DISPESION OF PARTICULATE MATTER IN COASTAL MOUNTAIN-GIRT SEOUL AREA

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INTRODUCTION

In the mountain-girt metropolitan with its western outlet connected with coast, the diurnal variations of emitted particulate concentrations are greatly affected by diurnal atmospheric circulation and the depth of atmospheric boundary (Ross *et al*., 1999). The purpose of this study is to investigate how wind, atmospheric boundary, topography and sea can act as important rolls on the occurrence of nocturnal high concentrations of total suspended particulates by meteorological model and particle model.

NUMERICAL METHOD

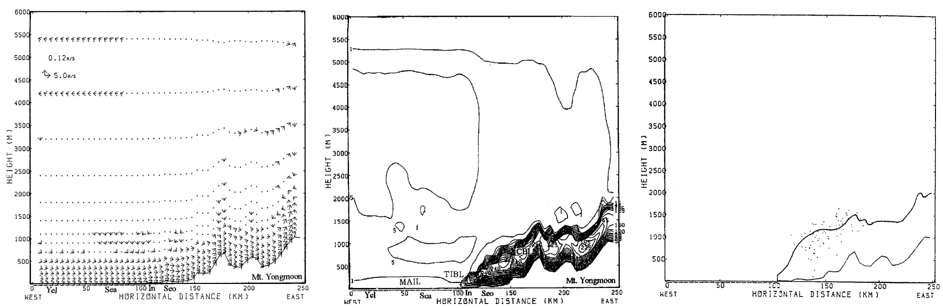
The dispersion and diffusion of suspended particulate matters floated from the ground surface were investigated by a meteorological model-three dimensional non-hydrostatic grid point model with a terrain influenced coordinate system (x, y, z*) and a pollution model-random walk model (or lagrangian particle model) with a terrain following coordinate system (x, y, z+) through the transforming z* into z+ coordinate for the conservation of mass. Numerical simulations of 48 hours from 20 to 22 May, 1998 were made by Hitachi super computer of Meteorological Research Institute. Two different domains of 50x50 grid points were adopted with a uniform horizontal interval-20km in a coarse-mesh and 5km in a fine-mesh for one-way double nesting, respectively and 15 vertical levels were divided from 10m into 6km.

RESULT AND DISCUSSION

During the day, divergence of wind field on the Yellow Sea in the western outlet of mountain-girt Seoul city (plain) like a jar could generate westerly synoptic wind toward the coast and the association of synoptic wind with westerly sea breeze in the coast produced relatively strong onshore wind toward Seoul city. Simultaneously, as westerly valley wind from plain to mountain was also generated, westerly resultant wind intensified by synoptic wind, sea-breeze and valley wind occurred in the metropolitan area. Thermal internal boundary layer with 100m thickness was developed from the coast toward inland basin below sea breeze circulation, and convective boundary layer (CBL) with 1km thickness was also developed in Seoul and further high mountains. Due to the thermal heating of the ground surface, particulates floated from the metropolitan surface toward the top of CBL and then, the westerly resultant wind transported them to widely spread over the girt mountains.

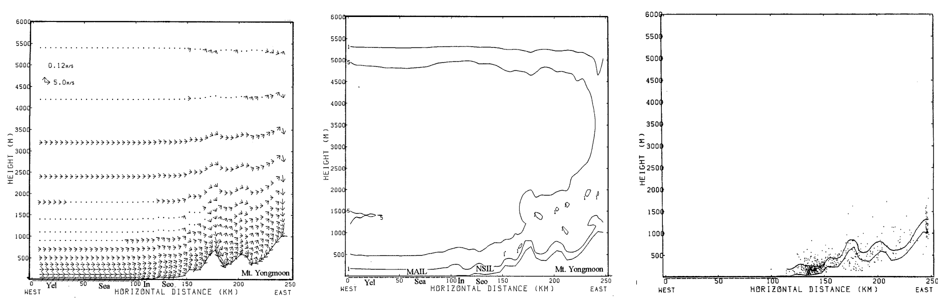
At night, nighttime radiative cooling of the ground produced a shallow nocturnal surface inversion layer (NSIL) with a 200m thickness over the inland surface, but a relatively thick marine atmospheric inversion layer thickness of 300m was found in the Yellow Sea. As downslope wind (mountain wind) from the girt mountain toward the inland plain-Seoul was combined with land-breeze from inland plain toward Yellow Sea, becoming strong easterly offshore wind (land-mountain breeze). As downslope wind penetrated into metropolitan area and the shrunken NSIL induced not only daytime floated particulates near the top of the CBL and transported ones into the mountain, but also nighttime emitted particulates from the surface to merge into the downtown of the city, a maximum ground level concentration of total suspended particulates (TSP) occurred at 0300LST.

Then, the particulates escaped through the western outlet of the city and further moved toward coastal sea. As westerly synoptic wind in the Yellow Sea could interrupt the propagation of easterly offshore wind in the coast, coastal resultant wind was weak westerly and induced the particulates transported from the city to continuously stay in the coast, enhancing high TSP concentration.



(a) (b) (c)

Figure 1. Vertical profiles of winds (m/s) on the Yellow Sea (Yel) (west)-Seoul (center)-Mt. Yongmoon (east) at 1200LST, May 21, 1998 (a). Vertical diffusion coefficients of turbulent heat (m^2/s) show the development of thermal internal boundary (TIBL) from the coastal Inchon city (In) toward the inland basin, convective boundary layer (CBL; 800m depth) of 1300m in Seoul (Seo) and marine atmospheric inversion layer (MAIL) (b). 6 hours later after releasing particulates, particulates float up to the CBL top and TSP concentration under westerly onshore wind is very low (c).



(a) (b) **(c)**

Figure 2. Vertical profiles of wind at 0000LST, May 22. Synoptic westerly wind suppresses offshore wind (land-mountain breeze), resulting in weak westerly wind in Seoul (Seo) (a). Vertical diffusion coefficient of turbulent heat (m^2/s) shows the formation of NSIL (b). From the daytime CBL top and the mountain, particulates merge into the metropolitan surface and shrunken NSIL causes a maximum ground level concentration of TSP at 0000LST in Seoul (c).

At 0800LST, on the next day, the dispersed particulates in the coastal inland and over the coastal sea return to the metropolitan area by strong onshore wind-synoptic westerly and sea breeze and float again toward the top of CBL in the city. These recycled particulates from the coast with daytime continuously emitted ones from the ground surface should induce a high particulate concentration.

REFERENCES

Ross, D. G., Lewis, A. M. and Koutsenko, G., (1999). Comalco Aluminum (Bell Bay) Ltd, Air Quality Modelling for winter validation IOP (IOP-F). CAMM report No. 5/99, July, 1999.