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The effect of orography and surface albedo on stratification in the summertime Saharan boundary layer: Dynamics and implications for dust transport

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Observations have shown that there are significant day-to-day variations in the stratification of the Saharan boundary layer, which is a control on regional dust transport and mixing. It has been suggested that the Hoggar mountains, in the east part of the Sahara desert, act as an elevated heat source that injects air out of the convective boundary layer, induces subsidence and inhibits the growth of the day-time convective boundary layer (CBL) over the western(remote) part of the Sahara. Here, model experiments are performed for three case study periods: control cases, and runs with the surface albedo and orographic variations in the Hoggar region removed. It is shown that plumes of hot air over the mountains can inject hot air (which may be dust-laden) through the Saharan residual layer, to altitudes of 8 km. The mountains and, to a smaller extent, the patches of low surface albedo, produce a deeper and warmer CBL up to 400 km west of the main peaks. The model simulations also provide evidence that the mountains inhibit the day-time growth of the remote convective boundary layer, as postulated in earlier observational papers. However, the mechanism for this remote influence on the boundary layer is not subsidence induced by the mountains. Instead, the mountains act as an obstacle to the larger-scale north-easterly flow and divert cooler air to the west and east of the mountain range. This cools the remote boundary layer and therefore, reduces the depth of the day-time CBL.