Supplementary information

1. Supplementary materials and methods

1.1.Hardware

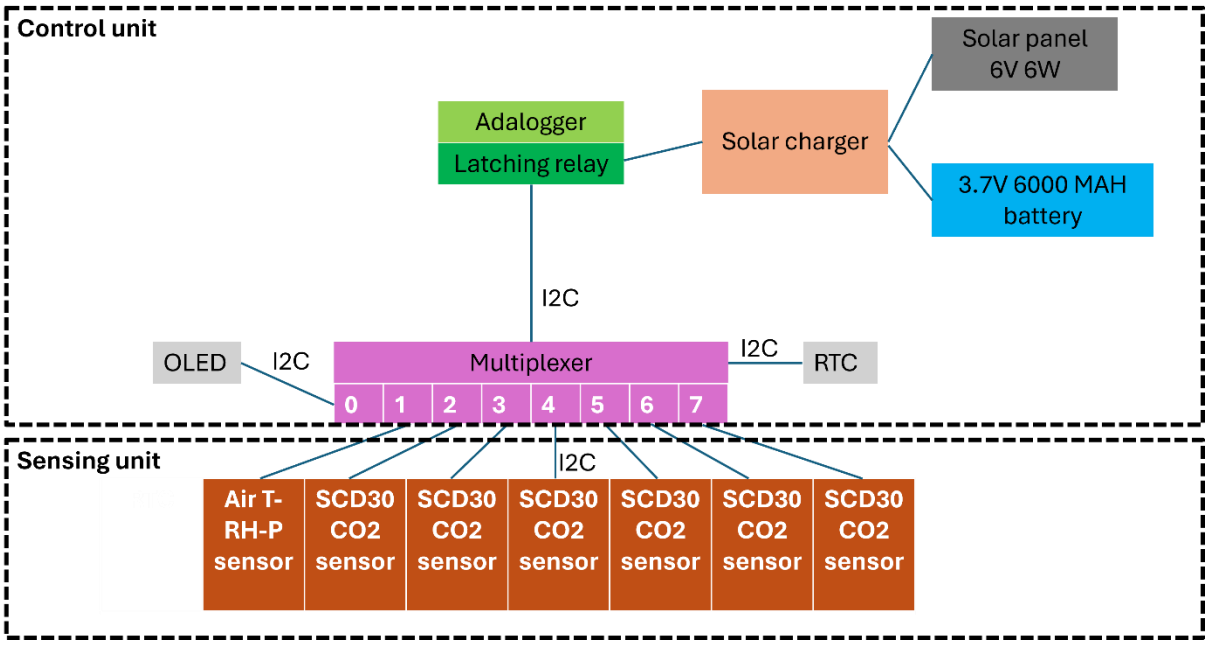

Figure S1: The schematic design of the LC-SS with the control unit and the sensing unit.

1.2. F_{GM} calculation

The low-cost CO_2 sensors are factory pre-calibrated at fixed pressure and temperature. **Eq. S1** is applied to correct soil CO_2 concentration to in-situ environmental field conditions according to ideal gas law (e.g., Chamizo et al., 2022).

$$C_v = C_{v0}\frac{P_c(273.2 + T_s)}{P_s(273.2 + T_c)} \quad [S1]$$

where C_v [µmol mol^{-1} or ppm] is the corrected soil CO_2 concentration, P_c [hPa] is the atmospheric pressure during factory calibration (Pc = 1013 hPa), P_s [hPa] is the air pressure in soil (assume P_s = atmospheric pressure), T_c [^{o}C] is the air temperature during factory calibration (T_c = 25 ^{o}C), and T_s is the soil temperature measured by the CO_2 sensors.

The CO_2 concentration or volume fraction (C_v [µmol mol^{-1} or ppm]) is converted to mole density (C_z [µmol m^{-3}]) by **Eq. S2**.

$$C_z = \frac{C_v * 1000}{22.41} \quad [S2]$$

To correct D_a to in-situ environmental conditions before using it in **Eq. 2** (Johns, 2013), **Eq. S3** is applied:

$$D_a = D_{a0}(\frac{T_a}{T_0})^{1.75}\ (\frac{P_0}{P_a}) \quad [S3]$$

where T_a [K] is the in-situ air temperature, P_a [hPa] is the in-situ air pressure, and D_{a0} [$m^2\ s^{-1}$] is the reference value of D_a at T_0 (293.15 K) and P_0 (1013 hPa) equals to 1.47×10^{-5} $m^2\ s^{-1}$.

