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Topographic normalization of thermal infrared data

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Land surface temperature is a key parameter for assessing fluxes at the surface-atmosphere interface, as well as surface soil water status, using earth observation. Models incorporating land surface temperature may however be restricted in areas with strong topography, since the latter will influence surface temperature through the decrease of air temperature with elevation and through the orientation of slopes relative to the incident solar radiation. Up till now, topographic normalization of surface temperature has generally been performed using standard lapse rates, Lambertian models or statistical-empirical linear regression approaches.

In this presentation, a new empirical topographic normalization is proposed, consisting of a correction for the elevation above sea level followed by a correction for the terrain illumination. It is shown that when landuse or vegetation cover are biased towards topography, a simple linear regression yields erroneous correction factors for elevation and illumination, caused by the interacting transpirative cooling of vegetation. Instead, surface temperature images should be stratified based on vegetation cover prior to the derivation of empirical linear regression coefficients. For the elevation correction, the temperature gradient is found to be independent of vegetation cover. The illumination correction, on the other hand, yields different temperature gradients for varying vegetation coverage, where bare soil surface temperatures are more strongly influenced by the orientation of the terrain than those of vegetated surfaces.