Supplementary Material

Optimizing Spectral Inputs for Deep Learning-Based Vegetation Destruction Detection Using Sentinel-2 Imagery

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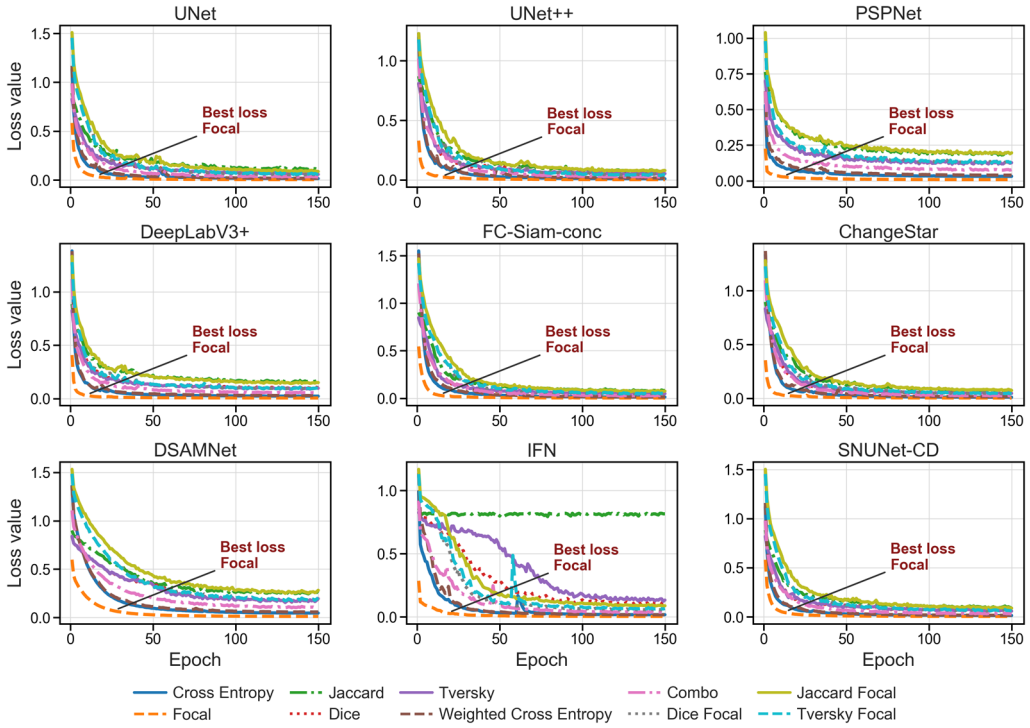

Figure S1. Preliminary screening of different loss functions based on training convergence. This step was conducted to establish a stable training baseline for the subsequent spectral feature evaluations.

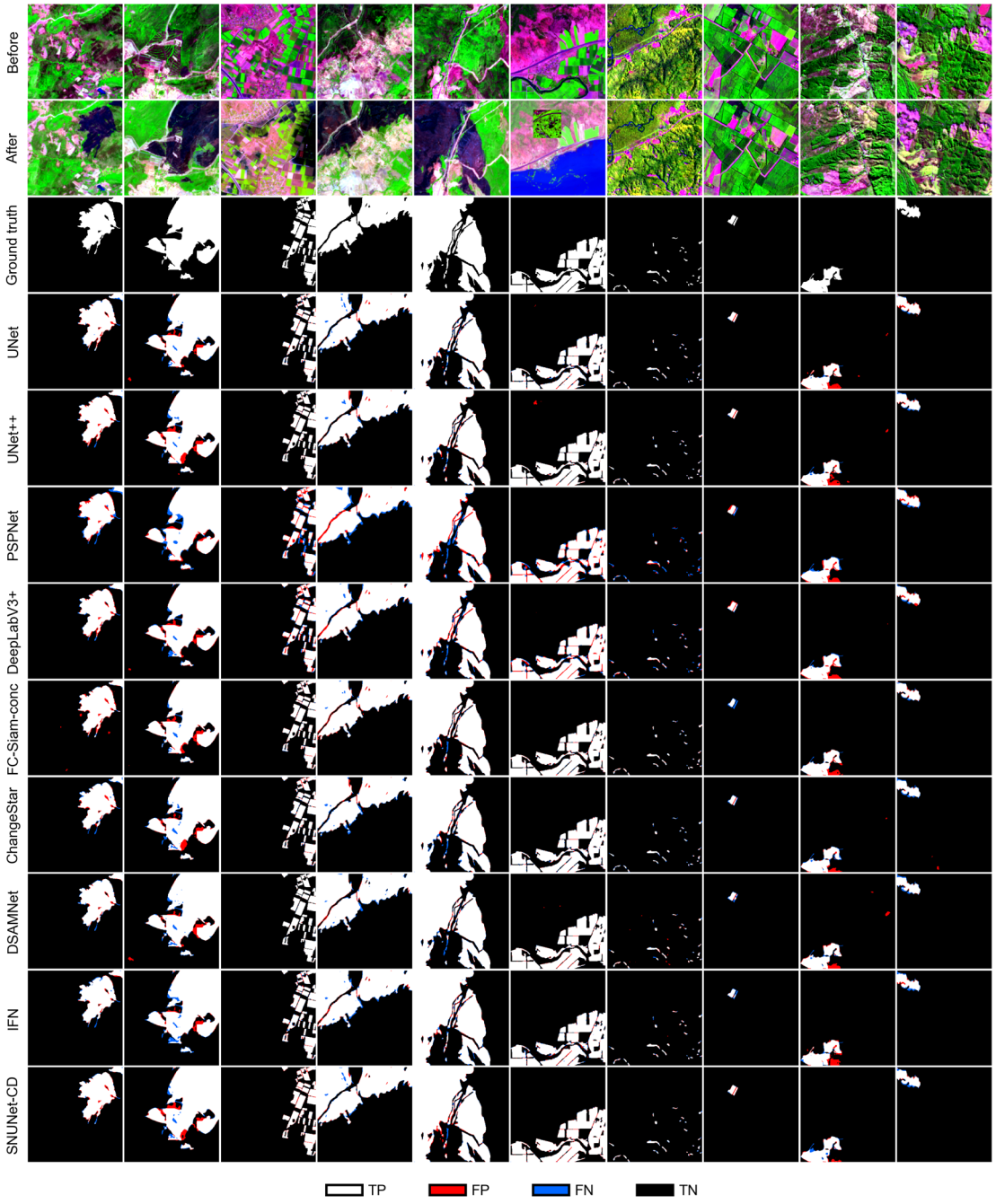

Figure S2. Detection results under RGBNS combined with multiple spectral indices. Each row shows the result of the corresponding model under the input combination with the best F1-score. The images in the first and second rows are displayed as false-color composites, with the R, G, and B channels corresponding to the SWIR, NIR, and Red bands of Sentinel-2, respectively.

