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Regional Wave Climates along Eastern Boundary Currents

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Abstract

Two types of wind-generated gravity waves coexist at the ocean surface: wind sea and swell. Wind sea waves are waves under growing process. These young growing waves receive energy from the overlaying wind and are strongly coupled to the local wind field. Waves that propagate away from their generation area and no longer receive energy input from the local wind are called swell. Swell waves can travel long distances across entire ocean basins. A qualitative study of the ocean waves from a locally vs. remotely generation perspective is important, since the air sea interaction processes is strongly modulated by waves and vary accordingly to the prevalence of wind sea or swell waves in the area.

A detailed climatology of wind sea and swell waves along eastern boundary currents (EBC; California Current, Canary Current, in the Northern Hemisphere, and Humboldt Current, Benguela Current, and Western Australia Current, in the Southern Hemisphere), based on the ECMWF (European Centre for Medium-Range Weather Forecasts) ERA-Interim reanalysis will be presented. The wind regime along EBC varies significantly from winter to summer. The high summer wind speeds along EBC generate higher locally generated wind sea waves, whereas lower winter wind speeds in these areas, along with stronger winter extratropical storms far away, lead to a predominance of swell waves there. In summer, the coast parallel winds also interact with coastal headlands, increasing the wind speed through a process called "expansion fan", which leads to an increase in the height of locally generated waves downwind of capes and points. Hence the spatial patterns of the wind sea or swell regional wave fields are shown to be different from the open ocean along EBC, due to coastal geometry and fetch dimensions. Swell waves will be shown to be considerably more prevalent and to carry more energy in winter along EBC, while in summer locally generated wind sea waves are either more comparable to swell waves or, particularly in the lee of headlands, or even more prevalent and more energized than swell. This study is part of the WRCP-JCOMM COWCLIP (Coordinated Ocean Wave Climate Project) effort.