Estimating soil moisture and its uncertainty by assimilating remote sensing data into a distributed hydrological model at the watershed scale

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The knowledge of spatially distributed soil moisture is of pronounced importance in various applications including flood control, agricultural production and effective water resources management. The soil moisture can not be obtained easily at regional scale with good spatial and temporal frequency because of the high spatial and temporal variability. The soil moisture can be obtained by ground point measurements, Satellite remote sensing, and through hydrological modelling. While point measurements allow for the collection of high resolution data through the soil profile, it is limited to a local scale due to instrument and logistic constraints. On the other hand satellite remote sensing is limited to the top few centimeters but yields good spatial information over large areas. And the hydrological model can provide vertical information (e.g. root zone soil moisture) on regional scale and better estimates of other hydrological variables with a good temporal frequency. To fully meet the requirements for soil moisture information for watershed management, it will be necessary to optimally combine the horizontal coverage and spatial resolution of remote sensing with the vertical coverage and temporal continuity of a soil moisture simulation model. Data assimilation approaches like Kalman filtering can be useful in doing so.

To assimilate the remote sensing data into a distributed hydrological model, the questions arise are: (i) how to suitably classify soil and crop classes at watersheds scale (ii) how best to obtain knowledge of parameters (e.g. soil and crop) and their uncertainty at the required spatial resolution at the watershed scale, (iii) what is the efficient and simplified hydrological model which can be used to assimilate the RS inputs into it, and (iv) what is an appropriate assimilation algorithm, which can combine the DHM and RS algorithms. In this paper, we address these questions through the application carried out in a semi-arid tropical watershed in south India.

Keywords: Data assimilation; remote sensing; hydrological modelling; parameter estimation.