Interactive comment on “Use of satellite and modelled soil moisture data for predicting event soil loss at plot scale” by F. Todisco et al.

Anonymous Referee #1. Received and published: 22 April 2015

Thank you very much for your insightful comments. We will address all the points highlighted, valuable to enhance this work

1. the writing style is quite varied throughout the manuscript. Some sections e.g. the abstract and introduction are reasonably well writ-ten with clearly stated arguments. Other sections require extensive language editing to ensure that the manuscript flows nicely.

We will carry out an extensive language revision to improve the readability of manuscript.

2. In the abstract the abbreviation USLE must be written in full at first mention as some readers may not be familiar with it.

3. On the results it is bad practice to duplicate results except if there is a clear benefit in doing so. For example, in Fig 3, the modeled and satellite derived soil moisture values are presented first as a line graph (a) and then again as a regression relationship (b). Choose one format that best projects your results.

4. Remove the raster in Fig 3a and 5a, respectively.

The suggested corrections 2, 3 and 4 will be implemented.

SPECIFIC COMMENTS

5. Firstly the authors use satellite derived soil water content data at a spatial resolution of 25 km for a plot level study of 22 m x 8 m. Given the large spatial variation in soil water content, clarity is required on the methods used to downscale the satellite soil water content to the plot scale. This detail is necessary in order for the study to be repeatable. Examples of downscaling approaches can be found in Friesen et al., 2008 and Gharari et al., 2011, among others.

The reviewer is right, soil moisture exhibits large spatial and temporal variability. However, it is widely known that the temporal dynamics of soil moisture field is often very similar across a wide range of scales; a phenomenon usually referred to as ‘‘temporal stability’’ (e.g., Brocca et al., 2010a; 2012a). Therefore, local point measurements can be used for obtaining an estimate of soil moisture over large areas (Brocca et al., 2009) and, viceversa, coarse scale soil moisture measurements can be properly used for small scale applications (Brocca et al., 2010b; 2012b). Based on the previous results obtained in the same study area, we are confident that coarse-scale soil moisture data obtained from ASCAT can provide an index of the soil saturation conditions to be used also at very small scale for erosion modelling. Indeed, in two previous studies, Brocca et al. (2010c; 2011) have already shown the good performance of the ASCAT soil moisture product in the study area. In the revised manuscript, we will add the details needed to clarify these points.

REFERENCES

Brocca, L., Melone, F., Moramarco, T., Singh, V.P. (2009). Assimilation of observed soil moisture data in storm rainfall-runoff modelling. Journal of Hydrologic Engineering, 14 (2), 153-165, doi:10.1061/(ASCE)1084-0699(2009)14:2(153).

Brocca, L., Melone, F., Moramarco, T., Morbidelli, R. (2010a). Spatial-temporal variability of soil moisture and its estimation across scales. Water Resources Research, 46, W02516, doi:10.1029/2009WR008016.

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Brocca, L., Melone, F., Moramarco, T., Wagner, W., Hasenauer, S. (2010c). ASCAT Soil Wetness Index validation through in-situ and modeled soil moisture data in central Italy. Remote Sensing of Environment, 114 (11), 2745-2755, doi:10.1016/j.rse.2010.06.009.

Brocca, L., Hasenauer, S., Lacava, T., Melone, F., Moramarco, T., Wagner, W., Dorigo, W., Matgen, P., Martínez-Fernández, J., Llorens, P., Latron, J., Martin, C., Bittelli, M. (2011). Soil moisture estimation through ASCAT and AMSR-E sensors: an intercomparison and validation study across Europe. Remote Sensing of Environment, 115, 3390-3408, doi:10.1016/j.rse.2011.08.003.

Brocca, L., Tullo, T., Melone, F., Moramarco, T., Morbidelli, R. (2012a). Catchment scale soil moisture spatial-temporal variability. Journal of Hydrology, 422-423, 63-75, doi:10.1016/j.jhydrol.2011.12.039.

Brocca, L., Ponziani, F., Moramarco, T., Melone, F., Berni, N., Wagner, W. (2012b). Improving landslide forecasting using ASCAT-derived soil moisture data: A case study of the Torgiovannetto landslide in central Italy. Remote Sensing, 4(5), 1232-1244, doi:10.3390/rs4051232.

6. Secondly, the soil water content data is also derived from a soil water balance model. Validation of the modeled or the satellite derived soil water content data with actual water content measurements on the plots is needed. The authors should, at least, give an indication of how accurate their soil water content data is given that inclusion of soil moisture in the erosion model is their main contribution.

The soil water balance model was extensively validated with actual soil moisture measurements in different studies already published in the scientific literature (Brocca et al., 2008; 2013; 2014; Lacava et al., 2012). Specifically, in Brocca et al. (2013) the model was validated exactly in the same area of this study by obtaining reliable and satisfactory results. On this basis, we believe the soil water balance model is an appropriate tool for soil moisture estimation in the area, and in the revised manuscript we will add more details on its validation. Moreover, the accuracy of the soil water balance model will be explicitly quantified.

