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Development and evaluation of the NO₂ profile algorithm from Pandora measurements in South Korea

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The algorithm developed for retrieving Nitrogen Dioxide (NO₂) profiles utilizes optimal estimation and is based on sky measurement data obtained from the Pandora instrument. In this study, the Aerosol Optical Thickness (AOT) was calculated and employed as an input parameter through the SMART-s algorithm (Jeong et al., 2022). The NO₂ profile was retrieved by least-square fitting utilizing the VLIDORT radiative transfer model with a priori information derived from Community Earth System Model (CESM) data. Pandora measurements were taken in Yongin, South Korea from December 2021 to January 2022. The retrieved NO₂ profile was compared with surface NO₂ concentrations near two in situ sites. The correlation and Root Mean Square Error (RMSE) between the surface concentration measured by Pandora and the two in situ sites were approximately 0.56 and 12.24 ppb, respectively. A higher correlation was observed with in situ locations positioned along the line of sight compared to nearer sites. This correlation was further enhanced when incorporating aerosol optical thickness directly obtained from Pandora measurements. The findings of this study suggest that considering aerosol information in the retrieval of NO₂ profiles, as measured values, can contribute to improvements.