

Figure S1. Schematic diagram of the dry extraction system used for this study. Details are described in Ahn et al. (2009). He-CCR stands for He-Closed Cycled Refrigerator.

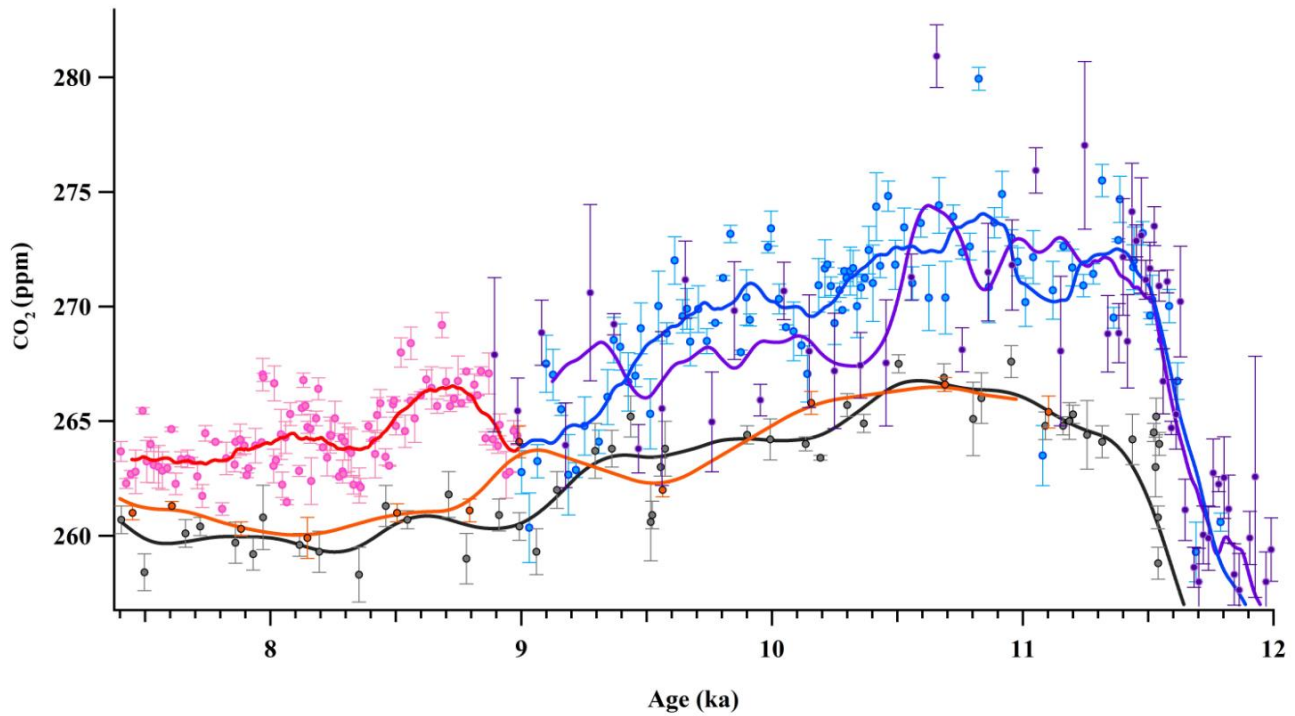


Figure S2. Comparison of Antarctic ice core CO₂ records. Pink and blue circles are Siple Dome ice core records obtained at Oregon State University (OSU) (Ahn et al., 2014) and Seoul National University (this study), respectively. Purple circles from WAIS Divide ice were analysed at OSU (Marcott et al., 2014). Black and orange circles are from the Dome C and Taylor Dome ice cores (Flückiger et al., 2002; Monnin et al., 2001; Monnin et al., 2004), respectively and they were analysed at University of Bern. Lines represent 250-year running means.

