4D1) 2004년 광주에서 관측된 장마 전후의 광화학적 특성 차이: 관측 및 모델 결과

Differences in Photochemical Characteristics Observed before and after 2004 Summer Monsoon in Gwangju, South Korea: Results of Measurements and Modeling

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1. Introduction

Rapid industrialization in the North East Asia, including China, Japan, and South Korea, over the past a few decades, have led to a drastic increase in emissions of pollutants(ozone precursors) such as nitrogen oxides(e.g., NO_x), volatile organic compounds(VOCs), and sulfur oxides(SO_x). These compounds have been well-known to be responsible for high levels of ozone pollution, visibility degradation, and acid deposition. From the results of observational and modeling studies in the large-scale airborne field campaigns, it was found that the export of Asian pollution could significantly influence atmospheric oxidizing power of the global atmosphere and therefore contribute to global climate change(Wild et al., 2004; Jaffe et al., 2003; Wild and Akimoto, 2001; Jacob et al., 1999). Although a number of ground-based and airborne measurements were conducted, little study focused on characterizing different atmospheric compositions before and after the summer monsoon. In this study, we investigated the contrasting photochemical characteristics.

2. Methods

Two field measurement intensives were conducted in the summer of 2004 at GIST(Gwangju Institute of Science and Technology), Gwangju, South Korea. Intensive I and II were conducted from May 23 to June 24 before the summer monsoon and from July 24 and August 13 after the monsoon, respectively. The separation of field observations was intended to avoid the heavy rains over a summer monsoon period frequently taking place from late June to mid July in the region. The measured gas-phase species included O_3, NO_x, NO_y, CO, SO_2, HONO, H_2O_2, ROOH, HCHO, various hydrocarbons, and aromatic compounds. In addition, meteorological parameters were continuously monitored, including ultraviolet(UV) radiation intensity, wind speed and direction, temperature, relative humidity, and air pressure. To estimate origins of airmasses observed during Intensives I and II, 5-day airmass back trajectories, arriving at the site(1,000m above sea level) every noon, were calculated with an 1h time step by using the HYSPLIT-4 model. We also carried out model simulations by utilizing a steady-state photochemical box model and concentrations of measured species as model inputs. The model chemistry was based on RACM(Regional Atmos- pheric Chemistry Model; Stockwell et al., 1997).

3. Results and Discussion

In terms of origins of trajectories, intensive I and II showed drastic differences. For instance, during Intensive I, most of trajectories originated from the Asian continent(i.e., Siberia and Mongolia), whereas during Intensive II, a majority of airmasses had predominant marine origins

such as the Pacific Ocean or East China Sea. As expected from the trajectory origins, levels of pollutants such as O_3, NO_x, NO_y, CO, and SO_2 observed during Intensive I were higher by about a factor of two than those during Intensive II. The model results indicated that chemical environment observed in Intensive I appeared to be VOC-limited, while that in Intensive II were close to NO_x -limited or in transition between the two.

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