

Appendix 1. Landsat image list

Satellite/Sensor	Row/Path	Year	Date	Satellite/Sensor	Row/Path	Year	Date
Landsat 5 TM	25039	1997	25-Jan	Landsat 5 TM	26039	2007	23-Jul
Landsat 5 TM	25040	1997	25-Jan	Landsat 5 TM	26039	2007	8-Aug
Landsat 5 TM	26040	1997	21-Mar	Landsat 5 TM	26039	2007	24-Aug
Landsat 5 TM	25040	1997	4-Jul	Landsat 5 TM	25039	2007	4-Oct
Landsat 5 TM	25039	1997	5-Aug	Landsat 5 TM	25040	2007	4-Oct
Landsat 5 TM	26039	1997	29-Sep	Landsat 5 TM	25039	2008	12-Mar
Landsat 5 TM	26040	1997	15-Oct	Landsat 5 TM	25040	2008	12-Mar
Landsat 5 TM	26039	1997	16-Nov	Landsat 5 TM	26039	2008	19-Mar
Landsat 5 TM	26039	1997	18-Dec	Landsat 5 TM	26040	2008	19-Mar
Landsat 5 TM	26040	1997	18-Dec	Landsat 5 TM	25039	2008	29-Apr
Landsat 5 TM	25039	1997	27-Dec	Landsat 5 TM	25040	2008	29-Apr
Landsat 5 TM	25040	1997	27-Dec	Landsat 5 TM	25039	2008	4-Sep
Landsat 5 TM	26040	1998	19-Jan	Landsat 5 TM	25040	2008	4-Sep
Landsat 5 TM	26039	1998	20-Feb	Landsat 5 TM	26039	2008	27-Sep
Landsat 5 TM	26040	1998	20-Feb	Landsat 5 TM	26040	2008	27-Sep
Landsat 5 TM	25039	1998	1-Mar	Landsat 5 TM	26039	2008	29-Oct
Landsat 5 TM	25040	1998	1-Mar	Landsat 5 TM	26040	2008	30-Nov
Landsat 5 TM	25040	1998	17-Mar	Landsat 5 TM	26039	2009	2-Feb
Landsat 5 TM	26039	1998	9-Apr	Landsat 5 TM	25039	2009	11-Feb
Landsat 5 TM	26040	1998	9-Apr	Landsat 5 TM	26039	2009	7-Apr
Landsat 5 TM	25039	1998	7-Jul	Landsat 5 TM	26040	2009	7-Apr
Landsat 5 TM	26039	1998	3-Nov	Landsat 5 TM	25039	2009	18-May
Landsat 5 TM	25040	1998	14-Dec	Landsat 5 TM	25040	2009	18-May
Landsat 5 TM	25039	1998	30-Dec	Landsat 5 TM	25039	2009	22-Aug
Landsat 5 TM	25040	1999	31-Jan	Landsat 5 TM	25040	2009	22-Aug
Landsat 5 TM	26039	1999	28-Apr	Landsat 5 TM	26040	2009	1-Nov
Landsat 5 TM	25039	1999	7-May	Landsat 5 TM	25040	2009	10-Nov
Landsat 5 TM	25040	1999	7-May	Landsat 5 TM	26039	2009	3-Dec
Landsat 5 TM	25039	1999	27-Aug	Landsat 5 TM	26040	2009	3-Dec
Landsat 5 TM	26039	1999	19-Sep	Landsat 5 TM	25039	2010	18-Mar
Landsat 5 TM	26040	1999	19-Sep	Landsat 5 TM	25040	2010	18-Mar
Landsat 5 TM	26040	1999	21-Oct	Landsat 5 TM	26039	2010	25-Mar
Landsat 5 TM	25040	1999	15-Nov	Landsat 5 TM	26040	2010	25-Mar
Landsat 7 ETM+	26040	1999	30-Nov	Landsat 5 TM	25039	2010	5-May
Landsat 5 TM	25039	1999	1-Dec	Landsat 5 TM	25040	2010	5-May
Landsat 5 TM	26039	1999	24-Dec	Landsat 5 TM	26039	2010	31-Jul
Landsat 7 ETM+	26039	2000	17-Jan	Landsat 5 TM	25039	2010	25-Aug

