CCS Metocean Database and its application to Marine Structures



CHINA CLASSIFICATION SOCIETY
中国船级社

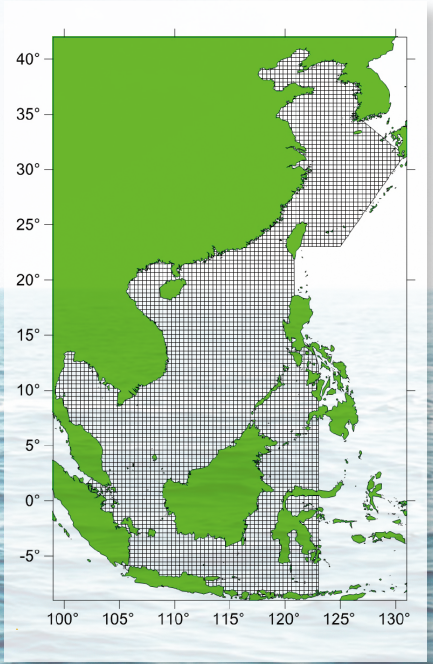
Introduction


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软件名称：南海海况数据查询系统 V1.0
著作权人：中国船级社;国家海洋局北海预报中心;青岛晖鹏信息技术有限公司
开发完成日期：2013年05月10日
首次发表日期：2013年05月10日
权利取得方式：原始取得
权利范围：全部权利
登记号：2013SR116964
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China Classification Society (CCS) took up the meterological and oceanographic (Metocean) study since 2011. After almost 9 years study, CCS has established the metocean database including winds, waves and currents which covering the Bohai Sea, the Yellow Sea, the East China Sea as well as the South China Sea for several decades long by using well-calibrated models. The database is set up based on the numerical hindcast method and has gone through verification of fully measured data including verification of measured data from sensors placed on offshore structures, data from buoys and satellites with high accuracy, long time span and wide coverage. Our services include site-specific technology service, generation of long-term climatologies for operability and design in the marine environment and the whole life cycle metocean technology service for offshore structures. In addition, CCS is developing our own "metocean design and operation guidance" which will be published in 2020. The guidance will give the specific wind, wave and current parameters for the design and operation of marine structures in China's waters as well as the southern part of China Sea and is in line with the norms of updated edition of API RP 2MET, Petroleum and natural gas industries-Specific requirements for offshore structures-Part1: Metoceandesign and operating considerations and ISO19901-1, Derivation of Metocean Design And Operating Conditions. Besides, CCS cooperated with State Oceanic Administration and Shan Dong University of Science and Technology to develop the analysis tool for displaying and calculation metocean hindcast statistics which named "the metocean database information system for sea condition of China's waters", in which has been awarded the certificate for the registration of software copyright by State Copyright Administration.

CCS Meocean database

For now, CCS has set up Metocean database for the Bohai Sea, the Yellow Sea, East China Sea, South China Sea and Southeast Asia Waters. The scope of the database is shown in the picture below:



● The database consists of the following 5 parts:

1) Metocean Database of winds, waves and currents for the fine grid area of the Bohai Sea, the Yellow Sea and East China Sea:

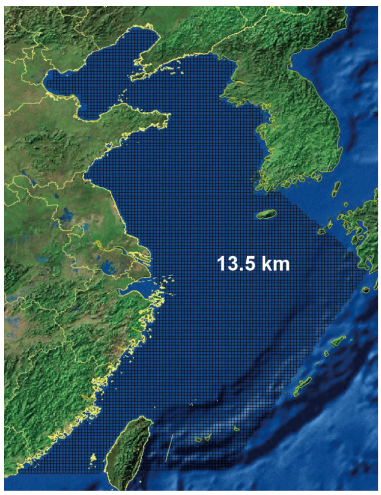
The data scope is shown in the picture below including data of winds, waves and currents with time spacing of 1 hour in 45 years and the grid size is 5.5Km×5.5Km.



