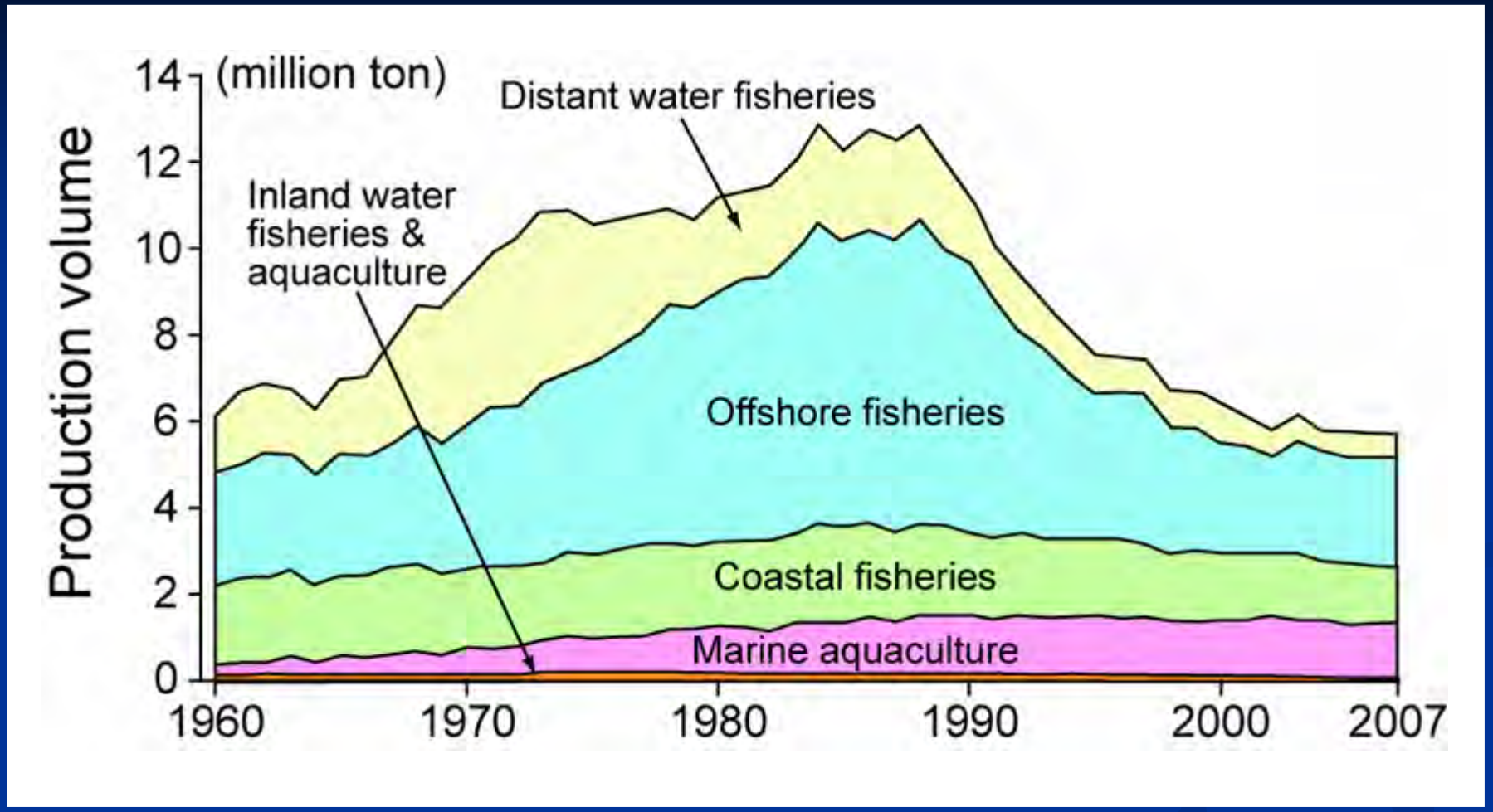
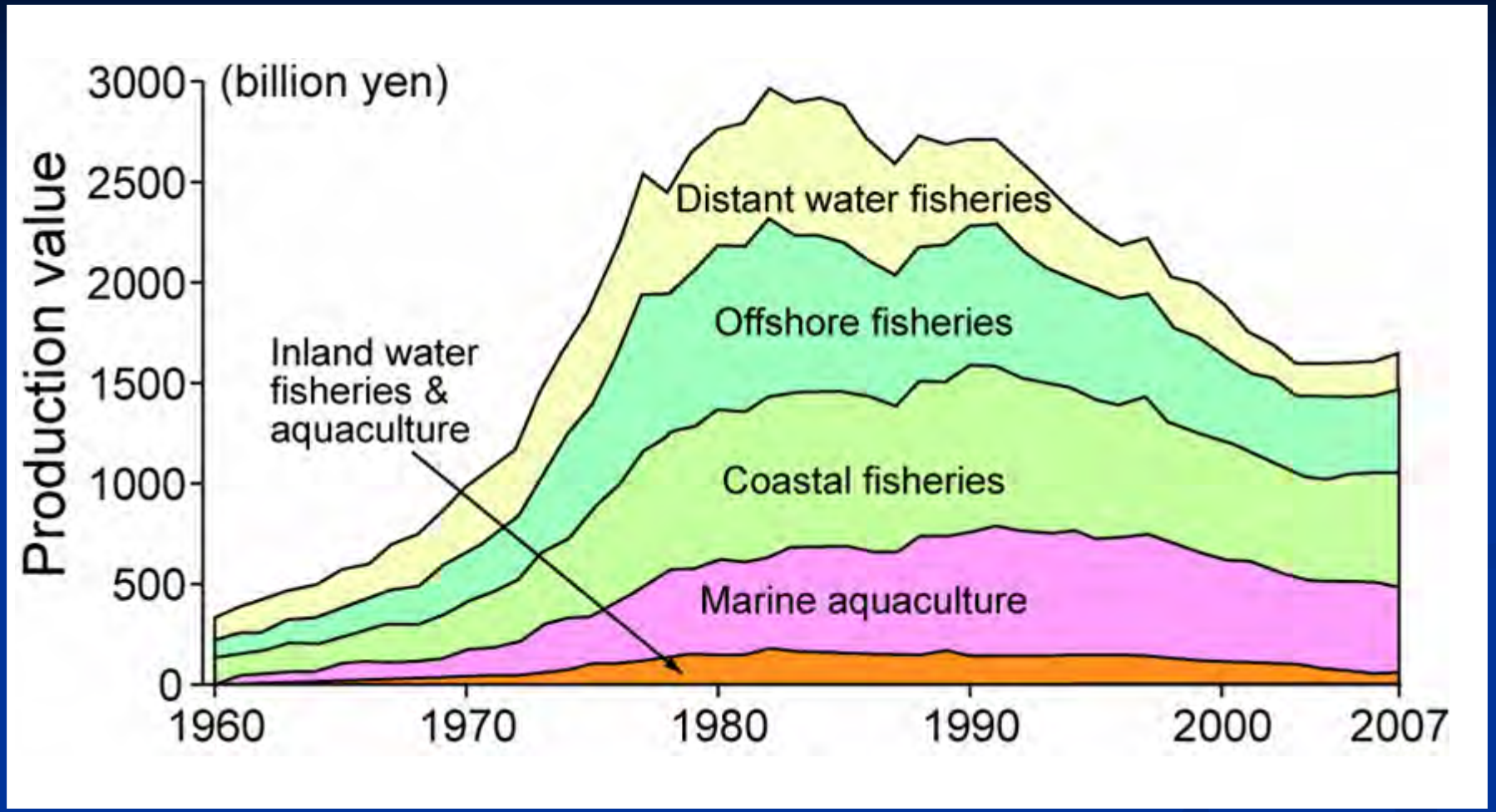
Assessing nutrient environments of Nori (*Porphyra*) aquaculture area using numerical model

