DELIMITING THE POSTMODERN URBAN CENTER:

AN ANALYSIS OF URBAN AMENITY CLUSTERS IN LOS ANGELES

by

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ABBREVIATIONS

CBD: Central Business District

CSA: Combined Statistical Area

DMM: Directory of Major Malls

E/R: Employment to Residents ratio

GCS: Geographic Coordinate System

GIS: Geographic Information Science

GLA: Gross Leasable Area

HAZ: High Amenity Zone

ICSC: International Council of Shopping Centers

LISA: Local Indicators of Spatial Association

MAUP: Modifiable Areal Unit Problem

MSA: Metropolitan Statistical Area

NAFTA: North American Free Trade Agreement

NAICS: North American Industry Classification System

OMB: Office of Management and Budget

SIC: Standard Industrial Classification

UA: Urban Area

UC: Urban Cluster

UTM: Universal Transverse Mercator

ABSTRACT

An analysis of urban morphology in the Los Angeles metropolitan area was conducted. Specifically, Local Indicators of Spatial Association (LISA) were used to identify clusters of different types of urban amenities. A centrality score was calculated for every location based on the number of spatially coincident clusters, which was used to delimit the central place.

The methodology, which was validated in the Chicago and New York metropolitan areas, employed multiple regular hexagonal arrays into which amenity location points were aggregated. These arrays, whose results were combined for a final analysis output, mitigated against the Modifiable Areal Unit Problem (MAUP) and revealed urban structures operating at multiple scales.

Prevailing methods for delimiting urban centrality tend to reduce urban place to a monetary space by focusing on employment centers, commuting patterns, or ‘central’ land uses in order to identify a downtown or a Central Business District (CBD). This study elevates the experience of place within urban structure to identify an ambiguously bounded and internally inconsistent central place: a postmodern urban center.

The study reveals both polycentrism and a strong core center in Los Angeles. The core center, called the *Wilshire/Santa Monica Corridor*, is delimited in detail.

CHAPTER 1: INTRODUCTION

In this paper I propose a new method for delimiting urban centers and I apply that method to Los Angeles. Past methods of identifying urban centers have focused mainly on using employment locations to delimit a Central Business District (CBD) and its satellite subcenters. The method put forward here uses intersecting clusters of urban amenities to identify postmodern urban centers. Past studies of centrality in Los Angeles have tended to conclude that the center of Los Angeles is weak or nonexistent. But this study, and a reinterpretation of the results of some past studies, reveals that Los Angeles has a clear and dominant center.

1.1 A new method for delimiting city centers

This analysis reveals postmodern urban centers by demarcating dense and concentrated cores of urban amenities. These cores are indicated by overlapping clusters of amenity types, identified through a Geographic Information Science (GIS) analysis technique known as Local Indicators of Spatial Autocorrelation (LISA).

LISA analysis identifies local clusters of high (or low) values among a spatial dataset. In this study, clusters of selected types of urban amenities are identified and overlaid to produce a sum of cluster membership for each location. This sum identifies places where clusters of several different amenity types coincide in space. I argue that these places are urban centers.

1.2 Delimiting the center of Los Angeles

As I show in the following discussion, the prevailing view among both urban theorists and popular opinion is that Los Angeles is a city with either no center or a weak center, and that the dominance of this center, if it exists, and urban centers generally, is degrading over time. I argue that Los Angeles does not lack a center, but rather that we have been looking for urban centers in the wrong way.

Specifically, the center of Los Angeles has gone unnoticed because it is physically large, it is culturally and visually diverse, it crosses municipal boundaries, its bounds are ambiguous, and it is internally inconsistent. But if we can accept regions with these characteristics then we can see a strong central place in Los Angeles.

CHAPTER 2: CONTEXT

There are two main questions to explore in order to establish the context for this analysis. The first question is: what are some existing methods for delimiting city centers? The second question: what is known about the center of Los Angeles?

2.1 Existing methods for delimiting city centers

As I will show, most previous attempts to delimit city centers have relied on measures of employment or on commuting for the purpose of employment. Those which do not focus on employment tend to focus on industry or on the offices of professional services firms. Many recent studies have also focused on revealing the existence of polycentricism, meaning that the dominance of the core center has been eroded by a network of smaller centers scattered across an urban region (Cladera, Duarte, & Moix, 2009).

2.1.1 Employment-based methods

Employment density thresholds

A popularly-cited employment-based approach to delimiting urban centers, known as ‘10-10’ or ‘20-20’ because of the threshold cutoffs as described below, was developed by Giuliano and Small (1991). Their method involves first identifying all spatial units in a given region having employment densities over a certain threshold, then identifying contiguous groups of these units as “subcenters” when a group’s total employment exceeds a certain threshold. In their original analysis, they find appropriate thresholds at “a density cutoff of 10 employees per acre, and a minimum total employment of 10,000” (p.167), hence the ‘10-10’ moniker. A more restrictive set of thresholds, ‘20-20’, is also employed. In this and in a later study using the same method (Giuliano & Redfearn, 2007) Giuliano and colleagues find a steady erosion of the dominance of primary urban centers compared to their subcenters over time, leading them to conclude that the very notion of urban centrality is losing its currency.

Another method utilizing employment densities is Redfearn’s (2007) study of Los Angeles. Redfearn converts aggregated employment density data into a smooth surface, proceeding to identify peaks in that surface and to test them for significance. The area around each significant peak is then divided by a contour whose threshold value is calculated locally for that peak, and the area inside the contour is declared to be a subcenter. This method is less arbitrary than Giuliano’s approach in that it does not “require. . . local knowledge to calibrate density cutoffs” (p.525). The method allows for the significance of any given peak to be assessed locally to that peak, rather than establishing a global threshold. Redfearn’s analysis finds asymmetry and dispersion among centers, but concludes that agglomeration remains a powerful force.

Besides simple employment density measures, another popular employment-based indicator is the E/R ratio, or Employment to Residents ratio, exemplified by Greene’s study of Chicago and Los Angeles (2008). Simply put, the E/R method looks at the ratio of absolute employment to absolute resident workers in each given spatial unit. An E/R ratio greater than one indicates that the spatial unit attracts more workers commuting from other units than it sends to other units itself. After selecting a largely arbitrary threshold for the value of the E/R ratio, one can then assemble contiguous spatial units which exceed the threshold into employment subcenters. Greene concludes that, while subcenters are generally widely dispersed, the notion of centrality remains relevant at least in local relation to subcenters.

Commuting networks

Another employment-centered approach involves the analysis of commuting for the purpose of employment. Cladera, Duarte, & Moix (2009) seek "to obtain a procedure for the definition of urban sub-systems that comprise metropolitan areas, based upon the interaction between place of residence and place of work" (p.2845). They accomplish this goal with an analysis that begins at the municipality level, aggregating together municipalities with strong commuting interaction. Once a "system" of municipalities reaches "50 per cent self-containment" it is declared to be a "metropolitan sub-system" (p.2846). The authors find a "breakdown of the traditional monocentric model" in their results (p.2859).

Holly L. Hughes, in her 1993 paper entitled "Metropolitan Structure and the Suburban Hierarchy", also defines centrality in terms of commuting patterns. Hughes undertakes an analysis of commuting patterns in 41 metropolitan areas in an effort to prove that urban structure is becoming multinodal. As a starting point, she defines a multinodal metropolitan area as one having "more suburban cities of 25,000 or more population than it has center cities" (p.418) under the definitions of metropolitan areas and center cities (the named cities in a metropolitan area's title) produced by the Office of Management and Budget and used by the Census Bureau.

Hughes employs tables of place-to-place commuting patterns for these metropolitan areas, analyzed under a "graph-theoretic measure of point centrality" (p.420), to determine the "network position" of each of a given metropolitan area's municipalities. The analysis tracks not just a municipality's share of work locations, but where the workers come from and which places attract more workers than they send away. Under her formulation, "places that attract a disproportionate share of the labor force occupy more central positions" (p.420). Hughes' results "demonstrate the continued dominance of the center city" while also showing that "some suburban cities are occupying increasingly dominant positions in the metropolitan system" (p.429).

Some problems with these approaches

All of these methods suffer some drawbacks. For the employment density methods, the selection of threshold values is largely an arbitrary exercise. For the commuting network studies, the use of municipal entities as units of analysis is problematic, since municipal areas can vary widely in size and their boundaries rarely conform to notions of center and periphery or even to notions of place. For all these methods, the focus on employment is troublesome because it reduces the entire experience of urban place to a simple journey-to-work exercise. Employment is indeed important to urban form, but employment is not the only thing that happens in cities.

One major question arising out of all these studies is: how useful is it to identify a structure which consists of scores of individual subcenters scattered haphazardly across the urban landscape? These studies all claim to be forging a new understanding of fundamental urban structure, but their resulting maps (figures 1, 2, & 3) generally show an urban region covered end-to-end in subcenters whose cumulative area seems to occupy nearly half of all the urban space. Such a high number of centers jumbled across the landscape reveals no fundamental structure at the macro level. If we want to understand the essence of urban form, I would argue, we need to look for an even more basic structure - one whose resulting map will be simpler and whose message will be more concise at the macro level.

Some authors posit that their maps of dispersed and jumbled subcenters indicate a fundamental lack of any centralizing force, but this viewpoint denies the human perceptions of monumental importance and excitement that I would argue are still experienced most strongly in the core urban areas. This conclusion also fails to account for the fact that the subcenters don't continue indefinitely across all space. Rather than indicating that centrality is declining as a relevant force in urban structure, perhaps these employment-based studies are instead revealing that employment is no longer a reliable indicator of centrality.

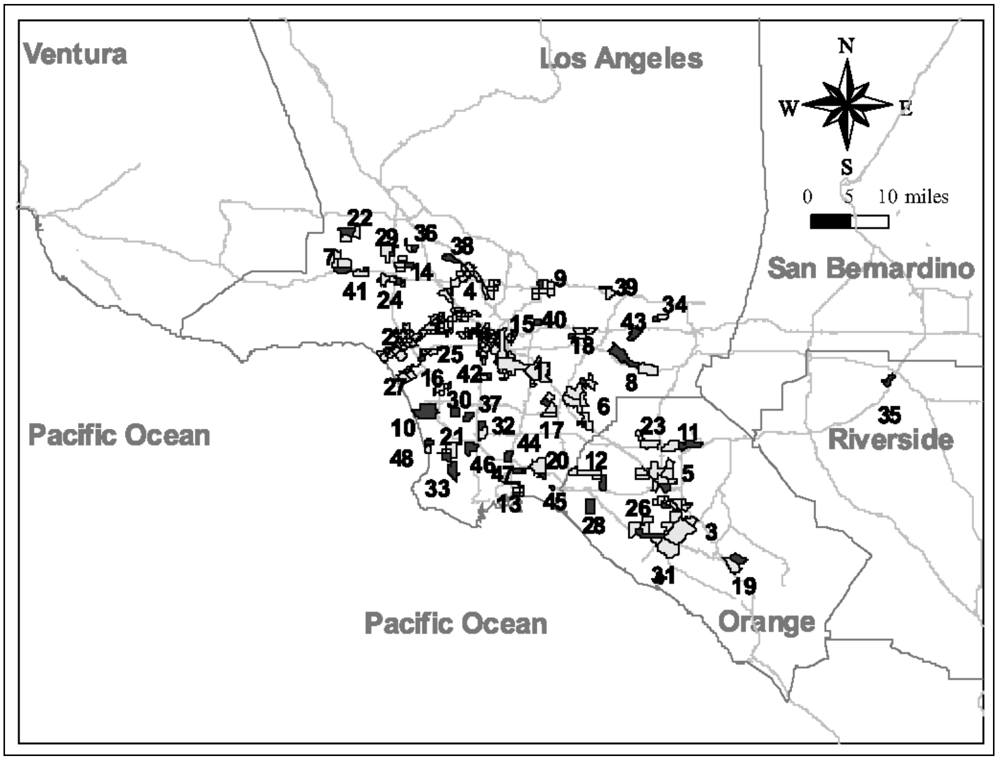

Figure 1: Giuliano & Redfearn's (2007, p.2946, fig. 3c) map of ranked '10-10' employment centers in Los Angeles.

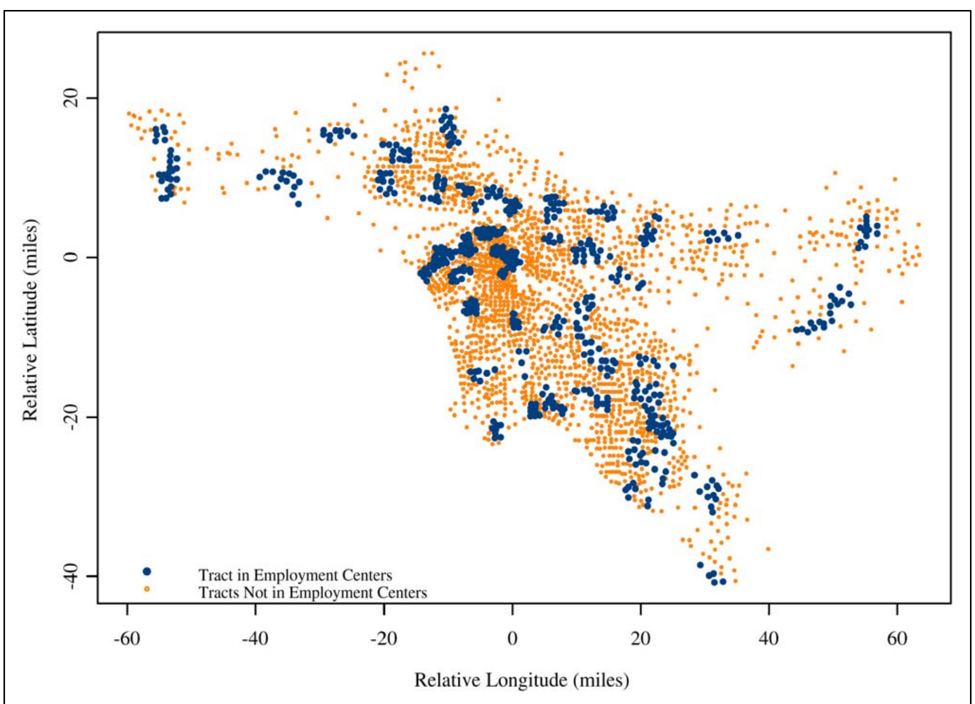

Fig. 9. Significant employment subcenters.

Figure 2: Redfearn's (2007, p.533, fig.9) map of employment centers in Los Angeles.

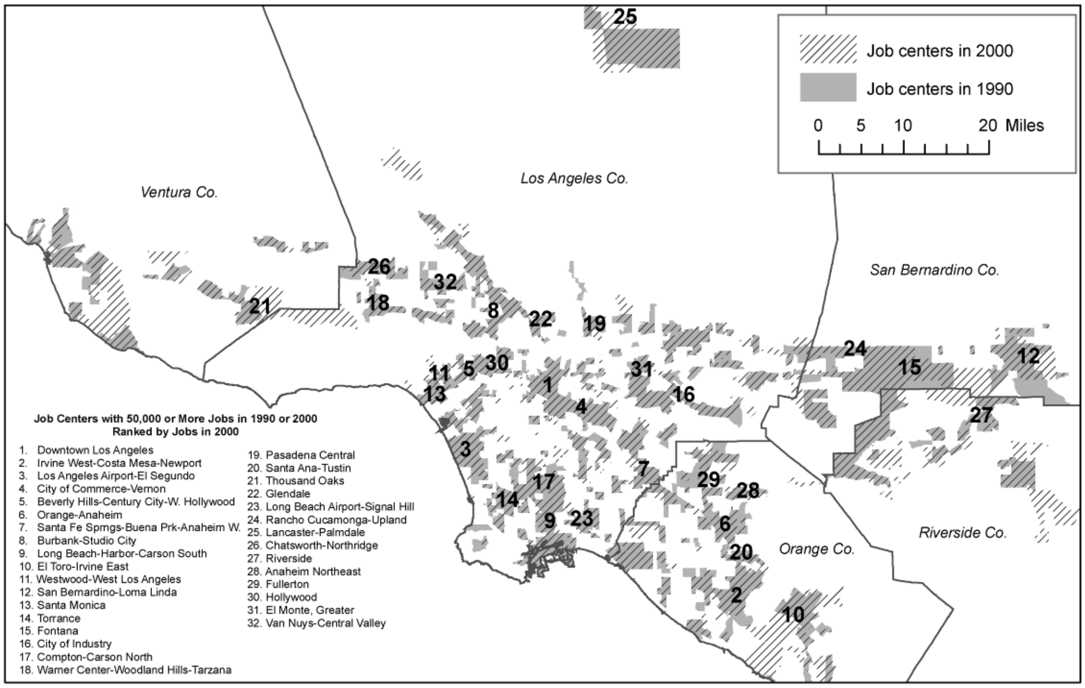

Fig. 1. Job centers in the Los Angeles area: 1990 and 2000.

Figure 3: Greene's (2008, p.141, fig. 1) map of ranked employment centers in Los Angeles.

2.1.2 Other methods

There are other historic approaches to delimiting centrality that do not rely exclusively on employment. These include methods analyzing retail and office space, or what is termed 'central business uses', as well as methods exploring industrial agglomeration economies and issues of visual form.

Central business uses

The idea behind studies of central business uses is to delimit a CBD by identifying all the blocks or buildings which are used for purposes befitting a central business district. The seminal central business use method originated in Raymond E. Murphy and J.E. Vance Jr.'s 1954 study, "Delimiting the CBD". Murphy and Vance set out to create a standardized method of defining a city's Central Business District (CBD) based on a synthesis of the techniques of various individual city planners and agencies. They begin their project with a survey of these techniques, finding that no two cities define their CBD in the same way and that most techniques consist merely of delimiting an area that is "'generally understood locally' to be the CBD" (p.192). One might argue that "generally understood locally" is a perfectly acceptable way to define centrality. But this being 1954, with the modernist project in full swing, Murphy and Vance declare that "it is only through the use of a standardized method of delimitation that significant comparisons of CBDs are possible. And it is only through such comparisons that a real knowledge of the content and functioning of this critical area can be attained" (p.189).

After a discussion of the salience and practicality of various CBD delimitation methods, the authors settle on mapping a "Central Business Height Index" by block, defining the CBD as occupying whatever contiguous space of blocks possesses an index value of 1 ("the equivalent of a one-story building devoted to central business uses and covering the entire block" (p.209)) or higher. Their definition of "central business uses" is "the retailing of goods and services for a profit and the performing of various office functions" (p.203). Murphy and Vance specifically exclude all establishments exhibiting an "absence of the normal profit motive" (p.203). Interestingly, Murphy and Vance include parking lots as a central use, since they are operated for a profit.

Joel Garreau, in his pioneering book, Edge City (1991), also recognizes centrality through the floor space of particular business uses. And, like Hughes, Giuliano, and Redfearn, he argues that the American cityscape has become multinodal, with some suburban locations taking up centralizing functions previously reserved exclusively for the traditional urban core. He calls these locations “Edge Cities” and has developed criteria for their definition. To qualify as an edge city, an area must not be a traditional urban center, must have at least 5 million square feet of office space and 600,000 square feet of retail space, must have more jobs than residents, and must be “perceived by the population as one place” (pp.6-7).

This last criterion is nebulous yet crucial, since Garreau recognizes that Edge Cities “just about never match boundaries on a map” (p.6); these new urban centers are usually located at the confluence of multiple municipalities and unincorporated land, spanning portions of multiple jurisdictions. This multi-jurisdictionality means that “few have come to recognize [it] for what it is” (p.4), but nevertheless, an Edge City contains “all the complexity, diversity, and size of a downtown” (p.9).

These criteria result in regions lacking hard edges and internal consistency. Garreau does address quandaries of spatial definition such as this by acknowledging that “it is a judgment call where [an Edge City] begins and ends” (p.6). Far from being a drawback, though, I see this freedom from either/or definitions as a step forward.

Like the employment-based analyses, though, these business floor-space methods reduce urban place to a monetary space where money is the only relevant factor. Nor is any attempt made to allow for locally-varying threshold levels. Another drawback to Murphy and Vance’s approach is the implicit assumption of monocentrism; no mention is made of the possibility that multiple non-contiguous areas within the same city might satisfy the Central Business Height Index threshold.

Industrial agglomeration

Allen Scott examines centrality from the perspective of the industrial sector in his 1983 paper, "Industrial Organization and the Logic of Intra-Metropolitan Location: I. Theoretical Considerations." Scott suggests that the locations of individual industrial plants are governed by three concerns: namely, "(a) the problem of inter-plant linkages and costs, (b) the dynamics of subcontracting, and (c) the interrelations between uncertainty, location, and vertical disintegration" (p.241). In Scott's analysis, uncertainty in particular marketplaces leads to high levels of subcontracting in order to distribute risk. Subcontracting in turn leads to large numbers of small plants with high linkages among the plants. The costs of maintaining those linkages create "strong pressures on plants to converge together in geographical space" (p.242), forming localized agglomerations of particular industries.

Not all economic sectors are subject to the uncertainty that leads to this convergence, however; Scott offers garment manufacturing and aerospace as examples of sectors that do spatially converge. In the end, Scott suggests that "land use/land rent relations" within urbanized areas "strengthen the observable tendency of small plants to gravitate towards the center of the land use system" where they can take advantage of their "high levels of industrial productivity per unit of land" (p.248). Scott suggests that urban centers can be identified by the locations of clusters of small industrial plants operating in economic sectors of high uncertainty.

Scott's method is more nuanced and flexible than the central business use studies or the employment center studies. But it still dehumanizes the urban landscape, leaving no room for the experience of place and reducing urban space to a series of economic decisions made by corporations.

Visual methods

There are more subjective ways of identifying city centers too. For example, a refreshing fluidity in perceiving urban form is offered by Josep Parcerisa in his 1989 architectural paper, “The Relief of the City”. Parcerisa embraces the visual form of the city which is so often ignored or even explicitly dismissed by quantitative analysts. He suggests that “the city is produced within a natural relief while at the same time producing its own particular relief” (p.26) and that it is this interplay between natural and manufactured relief that gives a city its identity. According to Parcerisa, “When we examine the form of cities we almost instinctively look for their outstanding features or reference points” (p.28) in an attempt to find the elements that are “vital to the identity of a place” (p.26).

Under this view, the signifiers of centrality can be understood to be the portions of the built environment which interact with the natural features and topography in such a way as to produce a recognizable, unique relief. As Parcerisa states, “The entire order of the composition only becomes understandable… at the confluence of man’s intervention with [natural] profiles” (p.28). In Los Angeles, I would suggest, we might recognize this order in the graceful linear curve of tall buildings along Wilshire, Santa Monica, and Sunset Boulevards, following the contour of the base of the Santa Monica Mountains while rising gradually from the beach before spilling over Bunker Hill into the riverside hollow of the original pueblo (Figure 4).

While salient and powerful, one major drawback to conceiving of centrality in this way is that it is impossible to quantify. Quantification is not always necessary, but if we want to map centrality and make a convincing argument for it a more objective measure will be required.

Figure 4a: Santa Monica, West L.A., Westwood, & Century City.

Figure 4b: Beverly Hills, West Hollywood, Miracle Mile, Fairfax/Melrose, & Hollywood.

Figure 4c: Hancock Park, Los Feliz, Koreatown, Westlake, & Downtown Los Angeles.

Figure 4: Author's photograph of the cityscape along the base of the Santa Monica Mountains from the Pacific Ocean to Downtown Los Angeles; photographed from the Kenneth Hahn State Recreation Area in the Baldwin Hills, February 20, 2011 (see Figure 6 below for a map of the area pictured).

2.1.3 Some problems with existing views of centrality

Many authors find strong evidence of polycentrism and conclude that the concept of centrality is no longer as powerful a force in structuring urban form. As I argue below in the case of Los Angeles, though, one irony of these conclusions is that their studies tend to continue to implicitly identify strong central regions whether their authors acknowledge them or not. Additionally, I would argue, most of these established approaches reveal a dehumanizing, monetized conception of what a city is for. There are other legitimate approaches, described below, which incorporate the experience of place.

2.2 New ways of seeing centrality

There are, of course, other ways of seeing centrality than as a function of employment densities or industrial agglomerations. Foremost among these is a willingness to see the city as more than simply a space wherein dehumanized economic processes play themselves out. Perhaps what is really important to urban structure is the way urban space is experienced by its inhabitants, a perspective given full and articulate voice a half-century ago by Jane Jacobs (1961). The lack of measurable phenomena is a serious issue with this concept of centrality, though, if one is interested in mapping urban structure.

One promising viewpoint from this perspective which involves measurable phenomena is that of the fundamental importance of urban amenities. But before discussing urban amenities I would like to situate ourselves within the framework of Michael Dear's *postmodern urbanism* (Dear, 2000 & 2002; Dear & Flusty, 1998). And before that discussion, I would like to briefly touch on a new approach to conceiving of regions which abandons the modernist idea that hard-edged borders delimiting a binary in/out classification are even possible – a necessary precondition for postmodern urbanism.

2.2.1 The heterogeneous region

I have already mentioned Joel Garreau's (1991) willingness to see regions that have no formal boundaries and are internally inconsistent. The 1998 work of John Allen, Doreen Massey, and Allan Cochrane, *Rethinking the Region*, explores this concept in full detail. While conducting a study of the Southeast region of England, the authors develop a new conceptualization of regionalism. They shed the requirements of hard borders and internal consistency in favor of a "spatially discontinuous region" (p.70).

Utilizing the metaphor of a doily, the authors posit that a region can have holes in it – that there can be "areas 'within' the region which are not characterized by the mechanisms/features which are part of the criteria for regional definition" (p.55). The authors go on to suggest that "apart from actual spatial discontinuities there will also be intra-regional variation" (p.56) resulting in areas within the region that are either more or less a part of that region rather than either in or out of the region. Thus, not only can a region be seen as a doily, but different parts of the doily can be harder or softer, and determining precisely where the doily begins and ends can be an impossible task. But the region does exist, just without as definitive a delimitation as modernists might like.

2.2.2 Postmodern urbanism

Taking from Parcerisa, Garreau, and Allen, Massey, & Cochrane the freedom to define a region with amorphous and discontinuous characteristics, and deriving from Garreau and the polycentric authors the ability to look for centrality outside of traditional CBDs, we are left with the question of how we might understand the form and function of central urban places. A suitable starting point is found in the postmodern urbanism of Michael Dear and Steven Flusty (1998).

Dear and Flusty begin by presenting their views as a "radical break" with those of the prevailing Chicago School: "The concentric ring structure of the Chicago School was essentially a concept of the city as an organic accretion around a central, organizing core. Instead, we have identified a postmodern urban process in which the urban periphery organizes the center within the context of a globalizing capitalism" (p.65).

They call this postmodern process "Keno Capitalism" (p.65), drawing the name from a gambling game wherein a card "appears as a numbered grid, with some squares being marked during the course of the game and others not, according to some random draw" (p.63). Under this approach to urban structure, "the once-standard Chicago School logic has given way to a seemingly haphazard juxtaposition of land uses scattered over the landscape" (p.62), where "capital touches down as if by chance on a parcel of land, ignoring the opportunities on intervening lots" (p.66). According to Dear and Flusty, "The consequent urban aggregate is characterized by acute fragmentation and specialization" (p.66) which forms "a noncontiguous collage of parcelized, consumption-oriented landscapes devoid of conventional centers".

Returning to the Keno metaphor, Dear and Flusty acknowledge that the selection of urban development locations, or game card squares, is "not truly a random process" (p.66) but is "determined by a rationalized set of procedures beyond the territory of the card itself" (p.63). They enumerate several such urban rationalities as postulated by other contemporary writers, situating their synthesizing vision of urban structure under the umbrella of “postmodern urbanism” with the following statement: “Such proliferating logics often involve multiple theoretical frameworks that overlap and coexist in their explanations of the burgeoning… order – a heterodoxy consistent with the project of postmodernism” (p.52).

There is much salience in Dear and Flusty’s description of urban form, but I would assert that they are too quick to discount the existence and continued importance of urban centrality. They implicitly, if unintentionally, acknowledge the existence of postmodern centrality with their suggestion of Las Vegas as a “youthful example” of the postmodern urban form (compared to Los Angeles, which is a “mature” example - p.66). But Las Vegas is perhaps one of the most highly-centered urban areas in the United States; the Las Vegas Strip is everything. In Las Vegas, a location is either “on the strip” or off it. If Las Vegas is to be taken as a more lucid example of postmodern urban form, then surely the existence of a strong center within that form must also be clear.

