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Supplementary Material

The impact of climate change and wildfire on decadal alpine vegetation dynamics

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Table S1. Comparisons of relevant plant community classifications to vegetation cover types.

Landcover Category			Australian Alpine Local Community Name (Venn *et al.* 2017)	Australian Alps Classes (Mackey *et al.* 2015)	Treeless Vegetation Group & Community (McDougall and Walsh 2007)		Kosciuszko Alpine Flora (Costin *et al.* 2000)
Vegetation cover type	**Code**	**Description**					
Subalpine Woodlands	SW	Subalpine Woodlands are dominated by *Eucalyptus niphophila* and are the highest treed areas in the Australian Alps. They are widespread, occurring generally between 1200 m and up to 2000 m a.s.l..	Sub-alpine woodland	Subalpine Woodlands & Low Open Forests		N/A	Subalpine woodland (*Eucalyptus niphophila*)
Dry Heathlands	DH	Dry Heathlands are tall, open to closed heathlands found high on slopes and rocky exposed areas on shallow soils.	Open heathland Closed heathland	Alpine Heathland	VII-23 X-39 XIV-46 XVI-51	*Grevillea – Nematolepis* open heathland *Epacris – Kunzea* open heathland *Nematolepis – Prostanthera* closed heathland *Austrodanthonia – Grevillea open heathland*	Heath (*Oxylobium – Podocarpus – Kunzea*)
Wet Heathlands	WH	Wet Heathlands are low, closed heathlands occurring in broad valleys and seepage zones on slopes with low relief and along margins on waterways.	Bog Wet Heaths	Alpine Bogs, Alpine Heathland	I-2 I-4 XVIII-53	*Richea – Carpha – Sphagnum* wet heathland *Epacris* moist heathland *Podocarpus – Epacris* open heathland	Heath (*Epacris*) Raised bog (*Epacris – Sphagnum*)
Dry Grasslands	DG	Dry Grasslands occur where snow cover is more prolonged. They range from extensive thick grassy swards on the high treeless plains to the grassy herbfields of the steep or concave high elevation slopes.	Tussock grasslands Tall alpine herbfield Valley grassland	Alpine Grasslands & Herbfields	VI-17 VI-18 VII-22 VI-19	*Poa – Celmisia* snowpatch grassland *Poa – Uncinia* grassland *Poa – Euphrasia* grassland *Chionochloa* grassland	Tall alpine herbfield a (*Celmisia – Poa*) Tall alpine herbfield b (*Brachyscome – Austrodanthonia*)
Wet Grasslands	WG	Wet Grasslands occur near low-velocity waterways and in seasonally inundated depressions and valleys, and are underlain by water-retentive soils that are filled by snow melt and precipitation.	Fen Short alpine herbfield Damp herbfields Wet mixed herbfield	Alpine Fens, Alpine Grasslands & Herbfields	I-5 I-6 III-10 VII-20	Alpine valley grassland Fen Short alpine herbfield Short turf snowpatch grassland	Sod tussock grassland Valley bog (*Carex – Sphagnum*) Fen (*Carex gauidchaudiana*) Short alpine herbfield (*Plantago – Neopaxia*)

Vegetation cover type	Landcover Category		Australian Alpine Local Community Name (Venn *et al.* 2017)	Australian Alps Classes (Mackey *et al.* 2015)	Treeless Vegetation Group & Community (McDougall and Walsh 2007)		Kosciuszko Alpine Flora (Costin *et al.* 2000)
	Code	Description					
Fellfield Screelands	FS	Fellfield Screelands are bare, low, open alpine heathlands and herbfields growing on skeletal soils of windswept ridges and summits, and leeward hollows where late thawing snow truncates the growing season.	Feldmark Snowpatch feldmark	Feldmark & Snowpatch	X-40	*Epacris – Veronica* feldmark	Feldmark a (*Epacris – Veronica*)
					IV-12	*Coprosma – Colobanthus* snowpatch feldmark	Feldmark b (*Coprosma – Colobanthus)*
Rocky Outcrops	RO	Rocky Outcrops are open rocky areas including scree slopes, with little or sparse vegetation, occurring on steep slopes at a range of elevations.	N/A	Open Rocky outcrops		N/A	

Table S2. Multi-dimensional features ingested by recursive feature elimination, with the seven selected features used to classify growing season composites in **bold**.

Band/Index	Description	Formula	Reference
B	Blue	SR_B1 (L5, L7); SR_B2 (L8)	Landsat
G	Green	SR_B2 (L5, L7); SR_B3 (L8)	Landsat
R	Red	SR_B3 (L5, L7); SR_B4 (L8)	Landsat
NIR	Near Infrared	SR_B4 (L5, L7); SR_B5 (L8)	Landsat
SWIR1	Shortwave Infrared 1	SR_B5 (L5, L7); SR_B6 (L8)	Landsat
SWIR2	Shortwave Infrared 2	SR_B7 (L5, L7); SR_B7 (L8)	Landsat
TIR	Thermal	ST_B6 (L5, L7); ST_B10 (L8)	Landsat
EVI	Enhanced Vegetation Index	$EVI = 2.5\left(\frac{NIR - R}{NIR + 6 \times R - 7.5 \times B + 1}\right)$	Landsat
MSAVI	Modified Soil Adjusted Vegetation Index	$MSAVI = \frac{(2 \times NIR + 1) - \sqrt{(2 \times NIR + 1)^2 - 8(NIR - R)}}{2}$	Landsat
NBR	Normalised Burn Ratio	$NBR = \frac{NIR - SWIR2}{NIR + SWIR2}$	Landsat
NBR2	Normalised Burn Ratio 2	$NBR2 = \frac{SWIR1 - SWIR2}{SWIR1 + SWIR2}$	Landsat
NDMI	Normalised Difference Moisture Index	$NDMI = \frac{NIR - SWIR1}{NIR + SWIR1}$	Landsat
NDVI	Normalised Difference Vegetation Index	$NDVI = \frac{NIR - R}{NIR + R}$	Landsat
SAVI	Soil Adjusted Vegetation Index	$SAVI = 1.5\left(\frac{NIR - R}{NIR + R + 0.5}\right)$	Landsat
DEME	Digital Elevation Model-derived Elevation	Derived from 2 m LiDAR	N/A
DEMS	Digital Elevation Model-derived Slope	Derived from 2 m LiDAR	N/A
DEMA	Digital Elevation Model-derived Aspect	Derived from 2 m LiDAR	N/A
ARVI	Atmospherically Resistant Vegetation Index	$ARVI = \frac{NIR - (2 \times R - B)}{NIR + (2 \times R - B)}$	Lin et al (2021)
DVI	Difference Vegetation Index	$DVI = NIR - R$	Lin et al (2021)
GARI	Green Atmospherically Resistant Index	$GARI = \frac{NIR - (1.7 \times (B - R))}{NIR + (1.7 \times (B - R))}$	Lin et al (2021)
GDVI	Green Difference Vegetation Index	$GDVI = NIR - G$	Lin et al (2021)

