PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
ESCUELA DE INGENIERÍA
DEPARTAMENTO DE INGENIERÍA HIDRÁULICA Y AMBIENTAL

Invitación Seminario N°05/2017

Predicting the particle size distribution of eroded sediment using artificial neural networks

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Miércoles 05 de Abril de 2017, 13:00

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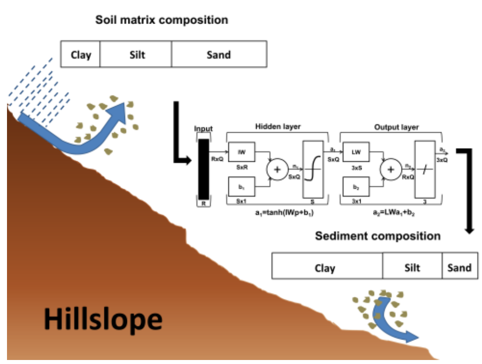

Water erosion causes soil degradation and nonpoint pollution. Pollutants are primarily transported on the surfaces of fine soil and sediment particles. Several soil loss models and empirical equations have been developed for the size distribution estimation of the sediment leaving the field, including the physically-based models and empirical equations. Usually, physically-based models require a large amount of data, sometimes exceeding the amount of available data in the modeled area. Conversely, empirical equations do not always predict the sediment composition associated with individual events and may require data that are not always available. Therefore, the objective of this study was to develop a model to predict the particle size distribution (PSD) of eroded soil. A total of 41 erosion events from 21 soils were used. These data were compiled from previous studies. Correlation and multiple regression analyses were used to identify the main variables controlling sediment PSD. These variables were the particle size distribution in the soil matrix, the antecedent soil moisture condition, soil erodibility, and hillslope geometry. With these variables, an artificial neural network was calibrated using data from 29 events (r^2=0.98, 0.97, and 0.86; for sand, silt, and clay in the sediment, respectively) and then validated and tested on 12 events (r^2=0.74, 0.85, and 0.75; for sand, silt, and clay in the sediment, respectively). The artificial neural network was compared with three empirical models. The network presented better performance in predicting sediment PSD and differentiating rain-runoff events in the same soil. In addition to the quality of the particle distribution estimates, this model requires a small number of easily obtained variables, providing a convenient routine for predicting PSD in eroded sediment in other pollutant transport models.

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