UKRVO – FEATURES AND COMPARISON OF THE NEW CATALOGUE OF PHOTOGRAPHIC SURVEY OF THE NORTHERN SKY

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ABSTRACT. UkrVO plate archives contain information obtained at different observatories for a long time. With using data of photographic survey of the northern sky (FON project, from -4° to 90°) in Main Astronomical Observatory of National Academy of Science (MAO) new catalogue of positions and magnitudes was obtained. The catalogue contains coordinates and magnitudes of more than 19 million stars and galaxies from 3^m to 17.5^m for the mean epoch of 1988.3. Comparison with the catalogues UCAC4, PPMX, XPM was carried out. The differences of common stars positions between catalogues are from 0.05"-0.06" for the 9-11^m stars to 0.30"-0.40" for the 5-7^m and 15-16^m stars. The differences of common stars B-magnitudes between catalogues are from 0.05^m-0.10^m for the 10-11^m stars to 0.4^m-0.5^m for the 6-7^m and 15-16^m stars. The obtained results suggest the advisability of using the new catalogue for improving proper motions of stars within the range of 8^m-14^m magnitudes.

Keywords: Astrometry – catalogues – methods: data analysis

1. Introduction

UkrVO plate archives contain information obtained at different observatories for a long time (Vavilova et al, 2010, 2011, 2012a, 2012b, 2014). New catalogue FONAC3 obtained from the Photographic Survey of the Northern Sky (observation 1980-1995 from -4° to 90°) in Main Astronomical Observatory of National Academy of Science (MAO NASU) in 2016 (Andruk et al., 2015, 2016a, 2016b). For our extended comparison of the FONAC3 catalogue we used the UCAC4 (Zacharias et al., 2013), PPMX (Roeser et al., 2008) and XPM (Fedorov et al., 2009) catalogues and own special software (Protsyuk et al., 2014, 2015a, 2015b).

2. FONAC3 catalogue parameters

The catalogue contains coordinates and magnitudes of more than 19.5 million stars and galaxies from 3^m to 17.5^m for the mean epoch of 1988.3 (Figure 1). Mean errors of catalogue are 214 mas in right ascension and 197 mas in declination (Figure 2). The mean number of observations for most objects of the catalogue is 4 (Figure 3). The catalogue also includes near 1.9 million stars with one observation, 5.6 million with two observations and ~1.2 million stars identified with the stars of the Tycho-2 catalogue.
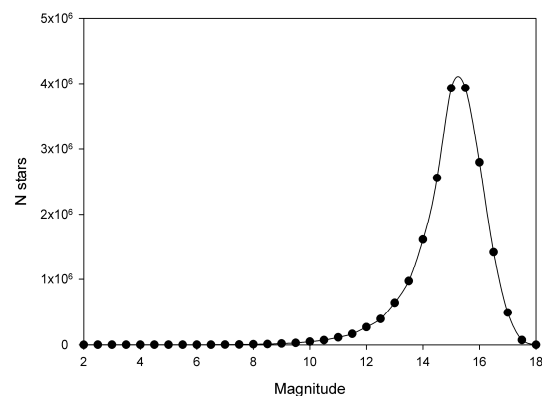

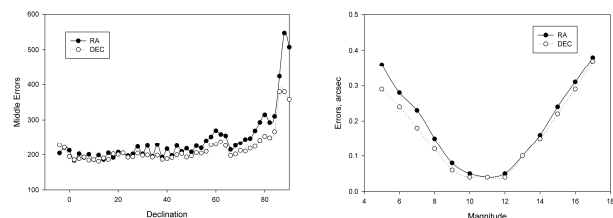Figure 1: Distribution of stars of FONAC3 catalogue vs magnitude.

Figure 2: Standard deviations (SD) of catalogue positions vs declinatiom (left) and vs magnitude (right).
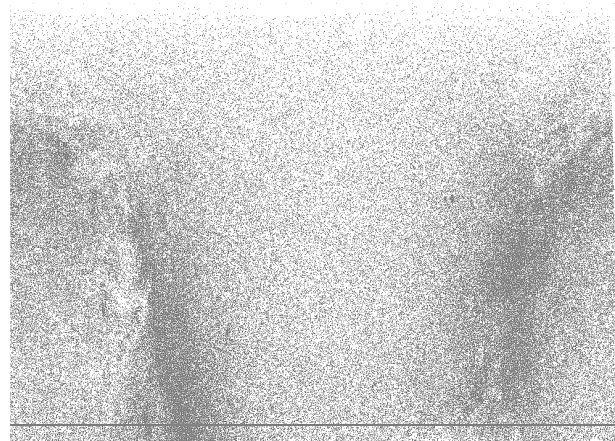

Figure 3. Distibution of density of FON catalogue in right ascension and declinationon.