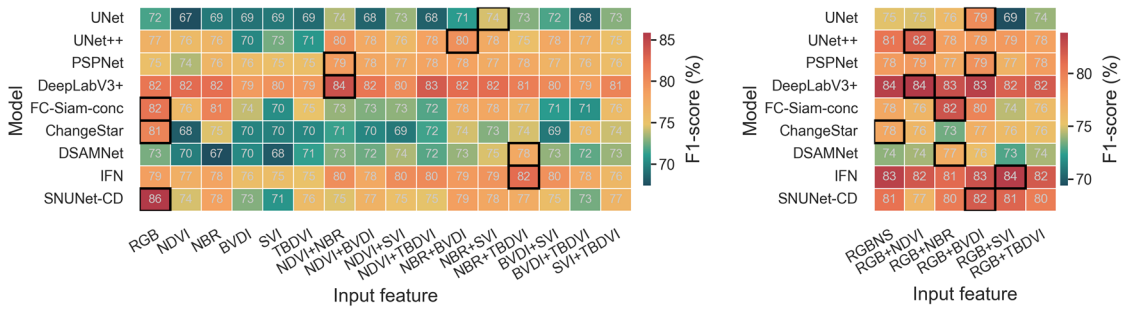

Figure S3. F1-score comparison of different models under spectral index inputs and spectral band inputs. The black boxes indicate the best accuracy metric for each model among the tested feature combinations.

Table S1. Sentinel-2 data used in this study.

Study area (Lon, Lat)	Data	Study area (Lon, Lat)	Data
China(104.67, 26.26)	2018-08-25, 2019-08-15	Brazil(-76.18, 0.02)	2020-01-04, 2020-06-27
China(102.11, 30.07)	2024-08-01, 2024-08-06	Brazil(-54.45, -11.71)	2020-07-02, 2020-09-03
China(113.24, 25.94)	2024-07-22, 2024-08-06	Brazil(-57.33, -11.51)	2020-07-03, 2020-09-06
China(116.12, 24.71)	2024-05-15, 2024-06-19	Brazil(-56.62, -11.63)	2020-07-05, 2020-09-03
China(108.57, 30.82)	2023-06-12, 2023-07-17	Brazil(-52.59, -11.61)	2020-07-07, 2020-09-05
Congo(28.91, -1.99)	2023-04-07, 2023-05-07	Congo(25.97, -1.60)	2020-07-29, 2020-09-17
Brazil(-45.76, -23.75)	2023-01-26, 2023-02-25	Canada(-66.72, 47.01)	2020-06-20, 2020-09-03
Greece(22.04, 39.54)	2023-08-16, 2023-09-10	Canada(-64.64, 48.94)	2020-07-15, 2020-09-03
China(113.62, 34.88)	2021-07-26, 2022-07-21	Canada(-74.55, 46.38)	2020-06-19, 2020-07-04
Pakistan(67.96, 26.96)	2022-07-12, 2022-09-05	Canada(-119.42, 50.97)	2020-07-26, 2020-08-05
China(109.94, 34.79)	2024-08-05, 2024-08-12	Mexico(-107.05, 24.51)	2020-07-26, 2020-08-05
Sweden(15.84, 56.41)	2020-05-31, 2020-06-25	USA(-120.15, 39.18)	2020-06-03, 2020-08-02
South Africa(31.90, -28.32)	2020-02-03, 2020-02-13	USA(-122.18, 46.64)	2020-07-14, 2020-09-02
South Africa(25.15, -33.66)	2020-06-08, 2020-07-18	USA(-122.52, 43.96)	2020-06-26, 2020-09-04
Mozambique(36.53, -16.45)	2020-04-05, 2020-05-25	Canada(-118.57, 54.78)	2022-08-10, 2023-06-06
Chile(-72.90, -39.35)	2020-03-14, 2020-09-20	Canada(-125.89, 49.87)	2022-06-25, 2023-06-05
Chile(-71.40, -35.04)	2020-03-04, 2020-08-11	Tunisia(9.55, 37.26)	2020-07-22, 2020-08-01
Paraguay(-62.03, -20.78)	2020-02-02, 2020-03-08	Algeria(4.65, 36.78)	2020-06-28, 2020-07-08
Paraguay(-61.19, -20.73)	2020-01-15, 2020-02-14	Portugal(-7.95, 39.84)	2020-07-18, 2020-08-02
Paraguay(-59.71, -20.36)	2020-01-15, 2020-01-20	Spain(-3.03, 42.25)	2021-08-19, 2021-08-24
Paraguay(-60.16, -21.33)	2020-01-15, 2020-02-04	Ethiopia(36.75, 6.71)	2020-08-02, 2020-08-27
Paraguay(-59.29, -19.52)	2020-01-15, 2020-02-04	Canada(-110.59, 57.09)	2021-06-30, 2021-08-26
Peru(-71.47, -12.80)	2020-04-19, 2020-07-18	Canada(-120.52, 57.21)	2020-08-18, 2023-0729
Peru(-73.71, -10.76)	2020-04-22, 2020-05-17	Canada(-139.17, 64.29)	2021-07-01, 2022-06-16
Italy(16.62, 39.31)	2020-08-02, 2020-08-27	Tunisia(9.27, 37.18)	2017-07-23, 2017-08-22

Table S2. Detection performance of different models under different spectral band combinations.

