RECOMMENDATION ITU-R P.841-1

CONVERSION OF ANNUAL STATISTICS TO WORST-MONTH STATISTICS

(Question ITU-R 201/3)

(1992-1999)

The ITU Radiocommunication Assembly,

considering

a) that for design of radiocommunication systems the required statistics of propagation effects pertain to the worst-month period of reference;

b) that the reference statistics for many radiometeorological data and propagation prediction methods is “the long-term average annual” distribution;

c) that consequently there is a need for a model that provides for the conversion of the “annual” to the “worst-month” statistics,

recommends

1 that the model given in Annex 1 be used for the conversion of the average annual time percentage of excess to the average annual worst-month time percentage of excess.

ANNEX 1

1 The average annual worst-month time percentage of excess, p_w, is calculated from the average annual time percentage of excess p by use of the conversion factor Q:

$$p_w = Q\,p \tag{1}$$

where $1 < Q < 12$, and both p and p_w refer to the same threshold levels.

2 Q is a two parameter (Q_1, β) function of p (%):

$$Q_{(p)} = \begin{cases} 12 & \text{for} \quad p < \left(\dfrac{Q_1}{12}\right)^{\frac{1}{\beta}} \% \\ Q_1\, p^{-\beta} & \text{for} \quad \left(\dfrac{Q_1}{12}\right)^{\frac{1}{\beta}} < p < 3\% \\ Q_1\, 3^{-\beta} & \text{for} \quad 3\% < p < 30\% \\ Q_1\, 3^{-\beta} \left(\dfrac{p}{30}\right)^{\frac{\log\left(Q_1\, 3^{-\beta}\right)}{\log(0.3)}} & \text{for} \quad 30\% < p \end{cases} \tag{2}$$

3 The calculation of the average annual time percentage of excess from the given value of the average annual worst-month time percentage of excess is done through the inverse relationship:

$$p = p_w / Q \tag{3}$$

and the dependence of Q on p_w can be easily derived from the above given dependence of Q on p. The resulting relationship for $12\, p_0 < p_w(\%) < Q_1\, 3^{(1-\beta)}$ is $(p_0 = (Q_1/12)^{1/\beta})$:

