Atmospheric correction effect on land surface temperatures derived from LANDSAT-7 ETM+ data

Maria Mira Sarrio, Albert Olioso, Vincent Rivalland, Dominique Courault, Olivier Marloie, P. Guillevic

ATMOSPHERIC CORRECTION EFFECT ON LAND SURFACE TEMPERATURES DERIVED FROM LANDSAT-7 ETM+ DATA

Mira M[1,2,3], Olioso A[1,2], Rivalland V[4], Courault D[1,2], Marloie O[5], Guillevic P[6]
[1]INRA, EMMAH – UMR 1114, 84914 Avignon, France,
[2]UAPV (Université d'Avignon et des Pays de Vaucluse), EMMAH - UMR 1114, Avignon, France
[3]Autonomous University of Barcelona, Spain
[4]CESBIO UMR 5126 UPS, CNRS, CNES, IRD, F-31401, Toulouse, France
[5]INRA, URFM – UR629, 84914 Avignon, France,
[6]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109
maria.mira@avignon.inra.fr
Telephone:0034.93.581.3273
Fax:0034.93.581.2001

Remote measurement of surface temperature (Ts) allows assessing surface energy balance. However, measured radiation includes not only the radiation emitted by the surface but also the radiation emitted by the atmosphere. The signal from the surface is also attenuated by the transfer through the atmosphere. Correction of these atmospheric effects requires information on the atmospheric profiles in temperature (Ta) and vapor pressure (ea) along the atmospheric path of the thermal infrared measurement. The effect of surface emissivity must also be accounted, since it directly affects the level of emitted radiation at a given temperature. Poor knowledge in either surface emissivity or atmospheric and reflection effects results in error in the determination of Ts from remote sensing measurement.
The objective of this study is to analyze the impact of using non-coincident radiosoundings to correct the Ts retrievals for atmospheric effects. We considered 27 Landsat-7 ETM+ images acquired from 2007 to 2010 over the lower Rhône Valley in France. Emissivities were estimated by considering the analysis of the NDVI – emissivity relationship together with in-situ measurements of soil and vegetation canopy emissivities performed in our study area. Ts derived from Landsat-7 were evaluated with their comparison with ground

measurements performed at four surface energy balance stations set on different ecosystems. Ts were derived considering atmospheric corrections performed using:
(1) the MODTRAN-4 radiative transfer code and atmospheric information derived from nearby radiosoundings with a time difference of 1h 45m with satellite overpass, and
(2) the operational atmospheric-correction tool from NASA, which allows to introduce the surface conditions and uses atmospheric profiles from the NCEP interpolated to our particular date, time and location.
We analyzed the effect of local topography and the variability of Ta and ea at surface level in space and time into atmospheric transmission (τa) and upwelling radiance (L↑), two parameters of the radiative transfer equation used for the atmospheric correction. These uncertainties led to an error of 1.6 K and to a systematic underestimation of 0.14 K for brightness temperature Tb, the temperature of a black body that would have the same radiance as the radiance actually observed with the radiometer. From the analysis of the entire images and completely clear sky days, there was a good correlation between Tb values atmospherically corrected by both methods (absolute RMSE and bias <1 K). Otherwise, highest temperatures were significantly underestimated or overestimated (subject to the atmospheric conditions) and the absolute RMSE and bias could be up to 2 K. The omission of surface atmospheric conditions (which characterize the lowest atmosphere layers) implied higher errors than considering them but acquired 1h 45m later (the error in Tb is almost double, while the bias is smaller).
Our study showed that in the conditions of our images, the effect of local topography and the atmosphere variability in space and time could be considered as negligible into the estimation of Ts. However, it is more important for Tb and consequently for the derivation of surface energy fluxes (particularly the sensible heat flux, and exceptionally negligible for net radiation).

RAQRS 2014

Programme and Abstract Book

4th international symposium

RECENT ADVANCES IN QUANTITATIVE REMOTE SENSING

22 – 26 SEPTEMBER 2014

Torrent (Spain)

Global Change Unit · esa · NASA · Ajuntament Torrent · l'Auditori Torrent

Airbus Defence & Space · elecnor deimos · SM GEODIM Modelos de Información de la Tierra · EOLAB

4th INTERNATIONAL SYMPOSIUM

RECENT ADVANCES IN
QUANTITATIVE
REMOTE SENSING

PROGRAMME AND ABSTRACT BOOK

22 – 26 SEPTEMBER 2014
TORRENT (VALENCIA) SPAIN