Feature	Metric	UNet	UNet++	PSPNet	DeepLabV3+	FC-Siam-conc	ChangeStar	DSAMNet	IFN	SNUNet-CD

RGB	Precision	75.98	78.95	82.33	85.55	82.57	83.68	76.11	85.31	88.24
	Recall	70.32	76.77	74.00	80.89	82.86	79.46	72.61	76.73	85.18
	F1-score	71.68	76.84	75.38	81.64	81.78	80.64	72.60	78.70	85.84
	IoU	67.79	73.12	69.81	76.31	77.84	76.35	68.53	73.35	81.62
RGBN	Precision	76.00(+0.02)	81.72(+2.76)	82.76(+0.42)	86.94(+1.39)	78.18(-4.39)	78.23(-5.45)	78.26(+2.15)	87.57(+2.26)	83.84(-4.39)
	Recall	72.96(+2.64)	80.83(+4.07)	74.77(+0.78)	82.32(+1.43)	78.62(-4.24)	74.01(-5.44)	74.55(+1.94)	79.33(+2.60)	80.64(-4.54)
	F1-score	73.30(+1.63)	80.62(+3.78)	76.44(+1.06)	83.14(+1.50)	77.51(-4.27)	75.08(-5.56)	75.04(+2.44)	80.77(+2.07)	81.39(-4.44)
	IoU	69.54(+1.75)	76.85(+3.73)	71.16(+1.35)	77.80(+1.48)	73.58(-4.26)	71.14(-5.21)	71.55(+3.03)	76.07(+2.73)	77.39(-4.22)
RGBS	Precision	82.07(+6.09)	84.31(+5.35)	83.05(+0.72)	87.95(+2.40)	79.90(-2.67)	85.35(+1.67)	75.78(-0.33)	87.33(+2.02)	83.40(-4.84)
	Recall	77.49(+7.17)	81.50(+4.74)	75.78(+1.79)	84.60(+3.71)	78.97(-3.89)	79.05(-0.40)	72.46(-0.15)	79.98(+3.25)	79.90(-5.28)
	F1-score	78.34(+6.66)	81.62(+4.79)	77.09(+1.72)	84.97(+3.33)	78.49(-3.29)	80.82(+0.18)	73.03(+0.43)	81.31(+2.61)	80.37(-5.47)
	IoU	73.78(+5.99)	77.20(+4.08)	71.19(+1.39)	79.27(+2.95)	74.68(-3.16)	76.32(-0.03)	69.10(+0.58)	75.92(+2.58)	76.22(-5.40)
RGBNS	Precision	78.04(+2.07)	83.11(+4.16)	84.60(+2.27)	86.95(+1.41)	78.09(-4.48)	80.57(-3.12)	76.86(+0.75)	88.86(+3.55)	83.44(-4.80)
	Recall	74.62(+4.29)	80.14(+3.38)	76.98(+2.99)	82.72(+1.83)	78.87(-3.99)	76.74(-2.72)	73.72(+1.11)	82.06(+5.33)	80.39(-4.79)
	F1-score	75.08(+3.40)	80.62(+3.79)	78.43(+3.06)	83.52(+1.88)	77.53(-4.25)	77.62(-3.02)	73.83(+1.22)	83.41(+4.71)	80.77(-5.07)
	IoU	70.95(+3.16)	76.75(+3.64)	72.95(+3.14)	78.46(+2.14)	73.76(-4.09)	73.75(-2.60)	70.52(+1.99)	78.80(+5.46)	76.90(-4.72)

Note: Values in parentheses indicate changes relative to RGB input. Red values denote performance gains, whereas blue values denote performance decreases.

Table S3. Pixel-level statistical significance (McNemar's test) for selected input feature comparisons.

Comparison	Models Tested	Mean Δ Accuracy (%)	Median Δ Accuracy (%)	Models with Positive Δ	Models with Sig. Difference ($p < 0.05$)
RGB+BVDI vs RGB	9	0.16	0.19	6	9
RGB+NBR vs RGB	9	0.19	0.18	7	9
RGBS vs RGB	9	0.02	0.07	6	9
RGBNS+SVI vs RGBNS	9	0.03	0.05	5	9

Note: Δ Accuracy represents the pixel-level classification accuracy difference between Feature A and Feature B (Feature A - Feature B). "Models with Positive Δ" indicates the number of models where Feature A outperformed Feature B. "Models with Sig. Difference" represents the number of models that showed a statistically significant difference ($p < 0.05$) based on McNemar's test.

Table S4. Detection performance of different models under RGB combined with a single spectral index.

Feature	Metric	UNet	UNet++	PSPNet	DeepLabV3+	FC-Siam-conc	ChangeStar	DSAMNet	IFN	SNUNet-CD
RGB	Precision	75.98	78.95	82.33	85.55	82.57	83.68	76.11	85.31	88.24
	Recall	70.32	76.77	74.00	80.89	82.86	79.46	72.61	76.73	85.18
	F1-score	71.68	76.84	75.38	81.64	81.78	80.64	72.60	78.70	85.84
	IoU	67.79	73.12	69.81	76.31	77.84	76.35	68.53	73.35	81.62
RGB+NDVI	Precision	78.62(+2.64)	84.85(+5.90)	83.06(+0.72)	87.21(+1.66)	77.09(-5.47)	79.03(-4.65)	78.56(+2.45)	88.02(+2.71)	78.49(-9.75)
	Recall	74.41(+4.09)	81.63(+4.87)	77.21(+3.22)	82.92(+2.03)	77.91(-4.94)	75.70(-3.75)	73.78(+1.17)	80.98(+4.26)	76.37(-8.81)
	F1-score	74.96(+3.28)	81.76(+4.92)	78.54(+3.16)	83.85(+2.21)	76.50(-5.28)	76.38(-4.26)	74.17(+1.57)	82.16(+3.46)	76.50(-9.33)
	IoU	71.49(+3.70)	78.01(+4.90)	73.12(+3.31)	78.74(+2.43)	72.69(-5.15)	72.25(-4.10)	70.08(+1.55)	77.51(+4.17)	73.03(-8.59)
RGB+NBR	Precision	78.90(+2.92)	80.89(+1.94)	83.19(+0.85)	85.97(+0.42)	83.56(+0.99)	76.30(-7.39)	80.40(+4.28)	86.41(+1.10)	84.44(-3.80)
	Recall	76.19(+5.87)	78.03(+1.27)	75.81(+1.82)	81.88(+0.99)	82.79(-0.06)	72.69(-6.76)	76.47(+3.86)	80.14(+3.42)	79.45(-5.73)
	F1-score	76.10(+4.42)	78.24(+1.40)	77.38(+2.00)	82.62(+0.98)	82.43(+0.66)	73.35(-7.29)	77.15(+4.54)	81.21(+2.51)	80.27(-5.57)

