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Variable Stars in NSVS Database I. 86 New Variables in Andromeda

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1 Introduction

One of the most extensive sky surveys in the recent years is the Northern Sky Variability Survey (NSVS, Woźniak et al., 2004a). Light curves of about 14 000 000 objects with instrumental magnitudes between 8 and 15.5 are included in the database of that survey, for the period April 1999 – March 2000, covering all of the Northern hemisphere and reaching $\delta = -38^\circ$ in the South.

Usually, search for new variables follows a standard procedure: a sample of stars from other sources (IR, X-ray surveys) is selected by some characteristics and then this selection is checked for variability in the NSVS database. This procedure does not reflect the whole variety of variable stars in the NSVS.

Several studies based on NSVS data have been published. Preliminary results of ROTSE-I (Akerlof et al., 2000) identified 1781 periodic variables of different types. The catalogue of red variables (Woźniak et al., 2004b) contains the greatest number so far: 8678 variable stars, 6474 of them newly discovered. Kinemuchi et al. (2006) studied 1188 RR Lyr stars, Wils, Lloyd and Bernhard (2006) identified 785 variables of the same type. The catalogue of Gettel et al. (2006) contains 1022 contact binaries. Otero et al. (2004, 2005a, 2005b, 2006a, 2006b) give information about new eclipsing variables from the NSVS. The NSVS database is also used for confirmation and determination of parameters of the objects from the GCVS and NSV catalogues (Kazarovets et al., 2005; Antipin et al., 2005).

Akerlof et al. (2000) estimate the total number of variables to be discovered using the NSVS as 32 000, Samus (2006) gives an estimate of tens of thousands expected variables. One of the aims of our research is to estimate the total number of variables which can be extracted from the NSVS database.

2 Search area

As mentioned above, the search procedure adopted to create earlier catalogues makes use of data external to the NSVS to preselect variability candidates.

To look for different types of variables, we rely only upon internal NSVS data. We select an area on the sky and check for variability in the NSVS database. Our test area covers 46 deg^2 in Andromeda, its coordinates are: $23^\mathrm{h}00^\mathrm{m} \le \alpha \le 23^\mathrm{h}45^\mathrm{m}$ and $43^\circ 30' \le \delta \le 49^\circ 30'$ (2000.0). The galactic latitude is in the $-10^\circ \div -20^\circ$ range. The total number of NSVS light curves in this area is $N_\mathrm{total} = 51\,955$ and every star has between 1 and 4 light curves, the mean value being 1.875 light curves per star. Our search is based on the variability parameter K:

$$K = \frac{\sigma_S}{\sigma_E}, \tag{1}$$

where σ_S is the scatter of measurements in the light curve and σ_E is the median value of the error of a single measurement. Both values are present in the on-line distribution of NSVS data in Sky Database for Objects in Time-Domain — the SkyDOT pages.

There are $N_{\rm limit} = 9\,083$ light curves in the selected field with $K \geq 1.5$, at which we cut off our manual examination. As our detection threshold, we accepted the amplitude $A \geq 0.15^m$ for long-period or irregular variability and the amplitude $A \geq 0\overset{\rm m}{.}1$ plus the period $0\overset{\rm d}{.}05 \leq P \leq 300^{\rm d}$ for periodic variables.

Period analysis was performed with the PERANSO code (http://www.peranso.com) by the ANOVA method, most suitable for light curves with two minima. Table 1 summarizes the data for detected variables. Its first column presents ordinal numbers of variables detected in our search, the next two columns are identification numbers of the variables' light curves in the NSVS and the variability parameter K of the respective light curves.

3 Results

Examination of all $N_{\rm limit}$ light curves revealed $N({\rm var})_{\rm total} = 255$ curves with variability, corresponding to $N_{\rm VS} = 136$ variable stars (Table 2). In Table 2, the first column presents the number of the star from Table 1. We identified the variables with the Tycho/Tycho2 (for brighter stars) or USNO B1.0 (for fainter stars) catalogues, the identifications are presented in the second column. Coordinates from the 2MASS catalogue (USNO coordinates, if the 2MASS identification is not reliable) are in the third and fourth columns. As a consequence of low angular resolution of the observations in the NSVS database (14″ per pixel), some of the objects are blended and this makes it difficult to exactly determine to which star a certain light curve belongs. In such cases, NSVS coordinates may be considerably different from 2MASS coordinates. Next columns contain the instrumental stellar magnitude in maximum $m_{\rm max}$, the amplitude A of variations in the light curve, the period P, and the variability type. The NSVS data do not allow a detailed classification of the GCVS level of detail, so we adopted the somewhat simplified classification of Akerlof et al. (2000) and Woźniak et al. (2004b). The last column contains star names from the GCVS, NVS catalogues and those from Woźniak et al. (2004b) if they exist. A star number in column 1 marked with an asterisk refers to additional remarks following the Table.

Variables revealed in our search are distributed as follows:

- Variability of the light curves is detected for 28 of the total of 56 already known GCVS variables in the field. There are also 2 other stars from the GCVS, which show variability of their NSVS light curves, but their variation amplitudes are within measurement errors. The remaining 26 GCVS variables are too bright and have saturated images, making photometry impossible.
- There are 32 suspected variables in the field, according to the NSV catalogue, but only 3 of them show variability in the NSVS light curves. Additional 11 NSV stars have NSVS light curves without apparent variability. The remaining 18 NSV stars are either too bright for photometry or their type of variability cannot be derived from the NSVS set of observations.

- The Catalogue of Woźniak et al. contains 21 stars belonging to our field and 13 of them are new variables.
- For 4 of the variables, there is unpublished information in the on-line VSX database (http://www.aavso.org/vsx). One more variable is present in Dahlmark (1999), and there is also information about another star in the catalogue of Gettel et al. (2006).
- For 86 of 136 variables detected in our search, there are no previous publications or any information in ADS or SIMBAD and they may be regarded as new variable stars. This number includes: 52 variables of irregular or semiregular types, 24 eclipsing binaries, and 10 periodic variables of different types.

The light curves of new variable stars are presented in Fig. 1 (irregular or semiregular variables), Fig. 2 (eclipsing binaries), and Fig. 3 (other periodic variables).

