The Influence of Sulfur Dioxide on Dobson Spectrophotometer Total Ozone Measurement

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INTRODUCTION

- At present, the Dobson spectrophotometer and Brewer spectrophotometer adopted by WMO, are used to measure total column ozone. Having strong absorption ability in the wavelength range of Dobson observation, SO_2 can interfere with the total ozone observation.
- Using the WOUDC observational data and absorption cross sections of O_3 and SO_2, SO_2 absorption coefficients and the theoretical factor C have been calculated to analyze the Dobson total ozone error caused by SO_2, which can provide reference for the data correction in Kunming station.

DATA & ALGORITHMS

- Bass-Paur (1985) ozone absorption cross sections (O_3CS).
- Bogumil (2003) SO_2 absorption cross sections (SO_2CS).
- The WOUDC observational data derived from Dobson and Brewer spectrophotometer at New Delhi (India) and Hohenpeissenberg (Germany).

- The Dobson total ozone data can be corrected by:

$$X' = X - C \cdot S$$

where X' is corrected ozone amount; X is the apparent ozone amount; S is total SO_2.

C is the influence factor defined as:

$$C = \frac{\Delta\gamma_{AD} n(\theta)}{\Delta\alpha_{AD}\mu(\theta)}$$

The SO_2 absorption coefficient $\gamma(\lambda)$ is calculated from the SO_2CS:

$$\gamma(\lambda) = \frac{\sigma(\lambda)P_0}{kT_0}$$

$\gamma(\lambda)$ has to be replaced by the slit function $s(\lambda,\lambda_i)$ weighted effective absorption coefficient γ_i:

$$\gamma_i = \frac{\int \gamma(\lambda)s(\lambda,\lambda_i)d\lambda}{\int s(\lambda,\lambda_i)d\lambda}$$

the ozone air mass and SO_2 air mass can be calculated as follows:

