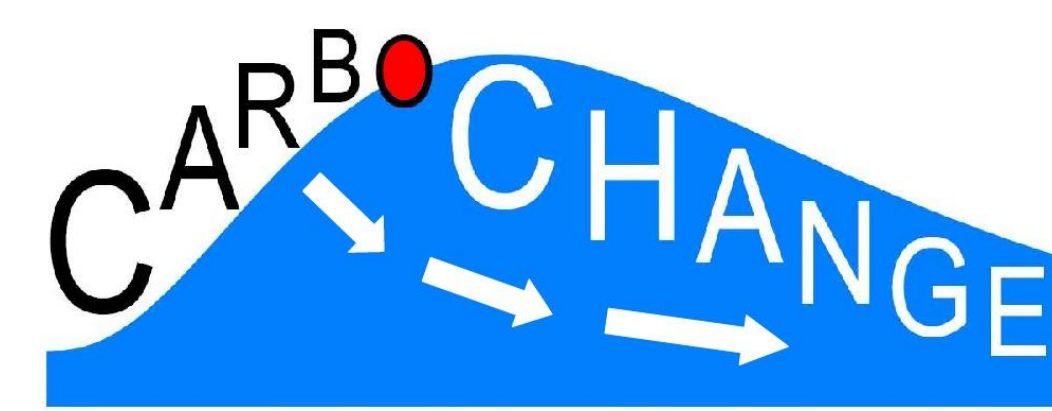


The Irminger Sea and the Iceland Sea time series measurements of sea water carbon and nutrient chemistry

