10.5 The Statistical Forecasting Model

A physical and chemical diffusion models are generally used for estimating air pollution. However, in the case of the pollution of which physical and scientific models have not established or when any input data for the physical pollution model can not be obtained or when it is only necessary to forecast the air pollution level for a few hours after then statistical methods to estimate the pollution using time series concentration data or the pollution and weather data are used.

The category classification method by weather charts is used for the forecasting of the air pollution level. This method estimates the pollution level by examining the concentration of the pollution for each pattern, classifying a pattern in the weather by season and the existence or non-existence of high atmospheric pressure, low atmospheric pressure, fronts and so on. This method is used to estimate the density level of photochemical oxidants and nitrogen oxides for the whole area. An example of a classification of a typical weather chart is shown in Table 10.5.1.

Table 10.5.1 An example of a weather chart classification for an air pollution estimate

Symbol	Explanation
PN	North high and south low type (Baiu type, Okhotsk high type, etc.)
PE	East high and west low type
PS	South high and north low type (Typical summer pressure type, the bright in May, etc.)
PW	West high, east low type (Strong northery wind type in winter)
OW	Weak west high and east low type (Weak northery wind type in winter)
H	Covered with a traveling high pressure. Covered with a long belt high.
F	Front (Influence from an active front).
T	Typhoon (Influence from a typhoon).
LF	Strong cyclone front
LC	Strong cyclone central area
LB	Strong cyclone rear area
LS	Strong cyclone warm area
OLF	Weak cyclone front
OLC	Weak cyclone central area
OLB	Weak cyclone rear area
OLS	Weak cyclone warm area
L_2	Middle area of twin cyclone
OL_2	Weak twin cyclone
MX	There are a low-atmospheric-pressure and a traveling high-atmospheric pressure which is strong within 500 km.
OX	Others

The auto-regression estimate method, which is called multiple regression analysis, a Karman filter or Wiener filter, is a way to make a quantitative estimate several hours after the concentration without using a physical diffusion model. The change of concentration is divided into the random component and the periodic component like the transition of a day and a numerical value filter method is used for the random component.

In other words, the estimate object, which is the concentration C(t) at the time of t is divided into the diurnal change Cp(t) and an irregular component C'(t), and past concentration data can be used for the day change. As for an irregular component, for example in the Wiener model, Ce(t), which is the estimate model of C'(t) is estimated by the weight function $w(\gamma)$ as shown in Eq. (21).

$$Ce(t) = \int_0^{\infty} w(\tau)\, C'(t-\tau)\, d\tau \qquad \cdots\cdots (21)$$

Here, τ is delay time and $w(t)$ is sought in order to minimize the error of $C'(t)$ and $Ce(t)$. Fig. 10.5.1 shows an example of the estimate results of one hour ahead for SO_2 using the Karman filter model.

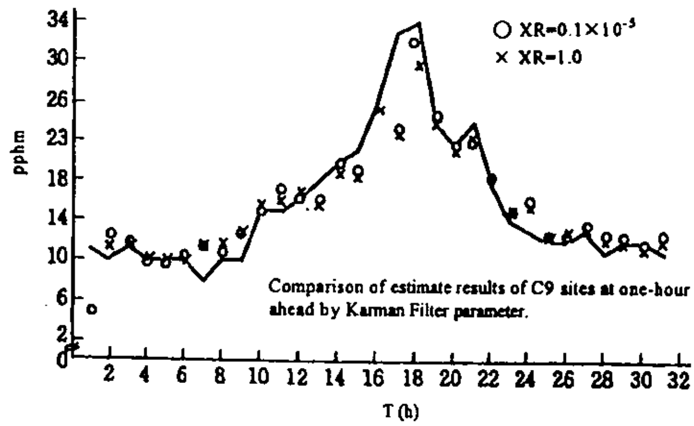

Fig. 10.5.1 An example of one-hour ahead estimate of SO_2 by the Karman filter model