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Climatology of dust deposition events on Garabashi Glacier, Mt Elbrus, Caucasus, developed from snow pits using remote sensing, climate models and sedimentological analysis

M. Shahgedanova (1), S. Kutuzov (1,2), K. White (1), G. Nosenko (2), and M. Woodage (1)

(1) University of Reading, Geography and Environmental Science, Reading, United Kingdom (m.shahgedanova@reading.ac.uk), (2) Institute of Geography, Russian Academy of Science, Moscow, Russian Federation

This paper examines climatology of dust deposition events in the Caucasus Mountains, presents a multi-disciplinary set of techniques used for dating and provenancing dust deposition events, and compares the observations with simulations by HiGAM model. Samples of desert dust were obtained for 2009-2011 from snow pits and shallow ice cores at the Grabashi Glacier, Mt Elbrus (43°18'16.8"N, 42°27'48,4"E) at the altitudes between 3860 and 5000 m above sea level. Desert dust deposition was recorded 3-4 times a year, mostly between March and June. Analysis of SEVIRI satellite imagery and back trajectory data revealed two main source regions of desert dust deposited on Mt Elbrus: the Saharan foothills of the Akhdar Mountains in northern Libya and the Arabian Peninsula. Transportation of dust from North Africa is associated with the Saharan depressions migrating north-east along the Mediterranean coast and across Syria and Iraq. Transportation of dust from the Arabian peninsula is associated with the extensions of the Siberian anticyclone north-west of the Caspian Sea. Dust deposition at Mt Elbrus occurred when the dust-containing air masses mixed with precipitation-bearing frontal systems. Analysis of volumatic particle size distribution indicated that that silt dominates and revealed significant presence of fine sand. The obtained climatology of frequency and pathways of desert dust and particle size distributions were in good agreement with HiGAM simulations. From this study, we conclude that dust deposition events in the high-altitude region of the Caucasus occur as frequently as in the European Alps and that both timing and intensity of dust deposition events may have significant impact on glacier energy balance and enhance glacier melt.