UPDATE ON JASON-1 SEA STATE BIAS MODELING FROM COMBINATION OF WAVE MODEL AND SATELLITE DATA

N. Tran (CLS), D. Vandemark (UNH), S. Labroue (CLS), H. Feng (UNH), B. Chapron (IFREMER), J. Lambin (CNES), N. Picot (CNES)

Abstract - A new generation of sea state bias (SSB) models steps forward lately. They rely on the inclusion of ocean gravity wave parameters from operational wave models as auxiliary data in the development of alternative SSB solutions. Presently, we describe two new 3-parameter models which incorporate such parameters in addition to the continued use of altimeter observed significant wave height (SWH) and wind speed (U) measurements.

Model development

We derived different 1-year Jason-1 SSB solutions in the form of a regular grid in a 3D space by applying directly a non-parametric estimation technique based on kernel smoothing [Gaspar et al., 2002] on sea level anomalies (SLA). This approach isolates the SSB term against the chosen correlations within the large variability of the SLA.

These new models incorporate wave field information related to its development degree not currently available in altimeter data and coming from the WaveWatch3 ocean wave model hindcast in order to provide operational alternatives to today’s correction.

Because a previous analysis [Tran et al., 2006] indicated potential for parameters such as swell height (H_swell) and mean wave period (Tm) to reduce systematic regional error in the actual operational correction based on (SWH, U), we developed 2 types of models: SSB (SWH, U, H_swell) and SSB (SWH, U, Tm) as shown in Figure 1.

Variance reduction assessment

The 3D models performance skills have been evaluated on collinear DSSH as provided in Table I to expand model validation. Comparison of skills with that from the operational parameterization version, i.e. SSB (SWH, U) is shown. The single term model SSB (SWH) = -3.8% SWH serves as the low limit benchmark.

The 1-year models and 1-year datasets allow to test the stability of the models behaviors and of their performances in reducing ΔSSH variability when corrected for SSB term.

The gain in variance reduction obtained globally with the 3D models (see Table I) is always larger than the ones obtained with the 2D solution. In Figure 2, one can see that this improvement applies at all latitudes for SSB model derived with Tm.

Geographical patterns

Figure 3 shows annually-averaged mean and variance differences between SSB estimates from the 2D and 3D models when derived with Tm.

Clear spatial patterns emerge and some west-to-east gradients are observed across each ocean basin. They are directly attributed to the changing wave period distributions, the 3D model proves to better capture the variability of the SSB by adjusting the magnitude of the correction between ‘old’ seas on the eastern edge of the basins and ‘young’ seas on the western edges.

<table>
<thead>
<tr>
<th>Variance gain (cm²) of the model when compared to the variance explained by SSB (SWH) = -3.8% SWH and when applied to ΔSSH</th>
<th>2002 models</th>
<th>2004 models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dataset</td>
<td>dataset</td>
</tr>
<tr>
<td>SSB (SWH, U, Tm)</td>
<td>2.80</td>
<td>3.97</td>
</tr>
<tr>
<td>SSB (SWH, U, H_swell)</td>
<td>3.76</td>
<td>4.02</td>
</tr>
<tr>
<td>SSB (SWH, U, alt, Tm)</td>
<td>4.18</td>
<td>4.51</td>
</tr>
</tbody>
</table>

Reference: