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Nonlinear force-free and potential field models of active-region and global coronal fields during the Whole Heliospheric Interval

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Between 2008/3/24 and 2008/4/2, the three active regions NOAA active regions 10987, 10988 and 10989 were observed daily by the Synoptic Optical Long-term Investigations of the Sun (SOLIS) Vector Spectro-Magnetograph (VSM) while they traversed the solar disk. We use these measurements and the nonlinear force-free magnetic field code XTRAPOL to reconstruct the coronal magnetic field for each active region and compare model field lines with images from the Solar Terrestrial RElations Observatory (STEREO) and Hinode X-ray Telescope (XRT) telescopes. Synoptic maps made from continuous, round-the-clock Global Oscillations Network Group (GONG) magnetograms provide information on the global photospheric field and potential-field source-surface models based on these maps describe the global coronal field during the Whole Heliospheric Interval (WHI) and its neighboring rotations. Features of the modeled global field, such as the coronal holes and streamer belt locations, are discussed in comparison with extreme ultra-violet and coronagraph observations from STEREO. The global field is found to be far from a minimum, dipolar state. From the nonlinear models we compute physical quantities for the active regions such as the photospheric magnetic and electric current fluxes, the free magnetic energy and the relative helicity for each region each day where observations permit. The interconnectivity of the three regions is addressed in the context of the potential-field source-surface model. Using local and global quantities derived from the models, we briefly discuss the different observed activity levels of the regions.

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