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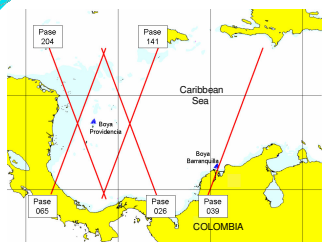
"Wave Spectra Construction in the Caribbean Sea Using Satellite Measurements after Buoy Data Analysis"

Rafael Ricardo Torres Parra*

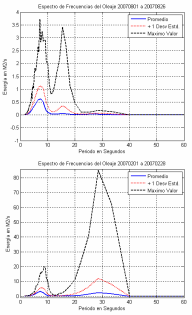
*Oceanographic and Hydrographic Research Center
CIOH
from Colombia's Maritime Authority
DIMAR.



Abstract: Construction of wave spectra, making use of significant wave height from Jason-1 satellite was explored employing the JONSWAP preconceived spectra, so this could be used on data assimilation on a third generation wave model operated in the Oceanographic and Hydrographic Research Center - CIOH in the Caribbean Sea. Information from an operational data product, the Operational Sensor Data Record (OSDR) available within 3-5 hours of delay was employed, on which a correction to eliminate systematic bias and necessary quality control were applied to achieve a higher accuracy offered on the Interim Geophysical Data Record (IGDR), a more detailed data product available within 2-3 days of delay. Two directional wave buoys installed by the Colombia's Maritime Authority were used to verify the wave spectra construction results, finding great coincidence between the buoy and constructed spectra.

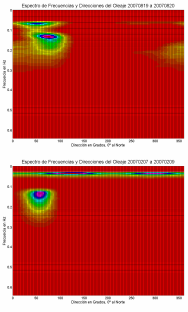
BUOYS DATA

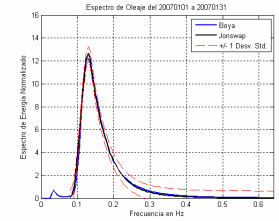
Information collected from march/06 to August/07 by two directional wave buoys of five deployed by Colombia's Maritime Authority **DIMAR** on jurisdictional waters were used.



Monthly mean data of the frequency spectrum was analyzed using iterative techniques looking for constants that gave best fit to Jonswap spectrum. It was found an important spatial and temporal variation on the wave behavior and also that Swell was an unusual event on the Caribbean.

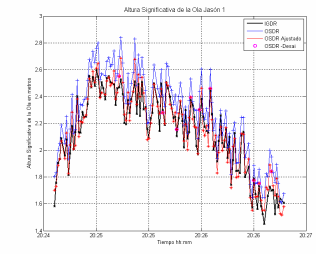
Quality control was applied observing the frequency and directional spectrums, rejecting erroneous data.





As shown on the figure above, with the Jonswap constants founded, the monthly mean wave frequency spectra acquired with the buoy (blue line) was reproduced satisfactorily (black line). It was proposed to continue the search of this constants as a function of the Significant Wave Height – SWH as more information became available.

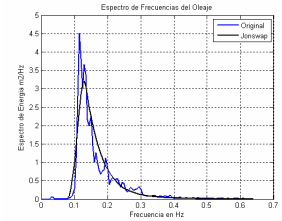
SATELITE JASON 1 SWH PRODUCTS, QUALITY CONTROL AND WAVE SPECTRA CONSTRUCTION

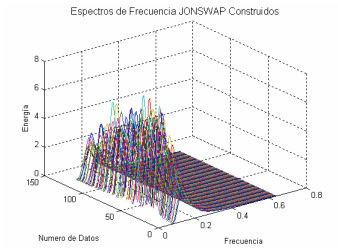


SWH measured by Jason-1 is available in Internet by AVISO-CNES & PO.DACC-NASA. Two products were used: The Operational Sensor Data Record – OSDR, available within 3-5 hours of delay, designed to be employed for data assimilation in operational wave models, and the Interim Geophysical Data Record – IGDR, which is a more detailed data product available within 2-3 days of delay.

