waterloopkundig laboratorium
delft hydraulics laboratory

the influence of nutrient availability on the ecosystem behaviour of Lake Grevelingen

Addendum
(tables, figures and programm listing)

report on investigations

R 1310 - 11

August 1984

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Tabel 2.1 *Summary of waterquality-, biological-, load and physical data of the Delft Hydraulic Laboratory DATABASE on behalf of ecosystem modelling of the lake GREVELINGEN.*

SAMPLING QUANTITIES	SAMPLING STATION *)	SAMPL. LAB.	CODE **)	FILENAME ****)	YEAR
Global radiation in Joule/cm2 (weektotals)	Naaldwijk / Oostvoorne	KNMI	RAD	STRAAL	71-80
Windvelocity in m/s (day - mean)	Zierikzee / Hellevoetsluis	KNMI	WIND	WINDvy	71-80
Windvelocity in m/s (week - mean)	Zierikzee / Hellevoetsluis	KNMI	WIND	WINDyy	71-80
Temperature in degrees Celcius	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	TMP	locYyy	72-80
Acidity in pH - units	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	PH	locYyy	72-80
Chloride in mg Cl/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	CL	locYyy	72-80
Salinity in promille	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	CLS	locYyy	72-80
Oxygen in mg/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	O2	locYyy	72-80
Oxygen in % of the saturation value	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	PO2	locYyy	72-80
Ammonium-nitrogen in mg N/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	NH4	locYyy	72-80
Nitrate-nitrogen in mg N/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	NO3	locYyy	72-80
Nitrite-nitrogen in mg N/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	NO2	locYyy	72-80
Total-nitrogen in mg N/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	TN	locYyy	72-80
Total-nitrogen after filtration in mg N/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	TNF	locYyy	72-80
Dissolved *Silicate* in ug *Si*/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	*SI*	locYyy	72-80
Ortho-Phosphate in mg P/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	OP	locYyy	72-80
Total Phosphate after filtration in mg P/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI	TPF	locYyy	72-80
Total Phosphate in mg P/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	TP	locYyy	72-80
Dissolved Calcium in mg Ca/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	CA	locYyy	72-80
Dissolved Magnesium in mg Mg/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	MG	locYyy	72-80
Total Iron in mg Fe/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	FE	locYyy	72-80
Total Iron(II) in mg Fe(II)/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	FE2	locYyy	72-80
Total Manganese in mg Mn/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	MN	locYyy	72-80
Sediment in mg/l	G11 P11	DIHO	*SED*	locYyy	72-80
Dissolved Organic Carbon mg C/l	GB4 GB5 GB6 GB7 G1 G2 G3	DDMI	DOC	locYyy	72-80
Particular Organic Carbon in mg C/l	GB4 GB5 GB6 GB7 G1 G2 G3 G11 P11	DDMI/DIHO	POC	locYyy	72-80
Particular Organic Carbon in mg C / 100 l () 63 u)	G11 P11	DIHO	POCZ	locYyy	76-80
Chlorophyl-a in ug/l	G11 P11	DIHO	CHLF	locYyy	76-80
Phytoplankton ug C/l	G11 P11	DIHO	FYTOC	locYyy	76-80
Phytoplankton production in mg C/m2/day	G11	DIHO	TP	fPyy	78-79
Bottom POC in 1-2 cm *sediment* layer in mg C/cm3	ARCH HERK1 HERK2 *SP5* G9	DIHO	POC*S*	MFBONDyy	77-78
Bottom POC in 2-5 cm *sediment* layer in mg C/cm3	ARCH HERK1 HERK2 *SP5* G9	DIHO	POCD	MFBDIEyy	77-78
Bottom pigments in 1-2 cm layer in ug/cm3	ARCH HERK1 HERK2 *SP5* G9 ***)	DIHO	CHLF*S*	MFBONDyy	77-80
Bottom pigments in 2-5 cm layer in ug/cm3	ARCH HERK1 HERK2 *SP5* G9 ***)	DIHO	CHLFD	MFBDIEyy	77-80
Ammonium-nitrogen in kg N / month	*see memo*	DDMI	TN	GBELyy	78-79
Nitrate + Nitrite in kg N / month	*see memo*	DDMI	TN	GBELyy	78-79
Total-Nitrogen in kg N / month	*see memo*	DDMI	TN	GBELyy	78-79
Ortho-Phosphate in kg P / month	*see memo*	DDMI	OP	GBELyy	78-79
Total-Phosphate in kg P/ month	*see memo*	DDMI	TN	GBELyy	78-79
Dissolved *Silicate* in kg *Si* / month	*see memo*	DDMI	*SI*	GBELyy	78-79

*) GB4, GB5, GB6, GB7, G1, G2, and G3 are DDMI measuring locations
G11 and P11 are DIHO measuring locations

**) CODE = codes for the variables as mentioned in the frequency tables

***) abbreviations of ARCHIPEL, HERKINGEN1, HERKINGEN2, *SP5* en G9

****) the filenames of the 114 datafiles of the GREVELINGEN DATABASE
'loc' can be location G1 G2 G3 GB4 GB5 GB6 GB7 G11 or P11
'yy' can be year 71 72 73 74 75 76 77 78 79 or 80

Remark : Not all the available data of DDMI and DIHO are included in the GREVELINGEN DATABASE

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
72	28	28	26	0	26	27	26	27	1	0	0	0	27	11*	0	0	0	0	0	0
73	38*	40*	39*	0	38*	37*	40*	39*	0	0	0	37*	40*	38*	0	0	0	0	0	0
74	38*	38*	38*	0	34*	38*	38*	37*	38*	17*	0	37*	37*	21*	0	38*	38*	38*	38*	34*
75	38*	33*	37*	0	38*	38*	36*	38*	38*	14*	0	37*	38*	17*	0	36*	36*	37*	37*	38*
76	23*	24*	23*	0	23*	20*	24*	24*	24*	12*	0	24*	24*	11*	0	24*	24*	24*	24*	24*
77	13*	12*	7*	0	12*	3*	13*	13*	13*	13*	0	13*	13*	13*	0	13*	13*	13*	13*	13*
78	11*	11*	1*	11*	11*	11*	11*	11*	11*	11*	11*	11*	11*	11*	11*	10*	10*	11*	11*	11*
79	12*	6*	5*	13*	13*	11*	12*	13*	12*	13*	12*	13*	13*	13*	12*	11*	11*	13*	13*	12*
80	11	11	8	11	11	8	13	13	13	13	13	13	13	13	13	13	13	13	13	13

Tabel 2.2 Frequency table of the waterquality data of location G1
Depth = 0 - 4 - 7 meter below surface
* = only a few or no measurements for depth 4

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
72	31	31	31	0	29	29	29	30	0	0	0	0	29	11*	0	0	0	0	0	0
73	39	40	40	0	36	35	40	40	0	0	0	39	40	39*	0	0	0	0	0	0
74	38	37	38	0	34	37	38	37	38	16*	0	37	37	21*	0	38	38	38	38	35
75	35	28	34	0	34	34	34	35	35	13*	0	34	35	15*	0	34	33	35	34	35
76	22	21	22	0	22	19	22	22	22	11*	0	22	21	11*	0	21	22	22	21	22
77	10	11	11	0	12	1	13	13	13	14*	0	13	13	14*	0	13	13	13	13	13
78	10	10	1*	10	10	10	10	10	10	10*	10*	10	10	10*	10*	9	9	10	9	10
79	11	5	3*	12	12	11	11	12	12	13*	12*	12	12	13*	12*	11	11	12	12	12
80	11	11	5	11	11	8	13	13	13	13*	13*	13	13	13*	13*	13	13	13	13	13

Tabel 2.3 Frequency table of the waterquality data of location G2
Depth = 0 - 12 - 23 meter below surface
* = no measurements for depth 12

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
72	32	32	32	0	30	29	30	31	0	0	0	0	30	12*	0	0	0	0	0	0
73	37	39	39	0	35	35	39	39	0	0	0	38	39	39*	0	0	0	11*	0	0
74	38	38	38	0	34	38	38	38	38	16*	0	38	37	22*	0	38	38	38	38	36
75	37	30	36	0	37	37	36	37	37	14*	0	36	37	16*	0	36	36	37	37	37
76	22	21	22	0	22	19	23	23	23	12*	0	23	23	11*	0	23	23	23	23	23
77	13	12	9	0	12	1	13	13	13	13*	0	13	13	13*	0	13	13	13	13	13
78	11	11	1*	11	10	10	11	11	11	11*	11*	11	11	11*	11*	10	10	11	11	11
79	11	6	5*	12	11	10	12	13	12	13*	13*	13	13	13*	13*	11	11	13	13	12
80	11	11	5	11	11	8	13	13	13	13*	13*	13	13	13*	13*	13	13	13	13	13

Tabel 2.4 Frequency table of the waterquality data of location G3
Depth = 0 - 26 - 52 meter below surface
* = no measurements for depth 26

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
72	30	30	30	0	28	28	29	30	0	0	0	0	30	11*	0	0	0	0	0	0
73	37	40	40	0	35	35	40	40	0	0	0	38	40	40*	0	0	0	1*	0	0
74	38	38	37	0	30	38	38	37	38	17*	0	37	37	21*	0	38	38	38	38	35
75	37	32	36	0	37	37	35	37	37	14*	0	36	37	16*	0	36	35	37	37	37
76	23	22	22	0	22	19	23	23	23	12*	0	23	23	11*	0	23	23	23	23	23
77	13	12	8	0	12	3	13	13	13	13*	0	13	13	13*	0	13	13	13	13	13
78	11	11	1*	11	11	11	11	11	11	11*	11*	11	11	11*	11*	10	10	11	11	11
79	11	5	3*	12	12	11	11	12	12	12*	12*	12	12	12*	12*	11	11	12	12	12
80	11	11	5	11	11	8	13	13	13	13*	13*	13	13	13*	13*	13	13	13	13	13

Tabel 2.5 Frequency table of the waterquality data of location GB4
Depth = 0 - 6 - 11 meter below surface
* = no measurements for depth 6

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
73	36	38	38	0	34	34	38	38	0	0	0	37	39	39*	0	0	0	0	0	0
74	37	38	37	0	34	37	38	37	38	16*	0	37	37	21*	0	38	38	38	38	35
75	37	32	36	0	37	37	36	36	37	14*	0	36	37	16*	0	35	35	37	37	37
76	22	22	22	0	22	19	23	23	23	12*	0	23	23	11*	0	23	23	23	23	23
77	13	12	9	0	12	1	13	13	13	13*	0	13	13	13*	0	13	13	13	13	13
78	11	11	1*	11	11	11	11	11	11	11*	11*	11	11	11*	11*	10	10	11	11	11
79	10	5	4*	11	11	10	11	12	12	13*	13*	12	12	13*	13*	11	11	12	12	12
80	11	11	6	11	11	8	13	13	13	13*	13*	13	13	13*	13*	13	13	13	13	13

Tabel 2.6 Frequency table of the waterquality data of location GB5
Depth = 0 - 6 - 12 meter below surface
* = no measurements for depth 6

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
72	30	32	32	0	29	28	27	29	0	0	0	0	29	11*	0	0	0	0	0	0
73	36	38	37	0	34	34	38	38	0	0	0	37	38	39*	0	0	0	0	0	0
74	37	38	37	1*	34	37	38	37	38	17*	1*	37	37	21*	1*	38	38	38	38	35
75	36	30	35	0	36	36	36	37	37	14*	0	36	37	16*	0	36	36	37	37	37
76	22	20	22	0	22	19	22	22	22	11*	0	22	22	11*	0	22	22	21	22	22
77	15	14	8	0	14	1	14	14	14	15*	0	14	14	15*	0	14	14	14	14	14
78	11	11	1*	11	11	11	10	10	10	10*	10*	10	10	10*	10*	9	9	10	10	10
79	10	5	3*	11	10	9	11	12	12	12*	12*	12	12	12*	12*	11	11	12	12	12
80	11	11	5	11	11	8	13	13	13	13*	13*	13	13	13*	13*	13	13	13	13	13

Tabel 2.7 Frequency table of the waterquality data of location GB6
Depth = 0 - 14 - 28 meter below surface
* = no measurements for depth 6

YY	TMP	PH	CL	CLS	O2	PO2	NH4	NO3	NO2	TN	TNF	SI	OP	TP	TPF	CA	MG	FE	FE2	MN
73	36	38	37	0	33	33	38	38	0	0	0	37	37	38*	0	0	0	8*	0	0
74	38	37	38	0	34	38	38	37	38	17*	0	37	37	21*	0	38	38	38	38	35
75	37	31	36	0	37	37	36	37	37	14*	0	36	37	16*	0	36	35	36	36	37
76	22	22	22	0	22	19	23	23	23	12*	0	23	23	11*	0	23	23	23	23	23
77	13	11	7	0	12	1	13	13	13	13*	0	13	13	13*	0	12	13	13	13	13
78	11	11	1*	11	10	10	11	11	11	11*	11*	11	11	11*	11*	10	10	11	11	11
79	11	5	5*	11	10	9	11	12	12	13*	13*	12	12	13*	13*	11	11	12	12	12
80	10	10	6	10	10	7	12	12	12	12*	12*	12	12	12*	12*	12	12	12	12	12

Tabel 2.8 Frequency table of the waterquality data of location GD7
Depth = 0 - 19 - 37 meter below surface
* = no measurements for depth 6

YY	TMP	PH	CL	O2	PO2	NH4	NO3	NO2	SI	OP	TPF	TP	SED	DEPTH (M)
76	41	31	41	41	4	42	42	42	42	36	35	36	41	0 0.5 1 2 3 5 7 10 15 17.5 20 21
77	40	37	40	39	39	40	39	40	39	40	40	39	39	0 0.5 1 2 3 5 7 10
77	14	5	14	14	14	14	14	14	10	9	9	13	13	13 15 17.5
78	36	38	36	0	36	37	38	38	36	37	37	37	38	0 2.5 5 7.5 12.5 17.5 20
79	33	33	33	33	33	34	34	34	32	33	32	31	30	0 2.5 5 7.5 10 12.5 15 17.5 20 22
80	44	42	44	45	45	45	45	43	45	45	44	44	41	0 2.5 5 7.5 10 12.5 15 17.5 20 22

Tabel 2.9 Frequency table of the waterquality data of location G11

YY	TMP	PH	CL	O2	PO2	NH4	NO3	NO2	SI	OP	TPF	TP	SED	DEPTH (M)
76	43	35	43	42.	42	42	42	42	42	40	38	40	41	0 0.5 1
76	6	4	6	6	6	6	6	6	6	6	6	6	6	2 2.5 3
77	38	36	38	38	38	39	38	39	39	39	39	39	39	0 0.5 1
78	20	41	25	0	37	39	41	41	39	40	40	40	39	0 1.5
79	42	39	40	39	39	41	41	41	39	40	40	38	38	0
80	45	40	45	45	45	45	45	43	45	45	44	43	39	0

Tabel 2.10 Frequency table of the waterquality data of location P11

YY	G1	G2	G3	GB4	GB5	GB6	GB7	G11	P11
78	3	2	2	2	2	2	2	-	-
79	3	3	3	4	3	3	3	-	-

Tabel 2.11 FREQUENCY TABLE OF DISSOLVED ORGANIC CARBON (DOC)

YY	G1	G2	G3	GB4	GB5	GB6	GB7	G11	P11
78	10	9	10	10	10	9	10	27	25
79	9	9	9	8	9	9	9	39	46
80	13	13	13	13	13	13	12	48	49

Tabel 2.12 FREQUENCY TABLE OF PARTICULATE ORGANIC CARBON (POC)

YY	G11	P11	G11	P11	G11	P11	G11	P11
	POC		FYTOC		CHLF		TP	
76	0	0	0	0	30	30	0	0
77	0	0	0	0	33	31	0	0
78	38	38	37	36	38	39	46	0
79	38	42	45*	0	33	40	47	0
80	42	41	42*	0	44	44	0	0

Tabel 2.13 FREQUENCY TABLE OF POC (>63U), FYTOC, CHLF AND TP
* = measurements on one depth (2.5 m)

YY	Archipel		Herkingen1		Herkingen2		SP5		G9	
	U	D	U	D	U	D	U	D	U	D
77	46	46	46	46	0	0	46	46	38	46
78	43	43	45	45	0	0	45	45	36	39

Tabel 2.14 FRECRUENCY TABLE OF BOTTOM POC IN 1-2 CM BOTTOMLAYER (UPPER) and Bottom POC in 2-5 cm bottomlayer (Deeper)

YY	Archipel		Herkingen1		Herkingen2		SP5		G9	
	U	D	U	D	U	D	U	D	U	D
77	46	46	46	46	0	0	46	46	38	46
78	43	43	45	45	0	0	45	45	36	39
79	13	13	13	13	13	13	13	13	0	0
80	12	12	12	12	12	12	12	12	0	0

Tabel 2.15 FREQUENCY TABLE OF BOTTOM PIGMENTS IN 1-2 CM BOTTOMLAYER (Upper) and Bottom pigments in 2-5 cm bottomlayer (Deeper)

Table 4.1 DDMI sampling stations

station	depth (meter)
G1	8.2
G2	24
G3	42
GB4	12.2
GB5	13.5
GB6	29
GB7	38

Table 4.2 Nutrient bottomfluxes

	calculated from G11	calculated by Kelderman March 1982		July 1982	
	1978	Sh.(<7m)	De.(>7m)	Shallow	Deep(>7m)
silicon mg Si/m2.day	85	85	110	95	210
ammonium mg N/m2.day	25	35	25	75	105

Table 5.1 Overview of stoichiometry of marine phytoplankton

Table 5.1.a.

Non-diatoms	Stoichiometry for N, P, Si and chlorophyll, relative to carbon and carbon to dry weight ratio (C/DW)					
	N	P	Si	Chlf	C/DW	References
Dynophyceae:						
- Ceratium sp.	0.22	0.017	0.09		0.33	Bigelow '77; Strickland '60
- Gonyaulax sp.	0.09	0.010			0.37	Strickland '60,'69; Jorgensen '79
- Peridinium sp.	0.08			0.014	0.41	Strickland '60, RI310-I
- unspecified		0.023			0.43	Jorgensen '79
Chlorophyceae:						
- Dunaliella sp.	0.15					
Cryptophyceae						
- Cryptomonas	0.28					Jorgensen '79
Non-diatoms, general	0.16	0.017	-	0.014	0.39	

Table 5.1.b.

'Spring'-diatoms [1)]	Stoichiometry, for N, P, Si and chlorophyll, relative to carbon, and carbon to dry weight ratio (C/DW)					
	N	P	Si	Chlf	C/DW	References
Skeletonema costatum	0.19	0.038	0.34	0.014	0.40 [2)]	RI310-I; Bigelow '77; De Haven '75; Sakshaug '77; Strickland '60; Bienfang '84 Paasche '80
Thalassiosira spec.	0.33	-	0.71	0.034	-	Jorgensen '79; Bienfang '83; Paasche '80
Chaetoceros spec.	0.22	0.066	0.39	0.005	0.32	Jorgensen '79; Bienfang '84; Paasche '80
Rhizosolenia spec.	0.06	0.014	0.52	-	0.40 [2)]	Bigelow '77; De Haven '75; Paasche '80
unspecified	0.07	0.018	0.64	-	0.40 [2)]	Bigelow '77; De Haven '75; Antia '83
'spring'-diatoms, general	0.17	0.034	0.52	0.018		

1) the following data are taken into account
- small planktonic diatom species, present in spring, experimental conditions (partly) specified as 'spring'-conditions (no nutrient limitation): Skeletonema
- planktonic diatom species, experimental conditions (partly) specified as 'spring'-conditions (no nutrient limitation and/or low light intensities): Thalassiosira, Chaetoceros
- (small) planktonic diatom species, present in spring and summer, experimental conditions not specified: Rhizosolenia, unspecified

2) when the carbon content is not specified, a carbon to dry weight ratio (C/DW) of 0.40 is assumed

Table 5.1.c.

'summer'-diatoms [1)]	Stoichiometry for N, P, Si and chlorophyll, relative to carbon, and carbon to dry weight ratio (C/DW)					
	N	P	Si	Chlf	C/DW	References
Cerataulina pelagica	-	-	0.30			Paasche '80
Nitschia closterium	0.12	0.019	0.44			Strickland '60
Dithylum brightwelli	0.09	0.012	0.10			RI310-I; Bienfang '84
Thalassiosira spec.	0.12	-	-	0.014		Jorgensen '79; Bienfang '83
Chaetoceros	0.17	0.066	0.10	0.005	0.32	Jorgensen '79;Bienfang '84;Paasche '80
Rhizosolenia	0.06	0.014	0.52		0.40 [2)]	Bigelow '77;DeHaven '75;Paasche '80
unspecified	0.07	0.018	0.64		0.40 [2)]	Bigelow '77;DeHaven '75;Antia '83
'summer'-diatoms, general	0.11	0.026	0.35	0.010		

1) the following data are taken into account:
- (large) planktonic diatom species, present in summer, experimental conditions not specified: Cerataulina, Nitschia, Dithylum
- planktonic diatom species, experimental conditions (partly) specified as 'summer-conditions' (nutrient limitation and/or high light intensity): Thalassiosira, Chaetoceros
- (small) planktonic diatom species, present in spring and summer, experimental conditions not specified: Rhizosolenia, unspecified

2) when the carbon content is not specified, a carbon to dry weight ratio (C/DW) of 0.40 is assumed

Table 5.1.d.

Stoichiometry in g/g C for N, P, Si and chlorophyll (mean ± standard deviation)				
	N	P	Si	chlorophyll
non-diatoms	0.16 (± 0.06)	0.017 (± 0.007)	-	0.014
spring-diatoms	0.17 (± 0.11)	0.034 (± 0.024)	0.52 (± 0.16)	0.018 (± 0.015)
summer-diatoms	0.11 (± 0.04)	0.026 (± 0.023)	0.35 (± 0.22)	0.010 (± 0.006)

Table 5.2 Stoichiometry in g/g C as used in the balance calculations

	'spring' algae	'summer' algae
silicon	0.45[a]	0.20[a]
nitrogen	0.17	0.14
phosphor	0.034	0.017

[a] planktonic diatoms only

Table 5.3 Coefficients for mineralization, denitrification and refractory silicon

coefficient	substrate	
Mineralization	suspended detritus	bottom detritus
Carbon	0.14	0.07
Silicon	0.14	0.07
Nitrogen	0.14	0.07
Phosphor	0.14	0.07
Denitrification	inorganic dissolved nitrogen	
Nitrogen	0.011	
Refractory silicon	dead planktonic and benthic diatoms	
Silicon	0.030	

- the dimension of all coefficients is /day, except for refractory silicon (dimensionless).
- mineralization and denitrification rates are given for 20 degrees C. The coefficient for temperature dependency is 1.09.
- for denitrification an extra dependency on temperature and oxygen concentration is used (see program listing, CDENO and FFOX).

Table 5.4 Annual values of some measured and calculated fluxes (in $g/m^2.year$)

	1977	1978	1979	1980
net load dissolved silicon (measured)	3.1	0.4	2.3	2.3
refractory silicon (calculated)	1.5	1.6	1.7	1.9
net load dissolved inorg. nitrogen (measured)	4.4	3.4	4.1	3.3
denitrification (calc., without O_2-dependency)	3.5	3.5	3.0	3.0
denitrification (calc., with O_2-dependency)	3.5	3.5	2.7	3.2
net load dissolved inorg. phosphorus (measured)	0.2	-1.2	-2.4	-0.2
mineralization of silicon in water	11.7	11.2	6.4	8.2
mineralization of nitrogen in water	6.5	6.1	5.0	6.9
mineralization of phosphorus in water	1.4	1.5	1.0	1.1
mineralization of silicon in bottom	35.8	42.3	48.6	52.1
mineralization of nitrogen in bottom	16.9	22.6	34.5	38.2
mineralization of phosphorus in bottom	3.6	5.2	6.5	6.2
total respiration in water (measured)				305
C-mineralization in water (calculated)	42	39	33	45
total respiration in bottom (measured)				390
C-mineralization in bottom (calculated)	114	149	229	255
net sedimentation of detritus (calculated)	22	57	138	169

Table 5.5 Turnover rates phytoplankton, dissolved silicon and dissolved inorganic nitrogen

	1976	1977	1978	1979	1980	1981
net production of phytoplankton, DIHO	80	60	90	171	194	225
(used in the model)		(63)	(97)	(172)	(214)	
net production of phytoplankton, DDMI				156	172	
phytoplankton biomass		0.75[1]	0.83	1.38	1.25	
turnover rate, phytoplankton (/year)		80	108	124	155	
percentage diatom in phytoplankton		73	72	59	55	
silicon, max. winterconc., measured		5.35	7.31	5.09	4.94	
net silicon load, measured		3.1	0.4	2.3	2.3	
refractory silicon, calculated		1.5	1.6	1.7	1.9	
total mineralization, silicon, calc.		47.5	53.5	55.0	60.3	
turnover rate silicon (/year)		7.7	8.0	10.2	11.7	
nitrogen, max. winterconc., measured		2.79	3.44	3.79	3.94	
net nitrogen load, measured		4.4	3.4	4.1	3.3	
denitrification, calculated		3.5	3.5	2.7	3.2	
total mineralization, nitr., calc.		23.4	28.7	39.5	45.1	
turnover rate nitrogen (/year)		7.2	8.5	8.8	11.3	

[1] not based on wet weight-carbon, but on chlorophyll-carbon conversion with a factor 40

all units are in g C, Si, N/m^2.(year), except the turnover rates (/year), and percentage diatoms (%)

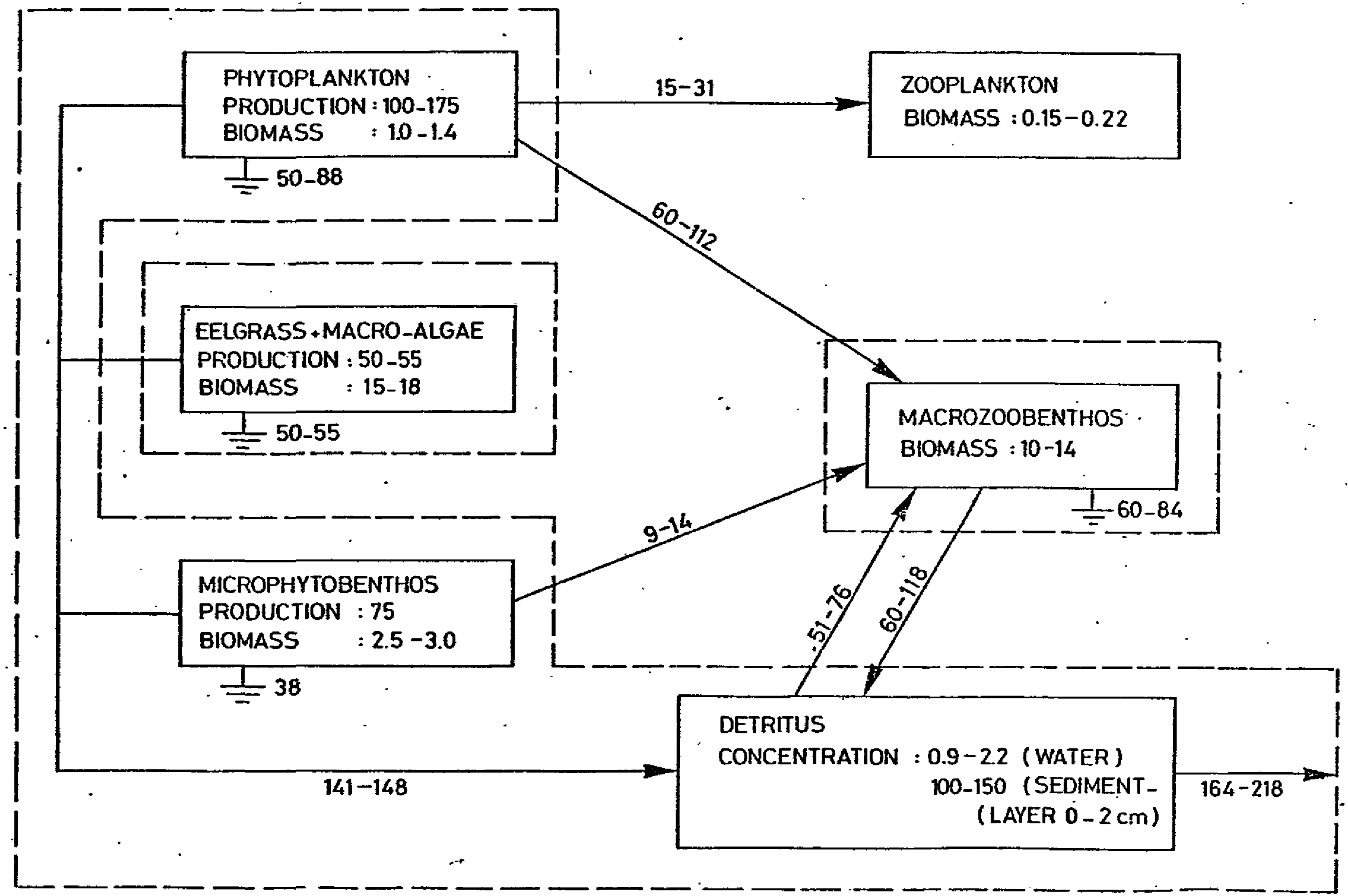


Fig. 1.1 Components and relations of the Grevelingen ecosysteem according to CABAMOD

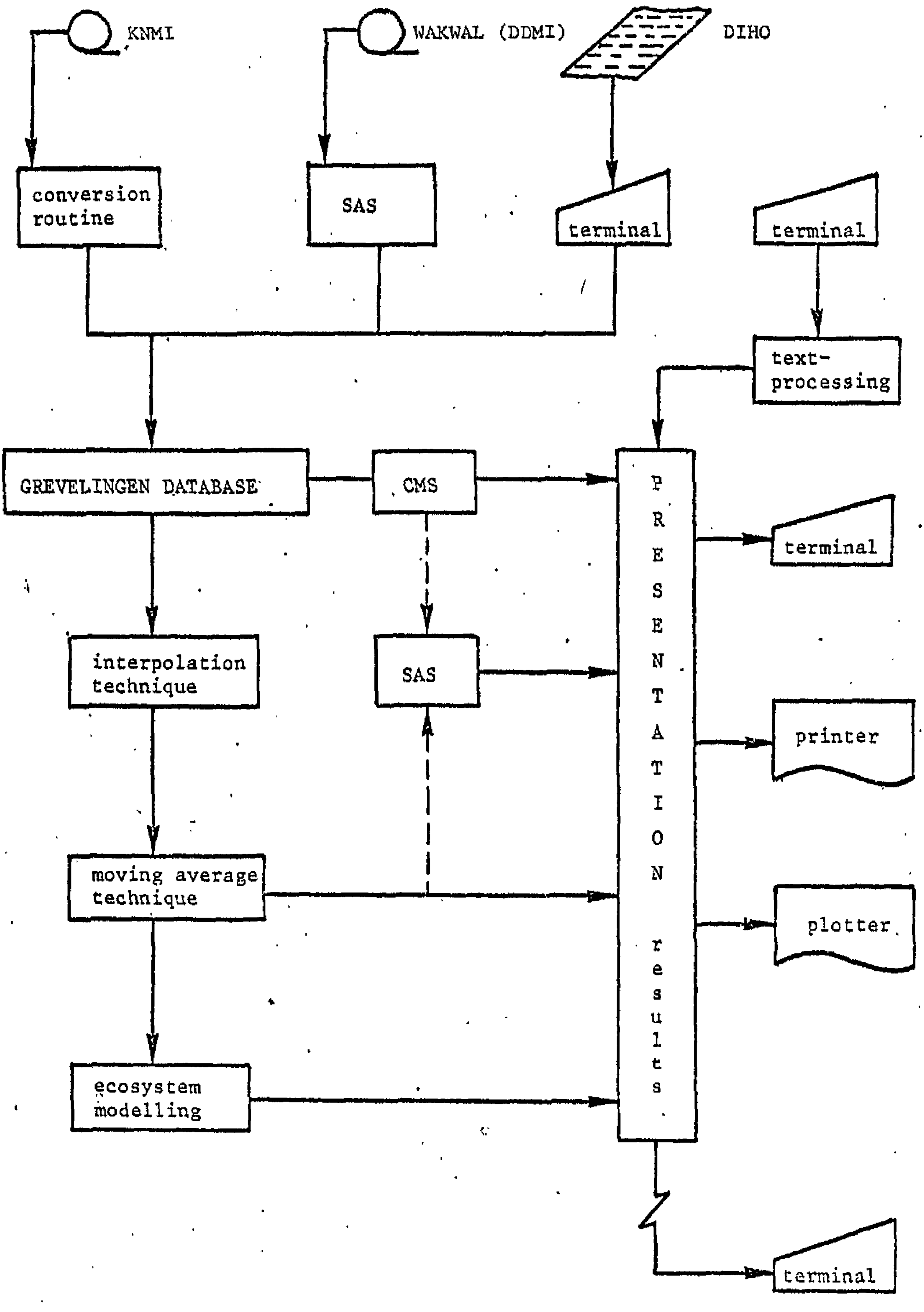


Figure 2.1 Schematization of the data-aquisition for the GREVELINGEN DATABASE.

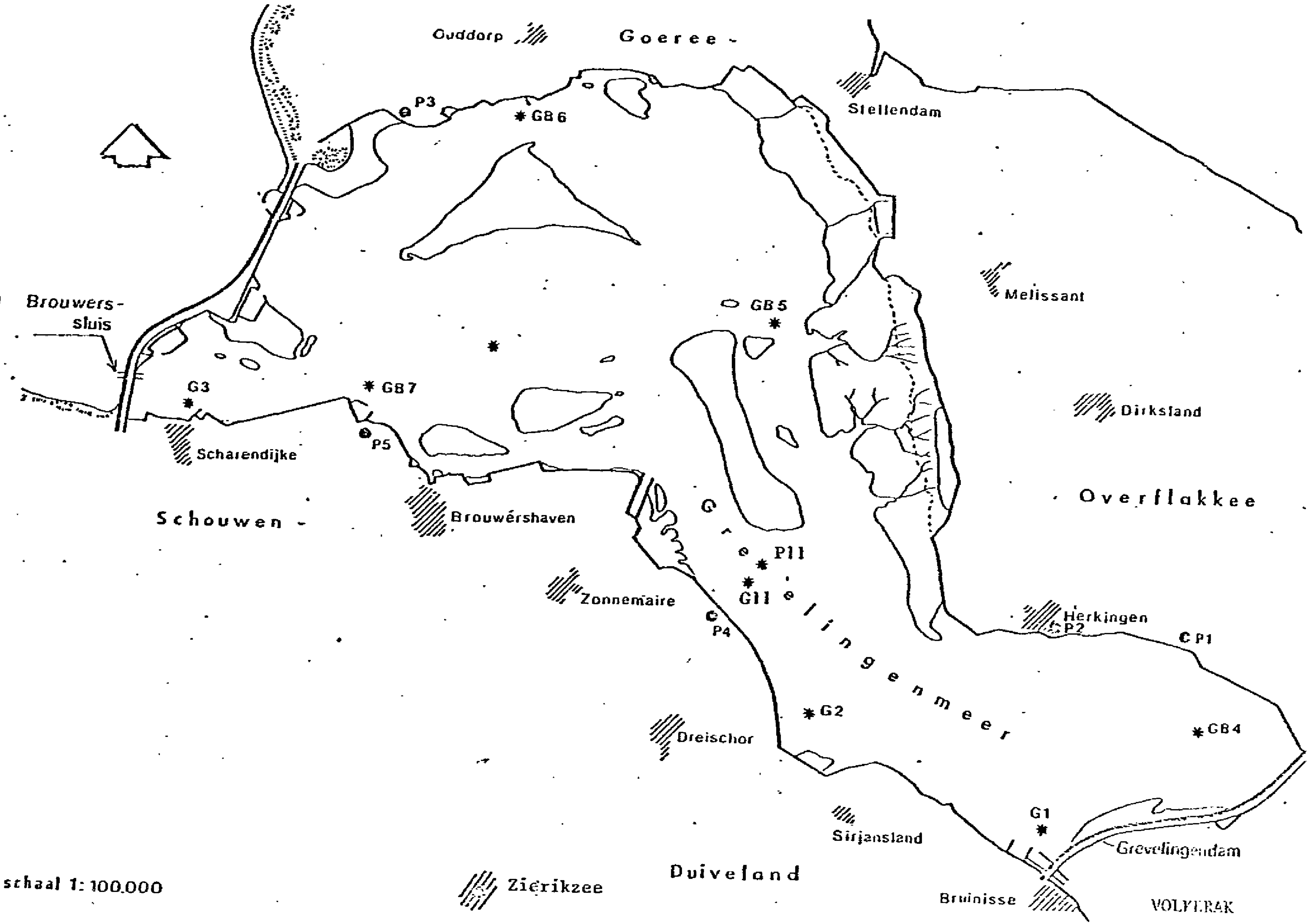


Fig.2.2 Location of sampling sites of DDMI and DIHO in Lake Grevelingen

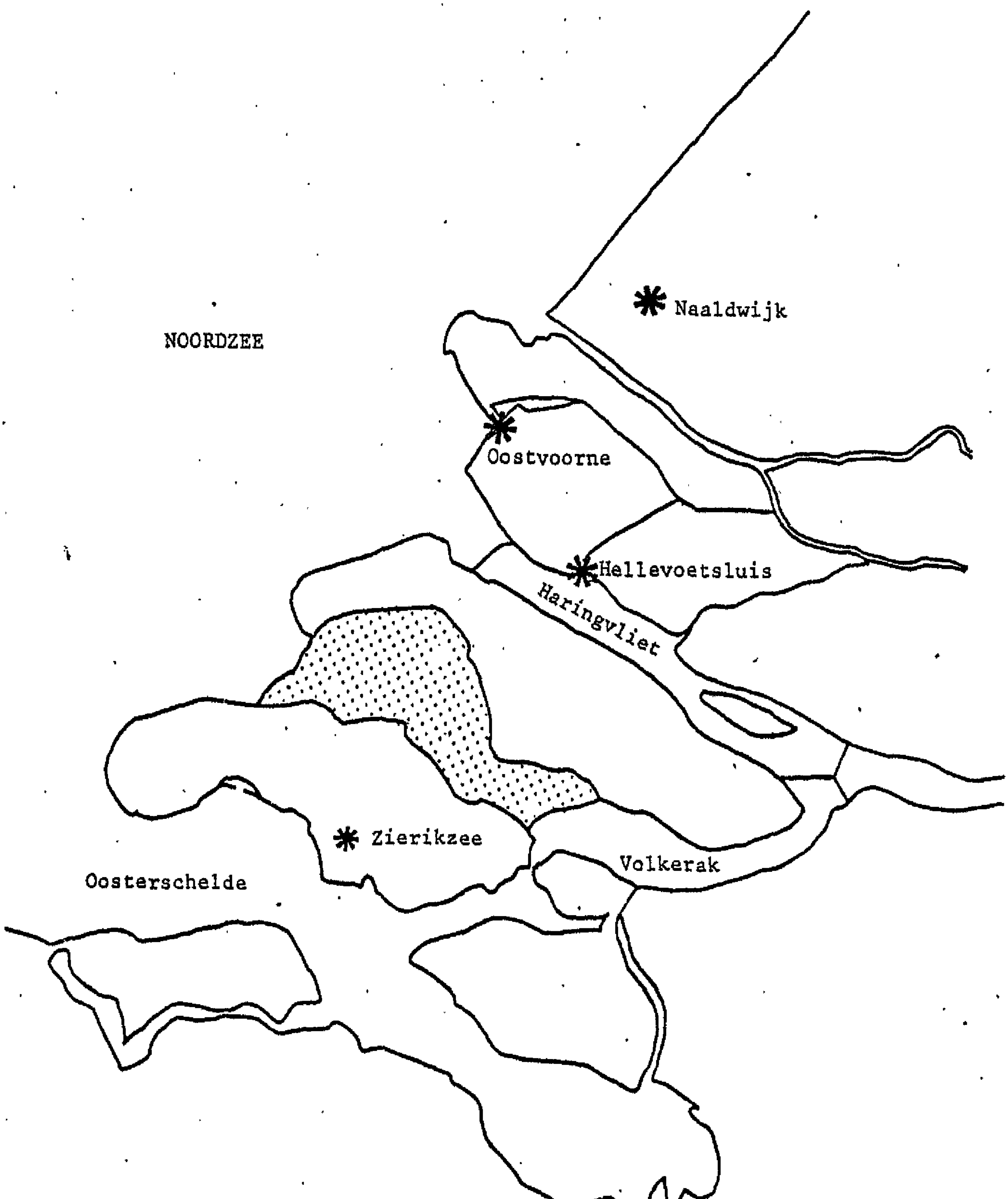
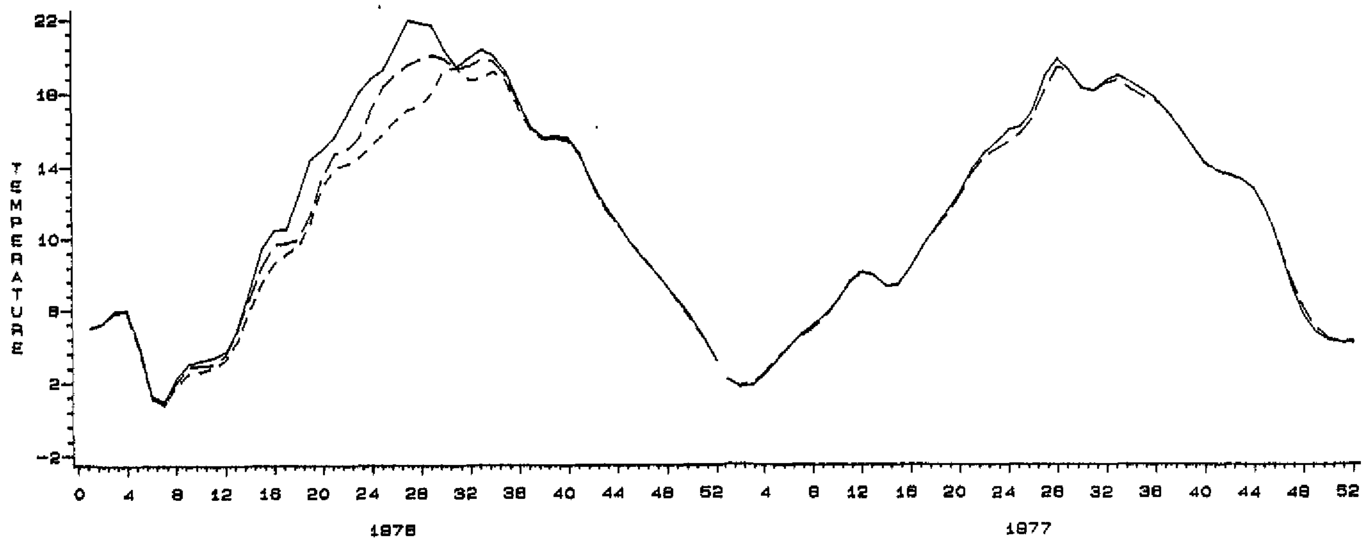
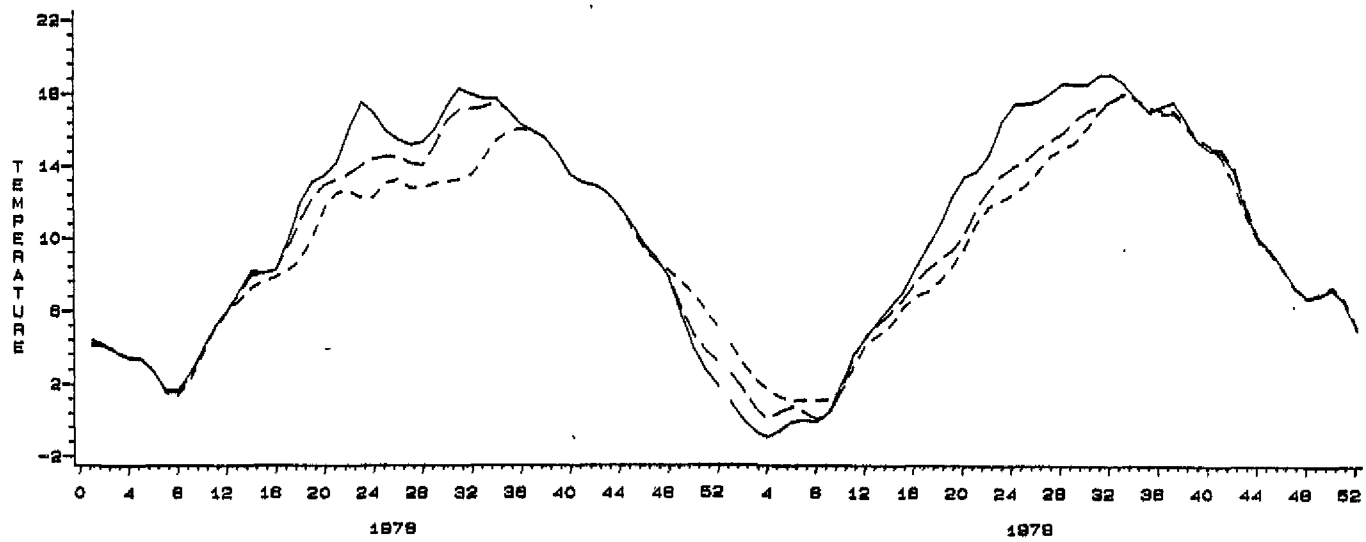


