

TS1: Description of the dataset employed in the present study

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(Veronese 1937)	0.034	2.346	0.1	1.025	0.0362	0.065
	0.045	2.364	0.145	1.053	0.0362	0.06
	0.053	2.37	0.16	1.056	0.0362	0.07
	0.063	2.382	0.19	1.072	0.0362	0.08
	0.035	2.391	0.215	1.134	0.0362	0.06
	0.029	2.391	0.215	1.144	0.0362	0.085
	0.053	2.395	0.225	1.118	0.0362	0.1
	0.06	2.399	0.235	1.118	0.0362	0.11
	0.067	2.398	0.233	1.106	0.0362	0.12
	0.025	2.007	0.21	1.146	0.021	0.055
	0.048	2.016	0.24	1.138	0.021	0.105
	0.053	2.019	0.25	1.141	0.021	0.11
	0.057	2.019	0.25	1.136	0.021	0.12
	0.02	1.972	0.092	1.04	0.021	0.05
	0.032	1.984	0.13	1.057	0.021	0.065
	0.042	1.985	0.135	1.048	0.021	0.08
	0.049	1.993	0.16	1.061	0.021	0.09
	0.057	1.987	0.14	1.032	0.021	0.12
	0.065	1.987	0.14	1.022	0.021	0.14
	0.019	1.749	0.165	1.112	0.0142	0.055
	0.032	1.754	0.185	1.11	0.0142	0.095
	0.052	1.769	0.25	1.143	0.0142	0.11
	0.012	1.719	0.05	1.014	0.0142	0.08
	0.021	1.724	0.07	1.018	0.0142	0.1
	0.03	1.73	0.09	1.021	0.0142	0.12
	0.039	1.732	0.1	1.018	0.0142	0.13
	0.047	1.732	0.1	1.008	0.0142	0.17
	0.053	1.732	0.1	1	0.0142	0.18
	0.06	1.73	0.09	0.982	0.0142	0.2

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(Veronese 1937)	0.021	1.483	0.1	1.046	0.0091	0.1
	0.026	1.483	0.1	1.037	0.0091	0.12
	0.039	1.489	0.13	1.047	0.0091	0.16
	0.048	1.487	0.12	1.025	0.0091	0.18
	0.056	1.481	0.09	0.987	0.0091	0.22
(D'agostino 1994)	0.022	1.041	0.083	0.71	0.0041	0.057
	0.022	1.041	0.086	0.71	0.0041	0.06
	0.022	1.041	0.191	0.71	0.0041	0.065
	0.022	1.041	0.239	0.71	0.0041	0.086
	0.022	1.041	0.244	0.71	0.0041	0.09
	0.022	1.041	0.326	0.71	0.0041	0.09
	0.043	1.046	0.103	0.71	0.0041	0.085
	0.043	1.046	0.119	0.71	0.0041	0.083
	0.043	1.046	0.211	0.71	0.0041	0.095
	0.043	1.046	0.349	0.71	0.0041	0.105
	0.043	1.046	0.385	0.71	0.0041	0.095
	0.062	1.05	0.274	0.71	0.0041	0.111
	0.062	1.05	0.365	0.71	0.0041	0.125
	0.062	1.05	0.4	0.71	0.0041	0.12
	0.081	1.054	0.208	0.71	0.0041	0.115
	0.081	1.054	0.241	0.71	0.0041	0.145
	0.081	1.054	0.325	0.71	0.0041	0.13
	0.081	1.054	0.38	0.71	0.0041	0.13
	0.099	1.057	0.255	0.71	0.0041	0.145
	0.099	1.057	0.307	0.71	0.0041	0.16
	0.099	1.057	0.36	0.71	0.0041	0.17
	0.099	1.057	0.4	0.71	0.0041	0.175
	0.117	1.06	0.319	0.71	0.0041	0.156
	0.117	1.06	0.322	0.71	0.0041	0.165
	0.117	1.06	0.354	0.71	0.0041	0.155

