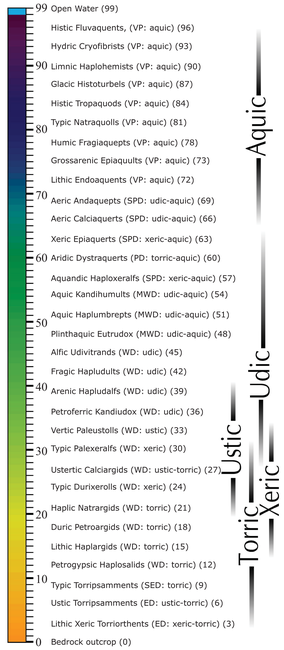
The Natural Soil Drainage Index (DI) – A useful tool for depicting soil wetness on a landscape scale

Randall J. Schaetzl

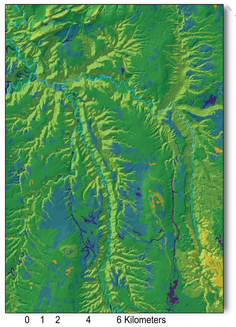
MICHIGAN STATE UNIVERSITY

Dept. of Geography, MSU, East Lansing, MI, 48824

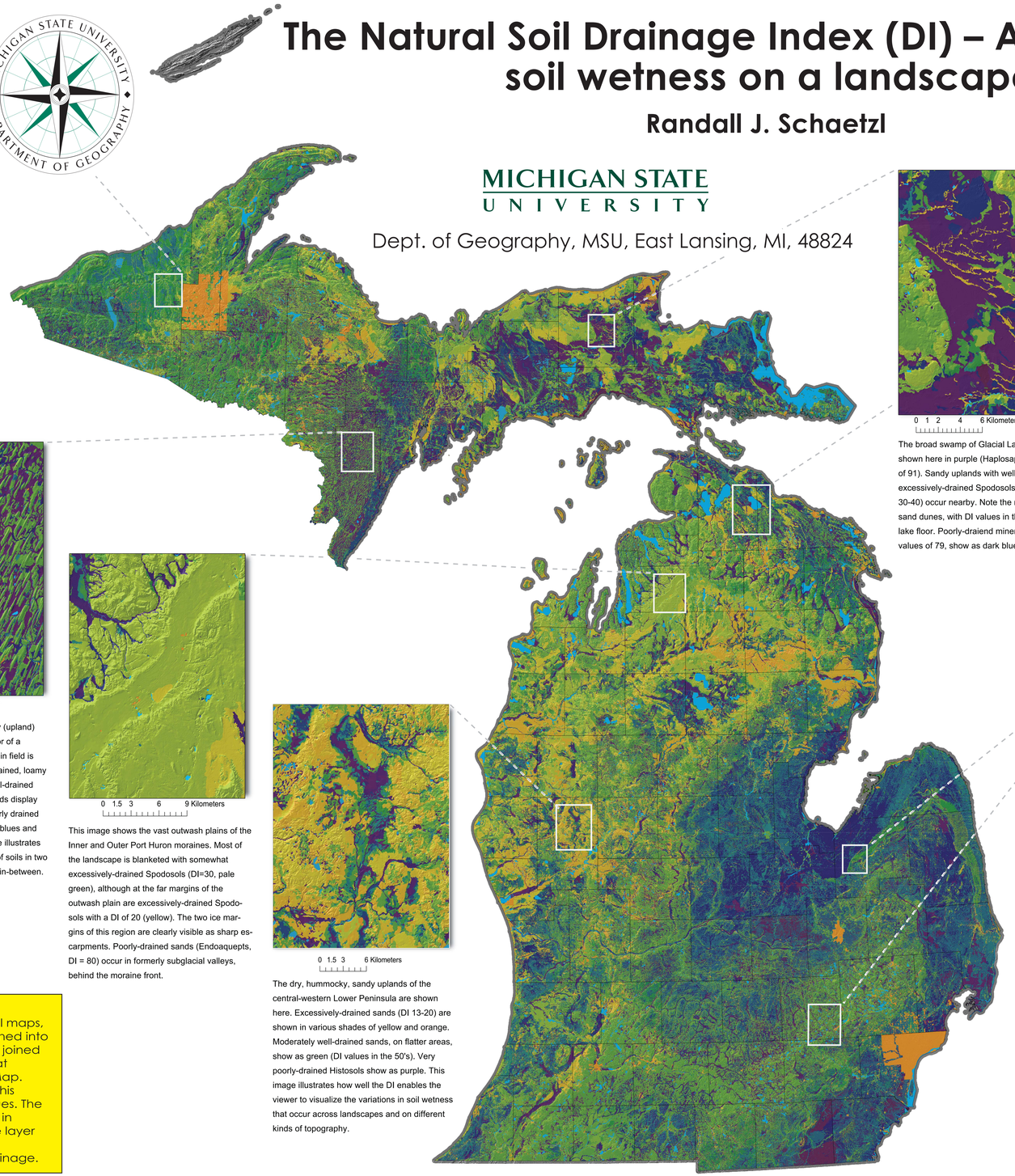
Visit the DI web page at http://www.drainageindex.msu.edu/



