

Supplementary Information for: Sea ice melt drives vertical pCO₂ variability modulating air-sea gas exchange

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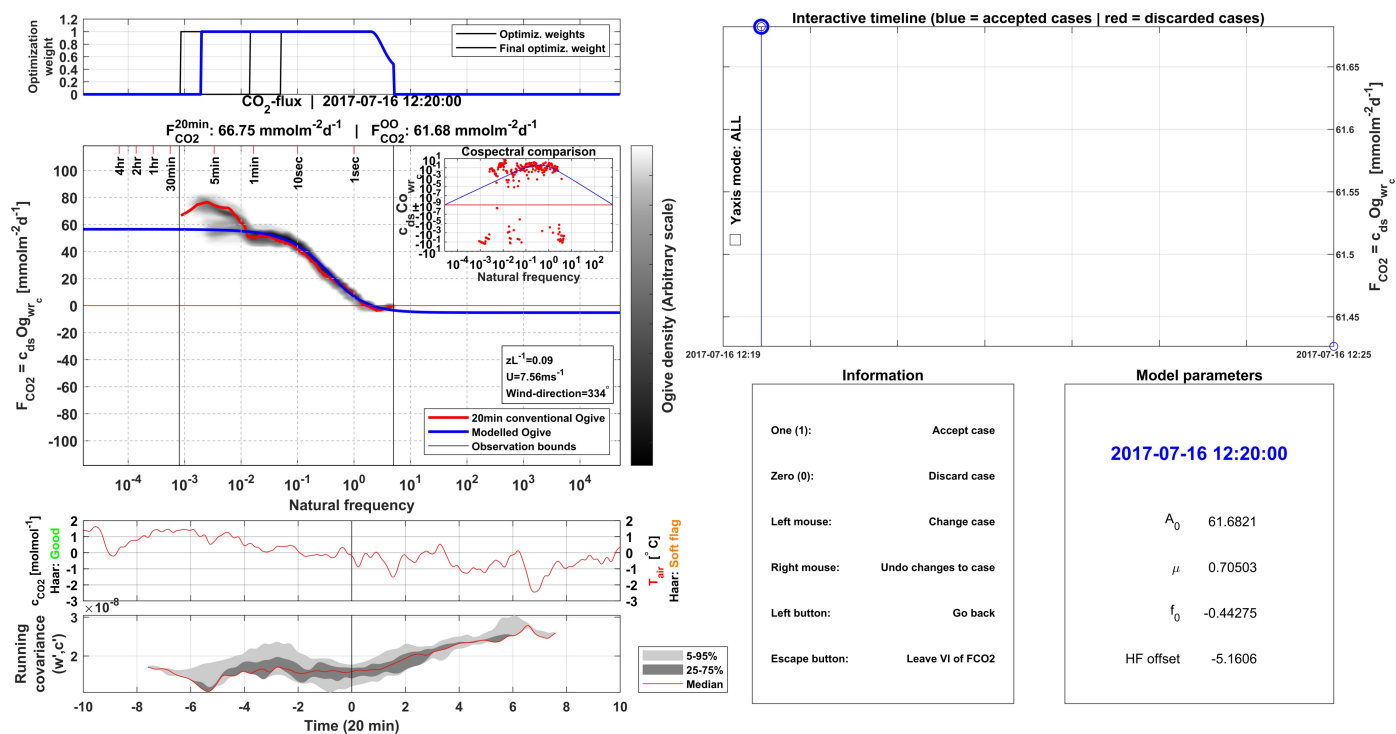


Figure S1. Example of OGIVE Optimization (OGM) analysis output illustrating modelled vs measured Cospectra amounting to a positive CO₂ flux (efflux). Cospectral Visual inspection of the cospectra can be done as part of the OGM method and after Haar analysis, where cospectral comparison is the summation of the molar concentration of dry air (c_{ds}) and the covariance of vertical windspeed and the CO₂ concentration (C_{Owr}).

