Geophysical Research Abstracts
Vol. 20, EGU2018-2474, 2018
EGU General Assembly 2018

Scientific thinking about light-absorbing impurities in snow, 1920-2004

Stephen Warren
University of Washington, Department of Atmospheric Sciences, Seattle, United States (sgw@uw.edu)

Beginning in the 1920s, reports of visibly-colored snow were attributed to winds carrying dust to Europe from the Sahara, to New Zealand from Australia, to Vermont from the U.S. Great Plains, and to the mountains of Central Asia from nearby deserts.

Black carbon (BC) is more subtle; it is present in the atmosphere in the form of colorless submicron particles, so it is not detected by eye in amounts present in natural snow even if it reduces the albedo by 10%.

In the 1970s, scientific studies of BC appeared in the literature of weather and climate modification, where BC was promoted as a tool to speed snowmelt on pastureland for grazing animals, or to enhance the melting of glaciers to provide water for irrigation.

In the 1980s, trace amounts of BC were invoked in a radiative transfer model to explain the puzzle of low observed albedos for apparently-clean natural snow on Arctic sea ice; this inspired the first geographical survey of soot in Arctic snow by Clarke and Noone. They estimated an average reduction of broadband albedo by 2%, which together with solar irradiance of 400 watts per square meter (typical of late spring and early summer in the Arctic) implied a sizeable local radiative forcing of 8 watts per square meter.

Those results were mostly ignored until 2004, when Hansen and Nazarenko added soot-in-snow as a forcing agent in a global climate model. Their paper inspired a blossoming of research on all aspects of this problem: optical properties of carbonaceous particles, methods of BC measurement, Arctic air pollution, measurements of BC mixing ratio in snow, and modeling of this forcing and its climatic effects.