

Regional studies: The carbon dioxide system in the Canary Islands region

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The North Atlantic around the Canary Islands and the Azores is one of the areas of regional studies funded by the European Commission (MAST III program) under the name CANIGO (Canary Islands Açores Gibraltar Observations). In this multidisciplinary approach also studies of the carbon dioxide system are included, carried out by one German and two Spanish groups.

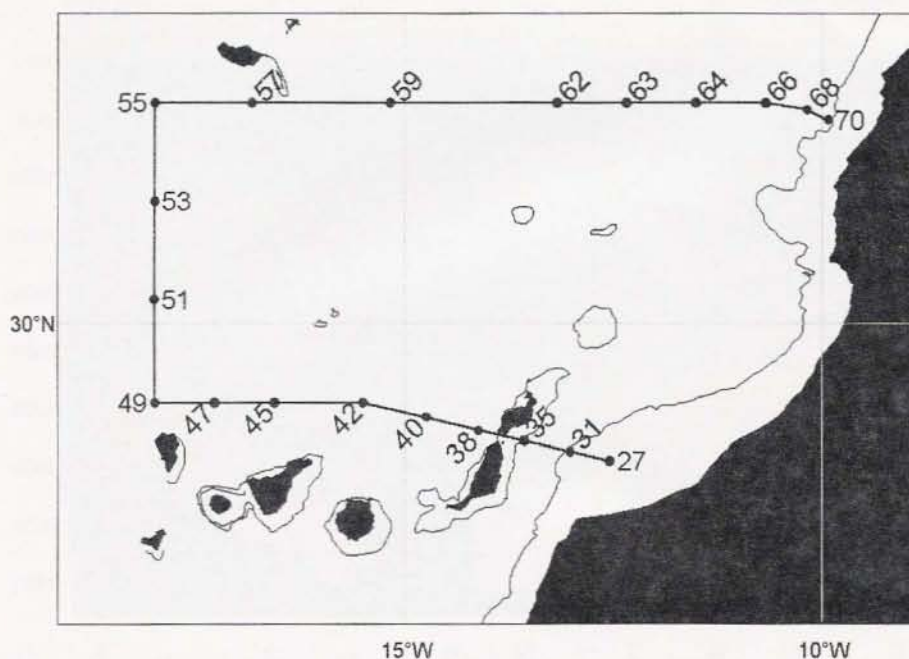


Figure 1. Cruise track and sampling stations for CO₂-measurements of R/V METEOR cruise 37/2 in January 1997.

During a joint cruise with R/V METEOR (January 6 to 17, 1997) measurements of the carbon dioxide parameters pH, fugacity of CO₂ in surface seawater and in the atmosphere ($f\text{CO}_2$), total dissolved inorganic carbon (C_T) and titration alkalinity (A_T) have been made in a densely sampled survey north of the Canary Islands. Figure 1 shows the cruise track and the sampling stations.

The depth distribution of the parameters C_T , A_T and pH is shown in Figures 2a-c. Characteristic features associated with water masses (AAIW, MOW) can be traced as also a Meddy, that was found passing the northern transect. The figures show the southern zonal transect on the left side, the meridional part in the center and the northern zonal transect on the right side of the figures. In the C_T distribution, the general increase with depth is observed, being more pronounced on the southern transect, while maxima are associated with Antarctic Intermediate Water (AAIW) in the 1000-1500 m depth range off the coast on the southern transect and with the Meddy at ~1200 m depth on the northern transect.

Taking also into account the depth distributions of A_T and pH, the data allow for a detailed analysis of water mass properties and their relation to the carbon dioxide system. From the atmospheric values and those of $f\text{CO}_2$ in surface seawater it can be concluded that during the cruise the ocean area studied was acting as a sink for CO₂.

This comprehensive data set of a small area was used to test the approaches to calculate anthropogenic CO₂ from measured data. Both the approach from Gruber *et al.* [1996] and a modification of the earlier method of Chen and Millero [1979] by Körtzinger *et al.* [1998] were followed using equations based on general relations for the Atlantic as well as using equations containing relations derived from the data measured in the area during the cruise. Results are

a)

