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The effect of 180° ambiguity on the three-dimensional coronal magnetic field

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Abstract. 180° ambiguity problem, which is the 180° ambiguity to determine the transverse direction of magnetic field on the photospher, is one of the important topics for the solar physics, because important physical values such as normal current distribution and magnetic helicity are derived from the transverse component of magnetic field. Unfortunately, this problem is open to be solved yet. In this study, we studied an effect of 180° ambiguity on the three-dimensional (3D) topology of coronal magnetic field. 3D coronal magnetic field was extrapolated under the Non-Liner Force-Free (NLFF) approximation using different boundary conditions based on 180° ambiguity. The different boundary conditions are obtained from HAO AZAM utility (AZAM method), Simulated Annealing method (SAM method) developed by K. D. Leka et al. and the method in which the direction of transverse field is determined by comparison to potential field (PF method). As a result, the transverse fields solved by the AZAM and SAM have continuous distributions, whereas the PF method shows discontinuity on part of the neutral line. Therefore the PF method has a localized strong current distribution on the photosphere. As a result of 3D extrapolations, we find that the AZAM and SAM methods provide smooth force-free structure than the PF where the Lorentz force is accumulated above discontinuity on the neutral line. Furthermore, in contrast to the PF method, the AZAM and SAM methods give results that depend on the grid resolution, where the magnetic shear along the neutral line is elongated as grid number increases. By compar-

ing extrapolated fields with an X-ray sigmoid, the AZAM and SAM methods show better fitting results than the PF method. We therefore conclude the AZAM and SAM methods are reasonable to apply to this active region.