IDEEA Group

Institute for Development of Environmental-Economic Accounting

ENVIRONMENTAL ACCOUNTS WITH EARTH OBSERVATION DATA

Mark Eigenraam, Director, IDEEA Group

Fenner Synthesis Workshop
Australia National University

11 May, 2018

EnSym: Environmental Systems Modelling Platform - v9.6.0 (Build 13867) : C:\Data\Dropbox\Data\Australia\Scenario\Australia_dlc_example.scn

File Model Layer Functions Accounts & Reporting Discrete Layer Filters Utilities Groundwater Export Display EcoSystem Tools Setup Plugins Help

SELECT GROUP

Additional
Input

VIEW TOOLS

SELECT LAYER

DLCD_v2_MODIS_EVI_1_20020101-20031231
DLCD_v2_MODIS_EVI_2_20030101-20041231
DLCD_v2_MODIS_EVI_3_20040101-20051231
DLCD_v2_MODIS_EVI_4_20050101-20061231
DLCD_v2_MODIS_EVI_5_20060101-20071231
DLCD_v2_MODIS_EVI_6_20070101-20081231
DLCD_v2_MODIS_EVI_7_20080101-20091231
DLCD_v2_MODIS_EVI_8_20090101-20101231
DLCD_v2_MODIS_EVI_9_20100101-20111231
DLCD_v2_MODIS_EVI_10_20110101-20121231
DLCD_v2_MODIS_EVI_11_20120101-20131231
NRMR_2016_AUST-100

Aerial

Distance

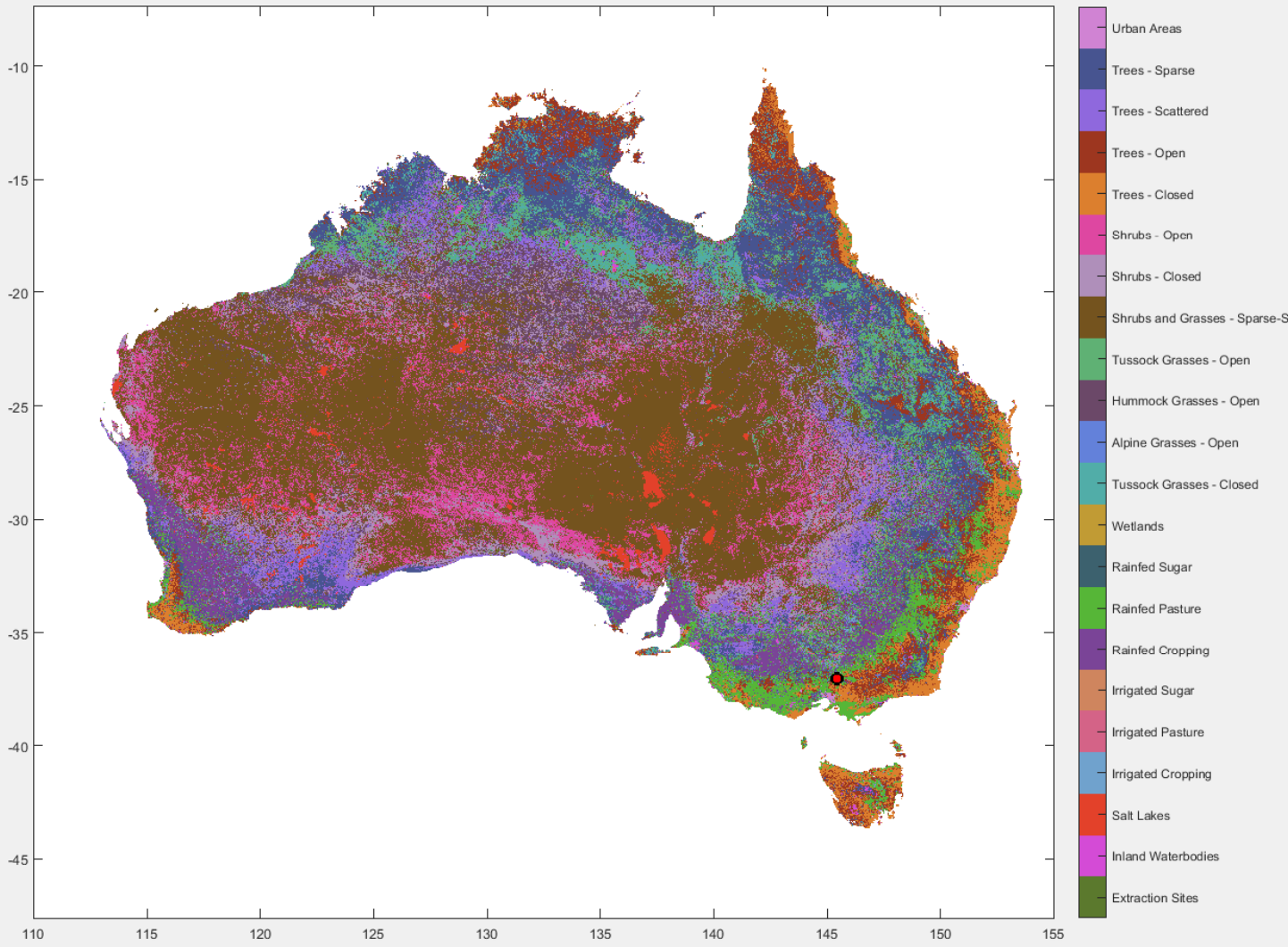
RoadMaps

POINT ATTRIBUTES

Feature	Value
X (click)	145.43
Y (click)	-37.05
X (reddot)	145.43
Y (reddot)	-37.05
DLCD_v2_MODIS_EVI_1_20020101-200...	8
DLCD_v2_MODIS_EVI_1_20020101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_1_20020101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_2_20030101-200...	8
DLCD_v2_MODIS_EVI_2_20030101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_2_20030101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_3_20040101-200...	8
DLCD_v2_MODIS_EVI_3_20040101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_3_20040101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_4_20050101-200...	8
DLCD_v2_MODIS_EVI_4_20050101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_4_20050101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_5_20060101-200...	8
DLCD_v2_MODIS_EVI_5_20060101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_5_20060101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_6_20070101-200...	8
DLCD_v2_MODIS_EVI_6_20070101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_6_20070101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_7_20080101-200...	8
DLCD_v2_MODIS_EVI_7_20080101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_7_20080101-200...	Rainfed Pasture
DLCD_v2_MODIS_EVI_8_20090101-201...	8
DLCD_v2_MODIS_EVI_8_20090101-201...	Rainfed Pasture

Show Statistics?