Landsat 5 TM	25039	2000	3-Feb	Landsat 5 TM	25040	2010	25-Aug
Landsat 5 TM	25040	2000	3-Feb	Landsat 5 TM	26040	2010	3-Oct
Landsat 7 ETM+	26039	2000	12-Aug	Landsat 5 TM	26039	2010	4-Nov
Landsat 7 ETM+	26040	2000	12-Aug	Landsat 5 TM	26040	2010	6-Dec
Landsat 5 TM	25040	2000	13-Aug	Landsat 5 TM	26039	2011	8-Feb
Landsat 7 ETM+	26039	2000	29-Sep	Landsat 5 TM	26040	2011	8-Feb
Landsat 7 ETM+	26040	2000	29-Sep	Landsat 5 TM	26040	2011	29-Apr
Landsat 5 TM	25039	2000	30-Sep	Landsat 5 TM	26039	2011	15-May
Landsat 5 TM	25040	2000	30-Sep	Landsat 5 TM	26039	2011	3-Aug
Landsat 7 ETM+	26040	2000	16-Dec	Landsat 5 TM	26040	2011	3-Aug
Landsat 5 TM	25039	2000	19-Dec	Landsat 5 TM	25039	2011	28-Aug
Landsat 5 TM	25039	2001	4-Jan	Landsat 5 TM	25040	2011	28-Aug
Landsat 5 TM	25040	2001	20-Jan	Landsat 5 TM	25039	2011	13-Sep
Landsat 7 ETM+	26039	2001	4-Feb	Landsat 5 TM	25040	2011	13-Sep
Landsat 7 ETM+	26040	2001	4-Feb	Landsat 5 TM	25039	2011	31-Oct
Landsat 5 TM	25040	2001	5-Feb	Landsat 5 TM	25040	2011	31-Oct
Landsat 5 TM	25039	2001	26-Apr	Landsat 7 ETM+	26040	2012	2-Jan
Landsat 5 TM	26039	2001	22-Jul	Landsat 7 ETM+	25039	2012	11-Jan
Landsat 5 TM	26040	2001	22-Jul	Landsat 7 ETM+	25040	2012	11-Jan
Landsat 5 TM	26039	2001	26-Oct	Landsat 7 ETM+	26039	2012	18-Jan
Landsat 5 TM	26040	2001	26-Oct	Landsat 7 ETM+	25039	2012	27-Jan
Landsat 5 TM	25039	2001	4-Nov	Landsat 7 ETM+	25040	2012	27-Jan
Landsat 5 TM	25040	2001	4-Nov	Landsat 7 ETM+	26039	2012	22-Mar
Landsat 5 TM	26039	2002	14-Jan	Landsat 7 ETM+	26040	2012	22-Mar
Landsat 5 TM	26040	2002	14-Jan	Landsat 7 ETM+	26040	2012	7-Apr
Landsat 5 TM	25039	2002	24-Feb	Landsat 7 ETM+	26039	2012	23-Apr
Landsat 5 TM	25040	2002	24-Feb	Landsat 7 ETM+	25039	2012	18-May
Landsat 5 TM	25039	2002	3-Aug	Landsat 7 ETM+	25040	2012	18-May
Landsat 5 TM	25040	2002	3-Aug	Landsat 7 ETM+	26039	2012	29-Aug
Landsat 5 TM	26039	2002	27-Sep	Landsat 7 ETM+	26040	2012	29-Aug
Landsat 5 TM	26040	2002	27-Sep	Landsat 7 ETM+	25039	2012	23-Sep
Landsat 5 TM	26039	2002	29-Oct	Landsat 7 ETM+	25040	2012	23-Sep
Landsat 5 TM	26040	2002	29-Oct	Landsat 7 ETM+	26039	2012	17-Nov
Landsat 5 TM	25039	2002	7-Nov	Landsat 7 ETM+	26040	2012	17-Nov
Landsat 5 TM	25040	2002	23-Nov	Landsat 7 ETM+	25039	2012	12-Dec
Landsat 5 TM	26040	2003	1-Jan	Landsat 7 ETM+	25040	2012	12-Dec
Landsat 5 TM	26039	2003	17-Jan	Landsat 8 OLI	26039	2013	27-Mar
Landsat 5 TM	25039	2003	31-Mar	Landsat 8 OLI	26040	2013	27-Mar
Landsat 5 TM	25040	2003	31-Mar	Landsat 8 OLI	25040	2013	11-Apr
Landsat 5 TM	25039	2003	18-May	Landsat 8 OLI	26040	2013	4-May