Katsuyuki Abo and Toshinori Takashi

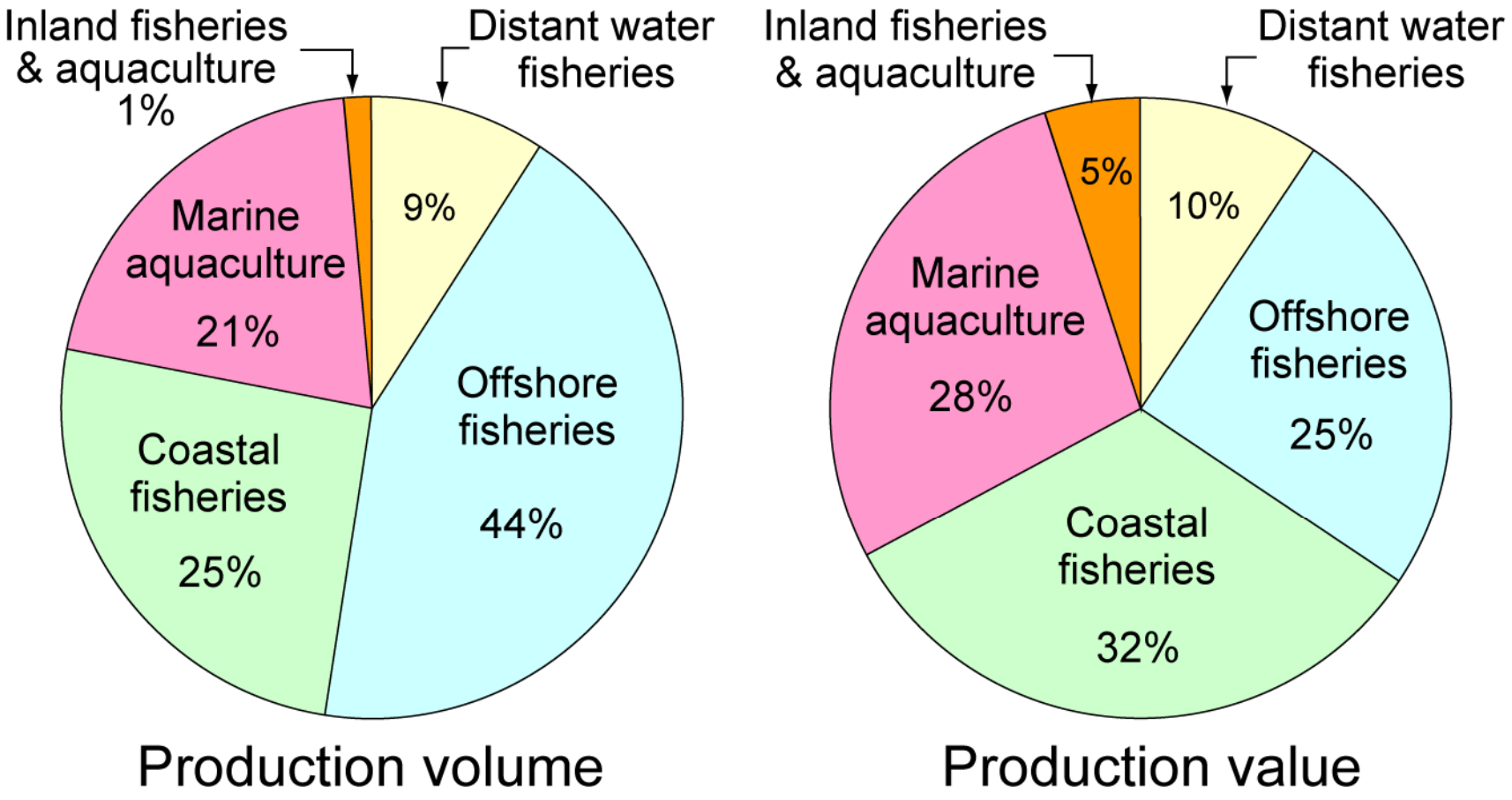
National Research Institute of Aquaculture, FRA, Japan



Fisheries production volume in Japan

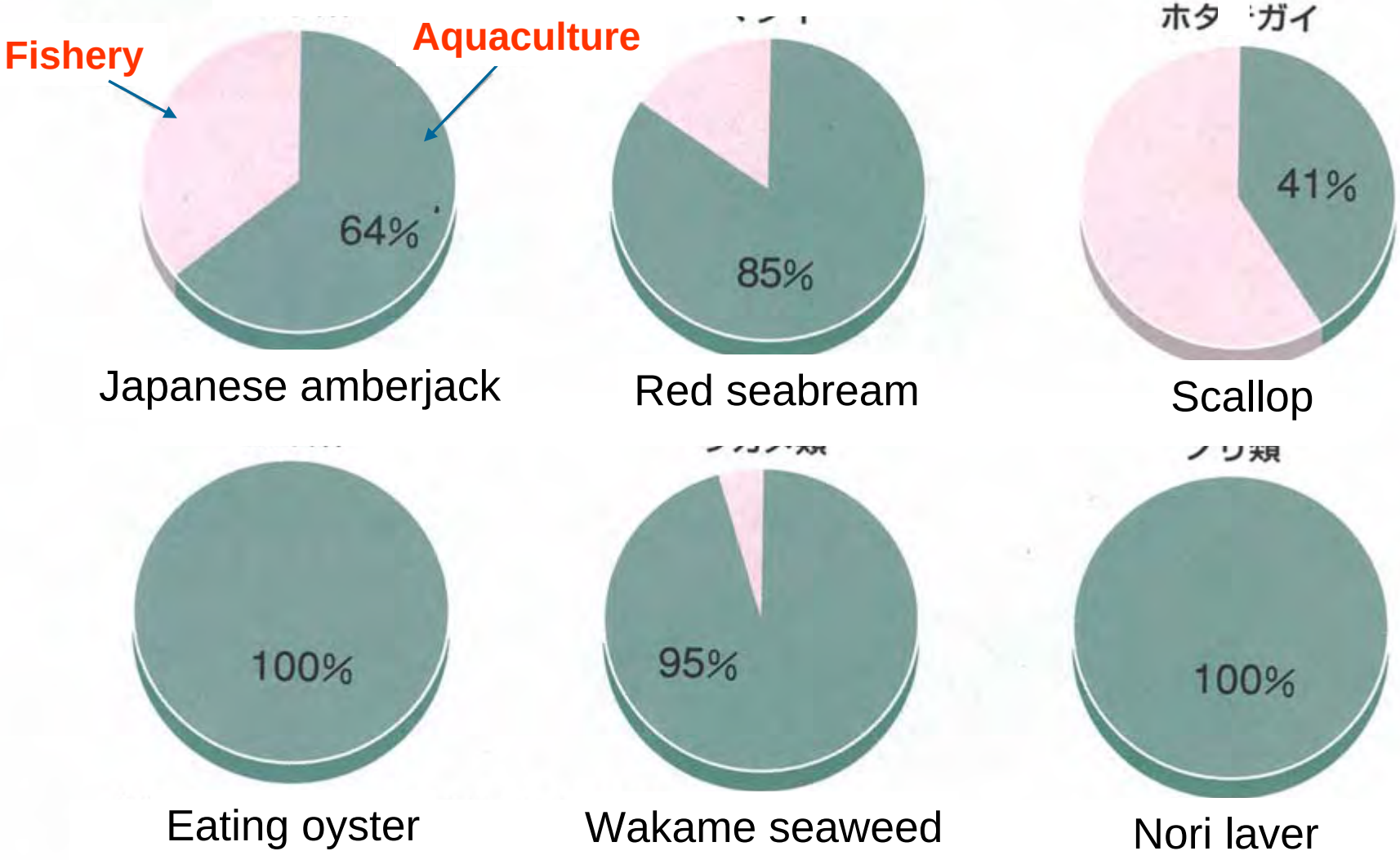


Fisheries production value in Japan



Fisheries production in Japan (2006)

■ 主な海面養殖対象種)総生産量に占める割合



Proportion of mariculture products in the total production volume

Marine aquaculture production in Japan (2007)

Species	Value (billion yen)	Production (thousand tons)
Fin fish	(213.8)	(262)
Yellowtail (Amberjack; *Seriola quinqueradiata*)	113.5	160
Red seabream (*Pagrus major*)	55.5	67
Flounder (Bastard halibut; *Paralichthys olivaceu*	7.4	5
Ocellate puffer (*Takifugu rubr*		
Coho salmon (*Oncorhynchus k*		
Shellfish		
Scallop (*Patinopecten yessoen*		
Oyster (*Crassostrea gigas*)		
Seaweed	(116.2)	(514)
Nori (Laver; *Porphyra spp*)	95.0	396
Kombu (*Laminaria spp*)	10.6	41
Wakame (Seamustard; *Undaria pinnatifida*)	7.3	54
Kuruma prawn (*Marsupenaeus japonicus*)	8.7	2
Pearl	18.0	3

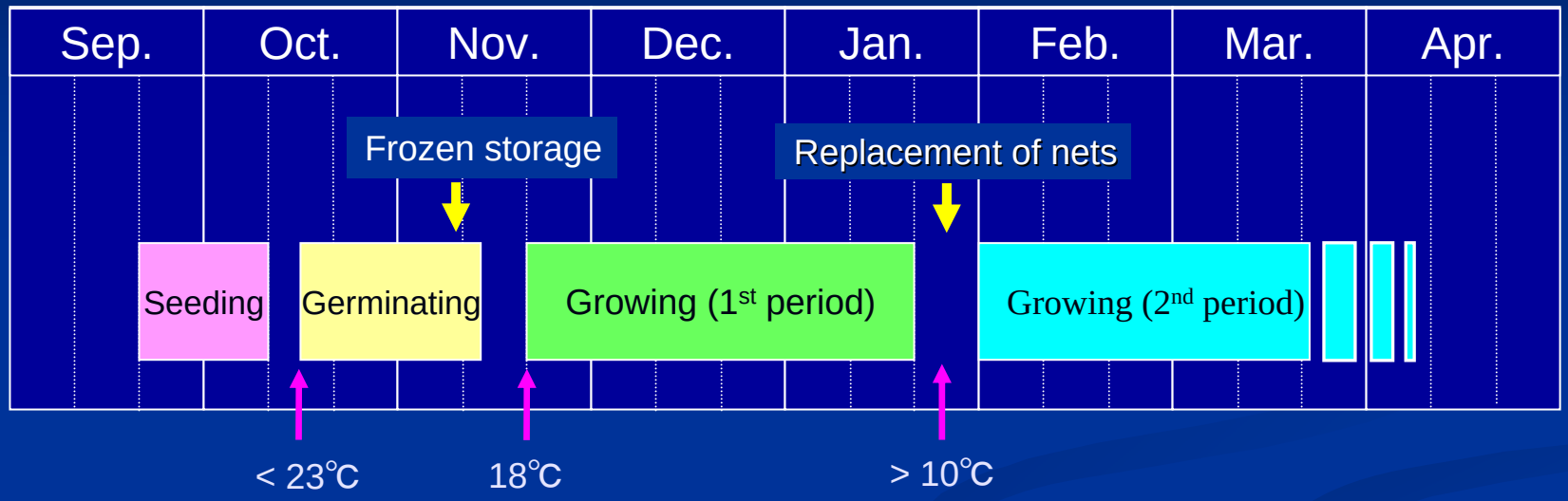
	Environmental impact	Sustainability
Fin fish aquaculture	△	△
Shellfish aquaculture	○	◎
Seaweed aquaculture	◎	◎

