Phase path variations of the reflected radio waves on a frequency of 2.4 MHz, around 70 km level at Waltair are found to be smooth and continuous with consistent change of phase path for extended periods of time, particularly in summer months. These are interpreted in terms of reflections coming from sea-waves.

There are occasions, particularly in the latter part of summer, when strong coherent phase-path variations are observed on 2.4 MHz, at heights around 70 km, below the level of reflection of E-region echoes. An example of such a record is shown in Fig. 1 wherefrom it can be seen that phase path variations of E-region echo (≈ 110 km) are very irregular, while those of the lower region echo are strong and coherent, showing continuous decrease of phase-path. Such echoes are received on different days in summer, but the nature of the phase-path variation is always the same. These reflections are originally thought of as coming from the lower D-region, but in view of the constant rate of decrease of phase-path and persistence of these echoes for many hours, these are attributed to non-ionospheric sources.

Dowden\(^1\) pointed out that the observed low reflections are not due to tropospheric irregularities, because of their low reflection coefficients; instead they are due to sea waves. Crombie\(^2\) observed a constant Doppler shift in the frequency of radio waves reflected from sea waves, irrespective of the wind conditions and the state of the sea. Fraser and Vincent\(^3\) recorded similar echoes (particularly in summer) and interpreted them in terms of reflections coming from sea waves. In view of the earlier observations, the reflections that are observed at 70 km level in the present investigations are considered to be reflections coming from sea waves, since the ionosphere research laboratory at Waltair is situated on the western coast line of the Bay of Bengal.

Sea reflections occur from the surfaces of the sea waves moving with a certain velocity \(v\), given by\(^4\)

\[
v = \left[\frac{(g/2\pi)L}{L}\right]^{1/2}
\]

where \(L\) is the wavelength of the sea waves, and \(g\) is the acceleration due to earth's gravity. Maximum signal will be reflected when \(L = \lambda/2\), where \(\lambda\) is the wavelength of the operating frequency. Using the operating frequency as 2.4 MHz, i.e. \(\lambda = 125\) m, \(v\) is found to be 10 m sec\(^{-1}\).

After analyzing data taken over a period of 15 yr on sea waves in the Bay of Bengal, Varadarajulu\(^5\) found that these waves have a maximum amplitude during the months of June, July and August. Their periods are in the range of 0-25 sec with a most probable value of 7 sec.

Using the most probable value of 7 sec for the period of the sea waves and the wavelength of the sea waves as 63 m (\(L = \lambda/2 = 125/2 = 62.5\) m) the velocity \(v\) is found to be 9 m sec\(^{-1}\) which agrees well with the theoretically calculated value of 10 m sec\(^{-1}\).

Thus, the radio reflections that are observed during June, July and August, must have been due to sea waves, which have higher amplitudes during these months. The failure to observe such reflections on 56 MHz frequency may be due to the orientation of the antenna being different (Delta antenna—transmitting section in the NE-SW direction), and also the wavelength being such that \(2L\) is nearly equal to an odd multiple of \(\lambda/2\), thus causing destructive interference.

Our above preliminary investigation has thus given a wide scope to study the characteristics of sea waves using radio signals—a major project which is planned to be taken up soon at Waltair.

The authors are thankful to Dr Varadarajulu for useful discussions and to the CSIR, New Delhi, for providing the financial support for the present investigation.

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