

Supplementary material

February 25, 2015

1 Cruise track for the winter cruise

The positions of the CTD stations are shown in figure 1. Figures ?? and ?? show the hydrographic data for the winter cruise. During leg 2, sampling was carried out from the ice edge to Marion Island in a straight line and then around the island in an anti-clockwise direction. The profiles for leg 2 are shown by station number rather than by latitude as the circular nature of the transect gives rise to overlaps in the latitude. The positions of the 15N stations where nitrogen uptake was measured are shown on the CTD plots.

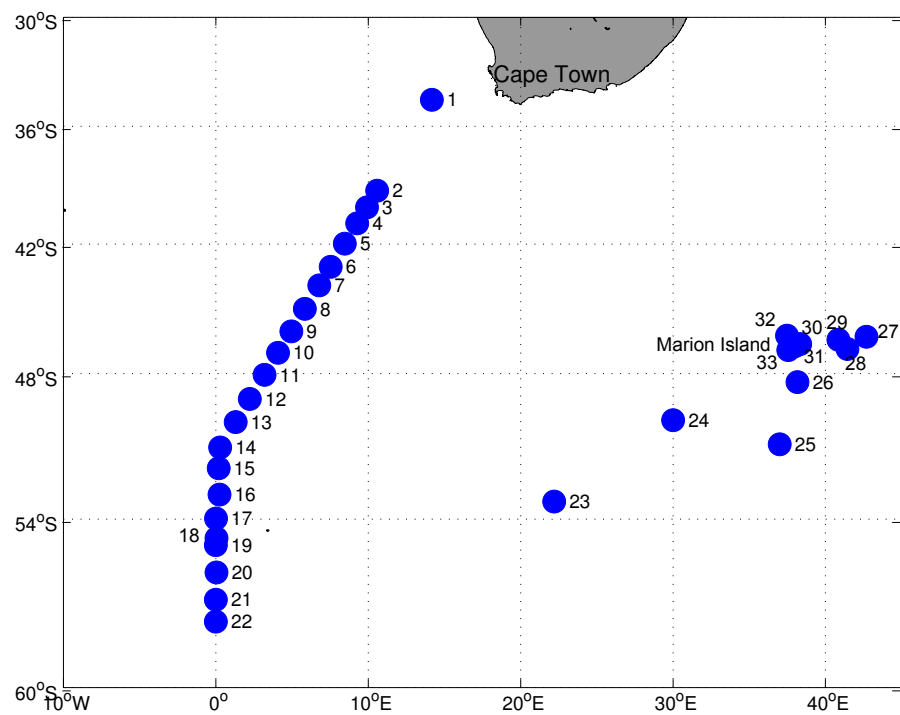


Figure 1: CTD positions for the winter cruise. The numbers represent the cruise CTD number.

