Decadal Trend of Dissolved Oxygen in the North Pacific along 165°E – A preview

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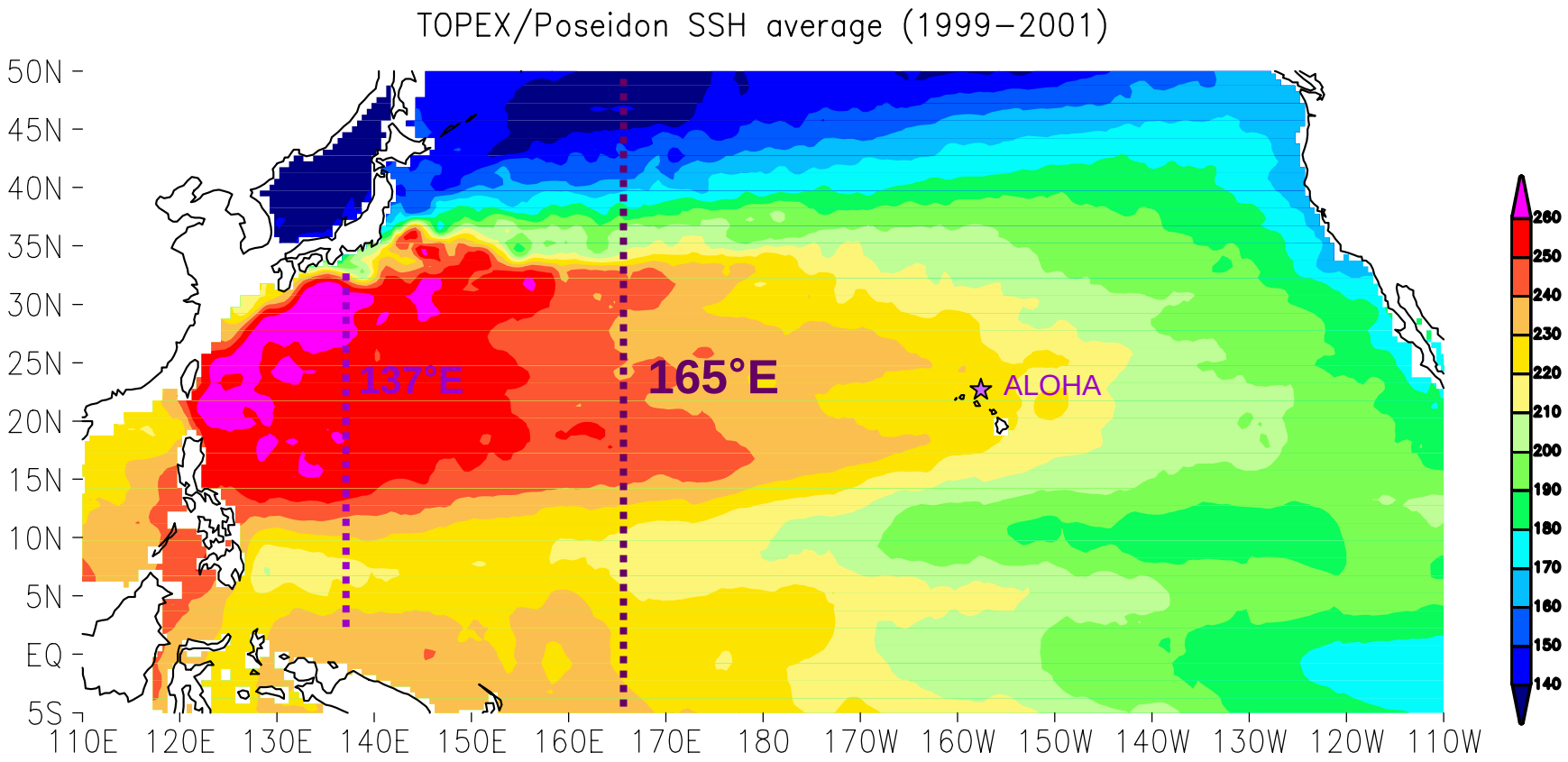
Objective

- To assess the interannual changes in the dissolved oxygen (DO) and apparent oxygen utilization (AOU) on the various isopycnal surfaces at the various latitudes in the western North Pacific since early 1990s.

- To infer the importance of the biogeochemical processes and/or the circulation changes, *i.e.,* the processes other than the anthropogenic CO_2 invasion, for the variability of CO_2 in the ocean.

Location


TOPEX/Poseidon SSH average (1999–2001)
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
5S
110E
120E
130E
140E
150E
160E
170E
180
170W
160W
150W
140W
130W
120W
110W
137°E
165°E
ALOHA
260
250
240
230
220
210
200
190
180
170
160
150
140