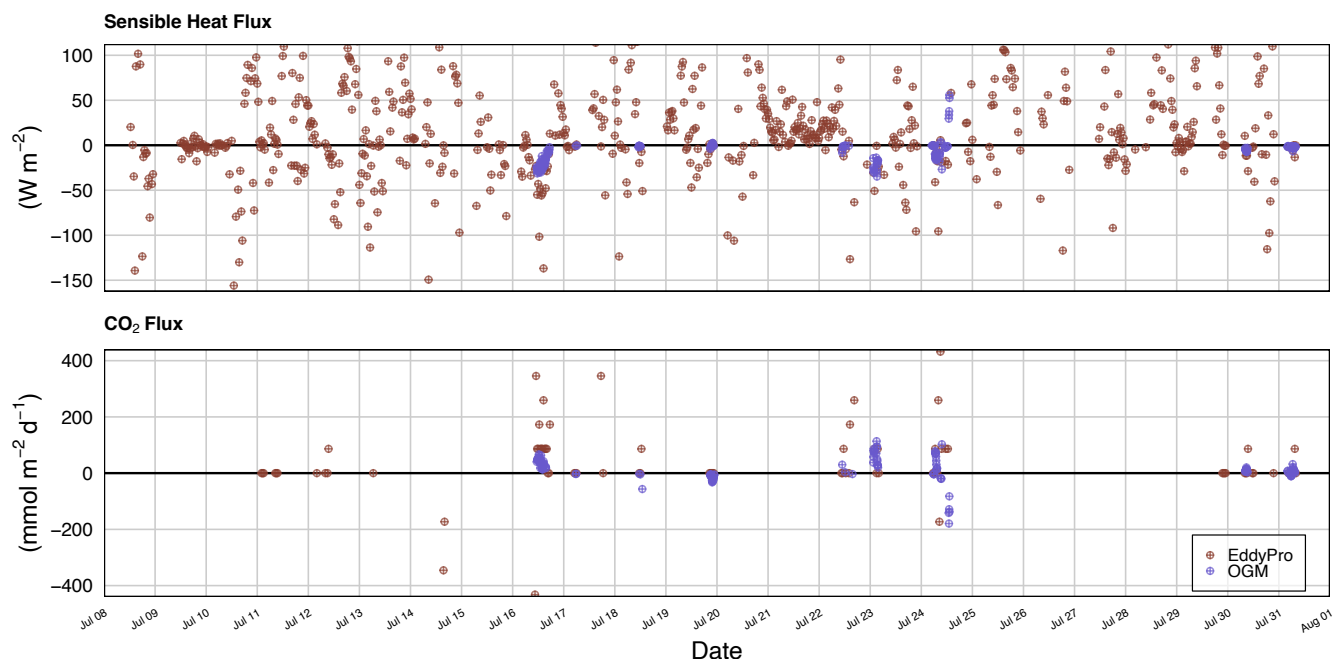


Figure S2. Comparison of two micrometeorological analysis techniques for CO₂ flux estimation over Young Sound during the transition from sea ice breakup to open water from 16 July 2017 to 1 August 2017. The standard eddy covariance (EC) method implemented in EddyPro software (Version 7.0.6, LI-COR Inc., 2019), and the ogive optimization method (OGM) described by Sievers et al. (2015).

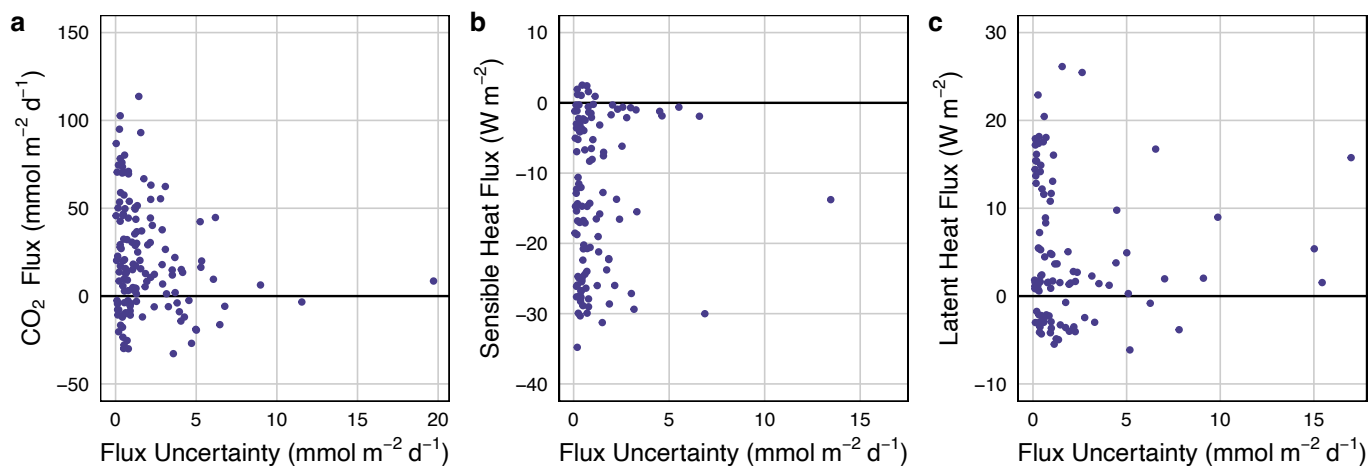


Figure S3. CO₂ (a) Sensible heat (b) and Latent heat (c) fluxes compared with their calculated uncertainties. Uncertainties were typically low compared with flux magnitudes demonstrating a good signal to noise ratio for those fluxes which were approved by OGM.