2.2.3 Amenities as practical indicators of centrality

While jobs and day-to-day retail stores have indeed followed residences as they disperse into the suburbs, central urban areas appear to remain strong attractors of leisure activity and the spending of discretionary income. The best specialty shops, the most famous nightclubs, the most exciting shopping districts (and malls), the best places to see and be seen, the regions of common experience – I argue that these remain clustered together in the central nodes of our metropolitan regions. It is hard to quantify such notions as “best” and “exciting” for the purposes of analysis, but I believe a study of the locations of individual urban amenities can reveal a centralizing/clustering pattern which can substitute for these notions.

There is precedent for considering culture and the experience of place as important aspects of urban function, including several existing comparisons of metropolitan areas based on their amenities (eg.: Sperling & Sander, 2007; Clark, 2004b), but there does not yet appear to have been much investigation of the spatial manifestations of this view of urban function on local, intrametropolitan, urban form.

The High Amenity Zone

Greene's idea of the "High Amenity Zone" (2006) provides a notable exception. In an E/R study of subcenters in Chicago, Greene identifies Chicago's North Side as having both high job densities and high residential densities, leading to a relatively low E/R ratio even though the area is a major employment center. After further investigation, Greene finds that the area occupies a corridor between the traditional CBD and the traditional high-income neighborhoods of the professional class – a corridor which has become densely populated with high-income creative professionals and surrounded by low-income residents who staff the local establishments serving those professionals. Greene also investigates amenities region-wide and finds that this particular corridor contains the highest concentration of "high-art" and "cool hangout" amenities in the region, along with a high concentration of retail and service establishments (p.66).

Greene dubs this new phenomenon a "High Amenity Zone" (HAZ). The particular types of establishments Greene determines to be important to HAZ formation are trendy retail establishments (he uses Starbucks as an indicator, but Starbucks may be too ubiquitous in the West to be of much use as an indicator there) and "high-culture" entertainment consisting of "theater companies, dinner theaters, musical groups, artists, other performing arts companies, and writers" (p.68). Greene argues that the HAZ type amenities are what drive urban growth and allow cities to compete with one another for investment and residents in the era of globalization. Therefore, according to Greene, the HAZ is a critical piece of Chicago's structure (73). In a later study (2008), he identifies a HAZ in Los Angeles occupying the territory along the base of the Santa Monica Mountains following Wilshire Boulevard from the ocean to Downtown Los Angeles (Figure 5).

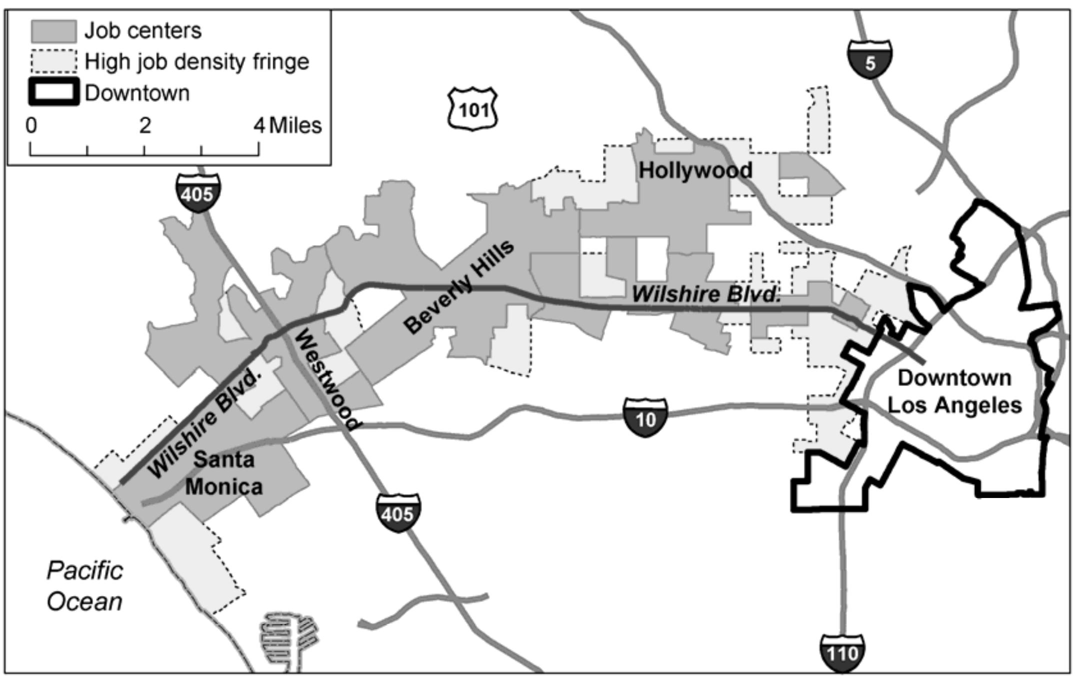

Fig. 5. Downtown Los Angeles and the West Side high-amenity zone.

Figure 5: Greene's (2008, p.152, fig. 5) map of the Los Angeles HAZ.

Amenities as fundamental drivers of urban growth

Although he does not explore their particular effects on local spatial structure, Terry Nichols Clark makes a strong case for seeing amenities as the principal functional forces in an urban system. He argues that, in the post-industrial era of globalization, consumer consumption has become the primary economic force, rather than manufacturing or commercial services, and that as technological advances have diminished the importance of location in the agglomeration economies of industry, a new agglomeration force has taken hold in cities that is centered around consumption (Clark, 2004a, p.297-298).

Clark goes on to assert that “Much of consumption is driven by local specifics: cafes, art galleries, geographic/architectural layout and aesthetic image of a city define its unique attractions” (p.293). These attractions “have grown more important than market transactions in explaining urban growth and decline” (p.296) because “Quality of life is not a mere byproduct of production; it defines and drives much of the new processes of production” (p.299). Clark defines the contemporary city as an “entertainment machine” whose primary function is to “become a cultural center offering diverse, sophisticated, and cosmopolitan entertainment lacking elsewhere” (p.301).

In this view, the primary drivers of urban form are the residential location decisions of professional individuals (those with disposable income) and the office location decisions of the firms who employ them (Clark, 2004b). Clark argues that particular trendy or high-culture amenities drive urban form in this context even though those amenities serve only a small segment of the population. He uses restaurants as an example:

> For persons pondering where to live and work, restaurants are more than food on their plate. The presence of distinct restaurants redefines the local context, even for persons who do not eat in them. They are part of the local market baskets of amenities that vary from place to place. . . . Their cumulative effects can shift individuals' and firms' location decisions, and hence drive population growth or decline (p.104).

Clark provides a preliminary investigation of the comparative strengths of whole metropolitan areas based on the amenities they offer. Among "constructed" amenities (as opposed to "natural"; p.111), Clark focuses on "bookstores, libraries, opera and museums," and on brew pubs, Whole Foods stores, Starbucks locations, juice bars, and community bicycle events (p.135).

Glaeser, Kolko, & Saiz (2004) also make a case for the shift in agglomeration primacy from industry to consumption. In an interesting reversal from the traditional industry-focused conceptions, they point out that "For consumers who want to be able to go to the Opera regularly. . . living in large cities is a necessity" (p.180), meaning that cities are not only necessary to support the Opera as an institution (the old industry-centered approach) but are necessary for individual consumers as well; the economics of agglomeration create the possibility for enhanced amenities.

Similarly both to Greene and to Clark, Glaeser, Kolko, & Saiz suggest that "There are four particularly critical urban amenities. First, and most obviously, is the presence of a rich variety of services and consumer goods. . . . Restaurants, theaters and an attractive mix of social partners are hard to transport and are therefore local goods" (p.178). The authors further suggest that hotels are important indicators too, because "Cities with more hotel rooms are presumably more attractive to visitors and potential residents as well" (p.183) - a concept which could easily be applied more locally, as in: different local places within a city with more hotel rooms are presumably more attractive than other local places within that same city.

2.3 A new concept for delimiting city centers

In the present paper, I translate Clark's and Glaeser, Kolko, & Saiz's inter-metropolitan focus on amenities into an investigation of the effects of amenities on the neighborhood-level spatial structure working within a single urban area, complementing Greene's HAZ work. If amenities are the fundamental drivers of urban growth at the macro, metropolitan level, then they should also be the fundamental elements of urban structure at the micro, urban structural level.

2.3.1 The postmodern urban center

In some versions of the game of Keno (e.g. the State of Oregon's lottery system), the process of selecting numbers from the grid is visually represented by computer animations of balls falling onto that grid, the chosen number corresponding to the cell on which the ball lands (Keno numbers are actually chosen through drawings or random-number generation algorithms). Applying this visualization to Dear and Flusty's Keno Capitalism metaphor of urban development, I suggest that perhaps there are metaphorical magnets in some locations on the gaming board which attract a disproportionate share of the falling balls of development.

These magnetic forces could be provided by initial land developments, for example. Once a seemingly-random initial grouping of amenities is in place, that group could itself attract further development in the same location, producing a cascading effect that serves over time to intensify the collection of amenities there more and more. The resulting cluster of amenities might eventually surpass a certain threshold of intensity, out of which would emerge a dynamic urban center.

That is to say, the development and structure of the postmodern city appears to have an element of random chance, but recognizing as Dear and Flusty do that there are rational logics influencing the process, perhaps we can identify particular regions within that structure which contain a significantly higher level of activity and development. These regions would perhaps not pass the centrality test as defined by modernism – they are not clearly spatially defined and they lack internal homogeneity – but recognizing that postmodernism requires a more fluid and nuanced vision, accepting of uncertainty, irregularity, and plurality, we must be willing to see centrality in a new way.

Under such a dynamic there will not exist a definitely-bounded "CBD". Rather, the types of development that signify centrality might simply be more clustered together in certain areas of the city than in others. Instead of exhibiting a growth pattern emanating outwards from an established core, this pattern would create a central area from the ground up as development yields new contiguities and new concentrations, ultimately forming a whole which is greater than the sum of its parts – an emergent property. I call this emergent property a *postmodern urban center* operating within a structure of *Magnetic Keno Capitalism*.

2.3.2 The core spaces of cultural production

The steady dispersion of employment centers outwards from traditional centers has led many authors to declare that the city center is losing its power as an organizing pole of the urban area. I argue that this dispersion of employment has been misinterpreted. Rather, the dispersion phenomenon merely indicates that employment is no longer a suitable indicator for centrality. Perhaps the center-hinterland dialectic can still be relevant when viewed through the lens of culture and place, or regarding the use of discretionary time and income.

Cities do seem to retain unique cultural identities, despite the apparent sameness of most suburban rings and the dispersion of employment into the periphery. Houston is different from New Orleans. Portland is not the same as Seattle. I would argue that the places where these unique cultures are maintained and propagated are the centers of their respective cities. These places may not be part of every metropolitan resident's daily work or errand routine - but they are important parts of every resident's total experience of the urban region. They are places of shared special experience, the only places within a metropolitan area that are common to most metropolitan residents' experience of leisure and discretionary time, and central to the formation of a metropolitan-wide sense of place. They are the core spaces of urban cultural production.

To be useful, the maps we make of fundamental urban structure need to be simpler than a multitudinous galaxy of employment centers. They need to call attention to the core spaces of urban cultural production. Everyone knows where these are, or at least whether any given location is near or far from a core space. But we need a way to map them.

2.3.3 Uncertain bounds

Such a subjective view of centrality requires acceptance of Allan, Massey, and Cochrane's doily region – discontinuous, internally heterogeneous, and with vague and uncertain boundaries. But accepting the doily region involves also accepting that no two given observers will necessarily agree with any one definition of the urban center. Rather, each citizen will have their own conception of the space of their city, with a complex structure of important nodes extending from a backbone anchored in the places most familiar to them as individuals.

For instance, a particular Korean-Angeleno's mental map may be centered in Koreatown whereas a particular Chinese-Angeleno's map may be centered in Monterey Park; a White-Angeleno may regard Westwood or Santa Monica as the primary center while a Black-Angeleno may see Leimert Park as central. But each individual's map will consist of a network of familiar places extending from their own primary nodes; and I would argue that when all citizens' mental maps are combined into one complicated network, particular regions of shared familiarity will emerge. These are the regions of common experience – the places understood by and important to all – the core spaces of urban cultural production. While impossible to map with hard edges and solid fills, these places could still be identified and their general shape delimited in order to reveal postmodern urban centers.

2.3.4 Intersecting clusters of urban amenities

So what suitable measurable phenomena might we identify for our maps? I would argue that the experience of free time is a major factor in shaping an individual's perception of their city. Work and home activities are economically important, but they are compelled experiences, dulled through repetition. Leisure activities, on the other hand, are highly experiential. One visits places of leisure by choice, for enjoyment, and they are therefore among the places that shine most brightly in a mental map. It follows that experiencing spaces of leisure shapes an individual's conception of the broad contours and outlines of their city and of their neighbors at least as much as experiencing spaces of employment. The leisure districts of a city – the areas that are congested with people enjoying themselves and experiencing their surroundings (rather than simply existing in them) – the core spaces of cultural production, in other words – might therefore constitute the postmodern urban center.

These leisure areas are likely to include destination/specialty retail districts, high-end restaurant areas, nightclub and theater agglomerations, and art museums and cultural infrastructure, to name a few. In short, clusters of urban amenities. I would argue that such clusters of amenities are more than merely identifiers of central places, but that they are themselves the engines driving the core spaces of cultural production. Such amenity clusters can attract a dispersed metropolitan population to spend discretionary income, enjoy a vibrant and exciting atmosphere, and to experience the commonality of the city.

Scott (1983) has already analyzed industrial agglomeration in cities through the identification of clusters of certain industry types. But if the city really is an “entertainment machine” (Clark, 2004a), then maybe clusters of urban amenities can be better indicators of centrality. Michael F. Porter (1998) defines clusters as “geographic concentrations of interconnected companies and institutions in a particular field,” which work by “stimulating the formation of new businesses, which expands and strengthens the cluster itself.” Clusters are thus, according to Porter, essential not only to their particular industry but also to the economy of the region in which they are located. While not explicitly discussing urban form, Porter does mention that “Clusters are a striking feature of virtually every national, regional, state, and even metropolitan economy.”

2.3.5 A conceptual method

But it would not seem to be enough to simply identify clusters of any one type of amenity. A cluster of museums alone is not enough to form a core space of urban cultural production, nor is a cluster of coffee shops alone. And mapping many individual types of amenities would likely produce a jumbled map of various amenities scattered around the landscape. Maybe the core places, then, are those locations where many types of amenity clusters coincide in a single place.

In my view, the process of Magnetic Keno Capitalism creates core spaces of urban cultural production by accreting overlapping clusters of urban amenities over time. Porter considers clusters to be “a robust organizational form” creating “a host of linkages. . . result[ing] in a whole greater than the sum of its parts” (1998). I would go further to argue that this emergent property of clusters is intensified when complementary clusters coincide in space, creating the unique vibrancy and reciprocal linkages necessary to form the emergent property that is the core space of urban cultural production. Thus, in my view, we can delimit postmodern urban centers by delimiting intersecting clusters of urban amenities.

2.4 Popular concepts regarding the center of Los Angeles

In this paper I describe one possible method by which postmodern urban centers may be delimited, and I apply it to Los Angeles. This application, of course, raises the question: what is known about the center of Los Angeles? Although some researchers have identified a strong center running along the base of the Santa Monica Mountains from the ocean at Santa Monica to Downtown Los Angeles, a more popular view, as described below, seems to be that Los Angeles lacks a strong center and is prototypical of a supposed new urban form wherein centrality has no meaning at all. I argue that most researchers' failure to identify a center in Los Angeles is more a symptom of their definition of 'center' than it is an indication of a true lack of a center in Los Angeles.

But this debate is drowned out in the popular culture by a common belief in the centerlessness of Los Angeles. The idea that there is no centralizing force in the region is so strong that Los Angeles stands in for the idea of centerlessness, placelessness, and sprawl in the public discourse.

2.4.1 Popular media

Popular (news) media often reflects the popular assumption of an absence of centrality coupled with a disorganized and inordinately-large sprawl in Los Angeles. It is particularly popular to assert that Los Angeles has no center – so popular that it has become an uncontroversial element of common wisdom. This popularity is evidenced by the fact that it is common to find passing references to Los Angeles' centerlessness in news articles on all manner of subjects.

Some examples: "Because Los Angeles has no centre. . . any visit here is essentially a trip to the 'burbs" (Haslam, 2008); "Downtown Los Angeles has long existed as a contradiction in terms -- the nominal center of a famously centerless collection of cities and suburbs" (Hawthorne, 2010); "Don't become Los Angeles, a freeway sprawl with no centre" (The Economist, 2010); "Los Angeles [is] infamous for being one massive suburb with no actual centre" (Johnston, 2007); "Wellington is a great writers' city, with a dramatic environment to respond to, not like Los Angeles, where there is no centre anywhere" (Gregory O'Brien, an editor, quoted in Dekker, 2008).

But common wisdom has also created a well-established concept of which particular places define the essence of Los Angeles, as evidenced in turn by countless travel publications recommending places in Santa Monica, Beverly Hills, the Fairfax/Melrose area, West Hollywood, Hollywood, and Downtown Los Angeles – with few exceptions – as the experiences not to miss when visiting the region (see: Begley, Levêque, & Ross, 2010, p.10; Hiss & Mueller, 2011, p.25; Horchow, 2005; O'Clery, 1993; Purdum, 1999; Ross, 2010).

This popular concept is both reflected and reinforced by the fact that the most common filmic representations of Los Angeles (perhaps the most frequently filmed city) are set in this same part of the region, with a particular focus on Beverly Hills (Carringer, 2001, p.253).

The irony of these two popular concepts about Los Angeles is that all of the popularly-conceived essential places of Los Angeles (with the exception perhaps of Disneyland) lie in mutual proximity within a continuous arc stretching from the Ocean to Downtown Los Angeles along the base of the Santa Monica Mountains (Figure 6). Thus, paradoxically, common wisdom both implicitly recognizes a singular and contiguous essential place while also holding that Los Angeles has no center.

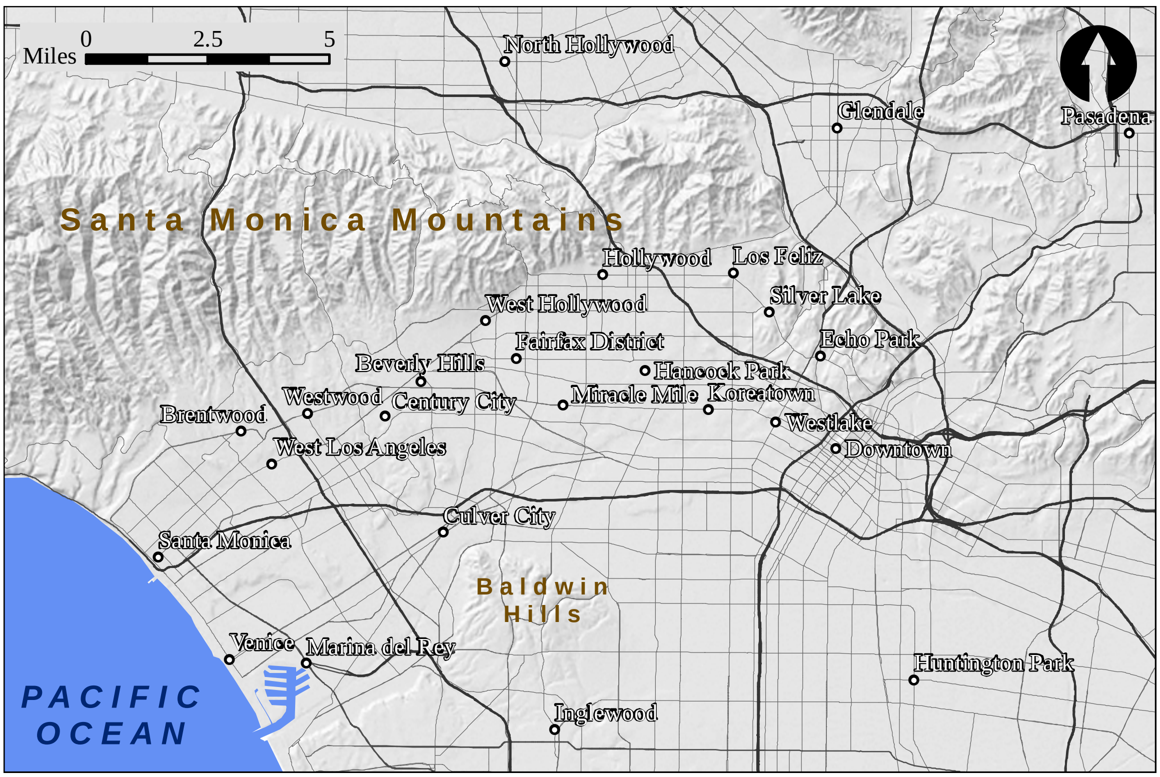

Figure 6: The popularly-conceived essential places of Los Angeles in mutual proximity along the base of the Santa Monica Mountains (streets: Esri; shoreline: U.S. Dept. of Transportation; hillshade: Cal-Atlas Geospatial Clearinghouse [atlas.ca.gov]).

2.4.2 Urban theorists

This same paradox can be found in the academic world. As I point out in the discussion below, a plethora of academic musings on the future of cities and the theories by which we may understand them consistently asserts that Los Angeles is prototypical of the future because of its lack of a structural core. Giuliano and Small (1991 p.166) acknowledge that “The conventional view of the [Los Angeles] region is one of endless urban sprawl, with employment and population dispersed throughout.” However, most empirical studies of the region continue to find a dominant core in the same region mentioned above (from the shores of Santa Monica to Downtown Los Angeles), although only a few authors explicitly identify the region as a single unit (see, again, the discussion below).

2.5 Research into the center of Los Angeles

Beginning in the 1980s, the structure of Los Angeles has been repeatedly studied. Most of these studies reveal a pronounced polycentrism in the region, with multiple centers scattered throughout the metropolitan area. The authors of these studies generally conclude that Los Angeles exhibits a polycentric urban structure with a weak central core (Giuliano and Small, 1991; Giuliano & Redfearn, 2007; Redfearn, 2007; Greene, 2008). Those whose analyses include time as a factor tend to conclude that Los Angeles’ core center is getting weaker over time (Giuliano & Redfearn, 2007). Many authors go on to assert that the small proportion of jobs occurring in centers versus jobs occurring outside centers indicates a trend beyond polycentrism towards total dispersion (Gordon & Richardson, 1996).

2.5.1 The problem of the arbitrary core

As discussed above in relation to urban form in general, and below in relation to Los Angeles in particular, the polycentrism idea has been thoroughly explored, but the conclusion of a weak central core is, in my opinion, questionable. Most of the time, authors' analyses of the 'core' center versus the rest of the 'subcenters' depend on an arbitrary definition of what the core is. Usually the core is narrowly defined as whichever job center identified in the study falls nearest the "CBD" of Downtown Los Angeles, meaning basically the area ringed by the 5, 10, 101, and 110 freeways (Figure 7).

After defining the core as such, authors then present the fact that the overwhelming majority of jobs occur in subcenters outside this core as evidence of a lack of strong centralizing forces in Los Angeles. But since fixing the spatial boundaries of the CBD is an arbitrary exercise, usually based on 'local knowledge' or arbitrary job density thresholds, any conclusions based on whether phenomena occur inside or outside of it are dubious. If the definition of the CBD were expanded to include its nearby subcenters it might not exhibit such a low proportion of total regional employment.

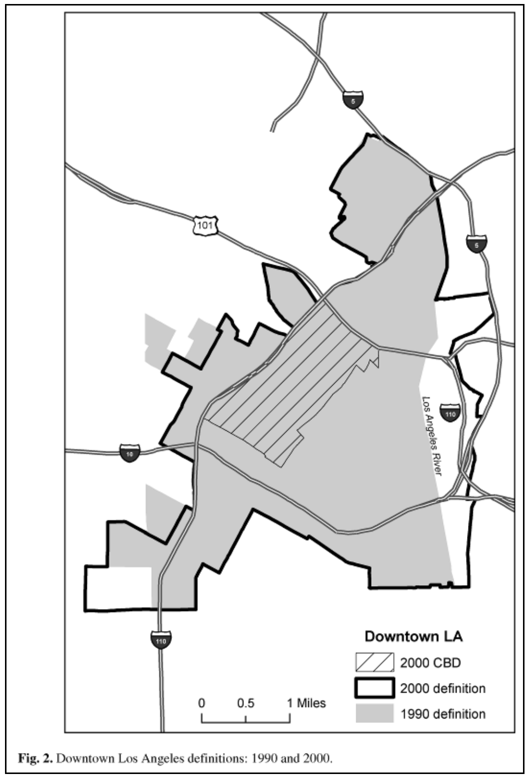

Figure 7: Greene’s (2008, p.144, fig. 2) map of the Los Angeles CBD.

2.5.2 A center is revealed, for those who choose to see it

Almost every study of urban structure in Los Angeles finds a tightly-spaced, nearly-contiguous group of subcenters arranged in an arc along the base of the Santa Monica Mountains from the ocean to Downtown Los Angeles (the arbitrary CBD). These subcenters individually are consistently among the strongest of the region, and sometimes are separated from each other not by discontinuity but by the study author’s assumption that a center so large in area is preposterous on its face, or at least not a useful analysis result (Giuliano & Small, 1991, p.167). Thus the supposed lack of centrality in Los Angeles is actually merely an unwillingness to accept the singular center that could be formed by the potential combination of these arc-aligned subcenters. There are a few studies which have taken the step, if only as a side note, to explore the ramifications of combining this arc into a single center. When they do, they find a center which once again dominates the surrounding urban landscape. But they generally choose to ignore it, concluding not that this dominant center exists but rather that their delimitation method requires further refinement (Giuliano & Small, 1991).

Giuliano and Small's (1991) seminal study of polycentrism in Los Angeles and its follow-up study 16 years later (Giuliano & Redfearn, 2007) find that the region exhibits a polycentric structure. The studies find furthermore that the region is dispersing over time, with the core center losing dominance to newer peripheral centers. Interestingly, both studies acknowledge an "overwhelmingly dominant" "megacenter. . . that spans an arc along the Wilshire Corridor from east LA to Santa Monica" (Giuliano & Redfearn, 2007, p.2952 & 2945).

The only reason this 'megacenter' doesn't overwhelm Giuliano et al.'s notions of polycentrism is that their particular (arbitrary) analysis thresholds ('10-10' or '20-20') happen to divide it at a few points into a number of smaller "subcenters" (Giuliano & Small 1991 p.167) (see centers 1 & 2 in Figure 1 above; centers 1, 2, 3, & 4 in Figure 8; and centers 1, 2, 3, & 8 in Figure 9). They do discuss this megacenter in passing, though, calling it the "Wilshire Corridor" (1991 p.167, 2007 p.2945), the "core" (1991 p.167), and the "LA Main Center" (2007 p.2948). Redfearn's own (2007) analysis of Los Angeles also identifies this corridor in passing, calling it an "east-west ridge" along Wilshire Boulevard in his map of employment density (p.526; see Figure 10), although he does not specifically address its implications for his discussion of polycentrism.

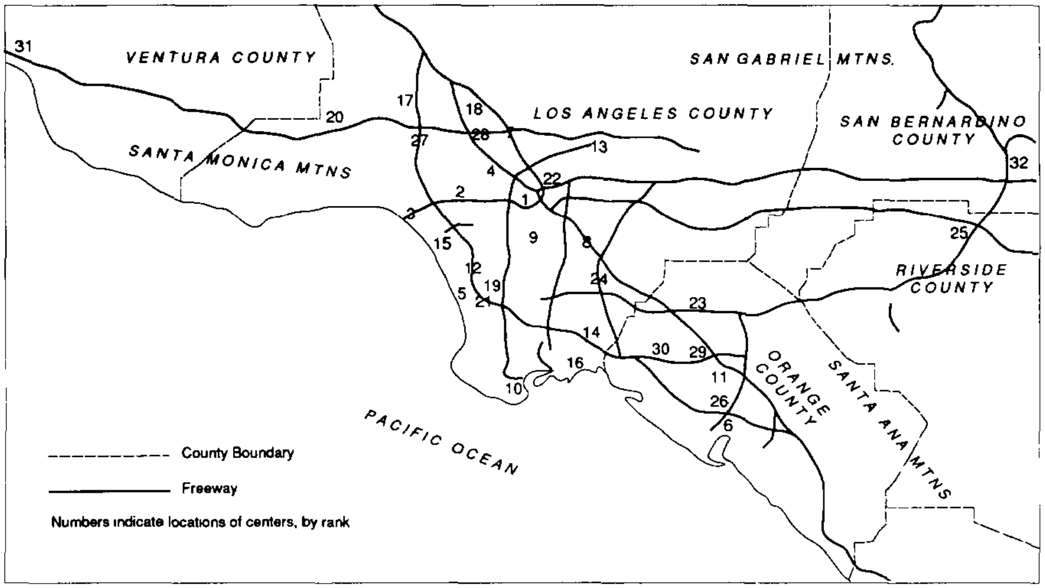

Fig. 1. Locations of employment centers.

