An estimation of direct and indirect effect of aerosols by a coupled global climate model: Different impacts between the mid-latitude and tropics

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We investigated the impact of anthropogenic aerosols on global surface radiation budget, using a coupled-atmosphere-ocean global climate model (CGCM), MIROC-ESM, by a statistical comparison between three-ensemble IPCC historical experiments and three-ensemble sensitivity experiments without the changes in anthropogenic aerosols from 1850 to 2005.

We preliminary examined the changes of global climate in northern summer, focusing on the different impacts between mid-latitude and tropics. In mid-latitude, clear-sky downward shortwave radiation at the surface was reduced by approximately 5~10 W/m2 near the aerosol source regions as the direct effect. As the indirect effect, which was defined by the difference between clear-sky shortwave radiation at the surface and all-sky shortwave radiation at the surface, shortwave radiation at the surface was statistically significantly reduced by 5~20 W/m2 over the broad area of downstream of the source regions. In tropics, the impact was more complicated. Decreases and increases in shortwave radiation at the surface were found not only near the source regions but also remote regions, which was possible that they were associated with the changes in the hydrological cycle, such as changes in precipitation, cloud cover, atmospheric circulation and waver vapor. Additional detailed investigations would be required.

Key words: aerosols, hydrological cycle in the atmospheric branch, indirect effect, regionality