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The radiosity method applied to the shortwave surface radiation balance in complex terrain

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An accurate surface energy balance forms the basis for the computation of surface characteristics e.g. surface temperatures of soil or snow. Due to additional effects in the presence of topography the radiation balance is required to be treated in detail especially for computing *local* surface characteristics. These effects due to topography are shading and multiple anisotropic terrain reflections. In particular in highly complex, partly snow covered, terrain the latter effect plays an important role and different approaches with different levels of complexity exist to take them into account.
Presently, the gap in complexity between realistic cloudy radiative transfer models and isotropic view factor approaches $1 - F_{sky}$ is large. To partly fill this gap, the radiosity approach was chosen to compute the three-dimensional radiation balance in complex terrain which accounts for diffuse terrain reflections and shadowing. The radiosity approach adopts the concept of sky view factor and a single terrain view factor by generalizing it to heterogeneous terrain with varying albedos. For this model the sky is treated as an opening that is an area of zero reflectivity.
The radiosity approach was implemented in the radiation balance part of the coupled surface model for alpine surface processes Alpine3D. For the iterative solution of the linear system of radiosity equations the Progressive Refinement algorithm is applied which best meets the high memory requirements for large model domains with local resolutions on single processor computers.
We choose randomly generated Gaussian digital height models with well defined statistical properties to discuss the performance of the radiation model module. A variety of results revealing the sensitivity of the surface radiation balance on geometric parameters of the topography is shown in order to systematically study the influence of

terrain characteristics.