4 Analysis

We subdivide all the light curves into 19 subsets for different ranges of K (Table 3). The first column of Table 3 contains the K range for the subset. The next column is the number of light curves, n, belonging to the subset. Columns 3 and 4 contain the cumulative number of light curves, N, and $\log N$. The number of light curves with variability, $n(\mathrm{var})$, cumulative number, $N(\mathrm{var})$, and its logarithm, $\log N(\mathrm{var})$, are presented in the next three columns. The last column shows the predicted number of light curves with variability, $N_{\mathrm{p}}(\mathrm{var})$, for the respective subset. The data from Table 3 are graphically presented in Fig. 4, as the function:

$$\log N(\mathrm{var}) = f(\log N). \tag{2}$$

Diamonds in Fig. 4 represent data for subsets with $K \geq 1.5$. Some of the light curves of variable stars with multiple light curves have $K < 1.5$, such data are displayed as crosses.The relation (2) for lower values of K can be linearly approximated as:

$$\log N(\mathrm{var}) = 1.9041 + 0.1212 \log N. \tag{3}$$

Its extrapolation to $N = N_{\mathrm{total}}$ gives an estimate for the expected number of light curves with variability in the selected field. Thus, the predicted total number of curves with detectable variability is $N_{\mathrm{p}}(\mathrm{var})_{\mathrm{total}} = 299$. This number correspond to $N_{\mathrm{VS}} = 159$ variable stars, i.e. 23 variables can be detected if the search covers the rest of the K range. Thus, the concentration ρ of variables per light curve in the field appears to be:

$$\rho = \frac{N_{\mathrm{VS}}}{N_{\mathrm{total}}} = 0.00306. \tag{4}$$

If we assume this approximation to be valid for all NSVS data, and the concentration ρ to be uniform for the survey, then an estimate of the total number of variable stars can be made. There are about $N(\mathrm{NSVS}) = 20\,000\,000$ light curves in the NSVS, and the total number of variable stars that can be expected to be extracted from the survey is:

$$N_{\mathrm{VS}}(\mathrm{NSVS}) = \rho\, N(\mathrm{NSVS}) \approx 61\,000 \qquad \text{variable stars.} \tag{5}$$

If we take into consideration only really detected variables, i.e. $N_{\mathrm{VS}} = 136$, then $\rho = 0.00262$, and this number corresponds to the total number of variables $N_{\mathrm{VS}}(\mathrm{NSVS}) \approx 52\,000$, which may be considered a lower limit to the total number of variables detectable in the NSVS.

Table 3 Light-curve statistics in the selected field

K	n	N	$\log N$	n(var)	N(var)	$\log N$(var)	N_{p}(var)
100 – 200	11	11	1.041	1	1	0.000	
50 – 100	25	36	1.556	6	7	0.845	
20 – 50	71	107	2.029	14	21	1.322	
10 – 20	121	228	2.358	21	42	1.623	
8 – 10	88	316	2.500	19	61	1.785	
6 – 8	123	439	2.642	31	92	1.964	
5 – 6	130	569	2.755	23	115	2.061	
4 – 5	271	840	2.924	28	143	2.155	
3 – 4	682	1522	3.182	30	173	2.238	
2.6 – 3	470	1992	3.299	10	183	2.262	
2.2 – 2.6	1019	3011	3.479	19	202	2.305	
1.8 – 2.2	2543	5554	3.745	26	228	2.358	228
1.6 – 1.8	2082	7636	3.883	9	237	2.375	237
1.5 – 1.6	1447	9083	3.958	5	242	2.384	242
1.3 – 1.5	4030	13113	4.118	5	247	2.393	253
1.1 – 1.3	8560	21673	4.336	7	254	2.405	269
0.9 – 1.1	16665	38338	4.584	1	255	2.407	288
0.7 – 0.9	11956	50294	4.702	0	255	2.407	298
0.4 – 0.7	1661	51955	4.716	0	255	2.407	299
Total :		51955			255		299

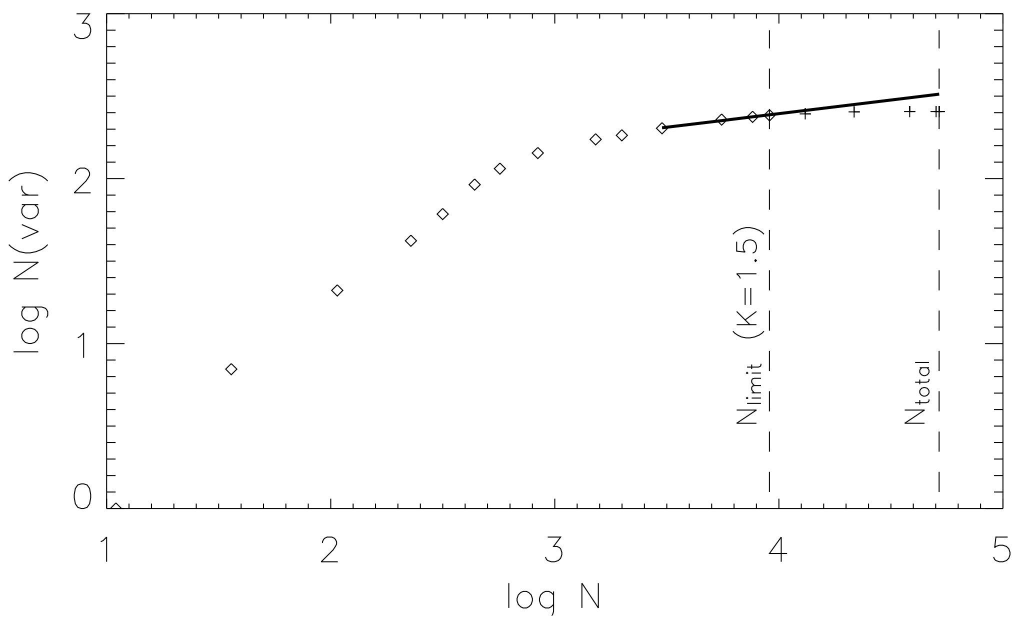

Figure 4. The cumulative number of light curves with variability in the field.