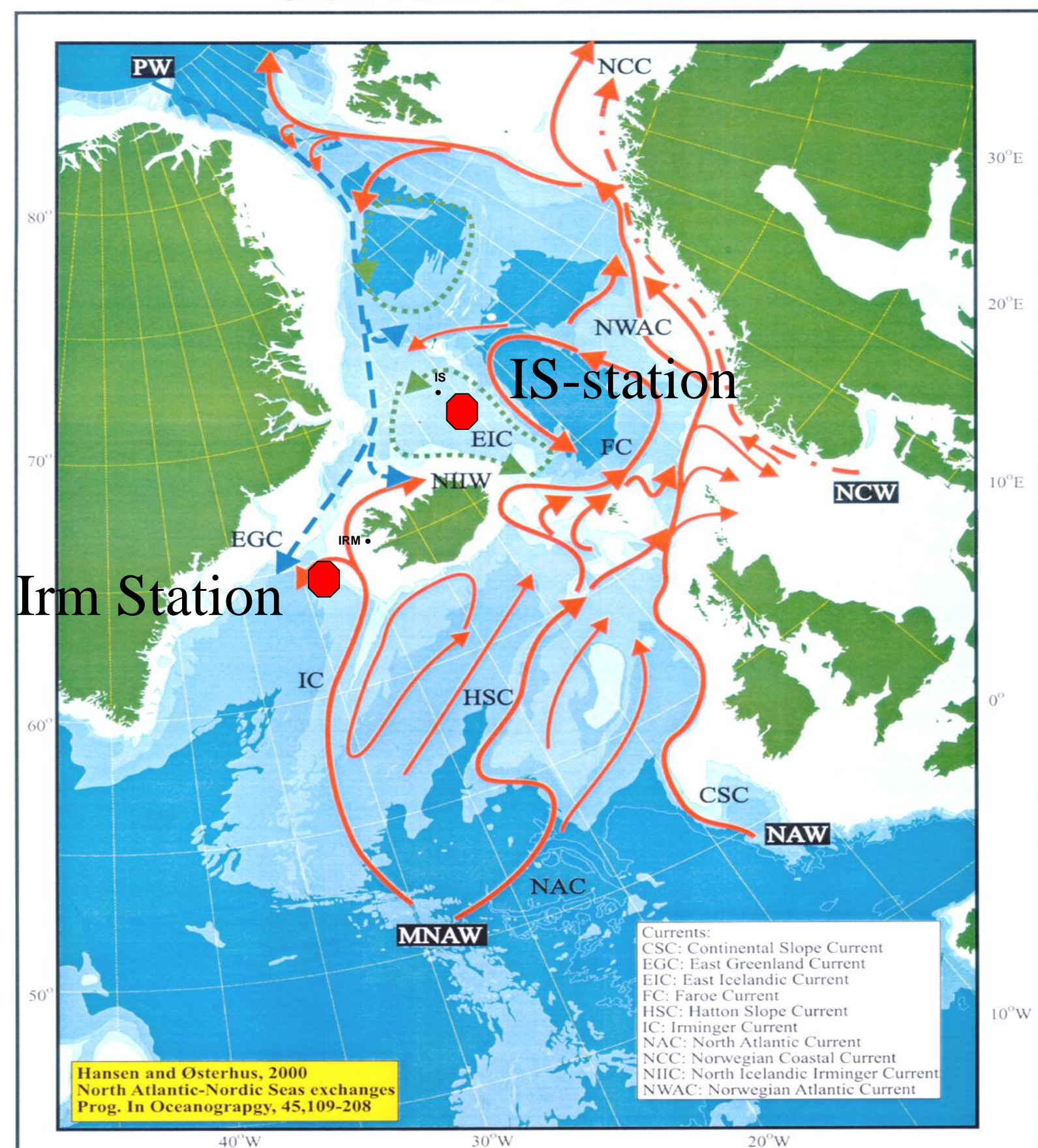


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Surface Currents



Introduction

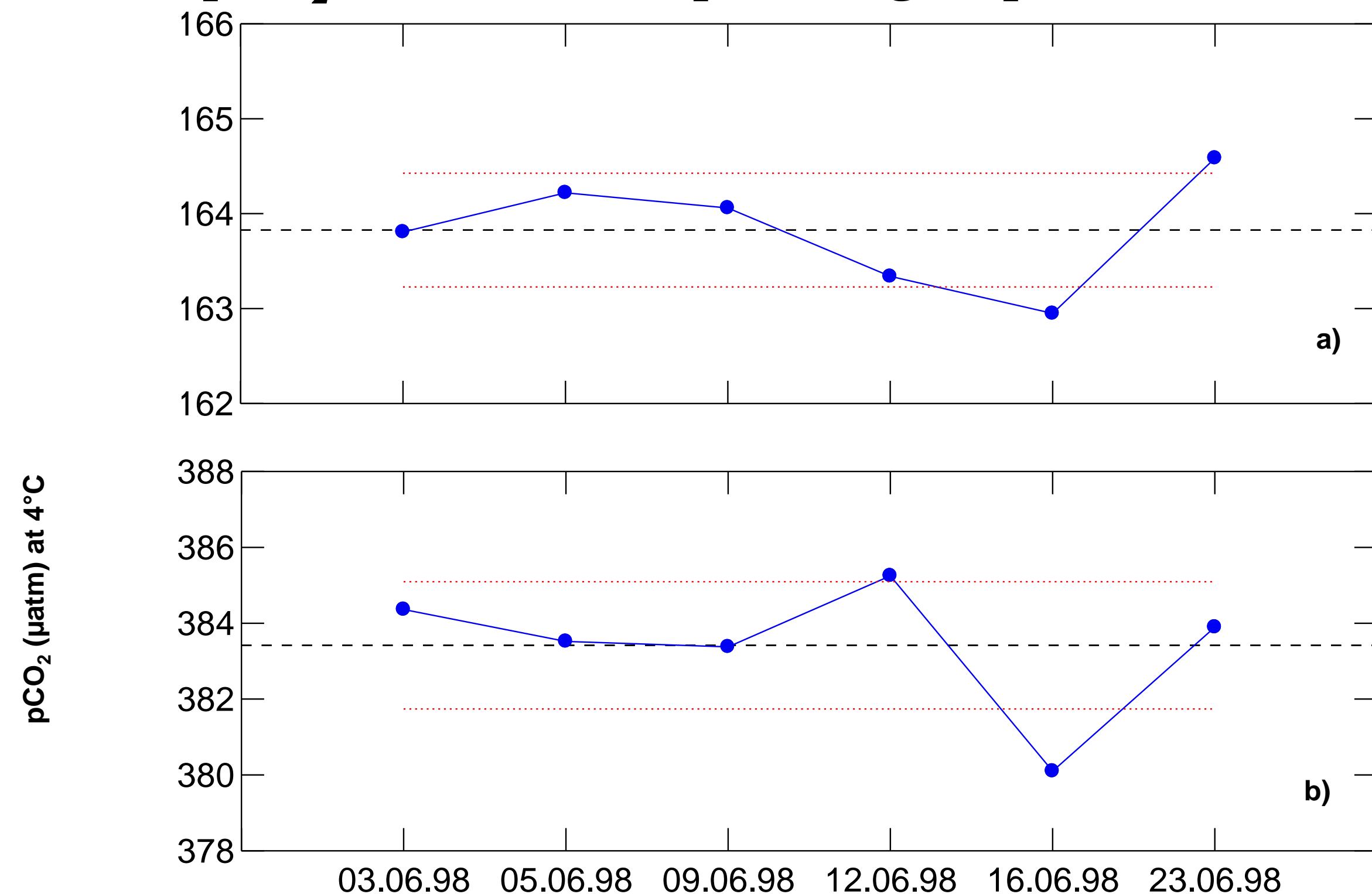
The high latitude North Atlantic are an intense sink for CO₂ on the basis of per area (Takahashi et al., 2009). The Nordic Seas, which consist of the Greenland, Iceland and Norwegian Seas are a region of transition between relatively warm saline (S > 35) Atlantic Water coming from the south and Polar Water (S < 34.4) of the East Greenland Current flowing from the Arctic Ocean (Fig. 1; Hansen, Osterhus et al., 2008). The surface waters of the Iceland Sea to the north of Iceland are a mixture of Atlantic Water and Polar Water, it is termed Arctic Water and has salinities of S: 34.6-34.9.

