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Supporting Information for

Carbon emissions from the edge of the Greenland Ice sheet reveal subglacial processes of methane and carbon dioxide turnover

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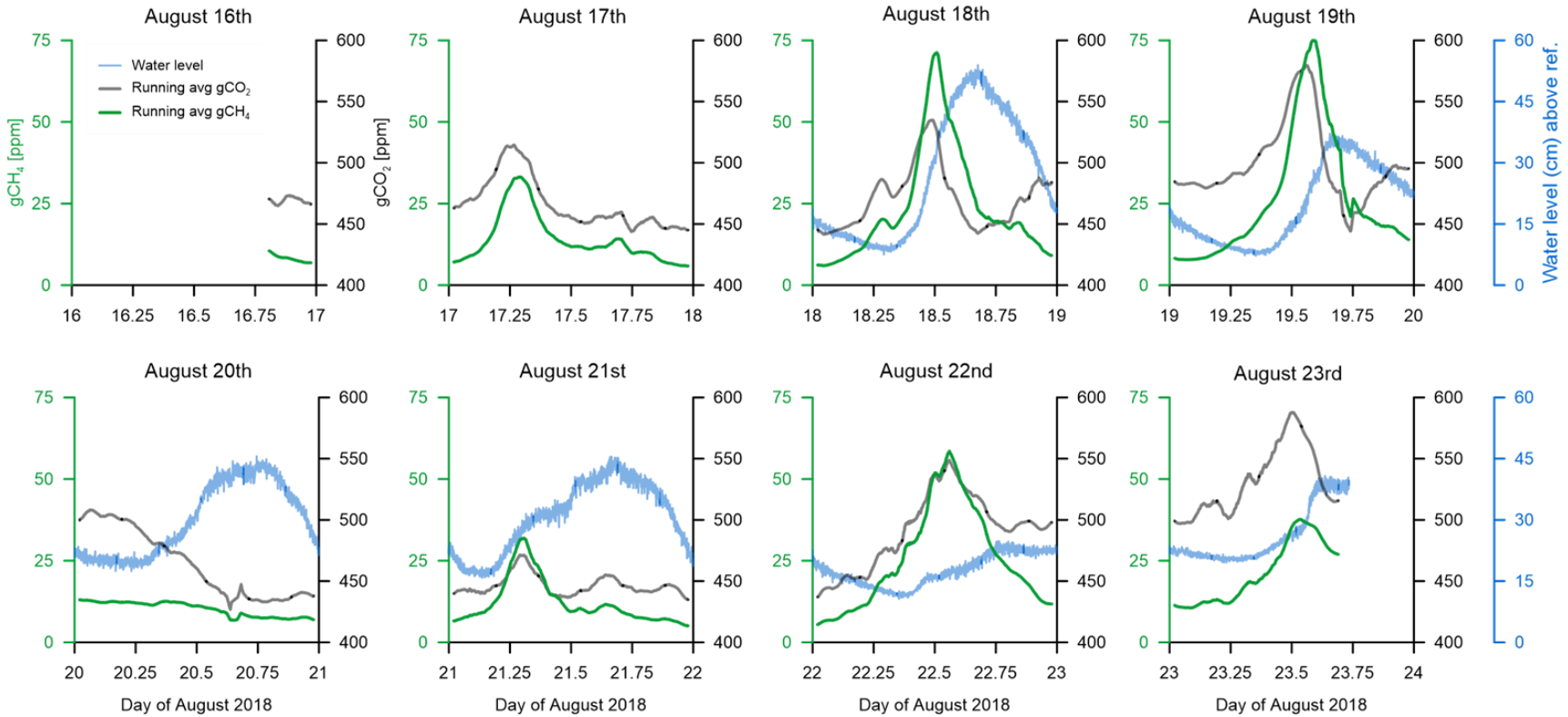
Introduction

This supplementary material presents additional data on subglacial methane and carbon dioxide mole fractions emitted from the Greenland Ice Sheet as well as their isotopic composition used for determination of the isotopic signature (source) of the subglacial gases. The data presented here was collected over three campaigns during the melting season of 2018 and 2019 representing three typical stages during the melt.

The mole fraction data was measured with a laser spectrometer in the field measuring at 1 Hz the mole fractions of methane, carbon dioxide and water vapor. The isotopic data is based on discrete water and gas samples from the field which were subsequently analyzed in the laboratory.