Total soil porosity (Φ) equals the sum of the volumetric air content (ε) and the volumetric water content (θ). Soil porosity is calculated using **Eq. S4**.

$$\Phi = 1 - \frac{\rho_b}{\rho_m} = \varepsilon + \theta \quad [S4]$$

where ρ_b [$g\ cm^{-3}$] is the bulk density and ρ_m [$g\ cm^{-3}$] is the particle density for the mineral soil (ρ_m = 2.65 $g\ cm^{-3}$).

2. Supplementary results

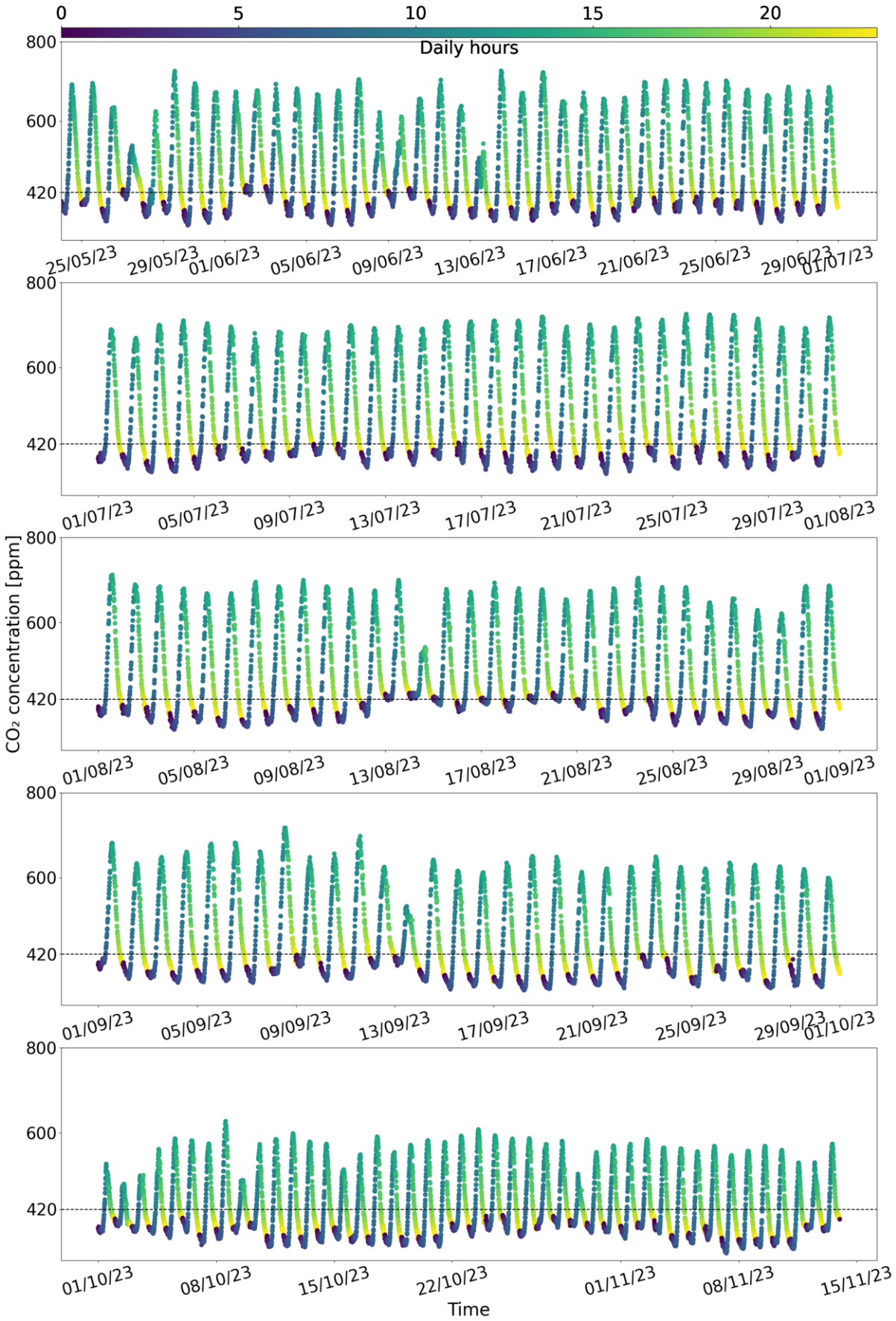

Figure S2. Soil CO_2 concentrations at 5 cm during the entire study period.

