

APPENDIX A
List of scenarios

No.	Scenario ID.	Scenario			
		Phase	Zone	Direction	Baseline Loss Intensity
1.	SC_01_1	I	A	Main	Minimum
	SC_01_2	I	A	Main	Average
	SC_01_3	I	A	Main	Maximum
2.	SC_02_1	I	A	Minor	Minimum
	SC_02_2	I	A	Minor	Average
	SC_02_3	I	A	Minor	Maximum
3.	SC_03_1	II	A	Main	Minimum
	SC_03_2	II	A	Main	Average
	SC_03_3	II	A	Main	Maximum
4.	SC_04_1	II	A	Minor	Minimum
	SC_04_2	II	A	Minor	Average
	SC_04_3	II	A	Minor	Maximum
5.	SC_05_1	II	B	Main	Minimum
	SC_05_2	II	B	Main	Average
	SC_05_3	II	B	Main	Maximum
6.	SC_06_1	II	B	Minor	Minimum
	SC_06_2	II	B	Minor	Average
	SC_06_3	II	B	Minor	Maximum
7.	SC_07_1	III	B	Main	Minimum
	SC_07_2	III	B	Main	Average
	SC_07_3	III	B	Main	Maximum
8.	SC_08_1	III	B	Minor	Minimum
	SC_08_2	III	B	Minor	Average
	SC_08_3	III	B	Minor	Maximum
9.	SC_09_1	III	C	Main	Minimum
	SC_09_2	III	C	Main	Average
	SC_09_3	III	C	Main	Maximum
10.	SC_10_1	III	C	Minor	Minimum
	SC_10_2	III	C	Minor	Average
	SC_10_3	III	C	Minor	Maximum

APPENDIX B
Scenario time to availability below 50%

Scenario no.	Time [days]	Scenario no.	Time [days]	Scenario no.	Time [days]	Scenario no.	Time [days]
SC_10_1_terrai n_1	31.5	SC_08_2_terrai n_2	18.2	SC_01_1_terrai n_4	13.4	SC_01_2_terrai n_3	10.0
SC_08_1_terrai n_1	28.6	SC_10_3_terrai n_1	17.4	SC_08_3_terrai n_2	13.4	SC_03_2_terrai n_2	10.0
SC_10_1_terrai n_2	28.6	SC_03_1_terrai n_1	17.1	SC_03_1_terrai n_3	13.3	SC_04_2_terrai n_4	10.0
SC_09_1_terrai n_1	26.5	SC_07_1_terrai n_4	17.1	SC_09_2_terrai n_4	13.1	SC_05_2_terrai n_3	10.0
SC_10_1_terrai n_3	26.1	SC_05_1_terrai n_2	16.9	SC_05_2_terrai n_1	13.0	SC_09_3_terrai n_4	9.6
SC_08_1_terrai n_2	25.8	SC_06_1_terrai n_4	16.9	SC_01_2_terrai n_1	12.9	SC_05_3_terrai n_1	9.5
SC_07_1_terrai n_1	23.8	SC_01_1_terrai n_2	16.8	SC_07_2_terrai n_3	12.9	SC_01_3_terrai n_1	9.4
SC_09_1_terrai n_2	23.8	SC_02_1_terrai n_4	16.8	SC_02_2_terrai n_3	12.7	SC_07_3_terrai n_3	9.4
SC_10_1_terrai n_4	23.8	SC_04_1_terrai n_3	16.8	SC_04_2_terrai n_2	12.7	SC_04_3_terrai n_2	9.3
SC_06_1_terrai n_1	23.6	SC_07_2_terrai n_1	16.5	SC_06_2_terrai n_3	12.7	SC_06_3_terrai n_3	9.3
SC_02_1_terrai n_1	23.5	SC_09_2_terrai n_2	16.5	SC_07_3_terrai n_1	12.1	SC_02_3_terrai n_3	9.2
SC_08_1_terrai n_3	23.4	SC_10_2_terrai n_4	16.5	SC_09_3_terrai n_2	12.1	SC_05_2_terrai n_4	9.0
SC_10_2_terrai n_1	23.1	SC_06_2_terrai n_1	16.4	SC_10_3_terrai n_4	12.1	SC_01_2_terrai n_4	8.9
SC_09_1_terrai n_3	21.4	SC_02_2_terrai n_1	16.3	SC_02_3_terrai n_1	12.0	SC_03_2_terrai n_3	8.9
SC_04_1_terrai n_1	21.2	SC_08_2_terrai n_3	16.2	SC_06_3_terrai n_1	12.0	SC_03_3_terrai n_1	8.4
SC_07_1_terrai n_2	21.2	SC_10_3_terrai n_2	15.3	SC_03_1_terrai n_4	11.9	SC_05_3_terrai n_2	8.3
SC_08_1_terrai n_4	21.2	SC_08_3_terrai n_1	15.3	SC_08_3_terrai n_3	11.9	SC_06_3_terrai n_4	8.3
SC_06_1_terrai n_2	21.0	SC_01_1_terrai n_3	15.0	SC_03_2_terrai n_1	11.5	SC_07_3_terrai n_4	8.3
SC_02_1_terrai n_2	20.9	SC_03_1_terrai n_2	15.0	SC_07_2_terrai n_4	11.5	SC_01_3_terrai n_2	8.2
SC_08_2_terrai n_1	20.5	SC_04_1_terrai n_4	15.0	SC_05_2_terrai n_2	11.4	SC_02_3_terrai n_4	8.2
SC_10_2_terrai n_2	20.5	SC_05_1_terrai n_3	15.0	SC_06_2_terrai n_4	11.4	SC_04_3_terrai n_3	8.2
SC_09_1_terrai n_4	19.4	SC_09_2_terrai n_3	14.7	SC_01_2_terrai n_2	11.3	SC_03_2_terrai n_4	7.9
SC_05_1_terrai n_1	19.2	SC_04_2_terrai n_1	14.5	SC_02_2_terrai n_4	11.3	SC_03_3_terrai n_2	7.3
SC_01_1_terrai n_1	19.1	SC_07_2_terrai n_2	14.5	SC_04_2_terrai n_3	11.3	SC_04_3_terrai n_4	7.3
SC_07_1_terrai n_3	19.0	SC_08_2_terrai n_4	14.5	SC_09_3_terrai n_3	10.7	SC_05_3_terrai n_3	7.3
SC_04_1_terrai	18.8	SC_06_2_terrai	14.4	SC_04_3_terrai	10.6	SC_01_3_terrai	7.2