$$\mu(\theta) = \frac{R+h_1}{[(R+h_1)^2-(R+r)^2\sin^2\theta]^{0.5}}$$

$$n(\theta) = \frac{R+h_2}{[(R+h_2)^2-(R+r)^2\sin^2\theta]^{0.5}}$$

RESURTS

- **SO_2 absorption coefficients**

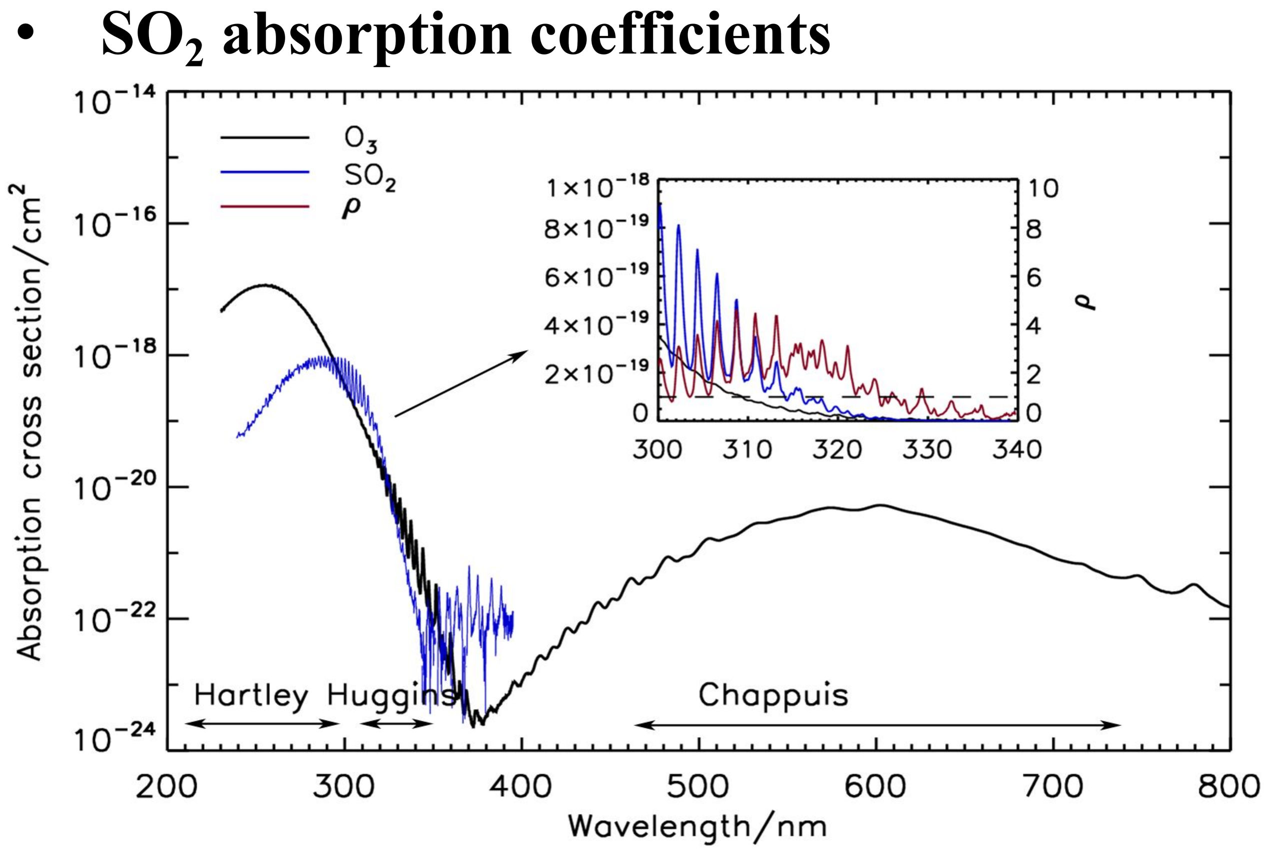

Fig.1 Cross section of SO_2 and O_3 and their ratio (ρ)

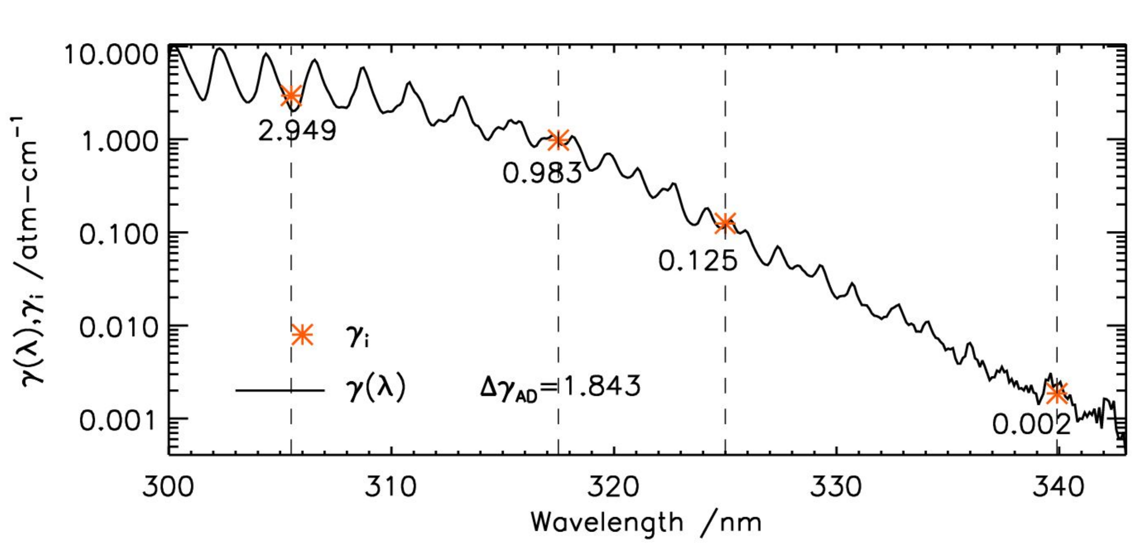

Fig.2 the monochromatic absorption coefficient $\gamma(\lambda)$ and the effective absorption coefficient γ_i of SO_2

