

ANALYSIS OF SEA SURFACE TEMPERATURE AT AN EQUATORIAL COASTAL STATION*

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ABSTRACT.

An analytical study of the sea surface temperature at Thumba Equatorial Rocket Launching Station (Lat 8°32'N, Long. 76°52'E) at two different hours—0930 and 1130 hrs IST—for a period of three years (1967-1970) is presented. A few interesting features of the daily and monthly variation of sea surface temperature are discussed in relation to the onset and withdrawal of the Indian South-west monsoon. The sea surface temperature off Kerala coast is found to be below 26°C during the south-west monsoon period (June to September) and its seasonal variation is in the range 22-30°C. The diurnal variation of the coastal sea water is found to be less significant (1-2°C) when compared to that of the canal water temperature (3-4°C) and surface air temperature (6-8°C). The standard deviation of sea, canal and surface air temperature is of the same magnitude 1.5°C.

INTRODUCTION.

SEA surface temperature is one of the important parameters affecting the air-sea interaction problems. Surface sea water characteristics in the Bay of Bengal off Madras have been reported by Rama Sastry (1963) and William (1963). Sea surface back temperature has profound influence on the amount of evaporation, sea breeze development of thunderstorms, cyclones, etc. Pisharoty (1967) has indicated its significance on the onset of the Indian South-west monsoon. The main factors controlling the sea surface temperature are (i) latitude (ii) season and (iii) character of ocean current (Sverdrup, 1945). In the Indian Ocean its magnitude is of the order of 25°-30°C. The International Indian Ocean Expedition (IIOE) has revealed the variation in the sea water temperature in the coastal belt, 100-500 km off west coast and farther beyond 500 km of the Arabian sea. The temperature measurements of the coastal sea water taken at Thumba Equatorial Rocket Launching Station (8°32'N, 76°52'E) at two different times 0930 hrs IST (April 1967 to March 1968) and 1130 hrs IST (August 1968 to July 1970) are analysed and discussed.

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DATA ANALYSIS

The sea-water was collected in a plastic bucket and the temperature was measured in the shore itself by ordinary thermometer daily at 0930 hrs IST from 1st April 1967. The time of observation was later changed to 1130 hrs IST from 1st August 1968.

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The surface air temperatures were also noted during the above periods. Five day mean and monthly mean temperature for coastal sea water and surface air were worked out and plotted (Fig. 1 and 2). The surface air temperature is 3-4°C higher than the coastal sea water temperature during the south-west monsoon period (June

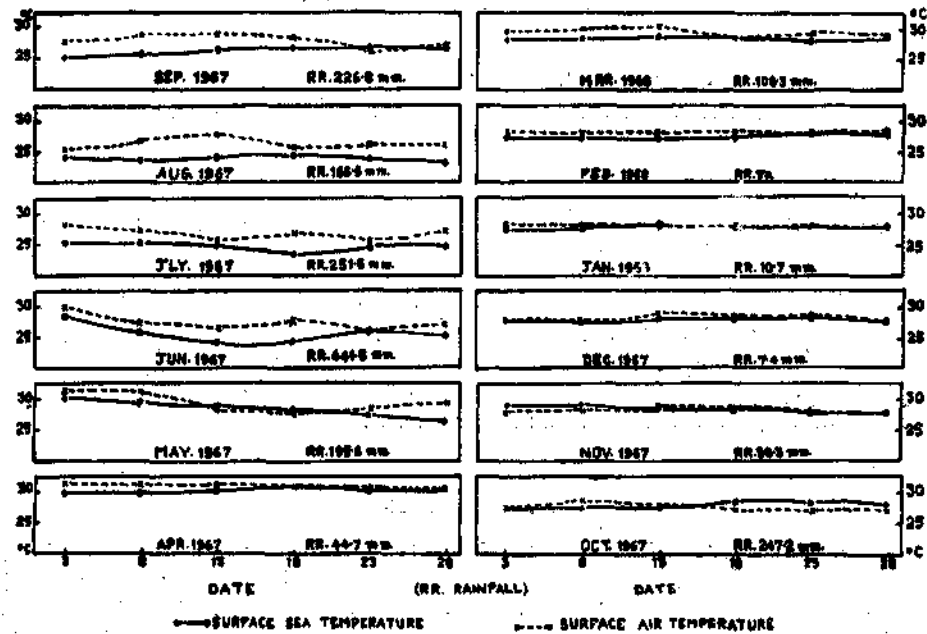


Fig. 1. Five day mean surface sea and surface air temperature at Thumba during April 1967 to March 1968.

to September). Their difference is only 1-2°C during the remaining seasons. Whenever a depression or cyclonic storm forms in the South Bay of Bengal or the Arabian Sea, the sea water temperature is above 28°C, nearly equal to the surface air temperature and falls with the passage of the storm over land raising the surface air temperature. Similar daily variation in sea surface temperature at several coastal stations during the passage of hurricanes in the Atlantic Ocean has been discussed by Hazelworth (1968). The highest and lowest measured sea water temperature are 31°C in April and 21°C in August respectively (Fig. 2 and 3). The standard deviation of these temperature measurements is on an average 1.5°C.