Figure 2.3 Sampling stations of KNMI





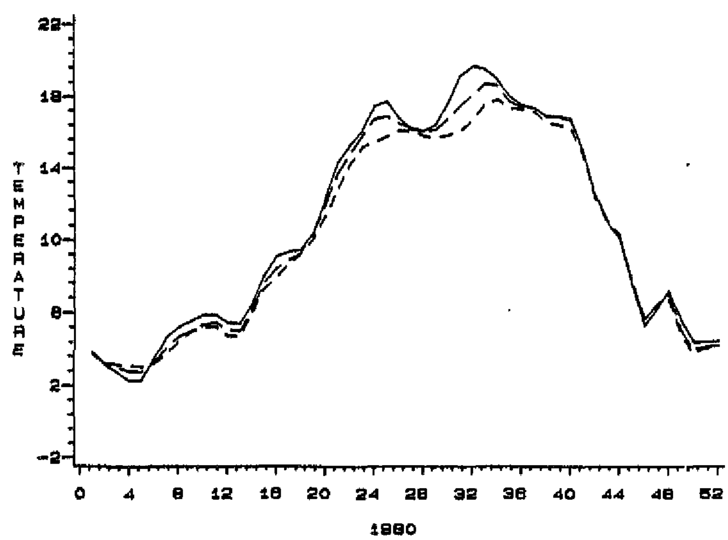
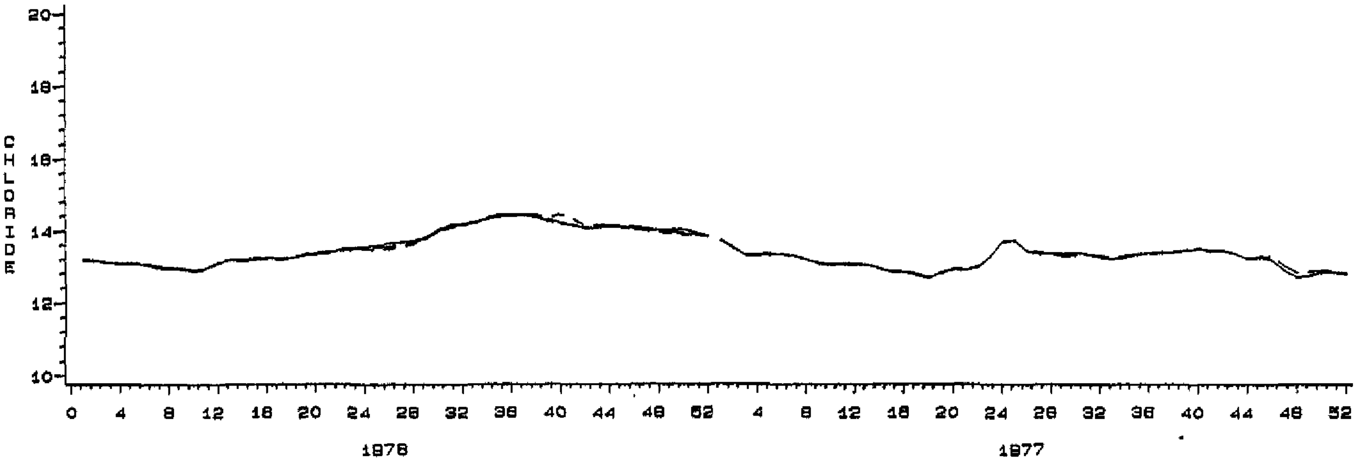


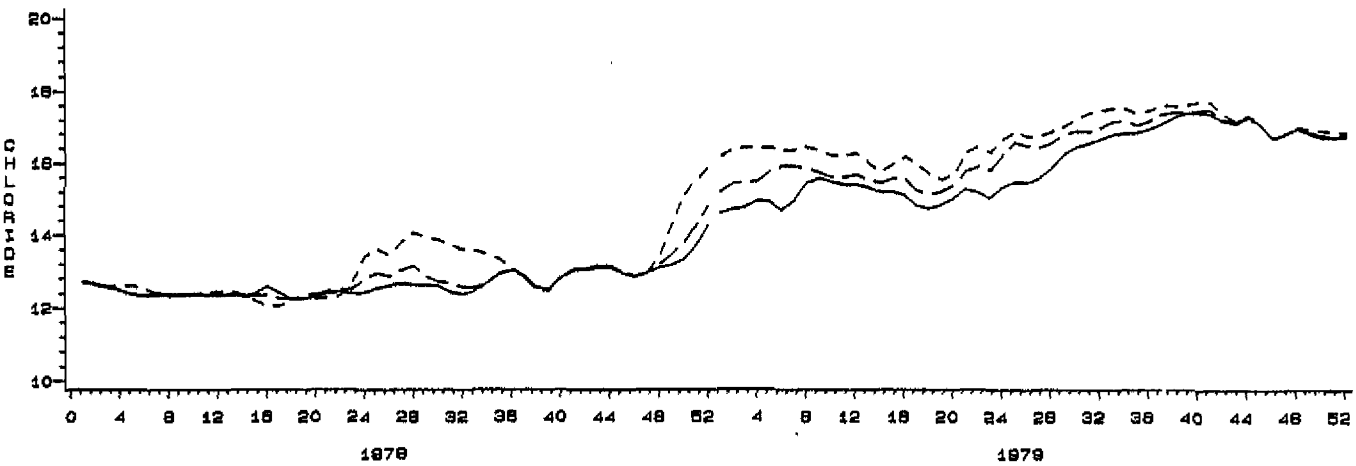
Figure 3.1

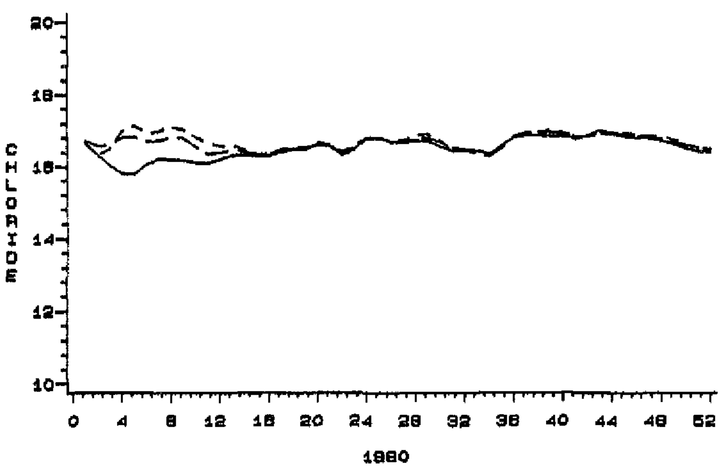
temperature in degrees Celsius

station G11 (DIHO - data)

- ——— waterdepth 0 - 5 m
- — — waterdepth 5 - 15 m
- ----- waterdepth 15 - 20 m





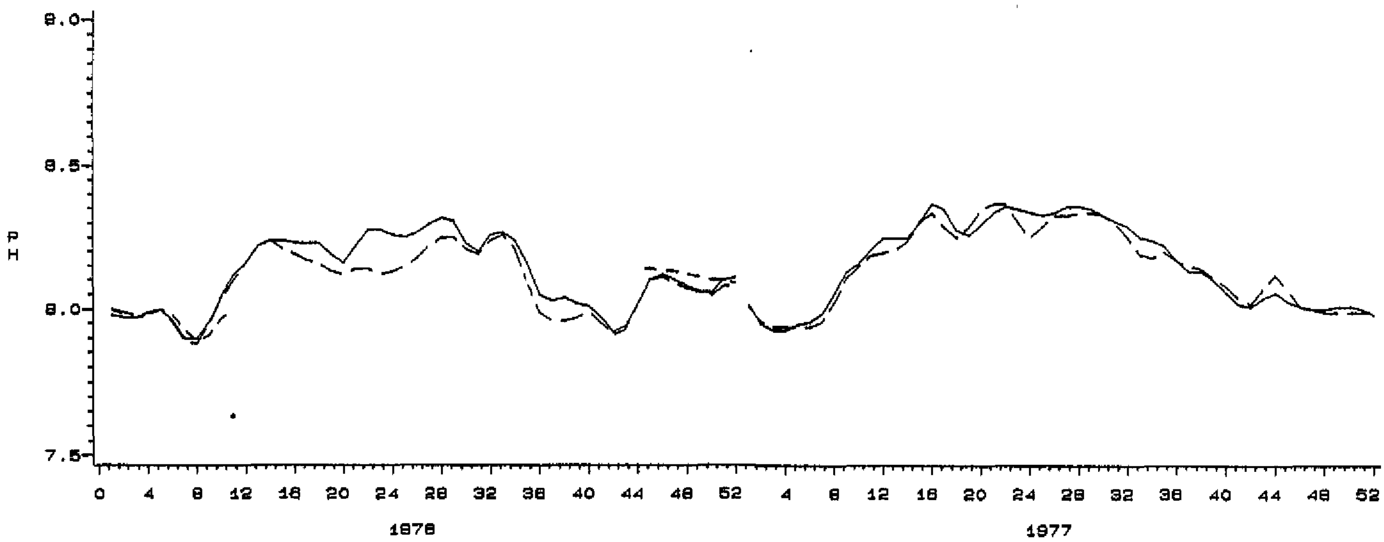


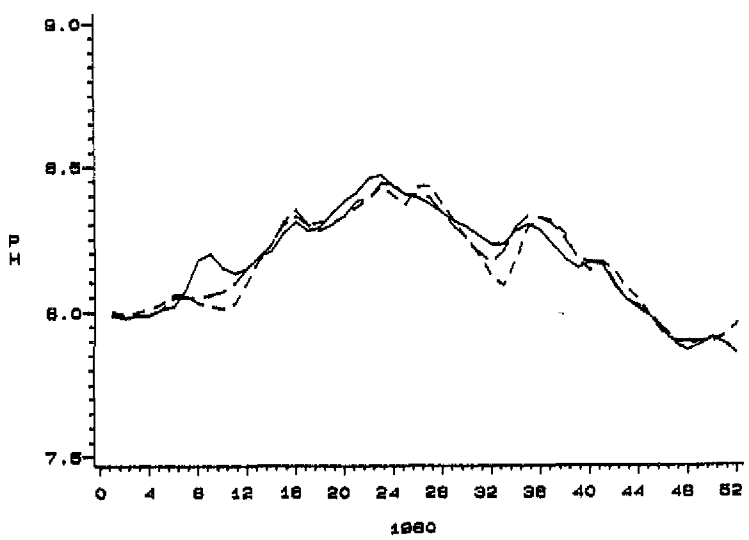
<u>Figure 3.2</u>

chloride concentration in $^{0}/_{00}$ Cl^{-}

station G11 (DIHO - data)

——— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
----- waterdepth 15 - 20 m





<u>Figure 3.3</u>

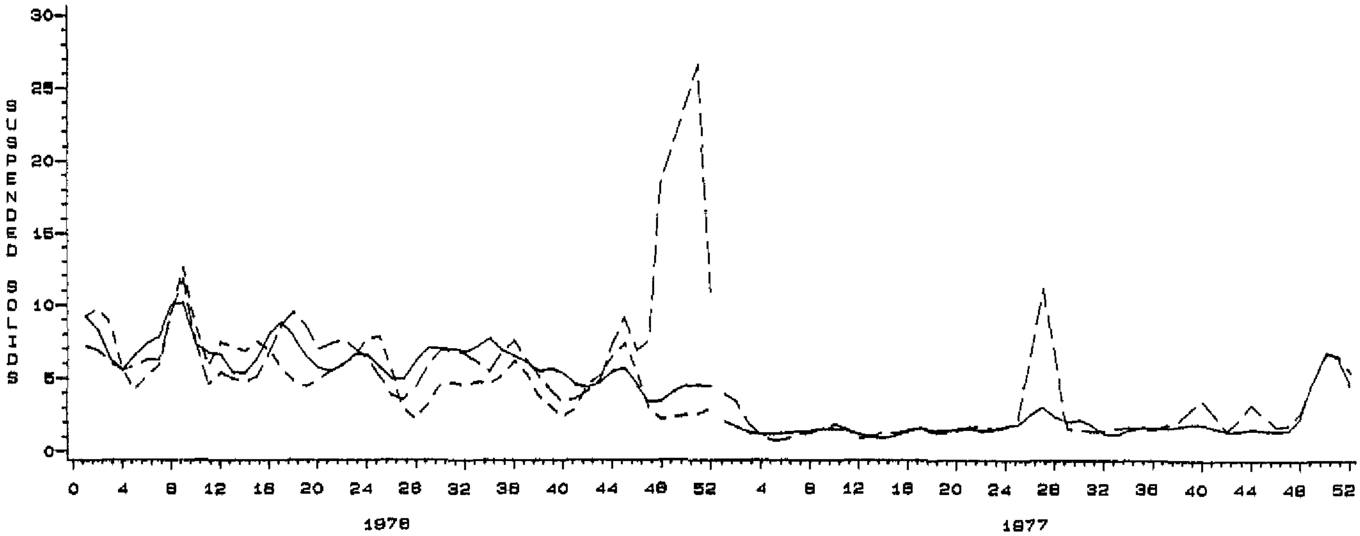
acidity in pH-units

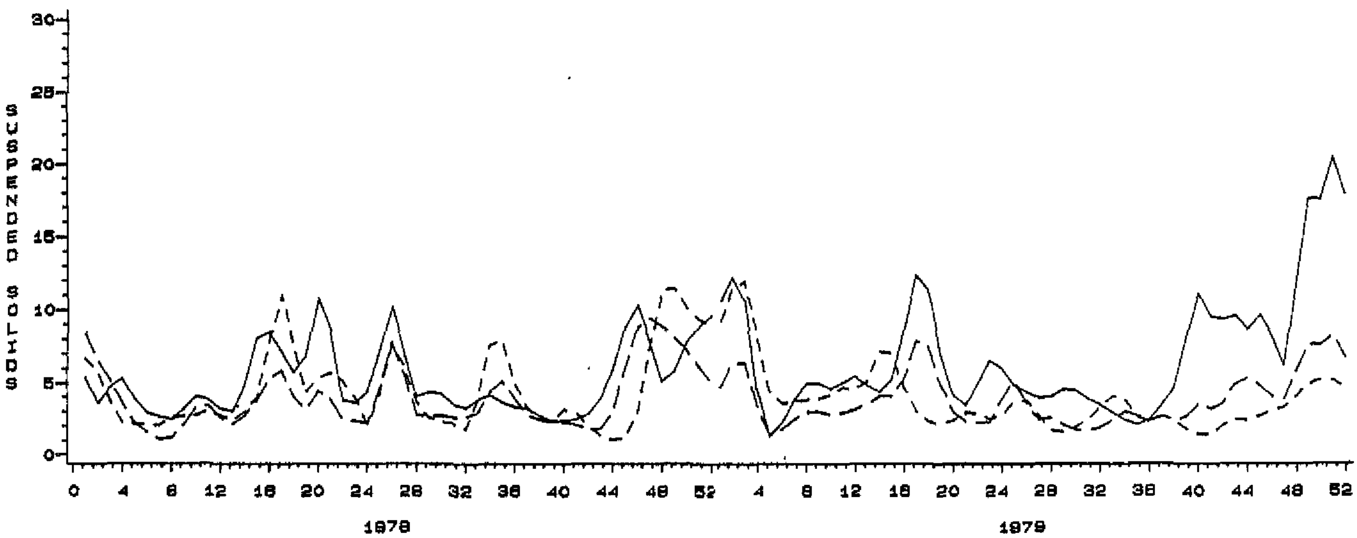
station G11 (DIHO - data)

——— waterdepth 0 - 5 m

— — waterdepth 5 - 15 m

- - - - waterdepth 15 - 20 m





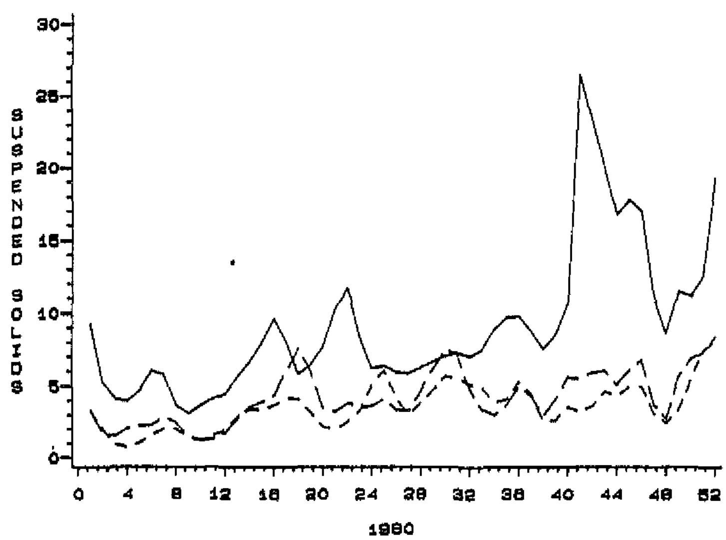
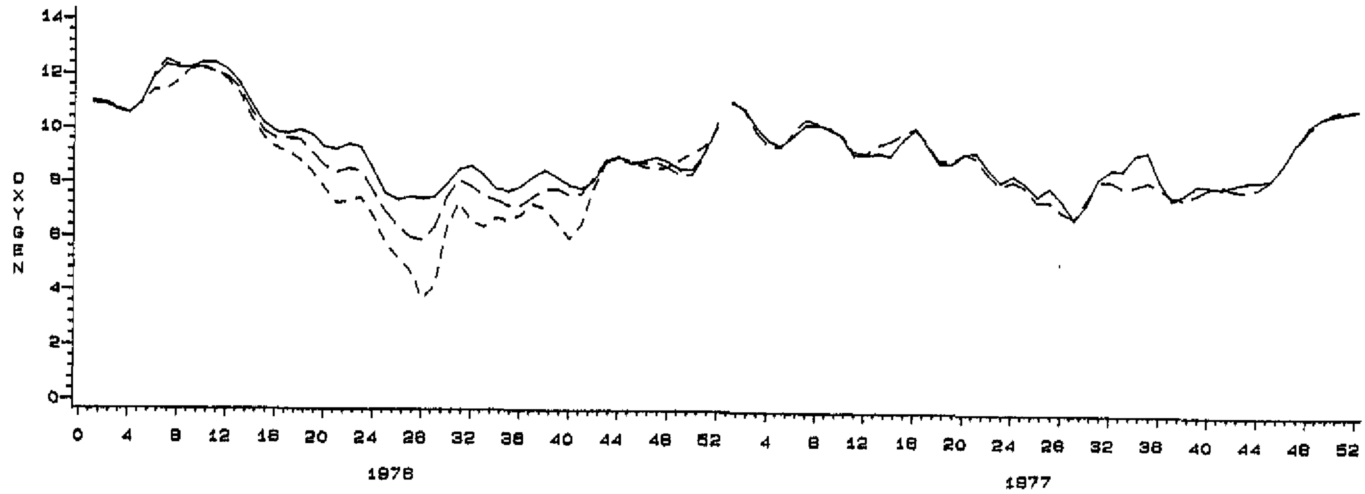
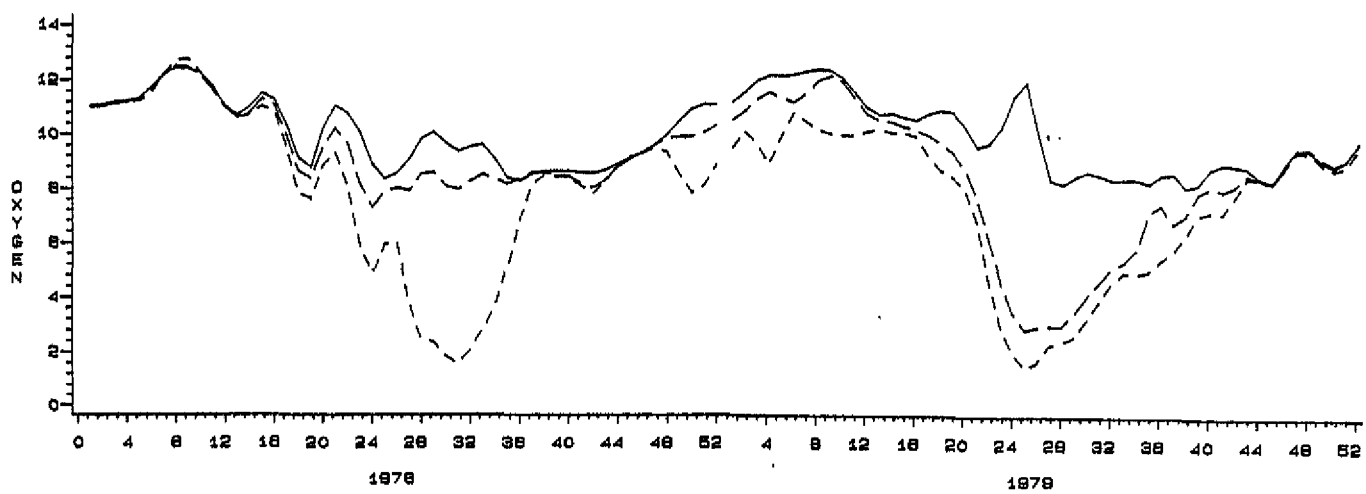


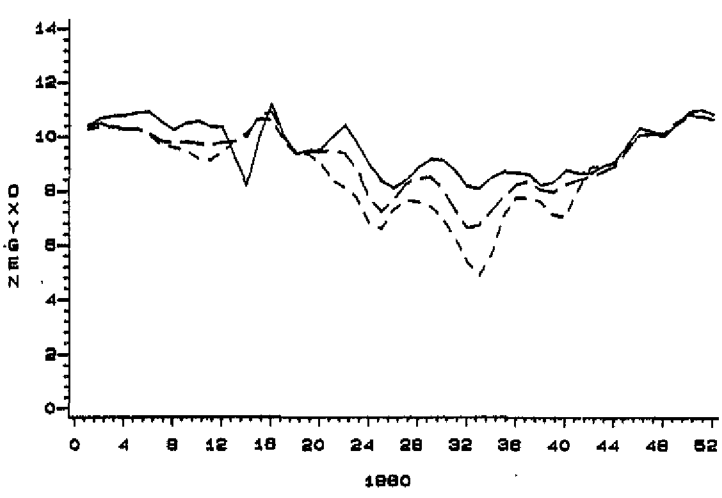
Figure 3.4

suspended solids in mg/l

station G11 (DIHO - data)
——— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
- - - waterdepth 15 - 20 m



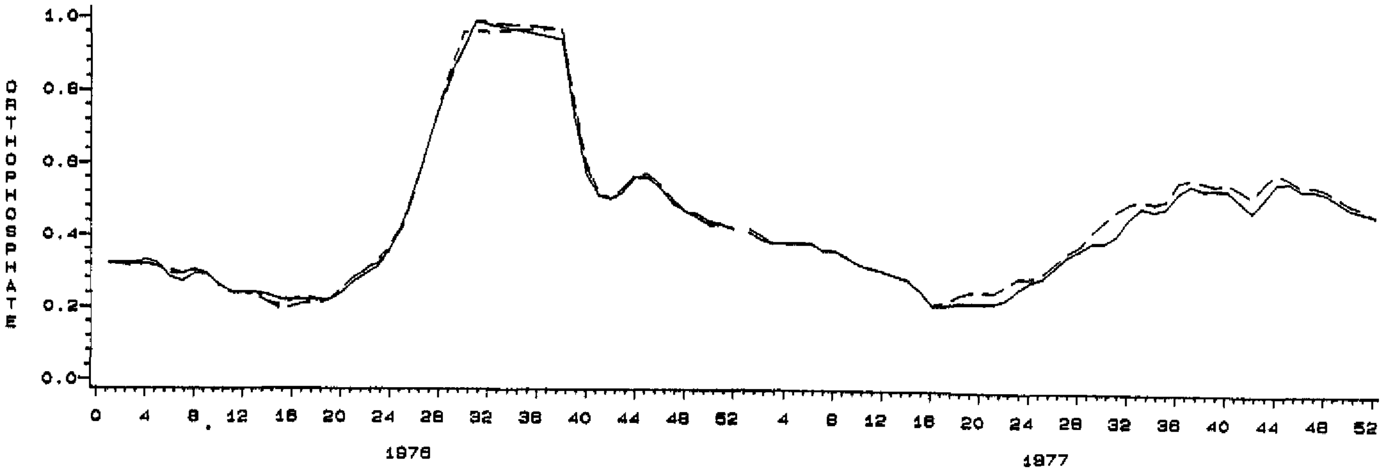


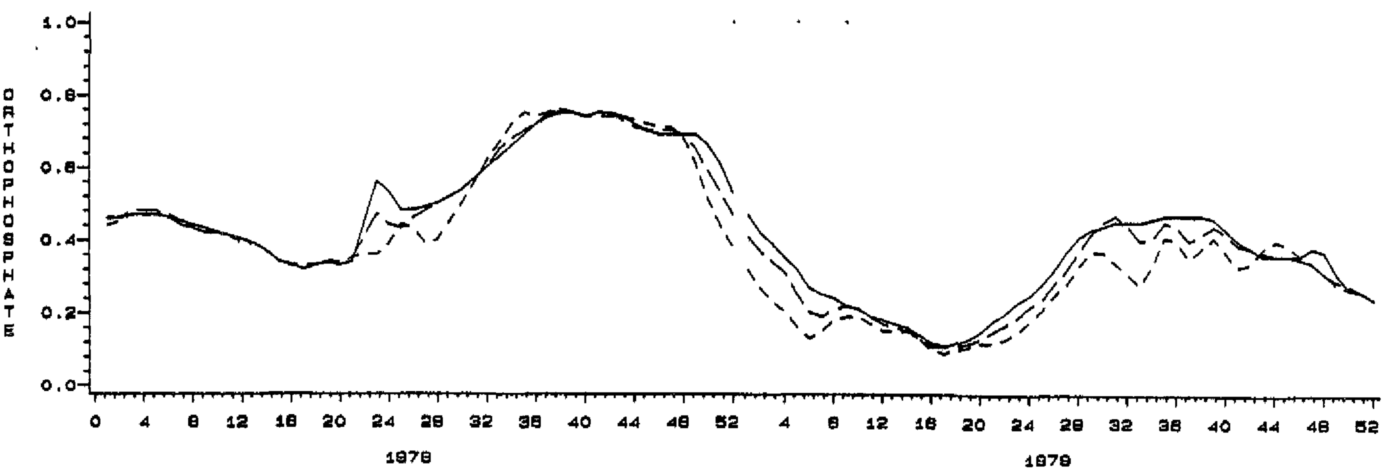


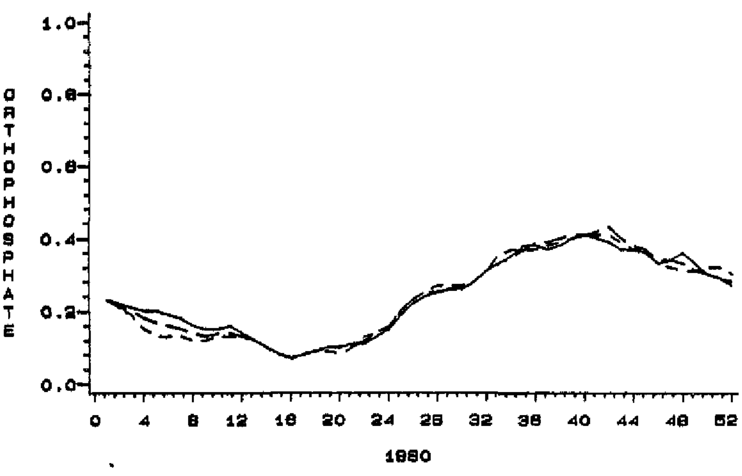
<u>Figure 3.5</u>

oxygen concentration in mg/l

station G11 (DIHO - data)
——— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
----- waterdepth 15 - 20 m







<u>Figure 3.6</u>

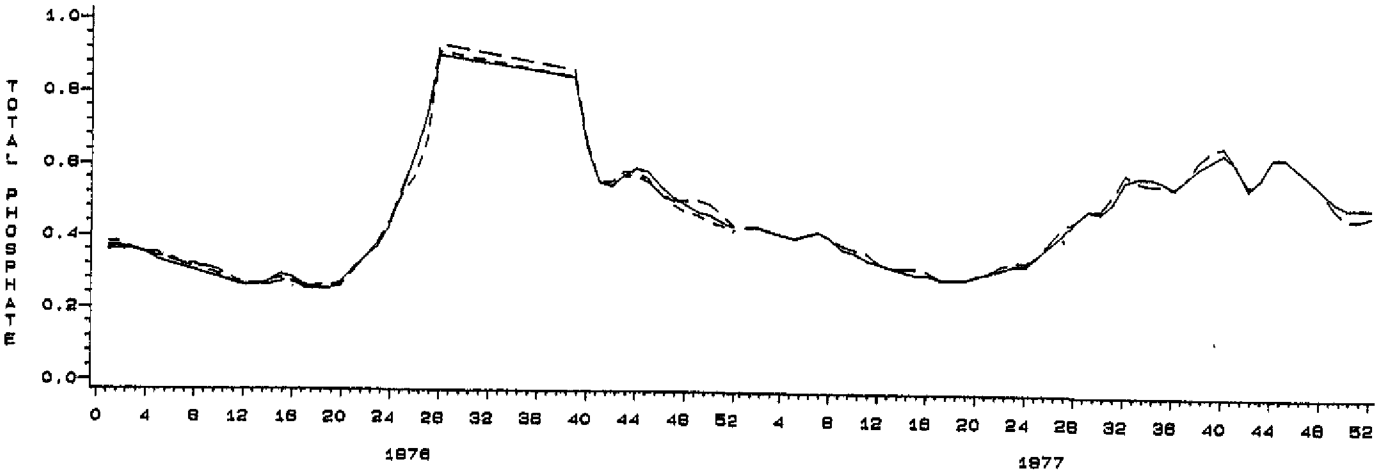
PO_4 concentration in mg P/l

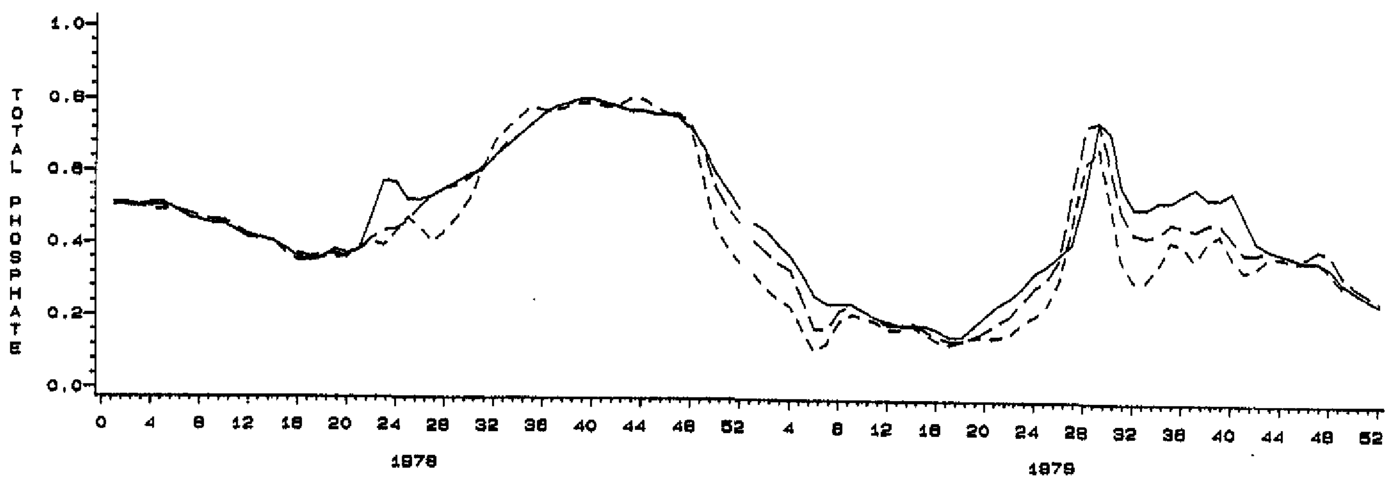
station G11 (DIHO - data)

——— waterdepth 0 - 5 m

— — waterdepth 5 - 15 m

----- waterdepth 15 - 20 m





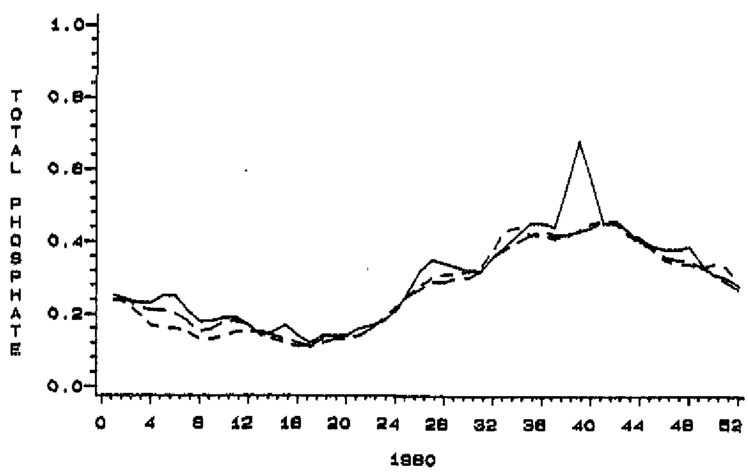
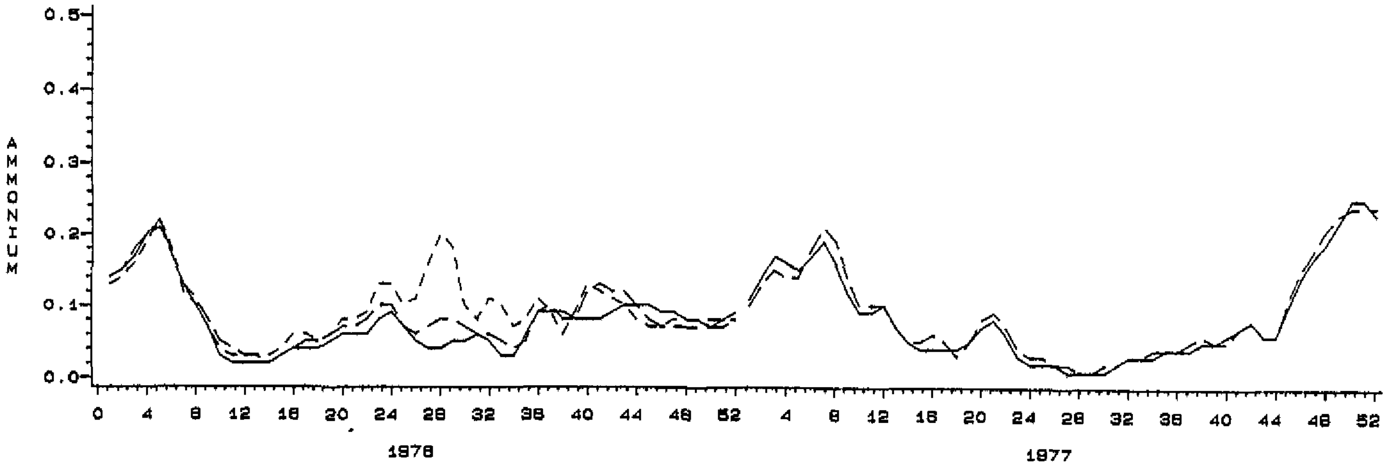
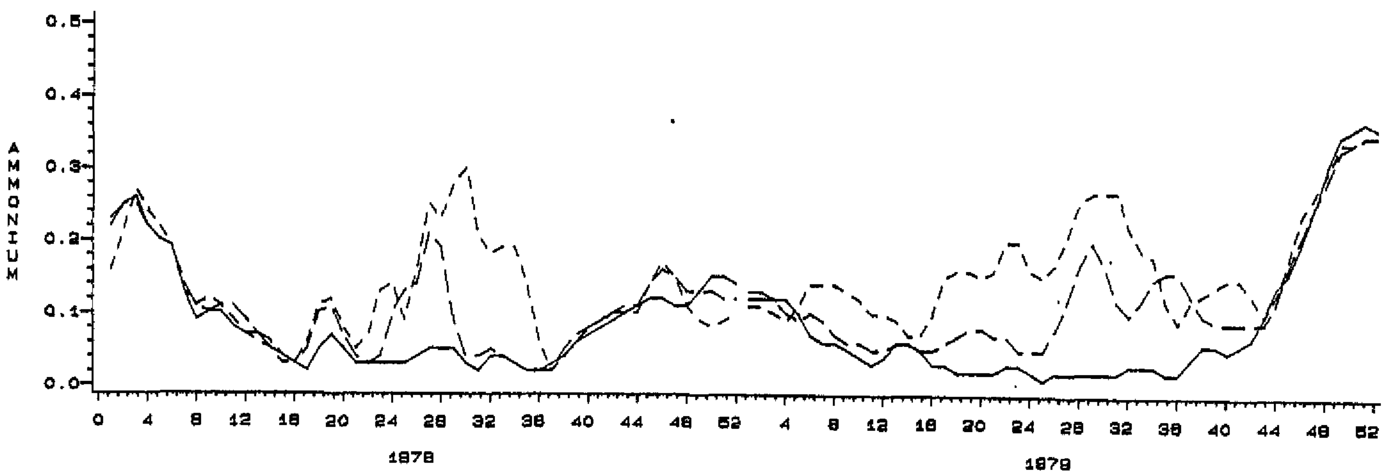


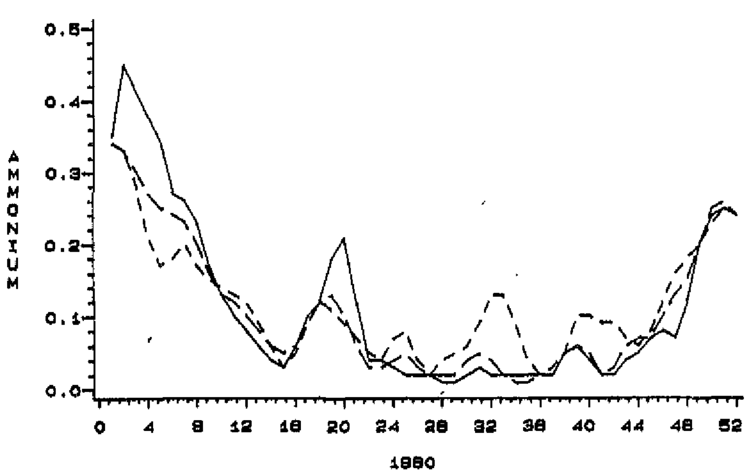
Figure 3.7

total-P concentration in mg P/l

station G11 (DIHO - data)
——— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
----- waterdepth 15 - 20 m