Nori (*Porphyra yezoensis*)

Nori aquaculture (fixed net with poles)

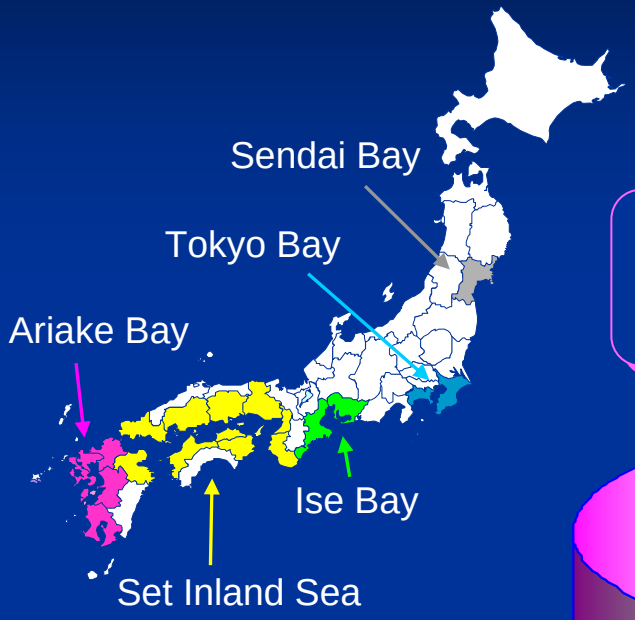
Harvesting of Nori (*Porphyra*)

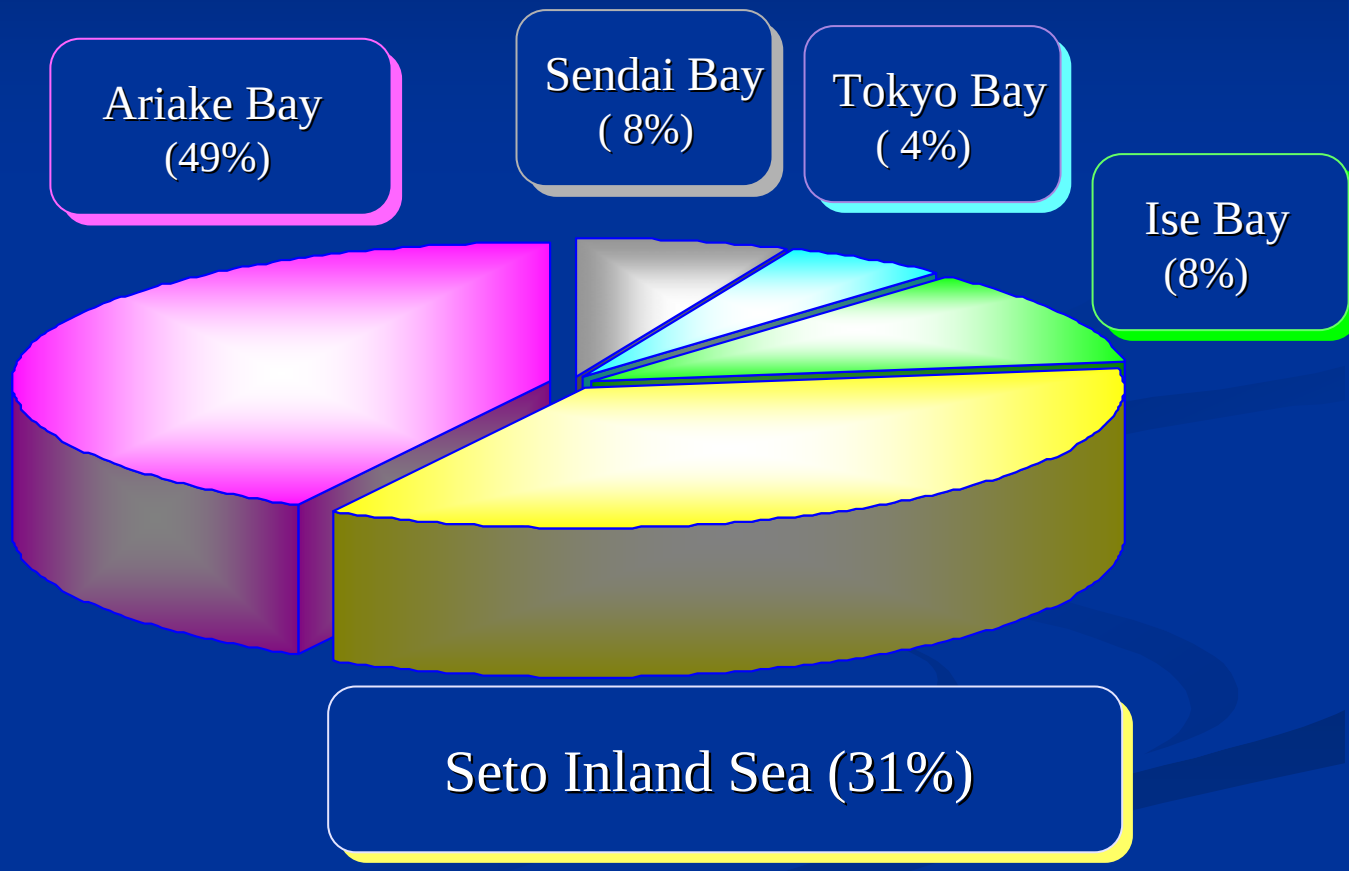
Process of Nori aquaculture

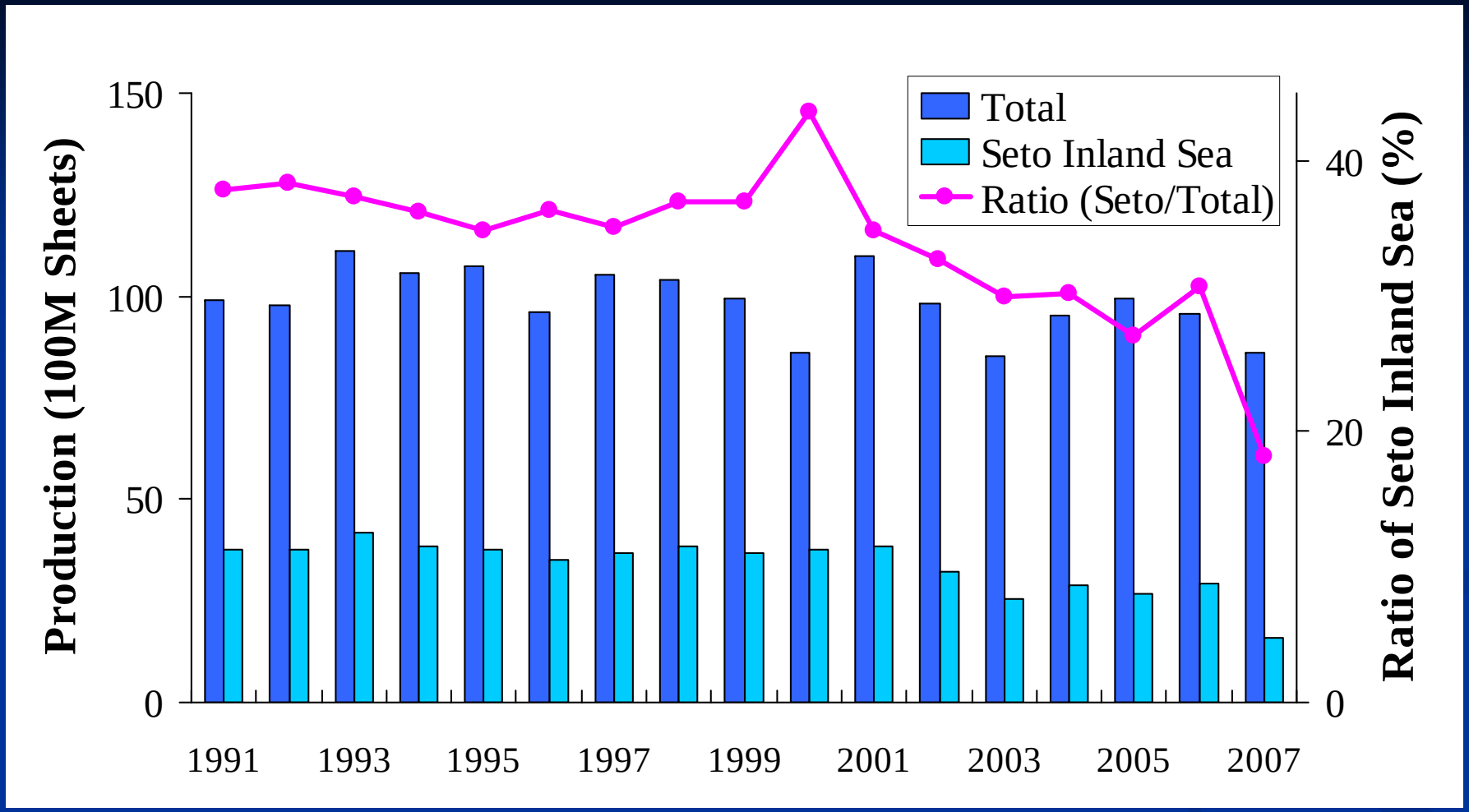


- Each process is done considering water temperature and nutrients in sea water
- Harvesting comes to an end when nutrient level goes down in spring
- Prediction of water temperature and nutrient level of sea water are required

Nori (Porphyra) Production in Japan (2006)







Transition of Nori aquaculture production in Japan

Bleaching of nori

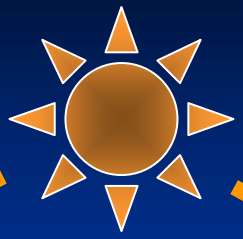
Normal

Abundant pigment

Phycoerythrin (Red)

Chlorophyll *a* (Gr.)

