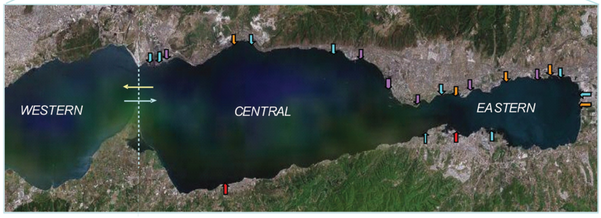
SSA 17 - IZMIT BAY
Appraisal Step

SPICOSA

TÜBİTAK MAM

1. İZMİT BAY COASTAL ZONE



Rivers ⇐ | Domestic inputs (ST ; TT) ⇐ ⇐ | Industrial inputs ⇐ | Water exchange ⇔

Figure 1: Location and main domestic, industrial inputs and rivers (creeks) and water exchange of the İzmit Bay system (original image was taken from the Google Earth)

MARINE SYSTEM	A two-layered water body located at the N-E of the Marmara Sea where brackish waters of the Black Sea overlays the saline Mediterranean water layer. Due to its stratified and semi-enclosed structure, the Bay has poor water exchange with the Marmara Sea.
WATERSHED	The major discharges are located in the northern part of the Bay. Eastern Channel and Dilderesi rivers are some of the most polluted discharges carrying high nutrient loads to the Bay.
HUMAN ACTIVITIES	Urban wastes, industrial wastes, heavy ship traffic, atmospheric pollution.
IMPACT RESPONSE	Oxygen deficiency in bottom waters, chemical pollution, eutrophication, accumulation of pollutants in sediments and biota, sediment toxicity, toxic algal blooms, bio-diversity loss, muscilage events.

2. POLICY ISSUE / HUMAN ACTIVITIES

The main drivers and related pressures on the system are :

1-Urbanization → oxygen deficiency in bottom waters; eutrophication

2-Industrialization → toxicity; harmful substance accumulation in biota and sediments

3-Marine transportation → harmful substance accumulation in biota and sediments

Pollution prevention attempts resulted only to decrease the industrial organic carbon levels in the 1990's and BOD loads arising from industries were decreased to 9,9 (90% reduction) tons /day in 2002. Since most of the treatment plants only remove organic matter, nutrient loads are still a problem for the Bay coastal waters.

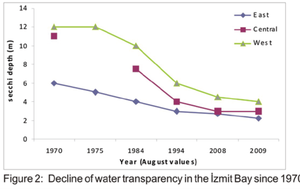


Figure 2: Decline of water transparency in the İzmit Bay since 1970.

The policy issue: Improvement of Water Quality in Izmit Bay

SDD changes since 1970 have shown that considerable decrease in the water quality in all the basins of the Bay is evident (Figure 2).

3. SCENARIOS

Scenario 1: WWTP upgrade for Golcuk and Karamursel cities

Scenario 2: Application of integrated control technologies

Table 1 : Estimated load reduction for relevant parameters

Parameters	Current situation		Scenarios			
	Total domestic WW kg/day	Golcuk-Karamursel WWTP kg/day	Surface run off kg/day	Total domestic WW kg/day	Scenario 1 kg/day	Scenario 2 kg/day
Total nitrogen	3336	1040	247	2421	125	99
Total Suspended Solids	7949	1635	214	7949	1635	86

4. CONCEPTUAL DIAGRAM

The Conceptual diagram of Izmit Bay(Fig.3) was developed in the design step on the basis of knowledge of the virtual system and improved according to the needs arise in the formulation and appraisal steps. It shows the relationships between the main components of the system and their functions. Recent version of the ecological model consists of 3 layers namely upper, intermediate layer and bottom layers.

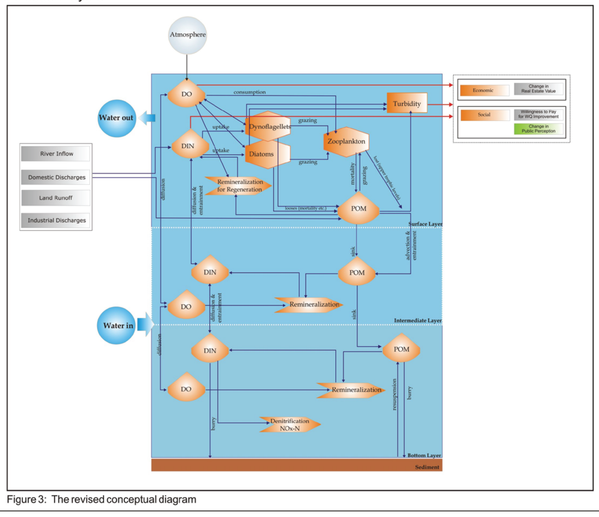


Figure 3: The revised conceptual diagram

5. EXTEND MODEL

Revisions are still being carried on in order to adapt the recent conceptual diagram to the Extend model in which all knowledge of the system can be stored in it in the form of equations. The accessory parameters and knowledge of the system is supplied in the form of time series.

In the ecosystem(natural) component of the model nutrient (nitrogen) and TSS (total suspended solids) inputs from land based sources(domestic, industrial and runoff) are considered as main inputs for the biochemical processes and the DO and SDD as main outputs.

