8. Pedotransfer Functions of Soil Water Retention Characteristic

8.1 Pedotransfer Function Equation of Soil Water Retention Characteristic

The pedotransfer function equation of soil water retention characteristic is expressed as:

$$\theta(h) = r_1 c + r_2 s + r_3 + \frac{\left(s_1 (1 - BD/2.65) + s_2 - r_1 c - r_2 s - r_3\right)}{\left[1 + ((a_1 + a_2 d_g) h)^{(n_1 + n_2 \sigma_g)}\right]^{(1 - 1/(n_1 + n_2 \sigma_g))}} \quad (1)$$

where $\theta(h)$ is volumetric water content ($cm^3\ cm^{-3}$) at the suction h (cm), BD is bulk density in g/cm^3, c is clay percentage, s is sand percentage, d_g is geometric mean diameter in mm, σ_g is geometric standard deviation in mm, and s_1, s_2, r_1, r_2, r_3, a_1, a_2, n_1 and n_2 are empirical parameters.

Geometric mean particle-size diameter (d_g in mm) and geometric standard deviation (σ_g in mm) can be calculated from main grain size fractions (m_1, m_2, m_3 are clay, slit and sand mass fractions respectively) as

$$d_g = \exp \sum_{i=1}^{3} m_i \ln d_i \quad (2)$$

$$\sigma_g = \exp\left[\sum_{i=1}^{3} m_i (\ln d_i)^2 - \left(\sum_{i=1}^{3} m_i (\ln d_i)\right)^2\right]^{0.5} \quad (3)$$

where m_i is the mass fraction and d_i is the mean particle size diameter of the i^{th} mass fraction class.

The parameters of pedo-transfer functions of soil water retention characteristics for Horizons A and B1 are presented in Tables 31.1 and 31.2.

Table 31.1 Soil Water Retention PTFs of Horizon A

Soil	Equation	Parameter	n	RMSR	R^2	MD	RMSD
All duplex soils in SIR	$\theta(h)=\theta_r+\frac{(\theta_s-\theta_s)}{(1+(\alpha h)^N)^{(1-1/N)}}$ $\theta_s = s_1 (1\text{-}BD/2.65) + s_2$ $\theta_r = r_1 c + r_2 s + r_3$ $\alpha = a_1 + a_2 d_g$ $N = n_1 + n_2 \sigma_g$	s_1=1.199 s_2= - 0.0394 r_1= 0.0029 r_2= - 0.0045 r_3= 0.03 a_1= 0.1 a_2= 0.80 n_1= 1.10 n_2=- 0.003	557	.043	0.78	0.000	0.032
Sandmount sand*	$\theta_S = s_1 c + s_2 BD + s_3$ $\theta_r = r_1 c + r_2 s$ $\alpha = a_1 + a_2 d_g$ $N = n_1 + n_2 \sigma_g$	s_1= 0.00724 s_2= - 0.454 s_3= 1.162 r_1= 0.002 r_2= 0.00047 a_1= - 0.724 a_2= 1.66 n_1= 2.917 n_2= - 0.461	16	0.019	0.98	0.00	0.020

Note: * Sandmount sand soil is not duplex soil and the shape of water retention curve is different from other soils, therefore it was considered separately.

Table 31.2 Soil Water Retention PTFs of Horizon B1

Point Estimation	Equation	Parameter	n	RMSR	R^2	MD	RMSD
All duplex soil in SIR	$\theta(h)=\theta_r+\frac{(\theta_s-\theta_s)}{(1+(\alpha h)^N)^{(1-1/N)}}$ $\theta_s = s_1 c + s_2 BD + s_3$ $\theta_r = r_1 c + r_2 s + r_3$ $\alpha = a_1 + a_2 d_g$ $N = n_1 + n_2 \sigma_g$	s_1= 0.00058 s_2= - 0.322 s_3= 0.9575 r_1= 0.00109 r_2= - 0.003 r_3= 0.230 a_1= 0.096 a_2= 1.74 n_1= 1.329 n_2= - 0.0087	506	0.038	0.82	0.00	0.028
Sandmount sand*	$\theta(h)=\theta_r+\frac{(\theta_s-\theta_s)}{(1+(\alpha h)^N)^{(1-1/N)}}$ $\theta_s = s_1 c + s_2 BD + s_3$ $\theta_r = r_1 c + r_2 s + r_3$ $\alpha = a_1 + a_2 d_g$ $N = n_1 + n_2 \sigma_g$	s_1= 0.011 s_2= - 0.331 s_3= 0.938 r_1= - 0.130 r_2= - 0.0045 r_3= 0.651 a_1= 1.691 a_2= - 1.355 n_1= 4.458 n_2= - 0.842	16	0.014	0.99	0.003	0.017

Note: * Sandmount sand soil is not duplex soil and the shape of water retention curve is different from other soils, therefore it was considered separately.