

Characteristics of long-period swells measured in the near shore regions of eastern Arabian Sea

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Received 27 October 2015; revised 28 February 2016; accepted 28 March 2016

Available online 1 July 2016

Abstract

Measured wave data covering two years simultaneously at 3 locations along the eastern Arabian Sea reveals the presence of long-period (peak wave period > 18 s) low-amplitude waves (significant wave height < 1 m) and the characteristics of these waves are described in this article. In a year, 1.4–3.6% of the time, the low-amplitude long-period swells were observed, and these waves were mainly during the non-monsoon period. The wave spectra during these long-period swells were multi-peaked with peak wave period around 18.2 s, the secondary peak period around 13.3 s and the wind-sea peak period at 5 s. The ratio of the spectral energy of the wind-sea peak and the primary peak (swell) was slightly higher at the northern location (0.2) than that at the southern location (0.15) due to the higher wind speed present at the northern location.

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Keywords: Surface waves; Swells; Significant wave height; Wave period; Wave spectrum; West coast of India

1. Introduction

Swells observed at the ocean surface can propagate thousands of kilometers (Munk et al., 1963). Identification of low-frequency swells propagating large distances from the generation region is vital in wave hindcast studies (Ardhuin et al., 2008). Due to near resonance conditions, the long-period swells can cause large heave motions of drilling rigs and hinder with other offshore operations (Gjevik et al., 1988). Many ports exposed to open ocean experienced a reduction in efficiency of cargo handling operations and mooring line breakages and structural damages to facilities and the factors identified for the cause were vessel and mooring characteristics, long-period swells and its orientation with moored vessel (McComb et al., 2009). The long-period waves and low-

amplitude swells observed from wave buoys deployed in the western North Atlantic Ocean are examined by Hamilton (1992). Sanil Kumar et al. (2011) reported long-period swells with peak wave period (T_p) more than 18 s in the northern Arabian Sea during 2009. Glejin et al. (2013) observed long-period waves with the period over 18 s at Ratnagiri, which were propagated from the Southern Ocean. Southwest (SW) waves with T_p values greater than 18 s were observed by Sanil Kumar et al. (2014a) off the central west coast of India. Waves in the eastern Arabian Sea also show a large response to seasonal variability [monsoon (JJAS), pre-monsoon (FMAM) and post-monsoon (ONDJ)] due to the reversal of the large-scale wind field over the north Indian Ocean between the boreal summer and winter (Sanil Kumar et al., 2014a). Characteristics of the long-period swell simultaneously at different locations in the eastern Arabian Sea are not studied. Hence, we examined the wave data collected during two years period simultaneously at 3 locations to know whether the long-period swells occur at different locations simultaneously in the eastern Arabian Sea. The objective of

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Peer review under responsibility of Society of Naval Architects of Korea.

¹ URL: www.nio.org.

the study is to document the observation of low-amplitude long-period swells in the eastern Arabian Sea and to study their characteristics.

The study region covers 350 km along the west coast of India and lies between Honnavar (southern location) and Ratnagiri (northern location). The measurement locations were i) off Honnavar at 9 m water depth (geographic position 14.3042° N; 74.3907° E), ii) off Karwar at 15 m water depth (geographic position 14.8217°, 74.0524°) and iii) off Ratnagiri at 13 m water depth (geographic position 16.9801° N; 73.2584° E) (Fig. 1). The distance of the locations from the west coast of Indian mainland is 2.5 km at Honnavar, 5 km at Karwar, 2 km at Ratnagiri. The distance between Honnavar and Karwar is 80 km, and that between Karwar and Ratnagiri is around 270 km. These locations were selected since they are open to the swells of the Indian Ocean, and the buoy measured wave data are available at these locations. The wave spectral characteristics of Ratnagiri and Honnavar are presented in Sanil Kumar et al. (2014a). The average significant wave height of the study area varies from 1.8 to 2 m during the

monsoon period and from 0.6 to 0.8 m during the remaining period (Sanil Kumar et al., 2014a). Tides in the region are mixed and are predominantly semi-diurnal (Sanil Kumar et al., 2014a). The average spring tidal range at Ratnagiri is about 1.8 m, and the neap tidal range is 0.9 m (Glejin et al., 2012). The average tidal range at Karwar, location 70 km north of Honnavar is 1.58 m during spring tide and 0.72 m during neap tide (Sanil Kumar et al., 2014a).