- **Bias in Dobson total ozone due to SO_2**

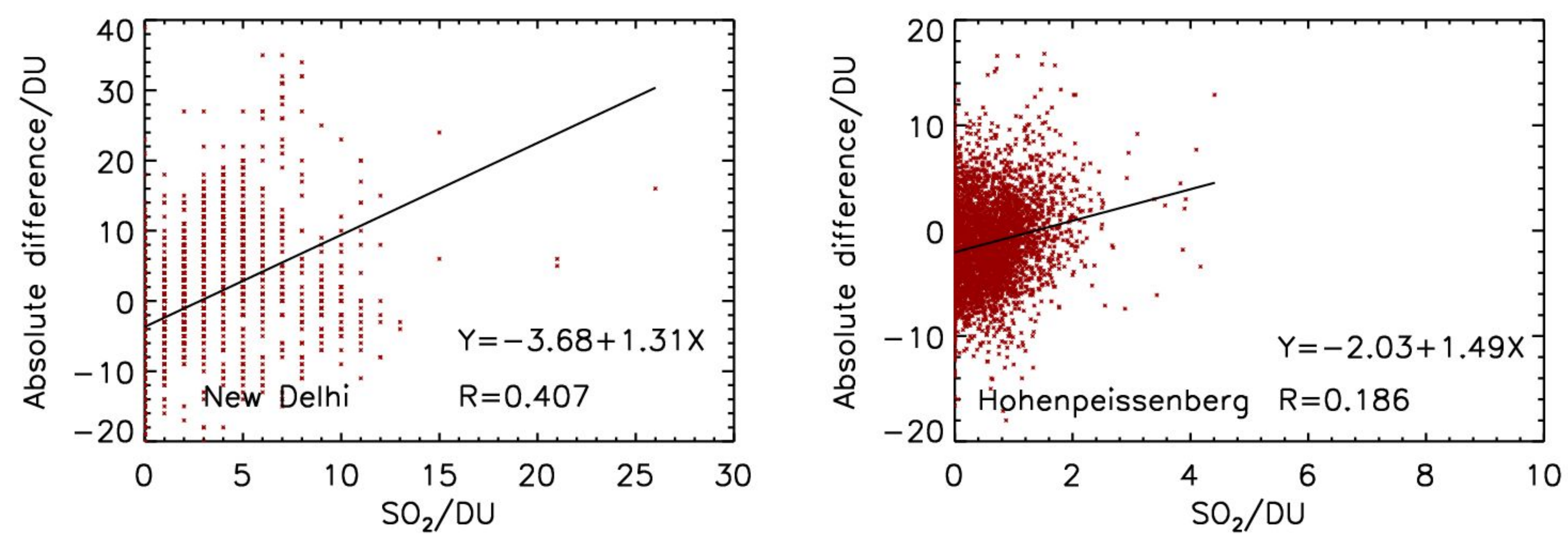

Fig.3 Correlation between total ozone absolute difference and total SO_2

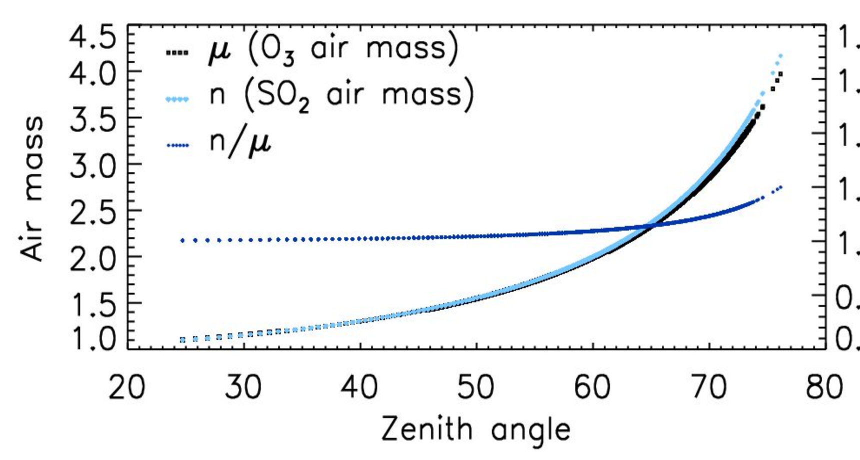

Fig.4 Air mass of O_3 and SO_2 and their ratio varied with zenith angle

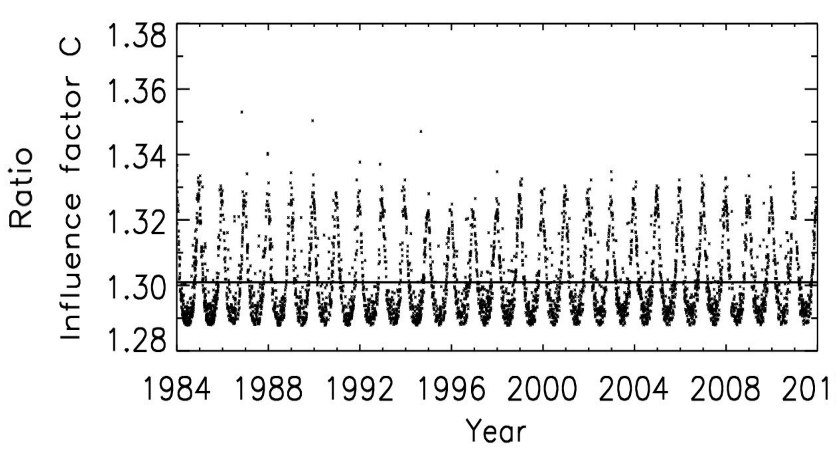

Fig.5 Influence factor C varied with time

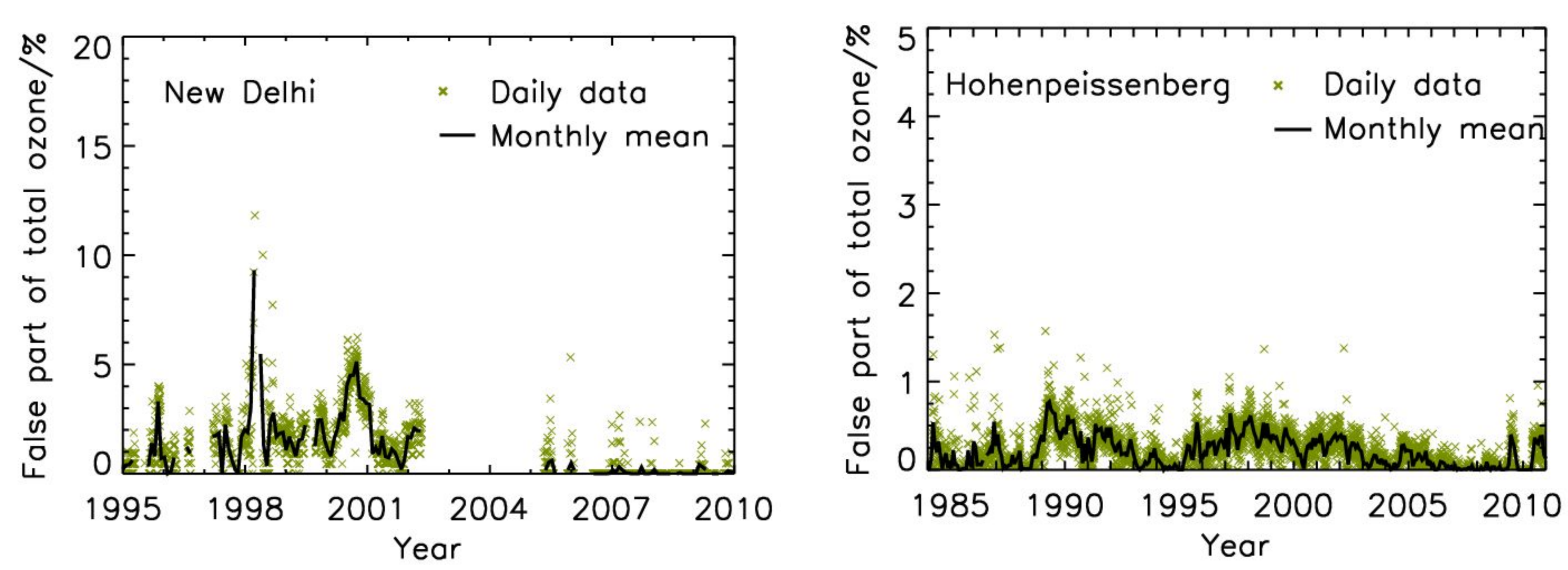

Fig.6 False part of Dobson total ozone responding to SO_2 at each station