	IoU	72.09(+4.30)	74.62(+1.51)	71.77(+1.96)	77.50(+1.19)	78.47(+0.63)	69.57(-6.79)	73.62(+5.09)	76.56(+3.22)	76.35(-5.26)
RGB+BVDI	Precision	81.01(+5.04)	80.11(+1.16)	84.69(+2.36)	86.05(+0.50)	80.06(-2.51)	79.86(-3.82)	79.02(+2.91)	88.72(+3.41)	82.96(-5.27)
	Recall	79.46(+9.14)	78.65(+1.89)	77.22(+3.22)	83.11(+2.22)	81.49(-1.36)	76.13(-3.32)	75.39(+2.78)	81.41(+4.68)	82.51(-2.67)
	F1-score	79.31(+7.63)	78.52(+1.69)	78.98(+3.60)	83.46(+1.82)	79.73(-2.05)	76.97(-3.67)	75.69(+3.09)	82.53(+3.83)	82.04(-3.80)
	IoU	75.15(+7.35)	74.53(+1.41)	73.38(+3.57)	77.86(+1.55)	75.83(-2.01)	73.18(-3.18)	72.02(+3.49)	77.56(+4.22)	77.92(-3.70)
RGB+SVI	Precision	72.29(-3.68)	81.32(+2.37)	81.95(-0.39)	86.49(+0.95)	75.29(-7.27)	79.70(-3.98)	76.27(+0.16)	90.48(+5.17)	84.02(-4.22)
	Recall	68.95(-1.38)	78.14(+1.38)	75.23(+1.24)	80.72(-0.16)	75.86(-6.99)	74.88(-4.57)	72.99(+0.38)	82.37(+5.64)	81.20(-3.98)
	F1-score	69.39(-2.29)	78.54(+1.70)	76.68(+1.31)	81.67(+0.03)	74.49(-7.29)	76.02(-4.62)	72.86(+0.26)	83.63(+4.93)	81.49(-4.35)
	IoU	65.87(-1.92)	74.58(+1.46)	71.31(+1.51)	76.48(+0.16)	70.55(-7.29)	72.20(-4.15)	69.12(+0.59)	78.71(+5.37)	77.46(-4.16)
RGB+TBDVI	Precision	77.03(+1.05)	81.12(+2.17)	82.77(+0.44)	86.23(+0.69)	77.30(-5.27)	79.28(-4.41)	76.69(+0.58)	87.58(+2.27)	82.41(-5.83)
	Recall	73.66(+3.33)	77.67(+0.90)	77.30(+3.30)	80.87(-0.02)	76.42(-6.44)	74.97(-4.49)	74.33(+1.72)	80.68(+3.96)	80.34(-4.84)
	F1-score	73.96(+2.28)	78.08(+1.25)	78.31(+2.94)	82.01(+0.38)	75.99(-5.78)	75.66(-4.97)	74.23(+1.63)	82.05(+3.35)	80.15(-5.69)
	IoU	70.04(+2.25)	74.28(+1.16)	72.93(+3.13)	76.94(+0.62)	72.26(-5.58)	71.90(-4.45)	70.39(+1.87)	77.12(+3.77)	76.36(-5.25)

Note: Values in parentheses indicate changes relative to RGB input. Red values denote performance gains, whereas blue values denote performance decreases.

Table S5. Image-level statistical significance (Wilcoxon signed-rank test) for selected input feature comparisons.

Comparison	Models Tested	Mean Δ F1 (%)	Median Δ F1 (%)	Models Improved (F1)	Models Sig. in F1 ($p < 0.05$)	Mean Δ IoU (%)	Median Δ IoU (%)	Models Improved (IoU)	Models Sig. in IoU ($p < 0.05$)
RGB+BVDI vs RGB	9	2.58	3.27	7	5	3.20	4.11	6	5
RGB+NBR vs RGB	9	2.01	3.61	6	7	2.76	4.17	6	7
RGBS vs RGB	9	0.72	2.35	6	5	0.85	2.77	6	6
RGBNS+SVI vs RGBNS	9	0.11	-0.18	3	2	-0.03	-0.66	4	2

Note: Δ F1 and Δ IoU represent the differences in macro F1-score and Intersection over Union between Feature A and Feature B, respectively. “Models Improved” indicates the number of deep learning models that achieved a higher metric score with Feature A. “Models Sig.” represents the number of models demonstrating a statistically significant improvement ($p < 0.05$) based on the Wilcoxon signed-rank test.

Table S6. Detection performance of different models under RGBNS combined with a single spectral index.

