Submitted Abstract

ID IMC22-FSAbstr- 815

First Author First Name Last Name	 Christian R. (1) Steger
Submitting Author First Name Last Name	 Christian R. Steger
Correspondence	christian.steger@env.ethz.ch
Co-Authors **>> E-Mails will be not listed**	Steger, Benjamin (2); Schär, Christoph (1)
Organisations	1: Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland 2: ESRI Research & Development Center Zurich, Switzerland
Country	Switzerland
Region	Western Europe
Title	Parameterisation Of Sub-Grid Topographic Effects On Surface Radiation In High-Resolution Atmospheric And Climate Modelling.
Keywords	Radiation, Terrain, Shading, Snow
Type	List Of Focus Session
Focus Session ID	82

Abstract

In regions with complex topography, incoming short- and longwave surface radiation is strongly influenced by local and surrounding terrain. Direct shortwave radiation depends both on local slope as well as on neighbouring terrain, which can induce topographic shading. Incoming diffuse shortwave radiation can be enhanced by terrain reflection – particularly under snow covered conditions, which feature a relatively high surface albedo. Finally, incoming longwave radiation can also be modulated by radiative exchange between facing slopes. All these effects can influence the energy balance of snow-covered, snow-free and glaciated surfaces in mountains significantly. Such influences can feedback to the atmosphere through e.g. changes in near-surface air temperatures and the development of meso-scale wind systems.

In many atmospheric and climate models, topographic effects on surface radiation are not considered at all. Radiation exchange is typically modelled in the vertical direction using the column approximation, which does not allow to consider the above-mentioned effects explicitly. However, parameterisations, which are based on pure geometrical considerations and/or derived from offline three-dimensional ray-tracing simulations, were developed and implemented in some models. We focus on the former approach with the aim of developing an improved parameterisation, which can be applied in weather and climate simulations – particularly at high spatial resolutions (~1 km and below). To consider topographic effects on surface radiation, a typical required parameter is the so-called Sky View Factor (SVF). Computing this parameter, especially from a sub-grid scale Digital Elevation Model, is computationally expensive. In a first step, we developed a faster method for this task, which is based on a high-performance ray tracing library. Beside its higher performance, the new algorithm is also less prone to artefacts in the SVF caused by terrain representation. Ongoing work addresses various subsequent challenges like representing terrain-reflected shortwave radiation more accurately and reducing the computational overhead of the scheme to make it affordable for online simulations.