Test procedure for the results obtained

Longley Rice SEAMCAT propagation plug-in

Test procedure was based on compared obtained results from SEAMCAT with obtained results from ITM v.1.5.5 (Developed in Department of Commerce NTIA), during taking test plug-in with the same input parameters. In some parts of Longley-Rice code are used algorithms with ITM, so we have expected similar results.

In the first phase examined the accuracy of the results (table 2) by changing each parameter individually, The rest of parameters were constant (as shown in table 1).

Please note, difference in obtained results is an absolute value.

Table 1: Constant input parameters

Parameter	Value	Parameter	Value
Distance	20 km	Polarization	Horizontal
Frequency	900 MHz	Site Criteria	Random
Antenna Height (Tx)	5 m	Climate	1
Antenna Height (Rx)	1,5 m	Percent of time	50%
Ground refractivity	301 N-units	Percent of locations	50%
Terrain irregularity parameter	90 m	Confidence level	90%
Relative permittivity	15	Mode of variability	Broadcast
Electrical ground Conductivity	0.005		

Climate: 0 – Equatorial, 1 - Continental Subtropical, 2 - Maritime Subtropical, 3 – Desert, 4 - Continental Temperate, 5 - Maritime Temperate over land, 6 - Maritime Temperate over sea

Table 2: Obtained result

Parameter: Distance **(d)**							
Distance [km]:	5	20	80	400	800		
SEAMCAT [dB]	-143,26	-162,1	-195,58	-231,12	-259,04		
ITM [dB]	-143,2	-162,1	-195,5	-231	-259		
Difference [dB]	**0,06**	**0**	**0,08**	**0,12**	**0,04**		
Parameter: Frequency **(f)**							
Frequency [MHz]:	100	900	1 500	3 000	10 000		
SEAMCAT [dB]	-155,74	-162,1	-166,33	-173,72	-191,6		
ITM [dB]	-152,7	-162,1	-166,3	-173,7	-191,6		
Difference [dB]	**3,04**	**0**	**0,03**	**0,02**	**0**		
Parameter: Antenna Height (Tx) **(h_{g1})**							
Antenna Height (Tx) [m]:	1	10	50	100	1 000		
SEAMCAT [dB]	-167,39	-159,58	-151,05	-145,61	-127,25		
ITM [dB]	-167,3	-159,6	-151,1	-145,6	-127,3		
Difference [dB]	**0,09**	**0,02**	**0,05**	**0,01**	**0,05**		
Parameter: Antenna Height (Rx) **(h_{g2})**							
Antenna Height (Rx) [m]:	1	10	50	100	1 000		
SEAMCAT [dB]	-163,78	-154,89	-145,15	-138,01	-127,27		
ITM [dB]	-163,7	-154,9	-145,2	-138	-127,3		
Difference [dB]	**0,08**	**0,01**	**0,05**	**0,01**	**0,03**		
Parameter: Terrain irregularity parameter **(Δh)**							
Irregularity param. [m]:	50	90	150	250	450		
SEAMCAT [dB]	-159,97	-162,1	-167,93	-178,27	-192,98		
ITM [dB]	-160	-162,1	-167,9	-178,2	-192,8		
Difference [dB]	**0,03**	**0**	**0,03**	**0,07**	**0,18**		

Parameter: Relative permittivity **(ε)**							
Relative permittivity:	4	15	25	81			
SEAMCAT [dB]	-162,1	-162,1	-162,1	-162,1			
ITM [dB]	-162,1	-162,1	-162,1	-162,1			
Difference [dB]	**0**	**0**	**0**	**0**			
Parameter: Electrical ground Conductivity **(σ)**							
E. g. Conductivity [S/m]:	0.001	0.005	0.01	0.02			
SEAMCAT [dB]	-162,1	-162,1	-162,1	-162,1			
ITM [dB]	-162,1	-162,1	-162,1	-162,1			
Difference [dB]	**0**	**0**	**0**	**0**			
Parameter: Polarization							
Polarization:	H	V					
SEAMCAT [dB]	-162,1	-162,11					
ITM [dB]	-162,1	-162,1					
Difference [dB]	**0**	**0,01**					
Parameter: Site Criteria							
Site Criteria:	Random	Careful	V. Careful				
SEAMCAT [dB]	-162,1	-152,43	-146,75				
ITM [dB]	-162,1	-152,4	-146,7				
Difference [dB]	**0**		**0,05**				
Parameter: Percent of time							
Percent of time:	0.1	0.5	0.9	0.97			
SEAMCAT [dB]	-159,36	-162,1	164,38	-165,46			
ITM [dB]	-159,3	-162,1	-164,4	-165,4			
Difference [dB]	**0,06**	**0**	**0,02**	**0,03**			
Parameter: Percent of locations							
Percent of locations:	0.1	0.5	0.9	0.97			
SEAMCAT [dB]	-150,01	-162,1	-175,32	-181,83			
ITM [dB]	-150,1	-162,1	-175,3	-181,8			
Difference [dB]	**0,09**	**0**	**0,02**	**0,03**			
Parameter: Confidence level							
Confidence level:	0.1	0.5	0.9	0.97			
SEAMCAT [dB]	-144,95	-153,54	-162,1	-166,15			
ITM [dB]	-144,9	-153,5	-162,1	-166,1			
Difference [dB]	**0,05**	**0,04**	**0**	**0,05**			
Parameter: Mode of variability							
Mode of variability:	Single	Individual	Mobile	Broadcast			
SEAMCAT [dB]	-169,31	-169,13	-162.13	-162,1			
ITM [dB]	-169,3	-169,13	-162,1	-162,1			
Difference [dB]	**0,01**	**0,03**	**0,03**	**0**			
Parameter: Ground refractivity **[Ns]**							
G. refractivity [N-unit]:	250	280	301	350	400		
SEAMCAT [dB]	-162,69	-162,38	-162,1	-161,4	-160,37		
ITM [dB]	-162,7	-162,4	-161,1	-161,4	-160,3		
Difference [dB]	**0,01**	**0,02**	**0**	**0**	**0,07**		
Parameter: Climate							
Climate:	0	1	2	3	4	5	6
SEAMCAT [dB]	-162,79	-162,1	-162,04	-162,85	-162,13	-162,33	-162,05
ITM [dB]	-162,8	-162,1	-162	-162,9	-162,1	-162,3	-162
Difference [dB]	**0,01**	**0**	**0,04**	**0,05**	**0,03**	**0,03**	**0,05**