During the south-west monsoon season (June to September) the sea-water temperature is of the order of 23°-26°C which is in good agreement with that recorded 25°C-26°C by IOE ship in the coastal strip 10 miles off the coast. The lowest temperature is seen on a day succeeded by a heavy rainfall day. But the first monsoon downpour is preceded by 2-3 days with a sudden fall of 2-3°C in the coastal sea water temperature. This was valid for the years 1967, 1968 and 1969. In 1970, the monsoon 'burst' was accompanied by a depression in the Bay of Bengal. On this occasion no significant fall in temperature was noticed. The sharp fall of 2-3°C in sea water temperature during the end of May or early June appears to be useful for forecasting the onset of the monsoon over Kerala, when it is accompanied, or preceded by a depression or cyclonic storm in the Bay of Bengal or Arabian Sea.

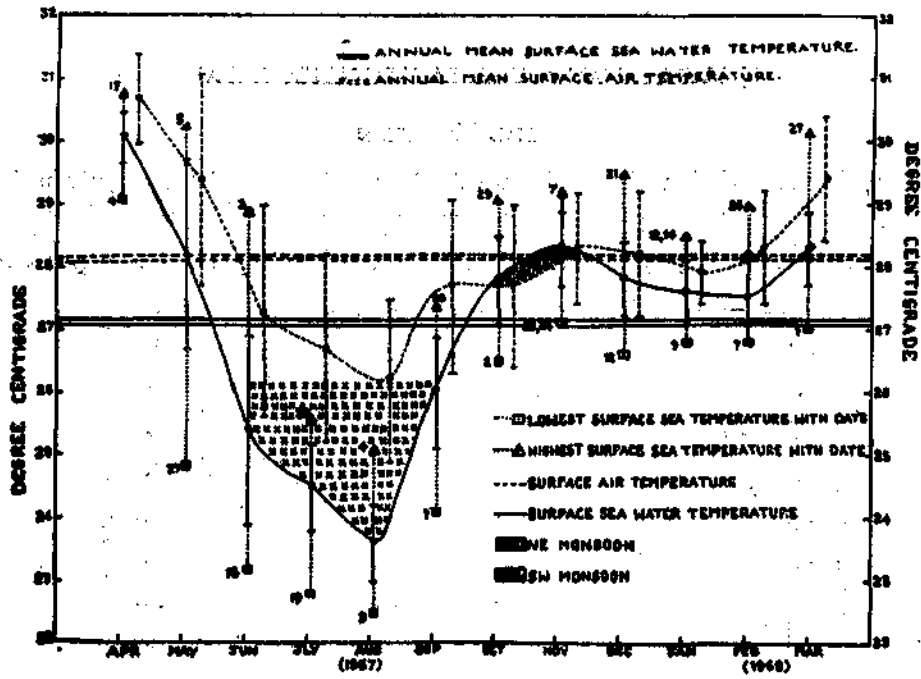


Fig. 2. Monthly mean surface sea and air temperatures at Thumba at 0930 hours IST (April 1967 to March 1968).