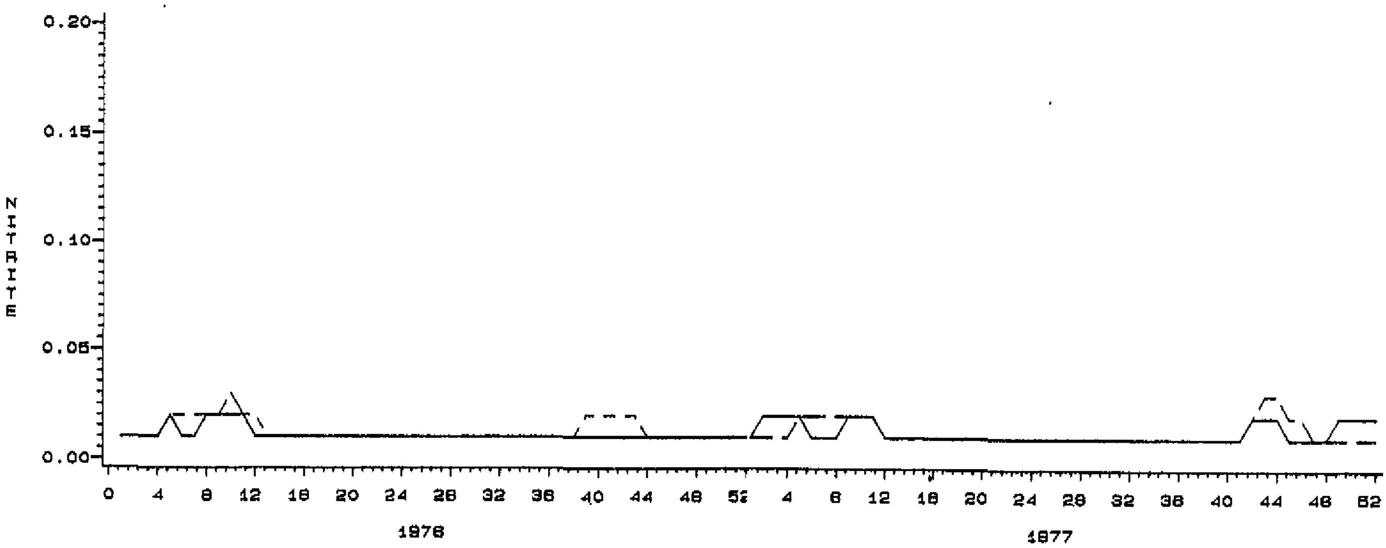


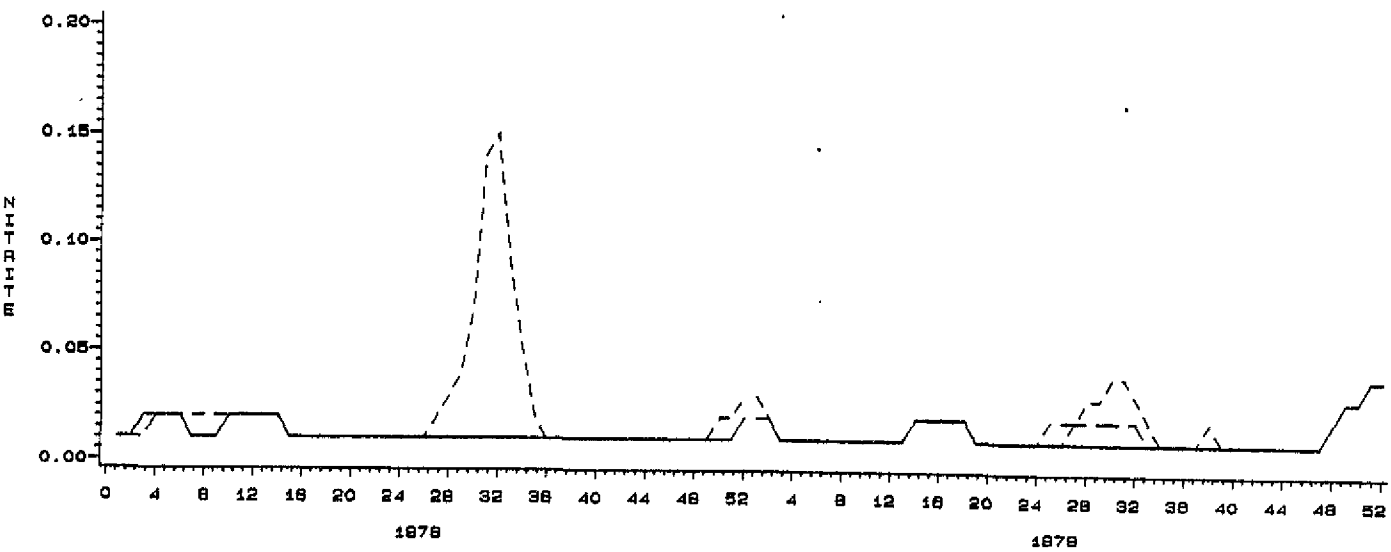
<u>Figure 3.8</u>

ammonium concentration in mg N/l

station G11 (DIHO - data)

———	waterdepth 0 - 5 m
— —	waterdepth 5 - 15 m
- - - -	waterdepth 15 - 20 m





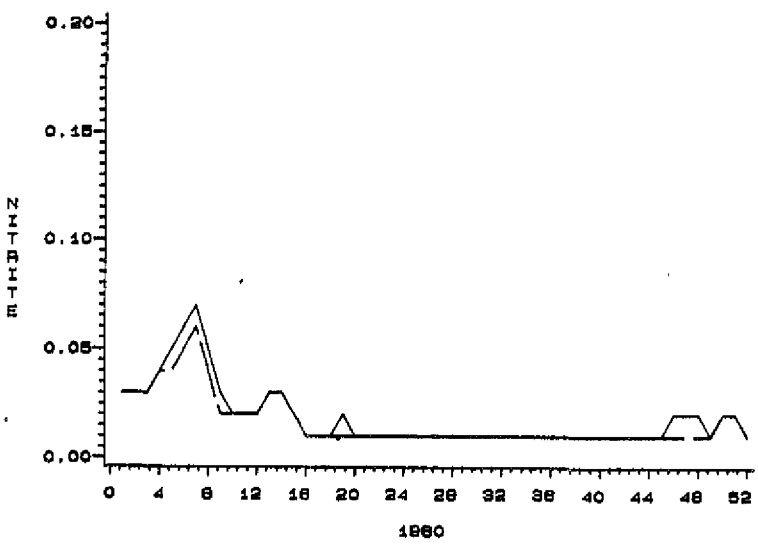
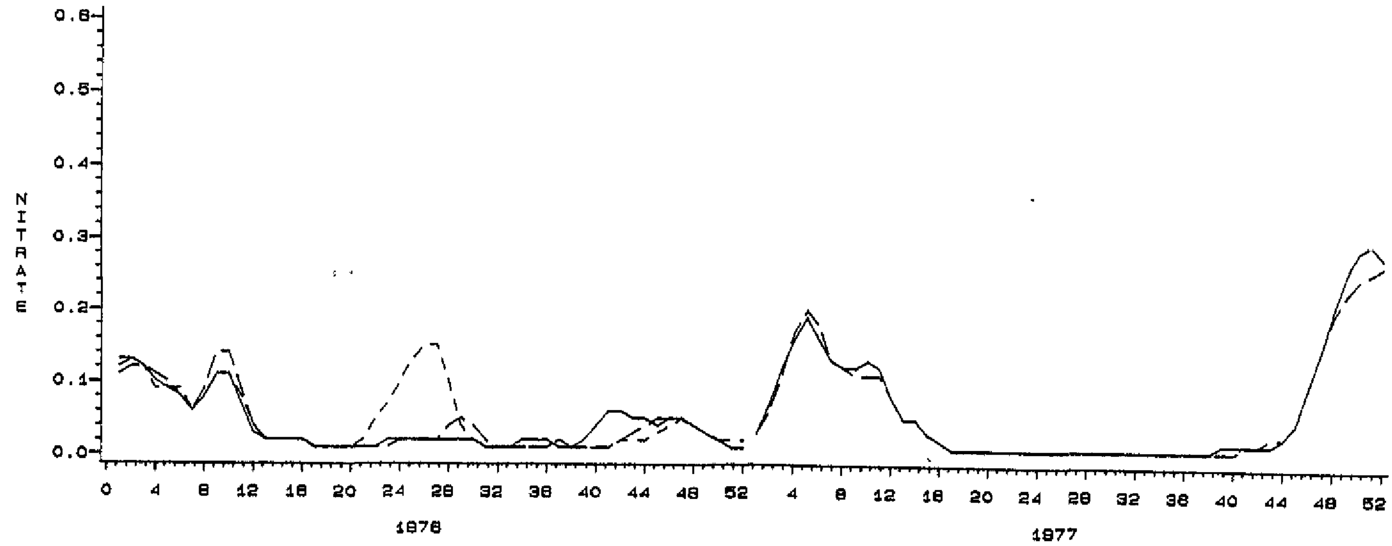
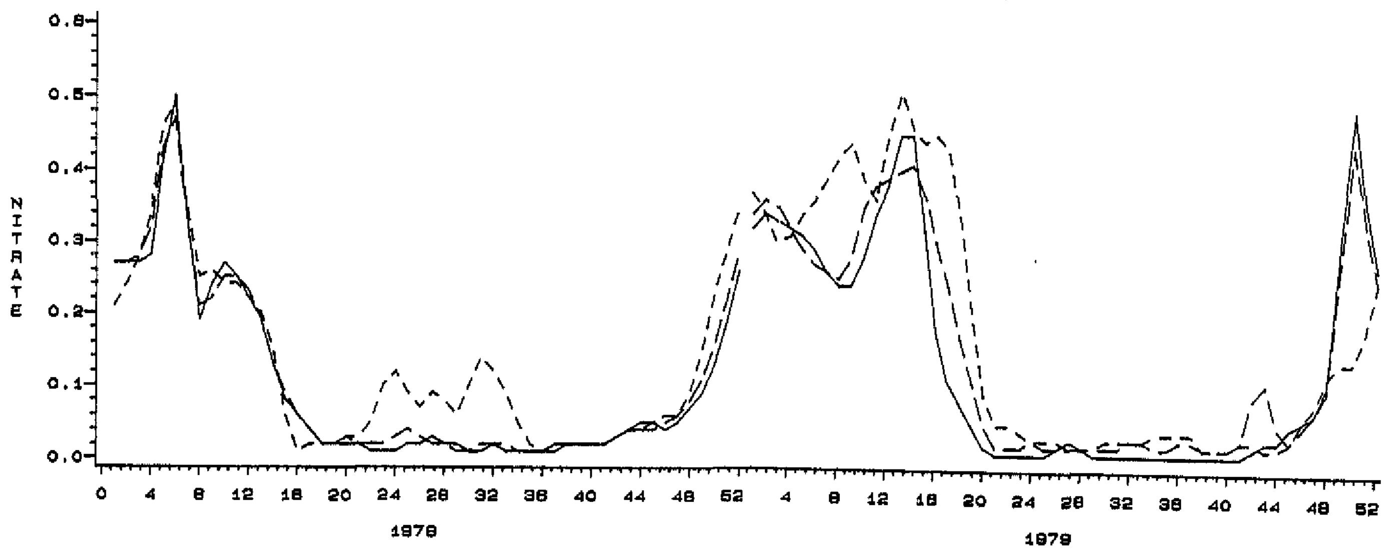


Figure 3.9

nitrite concentration in mg N/1

station G11 (DIHO - data)
——— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
----- waterdepth 15 - 20 m





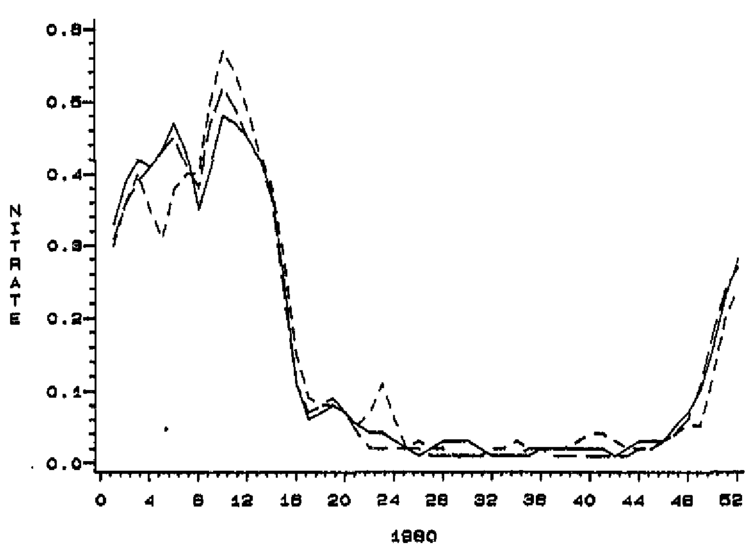


Figure 3.10

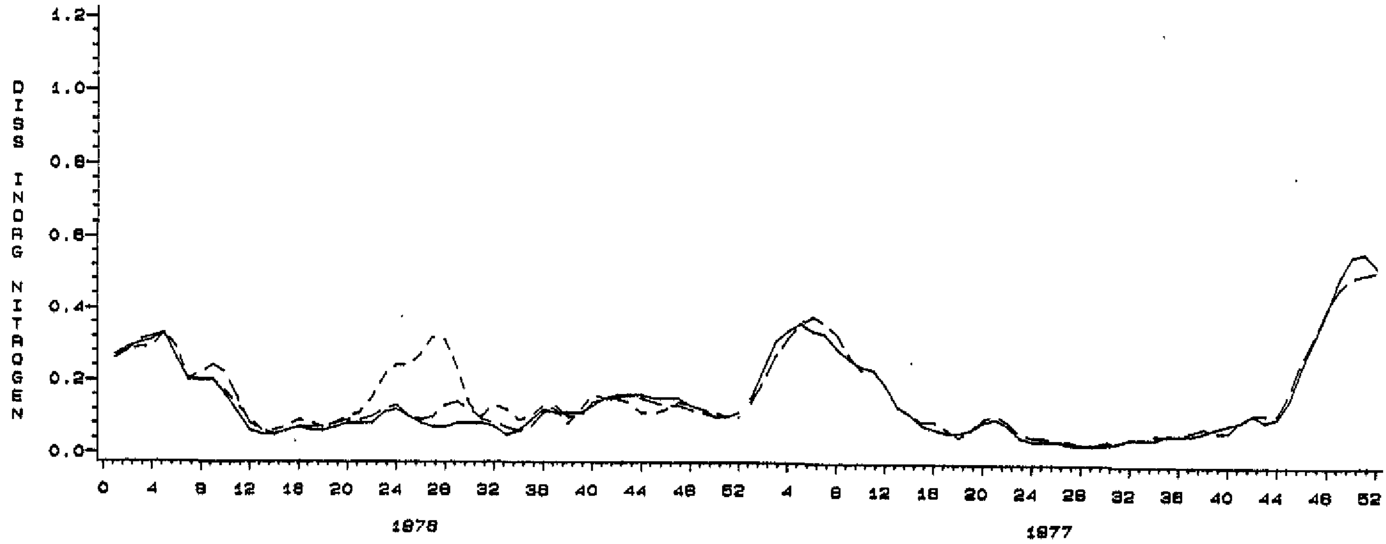
nitrate concentration in mg N/l

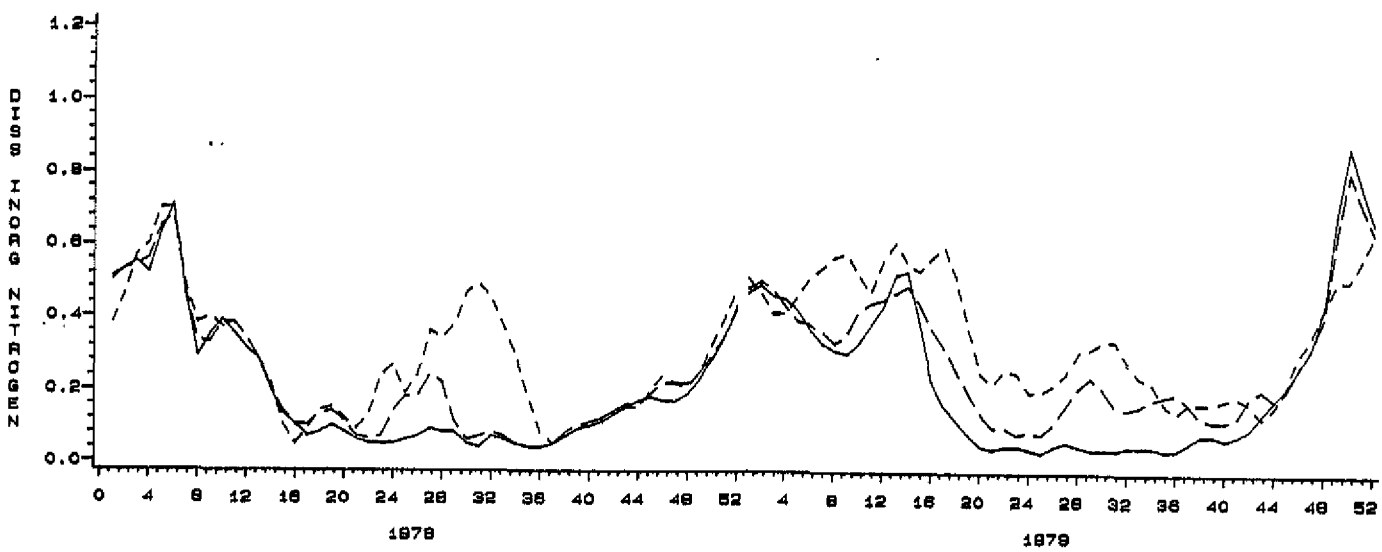
station G11 (DIHO - data)

——— waterdepth 0 - 5 m

— — waterdepth 5 - 15 m

----- waterdepth 15 - 20 m





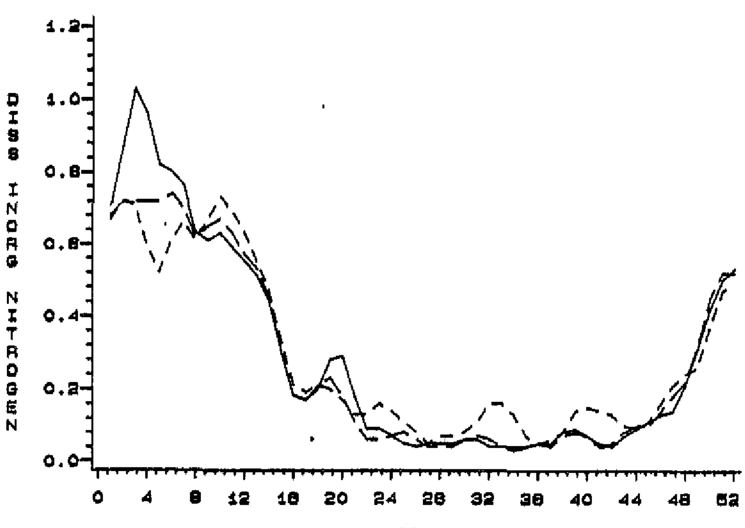
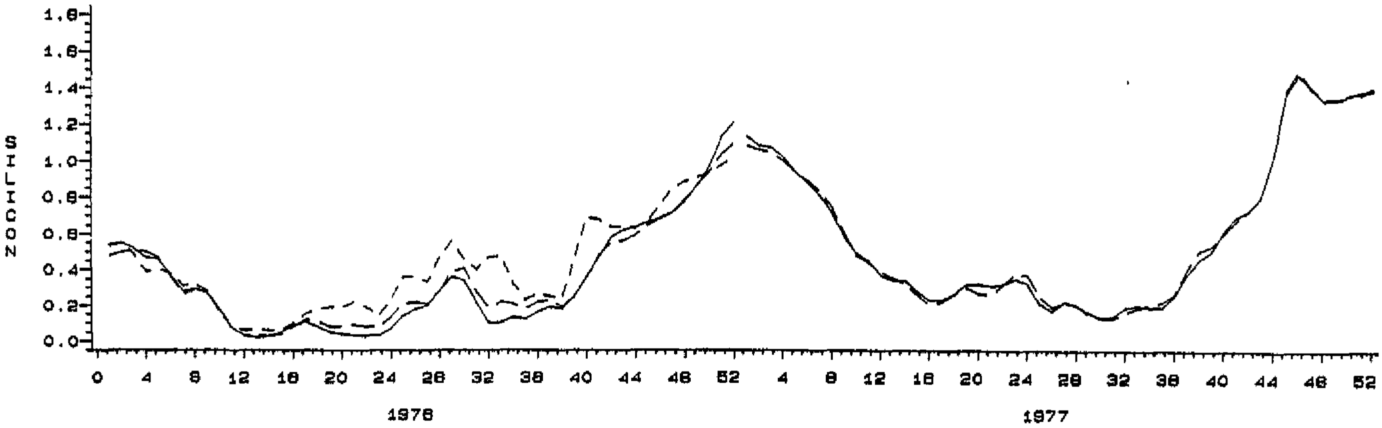
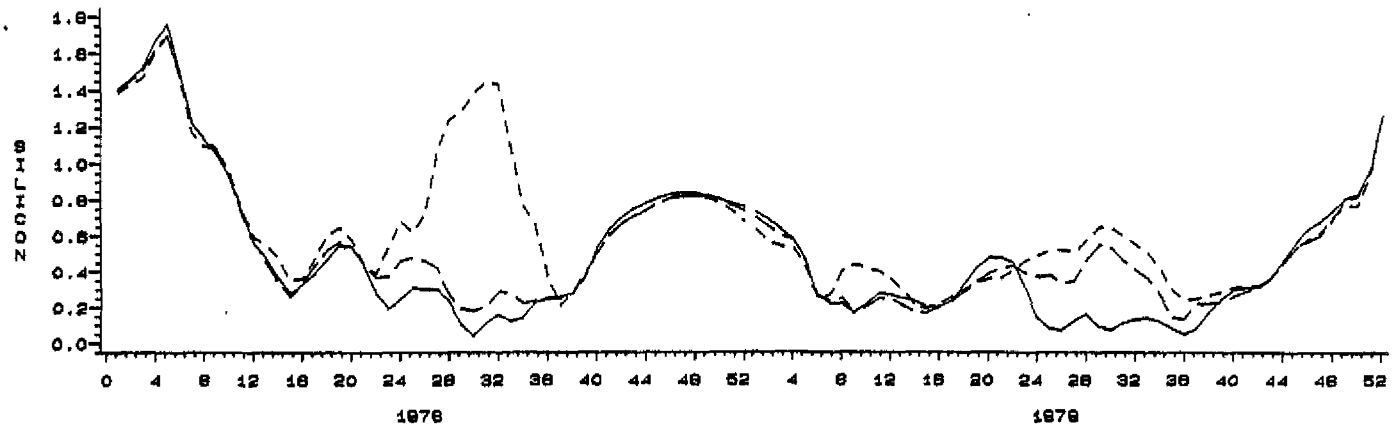


Figure 3.11

ammonium + nitrite + nitrate in mg N/1

station G11 (DIHO - data)
———— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
------ waterdepth 15 - 20 m





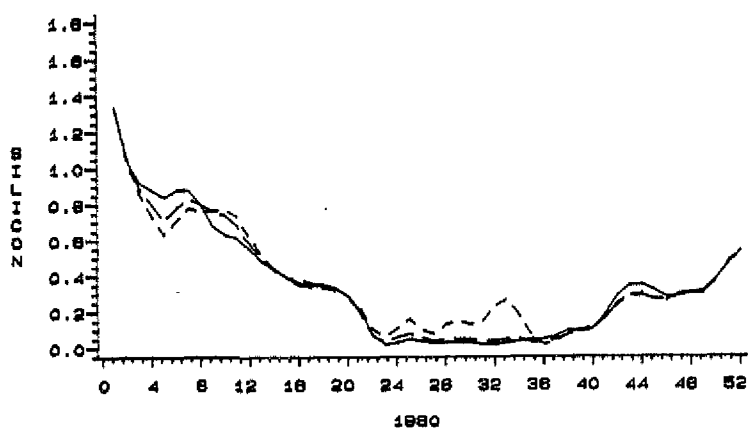
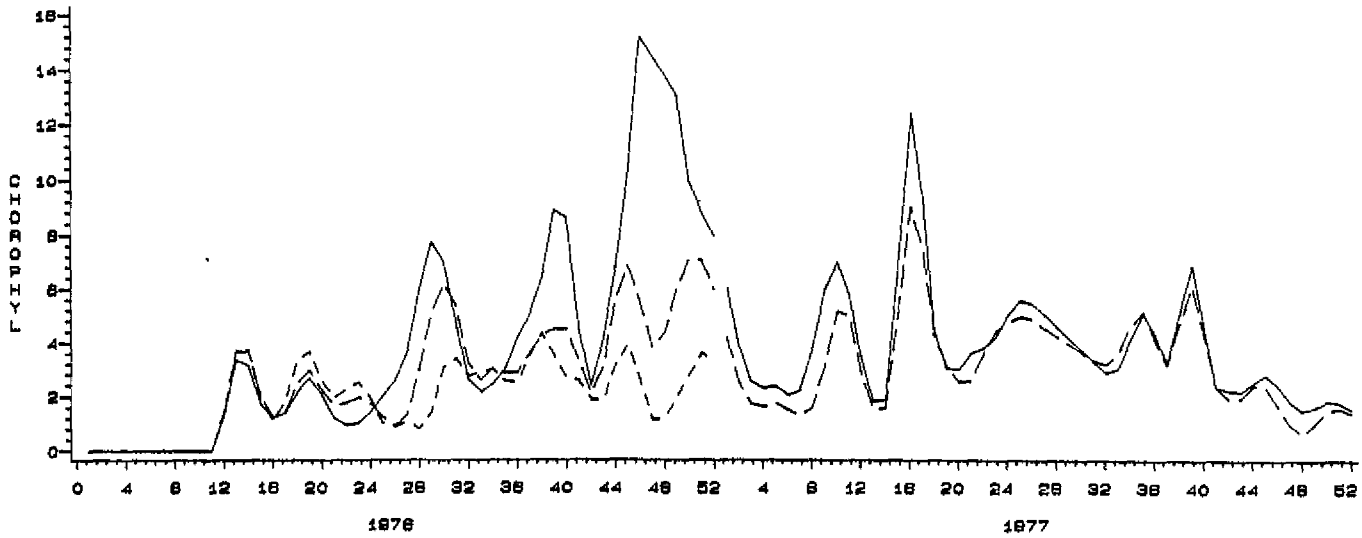
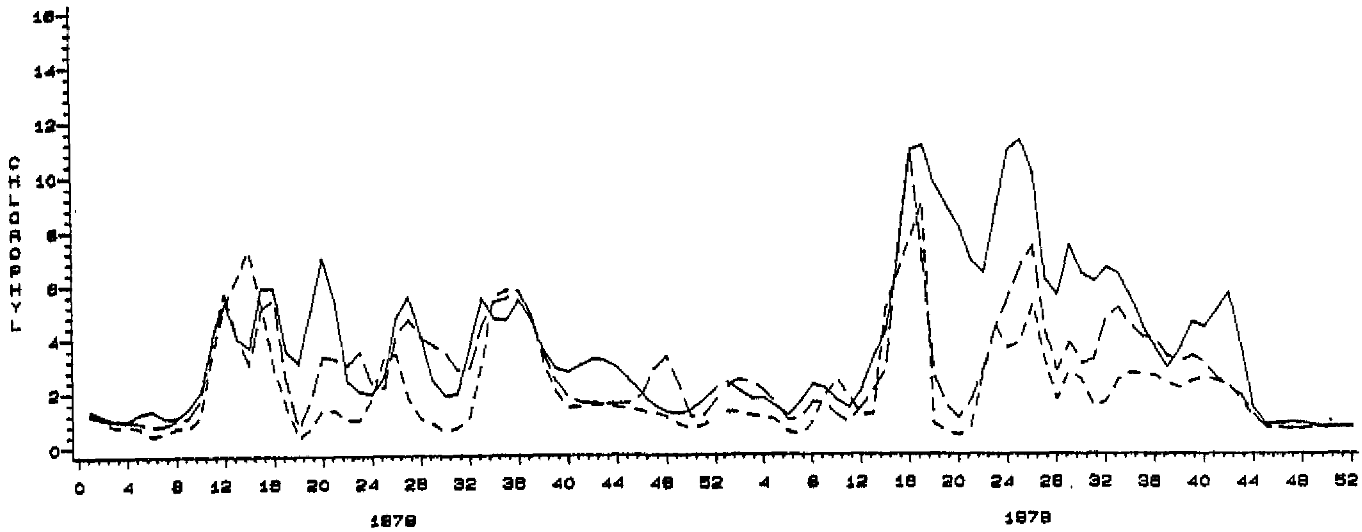


Figure 3.12

silicon concentration in mg Si/l

station G11 (DIHO - data)
———— waterdepth 0 - 5 m
— — — waterdepth 5 - 15 m
- - - - - waterdepth 15 - 20 m





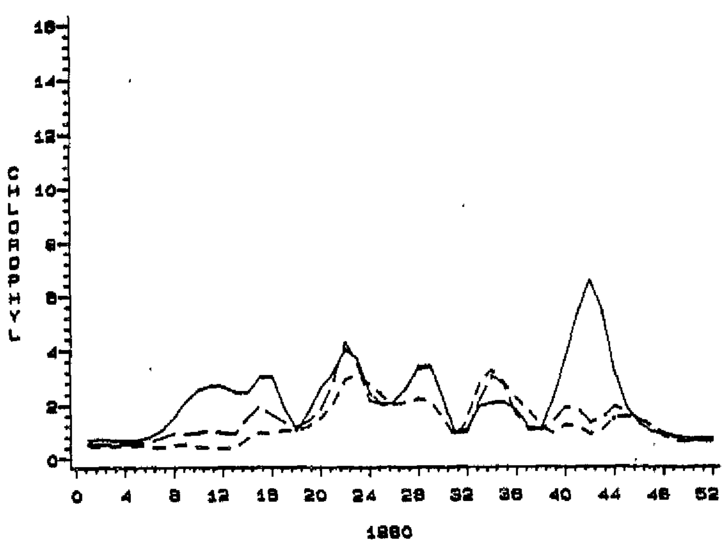


Figure 3.13

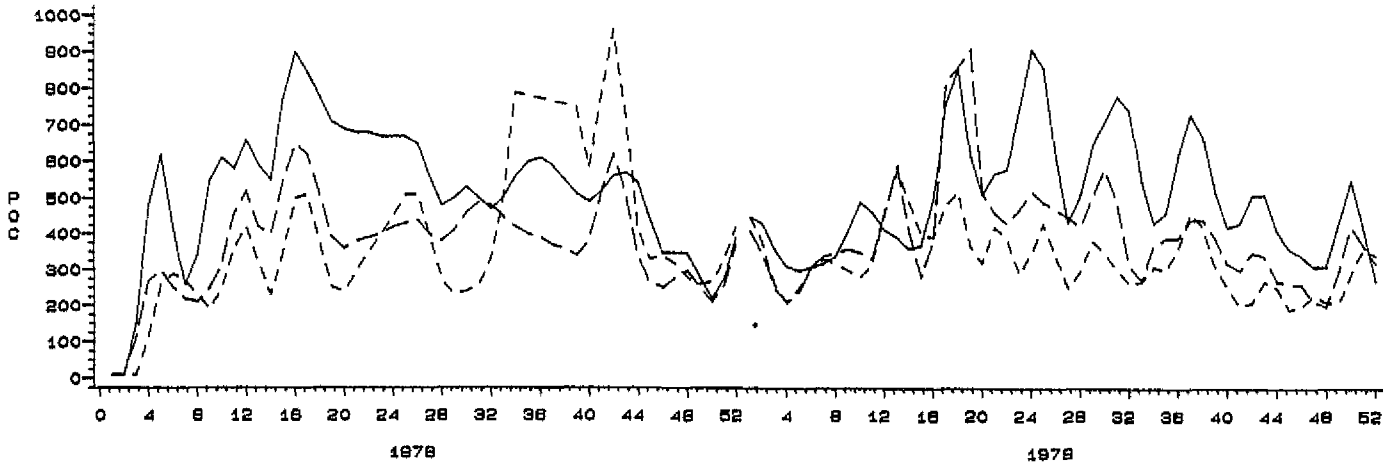
chlorophyl concentration in mg/m^3

station G11 (DIHO - data)

——— waterdepth 0 - 5 m

— — waterdepth 5 - 15 m

----- waterdepth 15 - 20 m



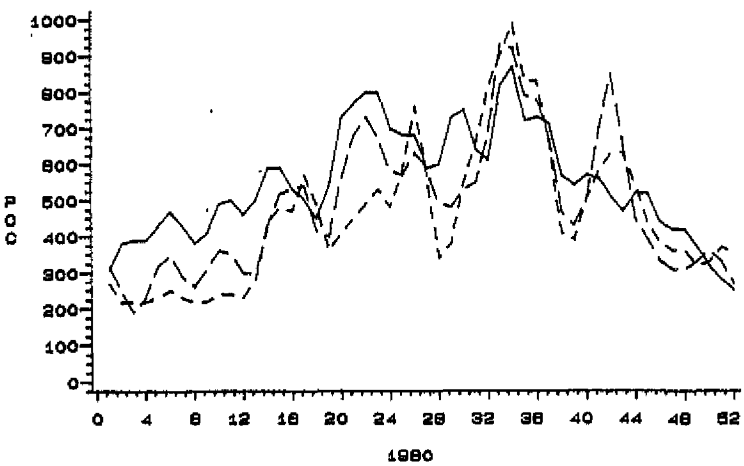
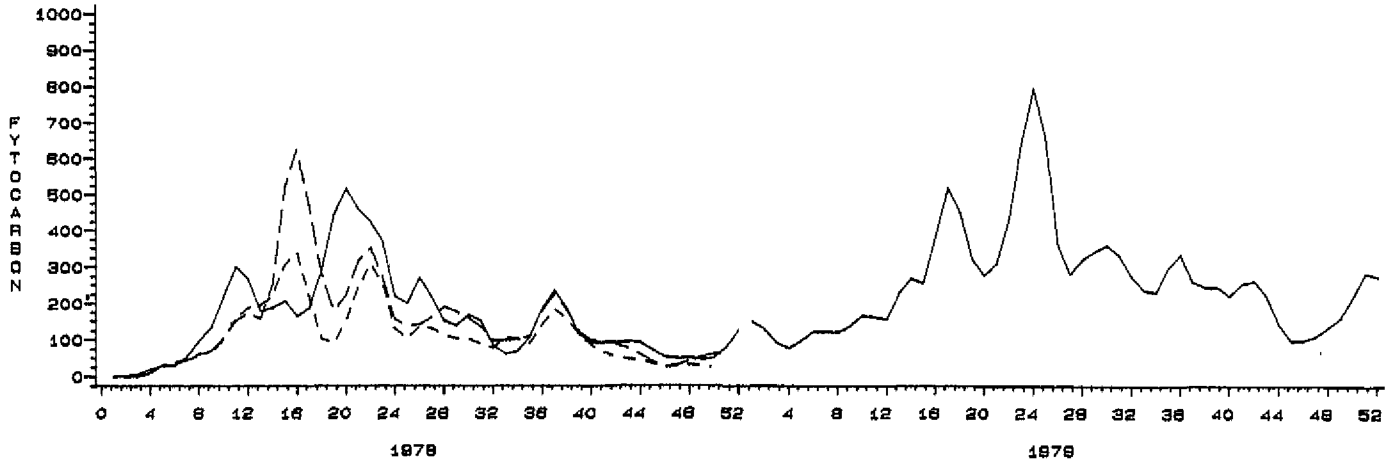


Figure 3.14

POC-concentration in mg C/m^3

station G11 (DIHO - data)
—— waterdepth 0 - 5 m
— — waterdepth 5 - 15 m
----- waterdepth 15 - 20 m



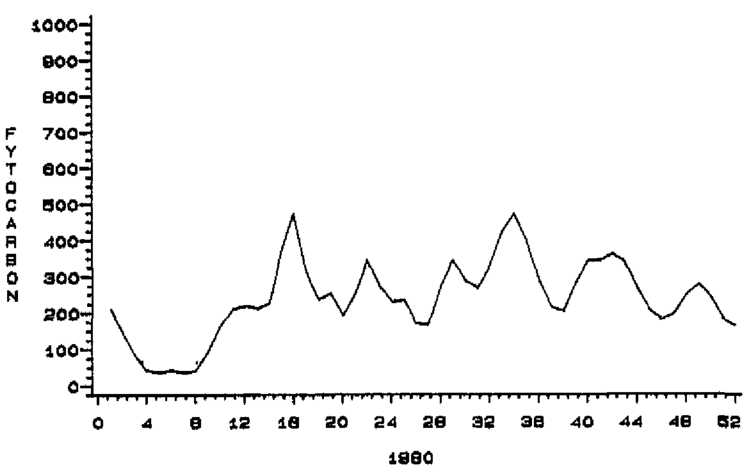
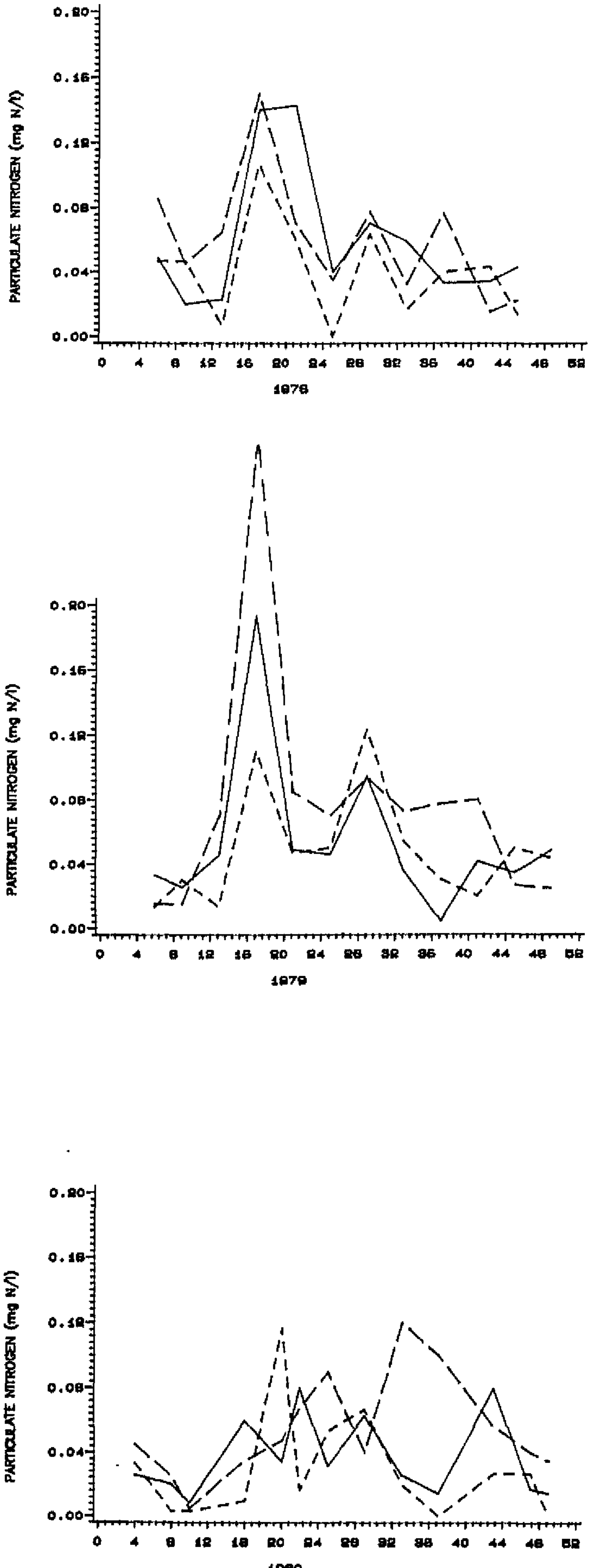


Figure 3.15

phytoplankton-carbon in mg C/m^3

station G11 (DIHO - data)

———	waterdepth 0 - 5 m
— —	waterdepth 5 - 15 m
-----	waterdepth 15 - 20 m



igure 3.16

uspended particulate nitrogen
n mg N/1 (DDMI - data)

———	0 m	average of 7 stations	
— —	5 - 15 m	average of 3 stations	(near bottom)
----	> 15 m	average of 4 stations	(near bottom)

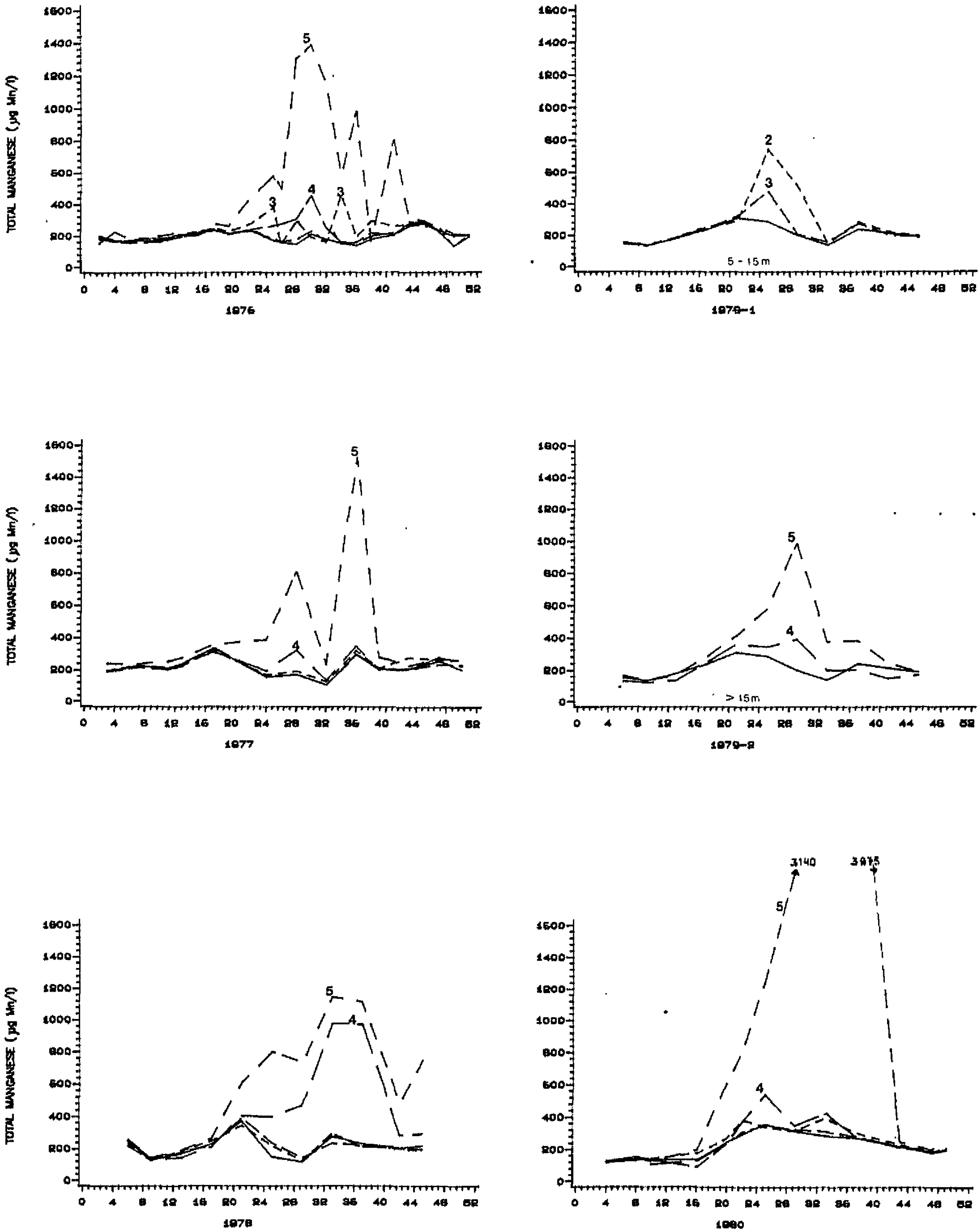


Figure 3.17

manganese concentration in mg Mn/m^3 (DDMI - data)

