Instrumental Wave Observations

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Traditionally, wave observations over the seas were mainly carried out by observers on board Voluntary Observing Ships (VOS; http://www.hko.gov.hk/wservice/tsheet/pms/images/Wave_observations-final.pdf). With the advance in technology, instrumental measurement of waves is becoming increasingly common, particularly in the coastal regions. Sophisticated wave-measuring devices installed on land, offshore platforms, buoys and on board research vessels can provide a detailed and continuous observations of wave conditions. Different techniques have been used and this article introduces some of the devices that are deployed to measure waves nowadays.

Wave recorders are commonly used to measure wave height and period in coastal waters. The methods include: (a) measuring the pressure variation at the bottom of relatively shallow sea water; (b) transmitting a sound beam at the bottom of the sea towards the sea surface and measuring the acoustic energy return; and (c) mounting an accelerometer on a partially stabilized platform in a wave buoy and determining the vertical displacement of the buoy from the measured acceleration readings[1].

In Hong Kong, measurement of waves using wave recorders was available for a limited period of time in connection with building works as early as the 1970s[2] when a wave recorder was installed near Waglan Island southeast of Hong Kong. Figure 1 shows a view of the wave recorder and the waves recorded off Waglan Island during the passage of Typhoon Rose in 1971. More recently, the Civil Engineering and Development Department has been making non-real time wave measurement using pressure type wave recorders at Kau Yi Chau and the West Lamma Channel. Results of the measurement can be found at: http://www.cedd.gov.hk/eng/services/modeling/.

While wave recorders can provide accurate measurement of the waves at a particular location, High Frequency (HF) ocean radars can monitor waves in addition to currents and surface wind directions over a finite sea area around the radar site. Usually located along the coastal areas, the radars typically work in pairs, sending radio waves and listening to the scattered signals from the ocean surface waves. Such radars have been installed in various parts of the world, e.g. the coastal areas of eastern and southeastern China, Japan, Korea, Australia (Figure 2), European coasts in UK and Germany, as well as the Gulf Coast, East Coast and West Coast of the United States.

Globally, remote-sensing instruments such as altimeters, scatterometers and radiometers on board satellites provide worldwide coverage of wave heights and surface winds. The remote-sensing techniques generally measure the average wave conditions over a large sea area. Figure 3 shows an example of climatological mean wave heights based on satellite altimetry.

Even though instrumental wave observations are becoming more common nowadays, manual wave observations conducted by VOS are still extremely useful, particularly over the data-sparse ocean areas where they may be the only source of information.

References:

1. WMO Guide to Wave Analysis and Forecasting, WMO-No. 702, 1998 (second edition)
2. Sea Waves at Waglan Island, Hong Kong, Hong Kong Observatory Technical Note No. 36