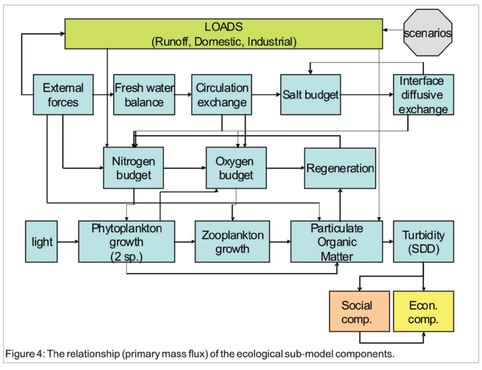
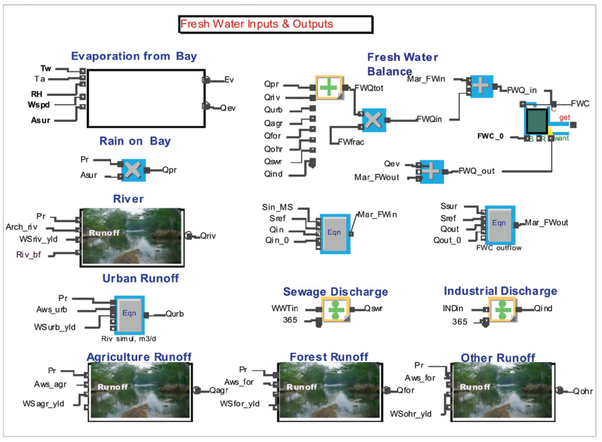


Figure 4: The relationship (primary mass flux) of the ecological sub-model components.

Atmospheric parameters such as, rain, humidity, wind, air and sea temperatures and light are the main external forces for the model. Salinity conditions of Marmara Sea and Izmit Bay boundary were used for initialization purpose. The primary mass flux and relationship between the functional components of the ecosystem sub-model can be seen in the figure 4.



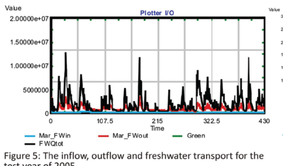


Figure 5: The inflow, outflow and freshwater transport for the test year of 2005

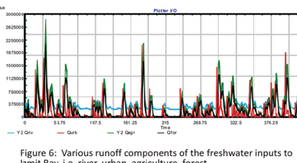
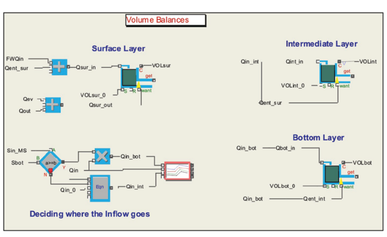
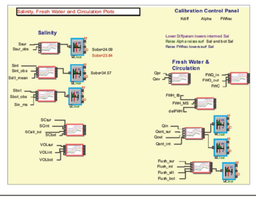


Figure 6: Various runoff components of the freshwater inputs to Izmit Bay, i.e. river, urban, agriculture, forest.





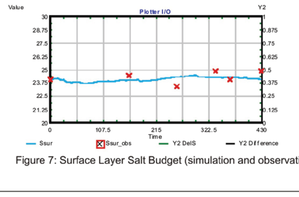


Figure 7: Surface Layer Salt Budget (simulation and observation)

6. ECONOMIC and SOCIAL COMPONENTS

Cost Benefit Analysis of Scenario1:

1) Financal CBA – whether it is financially feasible for municipalities to upgrade their WTTP to advanced treatment?

2) Economic CBA – whether the benefits of upgrading is more than costs from a macro economic point of view

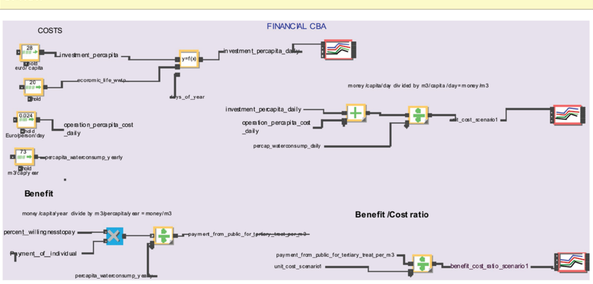
Financial CBA

Cost of treating one cubic meter of wastewater compared to the fee that the people would be willing to pay as wastewater charge

Investment Cost : 28 Euro / capita
Unit Investment Cost : 0.019 Euro / m3
Operation Cost : 0.024 Euro / capita / day
Unit Operation Cost : 0.12 euro / m3
Total Unit Cost : 0.139 Euro / m3

WTP for improved water quality was measured with the help of a questionnnaire :
55% is ready to pay
On the average, people are willing to pay 15,8 Euro /cap / annum. That converts to 0.256 Euro / m3.

B/C Ratio : 0.256/0.139 = 1.84



Economic CBA

The Hedonic Pricing Method:

Step 1 : Data Collection
*Residential property sales prices (174 data on sales prices & property characteristics)
*SDD in the area close to the district

Step 2: Regression analysis
P = -22,097 + 418 S + 2,515 (SDD)
P = sales price of an apartment in Euros
S = size of an apartment in square meters
SDD = measure of clarity of water in meters
R squared = 0.52
F value = 92.02

Total Economic Benefit

Benefit from rising real estate values :
(SDD target – SDD present) x 1,197 x apartments at the coast (pop. 18.326)
1 meter improvement will mean a benefit of ~22 million Euro

Benefit from increase in people's satisfaction :
733.051 people x 18.7 Euro/cap/year : ~13 million Euro

Total Economic Cost

Daily amount of water treated (146.000 m3) x 0.139 (Euro/m3) x number of days to reach the target SDD

SIXTH FRAMEWORK PROGRAMME