In the second test, we checked results for random parameters. We tried to use full range of inputs parameters in a different configuration. Result are shown in table 3-9.

Table 3: Test 2a

Parameter	Value	Parameter	Value
Distance	300 km	Polarization	Vertical
Frequency	3,5 GHz	Site Criteria	Very careful
Antenna Height (Tx)	600 m	Climate	6
Antenna Height (Rx)	30 m	Percent of time	97%
Ground refractivity	320 N-units	Percent of locations	97%
Terrain irregularity parameter	400 m	Confidence level	97%
Relative permittivity	15	Mode of variability	Mobile
Electrical ground Conductivity	0.005		
Att (SEAMCAT)	255,1 dB		
Att (ITM)	255,1 dB		
difference	**0 dB**		

Table 4: Test 2b

Parameter	Value	Parameter	Value
Distance	25 km	Polarization	Vertical
Frequency	10 GHz	Site Criteria	Careful
Antenna Height (Tx)	5 m	Climate	1
Antenna Height (Rx)	30 m	Percent of time	50%
Ground refractivity	400 N-units	Percent of locations	50%
Terrain irregularity parameter	30 m	Confidence level	1%
Relative permittivity	20	Mode of variability	Single
Electrical ground Conductivity	0.02		
Att (SEAMCAT)	134 dB		
Att (ITM)	134 dB		
difference	**0 dB**		

Table 5: test 2c

Parameter	Value	Parameter	Value
Distance	100 km	Polarization	Horizontal
Frequency	1800 MHz	Site Criteria	Random
Antenna Height (Tx)	1 m	Climate	2
Antenna Height (Rx)	0.5 m	Percent of time	50%
Ground refractivity	301 N-units	Percent of locations	50%
Terrain irregularity parameter	350 m	Confidence level	90%
Relative permittivity	20	Mode of variability	Individual
Electrical ground Conductivity	0.002		
Att (SEAMCAT)	244,4 dB		
Att (ITM)	244,4 dB		
difference	**0 dB**		

Table 6: 2d

Parameter	Value	Parameter	Value
Distance	10 km	Polarization	Horizontal
Frequency	430 MHz	Site Criteria	Random
Antenna Height (Tx)	1000 m	Climate	7
Antenna Height (Rx)	1,5 m	Percent of time	99%
Ground refractivity	250 N-units	Percent of locations	99%
Terrain irregularity parameter	10 m	Confidence level	99%
Relative permittivity	15	Mode of variability	Mobile
Electrical ground Conductivity	0.002		
Att (SEAMCAT)	141,0 dB		
Att (ITM)	141,1 dB		
difference	**0 dB**		

Table 7: 2e

Parameter	Value	Parameter	Value
Distance	1000 km	Polarization	Horizontal
Frequency	200 MHz	Site Criteria	Very careful
Antenna Height (Tx)	60 m	Climate	3
Antenna Height (Rx)	60 m	Percent of time	10%
Ground refractivity	290 N-units	Percent of locations	20%
Terrain irregularity parameter	500 m	Confidence level	30%
Relative permittivity	81	Mode of variability	Broadcast
Electrical ground Conductivity	5		
Att (SEAMCAT)	215,2 dB		
Att (ITM)	215,2 dB		
difference	**0 dB**		

Table 8: 2f

Parameter	Value	Parameter	Value
Distance	60 km	Polarization	Vertical
Frequency	5 GHz	Site Criteria	Very careful
Antenna Height (Tx)	80 m	Climate	4
Antenna Height (Rx)	430 m	Percent of time	1%
Ground refractivity	290 N-units	Percent of locations	1%
Terrain irregularity parameter	10 m	Confidence level	1%
Relative permittivity	15	Mode of variability	Broadcast
Electrical ground Conductivity	0.001		
Att (SEAMCAT)	135,0 dB		
Att (ITM)	135,0 dB		
difference	**0 dB**		

Table 9: 2g

Parameter	Value	Parameter	Value
Distance	9 km	Polarization	Vertical
Frequency	100 MHz	Site Criteria	Very careful
Antenna Height (Tx)	60 m	Climate	5
Antenna Height (Rx)	10 m	Percent of time	50%
Ground refractivity	301 N-units	Percent of locations	97%
Terrain irregularity parameter	90 m	Confidence level	99%
Relative permittivity	15	Mode of variability	Broadcast
Electrical ground Conductivity	0.001		
Att (SEAMCAT)	-133,5 dB		
Att (ITM)	-135,5 dB		
difference	**0 dB**		