Supplementary information of

Deployment and Evaluation of a Low-Cost Sensor System for Atmospheric CO_2 Monitoring on a Sea-Air Interface Buoy

Jialu Liu[1,2], Pengfei Han[3*], Huiling Ouyang[1,4], Ning Zeng[5,6], Zhenfeng Wang[1], Jian Wang[1], Weiwei Fu[1,2], Honggang Lv[7], Wenhao Lin[8], Zheng Xia[1,9,10], Bo Yao[1,2, 11*]

[1]Department of Atmospheric and Oceanic Sciences and Institute of Atmospheric Sciences, Fudan University, Shanghai, 200438, China

[2]Shanghai Frontiers Science Center of Atmosphere-Ocean Interaction, Key Laboratory of Polar Atmosphere-Ocean-Ice System for Weather and Climate of Ministry of Education, and Shanghai Key Laboratory of Ocean-Land-Atmosphere Boundary Dynamics, Fudan University, Shanghai, 200438, China

[3]State Key Laboratory of Atmospheric Environment and Extreme Meteorology, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China

[4]Observation and Research Station of Huaniaoshan East China Sea Ocean-Atmosphere Integrated Ecosystem, Ministry of Natural Resources, Shanghai, 200136, China

[5]Department of Atmospheric and Oceanic Science, University of Maryland, College Park, Maryland, 20742, USA

[6]Earth System Science Interdisciplinary Center, University of Maryland, College Park, Maryland, 20742, USA

[7]Key Laboratory of Marine Hazards Forecasting, National Marine Environmental Forecasting Center, Ministry of Natural Resources (MNR), Beijing, 100081, China; National Marine Environmental Forecasting Center, Beijing, 100081, China

[8]Zhejiang Environmental Monitoring Engineering, Co.Ltd., 310013, China

[9]Zhejiang Ecological and Environmental Monitoring Center, Hangzhou, 310012, China

[10]Zhejiang Key Laboratory of Ecological and Environmental Monitoring, Forewarning and Quality Control, Hangzhou, 310012, China

[11]National Observation and Research Station for Wetland Ecosystems of the Yangtze Estuary, Shanghai, 201112, China

Correspondence to: Bo Yao (yaobo@fudan.edu.cn); Pengfei Han (pfhan@mail.iap.ac.cn)

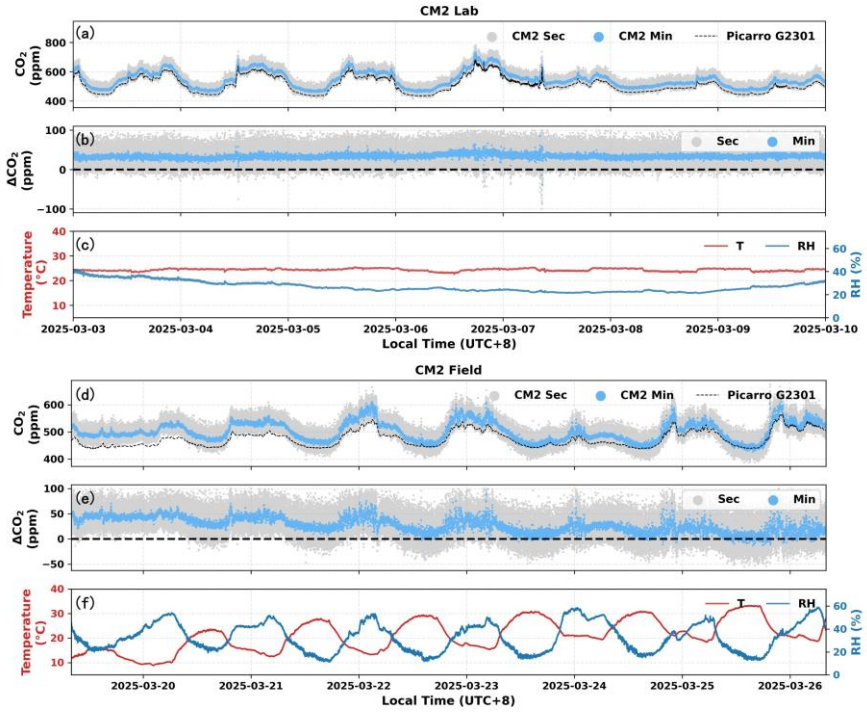

Figure S1: Time series of CM2 data during laboratory (a, c, e) and land-based field (b, d, f) observations. (a, d) CM2-measured CO_2 concentration at second-level resolution (grey dots) and minute-level resolution (blue dots), alongside Picarro-measured CO_2 concentration (black line). (b, e) Time series of CO_2 concentration difference (ΔCO_2=CM2-Picarro) at second-level (grey dots) and minute-level (blue dots) resolution. (c, f) Time series of ambient temperature (T, red line) and relative humidity (RH, blue line).

