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Snow cover sensitivity to black carbon deposition in the Himalaya: from ice core measurements to regional climate simulations

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We applied a coupled climate-chemistry model to evaluate the impact of Black Carbon (BC) on snow cover in the Himalayas from 1998 to 2008, taking into account the snow albedo variations induced by modelled aerosol deposition. In a first step, we performed a global simulation, but we could not evaluate accurately the "snow darkening effect" in such experiment, as the coarse resolution ($\sim$350 km) induced a strong overestimation of the snow cover extent in the Himalaya. In a second step, we performed a global simulation with a stretched grid to reach a horizontal resolution of 50 km over the Himalaya. In this experiment, the average number of days with snow on the ground (MNDWS) is correctly simulated compared to satellite observations. Both the atmospheric and the snow BC concentration take their maximum values during the pre-monsoon period (spring), a period of the year characterised by strong aerosol transport from southern areas. Similar temporal variations of the BC concentration in the snow were measured in a preliminary ice core extracted from the Mera glacier (6475m a.s.l, N27°43', E86°52', Nepal). In this ice core, we found the maximum BC concentration in the snow occurring also in spring, with values ranging from 5 and 50 ppbM between 2000 and 2010. For some parts of Nepal the simulated decrease of the MNDWS due to BC deposition reaches 5 days. However, due to the relatively limited region covered by seasonal snow in Nepal, this decrease remains limited for a small area. In contrast, very large areas of the Karakoram, and the Western and Eastern Himalaya are concerned by a decrease of 1 to 5 days of the MNDWS due to the "snow darkening effect".