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Interactive comment

Interactive comment on "GREEN: A new Global Radiation Earth ENvironment model" *by* Angélica Sicard et al.

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The GREEN model is a collage of several regional models, mostly those developed by the authors themselves. The models are superimposed upon each other by direct replacement with a priority scheme based on location, energy, and species.

It is described in the manuscript (but not in the title or abstract) as a beta version, meaning it will need additional work before it can be used for satellite design. I concur with publication only minor changes if it is designated as a beta, but I do not think this is made clear in the title or abstract, and it should be made absolutely clear. Satellite designers will be confused or even led astray trying to use this model when it arrives in OMERE if it is not brought up to a higher level of quality or more obviously indicated

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as a beta, not yet ready to be used for design.

As a developer of the AE9/AP9-IRENE global radiation belt climatology models, I was very interested to see whether this team of very gifted scientists has developed any new ideas to address the problems that AE9/AP9-IRENE continues to wrestle with. Unfortunately, at this stage of development of GREEN, its synthesis of the different constituent models is very superficial, meaning the underlying challenge of producing a truly global model has not really been attempted. As shown in figures 13 and 14, the GREEN model has large, sharp discontinuities at the boundaries of the underlying models. This will lead to strange results for orbit surveys looking at variations with altitude or inclination. Further, the treatment of temporal variability is similarly superficial: "worst cases" are taken over whatever duration of time the source data provided, and so cannot be applied to the user's mission duration with any corresponding confidence level. How will the engineer know whether to add additional margin (and how much) on top of the model output?

The data-model disagreements shown in Figures 15-18 are comparable to the ones that apparently lead AE9/AP9-IRENE to be "very controversial." How are we to know whether the first non-beta release of GREEN will actually resolve these discrepancies? I suspect from my own experience with AE9/AP9-IRENE that some discrepancies are essentially impossible to resolve definitively because the underlying data sets themselves do not agree. This means a more robust approach to model errors will be required.

I am also uncomfortable with the inner zone correction. It appears to be rather ad hoc. The Boscher et al 2017 paper (which is a very nice paper! and is now available on the IEEE explore website) only really looked at observations of one energy channel. Likewise, the IGP model of protons at geostationary orbit is rather ad hoc and has not been validated. I agree with the authors that these models make "reasonable" assumptions and extrapolations, but they need to be validated somehow. Also, it would be good to cite the RBSP papers by Li (doi:10.1002/2014JA020777) Claudepierre (doi:10.1002/2016JA023719) for the inner zone electrons.

This is a fair start to what will likely be a long and challenging effort to build a truly global model. The paper needs to be a bit more straightforward about the model's state of progress. There is still much work to do. But, this is real progress worthy of publication.

Minor points:

In the abstract, I suggest noting that the model covers all local times (in addition to "all along the magnetic field lines.")

In the introduction, first sentence, add "satellite" before industry.

Page 2, line 2 "no doubt that the obtained averages are more accurate than AP8 and AE8..." I hope the authors are correct! But, they should include AE8/AP8 and probably AE9/AP9-IRENE v1.5 in figures 15-18.

Section 2.1: L* and B/Beq are incompatible coordinates. L* is a drift invariant, but varies with B/Beq on any given field line, while B/Beq varies around the drift orbit. This means that particles with different coordinates are being mixed together depending on where they are measured. Replacing B/Beq with Bmirror solves this problem (or, as Selesnick doi.org/10.1002/2017JA024661 has done, mapping Bmirror and L* to a dipole value of B/Beq. I believe Salammbo does something similar).

What value of F10.7 should be used when running the OPAL model? Is there a long-term forecast built in for using it to design satellites to be flown in the future? This should be discussed, especially since LEO proton fluxes are anti-correlated with F10.7, and some naive users might attempt to be conservative by inputting a very large value of F10.7.

I do not think Figure 18 supports the claim on page 15, line 15 that, "If the period of time of in-situ measurements is long enough (several solar cycles) or is representative of a mean flux, data will easily be compared to GREEN- results." What it tells me, instead,

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is that the model-data disagreement can be factor of 4 or more, even when matching the solar cycle phase of the model and data. This suggests either a systematic issue with the model, the data, or something that must be addressed with error bars on one or the other.

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