. Table 2 showed the summary of character about subsidence inversion for five cases. The Fig.3 and Table 2 shows that there are inversion layer placed between average 0.7 and 1.2 km with a average gradient of 0.7 ℃ /100m, indicating that the PBL height is about 1.2 km.

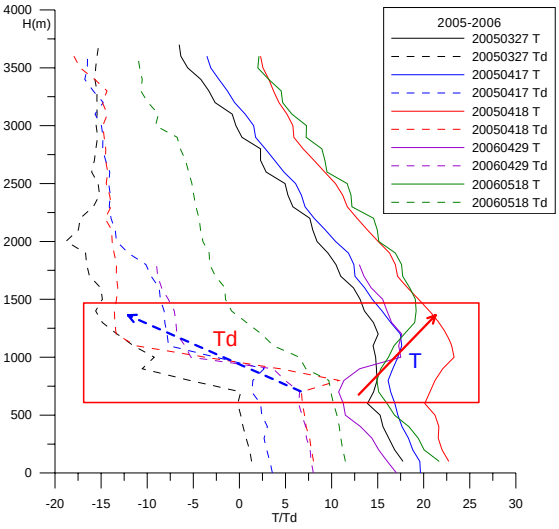

Fig.3. The measured vertical profiles of temperature and dew point of five cases during descending period

Table 1 summary of five cas

Date	Time of vertical measurement (Beijing Time)	Maximal altitude of vertical measurement (m)
2005-03-27	11:53-12:37	3600
2005-04-17	13:35-14:01	3600
2005-04-18	13:10-13:37	3600
2006-04-29	11:40-12:06	1800
2006-05-18	11:35-12:04	3600

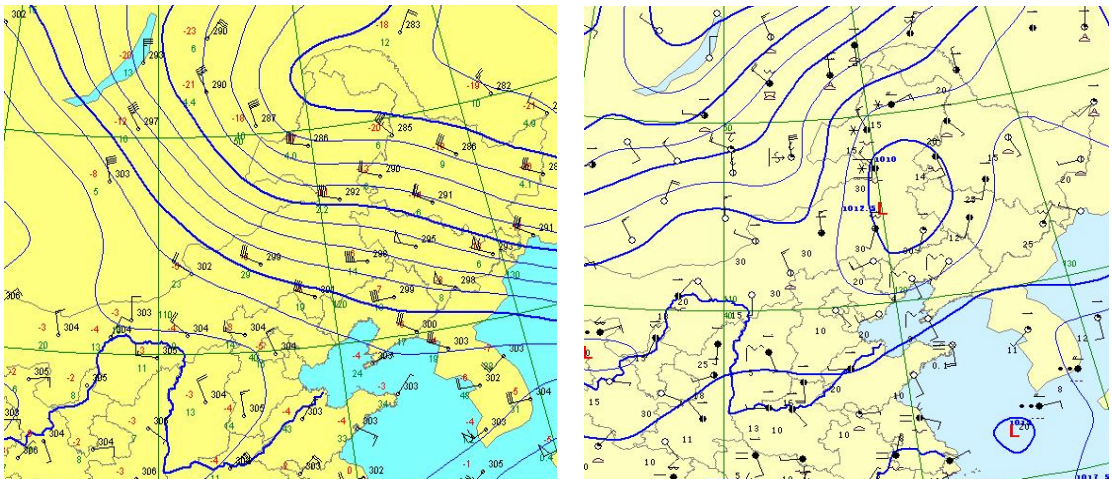

Fig.4. weather map of one cases. 1 March 27,2005, 0800(Beijing Time), 700 pha(left)

and 1100(Beijing Time), ground(right)

Table 2 summary of character about subsidence inversion for five cases

Date	Bottom of subsidence inversion（m）	Top of subsidence inversion（m）	thickness of subsidence inversion(m)	subsidence inversion（△T，℃）	Gradient of subsidence inversion（℃/100m）
2005-03-27	600	1200	600	+1.2	0.2
2005-04-17	800	1100	300	+1.5	0.5
2005-04-18	600	1000	400	+3.2	0.8
2006-04-29	700	1200	500	+6.8	1.4
2006-05-18	800	1400	600	+4.3	0.7
average	700	1180	480	+3.4	0.7

The whole weather situation formed two conditions witch brought about have severe pollute: (1)there is weak barometric depression in the ground , it is disadvantage to diffuse for pollute and advantageous to the accumulation of pollution;(2)atmosphere in the high went down and formed subsidence inversion layer, it is like a "cover", the smoke、dust and so on which suspend in the atmosphere are all hard to diffuse into the upper air by cutting through it, namely, it is disadvantageous for pollution to diffuse vertically.

