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A study of stable isotopic variations of Antarctic snow by albedo differences

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Snow's albedo can be decreased if there are any impurities on the snow surface other than snow itself. Due to the decrease of albedo of snow, melting rates of surface snow can be enhanced, which is very crucial in climate change and hydrogeology in many parts of the world. Anthropogenic black carbons caused by the incomplete combustion of fossil fuel affect on snow and tephra particles generated by geologic volcanic activities reduce snow albedo. In this study, we investigated isotopic compositions between snow covered by tephra particles and clean snow. Isotopic compositions of snow with tephra statistically shows more enriched than those of clean snow ($p<0.02$). This can be explained by the fact that snow becomes enriched in 18O or D relative to meltwater as melting rates are increased. In addition, the slopes of the linear regression between oxygen and hydrogen for snow with tephra and clean snow are 6.7 and 8, respectively, and the latter is similar to that of the global meteoric water line of 8. Therefore, we can conclude that snow impurities control the isotopic compositions of snow, which is very crucial in the study of climate change and hydrogeology. To quantitatively explain these observations, melting experiments and numerical approaches are required.