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Study on Spatial Distribution Characteristics of Industrial Pollution Sources in 2008

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Abstract. With the continuous development of China's economy, the problems of pollutant emissions and environmental governance are gradually emerging. Based on the monthly data of man-made emission sources in Asia from the 2008 East Asia MIX emission inventory, this study analyzed the temporal and spatial distribution characteristics of air pollutants including $PM_{2.5}$, PM_{10}, CO, CO_2, NOx, OC, etc., and explored the difference and variation law of material concentration distribution between designated special regions, as well as the possible impact of various atmospheric systems on them. Firstly, in most areas of China, the distribution of pollutants has obvious temporal and spatial differences, and the overall trend of pollutant concentration is higher in the north than in the south. The results show that the monthly variation trend of pollutants in India is significantly correlated with that in China. However, compared with the monthly trend in northern China, it is not particularly obvious.

1 Introduction and data

In recent years, with the continuous improvement of people's living standard and the acceleration of urbanization process and the increase of vehicle ownership, the air pollution in China has changed from pure soot pollution to coal smoke and traffic mixed pollution [1,2]. The characteristics of air pollution have also changed accordingly. Not only the particulate matter and pollution level are high, but also the nitrogen oxide pollution closely related to vehicle exhaust gas also presents the same characteristics. The trend of aggravation has become worse and the original serious air pollution becomes more and more severe [3-4]. However, air pollution has attracted the attention of many countries in the world and has become one of the global social problems [5,6]. Therefore, the spatial and temporal distribution of air pollutants in East Asia is analyzed in this study, which provides a certain basis for air defense and development law of pollution sources.

The MIX emission inventory is the Asian anthropogenic emission inventory developed in 2008 and 2010 for the third phase of the East Asia Model Comparison Program (MICs Asia III) and the United Nations hemispheric air pollution transmission program (HTAP). The inventory is developed by multi-scale data coupling method, which provides input data for multi-scale atmospheric chemical transport model by coupling localized emission inventories such as MEIC (China), pku-nh3 (China ammonia emission inventory), CAPSS (South Korea), anl India (India), REAS2 (Japan, China Taiwan), etc [7]. The mix inventory provides anthropogenic source pollutants and greenhouse gas emission data of 30 Asian countries and regions in 2008 and 2010, including 10 major atmospheric chemical components, including SO_2, NO_x, CO, NH_3, NMVOC (volatile organic compounds), PM_{10}, $PM_{2.5}$, BC, OC, CO_2, and NMVOC emission data of cb05 and SAPRC-99. The inventory provides monthly grid emission data of 0.25 degree spatial resolution for five emission sectors (power, industry, civil, transportation and agriculture), which can meet the simulation requirements of multi-scale atmospheric chemical transport model. The spatial resolution of emission is 0.25×0.25 degrees, and the spatial range is 40.125 degrees east longitude 179.875 degrees east longitude (grid center), 20.125 degrees south latitude 89.875 degrees north latitude (grid center). The dimension of each pollutant emission data is 560 (column) × 441 (row) × 12 (month).

2 Experiments and Results

China's air pollution mainly comes from heating emissions, motor vehicle emissions, industrial emissions and sandstorm weather [8]. The pollutants showed obvious regional distribution.

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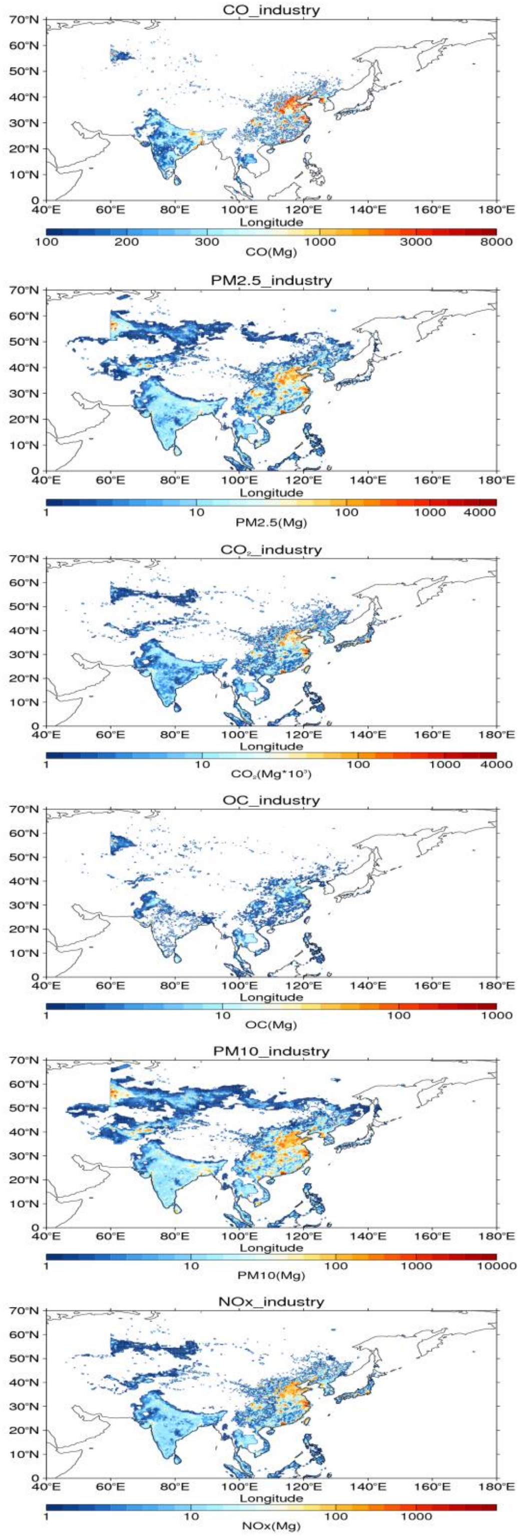

