



Evaluation of the Revised Ephemeral Gully Erosion Model (REGEM)

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Gully headcut migration is one of the main mechanisms contributing to the expansion of gully networks. Sediment generated by gully erosion ranges from 10 to 94% of the total sediment budget and predicting gully dynamics remains a challenge. The basic approach by Alonso et al. (2002) was incorporated by Flores-Cervantes et al. (2006) in CHILD, by Gordon et al. (2007) in REGEM, and by Bingner et al. (2009) in AnnAGNPS. However, a comprehensive validation of this model is still lacking.

In this work, we perform a global sensitivity analysis of the model to evaluate the most important input factors controlling the headcut retreat rates. We also evaluate the model performance for predicting gully retreat rates in a permanent gully network. For this purpose, we collected the necessary field data on gully headcut morphology. Gully retreat rates were measured from historic orthophotos, between 1956 to 2013. The geomorphic unit hydrograph (GUIH) method was used to generate daily discharge series. The main parameter that controlled gully headcut growth was found to be Manning's n . Critical shear stress, erodibility constant and plow depth were found less important. We also identified a potential problem with the definition of maximum gully length as a function of runoff contributing area that was used in the model, and proposed a new function for this. Finally, when comparing to field observations, the model performed reasonable well to simulate the observed gully headcut rates.

References

- Alonso CV, Bennett SJ, Stein OR. 2002. Predicting headcut erosion and migration in concentrated flows typical of upland areas. *Water Resources Research* 38(12): 1303. <https://doi.org/10.1029/2001WR001173>.
- Bingner, R.L., Theurer, F.D., and Yuan, Y., 2009. "AnnAGNPS Technical Processes, Documentation, Version 5.0, August 2009," USDA-ARS National Sediment Laboratory, MS; USDA-NRCS National Water and Climate Center, MD; and NCCHE University of Maryland, MS.
- Flores-Cervantes JH, Istanbuluoglu E, Bras RL. 2006. Development of gullies on the landscape: a model of headcut advance resulting from plunge pool erosion. *Journal of Geophysical Research: Earth Surface* 111(F01010), <https://doi.org/10.1029/2004JF000226>.
- Gordon LM, Bennett SJ, Bingner RL, Theurer FD, Alonso CV. 2007. Simulating ephemeral gully erosion in AnnAGNPS. *Transactions of the ASABE* 50(3): 857–866.