

PA17) 한국 기후변화감시센터에서의 입자 생성 및 성장 Particle Formation and Growth at the KGAWC in Korea

Young-Gon Lee · Baek-Jo Kim · Jiyoung Kim

Policy Research Laboratory, National Institute of Meteorological Research

1. Introduction

We examine nucleation and growth events observed at the Korea Global Atmosphere Watch Center (KGAWC) located in the western coastal region (36°32'N, 126°19'E, h = 45.7m a.s.l.) of Korea during 2005. Basic statistics and characteristics of the particle formation and growth events are estimated from the measurements. Meteorological parameters and concentrations of gaseous pollutants are used to find favorable weather and environmental situations for the nucleation events in Asian continental outflow region and compare with results from the previous studies.

2. Measurements

Particle size and number concentrations were measured with a Scanning Mobility Particle Sizer (SMPS model 3034, TSI Inc., USA). The SMPS was operated with an aerosol flow rate of 1.0L min⁻¹ and a sheath airflow rate of 4.0L min⁻¹. Data was collected in 34 size bins with midpoints ranging from 10 to 487nm in diameter. Mobility size distributions were collected every 3-minute to provide reasonable measurements between size resolution, time resolution, and particle counting statistics for the atmospheric application (Kulmala et al., 2004).

Surface meteorological parameters, accumulated UV-B irradiance ranged from 280 to 320nm, and two reactive gases (O₃ and SO₂) were measured in parallel with the aerosol measurements.

3. Results

The nucleation events have been analyzed at the KGAWC located in the western coast of Korea for the year 2005. The particle formation events were classified into four classes according to the shape of the number concentration of the nucleation mode particles, as considered in Mäkelä et al. (2000).

The results of this study can be summarized as follows:

- 1) Fifty-six days were detected as the particle formation event in the 291 analyzed days, and 48 event days (about 76.8% of the 56 event days) were categorized as class 1 and 2. The nucleation events were occurred most frequently during spring and autumn. The estimated growth rates for the classes 1 and 2 ranged from 1.0 to 15.7nm h⁻¹ and the averaged mean value were 5.9nm h⁻¹. Monthly variation of the growth rates was lowest in February and highest in October. These estimated values and temporal variation are well agreed with other experimental results in various sites in the world.
- 2) UV-B irradiance, relative humidity, and wind direction were analyzed with the formation events. The burst of ultrafine particles is usually found when the amount of UV-B irradiance exceeds 50mW m⁻², and its duration time is extended according to the solar irradiance. Relative humidity, however, shows a negative relationship with the nucleation events. The events are easily occurred at the low relative humidity of less than 67 % on the event days. Wind direction at 10-m height

over the KGAWC building was analyzed with total number concentration of nucleation mode particles(<20nm) for the formation events. The increase of the nucleation mode particles during the cold season were related with a westerly wind accompanied with the cold and dry air outbreak behind cold fronts. It is noted that the particle formation events are frequently observed on sunny days when cold and dry air mass is moved from west and the events are a synoptic-scale phenomenon.

- 3) Diurnal variations of O₃ and SO₂ were analyzed with the clear particle formation event(class 1 and 2) and non-event days. Both of the gases showed higher concentrations on event days than non-event days. The fact that most of the nucleation events are observed in high O₃ and SO₂ concentrations suggests an abundance of the gases creates favorable conditions for the production of particles.

Acknowledgements

This work was supported by the project of KMA's R&D program under grant NIMR-2009-B-6.

References

- Kulmala, M., H. Vehkamäki, T. Petäjä, M. Dal Maso, A. Lauri, V.-M. Kerminen, W. Birmili, and P.H. McMurry (2004) Formation and growth rates of ultrafine atmospheric particles: a review of observations. *Journal of Aerosol Science*, 35, 143-176.
- Mäkelä, J.M., M. Dal Maso, A. Laaksonen, M. Kulmala, L. Pirjola, P. Keronen, and L. Laakso (2000) Characteristics of the aerosol particle formation events observed at a boreal forest site in southern Finland. *Boreal Environment Research*, 5, 299313.