Band/Index	Description	Formula	Reference
GEMI	Global Environmental Monitoring Index	$GEMI = \frac{2(NIR \times NIR) + (1.5 \times NIR) + (0.5 \times R)}{NIR + R + 0.5} \times \left(0.75\left(\frac{2\left((NIR \times NIR) - (R \times R)\right) + \left((1.5 \times NIR) + (0.5 \times R)\right)}{NIR + R + 0.5}\right)\right) - \left(\frac{R - 0.125}{1} - R\right)$	Lin et al (2021)
GNDVI	Green Normalised Difference Vegetation Index	$GNDVI = \frac{(NIR - G)}{(NIR + G)}$	Lin et al (2021)
GRVI	Green Ratio Vegetation Index	$GRVI = \frac{NIR}{G}$	Lin et al (2021)
GVI	Green Vegetation Index	$GVI = (-0.2848 \times B) + (-0.2435 \times B) + (-0.5436 \times R) + (0.7243 \times NIR) + (0.0840 \times SWIR1) + (-0.18 \times SWIR2)$	Lin et al (2021)
IPVI	Infrared Percentage Vegetation Index	$IPVI = \frac{NIR}{\frac{NIR + R}{2} \times \left(\frac{R - G}{R + G} + 1\right)}$	Lin et al (2021)
LAI	Leaf Area Index	$LAI = \left(3.618\left(2.5\left(\frac{NIR - R}{NIR + 6 \times R - 7.5 \times B + 1}\right)\right)\right) - 0.118$	Lin et al (2021)
MSR	Modified Simple Ratio	$MSR = \frac{\frac{NIR}{R} - 1}{\sqrt{\frac{NIR}{R} + 1}}$	Lin et al (2021)
NLI	Non-Linear Index	$NLI = \frac{NIR^2 - R}{NIR^2 + R}$	Lin et al (2021)
OSAVI	Optimised Soil Adjusted Vegetation Index	$OSAVI = \frac{1.5(NIR - R)}{NIR + R + 0.16}$	Lin et al (2021)
RDVI	Renormalised Difference Vegetation Index	$RDVI = \frac{NIR - R}{\sqrt{NIR + R}}$	Lin et al (2021)
SR	Simple Ratio	$SR = \frac{NIR}{R}$	Lin et al (2021)
TDVI	Transformed Difference Vegetation Index	$TDVI = \sqrt{0.5 + \frac{NIR - R}{NIR + R}}$	Lin et al (2021)
VARI	Visible Atmospherically Resistant Index	$VARI = \frac{G - R}{G + R - B}$	Lin et al (2021)
ATSAVI	Adjusted Transformed Soil Adjusted Vegetation Index	$ATSAVI = 1.22\left(\frac{NIR - 1.22 \times R - 0.03}{1.22 \times NIR + R - 1.22 \times 0.03 + 0.08(1 + 1.22^2)}\right)$	Henrich et al. (2009)
BWDRVI	Blue-Wide Dynamic Range Vegetation Index	$BWDRVI = \frac{(0.1 \times NIR) - B}{(0.1 \times NIR) + B}$	Henrich et al. (2009)

Band/Index	Description	Formula	Reference
GCVI	Green Chlorophyll VI	$GCVI = \left(\frac{NIR}{G}\right) - 1$	Henrich et al. (2009)
CVI	Chlorophyll VI	$CVI = NIR \times \left(\frac{R}{G \times G}\right)$	Henrich et al. (2009)
CI	Coloration Index	$CI = \frac{R - B}{R}$	Henrich et al. (2009)
CTVI	Corrected Transformed VI	$CTVI = \left(\frac{\frac{R-G}{R+G} + 0.5}{\left\lvert\frac{R-G}{R+G} + 0.5\right\rvert}\right) \times \sqrt{\left\lvert\frac{R-G}{(R+G)+0.5}\right\rvert}$	Henrich et al. (2009)
GVMI	Global Vegetation Moisture Index	$GVMI = \frac{(NIR + 0.1) - (SWIR2 + 0.02)}{(NIR + 0.1) + (SWIR2 + 0.02)}$	Henrich et al. (2009)
GLI	Green Leaf Index	$GLI = \frac{(2 \times G) - R - B}{(2 \times G) + R + B}$	Henrich et al. (2009)
GOSAVI	Green Optimised Soil Adjusted VI	$GOSAVI = \frac{NIR - G}{NIR + G + 0.16}$	Henrich et al. (2009)
GSAVI	Green Soil Adjusted VI	$GSAVI = \frac{NIR - G}{NIR + G + 0.5} \times 1.5$	Henrich et al. (2009)
GBNDVI	Green-Blue NDVI	$GBNDVI = \frac{NIR - (G + B)}{NIR + (G + B)}$	Henrich et al. (2009)
GRNDVI	Green-Red NDVI	$GRNDVI = \frac{NIR - (G + R)}{NIR + (G + R)}$	Henrich et al. (2009)
INT	Intensity	$INT = \frac{1}{30.5} \times (R + G + B)$	Henrich et al. (2009)
MIDIRVI	Mid Infra-red VI	$MIDIRVI = \frac{NIR}{SWIR1}$	Henrich et al. (2009)
NORMG	Normalised Green	$NORMG = \frac{G}{NIR + R + G}$	Henrich et al. (2009)
NORMIR	Normalised Infrared	$NORMIR = \frac{NIR}{NIR + R + G}$	Henrich et al. (2009)
NORMR	Normalised Red	$NORMR = \frac{R}{NIR + R + G}$	Henrich et al. (2009)

