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## ***Interactive comment on* “Role of external factors in the evolution of the ozone layer and stratospheric circulation in 21st century” by V. Zubov et al.**

### **Anonymous Referee #3**

Received and published: 28 November 2012

The authors present an analysis of the response of their chemistry-climate model to the external factors of changing ozone-depleting substances, greenhouse gases, and sea surface conditions. Treating sea surface conditions as “external forcing” is somewhat artificial (as acknowledged by the authors) because in reality SSTs and sea ice respond interactively to anthropogenic and natural forcings and are inherent properties of the climate system. In many CCMs, however, sea surface conditions need to be prescribed and therefore count as an external forcing. For CCMVal-2, only one of the participating models used an interactive ocean; the other modelling groups used a variety of different climate model outputs as sea surface forcing. The authors make the point that actually climate change and ozone recovery respond sensitively to the prescribed sea surface

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conditions. This implies that the lack of uniformity in SSTs/sea ice forcing in CCMVal-1 and CCMVal-2 contributed to a general model spread regarding ozone recovery and the climate impact of ozone depletion which does not necessarily reflect disagreements amongst models but partially is the consequence of differences in sea surface forcing. The authors suggest that future model intercomparisons need to improve the way SSTs and sea ice are handled.

This is an important and timely result, considering that forcings for the next chemistry-climate model intercomparison (CCMI) are about to be decided. The paper has about the right length and a good balance of text and figures. The paper should be published subject to a minor revision, accounting for my comments listed below. The language is generally easily understood but it would help if the authors had an English native speaker iron out some phrasing issues.

Minor comments:

P28468L6: Cut out “distribution”.

L9: “the CCM SOCOL”

L10: Cut out “It was established that”

L13: “a very important role”

L14: “the atmospheric ozone content” -> stratospheric ozone

L18: Cut out “velocity” and “intensity”.

P28469L5: “the main feedbacks”. Replace “chemical atmospheric quantities” with “composition”

L7: “projection outputs” -> “projections”. “Most of the contemporary CCMs”

L12: Cut out “following”

L13: Cut out “of the”

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L14: “of economic development”

L14-15: “decline of ODSs”. “implementation of the Montreal Protocol”

L16: Cut out “limitation”

L17: “Last one” -> “The latter factor”

L20: Cut out “as”

L22: Very long sentence; consider rephrasing.

L28: “at different rates”

P28470L6: “the tropical “

L11: “the 21st century”

L13: “photochemical loss”

L18: “cannot be applied to an evaluation of the contributions of the main external anthropogenic factors”. Why not?

L19: “regarding the applicability of the MLR approach to an attribution of”

L20: Break sentence: “This motivates. . .”

P28471L5: “is no strong evidence on”

L6: “or by differences”

L9 “that participated”

L10 “However, this is not”. The SST/sea ice from GCMs used for the REF-B2 simulations also covered the past (1950-2100). On the other hand, for REF-B1 all models used the same HadISST sea surface forcing (for 1950-2007). Is it then the case that the inter-model spread is notably smaller in REF-B1 than in REF-B2?

L24: I take it that the CFCs count as ODSs but not as GHGs. Or do you take a more

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sophisticated approach and treat them separately for chemistry and radiation?

L28: “The ensemble approach offers an opportunity”

P28472L3: Drop “the” before “section” here and thereafter.

L5: Drop “given”

P28473L6: “inherently accounts for”

L22: “comparable to most other stratospheric CCMs”

P28474L17: Drop “the” before “table”.

L21: Why do you recalculate things in 2-year time slices? The straightforward approach might have been to use the last 10 years of a 20-year simulation and evaluate that. Also depending on your model and initial conditions, 10 years might be insufficient to achieve complete spin-up. Have you established that there are no remaining spin-up effects in your runs?

P28476L29: Cut out “As it was discussed in the literature” and reorder that sentence.

P28477L6: Move this sentence into the caption of figure 3.

L10: Cut out “the” before “both poles”.

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28467, 2012.

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