Phycocyanin (Bl.)



sufficient

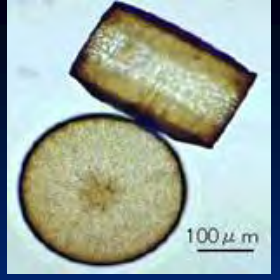
deficient

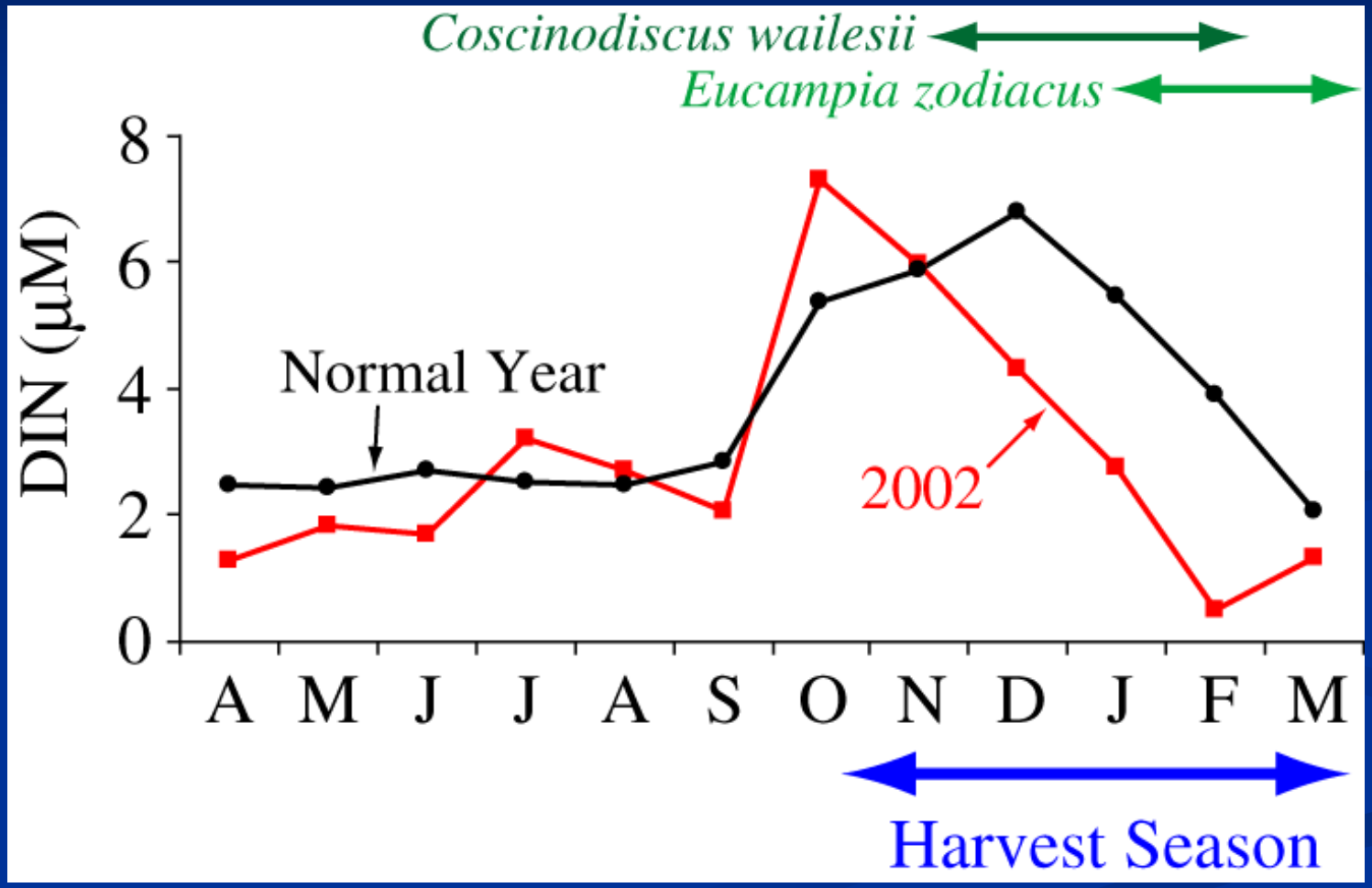
Nutrients
(N, P, metals)

Bleaching

Lacking of pigment

Decline in commercial value

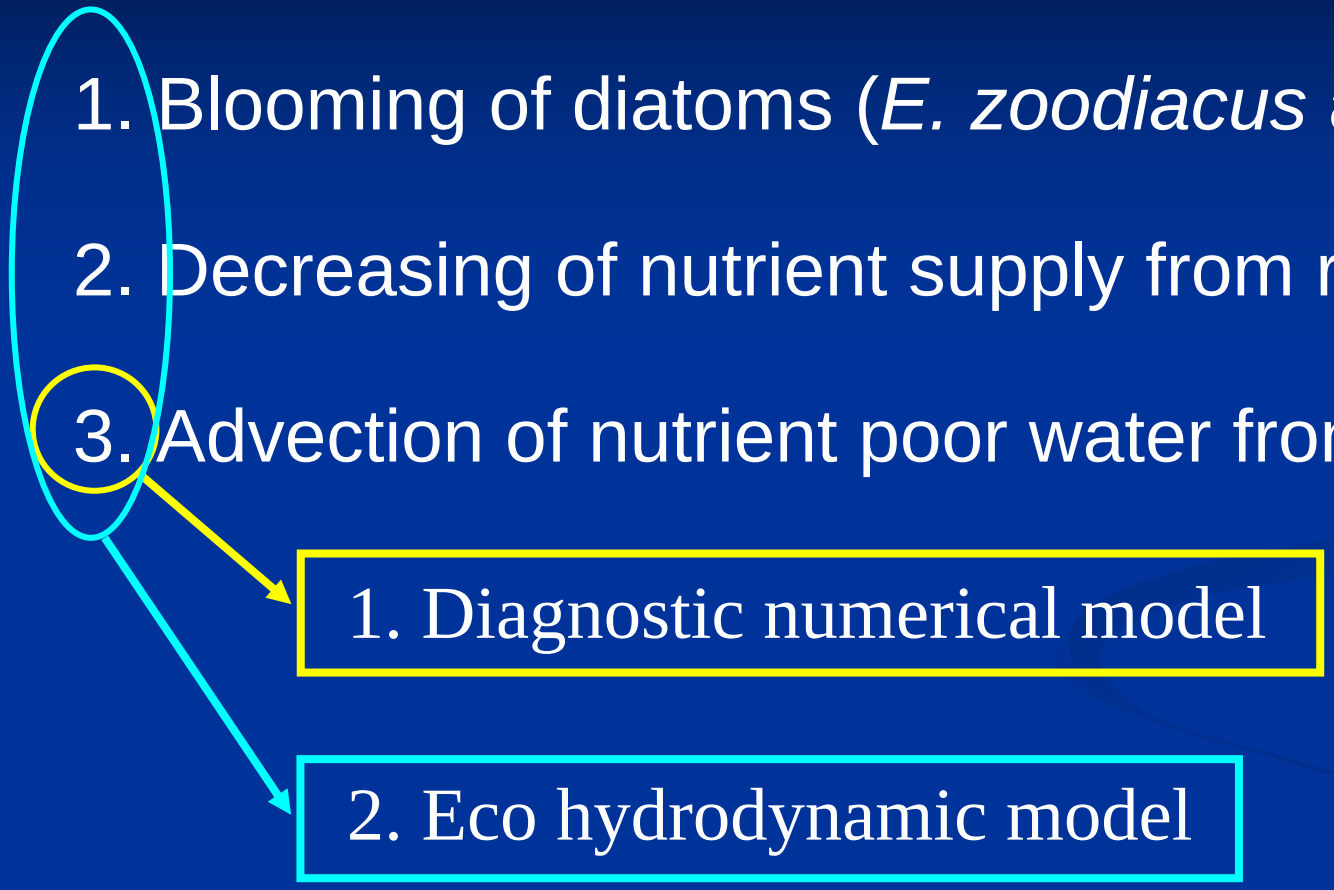




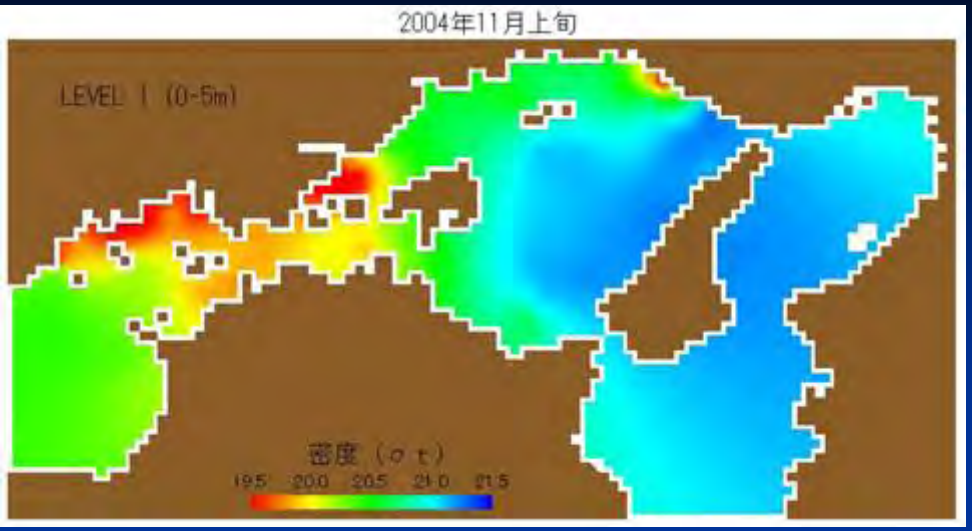
Seasonal fluctuation of nutrient level in 2002 (crop failure year) comparing with that in normal year