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(D'agostino 1994)	0.117	1.06	0.41	0.71	0.0041	0.185
	0.134	1.062	0.33	0.71	0.0041	0.195
	0.134	1.062	0.37	0.71	0.0041	0.203
	0.134	1.062	0.425	0.71	0.0041	0.195
	0.15	1.065	0.337	0.71	0.0041	0.19
	0.15	1.065	0.38	0.71	0.0041	0.21
	0.15	1.065	0.38	0.71	0.0041	0.215
	0.15	1.065	0.435	0.71	0.0041	0.205
	0.167	1.067	0.4	0.71	0.0041	0.255
	0.167	1.067	0.415	0.71	0.0041	0.24
	0.182	1.07	0.42	0.71	0.0041	0.28
	0.182	1.07	0.435	0.71	0.0041	0.285
	0.037	0.964	0.105	0.41	0.0041	0.065
	0.037	0.964	0.332	0.41	0.0041	0.09
	0.069	0.973	0.104	0.41	0.0041	0.102
	0.069	0.973	0.123	0.41	0.0041	0.1
	0.069	0.973	0.159	0.41	0.0041	0.11
	0.069	0.973	0.353	0.41	0.0041	0.14
	0.1	0.979	0.174	0.41	0.0041	0.13
	0.1	0.979	0.23	0.41	0.0041	0.145
	0.1	0.979	0.284	0.41	0.0041	0.15
	0.1	0.979	0.37	0.41	0.0041	0.155
	0.1	0.979	0.4	0.41	0.0041	0.14
	0.128	0.985	0.244	0.41	0.0041	0.145
	0.128	0.985	0.378	0.41	0.0041	0.175
	0.155	0.99	0.255	0.41	0.0041	0.165
	0.155	0.99	0.286	0.41	0.0041	0.195
	0.155	0.99	0.39	0.41	0.0041	0.2
	0.18	0.994	0.288	0.41	0.0041	0.185
	0.18	0.994	0.38	0.41	0.0041	0.225

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(D'agostino 1994)	0.205	0.998	0.33	0.41	0.0041	0.23
	0.205	0.998	0.365	0.41	0.0041	0.21
	0.205	0.998	0.415	0.41	0.0041	0.223
	0.228	1.002	0.349	0.41	0.0041	0.22
	0.228	1.002	0.405	0.41	0.0041	0.235
	0.251	1.006	0.395	0.41	0.0041	0.25
	0.273	1.009	0.405	0.41	0.0041	0.265
	0.273	1.009	0.42	0.41	0.0041	0.26
	0.043	1.045	0.106	0.71	0.0041	0.06
	0.043	1.045	0.298	0.71	0.0041	0.11
	0.081	1.053	0.179	0.71	0.0041	0.115
	0.081	1.053	0.317	0.71	0.0041	0.135
	0.117	1.06	0.195	0.71	0.0041	0.14
	0.117	1.06	0.334	0.71	0.0041	0.15
	0.151	1.065	0.242	0.71	0.0041	0.185
	0.151	1.065	0.35	0.71	0.0041	0.17
	0.183	1.069	0.375	0.71	0.0041	0.22
	0.043	1.046	0.086	0.71	0.0041	0.06
	0.043	1.046	0.138	0.71	0.0041	0.065
	0.043	1.046	0.192	0.71	0.0041	0.078
	0.043	1.046	0.33	0.71	0.0041	0.1
	0.043	1.046	0.412	0.71	0.0041	0.114
	0.081	1.053	0.158	0.71	0.0041	0.085
	0.081	1.053	0.35	0.71	0.0041	0.132
	0.117	1.06	0.228	0.71	0.0041	0.15
	0.117	1.06	0.365	0.71	0.0041	0.15
	0.15	1.065	0.244	0.71	0.0041	0.195
	0.15	1.065	0.385	0.71	0.0041	0.175
	0.182	1.07	0.307	0.71	0.0041	0.225
	0.037	1.383	0.136	0.41	0.0115	0.045