◎ Metocean database for the fine grid of the Bohai Sea, the Yellow Sea and the East China Sea (black shadow in the picture)

2) Metocean database of winds, waves and currents for the coarse grid area of the Bohai Sea, the Yellow Sea and the East China Sea:

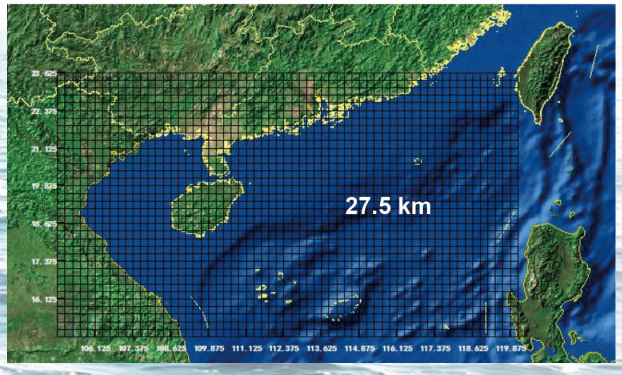
The data scope is shown in the picture below including data of winds, waves and currents with time spacing of 1 hour in 45 years and the grid size is 13.5Km×13.5Km.



◎ Metocean database for the coarse grid of the Bohai Sea, the Yellow Sea and the East China Sea (black shadow in the picture)

3) Metocean database for the northern part of the South China Sea and the Beibu Gulf (Database 1)

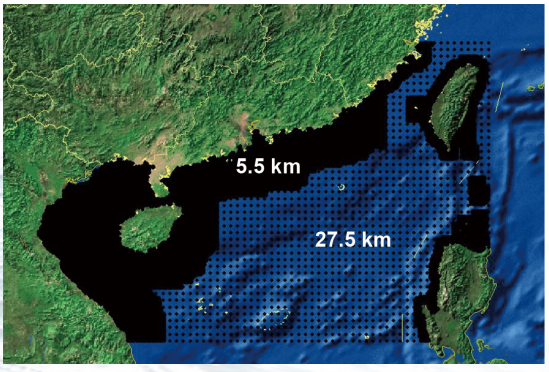
The data scope is shown in the picture below including data of winds, waves and currents with time spacing of 1 hour in 45 years and the grid size is 27.5Km×27.5Km.



◎ Metocean database for the northern part of the South China Sea and the Beibu Gulf (Database 1)

4) Metocean database for the northern part of the South China sea and the Beibu Gulf (Database 2)

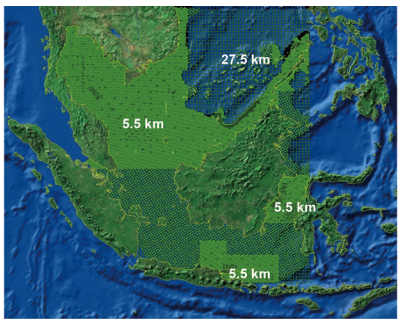
The data scope is shown in the picture below including data of winds and waves with time spacing of 1 hour in more than 50 years, with embedded fine and coarse grid



◎ Metocean database for the northern part of the South China Sea and the Beibu Gulf (Database 2)

5) Metocean Database for the southern part of the South China sea and the Southeast Asia waters:

The data scope is shown in the picture below including data of winds and waves with time spacing of 1 hour in more than 50 years and that of current in almost 20 years, with embedded fine and coarse grid.

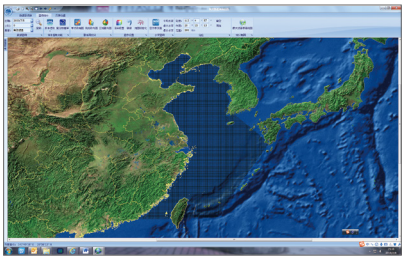


◎ Metocean Database for the southern part of the South China Sea and the Southeast Asia Waters (green shadow in the picture)

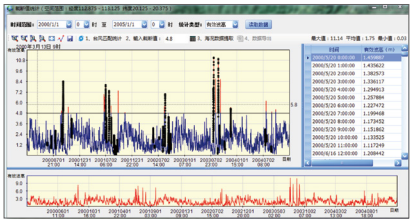
The metocean database information system for sea condition of China's waters

Through the database information system for sea condition of China's waters developed by CCS, we can provide service as follows:

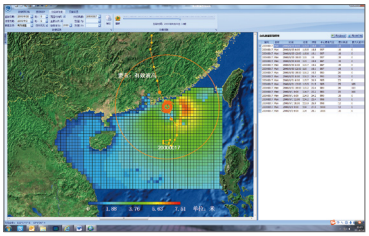
- Graphical display and export Metocean data within each grid point in CCS database;
- Extraction for Peaks-Over-Treshold (POT) samples as well as the extraction of Year (Month, Quarter) extreme sample;
- Extremal analysis, for the wind speed, significant wave height, current velocity and water level of various return periods with Gumbel, 3-para Weibull and Pierson-III distributions;
- Frequency of Occurrence tables on any two variables on a grid basis, including HS-TP/Tz, HS-direction, wind speed-wind direction, current velocity- direction;
- Frequency of Occurrence tables on any two variables on the regional basis.
- Dynamic graphical display for the typhoon path and related parameters;
- Water depth;
- Contour lines for wave heights and wind speeds;
- Wave spectrum of limited grid points.



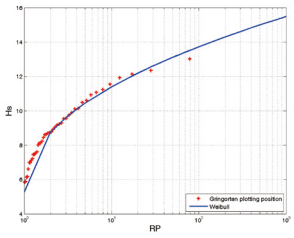
◎ The main interface of the metocean database information system for sea condition of China's waters (coarse grid area of the Bohai Sea, the Yellow Sea and the East China Sea)



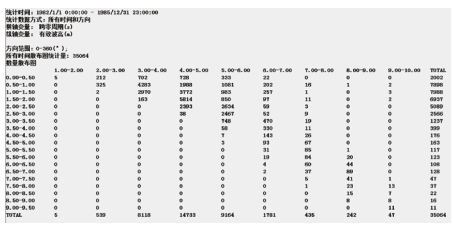
◎ Extraction for the typhoon sea condition (POT method)



◎ Dynamic graphical display for the typhoon (significant wave height with the change of typhoon time-histories)



◎ Long term distribution of significant wave heights in a location of the east waters of the South China Sea (Weibull)



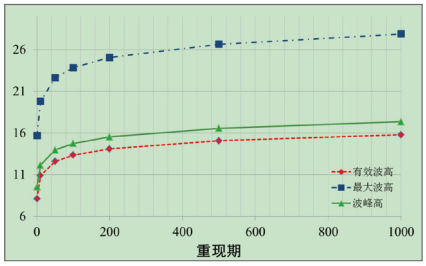
◎ Hs-Tz dispersion map for a location of the east waters of the South China Sea

The service capacity of China Classification Society

Based on our metocean database and *the metocean database information system for sea condition of China's waters* established by CCS, we can provide the marine environment data in full life cycle for offshore structures, domestic sailing ship and winds, waves and currents required by the offshore wind farm, including technology analysis & calculation, data recheck, etc.

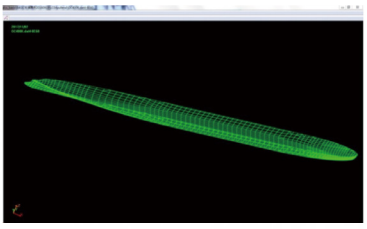
Case introduction

1) Calculation for the wave extremum in a location of the South China Sea;

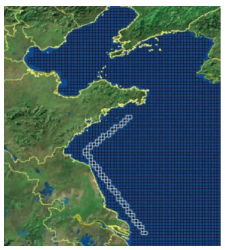


◎ Significant and maximum wave heights, and wave crest heights in each recurrence interval in a location of the northern part of the South China Sea.

2) The comparison of vertical load for the maximum profile between the environment of North Atlantic used by certain domestic sailing ships and that of chosen waterway.

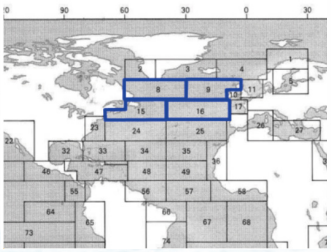


◎ Bulk carrier with 40t



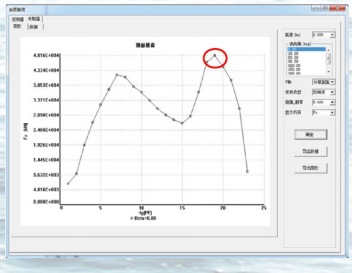
Tz/Hs	0-1	1-2	2-3	3-4	4-5	5-6	6-7	Total
2-3	289058	14	0	0	0	0	0	289072
3-4	530101	91134	76	0	0	0	0	621311
4-5	195936	79408	20196	148	0	0	0	295688
5-6	49141	12500	12094	3810	196	0	0	77741
6-7	7173	1477	910	1002	528	87	0	11177
7-8	609	187	136	153	177	51	0	1313
8-9	0	7	25	39	40	30	7	148
9-10	0	0	0	2	23	5	0	30
Total	1072018	184727	33437	5154	964	173	7	1296480

