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TWI: Making a statewide topographic wetness index

Kingsley M. Allan

*Illinois State Water Survey / Prairie Research
Institute*



illinois.edu



Genesis: Urban Flooding Awareness Act

- The development of TWIs for counties across Illinois is an action item in the Urban Flood Awareness Act (UFAA) report, which was published June 30, 2015 (State of Illinois, 2015).
- FEMA funded the development of a Topographic Wetness Index (TWI) for DuPage and Will Counties as part of their Community Engagement and Risk Communication (CERC) efforts.
- With the support of NRCS, ISWS has subsequently generated the index for most Illinois counties as high resolution DEMs derived from LiDAR have become available.



TWI is a function of both the slope and the upstream contributing area.

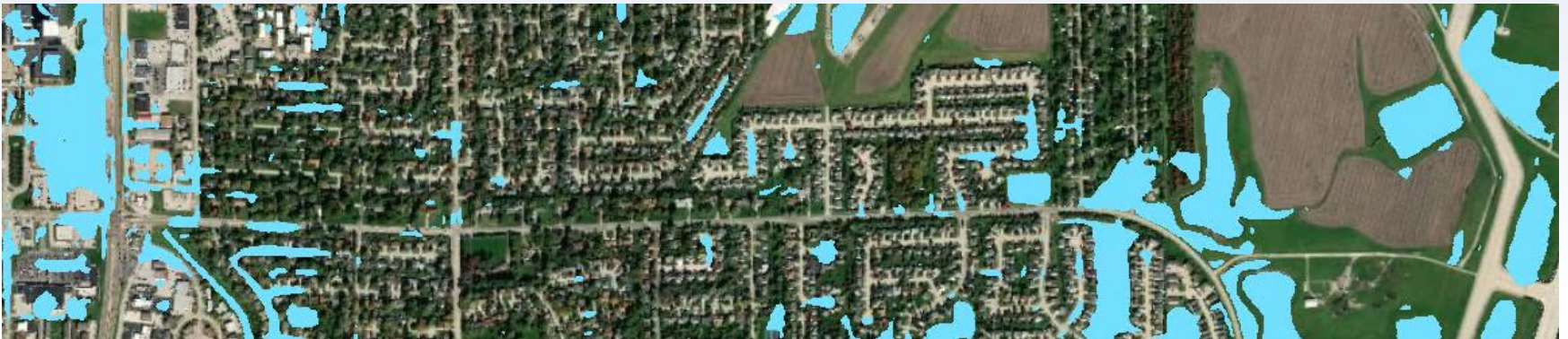
$$\ln \frac{a}{\tan b}$$

where a is the upslope contributing area and b is the topographic gradient

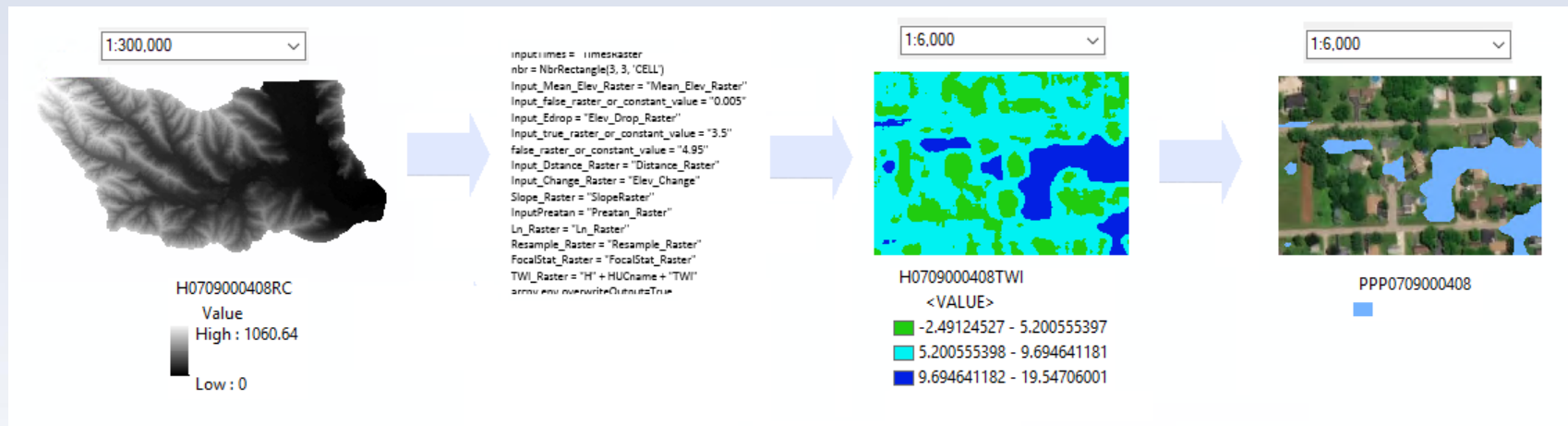


TWI shows

- Areas with increased accumulated runoff potential.
- Areas with low slope and large upslope contributing areas.