Feature	Metric	UNet	UNet++	PSPNet	DeepLabV3+	FC-Siam-conc	ChangeStar	DSAMNet	IFN	SNUNet-CD
RGBNS	Precision	78.04	83.11	84.60	86.95	78.09	80.57	76.86	88.86	83.44
	Recall	74.62	80.14	76.98	82.72	78.87	76.74	73.72	82.06	80.39
	F1-score	75.08	80.62	78.43	83.52	77.53	77.62	73.83	83.41	80.77
	IoU	70.95	76.75	72.95	78.46	73.76	73.75	70.52	78.80	76.90
RGBNS+NDVI	Precision	77.18(-0.87)	81.51(-1.60)	83.63(-0.97)	88.04(+1.09)	77.61(-0.48)	77.57(-3.00)	80.34(+3.47)	87.10(-1.76)	85.46(+2.01)
	Recall	74.64(+0.03)	79.14(-1.00)	77.84(+0.85)	83.35(+0.62)	79.58(+0.70)	74.65(-2.09)	75.54(+1.83)	81.41(-0.65)	80.91(+0.52)
	F1-score	74.45(-0.63)	79.23(-1.40)	78.81(+0.37)	84.46(+0.94)	77.51(-0.02)	75.28(-2.34)	76.44(+2.61)	82.47(-0.94)	81.68(+0.91)
	IoU	70.63(-0.32)	75.40(-1.35)	73.33(+0.38)	79.33(+0.87)	73.81(+0.05)	71.34(-2.41)	72.97(+2.46)	77.83(-0.97)	77.65(+0.75)
RGBNS+NBR	Precision	72.34(-5.71)	83.16(+0.05)	84.63(+0.02)	86.43(-0.53)	81.31(+3.23)	82.12(+1.55)	82.95(+6.09)	86.49(-2.37)	84.96(+1.52)
	Recall	68.36(-6.26)	81.28(+1.14)	78.98(+2.00)	83.29(+0.57)	82.20(+3.33)	77.94(+1.20)	79.03(+5.31)	82.11(+0.05)	81.97(+1.58)
	F1-score	68.63(-6.44)	81.35(+0.72)	80.19(+1.75)	83.59(+0.07)	80.93(+3.40)	78.79(+1.17)	79.50(+5.68)	82.86(-0.56)	82.37(+1.60)
	IoU	65.19(-5.77)	77.75(+1.00)	74.35(+1.41)	78.55(+0.09)	77.22(+3.47)	74.75(+1.00)	75.98(+5.46)	78.28(-0.53)	78.56(+1.66)
RGBNS+BVDI	Precision	75.84(-2.21)	80.70(-2.41)	83.30(-1.30)	87.22(+0.27)	79.82(+1.73)	81.56(+0.99)	83.27(+6.41)	90.43(+1.57)	82.21(-1.23)
	Recall	71.92(-2.69)	77.80(-2.34)	77.22(+0.24)	84.82(+2.10)	80.09(+1.22)	78.56(+1.82)	80.33(+6.61)	82.88(+0.82)	78.07(-2.33)
	F1-score	72.64(-2.43)	78.18(-2.44)	78.69(+0.25)	84.62(+1.10)	79.09(+1.57)	79.14(+1.52)	80.40(+6.57)	84.44(+1.03)	78.81(-1.96)
	IoU	68.97(-1.98)	74.29(-2.47)	73.11(+0.16)	79.28(+0.82)	75.46(+1.70)	74.96(+1.21)	76.75(+6.23)	79.60(+0.80)	74.76(-2.14)
RGBNS+SVI	Precision	83.18(+5.14)	81.01(-2.10)	85.57(+0.97)	87.24(+0.29)	81.53(+3.44)	81.18(+0.61)	84.12(+7.25)	88.78(-0.08)	81.92(-1.53)
	Recall	78.33(+3.72)	79.20(-0.94)	78.19(+1.21)	83.93(+1.21)	81.91(+3.04)	77.48(+0.74)	81.16(+7.44)	82.16(+0.10)	79.61(-0.78)
	F1-score	79.23(+4.15)	79.05(-1.58)	79.74(+1.30)	84.39(+0.87)	80.72(+3.20)	78.16(+0.54)	81.31(+7.49)	83.65(+0.24)	79.78(-0.99)
	IoU	75.14(+4.19)	75.35(-1.40)	74.02(+1.07)	79.22(+0.76)	76.78(+3.03)	74.25(+0.50)	77.74(+7.22)	78.73(-0.08)	75.87(-1.03)
RGBNS+TBDVI	Precision	77.79(-0.25)	80.66(-2.45)	84.61(+0.00)	86.31(-0.64)	81.10(+3.01)	80.72(+0.15)	85.09(+8.22)	88.69(-0.16)	82.65(-0.79)
	Recall	73.44(-1.18)	78.47(-1.67)	77.68(+0.70)	81.99(-0.73)	81.50(+2.63)	76.53(-0.21)	80.76(+7.04)	82.15(+0.08)	80.77(+0.37)
	F1-score	74.05(-1.02)	78.28(-2.35)	79.35(+0.92)	82.66(-0.86)	80.17(+2.65)	77.60(-0.02)	81.20(+7.37)	83.43(+0.01)	81.02(+0.25)
	IoU	70.30(-0.65)	74.73(-2.03)	73.67(+0.73)	77.52(-0.94)	76.33(+2.57)	73.55(-0.20)	77.52(+7.00)	78.99(+0.19)	77.04(+0.14)

Note: Values in parentheses indicate changes relative to RGBNS input. Red values denote performance gains, whereas blue values denote performance decreases.

Table S7. Description of different feature combinations.

Number	Feature combination	Number	Feature combination
C1	RGBNS	C14	RGBNS+NDVI+NBR+TBDVI
C2	RGBNS+NDVI+NBR	C15	RGBNS+NDVI+BVDI+SVI
C3	RGBNS+NDVI+BVDI	C16	RGBNS+NDVI+BVDI+TBDVI
C4	RGBNS+NDVI+SVI	C17	RGBNS+NDVI+SVI+TBDVI
C5	RGBNS+NDVI+TBDVI	C18	RGBNS+NBR+BVDI+SVI
C6	RGBNS+NBR+BVDI	C19	RGBNS+NBR+BVDI+TBDVI
C7	RGBNS+NBR+SVI	C20	RGBNS+NBR+SVI+TBDVI
C8	RGBNS+NBR+TBDVI	C21	RGBNS+BVDI+SVI+TBDVI
C9	RGBNS+BVDI+SVI	C22	RGBNS+NDVI+NBR+BVDI+SVI

C10	RGBNS+BVDI+TBDVI	C23	RGBNS+NDVI+NBR+BVDI+TBDVI
C11	RGBNS+SVI+TBDVI	C24	RGBNS+NDVI+BVDI+SVI+TBDVI
C12	RGBNS+NDVI+NBR+BVDI	C25	RGBNS+NBR+BVDI+SVI+TBDVI
C13	RGBNS+NDVI+NBR+SVI	C26	RGBNS+NDVI+NBR+BVDI+SVI+TBDVI

Note: Combinations C1 to C26 represent the different feature sets evaluated. C1 is the RGBNS baseline. Detailed compositions of these combinations are provided in Table S5.