Landsat 5 TM	25040	2003	18-May	Landsat 8 OLI	25039	2013	13-May
Landsat 5 TM	25040	2003	7-Sep	Landsat 8 OLI	26039	2013	8-Aug
Landsat 5 TM	26039	2003	30-Sep	Landsat 8 OLI	25039	2013	17-Aug
Landsat 5 TM	26040	2003	30-Sep	Landsat 8 OLI	25040	2013	17-Aug
Landsat 5 TM	25039	2003	10-Nov	Landsat 8 OLI	26039	2013	25-Sep
Landsat 5 TM	26039	2003	19-Dec	Landsat 8 OLI	26040	2013	25-Sep
Landsat 5 TM	26040	2003	19-Dec	Landsat 8 OLI	25039	2013	23-Dec
Landsat 5 TM	26039	2004	21-Feb	Landsat 8 OLI	25040	2013	23-Dec
Landsat 5 TM	26040	2004	8-Mar	Landsat 8 OLI	26039	2014	15-Jan
Landsat 5 TM	26040	2004	9-Apr	Landsat 8 OLI	26040	2014	15-Jan
Landsat 5 TM	25039	2004	4-May	Landsat 8 OLI	25039	2014	13-Mar
Landsat 5 TM	25040	2004	4-May	Landsat 8 OLI	25040	2014	13-Mar
Landsat 5 TM	26039	2004	14-Jul	Landsat 8 OLI	26039	2014	20-Mar
Landsat 5 TM	26040	2004	14-Jul	Landsat 8 OLI	26040	2014	20-Mar
Landsat 5 TM	26039	2004	15-Aug	Landsat 8 OLI	25039	2014	16-May
Landsat 5 TM	25039	2004	9-Sep	Landsat 8 OLI	25040	2014	16-May
Landsat 5 TM	25040	2004	9-Sep	Landsat 8 OLI	26039	2014	14-Oct
Landsat 5 TM	25039	2004	14-Dec	Landsat 8 OLI	26040	2014	14-Oct
Landsat 5 TM	25040	2004	14-Dec	Landsat 8 OLI	25039	2014	24-Nov
Landsat 5 TM	26039	2005	11-Mar	Landsat 8 OLI	25040	2014	24-Nov
Landsat 7 ETM+	25040	2005	12-Mar	Landsat 8 OLI	25039	2015	27-Jan
Landsat 5 TM	26040	2005	12-Apr	Landsat 8 OLI	25040	2015	27-Jan
Landsat 5 TM	25039	2005	23-May	Landsat 8 OLI	25040	2015	12-Feb
Landsat 5 TM	25040	2005	24-Jun	Landsat 8 OLI	26039	2015	23-Mar
Landsat 5 TM	25039	2005	10-Jul	Landsat 8 OLI	26040	2015	23-Mar
Landsat 5 TM	25040	2005	26-Jul	Landsat 8 OLI	26039	2015	1-Oct
Landsat 5 TM	26039	2005	21-Oct	Landsat 8 OLI	26040	2015	1-Oct
Landsat 5 TM	26040	2005	21-Oct	Landsat 8 OLI	25039	2015	10-Oct
Landsat 5 TM	26039	2005	22-Nov	Landsat 8 OLI	25040	2015	10-Oct
Landsat 5 TM	26040	2005	22-Nov	Landsat 8 OLI	26039	2015	4-Dec
Landsat 7 ETM+	25040	2005	23-Nov	Landsat 8 OLI	26040	2015	4-Dec
Landsat 5 TM	25039	2005	31-Dec	Landsat 8 OLI	26039	2016	6-Feb
Landsat 5 TM	25040	2005	31-Dec	Landsat 8 OLI	26040	2016	6-Feb
Landsat 5 TM	25039	2006	18-Jan	Landsat 8 OLI	25039	2016	2-Mar
Landsat 5 TM	25040	2006	18-Jan	Landsat 8 OLI	26039	2016	25-Mar
Landsat 5 TM	26039	2006	26-Feb	Landsat 8 OLI	25040	2016	3-Apr
Landsat 5 TM	26040	2006	14-Mar	Landsat 8 OLI	25039	2016	5-May
Landsat 5 TM	25040	2006	8-Apr	Landsat 8 OLI	25040	2016	5-May
Landsat 5 TM	26039	2006	17-May	Landsat 8 OLI	25040	2016	28-Oct
Landsat 5 TM	26040	2006	17-May	Landsat 8 OLI	26039	2016	20-Nov

