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Volatile organic compounds (VOCs) emission rates estimation using airborne in-situ formaldehyde (HCHO) observation from a petrochemical complex in Korea

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Large industrial facilities, such as petrochemical facilities, have a decisive effect on regional air quality directly due to their own volatile organic compounds (VOC) emissions and indirectly due to its contributions to secondary O_3 and particulate matter production. Thus, knowing the accurate emission rates of VOCs from industrial facilities is essential to make effective control policies for air quality improvement. In this study, we propose a new top-down estimation method of VOCs emission rates using in-situ airborne formaldehyde (HCHO) observation. For that, we utilized HCHO data acquired from the NASA Compact Airborne Formaldehyde Experiment (CAFE) instrument on Hanseo King Air during the KORUS-AQ2016 mission in Korea, which peaked up to 12ppb when it sampled the outflow of Daesan petrochemical complex (DPC) plume on May 22^{nd} flight. In conjunction with 0-dimensional box modeling analysis as well as VOCs species information provided by Whole Air Sampler (WAS) on NASA DC8, we estimate 31,000 ton of VOCs are emitted in a year as a lower limit by using inferred secondary HCHO production rates. Our estimate is roughly 7 times higher than the latest version of Korean emission inventory, KORUSv1.0. Considering the included VOC species for our lower limit estimation (i.e. ethene, propene 1, 3-butadiene, isoprene, toluene, benzene, acetaldehyde, i-butane, and n-butane), the discrepancy is likely be larger. Our new method as well as similar analysis of other source types and areas to validate the emission inventories will benefit to understand the characteristics of air quality in Korea.