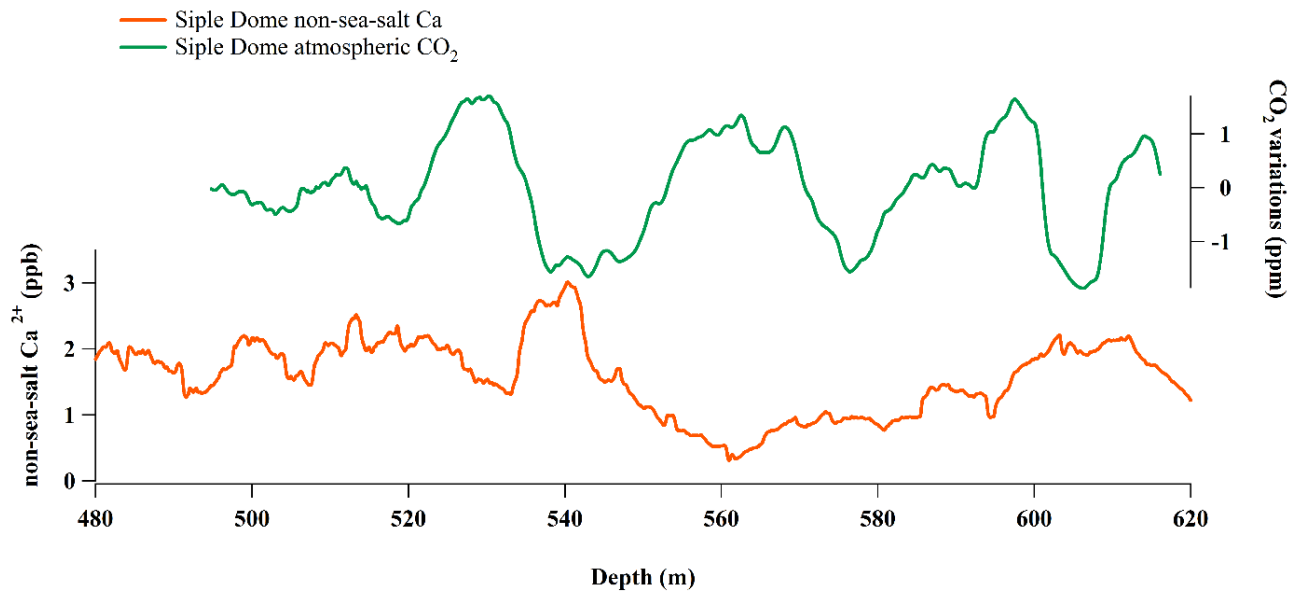


Figure S3. Comparison of Siple Dome millennial (filtered) CO₂ record (Ahn et al., 2014) and non-sea-salt Ca (nssCa²⁺) on
 5 depth domain. The nssCa data are 250-year running mean.

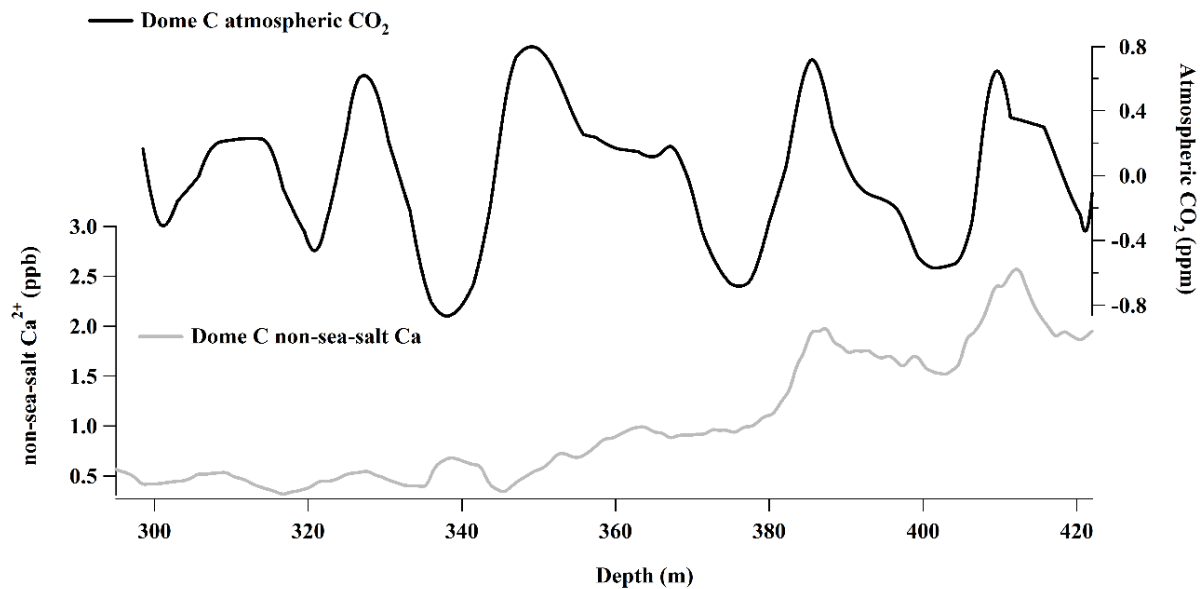


Figure S4. Comparison of Dome C millennial (filtered) CO₂ record (Monnin et al., 2001; Monnin et al., 2004) and non-sea-salt Ca (nssCa) (Lambert et al., 2012) on depth domain. The nssCa data are 250-year running mean.

