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# Modeling shortwave radiative forcing from surface albedo perturbation using radiative kernels derived from satellite climatologies of Earth's energy budget

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Due to the potential for land use / land cover change (LULCC) to alter surface albedo, there is need within the LULCC science community for simple and transparent tools for predicting radiative forcings from surface albedo changes. To that end, some researchers have adopted the radiative kernel technique – a method developed to diagnose internal feedbacks within global climate models (GCMs) – to perform offline radiative forcing calculations for surface albedo change. Elsewhere, in the remote sensing community, very simple radiative transfer models that treat the atmosphere as a single layer were developed to diagnose the global energy budget. Here, these two methodologies are combined to develop a radiative kernel for surface albedo change driven with satellite retrievals of Earth's shortwave radiation balance. A sixteen year (2001-2016) climatology of CERES Energy Balance and Filled (EBAF) data was applied as input to a single layer atmosphere model of radiative transfer to approximate the change in shortwave radiation at the top-of-the-atmosphere (TOA) as a function of an albedo change at the surface. Comparisons to two GCM-based kernels indicate good performance relative to the derived CERES kernel, with some qualitative differences owing to temporal discrepancies in the input data (atmospheric state). Comparisons to two simple radiative forcing models relying on atmospheric transmission parameters based on steady state conditions suggest that such models generate substantial discrepancies. Such discrepancies can be overcome through application of "effective" transmission parameters developed here for cases where the use of a site-specific incident solar radiation flux is preferred.