STUDENT RESEARCH PROJECT PROPOSAL

Boise's Noise: Mapping a Complex Soundscape in a Mixed-use Downtown Area

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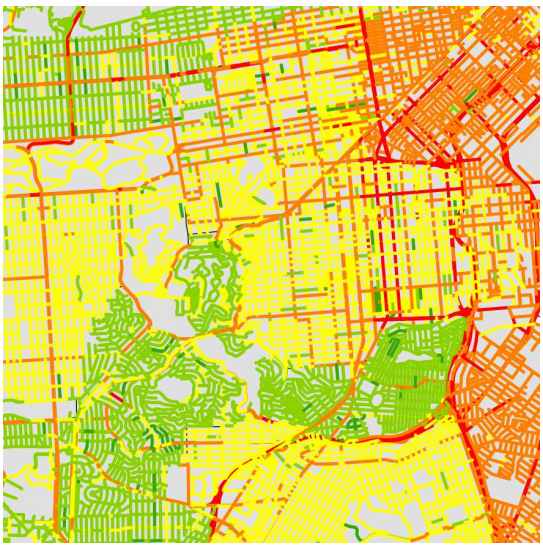
Proposal Overview

The mapping of noise in downtown areas of major U.S. cities has received little attention to date. Boise's downtown exhibits an unusually diverse, yet compact land use pattern, thus a complex soundscape. Eight distinct land use zones are encountered along a 2-mile transect through the city's urban core (university, city park, light industrial, high rise core, retail/condo, capital grounds, historic residential neighborhood, open space). While it is well recognized that noise levels in high-density, mixed-use landscapes are accentuated by high-rise structures, hard surfaces, and heavy vehicle traffic, it is not known how sound attenuates through a highly diverse cityscape. Investigations on urban noise are typically conducted as part of development planning (i.e., airport runway and freeway expansion projects). Most noise investigations involve GIS models that utilize proxy data (i.e., traffic counts) or linear distance-from-source attenuation equations. We propose to collect field measurements via a grid of sensors over a period of several weeks in order to characterize the downtown noise field over time (4D). Our goal is to provide data to esidential, commercial, and regulatory agencies involved in noise ordinance discussions. Many U.S. communities are actively exploring ways to reduce noise during off-peak hours in order to encourage residential growth in their downtown urban cores. Noise is a primary source of dissatisfaction with loft/condominium owners.

A.) Proxy Data Noise Model



B.) Ambient Sound Attenuation Model

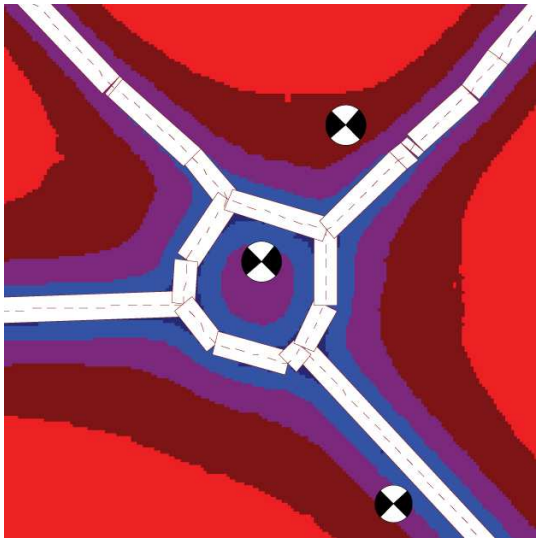


Figure 1. Traditional Noise Model Maps. Most noise maps produced for land use planning reports are not based on field measurements. Rather, they are GIS-derived maps that utilize proxy data (i.e., traffic counts) or simple sound attenuation equations. Our study will compare modeled data, similar to that shown in Map A, to measurements collected in the field.

Field Data Collection

We propose to measure street-level noise in downtown Boise, Idaho using fixed-station decibel meters/data loggers and handheld digital decibel meters (Future Apps, 2011). Our study area, centered on the intersection of N. 10th Street and W. Bannock, covers the central commercial downtown as well as portions of adjacent park land, greenbelt, university, and residential neighborhoods. Measurements will be collected throughout several dozen city blocks between Boise Avenue-Crescent Rim (south), Sherman Street (north), N. 27th (west), and Broadway-Fort Street (east). Data collection will capture mid-week rush hours, mid-week off-peak hours, and off-peak weekend hours. Fixed-meters will be deployed at locations within each land use category and set to record continuously over 24-hour periods for 2-weeks. Handheld meter measures will be collected at 2-minute intervals along a high-density grid (2-block spacing) for each land use category. Sound meters record only noise volume levels, not sound patterns (i.e., conversations).

