SUPPLEMENTAL MATERIAL 2

LiDAR Specifications

Airborne discrete return LiDAR data was collected on September 3-4, 2007 by Watershed Sciences, Inc. (Corvallis, Oregon USA). LiDAR was collected approximately 2000 m above ground level by a fixed wing aircraft equipped with a Leica ALS50 Phase II laser scanner with a 59 kHz pulse rate, scan angle of ±11°, and scan swath overlap of at least 50%. Average LiDAR point return density exceeded 10 points/m^2 within the study area, and root mean squared error between 523 real-time kinematic ground survey points and LiDAR data was 0.04 m.

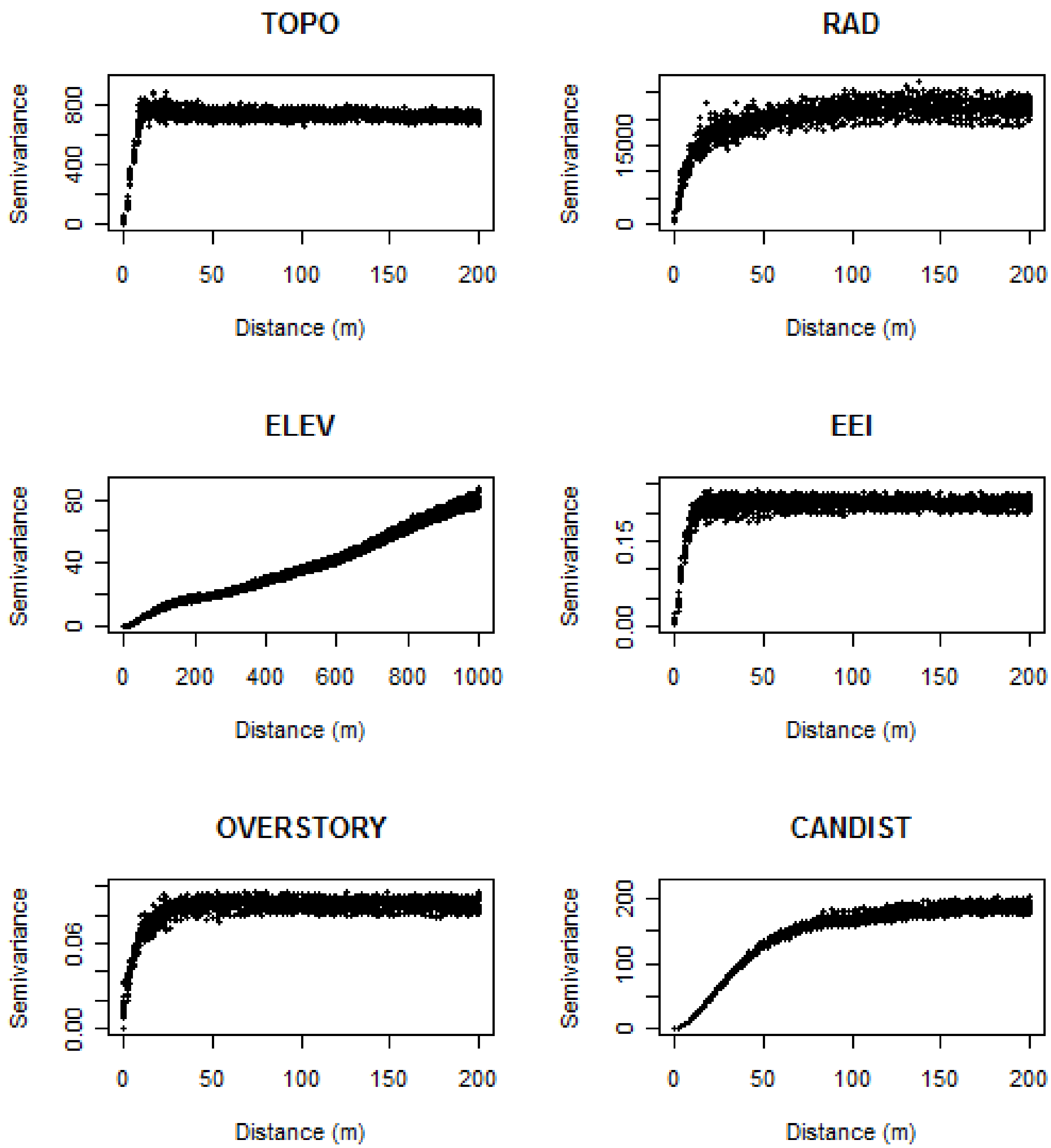
Calculation of ELEV and VEG Rasters

ELEV was generated using TerraScan software (Soininen 2004), beginning with removal of all LiDAR points not ‘near’ the earth based on geometric constraints used to evaluate multi-return points. These bare earth ground points were visually inspected, and additional ground point modeling (addition or subtraction of points) was performed in site-specific areas over a 50-meter radius to improve ground detail in areas with known ground modeling deficiencies (i.e. cliffs, dense vegetation, etc.). ELEV was then developed from triangulated irregular networks (TINs) of ground points. Finally, ELEV was visually inspected against the LiDAR point cloud using FUSION version 2.61 (McGaughey 2007) to insure ground elevations were not overestimated under dense vegetation. VEG was calculated from TINs of all non-ground LiDAR points.

