

The importance of appropriate isotope reference standards for determination of the isotopic composition of C and O in atmospheric CO₂



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Research problems and goals

- Continuous measurements of CO₂ in the atmosphere in the Gulf of Trieste
- Determination of the isotopic composition in atmosphere CO₂
- Quantitative estimate of the airsea CO₂ fluxes within the gulf

Study site

The Gulf of Trieste, N Adriatic



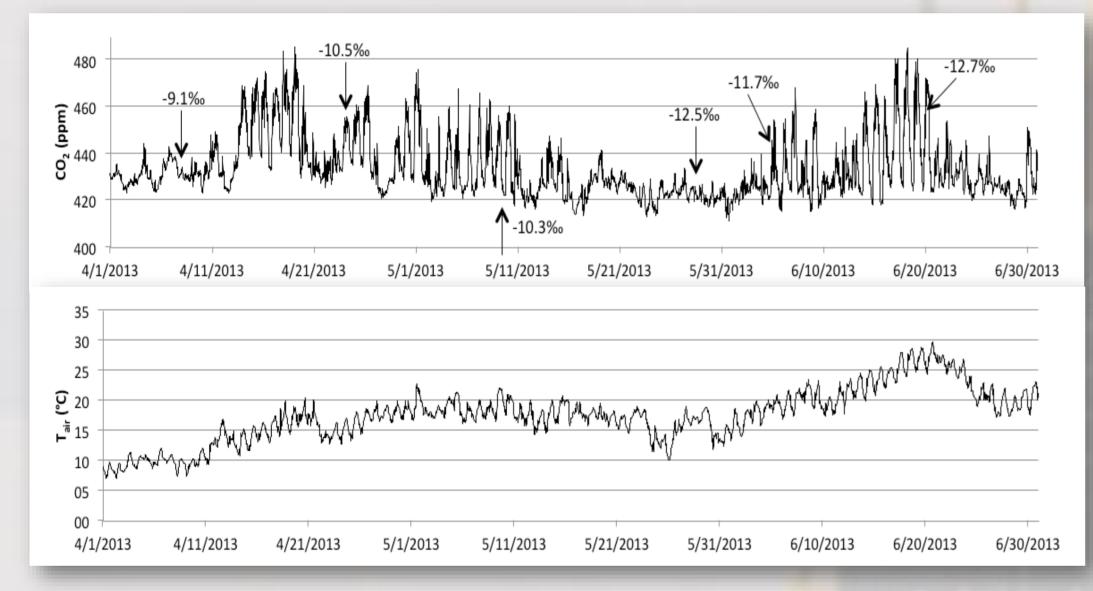


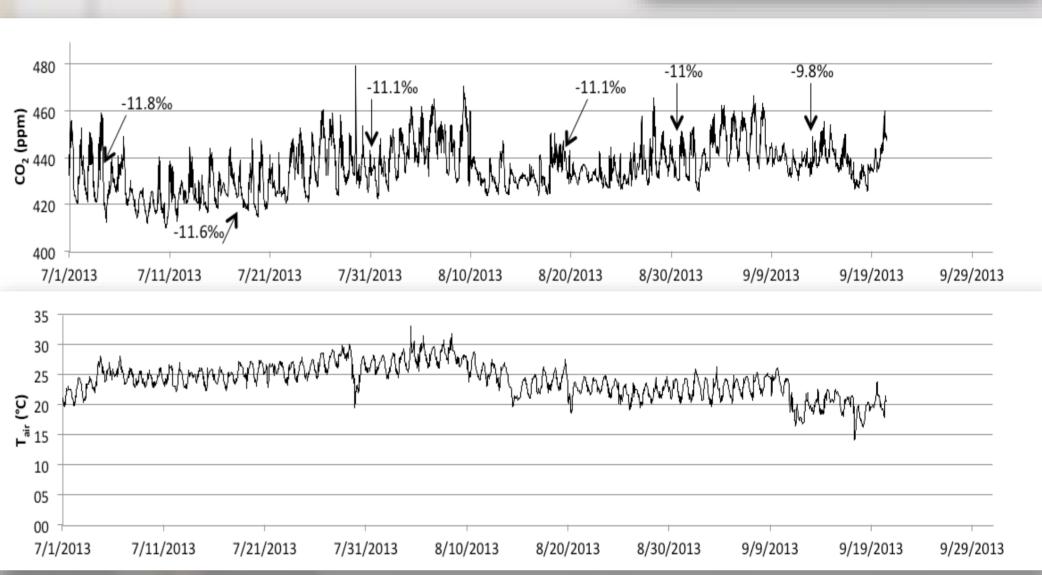


Measurements

- Continuous measurements of air temperature and humidity (VAISALA, HMP 45A) at 3.5 m above sea level
- Wind speed/direction (Gill Instruments, WindMaster Pro Ultrasonic Anemometer) at 5 m above sea level
- Sea surface salinity (SSS) and temperature (SST) (SeaBird, SeaBird 16plus SEACAT) at the depth of 3.5 m.
- Continuous measurements of atmospheric CO₂ concentrations were performed by a Vaisala CARBOCAP®
 Carbon Dioxide Probe GMP343 (diffusion model)