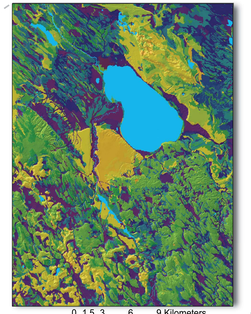
The DI color ramp, for GIS applications



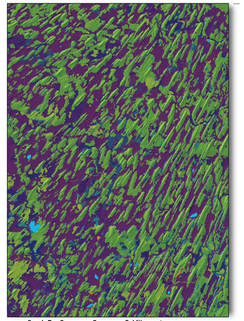
This image shows the DI color values across an area of silt loam and silty clay loam lacustrine sediments, deeply incised by streams in post-glacial times. Both the topography and the natural wetness of the landscape are easily visualized in this image. Glossudalf and Hapludalf soils that have formed in this material on the flatter uplands are moderately well-drained and somewhat poorly-drained, whereas sloping map units are well-drained. The DI adjusts for slope gradient, making the final DI value for well-drained soils on slopes *lower* than it would be if they were on areas of low slope.



The broad swamp of Glacial Lake Algonquin is shown here in purple (Haplosaprists, with a DI of 91). Sandy uplands with well- and somewhat excessively-drained Spodosols (DIs range from 30-40) occur nearby. Note the many parabolic sand dunes, with DI values in the teens, on the lake floor. Poorly-draiend mineral soils, with DI values of 79, show as dark blue.



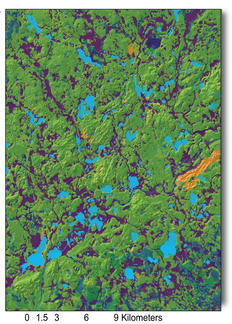
Use of the DI to examine the landscapes of NE Lower Michigan enabled us to find a heretofore undiscovered glacial delta, shown here in orange. Soils on this delta are excessively-drained Udipsamments (DI = 14) and Spodosols (20). The delta stands in contrast to the heterogeneous mix of soils, sediments and wetness on the ground moraine to its south, and the wetter lake plain to the north. Note the large, sandy upland with its well- and excessively-drained soils, just to the NE of the lake.



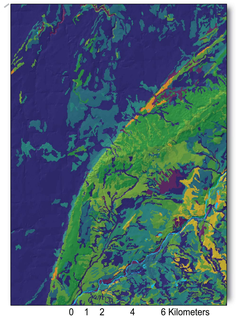
The pattern of wet (lowland) and dry (upland) soils in this area is a classic indicator of a drumlin field. The Menominee drumlin field is comprised of soils formed in well-drained, loamy glacial tills (DI values of 40-42). Well-drained Hapludalf soils on the drumlin uplands display as green, while poorly and very poorly drained Histosols and Humaquepts show in blues and purples (DI = 91). Use of the DI here illustrates that this landscape is mainly a mix of soils in two different drainage classes, with few in-between.