Band/Index	Description	Formula	Reference
NDBaI	Normalised Difference Bareness Index	$NDBaI = \frac{SWIR1 - THERM}{SWIR1 + THERM}$	Henrich et al. (2009)
NDBSI	Normalised Difference Bare Soil Index	$NDBSI = \frac{(SWIR2 + R) - (NIR - B)}{(SWIR2 + R) + (NIR + B)}$	Henrich et al. (2009)
NDGRI	Normalised Difference Green – Red Index	$NDGRI = \frac{G - R}{G + R}$	Henrich et al. (2009)
NDNIRBI	Normalised Difference NIR – Blue Index	$NDNIRBI = \frac{NIR - B}{NIR + B}$	Henrich et al. (2009)
NDNIRGI	Normalised Difference NIR – Green Index	$NDNIRGI = \frac{NIR - G}{NIR + G}$	Henrich et al. (2009)
NDMNI	Normalised Difference Modified NIR Index/Normalised Burn Ratio	$NDMNI = \frac{NIR - SWIR2}{NIR + SWIR2}$	Henrich et al. (2009)
NDRBVI	Normalised Difference Red – Blue VI	$NDRBVI = \frac{NIR - (G + R + B)}{NIR + (G + R + B)}$	Henrich et al. (2009)
NDRGRI	Normalised Difference Red – Green Redness Index	$NDRGRI = \frac{R - G}{R + G}$	Henrich et al. (2009)
NDRI	Normalised Difference Rock Index	$NDRI = \frac{SWIR1 - R}{SWIR1 + R}$	Henrich et al. (2009)
NDWI	Normalised Difference Water Index	$NDWI = \frac{G - NIR}{G + NIR}$	Henrich et al. (2009)
PNDVI	PAN NDVI	$PNDVI = \frac{NIR - (G + R + B)}{NIR + (G + R + B)}$	Henrich et al. (2009)
R54	Band Ratio 54	$R54 = \frac{SWIR1}{NIR}$	Henrich et al. (2009)
R35	Band Ratio 35	$R35 = \frac{R}{SWIR2}$	Henrich et al. (2009)
SRDI	Simple Ratio Drought Index	$SRDI = \frac{SWIR2}{NIR}$	Henrich et al. (2009)
SRGI	Simple Ratio Green Index	$SRGI = \frac{SWIR2}{G}$	Henrich et al. (2009)
SRRI	Simple Ratio Red Index	$SRRI = \frac{SWIR2}{R}$	Henrich et al. (2009)
SLAVI	Specific Leaf Area VI	$SLAVI = \frac{NIR}{R + SWIR2}$	Henrich et al. (2009)
TCV	Tasselled Cap Vegetation	$TCV = (-0.2848 \times B) - (0.2435 \times G) - (0.5436 \times R) + (0.7243 \times NIR) + (0.084 \times SWIR1) - (0.18 \times SWIR2)$	Henrich et al. (2009)

Band/Index	Description	Formula	Reference
TCW	Tasselled Cap Wetness	$TCW = (0.1509 \times B) + (0.1973 \times G) + (0.3279 \times R) + (0.3406 \times NIR) - (0.7112 \times SWIR1) - (0.4572 \times SWIR2)$	Henrich et al. (2009)
TVI	Transformed VI	$TVI = \sqrt{\frac{R-G}{R+G} + 0.5}$	Henrich et al. (2009)

Table S3. Selected features from Recursive Feature Elimination using 10-fold cross-validation repeated five times via the means of "Caret" package in R.