Feature	Value



EnSym

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ENSYM ACCOUNTS INTERFACE

change_table

Export Units

From: DLCD_v2_MODIS_EVI_1_20020101-20031231 to: DLCD_v2_MODIS_EVI_2_20030101-20041231

LUT Code	From: DLCD_v2_M...	To: DLCD_v2_MOD...	Area Lost	Area Gained	Area Unchanged
Alpine Grasses - Open	85,030.00	85,035.45	0.00	5.45	85,030.00
Extraction Sites	270,193.01	270,193.01	0.00	0.00	270,193.01
Hummock Grasses - Open	47,488,412.56	43,916,076.30	10,148,416.61	6,576,080.36	37,339,995.95
Inland Waterbodies	2,554,859.51	2,497,233.05	163,216.26	105,589.80	2,391,643.25
Irrigated Cropping	1,810,908.12	1,568,744.03	283,560.23	41,396.14	1,527,347.89
Irrigated Pasture	238,477.19	275,269.39	4,584.06	41,376.26	233,893.13
Irrigated Sugar	196,269.67	196,269.67	0.00	0.00	196,269.67
Rainfed Cropping	31,329,168.55	31,680,970.96	355,828.90	707,631.31	30,973,339.65
Rainfed Pasture	26,880,637.40	27,510,760.86	392,572.36	1,022,695.83	26,488,065.04
Rainfed Sugar	48,539.70	48,539.70	0.00	0.00	48,539.70
Salt Lakes	8,699,376.98	8,680,324.11	50,899.54	31,846.68	8,648,477.43
Shrubs - Closed	55,931,537.66	53,684,324.56	9,528,377.97	7,281,164.87	46,403,159.69
Shrubs - Open	57,675,199.45	66,154,846.10	5,947,060.04	14,426,706.70	51,728,139.40
Shrubs and Grasses - Sp...	280,163,872.34	282,899,458.34	16,693,878.42	19,429,464.42	263,469,993.92
Trees - Closed	23,197,742.24	23,424,502.37	675,063.86	901,823.99	22,522,678.39
Trees - Open	41,781,358.34	41,251,188.39	3,107,366.36	2,577,196.41	38,673,991.98
Trees - Scattered	45,038,206.77	42,999,766.93	6,428,338.44	4,389,898.60	38,609,868.34
Trees - Sparse	87,849,355.98	78,413,752.20	12,699,692.61	3,264,088.82	75,149,663.38
Tussock Grasses - Closed	20,563,199.30	22,490,985.88	2,756,516.40	4,684,302.98	17,806,682.90
Tussock Grasses - Open	33,744,269.23	37,325,524.92	4,855,964.34	8,437,220.02	28,888,304.89
Urban Areas	928,439.95	928,439.95	0.00	0.00	928,439.95
Wetlands	993,317.72	1,166,165.50	64,521.96	237,369.73	928,795.77

↑ DN UP DN UP DN UP DN UP DN UP DN

Close Filter

From Shrubs - Open to:

LUT Code	Area
Inland Waterbodies	796.86
Rainfed Cropping	2,406.77
Wetlands	23.58
Tussock Grasses - ...	7,773.04
Hummock Grasses -...	550,864.43
Tussock Grasses - ...	165,598.10
Shrubs and Grasse...	4,135,844.56
Shrubs - Closed	1,082,155.52
Shrubs - Open	51,728,139.40
Trees - Scattered	815.78
Trees - Sparse	781.41

UP DN UP DN

Filter

To Shrubs - Open from:

LUT Code	Area
Inland Waterbodies	1,911.17
Rainfed Cropping	976.96
Rainfed Pasture	9,133.42
Wetlands	36.90
Tussock Grasses - ...	5,956.61
Hummock Grasses -...	2,111,213.25
Tussock Grasses - ...	31,295.59
Shrubs and Grasse...	9,594,202.89
Shrubs - Closed	2,663,301.40
Shrubs - Open	51,728,139.40
Trees - Closed	86.87
Trees - Open	292.61
Trees - Scattered	7,841.54
Trees - Sparse	457.50

UP DN UP DN

Filter

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DLCD LAND ACCOUNT: 2002-03 (PART 1)

Classifications >>	Alpine Grasses - Open	Extraction Sites	Hummock Grasses - Open	Inland Waterbodies	Irrigated Cropping	Irrigated Pasture	Irrigated Sugar	Rainfed Cropping	Rainfed Pasture	Rainfed Sugar	Salt Lakes	Shrubs - Closed	Shrubs - Open	Shrubs and Grasses - Sparse-Scattered	
Opening Stock	85,030	270,193	47,488,413	2,554,860	1,810,908	238,477	196,270	31,329,169	26,880,637	48,540	8,699,377	55,931,538	57,675,199	280,163,872	23,197,
Additions to stock															
Managed expansion															
Natural Expansion															
Upward reappraisals															
Other additions	5		6,576,080	105,590	41,396	41,376		707,631	1,022,696		31,847	7,281,165	14,426,707	19,429,464	901,
Total additions to stock	5		6,576,080	105,590	41,396	41,376		707,631	1,022,696		31,847	7,281,165	14,426,707	19,429,464	901,
Reductions in stock															
Managed regression															
Natural Regression															
Downward reappraisals															
Other reductions			10,148,417	163,216	283,560	4,584		355,829	392,572		50,900	9,528,378	5,947,060	16,693,878	675,
Total reductions in stock			(10,148,417)	(163,216)	(283,560)	(4,584)		(355,829)	(392,572)		(50,900)	(9,528,378)	(5,947,060)	(16,693,878)	(675,
Net change in stock	5		(3,572,336)	(57,626)	(242,164)	36,792		351,802	630,123		(19,053)	(2,247,213)	8,479,647	2,735,586	226,
Closing stock	85,035	270,193	43,916,076	2,497,233	1,568,744	275,269	196,270	31,680,971	27,510,761	48,540	8,680,324	53,684,325	66,154,846	282,899,458	23,424,

DLCD LAND ACCOUNT: 2002-03 (PART 2)