Factors affecting nutrient deficiency of sea water

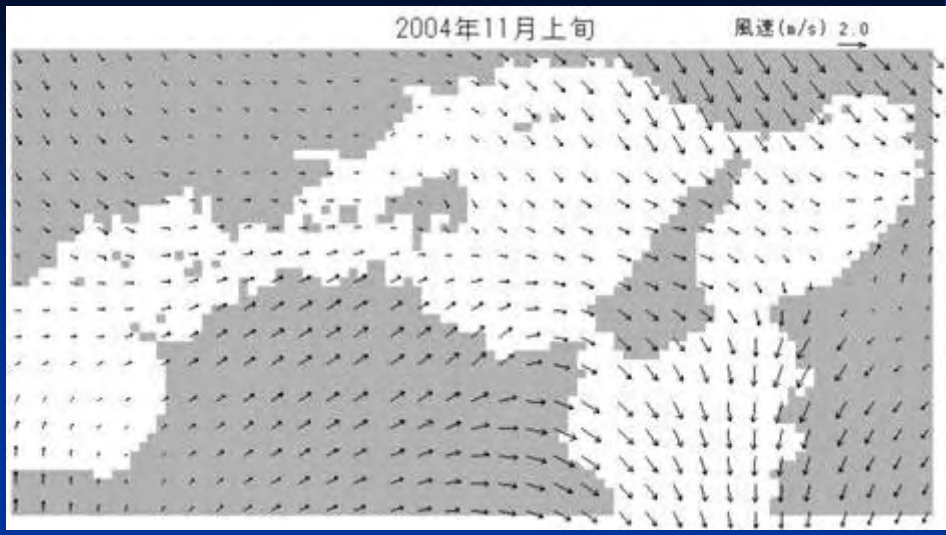
1. Blooming of diatoms (*E. zoodiacus* and *C. wilesii*)
2. Decreasing of nutrient supply from rivers
3. Advection of nutrient poor water from adjacent sea