<Insert Figure S1>

Figure S1. Diurnal variation of gCH4 (green line), gCO2 (black line) and water level (blue line) in the outlet river for eight days during the August 2018 campaign. Water level is shown in cm. Time is given as day of the month with decimal hours.

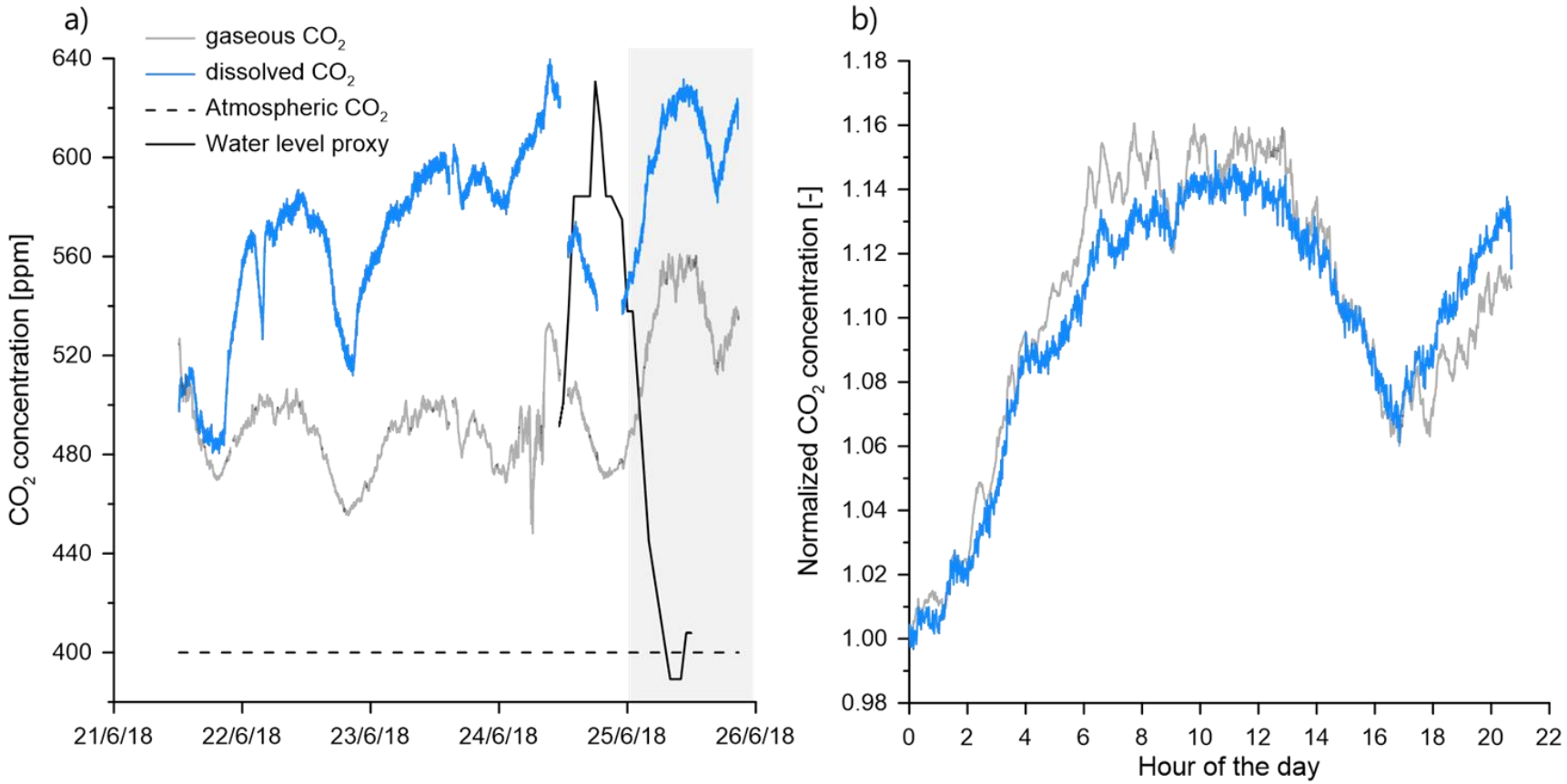


Figure S2 a) Simultaneous measurements of dissolved (blue line) and gaseous (grey line) CO2 (in ppm) from june 21st to 25th 2019., b) Normalized dissolved CO2 concentrations and gaseous CO2 mole fractions for June 25th (shaded area) to elucidate the co-variation of these two fractions. Water level proxy is shown in a black line.