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Table 1. Data for detected variable stars

No	ID	K	No	ID	K	No	ID	K	No	ID	K
1	6186115	3.167	43	3547609	5.000	69	6208993	2.133	95	6217788	4.667
2	6186577	3.083	43	6152420	4.333	70	3556454	20.667	96	3563428	1.896
3	6187334	4.545	43	6202530	5.348	70	3602473	19.100	96	3608642	1.933
4	6187630	1.714	44	3548903	6.364	70	6161158	7.636	96	6166548	1.940
5	6139890	3.020	44	3595661	9.750	70	6212453	21.455	96	6218514	2.269
5	6189126	2.741	44	6154088	5.200	71	3558091	4.286	97	3563745	1.615
6	6188888	4.400	45	3552715	1.137	71	6210669	4.389	97	3608929	2.846
7	6189231	111.636	45	6202233	1.526	72	3557127	9.800	97	6166219	1.268
8	6189117	5.600	46	3552235	5.769	73	3559429	5.000	97	6218135	1.900
9	6141665	1.556	46	6202829	38.769	73	6210124	6.818	98	3565288	1.396
10	6141226	5.625	47	3552035	2.680	74	3558846	9.000	98	6216130	1.608
10	6190599	3.833	47	6203386	3.158	74	6211799	5.500	99	3565538	20.000
11	6189799	78.615	48	3550366	10.500	75	3559834	1.722	99	6215912	18.727
12	6190823	2.182	48	3596992	6.800	75	6211628	1.938	100	3564585	5.400
13	6190476	1.926	48	6155303	3.063	76	3560782	2.949	100	6217647	3.800
14	6191048	3.909	48	6205797	4.412	76	6210513	3.633	101	3608657	2.348
15	6191796	7.000	49	3553878	1.154	77	3560802	13.214	101	6168680	3.333
16	6192152	4.480	49	6203881	1.289	77	6210777	14.231	102	3564994	7.833
17	6192307	23.889	50	3550888	1.964	78	3559333	5.000	102	6218809	7.000
18	6144773	2.286	50	3597481	1.851	78	6212638	6.100	103	3566117	7.214
19	6193197	6.645	50	6155931	1.868	79	3560610	1.200	103	6217539	4.467
20	6192361	2.200	50	6206475	1.887	79	6211350	1.867	104	3564685	1.333
21	6193521	8.643	51	3553020	49.722	80	3603453	2.857	104	3609749	2.195
22	6193347	4.650	51	6205585	99.385	80	6163539	2.071	104	6219862	1.674
23	6193574	7.091	52	3554519	11.111	81	3560869	2.813	105	3610070	2.700
24	6145821	5.182	52	6204296	10.813	81	6211762	3.200	106	3567233	2.083
24	6195309	6.583	53	3554901	62.786	82	3561118	3.917	106	6220235	7.333
25	6145959	3.056	53	6204430	70.615	82	6211539	4.000	107	3569143	9.900
25	6195466	4.700	54	3553463	4.417	83	3560181	6.385	107	6219568	9.091
26	6145748	2.400	54	6205838	3.917	83	6212739	6.667	108	3568410	15.250
26	6195243	8.200	55	3554667	3.909	84	3560867	2.278	109	3568744	1.103
27	6146625	9.818	55	6205337	3.000	84	6212163	2.563	109	3613282	1.833
28	6146897	12.500	56	3552095	3.762	85	3559745	9.355	110	3570253	2.625
29	3547289	4.229	56	3598584	3.786	85	3605370	13.103	111	3613265	1.692
29	6195086	11.465	56	6157531	4.000	85	6214417	9.733	112	3570601	8.308
30	3546966	1.679	57	3555211	0.974	86	3560628	5.958	113	3614244	8.091
30	6195550	1.506	57	6205431	1.202	86	6213406	6.100	114	3571956	8.176
31	6147628	2.200	58	3554560	20.000	87	3562336	6.600	115	3572834	2.326
31	6197257	1.875	58	6207069	25.556	87	6212191	6.500	116	3572667	8.810
32	3547061	15.182	59	3556338	3.200	88	3560466	47.067	117	3572711	4.571
32	6196777	20.700	59	6205354	4.400	88	6164110	22.059	118	3615389	6.545
33	3547859	9.273	60	3553940	1.758	88	6215818	85.583	119	3573890	11.500
33	6197085	10.300	60	6157013	3.075	89	3562846	6.000	120	3572275	8.364
34	3547537	33.444	60	6207739	1.370	89	6213143	5.636	120	3616412	3.200
34	6198369	49.857	61	3553359	3.700	90	3561083	12.647	121	3616581	10.100
35	3548459	11.000	61	3599707	8.182	90	6164281	9.720	122	3573034	2.462
35	6198178	6.455	61	6157883	4.700	90	6215983	11.625	122	3617166	4.214
36	6151020	53.615	62	3552946	5.769	91	3562822	4.583	123	3574480	1.568
37	6150652	2.476	62	3599331	6.000	91	6214723	4.917	124	3574249	5.909
37	6200568	2.500	62	6158399	6.941	92	3561438	1.568	124	3618229	6.500
38	3547362	2.338	63	3555230	7.300	92	3606866	4.867	125	3575069	2.379
38	6151022	2.189	63	6207329	9.500	92	6165437	1.941	126	3575950	17.000
38	6200982	1.375	64	3557230	4.308	92	6217269	2.000	127	3618839	2.400
39	3547577	6.294	64	6207305	4.238	93	3561748	5.636	128	3619146	3.545
39	3594632	7.143	65	3557969	5.364	93	3607121	13.400	129	3576200	30.273
39	6150834	5.308	65	6207074	5.900	93	6165627	11.818	130	3619554	6.000
39	6200769	5.167	66	3558064	1.414	93	6217509	6.273	131	3577456	3.800
40	3550226	2.429	66	6207285	1.840	94	3562295	3.333	132	3577684	3.214
40	6199438	5.846	67	3555958	2.521	94	3607613	3.364	133	3577652	1.605
41	3548394	3.625	67	6159146	2.143	94	6165629	3.067	133	3621269	4.625
41	6150988	6.280	67	6210116	2.385	94	6217511	2.846	134	3578849	4.143
41	6200937	1.941	68	3557654	4.167	95	3562913	5.167	135	3578756	3.600
42	3547157	1.842	68	6209964	4.167	95	3608209	7.364	136	3621797	2.803
42	6152131	2.417	69	3559411	1.889	95	6165877	5.938			

