Contaminant transport analysis by the tank model

Yuko Hatano[1]

[1] Inst. Eng. Mech & Sys., Tsukuba Univ.

http://www.kz.tsukuba.ac.jp/˜hatano

Recently the cross-media pollution, where the pollutants are transferred from one environmental media to another, draws more attention. For example, when rain falls, water washes out pollutants in the air, and runs into rivers or groundwater. Such transfer of contaminants between different media is called the cross-media pollution. Aoi (2001) found a possible case of cross-media pollution in Japan. He measured the concentration of nitrogen in a river water in a mountain region and found that the concentration is significantly increased for there years, suggesting that NOx in the urban atmosphere could be the source.

Another exmaple is given by Kirchner et al. (2000). They measured the rainfall and river discharge in several watershed area in the U.K. and North America, and found that the power spectrum of the chrolide concentration in the rainfall is a white noise, while the streamflow the spectrum shows a fractal 1/f scaling. When a time series shows the 1/f spectrum, it means that the component with a long period has a large amplitude among all the periods, and the component with a short period has a small amplitude; the spectrum power increases proportional to the period length. In other words, some tracer particles contained in the rainfall take a very long time until it reaches the streamflow. Kirchner et al.'s study means that the cathcment acts as such a filter for the pollutant, which converts the random fluctuation of the rainfall concentration into the 1/f noise of the streamflow concentration. They explainend such spectrum behaviors assuming a diverse travel time distribution. (Kirchner et al.,2001).

Our study is to apply such a fractal filter to the tank model and thereby reproduce the 1/f spectrum of the streamflow concentration. Since the tank model is widely used in Japanese local goverments to predict the flood, converting the tank model into the the tool which predict the river water quality should be convenient. We estimate the time span of the cross-media pollution. We give a stepwise fluctuation in the level of the tracer concentration in the rainfall and observe the responce of the river water quality. We found that it takes several years until the streamflow quality reflects the rainfall fluctuations.