Landsat 5 TM	25039	2006	27-Jun	Landsat 8 OLI	26040	2016	20-Nov
Landsat 5 TM	25039	2006	4-Dec	Landsat 8 OLI	26040	2016	6-Dec
Landsat 5 TM	25040	2006	4-Dec	Landsat 8 OLI	25039	2016	15-Dec
Landsat 5 TM	26039	2006	27-Dec	Landsat 8 OLI	26039	2017	7-Jan
Landsat 5 TM	26040	2006	27-Dec	Landsat 8 OLI	26040	2017	7-Jan
Landsat 5 TM	26039	2007	28-Jan	Landsat 8 OLI	26039	2017	23-Jan
Landsat 5 TM	26040	2007	28-Jan	Landsat 8 OLI	26040	2017	23-Jan
Landsat 5 TM	26040	2007	13-Feb	Landsat 8 OLI	25039	2017	21-Mar
Landsat 5 TM	26039	2007	1-Mar	Landsat 8 OLI	25040	2017	21-Mar
Landsat 5 TM	25039	2007	11-Apr	Landsat 8 OLI	26040	2017	28-Mar
Landsat 5 TM	25040	2007	11-Apr	Landsat 8 OLI	25039	2017	6-Apr
Landsat 5 TM	26040	2007	18-Apr	Landsat 8 OLI	25040	2017	6-Apr
Landsat 5 TM	25039	2007	13-May	Landsat 8 OLI	26039	2017	15-May
Landsat 5 TM	25040	2007	13-May				

Appendix 2. Validation imagery list

Sensor	Date
AndrewLonnieSikes aerial	17-Dec-98
AndrewLonnieSikes aerial	17-Dec-98
AndrewLonnieSikes aerial	17-Dec-98
AndrewLonnieSikes aerial	18-Jan-99
AndrewLonnieSikes aerial	18-Jan-99
AndrewLonnieSikes aerial	18-Jan-99
IKONOS	2-Jan-03
IKONOS	11-Nov-03
IKONOS	17-Aug-04
Quickbird	24-Apr-05
Quickbird	25-May-05
HGAC aerial	5-Aug-06
Quickbird	7-Jan-07
Quickbird	7-Jan-07
Quickbird	29-Jul-09
Quickbird	17-Jan-10
Worldview	23-Jul-10
Quickbird	24-Jul-10
Worldview	27-Jan-12
Worldview	27-Jan-12
Quickbird	30-Jul-12
Worldview	6-Jan-13
Quickbird	3-Jul-13
Worldview	15-Jan-14
Worldview	8-Jan-15
Worldview	16-Jan-15
Worldview	19-Jan-15
Worldview	28-Jan-16
Worldview	15-Jul-16
Worldview	22-Jan-17

Appendix 3. Land cover class definitions

Class code	Class name	NLCD code	NLCD class description*
1	Barren / Sand	31	Anthropogenically impacted areas of unconsolidated dirt and rock (e.g. dirt lots, strip mines, gravel pits and other accumulations of earthen material)
2	Developed - Open	21	Developed areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
4	Developed – Low intensity	22	Developed areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
8	Developed – Medium intensity	23	Developed areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units
13	Developed – High intensity	24	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
21	Cultivated Crops	82	Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
35	Grassland / Pasture	71, 81, 95	Upland and wetland areas dominated by grammanoid or herbaceous vegetation which may be subject to intensive management such as tilling, grazing, or the production of seed or hay crops.
50	Forest	41, 42, 43, 52, 90	Upland and wetland areas where forest (>5m) and shrubland (<5m) vegetation accounts for greater than 20 percent of vegetative cover.
71	Water	11	All areas of open water

* Derived NLCD class definitions from Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., Megown, K., 2015. Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information. Photogramm. Eng. Remote Sensing 81, 345–354.