Number of features	Accuracy		Kappa		Selected
	%	SD	Value	SD	
1	0.8465	0.0158	0.7842	0.0218	
2	0.8883	0.0103	0.8416	0.0147	
3	0.9347	0.0085	0.9077	0.0120	
4	0.9593	0.0070	0.9426	0.0100	
5	0.9648	0.0080	0.9503	0.0114	
6	0.9744	0.0058	0.9640	0.0082	
7	0.9761	0.0047	0.9664	0.0066	*
8	0.9758	0.0051	0.9659	0.0073	
9	0.9725	0.0057	0.9613	0.0081	
10	0.9715	0.0057	0.9599	0.0081	
11	0.9708	0.0053	0.9589	0.0074	
12	0.9711	0.0055	0.9593	0.0078	
13	0.9703	0.0059	0.9582	0.0083	
14	0.9704	0.0060	0.9583	0.0084	
15	0.9708	0.0058	0.9590	0.0082	
16	0.9709	0.0055	0.9590	0.0077	
17	0.9703	0.0058	0.9582	0.0081	
18	0.9703	0.0057	0.9582	0.0080	
19	0.9694	0.0069	0.9569	0.0097	
20	0.9697	0.0061	0.9573	0.0086	
21	0.9693	0.0060	0.9567	0.0084	
22	0.9698	0.0059	0.9574	0.0084	
23	0.9699	0.0058	0.9576	0.0082	
24	0.9694	0.0057	0.9568	0.0080	
25	0.9706	0.0056	0.9586	0.0079	
26	0.9707	0.0062	0.9587	0.0088	
27	0.9708	0.0060	0.9588	0.0085	
28	0.9699	0.0060	0.9576	0.0085	
29	0.9704	0.0061	0.9583	0.0086	
30	0.9705	0.0063	0.9584	0.0089	
31	0.9703	0.0059	0.9582	0.0084	
32	0.9703	0.0063	0.9581	0.0089	
33	0.9697	0.0059	0.9573	0.0084	
34	0.9696	0.0060	0.9572	0.0084	
35	0.9692	0.0060	0.9566	0.0086	
36	0.9697	0.0063	0.9574	0.0089	
37	0.9699	0.0059	0.9576	0.0083	
38	0.9696	0.0064	0.9572	0.0090	
39	0.9697	0.0064	0.9573	0.0091	
40	0.9697	0.0062	0.9573	0.0087	
41	0.9693	0.0066	0.9568	0.0093	

Number of features	Accuracy		Kappa		Selected
	%	SD	Value	SD	
42	0.9692	0.0060	0.9566	0.0085	
43	0.9690	0.0061	0.9564	0.0087	
44	0.9690	0.0067	0.9563	0.0094	
45	0.9686	0.0062	0.9558	0.0087	
46	0.9686	0.0062	0.9558	0.0088	
47	0.9682	0.0061	0.9552	0.0086	
48	0.9685	0.0065	0.9557	0.0092	
49	0.9688	0.0060	0.9560	0.0085	
50	0.9691	0.0061	0.9564	0.0086	
51	0.9686	0.0067	0.9558	0.0094	
52	0.9679	0.0063	0.9548	0.0089	
53	0.9684	0.0063	0.9554	0.0089	
54	0.9679	0.0062	0.9548	0.0087	
55	0.9681	0.0066	0.9551	0.0093	
56	0.9683	0.0064	0.9553	0.0091	
57	0.9681	0.0064	0.9550	0.0090	
58	0.9679	0.0064	0.9548	0.0090	
59	0.9676	0.0061	0.9544	0.0086	
60	0.9677	0.0063	0.9544	0.0089	
61	0.9680	0.0060	0.9549	0.0084	
62	0.9676	0.0060	0.9543	0.0085	
63	0.9675	0.0061	0.9541	0.0086	
64	0.9682	0.0062	0.9552	0.0088	
65	0.9680	0.0060	0.9549	0.0086	
66	0.9678	0.0061	0.9546	0.0086	
67	0.9681	0.0061	0.9551	0.0086	
68	0.9678	0.0064	0.9547	0.0090	
69	0.9678	0.0061	0.9547	0.0086	

Table S4.: Optimised Random Forest model (*p* = 7; *ntree* = 500; *mtry* = 2; Validation accuracy = 97.98%; OOBerr = 2.02%) confusion matrix and variable importance. Vegetation types include subalpine woodlands (SW), dry heathlands (DH), wet heathlands (WH), dry grasslands (DG), wet grasslands (WG) and fellfield screelands (FS).

Confusion Matrix								
	SW	**DH**	**WH**	**DG**	**WG**	**FS**	**RO**	**Error**
SW	3963	3	0	0	0	0	0	0.000756
DH	11	951	7	10	1	2	0	0.031568
WH	6	19	680	1	3	0	0	0.040903
DG	0	4	0	2238	1	5	1	0.004891
WG	0	17	5	21	177	1	0	0.199095
FS	0	4	0	44	0	658	1	0.069307
RO	2	0	0	9	0	2	68	0.160494
Variable importance per landcover class								
DEME	91.92	73.81	84.36	74.23	54.16	37.02	29.53	
DEMS	40.29	68.57	123.40	57.87	70.90	39.09	38.09	
TIR	31.18	44.95	53.13	50.34	32.54	50.99	30.07	
DEMA	33.48	49.56	39.85	60.25	36.17	44.79	21.15	
CI	25.30	50.34	41.25	63.10	37.89	38.30	31.64	
NBR2	51.65	84.38	41.14	74.89	38.94	29.08	46.07	
GARI	23.88	46.27	43.75	59.95	31.18	45.57	16.17	

Table S5. Linear regression between Year and climatic variables from Australian Gridded Climate Data (AGCDv1 – T_{min}, T_{mean}, T_{max}, P_{annual}, P_{summer}, P_{autumn}, P_{winter}, P_{spring}) and Snowy Hydro Spencers Creek Snow Course (log-transformed Snow Cover Metre-days).

