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Micrometeorological modeling to understand the thermal anomaly in the sand dunes across the Israel–Egypt border

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A thermal anomaly was observed on the remote sensing images in the sand dunes across the Israel–Egypt border. The Israeli side with more vegetation cover has higher ($>2^{\circ}$C) land surface temperature (LST) during the day than the Egyptian side where bare sand prevails. This anomaly is very obvious at about noon in the hot dry summer season. A micrometeorological model has been established in terms of surface energy balance for simulating the surface temperature change and heat flux variation of the region. The purpose of this modeling is to understand the mechanism leading to the occurrence of the thermal anomaly and to reveal the key factors controlling the surface temperature change. The characteristic of the model lies in its coupling soil temperature changing simultaneously with soil moisture movement, described as two differential equations. The methodology for the numerical solution of the model has been developed. The required meteorological data and soil parameters were measured at the study region in the hot summer season for the simulation. Two typical and the most important surface patterns of the region are considered: biogenic crust representing the Israeli side and the bare sand representing the Egyptian side. Results from simulation indicate that surface albedo contributes most to the surface temperature difference between the two typical surfaces, which is followed by sub-soil properties (mainly soil moisture) difference. Biogenic crust has lower surface albedo than bare sand. Consequently, it absorbs much more incident sky radiation. During the hot summer season, the region is very dry and vegetation is in dormancy. The canopy of most shrubs reduces to minimum. Even though the Israeli side has more vegetation, the evapo-transpiration contributed by the vegetation is still very small ($<7\%$) in comparison with the net radiation. This small latent heat flux has little effect on the surface energy balance process in the arid environment. LST change in the desert region is mainly controlled by the amount of incident solar energy absorbed by the ground as soil heat. Therefore, the anomalous LST change and

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