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# Aerosols impact on the multi-decadal SST variability simulation over the North Pacific

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Aerosol emission by the anthropogenic source has increased in the 20th century and the effects on climate have received much attention for understanding of historical climate change and variability. Aerosols contribute to change solar radiation at the surface directly and indirectly enhance radiative effect through cloud properties changes, altering surface climate and large-scale atmospheric circulation as well. Recently Oldenborgh et al. [2012] , Chikamoto et al. [2012] and Wang et al.[2012] showed the Pacific decadal scale variability is able to be affected by the aerosols. Since climate response in global warming is modulated by decadal variability and the Asian monsoon circulation changes are known to be affected by anthropogenic aerosols [Lau et al., 2006; Ramana et al., 2010], aerosol impact over the Pacific needs to be studied. Both effects by natural and anthropogenic emissions are important. To simulate the North Atlantic climate variability, aerosol forcing is important [Mann and Emanuel, 2006; Oldenborgh et al., 2012]. In particular, it is known to be better represented when indirect effect by anthropogenic emitted aerosols is considered [Booth et al, 2011]. Therefore, considering previous studies, this study investigates aerosol effect with indirect effect by anthropogenic aerosol emission over the Pacific.
In this study, comparison between historical run and fixed aerosol experiments using HadGEM2-AO shows that multidecadal variability in historical run is closer to the observed ERSST variability over the North Pacific. In detrended SST anomalies, warming and cooling in the period of 1925-1960 and 1965-1990 are reproduced in aerosol forced historical simulation. The climate variability is partly related by the shortwave changes in response to aerosols emission. There is cooling effect, directly. Here, we are interested in indirect cloud property changes and the Pacific SST variability is investigated using previous results [Williams et al., 2001; Rotstayn and Lohmann, 2002; Lohmann and Feichter, 2005]. The emitted aerosols contribute to decrease cloud droplet radius and increase cloud fraction and cloud albedo. The reduced shortwave radiation accompamies SST cooling over the North Pacific and large scale cyclonic atmospheric circulation. The anthropogenic aerosol effects are distinct after 1920s, when anthropogenic emission grows rapidly. Since 1920s, the Pacific SST anomalies between historical run and fixed aerosol experiments(NOA) shows discrepancy. Accordingly, from late 19th century to 1910s, volcanic aerosol forcing appears and SST anomalies in historical run and NOA are similar. Recent studies suggest that aerosol process can drive pronounced multi-decadal variability in historical North Atlantic climate variability and show that the forced variability appears in the Atlantic and the North Pacific as well. This study confirms their result that the consistent results are presented over the North Pacific.

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