Data	**Variable**	**ANOVA**			**Regression**					
		R^2	**df**	**F**	**Model**	**Estimate**	**SE**	**T**	***p***	
AGCD v1	T_{min}	0.335	1-109	54.310	Intercept	0.438	0.095	4.628	<0.001	***
					Slope	0.010	0.001	7.370	<0.001	***
	T_{mean}	0.359	1-109	60.515	Intercept	4.965	0.094	53.016	<0.001	***
					Slope	0.010	0.001	7.779	<0.001	***
	T_{max}	0.245	1-109	35.006	Intercept	9.493	0.128	73.930	<0.001	***
					Slope	0.010	0.002	5.917	<0.001	***
	P_{annual}	0.003	1-119	0.344	Intercept	1721.140	66.729	25.793	<0.001	***
					Slope	-0.561	0.957	-0.586	0.559	
	P_{summer}	0.035	1-118	4.292	Intercept	272.686	22.012	12.388	<0.001	***
					Slope	0.651	0.314	2.072	0.041	*
	P_{autumn}	0.003	1-119	0.375	Intercept	388.169	28.942	13.412	<0.001	***
					Slope	-0.254	0.415	-0.613	0.541	
	P_{winter}	0.038	1-119	4.684	Intercept	567.780	31.165	18.219	<0.001	***
					Slope	-0.968	0.447	-2.164	0.032	*
	P_{spring}	0.001	1-119	0.004	Intercept	495.788	28.485	17.405	<0.001	***
					Slope	0.026	0.409	0.065	0.948	
Snow course	Snow cover	0.058	1-67	4.144	Intercept	6.641	2.179	3.048	0.003	**
					Slope	-0.002	0.001	-2.036	0.046	*

Table S6: Decadal area for each vegetation type with annual rate of change and percentage change. Vegetation types include subalpine woodlands (SW), dry heathlands (DH), wet heathlands (WH), dry grasslands (DG), wet grasslands (WG) and fellfield screelands (FS).

	Vegetation	Year				Annual rate of change (km²/year)					Percentage change (%)				
	type	1990	2000	2010	2020	90-00	00-10	10-20	90-20	00-20	90-00	00-10	10-20	90-20	00-20
Area (km²)	SW	52.36	82.26	37.58	122.94	2.99	-4.47	8.54	2.35	2.03	57.10	-54.32	227.14	134.80	49.45
	SW_UB	11.40	16.42	12.57	30.99	0.50	-0.39	1.84	0.65	0.73	44.04	-23.45	146.54	171.84	88.73
	SW_B	40.96	65.84	25.01	91.96	2.49	-4.08	6.69	1.70	1.31	60.74	-62.01	267.69	124.51	39.67
	DH	143.69	137.77	159.69	93.23	-0.59	2.19	-6.65	-1.68	-2.23	-4.12	15.91	-41.62	-35.12	-32.33
	DH_UB	63.12	72.14	73.68	49.40	0.90	0.15	-2.43	-0.46	-1.14	14.29	2.13	-32.95	-21.74	-31.52
	DH_B	80.58	65.63	86.02	43.83	-1.49	2.04	-4.22	-1.22	-1.09	-18.55	31.07	-49.05	-45.61	-33.22
	WH	153.73	183.92	164.40	133.09	3.02	-1.95	-3.13	-0.69	-2.54	19.64	-10.61	-19.05	-13.43	-27.64
	WH_UB	36.01	53.61	50.02	43.81	1.76	-0.36	-0.62	0.26	-0.49	48.88	-6.70	-12.42	21.66	-18.28
	WH_B	117.72	130.31	114.38	89.28	1.26	-1.59	-2.51	-0.95	-2.05	10.69	-12.22	-21.94	-24.16	-31.49
	DG	47.88	25.87	36.53	53.25	-2.20	1.07	1.67	0.18	1.37	-45.97	41.21	45.77	11.22	105.84
	DG_UB	44.00	24.63	27.00	37.84	-1.94	0.24	1.08	-0.21	0.66	-44.02	9.62	40.15	-14.00	53.63
	DG_B	3.88	1.23	9.52	15.41	-0.26	0.83	0.59	0.38	0.71	-68.30	673.98	61.87	297.16	1152.85
	WG	47.32	16.82	49.50	36.31	-3.05	3.27	-1.32	-0.37	0.97	-64.45	194.29	-26.65	-23.27	115.87
	WG_UB	23.11	12.00	17.37	11.71	-1.11	0.54	-0.57	-0.38	-0.01	-48.07	44.75	-32.58	-49.33	-2.42
	WG_B	24.21	4.82	32.13	24.60	-1.94	2.73	-0.75	0.01	0.99	-80.09	566.60	-23.44	1.61	410.37
	FS	7.97	6.90	6.72	13.82	-0.11	-0.02	0.71	0.20	0.35	-13.43	-2.61	105.65	73.40	100.29
	FS_UB	7.94	6.90	5.72	11.61	-0.10	-0.12	0.59	0.12	0.24	-13.10	-17.10	102.97	46.22	68.26
	FS_B	0.03	0.00	1.01	2.21	<0.01	0.10	0.12	0.07	0.11	-100.00		118.81	7266.67	

B = Burnt in 2003; _UB = Unburnt in 2003

Table S7: Decadal mean elevation weighted by area for each vegetation type with annual rate of change and percentage change. Vegetation types include subalpine woodlands (SW), dry heathlands (DH), wet heathlands (WH), dry grasslands (DG), wet grasslands (WG) and fellfield screelands (FS).