2 Hydrographic data for the winter cruise

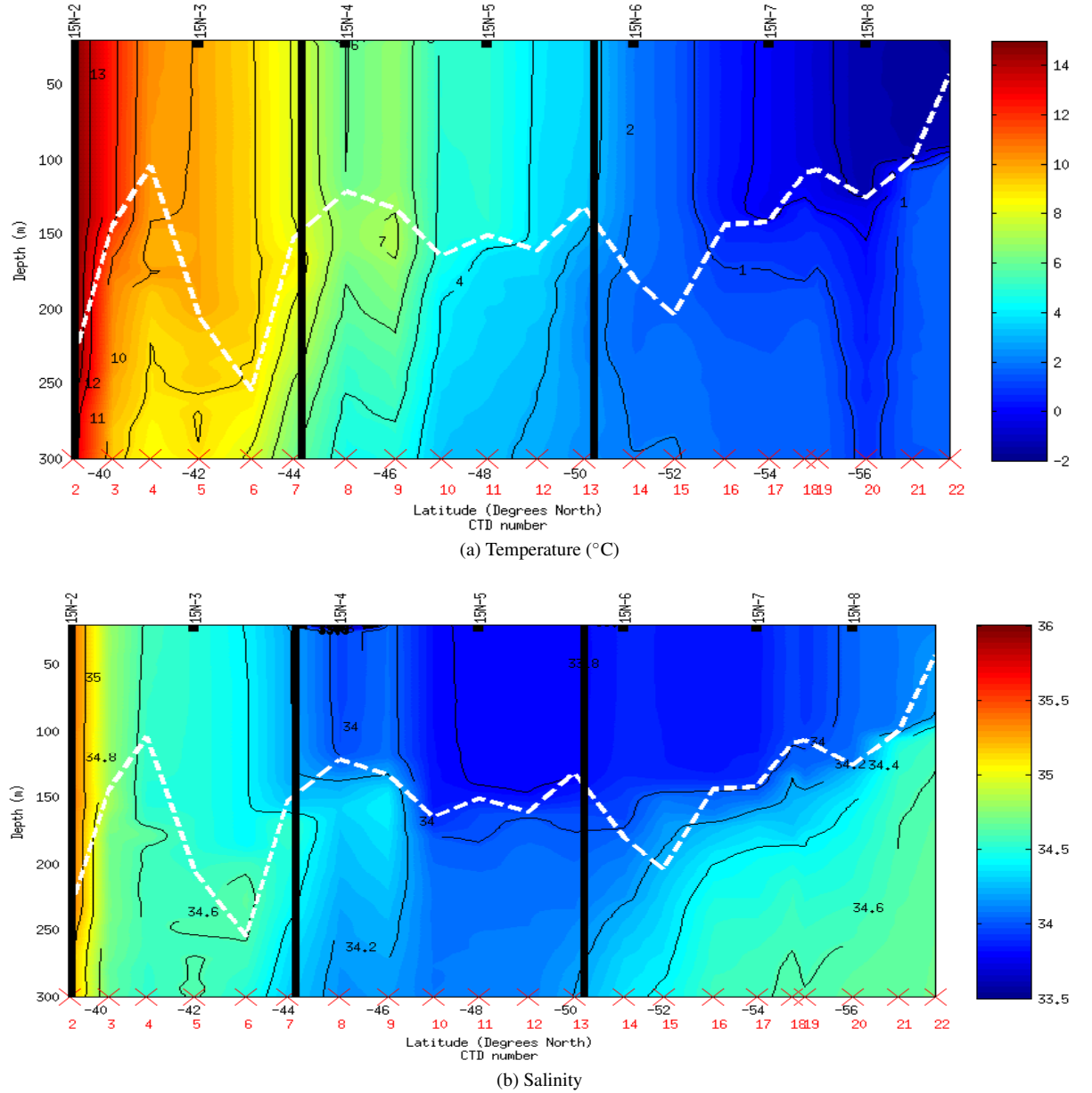