Scenario no.	Time [days]	Scenario no.	Time [days]	Scenario no.	Time [days]	Scenario no.	Time [days]
n_2		n_2		n_1		n_3	
SC_06_1_terrain		SC_02_2_terrain		SC_07_3_terrain		SC_01_3_terrain	
n_3	18.8	n_2	14.3	n_2	10.6	n_4	6.5
SC_02_1_terrain		SC_09_3_terrain		SC_08_3_terrain		SC_05_3_terrain	
n_3	18.7	n_1	13.9	n_4	10.6	n_4	6.5
SC_09_2_terrain		SC_10_3_terrain		SC_06_3_terrain		SC_03_3_terrain	
n_1	18.7	n_3	13.6	n_2	10.5	n_3	6.4
SC_10_2_terrain		SC_05_1_terrain		SC_02_3_terrain		SC_03_3_terrain	
n_3	18.4	n_4	13.5	n_2	10.4	n_4	5.7

APPENDIX C

The repeated-measures FANOVA model used to assess the influence of terrain on the availability trajectories is formulated in Eq. (C1) [41,47] :

$$p_{1,i}(t) = \mu + \alpha_i + \beta_j + \varepsilon_{ij}, \quad (C1)$$

where: μ average of the availability function, α_i – the effect of the i -th terrain class, β_j – the effect of the j -th time point, ε_{ij} - residual component of the model.

In the numerical implementation, the area and time block were treated as categorical factors. The model was estimated separately for each base case. The null hypothesis tested in the FANOVA procedure is given in Eq. (C2) [48]:

$$H_0: \alpha_1(t) = \alpha_2(t) = \alpha_3(t) = \alpha_4(t) \text{ for everyone } t \in T \quad (C2)$$

which means that terrain type had no significant effect on the course of the availability function throughout the entire time period analyzed. The alternative hypothesis posits that at least one terrain level caused a significant change in the value $p_1(t)$ [48]:

$$H_1: \exists t \text{ such that } \alpha_1(t) \neq \alpha_j(t) \text{ for } i \neq j \quad (C3)$$

The evaluation was conducted using statistical methods F_{terrain} and values p . The magnitude of the effect was expressed using a coefficient η^2 and the partial coefficient η_p^2 [49]. For the terrain effect under analysis, the following values were calculated according to Eq. (C4) [49]:

$$\eta^2 = \frac{SS_{\text{terrain}}}{SS_{\text{total}}}, \eta_p^2 = \frac{SS_{\text{terrain}}}{SS_{\text{terrain}} + SS_{\text{residual}}}. \quad (C4)$$

where: SS_{residual} - sum of squares of errors (SS_{error}) in the general definition of the partial coefficient η_p^2 . The analysis used a significance level of $\alpha = 0,05$.

