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Determination of 3D configuration of magnetic clouds using 2D imaging data of solar wind

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The structure of magnetic cloud (MC) has long been studied by fitting in-situ magnetic field measurements to magnetic flux rope models. Such studies generally provide the size and orientation of the model structure, which are taken to be applicable only locally to the portion where the cloud passed the spacecraft. The obtained geometry often changes depending on the models used for the fitting. For example, for a single observational data set, a cylinder model and a torus model often give different cloud axis orientations. Thus we need further consideration about the global configuration to deduce the 3D structure of the MC. 2D images from heliospheric remote sensing measurements provide reliable constraints about the global MC structure. With the above in mind we attempt to study the global structure of MC by combining the model fitting results and the 3D reconstruction data from the Solar Mass Ejection Imager (SMEI) and interplanetary scintillations (IPS). For this purpose, we first select MC events in which the proton densities are high enough (generally $>$ 20 /cc) in the sheath regions behind the driven shocks and/or in the regions occupied by MCs. Then we examine possible 3D configurations which are consistent with the orientation of the MC axis obtained from model fittings. The global MC structure is finally obtained by applying the constraints from 2D image data. Our preliminary examination shows that the above procedure is helpful for determining the most probable 3D global structures of MCs.

Keywords: solar wind magnetic field, magnetic flux rope, solar wind density, model fitting, magnetic cloud