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4B3) 오염의 영향을 받지 않은 해양 boundary layer에서의 H_2O_2, CH_3OOH, 그리고 HCHO에 대한 난류수송과 대기화학의 영향

Influence of turbulent transport and chemistry on the distribution of H_2O_2, CH_3OOH, and HCHO in the remote marine boundary layer

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1. Introduction

This study is motivated by the discrepancies found in previous studies that compared the observed photochemically reactive species in the marine boundary layer (MBL) with the model simulations. In particular, HCHO was underpredicted in PEM-Tropics (B) and overpredicted in TRACE-A, H_2O_2 overpredicted, CH_3OOH overpredicted, and CH_3OH significantly overpredicted (Thompson et al., 1993; Heikes et al., 1996; Davis et al., 1996; Jacob et al., 1996; Schultz et al., 1997; Suhre et al., 1998). Those studies employed a variety of photochemical box models and 1-D gas-phase photochemical transport models. None included all of the processes important to the MBL such as gas-phase photochemistry, eddy diffusion, exchange between the free troposphere and MBL, air-sea gas exchange, scavenging by seasalt aerosols, and seasalt aerosol chemistry involving halogen species.

2. Methods

Hypothesizing that incorporation of these processes in a single model would resolve the discrepancies, a one-dimensional photochemical model was developed. The model involves integrating 130 partial differential equations using the operator-splitting method.

3. Results and Discussions

A series of model simulations were conducted with varied model chemistry and material boundary flux conditions. The observational data (collected in the equatorial MBL during
the PEM-Tropics (B) field program) were compared with the model results. The results indicate that two processes; 1) the FT-to-MBL O_3 transport and 2) dry deposition critically influence the abundance of the key species. The results show that gas-phase chemistry alone with rationalized flux conditions is capable of capturing the behavior of CH_3OOH and HCHO and other processes (scavenging by seasalt particles and seasalt
aerosol chemistry involving halogen species) are found to be negligible under PEM-Tropics (B) conditions. The comparisons show general agreement between the observations and theory for O_3, OH, CH_3OOH, HCHO, NO_x, and SO_2. There remain gaps in our understanding of other species such as H_2O_2, CH_3OH, DMS, and total nitrate (HNO_3 + nitrate).

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