Spatial Autocorrelation of LiDAR-derived Explanatory Variables

Spatial autocorrelation of variables (ELEV, TOPO, RAD, OVERSTORY, and CANDIST) were evaluated by calculating empirical semivariograms, and semivariogram ranges were quantified to determine the distance at which variables were not spatial autocorrelated.

Omnidirectional empirical semivariograms were calculated using the classical method of moments estimation using the GeoR package for R (Ribeiro and Diggle 2001, R Development Core Team 2010). Computational constraints caused by the large of number cells (1,752,870 cells) with each variable grid necessitated random sampling of data to calculate semivariograms. 8764 points (0.5 percent of cells in a grid) were randomly sampled 20 times for each variable. Semivariograms of these samples were computed for each variable (SM2 Fig. 1). The range, partial sill, and nugget parameters of each semivariogram except ELEV (SM2 Table 1) were calculated with ordinary least squares parametric model using the Nelder-Mead algorithm (Nelder and Mead 1965).



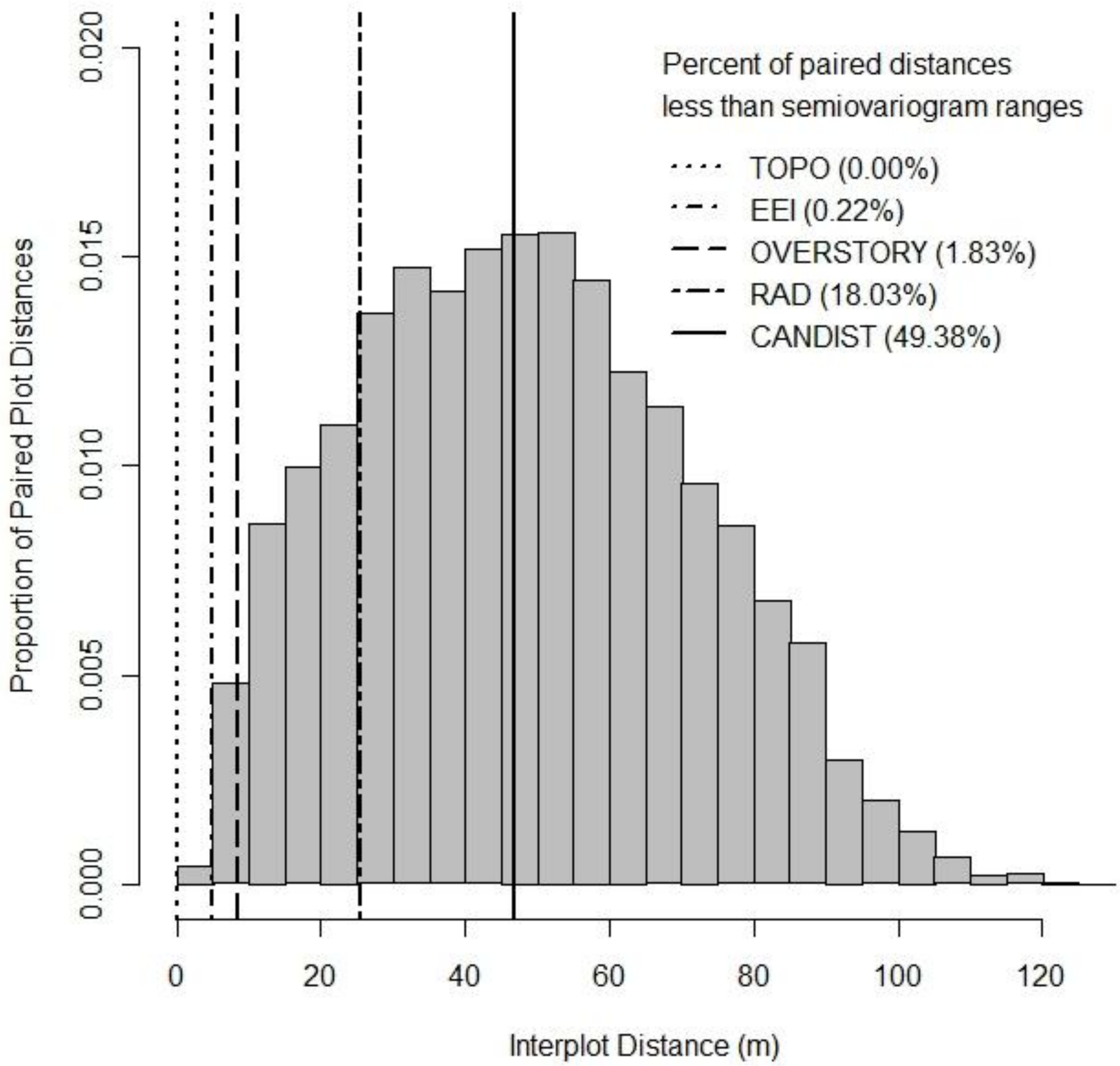
SM2 Figure 1. Composite empirical semivariograms of explanatory variables.

