

A Typhoon Swell Freak Wave Hindcast Example

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Abstract

At about 4 a.m. on August 7, 1992, four fishing ships were totally destroyed by sudden huge waves in the vicinity of Suao Harbor (24.63°N, 121.93°E) at the east coast of Taiwan. One man died, two persons were missing and five fishermen were wounded. As the accident was close to the harbor, some wrecks were drifted to shore. One fisherman reminded that he has never confronted such big waves in his 40 years' fishing career. Two days ago, a medium scale typhoon Janis had been in the area around 19°N, 136°E and moved fast toward Taiwan (Liang, 2006). The data of typhoon Janis are shown in Table I and its track is shown in Fig. 1. There was unfortunately no wave measurement. Using the author's "typhoon swell prediction scheme" (Liang, 2007) and assuming Kuroshio current being 2.5 knot, the hindcasted wave are shown in Table II.

Table I Data of typhoon Janis

Month	Day	Time	Latitude	Longitude	Central Pressure	Radius of Beaufort	Note
		(local)			P_c (hPa)	Scale No.7	$R7$ (km)
8	4	20	16.5	139.6	990	150	
	5	2	17.3	138.5	990	150	
		8	18.6	137.5	980	200	
		14	19.1	136.3	970	200	
		17	19.5	135.75	962.5	250	interpolated
		19	19.77	135.38	957.5	283	interpolated
		20	19.9	135.2	955	300	
		21	20.05	134.98	954.2	300	interpolated
		23	20.35	134.55	952.5	300	interpolated
	6	2	20.8	133.9	950	300	
		8	21.7	133.2	950	350	
		14	22.7	132.2	950	350	
		20	24.1	131.2	945	350	

Table II Hindcasted typhoon Janis swell

No.	Day	Time	H1/3	TP	TS	λ	DD	TD'	Approaching	Note
			(Meter)	(Sec.)	(Sec.)		(N.M.)	(Hour)	Speed (knot)	
1	7	20.6	0.96	6.9	8.28	2.29	1026.8	1.15		
2		9.88	1.17	8.7	10.49	1.414	940.6	-10.7	14.36	overrun
3		7.85	1.53	9.72	11.66	1.414	886.1	-2.03	12.4	overrun
4		5.58	2.14	10.75	12.9	1.414	827.8	-2.26	12.77	overrun
5		4.73	2.59	11.37	13.64	1.414	802.1	-0.85	12.85	overrun
6		4.46	2.8	11.66	14.0	1.414	789.6	-0.27	12.5	overrun
7		4.73	40.5	11.71	14.05	19.85	774.7	0.0025	14.9	

Due to the swiftly approaching speed around 14 knots and the quickly enhancing typhoon strength increasing from 970 hPa to 955 hPa in 6 hours, the data from No. 2 through No. 6 in Table II are always overrun. No. 7 is the first datum which is not overrun and the wave height modification factor λ amounts to 19.85. This hindcast can answer the reason of the accident. The source of No. 7 datum was when the typhoon was at 21 h, August 5. It was 31 hours before the accident. Actually one could predict it!

The following is another case. At about 2 p.m., October 23, 1987, regardless of the invasion of typhoon Lynn, 304 teachers and pupils of Hydraulic Elementary School of Pingtung County came to Mau-Bi-Tou coast for a tour (near southern tip of Taiwan, 21.91°N, 120.725°E). As the pupils walked one by one along aisle to the coral reef, suddenly three 2-story house waves attacked the coast and 9 pupils were drowned in the sea. The whole nation

dropped in a great grief. At the meantime, the typhoon scale has transferred from “strong” to “medium” and its center was about 500 km away but has moved fast previously toward Mau-Bi-Tou. On the next day, the headline of United Daily News wrote: “Typhoon Far Away, Hazard Close to Eyes”. The typhoon track is shown in Fig. 2. The freak wave source was approximately between 14h~20h, Oct. 22, of which the center locations are 18.0°N, 129.2°E and 18.0°N, 128.0°E respectively. The central pressure is the same, i.e. 945hPa, and the radius of Beaufort scale No. 7 is 400 kilometer. Because the latitude is the same, i.e. 18°N, only the longitude is interpolated each hour linearly. The hindcasted wave heights are about 5 meters assuming zero current speed. If the longitude at 17h is changed from 128.6°E to 128.7°E, a 7 meter wave height arrived at 14.1h. This is similar to the news paper description, i.e. 2-story house wave.

References

- Liang, N.K. (2003) “The typhoon swell Doppler effect”, *Ocean Engineering* 30 (2003) pp.1107-1115.
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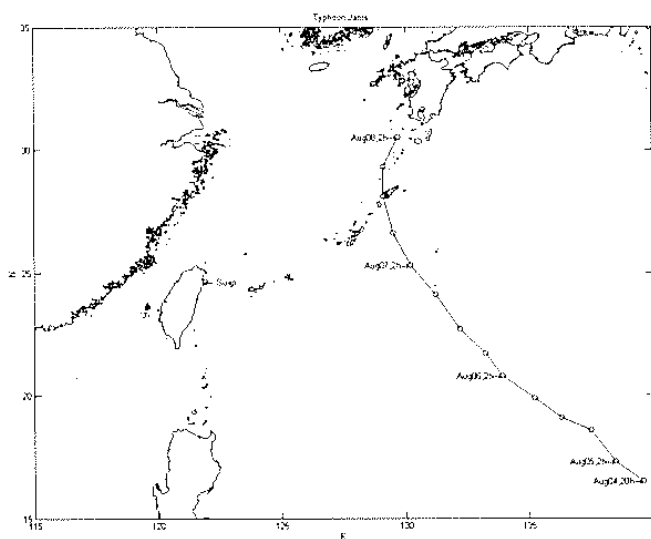


Fig. 1 Track of typhoon Janis

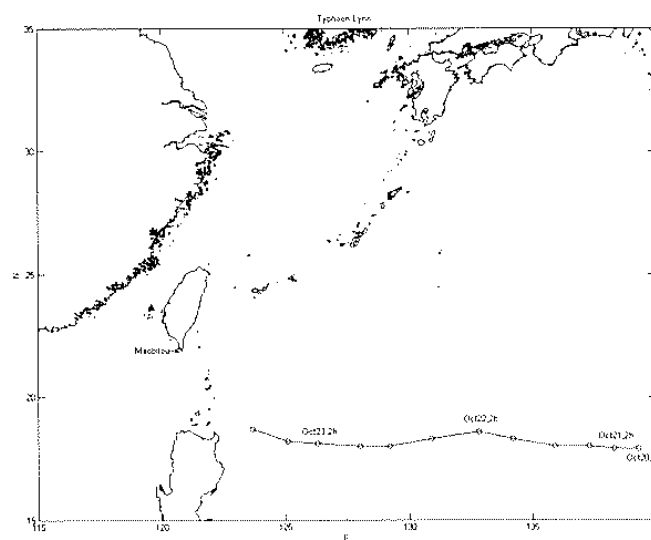


Fig. 2 Track of typhoon Lynn