ATMOSPHERIC ANGULAR MOMENTUM AND THE LENGTH OF DAY[1]

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ABSTRACT. We have used lunar laser ranging (LLR) observations from the McDonald Observatory in conjunction with pole positions from the Bureau International de l'Heure (BIH) to determine the length of day (l.o.d.) at five-day intervals over the period 1971 through 1979. We compared the changes in these l.o.d. values to those inferred from determinations of the angular momentum of the global atmosphere, for the years 1976-1979, computed from twice-daily analyses of the zonal wind. These latter analyses were carried out by the National Meteorological Center, Camp Springs, MD. In both the observed (LLR) and the inferred (meteorological) values of changes in l.o.d., we have identified the near 50-day oscillation recently noted by Feissel and Gambis at the BIH. For the period of overlapping dates, the two oscillations agree closely in both amplitude and phase. The typical amplitude is about 0.2 milliseconds or approximately half the amplitude of the annual and semiannual variations in l.o.d.

DISCUSSION

McCarthy : Could you comment on the contribution of atmospheric angular momentum on low-frequency variations in LOD ?

Langley : Our work to-date has concentrated on the high-frequency variations in LOD since we were interested in demonstrating the veracity of these variations, in particular the new 50-day variation. The twice-daily determination of atmospheric angular

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1. This paper has been submitted to the journal Nature under the title "Atmospheric Angular Momentum and the Length of Day: A Common Fluctuation with a Period Near 50 Days."

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O. Calame (ed.), High-Precision Earth Rotation and Earth-Moon Dynamics, 171–172.

momentum exist from the beginning of 1976 onwards. While this is not an extensive series for studying low frequency variations, we shall endeavour to look at such variations in our future work.

Kinoshita : In order to calculate z component of angular momentum of the atmosphere, did you include the total atmosphere ?

Langley : The integration over pressure is performed from the 1000 mb level to the 100 mb level. Ignoring the upper-most levels of the atmosphere incurs a systematic error of about 10 % or less in the determination of the mean value of angular momentum, but we expect it to have little impact on the day-to-day changes.

Silverberg : What is the highest frequency fluctuation in the Earth's rotation that you feel has been verified with the current VLBI, lunar laser data ?

Reply by King : I believe that the 0.3 ms fluctuations over 5-days, evident in the GSFC and NGS VLBI determinations for the MERIT period, are real. The present level of accuracy of the LLR results is just at this (0.3 ms)^2 level. Hence, we cannot yet detect such fluctuations reliably.

Yatskiv : Have you estimated the biennial variations in UT1 determined from LLR ?

Langley : No

Comment Yatskiv : There were many calculations of atmospheric effects in UT1. But, it is the first time that the two-day mean values have been determined. For the problem considered, it is very important for studying the high-frequency part of spectra of atmospheric excitation.

Shelus : Are LOD results obtained from smoothed LLR UT1 results ?

Langley : Yes.

Shelus : Are there correlations between lack of agreement of LLR and atmospheric results and data "gaps" in the LLR data set ?

Langley : Some of the differences between the variations in LOD derived from the LLR observations and those inferred from the angular momentum determinations can be attributed to gaps in the LLR data. The origin of the remaining differences is not yet known, but may be associated with deficiencies in the data used to determine angular momentum.

King : The year with the largest discrepancies is 1976. For that year, the uncertainties associated with both the lunar ranging data and the atmospheric angular momentum data are significantly larger than for later years. The year with the best agreement is 1979 in which the data are probably the most accurate, but may not be significantly more accurate than the data for 1978. We shall be anxious to compare the data for 1980 with the data for 1978 and 1979.