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2 **Table 1.** Mass equilibrium defining linear equations used for the inverse analysis. Flow names in the LIM-MCMC were composed of the three-
 3 letter code of the compartment of origin followed by the three-letter code of the destination compartment. Abbreviations: gpp = gross primary
 4 production, res = respiration, los = loss for the considered system.

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Compartments	Mass balance equation	Equations common to the eight models
pic	Mass balance for picophytoplankton	$gpp-pic - (pic-res + pic-doc + pic-pro) = 0$
nan	Mass balance for nanophytoplankton	$gpp-nan - (nan-res + nan-doc + nan-det + nan-pro + nan-met1 + nan-met2 + nan-los) = 0$
mic	Mass balance for microphytoplankton	$gpp-mic - (mic-res + mic-doc + mic-det + mic-pro + mic-met1 + mic-met2 + mic-los) = 0$
pro	Mass balance for protozooplankton	$(pic-pro + nan-pro + mic-pro + bac-pro) - (pro-res + pro-doc + pro-det + pro-met1 + pro-los) = 0$
met1	Mass balance for metazooplankton 200-700 μm	$(nan-met1 + mic-met1 + pro-met1 + det-met1) - (met1-res + met1-doc + met1-det + met1-met2 + met1-los) = 0$
met2	Mass balance for metazooplankton > 700 μm	$(nan-met2 + mic-met2 + pro-met2 + met1-met2 + det-met2) - (met2-res + met2-doc + met2-det + met2-los) = 0$
bac	Mass balance for bacteria	$doc-bac - (bac-res + bac-doc + bac-pro) = 0$
doc	Mass balance for dissolved organic carbon	$(pic-doc + nan-doc + mic-doc + pro-doc + met1-doc + met2-doc + bac-doc + det-doc) - (doc-bac + doc-los) = 0$
det	Mass balance for detritus	$(nan-det + mic-det + pro-det + met1-det + met2-det) - (det-doc + det-met1 + det-met2 + det-los) = 0$

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7 pic = picophytoplankton, nan = nanophytoplankton, mic = microphytoplankton, pro = protozooplankton, met1 = metazooplankton1,
 8 met2 = metazooplankton2, bac = bacteria, doc = dissolved organic carbon, det = detritus

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10 **Table 2.** Minimum and maximum values of flows (derived from *in situ* measurement for each seasons) used as inequalities for the eight
 11 networks.

		Spring		Summer		Autumn		Winter	
		Minimum - Maximum							
Process integrated as inequalities	Flux	Channel model	Bay model	Channel model	Bay model	Channel model	Bay model	Channel model	Bay model
pic gross primary production	gpp-pic	54 - 77	46 - 69	36 - 53	92 - 128	202 - 268	10 - 68	28 - 38	62 - 82
nan gross primary production	gpp-nan	88 - 121	48 - 75	102 - 135	92 - 122	4 - 6	1 - 2	4 - 6	2 - 3
mic gross primary production	gpp-mic	687 - 904	522 - 698	208 - 276	172 - 227	133 - 175	326 - 562	75 - 140	139 - 206
pic grazing by protozooplankton	pic-pro	17- 22	31 - 46	33 - 36	41 - 93	168 - 204	68 - 81	18 - 28	37- 66
nan grazing by protozooplankton	nan-pro	73 - 90	31- 41	37 - 51	20 - 25	2 - 3	1 - 1.5	2 - 3	1.62 - 2.27
mic grazing by protozooplankton	mic-pro	425 - 468	210 - 478	80- 110	76 - 82	48 - 65	190 - 352	46 - 49	67 - 84
doc uptake by bacteria	doc-bac	90 - 117	20 - 59	46 - 61	40 - 92	42 - 85	63 - 67	90 - 135	244 - 274
bacterial grazing by protozoa	bac-pro	58 - 61	13 - 16	29 - 32	18 - 37	42 - 47	24 - 53	67 - 68	137 - 159
mic sinking	mic-los	86 - 521	29 - 55	12 - 19	36 - 44	31 - 35	6 - 7	39 - 57	24 - 54
nan sinking	nan-los	1.5- 44	1 - 1.5	0.02 - 0.03	0.4 - 0.6	2 - 3	0.3 - 0.5	0.20 - 0.31	0.71 - 0.91
mic and nan grazing by met1	mic+nan-met1	36 - 49	17- 26	32 - 48	5 - 8	9 - 11	19 - 29	7 - 8	18 - 22
mic and nan grazing by met2	mic+nan-met2	66 - 85	0.12 - 0.16	0.10 - 0.20	14 - 21	0.05 - 0.08	7 - 19	14 - 18	40 - 52
met1+met2 sinking	met1+met2-los	16*	21*	0.65*	0.62*	4.24*	0.91*	0.47*	0.48*
det sinking	det-los	2361**	657**	6849**	1611**	4126**	7083**	1238**	684**

