METEOROLOGICAL FACTORS AFFECTING THE SALINITY OF SURFACE SEA WATER OFF WALTAIR

A study of variations in surface temperature and salinity of coastal waters at Waltair recorded at about 7 A.M. during 1954, and of the probable factors leading to such variations has been made. The data on wind speed, wind direction and rainfall were collected by the India Meteorological Department, at an observatory at Visakhapatnam aerodrome. The oceanographic data on surface sea temperatures and salinity have recently been collected systematically by the Zoology Department of the Andhra University at Waltair, and they refer to a site which is 10 miles east of the observatory. These two sets of data have been correlated for the year 1954, and their inter-relations have been studied.

The three main factors affecting salinity are wind, rain and run-off, and temperature. Winds cause both vertical and horizontal circulations, the former being more effective near land boundaries. In the northern hemisphere, upwelling occurs on the east coast when the wind blows north and parallel to the coast. Sinking takes place when the wind blows south and parallel to the coast. The result of upwelling is to bring subsurface low temperature and high salinity waters to the

surface. The converse is true in the case of sinking. Bathythermograms show a low layer depth during the upwelling season and a high layer depth during the sinking period. Surface currents caused by wind also alter the salinity by bringing in more or less saline waters to the area under observation. Wind, as a factor in evaporation, can also affect the salinity. Rain and runoff reduce the salinity by dilution and also by changing the temperature of the sea water. The third factor, the temperature variation, caused by wind and radiation, influence the salinity though not to a marked degree. In the following the influence of the above three factors, on salinity is discussed.

Actual computations show that salinity (Y) on any date is well correlated with (1) accumulated rainfall (R) upto the date calculated from the 1st of the calendar year 1954, (2) southwest component of wind velocity of previous date (W) obtained from the resultant of 24-hourly winds of previous day—the sea coast at Waltair running in a southwest-northeast direction—, and (3) the inland mean air temperature. The correlation coefficients are —0·80, 0·57 and 0·52 respectively. From the inter-correlation coefficients it is seen that the same between mean air temperature and the accumulated rainfall alone is high (—0.88). In view of this a regression equation connecting Y with R and W is derived and given below —

$$Y = 32 \cdot 59 + 0 \cdot 35\, W - 0 \cdot 0016\, R$$

where Y is in mille, W in miles per hour and R in inches, The multiple correlation coefficient is 0·83 which is highly significant. The above equation enables the calculation of salinity of sea water indirectly provided the relevant meteorological factors are known. It will, however, be seen that the changes in salinity that surface ocean currents may bring about have not been incorporated in the equation. In the present case the river water is indirectly influencing the salinity through advective ocean currents though not directly, as no river joins the sea near Waltair.
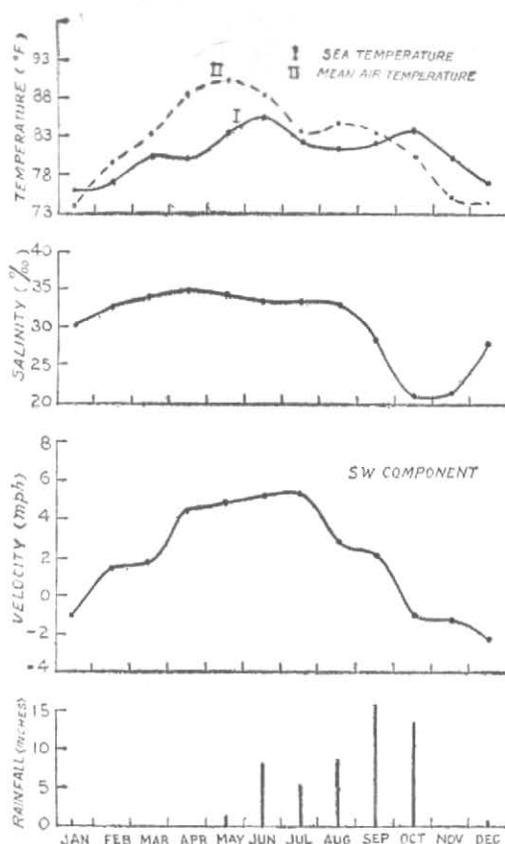

Fig. 1

The correlation coefficient (C.C.) between Y and W appears to decrease with an increase in the lag between wind and salinity. It changes sign when salinity data of more than two months hence are correlated with the SW component of wind force. If, instead of daily Y and W values, long period means are correlated, high C.Cs. are obtained. As the period of the mean increases, so does the C.C. Thus, the C.C. for the 5-day mean of Y and W is 0·63; for a 15-day mean it is 0·71.

Curves for the year 1954 have been drawn in Fig. 1 to show the variation of the monthly mean air temperature, the SW component of wind velocity and the monthly total rainfall in respect of the Visakhapatnam Observatory,

together with curves of the monthly mean sea surface temperature and salinity as measured near the Waltair coast. In Fig. 1, it will be seen that the wind had a SW component from February to September, in consequence of which upwelling occurred in the coastal waters during this period. At first sight the actual salinity variation would suggest that upwelling took place only from February to August, during the period of high salinity values. The low salinity in September could have been due to increased rainfall and the addition of dilute water brought into the area during this month by the SW current. In view of this, the real 1954 upwelling period should be considered to extend from February to September. During this period the sea temperature was less than the mean air temperature at the observatory.

During the remaining part of the year, October to January, the wind had a slight NE component which would cause sinking at the coast. In this year, 1954, sinking was not pronounced during the entire period, as evidenced by the salinity variation. This could be due to the reversal of the current in December. Also, the low October and November salinities could have been due to sinking, rainfall, or a SW current. The high salinity in December and January probably reflects the absence of rainfall and the presence of a NE current which introduces more saline water from the south. At this time (October to January) the sea temperature was higher than the mean air temperature at the observatory.

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