

Figure 1. Landsat images of BNNP area (1986-2016).

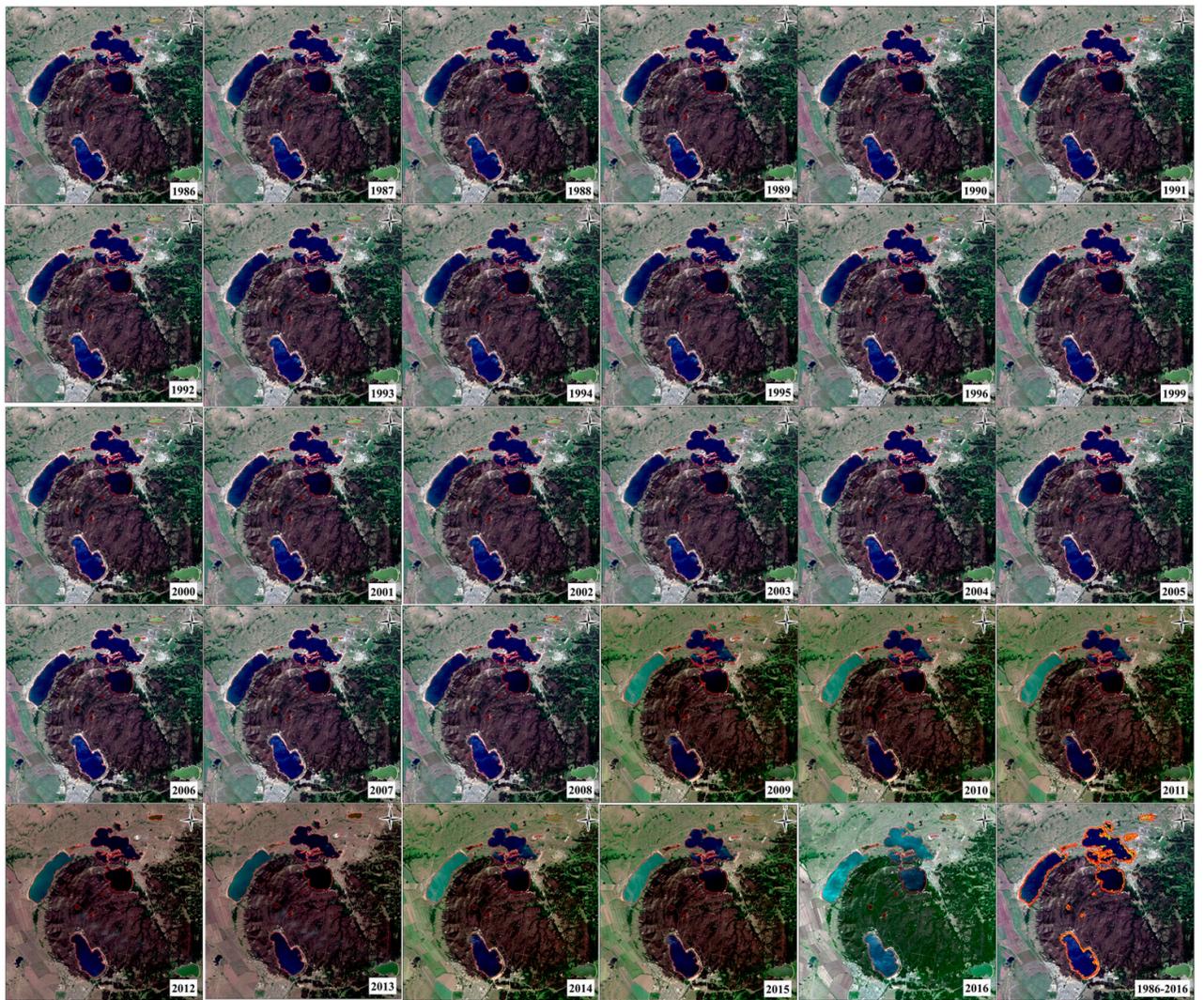


Table 1. List of used LandSat and KazEOSat-2 multispectral data

Name	Satellite	Data	Spatial resolution, m
LM51560231986257AAA03	Landsat-5	1986	60
LM51260231987212AAA03	Landsat-5	1987	60
LM41570231988166AAA03	Landsat-4	1988	60
LM41570231989184AAA03	Landsat-4	1989	60
LM51570231990259AAA06	Landsat-5	1990	60
LM51570231991150AAA03	Landsat-5	1991	60
LM41570231992257AAA03	Landsat-4	1992	60
LT51570231993219ISP00	Landsat-5	1993	30
LT51560231994119ISP00	Landsat-5	1994	30
LT51560231995106ISP00	Landsat-5	1995	30
LT51570231996212ISP00	Landsat-5	1996	30
LE71560231999285SGS05	Landsat-7	1999	15, 30
LE71560232000176SGS00	Landsat-7	2000	15, 30
LE71570232001121SGS00	Landsat-7	2001	15, 30
LE71560232002229SGS00	Landsat-7	2002	15, 30
LE07_L1TP_156023_20030516_20170125_01_T1	Landsat-8	2003	15, 30
