

# Ground-Based MAX-DOAS Observations for Spatiotemporal Distribution and Transport of Atmospheric Water Vapor in Beijing

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## S1. Comparison between MAX-DOAS and long-term ERA5 data

To further investigate the representativeness of the MAX-DOAS data used in this study, we conducted a comparative analysis with the long-term ERA5 precipitable water data (2014–2023). The 2014–2023 precipitable water data used in our study was obtained from the ERA5 reanalysis dataset provided by the European Centre for Medium-Range Weather Forecasts (ECMWF). ERA5 offers high-resolution, globally consistent climate and weather data, integrating observations with advanced modeling through data assimilation. Specifically, the dataset provides hourly estimates of various atmospheric parameters, with the data used in this study sourced from the monthly mean products on single levels.

The comparison results are shown in Figures S1 and S2. The seasonal distribution of water vapor observed by MAX-DOAS is consistent with the trend of ERA5 data over the past decade, with the highest concentrations in July and August and the lowest in winter. The comparative analysis between the one-year MAX-DOAS observations and the multi-year mean of ERA5 data shows good correlation, with  $r=0.95$  and the fitted line described by  $y=0.82x-0.92$ . This strong correlation further demonstrates that the one-year MAX-DOAS observations are representative of longer-term climatic conditions.

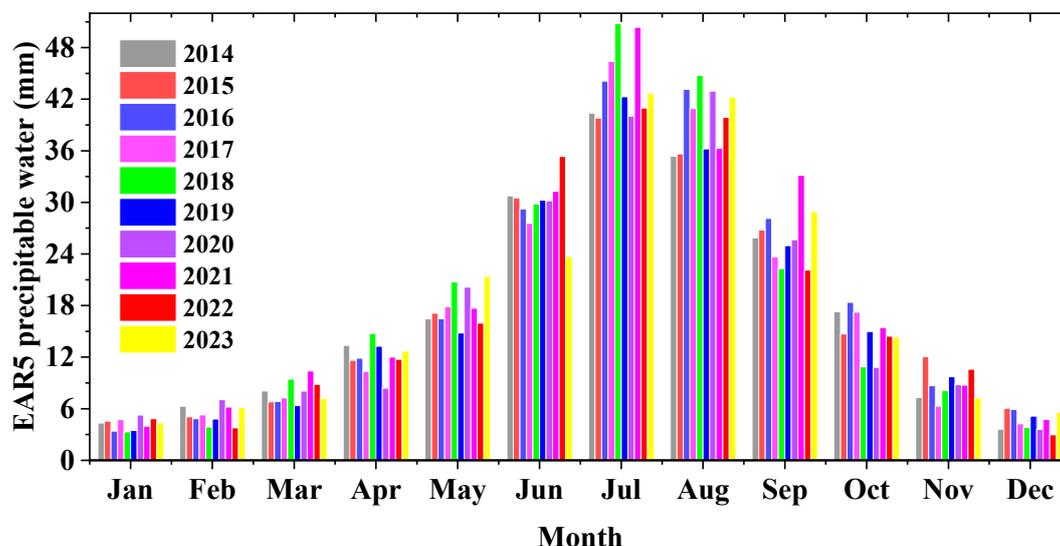
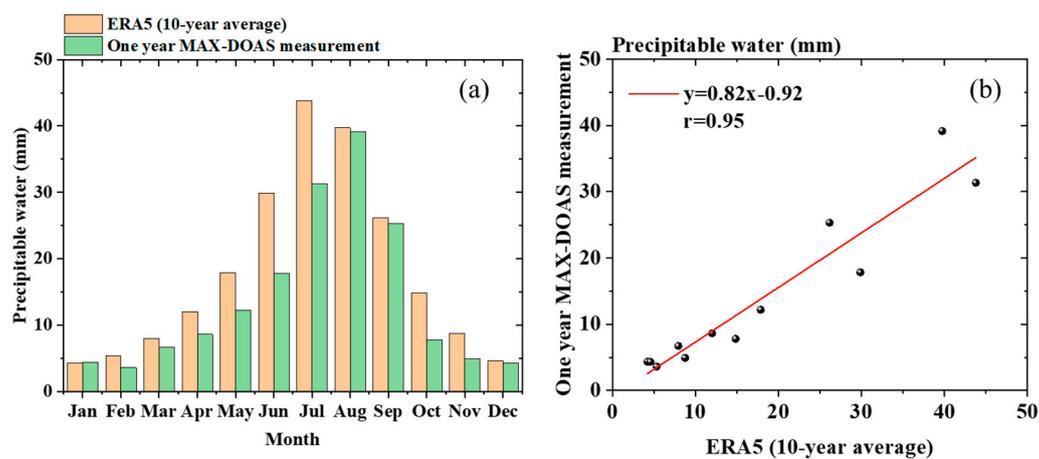


Figure S1. ERA5 monthly distribution of precipitable water in the most recent ten years (2014–2023).



**Figure S2.** Comparison between MAX-DOAS and long-term ERA5 data (a) comparison of trends; (b) correlation analysis.