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New algorithm to retrieve the effective snow grain size and pollution amount from snow

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In this paper different approaches for the retrieval snow grain size and pollution amount from snow spectral reflectance measured by satellite optical instrument will be compared and analyzed. The effect of various factors and assumptions used in retrieval algorithms on the accuracy of the retrieval will be elucidated. The use of model of snow as a scattering medium consistent of the spherical particles for the retrieval is one of the most wide-spread and important reasons of inaccuracy of retrieved snow characteristics in existent algorithms.

The main result presented is a new simple and efficient algorithm to retrieve the effective snow grain size and pollution amount from snow spectral reflectance measured by a satellite optical instrument. Unlike the known conventional algorithms, the developed algorithm uses no a priori snow optical model. It is based on a new approach to the snow optics, which considers snow as a close packed medium with irregularly shaped grains rather than with independent spherical particles and the accuracy of this algorithm does not depend on grain shape of real snow. Analytical nature of this algorithm provides very fast inversion. Algorithm was realized and validated for the GLI instrument with the radiance coefficients of a snow pixel in the GLI spectral channels 13, 19, 24, and 26 as input data. Algorithm allows the generalization for other satellite instruments with appropriate spectral channels.

The special tool, software *SRS* (Snow Remote Sensing), has been developed specifically for snow remote sensing problem to simulate satellite data and to test different algorithms to retrieve the snow grain size and snow pollution. *SRS* includes: realistic changeable atmospheric models with stratification of all components (aerosol, gases); accurate and fast radiative transfer code; simulations of possible measurement errors and noises in satellite optical instrument channels and can work with various snow

models (different snow grains size distributions and shapes). This *SRS* software provides calculations of the bi-directional reflectance both from a snow layer and a snow-atmosphere system and simulates the satellite optical instruments data. The testing of our algorithm employing the developed simulation has been performed and a good accuracy of the retrieval and stability to random measurement errors has been shown.