Density field

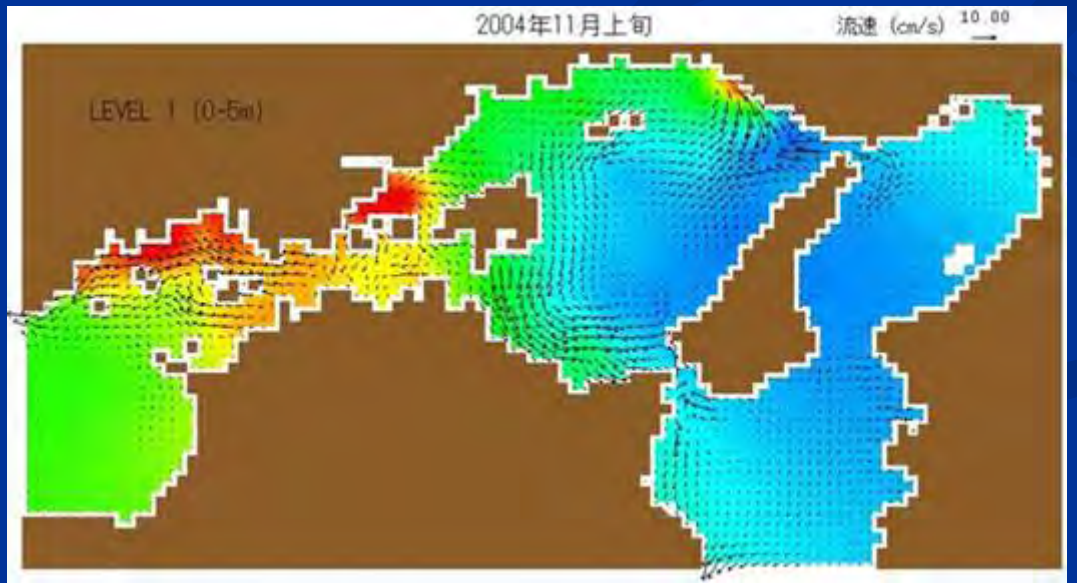


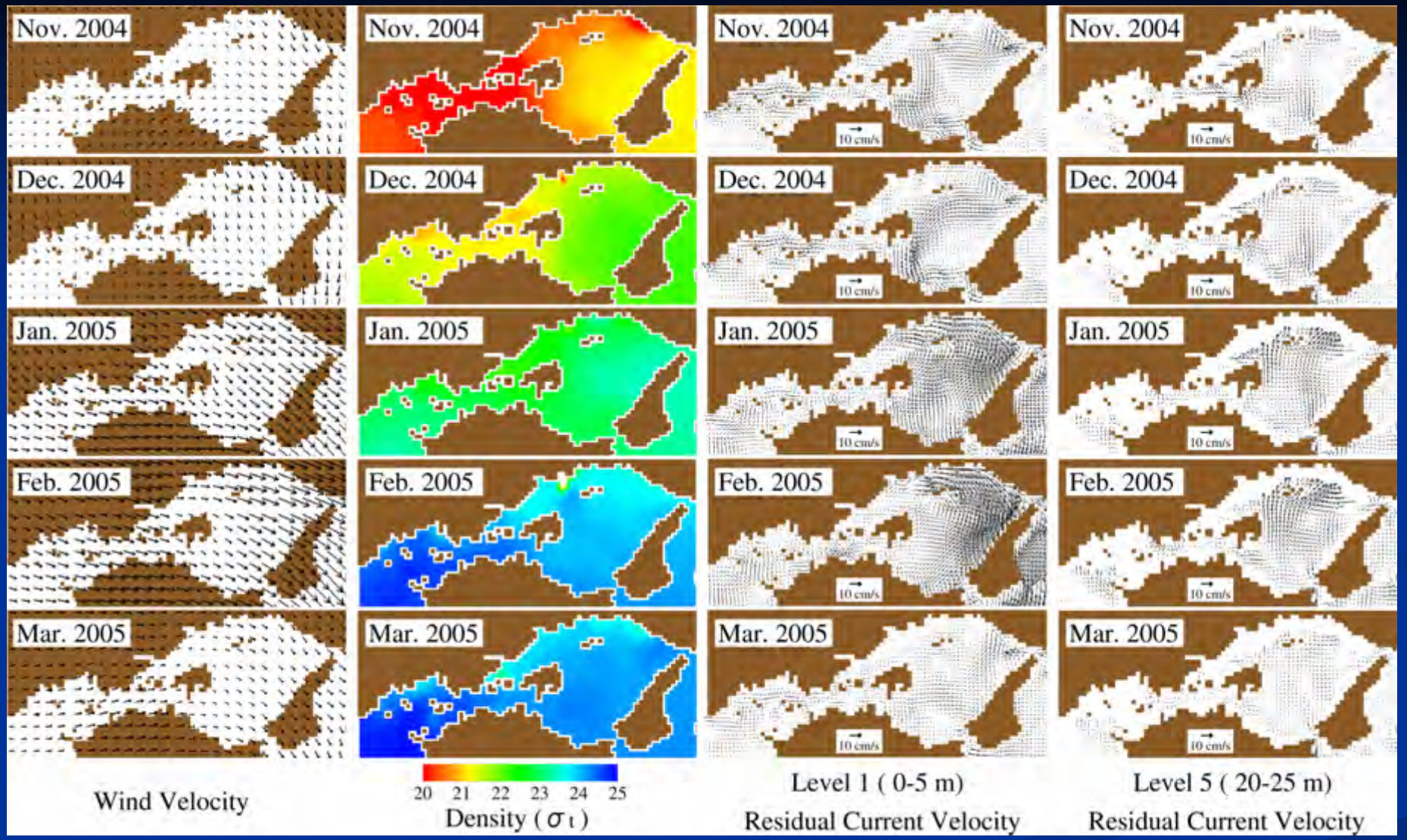
Wind field



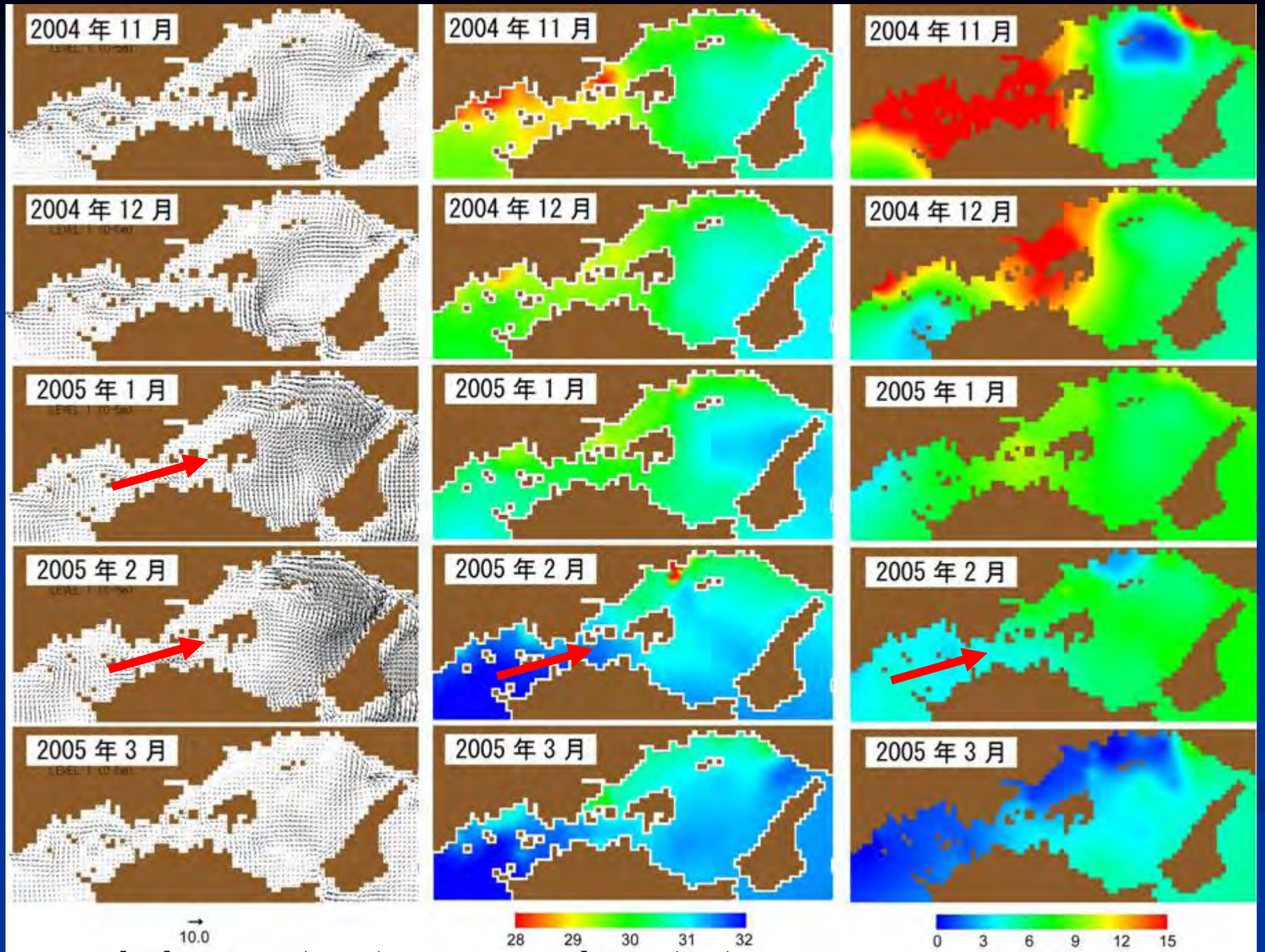
(diagnostic model)

Residual current flow

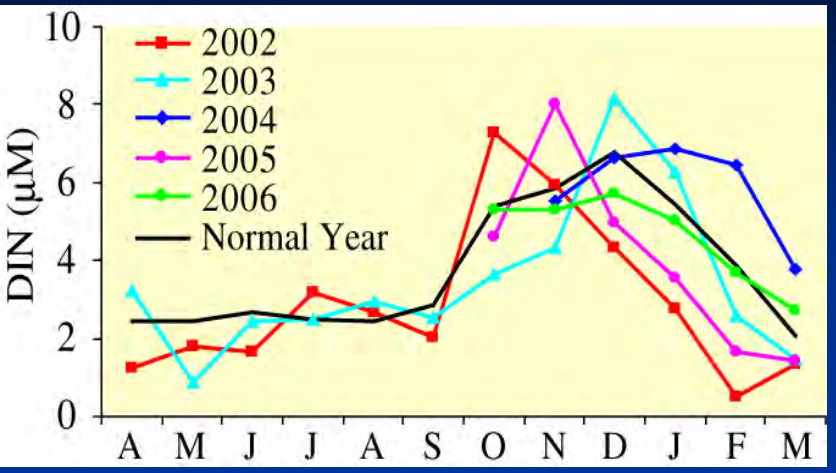




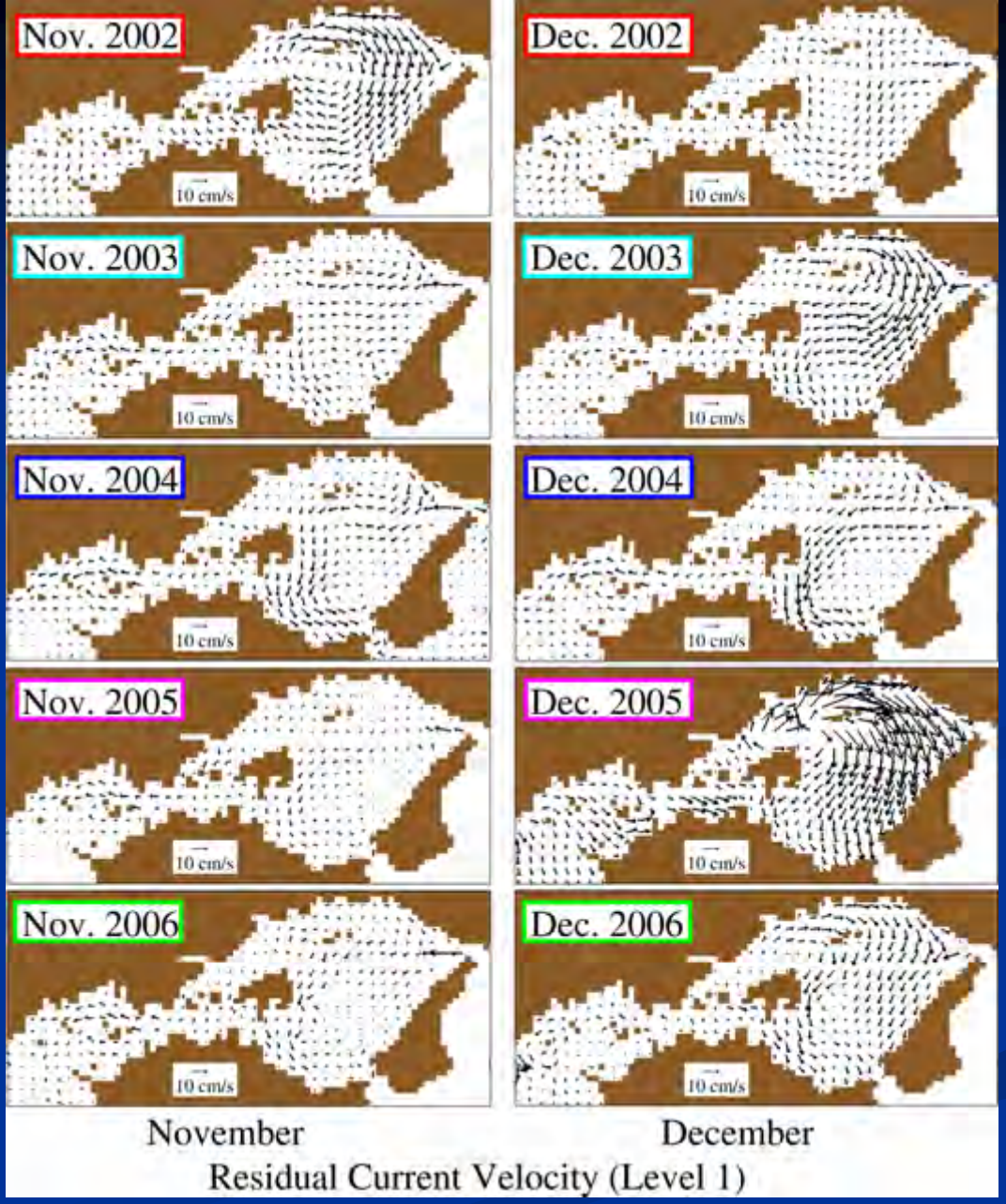
Result of diagnostic numerical model



Residual current (cm/s) Salinity (ppt) DIN (μM)



Fluctuations of nutrient level comparing with residual current flows in November and December



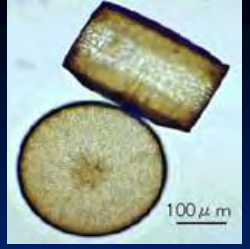
Factors affecting nutrient deficiency of sea water

