Clear Creek Environmental Hydrologic Observatory

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Introduction

The Clear Creek watershed is an intensively managed 270 km^2 area of the Upper Mississippi River Basin comprising wetlands, agricultural and urbanized catchments (figure 1). The downstream flux of nitrogen and phosphorus originating in the basin has been linked to eutrophication and hypoxia in the Gulf of Mexico, a pressing national environmental concern.

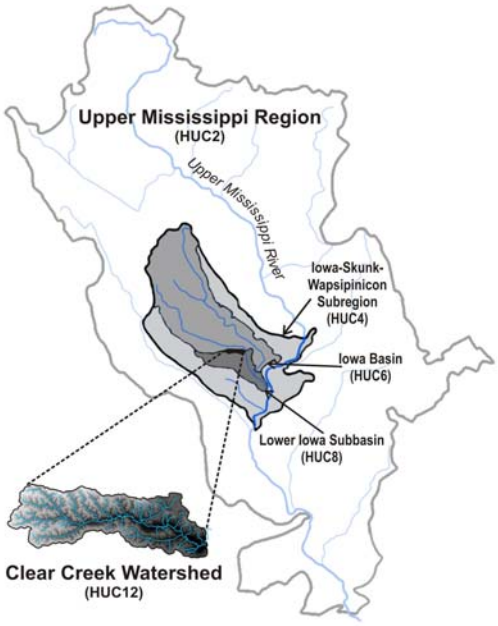

Figure 1. The Clear Creek Watershed.

The Clear Creek watershed is an important location for studying nutrient transport phenomena associated with heavy row cropping because this area has the highest erosion rates in Iowa. The watershed is currently a focal observational point whereby intensive measurements are acquired by federal and state agencies as well as by watershed-coalition groups to understand and promote positive land use practices.

The present project will establish a blueprint observatory whereby remote sensed data acquired by third parties (e.g., USGS, NOAA, EPA) will be real-time fusioned with in-situ measurements collected with wireless sensor networks in a geodabase. The stored data will be ingested in specialized simulation models (QUAL2K and WARMF) to enable new scientific and engineering insights into the runoff-drive processes. The small size of the watershed and its proximity to The University of Iowa makes it ideal for a pilot study where research and education can be seamlessly integrated. The observatory

design includes machine-to-machine communication through web services enabling networked collaboration and education activities.

The relevant current research plans focus within the headwaters of the Clear Creek Watershed (CCW), more specifically within the predominantly rural South Amana Catchment (SAC). The SAC is in the northwest corner of the CCW and encompasses about 26 km^2. Some of the highest erosion rates in the CCW are observed within the SAC mainly due to a combination of swelling, highly erodible soils with steep gradients and intensive agriculture. The average gradient is 4%, ranging from 1% to 10%.

In the SAC, there are two main sub-basins, both of which contain a first order tributary. Each tributary is approximately 6 river km long during the wet season. The outlet of the SAC is approximately 30 river km above the Iowa River confluence. This catchment is currently- as of 2006- being instrumented via different funding sources (including funding provided by IIHR) to monitor rainfall, streamflow, suspended sediment concentration, and other water quality parameters. Due to the mid-continental location of Iowa, the climate in the watershed is characterized by hot summers, cold winters, and wet springs. Summer months are influenced by warm, humid air masses from the Gulf of Mexico. The growing season lasts about 180 days in southeast Iowa. Average annual precipitation is approximately 889 mm/yr with convective thunderstorms prominent in the summer and snowfall in the winter, which averages 762 mm annually.

The dominant soil texture within the SAC is silty clay loam. There are four main soil types in the watershed comprising approximately 80% of the total acreage. The uplands are comprised of Tama, which is most prominent in the southern sub-basin, and Downs, which is prominent in the northern sub-basin. Both are formed from loess and glacial till and are highly organic. Floodplains are comprised of mostly Colo and Ely soils.

Currently, the dominant rotation in the watershed is corn-soybean and the two crops are in roughly equal proportions throughout the watershed. In the SAC, there are nine main land uses. Six of the land uses represent the various corn-soybean rotations currently present in the watershed. Each rotation involves a unique set of the following management practices: conservation tillage, spring tillage, spring and fall tillage.

At this point the aim is to better understand the role of raindrop on triggering erosion and initiating concentrating flow. In addition there is a need to understand the surface and subsurface flow exchanges on nutrient transport.

Geophysical survey design

The main focus of the planned geophysical surveys is to produce an improvement in the understanding of the processes involved in high soil erosion rates in the watershed and there relation to land use. This would in essence be a series of exploratory surveys; the aim of this initial trip is to map out the variations in ground conductivity. A number (3 to 4) of research plots, typically 200 x 200 m, have been chosen associated with differing land use properties.

The electromagnetic induction (EMI) method has been chosen based on its ease of acquisition of large spatial areas and the shallow depth of investigation needed. We aim to produce a high resolution ground conductivity map of each of the research plots using our in-house Dualem-1S instrument.

Budget

We would be out in the field for a total of 5 days, this includes 2 days travel / setting up, and 3 days on site to carry out the surveys (3 days for the EMI mapping).

On-site support provided by University of Iowa

We are receiving on-site support for this project in a number of ways, including;

- Personnel to assist with the acquisition of the geophysical data is being provided for the duration of the proposed field work.
- All travel, accommodation and subsidence costs would be met by the University of Iowa for the proposed field work.

Additional costs

All costs associated with this field work would be met by the University of Iowa.