Geophysical Research Abstracts
Vol. 15, EGU2013-11309, 2013
EGU General Assembly 2013

Geocentre motion determination from multi-satellite SLR data combination

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The geocentre is the centre of mass of the solid Earth-hydrosphere-atmosphere system (CM). Mass transport occurring within the Earth and at its surface drives the spatio-temporal variations of the geocentre collectively known as geocentre motion. Various procedures for determining geocentre motion from satellite data have been developed. In principle, it is possible to estimate geocentre coordinates along with other parameters in the precise orbit determination process. Annual and semi-annual signals ranging from millimetres to a few centimetres dominate the amplitude spectra. Among the space geodetic techniques, Satellite Laser Ranging (SLR) supplies the most stable geocentre motion time series. Consequently, the International Terrestrial Reference Frame (ITRF) origin is currently realised solely by SLR observations to the LAGEOS-1 and -2 satellites. The Etalon satellites are not routinely used in SLR analyses, mainly due to their high altitudes that are outside the ranging capabilities of some ground measuring systems. On the other hand, low Earth orbit (LEO) satellites such as Starlette, Stella and Ajisai are subject to non-negligible atmospheric drag which complicates force modelling and limits the accuracy of the estimated geodetic parameters. However, it is a common practice in the geodetic community to use measurements to LEO satellites in order to produce accurate times series of low-degree and order spherical harmonic coefficients. In fact, SLR is acknowledged to be the most appropriate technique for determining the long-period time-variable gravity field, including the degree-one terms which are proportional to the geocentre coordinates. We present an SLR geocentre motion solution obtained by integrating data from seven spherical geodetic satellites. In our approach, the motion of the geocentre is defined as the temporal variation of the vector offset between the centre of surface figure (CF) and CM. The multi-satellite data combination is expected to yield improved results over single-satellite analyses. We compare our results to the LAGEOS only solution as well as to independent solutions from other studies.