Table 2 Variable stars found in the field

No	USNO B1.0/ Tycho2 ID	α [2000] h m s	δ [2000] $^\circ$ $'$ $''$	$m_{\max}$ [mag]	A [mag]	P [days]	Type	Name
1	1387-0480726	23 00 04.67	48 47 36.1	12.00	0.31	195.9	SR	
2	3626-00107-1	23 00 23.92	48 18 09.7	10.40	0.28	19.974	EA	
3	3626-00834-1	23 01 02.15	47 53 44.0	10.10	0.15	52.9	SR+L	
4	3626-00396-1	23 01 35.51	48 39 11.3	12.55	0.25	20.345	EB	
5*	1348-0502527	23 01 48.63	44 48 29.1	12.91	0.64	0.73893	EB	
6	3626-01166-1	23 02 22.43	47 21 29.2	9.88	0.14	24.34	SR+L	
7*	1368-0523132	23 02 33.14	46 49 48.4	9.44	2.78	265.5	M	NSV14395
8	1381-0572277	23 02 52.10	48 06 10.1	11.66	0.46	52.3	SR+L	W8401
9	1342-0511619	23 03 25.74	44 12 13.5	13.05	0.35	2.6670	EA	
10	3622-02298-1	23 03 43.68	46 29 15.6	10.87	0.15	22.46	SR+L	
11*	3631-00011-1	23 03 50.99	48 51 53.5	9.64	2.57	198.1	M	AZ And
12	1373-0593303	23 04 15.60	47 19 51.9	12.45	0.30		SR+L	
13	1383-0527110	23 04 18.55	48 19 48.0	13.00	0.30	0.20085	RRAB	
14	3627-00110-1	23 04 22.82	47 03 18.5	10.33	0.14	60.24	SR+L	
15	3627-00436-1	23 05 22.84	47 40 34.8	11.16	0.57	0.9351	EA	AA And
16	1385-0485929	23 06 04.06	48 35 24.8	11.70	0.35	0.23385	RRAB	
17	1382-0557956	23 06 06.37	48 15 55.5	11.50	0.30	61.1	SR+L	W8420
18	1342-0512794	23 06 21.64	44 12 18.3	12.68	0.30	1.0974	EA	
19*	1372-0594633	23 06 36.23	47 15 30.6	12.30	0.46	0.39678	EW	
20	1393-0484769	23 06 38.12	49 23 27.5	11.73	0.47	1.2121	EA	
21	1372-0594793	23 06 54.93	47 16 36.3	11.23	0.35	78.5	SR+L	W8425
22	1384-0496799	23 07 15.07	48 28 41.3	11.80	0.35		SR+L	
23*	1380-0585624	23 07 18.40	48 05 36.2	10.62	0.25	143.4	SR+L	
24	3228-00350-1	23 07 29.23	44 29 50.0	10.15	0.25	37.31	SR+L	
25	1345-0502344	23 07 37.30	44 31 18.1	11.44	0.25		L	
26	1351-0505564	23 07 41.88	45 09 31.2	9.04	0.56		SR	
27	1341-0510466	23 08 07.81	44 10 45.7	10.07	0.36		SR+L	W8435
28	1340-0493850	23 08 19.80	44 00 47.9	11.38	0.76	98.2	SR+L	
29	1390-0488955	23 09 15.37	49 01 32.8	12.10	1.80	290.9	M	W8444
30	1382-0559992	23 09 19.93	48 14 47.5	13.56	0.39	0.5864	EB	
31	1352-0513026	23 09 35.25	45 16 44.6	12.70	0.25	27.064	C:	
32*	3627-01580-1	23 10 12.43	47 34 14.2	9.15	0.40	0.9375	EA	
33	1382-0560936	23 10 50.28	48 15 49.2	9.56	0.31		L	
34*	1370-0565053	23 11 30.06	47 02 52.6	10.86	1.44		M	
35	3627-01393-1	23 11 47.20	48 03 18.3	10.20	0.45		SR+L	
36	1340-0495435	23 12 23.52	44 05 33.8	10.70	0.36		SR+L	W8461
37	1351-0507811	23 12 33.59	45 11 58.8	11.97	0.28		SR+L	
38	1351-0507944	23 12 53.26	45 06 03.3	12.73	0.27	31.1	SR+L	
39	1354-0521070	23 12 53.23	45 29 13.2	10.86	0.36	58.6	SR+L	
40	1386-0488556	23 13 20.02	48 39 26.6	12.15	0.58		SR+L	W8469
41*	3623-02323-1	23 13 22.90	46 08 51.1	11.62	0.69	2.7676	EA	TT And
42	3229-02131-1	23 13 26.27	44 01 26.1	11.00	0.10	0.16878	DS	
43	1343-0517147	23 13 52.37	44 20 08.7	11.64	0.35		L	
44	3229-02271-1	23 15 31.46	44 11 25.1	9.34	0.23		L	
45	1387-0489759	23 16 03.21	48 46 35.6	12.70	0.25		L	
46	3640-00992-1	23 16 09.86	48 01 29.9	10.67	0.20	0.61128	RRAB	
47	1374-0597426	23 16 22.09	47 29 09.4	11.80	0.30		L	
48	3229-01054-1	23 16 52.99	44 29 18.3	11.20	0.46	0.7426	EB	
49	1385-0492074	23 17 26.14	48 33 06.1	12.70	0.15	0.45366	RRAB	DE And
50*	1344-0510547	23 17 29.50	44 26 14.9	12.85	0.25	0.45559	EW	
51*	1367-0520136	23 17 59.60	46 45 12.3	9.42	3.05	308.9	M	AO And
52*	3644-02114-1	23 18 02.35	48 46 58.3	10.82	0.58	0.71121		AC And
53	1389-0492848	23 18 18.82	48 57 31.4	8.90	2.86		M	AI And
54	1368-0531134	23 18 20.89	46 53 36.3	10.55	0.18	43.7	SR+L	
55	3640-00047-1	23 18 40.26	48 11 21.1	10.13	0.14		SR	DF And
56	3229-01483-1	23 18 58.37	44 05 48.5	11.16	0.19	44.6	RV	
57	1385-0492948	23 18 59.18	48 31 30.0	13.60	0.30	0.9786	EA	V452 And
58	1368-0531664	23 19 31.36	46 52 25.8	10.98	1.23	266.4	SR+L	W8498
59*	3644-02160-1	23 19 31.93	49 27 24.9	9.34	0.18		SR+L	

Table 2 (continued)