Appendix 4. Developed classes agreement with NLCD maps for 2001, 2006, and 2011.

Table 1. Combined Developed classes only, where NLCD is the reference map. U_{AG} - user's agreement; P_{AG} - producer's agreement.

	U_{AG}	P_{AG}	F-score
2001	86.6%	92.4%	89.4%
2006	81.6%	97.2%	88.7%
2011	81.3%	97.2%	88.5%

Appendix 5. Distribution of validation sample set in space and time.

Table 1. Class cover as total proportion of area (%). Values represent the areal proportions for each class in all validation imagery (sample) and the entire study area (population).

Class	Validation imagery	Full HGAC
Sand / Barren	0.3%	0.3%
Dev-Open	11.0%	8.2%
Dev-Low	6.1%	2.8%
Dev-Med	6.2%	2.3%
Dev-High	5.3%	1.8%
Cultivated Crops	7.2%	12.0%
Grass	32.3%	35.5%
Forest	27.0%	26.5%
Water	4.5%	10.7%

Table 2. Total samples (pixels) by Year.

Year	Total samples
1999	259
2003	213
2004	117
2005	306
2006	100
2007	228
2009	104
2010	280
2012	298
2013	240
2014	154
2015	387
2016	272
2017	132

Appendix 6. Raw confusion matrices (samples)

Table 1. Raw sample confusion matrix (full). UA – user’s accuracy; UE – User’s error (commission); PA - producer’s accuracy; PE - producer’s error (omission); OA – overall accuracy; OE – overall error.

		Reference										
		Sand/Barren	Dev-Open	Dev-Low	Dev-Med	Dev-High	Cultivated Crops	Grassland / Pasture	Forest	Water	UA	UE
Map	Sand / Barren	73	0	1	0	2	0	0	0	0	96.1%	4.4%
	Dev-Open	1	125	102	25	10	2	19	10	2	42.2%	5.6%
	Dev-Low	0	25	165	85	20	0	6	0	0	54.8%	5.6%
	Dev-Med	1	13	71	208	71	0	5	0	1	56.2%	5.1%
	Dev-High	2	4	18	52	247	0	0	0	0	76.5%	4.6%
	Cultivated Crops	0	2	1	0	0	110	41	4	1	69.2%	7.2%
	Grass	2	37	10	2	1	28	646	24	4	85.7%	2.5%
	Forest	0	26	8	1	0	1	38	462	5	85.4%	3.0%
	Water	3	1	2	0	1	0	10	3	196	90.7%	3.9%
	PA	46%	50%	36%	40%	57%	86%	83%	92%	95%	OA	77.9%
	PE	11%	33%	24%	22%	15%	13%	4%	3%	2%	OE	1.6%

Table 2. Raw sample confusion matrix (reduced). UA – user’s accuracy; UE – User’s error (commission); PA - producer’s accuracy; PE - producer’s error (omission); OA – overall accuracy; OE – overall error.

		Reference							
		Barren	Dev	Ag	Grass	Forest	Water	UA	UE
Map	Barren	73	3	0	0	0	0	96.1%	4.4%
	Dev	4	1241	2	30	10	3	96.2%	1.0%
	Ag	0	3	110	41	4	1	69.2%	7.2%
	Grass	2	50	28	646	24	4	85.7%	2.5%
	Forest	0	35	1	38	462	5	85.4%	3.0%
	Water	3	4	0	10	3	196	90.7%	3.9%
	PA	45.2%	80.8%	85.8%	83.9%	92.4%	94.9%	OA	86.2%
PE		11.4%	1.7%	12.7%	4.0%	2.4%	2.1%	OE	1.5%