

Distribution of Seawater and Riverine Suspended Matter in Coastal Waters of Trabzon

Nehirsel ve Denizel Askıda Katı Maddenin Trabzon Kıyılarındaki Dağılımı

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Abstract:

There are several small rivers along the coast from Trabzon to Rize. The region is most rainy area of the Southern Black Sea. Therefore, in this area erosion rate about 90%. As a result of this, the rivers along the Black Sea coast transports large amount of sedimentary solid matters to the sea.

In this work, 3 rivers and 1 creek runoffs to the Black Sea are studied. Transportation of suspended matter and its concentration were investigated in rivers and seawater. As it was expected, river in suspended matter concentration is high at spring and autumn. However, suspended matters are originated from marine organism and re-suspended sediments. In sea, coastal waters suspended matter concentrations are higher than open sea concentration and max. concentrations were found at near the river mouths.

Key Words: Black Sea, suspended matter, river effect, coastal waters

Introduction

The South-Eastern Black Sea shoreline is characterised by high mountains with low valleys. This area is covered by rich subtropical

plants (Zaitsev and Mamaev, 1997). The mountains came close to the sea. The shoreline is noticeably steep. South-Eastern Black Sea receives most rainfall in the Black Sea region (Durukanoğlu, 1997). Rize is located at the centre of South-Eastern Black Sea and receives 2300 mm precipitation annually (DMI, 1997). From the geomorphological stand point the entire Black Sea shore can be regarded as graded and complex. The abrasion phenomenon is quite characteristics of the whole shoreline and in some places takes complex form. The shelf along the Anatolian coasts predominantly consists of an abrasion type of relief (Zaitsev and Mamaev, 1997). The region lands have very high erosion rate (90 %).

The rivers of Kızılırmak, Yeşilirmak, Çoruh, Iron etc. which are in the South East part of the Black Sea transport 25% of terrigenous sediments to the Black Sea (Hay *et al*, 1990). It is reported that total annual sediment load of Solaklı River which is located at the centre of the research area, is approximately 27.000-43.000 t/a (Yüksek, 1992).

As in other coastal areas, the distribution and characteristic properties of suspended matter (SM) off South –Eastern Black Sea are subject to variability in time and space. Particules are introduced into the coastal seawater by wind, rivers, streams and they are generated *in situ* by biological production. Once existed in the coastal water column, they are transported by currents and gravitational settling, they are resuspended by wave action, they are consumed by organisms, and they change their characteristic properties by dissolution, fragmentation and aggregation (Small *et al*, 1989; Bishop *et al*, 1986).

Suspended matter plays an important role in water quality management in coastal zone since it is related to total primary production, fluxes of heavy metal and micropollutants. Suspended matter on surface water is an important factor to find the dynamics of pollutants (Symader and Strung, 1991). Riverine SM substances are deposited at river mouths and near coasts and, they are carried away by currents depending on current regime and particle size (Goldberg, 1992).

In this study, horizontal and vertical distribution of suspended matter were analysed by using two year data obtained from 4 small rivers and 12 sea stations. The research area and sampling stations are shown in Fig. 1.

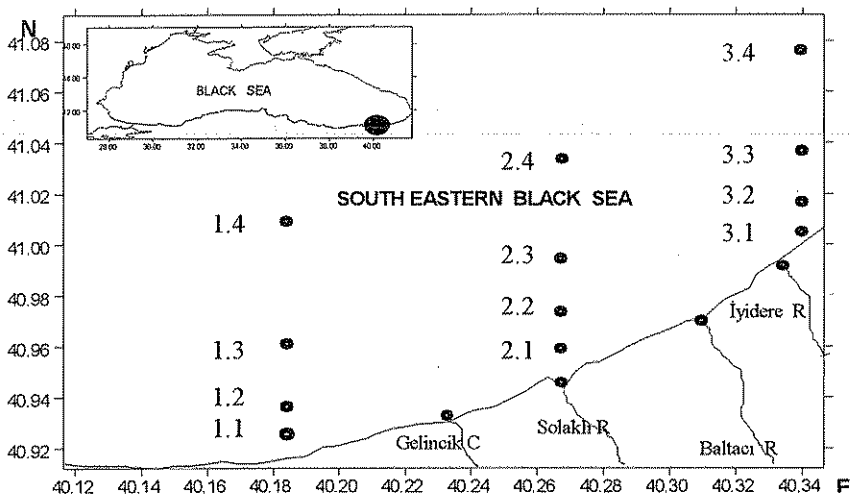


Figure 1. The sampling locations (o).

