Geophysical Research Abstracts
Vol. 20, EGU2018-10957, 2018
EGU General Assembly 2018

What Do We Know About the Sun's Gravity Field? Can We Measure It?

David E Smith and Maria T Zuber

Massachusetts Institute of Technology, Dept of Earth Atmospheric and Planetary Sciences, Cambridge, United States (david.e.smith@nasa.gov)

The strongest gravitational force in the solar system is the Sun, controlling the orbital motions of all the major planetary bodies, and yet we know little about the sun's gravity field beyond its central mass term. Observation of Mercury's orbit and helioseismic studies indicate a degree 2 zonal gravity coefficient larger than might be expected from a rotating gaseous sphere. In addition, there is evidence for a secular decrease in solar mass as result of the conversion of hydrogen to helium in the solar interior and particle radiation lost to the solar wind. Because of the significant changes in solar activity with a period of 11 years and the reversal of magnetic polarity every 22 years it seems reasonable that a change in the sun's low degree gravity field might be expected. Longitudinal variations probably exist but present observations are not accurate enough to detect any possible term of order 2.
As a result, the gravity field of the sun is anticipated to include the following componets: (1) a central mass term, GM, that is slowly decreasing with time and may be non-linear, (2) second, and fourth degree zonal gravitational terms that may vary periodically with a solar cycle period, (3) a very small degree-two longitudinal term that may vary on the time scale of months to years, and (4) a polar flattening term of approximately 1% of the dynamical flattening with a small variable longitudinal term, both due to the influence of the planets. The most recent suggestion that the interior of the sun is rotating four times faster than the surface is a result that, if true, would be expected to also manifest itself in the magnitudes of the low degree gravity field. We will discuss these ideas and how they may be measured.