1	————————	0 m	average of 7 stations
2	— — — — — —	5 - 15 m	average of 4 stations
3	-------------	5 - 15 m	average of 3 stations (near botton
4	—— —— ——	> 15 m	average of 2 stations
5	—— — —— —	> 15 m	average of 4 stations (near botton

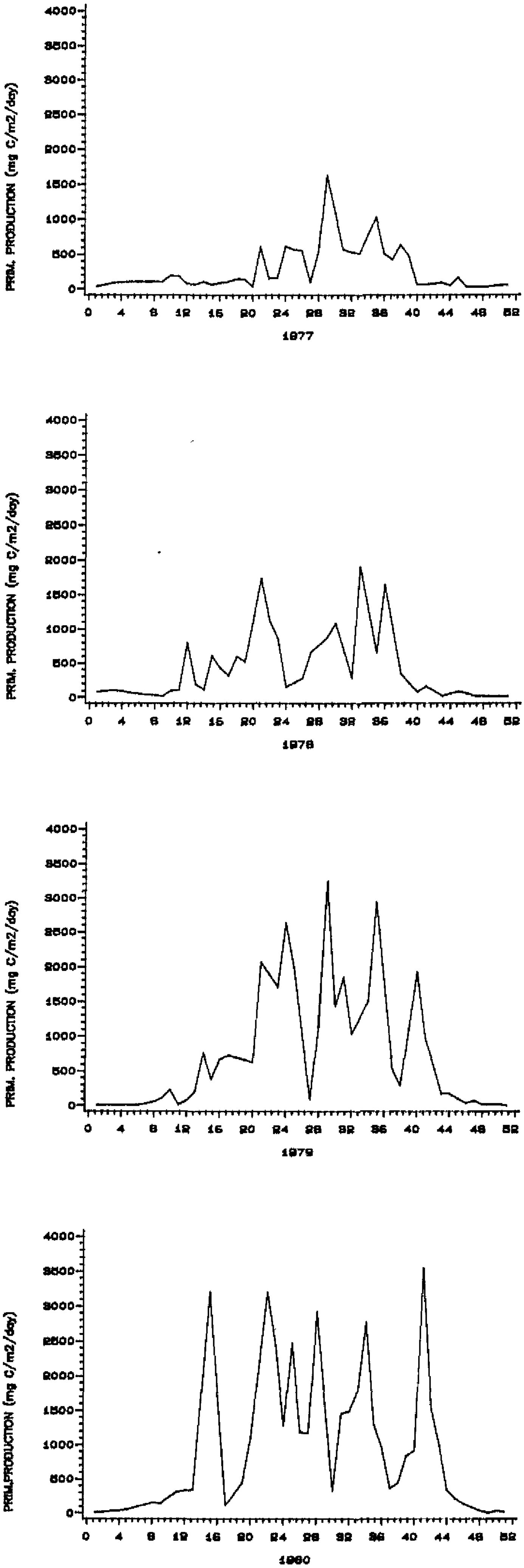


Figure 3.18

phytoplankton net primary production in mg C/m^3/day (station G11, DIHO - data)

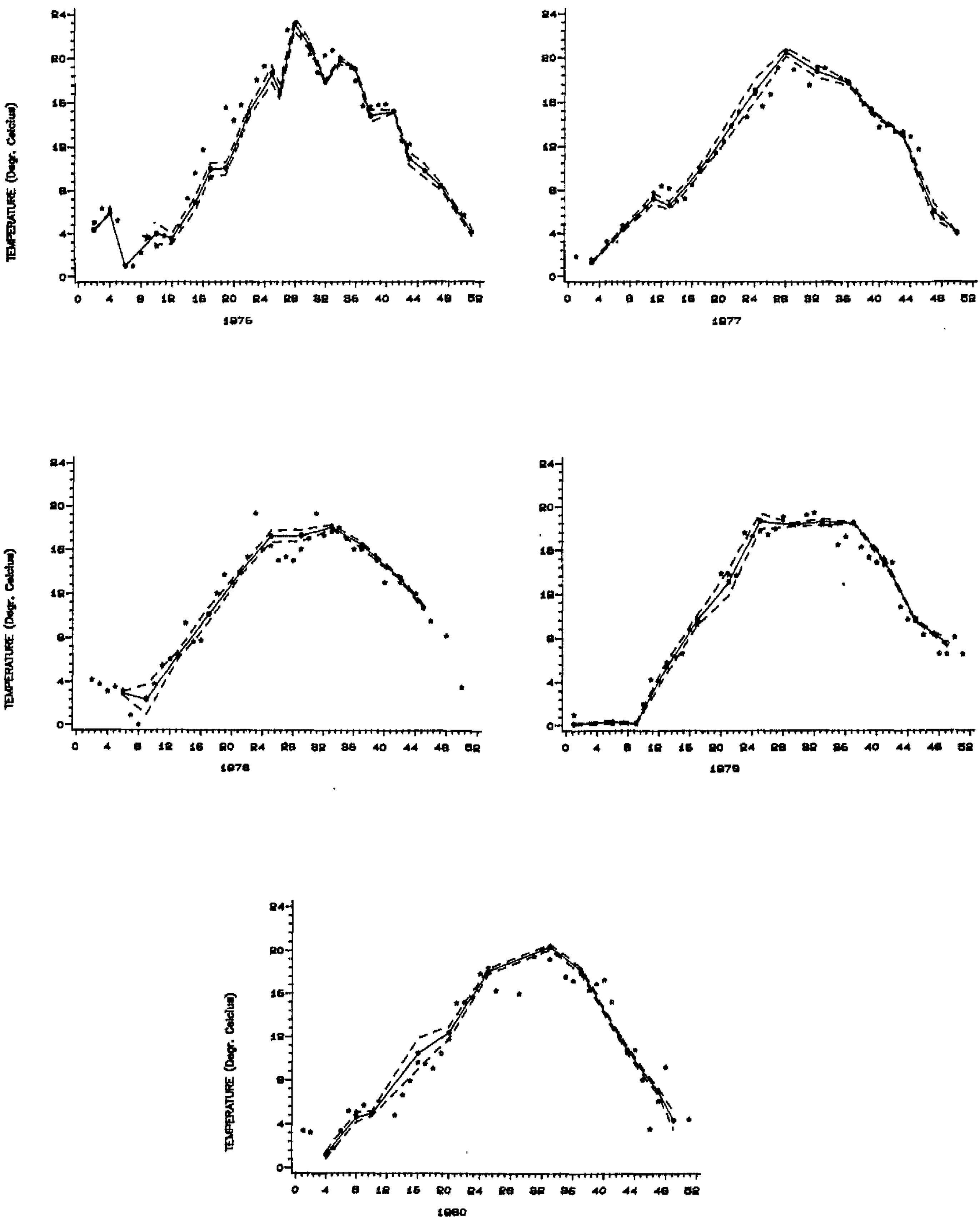


Figure 3.19

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 911)
•—• DDMI data (upper waterlayer, average of 7 stations)
— 95% confidence limits (DDMI-data)

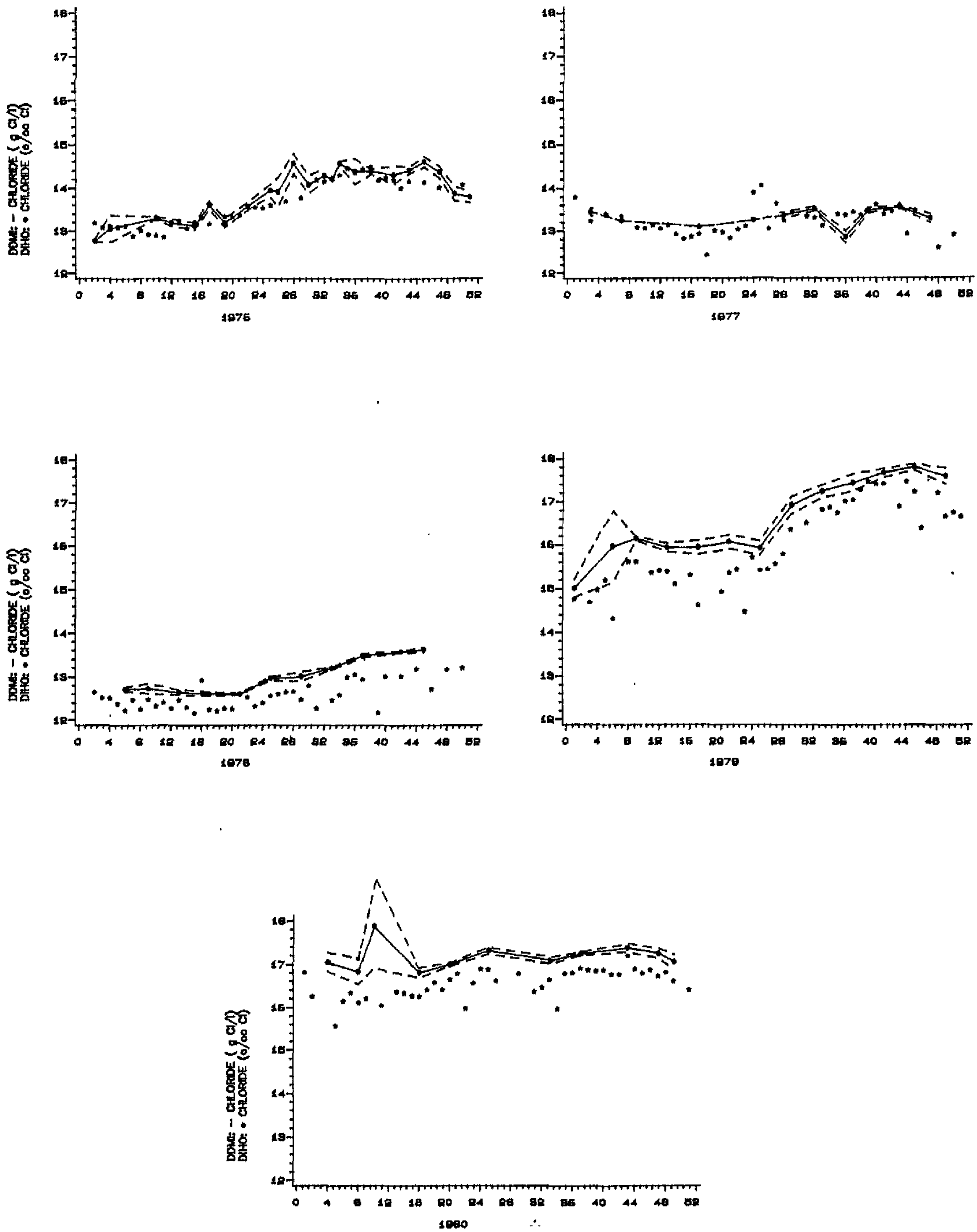


Figure 3.20

Comparison of DDMI and DIHO datasets
* DIHO data (upper waterlayer, station 9(1)
•—• DDMI data (upper waterlayer,
average of 7 stations)
--- 95% confidence limits (DDMI-data)

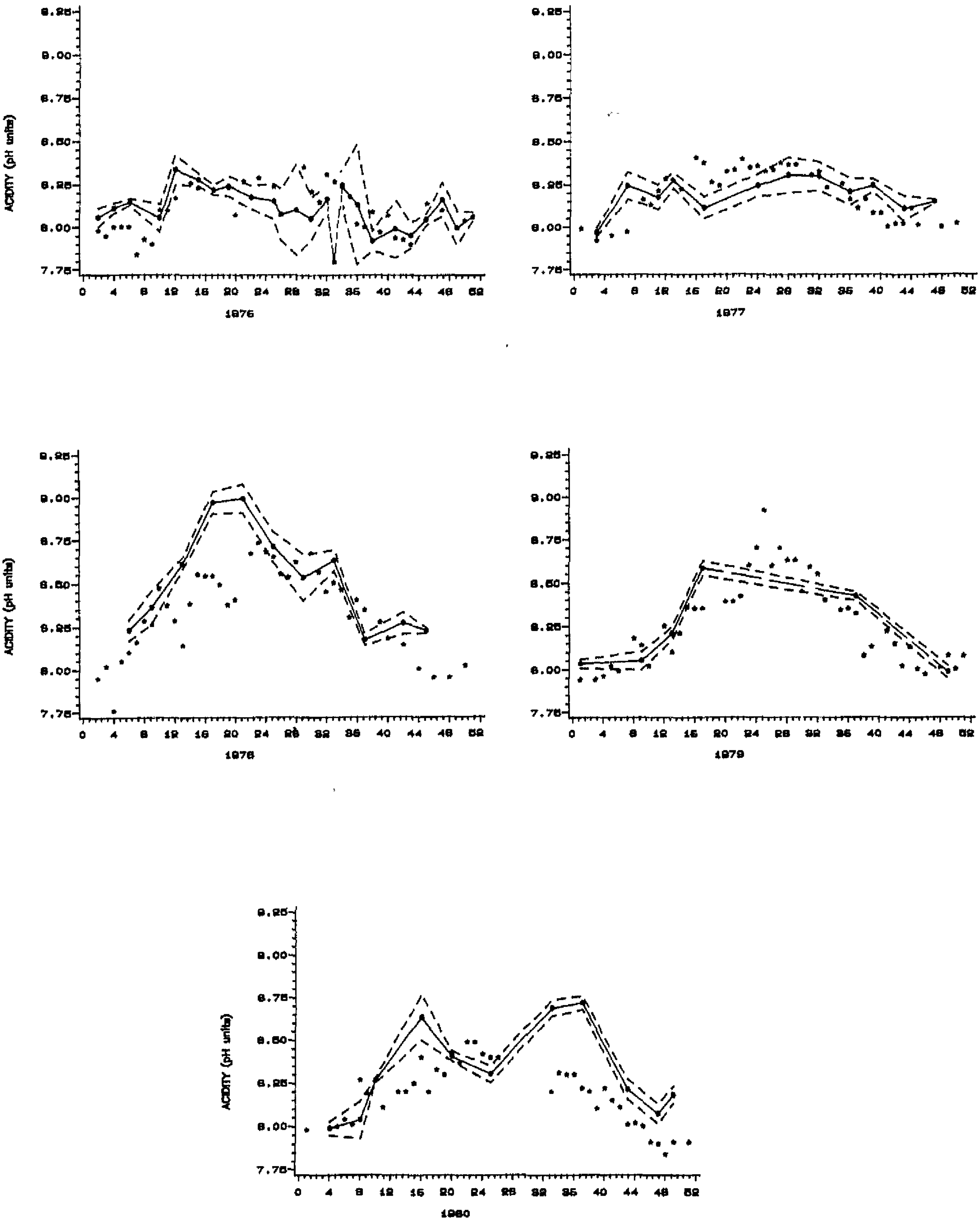


Figure 3.21

Comparison of DDMI and DIHO datasets
* DIHO data (upper waterlayer, station 01i)
•—• DDMI data (upper waterlayer, average of 7 stations)
--- 95% confidence limits (DDMI-data)

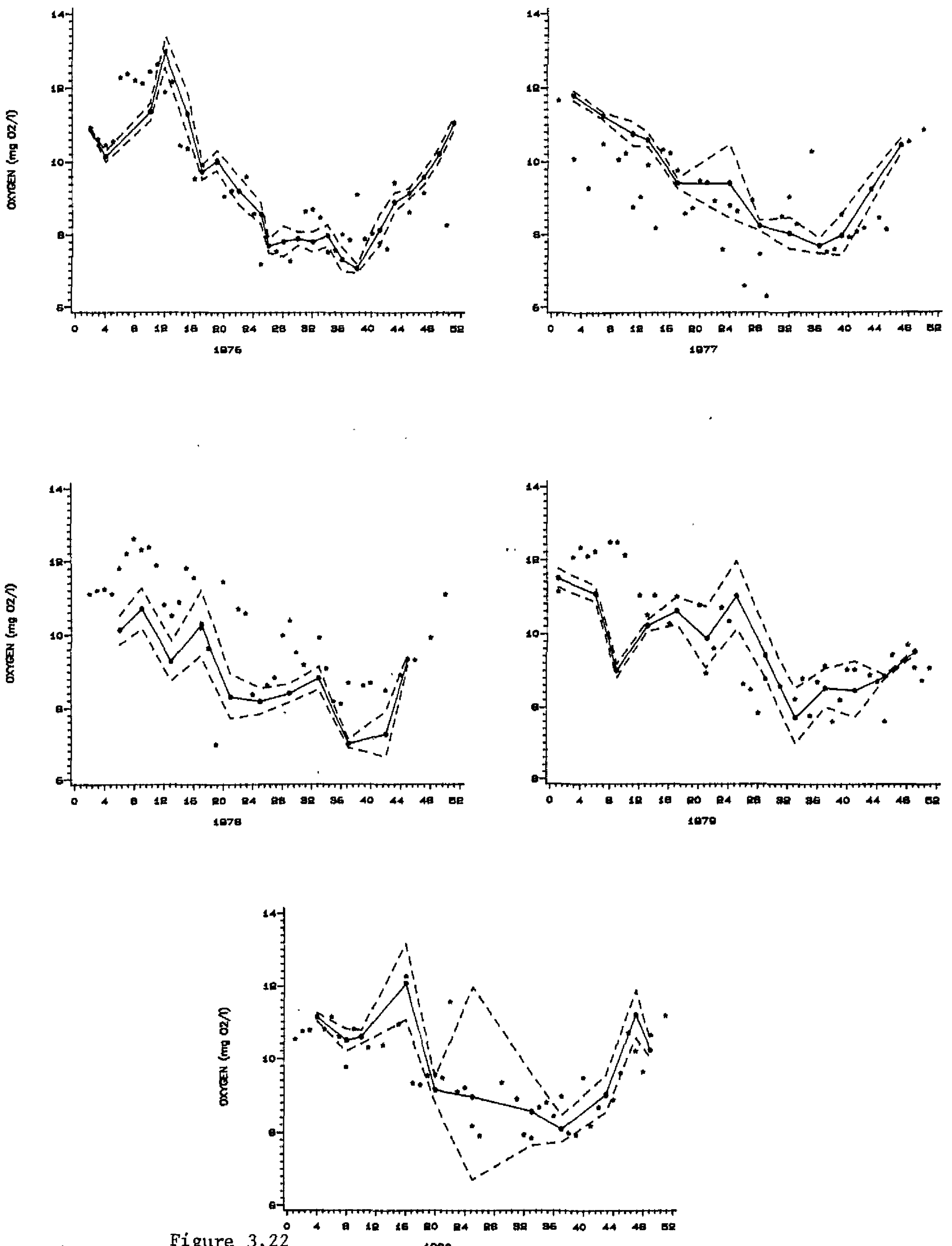


Figure 3.22

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 911)
•—• DDMI data (upper waterlayer, average of 7 stations)
---- 95% confidence limits (DDMI-data)

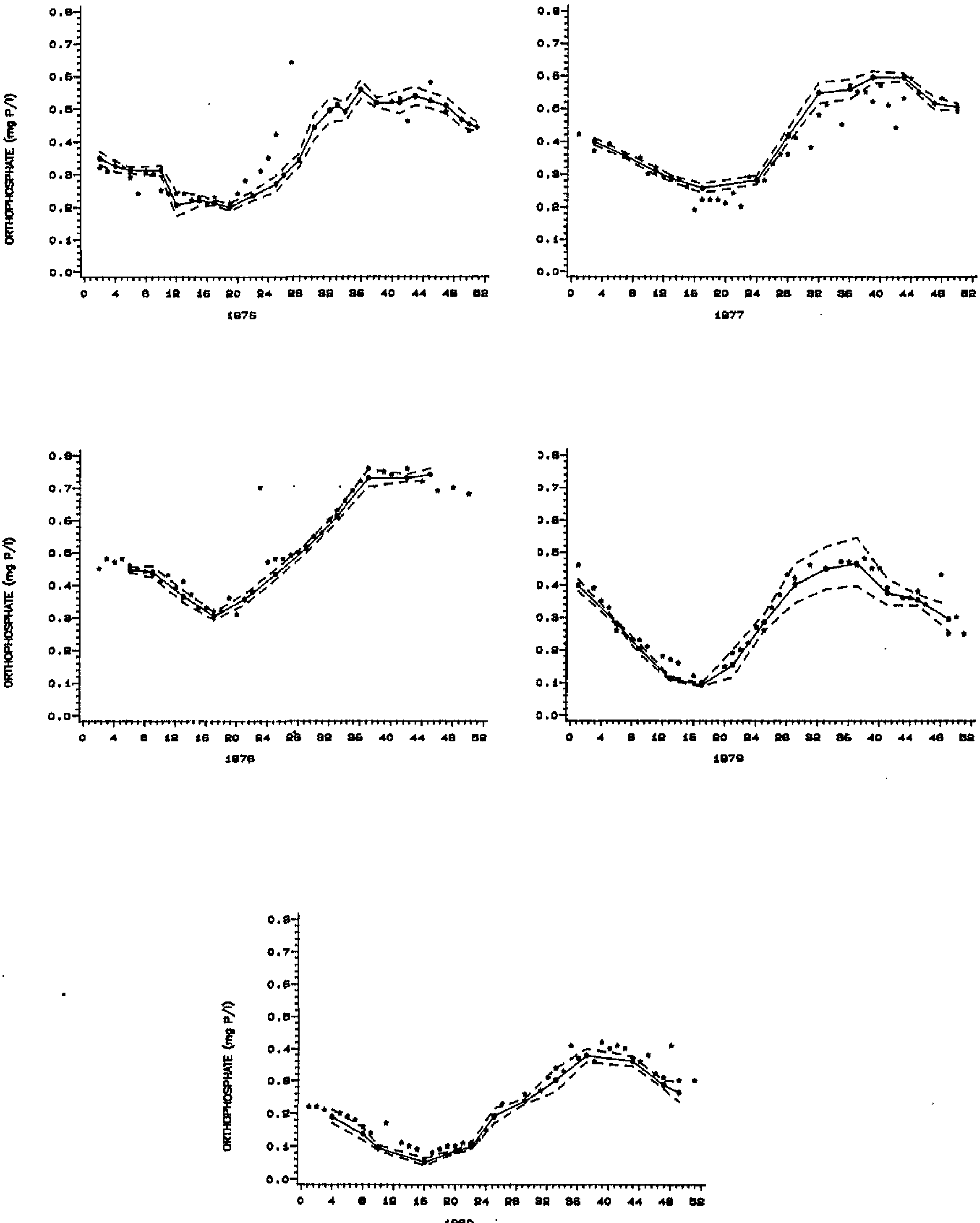
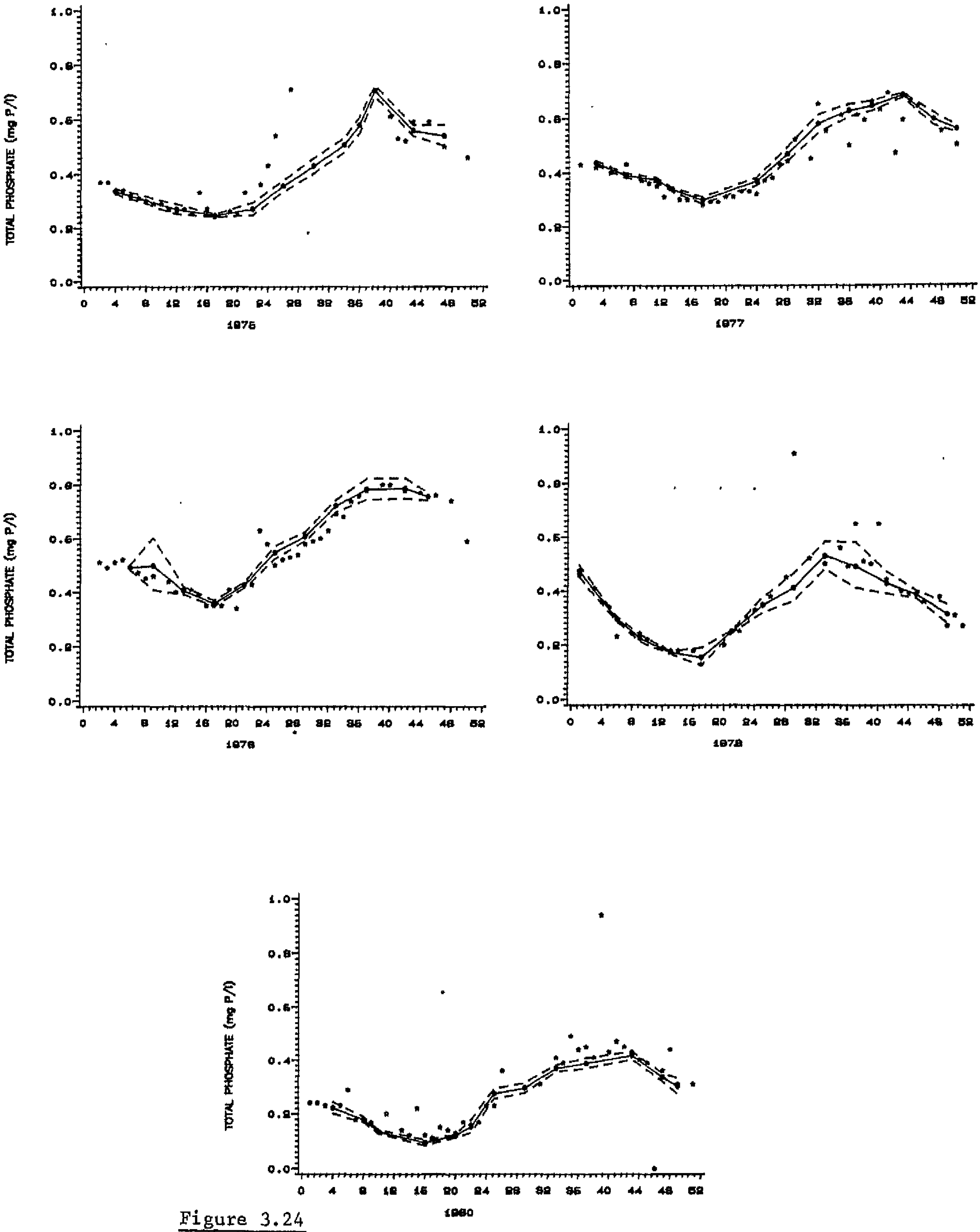


Figure 3.23

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 211)
●—● DDMI data (upper waterlayer, average of 7 stations)
---- 95% confidence limits (DDMI-data)



<u>Figure 3.24</u>

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 211)
●—● DDMI data (upper waterlayer,
average of 7 stations)
---- 95% confidence limits (DDMI-data)

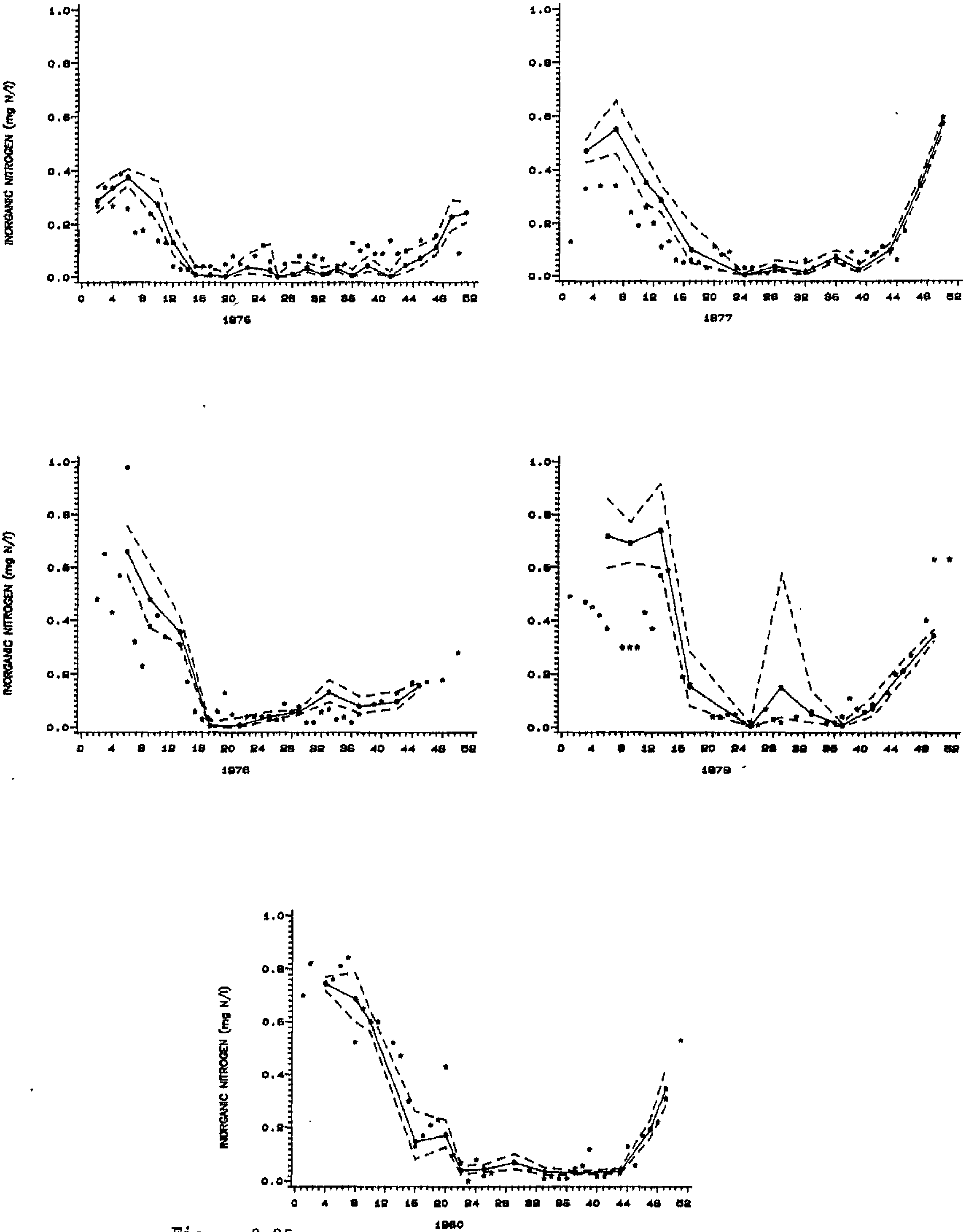


Figure 3.25

Comparison of DDMI and DIHO datasets
* DIHO data (upper waterlayer, station 911)
•—• DDMI data (upper waterlayer, average of 7 stations)
—— 95% confidence limits (DDMI-data)

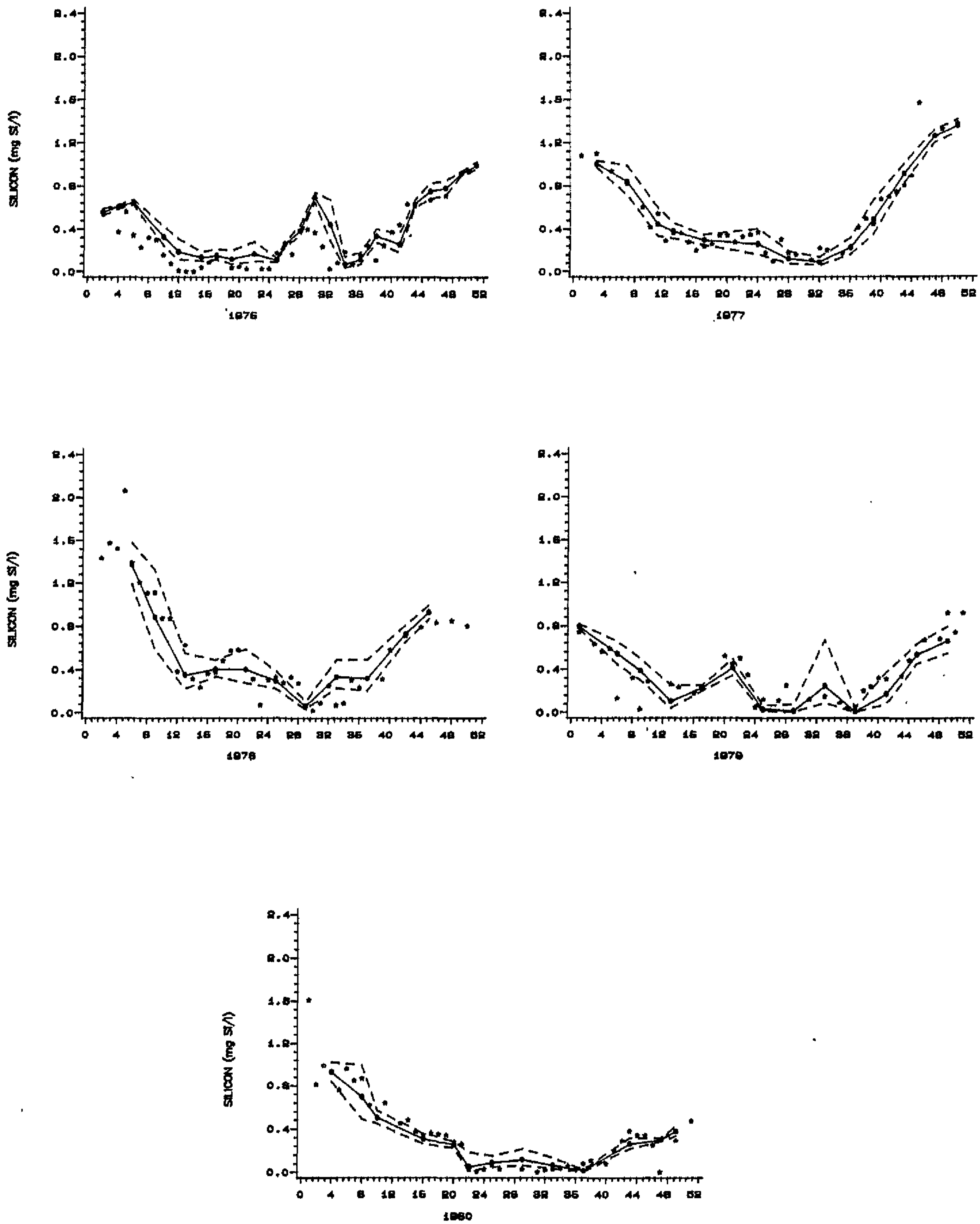


Figure 3.26

Comparison of DDMI and DIHO datasets
* DIHO data (upper waterlayer, station 011)
●—● DDMI data (upper waterlayer, average of 7 stations)
---- 95% confidence limits (DDMI-data)

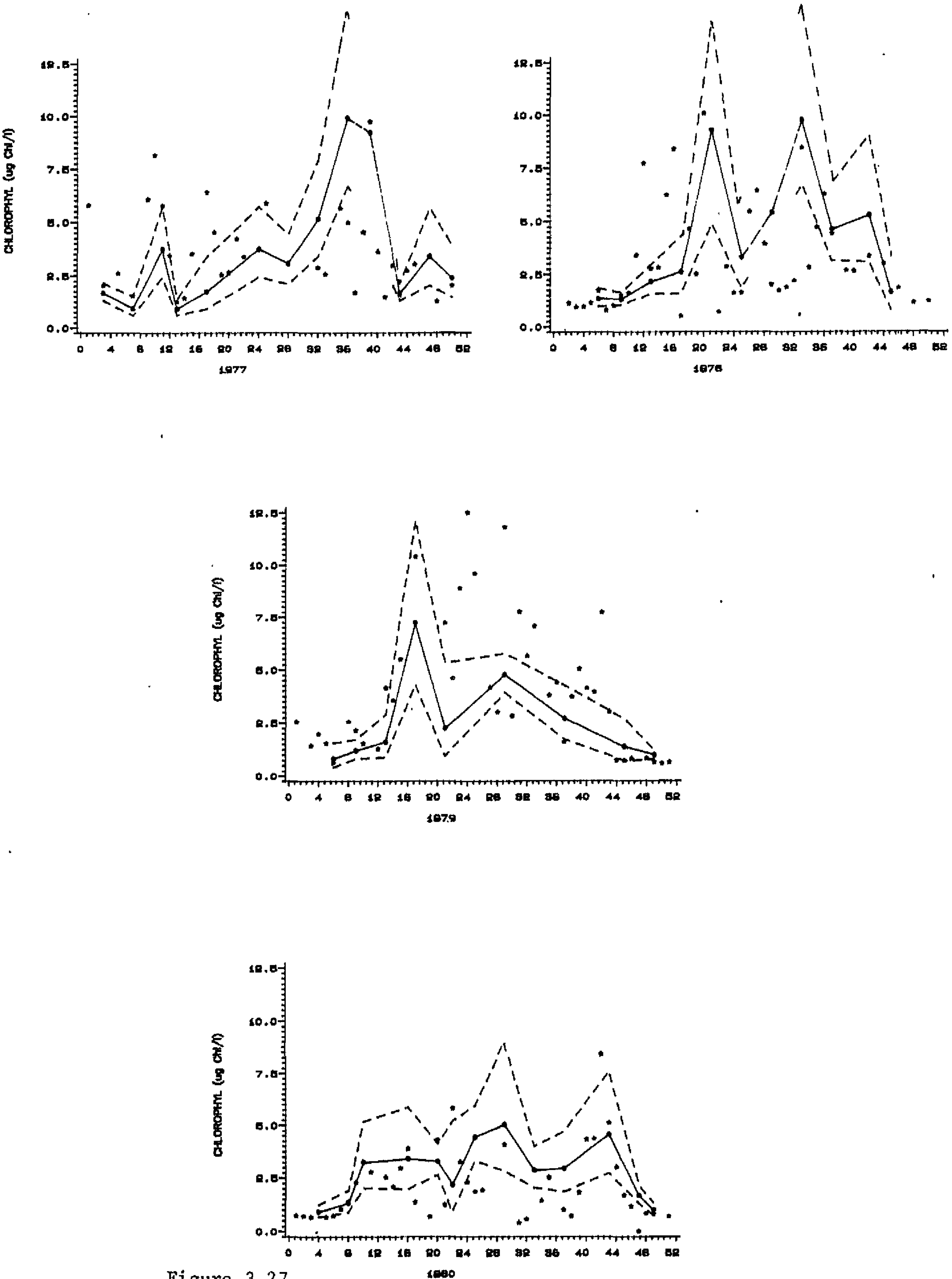


Figure 3.27

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 911)
●—● DDMI data (upper waterlayer, average of 7 stations)
--- 95% confidence limits (DDMI-data)

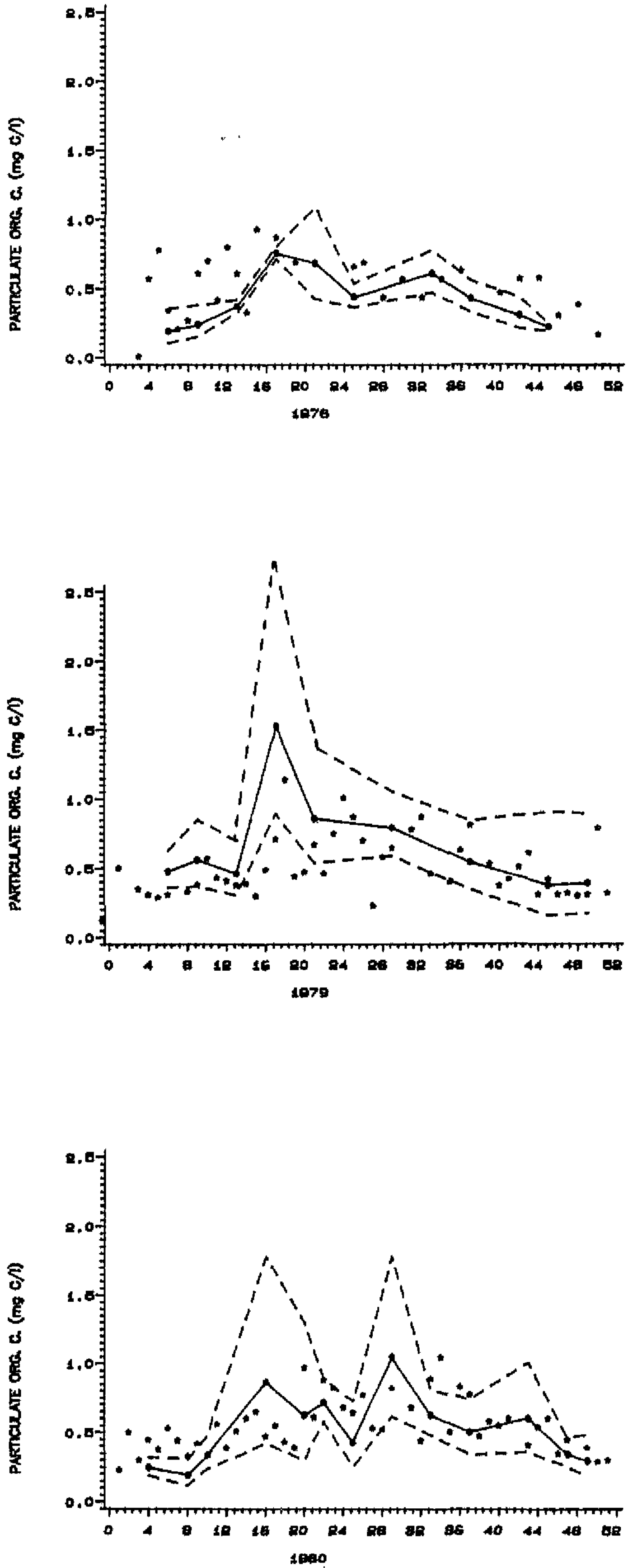


Figure 3.28

Comparison of DDMI and DIHO datasets
★ DIHO data (upper waterlayer, station 911)
●—● DDMI data (upper waterlayer, average of 7 stations)
—— 95% confidence limits (DDMI-data)