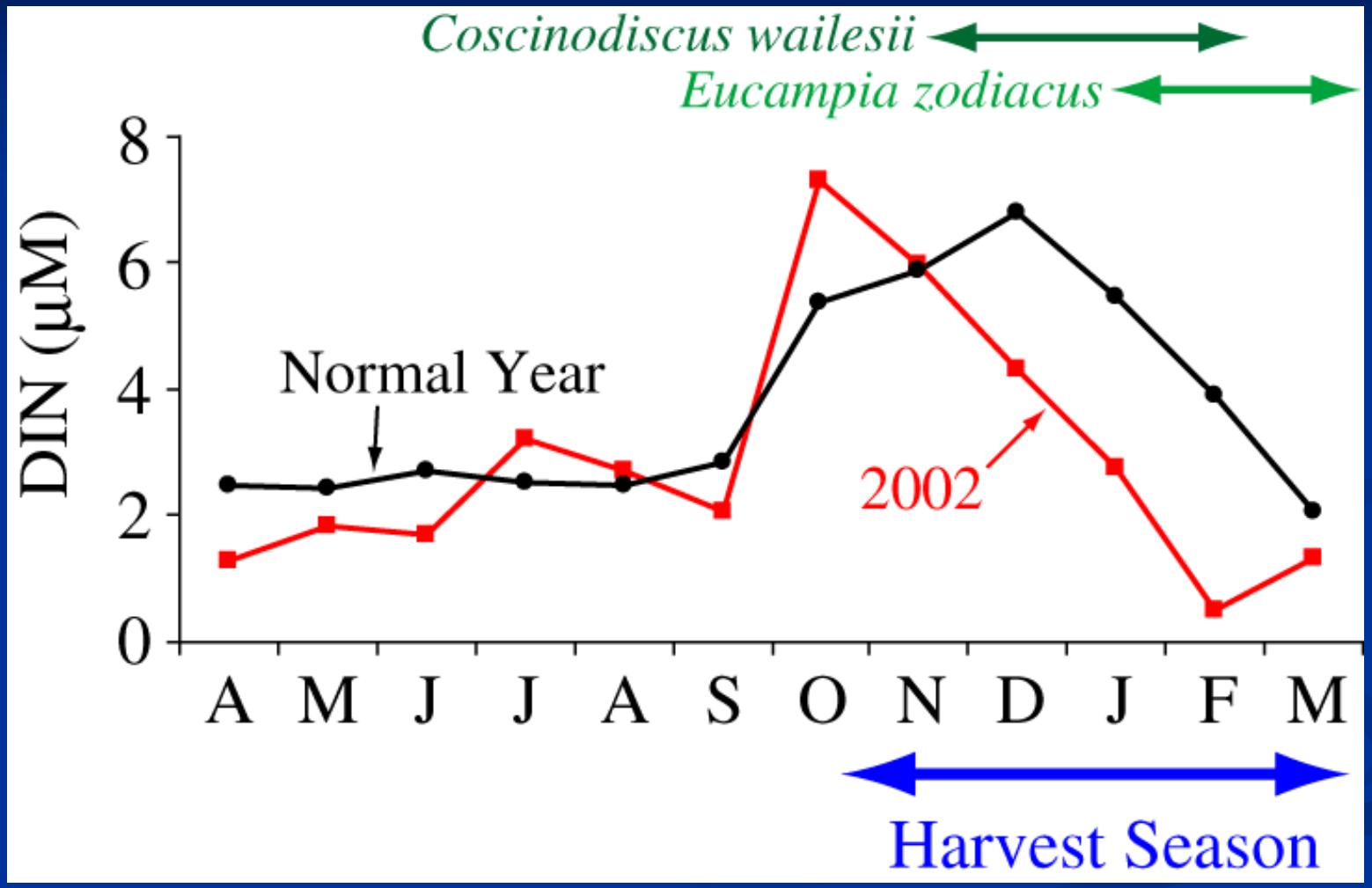
1. Blooming of diatoms (*E. zoodiacus* and *C. wilesii*)
2. Decreasing of nutrient supply from rivers
3. Advection of nutrient poor water from adjacent sea

