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An empirical expression to relate aerodynamic and surface temperatures for use within single-source energy balance models.

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Single-source energy balance models are simple and particularly suited to assimilate mixed pixel remote sensing data. Mixed pixels are made of a combination of two main elements, the soil and the vegetation. The use of single-source models implies that the source of convective fluxes, especially the aerodynamic temperature, is linked to the available remotely sensed surface temperature. There are many empirical relationships between both temperatures in the literature, but few that try to find objective constraints on this link. They usually modify the roughness length for thermal turbulent transport by an expression known as "radiometric kB-1", which depends mostly on Leaf Area Index (LAI). Acknowledging that the two temperatures should be similar for bare soil and high LAI conditions, we propose an empirical relationship between LAI and the ratio of the difference between the aerodynamic and the air temperatures and the difference between the surface and the air temperatures, also known as "beta function". Seven datasets over agricultural areas (3 in south western France nearby Toulouse, 3 in south eastern France near Avignon, one in Morocco nearby Marrakech) are used to evaluate this new relationship. They all span the entire cropping season, and LAI values range from 0 to about 5. The new mathematical function is then compared to the beta function retrieved from measured sensible heat flux and in-situ radiometric measurements as well as a two-source SVAT model (ICARE) whose parameters have been calibrated on the same datasets. Its performance in estimating the sensible heat compared to other empirical functions, either based on a "beta function" or a "radiometric kB-1", is also investigated. This work is carried out in the context of the preparation of the MISTIGRI satellite mission.