le07_l1tp_156023_20040518_20170120_01_t1	Landsat-7	2004	15, 30
le07_l1tp_156023_20050809_20170114_01_t1	Landsat-7	2005	15, 30
LT05_L1TP_156023_20060719_20161120_01_T1	Landsat-5	2006	30
LT05_L1TP_157023_20070915_20161112_01_T1	Landsat-5	2007	30
LT51560232008174KHC01	Landsat-5	2008	30
LT51560232009160KHC02	Landsat-5	2009	30
LT51560232010179MOR02	Landsat-5	2010	30
LT51560232011166MOR00	Landsat-5	2011	30
LC81560232013171LGN00	Landsat-8	2013	15, 30
LC81570232014213LGN00	Landsat-8	2014	15, 30
LC81560232015177LGN00	Landsat-8	2015	15, 30
LC81570232016155LGN00	Landsat-8	2016	15, 30
L1G-KM000b0aMI_013_MUL-20160905-113504	KazEOSat-2	2016	6.5

Table 2. The surface area of BNNP lakes estimated from Landsat images (1986-2016). Lakes: (11) Ulken & Kishi Shabakty, Shortandy, Burabay, Akkol, Zhaynak, Maybalyk, Tekekol, Gornoe, Karasie, Svetloe (see also Fig. 1). Missing years: 1997 and 1998.

