Geophysical Research Abstracts, Vol. 7, 02085, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02085

Soil erosion modelling at the catchment scale using remote sensing data

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Overland flow and soil erosion models are necessary for the prevention and mitigation of numerous hazards such as the pollution of water bodies, the degradation of the soil system or the occurrence of muddy floods in urban areas. However, the processes leading to overland flow and soil erosion are complex and involved numerous parameters that interact non-linearly in time and space and that show both high spatial heterogeneities and temporal fluctuations. Parameter description therefore needs to be spatially distributed and carried out at regular intervals in time. Such constrains imply time consuming field campaigns and restrict model use to small monitored areas. Satellite data exhaustively cover large areas and represent interesting potential alternative inputs in such model. The parameters we can extract from remote sensing imagery and which are of interest to overland flow and soil erosion modelling are: land cover (including linear features), vegetation cover, soil surface roughness, soil surface moisture and Digital Elevation Model (DEM).

The objective of this paper is to show examples of integration of remotely sensed data in a runoff and soil erosion model for several catchments in France with special emphasis on the use of radar data. The potential of synthetic aperture radar (SAR) data for monitoring roughness states over bare agricultural fields has been investigated using ERS and RADARSAT images. The results indicate a strong dependence of incidence angle on the discrimination between radar return over areas of different surface roughness. At a high incidence angle (47˚), the influence of soil roughness on radar return predominates over the influence of other soil parameters, making it possible to discriminate and map various surface roughness classes (smooth, medium and rough) over agricultural fields. For measuring surface soil moisture Advanced Synthetic Aperture Radar (ASAR) proves to be a good remote sensing tool, with accuracy

for the retrieved soil moisture that can reach 3.5% (RMSE). For the best estimates of soil moisture, ASAR data should be acquired at both low and high incidence angles. Nonetheless, some field data or at least good reference data are still necessary to achieve relevant erosion prediction simulations.