Table S8. Per-class accuracy for different deep learning models and input feature combinations

Model	Input feature	Class	Recall (%)	Precision (%)	F1-score (%)	IoU (%)
UNet	RGB	Deforestation	75.93	89.63	82.21	69.79
UNet	RGB	Flood	90.55	94.65	**92.55**	86.14
UNet	RGB	Landslide	57.18	76.23	65.34	48.53
UNet	RGB	Wildfire	94.43	94.97	**94.70**	89.93
UNet	RGBS	Deforestation	86.45	83.27	84.83	73.66
UNet	RGBS	Flood	91.18	95.29	**93.19**	87.25
UNet	RGBS	Landslide	57.76	79.69	66.98	50.35
UNet	RGBS	Wildfire	93.38	95.39	**94.38**	89.35
UNet	RGBNS	Deforestation	88.33	87.48	87.90	78.42
UNet	RGBNS	Flood	92.82	94.24	**93.53**	87.84
UNet	RGBNS	Landslide	40.44	77.57	53.17	36.21
UNet	RGBNS	Wildfire	96.03	95.87	**95.95**	92.22
UNet	RGB+BVDI	Deforestation	88.96	86.39	87.65	78.02
UNet	RGB+BVDI	Flood	91.93	95.47	**93.67**	88.09
UNet	RGB+BVDI	Landslide	58.29	74.49	65.41	48.60
UNet	RGB+BVDI	Wildfire	95.39	96.06	**95.72**	91.80
UNet	RGB+NBR	Deforestation	86.24	87.57	86.90	76.84
UNet	RGB+NBR	Flood	93.63	94.19	**93.91**	88.52
UNet	RGB+NBR	Landslide	53.46	73.75	61.99	44.91
UNet	RGB+NBR	Wildfire	96.11	95.10	**95.60**	91.57
UNet	RGBNS+SVI	Deforestation	82.42	88.66	85.43	74.56
UNet	RGBNS+SVI	Flood	92.30	94.83	**93.55**	87.88
UNet	RGBNS+SVI	Landslide	62.27	80.04	70.04	53.90
UNet	RGBNS+SVI	Wildfire	95.62	96.22	**95.91**	92.15
UNet++	RGB	Deforestation	75.93	89.63	82.21	69.79
UNet++	RGB	Flood	90.55	94.65	**92.55**	86.14
UNet++	RGB	Landslide	57.18	76.23	65.34	48.53
UNet++	RGB	Wildfire	94.43	94.97	**94.70**	89.93
UNet++	RGBS	Deforestation	86.45	83.27	84.83	73.66
UNet++	RGBS	Flood	91.18	95.29	**93.19**	87.25
UNet++	RGBS	Landslide	57.76	79.69	66.98	50.35
UNet++	RGBS	Wildfire	93.38	95.39	**94.38**	89.35
UNet++	RGBNS	Deforestation	88.33	87.48	87.90	78.42

UNet++	RGBNS	Flood	92.82	94.24	**93.53**	87.84
UNet++	RGBNS	Landslide	40.44	77.57	53.17	36.21
UNet++	RGBNS	Wildfire	96.03	95.87	**95.95**	92.22
UNet++	RGB+BVDI	Deforestation	88.96	86.39	87.65	78.02
UNet++	RGB+BVDI	Flood	91.93	95.47	**93.67**	88.09
UNet++	RGB+BVDI	Landslide	58.29	74.49	65.41	48.60
UNet++	RGB+BVDI	Wildfire	95.39	96.06	**95.72**	91.80
UNet++	RGB+NBR	Deforestation	86.24	87.57	86.90	76.84
UNet++	RGB+NBR	Flood	93.63	94.19	**93.91**	88.52
UNet++	RGB+NBR	Landslide	53.46	73.75	61.99	44.91
UNet++	RGB+NBR	Wildfire	96.11	95.10	**95.60**	91.57
UNet++	RGBNS+SVI	Deforestation	82.42	88.66	85.43	74.56
UNet++	RGBNS+SVI	Flood	92.30	94.83	**93.55**	87.88
UNet++	RGBNS+SVI	Landslide	62.27	80.04	70.04	53.90
UNet++	RGBNS+SVI	Wildfire	95.62	96.22	**95.91**	92.15
PSPNet	RGB	Deforestation	73.26	91.10	81.21	68.37
PSPNet	RGB	Flood	83.32	86.01	**84.64**	73.38
PSPNet	RGB	Landslide	27.48	64.70	38.58	23.90
PSPNet	RGB	Wildfire	90.88	93.49	**92.16**	85.47
PSPNet	RGBS	Deforestation	72.98	88.98	80.19	66.93
PSPNet	RGBS	Flood	82.95	87.84	**85.32**	74.40
PSPNet	RGBS	Landslide	34.07	60.80	43.67	27.93
PSPNet	RGBS	Wildfire	91.10	93.41	**92.24**	85.59
PSPNet	RGBNS	Deforestation	78.76	88.17	83.20	71.23
PSPNet	RGBNS	Flood	84.18	88.18	**86.13**	75.64
PSPNet	RGBNS	Landslide	34.13	64.29	44.59	28.69
PSPNet	RGBNS	Wildfire	92.62	93.63	**93.12**	87.13
PSPNet	RGB+BVDI	Deforestation	76.31	89.43	82.35	70.00
PSPNet	RGB+BVDI	Flood	82.18	88.02	**85.00**	73.91
PSPNet	RGB+BVDI	Landslide	32.79	64.90	43.57	27.85
PSPNet	RGB+BVDI	Wildfire	93.42	93.41	**93.42**	87.65
PSPNet	RGB+NBR	Deforestation	74.32	89.46	81.19	68.34
PSPNet	RGB+NBR	Flood	83.15	86.60	**84.84**	73.67
PSPNet	RGB+NBR	Landslide	33.37	73.10	45.83	29.72
PSPNet	RGB+NBR	Wildfire	94.29	91.57	**92.91**	86.76
PSPNet	RGBNS+SVI	Deforestation	79.66	88.46	83.83	72.16
PSPNet	RGBNS+SVI	Flood	85.13	87.34	**86.22**	75.78
PSPNet	RGBNS+SVI	Landslide	37.05	71.16	48.72	32.21
PSPNet	RGBNS+SVI	Wildfire	92.38	93.47	**92.92**	86.78
DeepLabV3+	RGB	Deforestation	81.95	87.04	84.42	73.04
DeepLabV3+	RGB	Flood	87.63	90.05	**88.82**	79.89
DeepLabV3+	RGB	Landslide	48.16	70.85	57.34	40.19
DeepLabV3+	RGB	Wildfire	94.15	93.71	**93.93**	88.55
DeepLabV3+	RGBS	Deforestation	84.35	87.94	86.11	75.61

