Developing an Impact Assessment of Local Air Quality as a Result of Biomass Burns

Cody Natoni Sifford, Indroneil Ganguly, Ernesto Alvarado, Ivan Eastin

Introduction

The prescribed burning of woody biomass in forests is a major source of greenhouse gas emissions in the western US. Biomass burning also adversely affects local and regional air quality, with acute negative impacts on human health at the local levels.

This project assesses where smoke particulates travel and deposit in the local area for the Pacific Northwest Region. Life cycle impact assessment methods are utilized to calculate the impacts to human health. These impacts are to be considered avoided impacts when residual pile burning is removed and instead the slash piles are collected for bio-fuel creation.

Objectives

- Spatially cataloging residual pile burn areas and using a forest inventory model for projecting slash amounts for year 2020.
- Utilize pile burning and chemical transport models to assess emission concentrations and plumes direction.
- Conduct an LCIA local health impact assessment using the data collected from chemical transport model (AIRPACT).

The results of the analysis can inform forest management departments about the amount of smoke particulate that can reach communities. Additionally, the analysis will help quantify the local human health and environmental impacts associated with the burning of slash piles.

Project Plan Overview

Forest inventory models project future amounts of residual slash based on target biomass supply zones within NARA network and harvest methods.

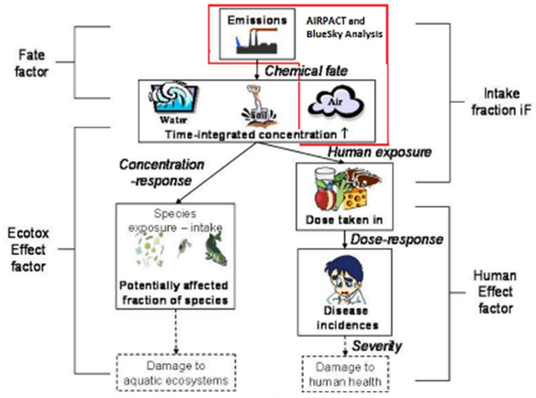
Large mechanical DNR Naches pile. July 14 2014

Inventory plot and pile results are then input into FS Bluesky "Playground" tool for projecting pile burn emissions. The plume information is then input into WSU AIRPACT model framework to project chemical transport and concentrations. Chemical amounts are used in the LCIA model to create a impact assessment of burning piles in the local area of the burn.

BlueSky "Playground" smoke modeling example for July 29 2014 over Eastern WA.

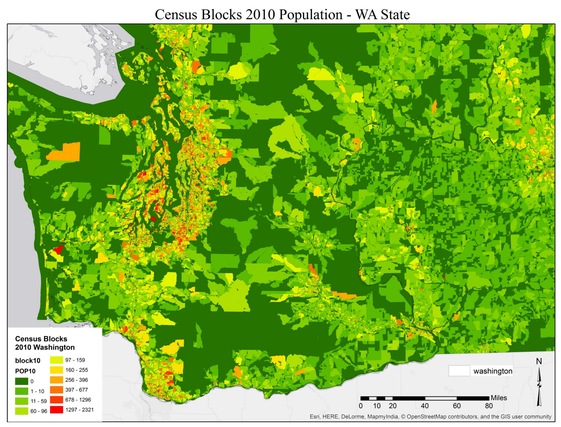
GIS and LCIA Methods

Three LCIA based health impacts will be investigated in this research, (i) Respiratory impacts, (ii) Carcinogenic Impacts and (iii) non-carcinogenic impacts.



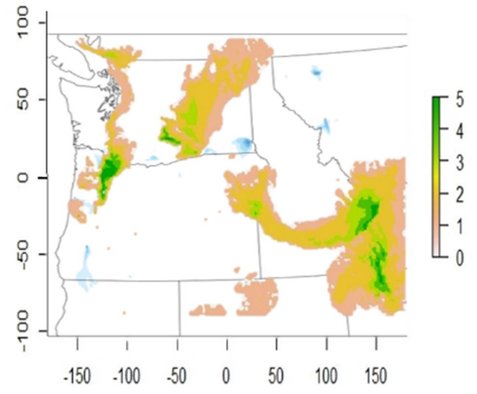
Steps of the USEtoxTM assessment. AIRPACT & Bluesky replacement inputs outlined in red.