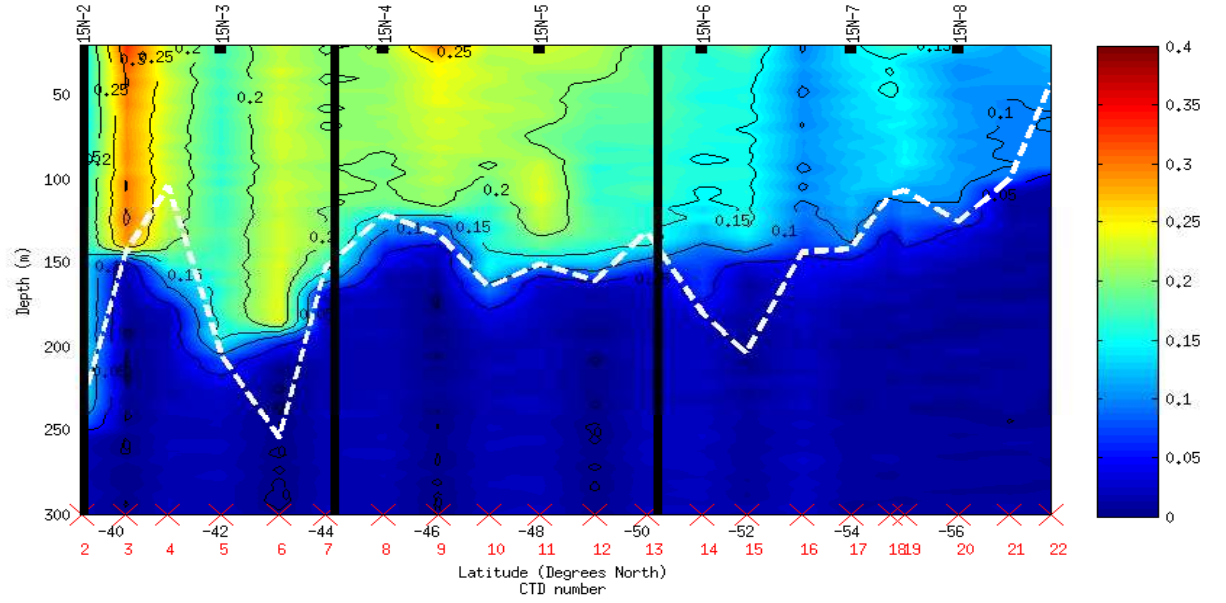
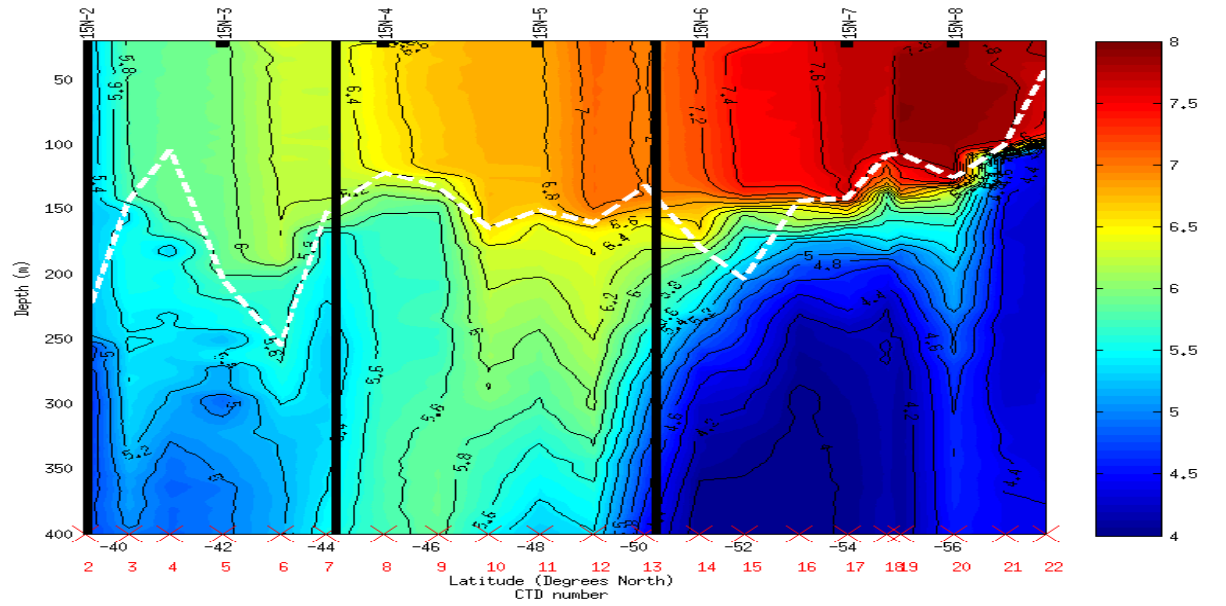