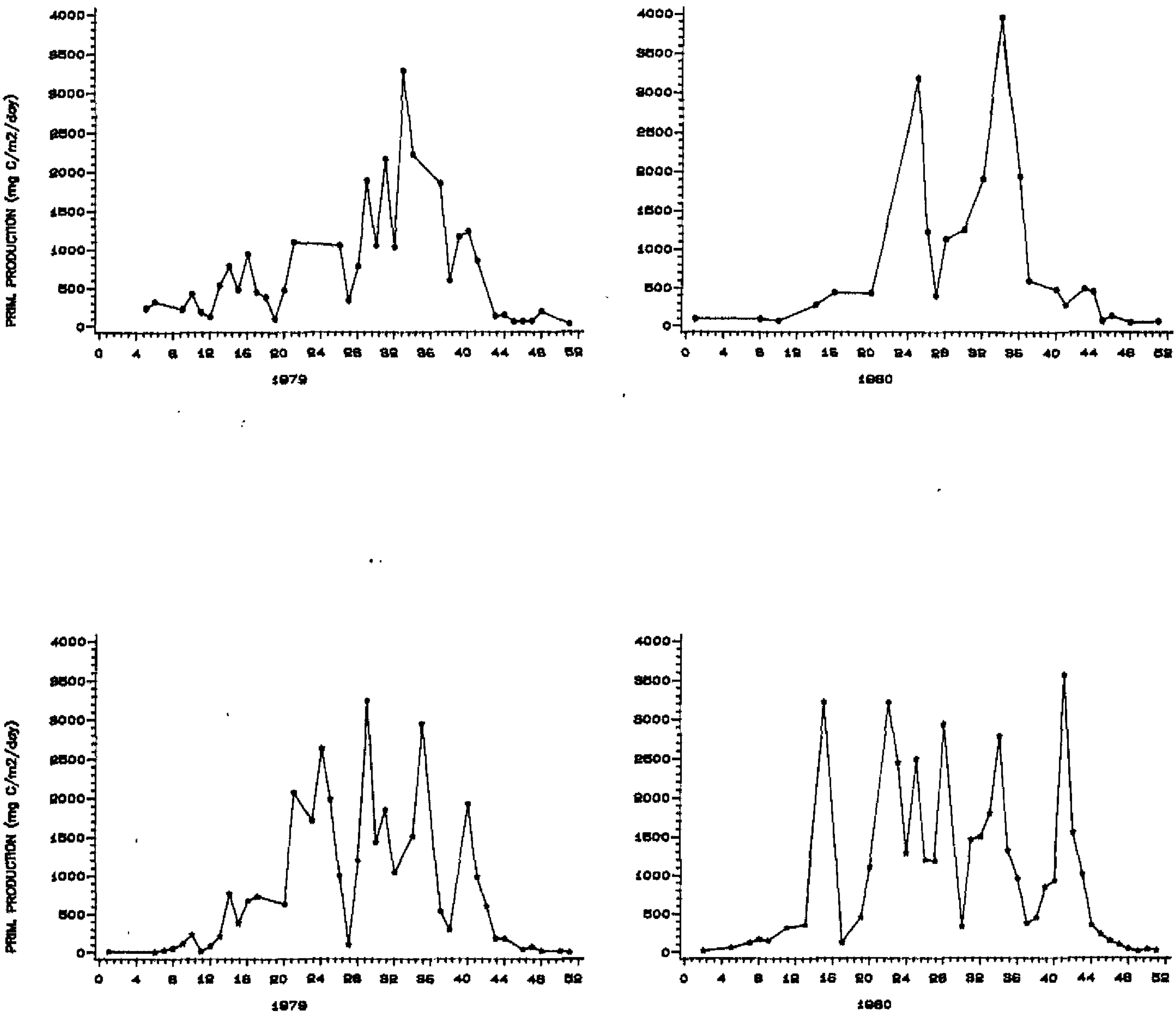


Figure 3.29

comparison of DIHO and DDMI datasets
Upper figure DDMI, lower figure DIHO
Station G11,
sometimes averaged over 2 measurements

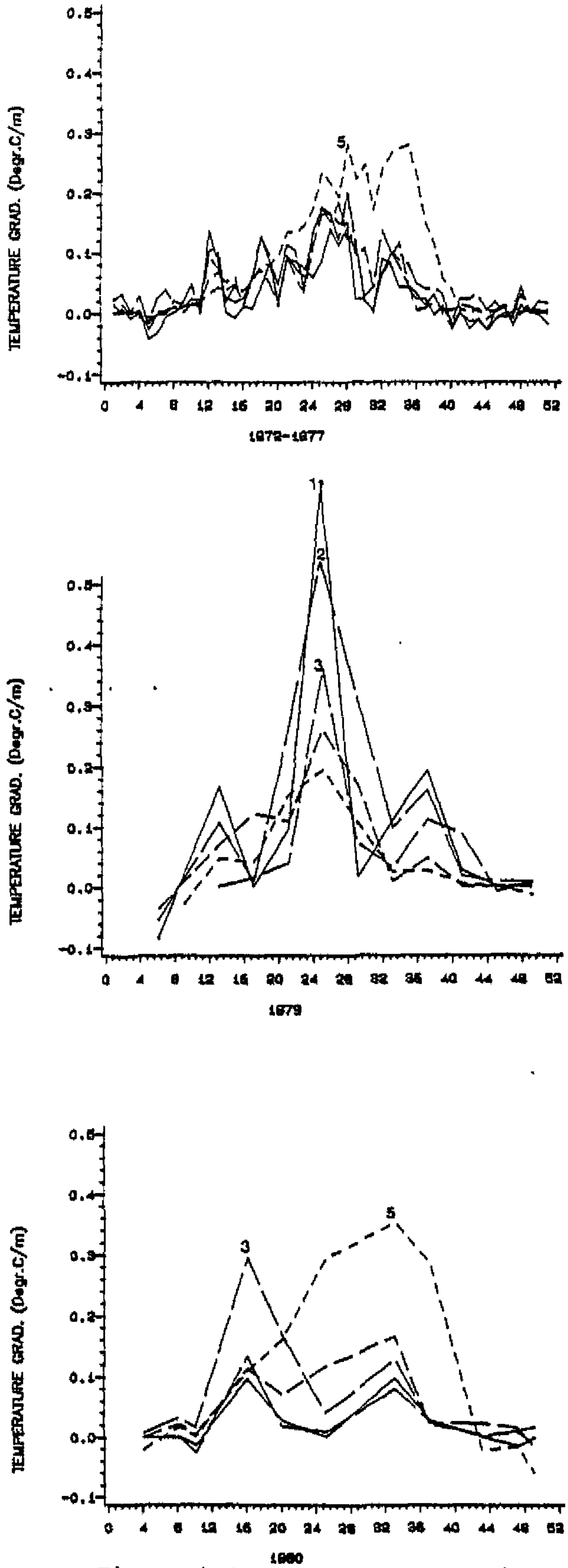


Figure 4.1: temperature gradients in degrees Celsius/m

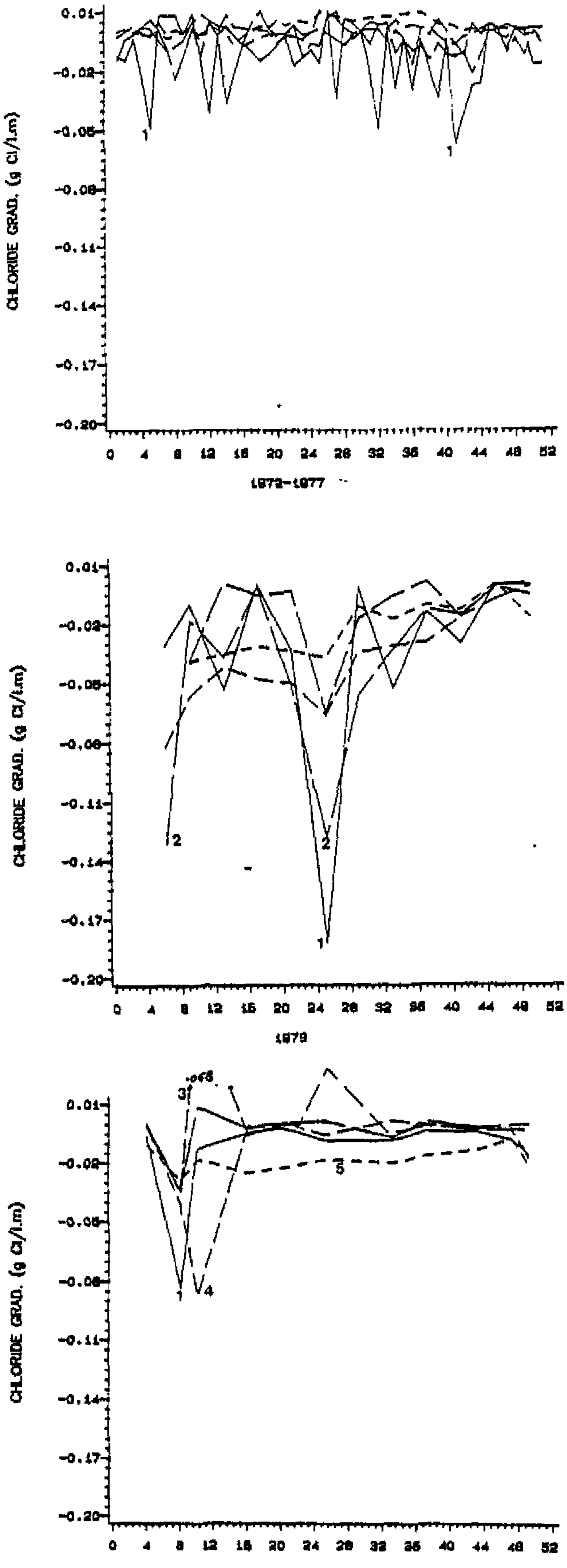
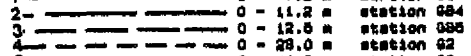


Figure 4.2: chloride gradients in g Cl/l.m

Gradients between upper waterlayer and waterlayer one meter above bottom, in 1972 - 1977 (averaged by week), 1979 and 1980 (DDMI - data)



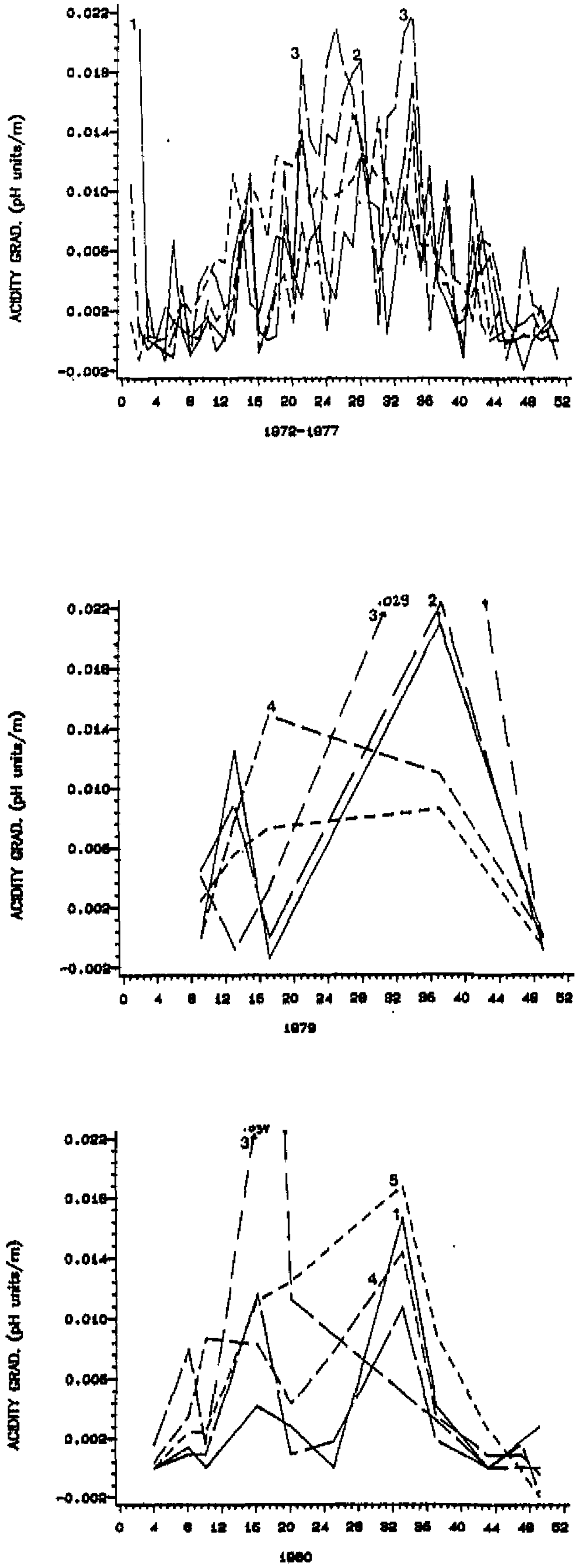


Figure 4.3: acidity gradients
in pH-units/m

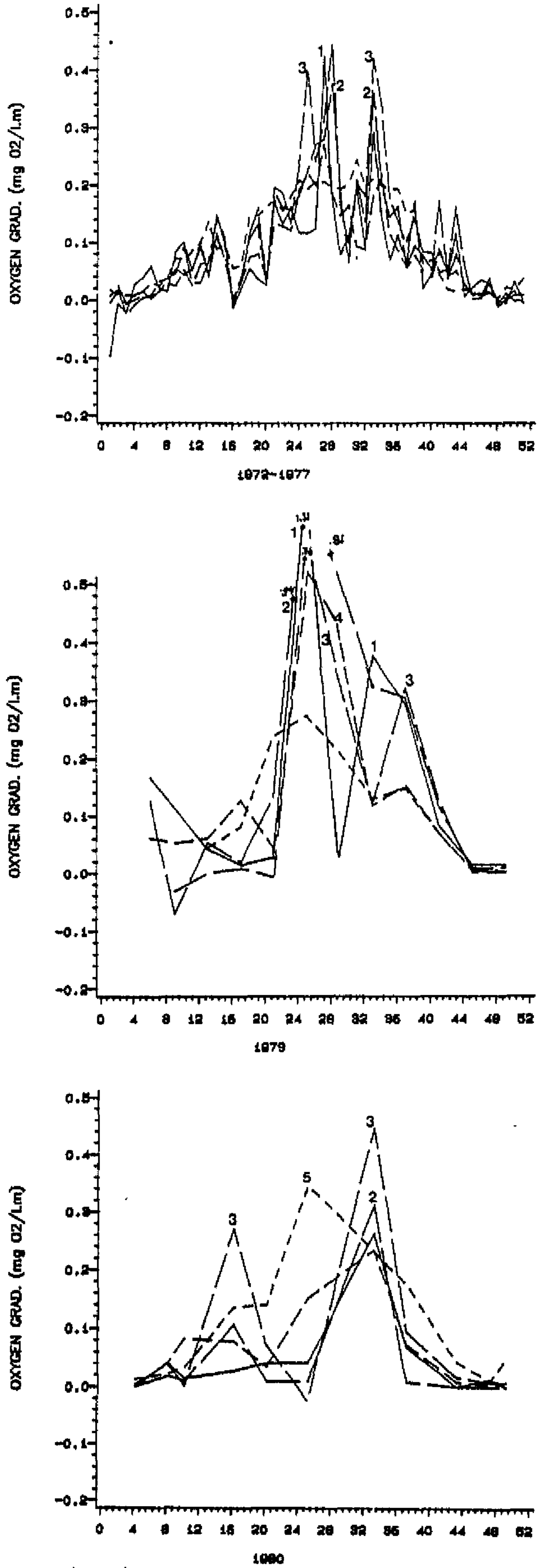
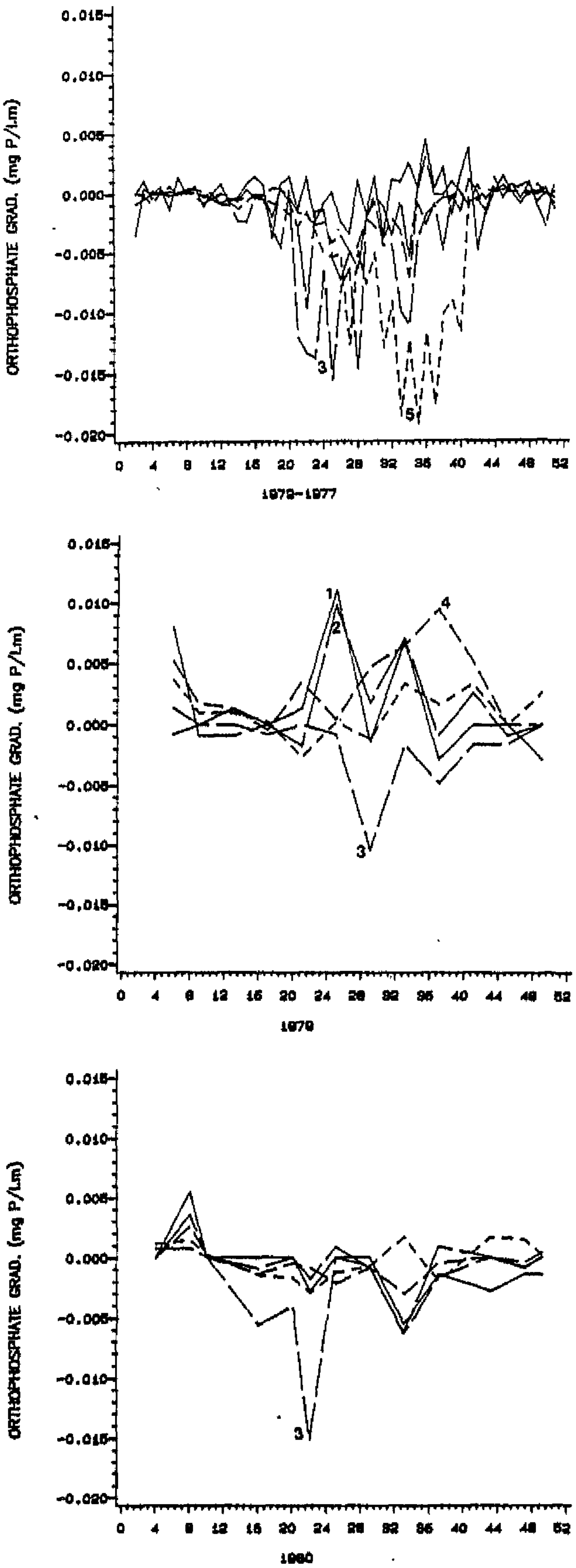
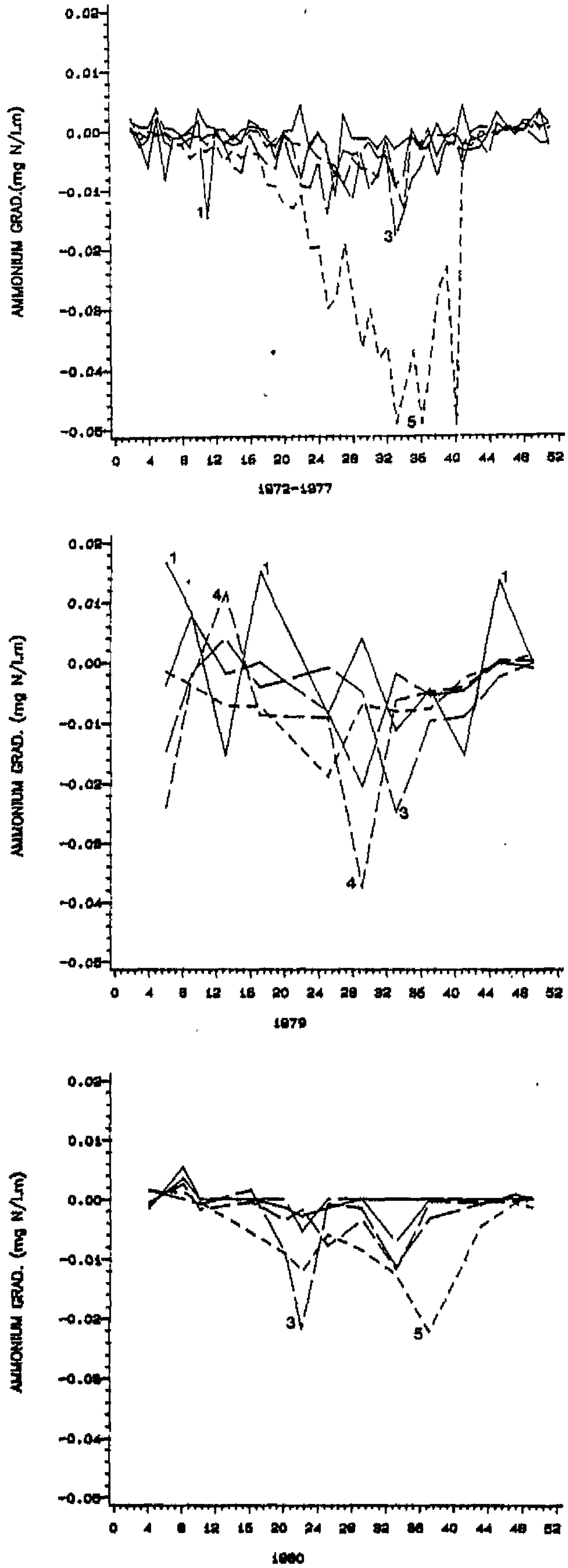


Figure 4.4: oxygen gradients
in mg O_2/l.m

Gradients between upper waterlayer and waterlayer one meter above bottom, in 1972 - 1977 (averaged by week), 1979 and 1980 (DDMI - data)

1 ———— 0 - 7.2 m station 91
2 — — 0 - 11.9 m station 984
3 — — 0 - 12.5 m station 985
4 — — 0 - 22.0 m station 92
5 - - - 0 - 41.0 m station 93

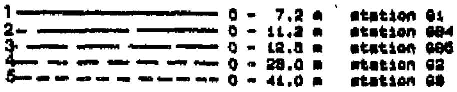




<u>Figure 4.5</u>: PO_4-gradients in mg P/l.m

<u>Figure 4.6</u>: ammonium gradients in mg N/l.m

Gradients between upper waterlayer and waterlayer one meter above bottom, in 1972 - 1977 (averaged by week), 1979 and 1980 (DDMI - data)



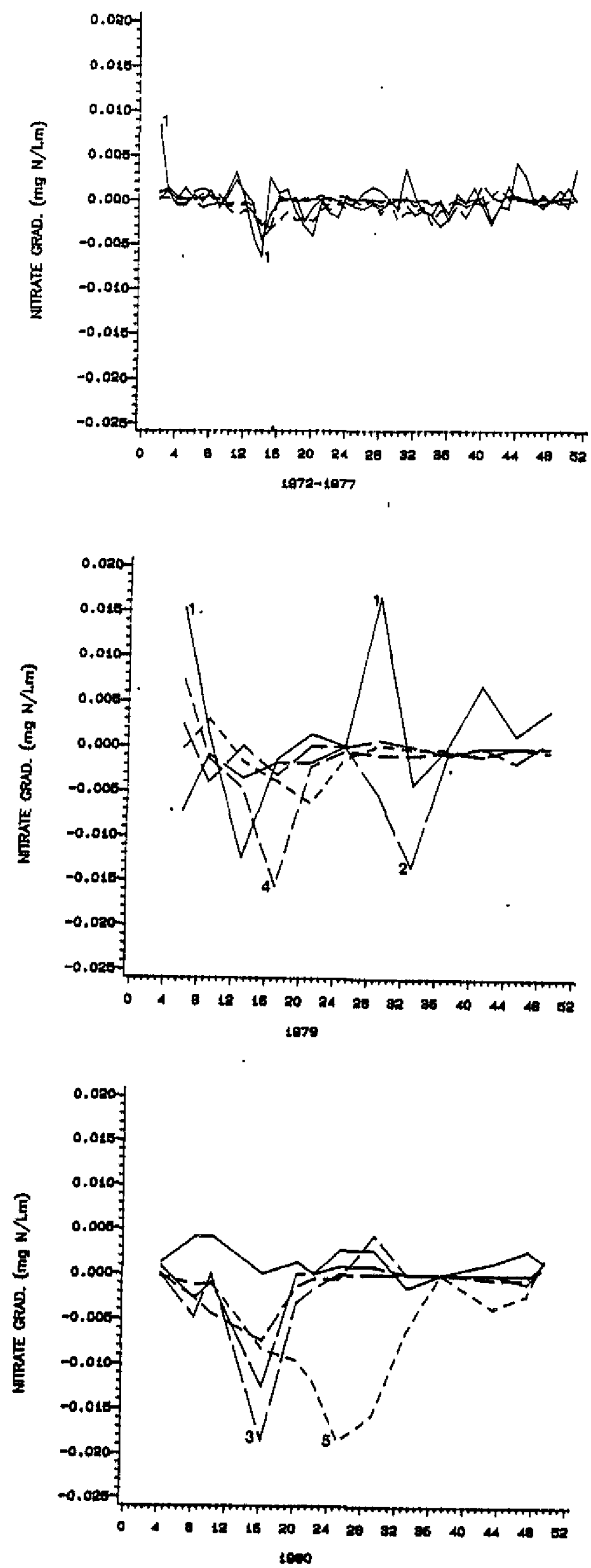


Figure 4.7: nitrate-gradients in mg N/l.m

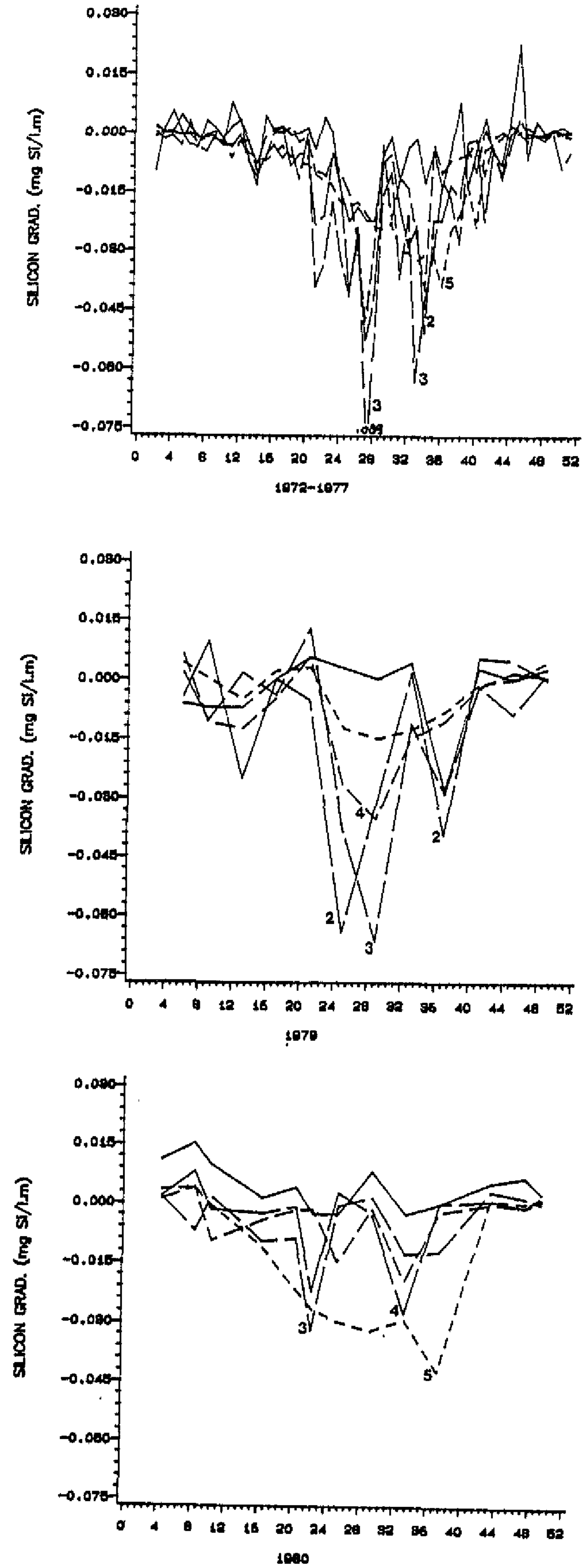


Figure 4.8: silicon-gradients in mg Si/l.m

Gradients between upper waterlayer and waterlayer one meter above bottom, in 1972 - 1977 (averaged by week), 1979 and 1980 (DDMI - data)

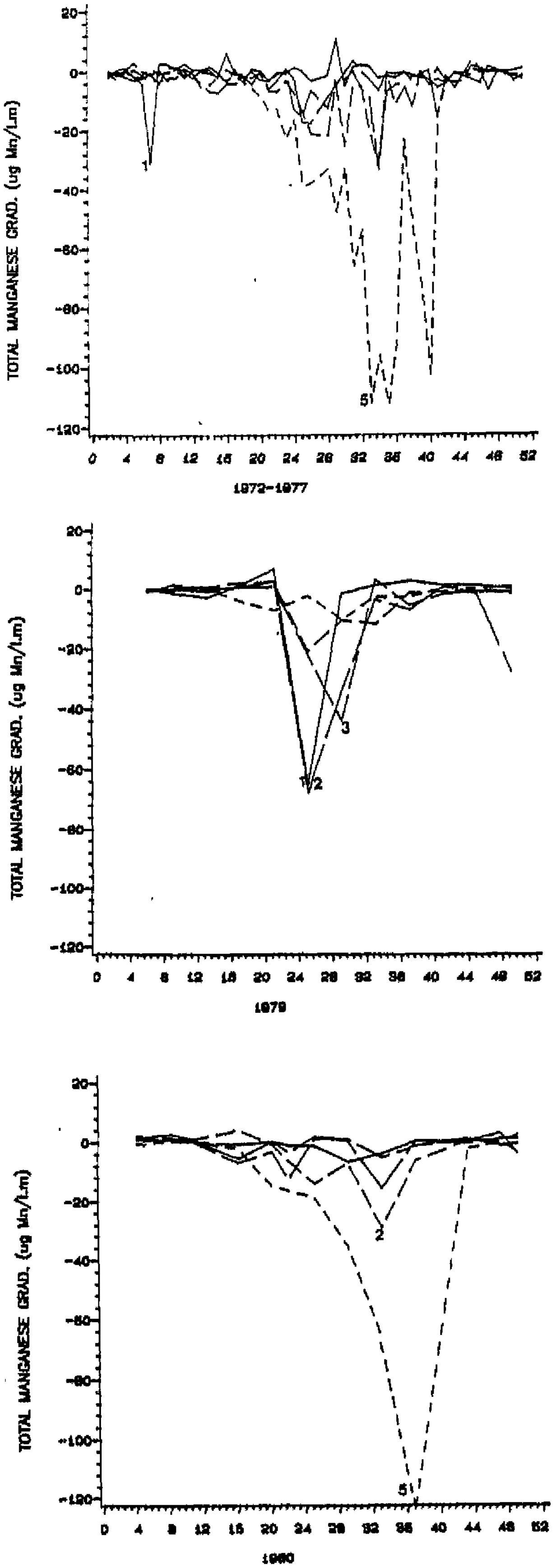


Figure 4.9: total-manganese gradients in mg $Mn/m^3.m$

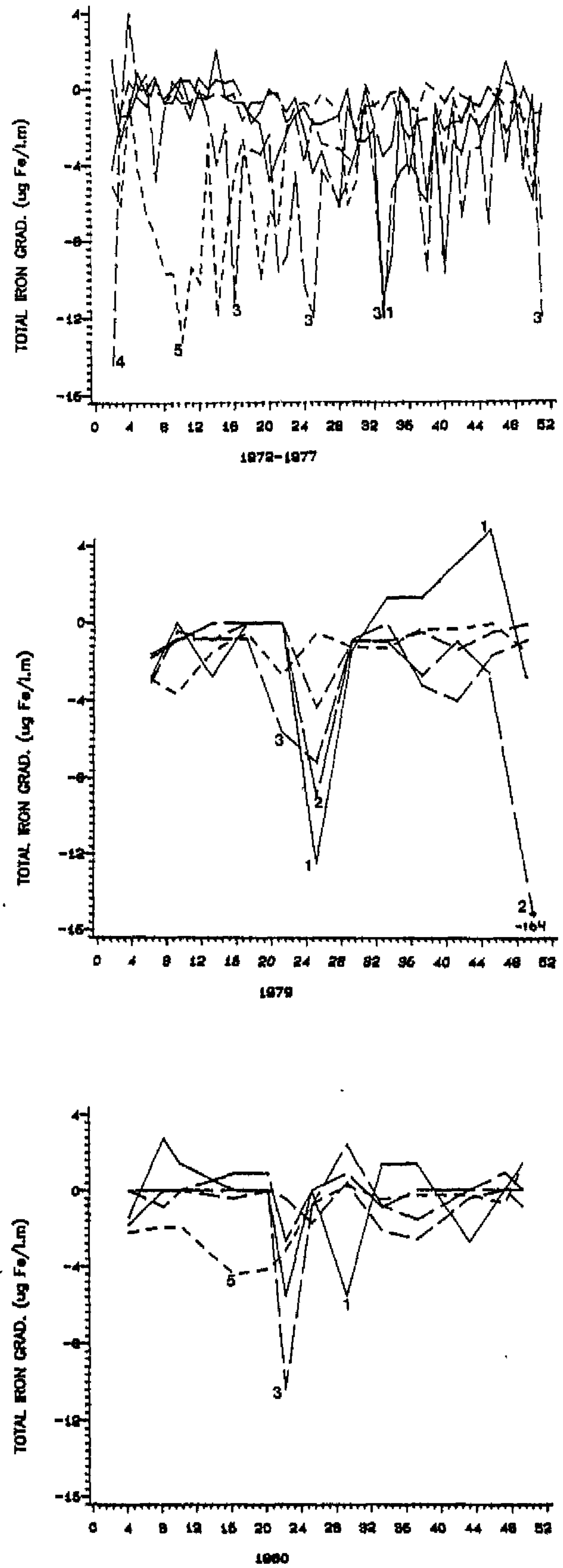
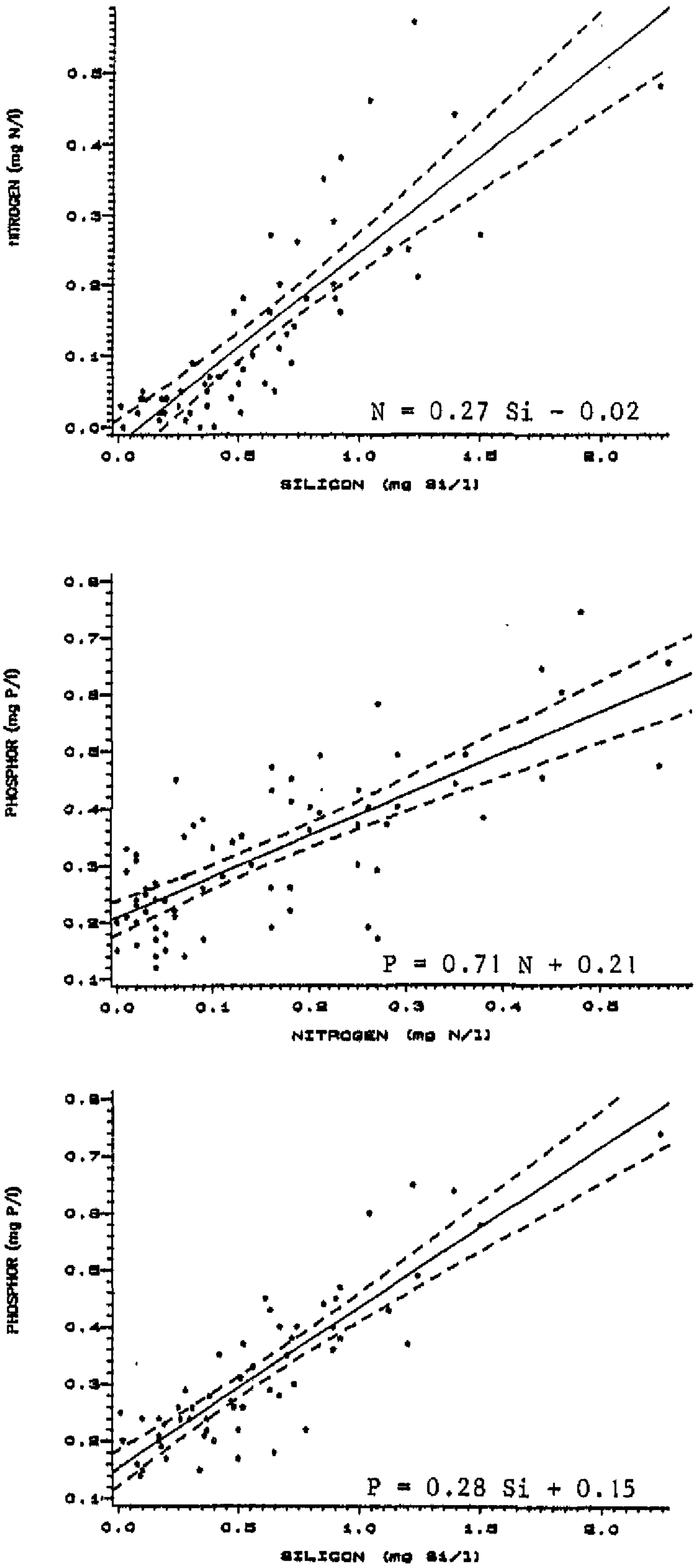
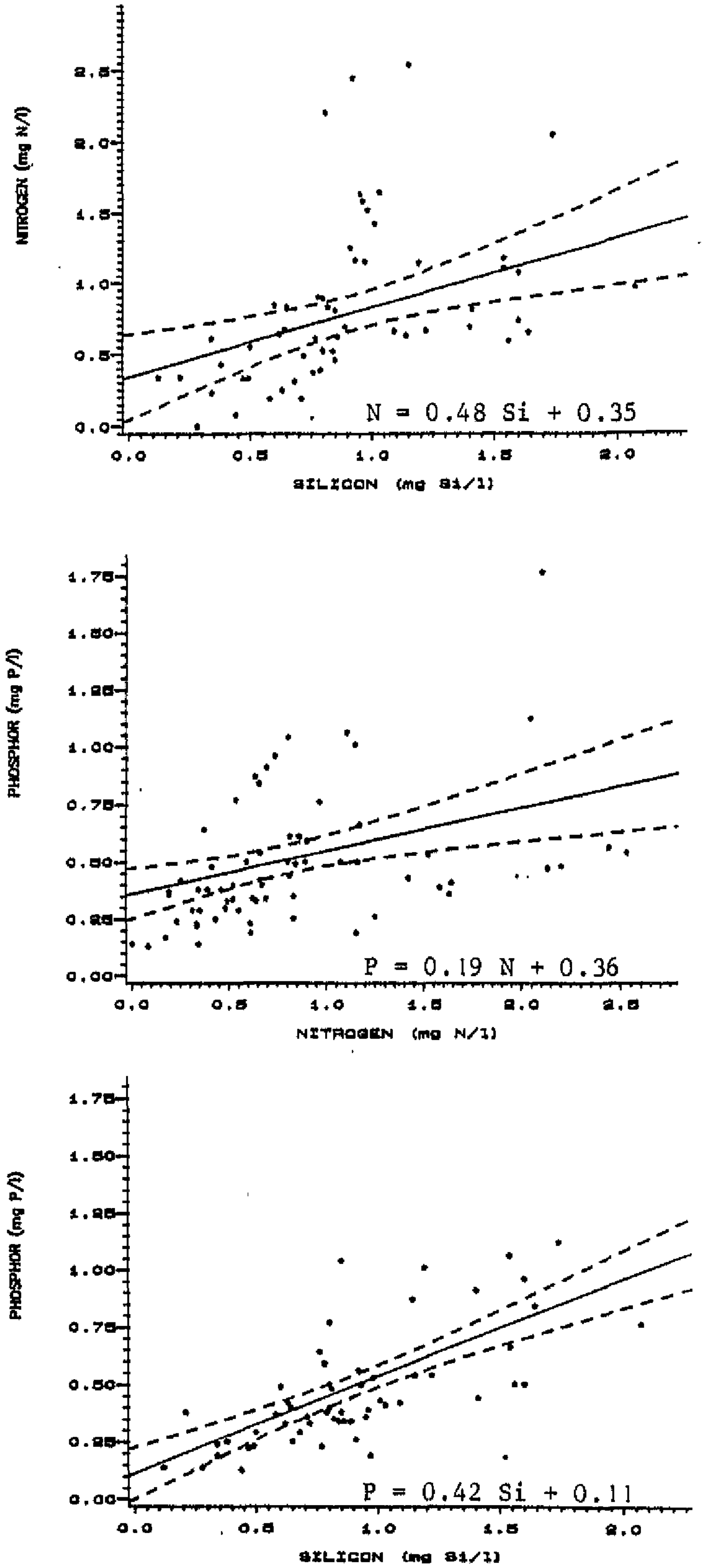


Figure 4.10: total-iron gradients in mg $Fe/m^3.m$

Gradients between upper waterlayer and waterlayer one meter above bottom, in 1972 - 1977 (averaged by week), 1979 and 1980 (DDMI - data)

1 —— 0 - 7.2 m station 91
2 —— 0 - 11.2 m station 884
3 —— 0 - 12.5 m station 886
4 —— 0 - 29.0 m station 92
5 —— 0 - 41.0 m station 93





<u>Figure 4.11</u>

Station G2 and GB6 (depth 23 and 28 m.)

<u>Figure 4.12</u>

Station G3 and GB7 (depth 41, 37 m.)

Linear regression of dissolved nutrients (DDMI data), from 1972-1977 (week 20-28), with 95 % confidence intervals.