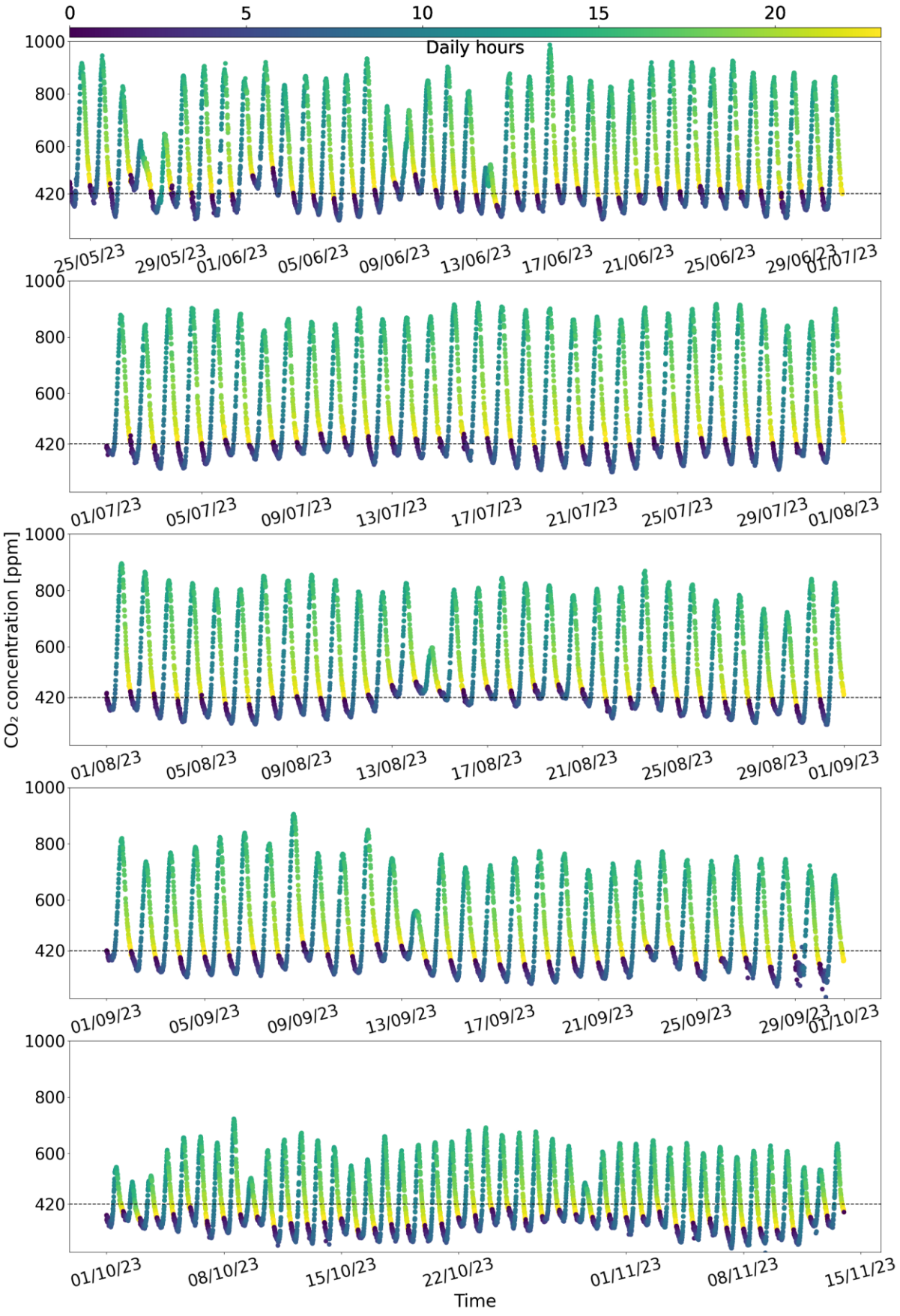

Figure S3. Soil CO_2 concentrations at 10 cm during the entire study period.