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Hydrology and Earth System Sciences Discussions

Interactive comment on "Evapotranspiration modelling at large scale using near-real time MSG SEVIRI derived data" *by* N. Ghilain et al.

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The authors tank Bob Su (HESS Editor) for his comments.

The reply is structured in the same order than the given comments. The editor comments are first reported and are followed by the authors' reply.

Two reviewers have provided very useful comments to your manuscript. While the general issues noted by both reviewers appear similar and both are positive about the manuscript, they have also pointed out some specific critical issues. The energy balance closure needs special attention, with specific references to the use of the eddy covariance (EC) data for comparison. Referee 1 "On page 7089 (15) you state correctly that the energy balance closure can leaf to 20% uncertainty in your E estimation." should read as "On page 7089 (15) you state correctly that the energy balance closure can lead to 20% uncertainty in your E estimation." but needs an error analysis as a quantification. You are invited to provide a point by point response to both reviews.

Response: We have addressed every point raised by the two referees, and we have taken into account most of their suggestions in the new version of the manuscript. We will reply hereafter to both specific questions (or suggestions) you posted.

1. "You need to analyze the relationship between the EC fetch area and the footprint of the satellite product. A critical question that needs to be answered is - are those spatial scales comparable to each other?"

Response: The footprint issue is indeed of great concern while performing comparisons between model estimates and data derived from observation at measurement sites. EC fetch is estimated to be included between 100 m and 1.5 km, depending on the CarboEurope site and the actual instability condition of the atmosphere. A typical pixel size for MET over Europe would be around 4x3 km2. Nevertheless, in-situ measurements are generally considered as the best reference for model validation. Data availability is a critical issue and we have to rely on the measurements available with sufficient quality. FLUXNET has now developed the wider network able to measure in-situ evapotranspiration, and it is a great opportunity to use it to validate land surface models and remote sensing based ET models. Taken into account this opportunity, EC data have already been used for the validation of coarse resolution models in independent studies (e.g. Sun et al., 2010; Miralles et al., 2010; Stisen et al., 2008). Aware of the footprint issue, an accompanying internal "validation file" is also created in the operational model implementation, for every generated ET image. In this file, variables calculated at tile level are stored for a selected set of flux sites and are used for validation purposes. When the energy balance for all tiles in pixel has been estimated, the pixel value is calculated as a weighted contribution of every tile in pixel. The scale impact is therefore reduced by performing the comparisons only with vegetation types that best corresponds to real vegetation type at the station. Of course, there are still differences due to the scale and the exercise has still its limitations (as pointed out in p.7091 §1). That is one of the reasons of introducing the "Product Requirement on Data Quality" in our statistical analysis.

References: - Z. Sun, M. Gebremichael, and H. A. R. de Bruin, Mapping daily evapotranspiration and dryness index in the East African highlands using MODIS and SEVIRI data, in review HESS. - G. Miralles, T. R. H. Holmes, R. A. M. De Jeu, J. H. Gash, A. G. C. A. Meesters, and A. J. Dolman, Global land-surface evaporation estimated from satellite-based observations, in review in the same issue - Stisen S., Sandholt I., Norgaard A., Fensholt R., Jensen K. H., 2008: Combining the triangle method with thermal inertia to estimate regional evapotranspiration : Applied to MSG-SEVIRI data in the Senegal River basin, Remote Sensing of Environment, 2008, vol. 112, no3, pp. 1242-1255.

2. "What is the difference or consistency between the LST from LandSAF and Tsk? What is the implication if they are different?"

Response: Although the use of remote sensing derived LST is not in the scope of the proposed contribution, we will try to answer it by providing some results we have obtained and their possible implications.

Consistence between LSA-SAF LST and Tskin computed by MET algorithm at selected locations has been investigated.

The computed Tsk is neither radiative nor aerodynamic temperature, but a mixture of both definitions. Physical interpretation of LST, derived by split-window technique, is neither straightforward. While LST and Tskin correspond to slightly different concepts and therefore should not be equal, we expect a coherent evolution between both. For example, comparisons of time series are shown for 3 MSG pixels encompassing 3 locations in Europe: Carpentras (44°N 5°E), Evora (38.5°N 8°W) and Melle (51°N 3.8°E) in Fig.1. On each figure, RMS is shown, as well as the size of the LST and

Tskin samples.

Globally, the two variables are relatively well comparable (RMS between 2.5 K and 3.5 K) for the considered period, keeping in mind that error associated to LST is of the order of 2K and that uncertainty of input variables has an impact on Tsk. In Evora, LST bias has been evaluated to 3.0 ± 1.5 K during the day (Kabsch et al., 2008). However, since LST and MET algorithms use different land cover maps and vegetation parameters, it is obvious that differences are expected. For the station of Melle (Belgium), radiative temperature is computed from the long- wave upward radiation measured at the station. Most of time, LSA-SAF LST and Tsk agree very well with the in-situ data. For some days, LST presents a different diurnal evolution. These differences could be due to a different characterization of surface, cloud contamination or viewing angle effect.

Other results are included in the MET validation report (see http://landsaf.meteo.pt/). This is an on-going research and overall results presentation will be the subject of a separated paper.

Reference: - E. Kabsch, F. S. Olesen and F. Prata, Initial results of the land surface temperature (LST) validation with the Evora, Portugal ground-truth station measurements, Int. J. Rem., Sens., 2008, 29 (17-18), 5329-5345.

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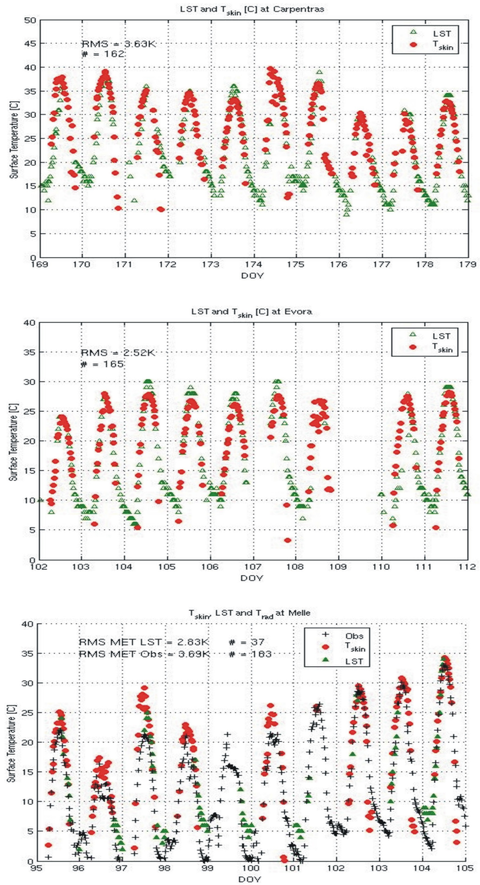

Fig. 1. Comparison of LSA-SAF LST (green triangles) and Tsk (red circles) for Carpentras, Evora and Melle (5 to 14 April 2007). Observations from Melle (black crosses), RMS and sample size (#).