Figure 8: Giuliano & Small's (1991, p.169, fig. 1) map of ranked '10-10' employment centers in Los Angeles.

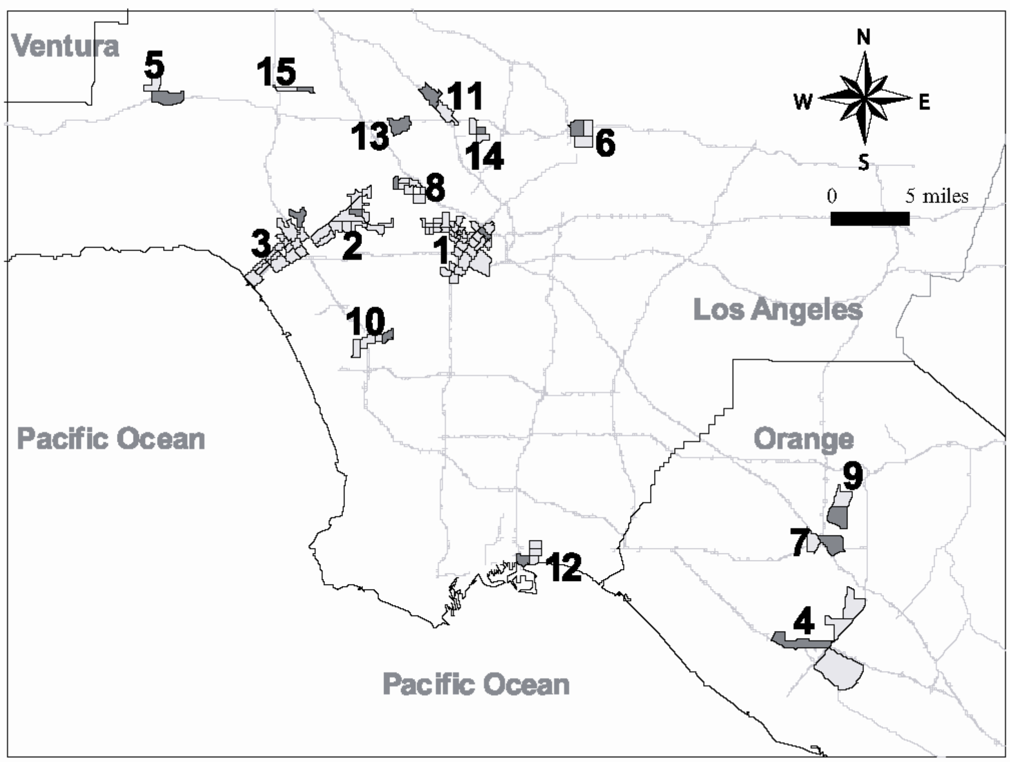

Figure 9: Giuliano & Redfearn's (2007, p.2951, fig. 4c) map of ranked '20-20' employment centers in Los Angeles.

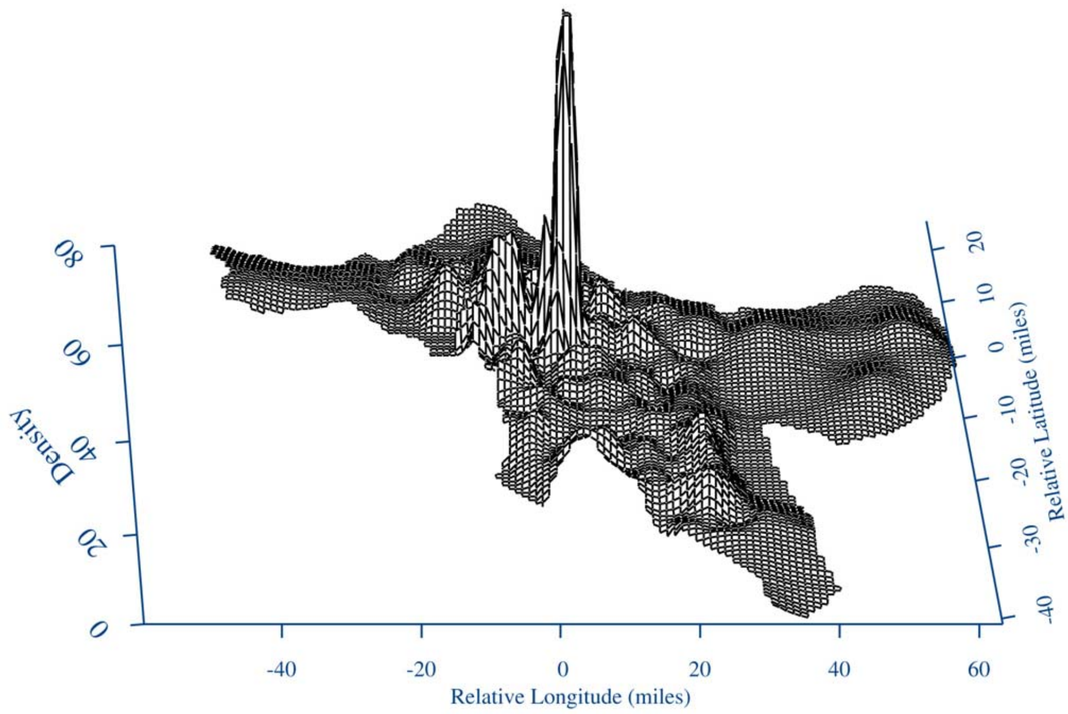

Fig. 2. Loess surface of employment density for Los Angeles CMSA

Figure 10: Redfearn's (2007, p.526, fig. 2) employment density map of Los Angeles.

Greene's (2008) E/R study of Chicago and Los Angeles finds "120 job centers. . . quite evenly spread throughout all but the least densly populated parts of the [Los Angeles] urban area" (p.140; see Figure 3), which he considers to be both a refutation of Dear's (1998) assertion that urban peripheries now organize the center and an indication that the importance of Los Angeles' core center has declined. Greene does, however, note "a small number of high-job-density tracts [which] had not been assigned to employment centers. . . [that] filled the gaps between the downtown L.A., Hollywood, Beverly Hills, and Santa Monica employment centers" to create a continuous formation along the base of the Santa Monica Mountains from the ocean to Downtown Los Angeles (Greene, 2008, p.151).

Greene dubs this formation the “Westside High Amenity Zone” (or HAZ; see Figure 5) after the concept he introduced for Chicago’s North Side (Greene, 2006; see also discussion above) - but he claims that Los Angeles’s HAZ is “not nearly as strong as it is in Chicago, because it sends only 12% of its resident workers to the CBD” (Greene, 2008, p.152). Greene discusses the ‘Westside HAZ’ only as a side note to his larger discussion of polycentrism, but it is worth noting that the Los Angeles CBD to which he refers is an arbitrary construct to begin with (see Figure 7 above), and that if one were willing to see the entire ‘Westside HAZ’ as a coherent functional unit, it might very well be the ‘CBD’ itself.

Gordon and Richardson (1996) look for “Activity Centers” based on a study of all kinds of trips, including both commuting and “nonwork” trips (p.290). The shift in focus away from employment is an improvement over other methods, but it takes their conclusions in an even less centralized direction. They find that “Activities are more dispersed than jobs are, and total trips are more diffuse than are work-trips” (p.291). Thus, “An alternative hypothesis [to that of polycentrism], a pattern of generalized dispersion, appears plausible” for Los Angeles (p.290). This conclusion could be due to their inclusion of all activity (such as mundane grocery shopping and workplace commuting) rather than focusing on select activities (such as those contributing to cultural production), thus obfuscating the centralizing forces at work in Los Angeles beneath a static noise of everyday errands and commutes.

Even more importantly, though, Gordon and Richardson share with many other authors a refusal to acknowledge the possible coherence of a central region as large and as internally inconsistent as that within Los Angeles even when their own map places it before their eyes - their map of activity centers (p.292) clearly indicates an overwhelming concentration along the base of the Santa Monica Mountains, stretching from the ocean to Downtown Los Angeles, whose contiguity is broken only at Hancock Park - Los Angeles's historic wealthy residential neighborhood (see Figure 11 for Gordon & Richardson's map; see Figure 6 above for the location of Hancock Park). Few of their activity centers lie outside this core corridor, and roughly half of those that do are located nearby. The map could easily be interpreted as indicating a very strong center, especially when such interpretation is liberated under Allen, Massey, & Cochrane's conception of regions as porous, discontinuous, and non-homogeneous (1998). But Gordon and Richardson (writing two years before publication of Allen, Massey, & Cochrane's seminal book) hold that their map indicates dispersion.

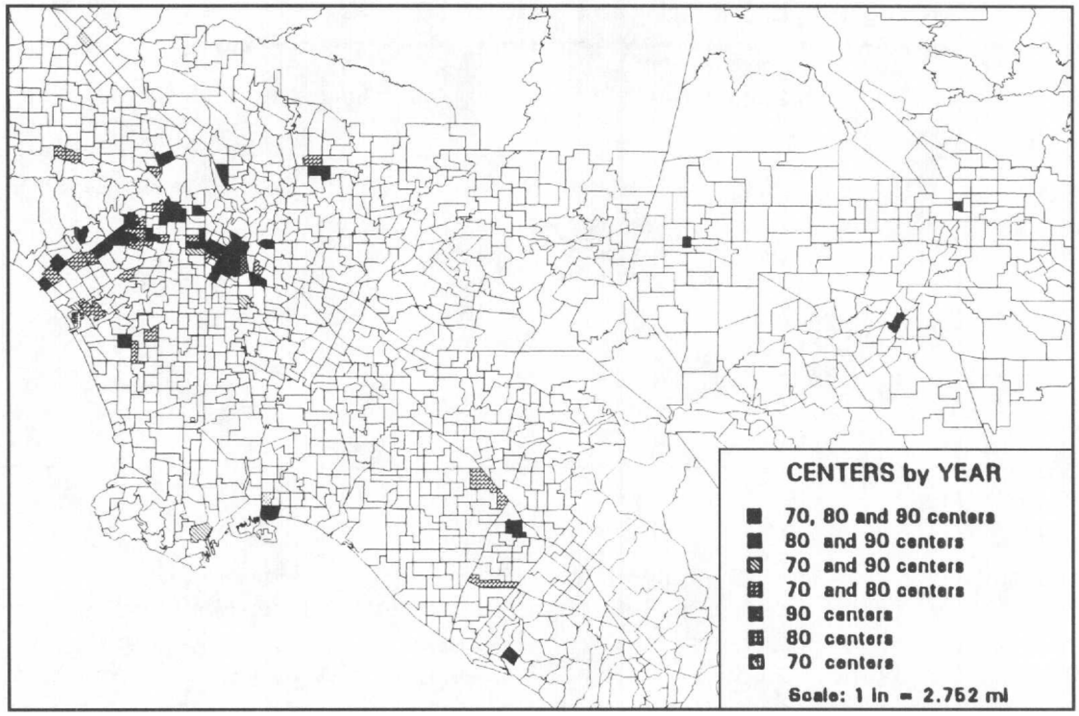

FIGURE 1. Map of Los Angeles activity centers, 1970, 1980, 1990

Figure 11: Gordon & Richardson's (1996, p.292, fig. 1) map of Los Angles activity centers.

Joel Garreau identifies many Edge Cities in the Los Angeles area (1991, p.262), including several which lie along the base of the Santa Monica Mountains, stretching from the ocean to Downtown Los Angeles: Marina del Rey/Culver City, West Los Angeles, Beverly Hills/Century City, Miracle Mile, and Mid-Wilshire, in addition to the traditional Los Angeles downtown (Figure 12). Garreau does not identify the borders of these Edge Cities, but a familiarity with the area (see Figure 6 above) and with Garreau's requirements for Edge City status (5 million square feet of office space and 600,000 square feet of retail space, as discussed above) leads one to conclude that these particular Edge Cities must be nearly contiguous.

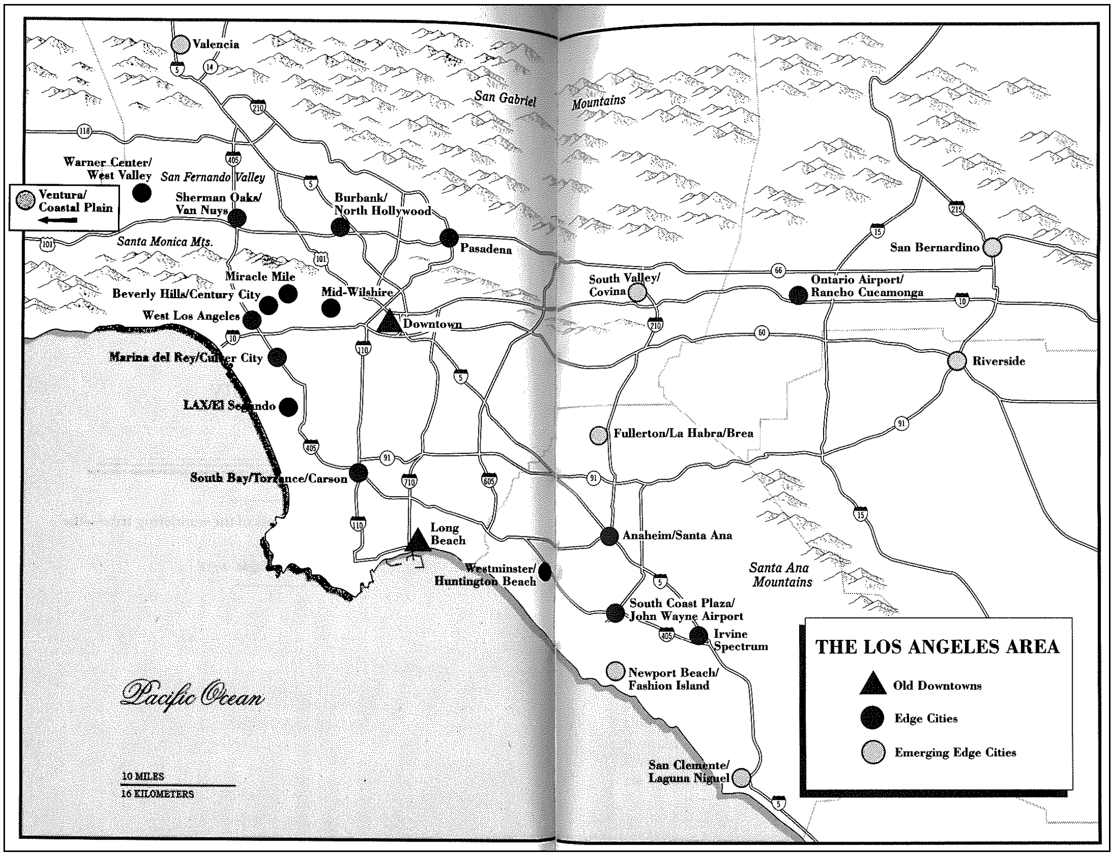

Figure 12: Garreau’s (1991, p.262) map of Los Angeles area Edge Cities.

Why, then, not consider them to be a single spatial unit? Perhaps because the size of such a unit would be too large even for Garreau to accept - but accepting a spatial unit of that size and complexity is essential to identifying a postmodern urban center. The addition of Santa Monica and Hollywood to Garreau’s list – areas perhaps lacking Garreau’s office space requirements but certainly serving as powerful draws for recreation and leisure spending – along with Westlake – an area often overlooked because of its lack of visitation by whites, but no less vibrant – would completely fill in the rest of the corridor from the ocean to Downtown Los Angeles.

2.5.3 An overwhelmingly dominant center

As noted above, studies of urban structure in Los Angeles generally conclude that polycentrism and dispersion are stronger forces than centrality in the region, and that no dominant center can be identified. But these studies tend to suffer from a preoccupation with a nominal ‘downtown’ or CBD which arbitrarily restricts the territory which can be considered central, and they are willfully blind to larger urban structures beyond that scale. Ultimately the conclusion that Los Angeles lacks a center seems to rely largely on map interpretations with preconceived expectations. If one accepts that a coherent region can be discontinuous and can have ambiguous boundaries and internal heterogeneity, then one can reinterpret these maps (figures 1, 2, 5, 8, 9, 10, 11, & 12 above) as revealing an overwhelmingly dominant center in Los Angeles.

2.6 The Wilshire/Santa Monica Corridor: a hypothesis

2.6.1 Asserting centrality

Based on such a reinterpretation, I assert that Los Angeles has a strong urban core, a space serving as the central place for the metropolitan region – the place where the unique culture of Los Angeles is maintained, propagated, and developed – a postmodern urban center. I begin with a hypothesis that this place occupies a narrow band of space stretching from the Pacific Ocean at Santa Monica in an arc along the base of the Santa Monica Mountains through West L.A., Brentwood, Westwood, Century City, Beverly Hills, Fairfax/Melrose, West Hollywood, Hollywood, Silver Lake, Echo Park, Koreatown, and Westlake, and culminating in Downtown Los Angeles (figures 13

& 14). Its principle artery is Wilshire Boulevard, with major support from Santa Monica Boulevard.

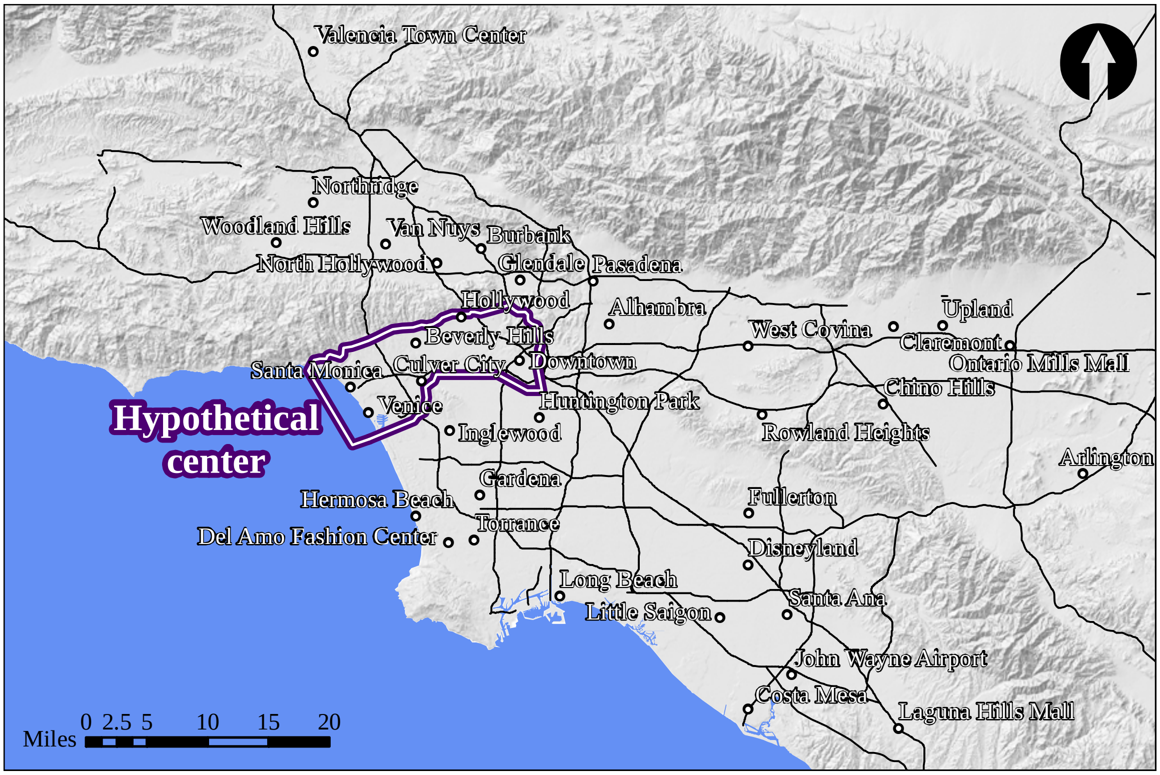

Figure 13: Hypothetical location of the center of Los Angeles (freeways & shoreline: U.S. Dept. of Transportation; hillshade: Cal-Atlas Geospatial Clearinghouse [atlas.ca.gov]).

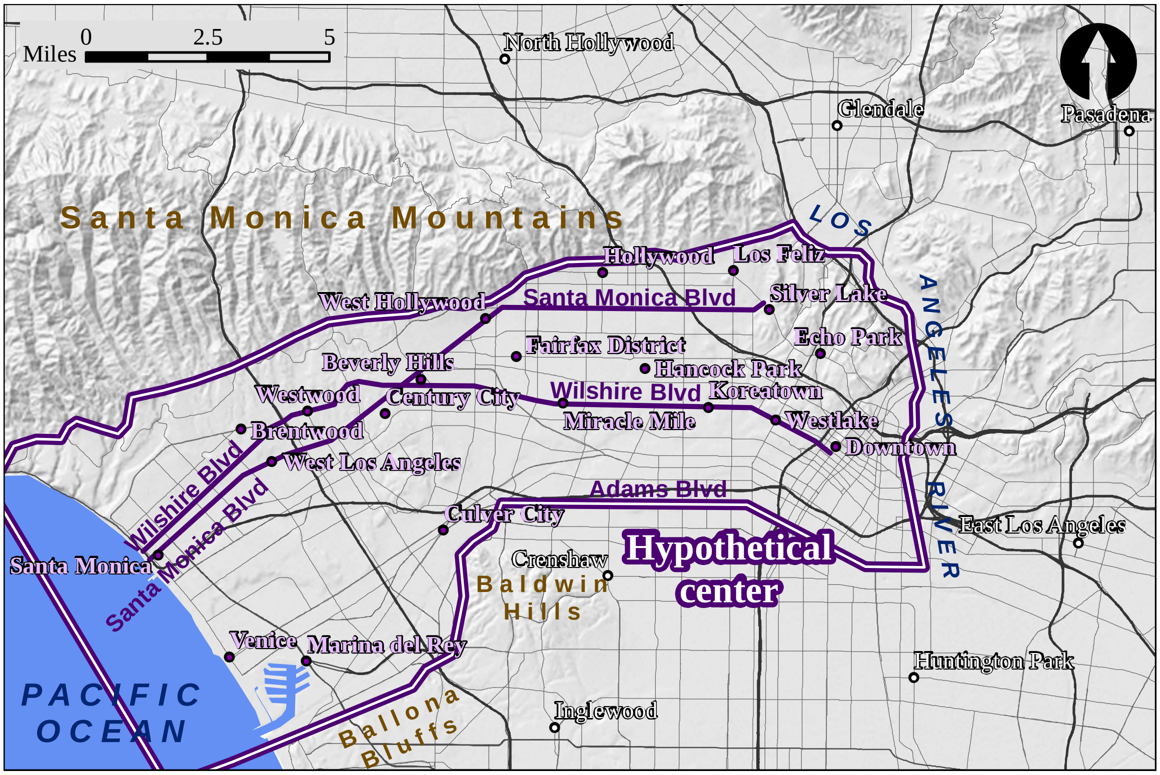

Figure 14: Detailed extents of the hypothetical center of Los Angeles (streets: Esri; shoreline: U.S. Dept. of Transportation; hillshade: Cal-Atlas Geospatial Clearinghouse [atlas.ca.gov]).

2.6.2 Delimiting the hypothetical center

For the purpose of delimiting this hypothetical postmodern urban center I chose to trace largely topographic contours: the Pacific Ocean on the west, the base of the Santa Monica Mountains on the north, and the Los Angeles River on the east; for the southern boundary, beginning at the coast, I traced the Ballona Bluffs eastward to the Baldwin Hills, then around the Baldwin Hills to the beginning of Adams Boulevard, which I followed to the Los Angeles River (see Figure 14 above). This delimited region generously contains all the central spaces described above plus ample extra space and is therefore intended to be only a rough approximation.

2.6.3 Naming the place

This place has already been identified in several analyses, as I have pointed out above, but it currently has no name, since it is not popularly seen as a single entity. A name is important if the concept of a Los Angeles center is to gain currency. The lack of any unifying place name may be a significant factor in the inability of so many to see a coherent central place.

A possible starting point can be found in the name *Santa Monica*, which denominates one of the major backbone boulevards, the bay which forms the western frame, and the mountain range that cradles this central region. Unfortunately, Santa Monica is already a powerful and evocative place name, used to refer specifically to the city, pier, and beach at the western end of this arc. Therefore, extending this name to the whole central region (as in, for example, the *Santa Monica Corridor*) might inaccurately imply that the City of Santa Monica has a special primacy or dominance in the region.

The core area is centered along the entire length of Wilshire Boulevard, and one of the only groups of authors to have attempted to name this same region, Giuliano et al., has appropriately called it the *Wilshire Corridor* (Giuliano & Small 1991; Giuliano & Redfearn, 2007). That name, though, is also popularly applied narrowly to several individual stretches of Wilshire Boulevard, as well as to the entire length of the Boulevard itself, without any wider regional implications (Lindsey, 1981; Ingwerson, 1985; The Economist, 2006; Aragon, 2007). Employing the *Wilshire* name alone to refer to this broader place, then, might imply reference to a too-narrow band of space.

The name should connote both the corridor shape of the place and the fact that it extends significantly beyond the immediate neighborhood of Wilshire Boulevard. I therefore refer to this central place as the *Wilshire/Santa Monica Corridor*. Both Wilshire and Santa Monica Boulevards provide major structural support to the shape of the central place (see discussion of analysis results below), and their paths diverge enough to imply the inclusion of a wide band of space.

2.6.4 The goal of this study

So why is it so difficult to acknowledge the existence of a center in Los Angeles? Perhaps we have been conditioned not to be able to see centers like this. The Wilshire/Santa Monica Corridor includes the traditional CBD only on its periphery, and it crosses several municipal boundaries. Both of these conditions are especially problematic to views of centrality in the United States. Also, The Wilshire/Santa Monica Corridor is larger in area than would be accepted as a single central place in most cities, and it is both discontinuous and far from internally homogeneous. But the CBD is largely an arbitrary construct, municipal boundaries have little impact on any given individual's use of urban space, and we can now define regions as ambiguously-bounded and spatially heterogeneous - even to the point of discontinuity (Allen, Massey, & Cochrane, 1998). Once we liberate ourselves from these artificial constraints on seeing regions, the Wilshire/Santa Monica Corridor becomes easy to identify as a coherent and functional central place.

The central core of Los Angeles, then, does not have to be spatially consistent or have a well-defined border in order for us to recognize its existence. The Wilshire/Santa

Monica Corridor is large; it consists of numerous districts and places serving disparate ethnic and economic needs; not all the spaces within it exhibit features of centrality, and those that do are not necessarily contiguous; its borders are hard to pin down, and they shift over time and depending on perspective. The present study, then, rather than offering a hard boundary categorizing places to either side as either central or non-central, serves as an indicator of the general spatial extent of the postmodern urban center of Los Angeles. This spatial extent is discerned here through an analysis of intersecting clusters of urban amenities.

I see the work of Dear and Flusty, Garreau, and Allen, Massey, & Cochrane, as first attempts to define the outlines of the new urban structures we see around ourselves. The aim of this study, then, is to show that an urban center does exist in Los Angeles, and to identify its location and extent, so that we can begin to understand its role and function in the postmodern urban dynamic.

CHAPTER 3: DATA

The primary input to this analysis consisted of the point locations of individual urban amenities. These point locations were extracted from Esri Business Analyst data. Most amenities were classified according to the North American Industrial Classification System (NAICS) while shopping malls were classified by the Directory of Major Malls (DMM; both classifications are discussed below).

3.1 Esri Business Analyst

The analysis necessitated a source that could provide consistent coverage in all the areas under study (Chicago, New York, and Los Angeles, as described below). In order to form useful analysis inputs, the amenities also needed to be categorized by a suitably detailed and nationally consistent classification regime. Esri Business Analyst was selected as the source because of its thorough and comprehensive national coverage of business and amenity locations, and because it includes the nationally-consistent NAICS (discussed below) among the attributes of those amenities.