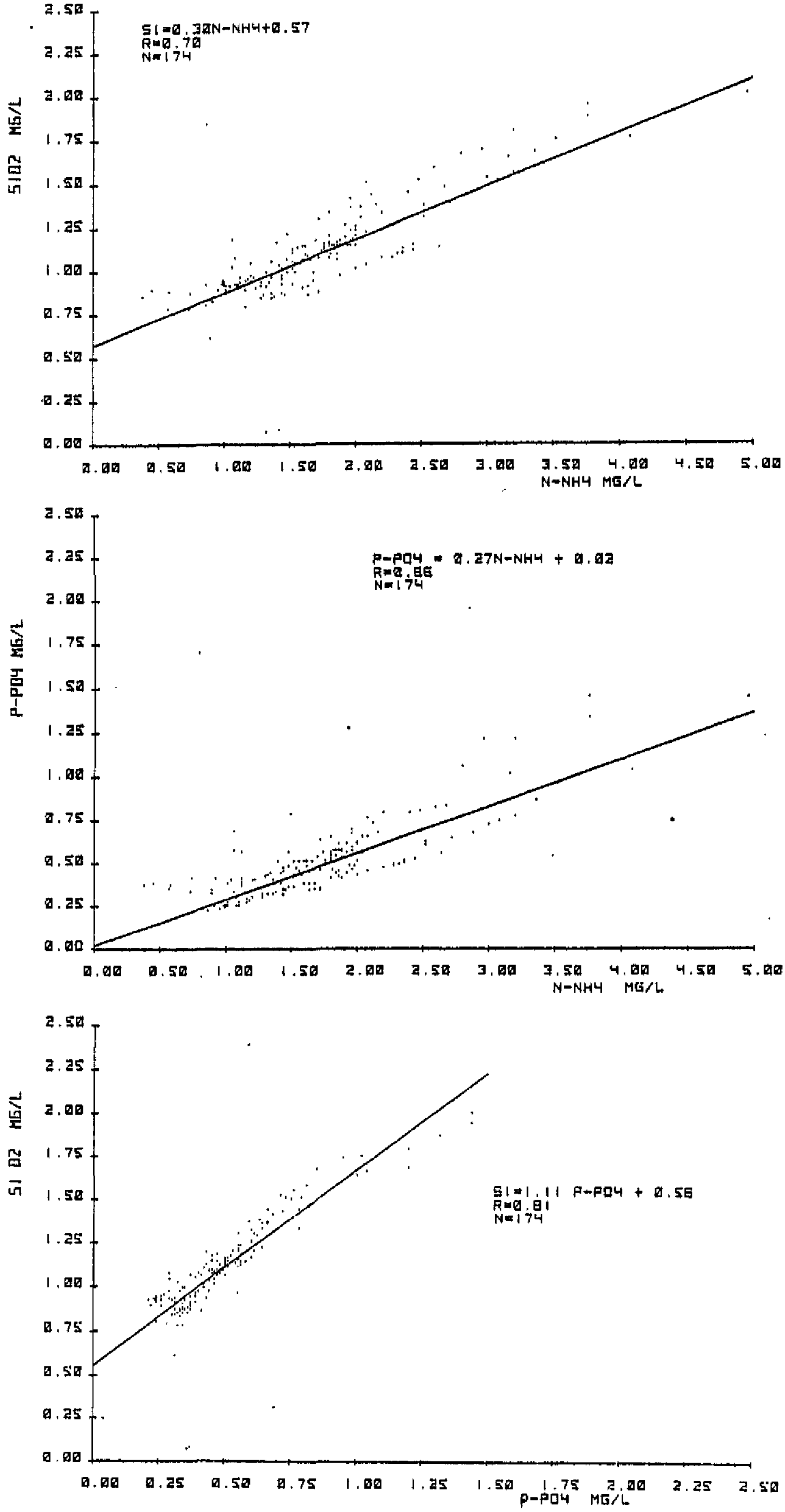


Figure 4.13

Linear regression of dissolved nutrients in the anoxic hypolimnion, station G3, 1973-1974 (Van der Meulen, unpublished)

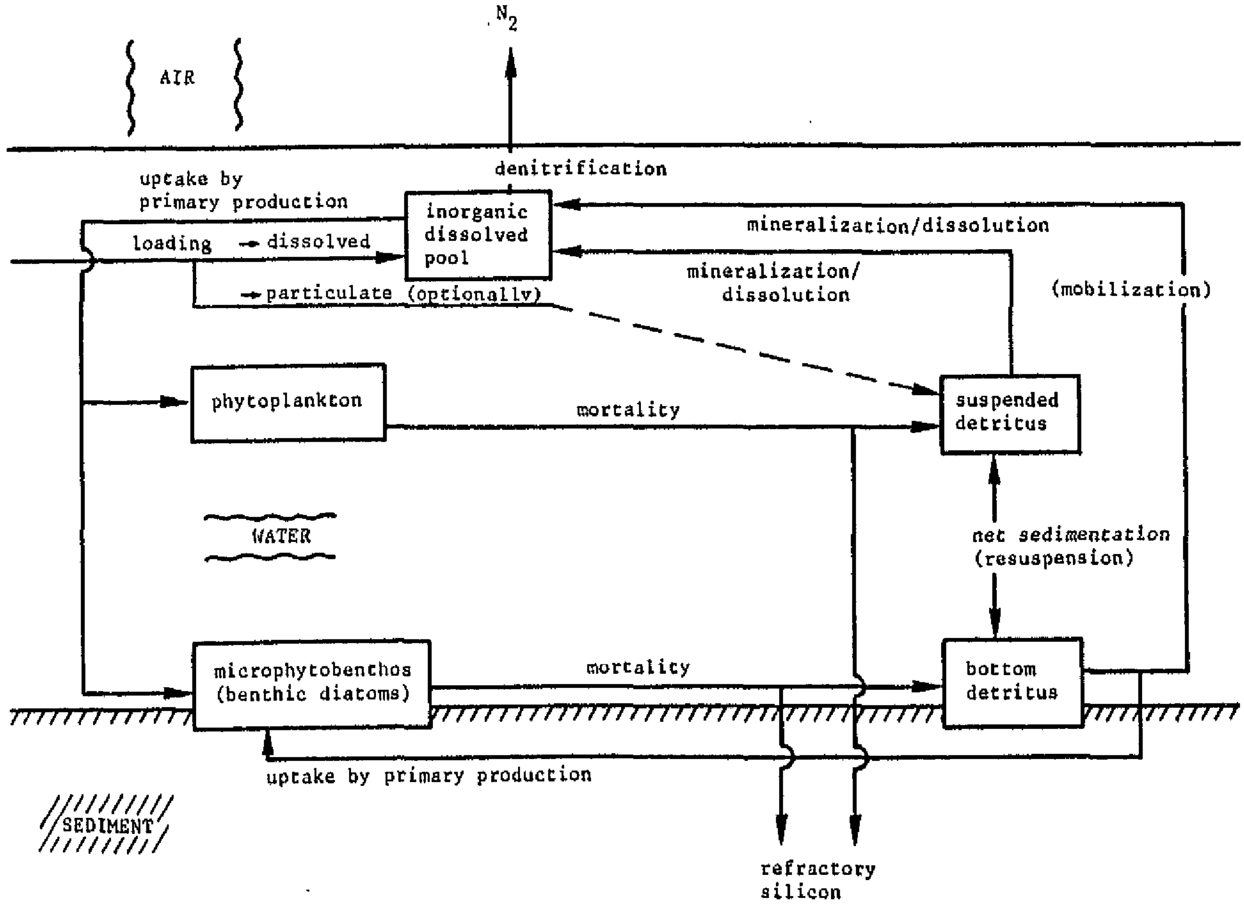


Figure 5.1: Scheme of nutrient balance calculations

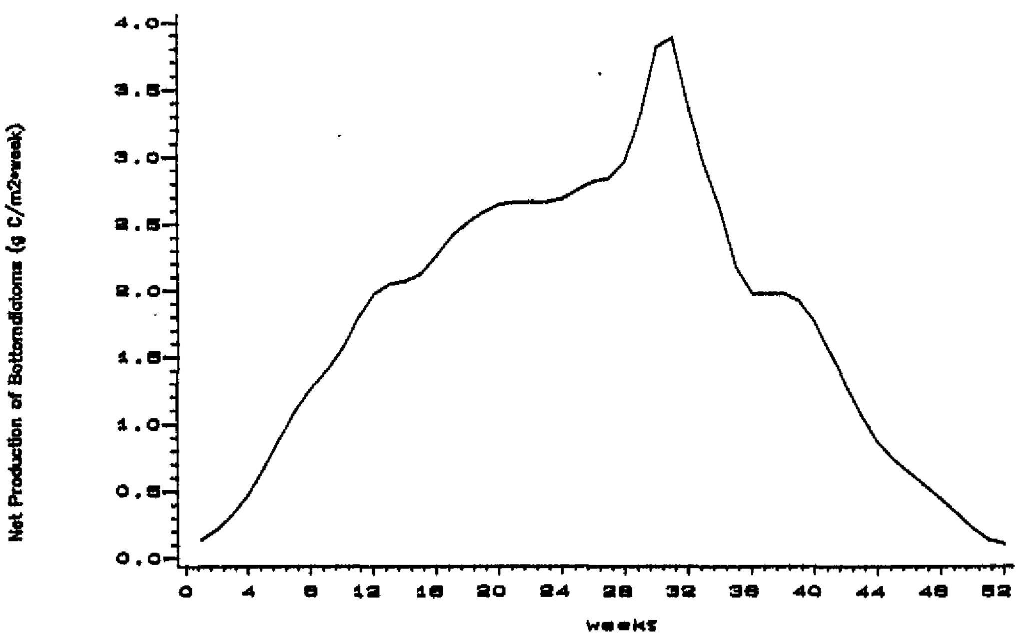


Figure 5.2

'The standard net production curve' of bottom diatoms used as input for the balance calculations, for the whole period of four years (1977-1980)

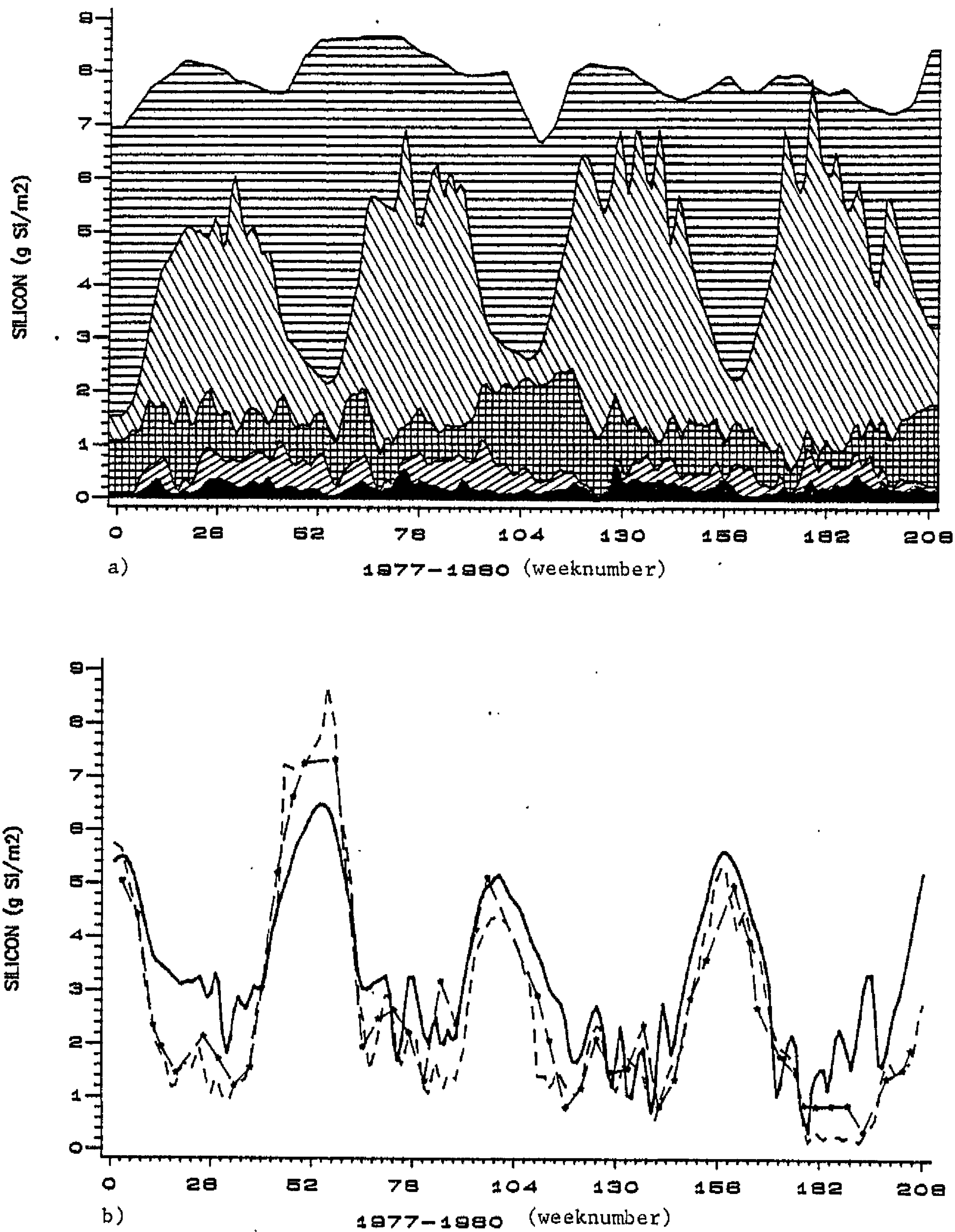


Figure 5.3 (DIHO phytoplankton production data)

a) Silicon balance, calibration run

b) Comparison of the calculated dissolved inorganic pool with measurements

Dissolved

Bottom detritus

Bottom diatoms

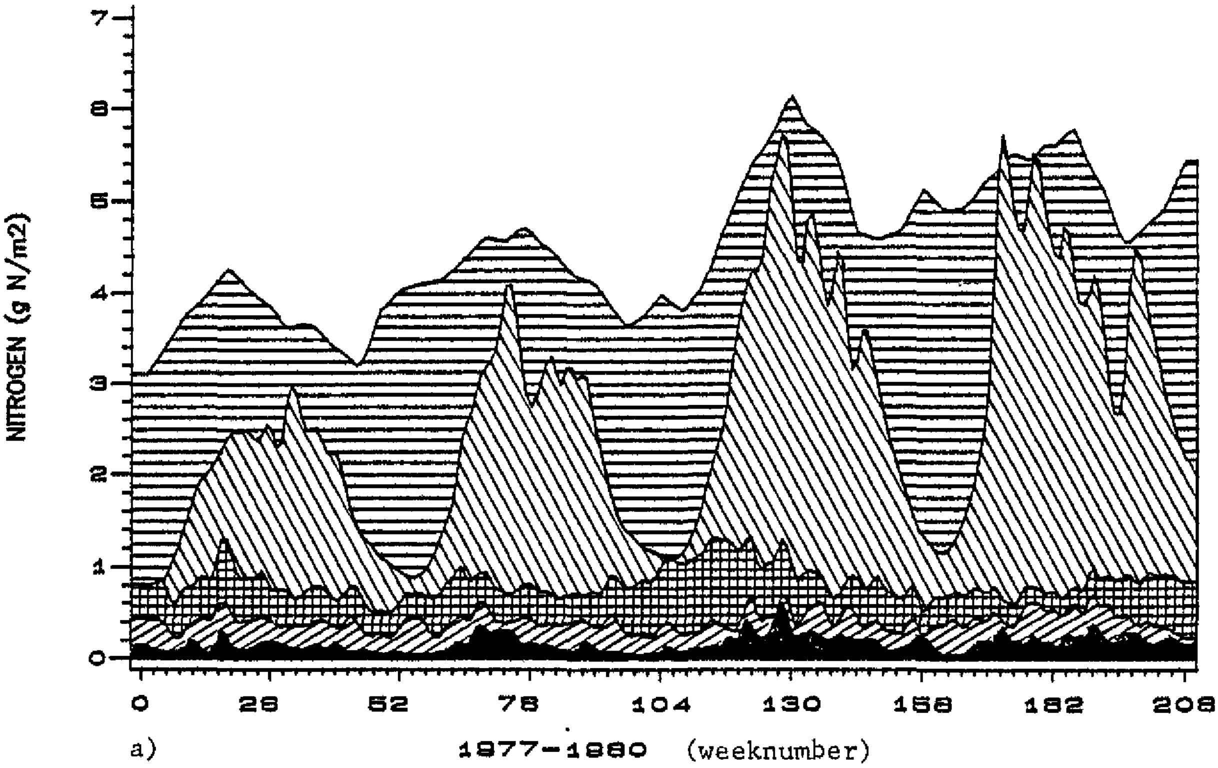
Suspended detritus

Phytoplankton

Calculated (dissolved)

Measured by DDMI (surface, 7 stations)

Measured by DIHO (surface)



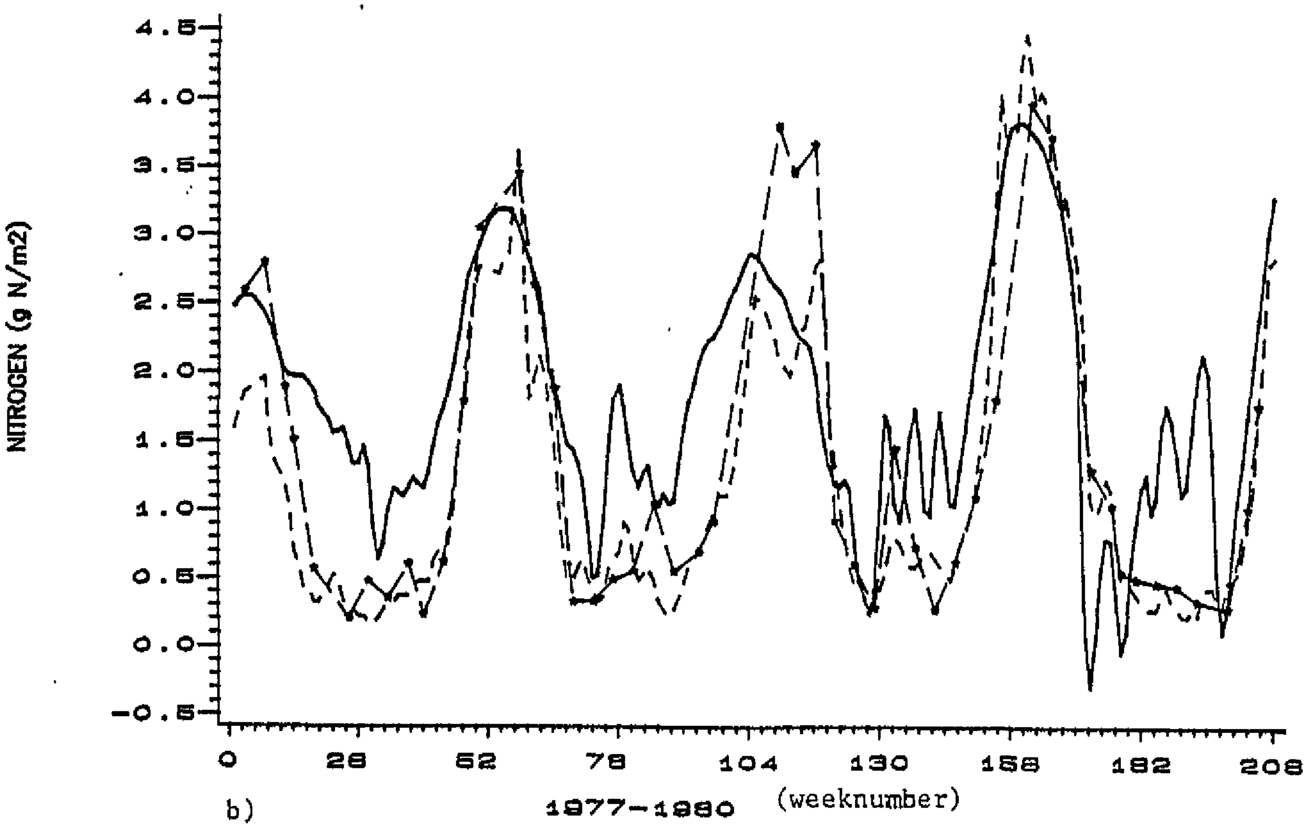
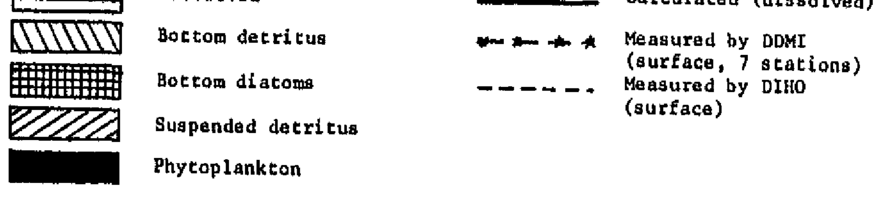
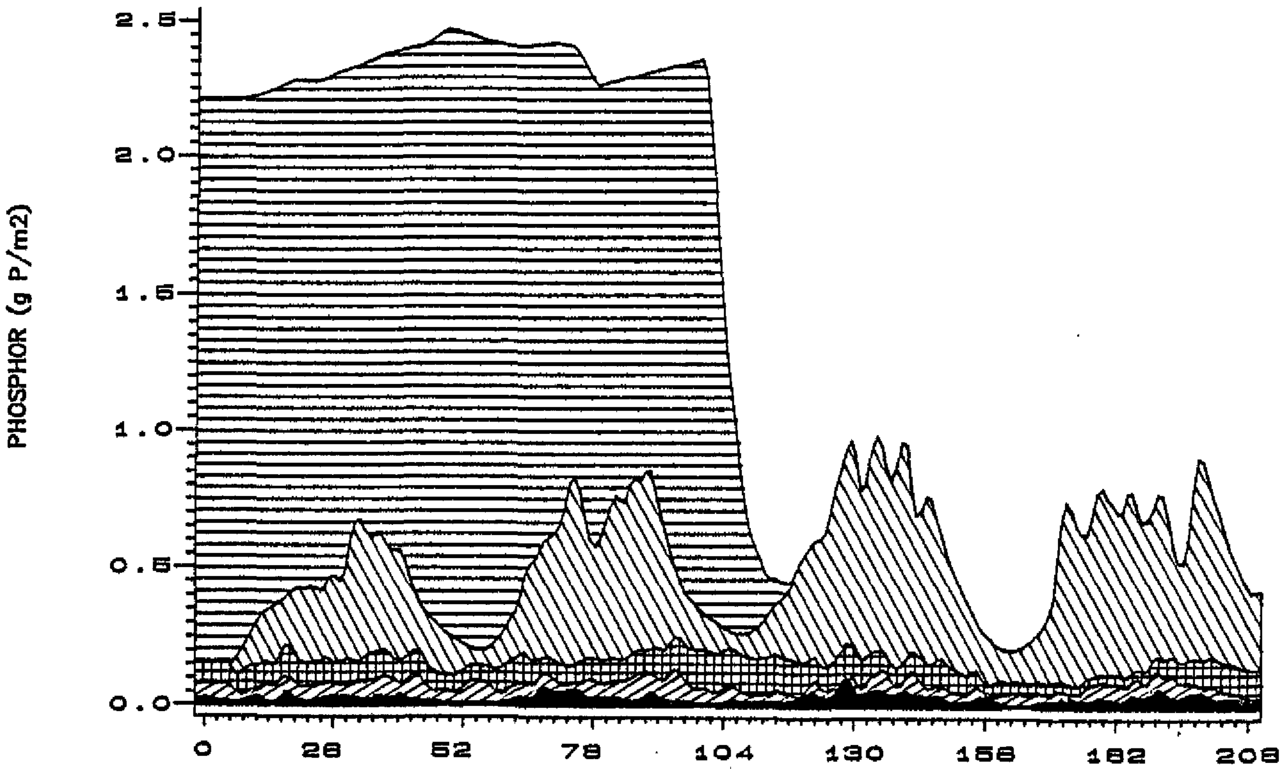


Figure 5.4 (DIHO phytoplankton production data)

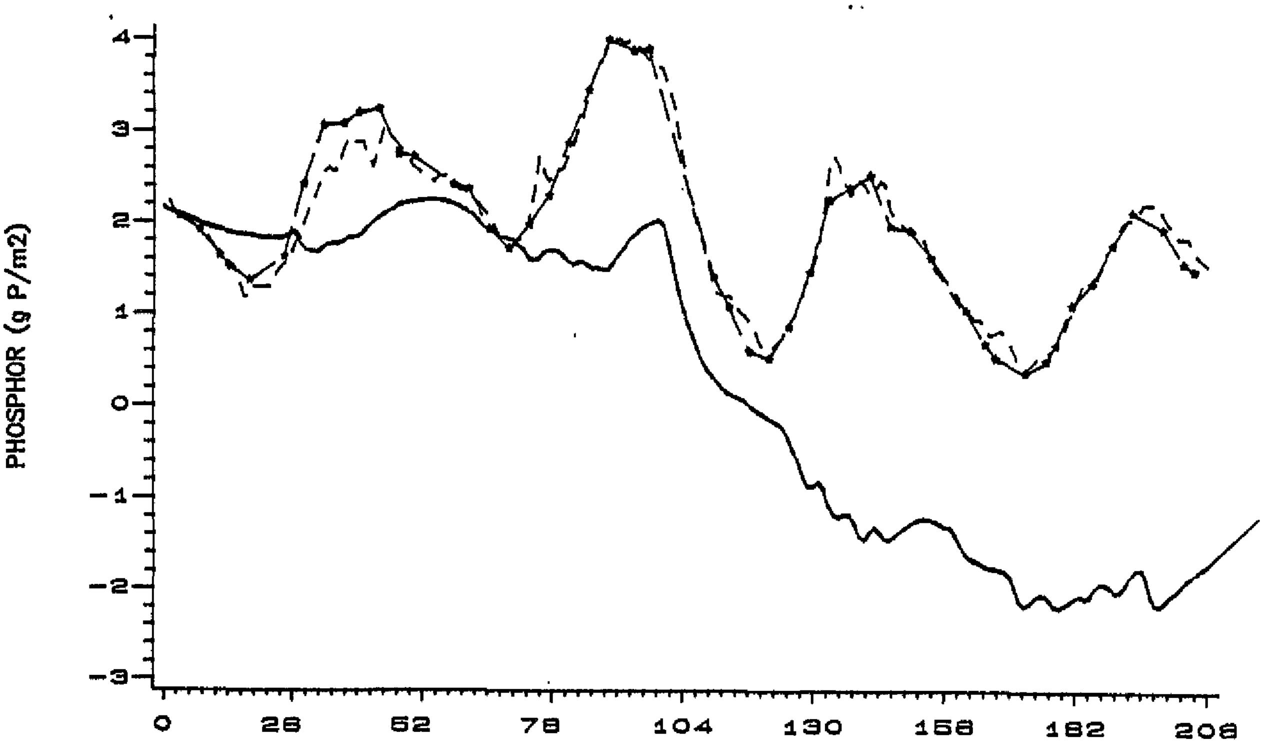
a) Nitrogen balance, calibration run

b) Comparison of the calculated dissolved inorganic pool with measurements





a) 1977–1980 (weeknumber)

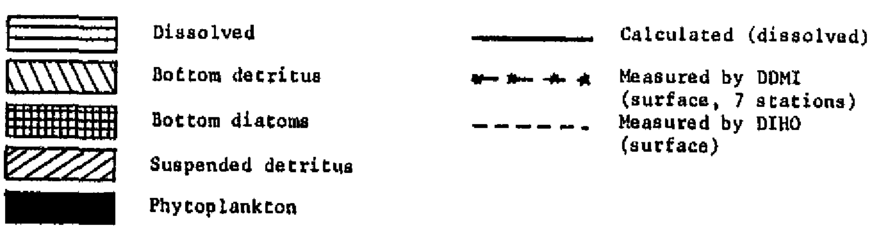


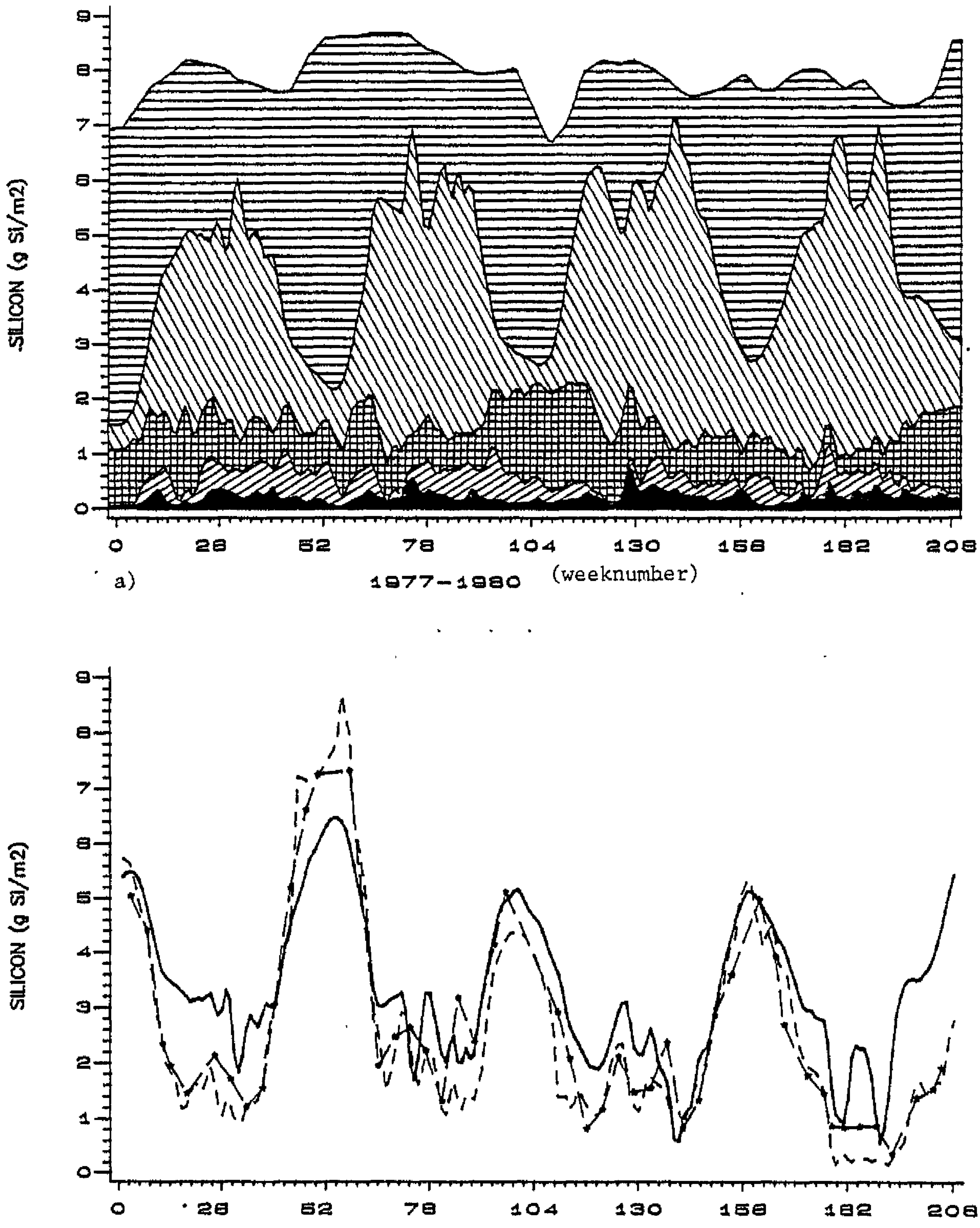
b) 1977–1980 (weeknumber)

Figure 5.5 (DIHO phytoplankton production data)

a) Phosphor balance, calibration run

b) Comparison of the calculated dissolved inorganic pool with measurements

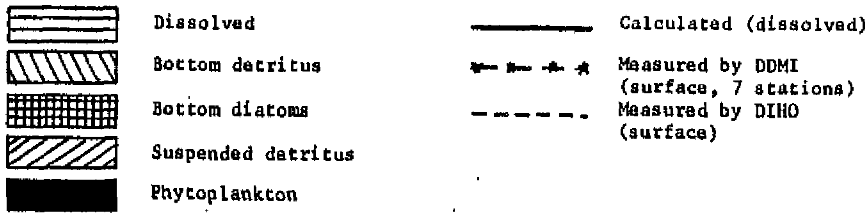




<u>Figure 5.6</u> (phytoplankton production data DIHO (77-78) DDMI (79-80)

a) Silicon balance, calibration run

b) Comparison of the calculated dissolved inorganic pool with measurements



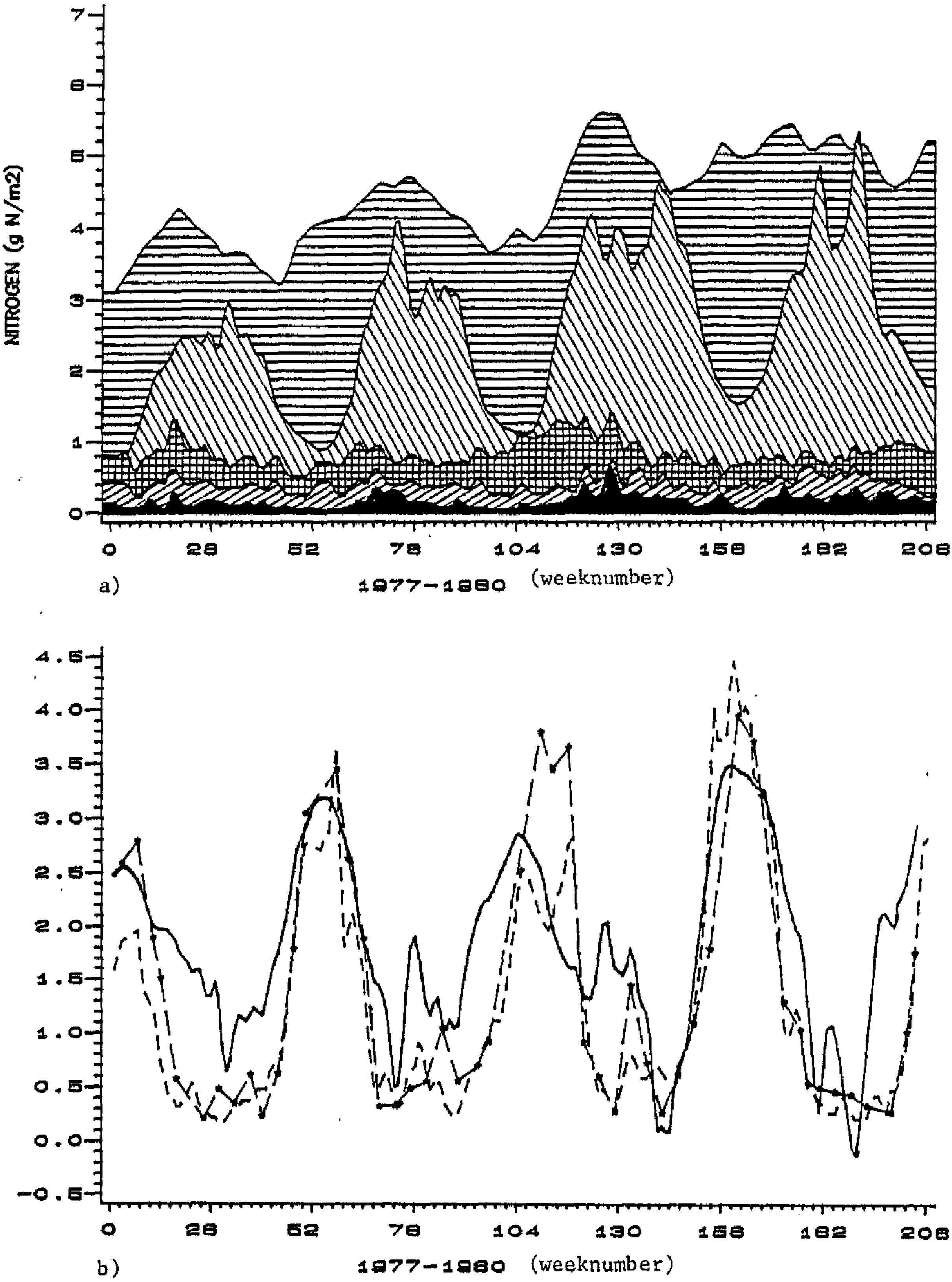
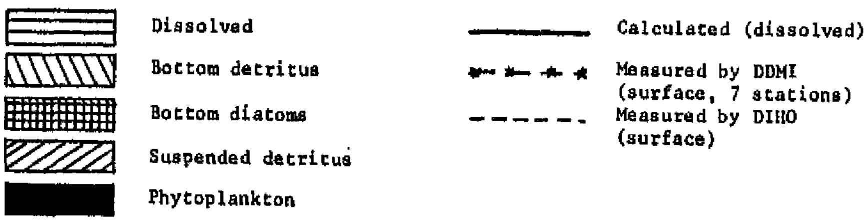


Figure 5.7 (phytoplankton production data DIHO (77-78) DDMI (79-80)

a) Nitrogen balance, calibration run

b) Comparison of the calculated dissolved inorganic pool with measurements



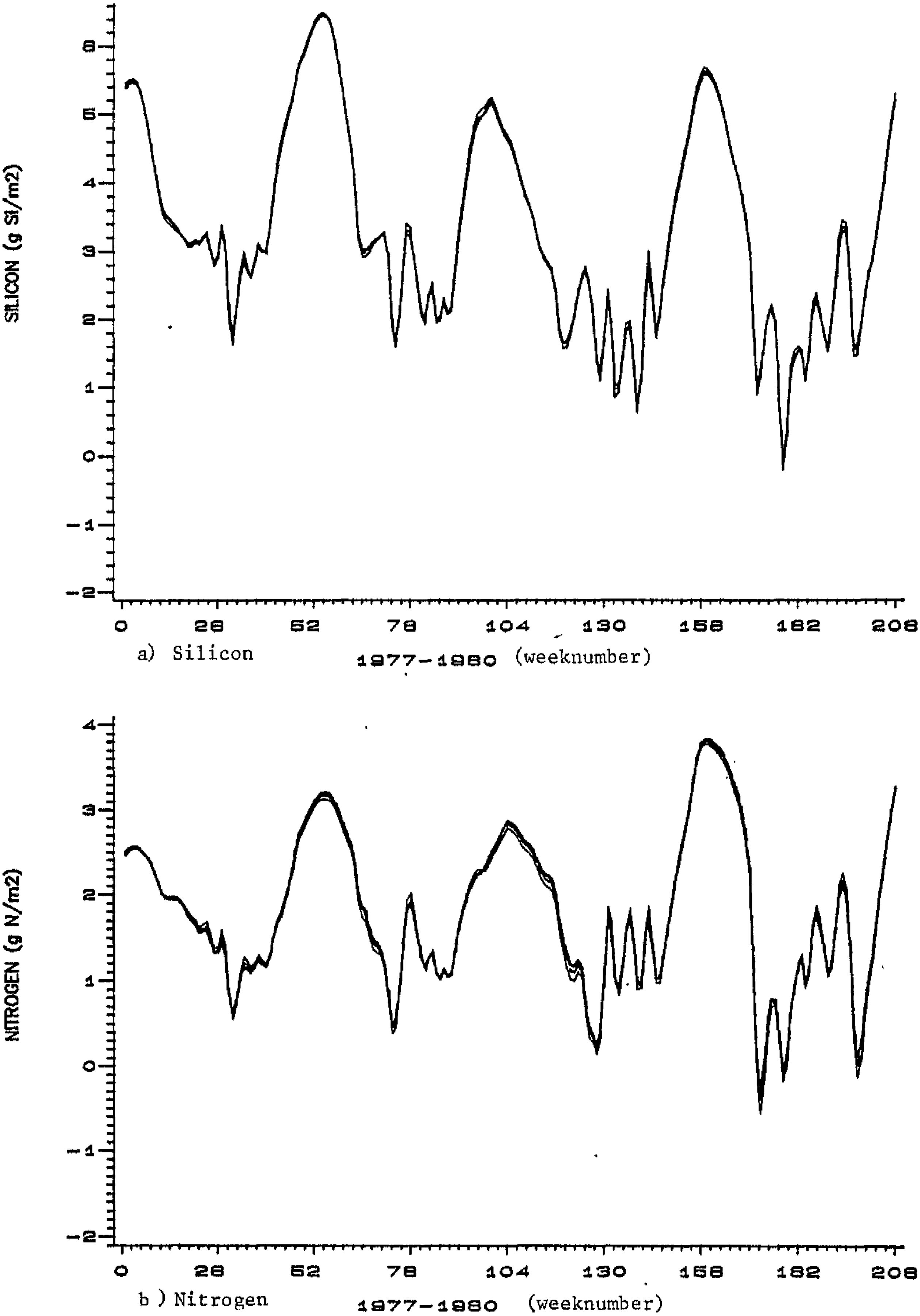
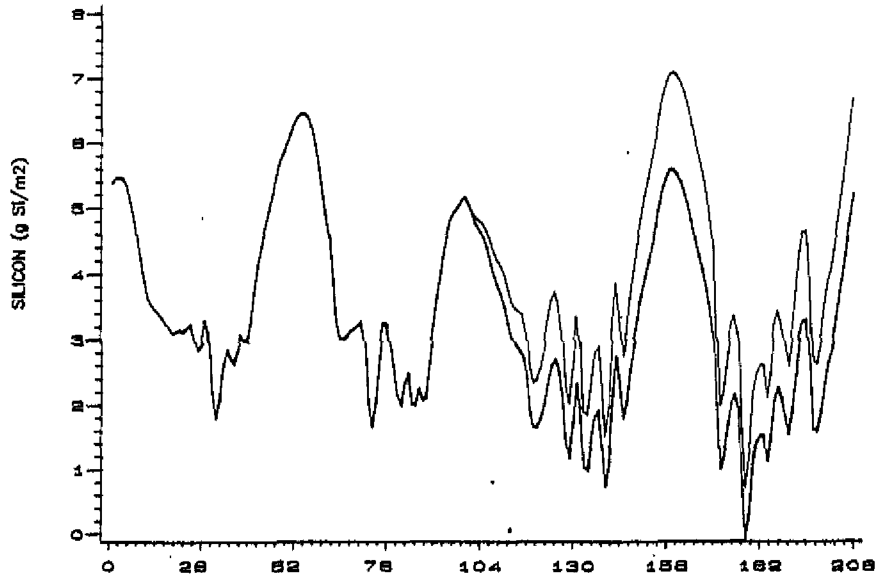


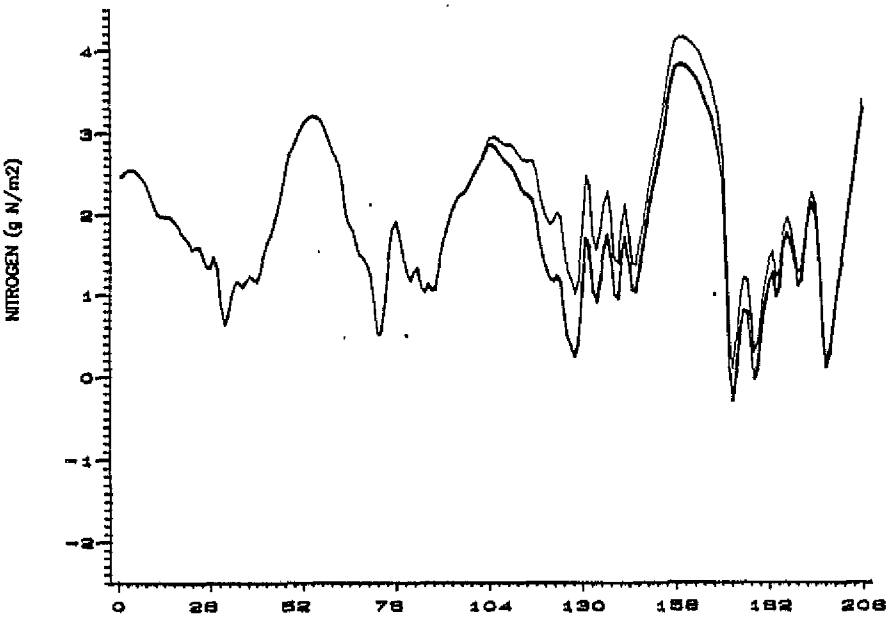
Figure 5.8

Modelresults for different timesteps (Δt)

