The Wet-areas and Depth-to-Water Mapping Initiative of the Forest Watershed Research Centre 1997 - 2015

Paul A. Arp
Faculty of Forestry and Environmental Management, UNB, Fredericton, New Brunswick

The Cartographic Depth-to-Water (DTW) mapping concept was first conceived in 1997 as part of the Wet-Areas Mapping Initiative (WAM) of the Forest Watershed Research Centre at UNB. The purpose of this Centre was to facilitate sustainable forest operations decision making (http://watershed.for.unb.ca/). Details about the DTW benefits emerged soon after, and were described formally by Meng et al. (2003), Case et al. (2005) and Ogilvie (UNB BScF thesis, 2006; Arp 2009). This was accompanied and followed by a series of articles about discerning the geospatial distribution of wetlands (i) (Murphy et al. 2007), (ii) soil, drainage and vegetation type (Murphy et al. 2009ab, 2011; White et al. 2012; Hiltz et al. 2012), (iii) denitrification (Murphy et al. 2009b), (iv) dissolved organic matter in streams and lakes (Jutras et al. 2011), and (v) soil resistance to penetration (Vega at al. 2009; Campbell et al 2013). Recent references deal with vegetation type and forest plantation productivity within the general remote sensing context (this site; Nijland et al. 2014, 2015).

Due to global SRTM-DEM availabilities, much DTW-related work has been done and will continue:

- At 10 m resolution: for entire provinces (New Brunswick, Nova Scotia), States (Maine, Vermont, Hawaii), countries (Bermuda, Belize, Haiti), and many other select across the world, e.g., Malawi, Tanzania, Germany, Hungary, Mexico, Borneo, Chile, Venezuela, Uruguay. Where additional DEM data are available, these delineations can be further improved through DEM blending and LiDAR-DEM based calibrations (Furze et al. 2015).
- With respect to LiDAR-DEM coverage at 1 m resolution, about 30,000,000 ha have been mapped for Alberta, and about 1,000,000 ha in New Brunswick. Many smaller areas have also been mapped for, e.g., Ontario, Saskatchewan, British Columbia, Prince-Edward Island, Maine, Sweden, Chile.

At this stage, algorithms and scope of WAM-based applications are expanding, as follows:

- to systematically inform about locations with actual as wells as potential erosion, mudslide and flooding hazards;
- to build new trails and roads, or to relocate these towards less vulnerable locations;
- to ascertain which areas are affected by the spreading of waterborne spills;
- to provide hydrologically based data layers for municipal planning regarding the placement of residential, industrial, and conservation developments;
- to ascertain off-road trafficability by weather/season;
- to map crop yields as affected by soil drainage across fields;
- to delineate vegetation type and habitats based on soil moisture regime preferences;
- to provide internet-based wet-areas mapping services.

References

Arp, P.A., 2009. High-resolution flow-channel and wet-areas maps: a tool for better forest operations planning. SFM Network Research Note Series No. 55; 6 pp.

Case, B.S., F-R. Meng, P.A. Arp. 2005. Digital elevation modelling of soil type and drainage within small forested catchments. Canadian Journal of Soil Science. 85: 127-137.

Furze, S., P.A. Arp. 2015. Digital elevation modelling: blending DEMs (this site).

Hiltz, D., J. Gould, B. White, J. Ogilvie, and P.A. Arp. 2012. Modeling and mapping vegetation type by soil moisture regime across boreal landscapes. Restoration and reclamation of boreal ecosystems: attaining sustainable development. Pages 56-75. ISBN-13: 978110701571.

Jutras, M.-F., M. Nasr, M. Castonguay, C. Pit, J. H. Pomeroy, T. P. Smith, C.-F. Zhang, C. D. Ritchie, F.-R. Meng, T. A. Clair, P. Arp. 2011. Dissolved organic carbon concentrations and fluxes in forest catchments and streams: DOC-3 model. Ecological Modelling. Volume 22, Pages 2291-2313. DOI: 10.1016/j.ecolmodel.2011.03.035.

Meng, F.-R., P.A. Arp, A. Sangster, G.L. Brun, A. Rencz, G. Hall, J. Holmes, D. Lean, T.A. Clair. 2003. Predicting total methyl mercury and dissolved organic carbon in Nova Scotia freshwaters using a GIS approach. Submitted to Environmental Toxicology and Chemistry.

Murphy, P.N.C., J. Ogilvie, F.-R. Meng, B. White, J.S. Bhatti, P. Arp. 2011. Modelling and mapping topographic variations in forest soils at high resolution: A case study. Ecol. Model. 222:2314-2332.

Murphy, P.N.C., J. Ogilvie, K. Connor, P.A. Arp. Mapping wetlands: a comparison of two different approaches for New Brunswick, Canada. Wetlands. 2007, Volumn 27, Issue 4, Pages 846-854.

Murphy, P.N.C.,, J. Ogilvie, M. Castonguay, C-F. Zhang, F-R. Meng, P.A. Arp. 2008. Improving forest operations planning through high-resolution flow-channel and wet-areas mapping. The Forestry Chronicle. 84:568-574.

Murphy, P.N.C.,, J. Ogilvie, P.A. Arp. 2009a. Topographic modelling of soil moisture conditions: a comparison and verification of two models. European Journal of Soil Science. 60:94-109.

Murphy, P.N.C., M. Castonguay, J. Ogilvie, M. Nasr, P. Hazlett, J. Bhatti, P.A. Arp. 2009b. A geospatial and temporal framework for modeling gaseous N and other N losses from forest soils and basins, with application to the Turkey Lakes Watershed Project, in Ontario, Canada. Forest Ecology and Management. 258:2304-2317.

Nijland, W., N. C. Coops, S. E. Macdonald, S. E. Nielsen, C. W. Bater, B. White, J. Ogilvie, J. Stadt. 2015. Remote sensing proxies of productivity and moisture predict forest stand type and recovery rate following experimental harvest. Forest Ecology and Management. 357: 239-247.

Nijland, W.; S.E. Nielsen, N.C. Coops; M.A. Wulder; G.B. Stenhouse. 2014. Fine-Spatial Scale Predictions of Understory Species Using Climate and LiDAR-Derived Terrain and Canopy Metrics. J. Appl. Remote Sens. 8(1), 083572

Ogilvie, J. 2005. Synthesis of geospatial data for better definition of hydrographic landscape fatures: a case study for Labrador. UNB BScF Thesis, 34 pp.

Vega-Nieva, D.J., P.N.C. Murphy, M. Castonguay, J. Ogilvie, P.A. Arp. 2009. A modular terrain model for daily variations in machine-specific soil forest trafficability. Canadian Journal of Soil Science. Volume 89, Pages 93-109.

White, B., J. Ogilvie, D.M.H. Campbell, D. Hiltz, B. Gauthier, H.K. Chisholm, H.K. Wen, P.N.C. Murphy, P.A. Arp. 2012. Using the cartographic depth-to-water index to locate small streams and associated wet areas across landscapes. Canadian Water Resource Journal. Volume 37, Issue 4, Pages 333-347.10.4296/cwrj2011-909.