

# The wave climate of the Baltic Sea

Ewa Jakusik ewa.jakusik@imgw.pl  
 Department of Climatology  
 Institute of Meteorology and Water Management,  
 Maritime Branch in Gdynia, Poland



## DEPENDENCE BETWEEN WAVE HEIGHT [m] AND WIND SPEED [ms<sup>-1</sup>] IN THE FUNCTION OF WIND DIRECTION ACCORDING TO THE HYPAS MODEL

Basins of the Baltic Sea	Wind direction			
	N	E	S	W
Western Bornholm Basin	$H = 0,21 * V - 0,33$ $r^2 = 0,88$	$H = 0,24 * V - 0,47$ $r^2 = 0,90$	$H = 0,21 * V - 0,48$ $r^2 = 0,88$	$H = 0,23 * V - 0,70$ $r^2 = 0,90$
Eastern Bornholm Basin	$H = 0,26 * V - 0,45$ $r^2 = 0,85$	$H = 0,23 * V - 0,44$ $r^2 = 0,88$	$H = 0,12 * V - 0,12$ $r^2 = 0,90$	$H = 0,27 * V - 0,50$ $r^2 = 0,92$
Western Gotland Basin	$H = 0,25 * V - 0,45$ $r^2 = 0,88$	$H = 0,14 * V - 0,13$ $r^2 = 0,85$	$H = 0,25 * V - 0,52$ $r^2 = 0,87$	$H = 0,17 * V - 0,20$ $r^2 = 0,94$
Eastern Gotland Basin	$H = 0,28 * V - 0,52$ $r^2 = 0,84$	$H = 0,18 * V - 0,23$ $r^2 = 0,85$	$H = 0,26 * V - 0,50$ $r^2 = 0,85$	$H = 0,25 * V - 0,44$ $r^2 = 0,89$

## EXTREME VALUES OF THE TOTAL WAVE HEIGHT IN CHOSEN BASINS OF THE BALTIC SEA

Data	Basins of the Baltic Sea	Date	Wind direction	Wind speed [ms <sup>-1</sup> ]	Wave height [m]	Wave period [s]
HYPAS	Eastern Gotland Basin	1990 -02 -27	SW	28,4	9,2	12,8
ERA -40	Eastern Bornholm Basin	1999 -12 -04	W	21,5	7,9	10,1
SHIP observation	Western Bornholm Basin	1995 -02 -15	SW	18,0	7,5	8,0
		1997 -12 -08	S	17,0	7,5	6,0
	Eastern Bornholm Basin	1999 -02 -04	SW	19,0	7,5	6,0

## CONDITIONAL PROBABILITY OF OCCURRENCE OF THE TOTAL WAVE WITH A DEFINITE HEIGHT[m] DEPENDING ON WIND DIRECTION IN CHOSEN BASINS OF THE BALTIC SEA ACCORDING TO THE HYPAS MODEL

Basins of the Baltic Sea	Wind direction															
	N				E				S				W			
	Wave height (H) larger or equal															
	0,2	1	3	5	0,2	1	3	5	0,2	1	3	5	0,2	1	3	5
Western Bornholm Basin	0,76	0,37	0,00	0,00	0,84	0,39	0,03	0,01	0,77	0,33	0,01	0,00	0,89	0,54	0,12	0,01
Eastern Bornholm Basin	0,94	0,40	0,05	0,00	0,83	0,29	0,01	0,00	0,84	0,18	0,00	0,00	0,95	0,68	0,23	0,02
Western Gotland Basin	0,87	0,51	0,08	0,01	0,82	0,17	0,00	0,00	0,86	0,43	0,06	0,00	0,93	0,55	0,03	0,00
Eastern Gotland Basin	0,91	0,54	0,09	0,02	0,88	0,32	0,00	0,00	0,93	0,52	0,08	0,01	0,95	0,61	0,13	0,01

- The results achieved and interpreted in the present work give basis for formulating the following conclusions:**
- The assessment of usefulness of different data sources for the compilation of the Baltic Sea wave climate on account of the lack of regular surveys showed that the HYPAS model is an optimal one and can be used in further climate research.
  - The results to date indicate the necessity of great caution while working with the ERA-40 model.
  - The results gained from the ERA 40 reanalysis in the discussed investigative period in relation to the HYPAS model understate both the average height and average wave period as well and the values are contained respectively in the range of: 0,1-0,5 m and 0,6-1 s. The result can be partly explained by understated values of wind speed received from the ERA-40 reanalysis.
  - The largest wave is present in central part of the Baltic, where wind expansion is large both for winds blowing from western, southern and northern sectors. Central Baltic is a region of the strongest winds and bigger depths than those present near the coasts and gulfs. Both wind speed and average wave elements are larger in northern, eastern and central rather than in the western part of the Baltic.
  - From the results of the analysis of co-occurrence of wave height and wind direction it appears that the waves above 1 m are most often caused by wind from the western sector, meanwhile the second frequency maximum, considerably smaller from the first one, is present in the case of south-west winds.
  - The smallest waves with wind from south to north are present in relatively shallow, western part of the Baltic, the area surrounded by land from three sides.
  - On the Baltic Sea over 50% of cases are cases of small wave ( $H_c < 1$  m), not creating any threat to sailing, sea shores and any work at sea. On the basis of the model data and the SHIP observation the waves above 4 m constitute about 3-4% of cases.
  - The analysis of dependence between wave height and wind speed in the function of wind direction on the Baltic showed, that values  $r^2$  are decidedly bigger (0,84-0,94). This confirms that wave field on the Baltic often can be an immediate answer for wind field.