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Interactive comment on "DynVarMIP: Assessing the Dynamics and Variability of the Stratosphere-Troposphere System" *by* Edwin P. Gerber and Elisa Manzini

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These comments reflect the discussion of the breakout discussion group on "The Circulation Response to External Forcing" that we led at the SPARC DynVar Workshop on June 8, 2016.

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Major Comments:

A chief purpose of DynVarMIP is to provide additional dynamical variables to help understand the mechanisms behind the atmospheric circulation response to external forcing. Yet, the choice of runs and periods of interest for the DynVarMIP output does not

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appear to maximize its potential. We have several suggestions that might help to improve the effectiveness of DynVarMIP.

1. DynVarMIP output is requested from the last 40 years of both the abrupt4xCO2 and 1pctCO2 DECK runs. In the abrupt4xCO2 run, this period represents an equilibrated 4xCO2 climate, whereas in the 1pctCO2 run, it represents the transient state of the climate upon CO2 quadrupling (at year 140). However, to really understand the mechanisms behind the atmospheric response to a quadrupling of CO2, it is also essential to study the initial transient response to forcing. A number of papers have provided important insight into the mechanisms behind the atmospheric circulation response by looking at the period immediately after the instantaneous doubling or quadrupling of CO2. For example, Wu et al. (2013) showed that, in the first few months following an instantaneous CO2 doubling, the extratropical circulation response appears to form first at stratospheric levels and then descend into the troposphere. Grise and Polvani (2014a) showed that, in response to an instantaneous quadrupling of CO2, the Southern Hemisphere mid-latitude jet responds faster than the global-mean surface temperature and reaches its equilibrium position within several decades (see their Fig. 10a). Shaw and Voigt (2015) showed that the summertime Pacific jet stream initially shifts poleward during the first 20-30 years after an instantaneous quadrupling of CO2 but then shifts equatorward (as its equilibrium solution would suggest) (see their Fig. 5b). Therefore, given these results, we feel that it is justified to also request DynVarMIP output for the first 40 years of the abrupt4xCO2 run.

2. Notably missing from the list of runs with DynVarMIP output are the CFMIP-led runs: amip4xCO2, amip4K, and amipFuture. These 30-year runs, which are companion runs to the amip runs for which DynVarMIP output is already requested, help to isolate the circulation responses due to radiative forcing only (amip4xCO2) and warming sea surface temperatures only (amip4K and amipFuture). For example, see the recent papers by Grise and Polvani (2014b), Shaw and Voigt (2015), and He and Soden (2015). Given the relatively short length of these runs, we feel that it is justified

to request output from these runs (at least on monthly-mean timescales), given their importance for isolating dynamical mechanisms.

3. A key point of discussion at the recent DynVar Workshop was being able to identify when key circulation responses become distinct from natural variability (a so-called "time of emergence"). It was agreed that this was an important diagnostic to include in future DynVar reports to the broader community. To calculate this diagnostic, it would be necessary to have the DynVarMIP output for all years of the 1pctCO2 run (but only at monthly-mean temporal resolution).

Minor Comments:

1. It would be good to clarify which DAMIP and VolMIP runs include DynVarMIP output. Single forcing runs may be especially important in isolating the mechanisms responsible for the circulation response.

2. Several other variables were discussed in our breakout group that would be useful to include in DynVarMIP output (maybe as priority 2 requests): a. Clear-sky temperature tendencies (on daily timescales) b. Ozone (on daily timescales) c. Potential vorticity (possibly on potential temperature surfaces)

3. It would be valuable to have a certain location (such as a website) to collect metadata that are relevant for understanding the response of the dynamics (e.g., details of orographic and non-orographic gravity wave schemes used, etc.) as such data is not readily documented in the peer-reviewed literature.

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