SM2 Table 1. Mean (and 95% confidence intervals) of fitted sill, range, and nugget parameters for empirical semivariograms.

Variable	Mean Range (95% CI)	Mean Sill (95% CI)	Mean Nugget (95% CI)
TOPO	0.2 (-0.19 - 0.6)	23.77 (17.99 - 29.55)	700.67 (687.22 - 714.12)
RAD	25.25 (23.19 - 27.31)	8360.23 (7534.82 - 9185.64)	14005.66 (13178.14 - 14833.19)
EEI	4.9 (3.74 - 6.06)	0.01 (0 - 0.01)	0.21 (0.2 - 0.22)
OVERSTORY	8.52 (7.48 - 9.56)	0.02 (0.01 - 0.02)	0.07 (0.07 - 0.08)
CANDIST	46.92 (45.68 - 48.16)	0 (0 - 0)	193.81 (190.21 - 197.4)
ELEV	269908660 (-66956121 - 606773442)	0 (0 - 0)	21125614 (-5303779 - 47555007)

Spatial Autocorrelation of Variables on Plots after Sampling

Stratified random sampling occurred within 20 100 x 100 m areas, with 25 plot centers randomly located within all combinations of 5-class EEI and CANDIST strata (i.e. one plot located in each of 25 levels in each sampling area). Plots centers also had to be at 2 m away from a stratum different from the one occupied and at least 4 m apart from each other, to ensure that GPS position errors did not result in plots occupying multiple strata or overlaping one another. Spatial constraints avoided strata and plot overlap, while spatial autocorrelation for TOPO, EEI, and OVERSTORY was likely removed, since the vast majority of interplot distances were greater than semivariogram ranges for these variables (SM2 Fig. 2). However, a large number of interplot distances were not greater than RAD or CANDIST semivariogram ranges, suggesting spatial autocorrelation may not have been removed from these variables on plots. To test if spatial autocorrelation was still present after sampling, Moran's I statistic (Moran 1950) was calculated for all variables on sampled plots (SM2 Table 2). Moran's I was calculated with a fixed distance threshold of 120 m (the maximum interpoint distance within a sampling area), Euclidean distances, and no row standardization.



SM2 Figure 2. Interplot distances and their relationship to semivariogram ranges of variables. Semivariogram range for ELEV not shown because it exceeded all interplot distances.

SM2 Table 2. Moran's I statistic for variables on sample plots

Variable	Moran's I	Expected Index	Variance	Z Score	p-value
TOPO	-0.0029	-0.0020	0.0001	-0.0831	0.9338
RAD	0.1117	-0.0020	0.0001	10.1110	0.0000
EEI	-0.0225	-0.0020	0.0001	-1.8170	0.0692
OVERSTORY	-0.0051	-0.0020	0.0001	-0.2800	0.7795
CANDIST	-0.0206	-0.0020	0.0001	-1.6447	0.1000
ELEV	0.7673	-0.0020	0.0001	67.9572	0.0000

Moran's I statistic suggests that spatially constrained stratified random sampling removed spatial autocorrelation from all explanatory variables except RAD and ELEV.

LITERATURE CITED

Nelder, J. A. and Mead, R. 1965. A simplex algorithm for function minimization. Computer Journal ***7***, *308–313.*

McGaughey, R. J. 2010. FUSION/LDV. Software for LIDAR data analysis and visualization. U.S. Forest Service, Pacific Northwest Research Station

Moran, P.A.P. 1950. Notes on Continuous Stochastic Phenomena. Biometrika 37: 17–23.

R Development Core Team. 2010. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Ribeiro, P.J., and P.J. 2001. geoR: a package for geostatistical analysis R-NEWS, 1(2):15-18.