Cruise List

Year	cruise	Period	Longitude	Latitude	ship
1996	RF9601	Feb 16 - Mar 06	165E	30N - 04S	R/ V Ryofu Maru
	RF9604	May 18 - May 24	165E	50N - 32N	R/ V Ryofu Maru
	RF9610	Oct 14 - Nov 10	165E	45N - 02S	R/ V Ryofu Maru
1997	RF9705	Jun 05 - Jul 11	165E	50N - 30N	R/ V Ryofu Maru
	RF9709	Sep 17 - Oct 14	165E	48N - 02S	R/ V Ryofu Maru
1998	RF9806	Jun 16 - Jun 21	165E	50N - 30N	R/ V Ryofu Maru
	RF9809	Sep 21 - Oct 17	165E	50N - 03S	R/ V Ryofu Maru
1999	RF9904	May 15 - May 20	165E	50N - 40N	R/ V Ryofu Maru
	RF9909	Sep 21 - Oct 17	165E	50N - 03S	R/ V Ryofu Maru
2000	RF0004	May 08 - May 15	165E	48N - 30N	R/ V Ryofu Maru
	RF0009	Sep 28 - Oct 18	165E	30N - 03S	R/ V Ryofu Maru
2001	KS0101	Jan 27 - Feb 12	165E	20N - 03S	R/ V Keifu Maru
	RF0104	May 15 - May 19	165E	48N - 35N	R/ V Ryofu Maru
	RF0106	Jul 10 - Jul 13	165E	48N - 35N	R/ V Ryofu Maru
	RF0110	Oct 17 - Nov 06	165E	30N - 03S	R/ V Ryofu Maru
2002	KS0201	Jan 25 - Feb 10	165E	20N - 03S	R/ V Keifu Maru
	RF0204	May 17 - May 22	165E	48N - 30N	R/ V Ryofu Maru
	RF0206	Jul 11 - Jul 16	165E	50N - 30N	R/ V Ryofu Maru
	RF0210	Oct 07 - Oct 30	165E	30N - 06S	R/ V Ryofu Maru
2003	KS0301	Jan 20 - Feb 10	165E	30N - 03S	R/ V Keifu Maru
	RF0304	May 02 - May 06	165E	43N - 37N	R/ V Ryofu Maru
	RF0306	Jun 27 - Jul 04	165E	50N - 26N	R/ V Ryofu Maru
	KS0306	Jul 03 - Jul 22	165E	28N - 05S	R/ V Keifu Maru
2004	RF0401	Jan 23 - Jan 10	165E	28N - 05S	R/ V Ryofu Maru
	RF0406	Jun 14 - Jun 20	165E	50N - 28N	R/ V Ryofu Maru
	KS0406	Jun 24 - Jul 13	165E	28N - 05S	R/ V Keifu Maru
2005	RF0501	Jan 24 - Feb 11	165E	26N - 05S	R/ V Ryofu Maru
	RF0506	Jun 22 - Jun 28	165E	50N - 28N	R/ V Ryofu Maru
	KS0506	Jun 23 - Jul 12	165E	28N - 05S	R/ V Keifu Maru
2006	RF0601	Jan 23 - Feb 09	165E	28N - 05S	R/ V Ryofu Maru