Figure 2: (a) Temperature ($^{\circ}\text{C}$) and (b) Salinity (psu) sections for leg 1 of the winter cruise: (a) Temperature ($^{\circ}\text{C}$) (b) (c) Chlorophyll ($\text{mg} \cdot \text{m}^{-3}$) (d) Oxygen ($\text{mL} \cdot \text{L}^{-1}$). The red crosses and numbers represent all the CTD stations during this leg. The stations where nitrogen uptake was measured are indicated by the black rectangles and "15N-" number at the top of each plot. The solid black lines from left to right show the positions of STF, SAF and the PF and the white dashed line shows the mixed layer depths.

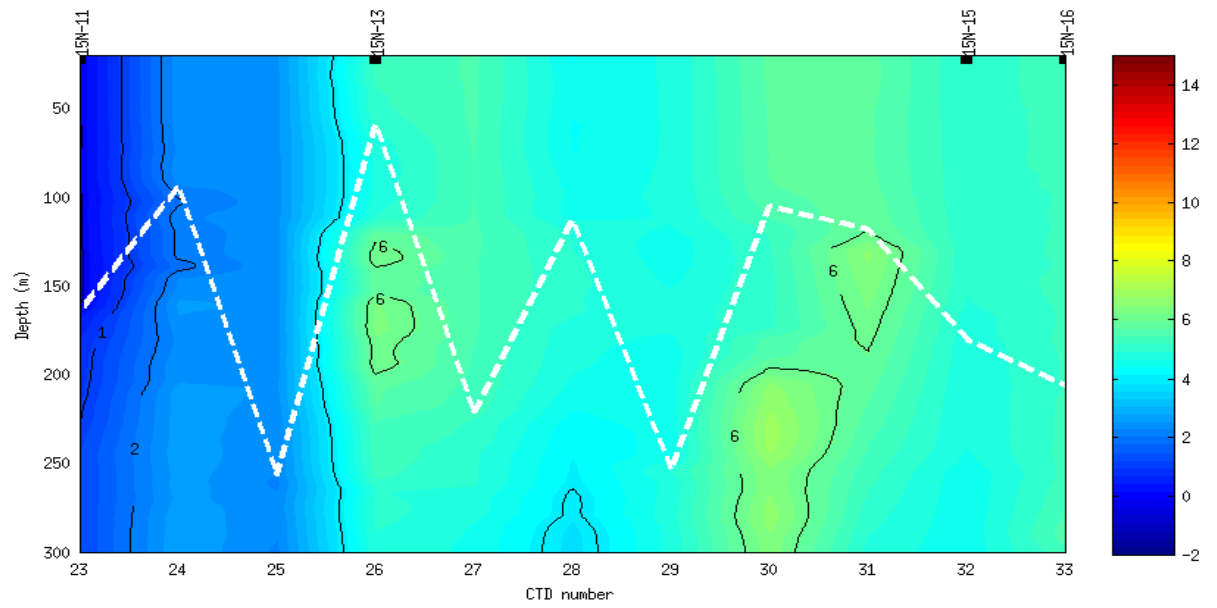


(a) Chlorophyll