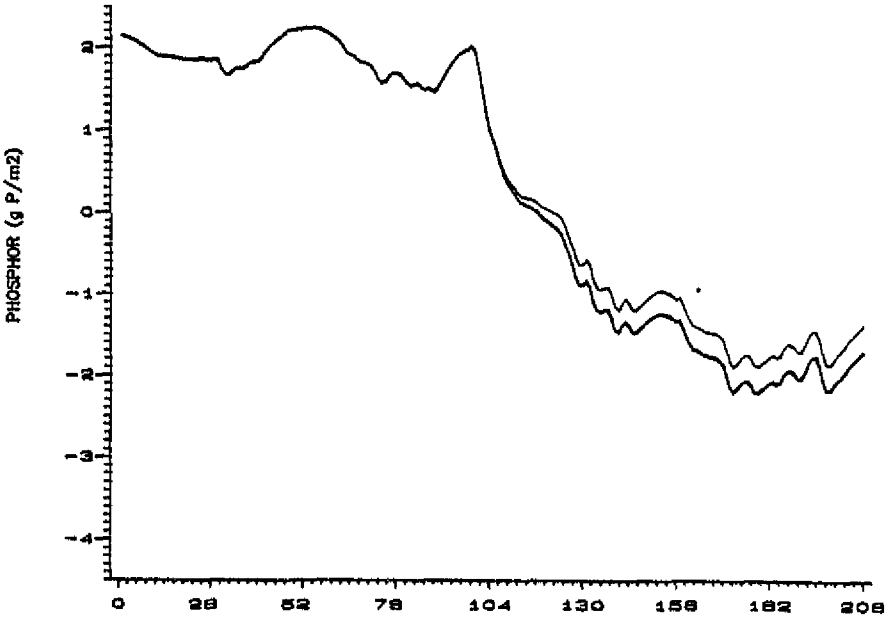
calibration run Δt = 1.0 day
Δt = 7.0 day
Δt = 3.5 day
Δt = 0.1 day



a) Silicon 1977-1980 (weeknumber)



b) Nitrogen 1977-1980 (weeknumber)

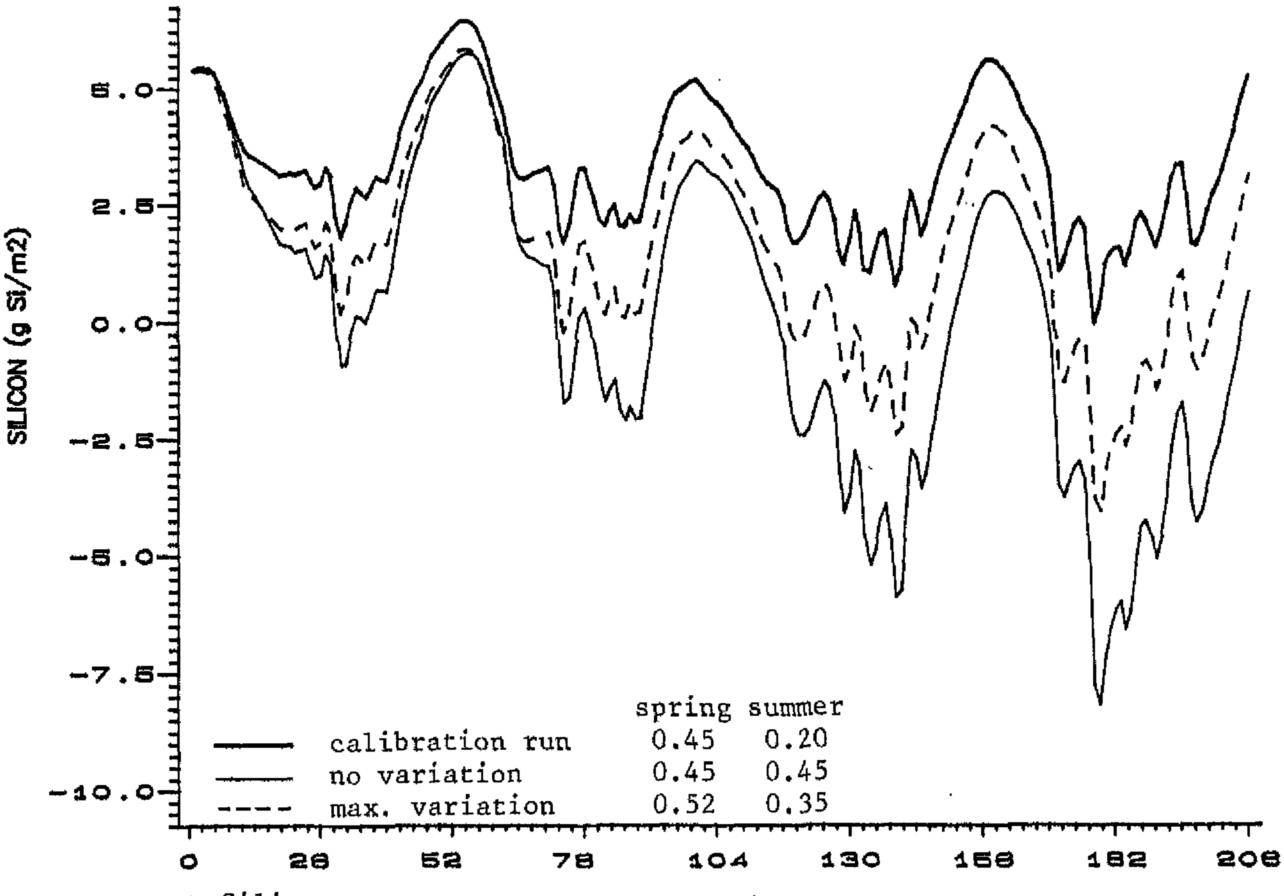


c) Phosphor 1977-1980 (weeknumber)

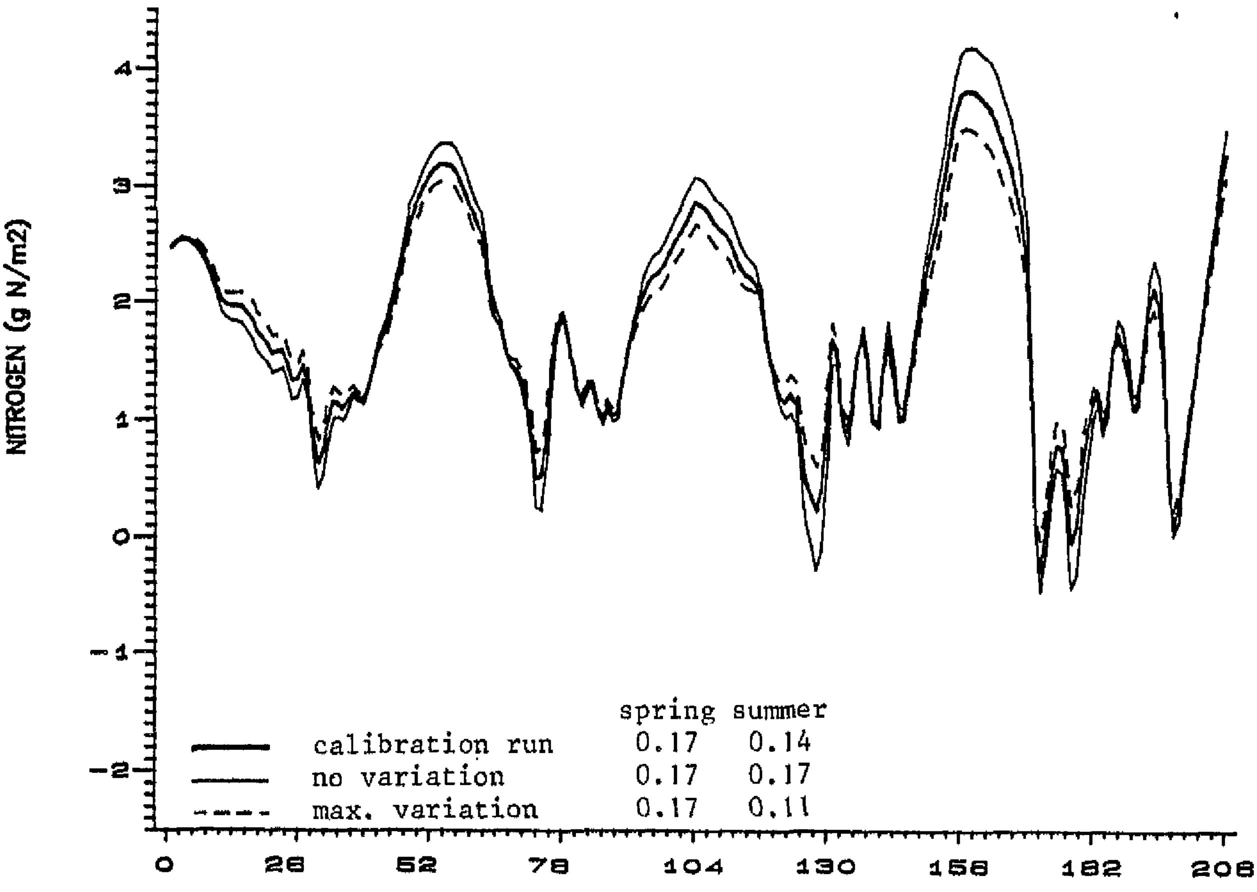
Figure 5.9
Influence of imported particulate organic matter (BCN) on modelresults

calibration

import of particulate organic matter incorporated



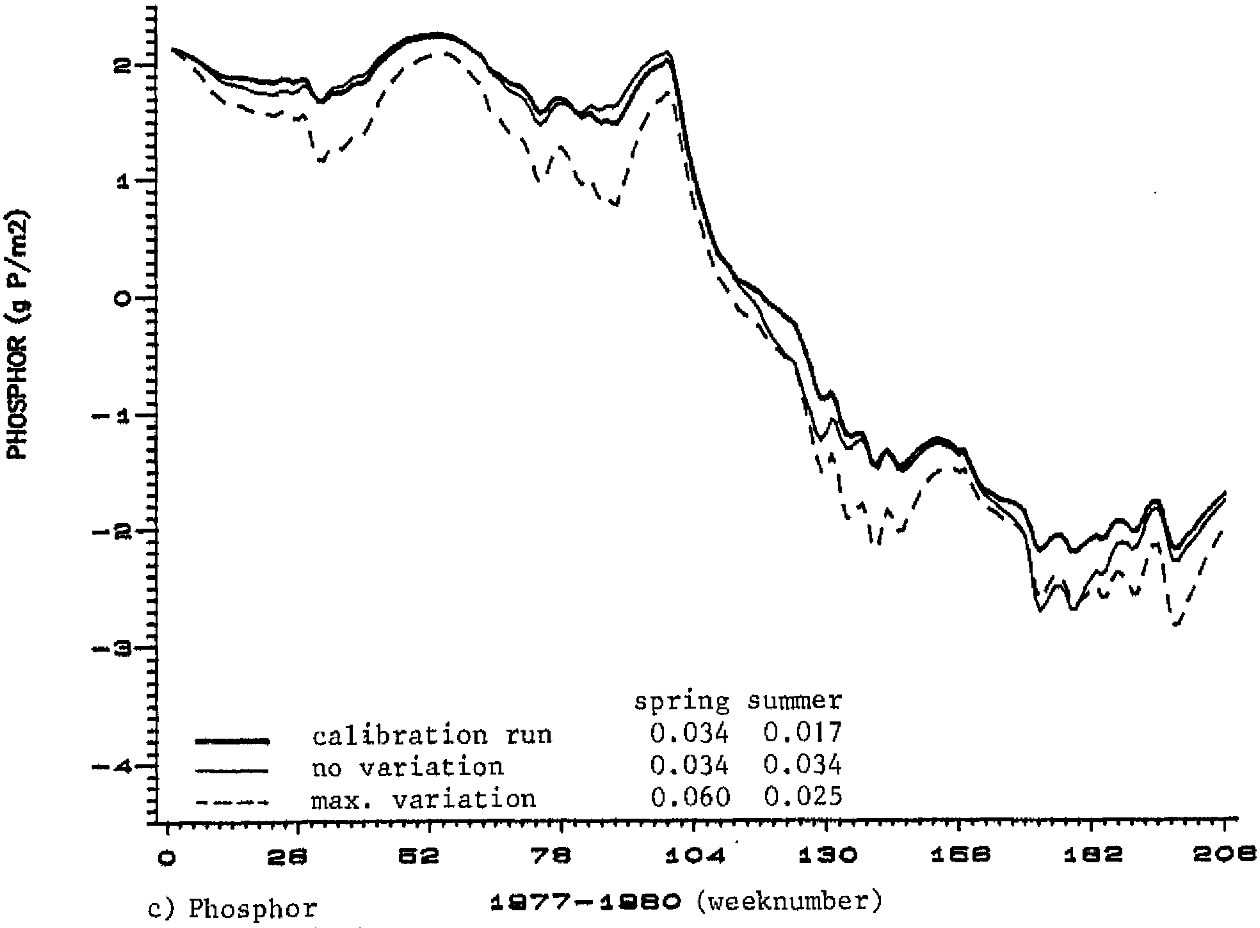
a) Silicon



b) Nitrogen

Figure 5.10 a) en b)

Model results for different values of stoichiometric coefficients



c) Phosphor

Figure 5.10 c)
Model results for different values of stoichiometric coefficients

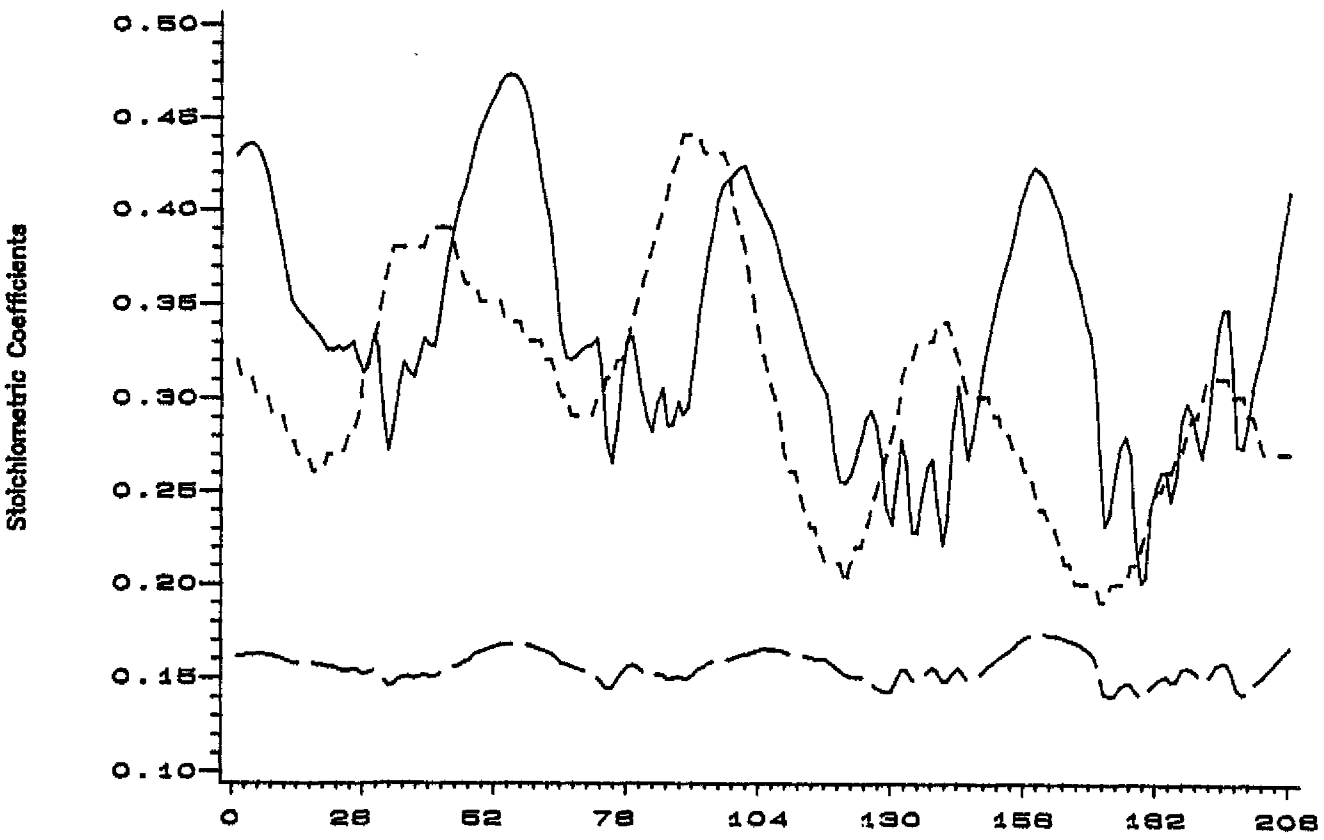
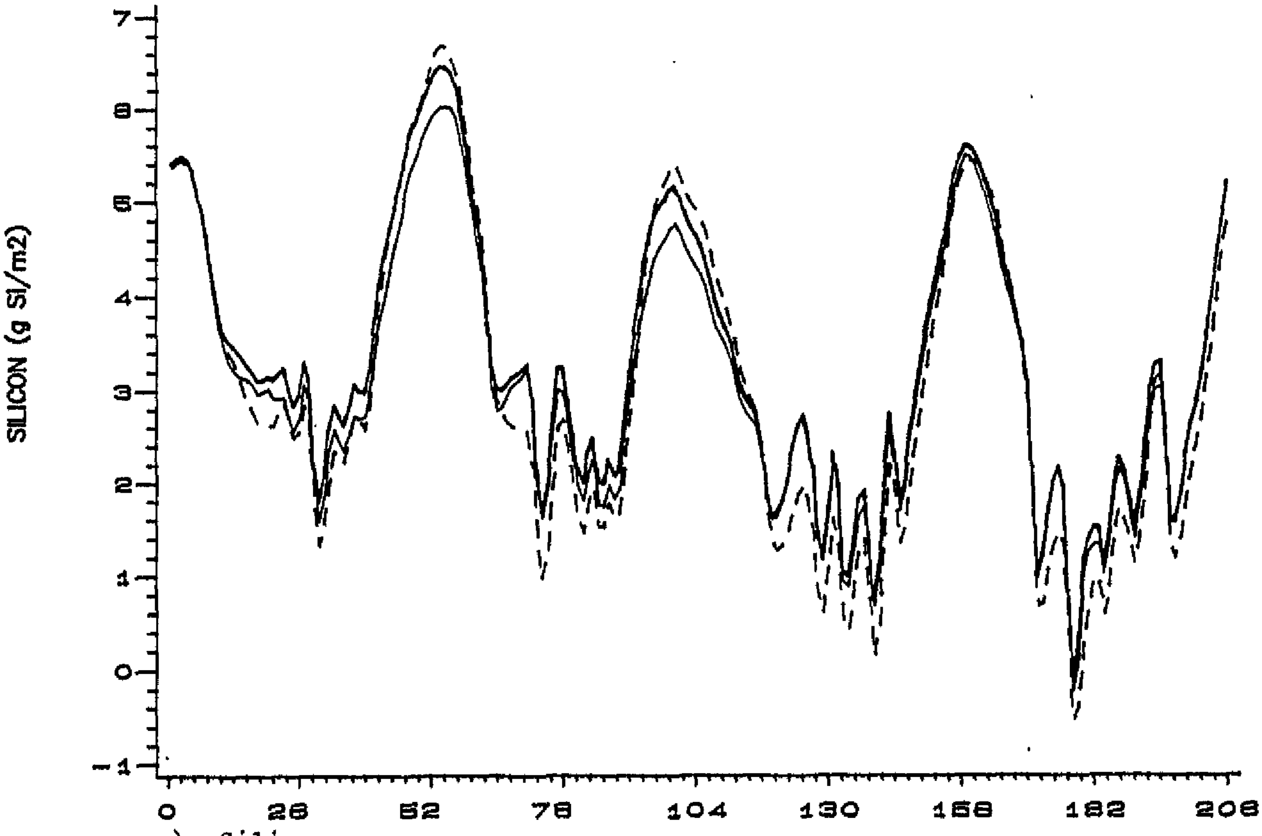
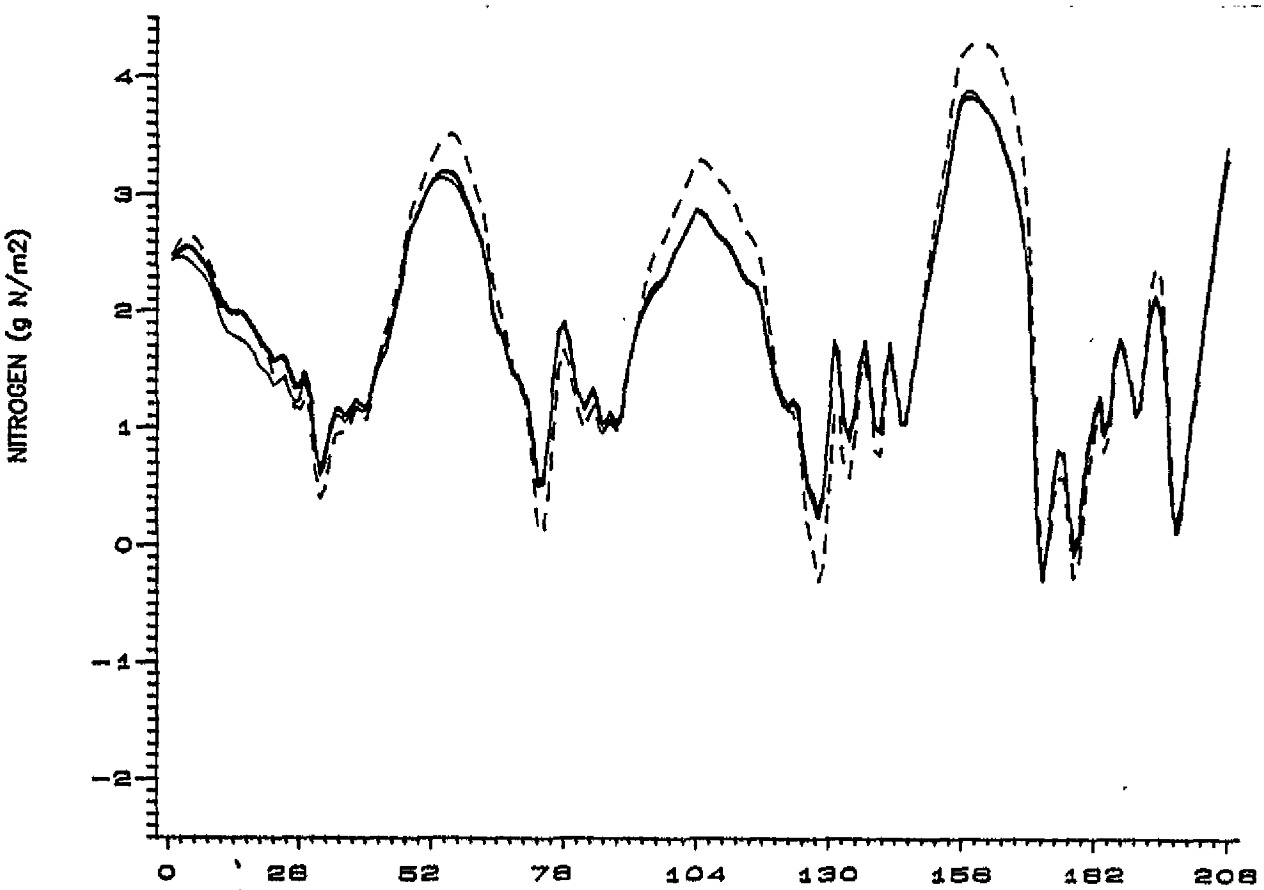


Figure 5.10 d) 1977-1980 (weeknumber)
Seasonal behaviour of stoichiometric coefficient values

——— Silicon	(CS)	in	gSi/g C
— — Nitrogen	(CN)	in	g N/g C
- - - - Phosphor * 10	(CP * 10)	in	g P/g C



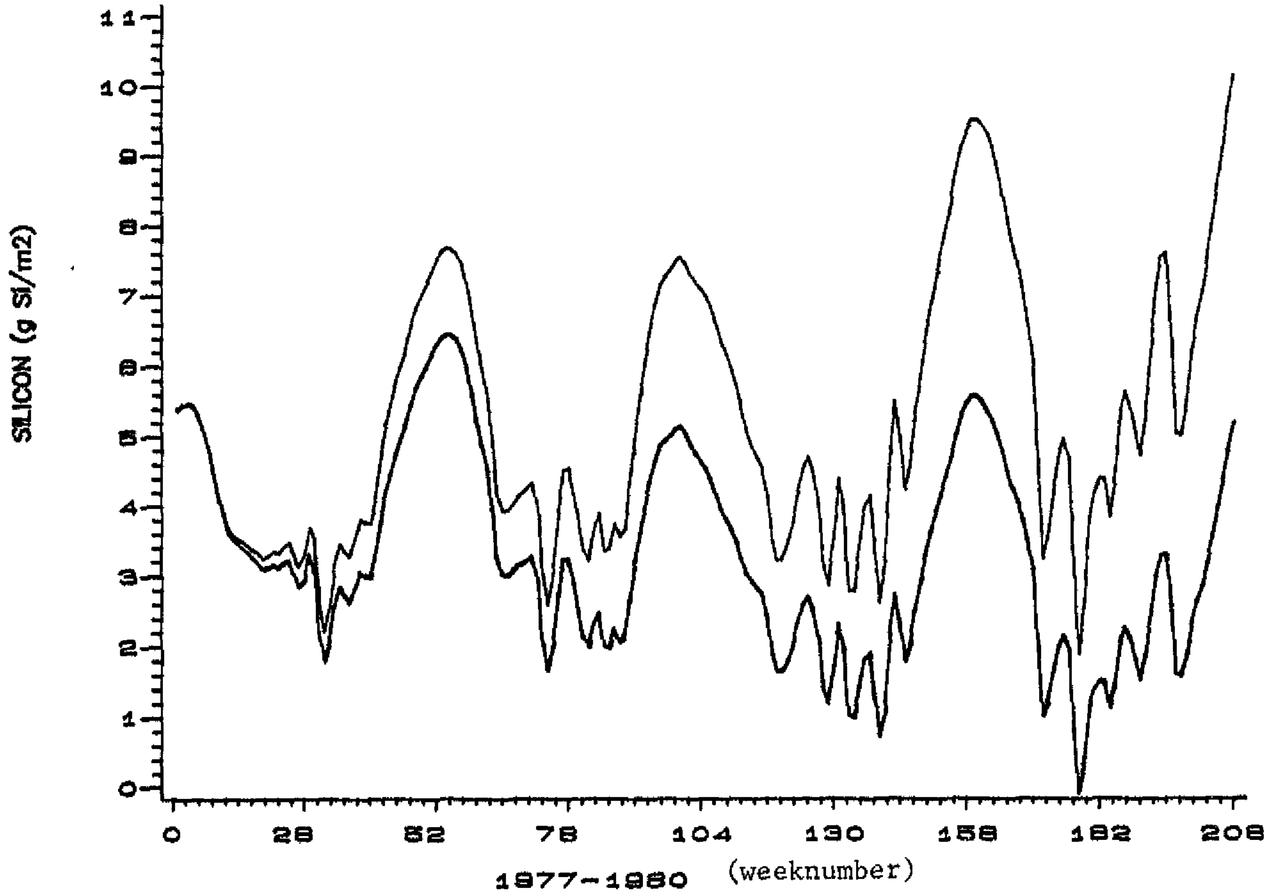
a) Silicon



b) Nitrogen

Figure 5.11
Modelresults for different values of mineralization coefficients

		coef.water	coef.bottom
——— (thick)	calibration run	0.140	0.070
———	equal coefficients	0.070	0.070
- - -	four times difference	0.200	0.070



a) Modelresults for different values of refractory silicon coefficient

calibration run, total ref.silicon formed (77-80): 6.71 g Si/m^2
no refractory silicon formed

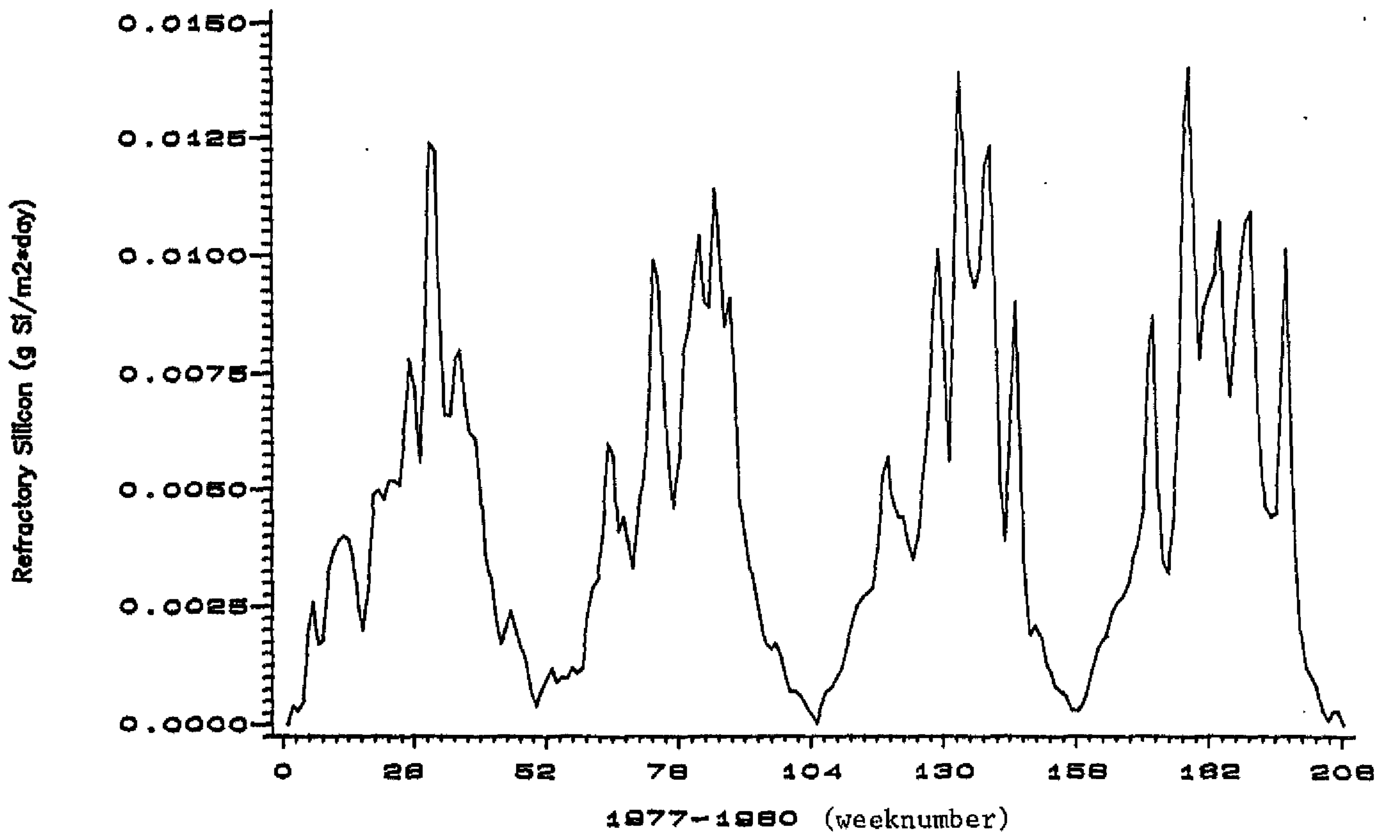
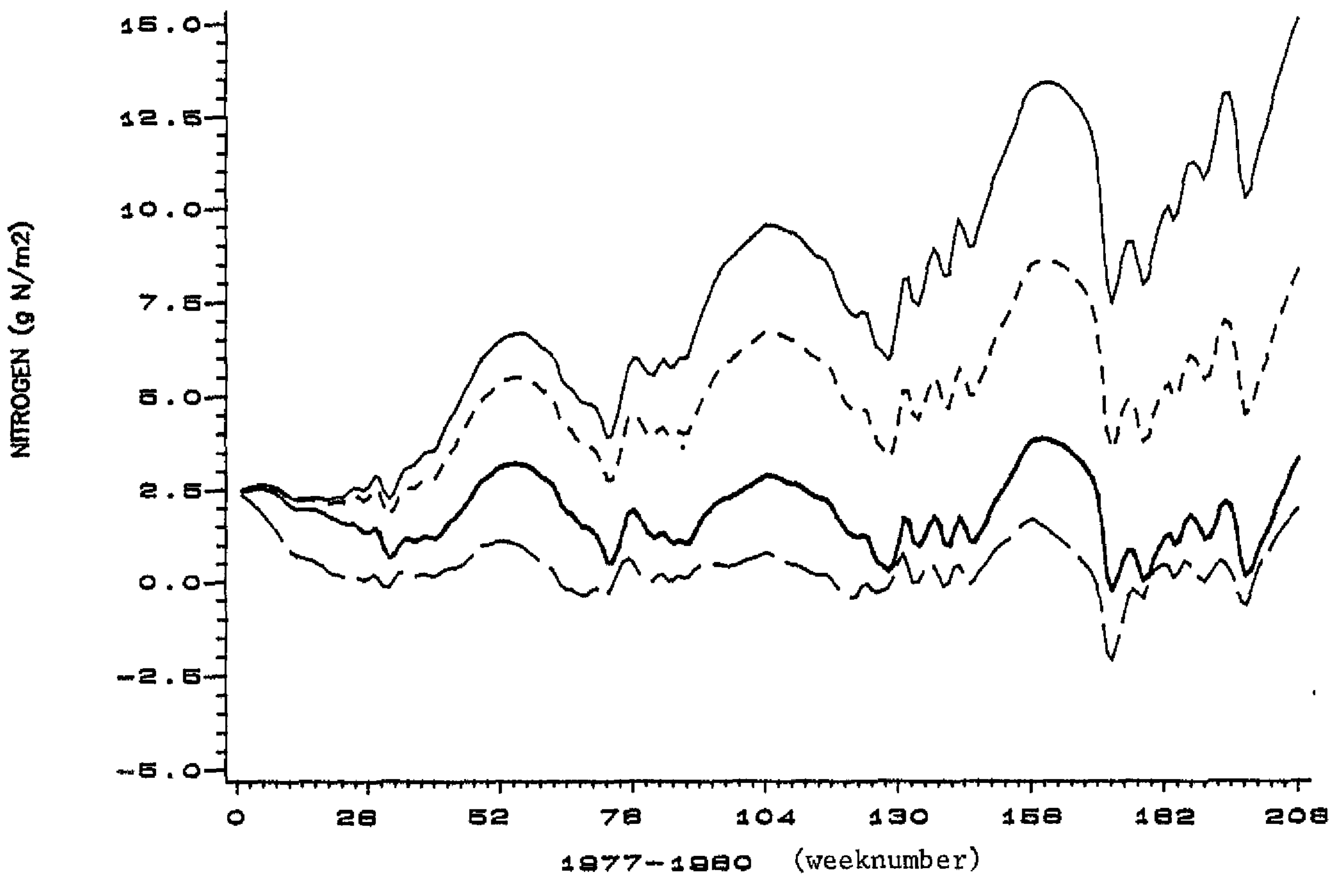


Figure 5.12

Influence of refraction of silicon on modelresults

b) Rate of formation of refractory silicon



a) Modelresults for different values of denitrification coefficient

calibration run	CDEN = 0.011	Tot.den.	12.98 gN/m^2	(77-80)
no denitrification	CDEN = 0.0	Tot.den.	0.0 gN/m^2	
low denitrification	CDEN = 0.002	Tot.den.	7.45 gN/m^2	
high denitrification	CDEN = 0.1	Tot.den.	14.46 gN/m^2	

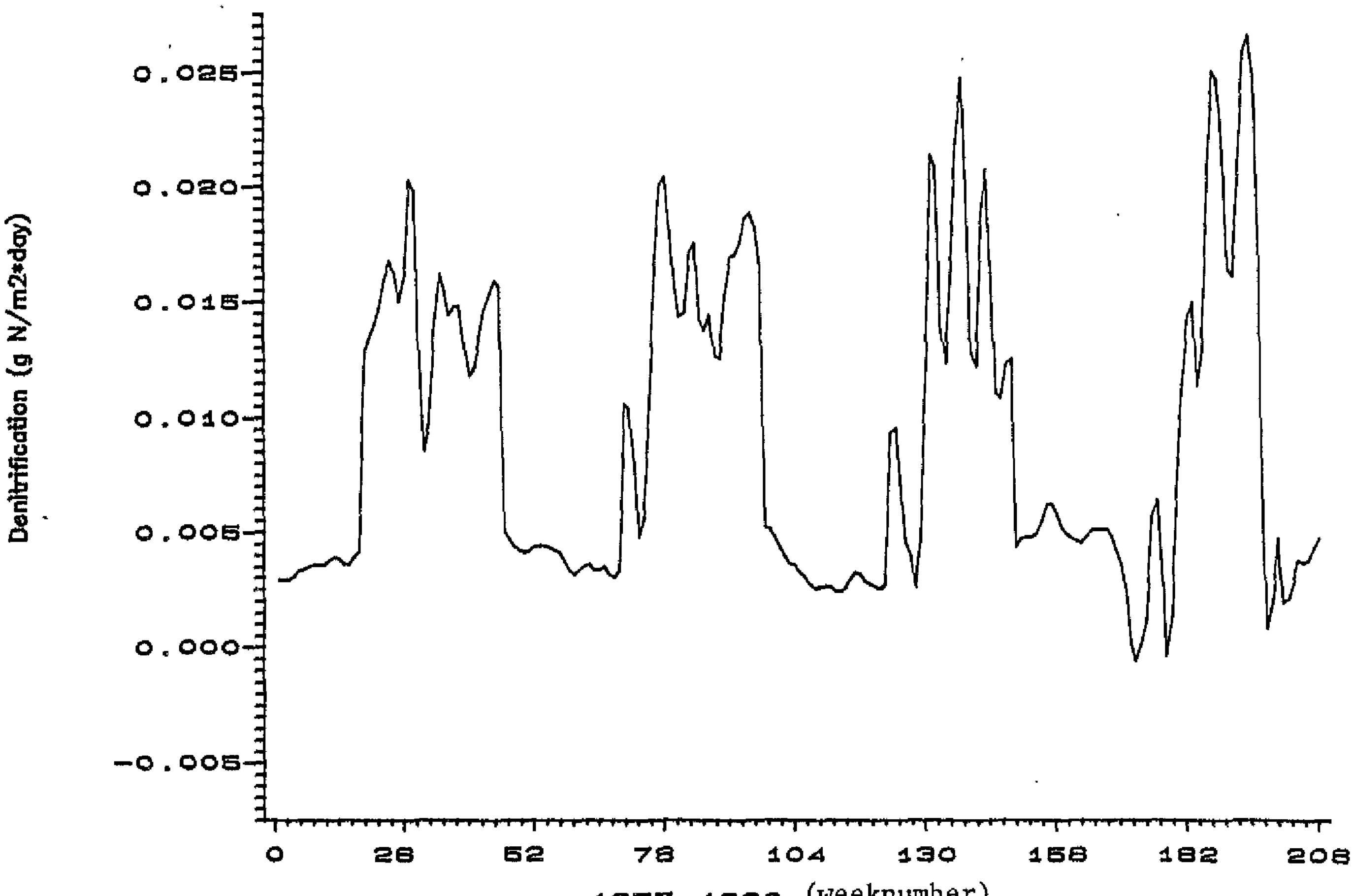


Figure 5.13

Influence of denitrification on modelresults

b) Rate of denitrification

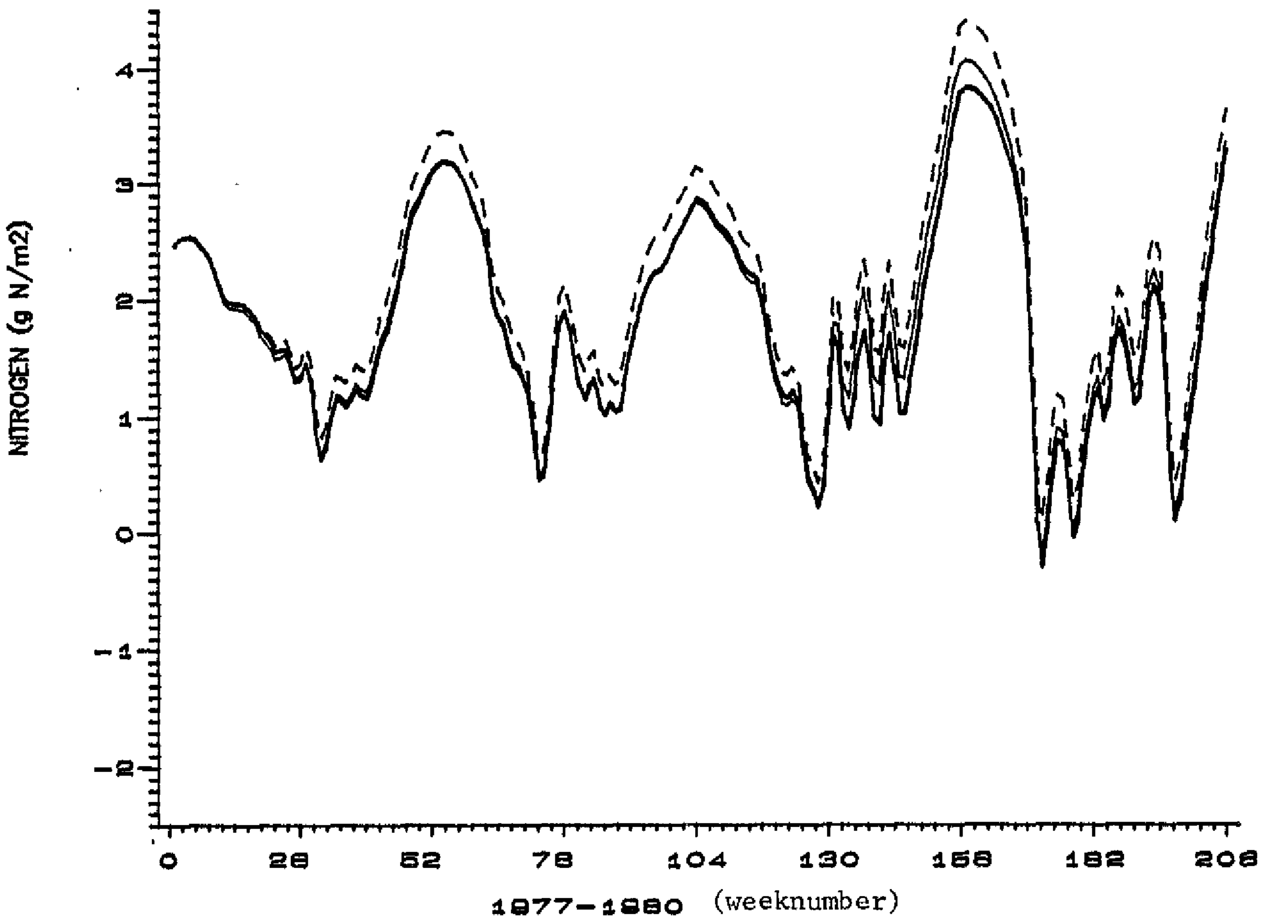


Figure 5.13

Influence of denitrification on modelresults

c) Modelresults for oxygen dependent denitrification

——— calibration run	CDEN = 0.011	Tot.den.	12.98 gN/m^2	(77-80)
– – – oxygen dependent	CDEN = 0.011	Tot.den.	12.60 gN/m^2	
—— oxygen dependent	CDEN = 0.013	Tot.den.	12.91 gN/m^2	

