Geoscientific Model Development Discussions

Interactive comment on "LANL* V1.0: a radiation belt drift shell model suitable for real-time and reanalysis applications" by J. Koller et al.

J. McCollough (Referee)

mccollou@colorado.edu

Received and published: 6 April 2009

1   General Comments

The authors provide a well-written paper describing what sounds like a fabulous new tool for the space weather community. The novel application of a neural network as a surrogate model for L* has great potential. Hopefully, the notions of surrogate models in general and neural networks in particular will catch on as solutios for space weather and magnetospheric modeling problems.

Using the surrogate model technique is ideal for computing a quantity like L*, a scalar which has an intuitive interpretation but a very complex, non-local calculation. Most

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

researchers who need L* values do not need to know the details of the configuration of the magnetosphere - they just need to convert their particle fluxes into a PSD as a function of the adiabatic invariants. Having a surrogate model that provides a performance increase of many orders of magnitude at the cost of the details of the magnetospheric field configuration is quite a bargain.

The best thing about this paper is not the paper at all - it's the source code for LANL* v1.0 that's included in the online version. This truly allows reproduction of the results and close-up examination of the tool that is the subject of the paper.

The weakest aspect of the paper is the description of the feedforward neural network used in the software. As someone with a minimal understanding of neural nets, a more thorough description of these would enhance the paper (see specific comments below).

2 Specific Comments

1. section 3 left me scratching my head on what exactly a neural network is. Can it simply be thought of as equation 3 plus the determination of the weight and bias matrices? It's safe to say many readers won't have any familiarity with the concept, and a more thorough exposition than the first paragraph if section 3 would improve the paper in this regard.

2. I disagree with the usage of the term "torus" in 169, line 22 to describe the shape in figure 2. In general, a torus is defined as a surface of revolution generated by revolving a circle about a specified axis. "Ring" is probably more appropriate.

3. I am having trouble understanding the term "leap-frog" in 170, line 15. From your description and figure, It seems like you're just calculating L^* at $R_E = 3$, MLT=00:00, and moving outward in radius until you get a bad value for L^*. The

last good value is your L^*_{max}. Is the actual method more complicated? I'm not sure how this is characterized as "leap-frog".

4. In 171, lines 15-18 the authors acknowledge the fact that there are other tasks a radiation belt researcher has to do that are not enhanced by this software. This leads to the question: Can some of these things, such as computing K, be done with methods analogous to those outlined in the paper? If the answer yes, this should be mentioned to add relevance.

3 Technical Comments

1. In order to make the equations grammatically consistent, a period should be placed after equation 2 and a comma should be placed after equations 3 and 5.

2. The term "omniweb" in 170, line 2 should be "OMNIWeb".

Interactive comment on Geosci. Model Dev. Discuss., 2, 159, 2009.