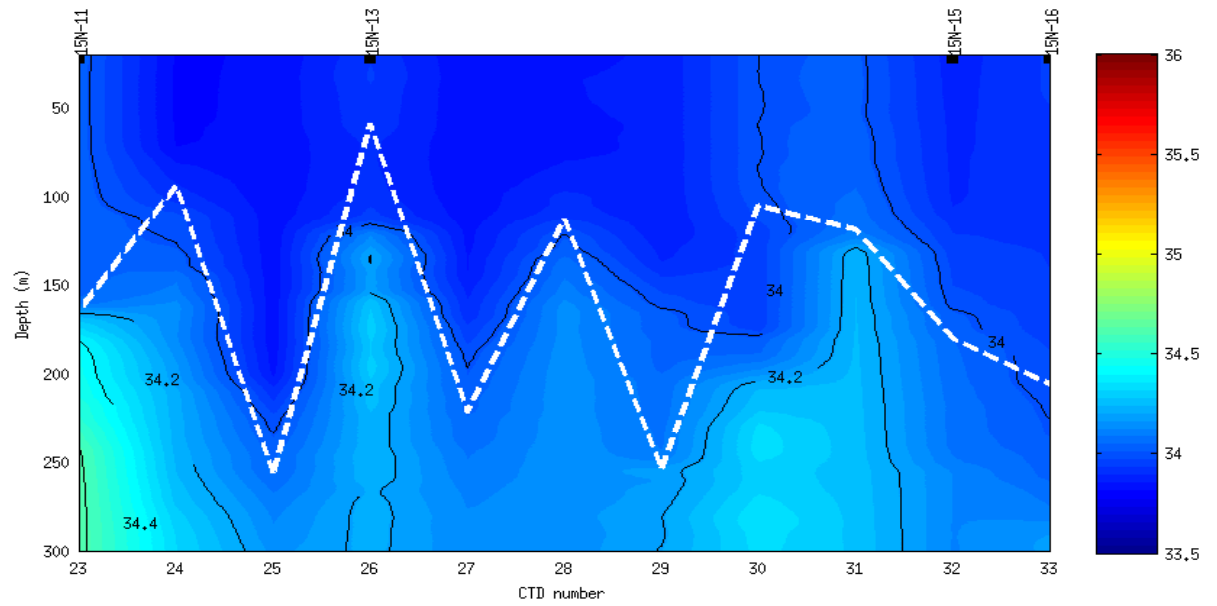


(b) Dissolved oxygen

Figure 3: (a) Chlorophyll ($\text{mg} \cdot \text{m}^{-3}$) and (b) dissolved Oxygen ($\text{mL} \cdot \text{L}^{-1}$) concentrations for leg 1 of the winter cruise. The red crosses and numbers represent all the CTD stations during this leg. The stations where nitrogen uptake was measured are indicated by the black rectangles and "15N-" number at the top of each plot. The solid black lines from left to right show the positions of STF, SAF and the PF and the white dashed line shows the mixed layer depths.

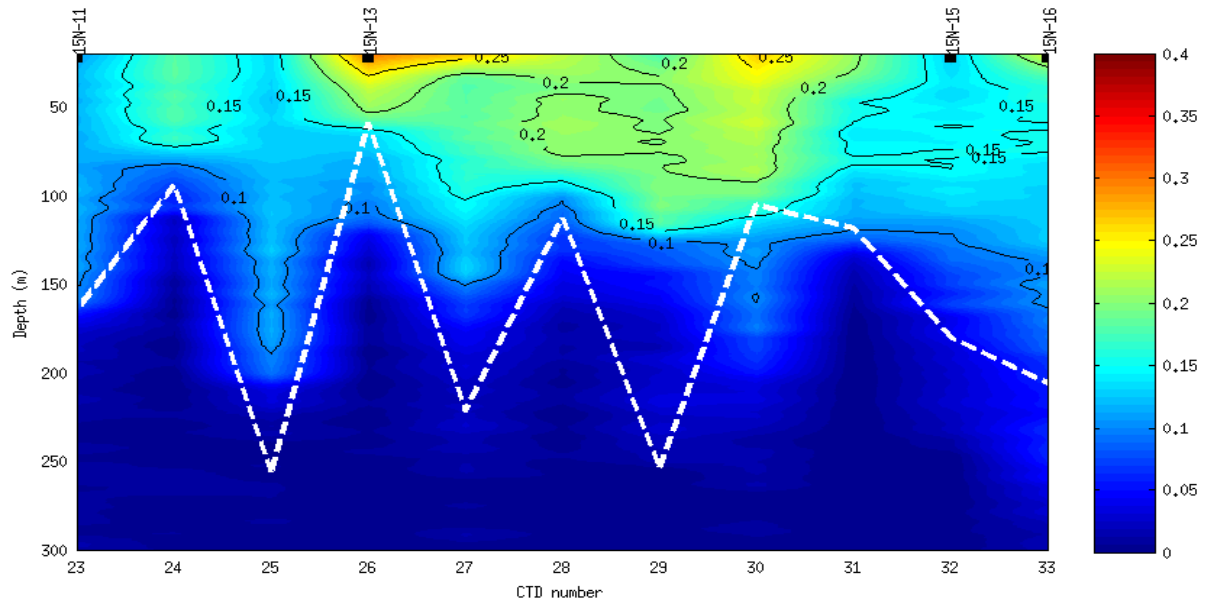


(a) Temperature ($^{\circ}\text{C}$)