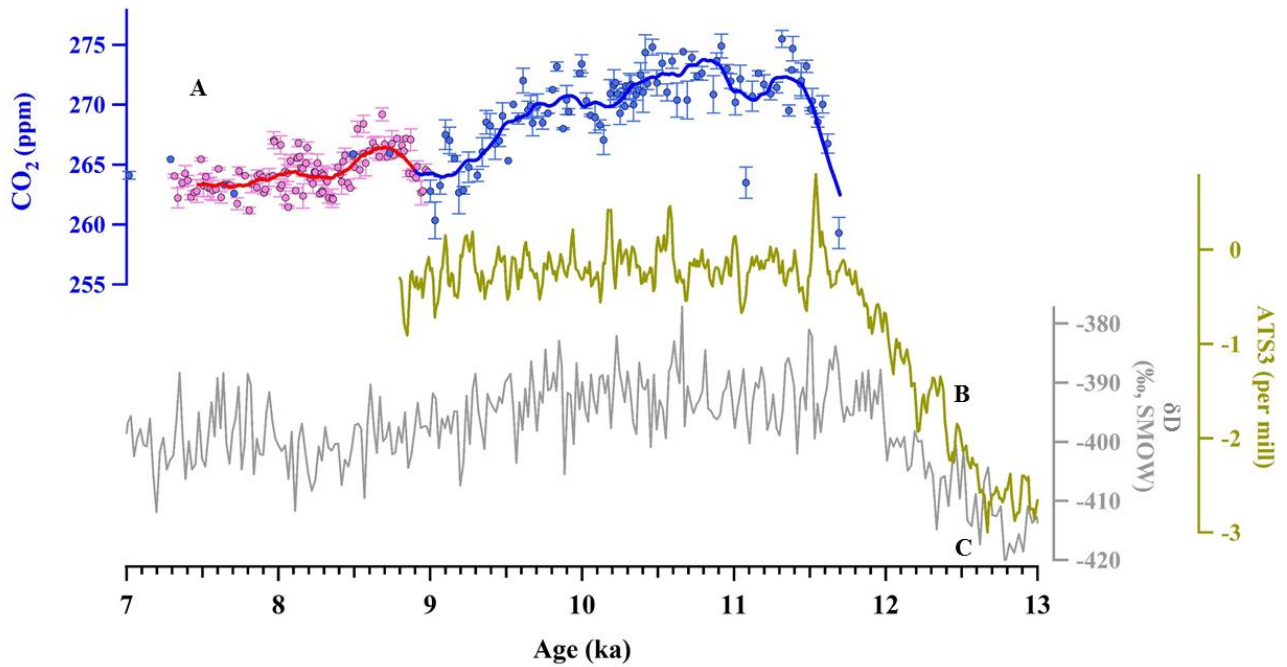


Figure S5. High-resolution atmospheric CO₂ records obtained from Siple Dome ice core, Antarctica during the early Holocene. A) Pink and blue circles are Siple Dome ice core records obtained at OSU (Ahn et al., 2014) and SNU (this study), respectively. Lines in pink and blue represent 250-yr running means. B) Antarctic temperature Stack 3 (ATS3) developed by Buizert et al. (2018) using five records: Dome C, Dome Fuji, Talos Dome, EPICA Dronning Maud Land and WAIS Divide. C) Grey line indicates δD in the Dome C ice core, Antarctica (Jouzel et al., 2007).