No	USNO B1.0/ Tycho2 ID	α [2000] h m s	δ [2000] ° ′ ″	$m_{\max}$ [mag]	A [mag]	P [days]	Type	Name
60*	3636-00729-1	23 19 32.55	45 55 32.0	12.22	0.60	4.279	EA	NSV 14500
61	3229-00049-1	23 19 45.40	44 49 29.5	8.83	0.28		L	
62	3229-00048-1	23 19 50.52	44 07 33.4	11.49	0.43	0.33271	EW	
63	3640-00752-1	23 19 58.89	47 14 34.6	9.08	0.30		SR	EU And
64	1387-0492673	23 21 00.87	48 46 09.6	12.30	0.80	241.7	SR+L	
65	3644-00437-1	23 21 17.37	49 28 46.7	9.70	0.25		L	
66	1394-0495072	23 21 27.18	49 25 39.4	11.98	0.12		SR+L	
67	1358-0513837	23 21 45.32	45 52 08.6	12.68	0.46	1.5098	EA	
68	1372-0603608	23 22 32.36	47 15 41.3	10.53	0.20	50.9	SR+L	
69	1392-0493896	23 23 00.63	49 14 33.7	13.05	0.40	0.41255	EW	
70	1346-0505774	23 23 04.84	44 37 05.5	9.78	0.67		SR+L	W8522
71	1371-0592715	23 23 05.80	47 06 51.9	11.63	0.35	56.7	SR+L	
72	3636-00338-1	23 23 14.17	45 24 58.9	8.73	0.29		SR	EV And
73	1384-0506412	23 23 33.36	48 27 10.7	9.78	0.45		SRA	BT And
74	3636-01830-1	23 24 01.81	46 52 12.6	8.85	0.39		L	NSV26077
75	3640-01137-1	23 24 29.12	47 43 50.1	11.55	0.10	1.6116	EA	
76	1392-0494655	23 24 30.19	49 12 56.7	12.32	0.48		SR+L	
77*	1390-0497457	23 24 38.66	49 03 01.9	10.75	0.58	239.1	SR+L	DH And
78	3636-02029-1	23 24 41.26	46 38 26.3	9.15	0.21		L	
79	3640-00731-1	23 24 48.92	48 30 07.3	12.45	0.20	1.2138	EA	
80	3242-00444-1	23 24 50.69	43 34 52.9	11.52	0.17	8.230	C:	
81	1384-0507301	23 25 07.63	48 25 02.6	11.35	0.17		SR+L	
82	1387-0494785	23 25 10.66	48 44 44.2	10.70	0.16	31.1	SR+L	
83	1372-0605032	23 25 12.63	47 14 48.6	10.67	0.43	57.8	SR+L	
84	1381-0587069	23 25 19.25	48 07 45.7	11.45	0.18		SR+L	
85*	1357-0528214	23 25 41.71	45 42 04.6	12.02	1.42		SR+L	V338 And
86	1370-0571459	23 25 44.81	47 05 14.0	11.62	0.49		SR+L	W8534
87	3644-01974-1	23 26 11.53	49 13 15.0	9.40	0.22	112.4	SR+L	
88*	1352-0519966	23 26 42.58	45 14 56.7	9.26	2.68	262.2	M	AL And
89*	1389-0497399	23 26 56.38	48 57 21.3	11.78	0.42	3.3892	IS	DI And
90	3637-00416-1	23 27 06.68	45 33 22.0	11.27	0.61	0.38044	EW	LO And
91*	1378-0620232	23 27 37.99	47 48 01.7	10.60	0.20		SR+L	
92	3242-00507-1	23 27 52.08	44 54 15.0	12.22	0.36	0.38542	RRC	
93	3242-00009-1	23 28 08.07	44 56 21.1	9.90	0.46		SR+L	
94*	3637-00396-1	23 28 27.49	45 22 40.3	10.63	0.42	1.7176	EA/RS	
95*	1356-0529574	23 28 56.89	45 38 29.4	10.53	0.24		SR+L	
96	1354-0527514	23 29 33.51	45 26 23.3	12.63	0.58	10.063	EA	
97	1359-0512348	23 29 33.62	45 59 09.4	12.82	0.32	0.4556	EW	
98	1386-0497150	23 29 43.21	48 36 57.8	12.90	0.40	0.6945	EA	
99*	1389-0498655	23 29 47.01	48 57 19.0	9.90	0.57	193.8	SR+L	DL And
100	3641-01548-1	23 29 53.81	46 58 08.3	9.35	0.20		L	
101	1335-0492761	23 30 34.31	43 30 42.4	11.71	0.22		SR+L	
102	3637-01152-1	23 30 37.25	46 24 04.2	10.62	0.29	0.09966	DS	
103	1381-0590162	23 30 49.96	48 11 31.9	10.92	0.48	63.9	SR+L	
104	1352-0521597	23 30 55.26	45 16 23.5	13.81	0.67	3.2041	C:	
105	3243-01131-1	23 32 01.32	43 49 20.4	8.58	0.12	0.38956	E	V0389 And
106	3637-01335-1	23 32 41.34	46 47 57.5	10.67	0.23	2.84822	EA	
107	3645-02066-1	23 33 39.95	48 49 05.9	9.25	0.49		ZAND	Z And
108*	1363-0512296	23 34 07.67	46 20 02.3	10.63	2.97		M	V339 And
109	1346-0510292	23 35 12.33	44 39 33.9	13.72	0.42	0.36169	EW	
110	1374-0607334	23 35 28.51	47 28 25.4	12.05	0.18	64.4	SR	
111	1337-0495784	23 35 33.34	43 46 56.6	13.30	0.30	0.36346	EW	
112	1369-0548757	23 36 03.75	46 55 46.2	10.87	0.44		SR+L	W8573
113	3243-00962-1	23 36 27.78	44 07 24.2	10.43	0.47	1.5580	EA	
114	3641-00151-1	23 36 45.01	48 40 15.6	11.38	0.57	0.9862	EB	AD And
115	1388-0498738	23 37 38.14	48 53 26.5	12.70	0.40	78.9	SR	
116	1384-0513395	23 37 38.48	48 24 11.9	12.20	1.20		INSB	BM And
117	1382-0578479	23 37 45.69	48 13 22.9	11.14	0.24		SR+L	
118*	1336-0497796	23 37 55.42	43 36 36.5	10.44	0.48		SR+L	

Table 2 (continued)