REFERENCES

Brocca, L., Melone, F., Moramarco, T. (2008). On the estimation of antecedent wetness conditions in rainfall-runoff modelling. Hydrological Processes, 22 (5), 629-642, doi:10.1002/hyp.6629.

Brocca, L., Zucco, G., Moramarco, T., Morbidelli, R. (2013). Developing and testing a long-term soil moisture dataset at the catchment scale. Journal of Hydrology, 490, 144-151, doi:10.1016/j.jhydrol.2013.03.029.

Brocca, L., Camici, S., Melone, F., Moramarco, T., Martinez-Fernandez, J., Didon-Lescot, J.-F., Morbidelli, R. (2014). Improving the representation of soil moisture by using a semi-analytical infiltration model. Hydrological Processes, 28(4), 2103-2115, doi:10.1002/hyp.9766.

Lacava, T., Matgen, P., Brocca, L., Bittelli, M., Moramarco, T. (2012). A first assessment of the SMOS soil moisture product with in-situ and modelled data in Italy and Luxembourg. IEEE Transaction on Geoscience and Remote Sensing, 50(5), 1612-1622, doi:10.1109/TGRS.2012.2186819.

7. Thirdly, the quality of the soil water content estimates from the soil water balance method can be improved by replacing the empirical Blaney-Criddle method of estimating evapotranspiration (section 3.2) with the physically based and more accurate Penman-Monteith approach. The authors are well placed to implement this given that they had a weather station at the site (second par, pg 2951).

As suggested, we will implement the Penmann Monteith method in the soil water balance model. However, we will first verify the actual differences, in terms of the pre-event soil moisture, between the Penmann Monteith and Blaney-Criddle approaches. The Penman-Monteith approach in fact gives better results in the short time but in the medium/long time the two models will probably converge to similar pre-event soil moisture.

8. Lastly, claims that power relations in the SM4E model gave better estimates than linear relations (pg 2957 line 20-25) should be supported by suitable statistics which is another area of weakness in the paper.

A more detailed statistical analysis will be performed. The aim will be to verify if the power functions give more accurate results than the linear models. To this purpose, the confidence intervals of the linear and power models coefficients will be derived and compared.

TECHNICAL CORRECTIONS

9. Abstract, write the abbreviation USLE in full at first mention;
10. Pg 2950 line 4: replace the phrase “large availability” with “widespread availability”;
11. Pg 2950 line 20: replace the phrase “compared with” with “evaluated against”;
12. Pg 2951 line 9: Replace “gauging station” with “weather station”

The suggested corrections 9, 10, 11, and 12 will be implemented.

13. Pg 2951 line 23-27: This sentence is too long, consider splitting.

We agree with the reviewer. The sentence will be split in two or more short sentences

14. Pg 2952 lines 1-2: indicate the source of the remote sensing data. A website will do;

The source of remote sensing data will be specified in the revised manuscript. Specifically, data have been obtained from TU-Wien who is the developer of the soil moisture product from ASCAT (Wagner et al., 2013).

REFERENCE

Wagner, W., Hahn, S., Kidd, R., Melzer, T., Bartalis, Z., Hasenauer, S., Figa, J., de Rosnay, P., Jann, A., Schneider, S., Komma, J., Kubu, G., Brugger, K., Aubrecht, C., Zuger, J., Gangkofner, U., Kienberger, S., Brocca, L., Wang, Y., Bloeschl, G., Eitzinger, J., Steinnocher, K., Zeil, P., Rubel, F. (2013). The ASCAT Soil Moisture Product: A Review of its Specifications, Validation Results, and Emerging Applications. Meteorologische Zeitschrift, 22(1), 5-33, doi:10.1127/0941-2948/2013/0399.

15. Pg 2952 line 12: Indicate the depth of the root zone;

An exact quantification of the depth of the root zone is not possible. However, we expect that for erosion modelling an estimate of the soil moisture conditions for a layer depth of 15 cm is required. It will be clarified in the revised manuscript.

16. Pg 2956: line 12: Good agreement between the ASCAT and SWBM soil moisture does not necessarily mean that they are accurate. Ground-truthing seems necessary here.

As mentioned above, both the soil water balance model and the ASCAT soil moisture product were extensively validate with actual soil moisture measurements in several studies. Anyhow, in the revised manuscript we will add the details of the expected accuracy of both modelled and satellite soil moisture data.

17. Pg 2958 lines line 1: Statistics needed to indicate that the power functions gave significantly more accurate results.

As mentioned above, a more detailed statistical analysis will be performed.

REFERENCES

Friesen J., Rodgers PG., Oguntunde JM et al (2008). Hydrotope based protocol to determine average soil moisture over large area for satellite calibration and validation results from an observation campaign in the Volta Basin, W Africa. IEEE Trans. Geosci. Remote Sens. 46(7), 1995-2004.

Gharari S., Hrachowitz F et al (2011). Hydrological landscape classification: investigating the performance of HAND based landscape classifications. Hydrol Earth Syst. Sci. 15, 3275-3291.

Thanks for the references. We will add to the revised manuscript where appropriate.