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13 All flows are considered as intervals between the minimum and maximum values estimated *in situ*, with the following exceptions:

14 * Flows considered as minimum

15 ** Flows considered as maximum

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17 **Table 3.** Flows description and values ($\text{mg C m}^{-2} \text{d}^{-1}$) estimated by the LIM-MCMC for the eight plankton food webs.

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Description	Symbole	Interfered value ($\text{mg C m}^{-2} \text{d}^{-1}$)							
		Spring		Summer		Autumn		Winter	
		Channel model	Bay model	Channel model	Bay model	Channel model	Bay model	Channel model	Bay model
Microphytoplankton gross primary production	gpp-mic	795	609	242	199	154	453	123	180
Nanophytoplankton gross primary production	gpp-nan	65	61	118	107	5	2	5	3
Picophytoplankton gross primary production	gpp-pic	105	56	44	109	236	117	33	73
Microphytoplankton respiration	mic-res	40	32	12	10	8	35	6	9
Microphytoplankton dissolved organic carbon exudation	mic-doc	69	54	21	17	13	49	11	16
Microphytoplankton detritus production	mic-det	35	143	77	41	34	76	0.2	0.3
Microphytoplankton grazing by protozooplankton	mic-pro	444	326	95	79	56	250	46	74
Microphytoplankton grazing by metazooplankton 1	mic-met1	33	15	20	3	10	24	6	18
Microphytoplankton grazing by metazooplankton 2	mic-met2	66	0.1	0.06	9	0.04	13	13	40
Microphytoplankton sinking	mic-los	109	40	15	40	33	6	40	24
Nanophytoplankton respiration	nan-res	4	4	6	6	0.3	0.1	0.2	0.1
Nanophytoplankton dissolved organic carbon exudation	nan-doc	6	6	10	9	0.5	0.2	0.4	0.3
Nanophytoplankton detritus production	nan-det	9	7	37	57	0.1	0.02	0.2	0.01
Nanophytoplankton grazing by protozooplankton	nan-pro	19	36	44	23	2	1	3	2
Nanophytoplankton grazing by metazooplankton 1	nan-met1	9	7	20	3	0.1	0.02	1	0.01
Nanophytoplankton grazing by metazooplankton 2	nan-met2	9	0.1	0.06	9	0.03	0.03	1	0.01
Nanophytoplankton sinking	nan-los	9	1	0.03	0.5	2	0.4	0.2	1
Picophytoplankton respiration	pic-res	6	4	3	7	12	6	2	4
Picophytoplankton dissolved organic carbon exudation	pic-doc	9	6	4	10	20	10	3	6
Picophytoplankton grazing by protozooplankton	pic-pro	90	46	36	92	203	101	28	62
Protozooplankton respiration	pro-res	181	127	63	67	89	113	39	89
Protozooplankton dissolved organic carbon excretion	pro-doc	95	66	33	35	47	59	38	89
Protozooplankton detritus production	pro-det	94	64	31	33	46	58	20	28
Protozooplankton consumption by met1	pro-met1	158	99	43	50	76	91	42	69

Protozooplankton consumption by metazooplankton 2	pro-met2	84	66	35	34	46	58	5	0.1
Metazooplankton 1 respiration	met1-res	92	80	54	45	43	63	19	36
Metazooplankton1 dissolved organic carbon excretion	met1-doc	47	41	28	23	22	33	18	36
Metazooplankton1 detritus production	met1-det	45	39	26	22	21	31	10	11
Metazooplankton1 consumption by metazooplankton 2	met1-met2	67	60	42	33	33	48	19	28
Metazooplankton1 sinking	met1-los	38	31	21	18	16	25	1	0.02
Metazooplankton 2 respiration	met2-res	96	68	45	43	37	57	13	22
Metazooplankton2 dissolved organic carbon excretion	met2-doc	48	35	23	22	19	29	12	22
Metazooplankton 2 detritus production	met2-det	46	32	21	21	18	27	6	7
Metazooplankton 2 sinking	met2-los	96	69	45	44	38	58	11	17
Bacteria respiration	bac-res	26	13	14	20	19	16	27	55
Bacteria dissolved organic carbon production	bac-doc	32	21	17	30	23	22	40	82
Bacteria grazing by protozooplankton	bac-pro	58	14	29	26	42	28	67	137
Dissolved organic carbon uptake by bacteria	doc-bac	117	48	60	77	85	65	135	274
Dissolved organic carbon output	doc-los	236	223	103	96	81	167	0.5	0.01
Detritus dissolution	det-doc	46	43	26	25	21	31	13	22
Detritus consumption by metazooplankton1	det-met1	89	130	87	84	50	85	17	24
Detritus consumption by metazooplankton2	det-met2	61	78	56	44	53	33	5	0.1
Detritus sinking	det-los	34	34	23	20	16	25	1	0.01