3. Comparison with PPMX catalogue

PPMX catalogue contains more than 18 million stars up to 15.2 magnitude. In declination zone from -4 to 90 number of stars is near 9.5 million. We made cross-identification of FONAC3 and PPMX catalogues with the search window 1.5" and found near 7.67 million common stars. This amount is about 39% of the FONAC3 catalogue. Also, we identified 1.37 million common stars having B-magnitudes and used them for analysis of the FONAC3 catalogue magnitudes. Mean systematic differences between catalogues are 63 ± 218 mas in right ascension, 39 ± 228 mas in declination and 0.04 ± 0.19^m in B-magnitude. Distribution of RMS of differences between catalogues in coordinates and magnitudes are shown in Figures 4,5.

4. Comparison with XPM catalogue

The XPM catalogue contains of about 314 million stars in the magnitude range $10^m < V < 20^m$. We made cross-identification of FONAC3 and XPM catalogues with the search window 2.2" and found near 18.48 million common stars. This amount is about 94.4% of FONAC3 catalogue. From this set we used 16.64 million stars with two and more observations. Mean systematic differences between catalogues are 33 mas in right ascension, 52 mas in declination and 0.06^m in B-magnitude. Mean (O-C) differences between
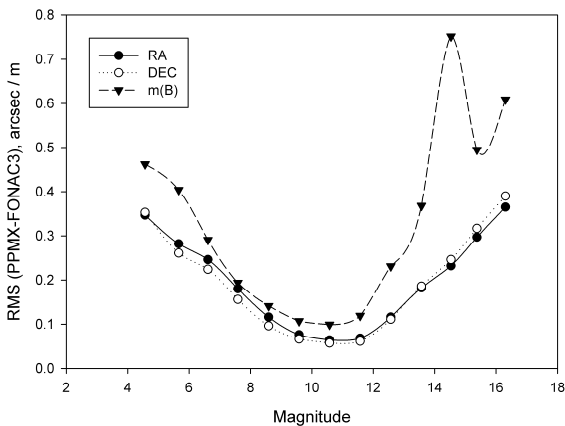
XPM and FONAC3 catalogues are 305 mas in right ascension, 312 mas in declination and 0.36^m in B-magnitude. Linear correlation of B-magnitude between catalogues is near 0.89. Distribution of mean (O-C) differences between catalogues in coordinates are shown in Figures 6,7.

5. Comparison with UCAC4 catalogue

The UCAC4 catalogue contains of about 113 million stars in the magnitude range $8^m < V < 16^m$. We carried out cross-identification of FONAC3 and UCAC4 catalogues with the search window 2.2" and found near 19.09 million common stars. This amount is about 97.6% of FONAC3 catalogue. From this set we used 17.2 million stars with two and more observations. Mean systematic differences between catalogues are 28 mas in right ascension, 38 mas in declination and -0.64^m in B-magnitude. Mean (O-C) differences between UCAC4 and FONAC3 catalogues are 302 mas in right ascension, 308 mas in declination and 0.41^m in B-magnitude. Linear correlation of B-magnitudes between catalogues is near 0.87. Distribution of mean (O-C) differences between catalogues in coordinates are shown in Figures 8,9.

6. Conclusion

The study of the new catalogue FONAC3, including more than 19.5 million stars from 3^m to 17.5^m for the mean epoch 1988.3, and its comparison with catalogs UCAC4, PPMX and XPM was done (Figure 10-12).

