

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-203

Anonymous Referee #2

Referee comment on "Fast infrared radiative transfer calculations using graphics processing units: JURASSIC-GPU v2.0" by Paul F. Baumeister and Lars Hoffmann, Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-203-RC2>, 2021

The authors present a detailed manuscript regarding the implementation or adaptation of the JURASSIC (non-scattering) radiative transfer code/model for use with graphics processing units.

The first few sections give a short, but rather dense introduction into the method of emissivity growth approximation, a technique originally used for limb-type observation geometries, but also compatible with nadir-type observations. Experts in that field will probably have no trouble following Section 2, however outsiders might find that section a little jarring. There are some minor (apparent) inconsistencies in notation, but it is clear the focus of the paper is Section 3, with Section 2 being more of a recap - the authors provide enough references for further reading on the EGA method.

From Section 3 onwards, the manuscript delves into the challenges of transferring the JURASSIC implementation onto GPU architecture. This portion (which is also the central part of the publication) highlights some very interesting aspects of GPU implementations of an established code base, which itself is an interesting read to anyone who is looking to attempt a similar task (even if it is a different forward model). Towards the end, the authors make fitting comparisons of their GPU implementation compared to the CPU-only code, and then finally conclude with some easy-to-grasp numbers about the overall performance gain and an estimate on power consumption.

The whole manuscript was generally pleasant to read and offers interesting insight into the difficulties and considerations of writing GPU-accelerated scientific code. While it stays focused on the chosen algorithm itself, there are definitely some take-aways for other algorithms.

Minor suggestions:

General:

There seems to be no mention of linearization of the JURASSIC model for use in inversions. I suspect there is a straightforward way of calculating various Jacobians. I understand the paper focuses on the forward model aspect exclusively, however it would be nice to have it mentioned somewhere in the text (even if it is an acknowledgement that linearization has not been investigated).

The Greek "mu" when used in units should be replaced by the μ (or equivalent) symbol.

L155:

(Very minor) "T" in the Planck function is not explained in text.

L245:

The equation should probably either say " $du = qp / (kT) ds$ " or have an integral wrapped around the right-hand side.

L250++:

Indices i,j,k are a little confusing as they're not explicitly written down.

L275 and following:

The emissivity notation (p,T,u) changed to (u,p,T) and then further (p, T, p, T, u) further down. This is a little confusing as well and would benefit from some more explicit explanation.

L350:

(comment) I'm somewhat surprised that the emissivity look-up tables are not manually copied into GPU memory; I might be missing something, but it seems like the look-up tables would be one constant array (per species) and could be kept in memory for any given wavenumber window of the user's choice. In Section 3.2.3, the authors investigate cold/warm caches, so there must be a reason as to why this was not done - but it feels like a somewhat obvious choice to load the tables into GPU memory at the very start of the algorithm.