To supplement the statistical analysis with a quantitative description of the extent of differences between regional trajectories, two measures of divergence were calculated for each baseline scenario. The average trajectory spread is defined in Eq. (C5), while the maximum instantaneous difference is defined in Eq. (C6):

$$\Delta \bar{p}_1 = \frac{1}{T} \sum_t \left(\max_k p_{1,b,k}(t) - \min_k p_{1,b,k}(t) \right) \quad (C5)$$

and

$$\Delta p_{1,\max} = \max_t \left(\max_k p_{1,b,k}(t) - \min_k p_{1,b,k}(t) \right), \quad (C6)$$

where: $\Delta \bar{p}_1$ average trajectory spread over time, $\Delta p_{1,\max}$ - the maximum instantaneous difference between terrain variants within the same base scenario.

This approach made it possible not only to assess the statistical significance of the terrain effect, but also to determine its scale and operational significance.

APPENDIX D

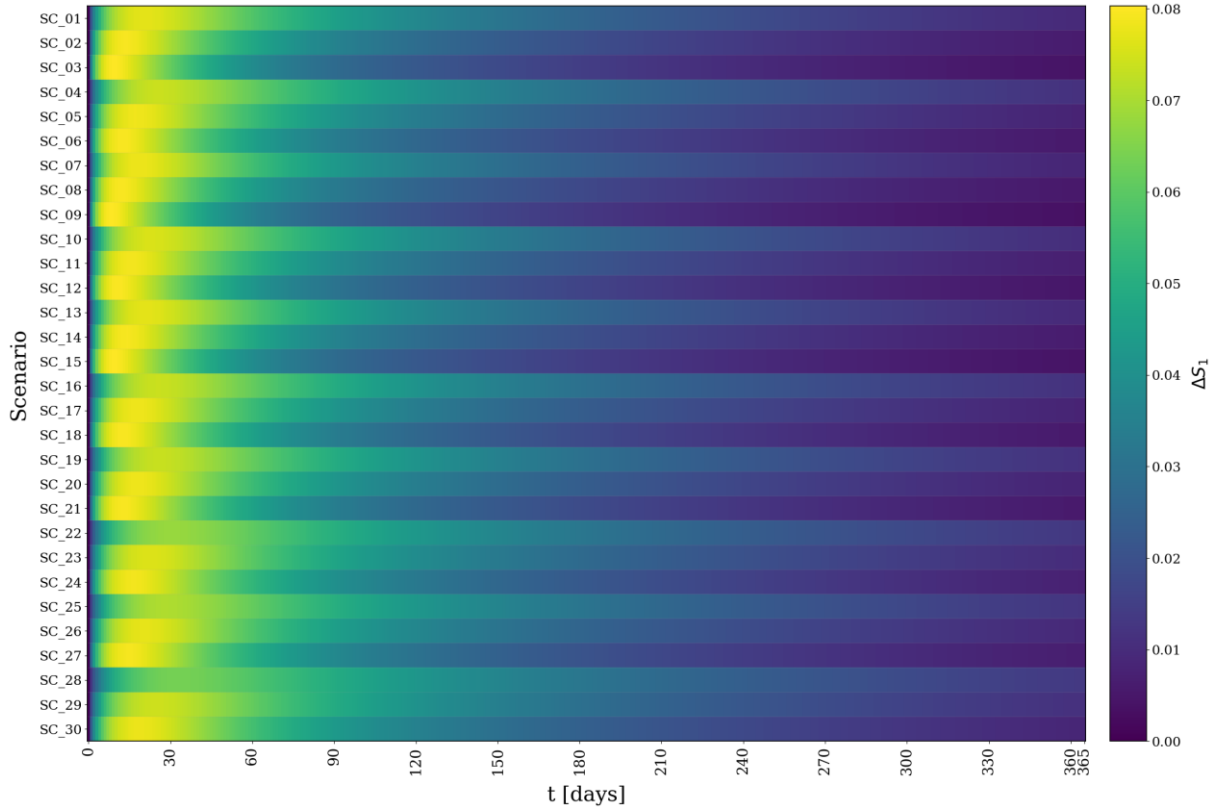


Figure D1. Heatmap of the instantaneous separation between the availability trajectories for terrain variants