Fig 5, the measured vertical profile of average number concentrations of aerosol particles during descending period is shown. The subsidence inversion layer has prevented the mixing between the particles below and above 1.2 km. Fig.5 indeed shows the strong separation of the characterization of aerosol particles between the two layers. The measurement from the PCASP instrument shows that above the PBL, the measured aerosol average number concentrations are about 1500 cm^{-3} with 1.2 um. By contrast, below the PBL, the

aerosol average number concentrations significantly increase to about 10000 cm^{-3}, and the size of the particles is greatly decreased to about 0.5 um. The striking different characterizations of aerosol particles suggest that aerosol above the PBL and below the PBL form different sources. The PBL maybe plays an important role to prevent the dust particles to be transported onto the surface, and confine the local emitted particles inside the PBL.

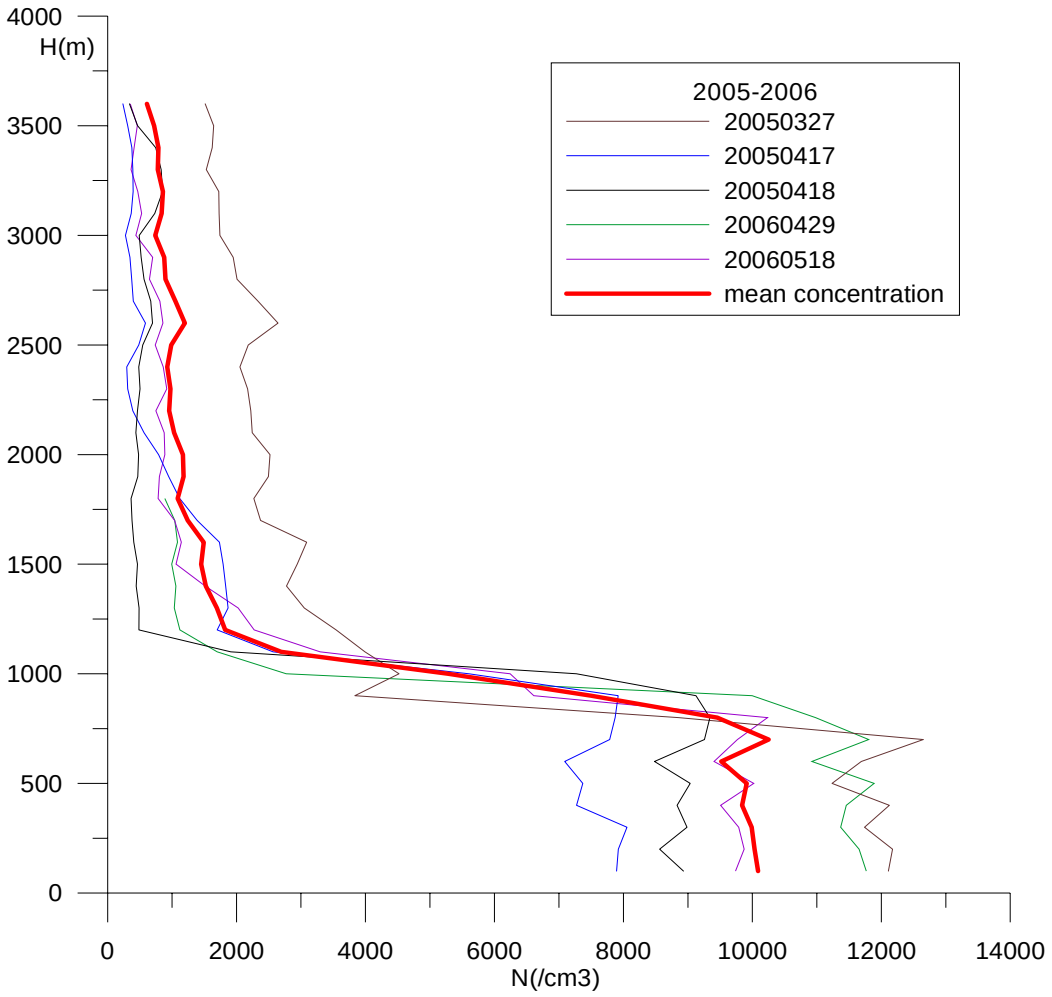

Fig.5.The measured vertical profiles of average number concentrations of aerosol particles during descending period.

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