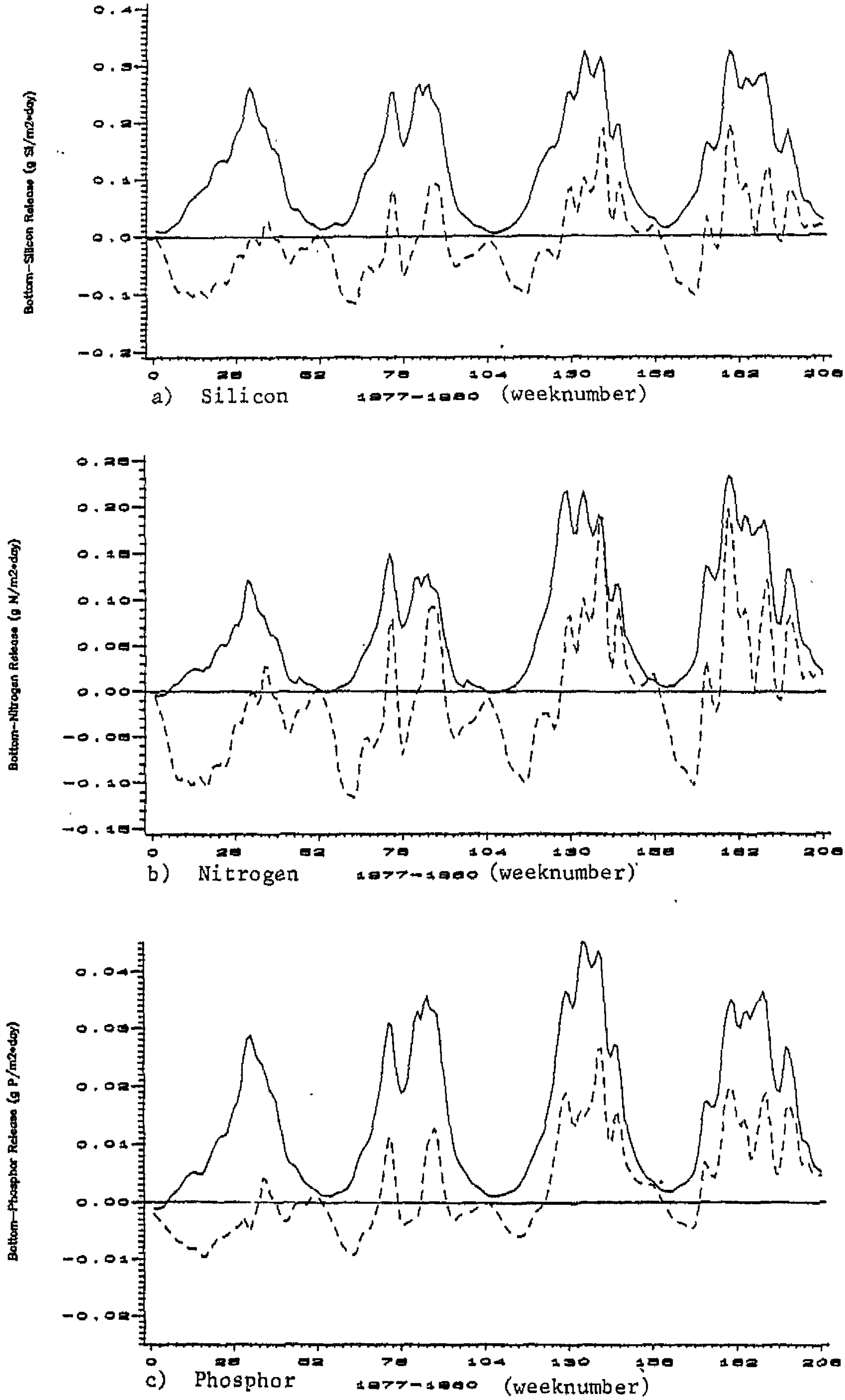


Figure 5.14 a) b) c)

Nutrient flux from mineralization of bottom detritus

——— deep bottoms (depth more than 4 m, 40% of bottom area)
– – – shallow bottoms (corrected for update by bottom diatoms)

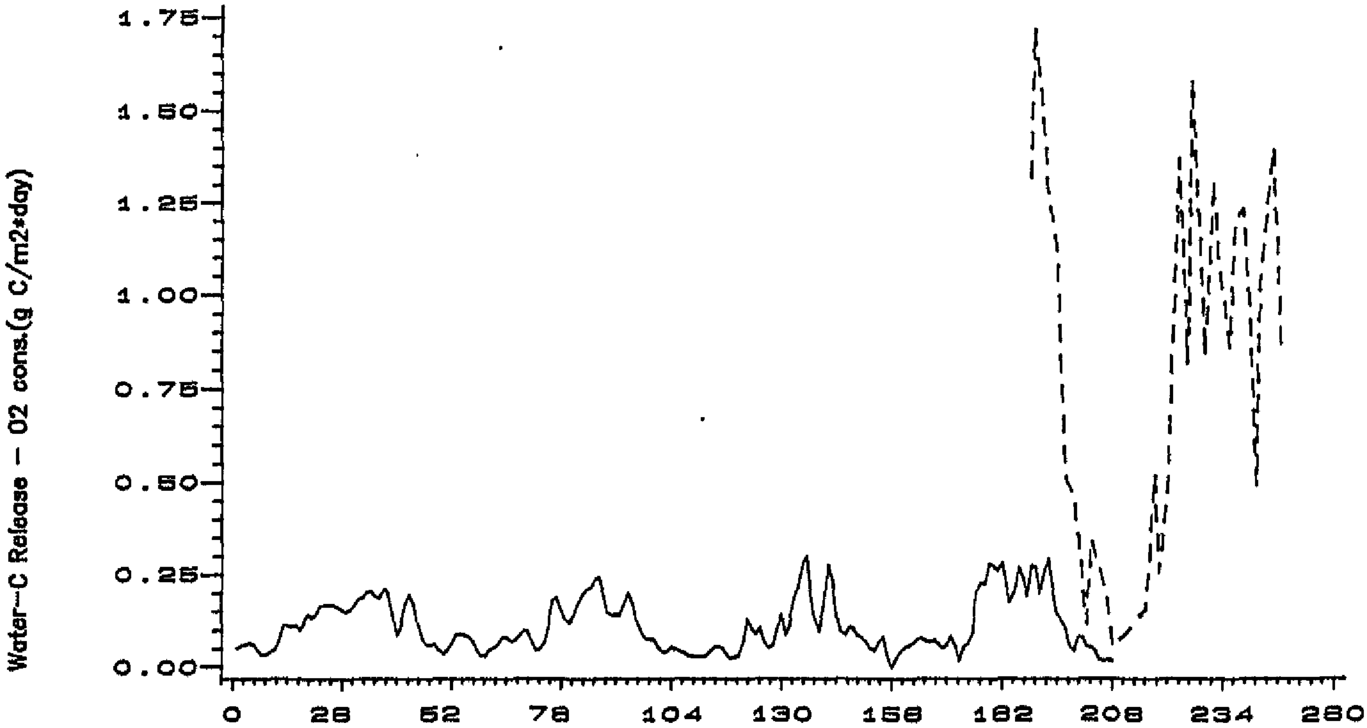


Figure 5.15 a) 1977–1981 (weeknumber)

Calculated carbon mineralization rate in water (solid line), compared with measured ecosystem respiration (broken line)

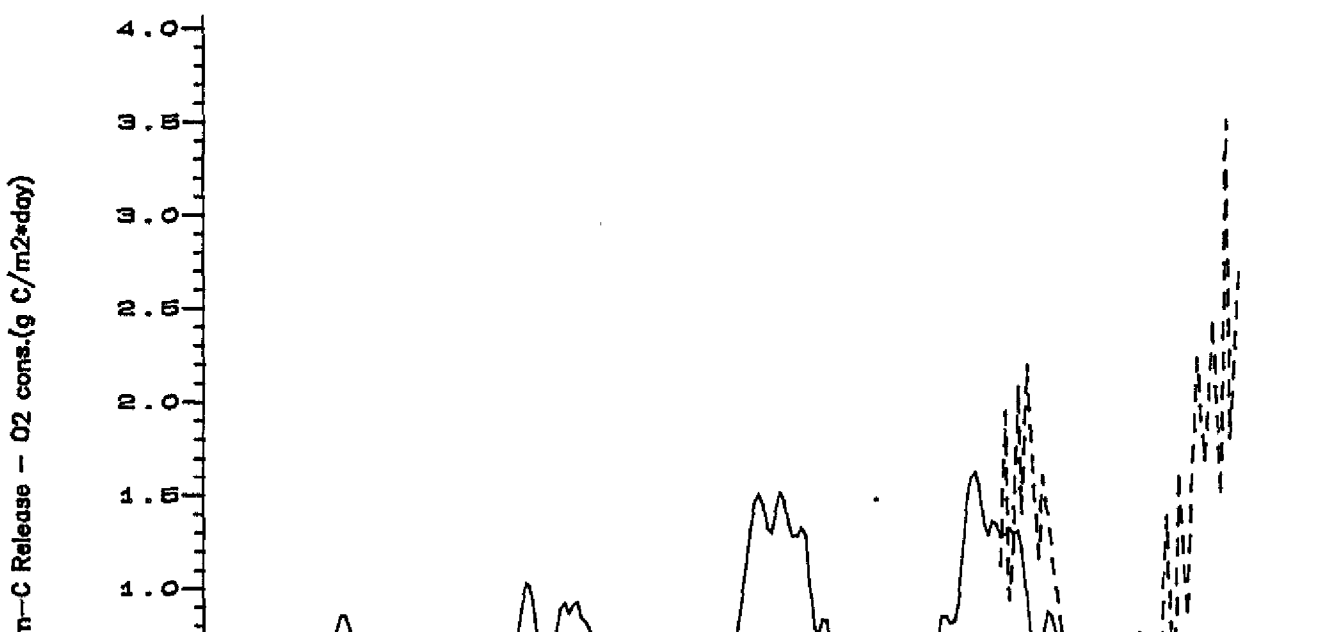


Figure 5.15 b) 1977–1981 (weeknumber)

Calculated carbon mineralization rate in bottom (solid line), compared with measured ecosystem respiration (broken line)

```
C*** NUTRIENT MODEL LAKE GREVELINGEN****************************************
C**VARIABLES IN ALFABETIC ORDER**  CM = INPUT VARIABLES (DDMI OR DIHO)
C
CM BCN     NET IMPORTED PARTICULATE ORGANIC MATTER           G C/M2
C  BCNC    CUMULATIVE BCN                                     G C/M2
C  BCNN    NITROGEN CONTENT OF BCN                            G N/M2
C  BCNNC   CUMULATIVE BCNN                                    G N/M2
C  BCNP    PHOSPHOR CONTENT OF BCN                            G P/M2
C  BCNPC   CUMULATIVE BCNP                                    G P/M2
C  BCNS    SILICON CONTENT OF BCN                             G SI/M2
C  BCNSC   CUMULATIVE BCNS                                    G SI/M2
C  BFLUXN  N-BOTTOMFLUX CORRECTED FOR UPTAKE BY B.DIATOMS    G N/M2*DAY
C  BFLUXP  P-BOTTOMFLUX CORRECTED FOR UPTAKE BY B.DIATOMS    G P/M2*DAY
C  BFLUXS  SI-BOTTOMFLUX CORRECTED FOR UPTAKE BY B.DIATOMS G SI/M2*DAY
C  BNTOTC  CUMULATIVE BNTOTN                                  G N/M2
CM BNTOTN  NET IMPORTED DISSOLVED NITROGEN                    G N/M2
C  BPTOTC  CUMULATIVE BPTOTN                                  G N/M2
CM BPTOTN  NET IMPORTED DISSOLVED PHOSPHORUS                  G P/M2
C  BSTOTC  CUMULATIVE BSTOTN                                  G SI/M2
CM BSTOTN  NET IMPORTED DISSOLVED SILICON                     G SI/M2
C  CARB2   PHYTOPLANKTON-CARBON + SUSP. DETRITUS              G C/M2
C  CARB3   CARB2 + BOTTOMDIATOMS                              G C/M2
C  CARB4   CARB3 + BOTTOMDETRITUS                             G C/M2
C  CCB     COEFF OF CARBON MINERAL. IN BOTTOM AT 20 DEGR C /DAY
C  CCF     COEFF OF CARBON MINERAL. IN WATER AT 20 DEGR C   /DAY
C  CDEN    COEFFICIENT OF DENITRIFICATION AT 20 DEGR. C      /DAY
C  CDENO   TEMP DEPENDENT MODIFIED CDEN                       /DAY
C  CMINNB  CUMULATIVE MINERALIZATION OF NITROGEN, BOTTOM     G N/M2
C  CMINNF  CUMULATIVE MINERALIZATION OF NITROGEN, WATER      G N/M2
C  CMINPB  CUMULATIVE MINERALIZATION OF PHOSPHOR, BOTTOM     G P/M2
C  CMINPF  CUMULATIVE MINERALIZATION OF PHOSPHOR, WATER      G P/M2
C  CMINSB  CUMULATIVE MINERALIZATION OF SILICON,  BOTTOM     G SI/M2
C  CMINSF  CUMULATIVE MINERALIZATION OF SILICON,  WATER      G SI/M2
C  CN      STOICHIOMETRIC COEFFICIENT FOR NITROGEN           G N/G C
C  CNB     COEFF OF NITROGEN MINERAL IN BOTTOM AT 20 DEGR   /DAY
C  CNF     COEFF OF NITROGEN MINERAL IN WATER AT 20 DEGR    /DAY
C  CNSP    CN UNDER SPRING(WINTER) CONDITIONS                 /DAY
C  CNSU    CN UNDER SUMMER(AUTUMN) CONDITIONS                 /DAY
C  CP      STOICHIOMETRIC COEFFICIENT FOR PHOSPHORUS         G P/G C
C  CPB     COEFF OF PHOSPHORUS MINERAL IN BOTTOM AT 20 DEG /DAY
C  CPF     COEFF OF PHOSPHORUS MINERAL IN WATER AT 20 DEGR /DAY
C  CPSP    CP UNDER SPRING(WINTER) CONDITIONS                 /DAY
C  CPSU    CP UNDER SUMMER(AUTUMN) CONDITIONS                 /DAY
C  CRESPB  CUMULATIVE CARBON MINERALIZATION IN BOTTOM        G C/M2
C  CRESPW  CUMULATIVE CARBON MINERALIZATION IN WATER         G C/M2
C  CS      STOICHIOMETRIC COEFFICIENT FOR SILICON            G SI/G C
C  CSB     COEFF OF SILICON MINERAL IN BOTTOM AT 20 DEGR    /DAY
C  CSF     COEFF OF SILICON MINERAL IN WATER AT 20 DEGR     /DAY
C  CSEDCF  CUMULATIVE SEDIMENTATION OF CARBON (SUSP.DETR.) G C/M2
C  CSREF   COEFFICIENT FOR REFRACTORY SILICON FORMATION      -
C  CSSP    CS UNDER SPRING(WINTER) CONDITIONS                 /DAY
C  CSSU    CS UNDER SUMMER(AUTUMN) CONDITIONS                 /DAY
C  DELFYN  CHANGE OF PHYTOPLANKTON BIOMASS (NITROGEN)        G N/M2*WEEK
C  DELFYP  CHANGE OF PHYTOPLANKTON BIOMASS (PHOSPHORUS)      G P/M2*WEEK
C  DELFYS  CHANGE OF PHYTOPLANKTON BIOMASS (SILICON)         G SI/M2*WEEK
C  DELFYT  CHANGE OF PHYTOPLANKTON BIOMASS (CARBON)          G C/M2*WEEK
C  DELMFB  CHANGE OF BOTTOMDIATOM BIOMASS (CARBON)           G C/M2*WEEK
C  DELMFN  CHANGE OF BOTTOMDIATOM BIOMASS (NITROGEN)         G N/M2*WEEK
C  DELMFP  CHANGE OF BOTTOMDIATOM BIOMASS (PHOSPHORUS)       G P/M2*WEEK
C  DELMFS  CHANGE OF BOTTOMDIATOM BIOMASS (SILICON)          G SI/M2*WEEK
C  DELT    TIMESTEP                                           DAY
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C  DENI     DENITRIFICATION                                   G N/M2*DELT
C  DETCB    BOTTOM DETRITUS POOL FOR CARBON                   G C/M2
C  DETCF    SUSPENDED DETRITUS POOL FOR CARBON                G C/M2
C  DETCFO   SUSPENDED DETRITUS POOL FOR CARBON, END OF WEEK   G C/M2
C  DETNB    BOTTOM DETRITUS POOL FOR NITROGEN                 G N/M2
C  DETNF    SUSPENDED DETRITUS POOL FOR NITROGEN              G N/M2
C  DETNFO   SUSPENDED DETRITUS POOL FOR NITROGEN, END WEEK    G N/M2
C  DETPB    BOTTOM DETRITUS POOL FOR PHOSPHORUS               G P/M2
C  DETPF    SUSPENDED DETRITUS POOL FOR PHOSPHORUS            G P/M2
C  DETPFO   SUSPENDED DETRITUS POOL FOR PHOSPHOR, END WEEK    G P/M2
C  DETSB    BOTTOM DETRITUS POOL FOR SILICON                  G SI/M2
C  DETSF    SUSPENDED DETRITUS POOL FOR SILICON               G SI/M2
C  DETSFO   SUSPENDED DETRITUS POOL FOR SILICON, END WEEK     G SI/M2
C  DINI     DISSOLVED NITROGEN, CALCULATED                    G N/M2
C  DIPHO    DISSOLVED PHOSPHORUS, CALCULATED                  G P/M2
C  DISI     DISSOLVED SILICON, CALCULATED                     G SI/M2
C  FFOX     FUNCTION FOR OXYGEN DEPENDENT DENITRIFICATION     -
CM FYTOC    PHYTOPLANKTON BIOMASS                             G C/M2
C  FYTOCO   PHYTOPLANKTON BIOMASS, END OF WEEK                G C/M2
C  FYTON    PHYTOPLANKTON BIOMASS, NITROGEN PART              G N/M2
C  FYTONO   PHYTOPLANKTON BIOMASS, NITROGEN PART, END WEEK    G N/M2
C  FYTOP    PHYTOPLANKTON BIOMASS, PHOSPHORUS PART            G P/M2
C  FYTOPO   PHYTOPLANKTON BIOMASS, PHOSPHOR PART, END WEEK    G P/M2
C  FYTOS    PHYTOPLANKTON BIOMASS, SILICON PART               G SI/M2
C  FYTOSO   PHYTOPLANKTON BIOMASS, SILICON PART, END WEEK     G SI/M2
C  IPLOT    SWITCH FOR PLOT OUTPUT                            -
C  IPRINT   SWITCH FOR PRINT OUTPUT                           -
CM IWEEK    WEEK NUMBER, INPUT                                WEEK
C  NEND     LAST WEEK                                         WEEK
C  NWEEK    WEEK NUMBER, PROGRAM                              WEEK
CM OX       OXYGEN CONCENTRATION AT G11, DEPTH 5-15 M         MG O2/L
C  PDENI    DENITRIFIED NITROGEN (CUMULATIVE)                 G N/M2
CM PDIAT    FRACTION OF DIATOMS IN PHYTOPLANKTON              -
C  PDINI    POOL OF DISSOLVED NITROGEN          , CALCULATED  G N/M2
C  PDIPHO   POOL OF DISSOLVED PHOSPHOR(INORG.), CALCULATED    G P/M2
C  PDISI    POOL OF DISSOLVED SILICON           , CALCULATED  G SI/M2
CM PFYTO    NET PRODUCTION OF PHYTOPLANKTON                   G C/M2*WEEK
CM PMFB     NET PRODUCTION OF BOTTOMDIATOMS                   G C/M2*WEEK
CM POC      SUSPENDED PARTICULATE ORGANIC CARBON, MEASURED    G C/M2
C  PO2      PHYTOPLANKTON + SUSP. DETR. (PHOSPHORUS PART)     G P/M2
C  PO3      PO2 + BOTTOMDIATOMS (PHOSPHORUS PART)             G P/M2
C  PO4      PO3 + BOTTOMDETRITUS (PHOSPHORUS PART)            G P/M2
C  PO5      PO4 + DISS. INORG. PHOSPHORUS (MEASURED CONC.)    G P/M2
C  PO6      PO5 - NET LOADING OF PHOSPHORUS                   G P/M2
C  PSIREF   POOL OF REFRACTORY SILICON                        G SI/M2
C  SEDCF    SEDIMENTATION (RESUSP.) OF DETR., CARBON PART     G C/M2*DELT
C  SEDNF    SEDIMENTATION (RESUSP.) OF DETR., NITROGEN PART   G N/M2*DELT
C  SEDPF    SEDIMENTATION (RESUSP.) OF DETR., PHOSPHOR PART   G P/M2*DELT
C  SIREF    REFRACTORY SILICON FORMATION                      G SI/M2*DELT
C  SI2      PHYTOPLANKTON + SUSP. DETR. (SILICON PART)        G SI/M2
C  SI3      SI2 + BOTTOMDIATOMS (SILICON  PART)               G SI/M2
C  SI4      SI3 + BOTTOMDETRITUS (SILICON PART)               G SI/M2
C  SI5      SI4 + DISSOLVED SILICON (CALCULATED POOL)         G SI/M2
C  SI6      SI5 - NET LOADING OF SILICON + PSIREF             G SI/M2
CM T        TEMPERATURE, MEASURED                             DEGR. C.
C  TCD      TEXP ** (T-20) * DELT                             DELT
C  TEXP     COEFFICIENT FOR TEMPERATURE DEPENDENCY            -
C  TIME     TIME COUNTER                                      DELT
CM TN       INORGANIC DISSOLVED NITROGEN, MEASURED            G N/M2
CM TP       INORGANIC DISSOLVED PHOSPHORUS, MEASURED          G P/M2
C  TPFYTO   NET PRODUCTION OF PHYTOPLANKTON (CUMULATIVE)      G C/M2
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C	TPMYFB	NET PRODUCTION OF BOTTOMDIATOMS (CUMULATIVE)	G C/M2
CM	TS	INORGANIC DISSOLVED SILICON, MEASURED	G SI/M2
CM	XMFBC	BIOMASS OF BOTTOM DIATOMS (MICROPHYTOBENTHOS)	G C/M2
C	XMFBCO	BIOMASS OF BOTTOM DIATOMS, END WEEK	G C/M2
C	XMFBN	BIOMASS OF BOTTOM DIATOMS, NITROGEN PART	G N/M2
C	XMFBNO	BIOMASS OF BOTTOM DIATOMS, NITROGEN PART, E.W.	G N/M2
C	XMFBP	BIOMASS OF BOTTOM DIATOMS, PHOSPHORUS PART	G P/M2
C	XMFBPO	BIOMASS OF BOTTOM DIATOMS, PHOSPHOR PART, E.W.	G P/M2
C	XMFBS	BIOMASS OF BOTTOM DIATOMS, SILICON PART	G SI/M2
C	XMFBSO	BIOMASS OF BOTTOM DIATOMS, SILICON PART, E.W.	G SI/M2
C	XMFYT	DEAD PHYTOPLANKTON	G C/M2
C	XMFYTN	DEAD PHYTOPLANKTON, NITROGEN PART	G N/M2
C	XMFYTP	DEAD PHYTOPLANKTON, PHOSPHORUS PART	G P/M2
C	XMFYTS	DEAD PHYTOPLANKTON, SILICON PART	G SI/M2
C	XMINCB	MINERALIZATION BOTTOM DETRITUS	G C/M2*DELT
C	XMINCF	MINERALIZATION SUSP. DETRITUS (+ BCN * DELT)	G C/M2*DELT
C	XMINNB	MINERALIZATION BOTTOM DETRITUS, NITROGEN PART	G N/M2*DELT
C	XMINNF	MINERALIZATION SUSP.DETRITUS(BCNN), NITR. PART	G N/M2*DELT
C	XMINPB	MINERALIZATION BOTTOM DETRITUS, PHOSPHORUS PART	G P/M2*DELT
C	XMINPF	MINERALIZATION SUSP.DETRITUS(BCNP), PHOS. PART	G P/M2*DELT
C	XMINSB	MINERALIZATION BOTTOM DETRITUS, SILICON PART	G SI/M2*DELT
C	XMINSF	MINERALIZATION SUSP.DETRITUS(BCNS), SILI. PART	G SI/M2*DELT
C	XMMFB	DEAD BOTTOM DIATOMS (MICROPHYTOBENTHOS)	G C/M2
C	XMMFBN	DEAD BOTTOM DIATOMS, NITROGEN PART	G N/M2
C	XMMFBP	DEAD BOTTOM DIATOMS, PHOSPHOR PART	G P/M2
C	XMMFBS	DEAD BOTTOM DIATOMS, SILICON PART	G SI/M2
C	XNI2	PHYTOPLANKTON + SUSP. DETRITUS (NITROGEN PART)	G N/M2
C	XNI3	XNI2 + BOTTOMDIATOMS (NITROGEN PART)	G N/M2
C	XNI4	XNI3 + BOTTOMDETRITUS (NITROGEN PART)	G N/M2
C	XNI5	XNI4 + DISS. INORG. NITROGEN (CALCULATED POOL)	G N/M2
C	XNI6	XNI5 - CUMUL. LOADING + CUMUL. DENITRIFICATION	G N/M2

```
C*****INPUT OF DATA*********************************************************
C      INPUT FILES  NUTGRE  INPUT1    A : UNIT 1     (TIME,IPRINT)
C                   NUTGRE  INPUT10   A : UNIT 10    (DATA)
C                   NUTGRE  INPUT20   A : UNIT 20    (COEF+STARTVALUES)
C      OUTPUT FILES NUTGRE  OUTPUT30  A : UNIT 30    (COMMON RESULTS)
C                   NUTGRE  OUTPUT40  A : UNIT 40    (PLOT   RESULTS)
C                   NUTGRE  OUTPUT50  A : UNIT 50    (PRINT  RESULTS)
C                   NUTGRE  OUTPUT60  A : UNIT 60    (PRINT  RESULTS)
C-------------------------------------------------------------------------
C

      IMPLICIT REAL*8(A-H,O-Z)

C-------------------------------------------------------------------------
C
C *** FORMAT STATEMENTS***
C

100   FORMAT(/)
101   FORMAT(I3,3F7.3,2F7.2,7F9.5,2F10.5,F11.5)
102   FORMAT(/,9F7.0,//,9F7.0,//,8F7.0,//,7F7.0,//,7F7.0,//,12F7.0)
111   FORMAT(17X,I8,/,
     1       17X,F8.3,/,
     2       17X,I8,/,
     3       17X,I8)
203   FORMAT('WEEK'  ,5X,'SEDCF' ,4X,'CSEDCF',5X,'DETCB' ,5X,
     1       'SEDNF' ,5X,'DETNB' ,5X,'SEDPF' ,5X,'DETPB' ,5X,
     2       'SIREF' ,5X,'DETSB' ,3X,'TPFYTO',4X,'TPMFB' ,3X,
     3       'CRESPW',3X,'CRESPB',2X,'WEEK'  ,4X,'XMINCF',4X,
     4       'XMINCB',4X,'XMINNF',4X,'XMINNB',4X,'XMINPF',4X,
     5       'XMINPB',4X,'XMINSF',4X,'XMINSB',6X,'DENI'  ,5X,
     6       'PDENI' ,4X,'XMFYT' ,4X,'XMMFB' ,5X,'BCNC')
213   FORMAT(I4,9F10.4,4F9.3,2X,I4,10F10.4,3F9.3)

204   FORMAT('WEEK' ,2X,'FYTOS',4X,'SI2'  ,4X,'SI3'  ,4X,'SI4'   ,4X,
     1       'SI5'  ,4X,'SI6'  ,2X,'FYTON',3X,'XNI2' ,3X,'XNI3'  ,3X,
     2       'XNI4' ,3X,'XNI5' ,3X,'XNI6' ,2X,'FYTOP',4X,'PO2'   ,4X,
     3       'PO3'  ,4X,'PO4'  ,4X,'PO5'  ,4X,'PO6'  ,2X,'WEEK'  ,2X,
     4       'PDINI',5X,'TN'   ,2X,'PDISI',5X,'TS'   ,1X,'PDIPHO',5X,
     5       'TP'   ,5X,'CN'   ,5X,'CP'   ,5X,'CS')
214   FORMAT(I4,18F7.3,2X,I4,9F7.3)

205   FORMAT('WEEK',  4X,'DELFYT',4X,'DELMFB',5X,'XMFYT', 5X,
     1       'XMMFB' ,5X,'DETCF' ,4X,'BNTOTC',4X,'BPTOTC',4X,
     2       'BSTOTC',5X,'BCNNC' ,5X,'BCNPC' ,5X,'BCNSC' ,4X,'PSIREF')
215   FORMAT(I4,12F10.4)

206   FORMAT('WEEK',  4X,'CMINNF',4X,'CMINNB',4X,'CMINPF', 4X,
     1       'CMINPB',4X,'CMINSF',4X,'CMINSB',4X,'BFLUXN', 4X,
     2       'BFLUXP',4X,'BFLUXS')
216   FORMAT(I4,9F10.4)
```

```
C-----------------------------------------------------------------------
C *** READ FROM INPUT FILES***
C

      WRITE(30,203)
      WRITE(40,204)
      WRITE(50,205)
      WRITE(60,206)
      READ (10,100)
      READ (20,102) TEXP  ,CNSP  ,CNSU  ,CPSP  ,CPSU  ,CSSP  ,CSSU  ,
     1              CCF   ,CCB   ,CPF   ,CPB   ,CNF   ,CNB   ,CSF   ,
     2              CSB   ,CDEN  ,FYTOCO,XMFBCO,DETCB ,DETNB ,DETPB ,
     3              DETSB ,PDINI ,PDIPHO,PDISI ,CSREF ,TPFYTO,TPMFB ,
     4              BNTOTC,BPTOTC,BSTOTC,BCNC  ,BCNNC ,BCNPC ,BCNSC ,
     5              CRESPW,CRESPB,CSEDCF,PDENI ,PSIREF,CMINNF,CMINNB,
     6              CMINPF,CMINPB,CMINSF,CMINSB,FYTONO,FYTOPO,FYTOSO,
     7              XMFBNO,XMFBPO,XMFBSO

      READ (1,111) NEND,DELT,IPRINT,IPLOT

C-----------------------------------------------------------------------
C *** MAIN PROGRAM *****************************************WEEK STEPS**
C

      NWEEK = 0
10    CONTINUE
      TIME  = 0.
      NWEEK = NWEEK + 1
      READ(10,101) IWEEK,TN,TP,TS,OX,T,FYTOC,XMFBC,PFYTO,PMFB,POC,PDIAT,
     1             BNTOTN,BPTOTN,BSTOTN,BCN

C-----OPTION---
      BCN=0.
C-----------------------------------------------------------------------
C *** SPRING-SUMMER STOICHIOMETRIE***
C *** DENITRIFICATION COEFFICIENT***
C

      CN = CNSU + (PDINI  / 3.5) * (CNSP - CNSU)
      CP = CPSU + (TP     / 2.5) * (CPSP - CPSU)
      CS = CSSU + (PDISI  / 5.8) * (CSSP - CSSU)
      IF (PDINI  .LT. 0.0) CN = CNSU
      IF (PDISI  .LT. 0.0) CS = CSSU

      CDENO = CDEN
      IF (T .LT. 10.)CDENO = CDENO * 0.5
      IF (T .GE. 10.)CDENO = CDENO * 1.5
      TCD   = TEXP ** (T-20.) * DELT
```

```
C-----------------------------------------------------------------------
C *** CARBON-NUTRIENT  MAIN FUNCTIONS***
C                                                         ***PHYTOPLANKTON**

      FYTON  = FYTOC * CN
      FYTOP  = FYTOC * CP
      FYTOS  = FYTOC * CS * PDIAT

      DELFYT = FYTOC  - FYTOCO
      DELFYN = FYTON  - FYTONO
      DELFYP = FYTOP  - FYTOPO
      DELFYS = FYTOS  - FYTOSO

      XMFYT  =  PFYTO                - DELFYT
      XMFYTN = (PFYTO * CN)          - DELFYN
      XMFYTP = (PFYTO * CP)          - DELFYP
      XMFYTS = (PFYTO * CS * PDIAT)  - DELFYS

      TPFYTO = TPFYTO + PFYTO

C-----------------------------------------------------------------------
C                                                     ***MICROPHYTOBENTHOS**

      XMFBN  = XMFBC * CN
      XMFBP  = XMFBC * CP
      XMFBS  = XMFBC * CS

      DELMFB = XMFBC  - XMFBCO
      DELMFN = XMFBN  - XMFBNO
      DELMFP = XMFBP  - XMFBPO
      DELMFS = XMFBS  - XMFBSO

      XMMFB  =  PMFB       - DELMFB
      XMMFBN = (PMFB * CN) - DELMFN
      XMMFBP = (PMFB * CP) - DELMFP
      XMMFBS = (PMFB * CS) - DELMFS

      TPMFB  = TPMFB  + PMFB

C-----------------------------------------------------------------------
C                                                              ***DETRITUS*

      DETCF  = POC - FYTOC
      DETNF  = DETCF * CN
      DETPF  = DETCF * CP
      DETSF  = DETCF * CS * PDIAT

      DETCB  = DETCB  + (DETCFO - DETCF)
      DETNB  = DETNB  + (DETNFO - DETNF)
      DETPB  = DETPB  + (DETPFO - DETPF)
      DETSB  = DETSB  + (DETSFO - DETSF)
```

```
C-----------------------------------------------------------------------
C                                                             ***LOADING*

      BNTOTC = BNTOTC + BNTOTN
      BPTOTC = BPTOTC + BPTOTN
      BSTOTC = BSTOTC + BSTOTN

      BCNN   = BCN * CN
      BCNP   = BCN * CP
      BCNS   = BCN * CS * PDIAT

      BCNC   = BCNC   + BCN
      BCNNC  = BCNNC  + BCNN
      BCNPC  = BCNPC  + BCNP
      BCNSC  = BCNSC  + BCNS

C --- VARIABLES CORRECTED FOR DELT STEPS--------------------------------

      DELTD  = DELT / 7.

      PFYTO  = PFYTO  * DELTD
      PMFB   = PMFB   * DELTD

      XMFYT  = XMFYT  * DELTD
      XMFYTN = XMFYTN * DELTD
      XMFYTP = XMFYTP * DELTD
      XMFYTS = XMFYTS * DELTD
      XMMFB  = XMMFB  * DELTD
      XMMFBN = XMMFBN * DELTD
      XMMFBP = XMMFBP * DELTD
      XMMFBS = XMMFBS * DELTD

      BNTOTN = BNTOTN * DELTD
      BPTOTN = BPTOTN * DELTD
      BSTOTN = BSTOTN * DELTD
      BCN    = BCN    * DELTD
      BCNN   = BCNN   * DELTD
      BCNP   = BCNP   * DELTD
      BCNS   = BCNS   * DELTD
```

```
C---- MINERALIZATION STEPS----------------------------------------------------
C
C*****FUNCTIONS WITH DELT STEP**************************************DELT**
C                                                              ***CARBON**

   20 CONTINUE
      TIME   = TIME + DELT


      XMINCF = CCF * (DETCF + BCN) * TCD
      XMINCB = CCB *  DETCB * TCD

      SEDCF  = XMFYT  + BCN    - XMINCF
      DETCB  = DETCB  + XMMFB - XMINCB + SEDCF

      CRESPW = CRESPW + XMINCF
      CRESPB = CRESPB + XMINCB
      CSEDCF = CSEDCF + SEDCF

C------------------------------------------------------------------------
C
C                                                            ***NITROGEN**

      XMINNF = CNF * (DETNF + BCNN) * TCD
      XMINNB = CNB *  DETNB * TCD

      CMINNF = CMINNF + XMINNF
      CMINNB = CMINNB + XMINNB

      BFLUXN = XMINNB - (PMFB * CN * 1.67)

      DINI   = XMINNF + XMINNB + BNTOTN - (PFYTO+ PMFB) * CN - DENI
      PDINI  = PDINI  + DINI

C-----OPTION---
C     FFOX   = OX / 10.
C     IF(FFOX .GE. 1.) FFOX=1.
      FFOX   = 1.

      DENI   = PDINI  * FFOX * CDENO * TCD
      PDENI  = PDENI  + DENI

      SEDNF  = XMFYTN + BCNN    - XMINNF
      DETNB  = DETNB  + XMMFBN - XMINNB + SEDNF
```

```
C-----------------------------------------------------------------------
C
C                                                            ***PHOSPHOR**

      XMINPF = CPF * (DETPF + BCNP) * TCD
      XMINPB = CPB *  DETPB * TCD

      CMINPF = CMINPF + XMINPF
      CMINPB = CMINPB + XMINPB

      BFLUXP = XMINPB - (PMFB * CP * 1.67)

      DIPHO  = XMINPF + XMINPB + BPTOTN - (PFYTO + PMFB)* CP
      PDIPHO = PDIPHO + DIPHO

      SEDPF  = XMFYTP + BCNP   - XMINPF
      DETPB  = DETPB  + XMMFBP - XMINPB + SEDPF

C-----------------------------------------------------------------------
C
C                                                             ***SILICON**

      XMINSF = CSF * (DETSF + BCNS) * TCD
      XMINSB = CSB *  DETSB * TCD

      CMINSF = CMINSF + XMINSF
      CMINSB = CMINSB + XMINSB

      BFLUXS = XMINSB - (PMFB * CS * 1.67)

      DISI   = XMINSF + XMINSB - PFYTO*PDIAT*CS - PMFB*CS + BSTOTN
      PDISI  = PDISI  + DISI

      SIREF  = CSREF * ( XMFYTS + XMMFBS + BCNS)
      IF (SIREF .LT. 0) SIREF = 0.0

      DETSB  = DETSB + XMFYTS + XMMFBS + BCNS - XMINSF - XMINSB - SIREF

      PSIREF = PSIREF + SIREF

C
C-----END DELT STEP-----------------------------------------------------

      IF (TIME/7. .LT. 1.) GOTO 20

C*************************************************************END*DELT**
```

```
C-----------------------------------------------------------------------
C *** ACCUMULATION IN POOLS***
C     C-N-P-SI
C     1.  PHYTOPLANKTON     2.+ SUSP.DETRITUS    3.+ BOTTOM DIATOMS
C     4.+ BOTTOM DETRITUS   5.+ DISSOLVED        6.- NETT LOADING
C

      CARB2 = FYTOC + XMFBC
      CARB3 = CARB2 + DETCF
      CARB4 = CARB3 + DETCB
      XNI2  = FYTON + DETNF
      XNI3  = XNI2  + XMFBN
      XNI4  = XNI3  + DETNB
      XNI5  = XNI4  + PDINI
      XNI6  = XNI5  - BNTOTC - BCNNC + PDENI
      PO2   = FYTOP + DETPF
      PO3   = PO2   + XMFBP
      PO4   = PO3   + DETPB
      PO5   = PO4   + PDIPHO
      PO6   = PO5   - BPTOTC - BCNPC
      SI2   = FYTOS + DETSF
      SI3   = SI2   + XMFBS
      SI4   = SI3   + DETSB
      SI5   = SI4   + PDISI
      SI6   = SI5   - BSTOTC - BCNSC + PSIREF
```

```
C-----------------------------------------------------------------------
C *** WRITING OF RESULTS ***
C

      IF(IPLOT .EQ. 1) WRITE(30,213)  IWEEK, SEDCF,  CSEDCF, DETCB,
     1                                SEDNF, DETNB,  SEDPF,  DETPB,
     2                                SIREF, DETSB,  TPFYTO, TPMFB,
     3                                CRESPW,CRESPB, IWEEK,  XMINCF,
     4                                XMINCB,XMINNF, XMINNB, XMINPF,
     5                                XMINPB,XMINSF, XMINSB, DENI,
     6                                PDENI, XMFYT,  XMMFB,  BCNC
      IF(IPLOT .EQ. 1) WRITE(40,214)  IWEEK, FYTOS,  SI2,    SI3,
     1                                SI4,   SI5,    SI6,    FYTON,
     2                                XNI2,  XNI3,   XNI4,   XNI5,
     3                                XNI6,  FYTOP,  PO2,    PO3,
     4                                PO4,   PO5,    PO6,    IWEEK,
     5                                PDINI, TN,     PDISI,  TS,
     6                                PDIPHO,TP,     CN,     CP, CS
      IF(IPRINT .EQ. 1) WRITE(50,215) IWEEK, DELFYT, DELMFB, XMFYT,
     1                                XMMFB, DETCF,  BNTOTC, BPTOTC,
     2                                BSTOTC,BCNNC,  BCNPC,  BCNSC,
     3                                PSIREF
      IF(IPRINT .EQ. 1) WRITE(60,216) IWEEK, CMINNF, CMINNB, CMINPF,
     1                                CMINPB,CMINSF, CMINSB, BFLUXN,
     2                                BFLUXP,BFLUXS

C-----------------------------------------------------------------------
C *** CREATION OF 'OLD' VARIABLES ***
C

      FYTOCO = FYTOC
      FYTONO = FYTON
      FYTOPO = FYTOP
      FYTOSO = FYTOS
      XMFBCO = XMFBC
      XMFBNO = XMFBN
      XMFBPO = XMFBP
      XMFBSO = XMFBS
      DETCFO = DETCF
      DETNFO = DETNF
      DETPFO = DETPF
      DETSFO = DETSF

C------------------------------------------------------*******END*RESTART**
C *** END PROGRAM OR RESTART ***
C

      IF(NWEEK .LE. NEND) GOTO 10
30    CONTINUE
      STOP
      END
```

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