Applying some filters, quality control and removing a systematic bios to OSDR SWH products, following Desai S. et al. (2003) work, it was achieved nearest the same measuring error estimated for IGDR products.

The figure at right corresponds to SWH measurements done by Jason-1 the 22 of jun/07 during pass 039 through of the Caribbean. The black line is SWH from the IGDR product (reference), the blue line SWH from the OSDR product after filtering and quality control. The red line SWH from OSDR after removing systematic bios.





For the wave spectra construction, SWH (Hs) from OSDR product was used after mentioned corrections, calculating the area under the spectrum (mo) using the following formula:

$$Hs = 4\sqrt{m_o}$$

Using the Jonswap constants founded from the buoy data analysis, the frequency at the spectral peak is iterated, calculating each time the area under the Jonswap spectra. When the area (mo) best matches with the area under the Jonswap spectra, that frequency value is used for wave spectra construction.

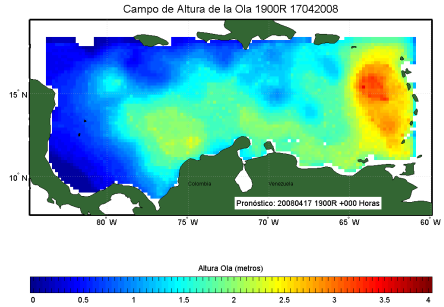
The figure at right shows the reconstruction of 127 values of SWH corresponding to measurements done by Jason-1 the 22 of jun/07 during pass 039 through of the Caribbean.

To evaluate the results, constructed wave spectra was compared with a frequency spectra measured by a wave buoy at nearly the same time and place that the SWH measured by Jason-1.

On figure above, the blue line shows the buoy wave spectra measured in a radius of 15 km from the Jason-1 foot print, during a 20 minutes time window that coincided with satellite transit. The black line is Jonswap constructed spectra.

A good match between measured and constructed spectra is observed.

FOLLOWING WORK



The Oceanographic and Hydrographic Research Center – **CIOH** from **DIMAR**, runs since 2001 an operational third generation wave model (NedWAM-III) in the Caribbean Sea.

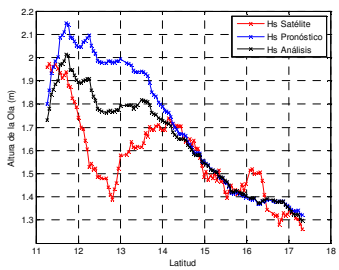
Daily outputs can be seen in www.cioh.org.co.

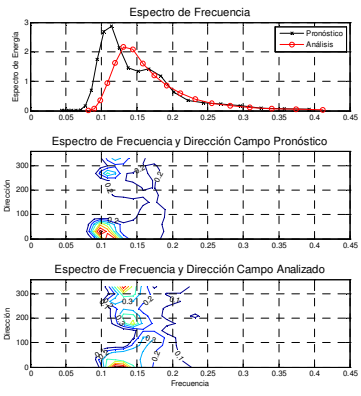
The figure above shows an output of the model.

Some development have been done at **CIOH** to assimilate satellite SWH in an operational way into the wave model. One possibility uses an alternative method based on the Functional Variation.

A second possibility is using optimal interpolation for correcting SHW fields. In the figure below is an example. The red line is SWH measured by Jason-1, the blue line is the "first guess" output at the observations. The black line is the SWH analyzed using optimal interpolation.

As the model doesn't have any restriction to calculate wave spectra, assimilated SWH will be used to construct wave spectra so it can be replaced into the model. At the figure at right: on top, the red line is the constructed analyzed wave spectra, in black the "first guess" spectra for the same node. At the middle first guess directional spectra, at the bottom the same for the analyzed spectra.





After improving the wave model forecast results with operational data assimilation, is planned to use it to calculate wave climatology from the Caribbean using reanalysis techniques.