

Supplementary file S2

This document gives more information about the adjustment of input parameters of the forest reflectance and transmittance model FRT. The document includes each tested combination of species-specific input parameters and for the selected best combination also the performance metrics for each simulated Sentinel-2 (S2) MSI band. The used performance metrics are Pearson correlation coefficient (r), relative root-mean-square error (rRMSE) and normalised mean bias (NMB).

Starting point

We started with the baseline input values.

Table 1. Performance metrics after using the baseline inputs.

S2 band	r	rRMSE (%)	NMB (%)
B2	0.51	21.1	5.8
B3	0.51	26.1	15.6
B4	0.44	26.4	12.4
B5	0.69	19.1	11.1
B6	0.82	26.4	21.5
B7	0.79	24.5	19.4
B8	0.80	23.4	18.8
B8A	0.79	25.1	20.7

Tree distribution parameter

We estimated a new value for tree distribution parameter (TDP). The baseline value was 1.2 and the new value was 2. The same value was used for each tree species.

Table 2. Performance metrics after using the new TDP value.

S2 band	r	rRMSE (%)	NMB (%)
B2	0.48	20.6	-1.0
B3	0.49	22.5	7.7
B4	0.40	23.1	2.5
B5	0.66	16.3	2.6
B6	0.82	21.1	14.8
B7	0.80	19.6	13.0
B8	0.81	18.4	12.2
B8A	0.80	19.8	14.0

Shoot length (m)

Shoot length (SHL) had the following baseline values: pine 0.1, spruce 0.05 and birch 0.4. Different combinations of species-specific SHL values were tested for pine, spruce and birch, respectively:
0.05 0.03 0.08,
0.05 0.05 0.08,
0.07 0.05 0.10,

0.08 0.03 0.10,
0.10 0.05 0.10 (selected as the best combination),
0.10 0.05 0.12,
0.10 0.05 0.15,
0.15 0.10 0.40,
0.25 0.20 0.55.

Table 3. Performance metrics after adjusting SHL.

S2 band	<i>r</i>	rRMSE (%)	NMB (%)
B2	0.51	19.1	−4.1
B3	0.52	18.9	4.4
B4	0.45	20.9	−1.0
B5	0.68	14.2	−0.3
B6	0.82	19.1	13.1
B7	0.80	18.3	11.6
B8	0.80	17.3	11.0
B8A	0.79	18.7	12.8

Branch area to leaf area ratio

The baseline values of branch area to leaf area ratio (BAILAI) were 0.18 for pine and spruce and 0.15 for birch. The following combinations of species-specific BAILAI were tested for pine, spruce and birch, respectively:

0.10 0.10 0.07,
0.13 0.13 0.10,
0.18 0.18 0.20,
0.18 0.18 0.22,
0.18 0.18 0.25,
0.18 0.18 0.30,
0.18 0.20 0.15,
0.18 0.25 0.15,
0.18 0.30 0.15,
0.26 0.21 0.18,
0.28 0.23 0.20,
0.30 0.18 0.15,
0.30 0.18 0.22,
0.30 0.23 0.20,
0.30 0.25 0.20,
0.30 0.25 0.22 (selected as the best combination),
0.35 0.18 0.15.

Table 4. Performance metrics after adjusting BAILAI.

S2 band	<i>r</i>	rRMSE (%)	NMB (%)
B2	0.48	20.8	2.4
B3	0.50	19.9	4.8
B4	0.41	25.7	11.0
B5	0.66	14.5	−0.5
B6	0.82	13.4	2.6
B7	0.81	13.3	0.6
B8	0.81	12.8	0.4
B8A	0.80	13.2	2.4

Shoot shading coefficient

With shoot shading coefficient (SSC) we achieved only minor improvements and decided on using the baseline values (pine 0.59, spruce 0.64 and birch 1). The combinations that were tested for pine, spruce and birch, respectively, are listed below:

0.4 0.64 1,
0.5 0.64 1,
0.59 0.44 1,
0.59 0.59 1,
0.59 0.64 0.8,
0.59 0.64 0.95,
0.59 0.64 1.2,
0.59 0.7 1,
0.59 0.9 1,
0.6 0.65 1,
0.7 0.64 1.

Specific leaf weight (g m^{-2})

With specific leaf weight (SLW) we achieved only minor improvements and decided on using the baseline values (pine 158, spruce 200 and birch 57). The combinations that were tested for pine, spruce and birch, respectively, are listed below:

115 200 57,
130 200 57,
133 200 57,
135 200 57,
158 152 57,
158 180 57,
158 200 20,
158 200 30,
158 200 37,
158 200 40,
158 200 50,
158 210 57,
160 167 76,
200 200 57.

Crown radius (m)

With crown radius, different coefficients were used to modify the allometry-based values for pine, spruce and birch, respectively:

0.90 1 1,
0.95 1 1,
1 0.90 1,
1 0.95 1,
1 1 0.85,
1 1 0.90,
1 1 0.95,
1 1 1.01,
1 1 1.10,
1 1.05 1,
1 1.10 1,
1.03 0.98 0.95,
1.03 1 0.95 (selected as the best combination),
1.05 1 1,
1.10 1 1.

Table 5. Performance metrics after adjusting crown radius.

S2 band	<i>r</i>	rRMSE (%)	NMB (%)
B2	0.51	19.6	1.0
B3	0.53	17.8	3.3
B4	0.45	24.0	9.4
B5	0.67	13.7	−1.7
B6	0.82	12.8	1.9
B7	0.80	13.2	0.0
B8	0.81	12.8	−0.0
B8A	0.79	13.2	1.9

Crown length (m)

With crown length, different coefficients were used to modify the allometry-based values for pine, spruce and birch, respectively:

0.75 1.00 1.05,
0.95 1 1,
1 0.95 1,
1 1 0.95,
1 1 1.05,
1 1.05 1,
1.05 1 1.

Only minor improvements were gained; thus we chose not to modify the allometry-based values.