3.1.1 Background

Esri Business Analyst is a complicated product maintained by Esri, the makers of the popular ‘ArcGIS’ software. It consists of both specialized data and software routines, and uses these in combination to assist businesses making decisions on new locations, market area divisions, and routing.

3.1.2 Structure

Among other data, Business Analyst includes points representing the locations of nearly every business, institution, and public amenity in the United States as part of its 'Business Locations' database. These businesses can be filtered by various attribute criteria, including by using NAICS codes to the finest level of categorization available under that system. These data are provided by Infogroup, a corporate research firm, under rigorous research and verification standards designed to ensure both currency and completeness (http://www.esri.com/data/esri_data/methodology-statements.html).

Business Analyst's 'Major Shopping Centers' database contains points representing shopping mall locations with several attributes including total retail floorspace. These data are provided by the Directory of Major Malls (DMM), which is described below.

Esri updates the Business Locations database annually and the Major Shopping Centers database semiannually. At the time of extraction for this analysis, the most recent confirmed data currency date was 2010.

3.1.3 Strengths and limitations

Business Analyst's primary strengths are its comprehensive coverage, consistency, and detail. The data covers the entire nation using the same classification scheme and to the same comprehensive level of detail.

The amenity points are in most cases placed as the result of geocoded addresses. Geocoding is a mostly-automated process by which a textual address is converted to a spatial coordinate location using information about street networks and their addressing systems. Geocoding is an inexact method which generally places the resulting points at an arbitrary offset from their addressed street. This practice sometimes results in point placements that can be hundreds of feet away from their true locations and, when multiple points share the same address (as with retail stores in a shopping mall), stacked on top of each other.

Since the points were aggregated into polygon cells for this analysis (as described below) their precise locations were unimportant. The polygon cells themselves were too large for Geocoding errors to make much of a difference. Furthermore, since the analysis used multiple sets of cell divisions (also described below), isolated instances of individual points falling on the incorrect side of any one particular cell division were not expected to have a significant overall effect.

A further question arises out of the commercial aspect of the data. Although NAICS is a government initiative, the actual Business Analyst data was collected and processed by a corporation for profitable ends. This compromise was necessitated by the need for such a wide ranging and complex set of inputs which are not available at this level of detail from any public agency (the Census Bureau makes available NAICS counts aggregated by zipcode but does not release individual business points).

3.2 North American Industry Classification System (NAICS)

In order to conduct a meaningful analysis, a classification scheme for amenities was needed. An analysis treating all amenities as equivalent inputs might have yielded some insights but would certainly have missed out on important nuances. For example, the importance of a single coffee shop is probably not equivalent to that of a single opera house. But since businesses and amenities can exhibit incredible variation in their particular operations, it would not be practical to attempt to manually sort them. The North American Industry Classification System (NAICS) provides a robust and easily accessible standardized typology for amenities.

3.2.1 Background

NAICS was implemented in 1997 by the United States Bureau of Labor Statistics with the dual goals of improving upon the older Standard Industrial Classification (SIC) system, which dated from the 1930s, and providing a consistent classification scheme for coordination among Canada, Mexico, and the United States following the implementation of the North American Free Trade Agreement (NAFTA) (Harchoi, 2004; Russell, Takac, & Usher, 2004).

3.2.2 Structure

Under NAICS, as opposed to the SIC, industries are grouped together based on their production processes rather than by their outputs (Harchaoui, 2004; Kelton, Pasquale, & Robelein, 2008; Krishnan & Press, 2003; Russell, Takac, & Usher, 2004). The classification scheme employs a nested hierarchy in the form of a six-digit numeric code. The nested codes categorize business establishments according to their primary activities.

The codes are structured such that the first digit identifies a very general class of industries (say, manufacturing or services) and each subsequent digit corresponds to a categorization of greater detail (Russell, Takac, & Usher, 2004, p.32). This system allows an individual researcher to choose the level of detail at which to group establishments by choosing to ignore some of the last digits.

The sixth NAICS code digit is for optional differentiation at the discretion of national governments (thus the sixth digit is not universal for all three countries) and is in most cases left at zero (undifferentiated). Since this study analyzed only areas within the United States, the sixth digit was utilized when it provided useful differentiation.

3.2.3 Strengths and limitations

NAICS is nearly universal since all businesses must report a code on their tax forms. This means that there are few unclassified amenities. Since the business operator generally self-declares a category, though, there is an element of uncertainty involved (Krishnan & Press, 2003, p.695). With self-reporting, there is room for amenity operators to misunderstand the categories or to make differing decisions about ambiguous or overlapping definitions.

Among businesses with multiple facilities, each physical establishment location is assigned an NAICS code. The codes therefore classify establishments, not businesses, so a single business may be involved with several different NAICS codes. This method makes the codes meaningful in physical location terms, which is useful for this study. If a single establishment is involved with activities classified under more than one code, that establishment is assigned the code covering its predominant activity (http://www.census.gov/eos/www/naics/faqs/faqs.html). This practice does allow for some further ambiguity in the classification system.

Several studies have found that the NAICS classifications are a significant improvement over SIC in terms of detail and consistency, especially in service industries such as restaurants and entertainment, and that businesses that share NAICS categories do tend to exhibit strong internal homogeneity on additional specific measures, which indicates that the NAICS categories are meaningful in real-world terms (Harchaoui, 2004; Kelton, Pasquale, & Robelein, 2008; Krishnan & Press, 2003). Even though it represents an improvement over the SIC, though, the detail for the service sector is still lacking when compared to that for the manufacturing sector (Kelton, Pasquale, & Rebelein, 2008, p.318).

3.2.4 Data selection

Several NAICS codes were chosen for selecting amenity inputs based on categories identified in the context section above. Specifically, NAICS codes were chosen to represent categories of establishments identified by the authors whose cited work focused on urban amenities: Greene; Clark; and Glaeser, Kolko, & Saiz. NAICS codes were selected according to the primary business categories identified by these authors.

Amenity inputs were organized into five primary categories as follows.

CATEGORY A - “Trendy Hangouts”: All three authors (Greene; Clark; and Glaeser, Kolko, & Saiz) identify the idea of trendy hangouts as important drivers of urban growth. Greene and Glaeser, Kolko, & Saiz refer generally to trendy retail stores, while Clark specifically identifies bookstores, brew pubs, Whole Foods, Starbucks, and juice bars.

CATEGORY B - “High Culture”: All three authors also identify the importance of what they term “High Culture” to urban growth. Clark specifically identifies opera companies and museums, while Greene identifies various performing arts venues along with artists themselves, and Glaeser, Kolko, & Saiz identify theaters in general.

CATEGORY C - “Restaurants”: Both Clark and Glaeser, Kolko, & Saiz emphasize the significance of full-service restaurants.

CATEGORY D - “Hotels”: Glaeser, Kolko, & Saiz suggest that hotels are useful indicators of the attractiveness of a particular city. Taking that suggestion a step further, this study uses hotels as an indicator of the attractiveness of a particular part of a city.

CATEGORY E - “Entertainment”: This category is included as a counterweight to the “high-culture” category put forward by the amenity authors. While high-culture is important for capturing the dynamics of urban growth as seen from the perspective of high-income professionals, it is hoped that the inclusion of broader entertainment options can expand the analysis to include the dynamics of a more general population. Entertainment amenities include, for the purposes of this study: cinemas, arcades, bowling alleys, stadiums, and shopping malls, among others.

Table 1 lists these amenity categories with the particular NAICS codes and descriptions selected to represent each. Listed codes with less than six digits include all possible further differentiations which could be made by the additional missing digits. For example, the listed code “4452” includes all possible six-digit permutations such as 445200, 445201, 445202, and so on. NAICS code descriptions are quoted from the U.S.

Census Bureau's NAICS code "drill-down" website (www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007).

Table 1: Amenity categories with NAICS codes and descriptions.

Category	**NAICS Code**	**NAICS Description**
CATEGORY A: "Trendy Hangouts"	722213 Snack and Nonalcoholic Beverage Bars	This U.S. industry comprises establishments primarily engaged in (1) preparing and/or serving a specialty snack, such as ice cream, frozen yogurt, cookies, or popcorn or (2) serving nonalcoholic beverages, such as coffee, juices, or sodas for consumption on or near the premises. These establishments may carry and sell a combination of snack, nonalcoholic beverage, and other related products (e.g., coffee beans, mugs, coffee makers) but generally promote and sell a unique snack or nonalcoholic beverage.
	451211 Book Stores	This U.S. industry comprises establishments primarily engaged in retailing new books.
	451220 Prerecorded Tape, Compact Disc, and Record Stores	This industry comprises establishments primarily engaged in retailing new prerecorded audio and video tapes, compact discs (CDs), digital video discs (DVDs), and phonograph records.
CATEGORY B: "High Culture"	453920 Art Dealers	This industry comprises establishments primarily engaged in retailing original and limited edition art works. Included in this industry are establishments primarily engaged in displaying works of art for retail sale in art galleries.
	712110 Museums	This industry comprises establishments primarily engaged in the preservation and exhibition of objects of historical, cultural, and/or educational value.
	7111 Performing Arts Companies	This industry group comprises establishments primarily engaged in producing live presentations involving the performances of actors and actresses, singers, dancers, musical groups and artists, and other performing artists.
CATEGORY C: "Restaurants"	722110 Full-Service Restaurants	This industry comprises establishments primarily engaged in providing food services to patrons who order and are served while seated (i.e, waiter/waitress services) and pay after eating. These establishments may provide this type of food services to patrons in combination with selling alcoholic beverages, providing carry out services, or presenting live nontheatrical entertainment. [This code specifically excludes pay-before-eating places, buffets, cafeterias, snack bars, caterers, and food trucks].
CATEGORY D: "Hotels"	721110 Hotels (except Casino Hotels) and Motels	This industry comprises establishments primarily engaged in providing short-term lodging in facilities known as hotels, motor hotels, resort hotels, and motels. The establishments in this industry may offer food and beverage services, recreational services, conference rooms and convention services, laundry services, parking, and other services.

(table continues. . .)

Table 1, continued.

Category	NAICS Code	NAICS Description
CATEGORY E: "Entertainment"	7112 Spectator Sports	
	713 Amusement, Gambling, and Recreation Industries.	[This code includes amenities like skiing, golfing, bowling, and arcades, but excludes cinemas and spectator sports].
	51213 Motion Picture and Video Exhibition	This industry comprises establishments primarily engaged in operating motion picture theaters and/or exhibiting motion pictures or videos at film festivals, and so forth.
	Shopping Malls (not an NAICS category)	Malls with a Gross Leasable Area (GLA) over 400,000 square feet were included.

The particular NAICS hotel code selected (721110) includes all kinds of hotels and motels but excludes establishments like campgrounds, RV parks, boarding houses, and bed-and-breakfasts. There is no further differentiation among hotels and motels available under NAICS. This hotel code also excludes casino hotels, which are classified under a different NAICS code, but no casino hotels were found in the study areas. Instead, hotels attached to casinos were found to be classified as individual hotels, while the casinos were separately classified under NAICS code 713. The casino hotels code was therefore not used in this study.

As mentioned above, Esri Business Analyst includes a Business Locations database, wherein business location points are classified by NAICS code. Points fitting the selected NAICS categories were extracted from the Business Locations database to serve as inputs to this study.

3.3 Directory of Major Malls (DMM)

Shopping malls were added to the entertainment amenity category because they provide a destination for entertainment and leisure similar to other amenities identified above. Malls provide this experience apart from the stores within them, meaning that the mall itself is a destination of its own even if it contains stores that fall into the other amenity categories (Goss, 1993).

3.3.1 Background

Not all malls provide this type of leisure destination - for example, standard strip malls arguably do not - so a classification system was needed for malls as well. The NAICS classifies businesses that operate and manage shopping malls, but it does not classify the locations of shopping malls themselves. Thus an alternative source was required, which was provided by the Directory of Major Malls (DMM). The DMM is an industry association which tracks shopping mall performance and categorizes them according to size and function. The directory is useful both for developers of new malls and for operators of retail businesses searching for locations for new stores.

3.3.2 Data selection

The International Council of Shopping Centers (ICSC) identifies several categories of malls, such as “Neighborhood”, “Regional”, “Power Center”, and “Lifestyle” malls (ICSC, 2012), but the Esri Business Analyst data does not include these category attributes. The data does, however, include Gross Leasable Area (GLA), a standard measure of mall size.

Only malls that can serve as leisure destinations in their own right were desired as amenity inputs for this study. In the absence of more descriptive categorizations, a GLA threshold was therefore employed for mall selection. Specifically, only malls with a GLA over 400,000 square feet, the typical minimum size of a "Regional Mall" (ICSC, 2012), were selected for inclusion in the analysis.

In addition to "Regional" malls, this threshold also includes "Super Regional" malls. Together, these two classes encompass nearly all indoor shopping malls. The GLA threshold was also sufficient to include larger "Lifestyle" malls, which are a newer class meant to capture outdoor malls that attempt to create the same type of atmosphere as an indoor mall through the inclusion of trendy anchors and carefully constructed environments (ICSC, 2012).

Lifestyle centers create idealized outdoor landscapes in which to shop such as old-fashioned urban streetscapes or idyllic pseudo-natural settings. In these malls, the mall setting itself is an entertainment destination and is therefore appropriate for inclusion in this analysis. Examples of lifestyle malls include "Downtown Disney" adjacent to Disneyland in Anaheim, and "The Grove" at 3rd St and Fairfax Ave in Los Angeles.

Unfortunately, there are some less entertaining mall classes whose larger malls can be included by the GLA threshold, including "Power Centers" (collections of giant big-box or warehouse style stores) and "Factory Outlets". These inclusions were not expected to be detrimental to the study, though, because some members of these mall classes can conceivably function as entertainment destinations, just as some members of the purposefully-included classes probably do not. Thus, the main effect of the GLA threshold was to filter out neighborhood- and convenience-oriented strip malls.

As mentioned above, Esri Business Analyst includes a Major Shopping Centers database, wherein mall location points include their GLA as provided by the DMM. Points representing malls with GLAs over the 400,000 square foot threshold were extracted from the Major Shopping Centers database to serve as inputs to this study.

CHAPTER 4: METHODOLOGY

This study delimits postmodern urban centers by identifying clusters of urban amenities. The key to this method is not just in finding clusters, but in finding intersecting clusters of different types of amenities.

After the imposition of several regular cell arrays onto an urban landscape, counts of particular types of amenities were aggregated into the cells. Clusters of high concentrations of each type of amenity were then identified and delimited within each array, identifying each cell that belonged to a cluster.

Clusters from each of the various cell arrays were then overlaid and cluster membership for each cell fragment was summed to achieve a *cluster score*, a measure of how many clusters of a single amenity type coincided at each cell. These cluster scores, in turn, were also summed to produce a *centrality score*, a measure of how many clusters of all amenity types were coincident over each spatial unit. The centrality score was then cartographically visualized.

4.1 Methodological considerations

The methodology employed several analytical tools, including: the use of control cities; a Local Indicators of Spatial Association (LISA) analysis; a process for aggregating points into polygons; and a process for constructing analysis cells. In the following section I discuss: the need for control cities and how they were selected; the concept behind and abilities of LISA analysis; and considerations of defining cell adjacency and mitigations for the Modifiable Areal Unit Problem (MAUP).

4.1.1 Controls

One goal of this project was to delimit the center of Los Angeles. In order to have confidence in the accuracy of the method, the analysis was also performed on two cities with widely-acknowledged centers: Chicago and New York. Since this analysis successfully identified centers in the control cities consistent in location with established expectations for the locations of centers in those cities, the analysis results can be assumed to be valid for Los Angeles as well.

The center of Chicago was expected to consist of The Loop and its immediate surroundings plus the Near North Side, a corridor along Lake Michigan north of and adjacent to The Loop (Abadie & Dermisi, 2008, p.454; Greene, 2008, p.147 & p.150; Park, Burgess, & McKenzie, 1967, pp.50-55). This area includes the Sears Tower, Grant Park, the Art Institute of Chicago, Navy Pier, and the Magnificent Mile (Figure 15).

The center of New York was expected to consist of Midtown and Lower Manhattan - the parts of Manhattan situated south of Central Park (Barr, Tassier, & Trendafilov, 2010, p.1060; Lee, 2007, p.495; Porter, 2010, p.392). This area includes Times Square, Wall Street, Rockefeller Center, the Empire State building, the Chrysler building, the United Nations, the World Trade Center, Penn Station, and Grand Central Station (Figure 16).

Figure 15: Expected center of Chicago (basemap: Esri).

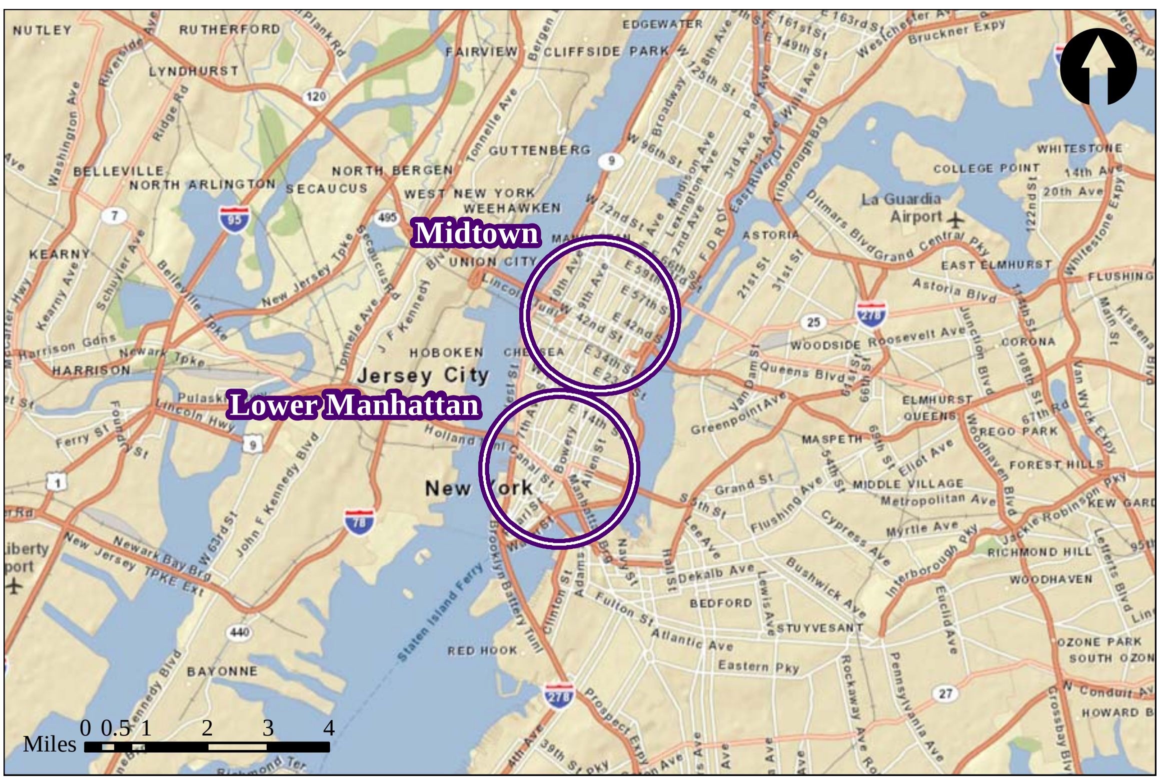

Figure 16: Expected center of New York (basemap: Esri).

The expected control centers as depicted by the graphics in figures 15 and 16 are not meant to be precise or restrictive. As mentioned in the context section above, the true urban centers are expected to be ambiguously bounded and internally inconsistent. The use of circles, rather than points, as indicators of expectations is meant to convey this sense of ambiguity. The circles are drawn over the places that are assumed to be the least controversial definitions of the centers of these two cities. It would be surprising if the actual centers delimited by this analysis were to match these expectations exactly, but identifying any additional territory as expected centers or delimiting the expectations with greater precision at this point would not be entirely uncontroversial.

4.1.2 Cluster analysis (LISA)

The primary analytical tool employed for this project was a Local Indicators of Spatial Association (LISA) analysis, which is a statistical measure of local clustering for area data developed in 1995 by Luc Anselin (now of Arizona State University) at West Virginia University (Anselin 1995). LISA is an adaptation of the more common *Moran's I* statistic, which measures the extent to which a given variable of a spatial dataset is either clustered or randomly distributed in space (Bailey & Gatrell 1995, p.270).

Concept

LISA essentially localizes *Moran's I*, producing a value for each individual areal unit of a spatial dataset. This value indicates the similarity or dissimilarity of that unit relative to its spatial neighbors as well as the proportion at which that local clustering relationship influences the global *Moran's I* for the entire dataset (Anselin 1995; Anselin, Sridharan, & Gholston 2007). LISA analyses identify clusters of local *Moran's I* values along with a *p-value* indicating significance.

Clustering is based on contiguity of areal units with significant *p-values*. The result is a *LISA Cluster Map*, which indicates four types of LISA clusters: clusters of high values (of the original variable being analyzed); clusters of low values; isolated high values surrounded by low values; and isolated low values surrounded by high values (Anselin, Syabri, & Kho 2006). The present project was concerned with clusters of high values, and the variable being analyzed was counts of urban amenities. Thus, the clusters identified in this study represent clusters of high counts of particular kinds of urban amenities.

Initial experiments for this study found robust clusters in all attempted trial cases, with cells in the centers of the identified clusters achieving significance values at the computational limit. In the interest of producing tight results with as much spatial resolution as possible, therefore, the significance threshold for all clusters in this study was set at a *p-value* of less than or equal to $1x10^{-9}$ (0.000 000 001), within a few digits of the computational limit.

This high p-value threshold means that the identified clusters are robust, but it also implies that the underlying phenomenon may be broader in areal extent than what is delimited here. Thus, while there can be a high degree of confidence in the results, they should be interpreted as representing only the strongest cores of processes which play out over wider areas. If we are to understand urban centers as being ambiguously bounded and internally inconsistent, the centers delimited under this analysis should be seen as comprising the innermost parts of such centers with the least ambiguity over their inclusion.

LISA's strengths

LISA's local derivation of significance allows for the identification of clusters of especially high values within a field of generally high values, as well as the identification of clusters of average values within a field of low values - all within the same dataset. In essence, significance is computed relative to the cluster's immediate surroundings as well as being relative to the global norms of the dataset.

One advantage to seeking spatial clusters in this way is that there is no need to establish absolute value thresholds to apply to a national dataset. LISA analysis is wholly dependent on the area under study. So if one city has many coffee shops throughout its area, it will take an especially large concentration of coffee shops to trigger a significant cluster identification. But if another city has virtually no coffee shops, a group of two or three of them would be sufficient to trigger a cluster. Thus the analysis identifies spaces that are important relative to their local surroundings. There is no need, then, to attempt to establish standard national thresholds such as 5 coffee shops per square mile or the like - a common problem with many other attempts to define urban centrality. The beauty of this method is that the center is defined locally.

Since contiguity, clustering, and significance are all computed, there can be a high degree of confidence that the resulting cluster boundaries have meaning. The only arbitrary aspect to the clusters is that of the original spatial aggregation scheme, which is an inescapable problem for any polygon-based GIS analysis (see the MAUP section below for mitigations of this problem). Another advantage of LISA compared to many other measures of spatial correlation is that LISA identifies the clusters that actually exist in a data set, rather than attempting to fit a smooth mathematical curve to the entire space.

LISA's limitations

LISA, however, is not a perfect tool. A LISA analysis will always identify some clusters, unless the attribute under study is completely evenly dispersed. This means that LISA will identify clusters in the data even if these clusters are merely the result of a random distribution. So the existence of a LISA cluster does not in itself reveal that the data exhibits strong autocorrelation, it merely delimits the extent of the clusters it does find.

This study mitigates for this limitation through the search for multiple coincident clusters of differing amenity types. Spatial coincidence of separate inputs implies that a non-random organization is operating above all the input variables. If the pattern were truly random, the different individual clusters wouldn't coincide to produce areas with high cluster scores (see below for a discussion of cluster scores) - instead the cluster scores would be generally low and evenly dispersed.

Since the analysis area in this study covers both urban and rural space, it could be expected to at the very least identify the urban space as a cluster within the study area. The question of interest then becomes: can we identify smaller clusters within this urban space?

Finally, it is important to note that LISA is an exploratory method, not a statistical analysis. This study is not concerned with determining some statistical measure of the data but rather with identifying where the data clusters in space.

Cluster fringes

A question of cluster fringe-inclusion is raised during the LISA analysis. The spatial units identified as clusters by the LISA analysis represent only the core of a given cluster, since inclusion in a cluster requires most neighbors to have high values. Thus, the actual extent of the cluster should be interpreted as including all the spatial units which are adjacent to the core cluster identified by the LISA analysis, in addition to that core cluster itself (Luc Anselin, personal communication, March 6, 2012).

A trail run of this analysis did produce clusters that appeared to be too small by approximately one spatial input unit around the fringes, given subjective general knowledge of the areas in question. Therefore, for this analysis a mechanism was devised for inclusion of cluster fringe polygons. The attribute indicating cluster membership was changed from a binary indication to a three-step relative scale, called a *cluster value*. Cells which were identified by the LISA analysis as belonging to a cluster were given a cluster value of two, while all cells adjacent to that core cluster were given a cluster value of one, and other cells a cluster value of zero.

This mechanism means that cluster-adjacency does allow a polygon to contribute to the sum of coincident cluster values, but at half the strength of the core cluster members. This method added some nuance to the analysis while also allowing for more realistic final cluster boundaries. The high *p-value* threshold for cluster identification and the half-weighted fringe-inclusion in the cluster score means that the real-world clusters identified by this analysis are probably in truth somewhat larger in area than as delineated here. As such, this analysis is only one perspective onto reality, not an exact representation of it.

Adjacency

A LISA analysis compares values among adjacent spatial units, and there are three basic ways to define adjacency. The simplest definition is to say that polygons are adjacent only when they share an edge, known as 'rook' adjacency. Another definition is to expand adjacency to include polygons that share an edge or a vertex, known as 'queen' adjacency. The third definition is to define adjacency by a distance limit, so that polygons which are very near to each other may be considered adjacent even if they don't actually touch.

The distance method is only necessary when using a highly irregular set of polygons (to allow adjacency to jump over an intervening sliver polygon) or when given a set of polygons that is too finely grained (to allow adjacency to include a large number of neighbors). Since the cells used in this study were both regular and deliberately sized (as described below), this method of defining adjacency was not necessary.

The difference between 'rook' and 'queen' adjacency comes into play with irregular polygons and with regular rectangular grids. The selection of one or the other definitions must be made according to the spatial processes being studied. This study used a hexagonal tessellation of cells in order to eliminate the uncertainty inherent in choosing between rook and queen definitions. In a hexagonal array, all cells that share a vertex also share an edge, so there is no difference between rook and queen adjacency.

For this reason, a hexagonal array is a more realistic model of real-world processes when adjacency is a factor in the analysis. Compared to a rectangular grid, a hexagonal array also has an advantage when applied in urban settings of reducing the number of artifacts resulting from interaction of the grid boundaries with the ubiquitous rectangular street grid pattern found in most American cities.

4.1.3 The Modifiable Areal Unit Problem MAUP

One significant issue with spatial analyses involving polygons is the Modifiable Areal Unit Problem (MAUP), which is a recognition that differing aggregations of the same underlying phenomena can produce differing analysis results. A spatial phenomenon that happens to be bisected by a polygon edge might be diluted into the two polygons' attribute values and thus fail to show up in an analysis. Also, spatial phenomena can be obscured by aggregation cells that are too large or too small.

Recognizing MAUP

Some of the figures in the analysis process section below provide examples of MAUP. For instance, there is a large group of restaurants in downtown Santa Monica which extends a few miles to the northeast (Figure 29 below). Under one aggregation scheme used in this study (Figure 35 below), the entire group is aggregated into a single cell. That cell consequently has a high number of restaurants and is included in the resulting LISA cluster. However, under another aggregation scheme (Figure 36 below), the group is split among three adjacent cells. While the two eastern cells also cover other groups of restaurants and therefore maintain high restaurant values and are included in the cluster, the western cell does not. This discrepancy in the way the cell borders intersect the underlying data changes the shape of the resulting cluster.