Figure 4: Distribution of RMS of differences PPMX-FONAC3 in coordinates and magnitudes vs magnitude

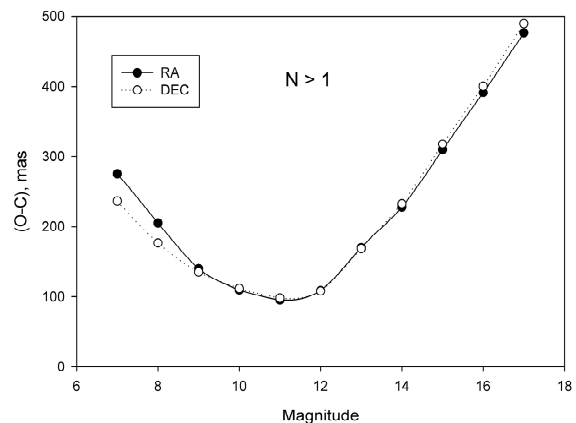Figure 6: Distribution of mean (O-C) differences XPM-FONAC3 in coordinates vs magnitude.

Figure 5: Distribution of RMS of differences PPMX-FONAC3 in coordinates and magnitudes vs declination.
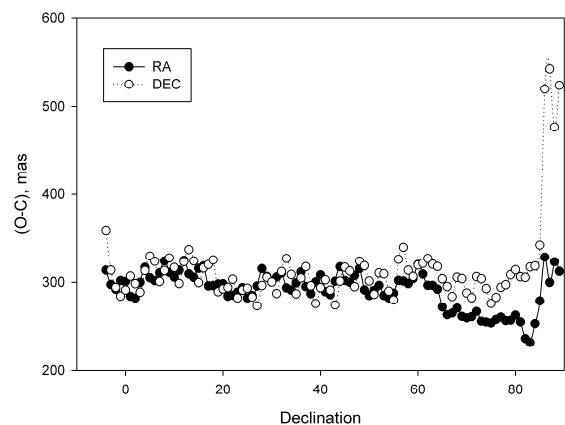

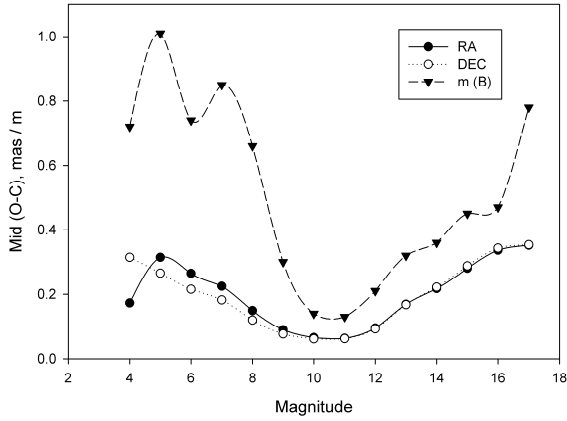Figure 7: Distribution of mean (O-C) differences XPM-FONAC3 in coordinates vs declination.

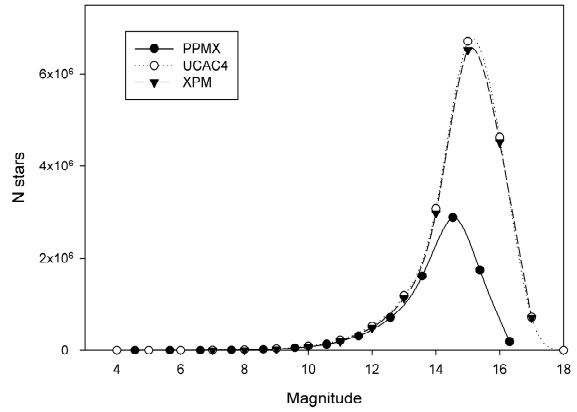Figure 8: Distribution of mean (O-C) differences UCAC4-FONAC3 in coordinates and magnitudes vs magnitude.
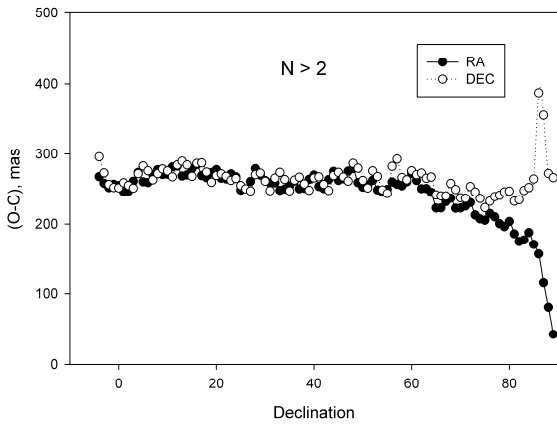

