The time-variation of the seasonal atmospheric angular momentum functions during 1979-2001

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The time-variation of the Earth rotation is excited by the geophysical fluids, such as the atmosphere, the oceans, the land water, etc.. Among them, the atmosphere plays the main role. The atmospheric excitation is quantified by the AAM (Atmospheric Angular Momentum) functions. However, AAM functions calculated from different meterological data sets have different values. Since the annual variation of the Earth rotation reflects the seasonal mass redistribution of the geophysical fluids on the Earth, it is important to examine which data set is in good agreement with the observed excitation.

In this study, we determine the seasonal (annual and semi-annual) AAM from a seven-year AAM time series. Next, we generate the time-variation of the seasonal AAMs by sliding the seven-year time window year by year. We use three meteorological reanalysis data sets for this study: the NCEP/NCAR reanalysis (hereafter, NCEP-1), the NCEP/DOE reanalysis (NCEP-2) and the ECMWF reanalysis (ERA40). The every data set covers the data for 23 years, from 1979 to 2001.

We have found that the annual AAMs calculated from the ERA40 are different from those calculated from two NCEP reanalyses, especially, in the wind terms of the Chi-1 (which excites the polar motion) and the Chi-3 (which excites the LOD variation) components. These discrepancies are stemmed from the discrepancies in the wind fields of the original meteorological data sets. Especially, large discrepancies in the wind field are observed in the pressure level of 100-300hPa in the equatorial region. Since the Chi-3 component of the AAM function is highly sensitive to the eastward/westward zonal wind in the equatorial region, we can detect the differences in the AAMs.

Through the comparison among the AAMs calculated from three reanalyses and the observed geodetic excitations, the AAM functions based on ERA40 are in best agreement with the geodetic observation. We can also observe strange characters in the discrepancies in the Chi-3 component
between the both NCEP-AAMs and the geodetic excitation: The discrepancies decrease monotonically with the time.

We must examine the discrepancies between AAMs and the observation in other frequency bands, because the atmospheric excitations exert over the wide frequency range. However, when we quantify the atmospheric excitation, we should take care of the meterological data sets used in the analysis.