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(D'agostino 1994)	0.037	1.383	0.331	0.41	0.0115	0.045
	0.069	1.398	0.155	0.41	0.0115	0.06
	0.069	1.398	0.355	0.41	0.0115	0.085
	0.1	1.409	0.169	0.41	0.0115	0.09
	0.1	1.409	0.365	0.41	0.0115	0.1
	0.128	1.418	0.208	0.41	0.0115	0.105
	0.128	1.418	0.351	0.41	0.0115	0.124
	0.155	1.427	0.221	0.41	0.0115	0.15
	0.155	1.427	0.36	0.41	0.0115	0.145
	0.18	1.435	0.232	0.41	0.0115	0.155
	0.18	1.435	0.353	0.41	0.0115	0.16
	0.205	1.442	0.276	0.41	0.0115	0.172
	0.205	1.442	0.36	0.41	0.0115	0.17
	0.23	1.446	0.309	0.41	0.0115	0.18
	0.23	1.446	0.38	0.41	0.0115	0.175
	0.252	1.453	0.319	0.41	0.0115	0.215
	0.252	1.453	0.39	0.41	0.0115	0.19
	0.275	1.458	0.335	0.41	0.0115	0.22
	0.275	1.458	0.375	0.41	0.0115	0.203
	0.07	1.397	0.104	0.41	0.0115	0.055
	0.07	1.397	0.301	0.41	0.0115	0.085
	0.18	1.435	0.136	0.41	0.0115	0.094
	0.18	1.435	0.334	0.41	0.0115	0.11
	0.272	1.461	0.195	0.41	0.0115	0.165
	0.272	1.461	0.36	0.41	0.0115	0.135
(Falciai and Giacomin 1978)	0.41	3.64	2.32	6.00	0.05	1.30
	2.28	2.63	1.86	0.30	0.03	0.70
	1.35	2.97	2.31	1.60	0.04	1.40
	0.80	2.72	2.00	2.50	0.03	0.80
	1.94	2.82	2.41	0.90	0.04	1.20

Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(Falciai and Giacomin 1978)	2.71	2.94	2.78	0.50	0.04	2.00
	1.05	3.29	2.63	2.80	0.05	1.30
	0.67	3.09	2.99	5.50	0.03	1.70
	1.08	2.63	2.52	2.50	0.03	2.00
	1.06	2.81	2.03	1.80	0.03	0.50
	1.03	3.34	2.60	2.80	0.05	1.50
	1.45	3.14	5.00	5.30	0.03	1.40
	0.68	3.61	1.68	2.30	0.07	0.40
	0.67	3.45	1.90	2.80	0.06	0.50
	1.14	3.05	1.53	1.00	0.05	0.90
	0.58	3.56	1.65	2.60	0.07	1.30
	0.72	3.08	1.86	2.50	0.04	1.40
	0.70	3.34	1.97	2.80	0.05	0.40
	0.86	3.69	3.15	2.85	0.05	1.90
	0.77	4.28	2.57	3.80	0.09	1.80
	0.49	4.30	1.89	3.80	0.10	1.30
	0.43	3.24	1.13	2.00	0.06	1.10
	0.72	4.02	3.40	6.20	0.06	1.30
	0.82	2.55	3.28	5.20	0.02	1.60
	0.81	4.09	3.09	4.80	0.07	2.50
	1.09	4.08	3.39	4.00	0.08	2.00
	1.50	4.04	3.48	2.80	0.08	2.40
	1.25	3.96	3.75	4.00	0.07	3.50
	1.543	3.197	2.318	1.3	0.05	1.1
(D'Agostino and Ferro 2004)	0.277	2.852	0.531	1	0.06	0.45
	0.319	2.769	0.511	0.82	0.06	0.65
	0.392	2.648	0.482	0.6	0.06	0.5
	0.302	3.001	0.669	1.3	0.06	0.55
	0.39	2.849	0.624	0.9	0.06	0.65
	0.501	2.702	0.578	0.6	0.06	0.65