Rainfed Cropping	Rainfed Pasture	Rainfed Sugar	Salt Lakes	Shrubs - Closed	Shrubs - Open	Shrubs and Grasses - Sparse-Scattered	Trees - Closed	Trees - Open	Trees - Scattered	Trees - Sparse	Tussock Grasses - Closed	Tussock Grasses - Open	Urban Areas	Wetlands	TOTALS
29,169	26,880,637	48,540	8,699,377	55,931,538	57,675,199	280,163,872	23,197,742	41,781,358	45,038,207	87,849,356	20,563,199	33,744,269	928,440	993,318	767,468,372
															-
															-
															-
															-
07,631	1,022,696		31,847	7,281,165	14,426,707	19,429,464	901,824	2,577,196	4,389,899	3,264,089	4,684,303	8,437,220		237,370	74,155,858
07,631	1,022,696		31,847	7,281,165	14,426,707	19,429,464	901,824	2,577,196	4,389,899	3,264,089	4,684,303	8,437,220		237,370	74,155,858
															-
															-
															-
															-
55,829	392,572		50,900	9,528,378	5,947,060	16,693,878	675,064	3,107,366	6,428,338	12,699,693	2,756,516	4,855,964		64,522	74,155,858
55,829)	(392,572)		(50,900)	(9,528,378)	(5,947,060)	(16,693,878)	(675,064)	(3,107,366)	(6,428,338)	(12,699,693)	(2,756,516)	(4,855,964)		(64,522)	(74,155,858)
51,802	630,123		(19,053)	(2,247,213)	8,479,647	2,735,586	226,760	(530,170)	(2,038,440)	(9,435,604)	1,927,787	3,581,256		172,848	-
80,971	27,510,761	48,540	8,680,324	53,684,325	66,154,846	282,899,458	23,424,502	41,251,188	42,999,767	78,413,752	22,490,986	37,325,525	928,440	1,166,165	767,468,372

LAND COVER CHANGE MATRIX: 2002-03

	Alpine Grasses - Open	Extraction Sites	Hummock Grasses - Open	Inland Waterbodies	Irrigated Cropping	Irrigated Pasture	Irrigated Sugar	Rainfed Cropping	Rainfed Pasture	Rainfed Sugar	Salt Lakes	Shrubs - Closed	Shrubs - Open	Shrubs and Grasses - Sparse-Scattered	Trees - Closed	Trees - Open	Trees - Scattered	Trees - Sparse	Tussock Grasses - Closed	Tussock Grasses - Open	Urban Areas	Wetlands	Total Reductions
Alpine Grasses - Open	85,030																						-
Extraction Sites		270,193																					-
Hummock Grasses - Open			37,339,996	5,234				905	540			2,068,249	2,111,213	5,501,224		166	369,052	23,491	3,172	63,824		1,348	10,148,417
Inland Waterbodies			5,253	2,391,643							31,847	3,468	1,911	51,101	43	479	4,429	3,526	13,691	8,066		39,402	163,216
Irrigated Cropping					1,527,348	41,262		188,852	41,337					12,109									283,560
Irrigated Pasture					4,472	233,893		18	78					17									4,584
Irrigated Sugar							196,270																-
Rainfed Cropping			1,700		24,023	23		30,973,340	56,680			2,107	977	60,398	2,395	11,022	8,164	85,978	75,844	26,519			355,829
Rainfed Pasture			12,023		9,511	61		20,850	26,488,065			25,785	9,133	32,042	87	7,910	39,281	132,745	53,694	49,449			392,572
Rainfed Sugar										48,540													-
Salt Lakes				50,900							8,648,477												50,900
Shrubs - Closed			2,581,751	2,413				1,406	801			46,403,160	2,663,301	3,274,400		34	246,909	24,995	36,260	695,269		839	9,528,378
Shrubs - Open			550,864	797				2,407				1,082,156	51,728,139	4,135,845			816	781	7,773	165,598		24	5,947,060
Shrubs and Grasses - Sparse-Scattered			2,065,788	27,928	3,390	30		304,168	876			2,022,223	9,594,203	263,469,994	32	895	745,677	160,168	179,515	1,586,989		1,996	16,693,878
Trees - Closed			789					1,464	617			267	87	5,293	22,522,678	645,556	142	17,840	2,058	193		759	675,064
Trees - Open			3,881	67				36,858	231,613			1,665	293	8,917	882,489	38,673,992	2,951	1,595,415	272,829	13,421		56,968	3,107,366
Trees - Scattered	5		1,287,092	2,502				46,262	36,820			1,740,582	7,842	1,663,562		289	38,609,868	434,191	31,925	1,175,021		2,246	6,428,338
Trees - Sparse			57,632	2,741				90,601	628,124			32,038	457	1,181,233	10,055	1,754,811	2,629,240	75,149,663	2,800,235	3,412,521		100,004	12,699,693
Tussock Grasses - Closed			532	1,359				7,575	24,398			25,839	5,957	883,042	5,391	135,655	17,283	389,807	17,806,683	1,236,720		22,959	2,756,516
Tussock Grasses - Open			8,581	4,055				6,265	813			276,595	31,296	2,617,819	7	109	325,068	382,709	1,191,824	28,888,305		10,825	4,855,964
Urban Areas																					928,440		-
Wetlands			193	7,596								191	37	2,463	1,325	20,272	887	12,442	15,485	3,630		928,796	64,522
Total Additions	5	-	6,576,080	105,590	41,396	41,376	-	707,631	1,022,696	-	31,847	7,281,165	14,426,707	19,429,464	901,824	2,577,196	4,389,899	3,264,089	4,684,303	8,437,220	-	237,370	

PERCENT CHANGES IN LAND CLASSES

Land Classes	Percent change	Percent additions	Percent reductions
Alpine Grasses - Open	0%	0%	0%
Extraction Sites	0%	0%	0%
Hummock Grasses - Open	-8%	14%	-21%
Inland Waterbodies	-2%	4%	-6%
Irrigated Cropping	-13%	2%	-16%
Irrigated Pasture	15%	17%	-2%
Irrigated Sugar	0%	0%	0%
Rainfed Cropping	1%	2%	-1%
Rainfed Pasture	2%	4%	-1%
Rainfed Sugar	0%	0%	0%
Salt Lakes	0%	0%	-1%
Shrubs - Closed	-4%	13%	-17%
Shrubs - Open	15%	25%	-10%
Shrubs and Grasses - Sparse-Scattered	1%	7%	-6%
Trees - Closed	1%	4%	-3%
Trees - Open	-1%	6%	-7%
Trees - Scattered	-5%	10%	-14%
Trees - Sparse	-11%	4%	-14%
Tussock Grasses - Closed	9%	23%	-13%
Tussock Grasses - Open	11%	25%	-14%
Urban Areas	0%	0%	0%
Wetlands	17%	24%	-6%

QUESTIONS THAT ARISE

Are the additions (subtractions) to a class from one class or many classes?

Are they expected or random? Is there a spatial pattern?

How do we describe and or measure these changes in a systematic manner?

Are there thresholds that would provide a user with guidance on the use of EO data?

Does the number of classes influence the outcome and what does that imply for ecosystem accounting?

Is earth observation data telling us something meaningful about land cover?

