

## ***Interactive comment on “Various aircraft routing options for air traffic simulation in the chemistry-climate model EMAC 2.53: AirTraf 2.0” by Hiroshi Yamashita et al.***

### **Anonymous Referee #1**

Received and published: 3 February 2020

This paper documents the AirTraf version 2 submodel of the EMAC chemistry-climate model, developed to enable simulation of global air traffic in a climate model in order to investigate optimized routing strategies for the aviation sector. A set of one day simulations are run, showing that the model gives plausible output and the results are discussed in the context of previous literature. While the topic of abatement strategies for reducing aviation’s climate impact is both important and current, and this modeling framework is a useful tool in this regard, the paper is not of a sufficient quality for publication in its current form. In general, the main messages can be polished and highlighted better. The introduction is long and unstructured, and it’s difficult to extract the essence of what’s new in this work (and why it’s important). This does not really

C1

get much clearer in the methods where most of AirTraf2 seems to follow AirTraf1 and is mostly described in Yamashita et al. 2016. While the discussion section is quite good, the results is only one page out of a 14-page paper, which is not quite convincing. The paper also needs substantial additional work to improve the writing and language. There are number strange formulations, short sentences and imprecise use of terminology that make the paper difficult to follow at times. Some examples are given below, but a general language check/ copyediting is recommended.

Selected specific comments: Title: suggest removing “Various”. Makes it seem vague.

Abstract: Line 1: Add “the” before “climate impact of aviation (. . .)” Line 6-9: unclear, I don’t really understand what the important result here is

Pg1: Line 16: The sentence starting with “the aviation sector is not” is redundant as you’ve just said that aviation contributes only 5% total climate impact. Line 23: a more up-to-date reference would be the Brasseur et al. 2016 paper in BAMS.

Pg2: Line 1: I don’t understand the rationale behind introducing the terminology radiative impact (RI) instead of keeping well-established radiative forcing (RF). This is confusing and adds nothing to the paper. Please explain or change. Line 5: there are number of more recent studies showing higher contrail-cirrus forcing, reflecting more recent emission inventories. One example is the 2016 paper by Bock and Burkhardt in JGR-A. Such work should be reflected. Line 6: “Here the difference between time scales (. . .)”: suggest removing, no point in telling the reader what you will tell them next. Line 6: “The emitted CO<sub>2</sub> (. . .)” – this is not precise; the emitted CO<sub>2</sub> does not have century-long timescale, the perturbation does. Line 7: “the impact is proportional to (. . .)”: this may be true for emission, and perhaps even for RF, but when approximating fuel with temperature impact or other climate change seems doubtful. Line 10: the recent work by Lund et al. 2017 ESD include all components and show how this translates into temperature impacts. Could be a useful references. Line 17: Why is climate-optimized routing limited to the present-day fleet? Line 22: because of the

C2

long residence time of CO<sub>2</sub>, its impact is the same regardless of location of emission. Please be more precise. Line 22: Please add a more detailed definition of CCS as the reader needs this later on. Line 24: Another strange sentence to suddenly introduce here instead of adding above when listing aviation non-CO<sub>2</sub> effects. Line 29: what about trade-offs between e.g., contrail avoidance and increased fuel use?

Pg.3 Line 2: Presumably this is global-mean temperature response? Please specify. Line 5: what about the other way around, does a cost-optimized route increase climate impact? Line 6: do you mean using different emission metrics, of which AGTP is one? And which other metrics do you find in the literature? Here you only describe one approach. (from here on I do not list language issues, but note that there are a number of them also in the next pages...)

Pg. 8: Section 2.5.4: The treatment of contrail-cirrus is quite essential for routing strategies and I would like to see some more details of how this is done and what the limitations are (e.g., natural cloud suppression, life cycle etc.) here, not just a reference to earlier work.

Pg. 9 Line 20: ATR20 needs a definition. Is it calculated based on input of RF? What is assumed for contrail-cirrus properties? Line 26: But ATR20 is an average over 20 years? How can values be negative when the overall contrail-cirrus effect is a warming? Perhaps related to the above comment. . .

Pg.10: Line 3: how sensitive are results and conclusions to the running of only one day? E.g., dependence on meteorological conditions that day? Line 11: showing direct results is not a verification of simulations output. Line 21: over what time frame is the km coverage estimated? Integrated over the 1-day simulations?

Pg.11: Line 2-3: this is a very strange argument for correctness

Pg. 14: Line 10-11: how well does the treatment of contrails work for longer time integrations (in particular decades as mentioned earlier)? Is the potcov based on present-

C3

day conditions? Line 5-10: this type of information would be useful in the introduction.

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2019-331>, 2019.

C4