Geophysical Research Abstracts
Vol. 15, EGU2013-7486, 2013
EGU General Assembly 2013

Modeling the impact of black carbon on snowpack properties at an high altitude site in the Himalayas

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Light absorbing aerosols in the snow can modify the snow albedo. As a result, the seasonal snowpack can melt earlier compared to the unaffected snow leading to a warming effect on the atmosphere. Several global model studies have indicated that the long-range transport of light absorbing aerosols into the Himalayas and the subsequent deposition to the snow have contributed to a temperature rise in these regions. Due to its strong light absorbing properties, black carbon (BC) may play an important role in this process. To evaluate the possible impact of BC on snow albedo we determined BC concentrations in a range of fresh and older snow samples collected between 2009 and 2012 in the vicinity of the Pyramid station, Nepal at an altitude of more than 5000 m. BC concentrations in the snow were obtained after nebulizing the melted samples using a single particle soot photometer. The observed seasonal cycle in BC concentrations in the snow corresponds to observed seasonal cycles in atmospheric BC detected at the Pyramid station. Older snow showed somewhat higher concentrations compared to fresh snow samples indicating the influence of dry deposition of BC. In order to study in detail the impact of black carbon on snow properties, we upgraded the existing one-dimensional physical snowpack model CROCUS to account for the influence of black carbon on the absorption of radiation by the snow. A radiative transfer scheme was implemented into the snowpack model taking into account the solar zenith angle, the snow water equivalent and grain size, the soil albedo, and the concentration of black carbon in the snow. The upgraded model was applied to a high altitude site in the Himalayas using observed BC concentrations and meteorological data recorded at Pyramid station. First results of the simulations will be presented.