As stated above, a spectral form of the JONSWAP spectrum with a f^{-4} power law for the high-frequency range is preferable. Modified forms have among others been proposed by Donelan *et al* (1985) and Aono and Goto (1995), which are summarised in Box 4.5.

Box 4.5 *Modified JONSWAP spectra compatible with a f^{4} high-frequency tail*

Modified JONSWAP spectrum as proposed by Donelan *et al* (1985) with input variables U_{10} and F or m_0 and T_p

Expression of frequency spectrum:

$$E(f) = \alpha\,(2\pi)^{-4}\, g^2\, f_p^{-1}\, f^{-4} \exp[\,-(f/f_p)^{-4}]\, \gamma^{\delta}$$

with the following relationships:

$\alpha = 0.006\,(U_{10}/c_p)^{0.55}$	for $0.83 < U_{10}/c_p < 5$
$\gamma = 1.7$	for $0.83 < U_{10}/c_p < 1$
$\gamma = 1.7 + 6\log(U_{10}/c_p)$	for $1 < U_{10}/c_p < 5$
$\sigma = 0.08 + 0.32\,(U_{10}/c_p)^{-3}$	for $1 < U_{10}/c_p < 5$
$\delta = \exp[-(f/f_p - 1)^2/(2\sigma^2)]$	

where c_p = phase speed corresponding to the peak frequency ($c_p = g/(2\pi f_p)$ in deep water); $U_{10}/c_p = 0.83$ corresponding to the point of full development; both f_p and c_p are a function of the wind-speed U_{10} and the fetch length F, through:

$$f_p\, U_{10}/g = 1.845\,(g\,F/U_{10}^2)^{-0.23}.$$

Young (1992) derived relationships to calculate the spectrum directly from the variance m_0 and the peak period T_p through:

$$\alpha = 200\, g^{-1.571}\, (m_0)^{0.786}\, (T_p)^{-3.143}$$

$$\gamma = 6.489 + 6\log\left[(2.649 \cdot 10^{7}\, g^{-2.857}\, (m_0)^{1.429}\, (T_p)^{-5.714})\right]$$

$$\sigma = 0.08 + 6.94 \cdot 10^{-26}\, g^{8.571}\, (m_0)^{-4.287}\, (T_p)^{17.142}$$

Modified JONSWAP spectrum as proposed by Aono and Goto (1995) with input variables $H_{1/3}$ and $T_{1/3}$

Expression of frequency spectrum:

$$E(f) = \alpha\,(2\pi)^{-3}\, g\, u^{*}\, f^{-4} \exp[\,-(f/f_p)^{-4}]\, \gamma^{\delta}$$

with the following relationships:

$u^{*} = (H_{1/3})^2/(g\,B^2\,(T_{1/3})^3)$	$B = 0.067$
$f_p = 1/(1.136\,T_{1/3})$	$f_{p*} = f_p\, u^{*}/g$
$\gamma = 6\,(f_{p*})^{0.15}$	$\alpha = 0.17\,\gamma^{-1/3}$
$\sigma_1 = 0.144$ for $f < f_p$	$\sigma_2 = 0.07\,(f_{p*})^{-0.16}$ for $f > f_p$
$\delta = \exp[-(f/f_p - 1)^2/(2\sigma^2)]$	

This spectrum conforms to the 3/2 power law of Toba (1973, 1997), $H^{*} = B\,T^{*3/2}$, with a slight modification of the B coefficient: 0.067 instead of the original value of 0.062 (Toba, 1973).

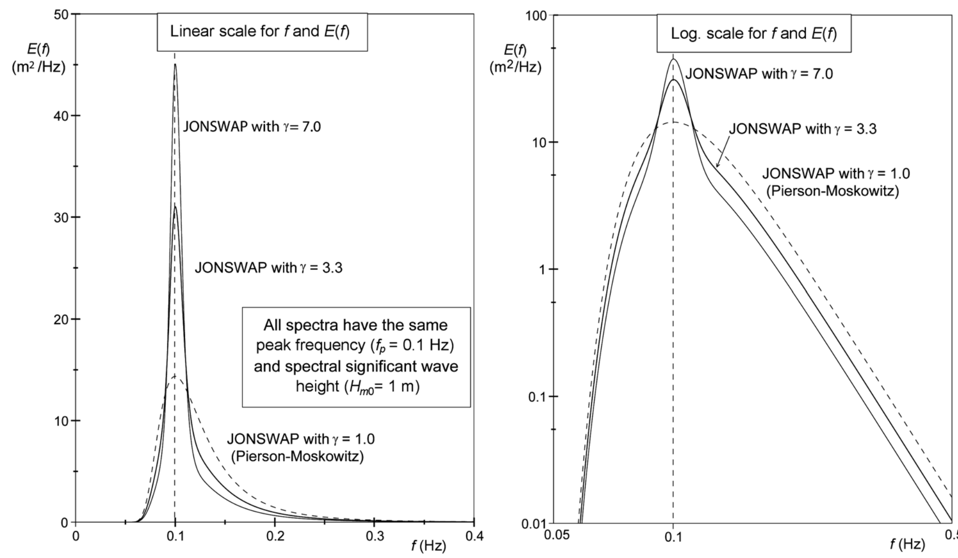

Figure 4.29 *Pierson-Moskowitz and JONSWAP spectra*