

Supplementary Material

Investigation of Vertical Profiles of Particulate Matter and Meteorological Variables up to 2.5 km in Altitude Using a Drone-Based Monitoring System

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1. Miniaturized aerosol instruments for particulate matter monitoring

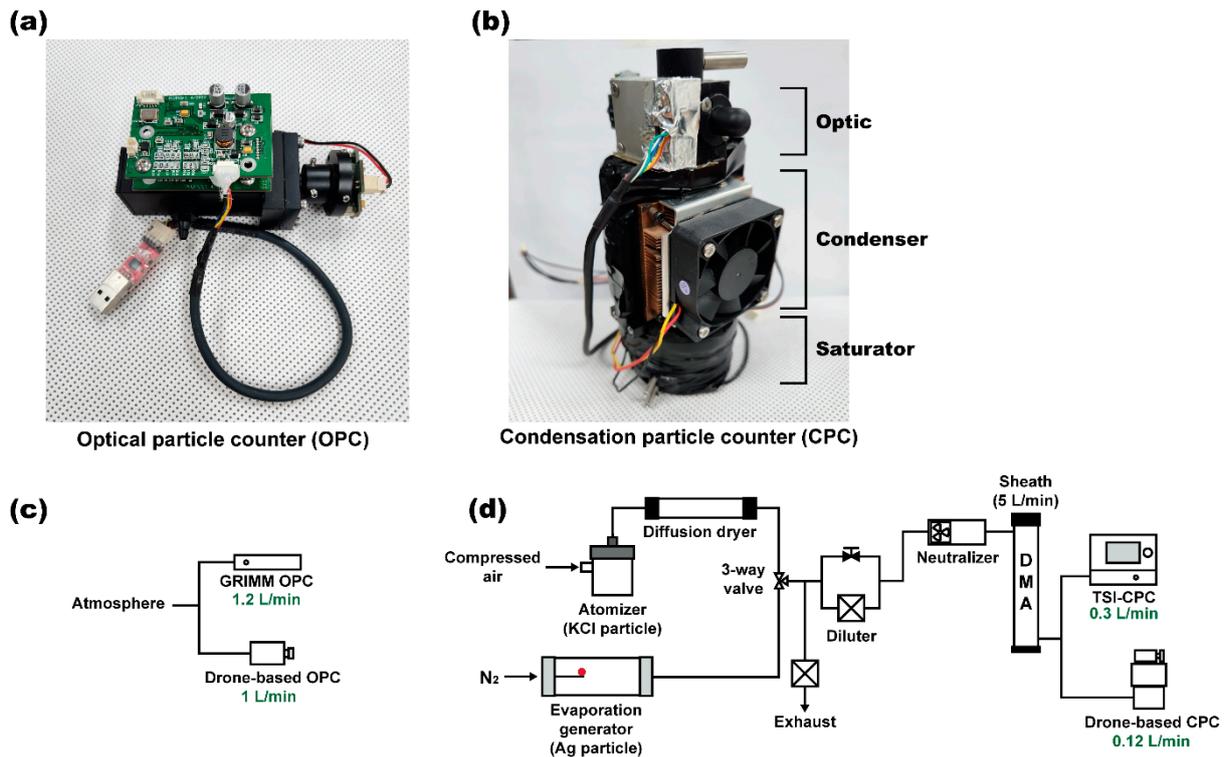


Figure S1. Miniaturized aerosol measurement instruments integrated into the UAV platform: (a) Optical particle counter (OPC) used for particle size detection based on light scattering; (b) Condensation particle counter (CPC) designed for ultrafine particle detection using a condensation growth technique. Calibration setups for (c) OPC using a GRIMM reference instrument and (d) CPC using a TSI-CPC with a monodisperse particle generation system.

