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Reply on RC2

Yasuhito Narita et al.

Author comment on "Magnetopause as conformal mapping" by Yasuhito Narita et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2022-26-AC2, 2022

The editorial office asked me to give some final response to the referee comment for the formal reason, even though the comment is friendly stating "recommended for publication". Anyway, I can comment on some future outlook for the benefit to the audience.

Conformal mapping is not widely used in space plasma physics, but the method has a lot of useful applications. The reason for this is that one may transform the exact solution or analytic expression of harmonic function (solution of the Laplace equation) obtained in a simplified geometry into a more realistic geometry. A particular example is the application of harmonic function (scalar magnetic potential) obtained by Kobel and Flueckiger (J. Geophys. Res., 99, 23617, 1994) for the magnetosheath region bounded by parabolically-shaped bowshock and magnetopause. Soucek and Escoubet (Ann. Geophys., 30, 973, 2012) and Schmid et al. (Ann. Geophys., 39, 563, 2021; Astron. Astrophys., in press) are highly suggestive of using the conformal mapping to model the flow and the magnetic field in the the magnetosheath.

There are, on the other hand, drawbacks or difficulties on the use of conformal mapping. (1) Finding an analytic expression is a tough work. There is no general method to find the analytic expression of conformal mapping. Usually, one finds the conformal mapping by try-and-error methods. (2) One may find the conformal mapping in the numerical way. If the boundaries are well defined, the problem of finding the conformal mapping reduces to solving the Laplace equation in two dimensions, and there are numerical algorithms such as Jacobi method, Gauss-Seidel method, and Successive Over-Relaxation (SOR) method. One may naturally extend the search for the conformal mapping from the magnetopause mapping to the magnetohsheath mapping, but the problem is that the boundary cannot easily be set to close the magnetosheath domain. A likely candidate is a hyperbolid grid generation method if the magnetosheath region is to be conformally mapped. (3) The method of conformal mapping is limited to the two-dimensional domain. So, one needs to impose some constraint such as axial symmetry or particular plane.