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IDENTIFYING NONCONTRIBUTING AREAS OF WATERSHEDS

Introduction

Non-contributing area delineation is important when assessing the hydrology of watersheds. These areas are not connected to stream networks by surficial hydrologic pathways [USGS and NRCS, 2009]. Water will pond in these areas and then evaporate, infiltrate, or fill up and produce overflow discharge. Differentiating these areas from other parts of the watershed is important when studying the hydrology of landscapes with non-contributing areas.

Existing methods of delineation are based on human delineation from topographic maps and delineation based on calibration of depression depth from a 30 meter digital elevation model (DEM). Our proposed method utilizes soil descriptions that have field verification of the mapped depressions. Field verification is unique to the soil method and results in improved delineation accuracy.

Purpose

The purpose of this research is to establish a new method for delineating non-contributing areas utilizing soil map information that is repeatable and increases the accuracy of delineations.

Study Areas

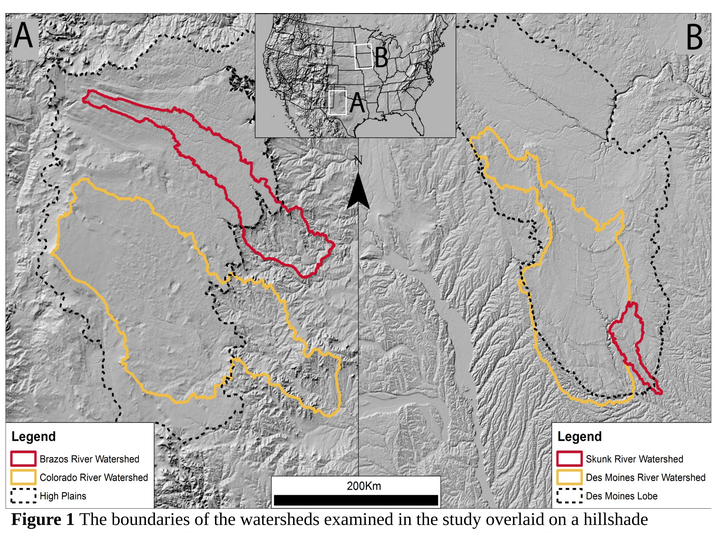

Figure 1 The boundaries of the watersheds examined in the study overlaid on a hillshade produced from a DEM. The extent map illustrates the location of the West Texas watersheds **(A)** and the North-Central Iowa watersheds **(B)**.

Methods

Soil Based Method	DEM Based Method
• Begins with interpretation of the soil series' in the desired study area. • Involves the evaluation of soil properties to determine if the series is depressional or not. • Block diagrams, like the one in figure 2, were used to determine depressional soils. • The soils determined to be depressional were mapped. • Depressions incorrectly mapped in floodplains were removed. • Remaining depressions were used as the sinks to delineate the non-contributing area in ArcMap.	• Begins with running the fill tool on a 30 by 30 meter DEM. • Filled DEM is subtracted from the raw DEM to acquire depression depth • Depth threshold of 0.5 meters determined to eliminate errors in DEM. • ArcMap Hydro Tools ran on DEM to acquire flow direction and flow accumulation. • Threshold of 100,000 cells used to delineate stream network. • Buffer used to eliminate depressions within 75 meters of a stream. • Remaining depressions were used as the sinks to delineate the non-contributing area in ArcMap.

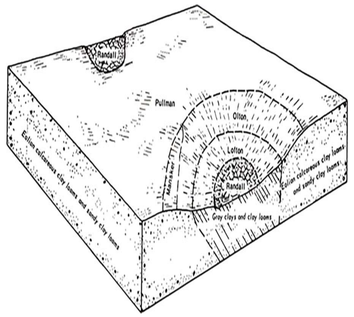

Figure 2 (Left) Block diagram of the Pullman-Olton soil association showing the landscape positions of soil series regularly mapped on the High Plains landform region of western Texas and eastern New Mexico. The Randall soil series is defined as occurring in depressions (Blakely and Koos, 1974).