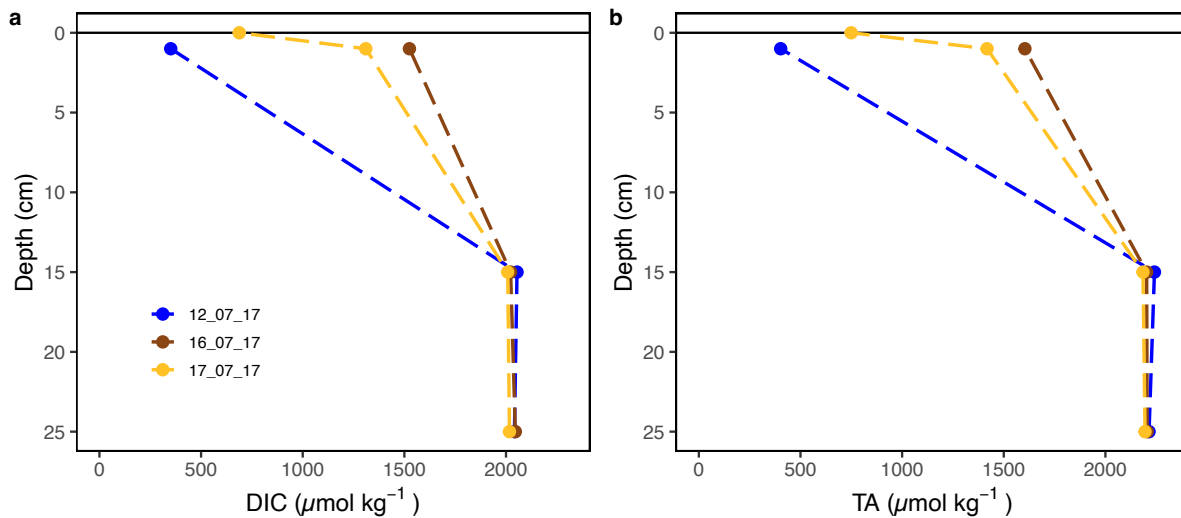


Figure S4. DIC (a) and TA (b) vertical profiles taken during July 2017.

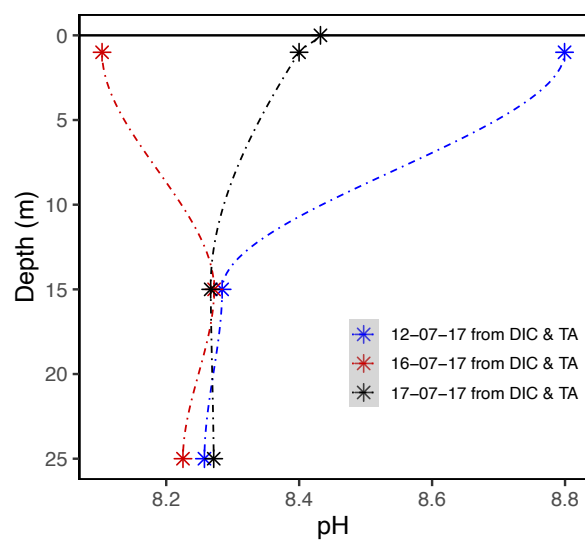


Figure S5. Calculated pH profiles based on measured carbonate chemistry parameters (dissolved inorganic carbon [DIC] and total alkalinity [TA]). The results illustrate that during both ice cover and sea ice breakup, surface water pH fluctuates significantly, influencing the distribution of inorganic carbon species (CO_2 , HCO_3^- , CO_3^{2-}) and consequently pCO_2 .

