Geophysical Research Abstracts,
Vol. 11, EGU2009-3095-2, 2009
EGU General Assembly 2009

Modelling increased soil cohesion by plant roots with EUROSEM

S. De Baets (1), J. Poesen (2), D. Torri (3), and M.P. Salvador (4)

(1) Dep. Earth and Environmental Sciences, K.U. Leuven, Celestijnenlaan 200E, B-3001 Heverlee, Belgium (sarah.debaets@ees.kuleuven.be, Fax: ++32/16/32.29.80), (2) Dep. Earth and Environmental Sciences, K.U. Leuven, Celestijnenlaan 200E, B-3001 Heverlee, Belgium (jean.debaets@ees.kuleuven.be, Fax: ++32/16/32.29.80), (3) Consiglio Nazionale Delle Ricerche, Istituto Di Ricerca Per La Protezione Idrogeologica (CNR-IRPI),Via madonna del piano, 10, 50019 Sesto Fiorentino, Italy (dino.torri@cnr.it, Fax: +39-055-5226550), (4) Protezione Idrogeologica (CNR-IRPI),Via madonna del piano, 10, 50019 Sesto Fiorentino, Italy (pilar.salvadorirpi.cnr.it, Fax: +39-055-5226550)

Soil cohesion is an important variable to model soil detachment by runoff (Morgan et al., 1998a). As soil particles are not loose, soil detachment by runoff will be limited by the cohesion of the soil material. It is generally recognized that plant roots contribute to the overall cohesion of the soil. Determination of this increased cohesion and soil roughness however is complicated and measurements of shear strength and soil reinforcement by plant roots are very time- and labour consuming. A model approach offers an alternative for the assessment of soil cohesion provided by plant roots However, few erosion models account for the effects of the below-ground biomass in their calculation of erosion rates. Therefore, the main objectives of this study is to develop an approach to improve an existing soil erosion model (EUROSEM) accounting for the erosion-reducing effects of roots.
The approach for incorporating the root effects into this model is based on a comparison of measured soil detachment rates for bare and for root-permeated topsoil samples with predicted erosion rates under the same flow conditions using the erosion equation of EUROSEM. Through backwards calculation, transport capacity efficiencies and corresponding soil cohesion values can be assessed for bare and root-permeated topsoils respectively.
The results are promising and show that grass roots provide a larger increase in soil cohesion as compared with tap-rooted species and that the increase in soil cohesion is not significantly different under wet and dry soil conditions, either for fibrous root systems or for tap root systems. Relationships are established between measured root density values and the corresponding calculated soil cohesion values, reflecting the effects of roots on the resistance of the topsoil to concentrated flow incision. These relationships enable one to incorporate the root effect into the soil erosion model EUROSEM, through adapting the soil cohesion input value. A scenario analysis performed with EUROSEM for different vegetation treatments, indicates that runoff and soil loss on root-permeated topsoils are slightly higher as compared to fully covered grass fields or harvested grass fields with some plant residue left, but much smaller as compared to bare topsoils. Moreover, when re-vegetating bare soils, roots are responsible for a large part of the reduction in soil loss and runoff by concentrated flow. Hence, this analysis shows that the contribution of roots to soil cohesion is very important for preventing soil loss and reducing runoff volume. The increase in soil shear strength due to the binding effect of roots on soil particles is two orders of magnitude lower as compared with soil reinforcement achieved when roots mobilize their tensile strength during soil shearing and root breakage.