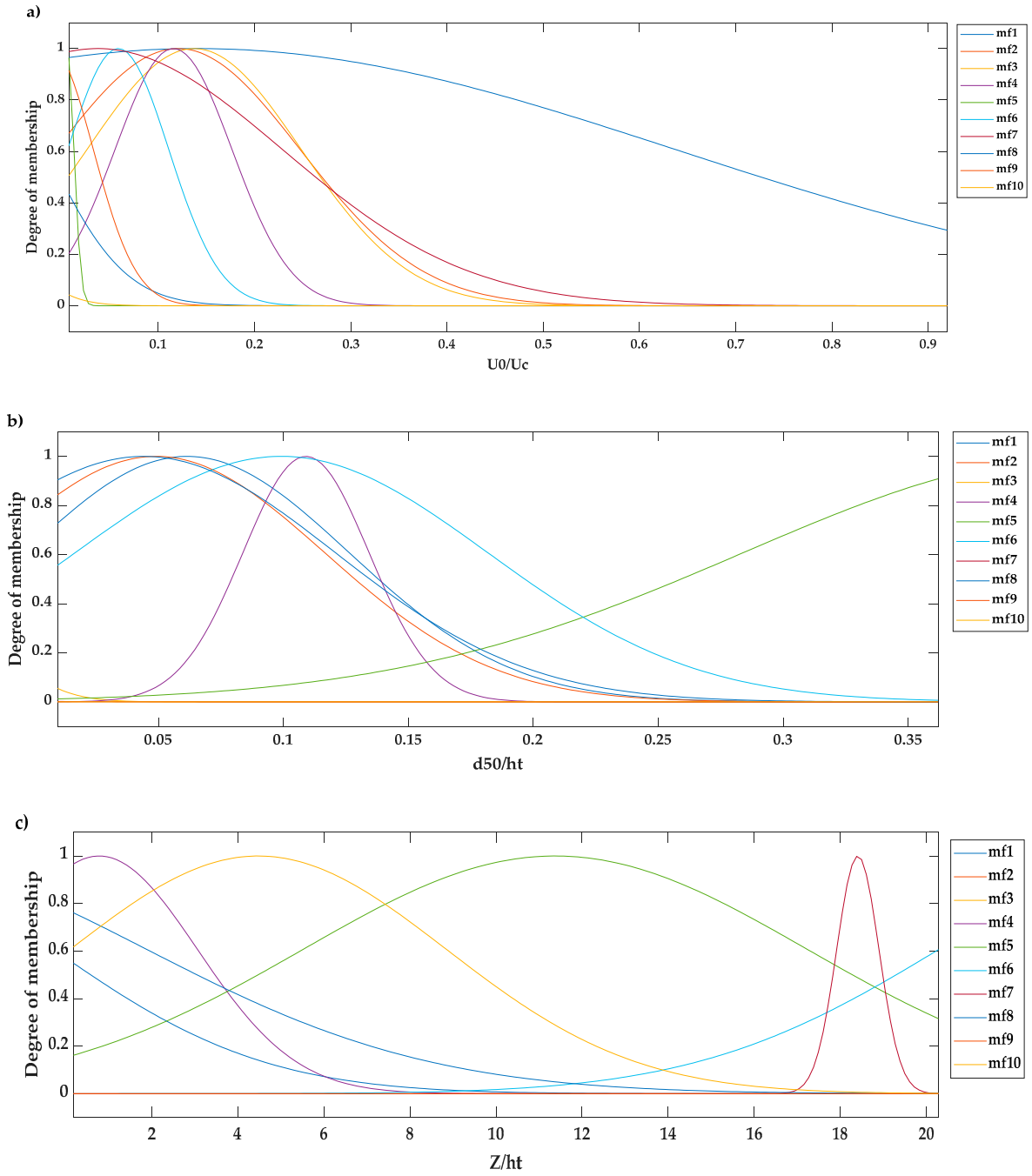
Scholar	U_0 (m/s)	U_c (m/s)	h_t (m)	z (m)	d_{50} (m)	d_s (m)
(D'Agostino and Ferro 2004)	0.526	2.673	0.568	0.55	0.06	0.65
	0.281	2.854	0.536	1	0.06	0.35
	0.386	2.685	0.502	0.65	0.06	0.45
	0.272	2.947	0.594	1.2	0.06	0.35
	0.362	2.695	0.493	0.68	0.06	0.4
	0.219	2.986	0.559	1.35	0.06	0.25
	0.341	2.713	0.491	0.72	0.06	0.15