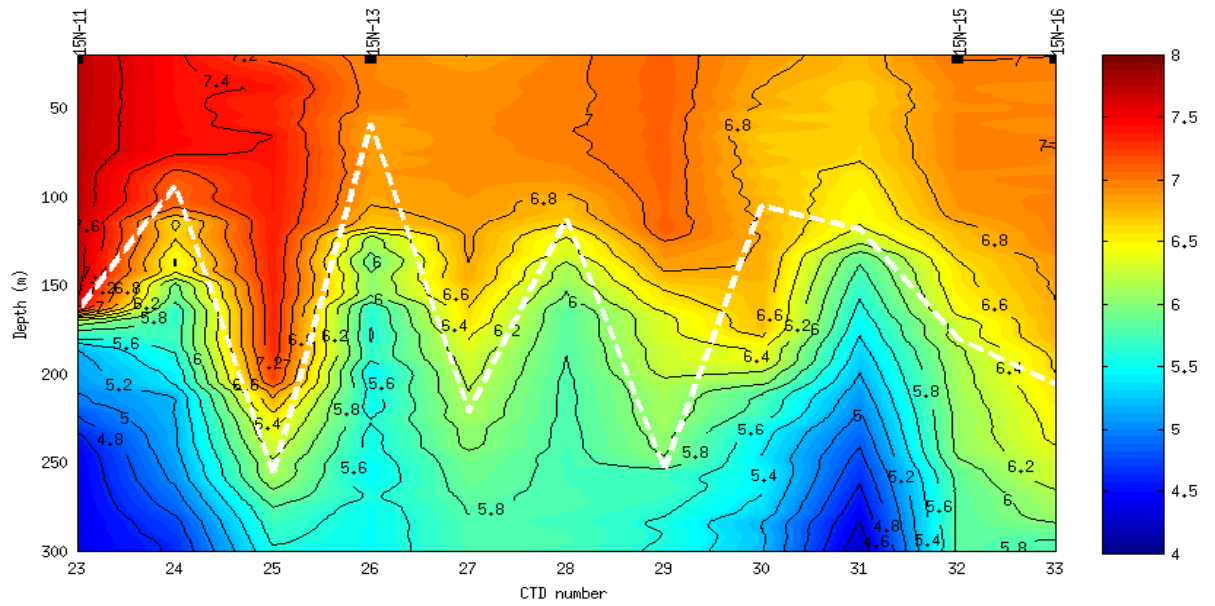


(b) Salinity

Figure 4: (a) Temperature ($^{\circ}\text{C}$) and (b) Salinity (psu) data for leg 2 of the winter cruise: The profiles are shown by station number rather than by latitude there are overlaps in the latitudes due to the circular nature of this leg. The distance between the stations is not shown at scale. The white dashed line represents the mixed layer depths. The stations where nitrogen uptake was measured are indicated by the black lines and "15N-" number at the top of each plot.



(a) Chlorophyll



(b) Dissolved oxygen

Figure 5: (a) Chlorophyll ($\text{mg} \cdot \text{m}^{-3}$) and (b) dissolved Oxygen ($\text{mL} \cdot \text{L}^{-1}$) concentrations for leg 2 of the winter cruise. The profiles are shown by station number rather than by latitude there are overlaps in the latitudes due to the circular nature of this leg. The distance between the stations is not shown at scale. The white dashed line represents the mixed layer depths. The stations where nitrogen uptake was measured are indicated by the black lines and "15N-" number at the top of each plot.