R/V Ryofu Maru

R/V Keifu Maru

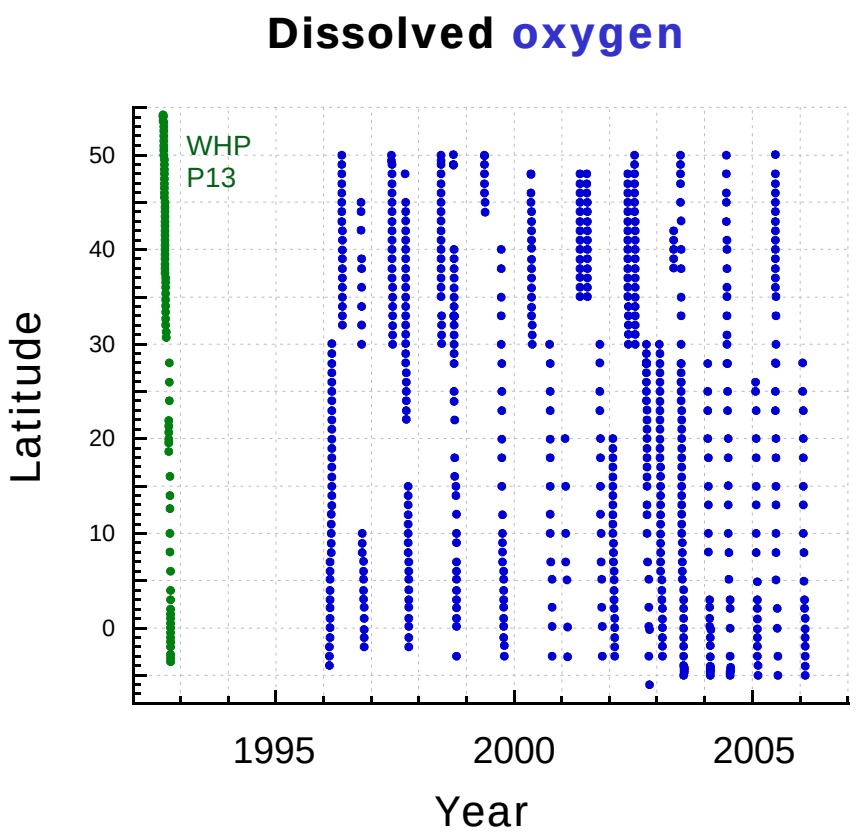
Total 30 cruises

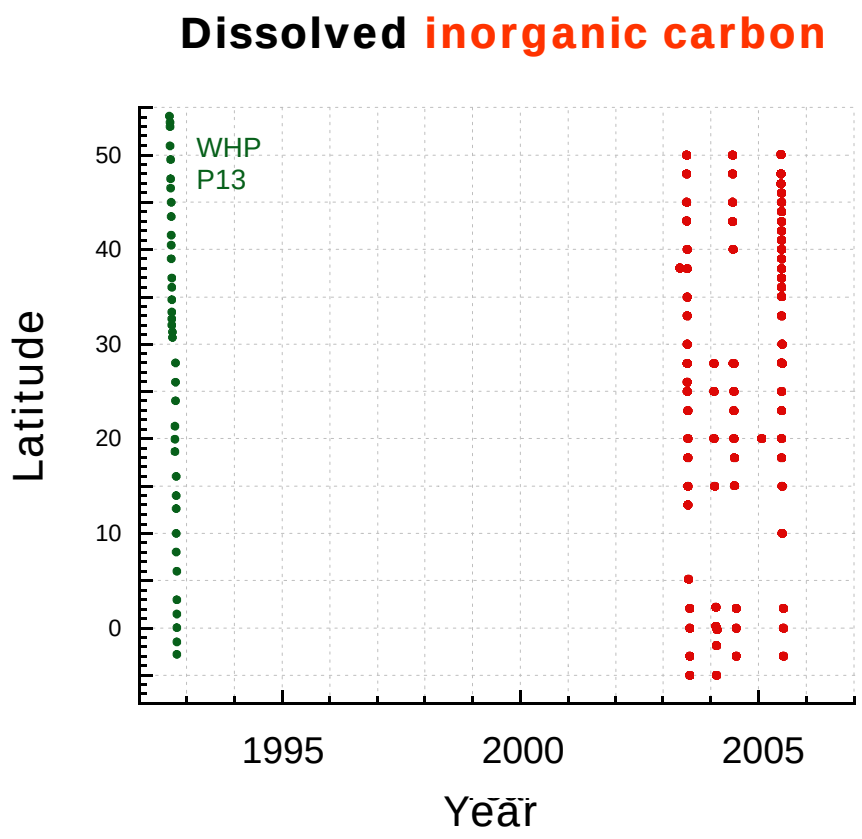
Jan. 1996 – Feb. 2006

> 30°N : 17 cruise