ENSYM ACCOUNTS INTERFACE

change_table

Export Units

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Salt Lakes	8,699,376.98	8,680,324.11	50,899.54	31,846.68	8,648,477.43
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Shrubs - Open	57,675,199.45	66,154,846.10	5,947,060.04	14,426,706.70	51,728,139.40
Shrubs and Grasses - Sp...	280,163,872.34	282,899,458.34	16,693,878.42	19,429,464.42	263,469,993.92
Trees - Closed	23,197,742.24	23,424,502.37	675,063.86	901,823.99	22,522,678.39
Trees - Open	41,781,358.34	41,251,188.39	3,107,366.36	2,577,196.41	38,673,991.98
Trees - Scattered	45,038,206.77	42,999,766.93	6,428,338.44	4,389,898.60	38,609,868.34
Trees - Sparse	87,849,355.98	78,413,752.20	12,699,692.61	3,264,088.82	75,149,663.38
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↑ DN UP DN UP DN UP DN UP DN UP DN

Close Filter

From Shrubs - Open to:

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UP DN UP DN

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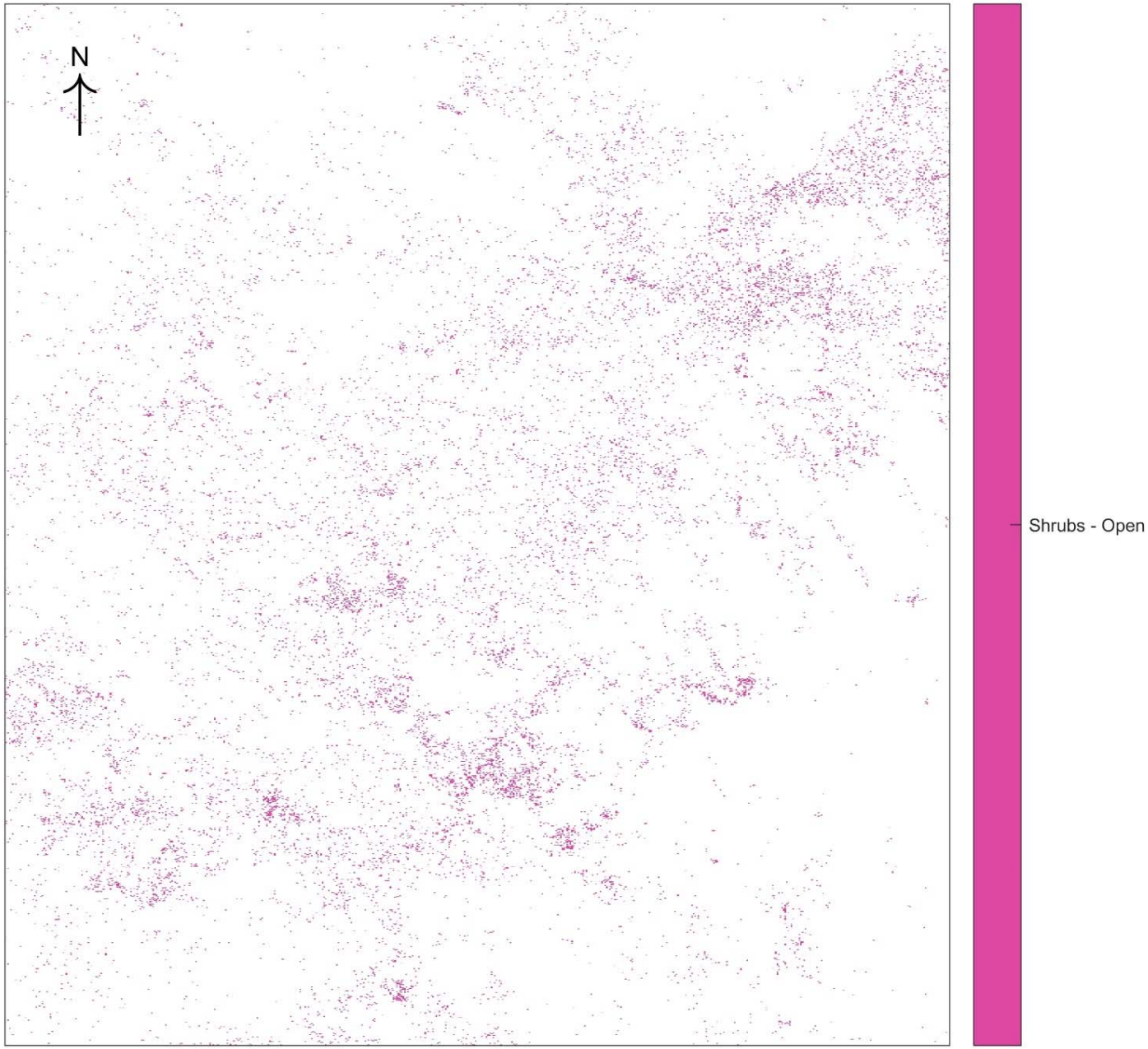
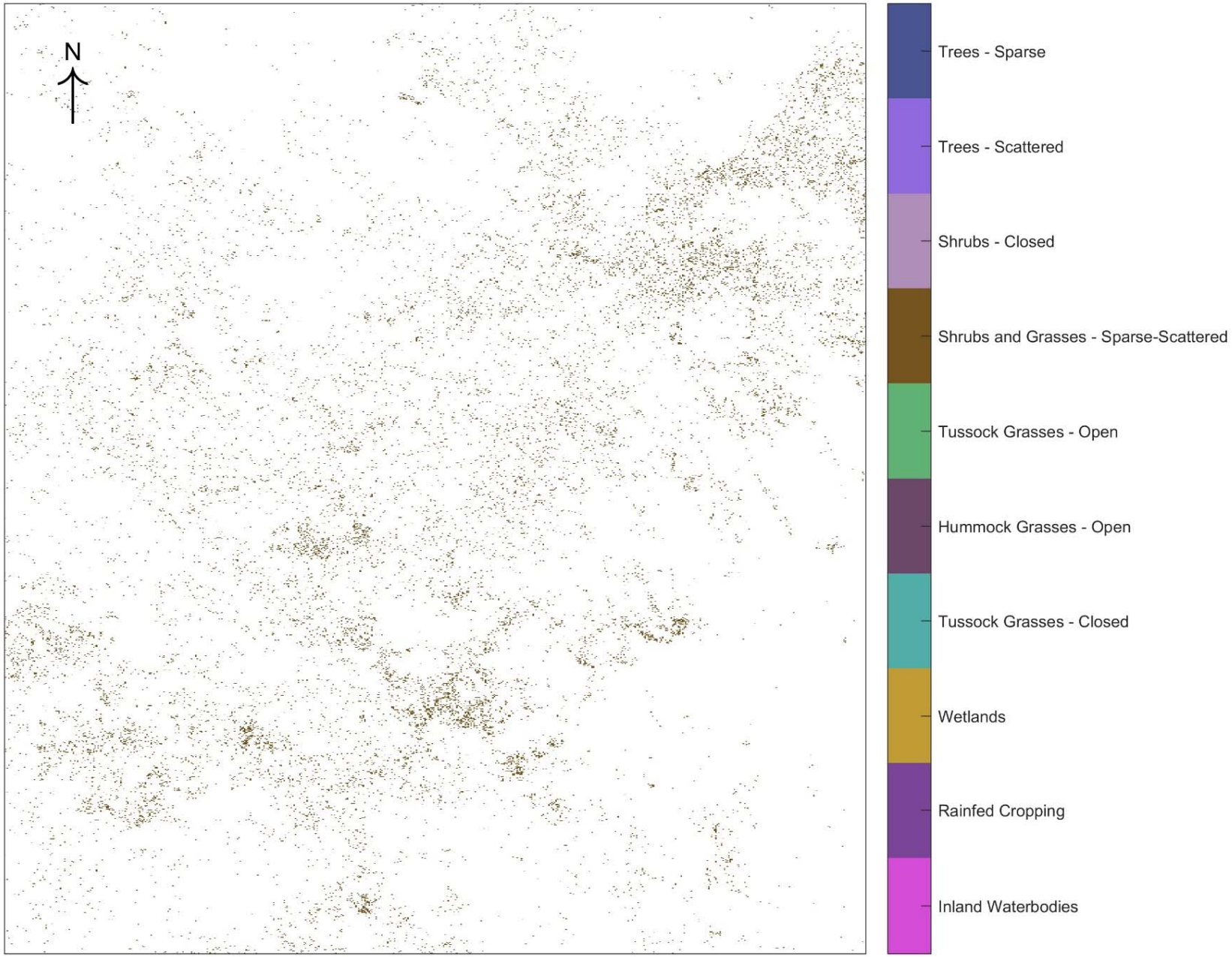
UP DN UP DN