No	USNO B1.0/ Tycho2 ID	α [2000] h m s	δ [2000] $\circ$ $'$ $''$	$m_{\max}$ [mag]	A [mag]	P [days]	Type	Name
119	1392-0501449	23 38 40.21	49 12 23.4	10.48	0.55	121.6	SR+L	W8586
120	3243-00348-1	23 38 48.75	44 24 45.4	9.27	0.35	2.0232	EA	V392 And
121	1340-0505196	23 39 06.29	44 03 06.0	9.40	0.52		SR+L	
122	1354-0531767	23 39 12.43	45 27 51.7	12.85	0.63	0.33802	EW	
123	3642-02010-1	23 39 51.91	47 45 01.8	12.70	1.50	1.6324	EA	EX And
124*	1348-0518558	23 40 40.76	44 48 55.9	9.26	0.26		L	
125	1372-0613113	23 40 42.27	47 14 26.0	12.00	0.30		SR+L	
126	3642-02398-1	23 41 29.68	47 35 43.8	8.22	0.40	95.3	SRD	WY And
127*	1337-0498239	23 41 43.33	43 45 17.1	12.11	0.17	0.51885	EW	
128*	1341-0523884	23 41 54.99	44 10 40.8	10.48	0.20		BY	HH And
129	3638-01097-1	23 42 09.08	46 24 34.0	10.14	0.87		SR+L	W8599
130	3244-00262-1	23 42 29.52	43 46 01.8	10.27	0.24		SR+L	
131	1378-0628992	23 42 57.30	47 49 20.1	11.14	0.23		SR+L	
132	1384-0516099	23 42 58.31	48 27 16.0	11.15	0.20		SR+L	
133	1356-0536414	23 43 47.32	45 40 45.4	12.23	0.40		L	
134	1381-0598307	23 44 18.90	48 08 50.1	11.10	0.17		SR+L	
135	3638-01617-1	23 44 53.55	45 41 11.5	11.06	0.39	23.183	EA	WW And
136*	1335-0498073	23 44 59.42	43 31 25.0	13.20	1.45		L	

Remarks:

5: Information in the VSX database (reported by J.S. Shaw, D. Hou).

7: NSV14395=W8400, Mira type, with $A = 2\overset{m}{.}749$ and $P = 248^{d}$.

11: AZ And=W8405.

19: Discovered by Gettel et al. (2006).

23: Information in the VSX database (discovered by M. Nicholson).

32: The other name is SAO 52758.

34: Very big amplitude $A \geq 1\overset{m}{.}44$, but not found as variable by Woźniak et al. (2004b).

41: The period in the GCVS is $P = 2\overset{d}{.}765142$.

50: Visual binary, separation $8''$, the other component with the 2MASS coordinates: $\alpha = 23^{h}17^{m}29\overset{s}{.}58$, $\delta = +44^{\circ}26'22\overset{''}{.}5$. The NSVS data accuracy is insufficient to determine which component varies.

51: AO And=W8491, the period in the GCVS is $P = 334\overset{d}{.}2$.

52: A multiple-period star. The primary period in the GCVS is $P = 0\overset{d}{.}52512677$, but this period cannot be found in the NSVS data. The third GCVS period based on the NSVS data is $P = 0\overset{d}{.}421253$.

59: The other name is SAO 52908.

60: The NSV coordinates are shifted by approximately $100''$ from the NSVS position.

77: DH And=W8526.

85: V338 And=W8533.

88: AL And=W8538.

89: The GCVS describes DI And as type IS (a rapidly changing irregular variable). Khruslov (2005) found a period $P = 3\overset{d}{.}388$.

91: USNO coordinates.

94: X-ray source 1RXS J232827.5 +452242.

95: USNO coordinates.

99: DL And=W8549.

108: V339 And=W8565.

118: Information in the VSX database (discovered by M. Nicholson).

124: Information in the VSX database (discovered by M. Nicholson).

127: The NSVS coordinates are influenced by a close object of similar brightness, USNO 1337-0498237.

128: X-ray source 1RXS J234155.0 +441047.

136: Discovered by Dahlmark (1999). The NSVS coordinates are influenced by a close object of similar brightness, USNO 1335-0498064.