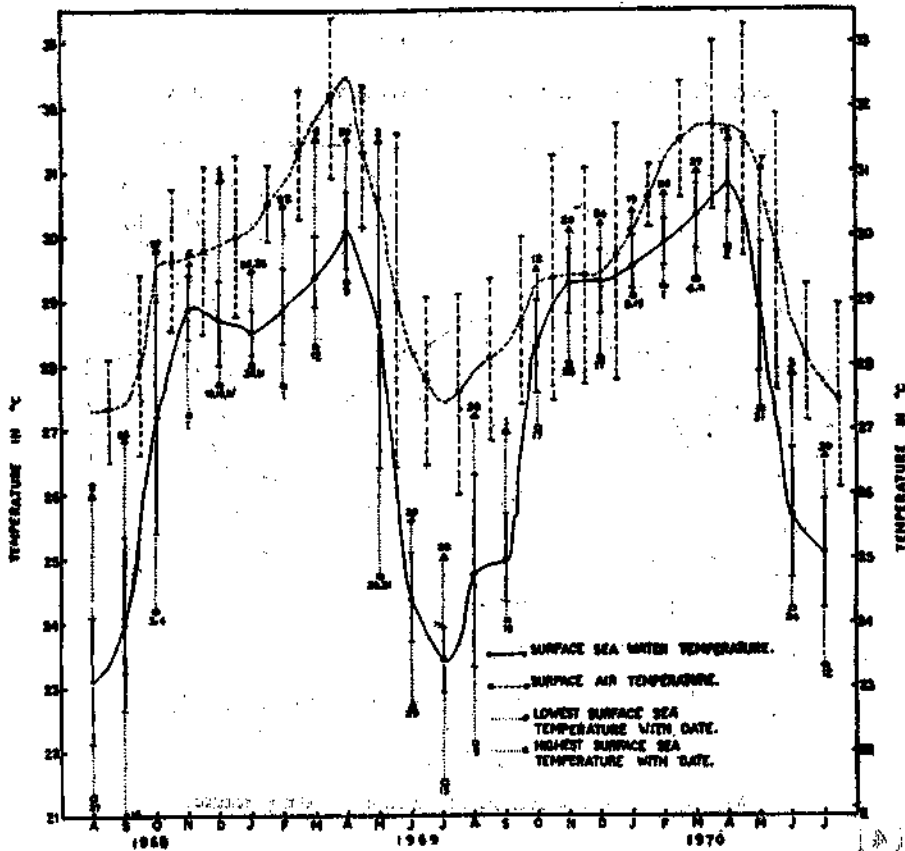


Fig. 3. Monthly mean surface sea and air temperatures at Thumba at 1130 hours IST (August 1968 to July 1970).

DIURNAL VARIATION

The diurnal variation of coastal sea-water temperature is different slightly in the four different seasons (Fig. 4). The diurnal variation of surface air temperature corresponding to the four surface sea-water temperature observations is somewhat similar in character (Fig. 5). The diurnal variation of coastal sea-water temperature

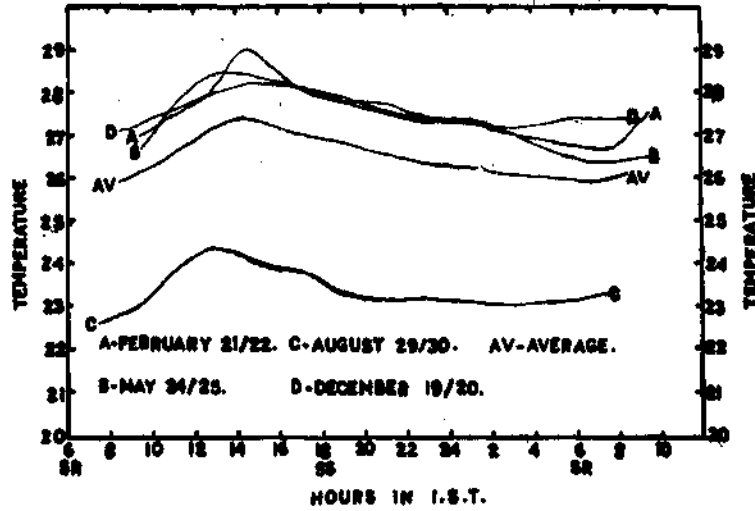


Fig. 4. Diurnal variation of coastal sea water temperature.

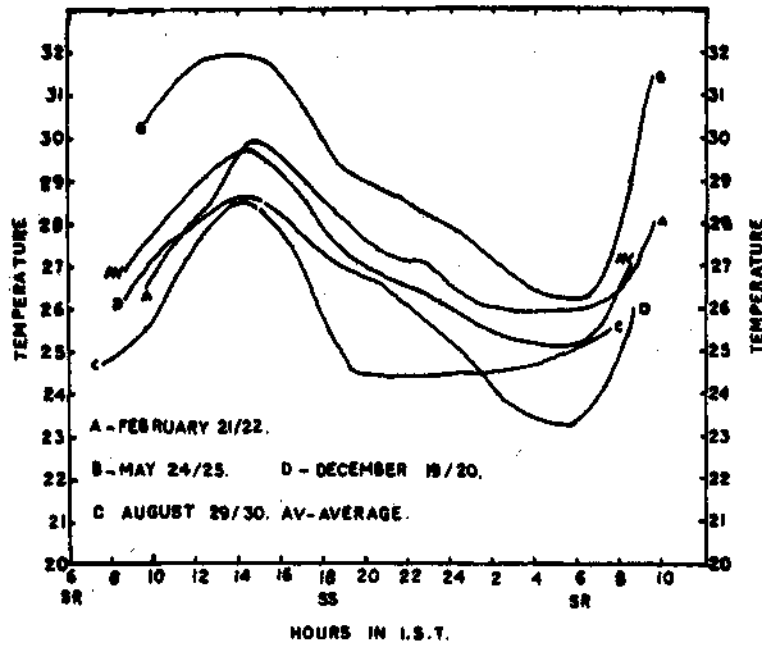


Fig. 5. Diurnal variation of surface air temperature.

is 1-2°C and that of the surface 6-8°C. It is well known that these two temperature variations have a definite bearing on the onset of land and sea breeze, as they denote the differential heating of the air masses over the land and sea.