TS2: The fuzzy if-then rules obtained based on the ten membership functions

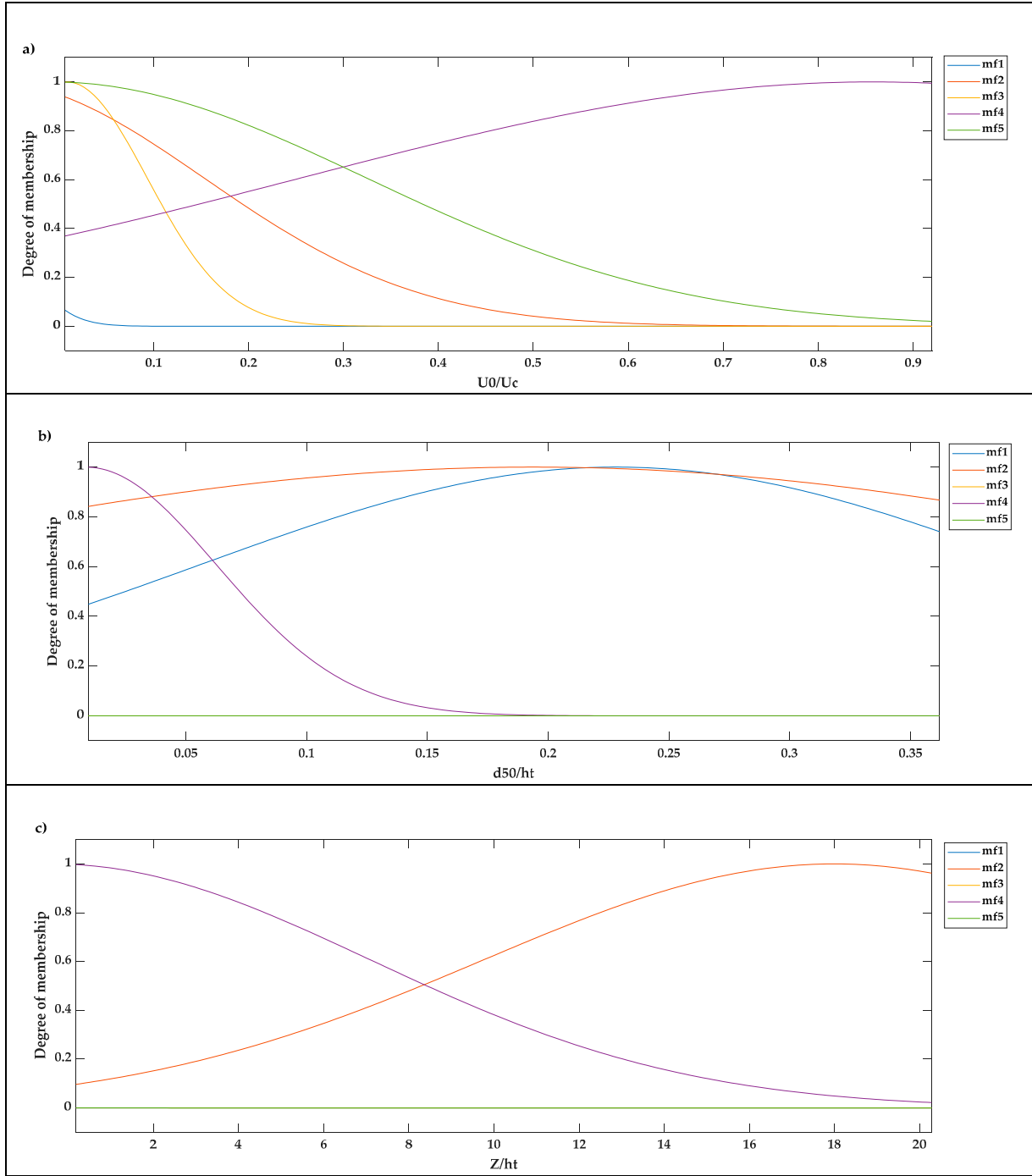
Rule	NO
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf1) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf1) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf1) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf1), $\frac{d_s}{h_t} = 0.4649 \frac{U_0}{U_c} + 0.295 \frac{d_{50}}{h_t} + 0.1648 \frac{z}{h_t} + 0.2141$	1
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf2) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf2) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf2) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf2), $\frac{d_s}{h_t} = 1.1974 \frac{U_0}{U_c} - 0.1721 \frac{d_{50}}{h_t} + 0.0216 \frac{z}{h_t} + 0.6849$	2
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf3) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf3) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf3) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf3), $\frac{d_s}{h_t} = -.8566 \frac{U_0}{U_c} - 0.0945 \frac{d_{50}}{h_t} - 0.1052 \frac{z}{h_t} + 0.7090$	3
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf4) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf4) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf4) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf4), $\frac{d_s}{h_t} = 7.8808 \frac{U_0}{U_c} + 0.1563 \frac{d_{50}}{h_t} - 0.0165 \frac{z}{h_t} + 0.1172$	4
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf5) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf5) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf5) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf5), $\frac{d_s}{h_t} = 4.3947 \frac{U_0}{U_c} + 0.0321 \frac{d_{50}}{h_t} + 0.0455 \frac{z}{h_t} - 0.0141$	5
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf6) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf6) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf6) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf6), $\frac{d_s}{h_t} = -1.3226 \frac{U_0}{U_c} + 0.202 \frac{d_{50}}{h_t} + 0.866 \frac{z}{h_t} - 0.2710$	6
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf7) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf7) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf7) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf7), $\frac{d_s}{h_t} = -2.3729 \frac{U_0}{U_c} + 0.0978 \frac{d_{50}}{h_t} + 0.193 \frac{z}{h_t} + 0.9376$	7
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf8) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf8) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf8) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf8), $\frac{d_s}{h_t} = -0.532 \frac{U_0}{U_c} + 0.173 \frac{d_{50}}{h_t} + 0.0508 \frac{z}{h_t} - .3415$	8
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf9) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf9) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf9) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf9), $\frac{d_s}{h_t} = -0.8339 \frac{U_0}{U_c} + 0.0199 \frac{d_{50}}{h_t} - 0.1556 \frac{z}{h_t} - .1397$	9
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf10) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf10) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf10) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf10), $\frac{d_s}{h_t} = 2.0684 \frac{U_0}{U_c} + 0.182 \frac{d_{50}}{h_t} - 0.1804 \frac{z}{h_t} + .4745$	10
Note: mf1-mf10 are the member functions used in prediction modeling.	