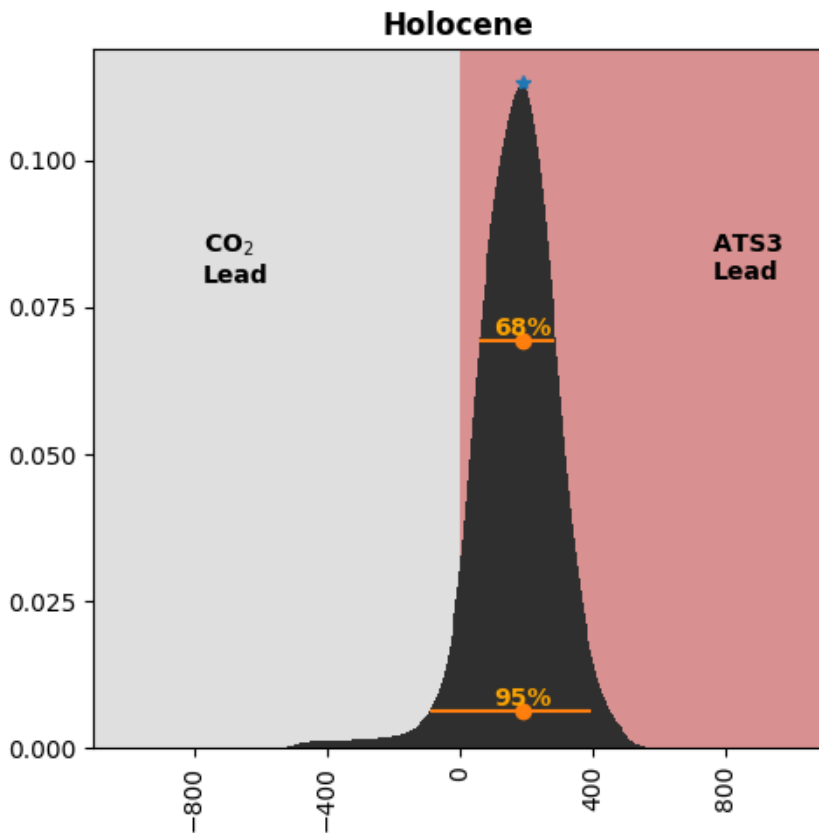


Figure S6. The relationship between CO₂ and Antarctic temperature Stack 3 (ATS3) at the onset of the Holocene. y axis indicates normalized probability density of an ATS3 lead. x-axis indicate the time lag between temperature and CO₂ in years. Positive x-axis indicate ATS3 leads CO₂. This graph shows ATS3 leads CO₂ by 190 yrs within a range of 60 to 285 yrs with 68% probability and within a range of -90 to 397 yrs with 95% probability.

Table S1. Comparison of CO₂ analysis with two different standard airs (188.89 and 293.25 ppm) in order to check the linearity in the gas chromatograph.

| Siple Dome ice core | With 188.9 ppm Standard air | | | | With 293.3 ppm Standard air | | | | Difference | |
|---------------------------|-----------------------------|----------------------------------|----------------------|-----------------|-----------------------------|----------------------------------|----------------------|-----------------|--------------------------|----------------------|
| | CO ₂ (ppm) | mean CO ₂ (ppm) | uncertainty (ppm) | # of samples | CO ₂ (ppm) | mean CO ₂ (ppm) | uncertainty (ppm) | # of samples | CO ₂ (ppm) | uncertainty (ppm) |
| 640.53 | 248.7 | 249.6 | 0.9 | 2 | 250.7 | 249.6 | 0.9 | 3 | 0.0 | 1.3 |
| | | 250.5 | | | 247.8 | | | | | |
| 644.22 | 246.0 | 246.0 | 0.1 | 2 | 247.8 | 247.2 | 0.6 | 2 | 1.2 | 0.6 |
| | | 246.1 | | | 246.6 | | | | | |
| 668.09 | 241.7 | 242.2 | 0.5 | 2 | 242.3 | 243.1 | 0.8 | 2 | 0.9 | 0.9 |
| | | 242.7 | | | 243.8 | | | | | |
| 671.51 | 243.7 | 243.0 | 0.7 | 2 | 242.8 | 243.5 | 0.4 | 3 | 0.5 | 0.8 |
| | | 242.3 | | | 243.5 | | | | | |
| 673.47 | 241.1 | 240.4 | 0.8 | 2 | 239.1 | 239.8 | 0.7 | 2 | -0.6 | 1.0 |
| | | 239.6 | | | 240.5 | | | | | |
| Average | | | | | | | | | 0.4 | 0.9 |

Table S2. Interlaboratory comparison between SNU and OSU using Siple Dome ice core.

| Depth range (m) | SNU CO ₂ (ppm) | #of replicates | OSU CO ₂ (ppm) | #of replicates | SNU-OSU (ppm) |
|--------------------|------------------------------|----------------|------------------------------|--------------------|------------------|
| 490.17–490.22 | 266.8 | 2 | 265.7 | 3 | 1.1 |
| 500.40–500.45 | 263.8 | 2 | 264.1 | 4 | -0.3 |
| 501.87–502.41 | 263.8 | 2 | 262.8 | 2 | 1.1 |
| 506.60–506.65 | 264.9 | 3 | 265.0 | 2 | -0.1 |
| 522.90–523.10 | 266.7 | 2 | 266.3 | 2 | 0.5 |
| 523.28–523.33 | 265.2 | 2 | 265.8 | 2 | -0.6 |
| 530.50–530.55 | 266.9 | 2 | 266.4 | 2 | 0.6 |
| | | | | Average | 0.3 |
| | | | | Standard deviation | 0.7 |

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