SEA SURFACE TEMPERATURE MEASUREMENT FROM TERLS SEA VESSEL

The coastal sea-water temperature is different slightly from the actual sea surface temperature. To investigate this, special temperature measurements were taken from the deck of TERLS Sea vessel sailing between Vizhinjam (Trivandrum) and Cochin on 24th May 1968. The sea surface temperature is measured at a distance of 200 metres from Thumba beach was 27.4°C while the simultaneous measurement at the sea shore showed only 26.7°C. This lower value about 1°C may be attributed to some upwelling at the shore or increased evaporation consequent on spray production near the shore [Pisharoty (1965)]. Evaporation from droplets associated with breaking waves makes an appreciable contribution to the cooling of the coastal water. The higher magnitude of diurnal variation is due to the shallow layer of sea water near the shore.

CANAL WATER TEMPERATURE

Temperature measurements were taken on selected days from the canal water flowing through the eastern boundary of the Thumba Rocket Range at a distance of 1 km from the sea shore. The comparison of sea-water, surface air and canal water temperature is given in Table 1. The canal water temperature is 3-4°C higher than

TABLE 1. Comparison of coastal, Sea and Canal Water Temperature.

Serial Number	Date	Time (Hrs. IST)	Sea Water Temperature (in °C)	Surface Air Temperature (in °C)	Canal Water Temperature (in °C)
1.	29-5-1968	1130	28.2	32.0	31.7
2.	11-6-1968	1130	24.5	26.9	28.0
3.	15-6-1968	1130	24.0	27.4	28.7
4.	9-7-1968	1130	23.7	28.4	28.1
5.	20-7-1968	1130	23.2	26.9	28.7
6.	29-8-1968	1130	23.3	27.2	29.3

the sea-water temperature. The diurnal variation of canal water temperature under clear and overcast sky conditions is different (Fig. 6). The cloudiness affects the canal water temperature to a great extent.

CONCLUDING REMARKS

Comparison of temperature of the coastal sea-water and canal water is an interesting observation. The canal water appears to have a temperature close to the surface air, that is about 4°C higher than that of the coastal sea water. The surface air temperature is obtained from Stevenson Screen. The coastal sea water temperature is taken equivalent to sea surface temperature for the purpose of analysis. The standard deviation of sea, canal and surface air temperature is of the same magnitude 1.5°C. A close watch on the sea surface temperature variation may be helpful for the forecasting of the onset of south-west monsoon. In this connection it is worth mentioning that satellite observation techniques are also applied in determining the ocean temperature. Shenk and Syekiolda (1972) have presented such study of the

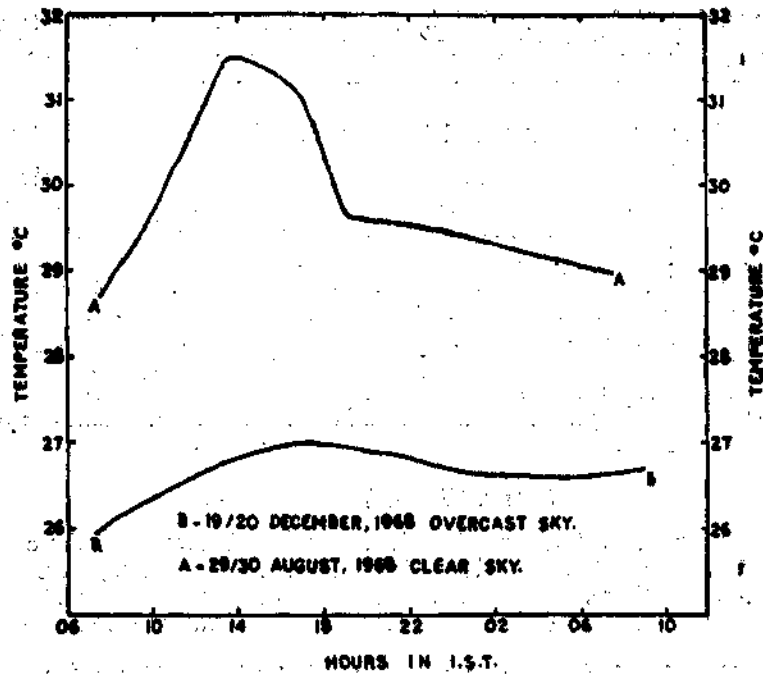


Fig. 6. Diurnal variation of canal water temperature.

Indian Ocean surface temperature obtained from infrared measurements. The Remote Sensing & Meteorology Division of the Satellite Application Centre, Indian Space Research Organisation (ISRO) Ahmedabad is planning to conduct infrared sensing of the sea surface temperature through satellites and aircrafts in the Bay of Bengal and Arabian sea. The results of the sea surface temperature reported above is expected to be confirmed and given additional support for the IIOE conclusions.

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