TS3: The fuzzy if-then rules obtained based on the five membership functions

Rule	NO
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf1) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf1) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf1) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf1), $\frac{d_s}{h_t} = 3.6488 \frac{U_0}{U_c} + 0.1209 \frac{d_{50}}{h_t} + 0.2478 \frac{z}{h_t} - 0.6911$	1
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf2) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf2) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf2) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf2), $\frac{d_s}{h_t} = 14.8965 \frac{U_0}{U_c} - 0.3244 \frac{d_{50}}{h_t} + 0.1117 \frac{z}{h_t} - 0.4355$	2
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf3) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf3) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf3) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf3), $\frac{d_s}{h_t} = 0.2305 \frac{U_0}{U_c} - 0.6202 \frac{d_{50}}{h_t} - 0.2794 \frac{z}{h_t} + 1.2239$	3
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf4) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf4) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf4) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf4), $\frac{d_s}{h_t} = 0.6184 \frac{U_0}{U_c} - 0.0347 \frac{d_{50}}{h_t} + 0.0611 \frac{z}{h_t} + 0.1337$	4
If ($\frac{U_0}{U_c}$ is $\frac{U_0}{U_c}$ mf5) and ($\frac{d_{50}}{h_t}$ is $\frac{d_{50}}{h_t}$ mf5) and ($\frac{z}{h_t}$ is $\frac{z}{h_t}$ mf5) then ($\frac{d_s}{h_t}$ is $\frac{d_s}{h_t}$ mf5), $\frac{d_s}{h_t} = 0.2318 \frac{U_0}{U_c} + 0.0937 \frac{d_{50}}{h_t} - 0.4992 \frac{z}{h_t} - 2.4733$	5
Note: mf1-mf5 are the member functions used in prediction modeling.	



FS1: The validity ranges of the ten membership functions of the predictive variables employed in the present study, a) $\frac{U_0}{U_c}$, b) $\frac{d_{50}}{h_t}$, and c) $\frac{Z}{h_t}$



FS2: The validity ranges of the five membership functions of the predictive variables employed in the present study, a) $\frac{U_0}{U_c}$, b) $\frac{d_{50}}{h_t}$, and c) $\frac{Z}{h_t}$