2. Drone operation sites and performance validation

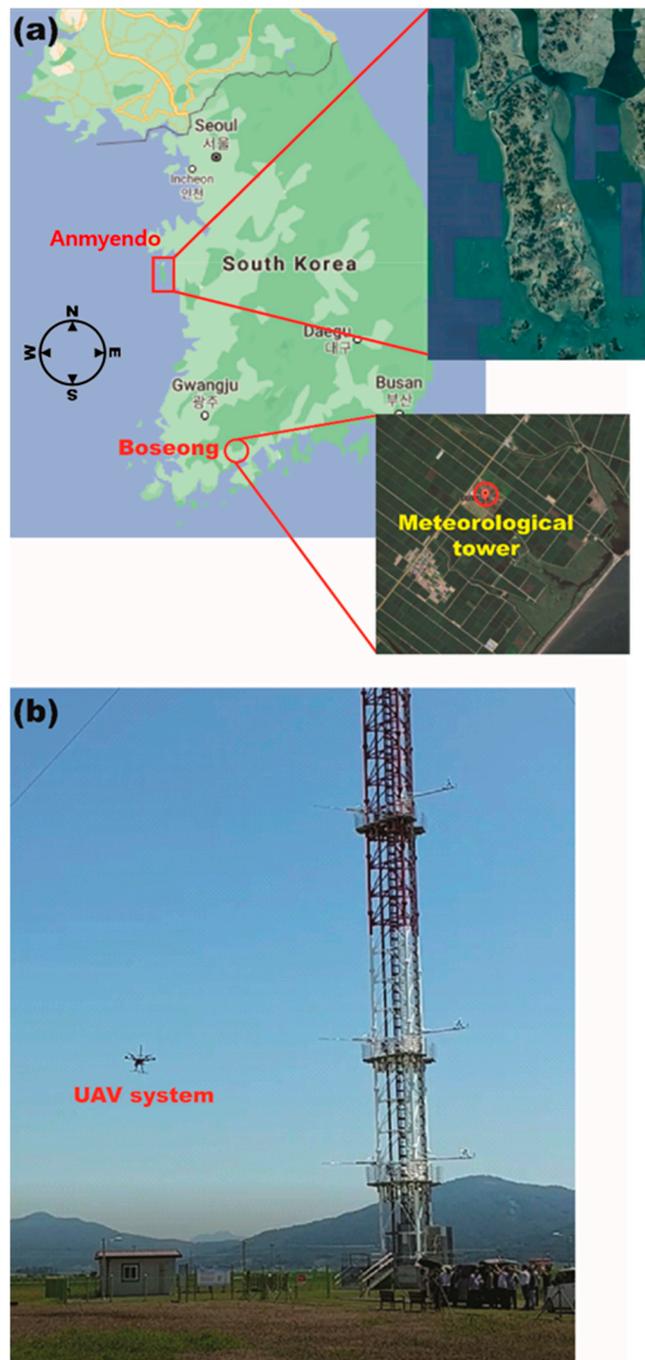


Figure S2. Experimental locations and UAV comparative measurements: (a) Map showing the locations of the meteorological tower in Boseong. The inset highlights the meteorological tower within the Boseong area. (b) Photograph of the UAV system in operation, hovering near the meteorological tower during comparative measurements to ensure sensor accuracy and data reliability.

