POLAR MOTION AND EARTH ROTATION MONITORING IN CANADA

J. Popelar
Earth Physics Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

PZT observations of the Earth's rotation and polar motion have been carried out from observatories near Ottawa and Calgary since 1952 and 1968 respectively. A comprehensive re-evaluation and analysis of the PZT data is currently under way, using a new self-contained computer program which can easily accommodate changes of astronomical constants as well as modifications of the star catalogue.

So far Ottawa PZT observations from the period 1956-1977 have been re-reduced in a uniform manner. Insufficient documentation and poor data quality made the re-processing of the 1952-1955 observations unprofitable. These results were obtained using two instruments (PZT 1 during 1956-1968 and PZT 2 since March 1968) operating from four different locations (the PZT was relocated in March 1960, January 1970 and December 1970). The interruptions in the observation series have been removed using a least squares technique for determining the datum bias and linear trend.

The observed rotational time (UT0) has been referred to an atomic time system which corresponds to TAI since 1961; the observations prior to 1961 have been related to TAI using A.1 (USNO). No appreciable linear trend has been determined for the latitude observations over the 22 years although some long period (> 1200 days) variations with relatively small amplitudes (< 0$''$.03) can be detected. The observations of rotational time show an average offset of -247×10^{-10} with respect to the atomic time scale over the 22 year period. With some fluctuation the offset has a clear tendency to decrease by about -12×10^{-10} per year, from 101×10^{-10} in 1956 to -321×10^{-10} in 1977; significant deviations from this average annual change occurred between 1963-64 (-58×10^{-10}) and 1973-74 ($+31 \times 10^{-10}$).

A preliminary least squares harmonic analysis positively detected the Chandler motion in both the latitude and UT0 observations as being very closely represented by a single harmonic with the amplitude of 0$''$.135 and the period of 434 days. The analysis of seasonal variations proved to be more complex and has not yet been completed. Due to a

D. D. McCarthy and J. D. Pilkington (eds.), Time and the Earth's Rotation, 73–74.

https://doi.org/10.1017/S0074180900036020 Published online by Cambridge University Press

number of factors (e.g. systematic errors in the star catalogue, irregularities in the Earth's rotation) the seasonal variations cannot be satisfactorily represented by a simple superposition of two harmonics (annual and semi-annual).

The Calgary PZT observations will also be re-reduced in a similar way; since the Calgary PZT was set up at the latitude of the Herstmonceux PZT of the Royal Greenwich Observatory in England and the same star catalogue is used, detailed analysis and comparison of the results obtained with the two instruments will follow.

Since 1974 two satellite Doppler tracking stations have been installed at the Ottawa and Calgary PZT observatories to compare polar motion as derived from the astronomical and satellite techniques and to analyse the station-related effects in the two independent systems. The satellite results have not shown apparent seasonal variations of the stations' coordinates; however, more data are needed to carry out a satisfactory harmonic analysis and assess the long term stability of the satellite system.

The Earth Physics Branch is currently sponsoring a planned experiment to use a long baseline radio interferometer for regular observations of the Earth's rate of rotation. Using the nearly east-west 3075 km baseline between the Algonquin Radio Observatory at Lake Traverse, Ontario, and the Dominion Radio Astrophysical Observatory in Penticton, British Columbia, UT1 is to be determined at regular intervals during the summer of 1979. The plans call for operation of the interferometer in a phase-stable mode by means of pilot tones transmitted via the Canadian communications satellite ANIK-B. The preliminary error budget indicates that atmospheric effects will limit the accuracy of UT determinations in this experiment to about 1-2 ms.

The main objective of this effort is to provide an accurate reference frame for world-wide precise geodetic positioning and for studies of the dynamics of the Earth. The general recognition of the dynamic evolution of the Earth emphasizes the need for a diversified, technologically advanced monitoring service which has, besides its scientific significance, important practical applications for resource development and for studies of geophysical effects on the Earth's environment. Continuity and detailed comparison of the results from various techniques during periods of simultaneous operation are essential to full understanding of the physical phenomena involved and to the proper reduction and interpretation of the results of the observations.

A high degree of automation of routine operating procedures, data processing and communication by means of a mini-computer network greatly increases the efficiency of this long-term program; it also expedites the activities of data management and exchange which are essential, because of the need for wide-ranging international cooperation, in studies of polar motion and the rotation of the Earth.