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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Processes controlling the seasonal variations of ^{210}Pb and ^{7}Be at the Mt. Cimone WMO-GAW global station, Italy: A model analysis" *by* Erika Brattich et al.

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We thank the editor for his comments. Below please find our itemized responses.

1). The authors may consider giving a brief description of what the physical and chemical processes are included in their model for the simulation of radionuclides Pb-210 and Be-7 in both the stratosphere and the troposphere, instead of just referring to the literatures (Page 10, Line 9-14).

Reply - Thanks for the suggestion. A brief description of the physical and chemical processes included in the GMI model used for the simulation of 210Pb and 7Be radionuclides in the stratosphere and the troposphere is given as follows. "In this work,

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we simulate 222Rn, 210Pb, 7Be, and 10Be using a version of the GMI model with the same basic structure as described by Considine et al. (2005) and Liu et al. (2016), including parameterizations of the important tropospheric physical processes such as convection, wet scavenging, dry deposition and planetary boundary layer mixing. Meteorological data used to drive the CTM at 2° latitude by 2.5° longitude resolution, e.g., horizontal winds, convective mass fluxes and precipitation fields, are the Modern-Era Retrospective analysis for Research and Applications (MERRA) assimilated data set from the NASA Global Modeling and Assimilation Office (GMAO) (Rienecker et al., 2011)." "The flux-form semi-Lagrangian advection scheme and a convective transport algorithm from the CONVTRAN routine in NCAR CCM3 physics package are used in the model. The wet deposition scheme is that of Liu et al. (2001): it includes scavenging in wet convective updrafts, and first-order rainout and washout from both convective anvils and large-scale precipitations. The gravitational settling effect of cloud ice particles included in Liu et al. (2001) is not considered here. Dry deposition of aerosols is computed using the resistance-in-series approach."

2). Pb-210 and Be-7 were analyzed from the PM10 samples according to a description of the radionuclide measurement (Page 9, Line 5-8). I wonder if the treatment of aerosol processes in the model could affect the simulation of radionuclides. How does the model treat the uptake of radionuclides on particulate matters? Does the uncertainties in the simulation of PM10 affect the simulation results of Pb-210 and, in particular, Be-7?

Reply – The model does not specifically simulate aerosols particles to which the radionuclides attach. Instead, those aerosol particles are assumed to be ubiquitous. Now we state in Introduction: "Once produced, both radionuclides rapidly attach to ubiquitous submicron aerosol particles in the ambient air (Papastefanou and Ioannidou, 1995; Winkler et al., 1998; Gaffney et al., 2004; Ioannidou et al., 2005), and are removed from the atmosphere mainly by wet and secondarily dry deposition (Kulan et al., 2006)."

3). The treatment of Be-7 source in the model is also suggested to be described more specifically, e.g., by providing the prescribed concentrations or by giving the production rates at certain altitudes.

Reply – We have added more information on the 7Be source in the model: “Following Brost et al. (1991) and Koch et al. (1996), we used the Lal and Peters (1967) 7Be source for 1958 (solar maximum year), as it best simulated stratospheric 7Be concentrations measured from aircraft (Liu et al., 2001). The rates of 7Be production reported more recently by Usoskin and Kovaltsov (2008) broadly agree with those of Lal and Peters (1967) with slightly (about 25%) lower global production rate and will be tested in a separate model study. The Lal and Peters (1967) source is represented as a function of latitude and altitude (pressure) and does not vary with season (see Figure 1 of Koch et al., 1996).”

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