Materials and methods

In this study, SM data of River and sea water Which were used for analysis were measured monthly in 1995 and 1996. Riverine SM data were taken from İyidere, Baltacı, Solaklı rivers and Gelincik Creek. Sea water samples were obtained from 12 stations.

Locations of 12 sea stations were found by using Magellan NAV5000D GPS. River stations were chosen at river mouths. Sea stations were selected as 1 km, 2 km, 5 km and 10 km away from the coast on three lines which were located 5 km apart from each other. Centre line was at the mouth of Solaklı River. Precipitation data were obtained from The State Meteorological Office (DMI, 1997), and flow rate of İyidere River was obtained from The State Water Institute and Directory of Hydroelectrical Surveys (EIEI, 1997). Sea water was sampled at 0.5 and 25 m depths.

Determination of SM was done by filtration (Stirring, 1985). Samples were taken from the stations by sample bottles montly. Then, one or two litre of water was filtered by using glass fibre filter paper. After drying papers at 105 °C for 24 hours, amount of SM was determined by weighing. Filtration was repeated several times to reduce filtration errors. All data were used in the analysis.

Results

Seasonal mean riverine and sea water SM were analysed and distribution of marine SM, river runoff, precipitation were compared with riverine SM (Tab. 1).

Table 1. Seasonally mean marine and riverine suspended matter values (mg/l)

Line No	Spring	Summer	Autumn	Winter	Yearly mean
1.1	4.53	4.94	5.03	4.5	4.75
1.2	7.58	4.33	2.58	3.58	4.52
1.3	6.13	3.63	4.61	3.05	4.36
1.4	3.85	5.93	7.05	2.7	4.88
2.1	1.05	9.35	4.5	3.5	6.96
2.2	4.78	6.44	2.65	3.6	4.37
2.3	4.53	4.75	2.28	2.3	3.47
2.4	3.5	5.54	2.75	5.55	4.34
3.1	5.86	4.15	5.3	3.1	6.44
3.2	4.85	3.3	3.15	3.9	3.8
3.3	3.3	3.0	2.62	3.5	3.11
3.4	5.68	4.1	5.7	4.3	4.95
Gelincik Creek	7.6	9.8	13.5	2.6	8.38
Solaklı River	17.3	14.2	27.6	11.5	17.65
Baltacı River	7.2	5.9	80.3	7.2	7.08
Iyidere River	9.9	15.5	29	73.5	15.44
Iyidere River discharge (m ³ /s)	36.5	36	24.4	13.9	27.7
Rainfall in Rize (mm)	264.6	121.3	157.8	214.1	191.7

Seawater and riverine SM showed seasonal and spatial changes due to resuspension by wave action, transportation by currents and biological activity. When distribution of seasonal SM was analysed, it was seen that SM was concentrated near the coast at the mouth of rivers (Fig. 2). Distribution of SM differed each season ($p < 0.001$). The maximum value was recorded in spring (mean 5.40 mg/l) and minimum in winter (mean 3.63 mg/l). Annual mean value was found as 4.66 mg/l and riverine suspended matter value was 12.14 mg/l. In literature, annual mean of SM was 1.1 mg/l in September (Ross, 1977) and 10 mg/l (DEÜ, 1988) in May.