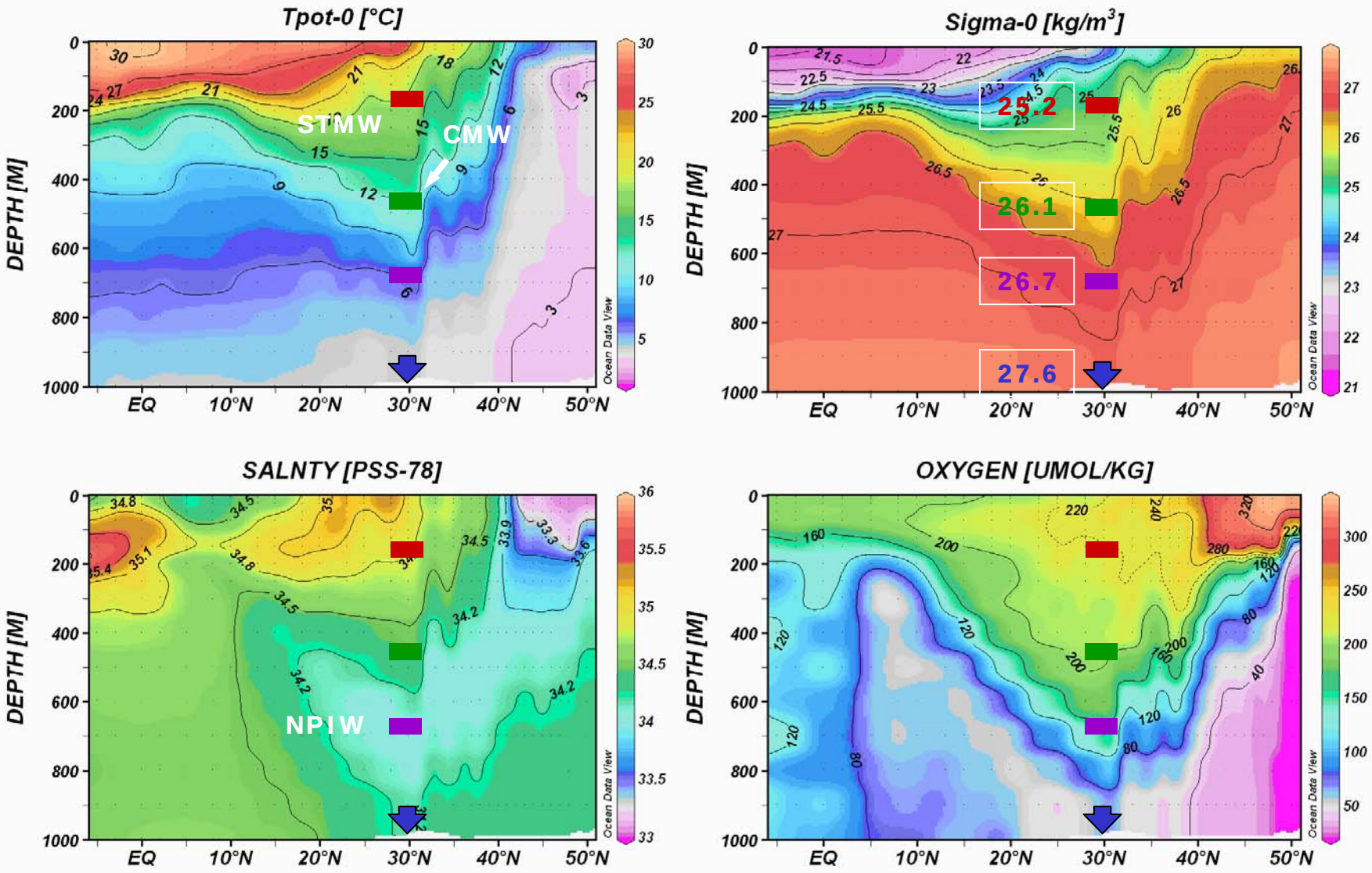
< 30°N : 18 cruise

Time and site of observation along 165°E

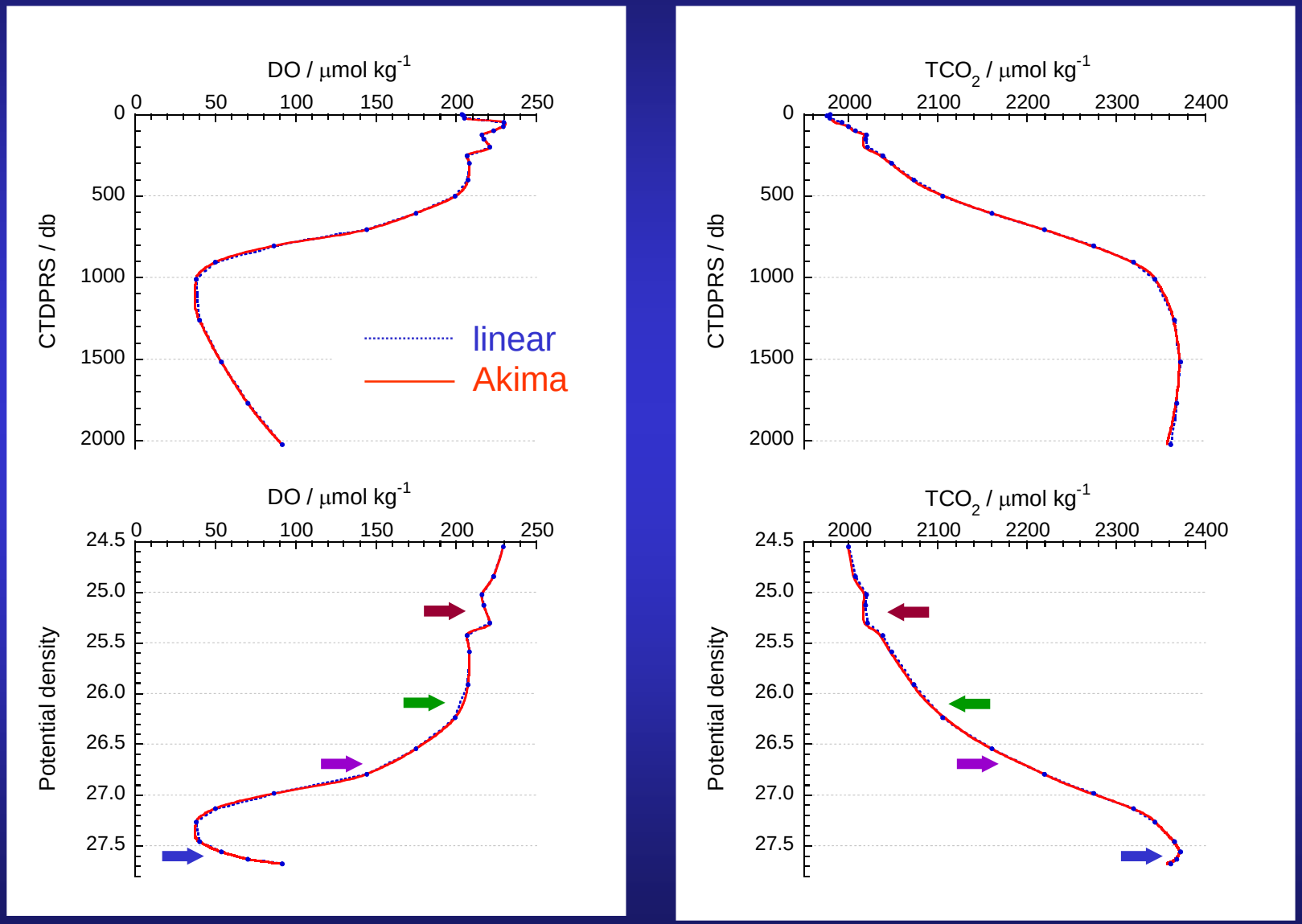




Vertical sections [June-July 2005]