Relatively warm and saline (S > 35) Atlantic Water is south of Iceland and in the Irminger Sea.

Quarterly time series observations of hydrography, nutrients and carbon chemistry have been conducted since 1983 at two sites, one in the Irminger Sea and the other in the Iceland Sea.

The carbon chemistry parameters observed are pCO₂ and TCO₂. Procedures and QC aspects are described in Olafsson et al., 2010.

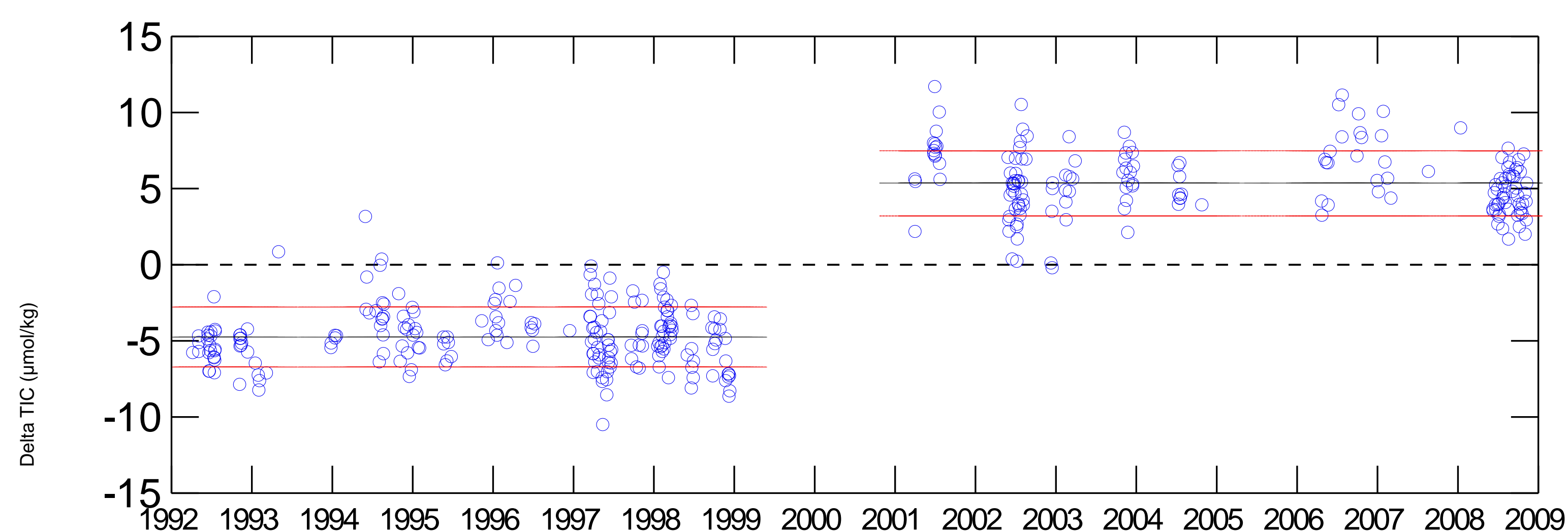
pCO₂ three week sample storage experiment



