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Editorial

Atmospheric black carbon and its effects on cryosphere

Black carbon (BC) is formed from the incomplete combustion of fossil fuels (e.g. coal and diesel oil), biofuel and biomass (like wildfires). As the most strongly light-absorbing component of atmospheric aerosols, BC could heat the atmosphere efficiently (i.e. the direct radiative forcing). Atmospheric BC also interacts with clouds to change cloud cover, lifetime, and brightness. Recently, the impact of BC on the cryosphere received increasing attention, because it could result in the significant glacier/snow cover melt through both the atmospheric warming and also the albedo reduction after its deposition on surface of snow/ice. Therefore, the importance of BC as the major forcing in the climate system has been highlighted in the Fifth Assessment Report of IPCC. However, substantial uncertainty regarding its spatial-temporal distribution and climate effect still remains.

In this special issue, the progress of BC effects on climate and cryosphere was presented from various aspects, such as the temporal variation, deposition and radiative forcing.

Dou and Xiao (2016) summarized the current understanding of BC deposition and its radiative forcing in Arctic. The spatial distribution of BC in snow was depicted based on the field observation. Furthermore, the deposition flux of BC and radiative forcing was modeled. To get more accurate assessment of BC-in-snow radiative forcing over Arctic, the sources of uncertainty and their corresponding solutions were also discussed.

Using the GEOS-Chem model, Mao and Liao (2016) addressed the temporal variation of atmospheric BC in the Tibetan Plateau (TP) from 1980 to 2010. Their results demonstrated that the decadal trends of surface BC concentrations were mainly driven by changes in emissions, while the interannual variations were dependent on variations of both meteorological parameters and emissions.

Jenkins et al. (2016) successfully reconstructed the long-term historic profile of BC (1843−1982) in the central TP using an ice core from the Mt. Geladaindong. There is a clear increasing trend of BC in recent decades, which is likely due to the increased emissions from regional BC sources, and also possibly linked to the reduction of glacier net accumulation.

Applying a regional climate model coupled with an aerosol−snow/ice feedback module, Ji (2016) simulated the radiative effect of insoluble impurities (BC and organic matter, OM) in snow/ice over the TP. Results indicated that the total deposition BC and OM in snow/ice in the monsoon season were much more than non-monsoon season, especially in the western TP. The maximum surface radiative forcing (5−6 W m^{-2}) were found in the Himalayas and southeastern TP in the non-monsoon season. Due to the deposition of BC and OM, the surface temperature increased by 0.1−1.5 °C and snow water equivalent decreased by 5−25 mm over the TP.

Zhang et al. (2016) revealed the impacts of global warming on dust aerosols over East Asia, using a regional climate model (RegCM3) coupled with a dust model. They proposed that global warming will lead to the increases of dust emissions and column burden by 2% and 14% over East Asia, respectively.

We hope that all articles in this collection will enjoy a broad readership, improving the scientific understanding of BC in the cryosphere, and stimulating the cooperation among different disciplines.

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