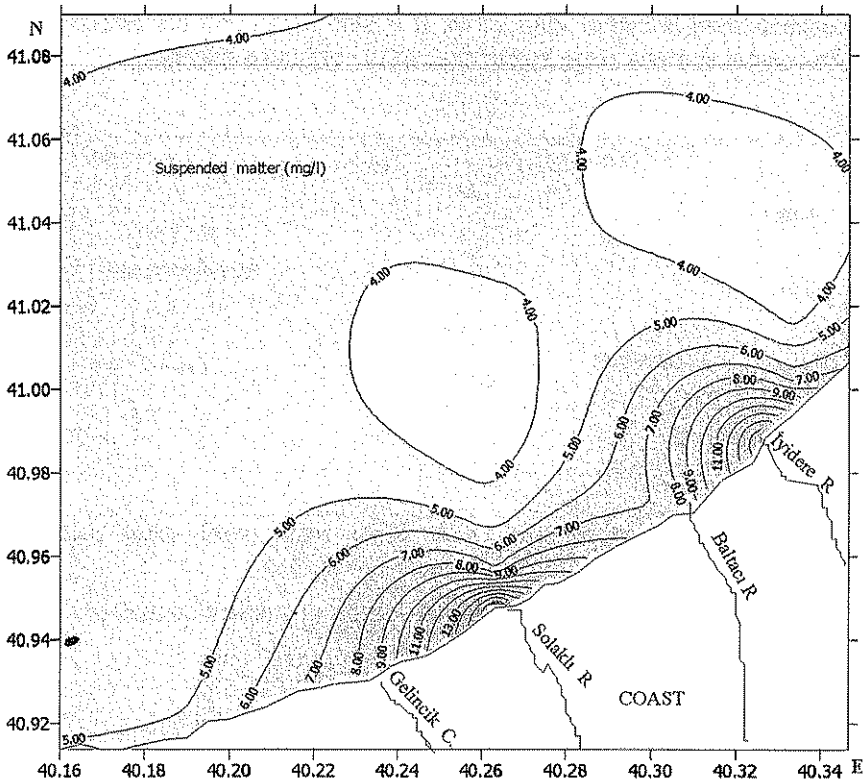


Figure 2. Yearly mean, horizontal suspended matter distribution in research area.

When yearly distribution of SM was investigated, it was seen that SM were concentrated at coastal zone, especially, zone of 1km (Fig. 2). This zone was different from the other zones (2, 5 and 10 km) ($p < 0.001$).

In the coastal coastal zone, from coast to 5 km offshore, vertical SM distribution in 0-10 m was different than deeper waters ($p < 0.001$). Concentrated SM was seen at 0-10 m depth and river mouth to 1.5 km offshore. Vertical SM distribution became homogeneous in the deeper than 20 m zones (Fig. 3).

Relationship was found as very weak among river discharge, precipitation and SM ($r=0.23$).

In the region, spatial and temporal change of surface (0-1m) SM concentration is higher than 25 m. It is also found that concentrations at the coastal stations were higher than at the offshore stations.

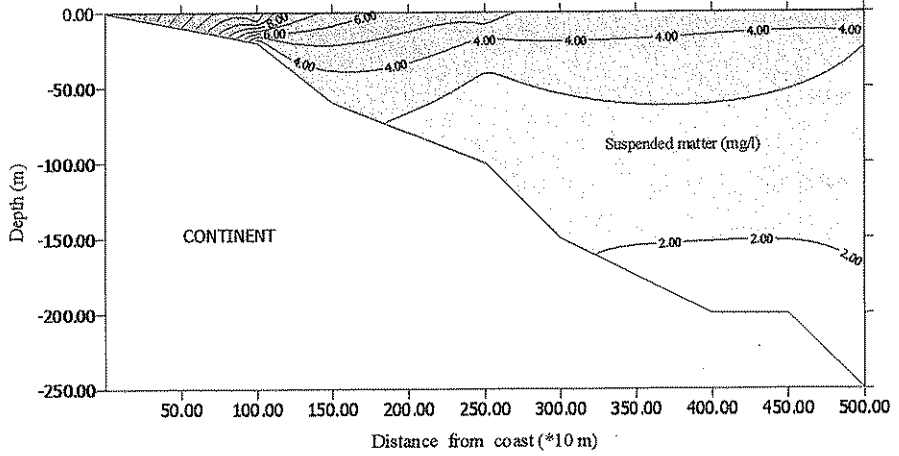


Figure 3. Yearly mean vertical distribution of suspended matter in the offshore of Solaklı River

Discussion

In this study, measurements were conducted for two years in order to investigate seasonal and yearly distribution of SM.

Source of SM in the region was seen as land and coast erosion, precipitation, road reconstruction and wave action. This SM can be seen at offshore due to transportation by sea currents.

The results show similarities to the results of Erüz *et al.* (1997). Surface (0-10m) SM concentration was higher than deeper waters and coastal water had more SM than offshore.

Özet

Karadeniz'in en yağışlı bölgesi Doğu Karadeniz Bölgesidir. Bu bölgede, Trabzon- Rize kıyı hattında sularını Karadeniz'e boşaltan pek çok çay ve dere mevcuttur. Yağışın fazla olması ve yüzey eğimlerin fazla olmasından dolayı bölgedeki erozyon oranı %90 civarındadır. Yüzey erozyonunun bir sonucu olarak, dere ve çaylardan Karadeniz'e fazla miktarda sediment taşınmaktadır.

Bu çalışmada, 1 dere ve 3 çay incelenerek, askıda katı madde taşınmasının akarsu ve deniz suyundaki etkileri belirlendi. Nehirsel askıda katı maddenin ilk ve sonbaharda yüksek olduğu görüldü. Benzer bir dağılım denizel askıda katı madde dağılımında da mevcut olduğu ve askıda katı madde yoğunluğunun kıyılarda, akarsu ağızlarına yakın bölgelerde daha fazla olduğu tespit edilmiştir.

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