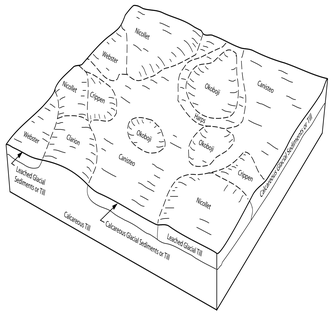

Figure 3 (Right) Block diagram of the Clarion-Webster-Okoboji soil association showing the landscape positions of soil series regularly mapped on the Des Moines Lobe landform region of Iowa and Minnesota. The Okoboji soil series is defined as occurring in depressions (Jones, 1997).

Results

	Non-contributing Area (km2)		
	USGS	DEM-based	Soil-based
Skunk	NA	1890.62	973.32
Des Moines	NA	21945.58	15370.85
Brazos	6822.03	7192.55	5231.95
Colorado	26573.28	29935.08	26050.59

Table 1 Comparison of the non-contributing values delineated from the three different methods. There are no available non-contributing area values from the USGS for the Skunk River and Des Moines River Watersheds.

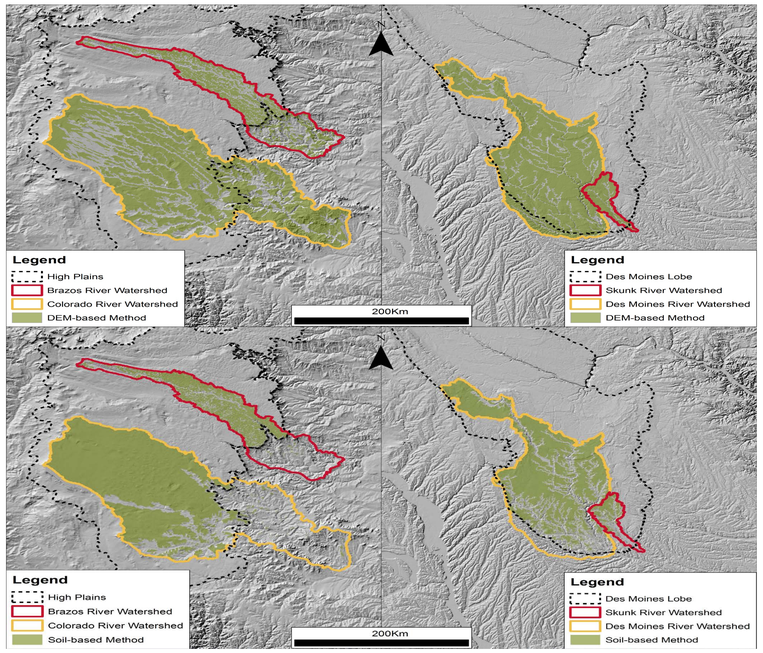

Figure 4 Comparison of the DEM based method **(Top Image)** of non-contributing area delineation and the soil based method **(Bottom Image)** of non-contributing area delineation using a 30 by 30 meter DEM. The change in landscape geomorphology is evident in the soil based method and is not picked up by the DEM based method without further time spent calibrating and re-running delineations.

Conclusions

- Non-contributing area delineation using soil information produces logical results.
- The soil based method uses logical reasoning to deduce naturally occurring depressions. Erroneous depressions in this method can be easily identified using aerial imagery and knowledge of soil properties of depressions.
- The DEM based method identifies many depressions that are more likely errors in the DEM. Leading to difficulty in setting a threshold to determine natural depressions versus mistakenly identified depressions.
- Further research with higher resolution DEMs is encouraged to increase the accuracy of the results presented here.

References

Blakely, E.R. and W.M. Koos. 1974. Soil Survey of Hale County, Texas. Soil Conservation Service, United States Department of Agriculture. US Government Printing Office, Washington, D.C.

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Geospatial Laboratory for Soil Informatics

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