A similar discrepancy can be observed in the area between North Hollywood, Burbank and Glendale. One arrangement of cells (Figure 33 below) captures the gap in restaurants here while another arrangement (Figure 34 below) does not. The area is included in the LISA clusters under both arrays of larger cells (figures 35 & 36 below), though, illustrating that cell size also causes MAUP discrepancies. Hence, the size of the polygons under analysis must be appropriate to the scale at which the phenomena under study are operating. Performing the same analysis on the same data aggregated into different sets of analysis cells can therefore produce different results.

Aside from these problems of aggregation, additional MAUP issues can arise in sets of politically drawn administrative boundaries such as zip codes or electoral districts. These types of boundaries tend to have convoluted outlines and widely-varying shapes and sizes which can cause unexpected behaviors when adjacency is an analysis factor.

Mitigations

This study mitigated for MAUP in three ways. First, the use of a regular array of hexagonal analysis cells eliminated the problems inherent in using pre-made administrative boundaries. Second, the analysis was repeated using cell arrays of different sizes so as to catch clustering processes operating at different scales. And third, the analysis was repeated using cell arrays that were offset from each other, allowing the true data points to be aggregated in different ways. The results of the analyses on these differing aggregation schemes were merged to produce an overall output that mitigated against some of the effects of MAUP.

Multiple cell sizes

Selecting a cell size is largely an arbitrary and subjective process. In order to reduce the uncertainty inherent in such a selection, this study used three cell sets each employing different cell sizes. One set employed a cell width (interior diameter) of 2 km, another set 5 km, and the third set 13 km (Figure 17). Kilometers were chosen as a unit of measurement so as to avoid any possible artifacts arising from interaction with the ubiquitous street pattern found in most American cities which, especially in Los Angeles, tends to place major streets at half-mile intervals.

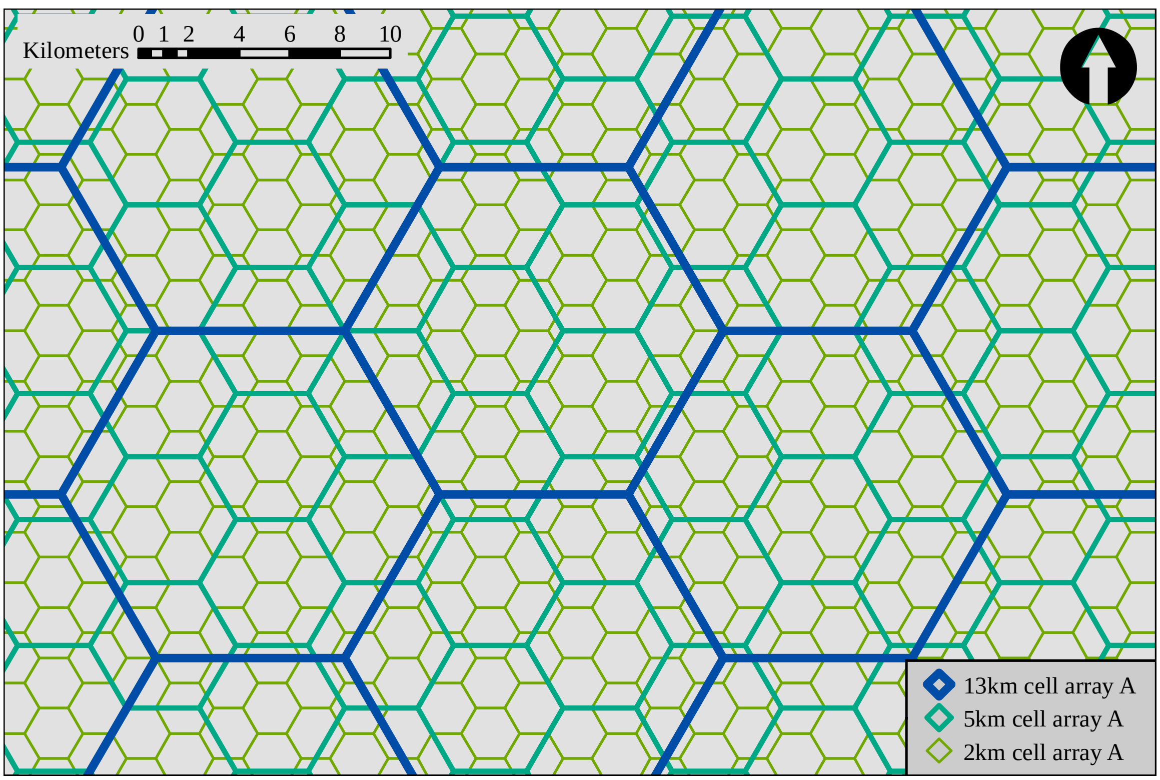

Figure 17: Varied cell sizes for capturing processes operating at multiple scales.

The proportional relationship among the cell sizes, roughly 2/5, was selected to avoid a situation in which the larger cell boundaries would frequently coincide with those of the smaller cells. Because the smaller cell array was meant to capture clustering processes operating at the neighborhood level, the two kilometer cell width was selected as a reasonable approximation of the size of an easily-walkable neighborhood. But since LISA finds local clusters, an array of small cells will result in many clusters across the area under study. The larger cell sizes were therefore necessary in order to identify more regional clustering trends at the sacrifice of neighborhood-level detail. The largest cell width, thirteen kilometers, was selected as a reasonable approximation of an easily-driveable neighborhood. The five kilometer width was selected as an intermediate scale between these two extremes.

Pairs of displaced cell arrays

In order to address the issue of underlying phenomena being arbitrarily divided into overlying cells, this study employed pairs of displaced cell sets. Specifically, each initial set of cells of each specific cell size (above) was copied and displaced by half the length of the cell's outer diameter, at an angle of 60 degrees. This resulted in two sets of cells for each cell size, wherein areas that straddled cell vertexes in the first array were contained in the centers of cells in the second array (Figure 18). Thus any spatial phenomena divided into different cells under one array would be either undivided, or at least differently divided, in the other array of cells of the same size.

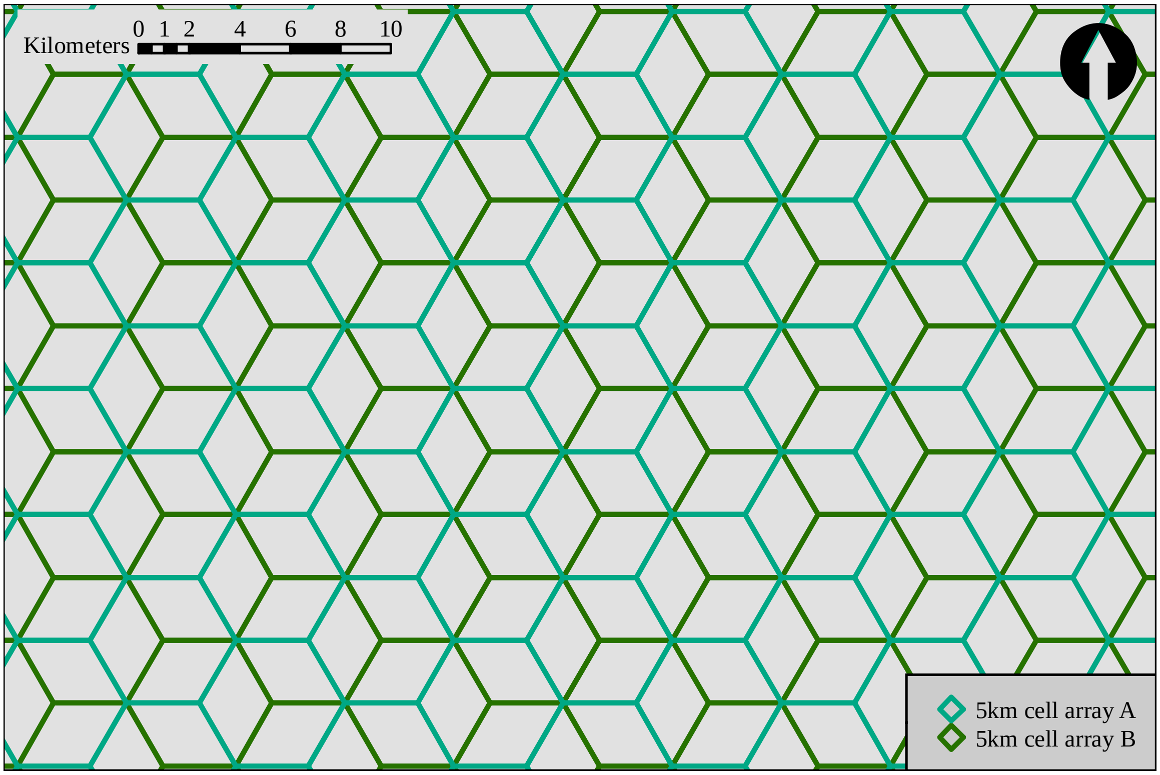

Figure 18: Offset pairs of cell arrays to aggregate the underlying data in different ways.

The internal cell diameters were 2 km, 5 km, and 13 km, which created external diameters of 2.309 km, 5.773 km, and 15.011 km, respectively. The arrays were displaced by half the outer diameter at 60 degrees by calculating the equivalent vertical and horizontal displacement: (0.57735, 1.000), (1.443375, 2.500), and (3.752775, 6.500), respectively. The six resulting sets of cells are subsequently referred to as *analysis arrays*.

Merged array

After identifying clusters within each analysis array, all six arrays were merged into a *union array* which combined the results of each, thus reducing the uncertainty arising from MAUP. To create the union array, all six analysis arrays were intersected

(Figure 19) to create a new array of cell fragments reflecting the boundaries of all six cell sets (Figure 20).

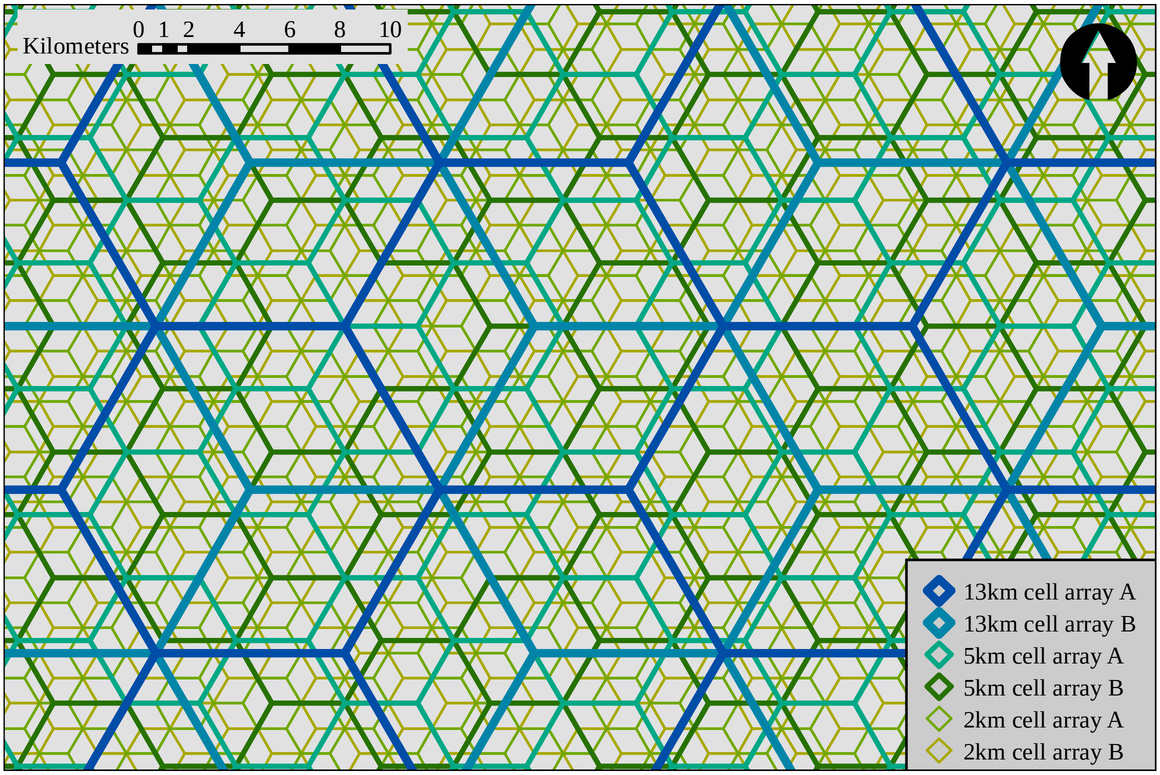

Figure 19: All six analysis arrays, intersected.

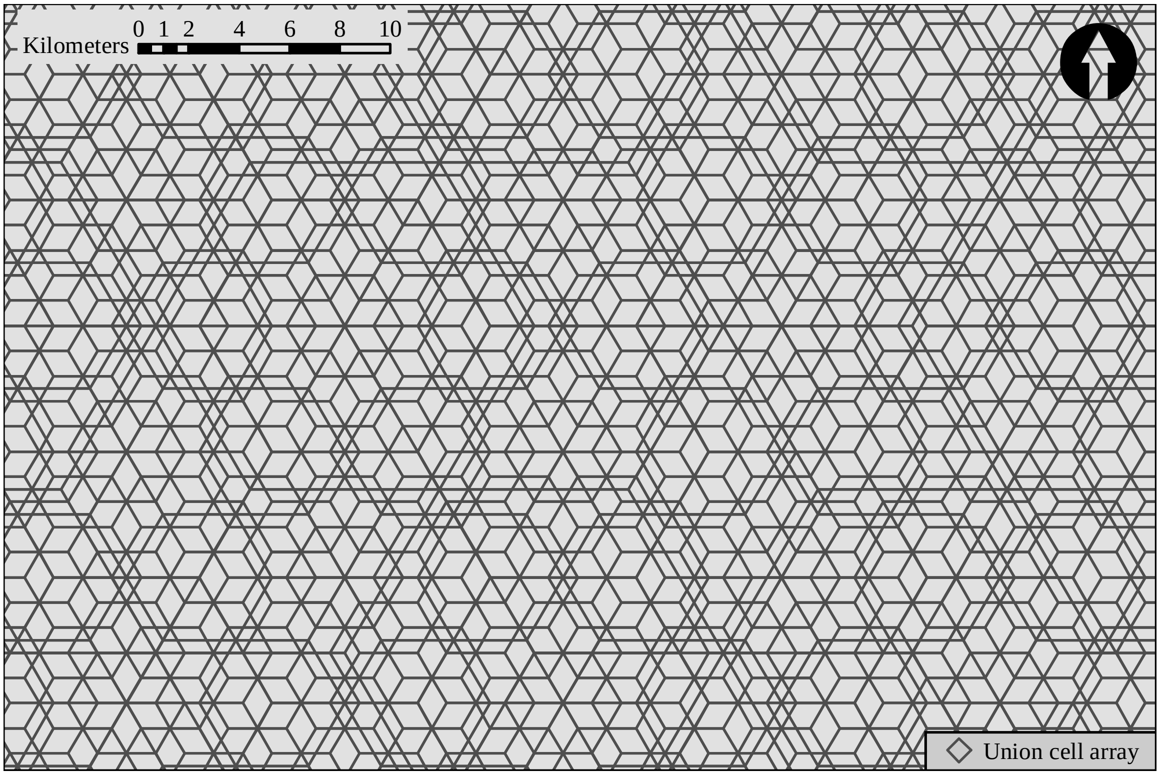

Figure 20: The union array, made from the intersected analysis arrays.

4.1.4 Attribute tables

In order to reduce data storage space and replication errors, all input variables and analysis outputs were kept as attributes of a single polygon feature class (each analysis array). In practice the analysis results were often output as new shapefiles, the relevant attributes of which were then joined back to the full table. A globally-unique identification number was assigned to every analysis cell, in order to facilitate the joining of data. Table 2 lists the attributes of each analysis array, while Table 3 lists the attributes of the union array.

Table 2: Attributes of each analysis array.

Group	Attribute	Description
Key	CellID	unique identification code for each cell
Amenity Counts (count of aggregated amenity points from each NAICS code)	Count_722213	count of Snack and Nonalcoholic Beverage Bars
	Count_451211	count of Book Stores
	Count_451220	count of Prerecorded Tape, Compact Disc, and Record Stores
	Count_453920	count of Art Dealers
	Count_712110	count of Museums
	Count_7111	count of Performing Arts Companies
	Count_722110	count of Full-Service Restaurants
	Count_721110	count of Hotels and Motels
	Count_7112	count of Spectator Sports
	Count_713	count of Amusement, Gambling, and Recreation Industries
	Count_51213	count of Motion Picture and Video Exhibition
	Count_Malls	count of Shopping Malls
Amenity Category Counts (sum of amenity counts for amenity categories with multiple member amenity types)	Count_A	“Trendy Hangouts” group: sum of Count_722213 + Count_451211 + Count_451220
	Count_B	"High Culture" group: sum of Count_453920 + Count_712110 + Count_7111
	Count_E	"Entertainment" group: sum of Count_7112 + Count_713 + Count_51213 + Count_Malls
Amenity Category Cluster Values (value of 0 for no cluster, 1 for cluster fringe, or 2 for cluster core)	Cluster_A	clusters of Count_A "Trendy Hangouts"
	Cluster_B	clusters Count_B “High Culture”
	Cluster_C	clusters of Count_722110 “Restaurants”
	Cluster_D	clusters of Count_721110 “Hotels”
	Cluster_E	clusters of Count_E “Entertainment”

Table 3: Attributes of the union array.

Group	Attribute	Description
Input Cell IDs	CellID_02a	CellID of the overlying cell in the 2 km analysis array A
	CellID_02b	CellID of the overlying cell in the 2 km analysis array B
	CellID_05a	CellID of the overlying cell in the 5 km analysis array A
	CellID_05b	CellID of the overlying cell in the 5 km analysis array B
	CellID_13a	CellID of the overlying cell in the 13 km analysis array A
	CellID_13b	CellID of the overlying cell in the 13 km analysis array B
Input Cluster Values	Cluster_A_02a	"Trendy Hangouts" cluster value from the overlying cell in the 2 km analysis array A
	Cluster_B_02a	“High Culture” cluster value from the overlying cell in the 2 km analysis array A
	Cluster_C_02a	“Restaurants” cluster value from the overlying cell in the 2 km analysis array A
	Cluster_D_02a	“Hotels” cluster value from the overlying cell in the 2 km analysis array A
	Cluster_E_02a	“Entertainment” cluster value from the overlying cell in the 2 km analysis array A
	Cluster_A_02b	"Trendy Hangouts" cluster value from the overlying cell in the 2 km analysis array B
	Cluster_B_02b	“High Culture” cluster value from the overlying cell in the 2 km analysis array B
	Cluster_C_02b	“Restaurants” cluster value from the overlying cell in the 2 km analysis array B
	Cluster_D_02b	“Hotels” cluster value from the overlying cell in the 2 km analysis array B
	Cluster_E_02b	“Entertainment” cluster value from the overlying cell in the 2 km analysis array B
	Cluster_A_05a	"Trendy Hangouts" cluster value from the overlying cell in the 5 km analysis array A
	Cluster_B_05a	“High Culture” cluster value from the overlying cell in the 5 km analysis array A
	Cluster_C_05a	“Restaurants” cluster value from the overlying cell in the 5 km analysis array A
	Cluster_D_05a	“Hotels” cluster value from the overlying cell in the 5 km analysis array A
	Cluster_E_05a	“Entertainment” cluster value from the overlying cell in the 5 km analysis array A
	Cluster_A_05b	"Trendy Hangouts" cluster value from the overlying cell in the 5 km analysis array B
	Cluster_B_05b	“High Culture” cluster value from the overlying cell in the 5 km analysis array B
	Cluster_C_05b	“Restaurants” cluster value from the overlying cell in the 5 km analysis array B
	Cluster_D_05b	“Hotels” cluster value from the overlying cell in the 5 km analysis array B
	Cluster_E_05b	“Entertainment” cluster value from the overlying cell in the 5 km analysis array B

(table continues. . .)

Table 3, continued.

Group	Attribute	Description
Input Cluster Values	Cluster_A_13a	"Trendy Hangouts" cluster value from the overlying cell in the 13 km analysis array A
	Cluster_B_13a	“High Culture” cluster value from the overlying cell in the 13 km analysis array A
	Cluster_C_13a	“Restaurants” cluster value from the overlying cell in the 13 km analysis array A
	Cluster_D_13a	“Hotels” cluster value from the overlying cell in the 13 km analysis array A
	Cluster_E_13a	“Entertainment” cluster value from the overlying cell in the 13 km analysis array A
	Cluster_A_13b	"Trendy Hangouts" cluster value from the overlying cell in the 13 km analysis array B
	Cluster_B_13b	“High Culture” cluster value from the overlying cell in the 13 km analysis array B
	Cluster_C_13b	“Restaurants” cluster value from the overlying cell in the 13 km analysis array B
	Cluster_D_13b	“Hotels” cluster value from the overlying cell in the 13 km analysis array B
	Cluster_E_13b	“Entertainment” cluster value from the overlying cell in the 13 km analysis array B
Cluster Scores (sum of amenity category cluster membership among each input analysis array)	ClusterScore_A	sum of Cluster_A_02a + Cluster_A_02b + Cluster_A_05a + Cluster_A_05b + Cluster_A_13a + Cluster_A_013b
	ClusterScore_B	sum of Cluster_B_02a + Cluster_B_02b + Cluster_B_05a + Cluster_B_05b + Cluster_B_13a + Cluster_B_013b
	ClusterScore_C	sum of Cluster_C_02a + Cluster_C_02b + Cluster_C_05a + Cluster_C_05b + Cluster_C_13a + Cluster_C_013b
	ClusterScore_D	sum of Cluster_D_02a + Cluster_D_02b + Cluster_D_05a + Cluster_D_05b + Cluster_D_13a + Cluster_D_013b
	ClusterScore_E	sum of Cluster_E_02a + Cluster_E_02b + Cluster_E_05a + Cluster_E_05b + Cluster_E_13a + Cluster_E_013b
Centrality Score (sum of all cluster scores)	CentralityScore	sum of ClusterScore_A + ClusterScore_B + ClusterScore_C + ClusterScore_D + ClusterScore_E

4.2 Analysis process

4.2.1 Establish study areas

This study sought to analyze processes of urban structure that operate at the level of ‘cities’ in the morphological sense rather than in the legal (incorporated municipality) sense, meaning an entire coherent metropolitan system - a central city plus its satellite centers and suburbs. But defining the bounds of metropolitan areas is still a complicated practice with many unresolved issues. The process by which the extents of the analysis areas were determined was therefore somewhat complicated in order to be consistent across all three study cities.

For each subject city, the initial study area was defined as a 50km buffer beyond the minimum bounding rectangle of all the urban areas within the subject metropolitan area. This initial study area was used to establish bounds for creating the analysis cells and for acquiring amenity points, but the analysis itself was carried out on a more restricted region delineated by the convex hull of the set of urban areas within the study area. A convex hull is the smallest polygon with an entirely convex exterior boundary that is capable of containing a set of given input shapes. For any given input, there is one and only one possible convex hull.

Combined Statistical Area (CSA)

The starting point for defining the study areas was provided by Combined Statistical Areas (CSA). CSAs are the highest level of metropolitan area aggregation defined by the Office of Management and Budget (OMB) and used by the Census. They represent the most inclusive conceptualization of metropolitan areas that are officially recognized.

A CSA is formed by combining multiple adjacent Metropolitan Statistical Areas (MSA) that have significantly integrated employment commuting areas (Office of Management and Budget, 2000, p.82237). An MSA, in turn, is defined by OMB as an urban core or cores plus the surrounding urban areas that “have a high degree of interaction” (p.82228). The smallest unit of aggregation making up an MSA is a county, so MSA and CSA boundaries are always coincident with county lines.

Most large metropolitan areas, including Los Angeles, Chicago, and New York, are represented by a CSA rather than by a single Metropolitan Statistical Area. For example, the "Oxnard-Thousand Oaks-Ventura, CA" MSA is subsumed within the larger "Los Angeles-Long Beach-Riverside, CA" CSA. Thus, CSAs are the most appropriate level of metropolitan analysis for this study, since focusing on MSAs would leave out significant chunks of truly integrated metropolitan areas.

Because MSAs and CSAs include only whole counties, they also include much rural land within their boundaries. They therefore do not serve well as spatial delimitations of the metropolitan areas they represent (p.82228). The Los Angeles CSA covers hundreds of square miles of sparsely-populated desert in northern and eastern San Bernardino and Riverside Counties, for example, because the urbanized portions in the south and west of those counties participate in the inter-county metropolitan activities that define the CSA (Figure 21). For spatial bounds, therefore, the Census’s Urban Areas become necessary.

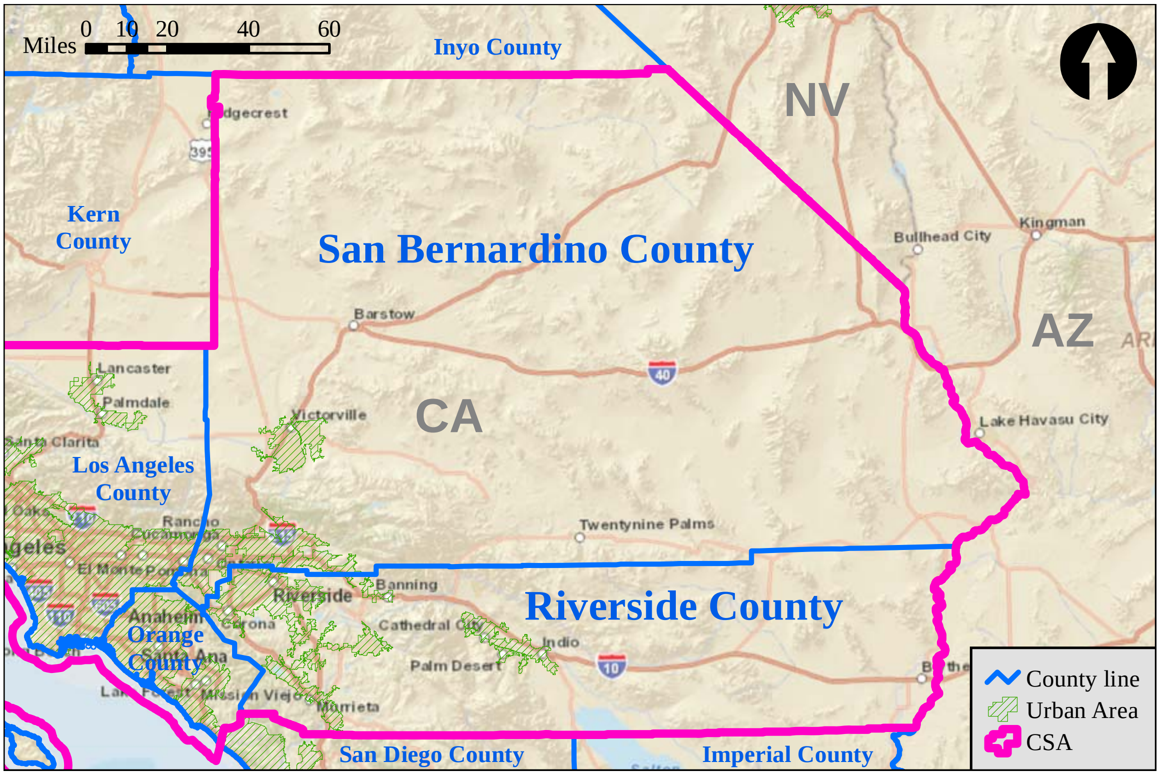

Figure 21: Urban areas in San Bernardino and Riverside counties (UAs & CSA: U.S. Census Bureau; county borders: Cal-Atlas Geospatial Clearinghouse [atlas.ca.gov]; basemap: Esri).

Urban Area (UA)

An Urban Area (UA) is defined by the Census as a contiguous collection of small spatial units (Census blocks and block groups) that each exceed a certain population density threshold and collectively exceed a certain total population threshold (Department of Commerce, 2002, p. 11667). Once a UA is established based on these population thresholds, adjoining and surrounded blocks exhibiting urban land uses but lacking the population density (such as airports, factories, or shopping malls) are added. Since Census Blocks are very small, this method yields very detailed and realistic depictions of the areal extents of cities. The concept of urban contiguity can skip over certain kinds of non-urban space (such as rivers or military bases) so long as the distance skipped is small, but in most cases intervening territory (such as small mountain ridges, large parks, or a few miles of farmland) cause breaks in contiguity which lead to the definition of multiple separate UAs nearby to each other (p.1168).