$$Q = Q_1^{1/(1-\beta)}\; p_w^{-\beta/(1-\beta)} \tag{4}$$

4 For global planning purposes the following values for the parameters Q_1 and β should be used:

$$Q_1 = 2.85, \quad \beta = 0.13$$

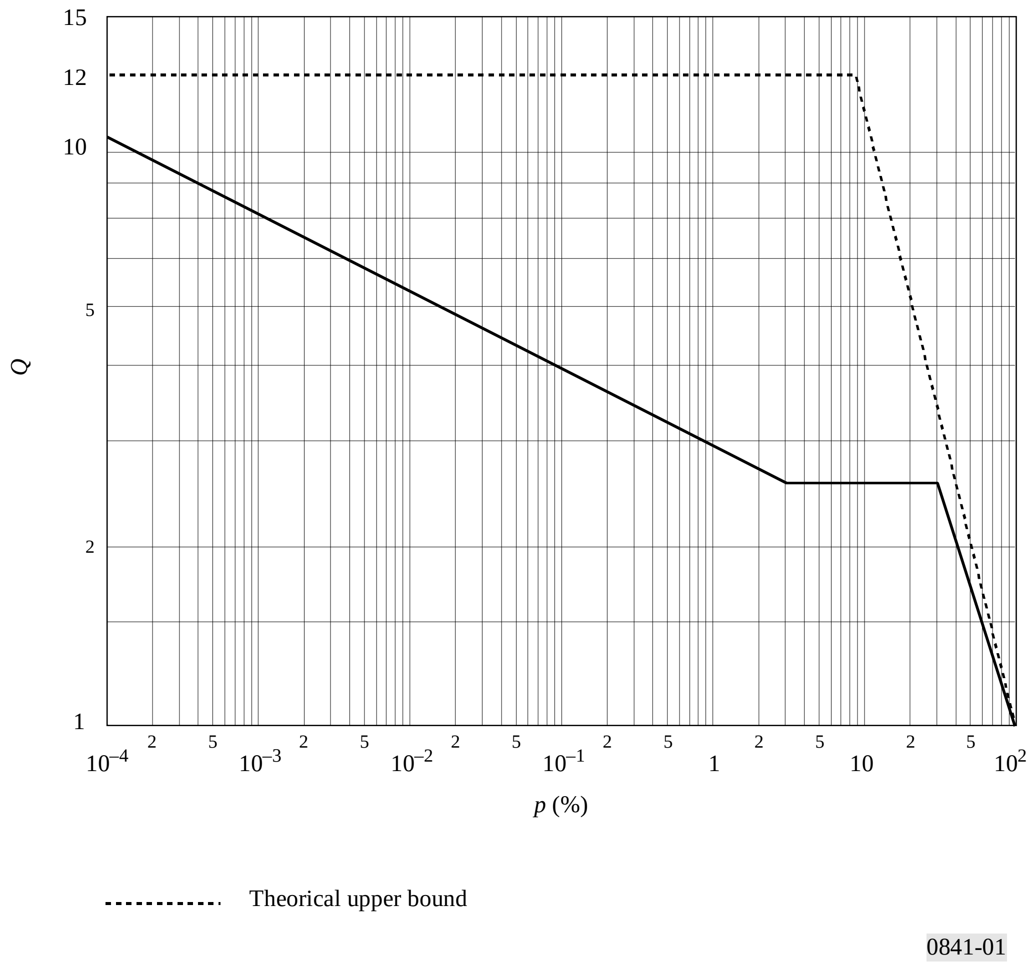
(see Fig. 1). This leads to the following relationship between p and p_w:

$$p(\%) = 0.30\; p_w(\%)^{1.15} \tag{5}$$

for $1.9 \times 10^{-4} < p_w(\%) < 7.8$.

FIGURE 1

Example of the dependence of *Q* on *p* (solid line) with parameter values Q_1 = 2.85 and β = 0.13



5 For more precision the values of Q_1 and β for the different climatic regions and various propagation effects given in Table 1 should be used where appropriate.

6 For trans-horizon mixed paths, the β and Q_1 values are calculated from those values for sea and land given in Table 1, through linear interpolation using the fractions of the link traversing sea and land respectively as weights.

TABLE 1

β and Q_1 values for various propagation effects and locations

	Rain effect terrestrial attenuation	Rain effect slant path attenuation	Rain rate	Multipath	Trans-horizon land	Trans-horizon sea
Global	0.13, 2.85	0.13, 2.85	0.13, 2.85	0.13, 2.85	0.13, 2.85	0.13, 2.85
Canada Prairie and North	0.08, 4.3					
Canada Coast and Great Lake	0.10, 2.7					
Canada Central and Mountains	0.13, 3.0					
United States of America Virginia		0.15, 2.7				
Australia Temperate/coastal			0.21, 2.25			
Australia Subtropical/coastal			0.15, 3.01			
Australia Tropical/arid			0.11, 4.35			
Japan Tokyo	0.20, 3.0					
Japan Yamaguchi		0.15, 4.0				
Japan Kashima		0.15, 2.7				
Congo	0.25, 1.5					
Europe North West	0.13, 3.0	0.16, 3.1		0.13, 4.0	0.18, 3.3	
Europe North West 1.3 GHz						0.11, 4.9
Europe North West 11 GHz						0.19, 3.7
Europe Mediterranean	0.14, 2.6	0.16, 3.1				
Europe Nordic	0.15, 3.0	0.16, 3.8		0.12, 5.0		
Europe alpine	0.15, 3.0	0.16, 3.8				
Europe Poland	0.18, 2.6					
Europe Russia	0.14, 3.6					
Indonesia	0.22, 1.7					