Wind wave climate along Brazilian coast using a spectral partitioning algorithm

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The Brazilian coast has its wave climate determined by the following meteorological events: trade winds and the semi-permanent tropical anticyclones (one north and other south of equatorial line); migratory extratropical cyclones on South Atlantic responsible for swell and wind-sea achieving mainly the Brazilian south coast; and migratory extratopical cyclones on North Atlantic, responsible for propagating swell towards the Brazilian north coast.

It is usual to have wave spectrum along the Brazilian coast with two or more peak periods, each one due to one meteorological event. For this purpose, it was developed an algorithm of spectral partitioning based on Hanson & Phillips, 2001. This algorithm localizes the peak frequencies and groups the energy around it. Each value associated to this point will be part of a wave system. The method used considers all points that are associated with the peak frequencies, ensuring that all energy of every wave system will be computed. The wind data utilized to simulate the waves systems were provided by the NCEP global atmospheric model from 1997 to 2009, each 3 hours. In this study, WAVEWATCH III (WW3) numerical ocean wave model (Tolman,2009), with 1° x 1° spatial resolution for a global domain was employed, with waves parameters mean values calculated considering the cases from a specific direction dividing for total cases.

The results showed that cyclones are responsible for waves system from south (75°-105° in trigonometric convention), covering cases since from south to northeast Brazilian coast. At the Rio Grande do Sul State the occurrences vary from 10 to 20 % along the year, rising to 20-30 % at the following states: Santa Catarina, Paraná, São Paulo, Rio de Janeiro and Espírito Santo. At northeast coast, the occurrences return to 10-20 % in the Spring and Autumn and to 20-30 % in the Winter and Summer. The mean peak period varies from 12-14 s from Rio Grande do Sul to São Paulo, rising to 14-16 s from Rio de Janeiro to Rio Grande do Norte State. The significant wave height mean is higher at southeast reaching 0.75-1.5 m during winter and autumn, 0.75-1.25 m at south and fewer than 0.75 m at northeast coast.

The trade winds are responsible for 5-20 % of the occurrences from northeast (195°-240°) waves systems at south coast. This percentage rise to 5-30% along the southeast coast, with the peak direction changing to 225°-255°. At north and northeast coast, waves systems from north are also computed, increasing the peak direction range to 225°-300°. In this area the wave systems are most frequent from 240°-270°, varying 15-25 % of cases. The mean peak period range at south coast is 6-12 s, while at the southeast it increases from 12-16 s in the Spring and Summer, and 6-12 s during the Winter and Autumn. The peak direction from northwest (330°) stood out showing mean peak period around 18 s. In the south and southeast area the mean significant wave height vary around 1.0-1.5 m, with values at northeast and north coast reaching 1.75 m, mainly at Maranhão, Pará and Amapá State.

The waves systems from southeast (120°-180°) in south and southeast region vary from 5-10 % during the year with mean peak period among 8-14 s andmean significant wave height until 1.0 m. The incidences rises to 10-15 % in northeast coast and 15-30 % in north coast. The mean peak period at northeast coast vary from 12-16 s and mean significant wave height from 1.0-1.75 m. At north coast theses values reach 16-18 s of mean peak period and until 2.0 m of s mean significant wave height.