Figure 1. Horizontal average distribution of $PM_{2.5}$, PM_{10}, CO, CO_2, NO_x and OC in Asia region in January of 2008.

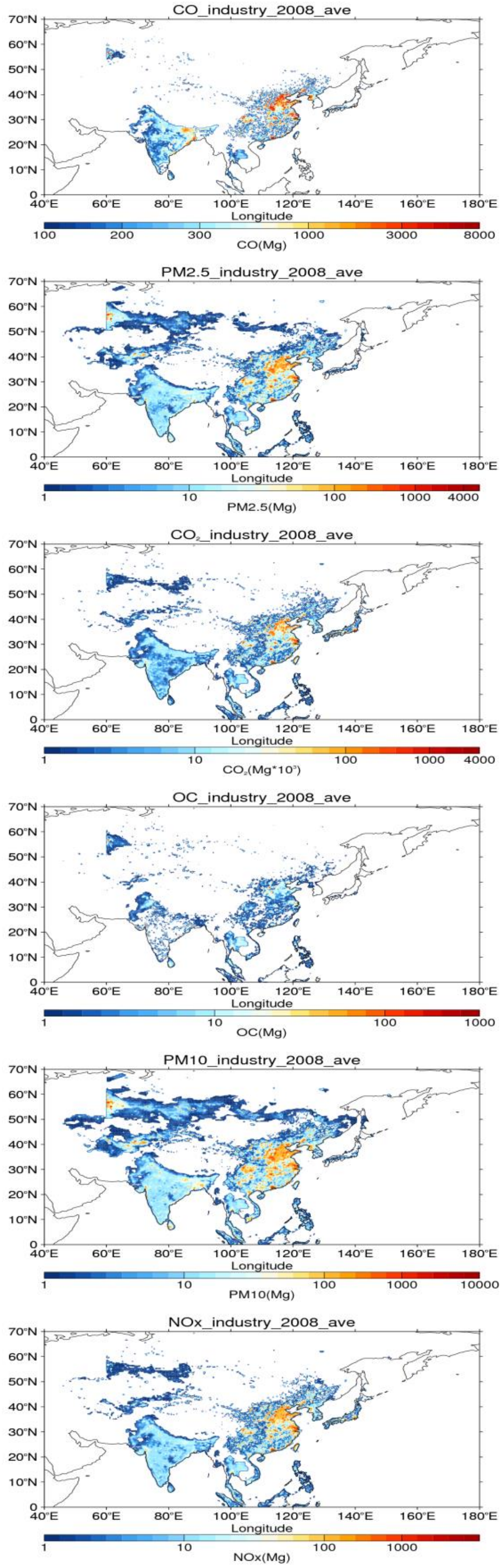

Figure 2. Horizontal average distribution of $PM_{2.5}$, PM_{10}, CO, CO_2, NO_x and OC in Asia region of 2008.

From Figure 1, we can see that the overall trend of pollutant concentration in industrial emissions is higher in the north than in the south. The pollution is more serious in the areas with dense heavy industry and high population density, such as southern Hebei and eastern Shandong. It can be seen from the distribution map in Figure 1 and annual average distribution in Figure 2 of average industrial emission source pollutants in January that OC's emission level of pollution source is relatively low and CO_2 emission is relatively high. And $PM_{2.5}$, PM_{10}, CO, CO_2, NOx and OC all present the characteristics of local pollution. In the South and west of China, the air quality is relatively good. And the pollutant emission sources in the western region are relatively low compared with the whole Asian region. Due to the barrier and boundary division of the Qinghai Tibet Plateau, we can see that there is an obvious boundary between the northern India and China. In addition to the impact of anthropogenic emissions, the unfavorable atmospheric diffusion conditions caused by the special topography and geographical environment are also important reasons for the serious pollution situation in the region. PM_{10} and $PM_{2.5}$ have a wide range of industrial emission sources in the eastern coast of China. Therefore, the concentrations of the two are generally on the high side.