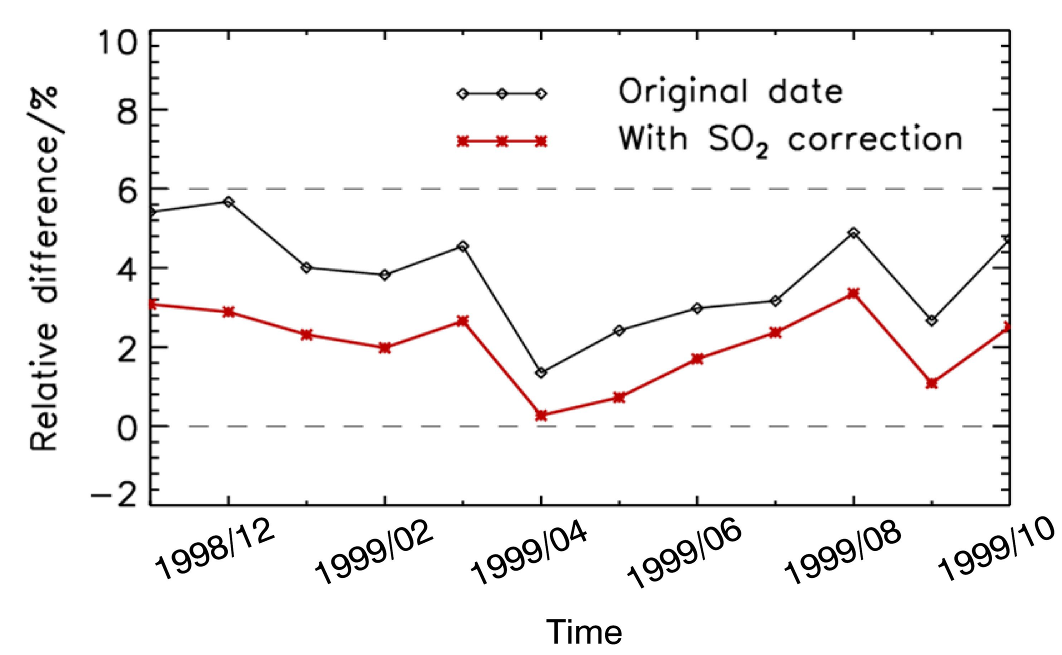

Fig.7 Relative difference of total ozone from Nov. 1998 to Oct. 1999 at New Delhi

CONCLUSIONS

- SO_2 has strong absorption in the UV spectrum, our calculation of SO_2 absorption coefficient $\Delta\gamma AD$ is 1.843.
- The presence of SO_2 will lead to Dobson ozone amount that are higher than the actual values. Influence factor C has obvious seasonal variation that reaches a maximum in winter and a minimum in summer.
- At New Delhi, the false part of total ozone reaches a maximum of 13.7%, while at Hohenpeissenberg, the false part concentrates within 2% because of little amount of SO_2.
- The relative difference between Dobson and Brewer data sets decreases by 1~3%, it shows that the precision of Dobson data improves after correction.

ACKNOWLEDGMENTS

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