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Development and Validation of Snow Albedo Algorithm for Temporally and Spatially Continuous Reanalysis Product over Greenland

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Surface albedo, defined as the ratio of the upward to downward solar irradiance, is an important parameter in the surface energy budget and polar environment. In the polar region and other snow-covered areas, surface albedo feedback is an important mechanism that contributes to climate change. NASA's MODerate Resolution Imaging Spectroradiometer (MODIS) sensor onboard the Terra and Aqua satellites provides two kinds of surface albedo products. MCD43A3 provides daily global land surface albedo with 500 m resolution using 16-day retrieval periods, MOD10A1 provides daily snow albedo with 500 m resolution. Further, the Global Land Surface Satellite (GLASS) product provides global land surface albedo with 1 km resolution every 8 days. The MCD43A3 albedo product algorithm is a physical algorithm based on soil and vegetation semi-empirical kernel functions to build a BRDF angular model (Schaaf et al., 2002). The GLASS albedo product algorithm is a direct estimation algorithm that establishes a linear regression relationship between the top of atmosphere (TOA) or surface reflectance and albedo (Liang et al., 2013). The MOD10A1 snow product algorithm is based on Discrete-Ordinate Radiative Transfer model to build the surface BRDF of snow (Klein and Stroeve, 2002).

For research in polar studies there is a need to improve the current global albedo products in the polar regions. For instance, there is a lack of median level of temporal resolution product (e.g., 8 days) at a spatial resolution of 500 m; plus, there are also gaps in MOD10A1 caused by clouds and other conditions; finally, validation and additional local ground observations can improve the quality of the products in Greenland. This paper takes Greenland ice sheet as an example. We developed a procedure to produce a temporally and spatially continuous albedo product from MOD10A1 using a set of processing steps, including data pre-processing, de-nosing and gap-filling. We plan to produce a new Greenland albedo reanalysis product from 2001 to 2020 with 500 m resolution every 8 days based on MOD10A1 product. The daily MOD10A1 product was chosen because of its higher temporal resolution and its inversion model is specialized in simulating the surface BRDF of snow called Discrete-Ordinate Radiative Transfer (DISORT). We downloaded 8 tiles of Greenland daily albedo from NSIDC and used MRT tools for bulk mosaic and reprojection. Then, the current snow albedo product was filtered by using an 11-day statistics technique. Finally, we used the spline function to fill the gap. The new experimental product had been validated with ground-truth albedo from the Programme for Monitoring of the Greenland Ice Sheet (PROMICE) provided by the Geological Survey of Denmark and Greenland (GEUS). The preliminary validation resulted in a RMSE under 0.05. Analysis and evaluation of the new experimental product were then carried out based on cross comparison between different products.