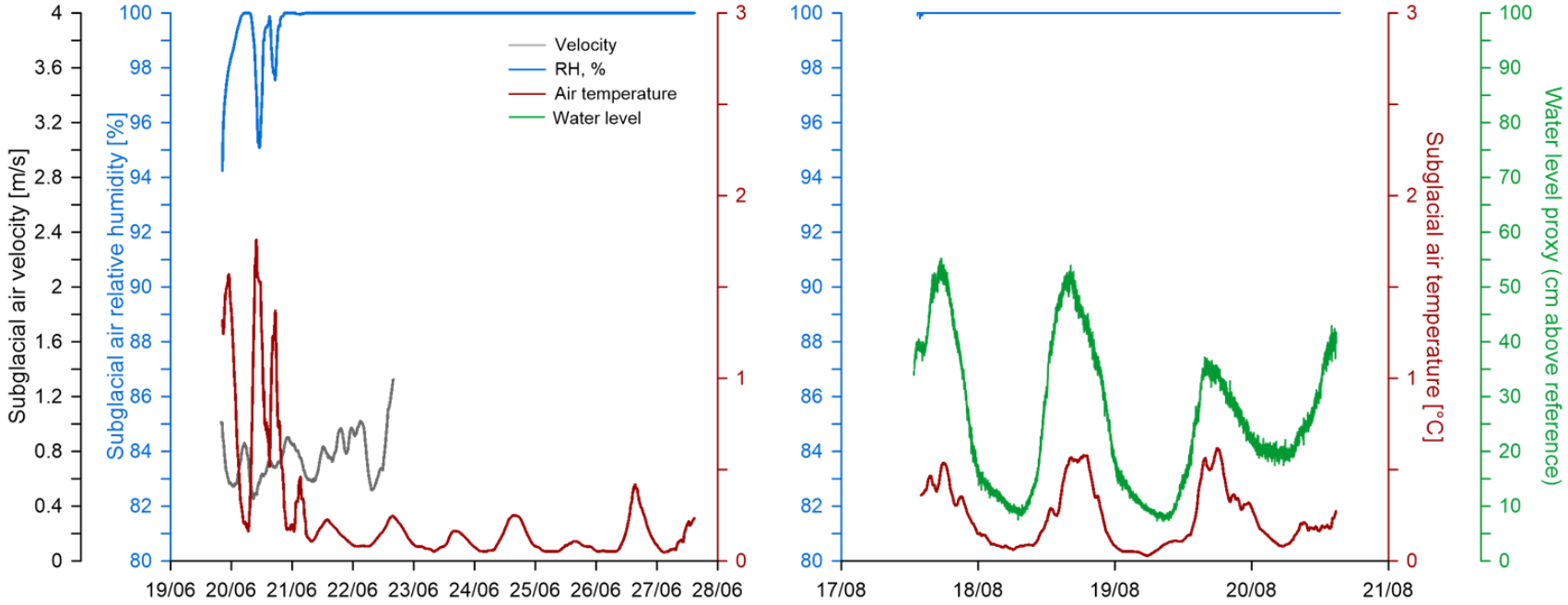


Figure S3 Meteorological parameters measured in the subglacial cavity in june (left panel) and august (right panel): velocity of air (grey), relative humidity (blue) and temperature (red), water level proxy (green). Air velocity was only measured in June and water level proxy was only measured in August. Meteorological variables are given as hourly means.