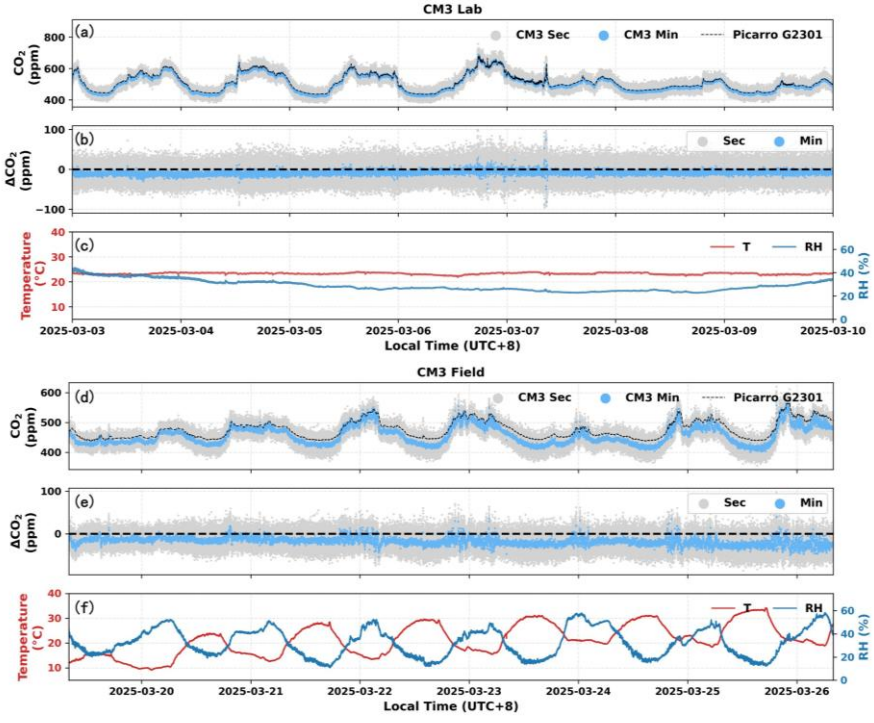

Figure S2: Time series of CM3 data during laboratory (a, c, e) and land-based field (b, d, f) observations. (a, d)

CM3-measured CO_2 concentration at second-level resolution (grey dots) and minute-level resolution (blue dots), alongside Picarro-measured CO_2 concentration (black line). (b, e) Time series of CO_2 concentration difference (ΔCO_2=CM3-Picarro) at second-level (grey dots) and minute-level (blue dots) resolution. (c, f) Time series of ambient temperature (T, red line) and relative humidity (RH, blue line).

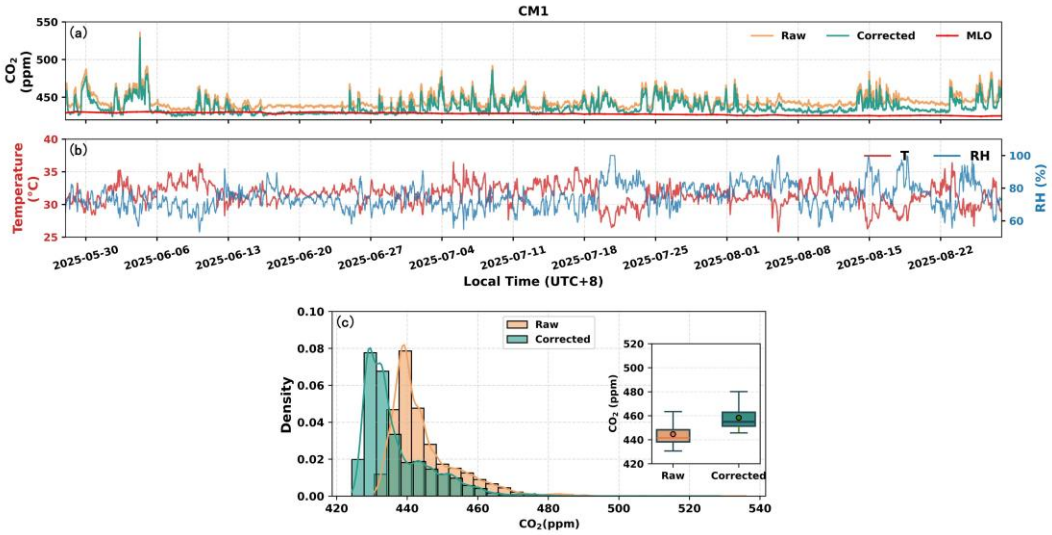

Figure S3: Offshore buoy observation results of CM1. (a) Hourly moving average time series of CO_2 concentrations from CMs before correction (orange line) and after correction (green line), together with daily mean CO_2 series from Mauna Loa Observatory (MLO, red line). The light red and light blue shaded backgrounds correspond to CO_2 fluctuation periods and stable periods, respectively. (b) Time series of ambient temperature (T, red line) and relative humidity (RH, blue line). (c) Histograms and boxplots showing the distributions of CO_2 concentrations before (orange bars) and after correction (green bars).