	Vegetation	Year				Annual rate of change (m/year)					Percentage change (%)				
	type	1990	2000	2010	2020	90-00	00-10	10-20	90-20	00-20	90-00	00-10	10-20	90-20	00-20
Mean elevation weighted by area (m a.s.l.)	SW	1782.11	1786.03	1779.60	1779.57	0.39	-0.64	-0.00	-0.08	-0.32	0.22	-0.36	-0.00	-0.14	-0.36
	SW_UB	1793.49	1796.78	1795.32	1792.05	0.34	-0.16	-0.32	-0.04	-0.24	0.18	-0.08	-0.18	-0.08	-0.26
	SW_B	1779.59	1778.71	1766.50	1770.42	-0.08	-1.22	0.39	-0.3	-0.41	-0.05	-0.69	0.22	-0.52	-0.47
	DH	1851.48	1878.64	1863.59	1885.01	2.71	-1.5	2.14	1.11	0.32	1.47	-0.80	1.15	1.81	0.34
	DH_UB	1885.45	1915.29	1907.38	1922.94	2.98	-0.79	1.55	1.24	0.38	1.58	-0.41	0.82	1.99	0.40
	DH_B	1825.79	1838.36	1826.09	1842.27	1.25	-1.22	1.61	0.54	0.20	0.69	-0.67	0.89	0.90	0.21
	WH	1814.64	1824.49	1811.28	1827.53	0.98	-1.32	1.62	0.42	0.15	0.54	-0.72	0.90	0.71	0.17
	WH_UB	1845.26	1856.50	1852.17	1860.80	1.12	-0.43	0.86	0.51	0.21	0.61	-0.23	0.47	0.84	0.23
	WH_B	1805.94	1811.32	1793.39	1811.21	0.53	-1.79	1.78	0.17	-0.01	0.30	-0.99	0.99	0.29	-0.01
	DG	2013.69	2034.73	2019.71	2000.94	2.1	-1.5	-1.87	-0.42	-1.69	1.04	-0.74	-0.93	-0.63	-1.66
	DG_UB	2017.85	2037.18	2039.76	2021.79	1.93	0.25	-1.79	0.13	-0.77	0.96	0.13	-0.88	0.20	-0.76
	DG_B	1973.15	1985.93	1962.85	1949.75	1.27	-2.3	-1.3	-0.77	-1.81	0.65	-1.16	-0.67	-1.19	-1.82
	WG	1851.45	1910.35	1860.00	1829.05	5.89	-5.03	-3.09	-0.74	-4.07	3.18	-2.64	-1.66	-1.21	-4.26
	WG_UB	1893.42	1944.25	1936.36	1884.20	5.08	-0.78	-5.21	-0.3	-3.00	2.68	-0.41	-2.69	-0.49	-3.09
	WG_B	1812.50	1825.95	1818.72	1802.81	1.34	-0.72	-1.59	-0.32	-1.16	0.74	-0.40	-0.87	-0.53	-1.27
	FS	2040.90	2049.33	2033.42	2024.77	0.84	-1.59	-0.86	-0.53	-1.23	0.41	-0.78	-0.43	-0.79	-1.20
	FS_UB	2041.62	2049.32	2044.57	2034.37	0.77	-0.47	-1.02	-0.24	-0.75	0.38	-0.23	-0.50	-0.36	-0.73
	FS_B	2044.55		1970.03	1975.25			0.52	-2.3	98.76	-100.00		0.26	-3.39	

B = Burnt in 2003; _UB = Unburnt in 2003

Supplementary Materials – Figures

Figure S1: Scarcely vegetated Rocky Outcrop (RO) in the study area.

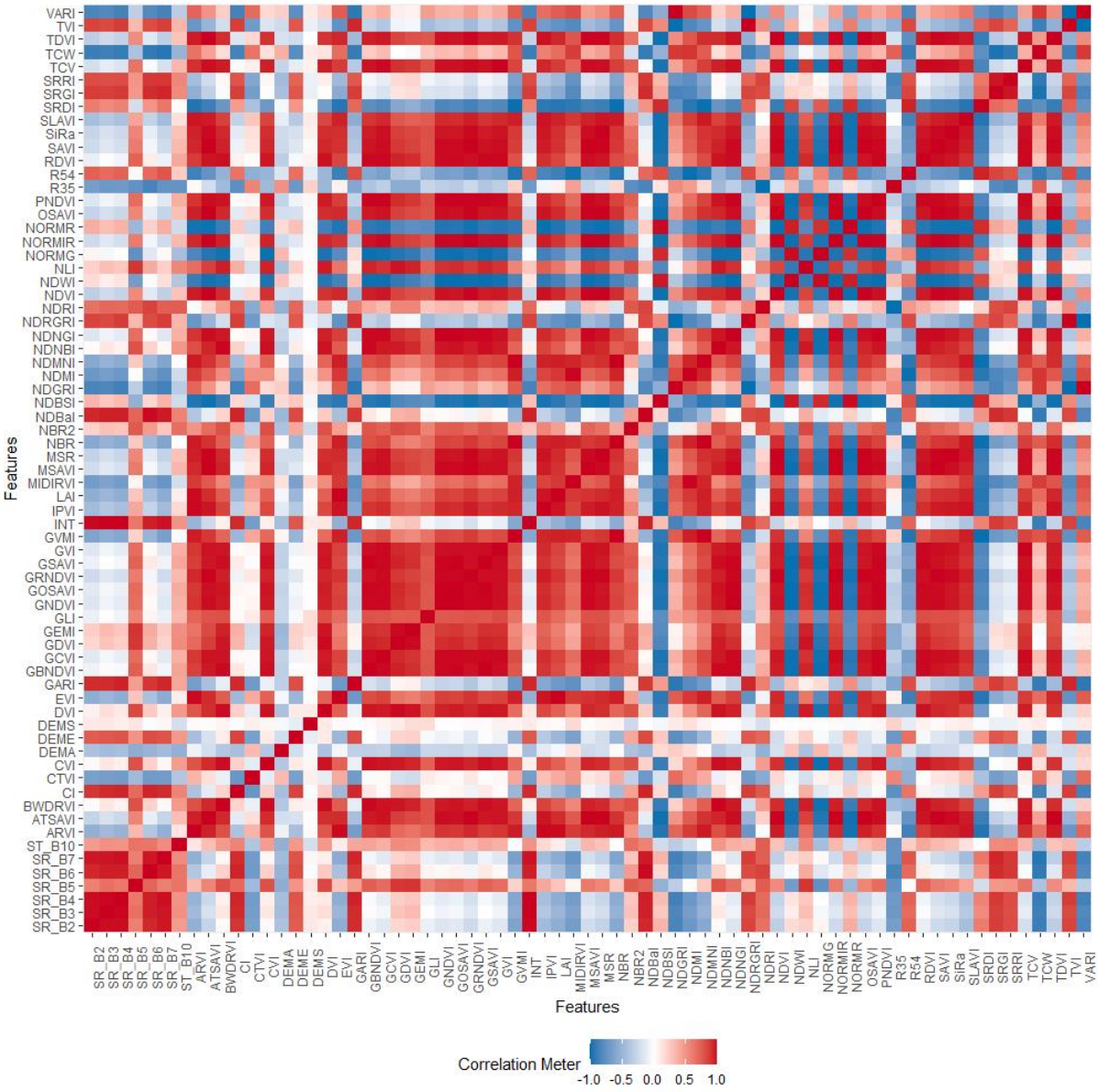

Figure S2: Correlation of all features prior to recursive feature elimination.

