C2253:

Comment:

It is better to quantitively divide the impacts of relative humidity and aerosol on visibility.

Response:

Thank you very much for your suggestion. This is indeed an interested question.

Although quantitively dividing the impacts of relative humidity (RH) and aerosol on visibility during Olympic 2008 is interesting, it is still a complicated issue. Hygroscopic growth factor of aerosol varies with different chemical composition and physical properties. However, long-term observing data of chemical species and size distribution of aerosol in Beijing is not available. If we assumed that aerosol's chemical composition and size distribution are relatively constant, especially in annual variation, we can roughly quantify the effect of RH and aerosol on visibility during 2008 Olympic. The method is described as follow.

An important parameter linking aerosol mass concentration with the light extinction is the mass extinction efficiency (MEE). It is defined as the ratio of extinction coefficient to PM_{10} mass concentration (Si et al. 2005; He 2009). The light extinction is calculated from the Koschmieder's formula relating visibility to the extinction coefficient (Eqation 1).

$$\sigma_{ext} = 3.912/V \qquad (1)$$

σ_{ext} is extinction coefficience, V denotes visibility. The dependence on RH of MEE is shown in Figure 10. Assume MEE is a function of RH: $MEE = f(\mathrm{RH}) = ax^3 + bx^2 + cx + d$, where x is 1/(1-RH). Then we can get the fitting coefficients based on daily mean mass extinction efficiency (MEE) and RH in summer of 2003-2008 (Fig.10)

$$MEE = -0.0032x^3 + 0.0161x^2 + 1.5703x - 0.0355 \qquad (2)$$

The correlation coefficient between MEE and x is 0.76, which is statistically significant at the 99% confidence level.

If we set PM_{10} concentration as the mean value from 2003 to 2007, and let RH equal to the mean RH during August of 2008, and we could get the visibility improvement due to RH from equation 2 and 1. In the same way, the PM10 effect on visibility during olympic 2008 can be derived. The proportion of RH and PM_{10} (aerosol) on improving visibility during August of 2008 is about 24% and 76%, respectively.

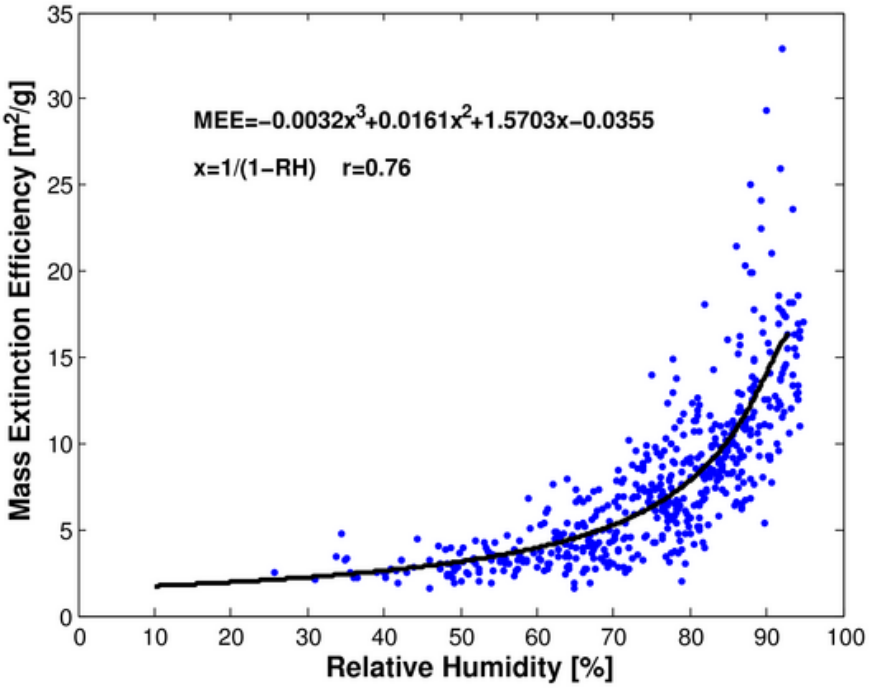

Figure 10. The relationship between daily mean mass extinction efficiency (MEE) and relative humidity in summer 2003-2008. The black curve is the fitting line of the scattering dots. The correlation coefficient between *MEE* and *x* is shown as the variable "*r*".

Reference:

Si F., Liu J., Xie H., Zhang Y., Liu W., Kuze, H., Liu C., Lagrosas, N., and Takeuchi, N.: Determination of aerosol extinction coefficient and mass extinction efficiency by DOAS with a flashlight source, Chin. Phys., 14, 2360, 2005.

He X., Aerosol surface observation and the application of MODIS AOD in PM10 evaluation, 28pp, Master dissertation of Peking University, 2009. (in Chinese)