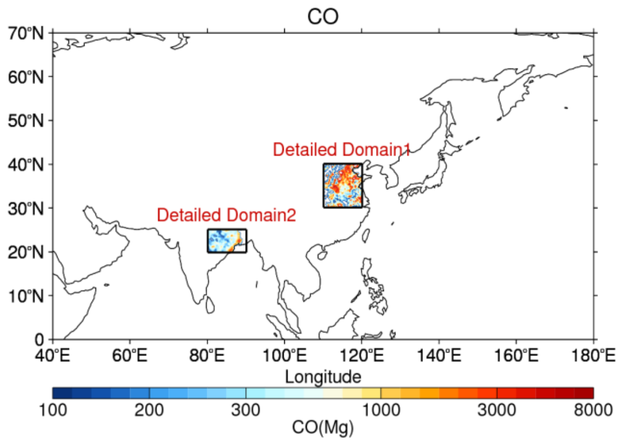

Figure 3. Horizontal distribution of CO in detailed domain1 which represents the Hebei and Shandong region of China and detailed domain2 which represents the northern region of India in January of 2008.

According to Figure 3, we select two representative regions with industrial source emissions, namely Hebei and Shandong in China, and northern India. All of them belong to the important source areas of heavy industry emissions. We sum the monthly average grid data in the two regions and analyze its monthly trend and possible reasons.

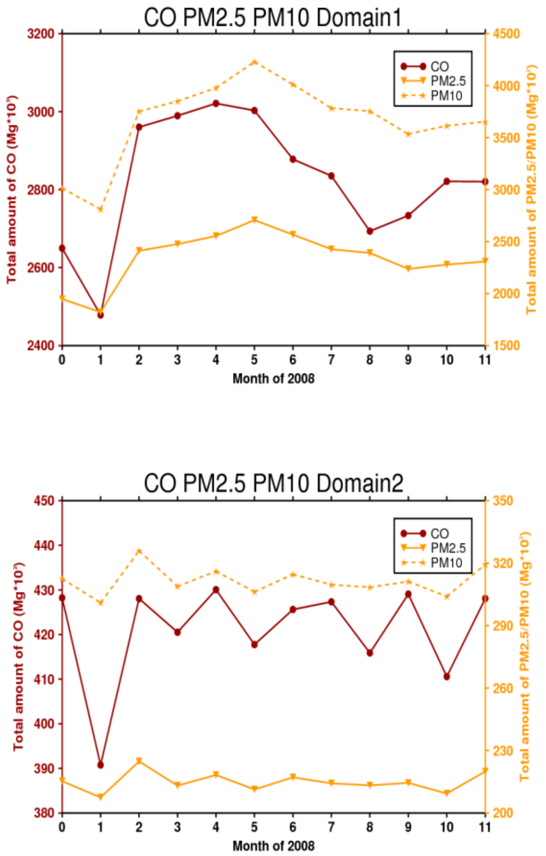

Figure 4. Time series of monthly mean CO, $PM_{2.5}$, and PM_{10} during the year of 2008

The spatial and temporal distribution of air pollutant concentration is a basic problem in the study of air pollution. In recent years, many related researches have been carried out in many areas of China [9-12]. From the time series chart of monthly change in Figure 4, we can see that the change of industrial pollutant emission shows an obvious month by month unstable trend. While in winter, it's on the contrary. In particular, the seasonal variation of CO is the most obvious, and it has a trough in January, both in China and northern India. PM_{10} pollution also showed obvious seasonal changes. In heating period, PM_{10} mainly came from coal-fired emissions and motor vehicle exhaust emissions. In non heating period, it was significantly affected by sandstorm weather, and maintained a high value in spring and autumn. PM_{10} is mainly composed of "primary" pollutants produced by mechanical processes such as building construction, road dust and blowing sand, and chemical processes such as fuel combustion, so it is also known as "primary pollutant in ambient air" PM_{10} has a strong adsorption capacity, and is the "carrier" and "catalyst" of a variety of pollutants. Therefore, PM_{10} has become the aggregation of a variety of pollutants and is the main cause of various diseases. Therefore, we further analyzed the change trend of PM_{10}.

The change trend of $PM_{2.5}$ is not as significant as that of CO and PM_{10}. Although it also shows a trend of emission reduction in January, the monthly change in

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2008 is relatively flat. Strong $PM_{2.5}$ emissions from seasonal crop residues burning and coal burning for heating in winter are the main causes of extreme haze events. In the coldest months, severe haze pollution events are mainly caused by high $PM_{2.5}$ emissions from coal combustion and automobile fuel consumption, low atmospheric boundary layer and poor atmospheric diffusion

3 Conclusion

From the analysis results of this study, it can be seen that in most areas of China, the emission of pollutants is not particularly obvious. However, the obvious emission trend is less in the South than in the north, and presents a certain seasonal variation. This is one of the most serious industrial pollution sources in Shandong Province, which is also one of the most serious industrial pollution trends. The trend of industrial emission sources in India was compared. Both of them have obvious seasonal variation trend according to the CO, $PM_{2.5}$, and PM_{10} variation from January to December of 2008.

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