3 Correction of nitrogen uptake rates

In this paper, nitrogen uptake rates were calculated from the equation by (Collos, 1987). However, these do not account for isotopic dilution (specially for ammonium uptake rates) nor for the high tracer enrichment at some stations. Figure 6 compares ammonium uptake rates corrected for isotopic dilution according to the equation by (Kanda et al., 1987). Figure 7 compares all the nitrogen uptake rates corrected for high tracer enrichment according to the equation by Eppley et al. (1977).

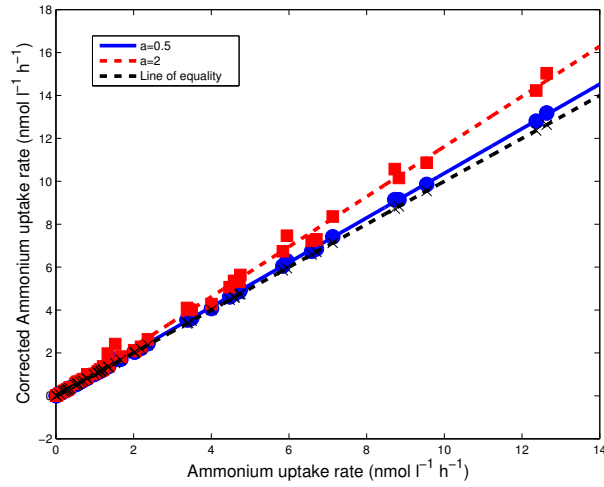


Figure 6: Comparison of uncorrected ammonium uptake rates and those corrected for isotopic dilution to the equation by Kanda et al. (1987)

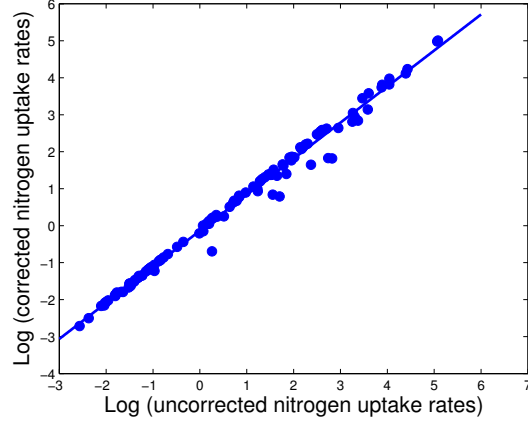


Figure 7: Comparison of uncorrected nitrogen uptake rates and those corrected for large enrichments according to the equation by Eppley et al. (1977)

4 Comparison of integrated nitrogen uptake rates

Table 1: Overview and comparison of integrated nitrogen uptake rates, ρ_{NO_3} and ρ_{NH_4} ($\text{mmol N m}^{-2} \text{d}^{-1}$). Average rates and the range are presented here

Integrated ρ_{NO_3}		Integrated ρ_{NH_4}		Month	Reference
mean	range	mean	range		
0.20	0.10–0.38	4.39	1.12 – 9.05	March	this study
1.14	0.17–5.20	6.73	0.60 – 32.86	July	this study
3.01	1.75 – 6.58	1.06	0.55 – 2.18	March	Smith and Nelson (1990)
3.33	0.79 – 8.63	14.58	2.65 – 39.17	April	Thomalla et al. (2011)
1.49	0.82 – 2.48	3.68	0.35 – 10.55	February	Sambrotto and Mace (2000)
4.37	1.32 – 8.86	2.34	1.62–2.91	October	Savoye et al. (2004)
5.25	1.85 – 9.26	4.63	1.51– 10.06	November	Smith and Nelson (1990)
10.43	0.9 – 34.94	12.63	2.84 – 23.19	November	Waldron et al. (1995)
6.10	1.90 – 12.58	5.65	3.03 – 8.80	December	Sambrotto and Mace (2000)
1.50	0.3 – 4.1	1.1	0.8 – 1.6	December	Gandhi et al. (2012)*
4.07	3.63 – 4.55	1.37	0.98 – 1.91	December	Savoye et al. (2004)

*values reported to 1 decimal place

References

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