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Improved representation of snow albedo in regional climate models by using a coupled spectral snow albedo model.

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Snow and ice albedo schemes in climate models often lack a sophisticated radiation penetration scheme and are limited to a broadband albedo. As a result, the effect of clouds, snow impurities and snow metamorphism on the albedo must be parameterized. Here, we present the first results of coupling the Two-streAm Radiative TransfEr in Snow model TARTES with the ECMWF radiation scheme embedded in the regional climate model $RACMO_2$. This coupling enables us to resolve explicitly the effect of clouds, snow impurities and snow metamorphism on the albedo, which all has to be parameterized in common albedo models.

Firstly, we present a calculation optimization method by predefining representative wavelengths for the 14 relevant spectral bands of the ECMWF shortwave radiation scheme. For this aim, TARTES high-resolution spectral albedos are weighted with energy fluxes derived with the DIScrete Ordinate Radiative Transfer model DISORT.

Secondly, we present first results of an offline coupling using $RACMO_2$ results for South Greenland, and compare these results with albedos derived with the broadband albedo parameterization of Gardner and Sharp (2010, GS), currently implemented in $RACMO_2$, and the multilayer broadband albedo parameterization of Kuipers Munneke et al. (2011, PKM). Many distinct differences are observed. Both GS and PKM predict increasing net albedo with increasing solar zenith angle (SZA) due to the shorter vertical path of light through snow. However, our results show that the spectral shift to larger wavelengths for high SZA dominates, resulting in a lower net albedo. Moreover, the lack of radiation penetration in GS leads in general to a higher albedo with respect to TARTES and PKM. Finally, large albedo differences are observed before and after melt events.

Concluding, coupled spectral albedo calculations are potentially leading to strongly improved net albedo estimates.