In USEtoxTM, the eco-toxicological characterization factor of chemicals includes a fate factor (FF), an exposure factor (XF) and an effect factor (EF) (Figure):$CF = FF \times XF \times EF$.



Methodology for determining population interpolation is in progress. Map above calculated based on available Washington state census block (2010) data.

Proposed LCIA Methods



*Toxicity level of NOx using the USEtoxTM assessment. 11/11/2011 modeled. *preliminary example results without population layer*

Further data analysis is in progress to complete the project goals of calculating all the necessary chemical species and population impact. The figure above displays a preliminary example of NOx toxicity levels and the final step is to correlate population densities for the region. Once population density is added, this method can be used to develop detailed local community impacts from burning.

Authors

Mr. Cody Natoni Sifford, Graduate Research Fellow, School of Environmental and Forest Sciences, College of the Environment. University of Washington.
Dr. Indroneil Ganguly, Assistant Professor, School of Environmental and Forest Sciences, College of the Environment. University of Washington.
Dr. Ernesto Alvarado, Associate Professor, School of Environmental and Forest Sciences, College of the Environment, University of Washington.
Dr. Ivan Eastin, Professor/Director CINTRAFOR, School of Environmental and Forest Sciences, College of the Environment. University of Washington.

Collaborators

Dr. Brian Lamb, Professor, Department of Civil & Environmental Engineering, Washington State University.
Vikram Ravi , Laboratory for Atmospheric Research, Washington State University
Dr. Susan O'Neill, Air Quality Engineer, U.S. Forest Service, Pacific Wildland Fire Sciences Laboratory, Seattle, Washington
Luke Rogers, University of Washington, Research Scientist GIS, Remote Sensing, and Forest Engineering
Ms. Miriam Rorig, Meteorologist, U.S. Forest Service, Pacific Wildland Fire Sciences Laboratory, Seattle, Washington

References

Adams, D. M., & Latta, G. S. (2007). Timber trends on private lands in western Oregon and Washington: a new look. Western Journal of Applied Forestry, 22(1), 8–14.
Chen, J., J. Vaughan, J. Avise, S. O'Neill, and B. Lamb. (2008). Enhancement and evaluation of the AIRPACT ozone and PM2.5 forecast system for the Pacific Northwest, Journal of Geophysical Research, 113, D14305.
Chung, S., Thorpe, F. H., Gonzales, R., Vaughan, J., Zhang, R., & Lamb, B. (n.d.). Airpact: Air Indicator Report for Public Awareness and Community Tracking.
Strand, T. Larkin, S. Craig, K. Raffuse, S. Sullivan, D. Solomon, R. Rorig, M. Wheeler, N. Pryden, D. (2012). Analyses of BlueSky Gateway PM2.5 Predictions during the 2007 Southern and 2008 Northern California fires. Journal of Geophysical Research, 117, D17301.
Vaughan, J., B. Lamb, R. Wilson, C. Bowman, C. Figueroa-Kaminsky, S. Otterson, M. Boyer, C. Mass, M. Albright, J. Koenig, A. Collingwood, M. Gilroy, and N. Maykut. (2004). A numerical daily air-quality forecast system for the Pacific Northwest, Bulletin of American Meteorological Society, 85, 549-561.
Wiedinmyer, C. Quayle, B. Geron, C. Belote, A. McKenzie, D. Zhang, X. O'Neill, S. Wynne, K. (2006). Estimating Emissions from Fires in North America for Air Quality Modeling. Atmospheric Environment, 40, 3419-3432.

NARA is led by Washington State University and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.