Year	Ulken Shabakty, km ²	Burabay, km ²	Shortandy, km ²	Kishi Shabakty, km ²	Akkol, km ²	Zhaynak, km ²	Maybalyk, km ²	Tekekol, km ²	Gornoe, km ²	Karasie, km ²	Svetloe, km ²	Total, km ²
1986	20.56	9.64	16.24	17.50	0.94	0.83	0.50	0.96	0.07	0.12	0.17	67.53
1987	20.04	9.62	16.12	17.47	0.94	0.83	0.45	0.95	0.05	0.10	0.17	66.75
1988	21.00	9.96	16.44	17.95	1.03	1.01	0.62	1.05	0.07	0.14	0.19	69.46
1989	19.63	9.37	15.48	17.02	0.84	0.85	0.45	0.91	0.05	0.10	0.15	64.87
1990	20.02	9.70	15.69	17.27	0.86	0.84	0.50	0.99	0.07	0.13	0.18	66.23
1991	19.34	9.51	15.31	17.02	0.70	0.85	0.45	0.95	0.06	0.10	0.14	64.43
1992	20.22	9.78	15.54	17.11	0.93	0.94	0.54	1.05	0.05	0.15	0.18	66.50
1993	19.68	9.87	15.57	17.37	0.81	1.01	0.51	1.01	0.08	0.15	0.21	66.27
1994	20.75	10.12	15.85	17.81	0.91	1.18	0.64	1.12	0.14	0.15	0.23	68.91
1995	20.60	10.05	15.70	17.76	0.83	1.09	0.59	1.07	0.10	0.15	0.21	68.15
1996	20.38	10.01	15.52	17.74	0.76	1.06	0.55	1.06	0.08	0.11	0.20	67.48
1999	19.89	9.94	15.12	17.23	0.65	1.05	0.56	1.07	0.08	0.15	0.20	65.94
2000	19.28	9.95	15.02	17.26	0.70	1.11	0.54	1.07	0.09	0.16	0.22	65.42
2001	19.40	10.03	15.24	17.32	0.73	1.15	0.59	1.10	0.10	0.16	0.23	66.04
2002	20.58	10.12	15.45	17.77	0.70	1.11	0.65	1.13	0.09	0.16	0.21	67.98
2003	19.46	10.02	15.20	17.62	0.59	1.13	0.59	1.08	0.08	0.11	0.19	66.08
2004	19.24	9.84	14.94	17.00	0.53	1.04	0.57	1.02	0.08	0.13	0.19	64.59
2005	18.67	9.74	14.63	16.75	0.50	0.96	0.54	1.00	0.08	0.14	0.18	63.19
2006	18.92	9.89	14.98	17.02	0.53	1.06	0.52	1.06	0.08	0.15	0.20	64.40
2007	19.32	9.97	14.89	17.19	0.53	1.05	0.55	1.06	0.09	0.15	0.19	65.01
2008	18.66	9.71	14.67	17.13	0.62	0.95	0.53	1.05	0.07	0.13	0.17	63.68
2009	18.87	10.19	15.20	17.39	0.36	1.20	0.65	0.80	0.07	0.16	0.23	65.12
2010	18.60	9.78	14.63	17.02	0.23	1.03	0.52	1.05	0.07	0.13	0.18	63.25
2011	18.77	10.07	14.84	17.00	0.12	1.19	0.58	1.11	0.11	0.17	0.22	64.18
2012	18.02	9.88	14.67	16.44	0.00	1.10	0.52	1.01	0.07	0.15	0.20	62.07
2013	18.04	9.94	14.72	16.63	0.03	1.11	0.52	1.06	0.09	0.15	0.21	62.49
2014	18.37	10.04	14.82	16.90	0.40	1.11	0.61	1.08	0.09	0.17	0.21	63.80
2015	18.11	10.01	14.84	16.95	0.00	1.11	0.62	1.08	0.08	0.16	0.21	63.16
2016	18.04	10.00	14.70	16.79	0.15	1.14	0.59	1.07	0.09	0.16	0.21	62.93

Table 3. The water volumes of three main BNNP lakes (1986-2016). Lakes: (3) Ulken Shabakty, Shortandy and Burabay, (see also Fig 4 & 6). Missing years: 1997 and 1998.

Year	Ulken Shabakty, km ³	Burabay, km ³	Shortandy, km ³	Total, km ³
1986	169.83	30.72	182.75	383.31
1987	168.67	30.73	181.74	381.14
1988	170.86	31.16	182.20	384.22
1989	167.91	30.19	180.46	378.56
1990	169.17	30.78	181.09	381.04
1991	167.41	30.52	180.71	378.65
1992	169.83	30.92	180.61	381.36
1993	168.78	31.16	180.88	380.82
1994	170.76	31.40	181.71	383.87
1995	170.10	31.28	181.12	382.50
1996	169.71	31.26	180.89	381.85
1999	169.04	31.14	180.19	380.38
2000	167.82	31.14	180.20	379.16
2001	168.28	31.25	180.29	379.82
2002	170.36	31.34	181.06	382.75
2003	168.55	31.27	180.47	380.29
2004	167.78	30.97	179.72	378.48
2005	166.56	30.88	178.99	376.44
2006	167.46	31.18	179.83	378.47
2007	168.21	31.27	179.63	379.11
2008	166.54	30.84	178.89	376.27
2009	166.98	31.31	179.46	377.75
2010	166.54	30.96	178.89	376.39
2011	166.91	31.22	179.42	377.55
2012	165.61	31.09	179.28	375.98
2013	165.99	31.25	179.58	376.83
2014	166.70	31.35	179.80	377.85
2015	166.16	31.34	179.88	377.38
2016	166.01	31.33	179.35	376.69