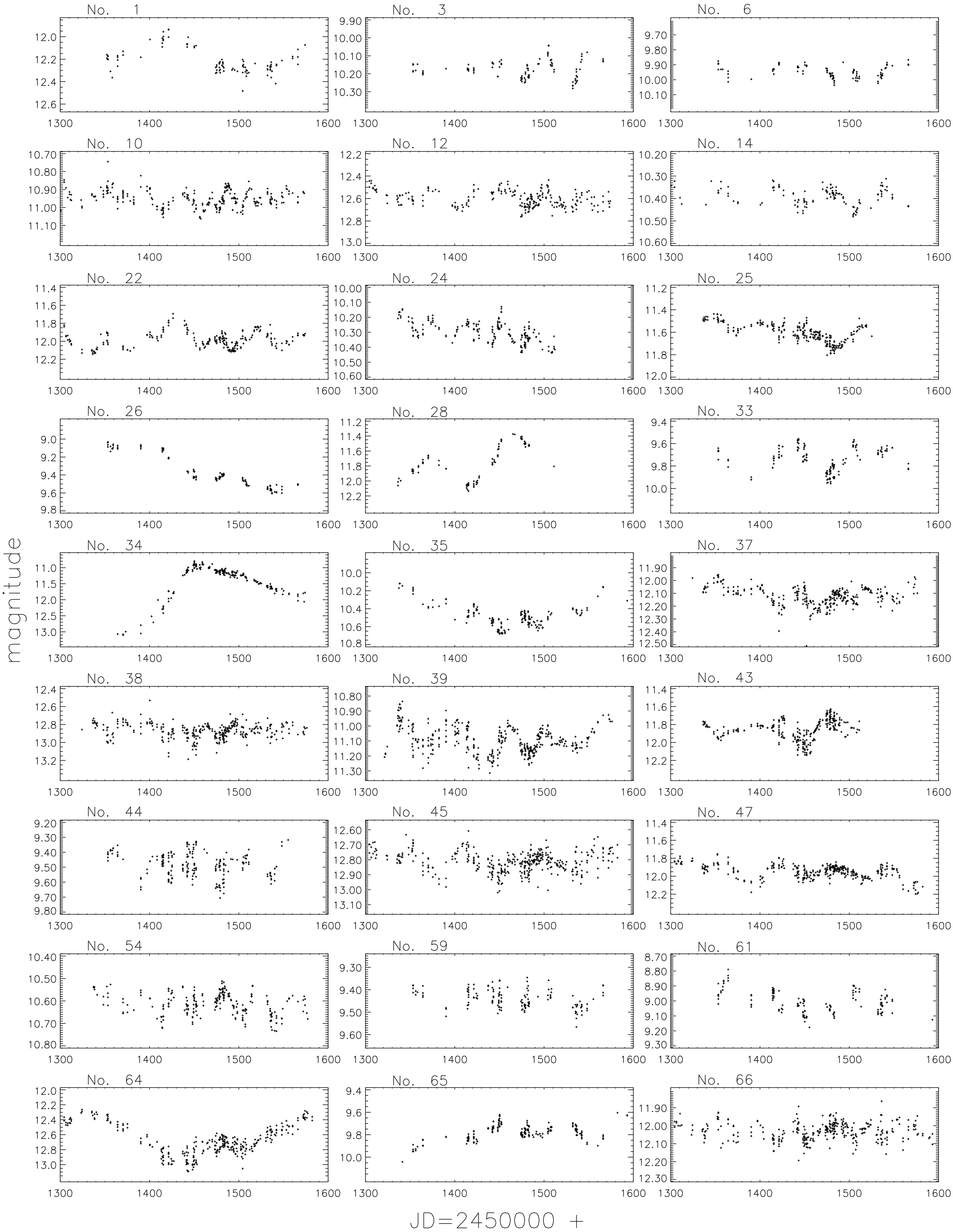

Figure 1. Light curves of irregular and semiregular variable stars. Title numbers correspond to those in Table 2.

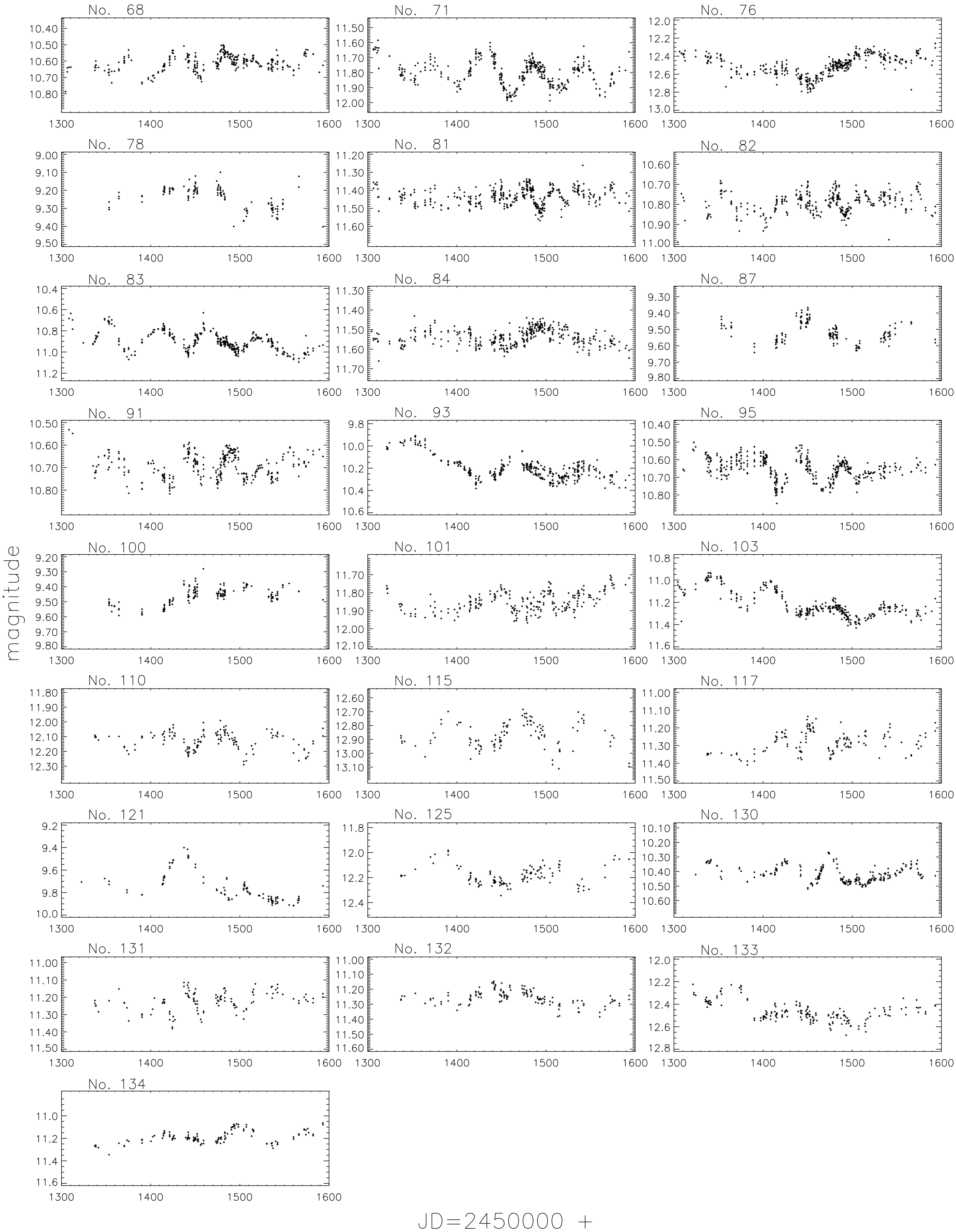

Figure 1. (continued)