Figure 9: Distribution of mean (O-C) differences UCAC4-FONAC3 in coordinates vs declination for stars with more than two observations.
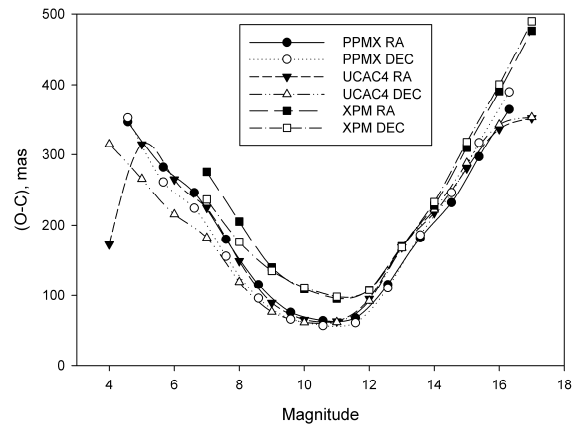

Figure 10: Distribution of common stars of FONAC3 catalogue with other catalogues vs magnitude.

Figure 11: Distribution of mean (O-C) differences between FONAC3 and other catalogues in RA and DEC.

Figure 12: Distribution of mean (O-C) differences between FONAC3 and other catalogues in magnitude.

The most accurate part of the new catalogue includes about 5 million stars from 8^m to 14.5^m (Figure 11).

The convergence of the coordinates was better in comparison with UCAC4 and PPMX catalogues (Figure 11), the convergence of magnitudes was better for PPMX (Figure 12).

The XPM catalogue showed the worst convergence with FONAC3 in coordinates and in magnitudes (Figure 11-12).

In comparison with all catalogues the FONAC3 indicated low accuracy in the pole region.

These results suggest the feasibility of using this new catalogue to improve proper motions of stars in the range of 8^m - 14^m and from $-4°$ to $80°$.
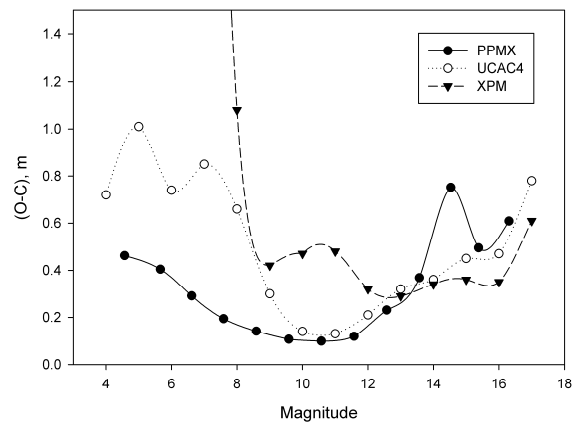
References

Andruk V. et al.: 2015, *arxiv.org/abs/1512.05535*
Andruk V. et al.: 2016, *Kinem. Phys. Cel. Bodies*, **32**, **N1**, 56.
Andruk V. et al.: 2016, *Kinem. Phys. Cel. Bodies*, **32**, **N5**, 1.
Fedorov P. et al.: 2009, *MNRAS*, **393**, 133.
Protsyuk Yu. et al.: 2014, *OAP*, **v.27/1**, 59.
Protsyuk Yu. et al.: 2015, *OAP*, **v.28/2**, 202.
Protsyuk Yu. et al.: 2015, *OAP*, **v.28/2**, 207.

Roeser S. et al.: 2008, A&A, **488**, 401.
Vavilova I.B. et al.: 2010, *KosNT.,* **16, N5**, 62.
Vavilova I.B. et al.: 2011, *KosNT.,* **17, N4**, 74.
Vavilova I.B. et al.: 2012, *Kinem. Phys. Cel. Bodies*, **28, N2**, 85.
Vavilova I.B. et al.: 2012, *Baltic Ast.,* **21, N3**, 356.
Vavilova I.B. et al.: 2014, *OAP*, **v.27/1**, 65.
Zacharias N. et al.: 2013, *Astron. J.,* **145,** 44.