◎ Dispersion map for the chosen waterway

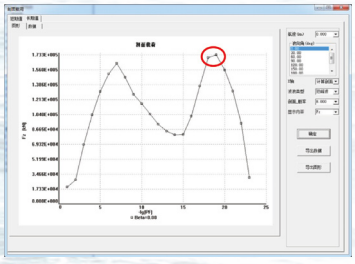


Hs/Tz	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	Total
0.5	0	0	1.3	133.7	865.6	1186	634.2	186.3	36.9	5.6	0.7	0.1	0	0	0	0	0	0	3050.4
1.5	0	0	0	29.3	986	4976	7738	5569.7	2375.7	703.5	160.7	30.5	5.1	0.8	0.1	0	0	0	22575.4
2.5	0	0	0	2.2	197.5	2158.8	6230	7449.5	4860.4	2066	644.5	160.2	33.7	6.3	1.1	0.2	0	0	23810.4
3.5	0	0	0	0.2	34.9	695.5	3226.5	5675	5099.1	2838	1114.1	337.7	84.3	18.2	3.5	0.6	0.1	0	19127.7
4.5	0	0	0	0	6	196.1	1354.3	3288.5	3857.5	2685.5	1275.2	455.1	130.9	31.9	6.9	1.3	0.2	0	13289.4
5.5	0	0	0	0	1	51	498.4	1602.9	2372.7	2008.3	1126	463.6	150.9	41	9.7	2.1	0.4	0.1	8328.1
6.5	0	0	0	0	0	12.6	167	690.3	1257.9	1268.6	825.9	386.8	140.8	42.2	10.9	2.5	0.5	0.1	4806.3
7.5	0	0	0	0	0	3	52.1	270.1	594.4	703.2	524.9	276.7	111.7	36.7	10.2	2.5	0.6	0.1	2586.2
8.5	0	0	0	0	0	0.7	15.4	97.9	255.9	350.6	296.9	174.6	77.6	27.7	8.4	2.2	0.5	0.1	1308.5
9.5	0	0	0	0	0	0.2	4.3	33.2	101.9	159.9	152.2	99.2	48.3	18.7	6.1	1.7	0.4	0.1	626.2
10.5	0	0	0	0	0	0	1.2	10.7	37.9	67.5	71.7	51.5	27.3	11.4	4	1.2	0.3	0.1	284.8
11.5	0	0	0	0	0	0	0.3	3.3	13.3	26.6	31.4	24.7	14.2	6.4	2.4	0.7	0.2	0.1	123.6
12.5	0	0	0	0	0	0	0.1	1	4.4	9.9	12.8	11	6.8	3.3	1.3	0.4	0.1	0	51.1
13.5	0	0	0	0	0	0	0	0.3	1.4	3.5	5	4.6	3.1	1.6	0.7	0.2	0.1	0	20.5
14.5	0	0	0	0	0	0	0	0.1	0.4	1.2	1.8	1.8	1.3	0.7	0.3	0.1	0	0	7.7
15.5	0	0	0	0	0	0	0	0	0.1	0.4	0.6	0.7	0.5	0.3	0.1	0.1	0	0	2.8
16.5	0	0	0	0	0	0	0	0	0	0.1	0.2	0.2	0.2	0.1	0.1	0	0	0	0.9
Total	0	0	1.3	165.4	2091.2	9279.9	19921.8	24878.8	20869.9	12898.4	6244.6	2479	836.7	247.3	65.8	15.8	3.4	0.7	100,000

