Review of "Experimental Protocol for Phase 1 of the APARC QUOCA (QUasibiennial oscillation and Ozone Chemistry interactions in the Atmosphere) Working Group"

by C. Orbe et al.

Recommendation: Minor revision

This is a useful summary of the experimental design for Phase 1 of the APARC QUOCA project, including a detailed set of tables that specify the model output requested. It is suitable for publication once the authors address the specific comments below.

Specific Comments (line number):

(66) "a dampening of": This should be "damping", as in "reducing", or "dissipating"—not as in "moistening" (dampening)

(71) "former claims": "previous claims" would be better.

(118) Figure 2, caption: "dampened" → damped

(141) "dampened" → damped

(146) "dampening" → damping

(150) "whether other models exhibit similar vertical structure": The version of WACCM used by Calvo et al. (JAS, 2015) does not appear to have the same response in the deep branch.

(179) "anomalous triggers (volcanoes, ENSO, wildfires)": However, among these, only ENSO is intrinsic to ocean-coupled simulations. Volcanoes and wildfires are boundary conditions that can be specified (or left out) as desired.

(184) "input4MIPs": This needs a link and/or reference.

(189) "at least ozone needs to run interactively": Note that the QBO-ozone perturbation above ~20 hPa will be driven mainly by changes in NO_X, which are due to advection. So, interactive NO_X and its precursors (N_2O, tropospheric generation of NO_X via lightning) should also be part of any INT experiment.

(192) "monthly annual cycle of three-dimensional ozone fields": This would be clearer as "annual cycle of three-dimensional, monthly-mean ozone fields".

(193) "The 90-year-long PD-INT experiment … three successive 30-year … climatologies": You may want to offer some motivation for using a separate 30-year climatology for each NINT experiment instead of driving all of them with a single 90-year climatology. I would not expect 30-year slices of the 90-year INT run to be significantly different. That is, the statistical

properties of 30 vs 90-year climatologies derived from the INT run ought to be statistically identical.

(209) “to ensure that the chemistry is sufficiently spun up”: I do not understand this. The entire 90-year PD-INT run should be properly spun up because you are already asking for a 10-year spin-up before starting the 90-year PD-INT run. It seems to me that the real purpose of picking different times within the 90-day PD-INT run to initialize the FT-INT runs must be to ensure that each member of the PD-NINT ensemble is an independent realization. Am I misunderstanding this?

(230) “projects onto”: “affects” would be clearer.

(238) “controlled more directly”: Why “more directly”? The O_X lifetime at and above 10 hPa is less than a month and becomes even shorter (1 day) by 0.5 hPa, so I think it is safe to say that O_X (hence, ozone) is photochemically controlled at these altitudes.

(250) “the QBO period reduces”: this should be “is reduced” or “decreases” (reduces is a transitive verb).

(262) “contributed submissions”: “contributed results” or “submitted results” would be better.

(284) “tropopause air pressure and …”: Will there be a common definition of “tropopause”? Will it be the same in the Tropics vs. extratropical latitudes?

(284) “Table B2”: It would be useful to indicate in the table header that the quantities in the table are zonal averages.

(292) “subset of latitudes (15°S to 15°N)”: ±20° might be more appropriate since forcing is substantial across this range of latitude (see, e.g., Garcia and Richter (2019), their figure 7).

(298) “including” → included

(306) “Table B4”: Again, it would be useful to indicate in the table header that most of these are zonally averaged quantities, except for $O3_{STE}$, AOD and $ST80_{25}$. By the way, the table does not state what $ST80_{25}$ denotes; ditto for e90. This information should be included in the “long name” column, as is the case for other fields.

(312) “these will be used to calculate the TEM … to verify consistency … Table B2”: I find this a bit confusing. I presume you do not intend to calculate TEM quantities from the eddy fluxes (*u'v'*, *v'T'*, etc.) in Table B2 (plev42 grid) but will instead compare TEM fields calculated from the outputs specified in Table B3 (plevTEM grid) with the *pre-calculate*d TEM quantities in Table B2 (vtem, wtem, psitem, epfy, epfz). Is that the idea? Note also that it is unlikely that the EP flux divergence, which involves the vertical derivative of epfz, can be calculated accurately from epfz output in Table B2 because the levels in that output are not native model levels. So, if one wants monthly div(F) on the plev42 grid, it ought to be included as a pre-computed field in table B2. I may be misunderstanding your intent, but I think this requires some clarification.

(316) “further below” → farther below

(321) “6-hourly (3-D) instantaneous output … for only 10 years”: If this is going to be used to analyze QBO forcing by, say, compositing with respect to QBO phase, 10 years may not be enough for statistical reliability since that interval spans less than 5 QBO cycles.