Average pCO₂ (µatm at 4°C) in a) phytoplankton bloom samples from 5 m depth, and b) samples below photic zone from 200 m depth.

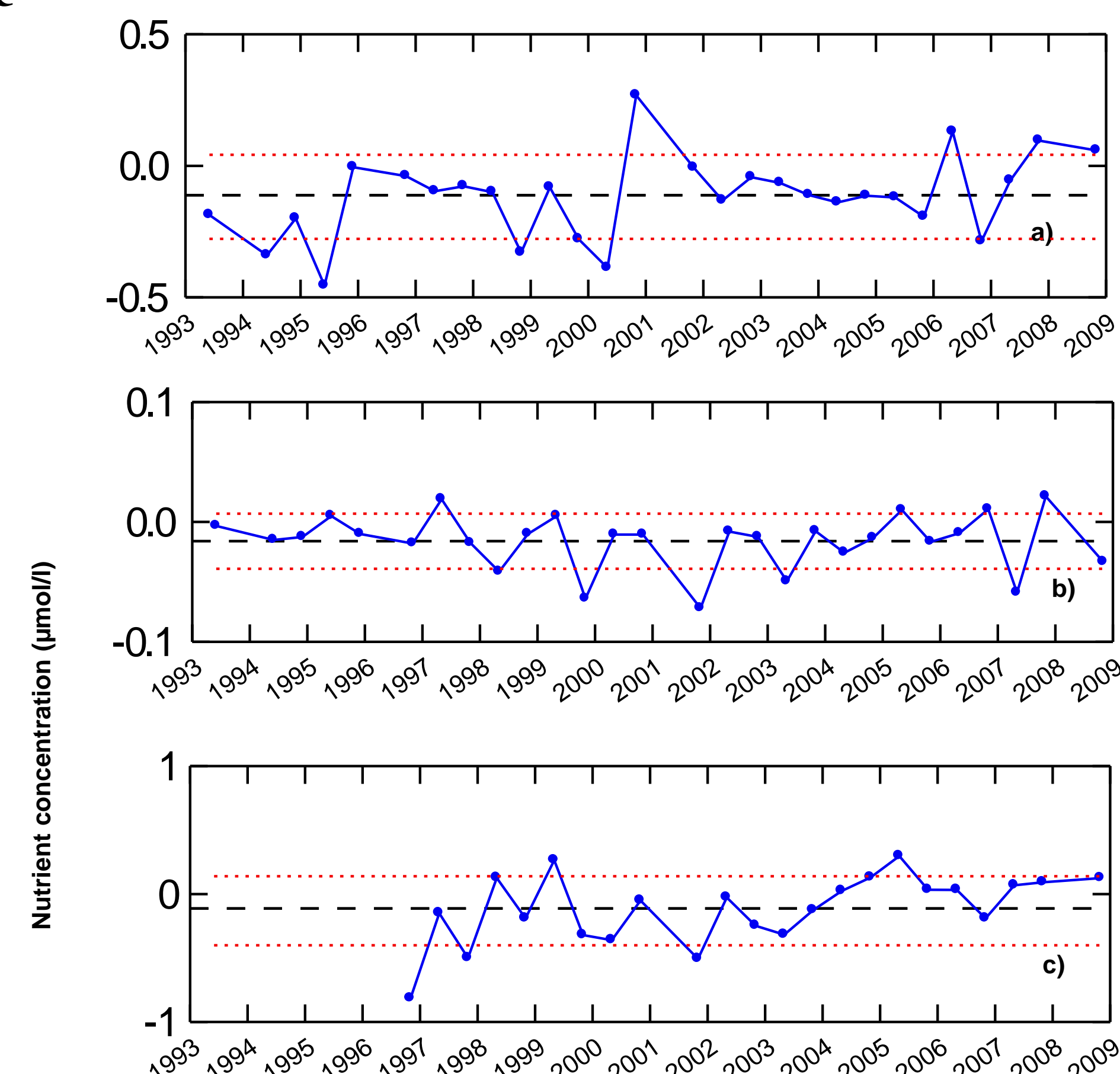
The average concentrations for the storage experiment are shown with a black dashed line and their standard deviations are shown with red dotted lines. The average concentration is 163.8 ± 0.6 µatm at 5 m depth and 383.4 µatm ± 1.7 at 200 m depth.