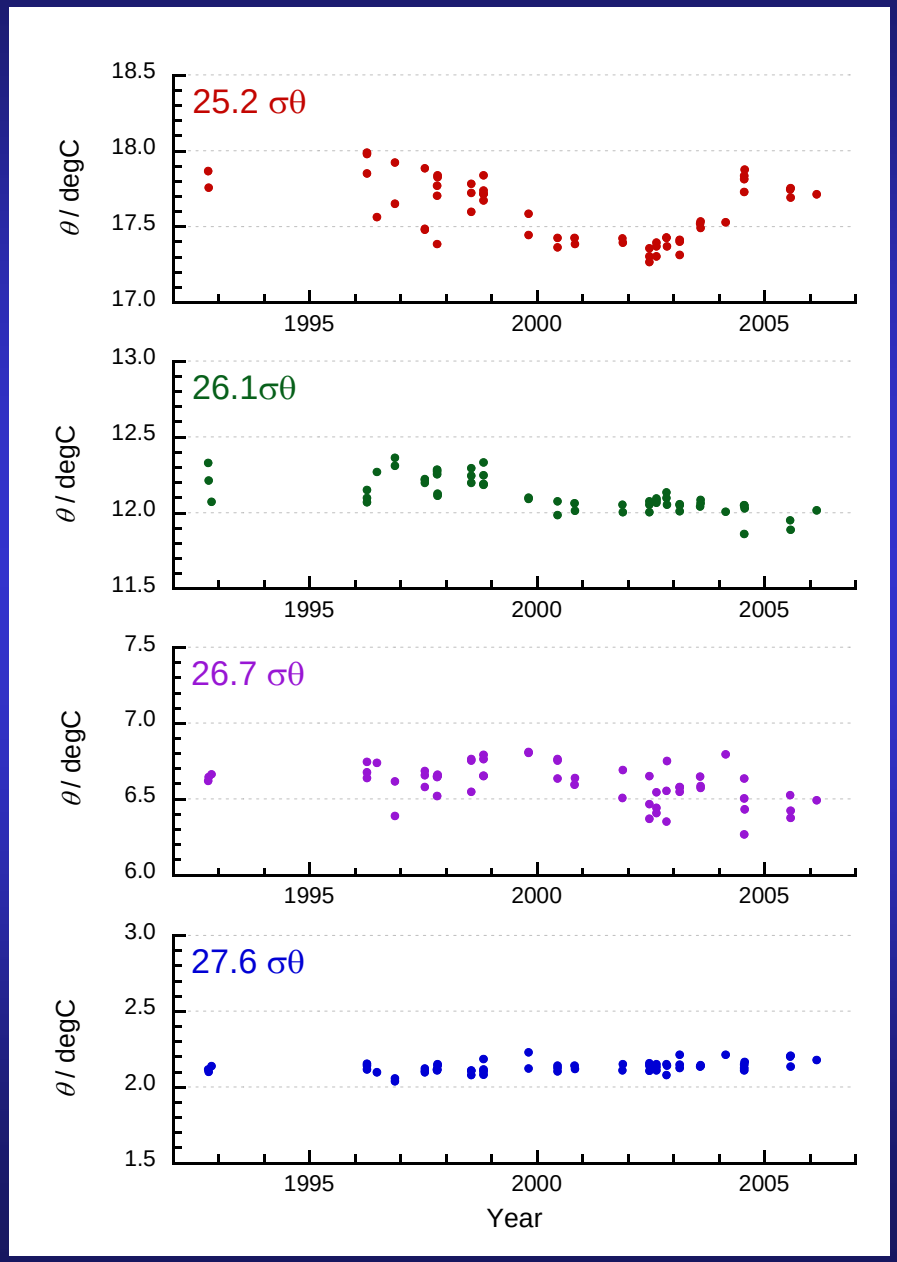


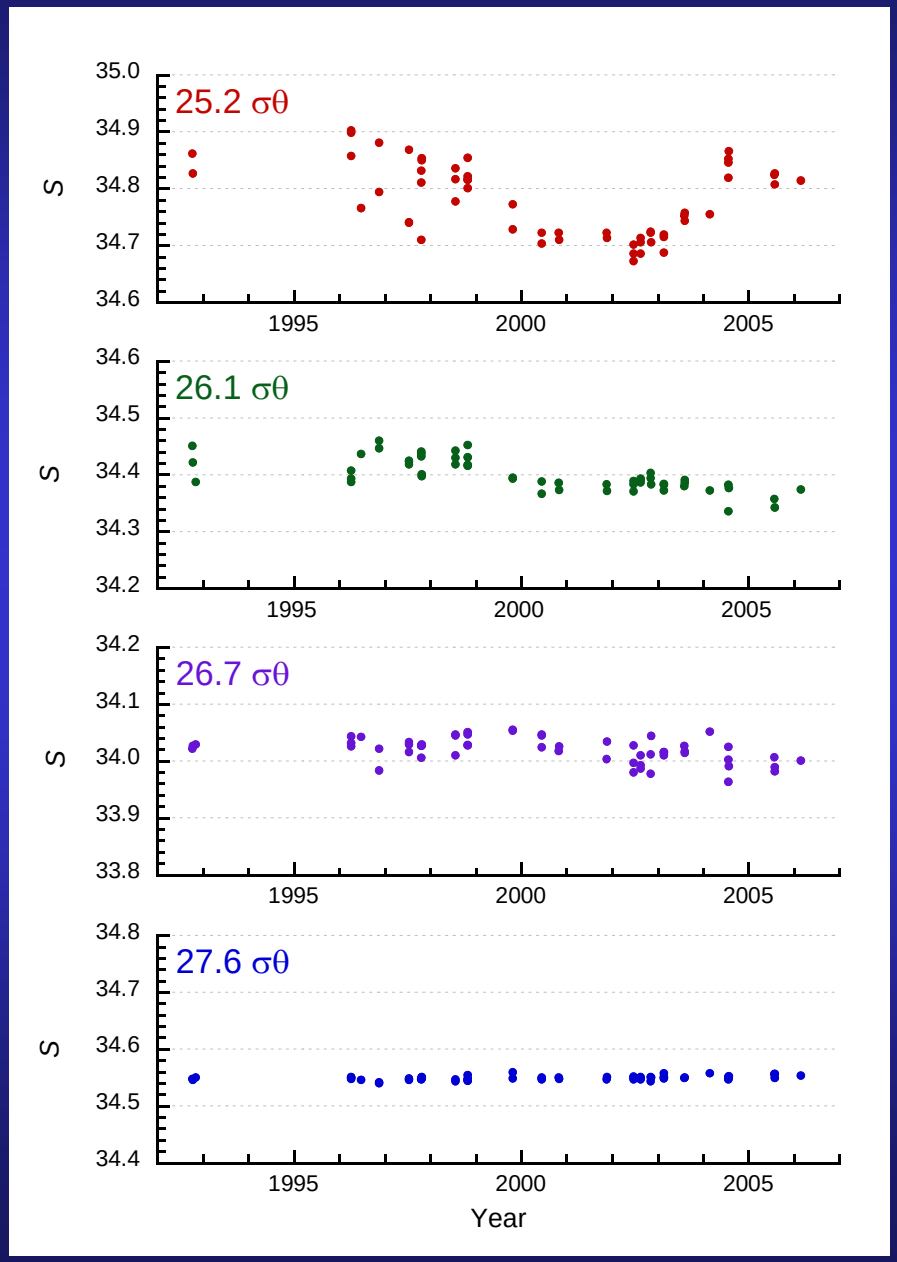
Interpolation - Akima method



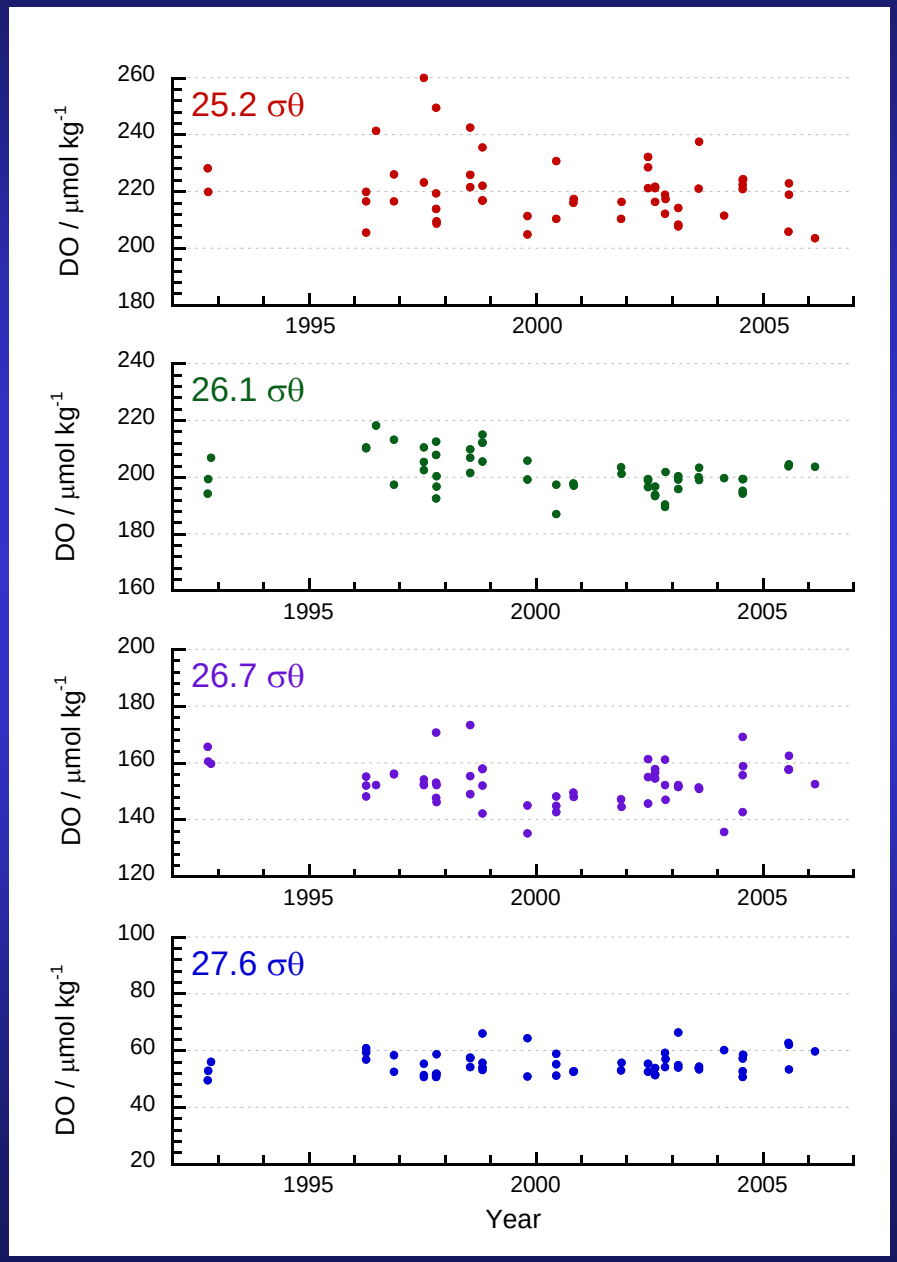
Data from 28°N, 165°E on June 28, 2005

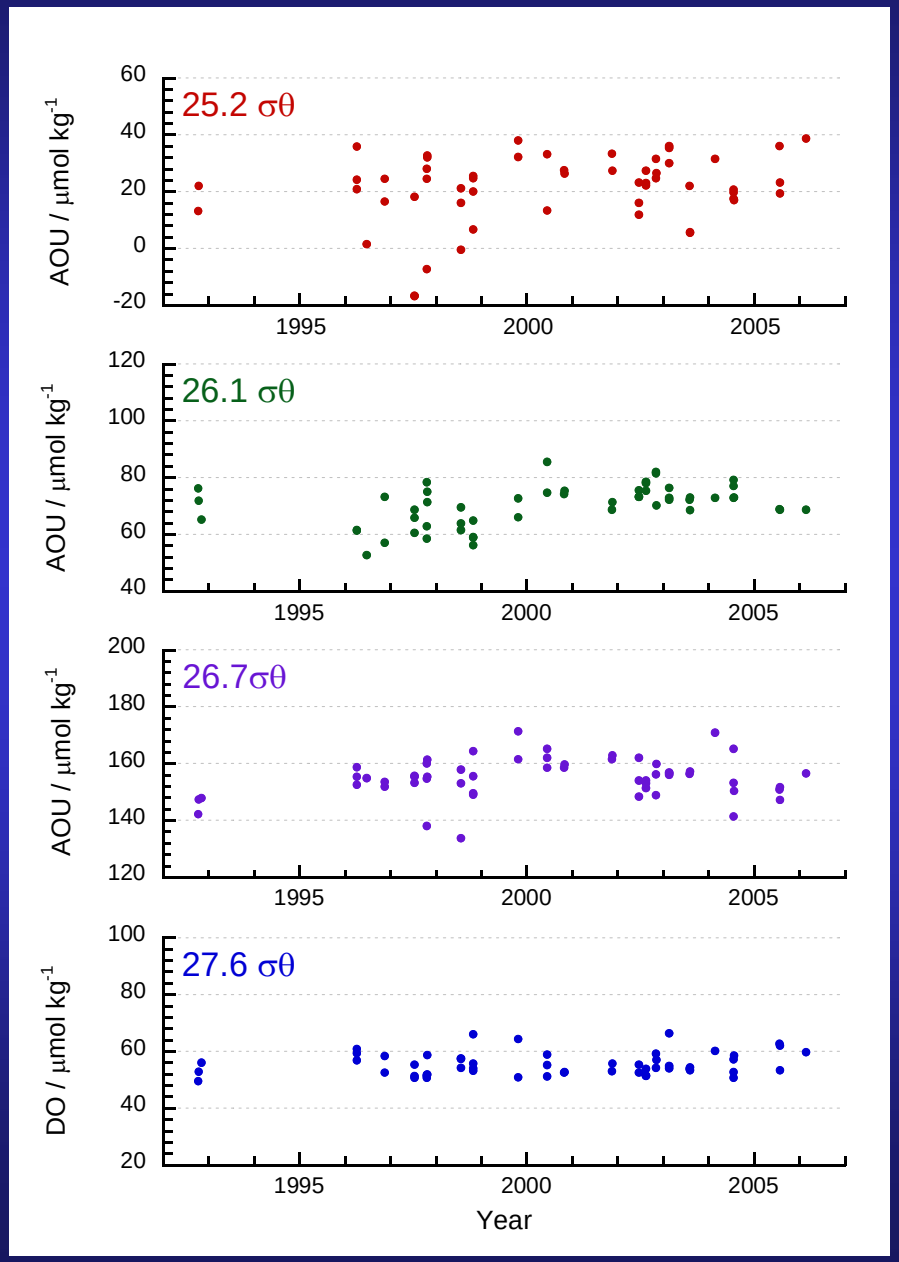
Trend - θ and S



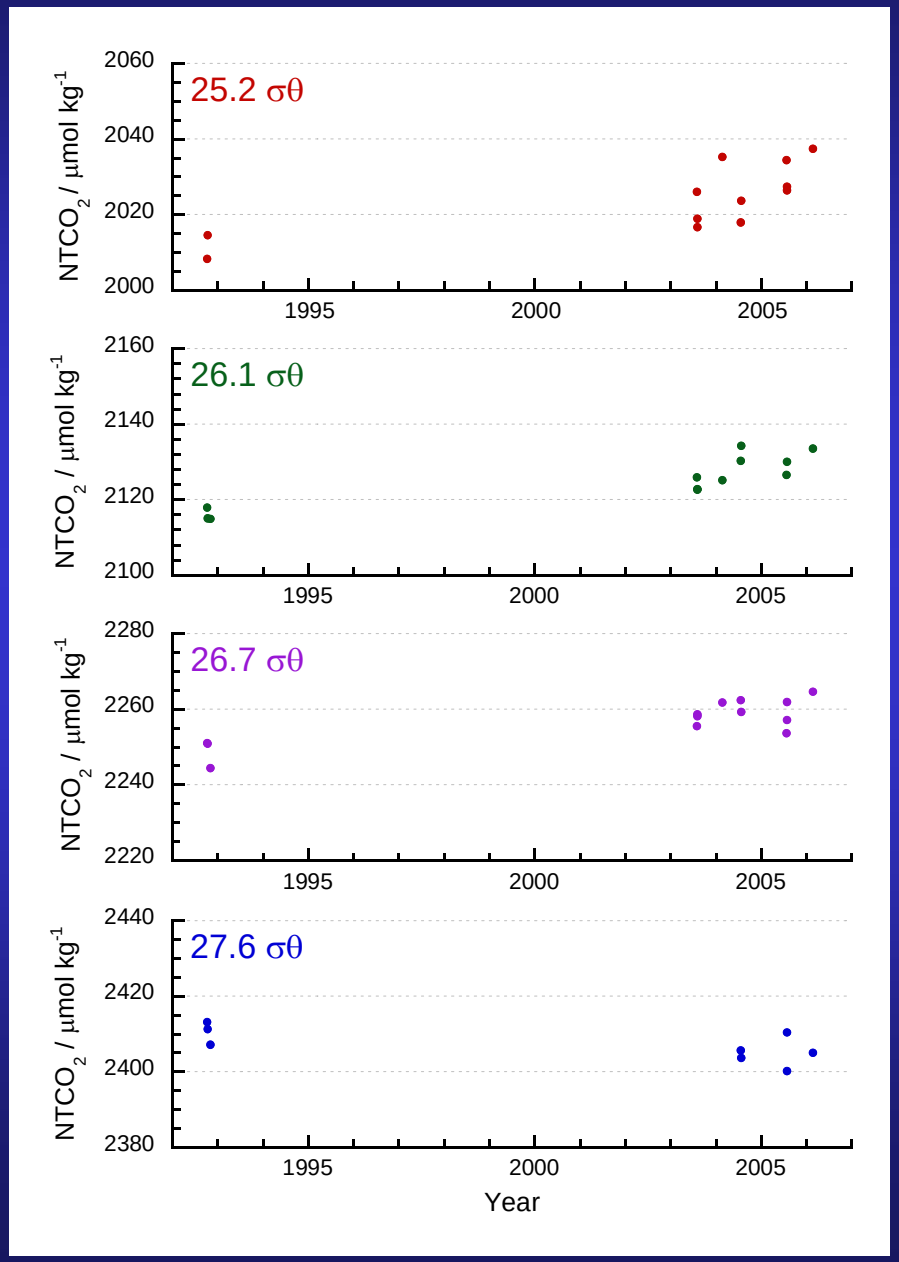


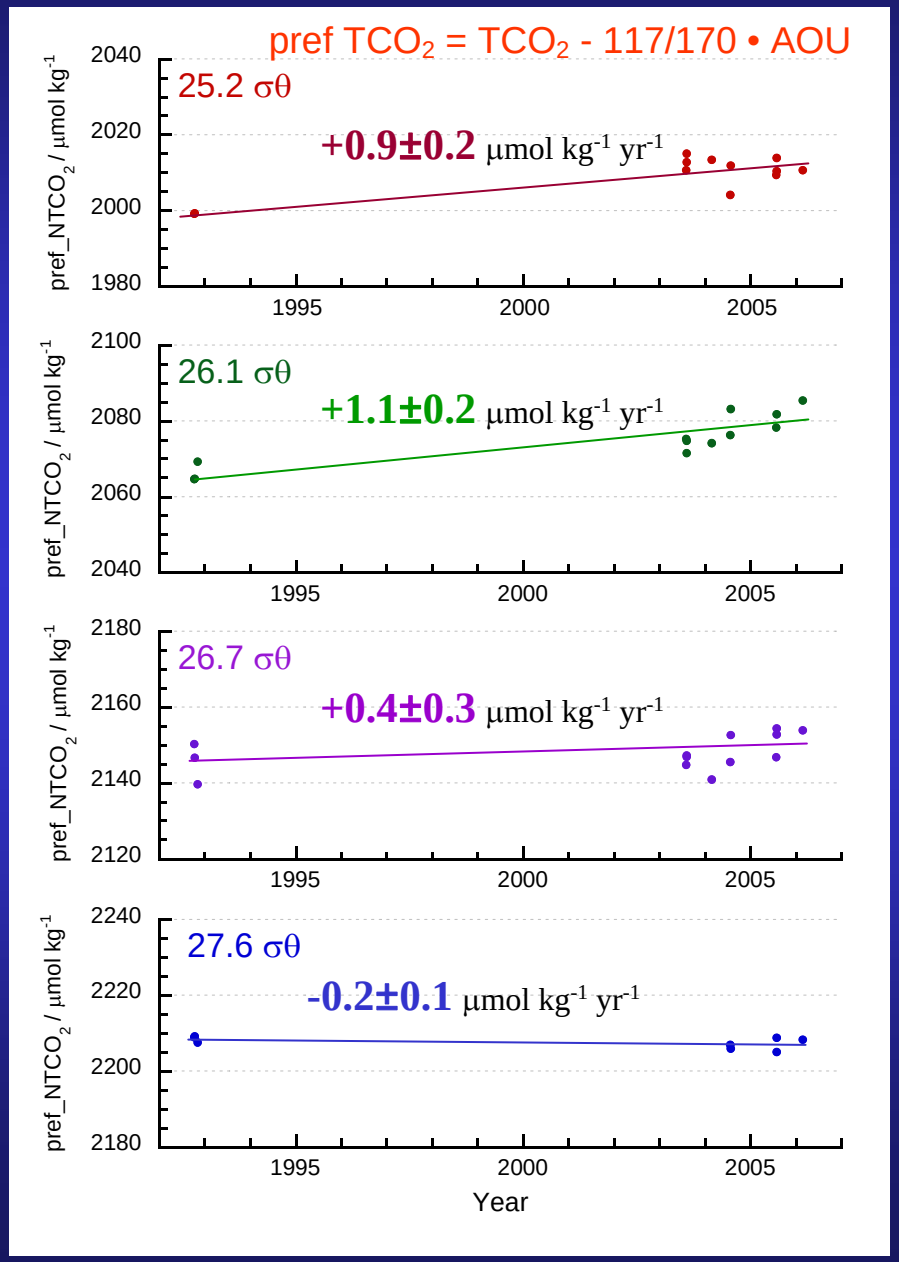
Trend - DO and AOU



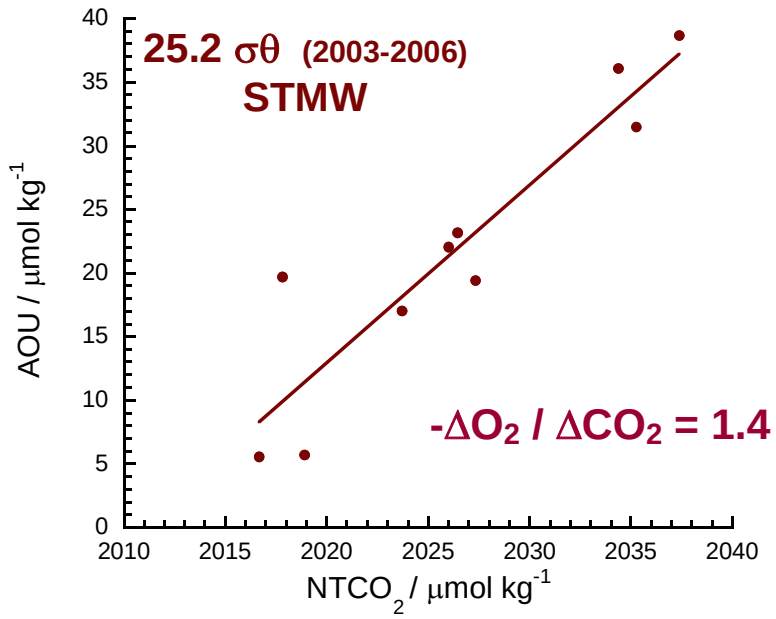