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21 **Table 4.** Constraints (inequalities) used for the eight networks based on literature.

Process	Concerned compartment	Bound	Description	Equation	Reference
Respiration	pic, nan, mic	Lower	Autotroph respiration (r) is higher than 5% of gross primary production (gpp)	$5\% \text{ gpp} < r$	Vézina and Platt (1988)
		Upper	Autotroph respiration (r) is no more than 30% of gross primary production (gpp)	$r < 30\% \text{ gpp}$	
	bac	Lower	Bacteria respiration (r') is higher than 20% of total uptake of doc (udoc)	$20\% \text{ udoc} < r'$	Vézina and Savenkoff (1999)
	pro, met1, met2	Lower	Zooplankton respiration (r'') is at least 20% of their total ingestion (ΣIng)	$20\% \Sigma\text{Ing} < r''$	Vézina and Savenkoff (1999)
Dissolved organic carbon production	pic, nan, mic	Lower	Autotroph doc exudation (e) is higher than 10% of their net primary production (npp)	$10\% \text{ npp} < e$	Vézina and Savenkoff (1999)
		Upper	Autotroph doc exudation (e) de not exceed 55% of their net primary production (npp)	$e < 55\% \text{ npp}$	
	pro, met1, met2	Lower	Zooplankton excretion (ex) of doc is at least 10% of their total ingestion (ΣIng)	$10\% \Sigma\text{Ing} < \text{ex}$	Vézina and Pace (1994)
		Upper	Zooplankton excretion (ex) doesn't exceed their respiration (r'')	$\text{ex} < r''$	Vézina and Platt (1988)
	bac	Upper	Bacteria doc release (rdoc) is lower than their respiration (r')	$r\text{doc} < r'$	Vézina and Pace (1994)
Growth efficiency	pro, met1, met2	Lower	The growth efficiency of zooplankton is at least 25% of their carbon uptake	$25\% \Sigma\text{Ing} < \text{Ing} - (r'' + \text{ex} + \text{det})$	Vézina and Pahlow (2003)
		Upper	The growth efficiency of zooplankton is no more than 50% of their carbon uptake	$\text{Ing} - (r'' + \text{ex} + \text{det}) < 50\% \Sigma\text{Ing}$	Vézina and Pahlow (2003)
	bac	Lower	Growth efficiency of bacteria is at least 5 % of their total ingestion	$5\% \text{ udoc} < \text{udoc} - (r' + r\text{doc})$	Vézina and Pahlow (2003)
		Upper	Growth efficiency of bacteria is no more than 50% of their total ingestion	$\text{udoc} - (r' + r\text{doc}) < 50\% \text{ udoc}$	Vézina and Pahlow (2003)
Assimilation efficiency	pro, met1, met2	Lower	Assimilation efficiency of zooplankton is at least 50 % of their total ingestion	$50\% \Sigma \text{ Ing} < \text{Ing} - \text{det}$	Vézina et al. (2000)
		Upper	Assimilation efficiency of zooplankton is no more than 90% of their total ingestion	$\text{Ing} - \text{det} < 90\% \Sigma \text{ Ing}$	
Detritus production	pro, met1, met2	Lower	Zooplankton det production is at least 5% of their det production and respiration combined	$5\% (\text{zoo-det} + \text{zoo-res}) < \text{zoo-det}$	Steinberg et al. (2000)
		Upper	Zooplankton det production is no more than 42% of their det production and respiration combined	$\text{Zoo-det} < 42\% (\text{zoo-det} + \text{zoo-res})$	
Detritus dissolution	det	Upper	Det dissolution does not exceed 10% of net primary production	$\text{det-doc} < 10\% \text{ npp}$	Pace et al. (1984)

