Reply to the referee comments on the paper "Anthropogenic changes in the surface all-sky UV-B radiation through 1850–2005 simulated by an Earth system model" by S. Watanabe et al.

Dear Referee #3,

We would like to thank you for providing constructive comments on our paper. In the following our response to the comments are underlined and revisions we have made are highlighted.

Sincerely,
Shingo Watanabe

1. The effect of aerosols are isolated by AERO = HIST - GHGo (page 4226, line 7). According to Table 1, shouldn't that be AERO = HIST - GHGo - NATo? At the moment, the authors also attribute changes from natural forcings to aerosol and land use changes.

Yes, your comment is right. We agree with you that our assumption is not always valid. For simplicity, we assume AERO = HIST - GHGo when and where effects of natural forcings are negligible. This simplification is practically useful when we decompose effects of GHGs and aerosols on the surface UV radiation in the present-day (1996-2005) conditions (Figs.3 and 4).

It would be worth mentioning in the text that effects of climate change on aerosol and ozone concentrations, and of ozone chemistry on aerosol formation, will break the linearity implied by the authors' method.

We agree with you and have added a brief comment to the text on this issue.

Discussion of model skill is currently in the conclusion (page 4231, line 23 to page 4232 line 20), but it should really be in section 2.1, when the model is described.

We agree with you and have moved some part of the discussion to the model description section.

Also, it is difficult for the reader to get an idea of the model skill in simulating ozone and aerosol distributions: Watanabe 2011a and 2011b do not contain much validation of those elements. A discussion of the strengths and weaknesses of the simulation of UV-absorbing gases and aerosols, on a global scale, is needed to bring confidence in the results presented here.

We really understand what you are pointing out. Indeed, process-based evaluations of model's global distribution of UV-absorbing gases and aerosols are currently underway, under frameworks of model-intercomparison projects, e.g., ACCMIP and Aerocom. At this moment, it is difficult to say more on the model's skill to reproduce those distributions.

We have added some information on several ongoing model validation projects to the end of discussion.

Minor editing will be needed, for example "diffusive" should read "diffuse", and "ozone containing air" should read "ozone-containing air" throughout the paper.

We have revised the text following your suggestions.