Processing Overview



DEM

Script

Raster

Polygon



Processing Overview

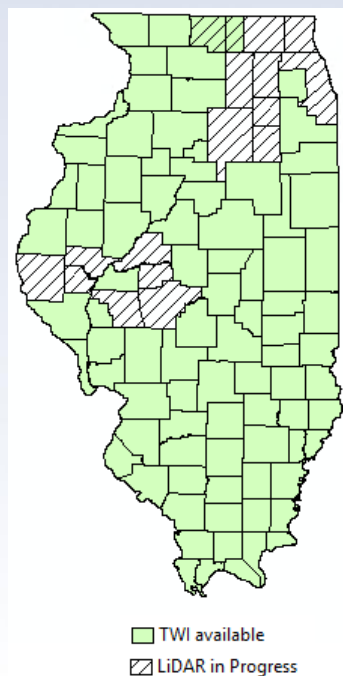
1. Create a DEM for the HUC10 area by clipping from county DEMs, and aggregating cell size to 6 feet.
 - Desktop computing environment not suitable for larger HUC size.
 - Larger cell size reduces effect of field furrows, and geometric patterning from TIN.
2. Python script created raster TWI.
3. TWI converted to polygon format for easy of use.
 - i.e. HUC 0709000408 raster is 70x larger than vector (277 MB v. 4 MB)
 - Small polygons eliminated (less than 12' x 12').
 - Eliminated confusion in determining threshold for raster display.



Distributing @

www.illinoisfloodmaps.org/twi

All counties available in shapefile format for download except where new LiDAR will soon become available.



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Topographic Wetness Index

The TWI is a physically based index or indicator of the effect of local topography on runoff flow direction and accumulation. The index is a function of both the slope and the upstream contributing area. The computation of TWI is performed using both geographic information systems (GIS) and Python, a programming software used to enhance computing capabilities. The indices help identify rainfall runoff patterns, areas of potential increased soil moisture, and ponding areas.

With support from FEMA, Illinois State Water Survey generated the index for the Illinois counties of DuPage and Cook (see [report](#)), and with the support of NRCS has subsequently generated the index for most Illinois counties as high resolution DEMs derived from LiDAR have become available. While TWI is usually viewed in raster format, ISWS is distributing a version in polygon format for easier access and use. This first release version is a direct product of computer processing without manual examination of areas across the state and may therefore inaccurately display areas such as lakes, rivers, and areas where road culverts were missing from the LiDAR.

Select a county of interest to download the shapefile. Please see our [disclaimer](#).

| | | | | |
|------------|-----------|------------|-------------|------------|
| Alexander | Edgar | Jefferson | McLean | Scott |
| Bond | Edwards | Jersey | Mercer | Shelby |
| Boone | Effingham | JoDaviess | Monroe | Stark |
| Bureau | Fayette | Johnson | Montgomery | St Clair |
| Calhoun | Ford | Kankakee | Moultrie | Stephenson |
| Carroll | Franklin | Knox | Ogle | Tazewell |
| Cass | Fulton | Lawrence | Peoria | Union |
| Champaign | Gallatin | Lee | Perry | Vermilion |
| Christian | Greene | Livingston | Piatt | Wabash |
| Clark | Hamilton | Logan | Pike | Warren |
| Clay | Hancock | Macon | Pope | Washington |
| Clinton | Hardin | Macoupin | Pulaski | Wayne |
| Coles | Henderson | Madison | Putnam | White |
| Crawford | Henry | Marion | Randolph | Whiteside |
| Cumberland | Iroquois | Marshall | Richland | Williamson |
| DeWitt | Jackson | Massac | Rock Island | Winnebago |
| Douglas | Jasper | McDonough | Saline | Woodford |

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Limitations

- This first release version is a direct product of computer processing without manual examination of areas across the state.
- May inaccurately display areas such as lakes and rivers due to deficiencies in hydro flattening and hydro correction of DEM surface leading to geometric patterning from TIN
- Areas where road culverts were missing from the LiDAR may be excessively large.



Future plans

- Create a statewide web map service when LiDAR becomes available.
- Use HPC (high performance computing) environment to process larger areas (HUC8), and in less time.