This image shows the vast outwash plains of the Inner and Outer Port Huron moraines. Most of the landscape is blanketed with somewhat excessively-drained Spodosols (DI=30, pale green), although at the far margins of the outwash plain are excessively-drained Spodosols with a DI of 20 (yellow). The two ice margins of this region are clearly visible as sharp escarpments. Poorly-drained sands (Endoaquepts, DI = 80) occur in formerly subglacial valleys, behind the moraine front.

The dry, hummocky, sandy uplands of the central-western Lower Peninsula are shown here. Excessively-drained sands (DI 13-20) are shown in various shades of yellow and orange. Moderately well-drained sands, on flatter areas, show as green (DI values in the 50's). Very poorly-drained Histosols show as purple. This image illustrates how well the DI enables the viewer to visualize the variations in soil wetness that occur across landscapes and on different kinds of topography.



The topography and soils of this region, a complex interlobate moraine with abundant kettles and kettle lakes, displays particularly well with the hillshade and DI color ramp. Upland soils are sandy, well-drained Hapludalfs, with DI values of 39-44. Mucks in the intervening swamps show as purple. The orange area is a gravel pit. Use of the DI helps the user to understand that this is a landscape of high, dry hills and low, wet swamps, but few other types soils or "wetness conditions" exist here.



Topography, relief and soil wetness all change dramatically across this image, near the junction of the Port Huron moraine and the lake plain of Glacial Lake Saginaw. The DI successfully captures these changes and depicts them clearly. The moraine is dominated by well-drained and moderately well-drained Glossudalfs (DI values 42-53) formed in loam till. The lake plain has large areas of loamy Endoaquolls, with a DI value of 82. Distal to (SE of) the moraine are areas of somewhat poorly-drained sands (DI = 66), shown in cyan.

Abstract

In this poster I draw attention to a recently published index of soil wetness – the Natural Soil Drainage Index, or DI. The DI is ordinally based, ranging from 0 for the very driest soils, e.g., those shallow to bedrock in a desert, to 99, for areas of open water. The index was developed to reflect the long-term amount of useable water that a soil can supply to growing plants under natural conditions. It operates on the assumption that soils in drier climates and with deeper water tables have less useable water; therefore, the soil's natural drainage class and soil moisture regime figure prominently in the calculation of the "base DI." Other soil attributes, such as texture, organic matter content, and salinity, also affect the final DI value, but more subtly. The DI of each of Soil Taxonomy's suborders is available from pull-down menus, and for download, at **www.drainageindex.msu.edu.** In this poster, I present examples of how the DI, when linked to a NRCS digital soil map and our color ramp (for mapping symbology), can provide insight into wetness patterns across landscapes, at various scales. Other applications of the DI, such as in forestry and landscape ecology, are likely to emerge as word of the index spreads.

Citation:

Schaetzl, R.J. et al. 2009. The Natural Soil Drainage Index: An ordinal estimate of long term, soil wetness. Phys. Geog. 30:383-409.

Methods

Michigan's SSURGO (county-scale) soil maps, obtained from the NRCS, were combined into a mosaic for the state, rasterized, and joined with the DI table, which is accessible at **www.drainageindex.msu.edu**, in ArcMap. The color ramp, shown elsewhere on this poster, was used to display the DI values. The soil layer's transparency was adjusted in ArcMap to partially show the hillshade layer below, thereby better illustrating how topography influences natural soil drainage.

Acknowledgements:

Funding for this project was provided by the USDA-Forest Service. M. Luehmann and S. AcMoody assisted with graphics.