

Interactive comment on “On application of asymmetric Kan-like exact equilibria to the Earth magnetotail modeling” by Daniil B. Korovinskiy et al.

Anonymous Referee #1

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Review on paper “On application of asymmetric Kan-like exact equilibria . . .” submitted by Korovinskiy et al. This draft describes a new model of 2D magnetotail-like current sheet with the north-south asymmetry. Authors use this interesting generalization of the class of 2D models to simulate/mimic effects of the Earth’s dipole inclination. The comparison of flux tube volumes calculated using the presented model and the empirical T96 model demonstrates the analytical model applicability. Paper is well written and logically consistent. It can be interesting to AnGeo readers, but additional work should be done before publication.

My main concern corresponds to the model verification. . . using T96 is a good ap-

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proach, because it allows to compare nonlocal model characteristics (i.e., flux tube volume). However, I would expect to see some comparison with actual spacecraft observations. Or, at least, some discussion of such comparison. Most of Authors are affiliated to IWF Graz, one of the centers of the magnetotail current sheet investigations. Thus, I’m surprised by absence of references to main important results about the magnetotail current sheets obtained in this Institute. Below Authors can find some recommendation about further model verification and list of small (mostly editorial) changes.

(1) There are several publications by Runov et al. (2005, 2006 AnGeo), Nakamura et al. (2006 SSR), Artemyev et al. (2008, 2009 AnGeo) and two reviews by Baumjohann et al. (2007, AnGeo) and Petrukovich et al. (2015 SSR) devoted to the magnetotail current sheet as observed by Cluster. These publications provide statistical estimates for current sheet thickness, L , and current density intensity, j_y , for different geomagnetic activity level and different locations. I suggest Authors to use these (already published) materials to verify their model and address following questions: A) can modified Kan-like current sheet model (with $B_z \sim 1/x$) describe observed intensities of currents ($j_y \sim 5 - 10 \text{ nA/m}^2$) for reasonable lobe magnetic field magnitudes and magnetotail configurations? B) How does current sheet thickness vary with x (for different geomagnetic activity) and can model describe observed current sheet thicknesses?

(2) Authors demonstrated the model dependence on the rotational angle φ . . . but I believe readers would be interested to get more details about this dependence. How do distribution of current density and B_z (in model with $B_z \sim 1/x$) depend on φ in 2D (x, z) plane? Can a finite φ result in local (in x) current density increase? What are expected locations (along x) of current density intensifications for different φ and how do these locations relate to Cluster (Petrukovich et al. 2009 JGR) and Geotail (e.g., Genestreti et al. 2014 JASTP) observations of the reconnection onset?

List of small changes:

(1) Abstract, line 7: I did not find any comparison with “realistic current sheets” in the

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draft.

(2) page 1, lines 14-15: be more accurate here: Burkhart et al. 1972 should be 1992; Kuznetsova et al. 1995 did not provide numerical CS model, but use the analytical model for numerical simulations; Sitnov and Merkin 2016 describe analytical model. . . as well as Vinogradov et al. 2016;

(3) page 6, line 15-19: $B_z \sim 1/x^3$ is a property of chosen general class (3,4) of solutions of Eq. (1). Alternative solutions of Eq. (1) give $B_z \sim 1/x^\alpha$ with different α (see Vasko et al. 2013 PoP)

(4) I did not get an idea of the paragraph (page 7, line 30 – page 8, line 5). Please, rewrite it with more details.

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2018-1>, 2018.