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Dynamical Behaviors between the PM10 and the meteorological factor using the detrended cross-correlation analysis method

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There is considerable interest in cross-correlations in collective modes of real data from atmospheric geophysics, seismology, finance, physiology, genomics, and nanodevices. If two systems interact mutually, that interaction gives rise to collective modes. This phenomenon is able to be analyzed using the cross-correlation of traditional methods, random matrix theory, and the detrended cross-correlation analysis method. The detrended cross-correlation analysis method was used in the past to analyze several models such as autoregressive fractionally integrated moving average processes, stock prices and their trading volumes, and taxi accidents.

Particulate matter is composed of the organic and inorganic mixtures such as the natural sea salt, soil particle, vehicles exhaust, construction dust, and soot. The PM10 is known as the particle with the aerodynamic diameter (less than 10 microns) that is able to enter the human respiratory system. The PM10 concentration has an effect on the climate change by causing an unbalance of the global radiative equilibrium through the direct effect that blocks the stoma of plants and cuts off the solar radiation, different from the indirect effect that changes the optical property of clouds, cloudiness, and lifetime of clouds. Various factors contribute to the degree of the PM10 concentration. Notable among these are the land-use types, surface vegetation coverage, as well as meteorological factors.

In this study, we analyze and simulate cross-correlations in time scales between the PM10 concentration and the meteorological factor (among temperature, wind speed and humidity) using the detrended cross-correlation analysis method through the removal of specific trends at eight cities in the Korean peninsula. We divide time series data into Asian dust events and non-Asian dust events to analyze the change of meteorological factors on the fluctuation of PM10 the concentration during Asian dust events. In particular, our result is compared to analytic findings from references published in all nations.

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