Geophysical Research Abstracts
Vol. 19, EGU2017-769-1, 2017
EGU General Assembly 2017

The use of rainfall simulations to study the erodibility of post-mining reclaimed lands in hyper-arid areas in southern Israel

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Disturbed landscapes, such as mining areas, appear to experience accelerated erosion rates in comparison to natural mature landscapes. This implies a difficulty of these landforms to reach equilibrium and allow the rehabilitation of bio-diversity. Despite previous studies of post-mining reclamation in other locations, still little is known about the behavior of such landscapes in hyper-arid climates.
Our goal is to obtain initial data related to erosional processes in post-mining hillslopes in a hyper-arid environment by using rainfall simulations. Such new knowledge may serve to design reliable reclamation procedures that will satisfy erosional stability criteria.
Rainfall simulator experiments were carried out under lab and field conditions in natural soils and in reclaimed post-mining lands in the hyper-arid region of 'Rotem Amfert Negev' phosphate plants in the Negev, Israel. The objectives were to examine infiltration rates and soil loss in disturbed material (>4mm aggregates from 0-20 cm soil layer) in lab conditions, and to examine runoff rates, runoff-rainfall relationships, and soil loss in small plots (0.8 m^2) of undisturbed soils (in situ).
In the Lab experiment, the effects of stone cover, slope gradient (9 and 15 degrees), and physical crust formation on infiltration, runoff, and soil loss were tested.
Lab results show that final infiltration rates of the crusted materials from reclaimed and natural areas were ∼5 and ∼2 mm/h, respectively, regardless of stone cover or slope gradient. In contrast, final infiltration rates of the non-crusted materials were ∼20 and ∼5 mm/h, respectively, for reclaimed and natural materials. Soil loss amounts were higher for natural material regardless of rainfall simulation conditions. The lowest soil loss in the natural material was ∼32 [g / (m^2 mm)], and, in comparison, the highest soil loss in the reclaimed material was ∼21 [g/(m^2 mm)].
In the field, the runoff threshold was significantly higher in reclaimed plots (∼16 mm) than in natural plots (∼4 mm). During rainstorms with low rain intensity (∼21mm/h) on dry soil, runoff rates and soil loss were lower in the reclaimed plots. However, during high intensity rainstorms (∼55 mm/h) on wet soil, in the reclaimed plots, runoff rates were still lower, but soil loss was similar or higher to that of natural plots.
It appears that small scale rain simulations give good initial information about the erosional processes on reclaimed slopes. Consequent research is required to study larger scale erosional processes of rill and gully formation on reclaimed hillslopes in this hyper-arid area.