MICRO PROPERTIES OF THE WAVE CLIMATE STATISTICS AND ITS APPLICATIONS
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Spectrum Modeling Method:
Figure 1 and 2 show the observed $H_{1/3}$ (Rumoi) and its spectrum $|F(f_x)|$.

The spectrum $|F(f_x)|$ (Fig.2) can be divided into 3 regions (A,B,C). Kimura and Ota (2012, 2013) showed that the spectrum can be approximated with the fundamental few Fourier components (region A), the constant (region B) and $\propto f^{-1}$ (region C). $H_{1/3}(t)$ is expressed as

$$H_{1/3}(t) = H_0 + H_a R_{a3t}$$

$H_0(t) = \frac{1}{2} \sum \{ \alpha_n \sin 2\pi f_n t_i + \beta_n \cos 2\pi f_n t_i \}$

$t_i = \frac{i}{n}$, $n = 0, 1, 2, \cdots$  $e_i = 2\pi R_{a3t}$, $e_0 = 2\pi R_{a3}$  $R_{a3}$, $R_{a3t}$ are mutually independent normal random number $N(0, 1)$. $R_{a3}$ and $R_{a3t}$ are uniform random number $[0, 1]$.

Figure 3 shows the comparison between the observed (+) and the simulated frequency distribution $P(H_{1/3})$ (black line). Observed data from 7 observatories along the Sea of Japan coast are analyzed. All data from another observatories also show the similar spectral properties.

Micro properties of $H_{1/3}$ statistics:
The statistical properties of the simulated $H_{1/3}$ show good agreements with the observed properties of $H_{1/3}$.

MONTHLY NUMBER OF EVENT $H_{1/3} \geq H$

Figure 4 shows the mean days of the event $H_{1/3} > H$, (data: 06:00~18:00 every day) every month ($H = 1$m, 2$m$ and 3$m$ : Tottori). Symbols show observed data (1991~2008). Lines show the simulated results (10000 years)

Figure 5 shows the mean days of the event $H_{1/3} < H$ (data: 06:00~18:00 every day) every month ($H = 0.5$m and 1.0$m$ : Niigata).

Run of the event $H_{1/3} \geq H$

Figure 6 shows frequency distribution of the runs of event $H_{1/3} > 3$m in 24 hours (Wajima and Hamada).

APPROPRIATE START DATE OF CONSTRUCTION WORKS:

Figure 7 shows examples of the relations between the necessary days (including non-work days) and the start date for 60 and 90 days repair work (Rumoi).

Comparison between statistics of extreme wave height and wave climate.

Extreme value statistics give the relation between the return period $R$ (years) and corresponding wave height $H_{1/3R}$ as

$$R = 1/[1 - F(H_{1/3R})]$$

where $1 - F(H_{1/3R})$ is the probability function of the annual maximum wave height. Total hours $T_{116}$ of the event $H_{1/3} > H_{1/3R}$ which takes place in $R$ years is given from the wave climate statistics as

$$T_{116} = R \times 24 \times 365 \times \int_{H_{1/3}}^{\infty} P(H_{1/3}) dH_{1/3}$$

GLOBAL CLIMATE CHANGE

Global climate change may also bring wave climate changes. Figure 9 shows the large part ($H_{1/3} \geq 3.0$m) of $P(H_{1/3})$ assuming $\pm 10%$ linear yearly changes in 50 years from the present annual average $H_{1/3}$(Kimura and Ota, 2012, 2013).

Figure 8 shows the relations between $R$ years annual maximum wave height $H_{1/3R}$ and $T_{116R}$ for $H_{1/3R}$.

Reference
