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Discussion

A field study of wave reflections from an exposed dissipative beach, by R.C. Nelson and J. Gonsalves*

COMMENTS

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Nelson and Gonsalves (1990) provide an interesting paper on infragravity waves in a high-energy dissipative environment. As infragravity waves may be particularly important under such conditions, and as literature on the subject is still relatively scarce, this information is very useful. However, there are a few misconceptions in their discussion of infragravity edge waves.

The authors ascribe the low-frequency energy identified in their data sets to leaky mode standing waves and they dismiss the importance of edge waves on a number of grounds. Referring to Guza and Bowen (1976), they state that edge waves will be suppressed by the turbulence associated with breaking and broken waves. Therefore they reason that edge waves should be absent in this highly dissipative study environment. However, an important distinction must be made here between infragravity edge waves generated by wave groups, and high-frequency edge waves, i.e. subharmonic and synchronous edge waves generated by the incident waves. While the authors' statement is true in the case of the latter category (to which Guza and Bowen's work refers), this is not valid in the former case where the temporal and spatial scales involved are significantly larger than those associated with breaking incident waves. Bowen and Guza (1978) actually showed experimentally that infragravity edge waves were important when incident waves were breaking and that edge wave modes/periods may increase with surf zone width. This is in accord

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with field evidence which tends to show that while subharmonic edge waves dominate on reflective beaches, infragravity edge waves exist under more dissipative conditions and may even be dominant close to the shoreline (e.g. Wright et al., 1979; Holman and Bowen, 1984).

The authors further state that edge waves were unlikely as they did not find any consistent energy troughs in their wave spectra, the wave recorders being situated in a cross-shore transect. Standing edge waves, occupying a continuum of frequencies would tend to exhibit such spectral features. The authors offer two explanations: (1) either the edge wave band was rather limited in frequency, or (2) that possible standing edge waves were very weak. They fail to identify a third possibility, namely that the edge waves were progressive alongshore. In actual fact, some field evidence suggests that edge wave energy may be progressive alongshore under highly energetic and/or dissipative conditions (Wright et al., 1979; Aagaard, 1990).

Finally, Guza and Bowen (1976) suggested that edge waves must have offshore length scales comparable to the surf zone width. In the present case this would imply that edge waves must have long periods and/or high mode numbers. According to the authors (p. 476), mode numbers 4 or 5 ($n=4$ or $n=5$) would have been necessary, as the surf zone was ~ 500 m wide. Referring to Guza and Inman (1975) and Guza and Bowen (1976) they conclude that these high mode numbers are unlikely, the reason being that their growth rates are low in comparison with lower modes. A number of objections may be raised on this issue.

First of all, the authors identify three nodal frequencies indicative of standing wave motion, these being centered at ~ 0.01 Hz, 0.0275 Hz and 0.0444 Hz (Table 6, p. 473). A 0.01 Hz, $n=2$ edge wave would extend ~ 500 m seaward on this beach (approximately equal to the surf zone width), or twice that amount in the $n=3$ case. However, high frequency waves would of course require higher modes to fulfil the length scale criterion. Secondly, even though edge wave growth rates would tend to favour low modes, the excitation of these modes still require an external forcing mechanism (e.g. the wave groups). Low modes would need a very low frequency to cover the surf zone. If the frequency of the external forcing is incompatible with the frequency required, the low modes will not be excited and higher modes could be generated instead, even though they might have a low growth rate. Finally, the existence of high modes is indeed possible (e.g. Huntley, 1976; Sasaki and Horikawa, 1978). In fact, Katoh (1981) presented evidence to suggest the existence of edge wave modes up to $n=7$.

While the arguments presented above certainly do not prove any existence of infragravity edge waves in the data reported by Nelson and Gonsalves, it seems that the authors' reasons for rejecting edge waves as a possible source of the low-frequency energy in their records are inadequate.

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REPLY

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We would like to thank Aagaard for his interest in our paper and for the opportunity to clarify issues raised in his discussion. It seems that Aagaard feels that:
(i) the authors have dismissed the existence of edge waves out of hand because of the wide surf zone and turbulence;
(ii) the authors have ignored the fact that there could have been progressive edge waves;
(iii) the 0.01 Hz nodal frequency could have been a mode 2 edge wave.
In the paper it was clearly stated (p. 475) that for edge waves to exist on dissipative beaches, their off-shore length scales should be at least of the order of the width of the surf zone or greater. This point was emphasised by Guza