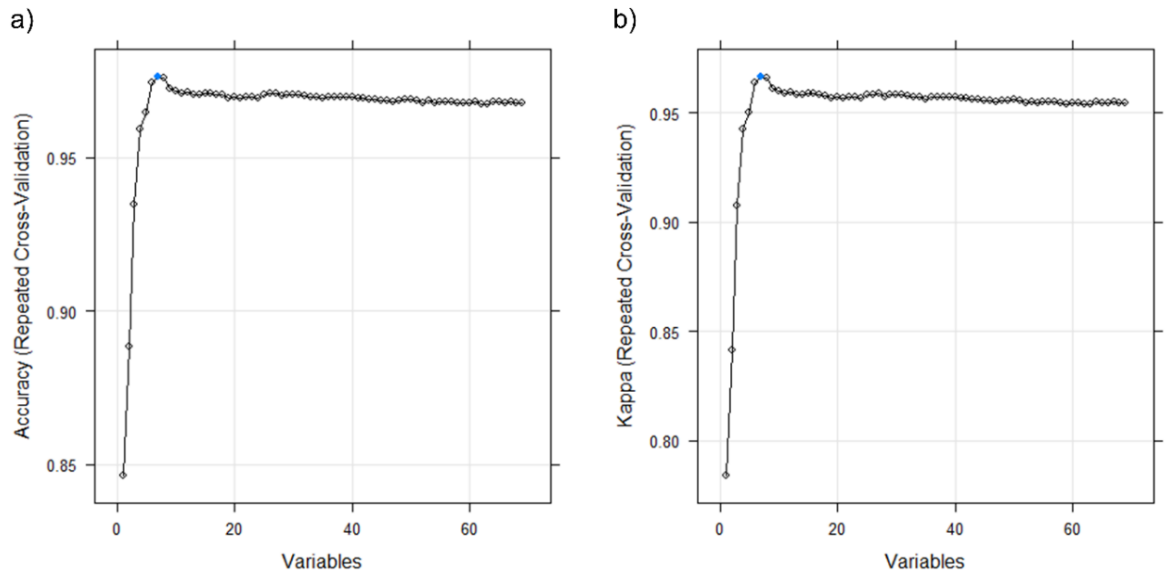

Figure S3: Most important variables (7) based on the least a) Accuracy and b) Kappa for five times repeated, 10-fold cross-validation for LANDSAT 8 composite data for 2020 growing season (01/01/2020 – 30/05/2020).

