PROBLEMS OF LOCAL PLUMB RECONSTRUCTION FROM LONG-TERM ASTROOPTICAL SETS

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ABSTRACT. Problems of reconstruction of a local plumb variations from long sets of astrooptical observations are considered. The attempt of its practical realization on the data of latitude observations in Poltava with 3 astrometrical instruments is undertaken.

Key words: Astrometry: latitude variation, zenith-telescope, astrolabe; geodynamic: local plumb, the Earth figure evolution.

1. Introduction

Long-term sets of astrometrical observations of coordinates of station contain diverse information about processes in all geo-stratums. Most important for geodynamic is information about variations of local plumb (Gozhy, Tyshchuk,1995). Available data about local plumb are contained in slow zenith variations which are caused by many factors. There are the reasons to solve this problem now. The pure local vertical variations may be obtained after excluding such factors from zenith variations. 1) Polar component, by using C04 solution for EOP. 2) Errors of coordinates and proper motions of stars, by using new catalogues (HC, ARIHIP, FK6, Thycho-2). 3)Inexactitude of Earth rotation model, by using IAU2000 precession-nutation model. 4) Influences of tectonics of lithosphere plates, by basing on NUVEL-1 NNR model. 5) Local shifts of Earth crust, by geodetic monitoring. 6) Long-term instability of instrumental system should be researched specially. 7) Possible long-term influences of atmospheric states. The last two items are problematic. The use of the observations results obtained with several instruments at the same station gives opportunity to avoid the problems. There is the opportunity in Poltava gravimetrical observatory (PGO) where the regular observations of latitude have been conducted with 3 instruments (2 zenith-telescopes (Z-t) and prismatic astrolabe) during 30-40 years.

2. Initial data

For preliminary attempt to obtain local plumb variations, 3 latitude sets had been used. There is short information about them in Table 1.

Table 1: Set characteristics.

Instrument	Observational method	Duration	Short marking
Astrolabe	equal height	1962-2007	FA
Z-t Zeiss	Talkot pairs	1949-1987	FZ
Z-t Zeiss	zenith stars	1939-1967	FB
Z-t ZTL-180	zenith stars	1968-2007	FB

The set FA and fragment of FZ (1962-1987) are reprocessed in reference to the ICRS catalogues (HC, ARIHIP, Thycho-2) and with use of the IAU2000 precession-nutation model. The combined series of bright zenithal stars observations FB were kindly given to us for analysis by colleagues A.Gozhy and M.Tyshchuk. The common analysis for three series is conducted beginning with 1962.0. The sets were reduced to single origin, which coincides with astrolabe point, by using the geodetic determining (Popov, Budz'ko,1980; Samoilenko *et al.*,1999). The geodetic measurements do't show relative displacements of instruments during twenty years. GPS observations, that began in PGO in 2001, also reveal the absence of horizontal moving. The change of latitude due to move of Eurasian plate is taken into account. Non-polar components of latitude are obtained by excluding of the polar ones, by using C04 EOP solution. Long-term instrumental instability are determined most carefully for astrolabe (Khalyavina *et al.*, 2001). So the resulting series are refined from factors 1-6.We mark them as ZA,ZZ,ZB, respectively. Due to some uncertainty of instrumental errors for FZ set the common analysis of three series have shortened up to 1981.0.

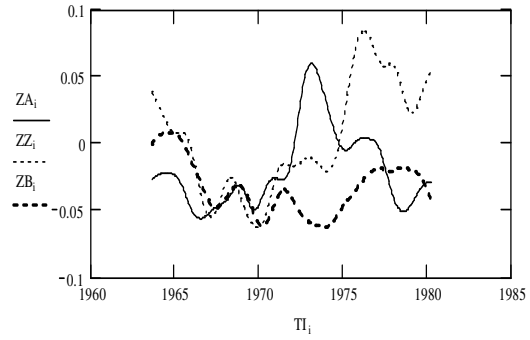

Figure 1: Slow zenithal variations in meridian observations with 3 instruments.

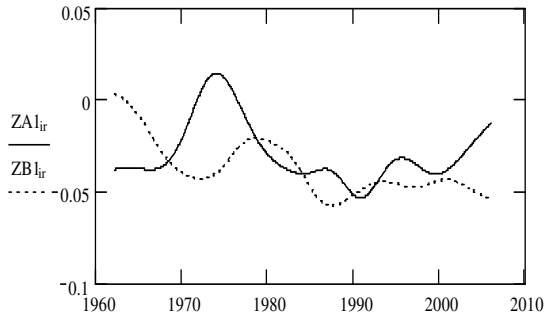

Figure 2: Slow zenithal variations from observations with astrolabe and zenith-telescope ZTL-180.

3. The reconstruction variances

In order to obtain slow zenith variations the series ZA,ZZ,ZB was smoothed by movin method with Gauss window with 1,5 year w high-frequency variations of zenith in meric cut down. The smoothed curves are presente

During of 1964-1972y. all curves were locat ridor with width less then 0,05″ and correlati cients between them approached to 0,9. Thi may be one of the basic segments for recon of local plumb. Since 1972 the curves div bly up to 0,12″. Similar results had been in the earlier analysis (Popova *et al.*,1983). T ble reason of the divergences may be due to of non-modeling refraction on diverse observ stars (zenithal, meridional, at equal heights). that discrepancies of real conditions of at from its standard model differ considerable case. Indirectly it is confirmed by degree of c between the short-periodic components for ZB sets: corr(ZA^s,ZZ^s)=0,11; corr(ZA^s,ZI corr(ZZ^s,ZB^s)=0,37. The components depen on refractions.

Obviously, refractional and plumb effect be separated for the middle-term variations ($1.5 < T < 6.0$). As the atmospheric influ more instable comparing the slow variations we have increased the smoothing window to So refractional influences on resulting curves diminished considerably. In Fig.2 new versio ations of meridional component of zenith fo and ZB is presented on 44-year interval (196

The divergences between two curves do n 0.055″ now. For long-term intervals they in bounds of 0.01″. These segments are ones, which are cleaned from refractional i to a marked degree. We suppose that they the supported data for local plumb recons The average meanings of ZA and ZB dat corresponding intervals can be seen as a first

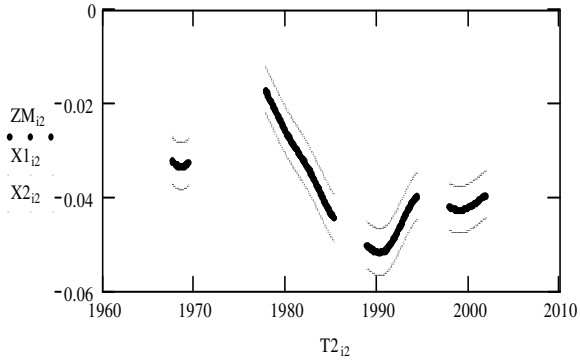

Figure 3: Fragments of reconstructed plumb variations in Poltava.

Derived fragments of curve ZM show: 1)non-linear character of changes; 2)the negative trend with rate about -0.0006"/y. on interval 1962-2006y. The results should be thoroughly checked and compared with data of other geophysical sciences.

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