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# Estimation of evaporative fraction from top-of-atmosphere radiance

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**Abstract** The evaporative fraction (EF) is the ratio of evapotranspiration to available energy on the Earth's surface. Recent studies have successfully estimated the EF using a contextual interpretation of satellite-retrieved land surface temperature (LST) and normalized difference vegetation index (NDVI). However, satellite retrieval is often complicated and the retrieved LST is criticized for its uncertainties and limitations, which may result in a false EF. This study proposed a simple retrieval algorithm for the EF, based on radiative transfer theory and Planck's law. The algorithm can determine the EF value for each pixel using top-of-atmosphere (TOA) radiance instead of satellite-retrieved LST. It was validated using the Moderate Resolution Imaging Spectro radiometer (MODIS) data over a heterogeneous area of the Poyang Lake basin of China. Our results showed that the TOA radiance-based EF values agreed quite well with the LST-based values by a high correlation coefficient ranging from 0.956 to 0.977. The biases between the TOA radiance-based and the LST based EF values varied from –0.024 to 0.016, and the root mean square error (RMSE) from 0.030 to 0.058, all of which indicated that the proposed algorithm using the TOA radiance was accurate enough for determining the EF. Notably, the proposed algorithm has fewer assumptions and thus can avoid the uncertainties associated with the LST retrieval. It should be highly valuable for determining EF and for satellite data processing as well.

**Key words** evaporative fraction; land surface temperature; TOA radiance