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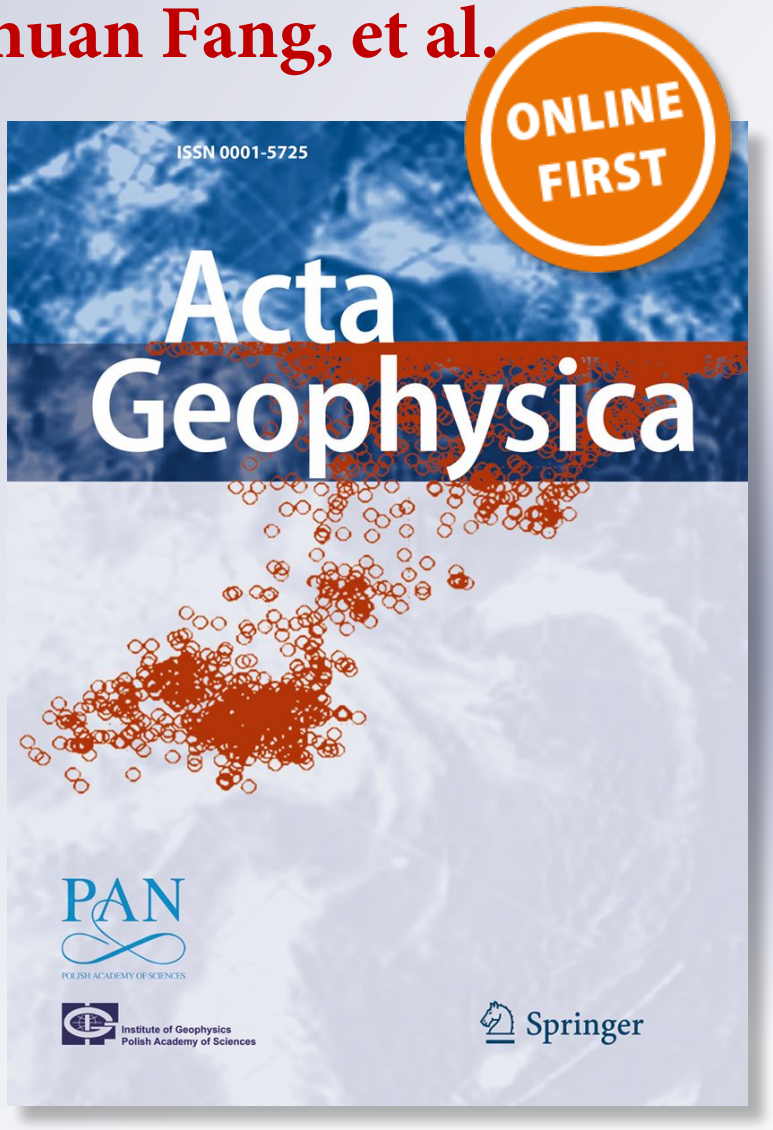

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RESEARCH ARTICLE - HYDROLOGY

Estimation of annual average soil loss using the Revised Universal Soil Loss Equation (RUSLE) integrated in a Geographical Information System (GIS) of the Esil River basin (ERB), Kazakhstan

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Abstract

The Revised Universal Soil Loss Equation (RUSLE) has enormous potential for integrating remote sensing and Geographical Information System (GIS) technologies for producing accurate and inexpensive assessments of soil erosion. In this study, the RUSLE method was applied to the Esil (Ishim) River basin (ERB), which is situated in Northern and Central Kazakhstan. The northern part of the ERB extends through the Tyumen and Omsk regions of the Russian Federation to the confluence of the Irtysh River. This article may be of interest to experts and specialists in the field of agriculture, as the findings can assist agricultural producers and government entities in making decisions that prevent soil degradation and promote optimal cropping systems for land and crop cultivation. The objective of this research is to detect, estimate and map areas of land plots most vulnerable to potential soil erosion within the ERB, using the RUSLE model under Arc GIS 10.2. The results reveal that average annual soil loss during the study period ranges from 0 to 32 (t y^{-1}) and that 108,007.5 km^2 (48%) of the ERB has no erosion. The remainder of the basin is prone to soil erosion ranging from 1 to 32 t ha^{-1} y^{-1}, which comprises 117,216.9 km^2 (52%), and total soil erosion is 565,368.7 (t y^{-1}). Soil erosion in the ERB is relatively moderate due to low hill steepness and low annual precipitation (198–397 mm). Exceptions occur in plots which feature high slope length steepness, which are scattered throughout the region.

Keywords Agriculture producers · Cropping system · RUSLE · Soil erosion

Introduction

Soil degradation is a serious problem throughout the world, which ultimately affects the reduction in soil fertility—reducing productivity in the agricultural sector, creating negative impact on the environment and consequently the quality of drinking water with further effects on the quality of life (Ganasri and Ramesh 2016; Issaka and Ashraf 2017; Vaezi and Sadeghi 2011).

Topsoil is most valuable for agricultural production and most vulnerable due to natural changes in ecosystems and inappropriate land management systems (Blanco and Lal 2010).

For proper operation and use of land resources, many factors need to be taken into account, one of which is the spatial assessment of soil loss (Prasuhn et al. 2013).

To understand the degree of soil erosion over a large area, it is necessary to collect soil samples, conduct field experiments and perform required analysis for planning

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