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# A new method for rainfall estimation through soil moisture observations

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Rainfall and soil moisture are two important quantities for modelling the interaction between the land surface and the atmosphere. Usually, rainfall observations are used as input data for modelling the time evolution of soil moisture within hydrological and land surface models.
In this study, by inverting the soil water balance equation, a simple analytical relationship for estimating rainfall accumulations from the knowledge of soil moisture time series is obtained. In situ soil moisture observations from different sites in Europe are used to test the reliability of the proposed approach in contrasting climatic conditions. Moreover, remotely sensed soil moisture data derived from the Advanced SCATterometer (ASCAT) and the Advanced Microwave Scanning Radiometer (AMSR) are employed.
The results show that the model is able to satisfactorily reproduce daily rainfall data when in situ soil moisture observations are employed with correlation coefficient between observed and predicted rainfall data nearly equal to 0.9 for all the investigated sites. Furthermore, also by using satellite data, reasonable results are obtained in reproducing 4-day rainfall accumulations with correlation values close to 0.8 and by analysing a period of four years.
Based on these satisfactory results, the method is applied for the whole Italian territory for assessing the reliability of the two satellite soil moisture products (obtained by ASCAT and AMSR) over a large area. In particular, the rainfall estimates derived from the two satellite products are compared with ground observations. The product showing the higher correlation is expected to be the more accurate. The intercomparison between the results of this analysis and classical approaches based on the use of in situ soil moisture observations is also investigated.
The proposed approach can be adopted conveniently to improve rainfall estimation at a catchment scale and as a supplementary source of data to estimate rainfall at a global scale. Some preliminary comparisons between the accuracy of this method and the "classical" satellite rainfall products (provided by the NASA Tropical Rainfall Measuring Mission) will be also shown.