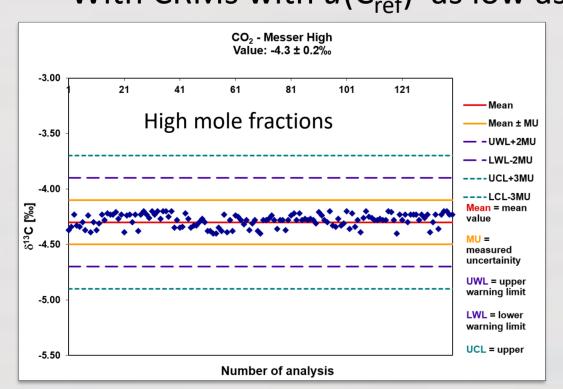


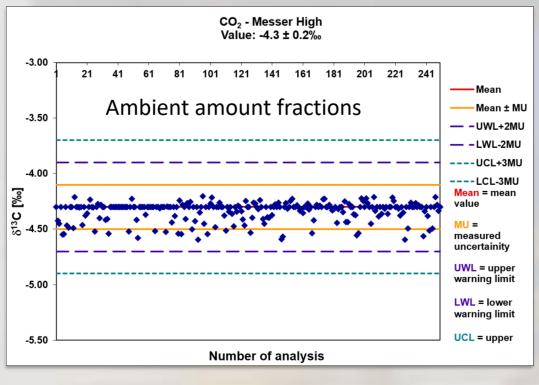


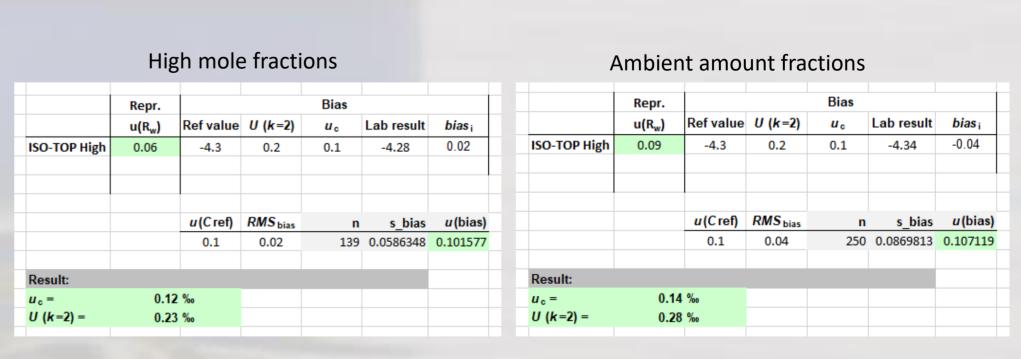
Results of the continuous atmospheric CO₂ concentration measurements (above) from the buoy "VIDA" along with the air temperature measurements (below). The arrows indicate the times of sampling, together with the results of the $\delta^{13}C_{CO2,air}$ analysis.

Stable isotope measurements

- Carbon isotope analyses in atmospheric CO_2 ($\delta^{13}C_{CO2,air}$) performed on a Europa Scientific 20–20 IRMS with an ANCA-TG preparation module for trace gas samples.
- Expanded uncertainty of the measurement method for the ambient amount fractions of CO_2 is: U(k=2) = 0.28 %
- The highest contribution to the combined uncertainty comes from reference materials. In our case $u(C_{ref}) = 0.1 \%$
- With CRMs with $u(C_{ref})$ as low as 0.03 % or 0.01 % we would get U(k=2) as low as 0.14 % and 0.12 %, respectively.







Reference material δ^{13} C of CO $_2$ at high and ambient amount mole fractions on Europa Scientific 20-20 with ANCA TG

Uncertainty calculation (Nordtest approach) at high and ambient amount mole fractions on Europa Scientific 20-20 with ANCA TG

Conclusions

- The high daily atmospheric CO_2 concentration fluctuations, which start to occur in mid-April and are present until early September are most probably a consequence of biological activity in the water column. The CO_2 concentration and solar radiation intensity during this time were moderately anticorrelated (r = -0.52; p < 0.05) which further supports this assumption.
- Atmospheric CO₂ concentrations within our study were measured continuously on site and were substantially higher than the global average concentrations, which at the moment are around 400 ppm
- The Gulf of Trieste clearly acts as a sink of CO₂ with the annual estimated air-sea CO₂ flux being -1.47 \pm 1.41 mol C m⁻² yr⁻¹