◎ Dispersion map for North Atlantic



◎The vertical load for the profile of chosen waterway



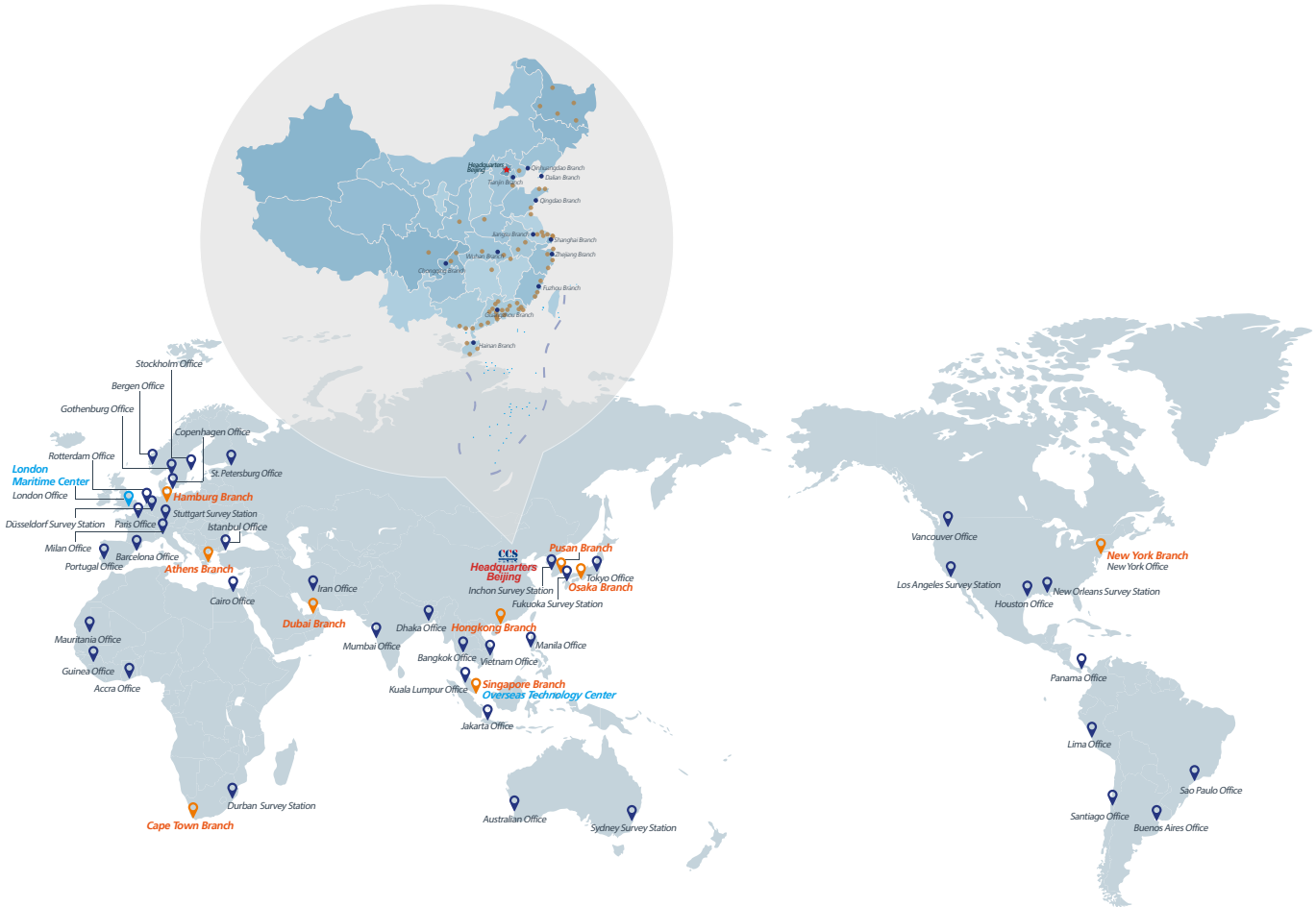
◎ The vertical load for the profile of the North Atlantic.

◎ The vertical load for the profile of the North Atlantic is 3.6 times the size of maximum vertical load for the chosen waterway

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Contact us

To meet the demand of our customers, we have set up branches and offices in major port cities in China as well as in Asia, Europe, America, Middle East, Australia and many other countries or regions worldwide, forming a global survey network.



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APR, 2022