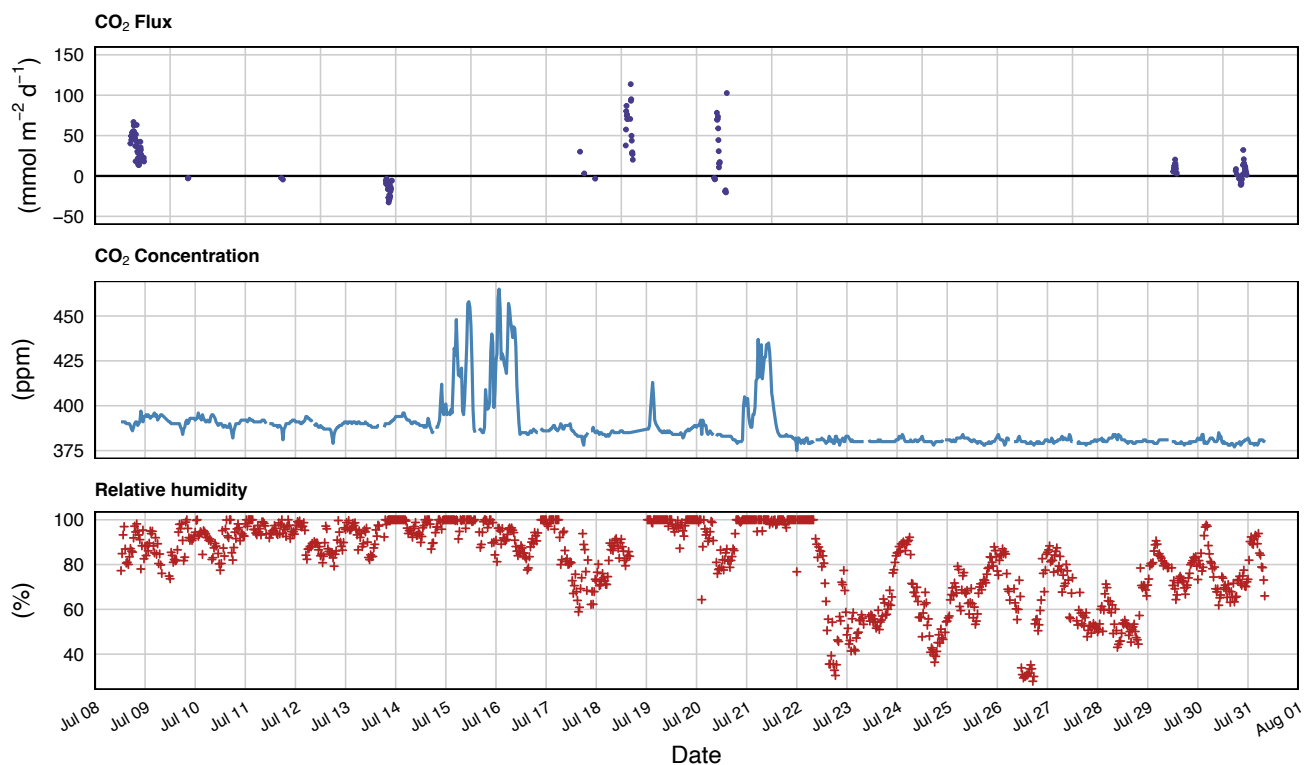


Figure S6. CO₂ fluxes (a) measured CO₂ concentrations (b) and Relative humidity (c) during the spring seasonal transition in Young Sound 2017. Elevated CO₂ concentrations were observed at high relative humidities (RH). However similar periods of high RH showed low CO₂ concentrations, indicating CO₂ measurements measured on the open-path NDIR sensor were not continuously biased by water-vapor. Indeed, some of the outgassing events, depicted as positive CO₂ fluxes occurred at both lower CO₂ concentrations and lower RH.

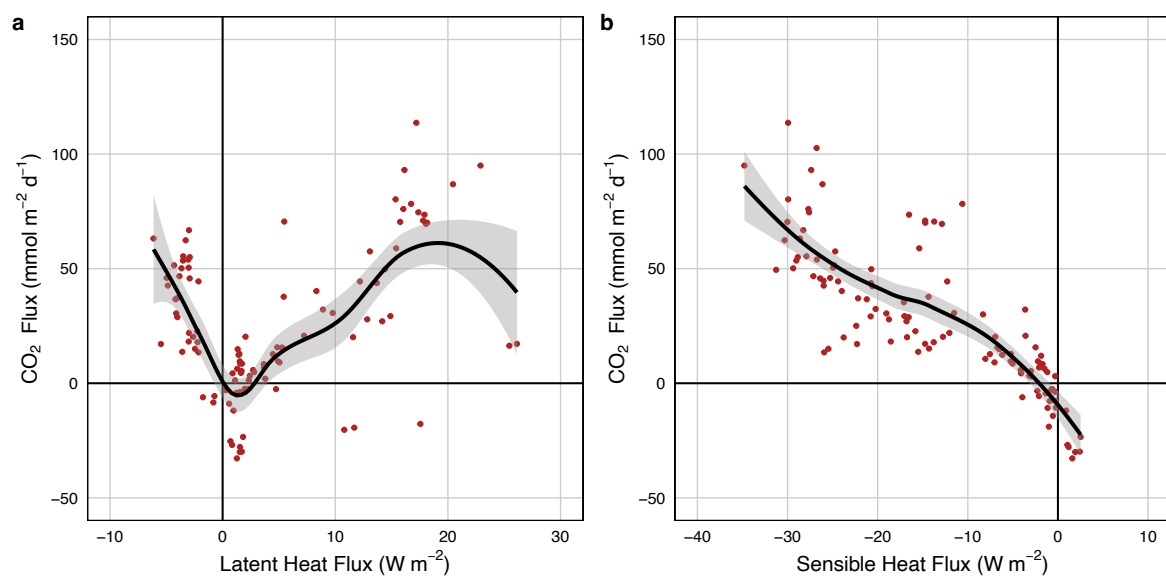


Figure S7. The relationship between CO₂ fluxes and Latent Heat (a) or Sensible heat (b) fluxes during the study period.