2. Data and methodology

Wave data measured simultaneously at all the 3 locations from 1 January 2011 to 31 December 2012 using a 0.9-m diameter Datawell Directional Waverider buoy (Datawell, 2009) equipped with a three-component Hippy accelerometer, compass, and tilt sensors were used in the study. The vertical and horizontal (eastward and northward) displacements of the buoy were obtained by double integration of the respective acceleration signal without applying a filter. The time referred in the paper is in UTC. The displacement data

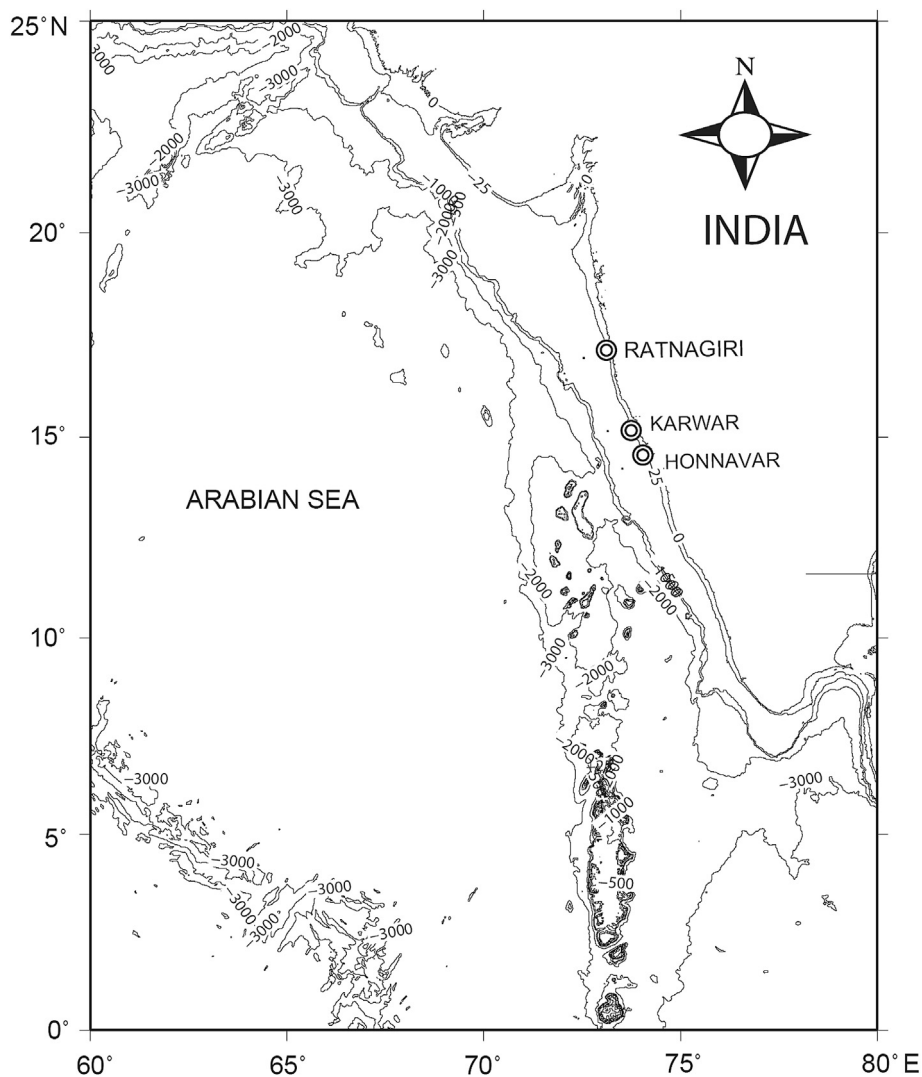


Fig. 1. Study area showing the measurement locations.

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