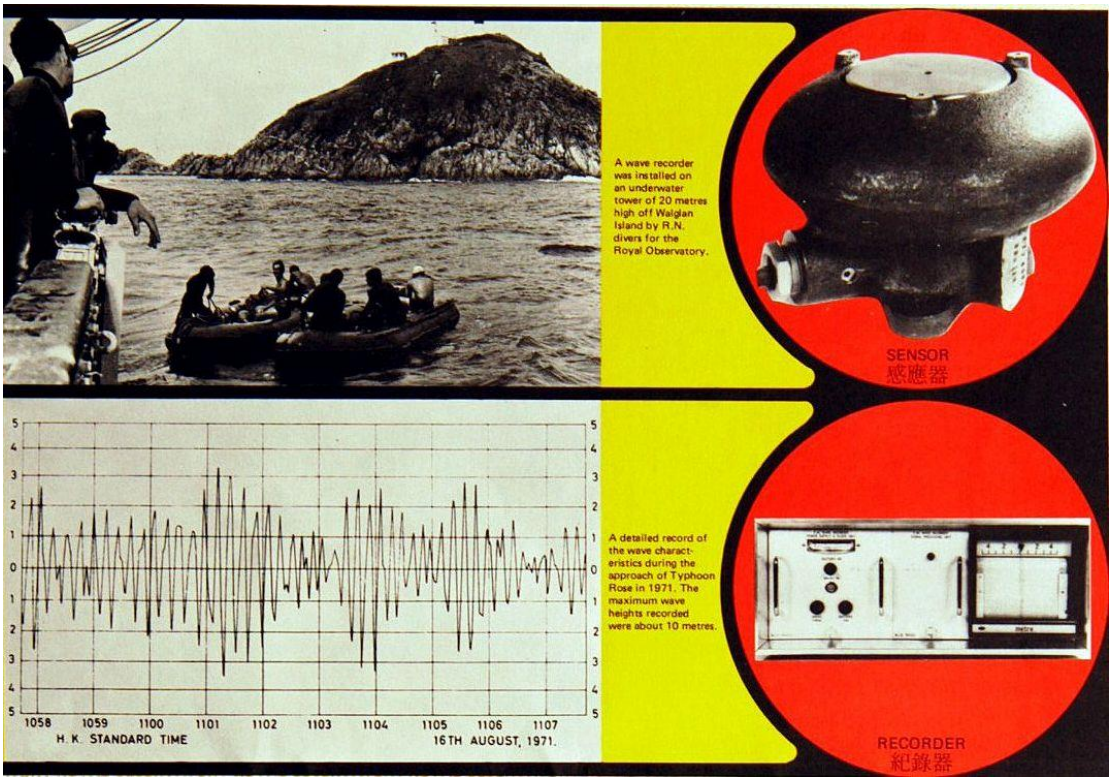

Figure 1 Waves off Waglan Island recorded on 16 August 1971 (bottom left) by a wave recorder (right) when Typhoon Rose was centred about 100 nautical miles south of Hong Kong. The maximum wave height recorded after corrections was about 10 metres. The typhoon subsequently came even closer to Hong Kong, but unfortunately the cable was damaged and no records were available thereafter (extracted from Hong Kong Observatory Calendar 1974).

Figure 2 An array of antennas for the HF ocean radars in western Australia, part of the Australian Integrated Marine Observing System/Australian Coastal Ocean Radar Network. (Photo courtesy of Professor Malcolm Heron, James Cook University, Townsville, Australia)

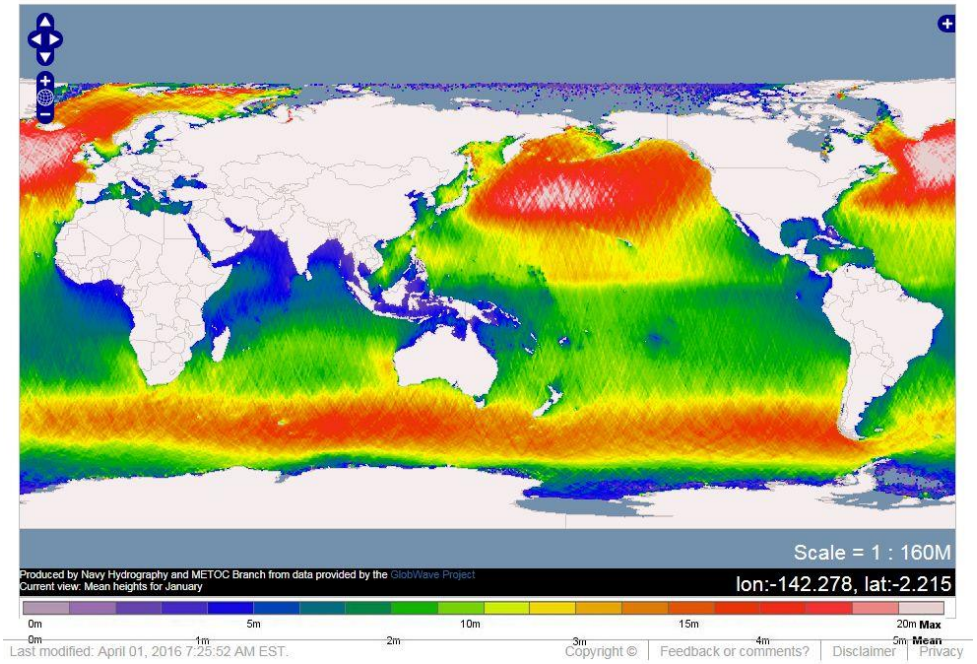

Figure 3 Climatology of global mean wave heights for January 2016 compiled using altimeter data from the satellites ENVISAT, ERS1, ERS2, GFO, Jason1, Jason2 and TOPEX. (Image courtesy of Royal Australian Navy Hydrology and METOC Branch, © Department of Defence (http://www.metoc.gov.au/products/wms_globwave.php), based on data from GlobWave Project (http://globwave.ifremer.fr/))