



Estimation of a ship-plume ozone production efficiency: ITCT 2K2 case study

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Ozone Production Efficiency (OPE) of ship plume was first evaluated in this study, based on ship-plume photochemical/dynamic model simulation and the ship-plume composition data measured during the ITCT 2K2 (Intercontinental Transport and Chemical Transformation2002) aircraft campaign. The averaged instantaneous OPEs ($\overline{OPE^i}$) estimated via the ship-plume photochemical/dynamic modeling for the ITCT 2K2 ship-plume ranged between 4.61 and 18.92, showing that the values vary with the extent of chemical evolution (or chemical stage) of the ship plume and the stability classes of the marine boundary layer (MBL). Together with $\overline{OPE^i}$, the equivalent OPEs ($\overline{OPE^e}$) for the entire ITCT 2K2 ship-plume were also estimated. The $\overline{OPE^e}$ values varied between 9.73 (for the stable MBL) and 12.73 (for the moderately stable MBL), which agreed well with the $\overline{OPE^e}$ of 12.85 estimated based on the ITCT 2K2 ship-plume observations. It was also found that both the model-simulated and observation-based $\overline{OPE^e}$ inside the ship-plume were 0.29-0.38 times smaller than the $\overline{OPE^e}$ calculated/measured outside the ITCT 2K2 ship-plume. Such low OPEs insides the ship plume were due to the high levels of NO and non-liner ship-plume photochemistry. Possible implications of this ship-plume OPE study in the global chemistry-transport modeling are also discussed.