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# A new method to model partially distributed magnetic field measurements, with application to Mercury

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Hermean magnetic field measurements acquired over the northern hemisphere by the MESSENGER spacecraft, in orbit since March 2011, provide crucial information on the field of the planet. We develop a new method, the Time Dependent Equivalent Source Dipole, to model Mercury's magnetic field and its temporal variation over a limited spatial region. Tests with synthetic data distributed on regular grids as well as at spacecraft positions confirm the validity of the new method. Our modeled magnetic field can be upward or downward continued in an altitude range of -300 to 1460 km for regular grids. When using synthetic magnetic field measurements at spacecraft locations the altitude range reduces to 10 to 970 km. We apply our method to model the magnetic field during the first four individual sidereal days as measured by MESSENGER and excluding the secular variation terms. We find a dominantly zonal field with small-scale non-axisymmetric features co-rotating with the Sun in the Mercury Body Fixed system, suggestive of external origin. When modeling the time-average field during one complete solar day these small-scale features decrease and the field becomes even more axisymmetric. The lack of any coherent non-axisymmetric feature recovered with our method, which was designed to allow for such small-scale structures, provides strong evidence of the large scale and close to axisymmetry structure of the magnetic field of Mercury.