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GEMSIS project: Database of coronal magnetic fields calculated from magnetograms of Hinode satellite

Tetsuya Yamamoto^{1*}, Satoshi Inoue², Daikou Shiota³, Yukio Katsukawa⁴, Satoshi Masuda¹, Kanya Kusano¹

¹STEL, Nagoya University, ²NiCT, ³Riken, ⁴NAOJ

We report the database of coronal magnetic fields of solar active regions. This database is a part of the GEMSIS (Geospace Environment Modeling System for Integrated Studies) project of Solar-Terrestrial Environment Laboratory (STEL), Nagoya University (URL, <http://st4a.stelab.nagoya-u.ac.jp/gemsis/index.shtml.ja>). The GEMSIS project is the modeling project for understanding energy and mass transportation from the Sun to the Earth in the geospace environment. We, the GEMSIS-Sun working team, are preparing database of coronal magnetic fields of solar active regions calculated from magnetic field data obtained by the Hinode satellite, as one of our projects. This is collaboration with Hinode Science Center, National Astronomical Observatory of Japan. We expect that this database could help solarphysicists to understand energy release processes (e.g., acceleration of high energy particles and trigger mechanisms of solar flares) in the corona.

Magnetic field is a main energy source of solar active phenomena (e.g., filament eruption, solar flare, and others). Thus, in order to understand solar active phenomena, we need to investigate temporal evolution of coronal magnetic fields. Reproduction of coronal magnetic fields is considered as an only way to understand coronal magnetic field structure. At present, it is very difficult to obtain three dimensional structures of coronal magnetic fields from polarized light observations, because of small intensity and optical thinness of solar corona. On the other hand, under the rest condition, we can describe coronal magnetic fields with two simple equations ($\text{div}B=0$ and $\text{rot}B \times B=0$). This is because the Lorentz force is stronger than the gas pressure and gravity forces in the corona. Such magnetic fields are called as the non-linear force free fields (NLFFFs). Since 1960s, scientists have developed schemes to calculate NLFFFs. In this database, we use a scheme developed by Inoue et al. (ApJ, in submitted). Boundary condition on the photosphere is given from magnetic field data obtained by Hinode. Other boundary conditions are given from potential coronal magnetic fields. Potential coronal magnetic fields are calculated from SoHO/MDI magnetograms.

For this database, we now make a program that automatically perform data fitting between Hinode and SoHO/MDI magnetograms, potential field calculation, and NLFFF calculation. The code for NLFFF calculations is provided from Dr. Inoue (NiCT), and the code for potential field calculations is from Dr. Shiota (Riken). We confirmed results of data fitting and potential field calculations, and now test NLFFF calculation. In this presentation, we report these results, and also report primary results for test active regions.

Keywords: corona, magnetic field, sun