Tidal fluctuations in relation to certain physico-chemical parameters in Swarnamukhi river estuary, east coast of India

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Received 7 October 1992, revised 1 March 1993

Diurnal variations in environmental features covering over 3 days were recorded. Wind velocity and salinity followed the tidal fluctuations. A slight inverse relationship was observed between water temperature and dissolved oxygen. Variations in the environmental features during the day and night with tides were not so marked. However, these features showed significant variations during the two low tides. The low tides of the day hours showed higher dissolved oxygen content and relative higher temperatures when compared with low tides of night.

Good amount of work has been carried out on tidal cycles of some Indian estuaries\(^1\)\(^-\)\(^5\). But so far no work has been carried out in Swarnamukhi estuary on tidal fluctuations in relation to certain physico-chemical parameters. The present work pertains to relationship between the tidal cycle and environmental variables in this shallow, tidal, seasonal estuary.

The river Swarnamukhi is one of the major rivers along the east coast of India (lat. 13°48'-13°50'N; long 80°09'-80°15' E). It is connected to the Bay of Bengal through a narrow channel of 4 m width. The length of the estuary is 1.5 km having a depth of 1 m and an area of 6.25 km\(^2\). The estuary runs almost perpendicular to the coast. The opening of the estuary is very shallow and the depth increases only during monsoon when there is an appreciable amount of flood water.

Hourly variations were observed at the mouth of the estuary during high and low tides for 3 days (from 1600 hrs on 22 March to 1700 hrs on 24 March 1989) to know the significance of hourly variations in environmental features caused by tides. The method of collection of sample at the surface was same as suggested by Rainwater & Thatcher\(^6\). Temperature measurements were made using a graduated centigrade thermometer. Dissolved oxygen was determined using a water analysis kit (Elco Company, Hyderabad) in the field itself. Salinity was determined in terms of conductivity measurements (IAPSO, Pub. Sciq No. 32, SUNWG recommendations, 1979). Wind velocity was determined using DYNALAB anemometer. Tidal level changes were determined using the instrument designed (Fig. 1) following the suggestions of Prof. Eugene C. LaFond (personal communications). Correlation co-efficient values were calculated and the level of significance was determined\(^7\).

![Fig. 1—Apparatus to measure the hourly tidal level changes](image-url)
Profiles showing the environmental features are given in Fig. 2. Fluctuations in the tidal level changes were greater during high tide encountered during night, than that of day time. Wind velocity showed more fluctuations in the night hours than during day hours. Correlation co-efficient between tidal level and wind velocity (+0.58) was significant and showed a positive relationship. The variation in temperature was around 10°C for days. The maximum difference of temperature with the state of the tides was 6°C between 0700 hrs and 1300 hrs on 23 March 1989. Correlation co-efficient values for tidal level and temperature showed a highly inverse relationship (−0.69) indicating that the temperature had not followed the tidal fluctuations. Dissolved oxygen showed irregular variations from hour to hour. It’s values for low tide in the afternoon were slightly higher than those for low tides in the night times. A slight inverse relationship was noticed between dissolved oxygen and salinity with reference to tides. Lowest value of 2.6 ml l⁻¹ was observed at 0300 hrs during low tide at night and the highest value of 3.9 ml l⁻¹ was observed at 1600 hrs in the afternoon also during low tide. The correlation co-efficient value for tidal level and dissolved oxygen (−0.34) showed an inverse relationship indicating that dissolved oxygen doesn’t follow tidal cycle. Salinity closely followed the tidal level changes. The lowest value of 29.2 × 10⁻³ was during low tide and high value of 36 × 10⁻³ was during high tide. It showed higher values during high tide than during low tides because during high tides the seawater intrudes into the estuary causing increase in the salinity values. However, the correlation co-efficient value for tidal level and salinity (+0.091) showed a low positive correlation which is well below the significant value. Hence it is concluded that the relationship between salinity and tidal level changes is slightly significant.

Observations in the study area were made during March when the river runoff was almost meagre as it was at the end of postmonsoon period and almost the beginning of summer. Very little amount of water was present in the estuary at the time of collection which is evident from the low fluctuations in salinity between high tide and low tide. The tidal changes showed a good rhythm and the wind velocity also followed closely with tidal level changes. Temperature showed wide fluctuations with reference to tides. Dehadrai in his studies on Zuari and Mandovi estuaries observed that the tidal influence on the temperature was between 1° and 2°C. The increase and decrease in temperature in these estuaries followed ebb and flood tides respectively. In the present investigation, it is observed that there is a gradual decrease in temperature from afternoon low tide water to early morning low tide water and a general rise during high tide water was observed. Due to the shallowness of estuary, atmospheric temperature plays an important role in warming and cooling of waters during day and night respectively, which overshadows the difference brought about by the tides. The dissolved oxygen content of the waters of this estuary showed an increase from early morning low tides to afternoon low tides. The values were higher from afternoon low water and low during early morning low tides. Observations of Kaliyamurthy in Pulicat lake showed that the oxygen values began to increase after sunrise and reached the maximum in the afternoon. Similar observations have been made in the Vellar estuary. A slight inverse relationship was observed between oxygen content and salinity, which is in agreement with the results reported. The high water doesn’t show much variation at all times. The variations in the salinity changes, at low tide depend upon the entry of river water (waters from the dam across the river) into the estuary when seawater retreats during low tide. Although salinity seems to follow tidal cycle the relationship between these two is not much significant. In the present study, among environmental factors, only the tidal level changes followed wind velocity. Inverse relationship was observed between temperature, dissolved oxygen and tidal level changes.

Authors express their deep sense of gratitude to Prof. Eugene C. LaFond, Chairman, LaFond Institute of Oceanography, California, USA for helpful suggestions.
References