

## 2D3) 해수면으로의 오존침적 Ozone deposition to the sea surface

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### 1. Introduction

Deposition to the sea surface is one of ozone's principal loss mechanisms (Galbally and Roy, 1980; Levy et al., 1985; Kramm, 1995). However, since complicated physical and chemical processes are involved, large uncertainties remain in evaluating this loss mechanism that need to be better characterized. In this study we attempted to explore possible causes that give rise to large variability of ozone deposition velocity in terms of wind speed and chemical reactivity in the aqueous-phase film.

### 2. Methods

A numerical module was developed to estimate the deposition velocity. It is analogous to formulations by Liss and Merlivat (1986), Wesely (1989), and Duce et al. (1991). This module describes the gas-transfer processes using three layers from top to bottom: an atmospheric surface layer, a gas-phase film, and a liquid-phase film. The gas-transfer processes are described in terms of layer resistances; aerodynamic resistance ( $R_1$ ), gas-phase film resistance ( $R_2$ ), and aqueous-phase film resistance ( $R_3$ ), respectively. The total resistance ( $R_T$ ), a reciprocal of deposition velocity ( $v_d$ ), is the sum of these layer resistances. In particular, we parameterized  $R_3$  as a function of wind speed at 10 m height ( $U_{10}$ ) and chemical reactivity in the liquid-phase film.

### 3. Results and Discussions

We applied the model to the most recent and frequently cited open-ocean data where wind speed and  $R_T$ , both were measured (Kawa and Pearson, 1989). The resulting  $v_d$  increases from 0.017 to 0.078 cm/s by about factor of 4.6 as  $U_{10}$  increases from 0 to 20 m/s, indicating importance of wind-induced gas-transfer.  $v_d$  stays nearly constant when  $U_{10}$  varies from 0 to 4 m/s, suggesting significance of molecular gas-transfer at low wind speed. We also examined surface ocean distributions of chemical compounds reacting with ozone in order to assess ozone loss by the molecular gas-transfer. Only iodide was identified to significantly contribute to the ozone loss of  $v_d$  confirming finding of Garland et al. (1980). In addition, considering reactions and reactants, known to date to be involved with ozone destruction in seawater, dissolved organic matter does not appear to play a substantial role. The large variability of  $v_d$  may be interpreted by the difference in chemical characteristics of the sea-surfaces. Wide range of surface iodine concentrations found in open oceans provided a potential cause for the variability. Clearly more observational data of ozone surface deposition are needed under a variety of wind speeds and ocean surface chemical regimes to constrain this loss process.

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