DeepLabV3+	RGBS	Flood	86.48	90.72	**88.55**	79.45
DeepLabV3+	RGBS	Landslide	48.76	73.96	58.77	41.62
DeepLabV3+	RGBS	Wildfire	94.63	94.07	**94.35**	89.30
DeepLabV3+	RGBNS	Deforestation	82.14	88.53	85.21	74.24
DeepLabV3+	RGBNS	Flood	89.14	90.04	**89.59**	81.14
DeepLabV3+	RGBNS	Landslide	45.46	75.16	56.66	39.53
DeepLabV3+	RGBNS	Wildfire	95.14	93.76	**94.45**	89.48
DeepLabV3+	RGB+BVDI	Deforestation	82.59	83.57	83.07	71.05
DeepLabV3+	RGB+BVDI	Flood	88.85	90.85	**89.84**	81.55
DeepLabV3+	RGB+BVDI	Landslide	49.48	68.39	57.41	40.27
DeepLabV3+	RGB+BVDI	Wildfire	95.68	94.44	**95.05**	90.57
DeepLabV3+	RGB+NBR	Deforestation	82.50	88.79	85.53	74.72
DeepLabV3+	RGB+NBR	Flood	89.13	90.34	**89.73**	81.38
DeepLabV3+	RGB+NBR	Landslide	50.63	74.62	60.33	43.20
DeepLabV3+	RGB+NBR	Wildfire	95.61	94.01	**94.80**	90.12
DeepLabV3+	RGBNS+SVI	Deforestation	85.94	88.31	87.11	77.16
DeepLabV3+	RGBNS+SVI	Flood	89.80	90.14	**89.97**	81.77
DeepLabV3+	RGBNS+SVI	Landslide	56.59	68.74	62.08	45.01
DeepLabV3+	RGBNS+SVI	Wildfire	95.37	94.15	**94.76**	90.03
FC-Siam-conc	RGB	Deforestation	90.98	85.14	87.96	78.51
FC-Siam-conc	RGB	Flood	95.45	95.78	**95.61**	91.59
FC-Siam-conc	RGB	Landslide	80.49	73.97	77.10	62.73
FC-Siam-conc	RGB	Wildfire	96.69	94.24	**95.45**	91.30
FC-Siam-conc	RGBS	Deforestation	88.70	86.53	87.60	77.94
FC-Siam-conc	RGBS	Flood	96.54	95.60	**96.06**	92.43
FC-Siam-conc	RGBS	Landslide	77.83	75.20	76.49	61.93
FC-Siam-conc	RGBS	Wildfire	96.47	93.44	**94.93**	90.35
FC-Siam-conc	RGBNS	Deforestation	87.18	87.68	87.43	77.66
FC-Siam-conc	RGBNS	Flood	96.21	94.76	**95.48**	91.35
FC-Siam-conc	RGBNS	Landslide	77.71	70.78	74.08	58.84
FC-Siam-conc	RGBNS	Wildfire	97.30	94.05	**95.65**	91.66
FC-Siam-conc	RGB+BVDI	Deforestation	92.18	83.41	87.57	77.89
FC-Siam-conc	RGB+BVDI	Flood	95.91	94.26	**95.08**	90.61
FC-Siam-conc	RGB+BVDI	Landslide	78.26	76.54	77.39	63.12
FC-Siam-conc	RGB+BVDI	Wildfire	97.50	93.52	**95.47**	91.33
FC-Siam-conc	RGB+NBR	Deforestation	88.41	87.16	87.78	78.22
FC-Siam-conc	RGB+NBR	Flood	96.43	94.91	**95.66**	91.69
FC-Siam-conc	RGB+NBR	Landslide	78.22	75.61	76.89	62.46
FC-Siam-conc	RGB+NBR	Wildfire	96.82	95.25	**96.03**	92.37
FC-Siam-conc	RGBNS+SVI	Deforestation	89.90	86.95	88.40	79.21
FC-Siam-conc	RGBNS+SVI	Flood	96.08	94.45	**95.25**	90.94
FC-Siam-conc	RGBNS+SVI	Landslide	74.05	72.52	73.28	57.83
FC-Siam-conc	RGBNS+SVI	Wildfire	96.88	94.42	**95.64**	91.64
ChangeStar	RGB	Deforestation	87.39	90.32	88.83	79.90

ChangeStar	RGB	Flood	93.40	94.43	**93.91**	88.52
ChangeStar	RGB	Landslide	69.27	78.77	73.72	58.37
ChangeStar	RGB	Wildfire	94.55	95.97	**95.25**	90.94
ChangeStar	RGBS	Deforestation	83.56	89.56	86.46	76.14
ChangeStar	RGBS	Flood	93.11	95.13	**94.11**	88.87
ChangeStar	RGBS	Landslide	57.06	79.84	66.55	49.87
ChangeStar	RGBS	Wildfire	93.19	95.31	**94.24**	89.10
ChangeStar	RGBNS	Deforestation	87.62	89.48	88.54	79.44
ChangeStar	RGBNS	Flood	92.97	95.58	**94.26**	89.14
ChangeStar	RGBNS	Landslide	63.28	79.87	70.61	54.58
ChangeStar	RGBNS	Wildfire	94.62	95.45	**95.03**	90.53
ChangeStar	RGB+BVDI	Deforestation	85.50	91.48	88.39	79.20
ChangeStar	RGB+BVDI	Flood	93.54	95.12	**94.33**	89.26
ChangeStar	RGB+BVDI	Landslide	68.67	79.87	73.85	58.54
ChangeStar	RGB+BVDI	Wildfire	94.62	94.89	**94.75**	90.03
ChangeStar	RGB+NBR	Deforestation	83.95	89.41	86.60	76.36
ChangeStar	RGB+NBR	Flood	92.30	94.48	**93.38**	87.58
ChangeStar	RGB+NBR	Landslide	63.62	82.35	71.78	55.98
ChangeStar	RGB+NBR	Wildfire	94.97	95.90	**95.43**	91.27
ChangeStar	RGBNS+SVI	Deforestation	85.08	91.33	88.10	78.72
ChangeStar	RGBNS+SVI	Flood	93.89	93.74	**93.82**	88.35
ChangeStar	RGBNS+SVI	Landslide	67.41	75.79	71.36	55.47
ChangeStar	RGBNS+SVI	Wildfire	94.94	95.56	**95.25**	90.94
DSAMNet	RGB	Deforestation	78.35	91.44	84.39	72.99
DSAMNet	RGB	Flood	86.78	93.11	**89.83**	81.54
DSAMNet	RGB	Landslide	45.06	78.55	57.27	40.12
DSAMNet	RGB	Wildfire	95.25	95.40	**95.32**	91.06
DSAMNet	RGBS	Deforestation	77.24	92.39	84.14	72.62
DSAMNet	RGBS	Flood	92.37	93.14	**92.76**	86.49
DSAMNet	RGBS	Landslide	53.04	72.22	61.16	44.05
DSAMNet	RGBS	Wildfire	95.10	95.24	**95.17**	90.78
DSAMNet	RGBNS	Deforestation	86.14	91.61	88.79	79.84
DSAMNet	RGBNS	Flood	95.14	96.16	**95.65**	91.66
DSAMNet	RGBNS	Landslide	49.40	80.03	61.09	43.98
DSAMNet	RGBNS	Wildfire	95.71	95.89	**95.80**	91.93
DSAMNet	RGB+BVDI	Deforestation	79.36	92.38	85.38	74.49
DSAMNet	RGB+BVDI	Flood	95.59	93.45	**94.50**	89.58
DSAMNet	RGB+BVDI	Landslide	47.81	79.47	59.70	42.56
DSAMNet	RGB+BVDI	Wildfire	94.80	96.60	**95.69**	91.74
DSAMNet	RGB+NBR	Deforestation	51.35	87.91	64.84	47.97
DSAMNet	RGB+NBR	Flood	94.40	96.79	**95.58**	91.53
DSAMNet	RGB+NBR	Landslide	58.65	77.12	66.63	49.96
DSAMNet	RGB+NBR	Wildfire	95.69	95.70	**95.69**	91.74
DSAMNet	RGBNS+SVI	Deforestation	50.16	87.92	63.88	46.92