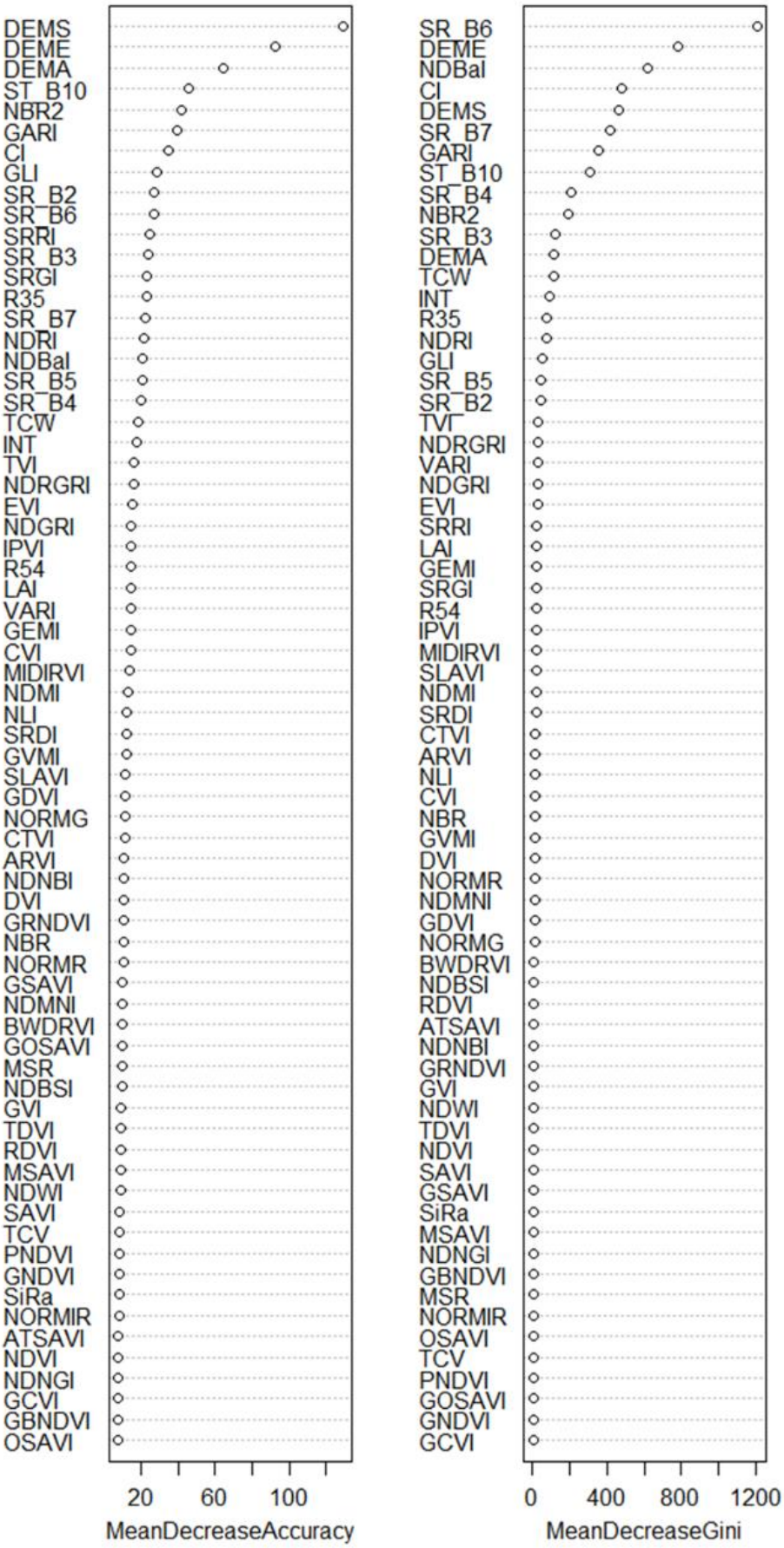

Figure S4: Feature importance ranked by mean percentage decrease in Accuracy and Gini Index

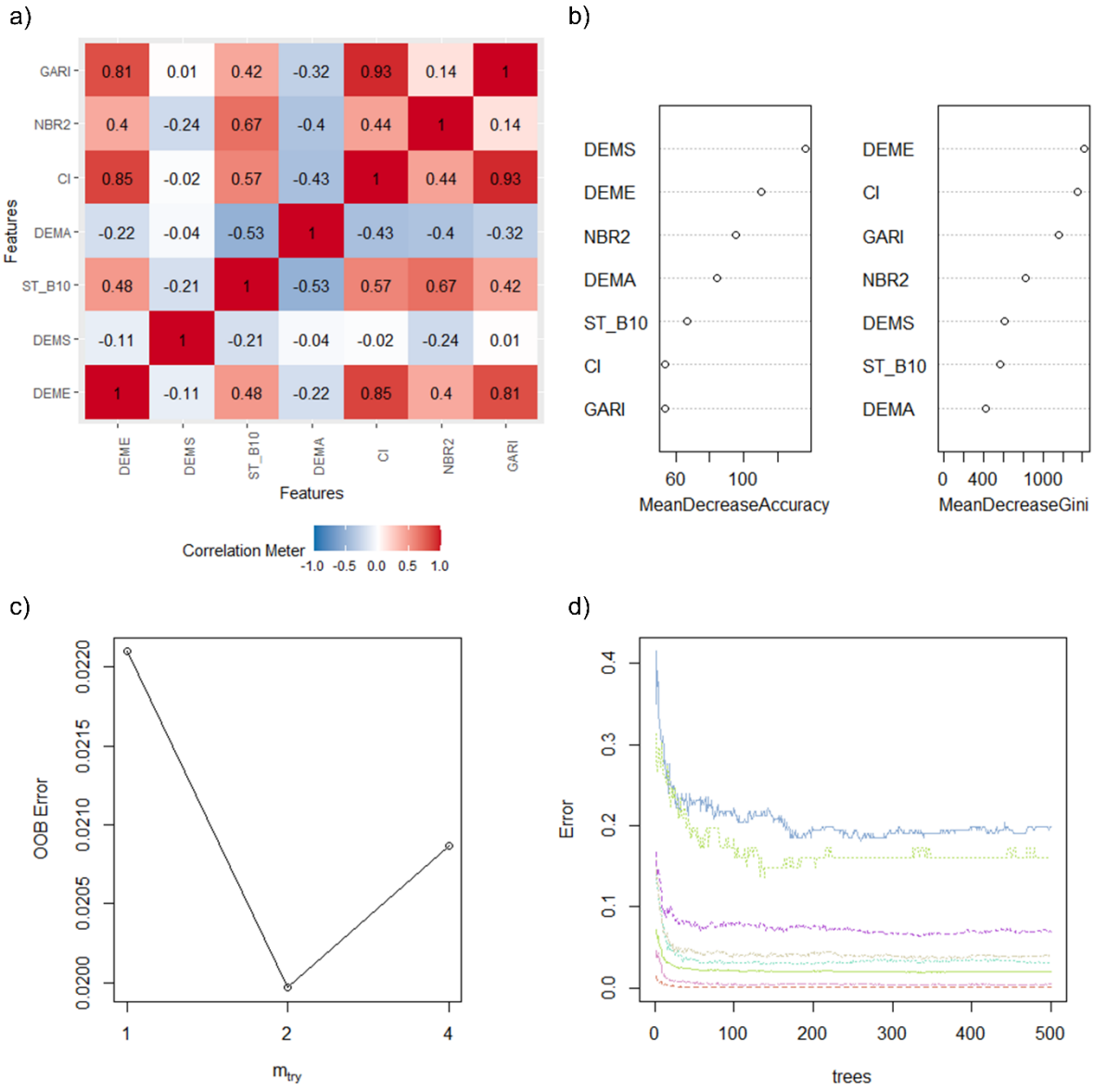

Figure S5: Optimised Random Forest model parameters after recursive feature elimination showing a) feature correlation, b) feature importance ranked by mean percentage decrease in Accuracy and Gini Index, c) optimised *mtry* based and d) optimal *ntree* for each feature.

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