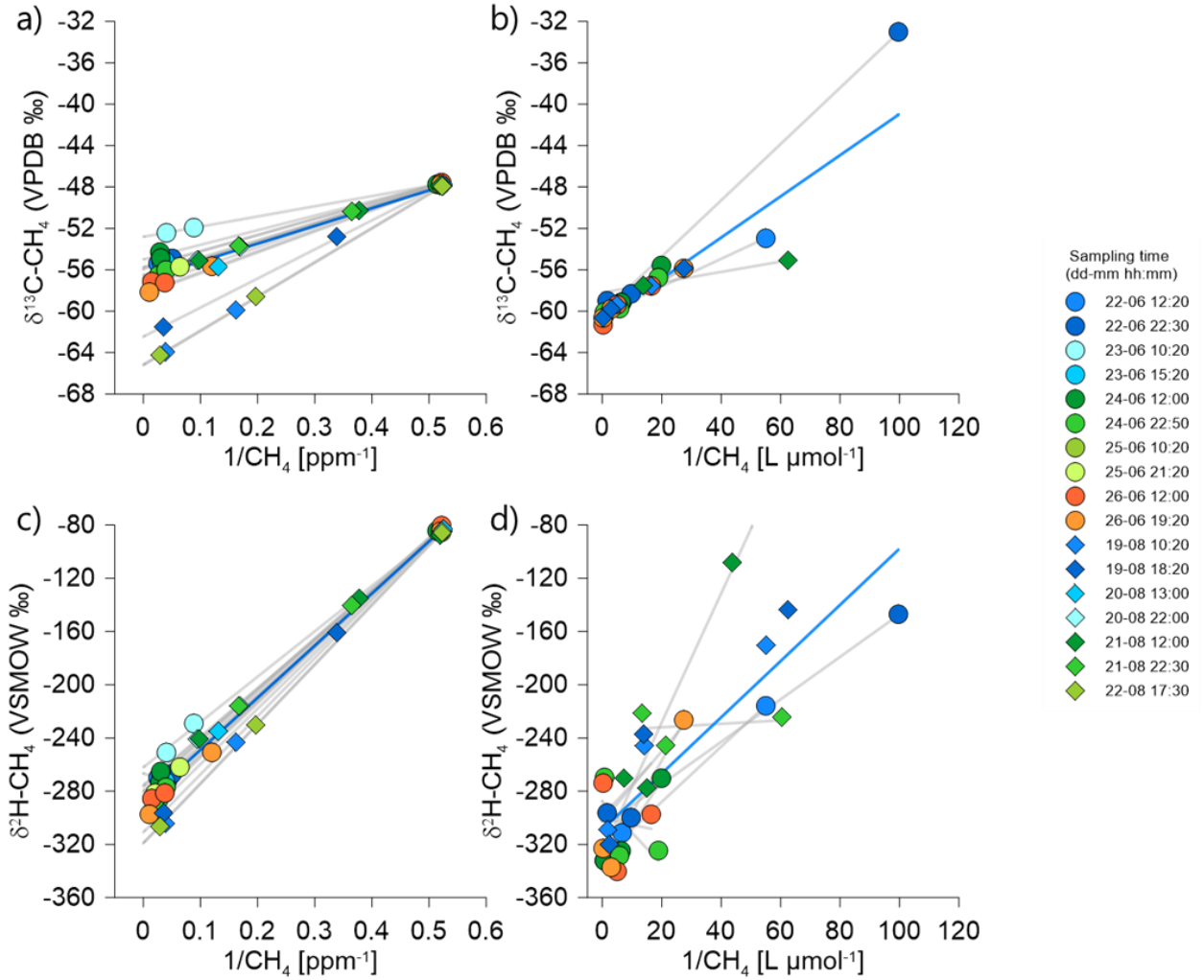


Figure S4 Keeling plots used to determine the isotopic source signature (δ13C-CH4 and δ2H-CH4) versus the inverse CH4 concentration for a) δ13C values for gaseous CH4, b) δ13C values for dissolved CH4, c) δ2H values for gaseous CH4 and d) δ2H values for dissolved CH4 values for the June (circles) and August (diamonds) 2018 campaigns. The colors represent different sampling times.