Because of these breaks in UA contiguity, CSAs generally contain dozens of individual UAs within their borders. It would be inappropriate to analyze individual UAs for this study, since metropolitan processes operate at the CSA level and include multiple UAs, but CSAs do not provide a good spatial boundary for spatial analysis. Thus, all the UAs within a single CSA were combined by this study to create the spatial outline of that metropolitan area for use in establishing the study areas.

Notes

Urban Clusters (UC) are a newer concept that are related to UAs and are intended to capture the boundaries of even the smallest and least dense settlements. UCs must be mentioned here because they are often categorized and delivered by the Census alongside UAs, as with the UA & UC shapefile obtained from the Census for this study. UCs were excluded from the process of defining the study areas for this project because their generous inclusiveness makes them spatially ubiquitous. This ubiquity in turn makes them unhelpful during attempts to define spatial limits.

Because Census 2010 Urban Areas were not yet available at the time of this study, Census 2000 definitions were used. This lack of currency was not expected to significantly affect the analysis, though, because the study areas were broadly defined and included ample buffer zones. Shapefiles representing CSA and UA boundaries were obtained from the Census website (www.census.gov).

Method

Since some UAs overlap CSA borders, there is no binary in/out relationship between the two classes. Therefore all UAs whose centroid fell within a given CSA were deemed to be a part of that CSA for this study. Selection based on centroid containment is a standard spatial selection method offered on-the-fly within ArcMap without necessitating the separate calculation of centroid locations.

Once all of a CSA's UAs were selected, a minimum bounding rectangle was drawn around them and buffered outwards an additional 50 km. This rectangle defined the initial study area for that city. The smaller analysis area, as mentioned above, was defined by the convex hull of the selected UAs. These operations were conducted in an unprojected workspace using the native coordinate system of the shapefiles as received from the Census: GCS North American 1983. Figure 22 outlines the study area and analysis area definition process. Figures 23, 24, and 25 depict each subject city's study area and analysis area, and the CSA and UAs that defined them.

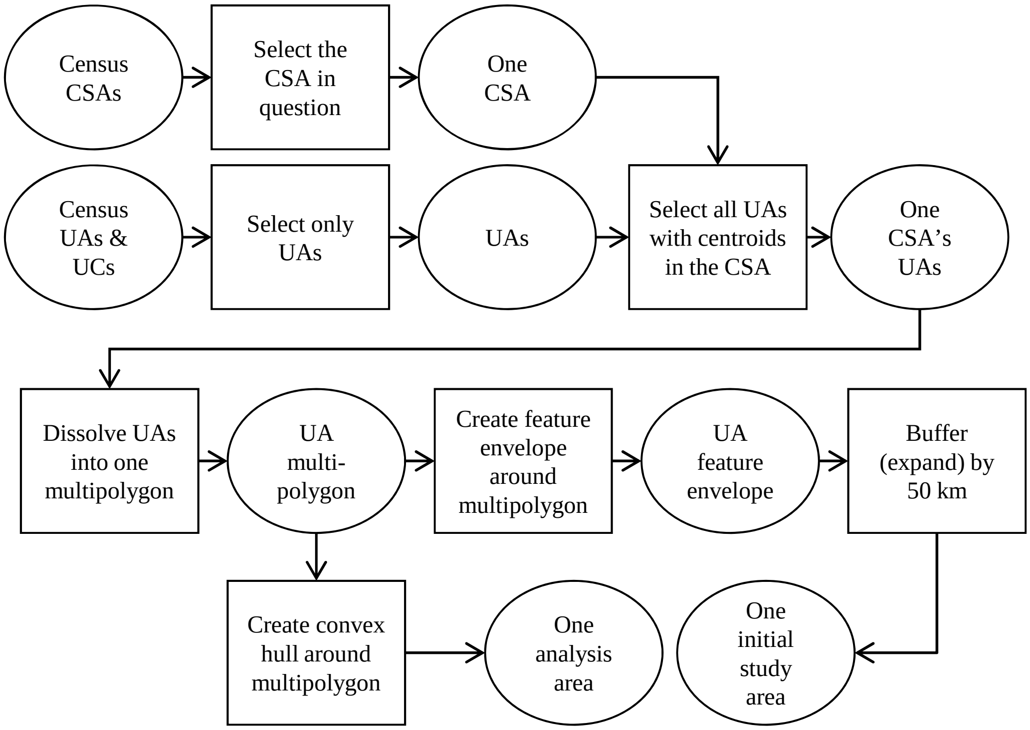

Figure 22: Study area and analysis area creation process.

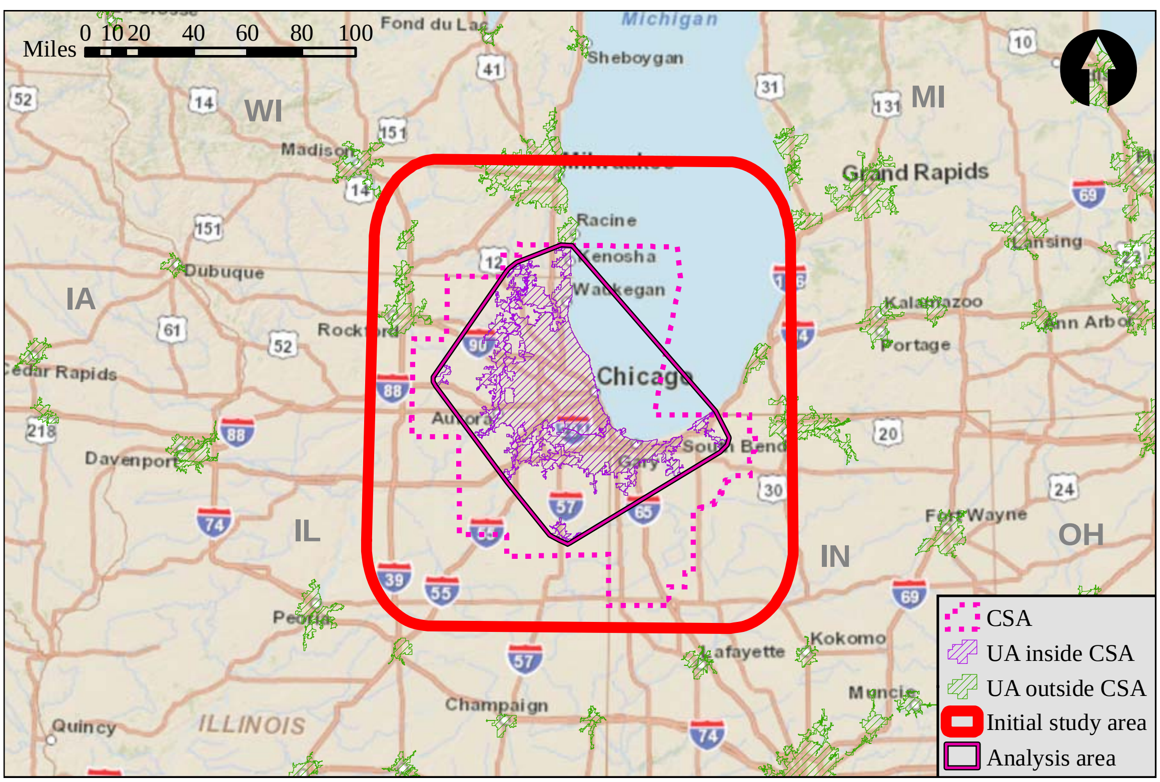

Figure 23: Chicago initial study area and analysis area (UAs & CSA: U.S. Census Bureau; basemap: Esri).

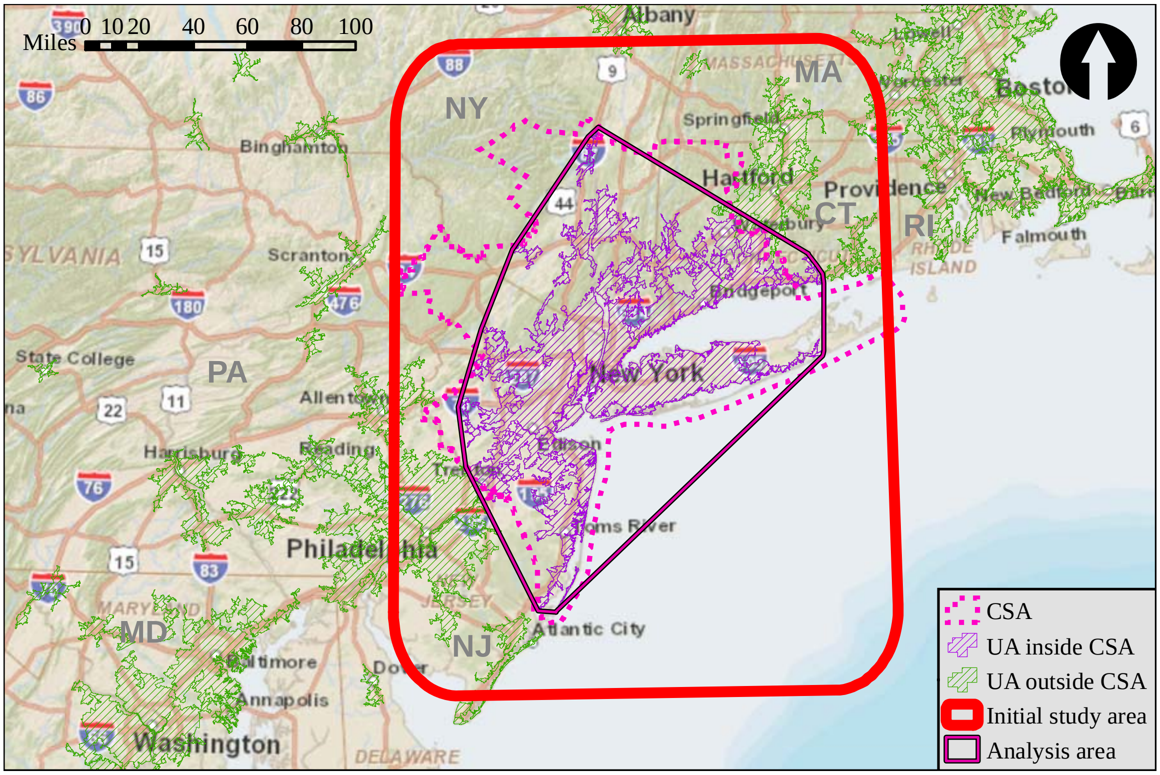

Figure 24: New York initial study area and analysis area (UAs & CSA: U.S. Census Bureau; basemap:Esri).

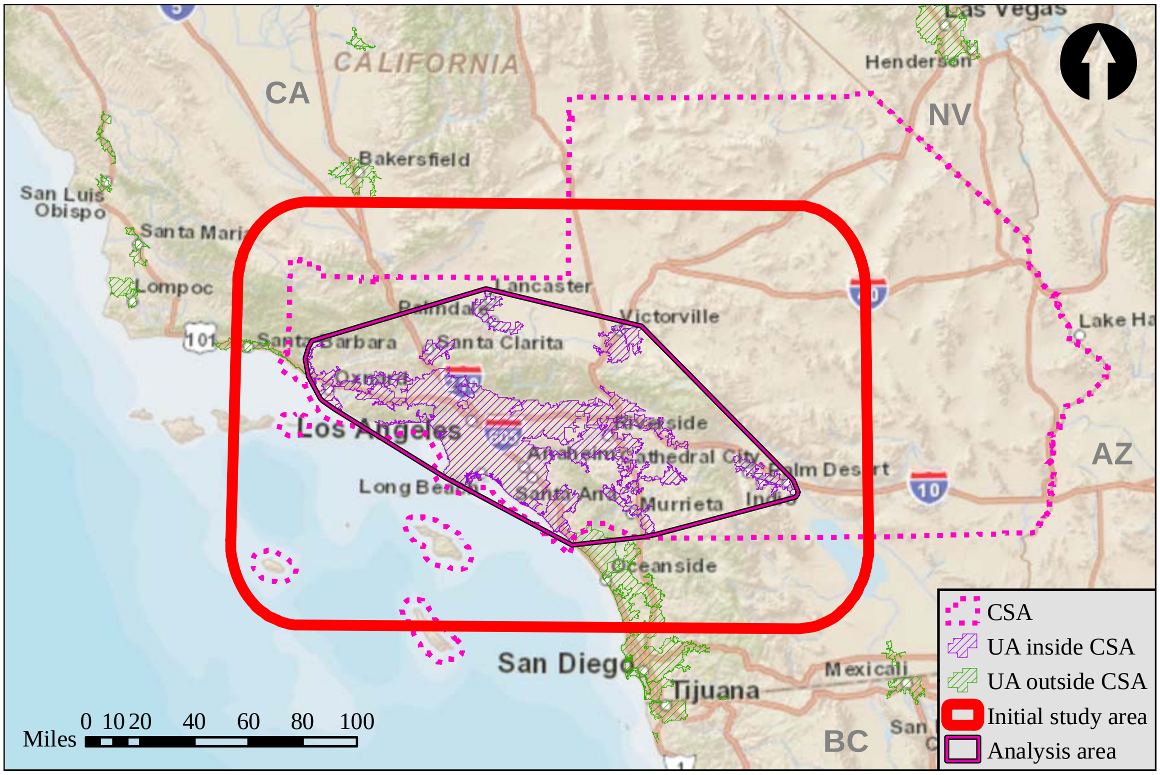

Figure 25: Los Angeles initial study area and analysis area (CSA & United States UAs: U.S. Census Bureau; basemap & Mexican UAs: Esri).

4.2.2 Create analysis arrays

Creation of initial arrays

The analysis cell arrays were created using the initial study areas as spatial limits. In order that the arrays would look “square” in the eventual analysis maps, the projection for this and all subsequent work was changed to the appropriate UTM zone for each city (Zone 11 North for Los Angeles, 16 North for Chicago, 18 North for New York), using the North American Datum of 1983.

A free ArcMap “Create Hexagons” tool was used to create the regular hexagonal analysis arrays. The tool is available from Esri’s ArcGIS Resource Center and runs from ArcMap’s toolbox (http://resources.arcgis.com/gallery/file/Geoprocessing-Model-and-

Script-Tool-Gallery/details?entryID=6043EA4D-1422-2418-3421-D80F2F5C5F92 , 06-22-2010 version). The inputs to this tool are any feature or shapefile which is used to define the extents of the array, plus the desired width (internal diameter) of the cells. In this case, an initial study area polygon was used to define the extents.

The tool runs a script which works by first creating a rectangular grid of points across the input extents using ArcMap's built-in "Fishnet" tool. Then another rectangular grid of points is created at an offset from the first grid so that the resulting set of points forms a hexagonal tessellation. Finally, Thiessen polygons are generated around the points, resulting in a regular hexagonal array. The tool was run once for each cell size over each study area. Then each resulting array was duplicated and manually offset to create a pair of arrays for each cell size as described above.

Selection of analysis arrays

Once a full set of six initial arrays was generated for an initial study area, only those cells overlapping the analysis area were selected. Cells near the edge of an array, though, can behave in unexpected ways during spatial analyses because they have fewer neighbors than most cells in the array and they lack information about the attributes of neighbors that are off the edge. This phenomenon is known as an 'edge effect'.

In order to mitigate against possible edge effects, the selection of cells was expanded to include all immediately adjacent cells. The final selection, then, consisted of cells covering the entire analysis area plus a complete set of neighboring cells. This selection became the analysis array. Six analysis arrays were generated for each subject city. Figure 26 outlines the cell array creation process. Figure 27 depicts one initial array and its selected analysis array for Los Angeles.

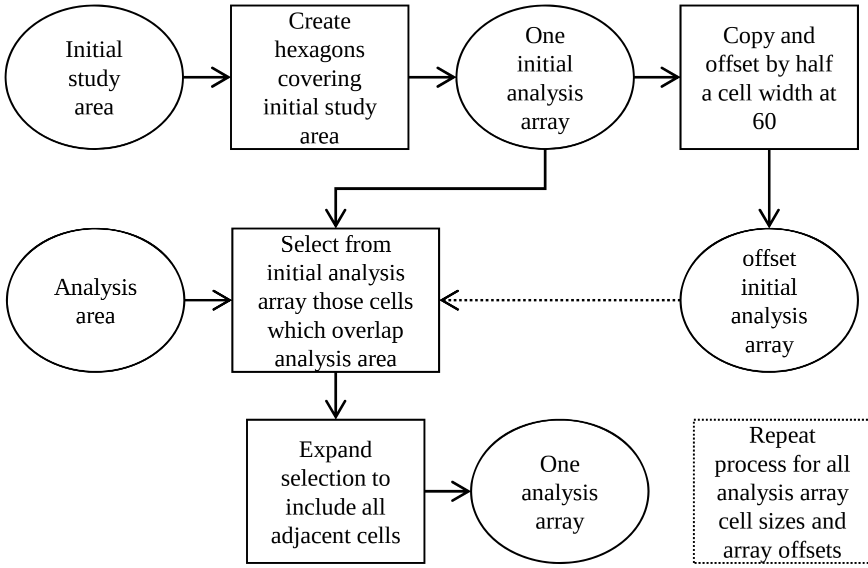

Figure 26: Analysis array creation process.

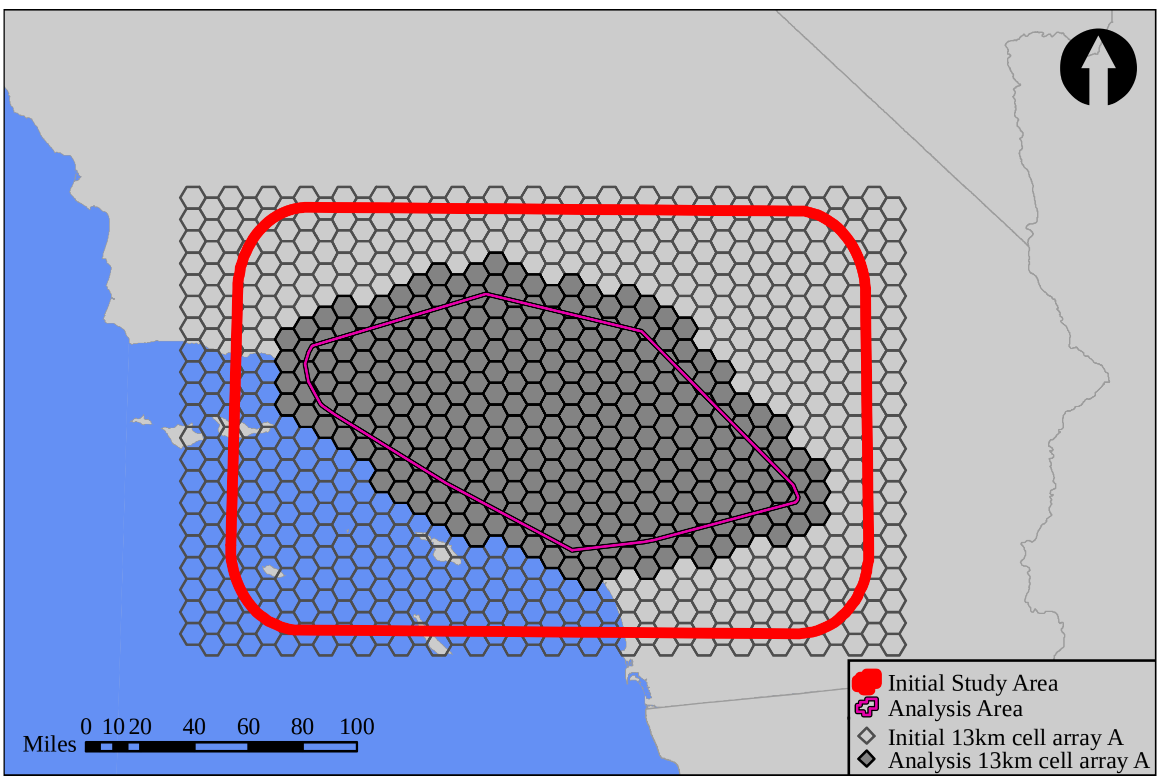

Figure 27: Example cell arrays over Los Angeles (United States state borders: U.S. Dept. of Transportation; Mexican state borders: Esri).

4.2.3 Collect amenity points

As mentioned above, Esri Business Analyst was used to obtain points representing the locations of individual urban amenities. The Business Analyst tool called "Add Business Listings" was used to display points representing the geocoded locations of all the businesses matching a selected NAICS code within an initial study area. Businesses with longer codes nesting inside the selected NAICS code were also displayed.

Once displayed, the points were exported as a feature class for later aggregation. This process was repeated for each of the selected NAICS codes and for each subject city. Figure 28 outlines the amenity point collection process. Figure 29 depicts an example of some collected points, specifically full-service restaurants (NAICS code 722110) in the central Los Angeles area.

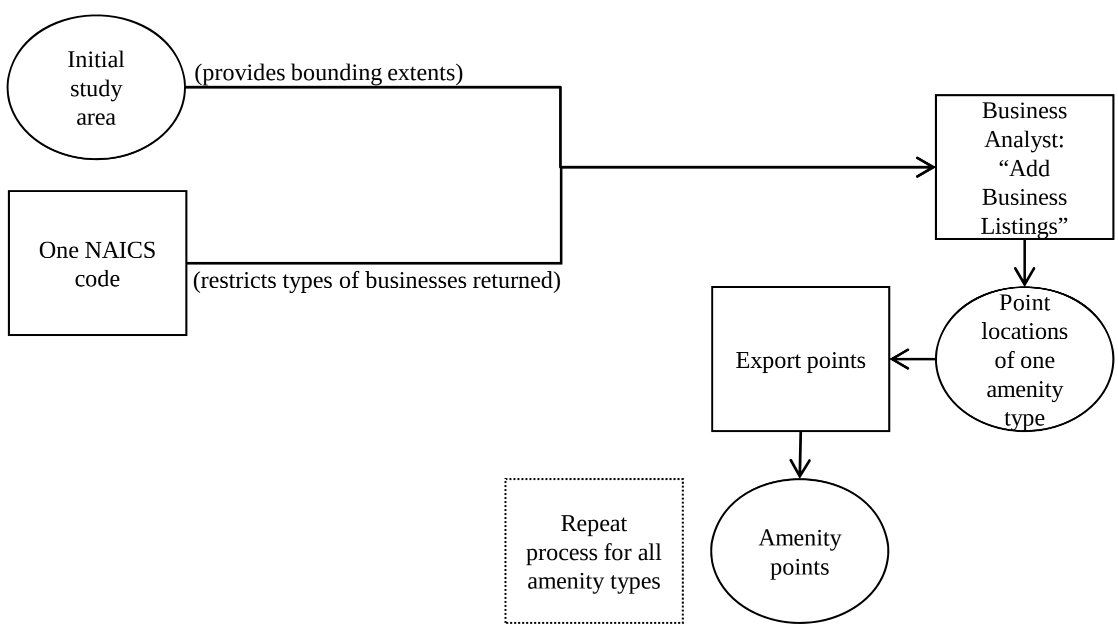

Figure 28: Amenity point collection process.

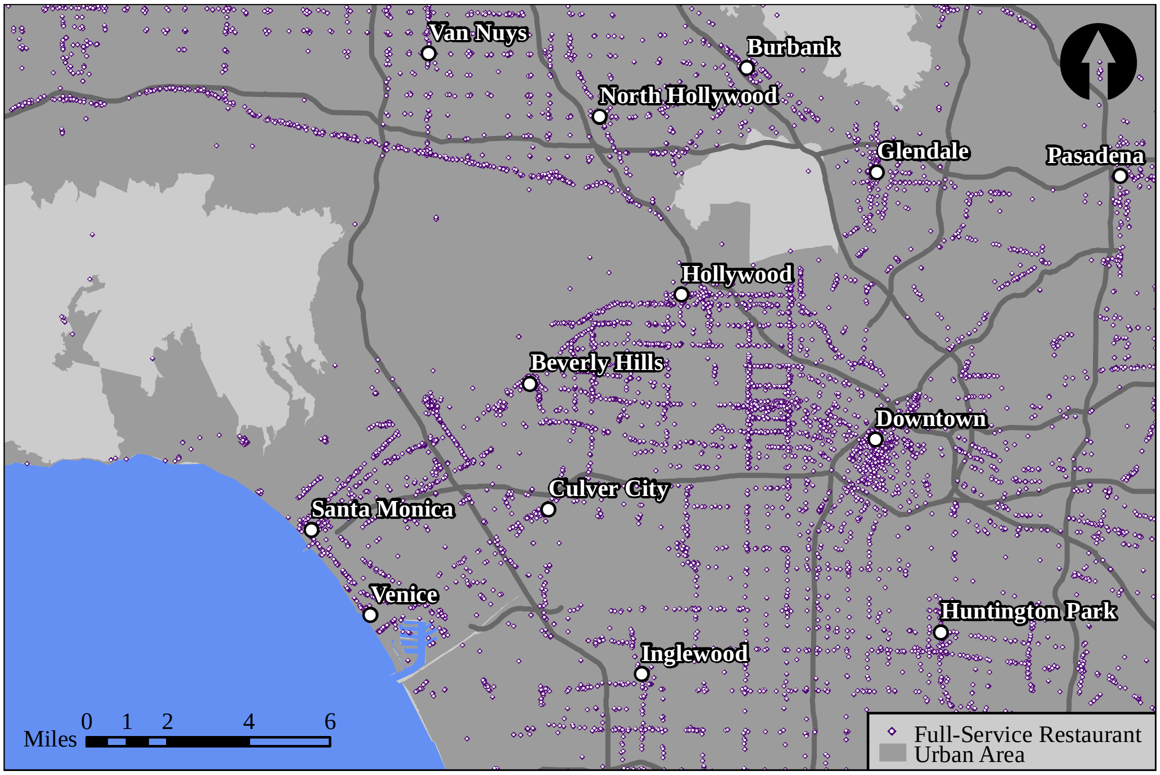

Figure 29: Full-Service restaurants in central Los Angeles (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation; urban area: U.S. Census Bureau).

4.2.4 Aggregate points into cells

The need to aggregate

The need to aggregate amenity point locations into polygons arose because the study sought the areal bounds of clusters rather than measures of clustering at given points or generalized measures of clustering for the whole dataset. The use of LISA (a polygon-based method) rather than a point pattern analysis allowed for the combination of abstract values (cluster scores) in particular spatial regions (analysis cells).

Thus, attribute values - not point locations - were the spatial behavior of interest. In other words, the amenities themselves were not modeled as singular events but as attributes of a space. These needs necessitated the conversion of the original point data into polygons with aggregated counts of input points (Bailey & Gatrell, 1995, p.76 & 248).

Aggregation method

The method of aggregating points into polygons is a straightforward and commonplace geoprocessing tool, which Esri calls a “spatial join”. Once a grid of analysis cells was created, the points representing a given set of amenities were overlaid upon it. Then the number of points falling within each cell was computed and that count was recorded as an attribute value of the cell in an output table. This table was then joined to the analysis array’s table based on the unique cell IDs and the counts of amenities were copied to the analysis array. The process was repeated for each amenity type, resulting in a table of attributes wherein each record represented a single analysis cell and each attribute recorded the count of a particular set of amenities for each cell (see Table 2 above). Figure 30 outlines the aggregation process. Figures 31 through 36 depict the aggregations of restaurants into each of the six analysis arrays in central Los Angeles. These figures also show the cluster core outlines produced by the analysis, which are explained below.

While it is common in many urban analyses to normalize certain count values according to the underlying population distribution, amenity counts in this study were not normalized for population density. This study sought to identify clusters of amenities, not to identify where there were amenities in numbers disproportionate to their surrounding population density. Normalization was also made unnecessary by the uniform analysis cell sizes.

