Review of "Calculations of the integral invariant coordinates *I* and *L** in the magnetosphere and mapping of regions where *I* is conserved"

This manuscript describes a systematic examination of the second and third adiabatic invariants *I* and *L** calculated with two models available to the community as well as a particle-tracing model written specifically for the study. While the results are interesting and highlight the importance of utilizing adiabatic invariants with care, more discussion and analysis is needed for this study to be considered complete.

I encourage the authors to address the issues below and resubmit their work.

General Comments

1) As mentioned above, the main issue preventing this manuscript from being ready for publication is the lack of discussion of the results of the study. What should we conclude from the various discrepancies between the models? How should scientists utilize the region maps illustrating constancy of the invariants? What physical mechanisms lead to breaking of the invariants in the regions illustrated? What should we use if we are interested in sorting data from those regions? There is a complete lack of discussion that is somewhat surprising and must be rectified for this to be considered a complete paper.

2) The definition and description of the invariants, particularly *L**, definitely needs some fleshing out. How is *L** defined in terms of integrals of motion? How is it calculated in the various models? In particular, a brief description of how the authors implemented "the method described by Roederer" is needed.

Specific Comments/Technical Corrections

1) Abstract Line 2: "invariants respectively," → "invariants, respectively,".
2) Abstract Line 6: "roughly" is a weasel word. Omit or be more precise, whichever is appropriate.
3) Abstract Line 15: Omit "related".
4) Abstract Line 15: "source code" → "software".
5) Abstract Line 19: Omit "geocentric distance".
6) Abstract Line 20: I would say you more than attempt to map, you do actually map.
7) Abstract Line 22: "proton" → "protons".
8) Abstract Line 24: See Item 5.
9) Introduction Line 9: Omit "For particles in magnetic fields, and", and capitalize "for".

10) Introduction Line 11: Omit "of the three types of motion mentioned above."
11) Equation 1: What is B_m? What is s_m? What is $B(s)$? These should be defined.
12) Equation 2: What is k_0? Is there an expression for Φ?
13) Title, Section 2.1: Is it LANLstar or LANL*? Be consistent.
14) LANLstar Line 15: TS05 is just empirical. I'm not sure what "semi-empirical" means.
15) LANLstar Line 23: What is SpacePy?
16) LANLstar Line 25: Why is LANLmax relevant for this discussion?
17) IRBEM-lib Line 12: How is L^* calculated?
18) SPENVIS Line 23: "as given above"; where was it given?
19) 3-D Tracer Line 7—8: "so as to facilitate" $\rightarrow$ "for"
20) 3-D Tracer Line 13: TS05 only needs to be cited when first introduced.
21) Calculations of I Line 4: what initial distances, exactly? How were they distributed between 4 and 8 R_E?