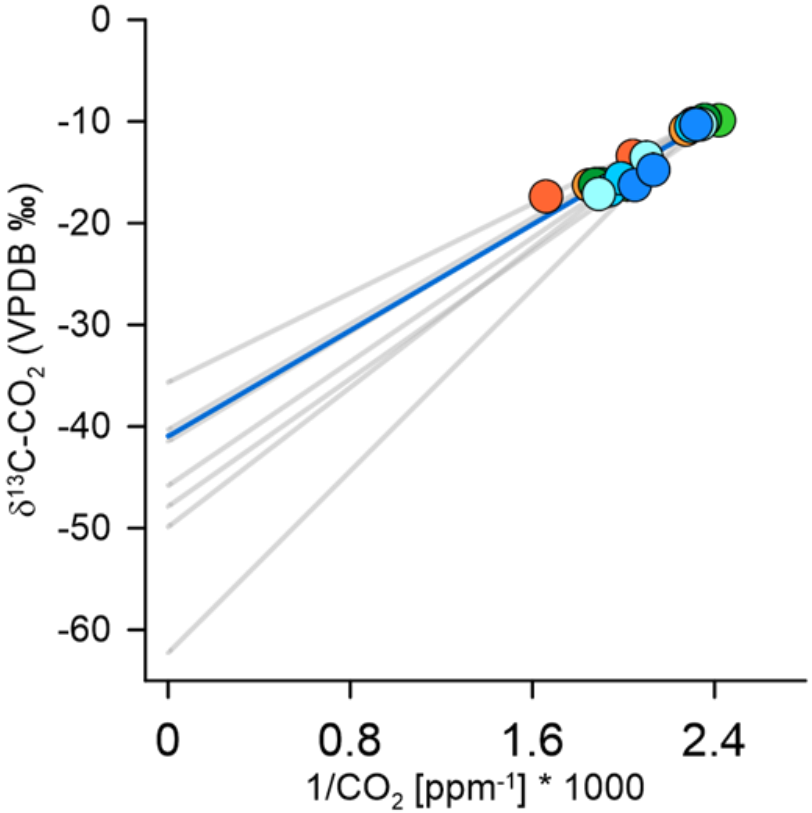


Figure S5 Keeling plots of δ13C values of gCO2. Colors represent different sample dates during the June 2018 campaign (See legend in Supplementary figure 4 for exact times)

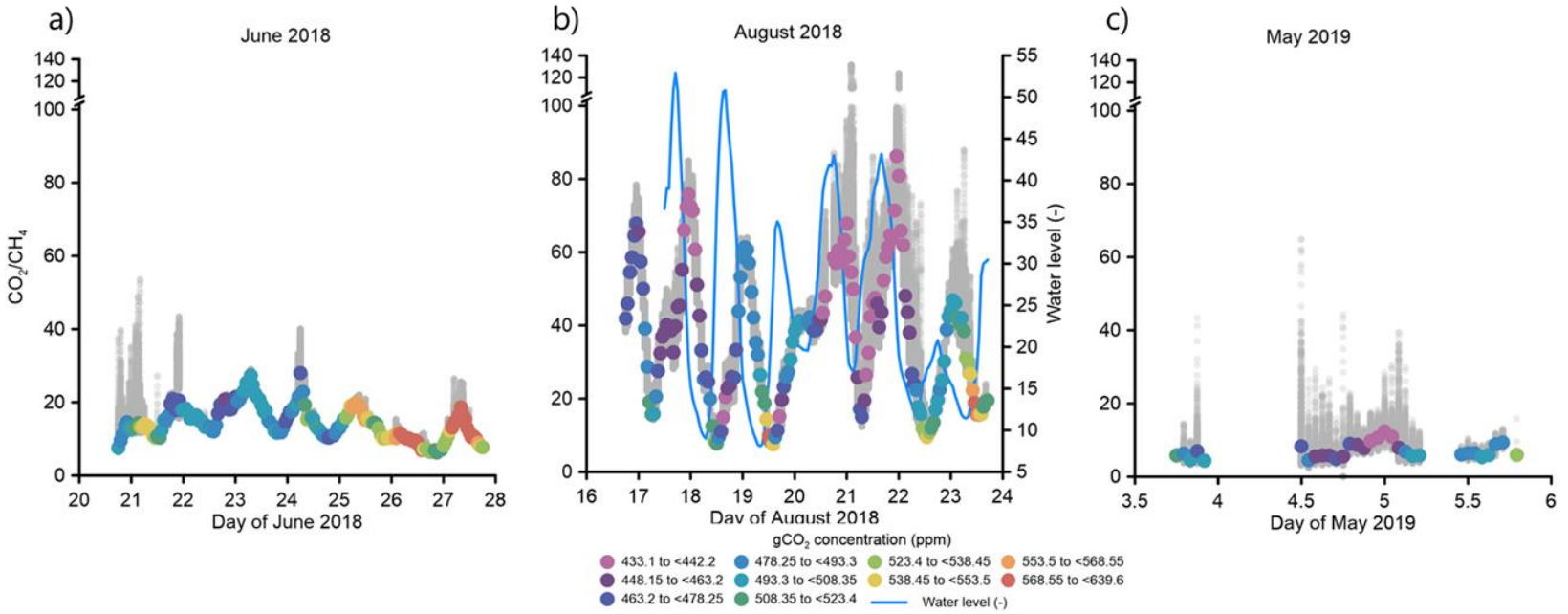


Figure S6 Time series of gCO2/gCH4 ratio in subglacial air for a) June 2018, b) August 2018 and c) May 2019. Grey symbols are the gCO2/gCH4 at 1 hz and the colored symbols are hourly averages. The color gradient represents the hourly averaged gCO2 concentration.