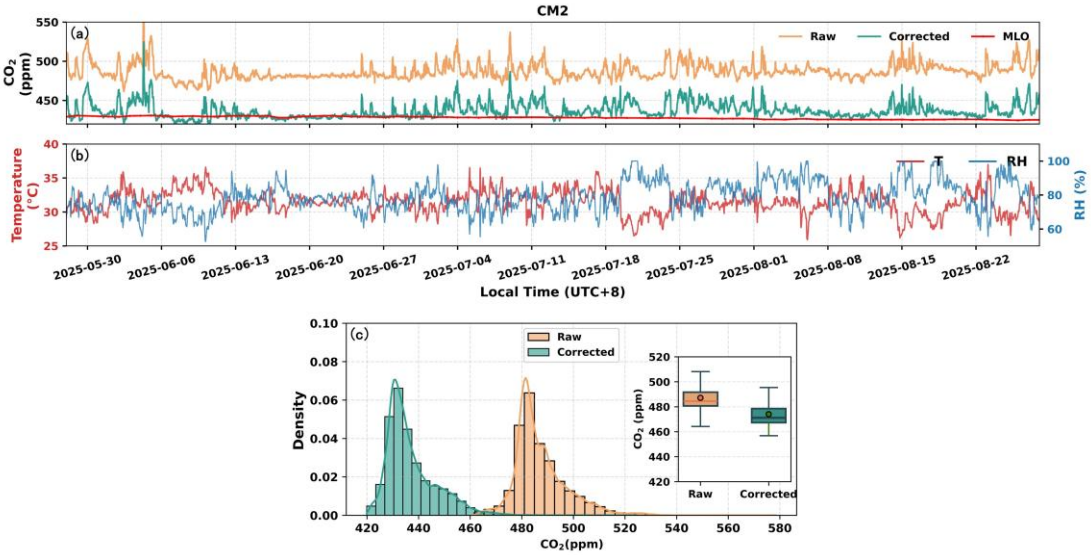

Figure S4: Offshore buoy observation results of CM2. (a) Hourly moving average time series of CO_2 concentrations from CMs before correction (orange line) and after correction (green line), together with daily mean CO_2 series from Mauna Loa Observatory (MLO, red line). The light red and light blue shaded backgrounds correspond to CO_2 fluctuation periods and stable periods, respectively. (b) Time series of ambient temperature (T, red line) and relative

humidity (RH, blue line). (c) Histograms and boxplots showing the distributions of CO_2 concentrations before (orange bars) and after correction (green bars).

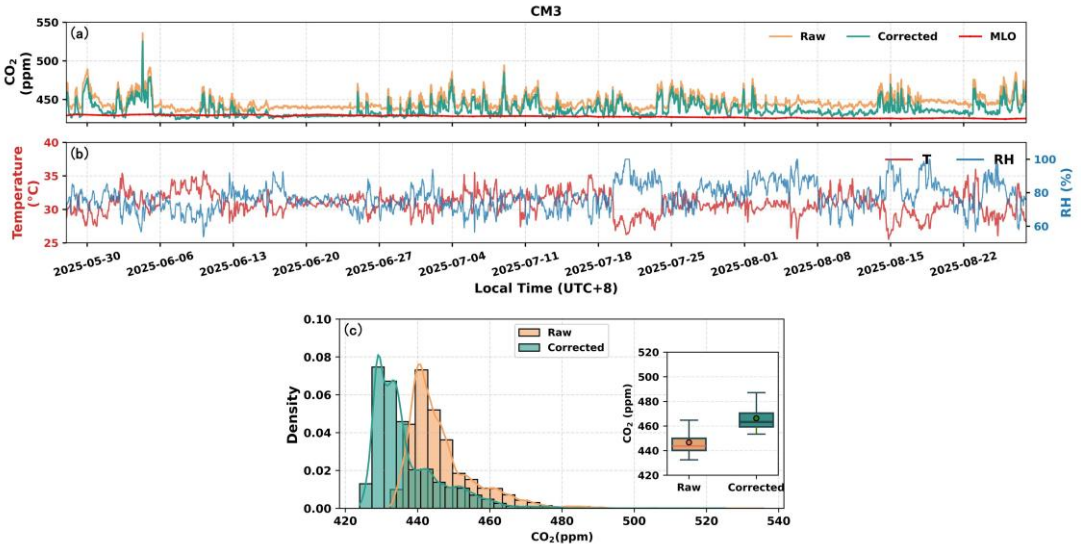

Figure S5: Offshore observation results of CM3. (a) Hourly moving average time series of CMs CO_2 before correction (yellow line) and after correction (green line), together with daily mean CO_2 series from MLO (red line). The light red and light blue shaded backgrounds correspond to CO_2 fluctuating and stable periods, respectively. (b) Time series of temperature (red line) and relative humidity (blue line). (c) Histograms and boxplots of CO_2 distributions before and after correction.