Preliminary Work

Initial traffic count data and qualitative noise observations collected in the study area (unpublished data by Cooley) indicate Boise's sound environment is spatially complex and highly variable. While peak noise levels tracked closely with rush-hour periods during weekdays, average levels were highly variable from one block to the next. Strong gradients over short distances point out the need for high density measurements during peak and off-peak hours as well as weekends to obtain noise minimums. We expect the observed soundscape will exhibit sound "glare" and "shadow" zones absent from noise models produced from proxy data alone (Figure 2).

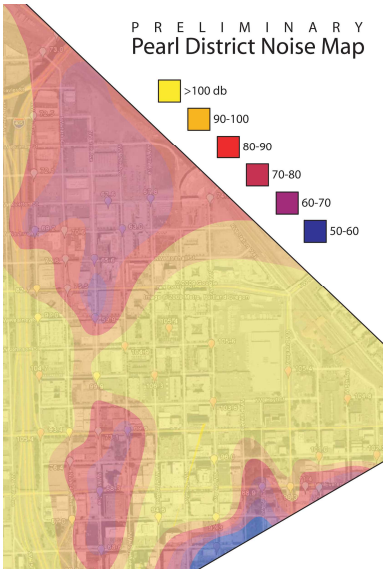


Figure 2. Noise Map of Pearl District. Contour map created from 50 sound measurements collected during a pilot study on the Pearl District of Portland,OR (Cooley, 2009).

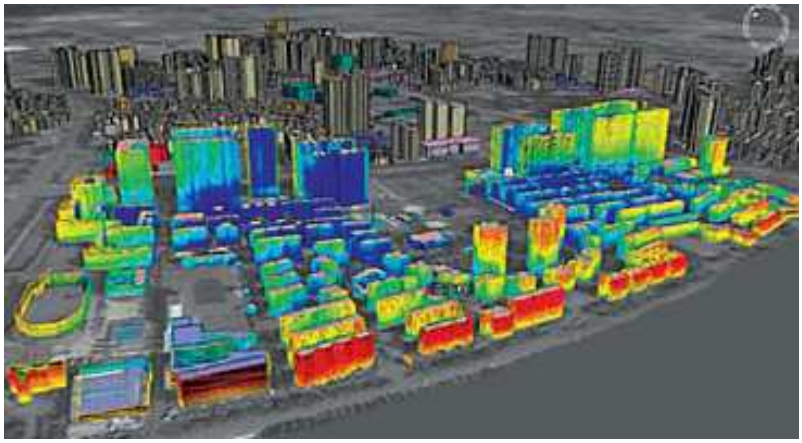
Predictive Noise Map

We will produce a predictive noise map from traffic count data, road surface/load ratings (ACHD, 2010), and speed limits for road segments in the study area using a GIS. This type of map is commonly produced for environmental planning documents (Figure 1).

Data Analysis

Point data (n = 300) will be entered into a GIS and used to produce 2D street-level noise rasters suitable for planning purposes. A 3D model of noise attenuation with elevation will be produced for a modeled "urban canyon" using methods of Walerian et al. (1999). A basic spatial-statistical comparison of field-observed and model-predicted sound levels will be completed. Data processing will be done in ESRI ArcGIS 10 w/ Spatial Analyst, 3D Analyst, Decibel Meter version 1.8 (Future Apps, Inc.), Microsoft Excel, and Adobe Systems Photoshop/Illustrator CS.

Figure 3. Example of 3D sound modeling on GIS-generated building surfaces.



Timeline

Total estimated time for student to complete project is 100-150 hours.

Data collection and method refinement is anticipated to take 2-3 weeks (part time). GIS analysis is anticipated to take 4-5 weeks (part time). An additional 2 weeks is budgeted for preparation of conference presentation (poster or talk).

Academic Credit
We request 2-3 internship credits for Lange, a student majoring in Biology/Minor in Geospatial Information Analysis at BSU.

Funding
We will seek funding from Geosciences, BSU Service Learning, and City of Boise City Grants.

Student Presentation
Results will be presented at the 2012 BSU Undergraduate Research Conference, Geological Society of America Annual Meeting, and BSU Service Learning.

References

Noise Modeling with GIS
Nobel et al., 1985; Mikkonen and Tuominen, 1998; CERC, 2002; Hinton, 2002; Stocker and Caruthers, 2002; McNamara and Buland, 2003; Yilmaz and Hocanli, 2006; Adetunji, 2008; Al-Mutairi et al., 2009; Mahbub et al., 2009

Community Noise Ordinances
Jacobson, 2010; Troy Record, 2010; Wireback, 2010; EU Directive 49C, 2002; City of Portland Auditors Office, 2011: Title 18.10

Highway Noise
Hogan, 1973; Cook, 1981; Herman and Ambroziak, 2007; Makarewicz and Zortowski, 2009; Shaffer and Fernando, 2009; Cirrus Environmental, 2011

Health Effects of Noise
Kuroiwa et al., 2002

Noise Litigation
Noise Control Act, 1972; Lake et al., 1998; Lilly, 2009; Kamali et al., 2008; Nepomuceno et al., 2009