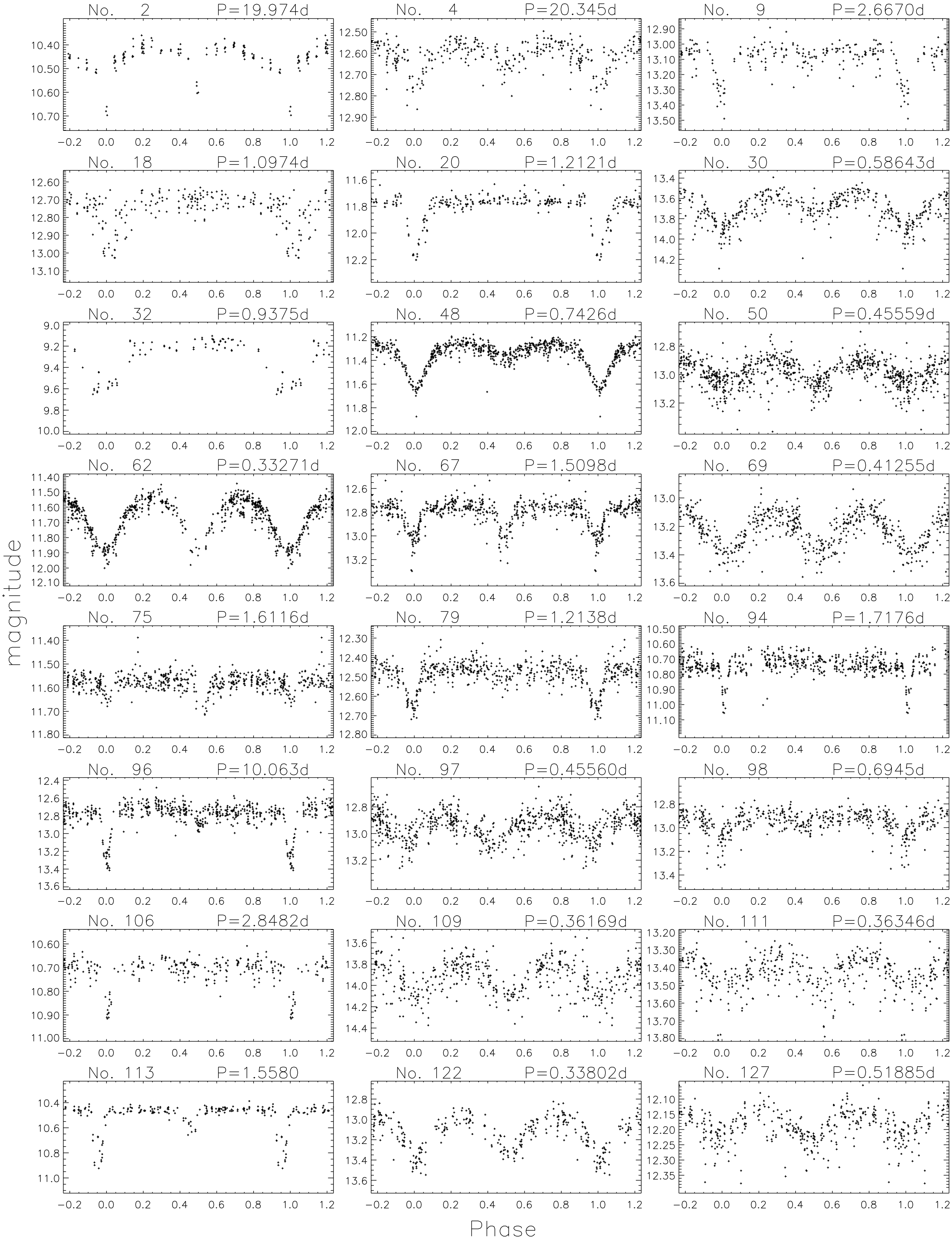

Figure 2. Light curves of eclipsing binaries. Title numbers and periods correspond to those in Table 2.

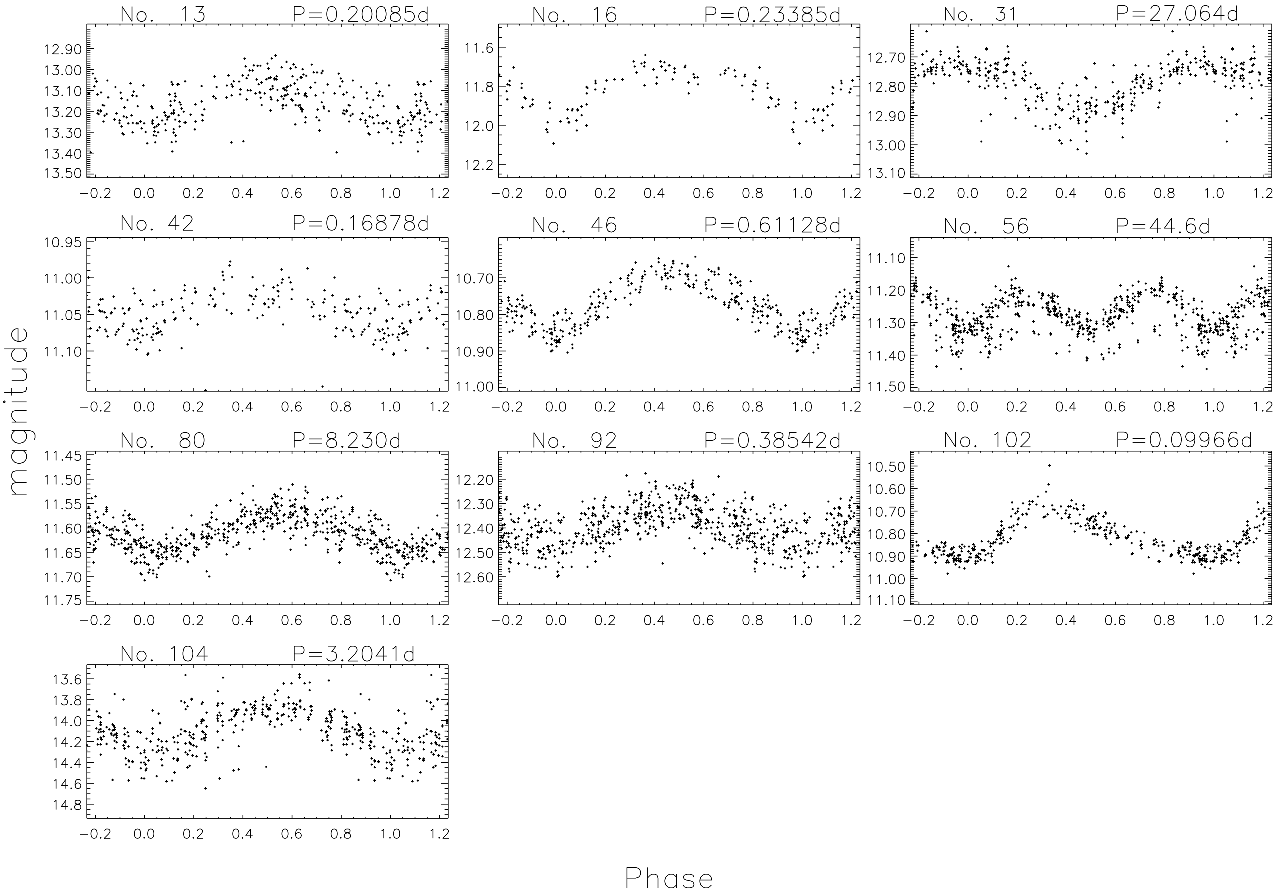

Figure 3. Light curves of periodic variable stars. Title numbers and periods correspond to those in Table 2.