1. Diagnostic Numerical Model

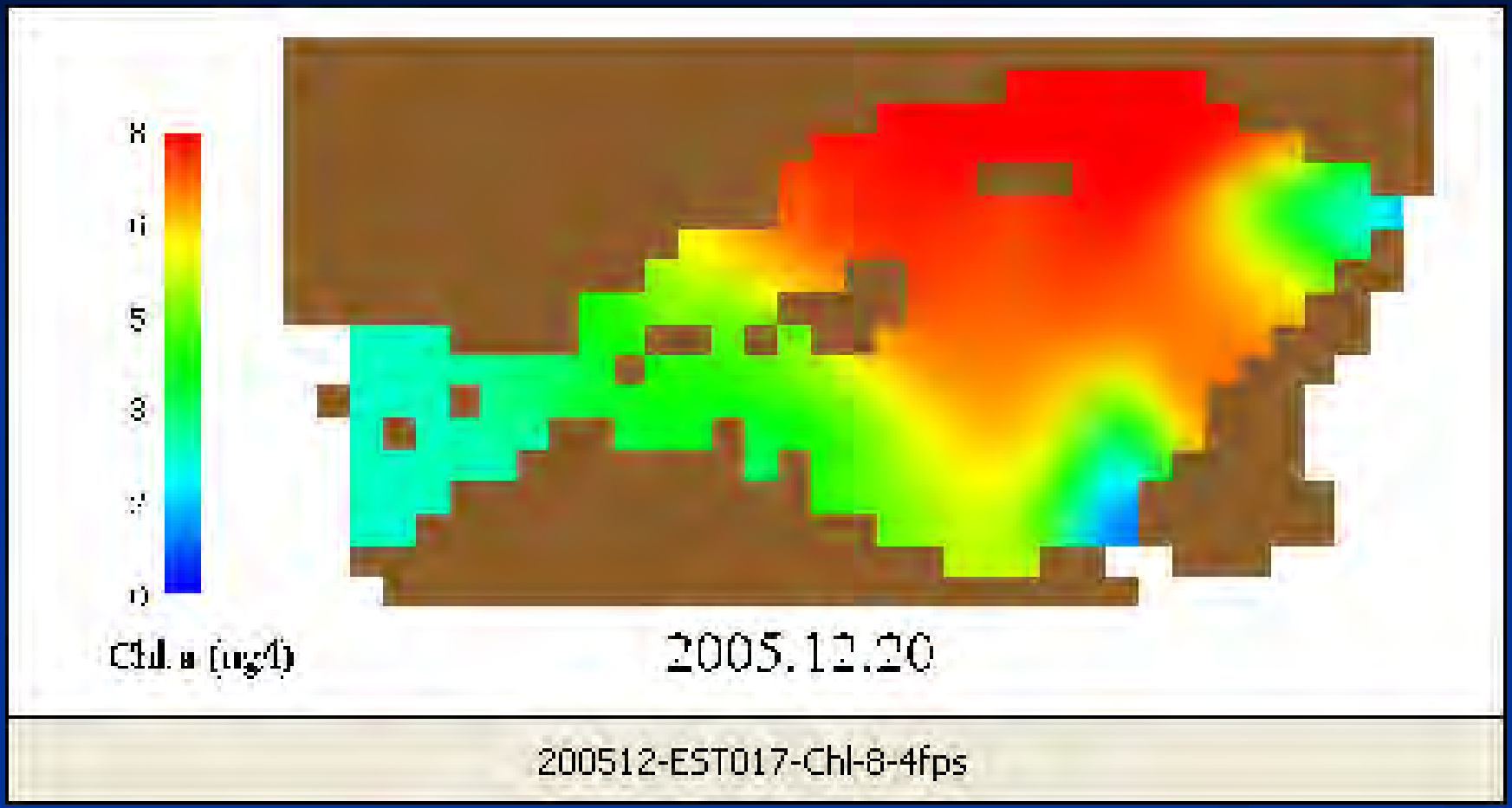
2. Eco Hydrodynamic Model

→ Short term prediction of nutrient level

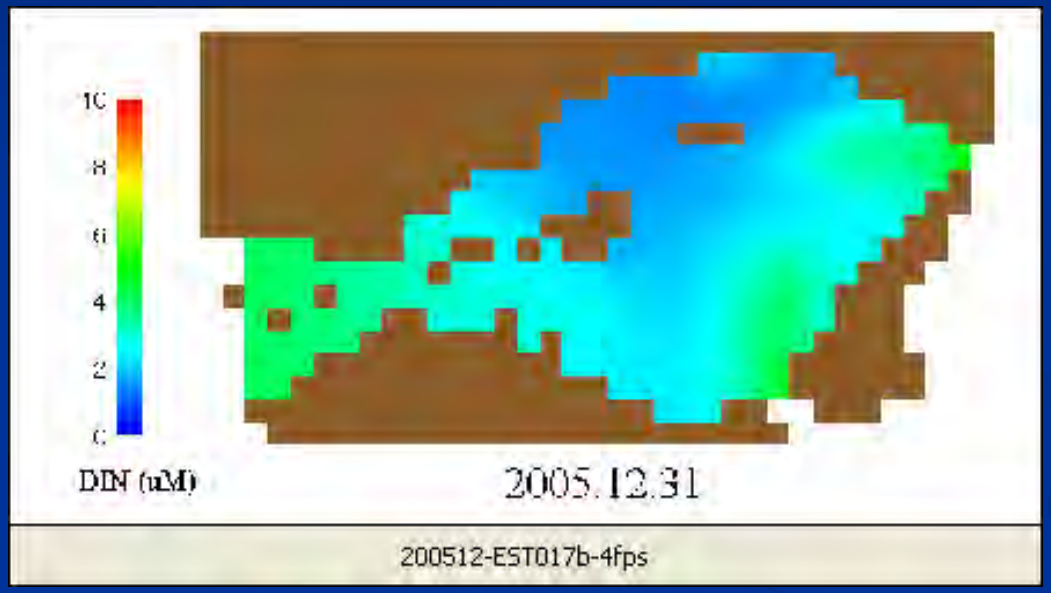


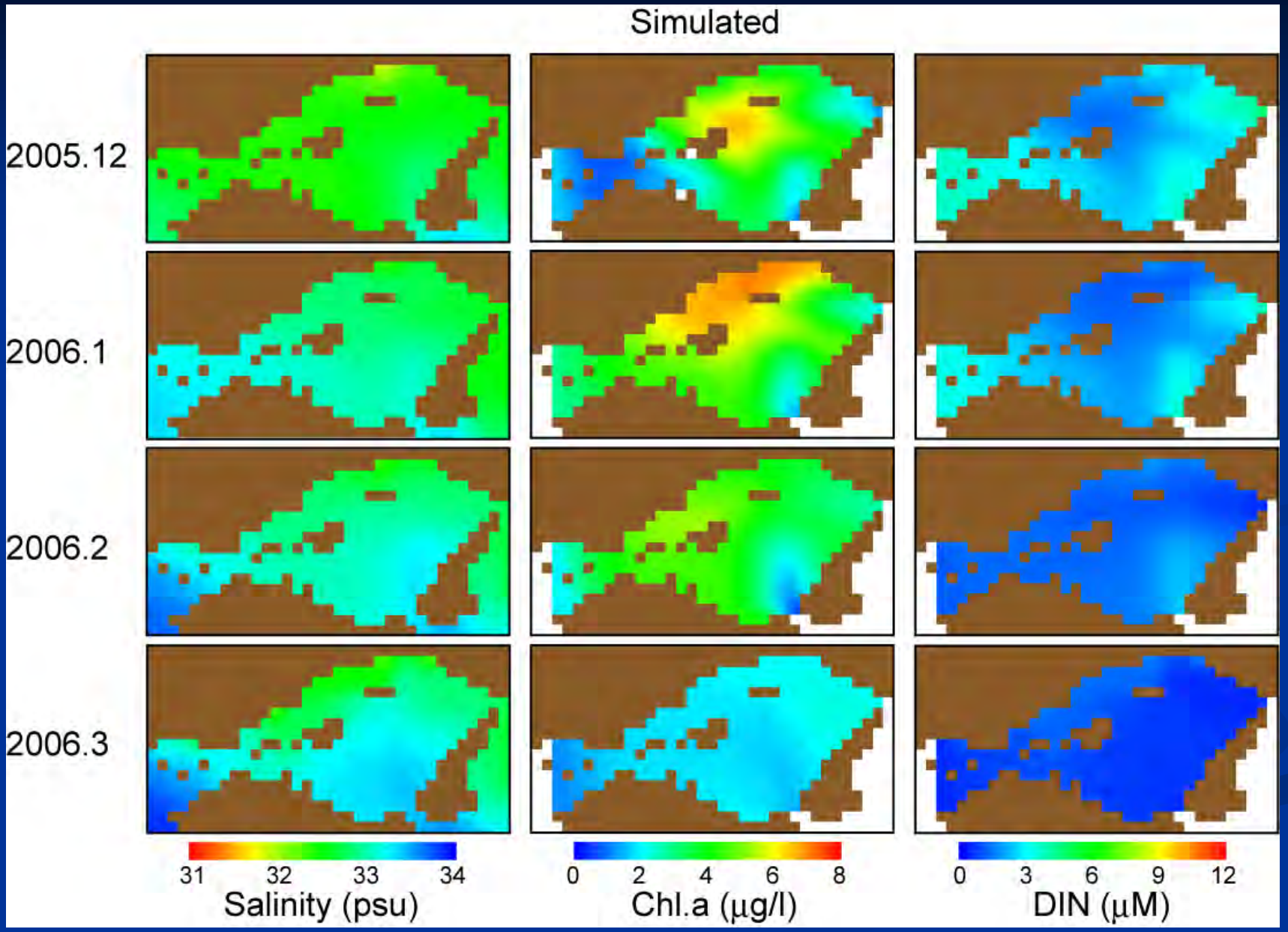


Seasonal fluctuation of nutrient level in 2002 (crop failure year) comparing with that in normal year



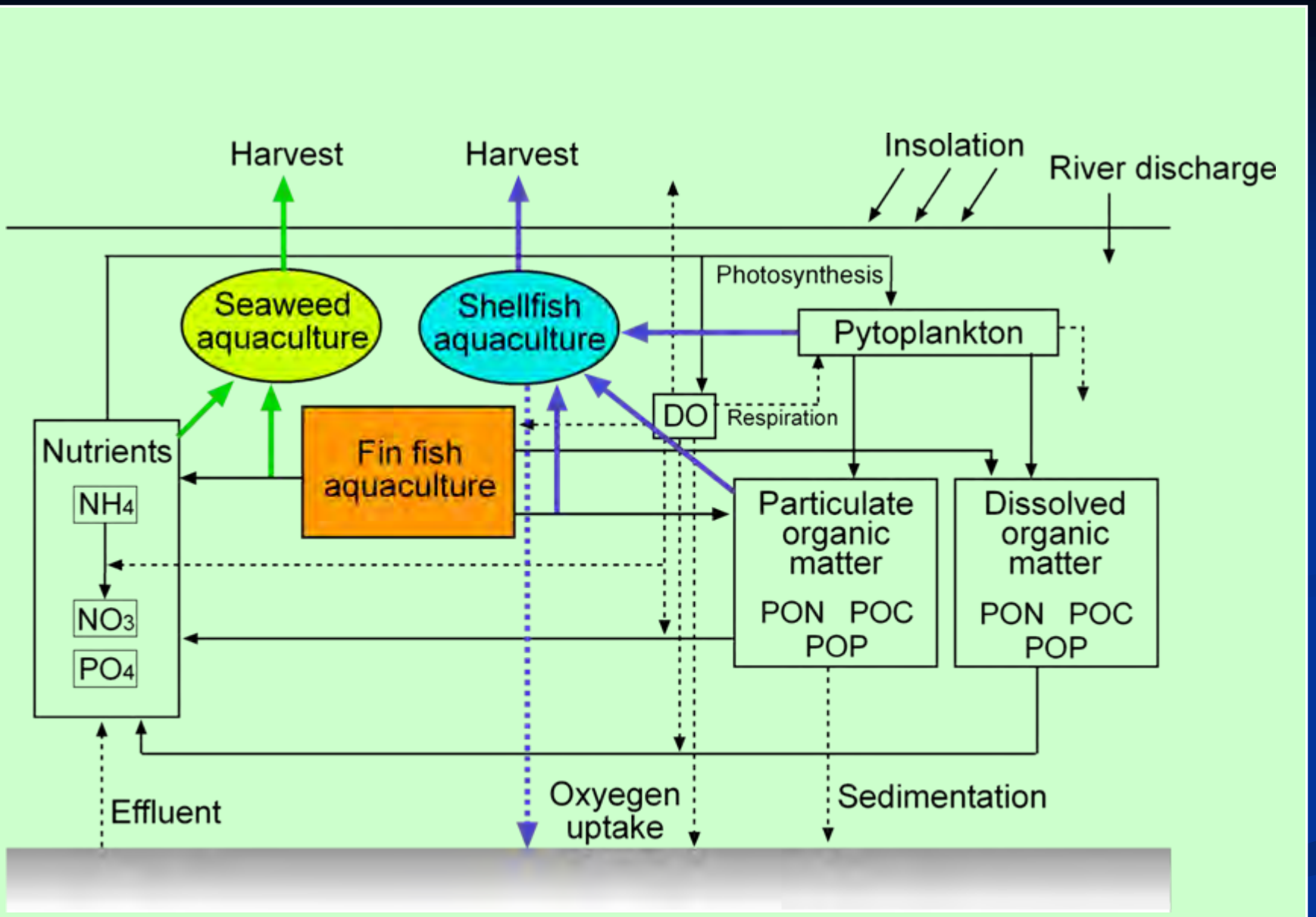
200512-EST017-Chl-8-4fps


10
8
6
4
2
0
DIN (uM)
2005.12.31
200512-EST017b-4fps


Simulated
2005.12
2006.1
2006.2
2006.3
31
32
33
34
Salinity (psu)
0
2
4
6
8
Chl.a (μg/l)
0
3
6
9
12
DIN (μM)

Marine aquaculture production in Japan (2007)

Species	Value (billion yen)	Production (thousand tons)
Fin fish	(213.8)	(262)
Yellowtail (Amberjack; *Seriola quinqueradiata*)	113.5	160
Red seabream (*Pagrus major*)	55.5	67
Flounder (Bastard halibut; *Paralichthys olivaceu*	7.4	5
Ocellate puffer (*Takifugu rubripes*)	9.1	4
Coho salmon (*Oncorhynchus kisutch*)	5.6	14
Shellfish	(72.1)	(454)
Scallop (*Patinopecten yessoensis*)	40.9	248
Oyster (*Crassostrea gigas*)	30.0	205
Seaweed	(116.2)	(514)
Nori (Laver; *Porphyra spp*)	95.0	396
Kombu (*Laminaria spp*)	10.6	41
Wakame (Seamustard; *Undaria pinnatifida*)	7.3	54
Kuruma prawn (*Marsupenaeus japonicus*)	8.7	2
Pearl	18.0	3


Harvest
Harvest
Insolation
River discharge
Photosynthesis
Seaweed aquaculture
Shellfish aquaculture
Pytoplankton
DO
Respiration
Nutrients
NH4
NO3
PO4
Fin fish aquaculture
Particulate organic matter
PON POC POP
Dissolved organic matter
PON POC POP
Effluent
Oxyegen uptake
Sedimentation

E N D