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Hydrology and Earth System Sciences Discussions

Interactive comment on "Soil moisture-runoff relation at the catchment scale as observed with coarse resolution microwave remote sensing" *by* K. Scipal et al.

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General remarks,

The paper presents application of remotely sensed soil moisture in hydrological cycle analysis. The large dataset from active microwave instrument onboard ERS satellite (scatterometer) was used for this comparison. Authors are trying to move attention of the readers to potential use of soil moisture estimated by the satellite measurements arguing, that still exist a gap in proper use of this parameter in hydrological modelling. Discussing quality of scatterometer measurements authors mentioned results from long term comparison of satellite derived soil moisture and ground measurements based on large probe of 45 000 ground measurements, to convince that remotely sensed soil moisture measurements with space resolution 50 km give very similar results to point ground measurements. In fact, it is detailed documented on suggested web page of Vienna University of Technology. Microwave remote sensing technology for soil moisture retrieval at various scales were described focusing mainly on SAR, SCAT sensors and future SMOS and HYDROS missions. The previous attempts to use remote sensing of soil moisture in hydrological modelling was proved by many examples from literature concluding, that it's first attempt to use coarse resolution space born data in hydrology. This conclusion is further extended by discussion on spatial scales of soil moisture. Authors stated, that coarse resolution sensors reflect large scale processes in the soil, driven by meteorological and climatic conditions mainly represented by precipitation and evapotranspiration. The main purpose of the paper was to present comparison of remotely sensed soil moisture with runoff or water level at the Zambezi river upstream of Kariba reservoir (including one tributary of mentioned reservoir), trying to find direct relationship. This comparison was simplified as much as possible. Authors aware of this simplification, included necessary clarifications. Results and functions fitting soil moisture estimations and hydrological measurements were presented and discussed. Future use of such type of measurements was proposed with use of new satellite missions scheduled in this decade.

Specific remarks,

1. Unfortunately there is not presented any more detailed clarification concerning relationship between satellite and point measurements of soil moisture, specially relation to the depth of measurements. The results of satellite measurements concerns very thin upper layer of soil, for C-band scatterometer practically not more then 5 cm. Soil moisture is not uniform in 1 m layer taken for comparison. The same concern spatial representation of point measurements. If there is so good agreement between measurements taken at so much different scales, point measurements would be representative for really large areas and can be used directly in hydrological modelling !

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2. Other microwave sensors used for soil moisture retrieval (e.g. AMSR/AQUA, SSMI) unfortunately nor mentioned for more complete view of the problem. 3. Reading the paper, it looks simple to avoid weaknesses of active microwave measurement specially those concerning vegetation cover, surface roughness and orientation, very low penetration of C band scatterometer into the soil, which have substantial influence on the results, specially on tropical territory covered by savanna and shrubs and partially located in mountains. Also heterogeneity of the land surface conditions is one of the critical issues due to large footprints of scatterometer.

4. In fact authors compared two variables mainly depending on the same variable which is precipitation. Both runoff and soil moisture strongly depends on amount of precipitation (excluding drought conditions). As a result, annual and inter annual variability of those two variables was detected. Relation between them is not straightforward, so results differs for each gauging stations.

5. Completely lack of any remark concerning catchment morphology which has large influence on rainfall-runoff relation and lag time. The differences of observed measurements on selected stations were not deeply analysed.

6. Water levels used for comparison in half of cases and derived results are useless without good knowledge of cross-sections and resulting consumption curve.

7. I have an impression, that there is lack of hydrological model use in this analysis. In such case estimations of soil moisture may be used as one of the model inputs. Benefits of such a use have much more practical aspect. I cannot imagine, that in the catchment including two really large reservoirs (Kariba and Gabora Bassa) used for electricity production, there is not used operationally any (even simple) hydrological model.

Technical corrections

Fig 3 completely not readable, Fig. 2 not much better. It looks, that they were not

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optimised for B/W printing. Section 1/20: Metop-1 satellite will be launched in 2006.

Conclusions

The paper is well written, presented ideas well documented both by literature and authors results from previous works available in Internet. The discussed problem of utilisation of satellite soil moisture estimations in operational hydrology, advantages and limitations of this techniques are very interesting specially when confirmed by long term comparisons of results. In fact this parameter is very difficult for direct comparison with conventional observations. Selected by authors idea to compare satellite measurements with measured runoff is a solution to avoid not representative point measurements. Results proved, that large scale temporal variability of soil moisture has interesting agreement with runoff in climatic conditions typical for tropics with dry and wet seasons. Points for discussion presented above and suggested small corrections, do not diminish the value of paper. I hope, they could be used in next studies performed by authors. I suggest to accept a paper for printing after mentioned technical corrections.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 417, 2005.