Dickson's sea water CRM comparisons



Results of TCO₂ determinations in Dickson's sea water reference materials (CRM) 1992-1998 and 2001-2008. The average differences (MRI-CRM) are shown as black dashed lines and their standard deviations are shown with red dotted lines. The differences of -4.7 µmol C kg⁻¹ for the period 1992-1998 are as observed and without a loop volume correction which was applied to data from this period. The differences observed in the period 2001-2008 and with a mean of +5.3 µmol C kg⁻¹, were found after taking account of a loop volume correction and they result from instrumental adjustments.

QUASIMEME sea water test materials for nutrients

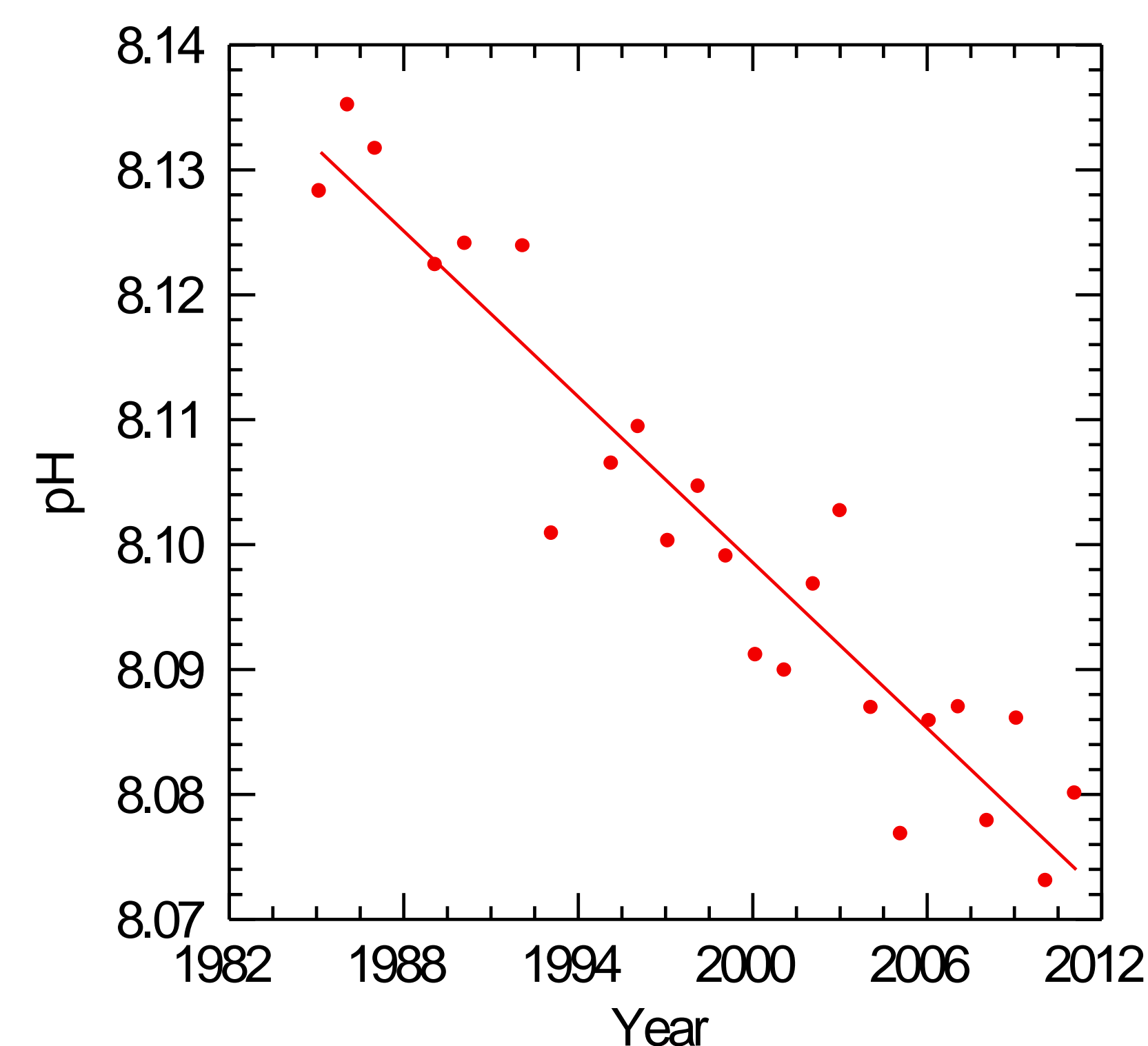


Average deviations of a) nitrate, b) phosphate and c) silicate concentrations (in µmol/l) from assigned values in QUASIMEME sea water test materials 1993-2008 (silicate from 1996).

The overall long term mean deviations are shown with black dashed lines and their standard deviations are shown with a red dotted lines.

The long term mean deviation is -0.12 µmol/l for nitrate (s.d. 0.16, n=28), -0.02 µmol/l (s.d. 0.02, n=28) for phosphate and -0.11 µmol/l (s.d. 0.27 n=23) for silicate.

Iceland Sea acidification rate



Iceland Sea Time series station. Surface water pH in winter decreases: -0.0024 ± 0.0002/y
J. Olafsson et al., 2009

References

- Hansen, Bogi, Østerhus, Svein, Turrell, William R., Jónsson, Steingrímur, Valdimarsson, Héðinn, Hátún, Hjálmar, & Olsen, Steffen Malskær. (2008). The inflow of Atlantic Water, heat and salt to the Nordic Seas across the Greenland-Scotland Ridge. In R. R. Dickson, J. Meincke & P. Rhines (Eds.), *Arctic-Subarctic Ocean Fluxes* (pp. 15-43). Dordrecht: Springer.
- Olafsson, J., Olafsdottir, S. R., Benoit-Cattin, A., Danielsen, M., Arnarson, T. S., & Takahashi, T. (2009). Rate of Iceland Sea acidification from time series measurements. *Biogeosciences*, 6, 2661-2668.
- Olafsson, Jon, Olafsdottir, Solveig R., Benoit-Cattin, Alice, & Takahashi, Taro. (2010). The Irminger Sea and the Iceland Sea time series measurements of sea water carbon and nutrient chemistry 1983-2008. *Earth Syst. Sci. Data*, 2, 99-104. doi: doi:10.5194/essd-2-99-2010
- Takahashi, Taro, Sutherland, Stewart C., Wanninkhof, Rik, Sweeney, Colm, Feely, Richard A., Chipman, David W., . . . Baar, Hein J. W. de. (2009). Climatological Mean and Decadal Change in Surface Ocean pCO₂ and Net Sea-air CO₂ Flux over the Global Oceans. *Deep-Sea Research II*, 56, 554-557. doi: doi:10.1016/j.dsr2.2008.12.009