23 **Table 5.** Ecological indicators used for the Channel and the Bay models. Nomenclature of symbols used in formula calculation of network index
 24 equations: i : flow out of the system from i , $i=1, \dots, n$; j : flow into the system to j , $j=1 \dots n$; T_i : Total outflow from compartment i ; T_j : Total inflow
 25 for compartment j ; and T_{ij} : Flow from compartment i to compartment j . TST_c is the total flow that is recycled, Z : equals the sum of all
 26 exogenous inputs.
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Ecological indicator	Definition	Formula calculation	Unit	Reference
Total System Throughput (TST)	The sum of all the flows circulating through all compartments and a measure of the total system activity.	$TST = \sum_{i=1, j=1}^n T_{ij}$	mg C m ⁻² d ⁻¹	Kay et al. (1989)
Ascendency (A)	Ascendency represents the organized part of the ecosystem and merges the quantification of the system activity and the degree of specialization.	$A = \sum_{ij} (T_{ij}) * \log \left(\frac{T_{ij} * TST}{T_j * T_i} \right)$	mg C m ⁻² d ⁻¹ x bits	Ulanowicz and Wulff (1991) Ulanowicz (2000)
Development Capacity (DC)	Represents the maximum possible value of Ascendency that an ecosystem may reach.	$DC = -TST * \sum_{ij} \frac{T_{ij}}{TST} * \log \left(\frac{T_{ij}}{TST} \right)$	mg C m ⁻² d ⁻¹ x bits	Ulanowicz and Wulff (1991) Ulanowicz (2000)
Relative Ascendency (A/DC)	Defines the ecosystem degree of development. High A/DC ratios reflect a high degree of organization, highly specialized and less redundant pathways.	$\frac{A}{DC}$	%	Baird et al. (1991, 1998)
Average Path Length (APL)	It is the average number of compartments crossed by a unit of carbon from entering to exiting the ecosystem. Represents a measure of the ecosystem retention capacity.	$APL = \frac{TST - \sum_i imports}{\sum_i imports}$	no unit	Kay et al. (1989) Baird et al. (1991)
Finn Cycling Index (FCI)	Quantifies the fraction of all flows involved in recycling and can be considered as a measure of the retentiveness of the system.	$FCI = \frac{TST_c}{TST}$	%	Finn (1976)
Detritivory/Herbivory (D/H)	Indicates the importance of living trophic interactions compared to detritus chain.	$\frac{D}{H}$	No unit	Ulanowicz (1992)

28 **Table 6.** Results of the Cliff's δ test applied to ecological network indices calculated for the Channel and the Bay over the four seasons.
 29 Comparison was made between seasons (spring/summer, spring/autumn, spring/winter, summer/autumn, summer/winter and winter/autumn) for
 30 each ecological indices (TST, A, DC, A/DC, APL, FCI and D/H. Asterisk Between brackets represent the magnitude of the effect (***) : large
 31 and (ns) negligible effects.

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		Spring/Summer		Spring/Autumn		Spring/Winter		Summer/Autumn		Summer/Winter		Winter/Autumn	
Channel (inshore station)	TST	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)
	A	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)
	DC	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)
	A/DC	0.54	(***)	0.54	(***)	-0.99	(***)	0.54	(***)	-0.99	(***)	0.99	(***)
	APL	-0.92	(***)	0.99	(***)	-1	(***)	0.99	(***)	-1	(***)	0.99	(***)
	FCI	-0.67	(***)	0.99	(***)	-1	(***)	0.99	(***)	-1	(***)	0.99	(***)
	D/H	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)
Bay (marine station)	TST	0.99	(***)	0.99	(***)	0.99	(***)	-0.99	(***)	0.99	(***)	0.99	(***)
	A	0.99	(***)	0.99	(***)	0.99	(***)	-0.99	(***)	0.87	(***)	0.99	(***)
	DC	0.99	(***)	0.99	(***)	0.99	(***)	-0.99	(***)	0.99	(***)	0.99	(***)
	A/DC	0.95	(***)	-0.01	(ns)	-0.94	(***)	-0.96	(***)	-1	(***)	-0.96	(***)
	APL	-0.62	(***)	-0.53	(***)	-1	(***)	0.12	(ns)	-1	(***)	-1	(***)
	FCI	-0.94	(***)	-0.60	(***)	-1	(***)	0.87	(***)	-1	(***)	-1	(***)
	D/H	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)	0.99	(***)

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