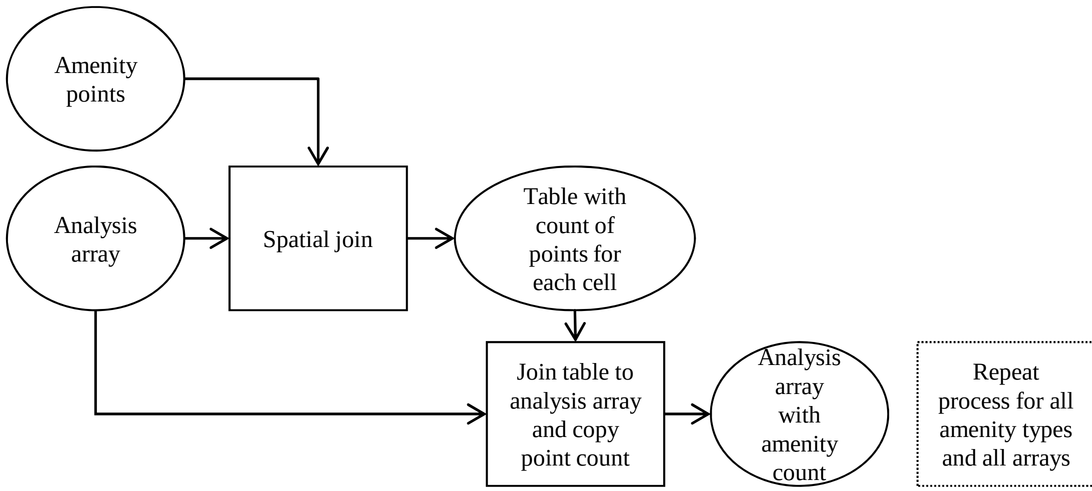

Figure 30: Amenity point aggregation process.

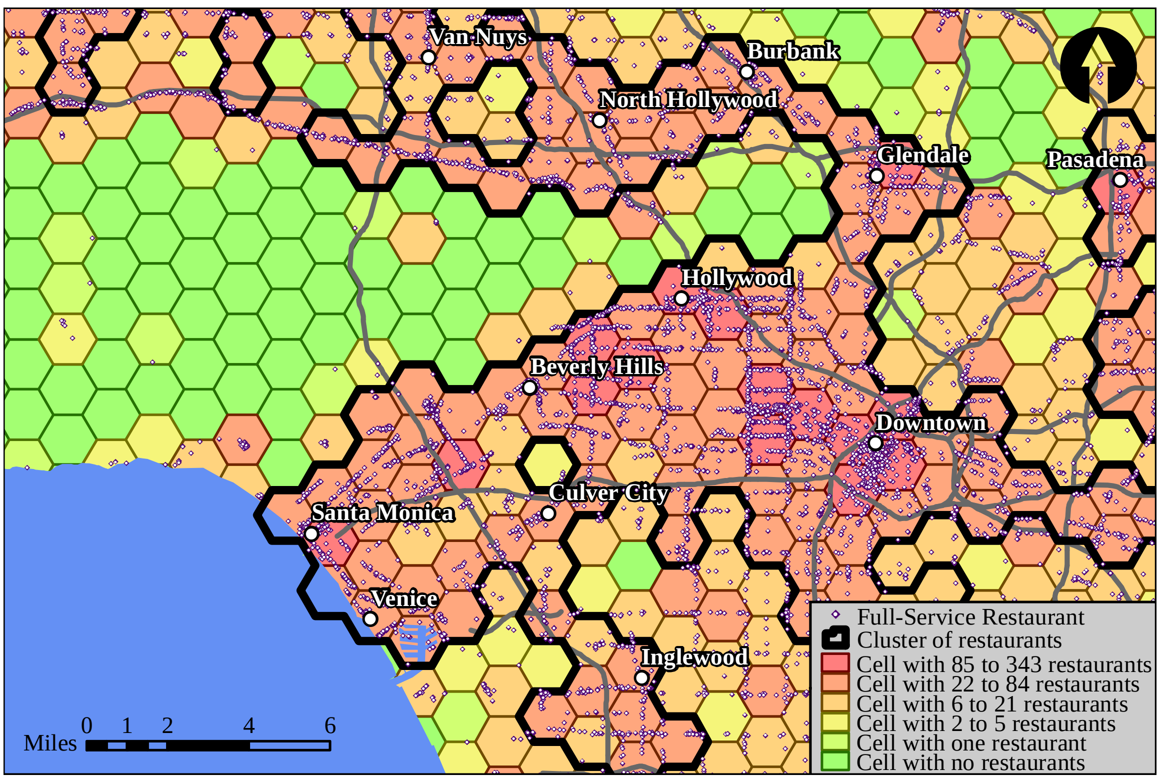

Figure 31: Los Angeles restaurants aggregated into the 2km analysis array A with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

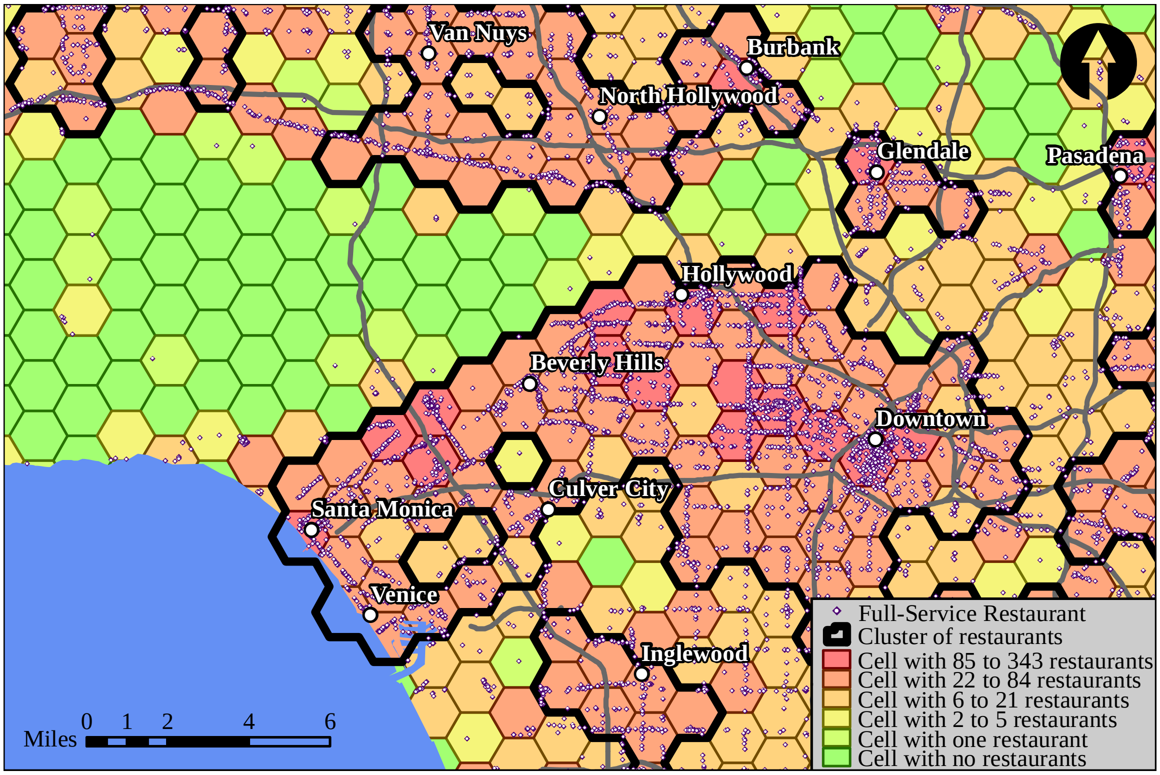

Figure 32: Los Angeles restaurants aggregated into the 2km analysis array B with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

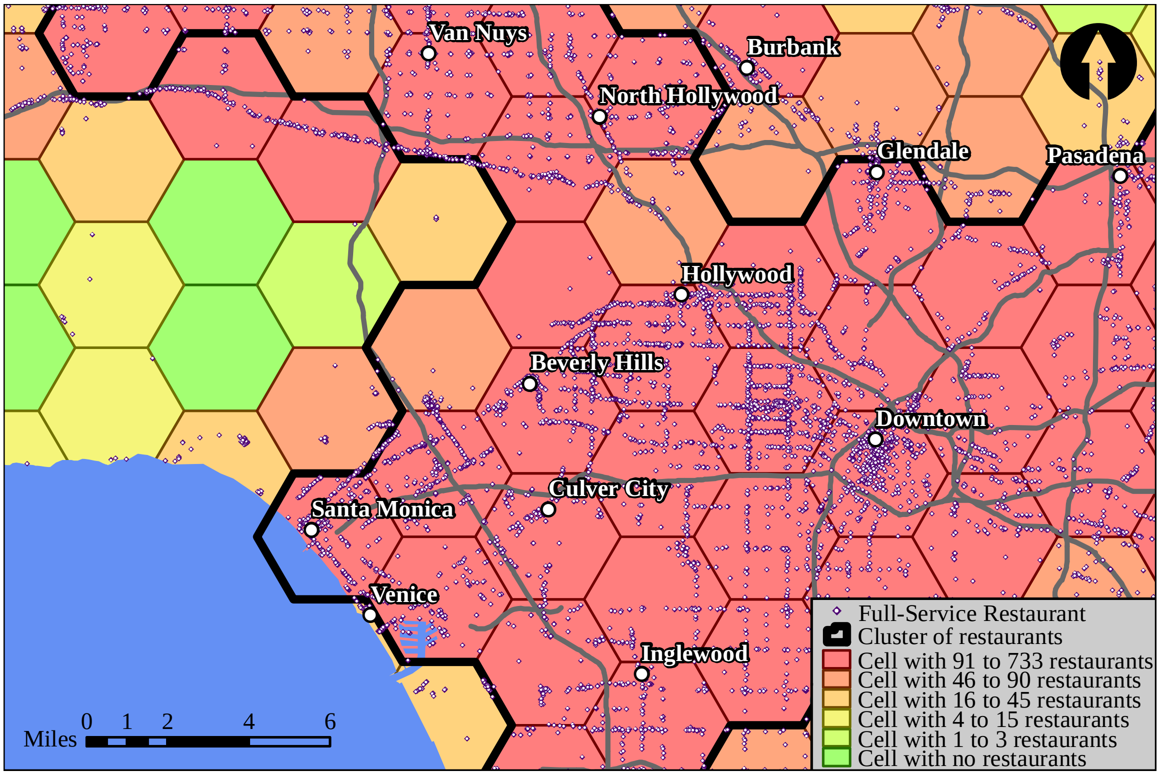

Figure 33: Los Angeles restaurants aggregated into the 5km analysis array A with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

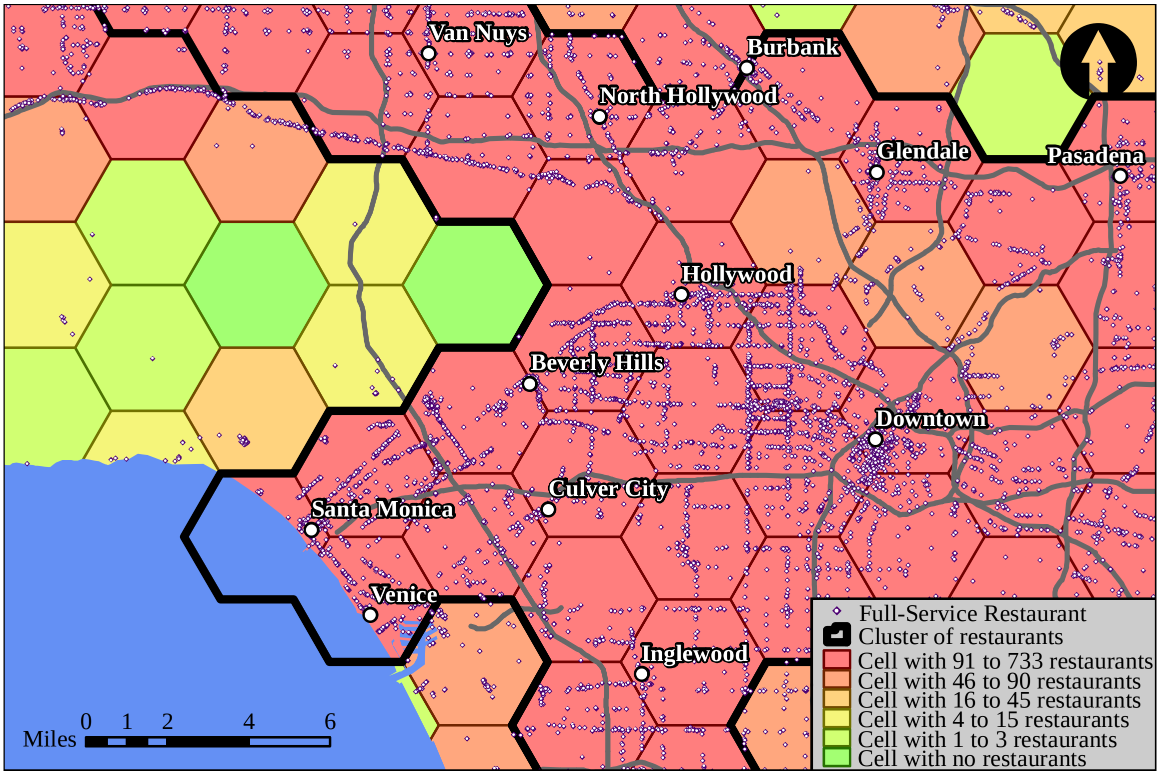

Figure 34: Los Angeles restaurants aggregated into the 5km analysis array B with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

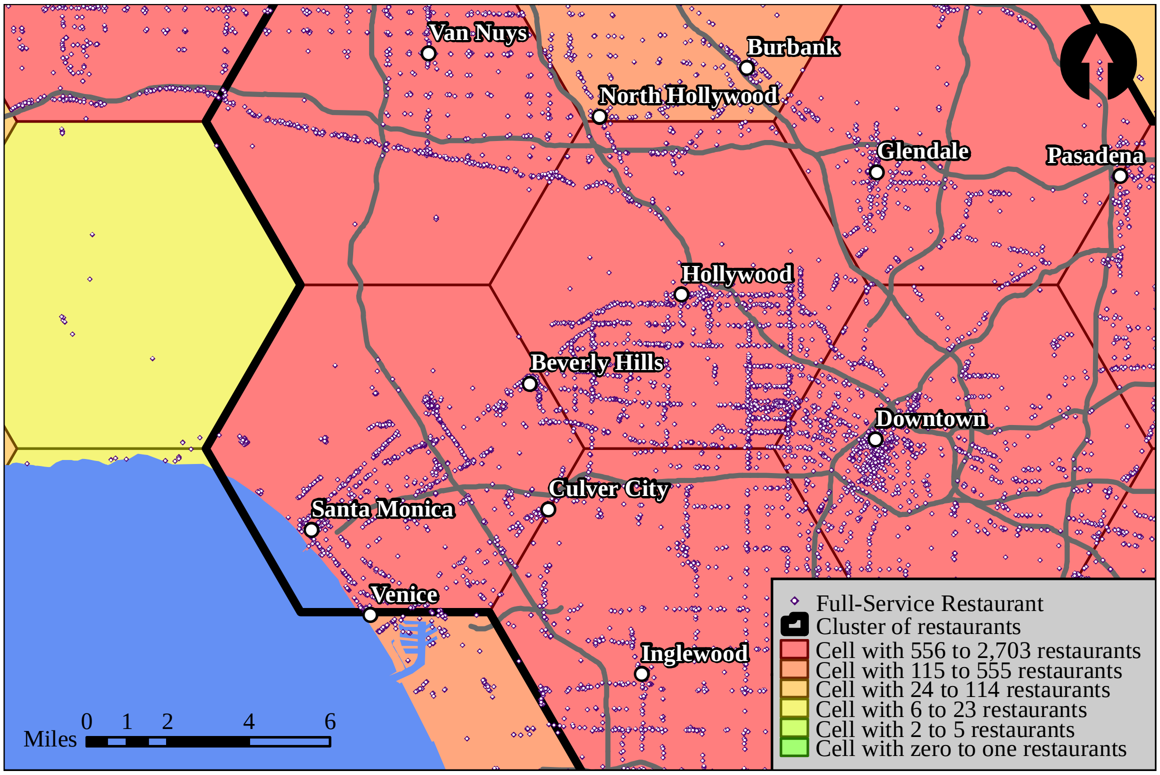

Figure 35: Los Angeles restaurants aggregated into the 13km analysis array A with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

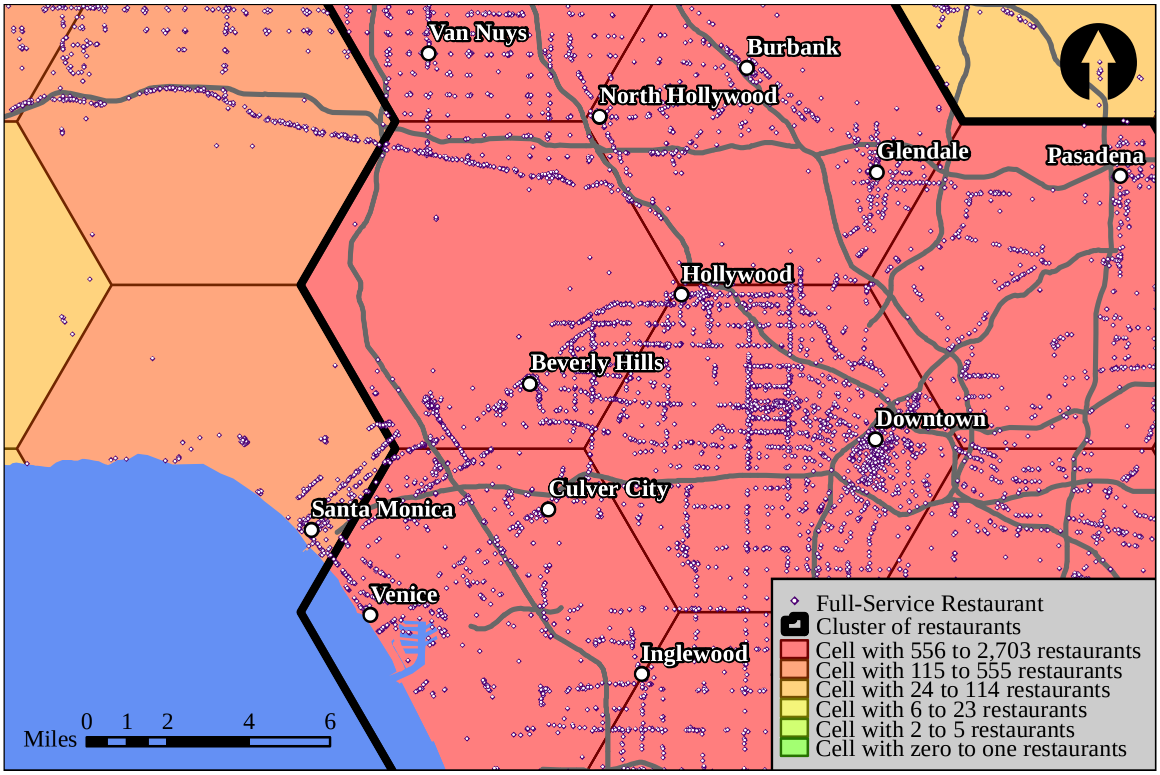

Figure 36: Los Angeles restaurants aggregated into the 13km analysis array B with resulting core cluster delineation; cell counts are classified on a logarithmic scale (restaurants: Esri Business Analyst; freeways & shoreline: U.S. Dept. of Transportation).

4.2.5 Calculate amenity category counts

Once individual amenity points were aggregated into the analysis arrays, amenity category counts were calculated for each cell by summing the appropriate amenity counts for each category in each cell. For example, since amenity category B, “High Culture”, contained three individual amenity types - art dealers, museums, and performing arts companies - the amenity counts for these three amenity types were summed within each analysis cell to produce the amenity count for category B for that cell. Figure 37 outlines the amenity category count calculation process (see also Table 2 above).

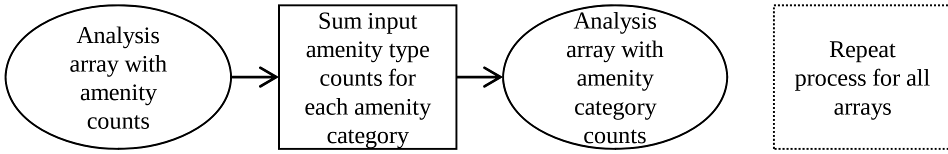

Figure 37: Amenity category count calculation process.

4.2.6 Identify amenity clusters

The ArcMap tool for performing LISA analysis is called “Cluster & Outlier Analysis (Anselin Local Morans I)”. The input for this tool is a polygon shapefile, and parameters include the identification of a particular attribute of that shapefile upon which to perform the analysis as well as a desired contiguity definition. In this case an analysis array was the input, and the attribute to analyze was a particular amenity category count. “Rook” contiguity was selected.

The output of this tool is a new shapefile with the same geometry as the input but with a new attribute table recording cluster type membership and statistical values (such as the *p-value*) for each cell. The cells of this shapefile identified as members of clusters of high values and attributed with *p-values* at or below the significance threshold of $1x10^{-9}$ (see discussion above) were then selected to represent the cores of the amenity clusters. Figure 38 outlines the cluster identification process. Examples of restaurant cluster core outlines are shown in figures 31 through 36 above.

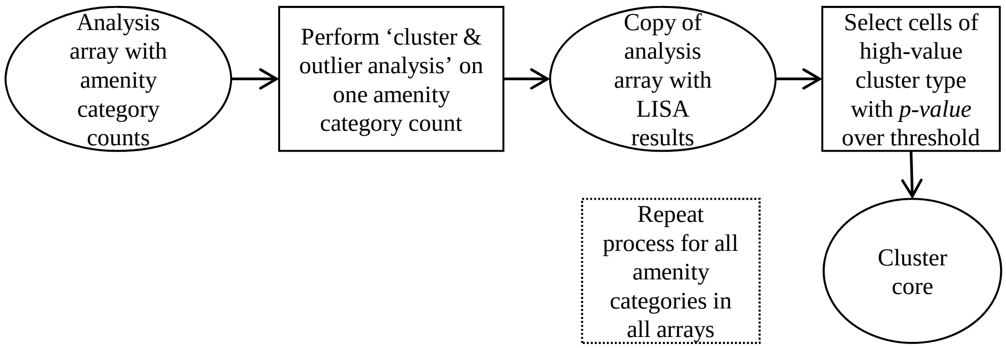

Figure 38: Amenity cluster identification process.

4.2.7 Assign cluster values to cells

All analysis cells began with cluster values of zero for all amenity clusters. The cells representing a particular amenity cluster core were then overlaid on their parent analysis array for cluster value assignment according to two spatial selection methods: 'intersect' and 'contain'. Figure 39 illustrates the difference between 'intersect' and 'contain' selections. In the 'intersect' selection, the polygons around the outside of the source shape are selected because they share edges with the source and therefore intersect it. In the 'contain' selection, though, only polygons inside the source are selected.

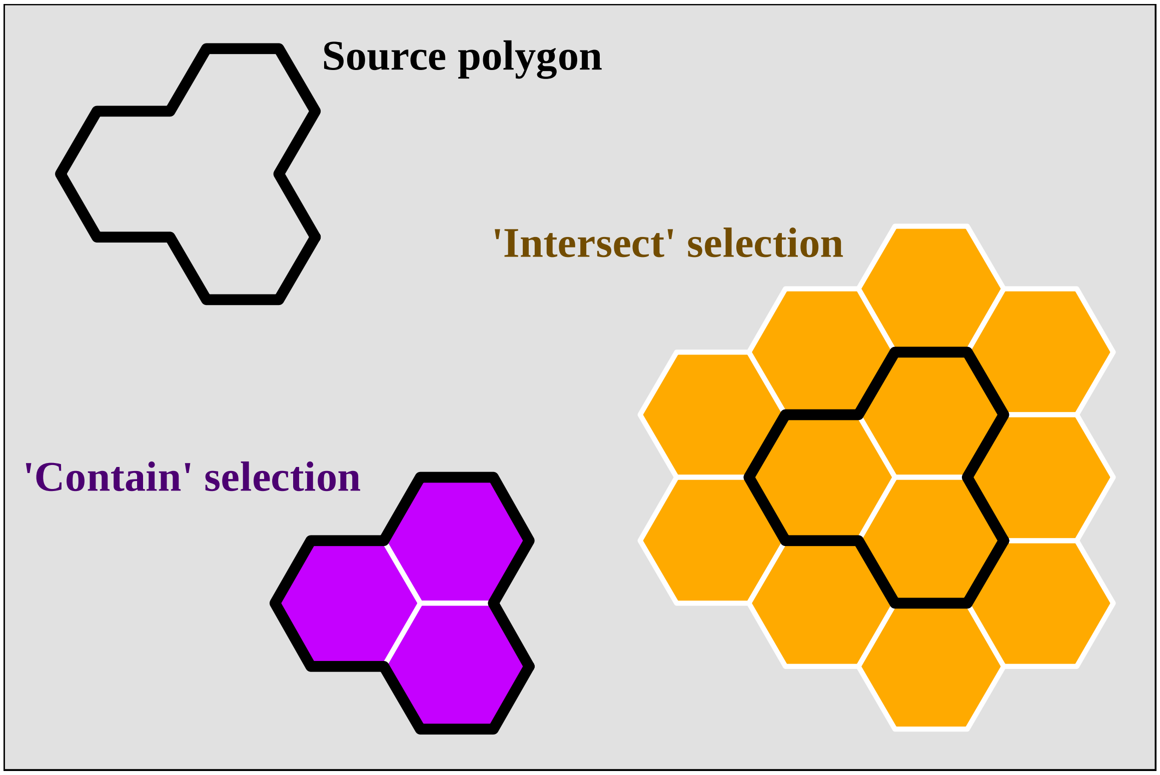

Figure 39: The ‘intersect’ and ‘contain’ spatial selection methods.

For cluster value assignment, a value of 1 was assigned to all intersecting analysis cells. This operation (intersect) included the fringe cells around the core cluster as well as the core cluster itself. Next, a value of 2 was overwritten onto all analysis cells contained by the core cluster (in effect, the cells identical to the core cluster).

Thus the cluster core cells received a cluster value of 2 while the cluster fringe cells received a value of 1. This process was repeated for all amenity categories in all analysis arrays. Figure 40 outlines the cluster value assignment process while Figure 41 depicts an example cluster with core and fringe cluster value assignments.

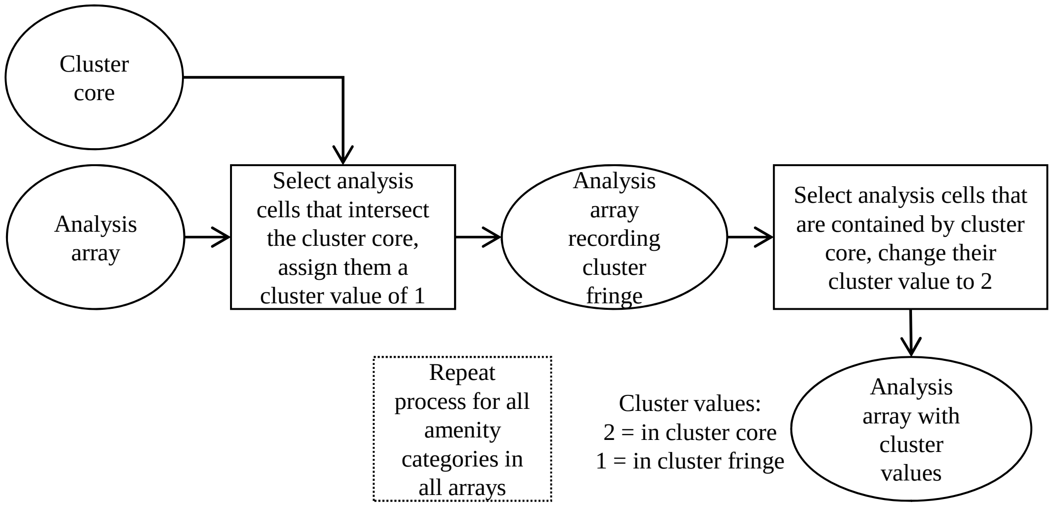

Figure 40: Cluster value assignment process.