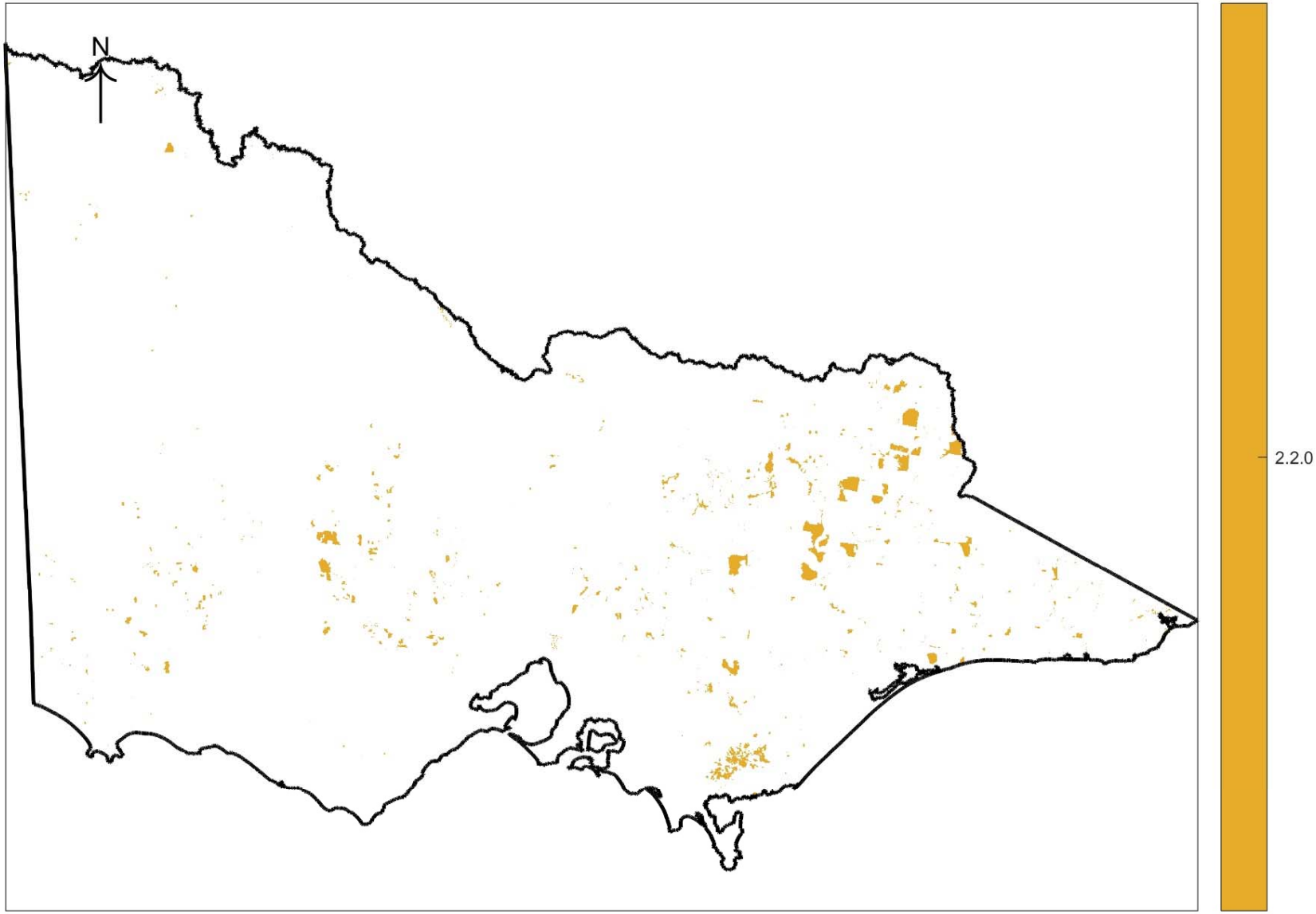
Filter

IDEEA Group

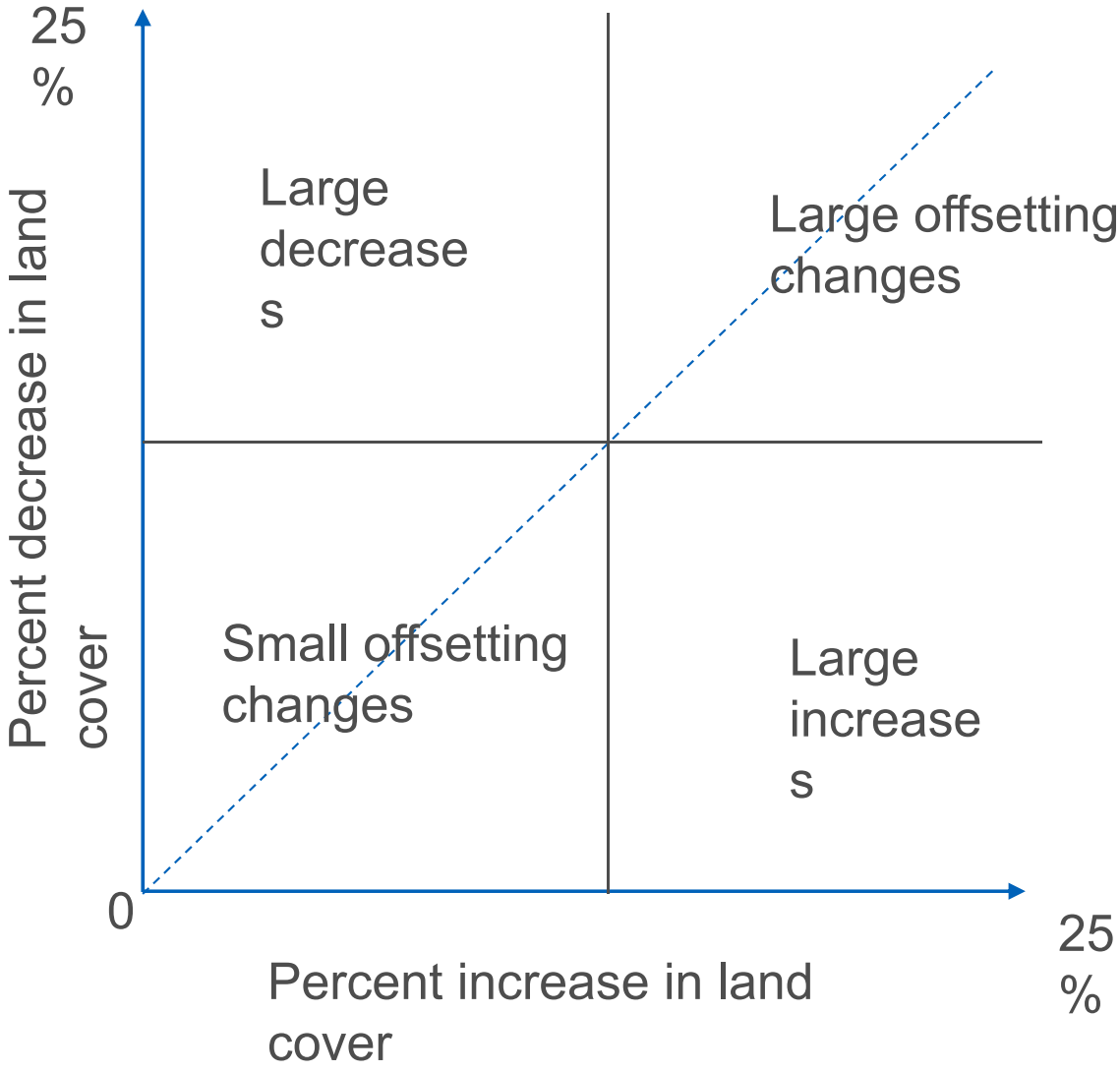
produced using EnSym 10®



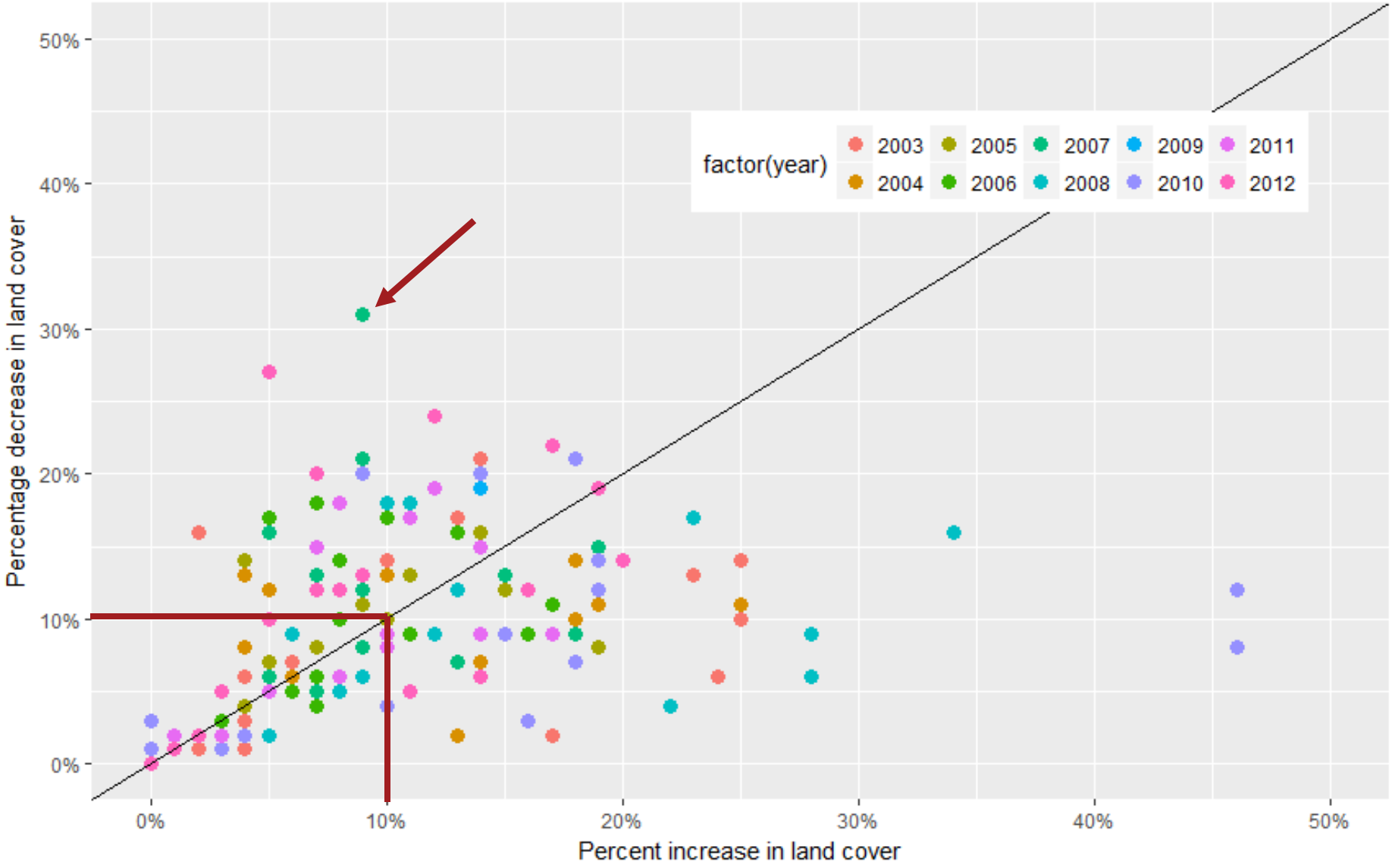


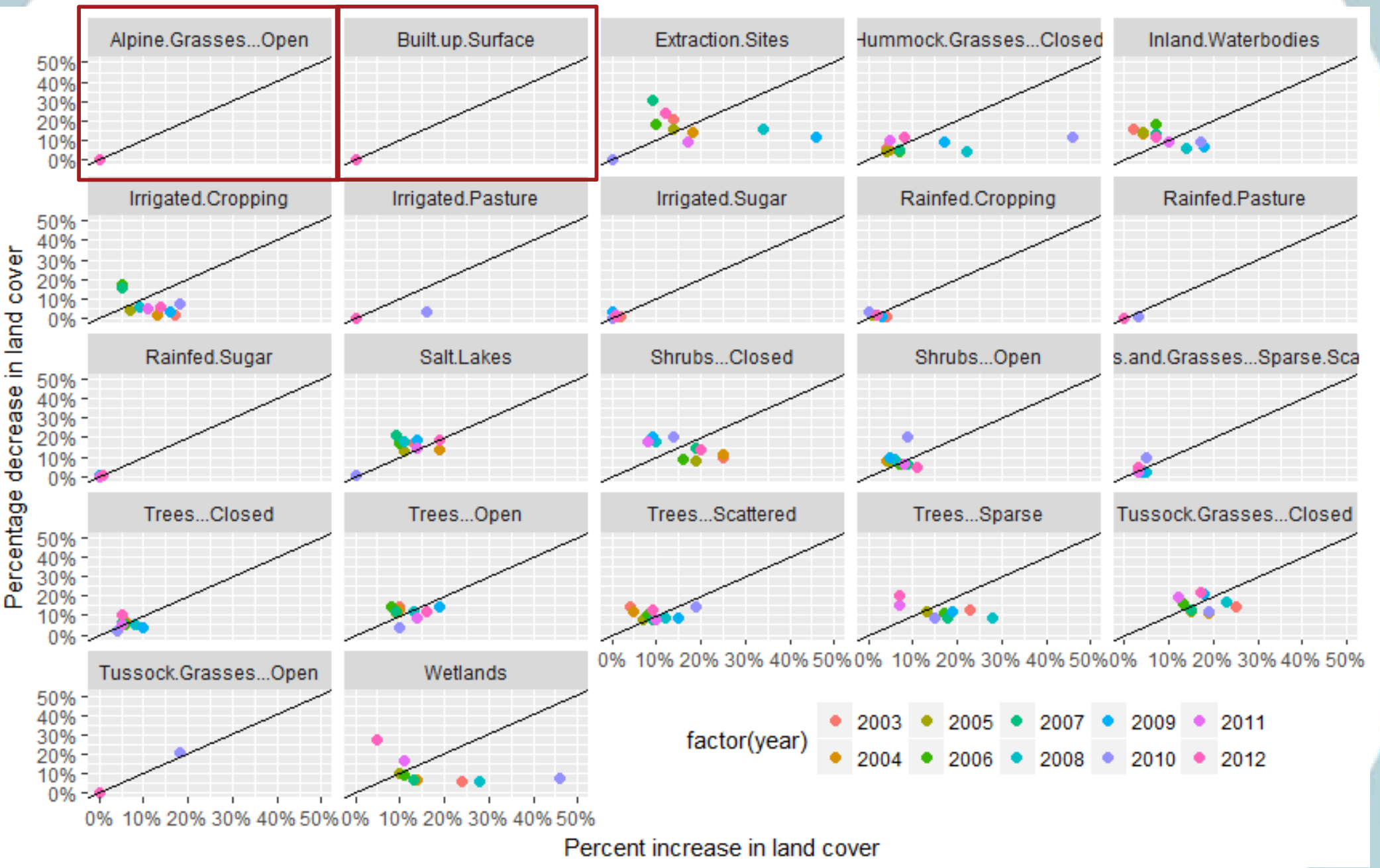


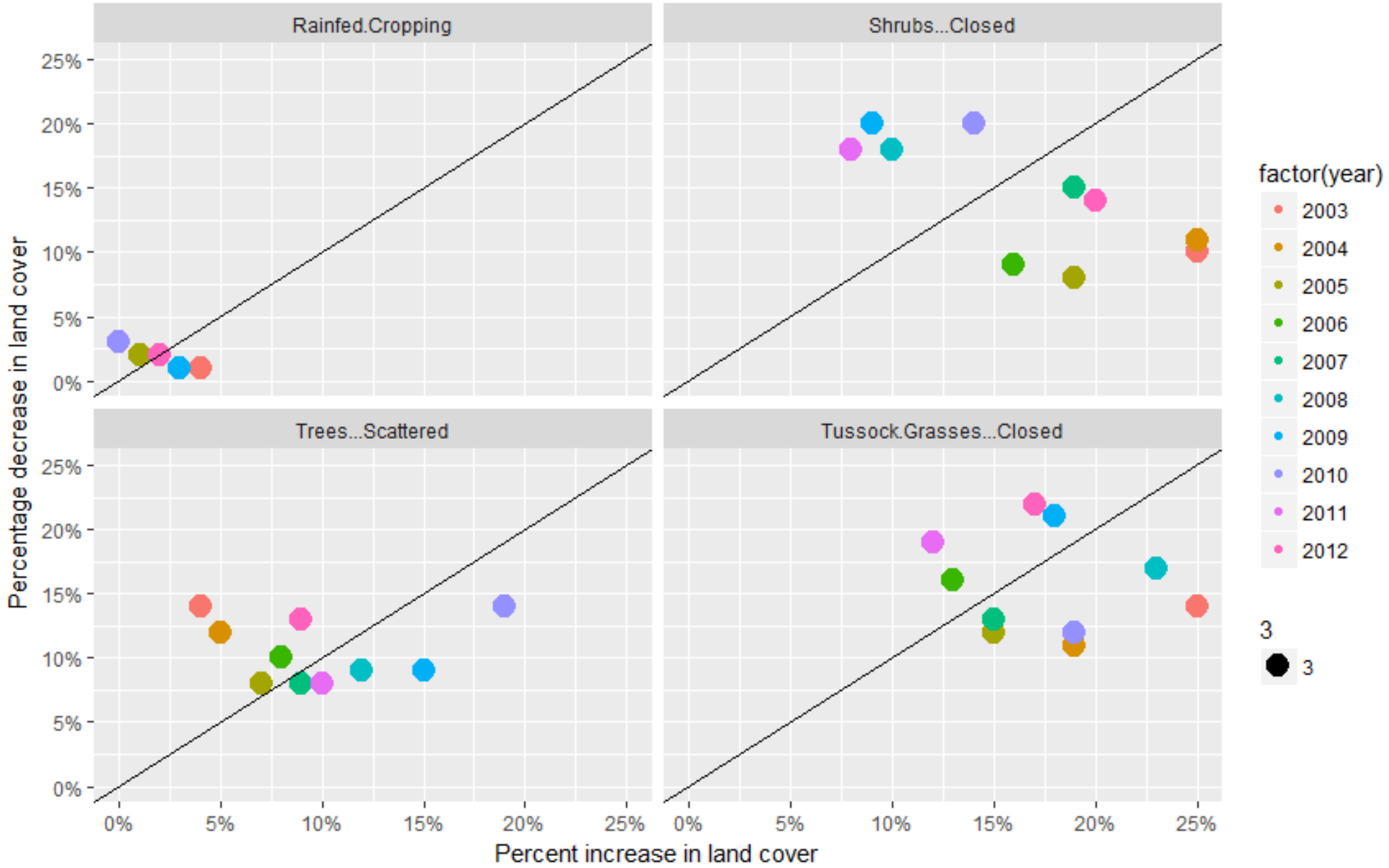
CHARACTERISING CHANGES IN LAND CLASSES



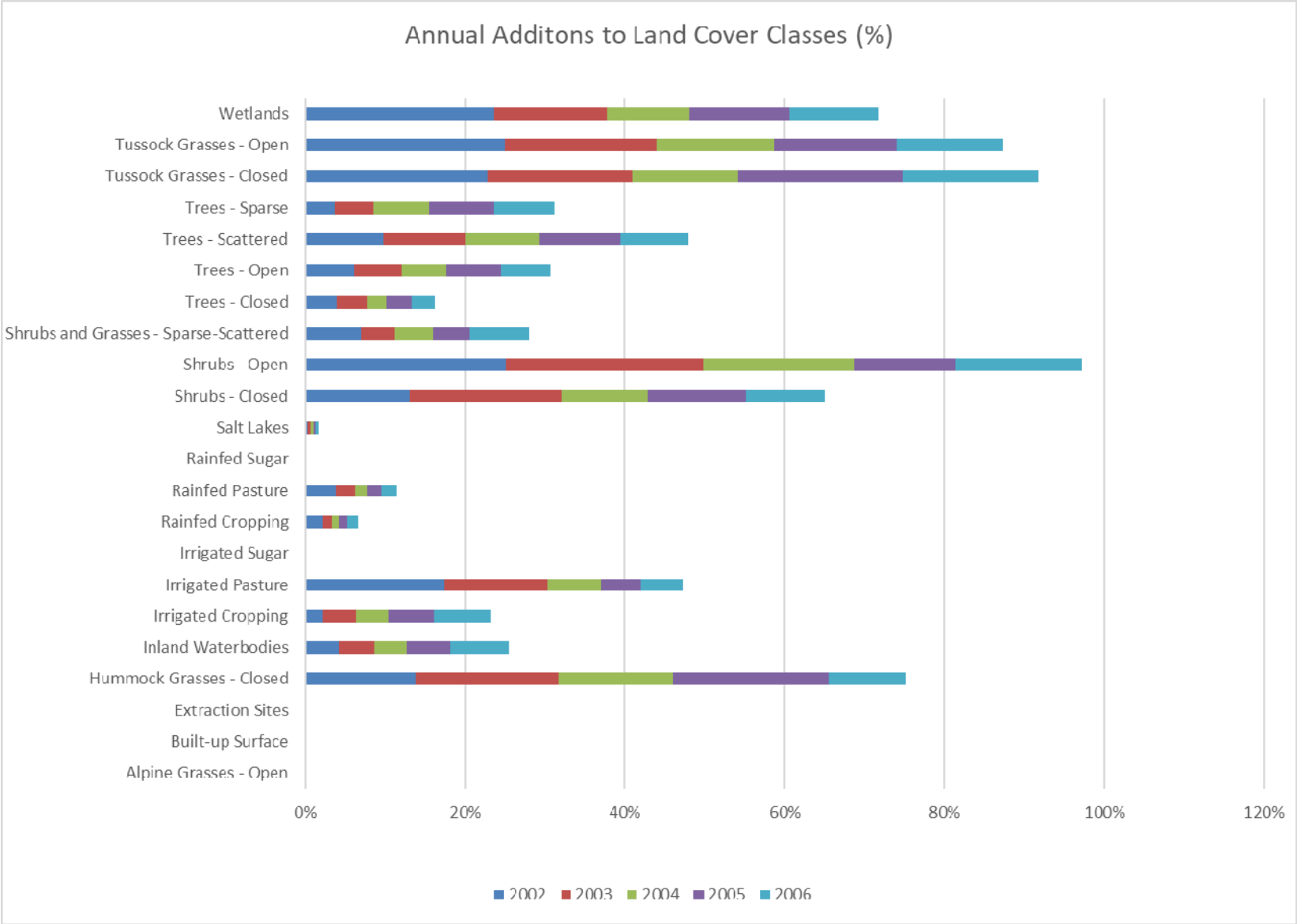
LAND CLASS CHANGES (2003-2012)







ANNUAL ADDITIONS TO LAND COVER CLASSES



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QUESTIONS THAT ARISE FOR ACCOUNTING

Are the additions (subtractions) to a class from one class or many classes?

- Additions (subtractions) are coming from many different classes without any apparent pattern……

Are they expected or random? Is there a spatial pattern?

- Appears to be random, no pattern – further work required to explain changes

How do we describe and or measure these changes in a systematic manner?

- A simple attempt has been made but further work required…

QUESTIONS THAT ARISE FOR ACCOUNTING

Are there thresholds that would provide a user with guidance on the use of EO data?

- There are none currently available, there is a need for some and guidance for *users* of EO data

Does the number of classes influence the outcome and what does that imply for ecosystem accounting?

- Yes, reducing the classes reduces the level of noise, however that does not imply an improvement in the solution/accounts.

Is earth observation data telling us something meaningful about land cover?

- Potentially, but more work required before it can be used (policy and decision-making) reliably. Further work needed to link with non-EO sources

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Institute for Development of Environmental-Economic Accounting

Accounting for ecosystem outcomes

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