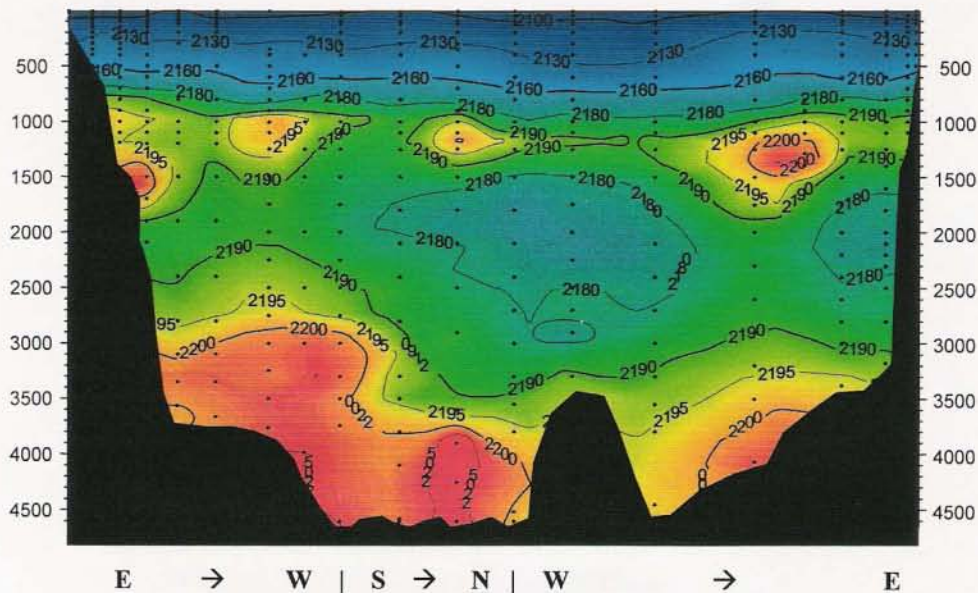
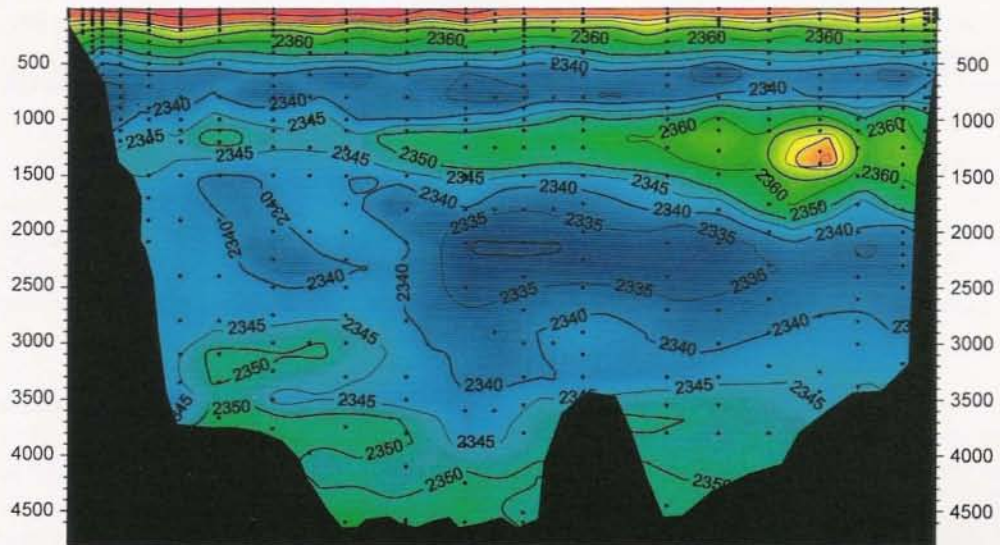


Figure 2a. Depth distribution of C_T [$\mu\text{mol/kg}$] along the cruise track of METEOR 37/2

b)



c)

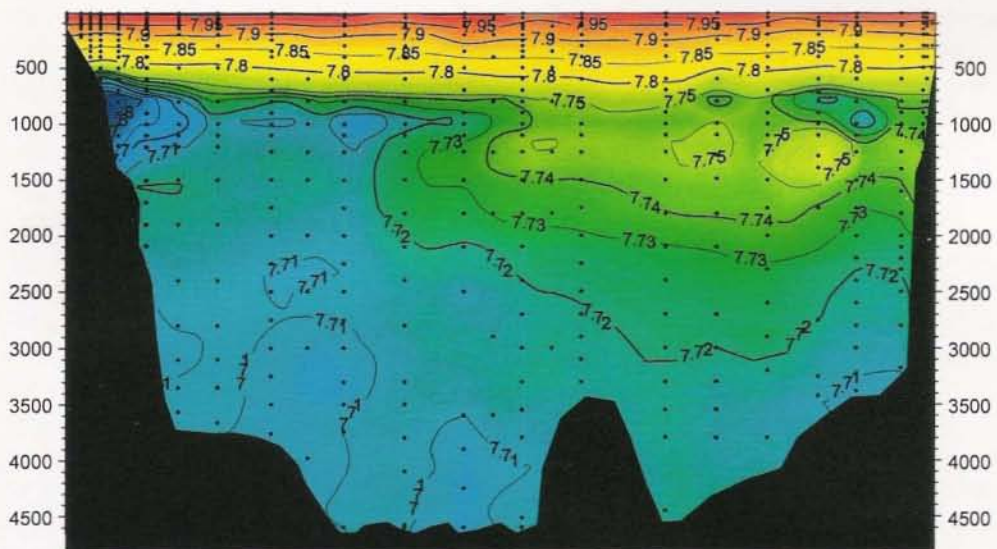


Figure 2b, c. Same as Figure 2a for A_T [$\mu\text{mol/kg}$] (b) and pH (c)

presented from either approach and the problems for their application on regional studies are discussed.

References

- Chen, C.-T. A., and F. J. Millero, Gradual increase of oceanic CO₂, *Nature*, 277, 205-206, 1989.
- Gruber, N., J. L. Sarmiento, and T. F. Stocker, An improved method to detect anthropogenic CO₂ in the oceans, *Global Biogeochem. Cycles*, 10, 809-837, 1996.
- Körtzinger, A., L. Mintrop, and J. C. Duinker, On the penetration of anthropogenic CO₂ into the North Atlantic Ocean, *J. Geophys. Res.*, 103, 18,681-18,689, 1998.