DSAMNet	RGBNS+SVI	Flood	96.25	96.63	**96.44**	93.12
DSAMNet	RGBNS+SVI	Landslide	63.66	78.07	70.13	54.00
DSAMNet	RGBNS+SVI	Wildfire	95.25	96.27	**95.76**	91.86
IFN	RGB	Deforestation	67.73	92.57	78.22	64.24
IFN	RGB	Flood	85.89	94.91	**90.17**	82.11
IFN	RGB	Landslide	49.45	73.52	59.13	41.97
IFN	RGB	Wildfire	91.44	94.66	**93.03**	86.96
IFN	RGBS	Deforestation	49.50	86.50	62.96	45.95
IFN	RGBS	Flood	90.74	93.00	**91.86**	84.95
IFN	RGBS	Landslide	46.36	76.81	57.82	40.67
IFN	RGBS	Wildfire	92.21	94.45	**93.31**	87.47
IFN	RGBNS	Deforestation	49.08	86.73	62.69	45.65
IFN	RGBNS	Flood	91.70	95.56	**93.59**	87.95
IFN	RGBNS	Landslide	45.58	81.63	58.50	41.34
IFN	RGBNS	Wildfire	93.72	95.82	**94.76**	90.04
IFN	RGB+BVDI	Deforestation	45.16	89.65	60.07	42.92
IFN	RGB+BVDI	Flood	90.46	94.70	**92.53**	86.11
IFN	RGB+BVDI	Landslide	44.89	73.11	55.62	38.53
IFN	RGB+BVDI	Wildfire	94.34	95.66	**95.00**	90.47
IFN	RGB+NBR	Deforestation	74.83	91.61	82.37	70.03
IFN	RGB+NBR	Flood	91.25	92.55	**91.90**	85.01
IFN	RGB+NBR	Landslide	48.35	80.60	60.45	43.31
IFN	RGB+NBR	Wildfire	94.41	95.33	**94.87**	90.23
IFN	RGBNS+SVI	Deforestation	46.37	88.04	60.75	43.63
IFN	RGBNS+SVI	Flood	90.53	95.87	**93.12**	87.13
IFN	RGBNS+SVI	Landslide	48.73	80.58	60.73	43.61
IFN	RGBNS+SVI	Wildfire	93.54	95.76	**94.64**	89.82
SNUNet-CD	RGB	Deforestation	86.38	89.19	87.76	78.19
SNUNet-CD	RGB	Flood	94.72	95.68	**95.20**	90.84
SNUNet-CD	RGB	Landslide	70.87	78.23	74.37	59.20
SNUNet-CD	RGB	Wildfire	94.88	95.35	**95.12**	90.69
SNUNet-CD	RGBS	Deforestation	87.51	88.64	88.07	78.69
SNUNet-CD	RGBS	Flood	93.48	96.27	**94.85**	90.21
SNUNet-CD	RGBS	Landslide	62.55	77.46	69.21	52.92
SNUNet-CD	RGBS	Wildfire	93.51	94.97	**94.23**	89.09
SNUNet-CD	RGBNS	Deforestation	88.21	87.62	87.91	78.44
SNUNet-CD	RGBNS	Flood	95.47	95.35	**95.41**	91.22
SNUNet-CD	RGBNS	Landslide	59.67	80.55	68.55	52.15
SNUNet-CD	RGBNS	Wildfire	95.72	94.82	**95.27**	90.96
SNUNet-CD	RGB+BVDI	Deforestation	88.47	88.20	88.33	79.11
SNUNet-CD	RGB+BVDI	Flood	92.24	95.54	**93.86**	88.44
SNUNet-CD	RGB+BVDI	Landslide	66.40	73.30	69.68	53.47
SNUNet-CD	RGB+BVDI	Wildfire	95.76	94.64	**95.20**	90.83
SNUNet-CD	RGB+NBR	Deforestation	83.38	92.55	87.73	78.13

SNUNet-CD	RGB+NBR	Flood	94.64	94.19	**94.42**	89.43
SNUNet-CD	RGB+NBR	Landslide	65.60	80.63	72.34	56.67
SNUNet-CD	RGB+NBR	Wildfire	95.87	94.88	**95.37**	91.15
SNUNet-CD	RGBNS+SVI	Deforestation	86.65	89.26	87.94	78.47
SNUNet-CD	RGBNS+SVI	Flood	94.06	94.69	**94.37**	89.35
SNUNet-CD	RGBNS+SVI	Landslide	55.51	77.10	64.55	47.66
SNUNet-CD	RGBNS+SVI	Wildfire	95.59	94.74	**95.16**	90.77