1 Calibration and validation of regional wave model data

1.1 Summary

The wind speeds used to drive the regional wave model are generally underestimated, typically $\sim 20\%$. For this reason the wave model has been tuned to compensate for the underestimated wind speeds. However, the model was slightly overcompensated resulting in an overestimation of the significant wave height of typically $\sim 10\%$. The calibration procedure will remove this overestimation.

1.2 Validation of regional wave model data

Validation results of the regional wave model are based on satellite altimeter observations from Jan1997 until December 2001.

The regional wave model is compared with the significant wave height and wind speed obtained from the ERS2 and Topex /Poseidon satellite altimeters measured within a distance of 50 km and less than 3 hours earlier or later. For the validation the model results are grouped into 5 geographical regions:

- Mediterranean
- Aegean Sea
- ♦ Black Sea
- Red Sea
- Caspian Sea
- Arabian Gulf

The locations of the validated grid points are given in Figure 1.



Figure 1 Locations of the regional grid points used the validation.

www.waveclimate.com January 2004 ARGOSS The error is defined as the difference (altimeter minus model) between the calibrated (Validation offshore climate' report) altimeter observations (wind speed and significant wave height) and the model results. The quality of the model data is expressed in terms of:

- Mean: Mean value of the altimeter observations.
- Bias: Mean value of error (altimeter minus model data)
- StDev: Standard deviation of error.
- Rrms: Relative root mean square of error.
- Corr: Correlation coefficient.
- Reg coef Linear regression coefficient.

The statistical parameters are defined in section 2 of the 'Validation offshore climate' report but instead of buoy measurements one should read model data. The statistical wave parameters were computed from the calibrated wave model results (section 1.3).

The statistics of the significant wave height and wind speed are collected in the tables below. Scatter plots and the least squares fits (used for the calibration of the wave energy) are given in section 1.4 and 1.5

Location			Statistical parameter						
			After calibration					calibration	
								constants	
grid ID	Region	(lat,lon)	N	Mean	Corr	StDev	Rrms	Bias	Reg
		[deg]		[m]		[m]	[%]	[m]	coef
000466	Mediterranean	(43.00,4.00)	500	1.1	0.86	0.40	30	0.17	0.92
000044		(36.0, -3.25)	326	1.08	0.85	0.40	31	0.07	1.08
000577		(38.0,5.25)	281	1.42	0.95	0.36	20	-0.04	1.04
001719		(39.25,14.75)	147	0.97	0.92	0.31	25	0.14	1.16
001882		(42.75,15.75)	505	0.77	0.84	0.32	34	0.19	1.04
004483		(33.25,34.75)	278	0.96	0.88	0.37	30	-0.05	0.98
001362		(35.25,12.50)	502	1.04	0.91	0.29	23	-0.12	1.17
003031	Aegean Sea	(38.25,24.50)	271	1.03	0.91	0.32	25	0.20	1.04
003956	Black Sea	(43.50,31.25)	150	1.11	0.89	0.33	25	-0.13	1.11
005233		(43.75,39.25)	311	0.82	0.81	0.35	35	0.22	1.10
004654	Red Sea	(25.50,35.75)	325	1.00	0.86	0.31	27	0.18	1.01
005396		(16.75,40.75)	274	0.93	0.82	0.30	28	-0.08	1.26
006350	Caspian Sea	(38.50,51.75)	137	0.85	0.89	0.35	31	-0.10	1.05
006392	Arabian Gulf	(27.0,52.0)	147	0.81	0.78	0.34	36	0.08	1.20

 Table 1
 Error statistics of regional model wave spectra based on altimeter data.

Location			Statistical parameter						
grid ID	Region	(lat,lon)	Ν	Mean	Corr	StDev	Rrms	Bias	Reg
-	-	[deg]		[m/s]		[m/s]	[%]	[m/s]	coef
000466	Mediterranean	(43.00,4.00)	500	6.91	0.87	2.05	26	0.40	0.83
000044		(36.0,-3.25)	326	5.80	0.86	1.95	28	0.12	0.83
000577		(38.0,5.25)	281	5.81	0.88	1.68	25	0.17	0.92
001719		(39.25,14.75)	147	4.74	0.86	1.76	31	0.33	0.76
001882		(42.75,15.75)	505	4.87	0.83	1.79	32	0.39	0.77
004483		(33.25,34.75)	278	4.62	0.83	1.59	33	0.78	0.69
001362		(35.25,12.50)	502	5.78	0.88	1.53	23	0.02	0.86
003031	Aegean Sea	(38.25,24.50)	271	6.32	0.87	1.87	29	1.07	0.76
003956	Black Sea	(43.50,31.25)	150	6.04	0.90	1.40	21	0.13	0.86
005233		(43.75,39.25)	311	4.60	0.74	2.15	44	1.21	0.58
004654	Red Sea	(25.50,35.75)	325	5.59	0.80	1.54	26	0.46	0.85
005396		(16.75,40.75)	274	4.33	0.72	1.80	36	0.16	0.96
006350	Caspian Sea	(38.50,51.75)	137	4.51	0.80	1.72	33	0.32	0.78
006392	Arabian Gulf	(27.0,52.0)	147	4.72	0.72	2.05	48	0.53	0.79

 Table 2
 Error statistics of the wind speed driving the wave model based on altimeter data.

1.3 Calibration of regional wave model data

Wave heights and wind-sea wave periods computed by the wave model are calibrated on-the-fly with altimeter wave heights (similar to the calibration of SAR data as described in section 4.2 of the 'Validation offshore climate' report). This calibration of wave model data with altimeter observations has been taken into account in the previous section.

1.4 Scatter plots significant wave heights

Least squares fits of the regional model (non-calibrated) significant wave height and the satellite altimeter wave height per region are given in the figures below.



Figure 2 Mediterranean.



Figure 3 Aegean Sea.







Least squares fit (1997-2001) lat: 43.75 lon: 39.25 (deg)

4 Hs satellite [m]

2

Raw data Sorted data LS fit

8

8

y=x

6

ε

6

5 4 3

Hs wave model [m]

Figure 5 Red Sea.

www.waveclimate.com January 2004 ARGOSS



Figure 6 Caspian Sea.



Figure 7 Arabian Gulf.

1.5 Scatter plots wind speed

Least squares fits of the wind speed used to drive the regional wave model and the satellite altimeter wind speed are given in the figures below.



Figure 8 Mediterranean.



Figure 9 Aegean Sea.







Raw data Sorted data LS fit

20

γ=x

15

5 10 windspeed satellite [m/s]

5

Figure 11 Red Sea.

www.waveclimate.com January 2004 ARGOSS



Figure 12 Caspian Sea.



Figure 13 Arabian Gulf.