3. Comparison between tower- and drone-based measurement values for meteorological data

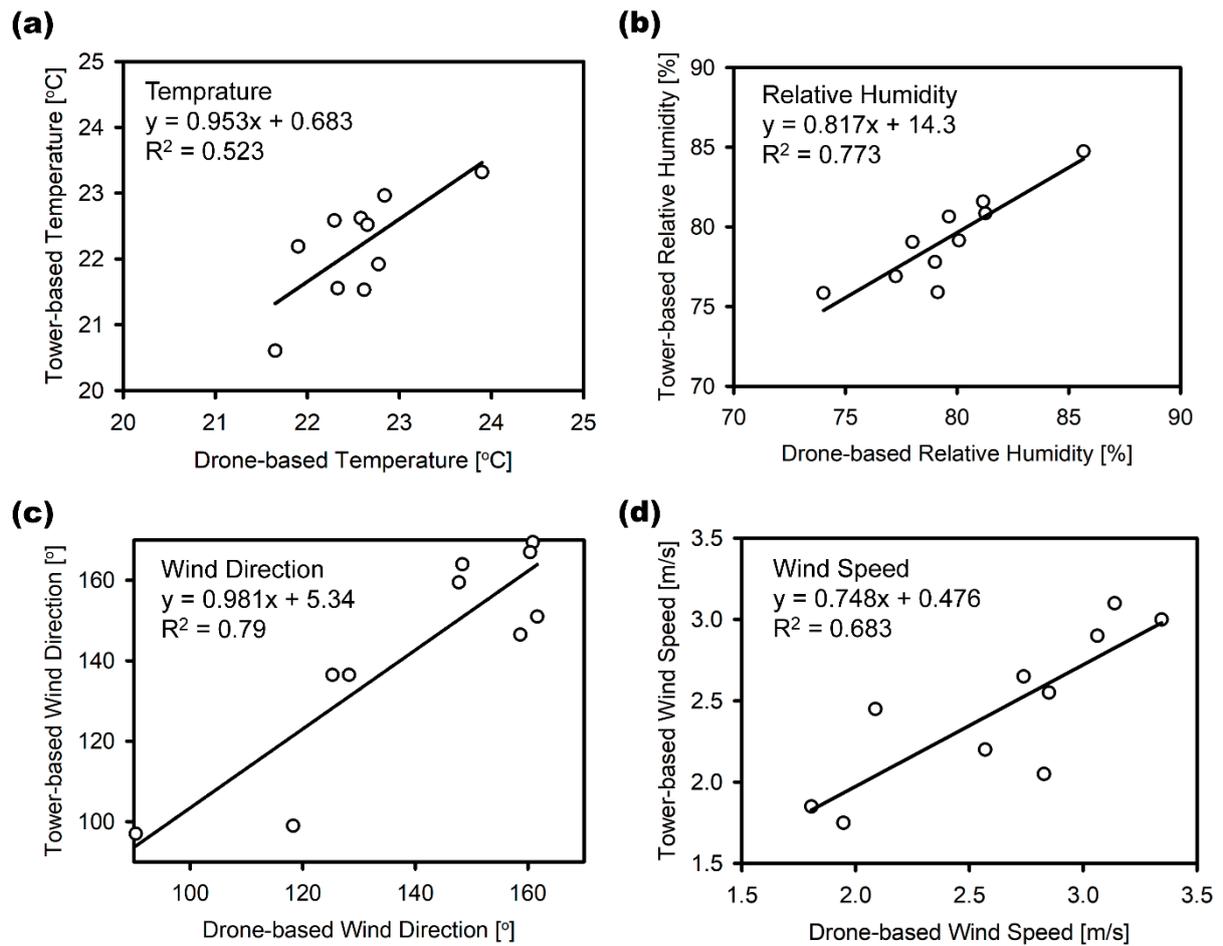


Figure S3. Comparison between tower-based and drone-based measurements for (a) temperature, (b) relative humidity, (c) wind direction, and (d) wind speed. Each plot presents the linear regression equation and the coefficient of determination (R^2) for the correlation between the two measurement methods.

