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# Seasonal Variation Analysis of Geo-Center Motion based on SLR Time Series with respect to ITRF2005

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The current origin of the International Terrestrial Reference System (ITRS) is defined as the Mass Center (CM) of the Earth, including the whole solid earth, ocean and atmosphere, which is also a dynamic center for Earth-orbit satellites. In the realization of ITRS, globally distributed tracking reference stations have been widely employed to determine the origin of the International Terrestrial Reference Frame (ITRF). However, many previous works indicated that the origin of ITRF2005 does not coincide with the CM of the Earth because of the seasonal variation of the geo-center. Therefore, geo-center motion monitoring is of significant importance, when constructing and maintaining non-linear ITRF. Normally, Satellite Laser Ranging (SLR) observations are used to obtain geo-center with three main approaches which referred as to geometry-based method, direct method and dynamic method. For the latter two approaches, complex algorithms for precise orbit determination must be applied to obtain the geo-center and orbit simultaneously. On the other hand, geometry-based method can be easily realized, but it is low precision and is very sensitive to the distribution of involved stations. In this paper, by means of existing residual products, Helmert transformation between SLR weekly solutions and ITRF2005 data are carried out to compute the seven transformation parameters series from 1993 to 2005. Then, the paper explains that the translation components of the Helmert transformation can be considered to describe the geo-center motion. Further, by applying wavelet analysis and least square fitting to the resulted time series, the seasonal variation characteristics of geo-center motion are derived quantitatively and qualitatively. The results show that the main spectral term of geo-center is annual and semi-annual periodic motion. The annual periodic motion amplitudes in three directions are 2.3mm, 3.5mm and 2.0mm respectively, and accordingly, the semi-annual amplitudes are 0.3mm, 0.6mm and 0.2mm. Additionally, there is no evidence of a long-term trend in the derived geo-center motion.