$$\frac{g\,T_p}{U_{10}\cos(\theta-\phi_w)}=0.542\left(\frac{g\,F_\theta}{\left(U_{10}\cos(\theta-\phi_w)\right)^2}\right)^{0.23} \tag{4.87}$$

$$\frac{g\,t_{min}}{U_{10}\cos(\theta-\phi_w)}=30.1\left(\frac{g\,F_\theta}{\left(U_{10}\cos(\theta-\phi_w)\right)^2}\right)^{0.77} \tag{4.88}$$

The value of the directional fetch, F_θ, is limited by the criterion expressed by Equation 4.89 to avoid over-development of wave energy.

$$\frac{gF_\theta}{\left(U_{10}\cos(\theta-\phi_w)\right)^2}\leq 9.47{\cdot}10^4 \tag{4.89}$$

At this value of non-dimensional directional fetch, F_θ, fully development of waves is reached, resulting in Equations 4.90 and 4.91.

$$\frac{gH_s}{\left(U_{10}\cos(\theta-\phi_w)\right)^2}=0.285 \tag{4.90}$$

$$\frac{gT_p}{U_{10}\cos(\theta-\phi_w)}=7.56 \tag{4.91}$$

(c) Young and Verhagen method

Young and Verhagen (1996) analysed a large set of wave measurements performed on Lake George (Australia). From this comprehensive dataset they were able to propose wave prediction formulae including both the effect of fetch F and water depth h (see Equations 4.92 and 4.93). The formulae are based on the form of the formulae of SPM (1984) for wave generation in finite water depth:

$$\frac{gH_s}{U_{10}^2}=0.241\left(\tanh A_1 \tanh\left(\frac{B_1}{\tanh A_1}\right)\right)^{0.87} \tag{4.92}$$

where: $A_1=0.493\left(\frac{gh}{U_{10}^2}\right)^{0.75}$ and $B_1=0.00313\left(\frac{gF}{U_{10}^2}\right)^{0.57}$.

$$\frac{gT_p}{U_{10}^2}=7.519\left(\tanh A_2 \tanh\left(\frac{B_2}{\tanh A_2}\right)\right)^{0.37} \tag{4.93}$$

where: $A_2=0.331\left(\frac{gh}{U_{10}^2}\right)^{1.01}$ and $B_2=0.0005215\left(\frac{gF}{U_{10}^2}\right)^{0.73}$.

This latter method offers the advantage of taking account of the actual water depth, which is important for reservoirs. Indeed, the mean water level in a reservoir may change significantly over a year leading to significant variations of fetch length and water depth. Both these parameters are present is the above formulae.

Later Young (1997) observed that these formulae fail to correctly model the wave height for short fetches, which was attributed to the fact that the formulae revert to JONSWAP formulae (Hasselmann *et al*, 1973) for such cases. For a better treatment of this case, he proposed an equation that has to be integrated numerically to obtain a wave growth curve.