4. Diurnal variations of WD, WS, T, and RH

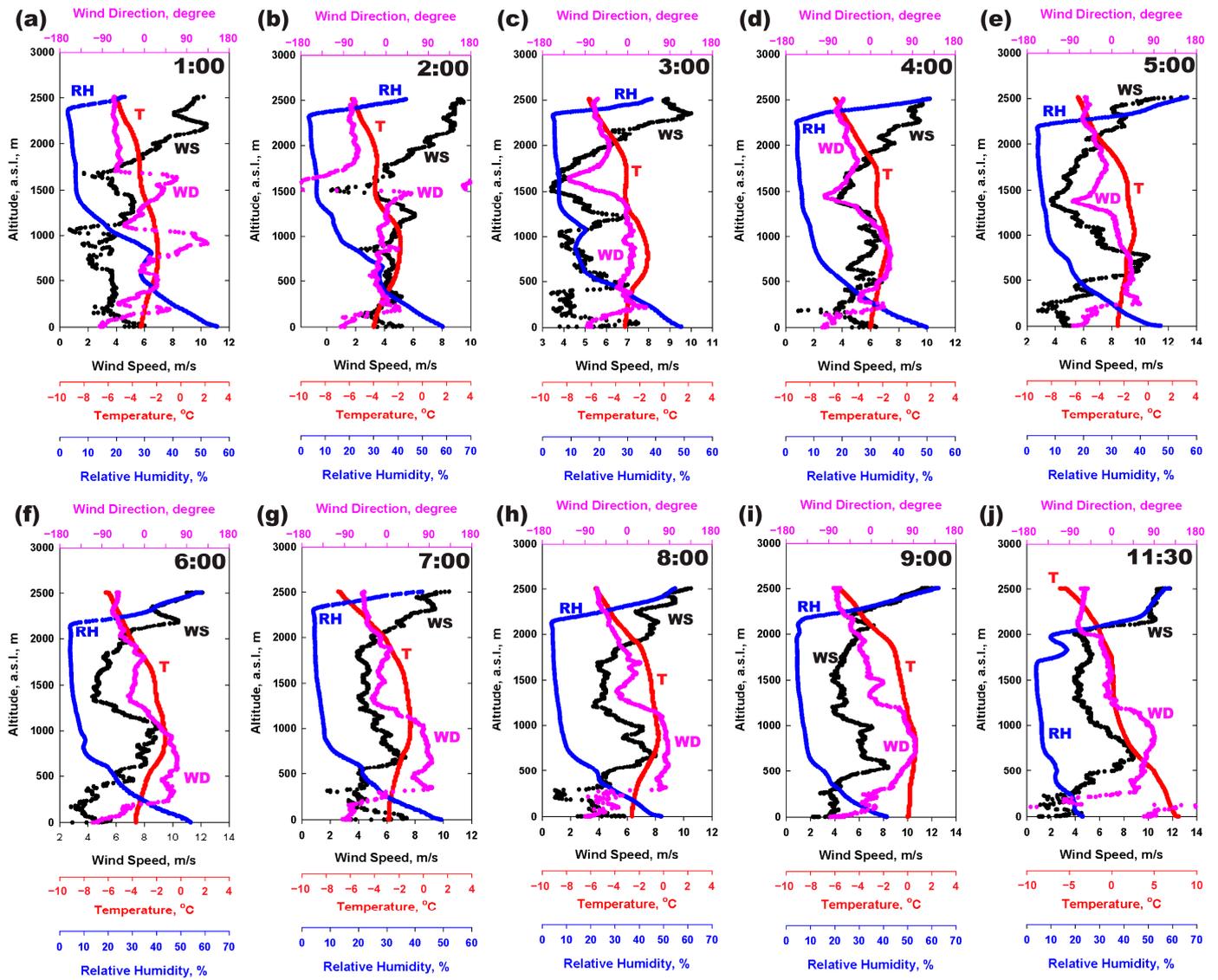


Figure S4. Diurnal variations of WD, WS, T, and RH with altitude up to 2,500 m, measured hourly from 1:00 to 23:00.

4. (Continued) Diurnal variations of WD, WS, T, and RH

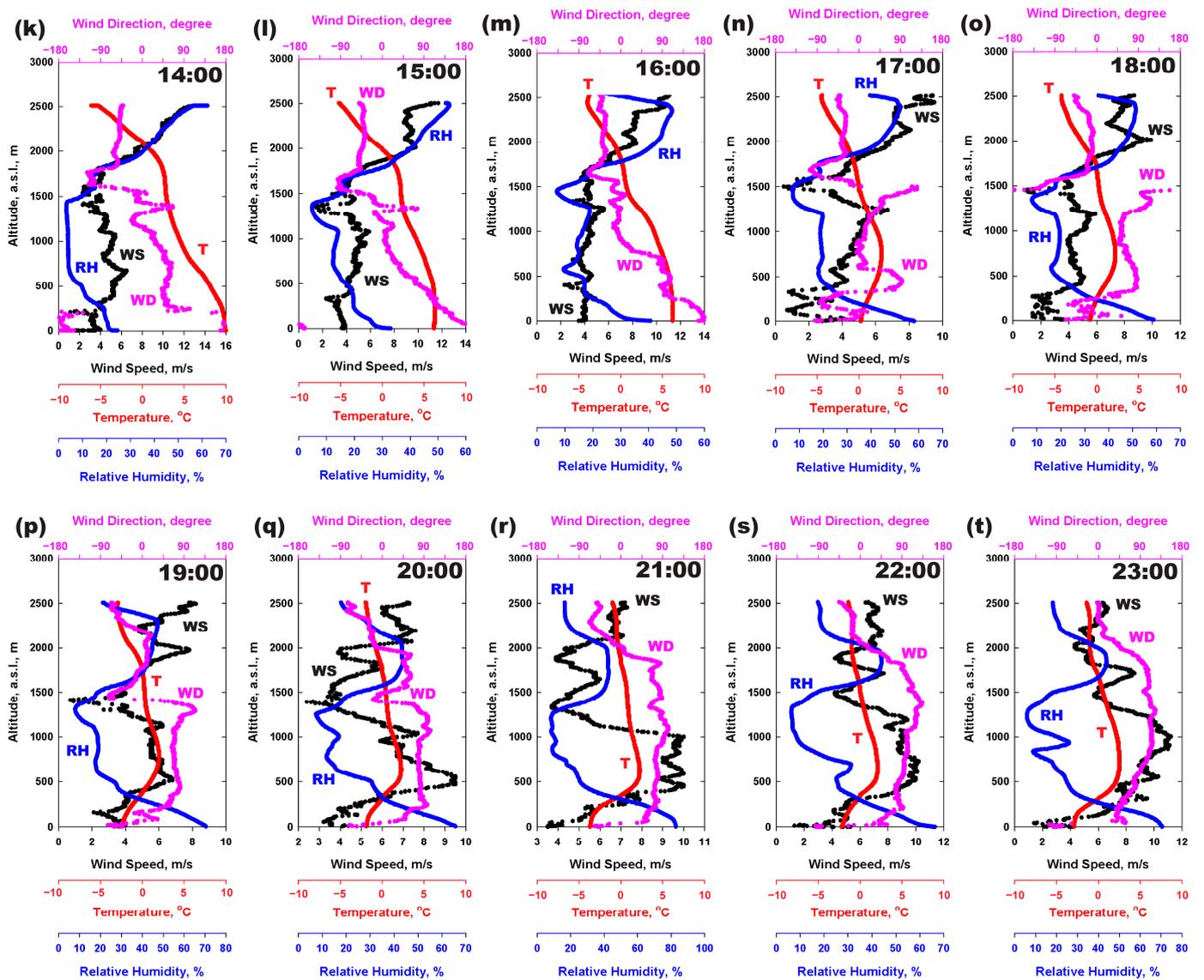


Figure S4. (Continued) Diurnal variations of WD, WS, T, and RH with altitude up to 2,500 m, measured hourly from 1:00 to 23:00.