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田辺湾における植物プランクトン増殖過程の観測と群集密度変動のリアルタイム予測

OBSERVATION OF PHYTOPLANKTON MULTIPLICATION PROCESSES AND REAL-TIME PREDICTION OF ITS BLOOMING IN TANABE BAY

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Tanabe bay, is a part of the coastal area located in Wakayama Prefecture, Central Honshu, facing the western North Pacific and is situated in a critical position for Kuroshio current dynamics. The importance of environmental dynamics in the Kii Channel has been studied intensively over recent years resulting in the realization of how periodical variability in this band can have local scale consequences. So, the study site is strongly affected throughout the year by the activity of the Kuroshio off the bay, by the influences of coastal water, by the estuarial discharges and possibly by direct or indirect meteorological impacts caused by the atmospheric disturbances. This area is a very important area for agricultural fisheries and recreation area. Cultural fisheries have traditionally dominated the area and this is still the case, with over 90% of the cultural fish in the Wakayama prefecture. A number of red tide blooms have been present and affected to fishery and marine resort industrials in Tanabe Bay on a large scale since the 1970s. Understanding the natural dynamics of this region is, therefore, of vital importance if the fisheries resources of this productive area are to be sustainably managed.

This research describes that the physical conditions, the chemical and biological features encountered by water circulation. The examination and identification of the relevant spatial-temporal scales over the environmental factors can be detected and to investigate the relationship between the phytoplankton dynamic and environmental condition. We have provided an approach to predict the temporal variation of phytoplankton species using the artificial neural network system and aided kalman filter method and find the optimized data for prediction with environmental factors.

The emphasis is given to the building the real time observation using telemetry system, the analysis of observation and variations of ecosystem as represented by physical water properties and biological aspects at Tanabe Bay. The results have been compared with the features of the ecosystem, and the dynamics of the phytoplankton bloom have been analyzed at the station 1 and the functional linkages with the hydrodynamics are presented. Particular attention has been paid to the correlation among the components.

Table 1 Correlation coefficients between the environmental variables and phytoplankton data in 1999, 2000 and 2000.
In bold, significant values at the level of significance alpha=0.050 (Two-tailed test)

	W.T.	Salinity	A.T.	S.R.	Rain	D.O.	Current	NO3	NO2	NH4	PO4	SiO2	Total phy.	Dinofl.ag.	Diatoms
W.T.	1														
Salinity	**-0.459**	1													
A.T.	**0.625**	-0.089	1												
S.R.	0.005	-0.028	**0.411**	1											
Rain	0.118	0.179	-0.126	**-0.577**	1										
D.O.	-0.315	0.316	0.005	0.138	-0.159	1									
Current	**0.344**	-0.206	0.157	-0.073	**0.376**	**-0.341**	1								
NO3	0.148	**-0.698**	-0.255	0.058	-0.035	**-0.369**	0.174	1							
NO2	-0.007	0.082	**0.390**	-0.178	0.103	0.194	-0.017	-0.280	1						
NH4	0.282	-0.262	0.177	-0.083	0.126	**-0.370**	0.286	**0.356**	0.299	1					
PO4	0.167	**-0.322**	-0.001	0.018	0.031	**-0.424**	0.208	**0.532**	0.174	**0.608**	1				
SiO2	-0.087	**-0.592**	**-0.329**	0.042	-0.157	-0.237	0.110	**0.754**	-0.055	0.313	**0.521**	1			
Total phy.	-0.043	0.160	0.001	0.188	-0.141	0.041	**-0.301**	-0.271	-0.221	-0.284	-0.221	**-0.372**	1		
Dinofl.ag.	0.063	0.209	**0.500**	-0.009	**0.342**	0.055	0.103	**-0.415**	**0.477**	0.051	-0.106	**-0.376**	0.030	1	
Diatoms	-0.044	0.148	-0.025	0.190	-0.161	0.038	**-0.389**	-0.247	-0.245	-0.286	-0.214	**-0.350**	**0.998**	-0.026	1

The numerical modeling method is the fundamentals of the Artificial Neural Networks (ANNs) and the characteristics of the used neural network definitions. We have assessed the possibility of model for phytoplankton prediction with different two phytoplankton species and compared model results with the known behavior of the analyzed systems. This research presents hybrid and coupling of neural network and Kalman filter for the modeling tool. The importance of real time prediction in driving coastal ecosystem behavior has been analyzed with an Artificial Neural Network and Kalman filter coupled model in Tanabe Bay.

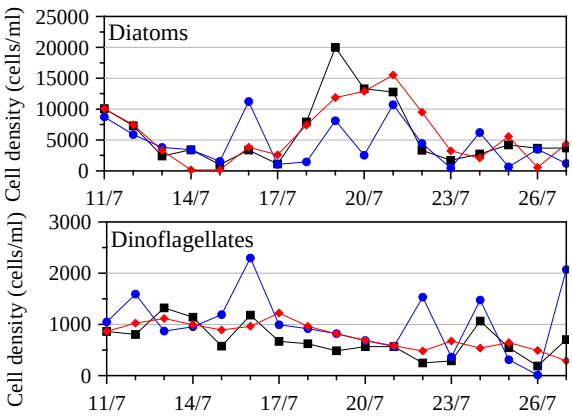

Figure 1 Temporal variation of observed and predicted two phytoplankton species during 11th July, 2001. Results of the neural network aided Kalman filter prediction for phytoplankton bloom dynamics with considering currents components (■ : Observed, ● : ANNs, ◆ : ANNs aided Kalman filter).