Re-estimate the Mercury's dipole moment by employing a new technique

Zhaojin Rong[1,2], Zhen Shi[1,2]

[1] Key Laboratory of Earth and Planetary Physics, Institute of Geology and Geophysics, Chinese Academy of Sciences, [2] College of Earth and Planetary Science, University of Chinese Academy of Sciences

e-mail (speaker): rongzhaojin@mail.iggcas.ac.cn

The early surveys of Mercury 10 showed that Mercury should have a global dipole magnetic field. The global dipole field is not confirmed until the arrival of MESSENGER spacecraft. MESSENGER into orbit around Mercury in 2011, and operate successively for four years. Using the magnetometer data of Mercury 10 and MESSENGER, many researchers estimate the dipole moment with different methods, and the yielded moments are volatile. Based on some assumptions and complicated data processes, such as analyzing the deviation position of the magnetic tail current plate near Mercury and deducting the magnetic field outside the magnetosphere model, the current acceptable knowledge demonstrates that the global magnetic dipole moment of Mercury is 195 nT*RM^-3 [1, 2], the dipole Angle is less than 3°, and the dipole center is shifted 480km to the north. Here, being different from previous studies, we use a state-of-art method to diagnose the Mercury's dipolar field which is assumed to originate from a magnetic dipole. This method can effectively separate and solve the dipole parameters (six parameters with three dipole center, two dipole axis, and one dipole moment), and gives the error of how much the dataset of sampled magnetic field deviated from the dipole field [3]. By employing this method and the MESSENGER field data, the dipole parameters are derived and compared at different altitudes, latitudes and local times. We carefully selected the study region relying on the derived errors that can be seen as the proxies of non-dipole field components and the external fields. After the proper selection of the study region, we found the region with low-altitude (h<100 km), mid-latitude (40~50 degree), and night side location (20<local time<04) can yield minimum fitting errors. The derived optimum dipole parameters demonstrated that the dipole center is at [x=5.0;y=-16.0;z=480.5]km, the dipole moment is about M=2.5*10^19 nA.m^2 (or 172 nT*RM^-3), the dipole tilt angle is 3.7 degree. Our yielded dipole moment is weaker than that estimated in previous studies. We compared and discussed with previous results.

References

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Figure 1. The comparison of the predicted inverted dipole model and the series of MESSENGER's dataset