An interactive online tool to forecast spatially distributed saturation and runoff dynamics in the Finger Lakes region

Helen E. Dahlke[1], Zachary M. Easton[1], Daniel R. Fuka[1], and Tammo S. Steenhuis[1]

Introduction:

The spatial distribution of areas that produce runoff is an important consideration in numerous applications, such as water resource planning or best management practices (BMPs). In the Finger Lakes region runoff originates from areas in the landscape that saturate frequently and contribute pollutants from source areas to streams. Hence, these areas are often referred to as Hydrological Sensitive Areas (HSAs). However, in practice it is difficult for BMP planners and local stakeholders to determine the spatial distribution of these saturated areas. In order to simplify the BMP planning process, we developed an interactive web-based tool for Salmon Creek watershed, NY. The tool incorporates hydrologic, administrative and land management information in an ESRI ArcIMS framework and presents the resulting HSA maps online.

Salmon Creek Watershed:

The HSA Tool was developed for the 230 km^2 Salmon Creek watershed, NE of Ithaca, NY.

- Elevation: 122 to 441 ma.s.l., slopes: 0 to 73°.
- Land use: 46% crop land, 26% pasture or grassland, 19% mixed and coniferous forest, 5% wetlands, and 4% is a mix of residential, commercial, and mixed urban land.
- Soils are generally deeper (< 200 cm) on the hilltops, well to moderately drained (glacial origin). Shallow soils underlain by a restricting soil layer dominate in the SE of the catchment.

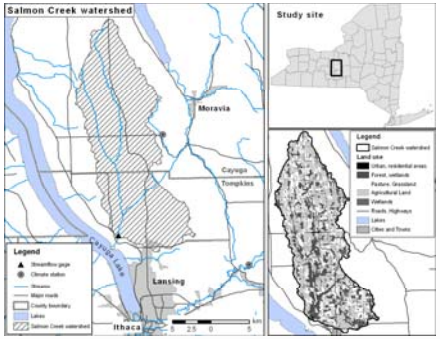


Figure 1: Salmon Creek watershed. Location of climate stations, streamflow gage and land use characteristics of the watershed.

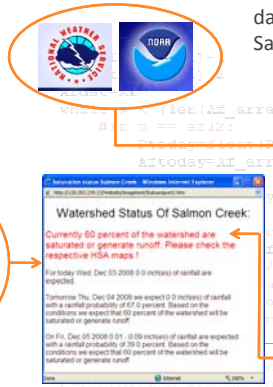
The HSA Tool:

The HSA tool displays the fraction of the watershed that is saturated for the current day. Predictions and the 48-hr forecast depend on antecedent moisture conditions and the meteorological conditions as forecasted by NOAA services.

Figure 2: Snapshot of the HSA web application for Salmon Creek.

Python Routine:

A Python script is the center application for the daily predictions of hydrological conditions for Salmon Creek watershed in the HSA Tool .



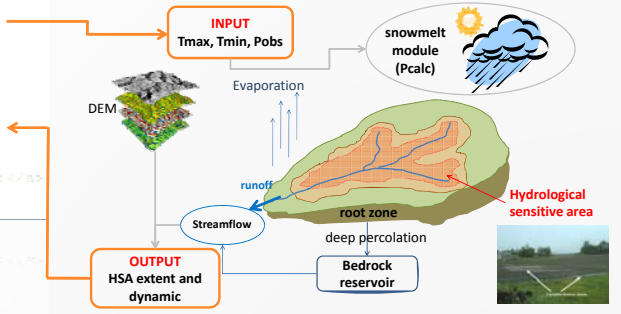
Script Functionalities:

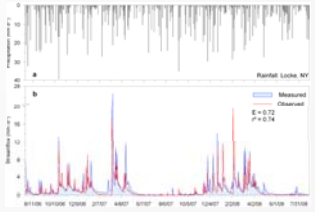
- Grab min, max temperature and precipitation data from the national weather service and add to existing time series
- Run the water balance model based on the updated time series
- Calculate saturation conditions for actual day and the next 48 hrs
- Update webpage with status and forecast of expected rainfall, the fraction of the watershed that generates runoff and the probability of precipitation
- Generate updated list of shape files that get displayed in the web application

Red areas on top of air photographs indicate current HSA as predicted with the water balance model. Based on the hydrological conditions the Python script updates daily, which maps are displayed for today and the next 48 hours.

Water Balance Model:

A water balance model based on the Thornthwaite-Mather method is used to predict daily streamflow and the fraction of the watershed that generates runoff. Depending on the antecedent moisture conditions runoff source areas or HSAs are then located throughout the watershed using the soil topographic index.





The water balance model runs in the background of the web application. A python script updates daily the actual climate data input.

Affiliations:

[1] Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY 14853, USA.

HSA Tool Website:

http://128.253.238.176/Website/Imagetest/viewer.htm

Contact: **Helen E. Dahlke**
Biological and Environmental Engineering
Cornell University
Ithaca, NY 14850, USA

Phone: +1 (607) 255 2463
Fax: +1 (607) 255 4080
E-mail: hed23@cornell.edu