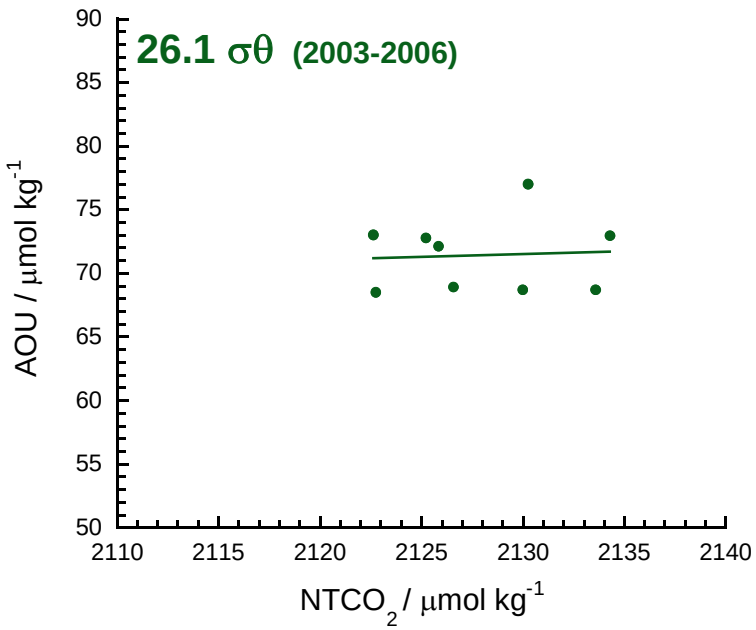
Trend - TCO_2 and preformed TCO_2 @S=35

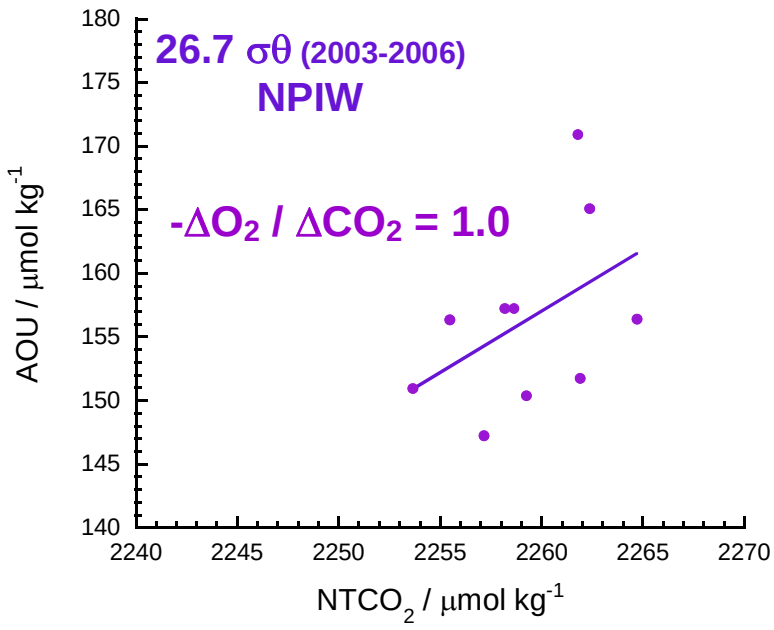




Spatial and interannual variation of TCO_2 *vs* those of AOU







Summary

- In the STMW (25.2$\sigma\theta$), both AOU and TCO_2 @*S*=35 exhibited large variation (*ca.*60 μmol kg^{-1}) in space and time, and no significant trend was detected during the last decade. Their variability is ascribed to the variability in the biological activities and/or the ocean circulation. Choice of biological $-\Delta O_2/\Delta CO_2$ stoichiometric ratio could be critical in evaluating the TCO_2 change due to the anthropogenic CO_2 accumulation.

- At 26.1$\sigma\theta$, DO was higher and AOU was lower by *ca.* 10 μmol kg^{-1} in the late 1990s than in the early 2000s. The role of biological activities look minor for the interannual and spatial TCO_2 variation.

- In the NPIW (26.7$\sigma\theta$), DO was lower and AOU was higher at around 2000. The difference in TCO_2 @*S*=35 between 1992 and 2003-2006 (+11 μmol kg^{-1}) is ascribed to both the anthropogenic CO_2 invasion into the ocean and changes in biological activities and/or circulation.