Maps of biogeochemistry and soil properties for use as indicators of site sensitivity to logging residue harvesting

This publication contains thirteen (13) maps of different biogeochemical and soil properties of forest ecosystems of Canada's managed forest. A scientific article gives additional details on the methodology: Paré, D., Manka, F., Barrette, J., Augustin, F., Beguin, J. 2021. Indicators of site sensitivity to the removal of forest harvest residues at the sub-continental scale: mapping, comparisons, and challenges. Ecol. Indicators.

Four (4) maps of soil properties. These maps were produced using predictive mapping techniques and random forest. The co-variables that were used for each map are listed in Paré et al. (2021) as well as the uncertainty level of modelled parameters. A groundplot data base containing data from several sources was used (see Paré et al. 2021 for details). Soil property maps are for the top (0-30cm) of the mineral soil unless indicated otherwise:

1-Soil pH

2-% Sand content

3-% Clay content

4-N content of the humus layer + the top (0-30cm) mineral soil (kg ha^{-1})

Two (2) maps of rates of atmospheric element wet deposition.

5-Atmospheric deposition Nitrogen (N kg ha^{-1} y^{-1}): data obtained from Natchem (Amanda S. Cole, personal communication). For Ontario and Quebec, average values for year 2006-2010 obtained from Natchem for wet deposition. For the rest of Canada, Natchem provides only point source data. Interpolation (this study) was made with the Kriging tool of Arcgis10 for year 2003-2007.

6-Atmospheric deposition base cations (keq ha^{-1} y^{-1}): data obtained from Natchem (Amanda S. Cole, personal communication). For Ontario and Quebec, average values for year 2006-2010 obtained from Natchem for wet deposition. For the rest of Canada, Natchem provides only point source data. Interpolation (this study) was made with the Kriging tool of Arcgis10 for year 2003-2007.

Three (3) maps of nutrient fluxes

7-Base cation weathering rate (keq ha^{-1} y^{-1}): Base cation weathering was first calculated using Equation # 2 from Whitfield et al. (2006) for each groundplot in the database containing sufficient information to run this equation (see Table 3); $BcW = (56.7xClay - (0.32x(Clay^2))) \times p \times exp((3600/281)-(3600/SoilTemp50cm))$; *p is* profile depth (m); Clay is the fraction of soil less than 0.002mm; SoilTemp50cm is the temperature of the soil (K) obtained from Zhang et al.

(2005). Predictive mapping techniques using random forest and co-variables were then used to produce a BcW map.

8-Nitrogen export in whole-tree harvesting (N kg ha^{-1} y^{-1}) : N concentrations (kg/t) by tree genus and biomass component (bark, bole, branch and foliage) from Paré et al. (2013) times biomass per genus and biomass component (t/ha) from Beaudoin et al. (2018) for 250m pixels classified as mature forests from Barrette et al. (2018). Values were divided by 50 assuming a rotation of 50 years, a value commonly used for temperate and boreal forests (Griscom et al. 2017).

9-Base cation (Ca, Mg, K, Na) export in whole tree harvesting (keq ha^{-1} y^{-1}): Cation concentration (kg/t) by tree genus and biomass component (bark, bole, branch and foliage) from Paré et al. (2013) times biomass per genus and biomass component (t/ha) from Beaudoin et al. (2018) for 250m pixels classified as mature forests from Barrette et al. (2018); as no biomass value were available for Na, its value was assumed to be proportional to potassium content (0,08.K). All values were converted to elementary charge value (eq). Values were divided by 50 assuming a rotation of 50 years, a value commonly used for temperate and boreal forests (Griscom et al. 2017).

Three (3) nutrient balance indicators. These maps were produced by combining the maps of nutrient budget and nutrient fluxes previously described according to the description below:

10-Nitrogen Budget Indicator (kg ha^{-1} y^{-1}): Atmospheric deposition nitrogen (minus -) Nitrogen export in whole tree harvesting.

11-Base Cation Budget Indicator (keq ha^{-1} y^{-1}): Base cation weathering (plus +) Atmospheric_ deposition base cations (minus -) Base cation export in whole tree harvesting.

12-Nitrogen Stability ratio (unitless): Nitrogen export in whole-tree harvesting (N kg ha^{-1} y^{-1}) (divided /) by _Soil total Nitrogen content.

One (1) map of site property:

13-% Slope obtained from DEM and ArgGis functionxxxx

Cited documents:

Barrette, J.; Paré, D.; Manka, F.; Guindon, L.; Bernier, P.; Titus, B. 2018. Forecasting the spatial distribution of logging residues in Canada's managed forests. Can. J. For. Res. 48: 1470-1481. S doi:10.1139/cjfr-2018-0080.

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Zhang, Y., Chen, W., Smith, S. L., Riseborough, D. W., Cihlar, J. 2005. Soil temperature in Canada during the twentieth century: Complex responses to atmospheric climate change. Journal of Geophysical Research: Atmospheres, 110(D3). https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2004JD004910

Maps:

1-Forest soil pH for the top mineral soil (0-30cm): Predictive mapping techniques using random forest and co-variables were used to produce a map.

2-Forest soil % Sand content for the top mineral soil (0-30cm). Predictive mapping techniques using random forest and co-variables were used to produce a map.

3-Forest soil % Clay content for the top mineral soil (0-30cm): Predictive mapping techniques using random forest and co-variables were used to produce a map.

4- Soil total Nitrogen content (kg ha^{-1}): total N content in the organic layer and the top (0-30cm) mineral soil. Predictive mapping techniques using random forest and co-variables were used to produce a map.

5-Slope %

5-Atmospheric deposition Nitrogen (N kg ha^{-1} y^{-1}): data obtained from Natchem (Amanda S. Cole, personal communication). For Ontario and Quebec, average values for year 2006-2010 obtained from Natchem for wet deposition. For the rest of Canada, Natchem provides only point source data. Interpolation (this study) was made with the Kriging tool of Arcgis10 for year 2003-2007.

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