

Interactive comment on “High levels of ultraviolet radiation observed by ground-based instruments below the 2011 Arctic ozone hole” by G. Bernhard et al.

Anonymous Referee #2

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This is a very good paper dealing with the effects of the 2011 ozone depletion episode in the Arctic on solar UV radiation received at the surface. The aim of the paper is to provide quantitative estimates of the enhancement of different UV radiation quantities during the winter spring season of 2011 and also to partition the observed changes to ozone depletion and to changes in cloud cover. The authors analyze all available UV measurements at 13 sites in the Arctic region of N. America and Europe, provide estimates of the measurement uncertainties and demonstrate the large increases of UV occurred during that period. In addition the authors provide a lot of supplementary material which support the finding of the main paper. Overall the paper is sound and, to

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my opinion, only a few parts of it need further consideration. The subject of the paper falls well within the thematic of APC and therefore I would be glad to see the paper published after some, generally minor, revisions.

Specific comments:

17260,27: I think that the uncertainty estimates for the Canadian Brewers might be too optimistic, although they come from an accepted publication, because in the winter spring periods the UVB signals are very weak and the stray light becomes more important (so the uncertainty of a single monochromator increases), and in addition, the calibration checks were done every 1-2 years. Similar doubts due to low signals may arise also for the other instruments used in the study. Of course an increased uncertainty estimate will not alter qualitatively the results of the study.

1762,21: It would be good to provide here an uncertainty estimate of the spectral extrapolation, as it was done for the Canadian Brewer in 17259,17.

17263, 3: Have the data been corrected for the 1-6% drift established by comparison to the QASUME instrument?

17264, 5-11: These criteria look like arbitrarily selected. Why the length of the accepted data gaps are different at different sites? Why 1° is selected for the SZA?

17264, 15-16: Please explain how the start of the periods was calculated from UV measurements. It is not clear as it stands now.

17264, 21-22: “two consecutive days or more than 3 days in total”, in each year?

17266: 25-27: Can these results be considered representative also for the Canadian stations where, presumably, the weather regimes are different?

17267, 8-19: Would the overall picture change if climatological means based on the common years (e.g., 2001-2010) are used instead?

17269, 25: I do not see the reason for moving the explanation to another section?

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17270, 29: I am not sure about the significance of this estimate (5.3 stds) given the very small absolute doses in conjunction with the uncertainties of the single Brewers under low signal conditions. No doubt that the ozone depletion signal on UV was detectable at the sites examined, but I am a bit skeptical about the validity of the absolute changes reported.

17273, 3-24: I have the feeling that these paragraphs do not belong here. They look to me isolated without clear connection to the text before and after. Maybe the authors can consider moving them to the Introduction.

17273, 26-28: This sentence is unclear to me. Please rephrase.

17275, 16-20: This sentence is not very relevant to the first sentence of the paragraph. Maybe it belongs and should be connected to the following paragraph "Because surface UV . . .".

Technical:

17264, 25: Change "site" to "sites"

17268, 15: Replace "and" with "-".

17269, 28: Change to: "Relative increases for CED range . . ."

17270, 5: Maybe "metric" would be a better word instead of "measure".

17270, 9: Change "large" to "largest".

17270, 10: Change "early" to "earlier".

17270, 14: Delete "a" after "UVI for".

17270, 19: Change to: "...2011 with the average doses determined for the same period from all years."

17273, 29: Delete "evaluating"

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17274, 1: Replace "UV anomalies based on" with "for".

17274, 1: Delete "phenomenon"

17274, 8: Replace "UVI Anomalies" with "Relative anomalies" (UV doses cannot result in UVI anomalies!)

17275, 14: Change to "At the high-latitude Arctic sites"

17276, 2: Change to "particularly"

17276, 13-14: Change to plural "deviations" (2 occurrences).

17297, 2: Change to "The average climatological dose for . . ."

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