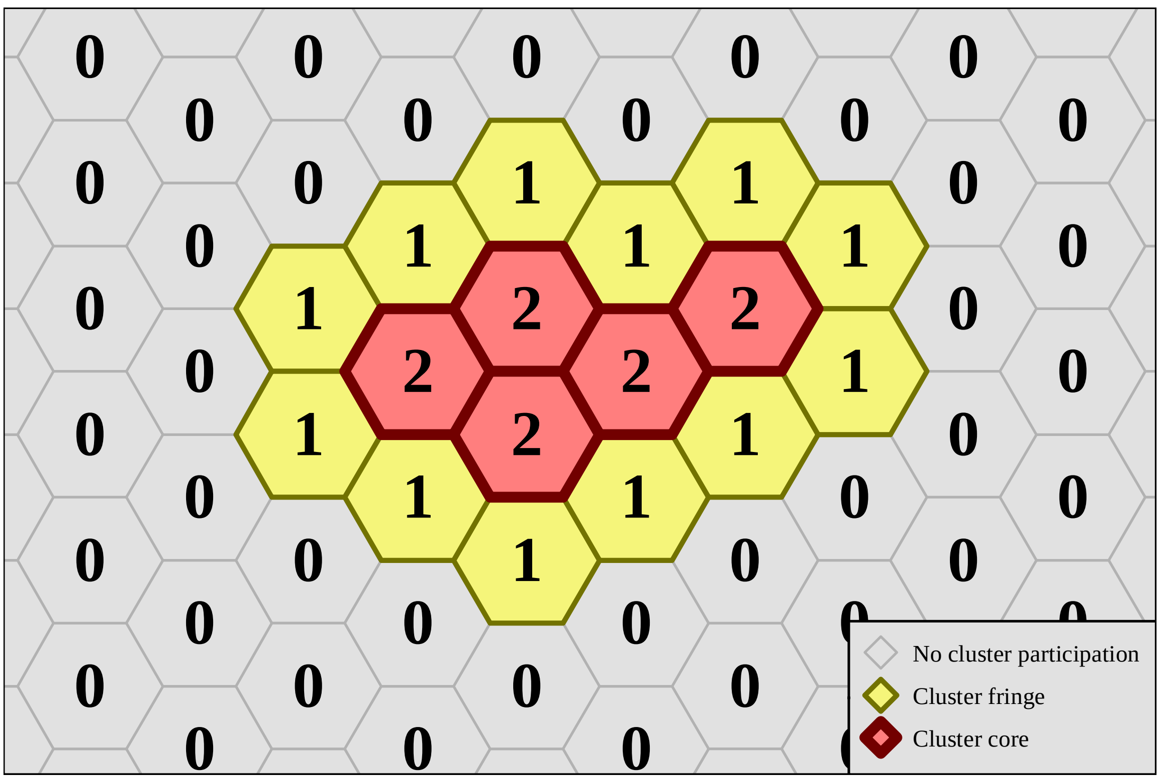

Figure 41: Cluster value core and fringe assignments.

4.2.8 Merge analysis arrays

Once cluster values were assigned for each amenity category in each analysis array, all six arrays were merged using ArcMap's "Union" tool to create the *union array*.

The inputs to the Union tool are multiple polygon shapefiles. The tool overlays the polygon inputs and intersects all of their boundaries. The output is a polygon shapefile with a single feature for every uniquely-bounded area from the intersected inputs. Figure 19 (above) shows six different analysis array inputs, and Figure 20 (also above) shows the resulting union array. Figure 42 outlines the union array creation process.

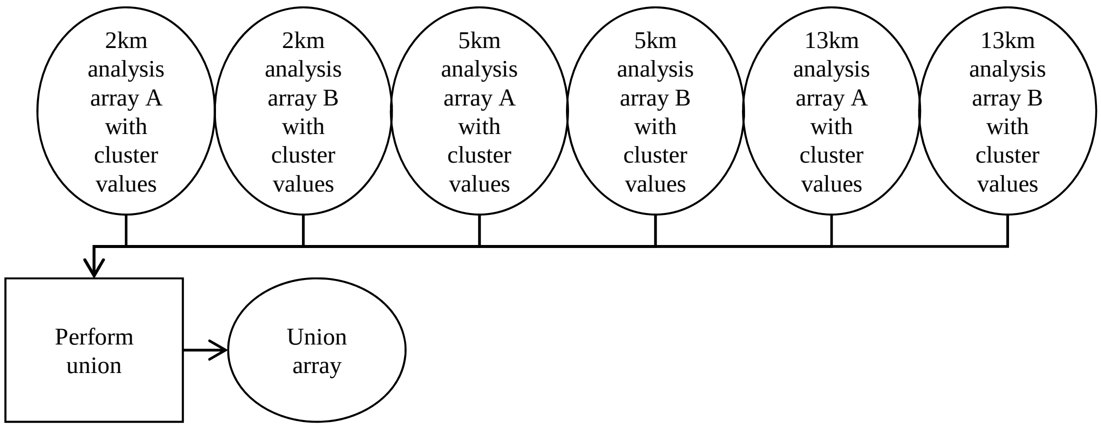

Figure 42: Union array creation process.

All attributes of the input polygons are retained in the new union polygons, meaning that each cell fragment in the union array retained a cluster value for each amenity category from each of the six analysis arrays. In other words, each union array cell fragment knows what the individual attributes were of each of the overlapped input cells which created that fragment. Thus, creation of the union array resulted in no loss of information. The attributes and geometry of the union array could, if desired, be used to reconstruct each of the six input arrays (see Table 3 above).

4.2.9 Calculate cluster scores

The retained cluster values from each analysis array were summed within each cell of the union array for each amenity category and stored as that cell's *cluster score* for that category. Thus, the cluster score records how many clusters of a single amenity category coincided over each unique fragment of the union array, with the input cluster centers weighted at twice the value of their cluster fringes. Since there were six input analysis arrays with cluster values ranging from zero to 2, the cluster score for each amenity category ranged from zero to 12. Figure 43 outlines the cluster score calculation process (see also Table 3 above). As an example, Figure 44 depicts the restaurant category cluster scores for the union array in the central Los Angeles area.

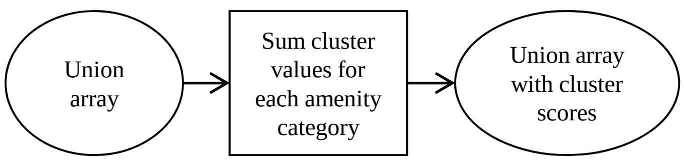

Figure 43: Cluster score calculation process.

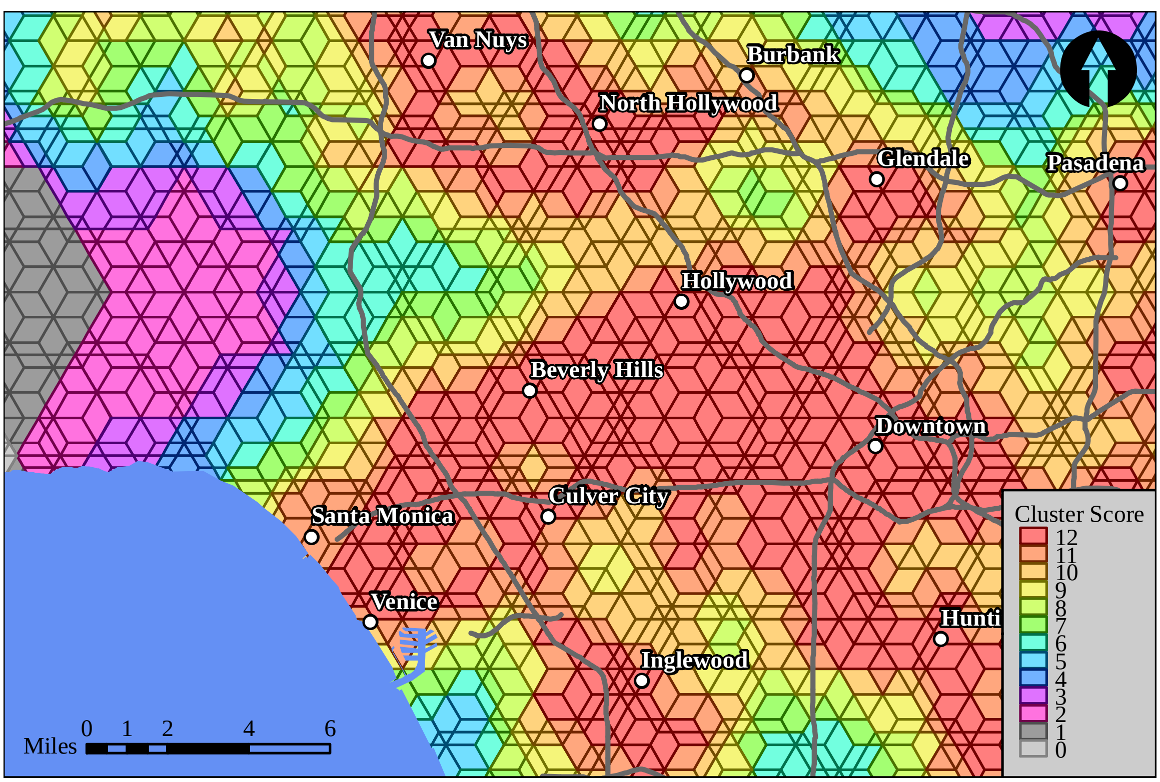

Figure 44: Restaurant cluster scores in central Los Angeles (freeways & shoreline: U.S. Dept. of Transportation).

4.2.10 Calculate centrality scores

As a final step, each of the amenity category cluster scores was summed for each cell of the union array, resulting in a *centrality score*. Figure 45 outlines the centrality score calculation process (see also Table 3 above).

Figure 45: Centrality score calculation process.

While the cluster score recorded the number of coincident clusters of a single amenity category, the centrality score records the number of coincident clusters of all amenity categories. Since each of the five amenity category cluster scores had values ranging from zero to 12, the centrality score ranged from zero to 60.

A centrality score of 60 for a particular cell therefore indicates that that area participated in the core of every amenity category cluster under every analysis array. A centrality score of zero indicates participation in no clusters at all. A centrality score of 30 could indicate participation in cluster fringes under all 30 combinations of analysis arrays and amenity categories, or it could more likely indicate participation in some core clusters and some fringe clusters under some analyses, and no cluster participation under other analyses.

Since spatially-coincident clusters of differing types of amenities are seen as constituting urban centrality under this study, the centrality score is therefore a direct indicator of the degree to which each cell participates in the urban center; it is a direct measure of centrality as centrality is defined for this study. Thus, regions of high centrality scores are, by definition, urban centers.

Aside from simply summing the various cluster scores, a few different formulae were experimented with involving different weights for the different amenity categories. None of these weighted formulae yielded spatial results different enough to note, at least in initial trials. The centrality score was therefore kept as a straightforward sum for the sake of simplicity and defensibility. Weighting different individual amenities during the category count process (such as weighting museums more heavily than art dealers when calculating the High Culture count) was also considered and rejected for its minimal impact on the final results.

4.2.11 Cartographically visualize centrality scores

Since the goal of the study was a delimitation of urban centers, a cartographic visualization of the spatial patterns of the centrality score was the final part of the analysis. Several approaches to visualization were attempted, the most useful of which seems to be a choropleth classification of cells according to their centrality score as represented by a percentage of the highest possible score. The class thresholds, selected to balance simplicity with visual effectiveness, were 10, 25, 50, 75, 90, and 100 percent.

The highest possible centrality score under the union analysis is 60: there are 5 amenity categories, cluster values from zero to 2 for each category, two analysis arrays at each cell size, and three cell sizes. The 10% to 25% class thus represents centrality scores greater than or equal to 6 and less than 15, for example. Some of the maps, though, depict centrality scores calculated for only one analysis cell size (as opposed to the union array), with total possible scores of 20. The scores represented by the percentage classes in these maps are changed accordingly.

For cartographic purposes, all the cells belonging to a single class were dissolved together into a single polygon. This operation allowed the spatial extent of each class to be symbolized as a single polygon with a single external boundary line rather than as a collection of adjacent cells each with their own individual boundaries. Since the centrality scores tend to vary in incremental steps across neighboring space, rather than exhibiting sharp changes in value, this visualization technique produced results that look similar to contours.

Figure 46 depicts the cartographic visualization process. The resulting maps are presented in the discussion section below.

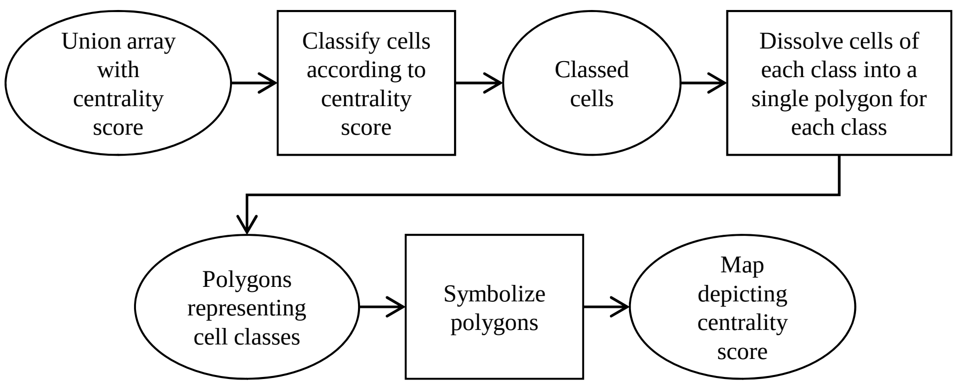

Figure 46: Cartographic visualization process.

CHAPTER 5: DISCUSSION

5.1 Results

The cartographically visualized analysis results are presented in figures 47 through 53. A pair of maps is provided for each city, one map showing the entire analysis area and another map showing detail in the central area. The pair of map scales is the same for each city to facilitate comparison. Chicago is depicted in figures 47 and 48; New York is depicted in figures 49 and 50; Los Angeles is depicted in figures 51 and 52. An additional map, Figure 53, is presented for Los Angeles, showing a wider central area at a detailed scale.

The overall impression revealed by the centrality scores is one of strong centers in all three cities. In each city only one relatively compact area achieves the highest score, and scores in other areas generally decay with distance from this primary center. Patterns in the score do hint at the existence of peripheral centers, though, especially in Los Angeles.

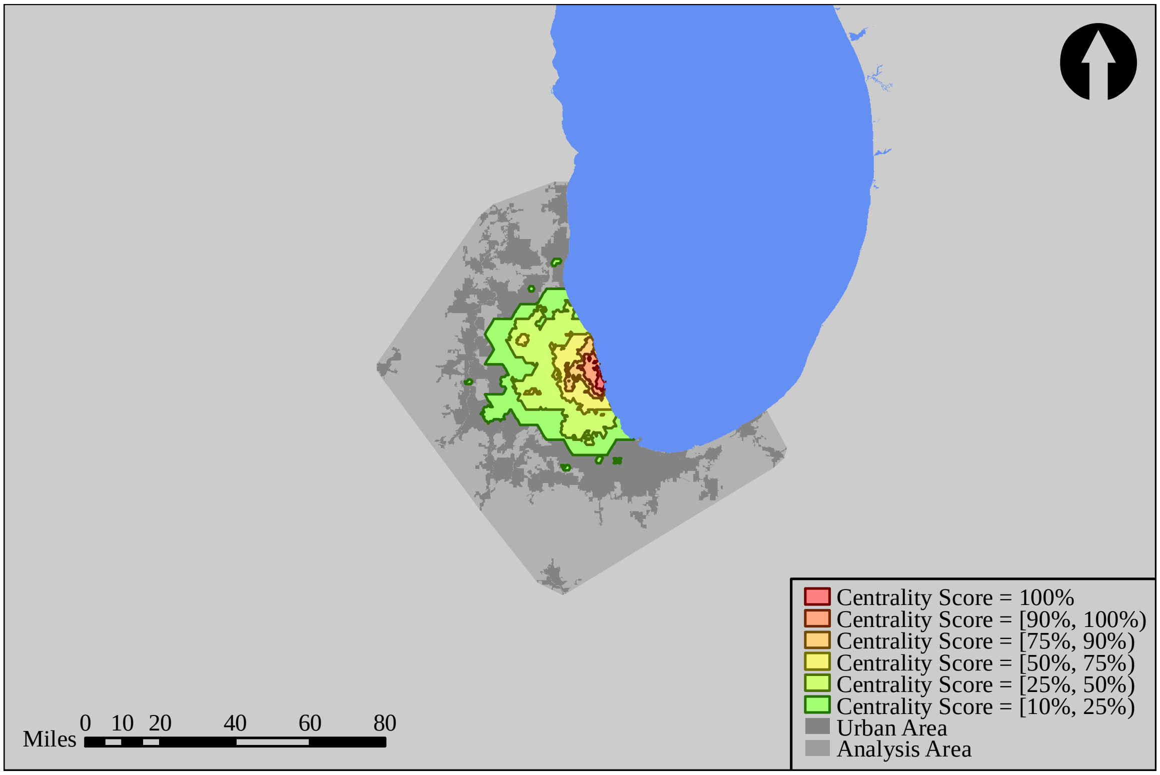

Figure 47: Chicago centrality score under the union analysis array across the entire analysis extent (urban area: U.S. Census; shoreline: U.S. Dept. of Transportation).

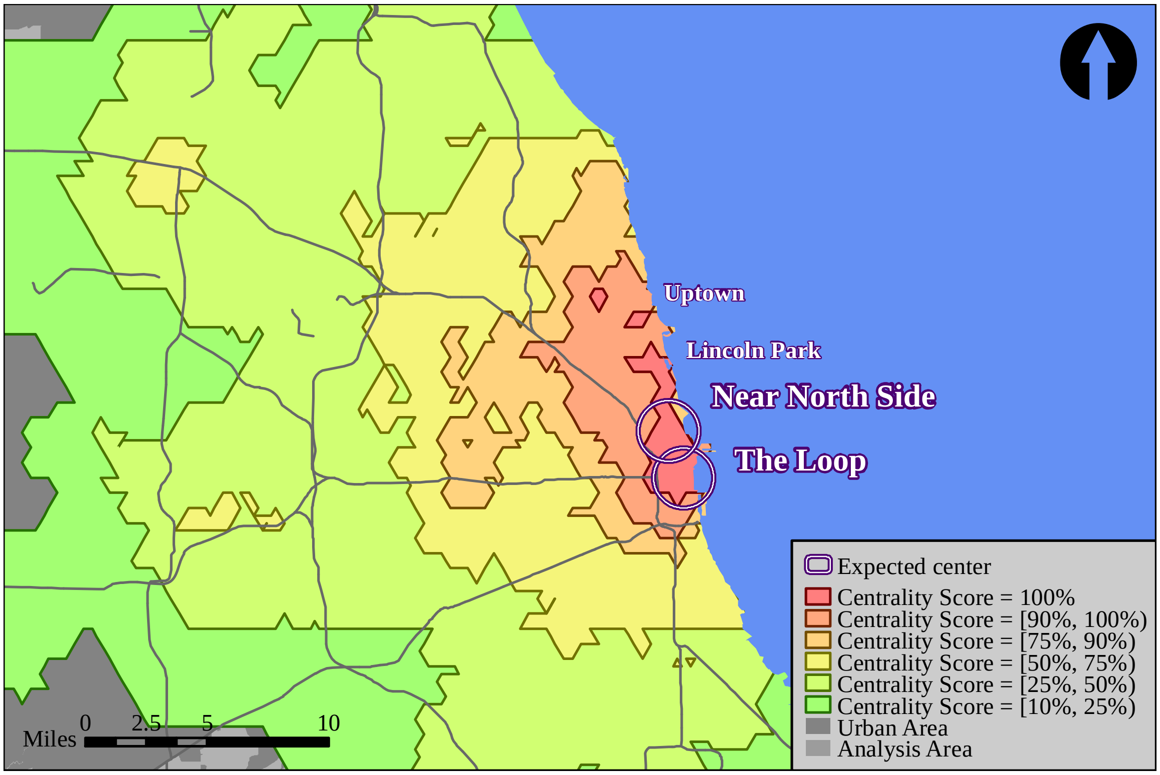

Figure 48: Chicago centrality score under the union analysis array in the central area (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

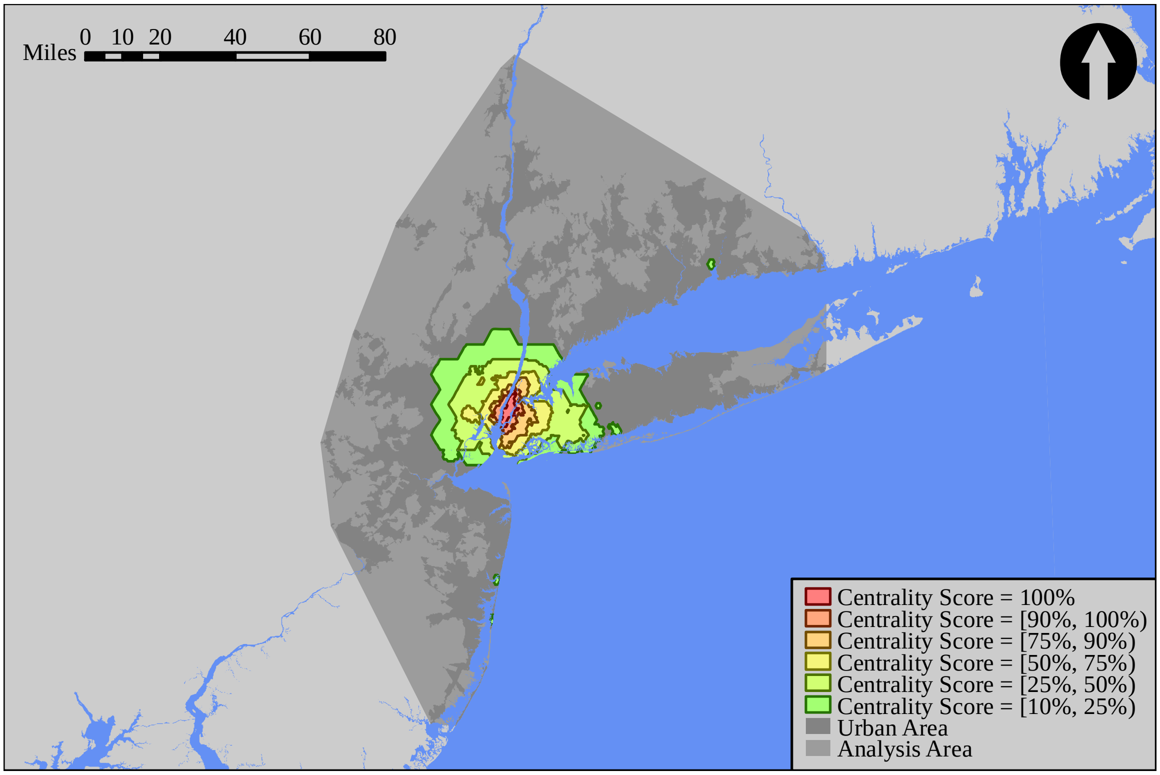

Figure 49: New York centrality score under the union analysis array across the entire analysis extent (urban area: U.S. Census; shoreline: U.S. Dept. of Transportation).

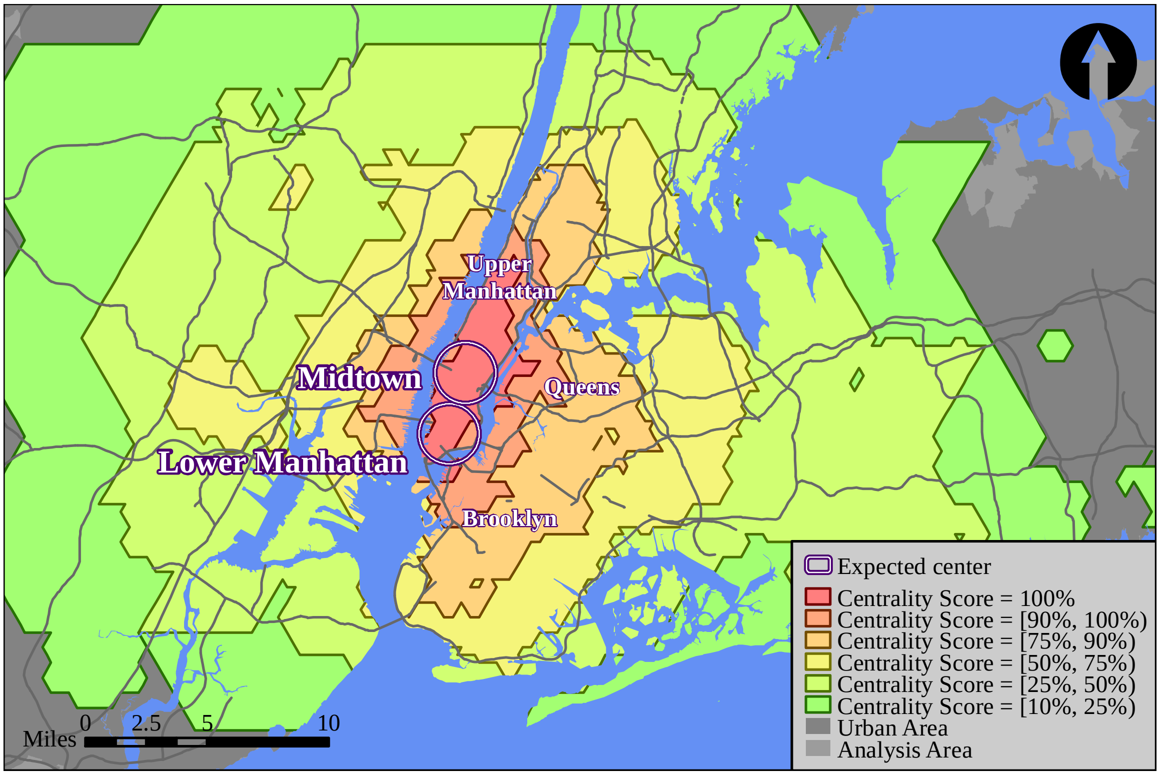

Figure 50: New York centrality score under the union analysis array in the central area (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

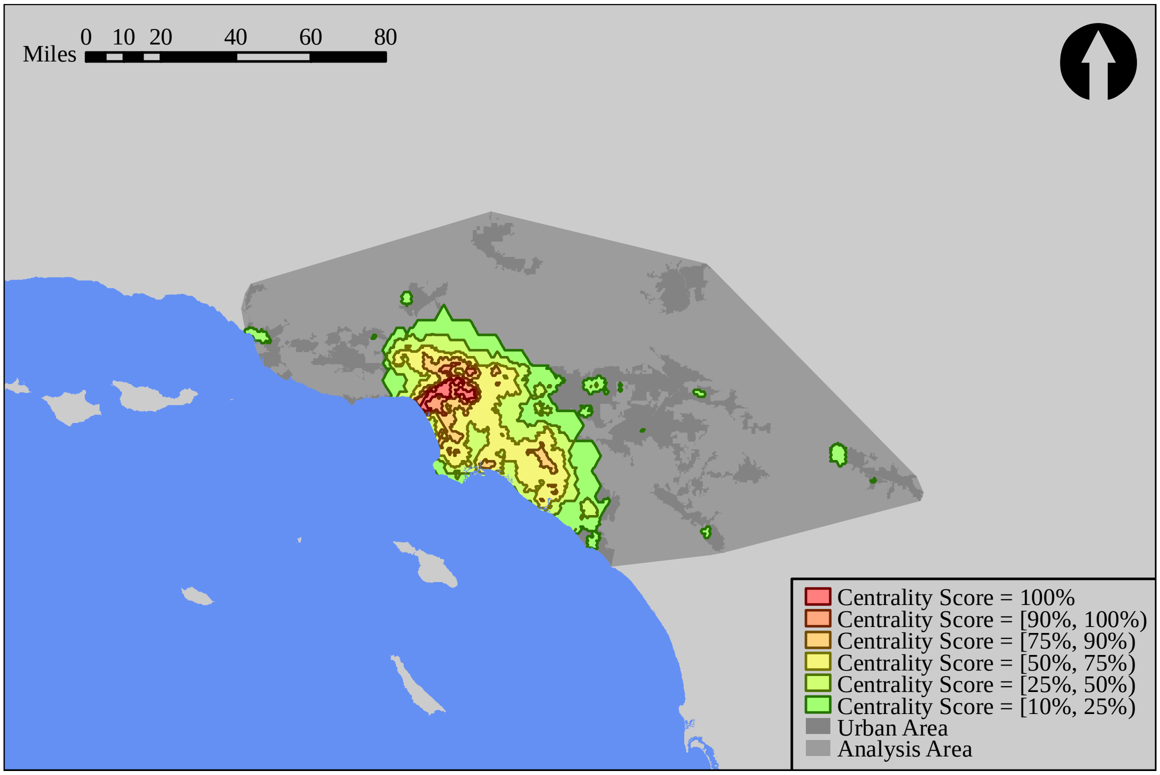

Figure 51: Los Angeles centrality score under the union analysis array across the entire analysis extent (urban area: U.S. Census; shoreline: U.S. Dept. of Transportation).

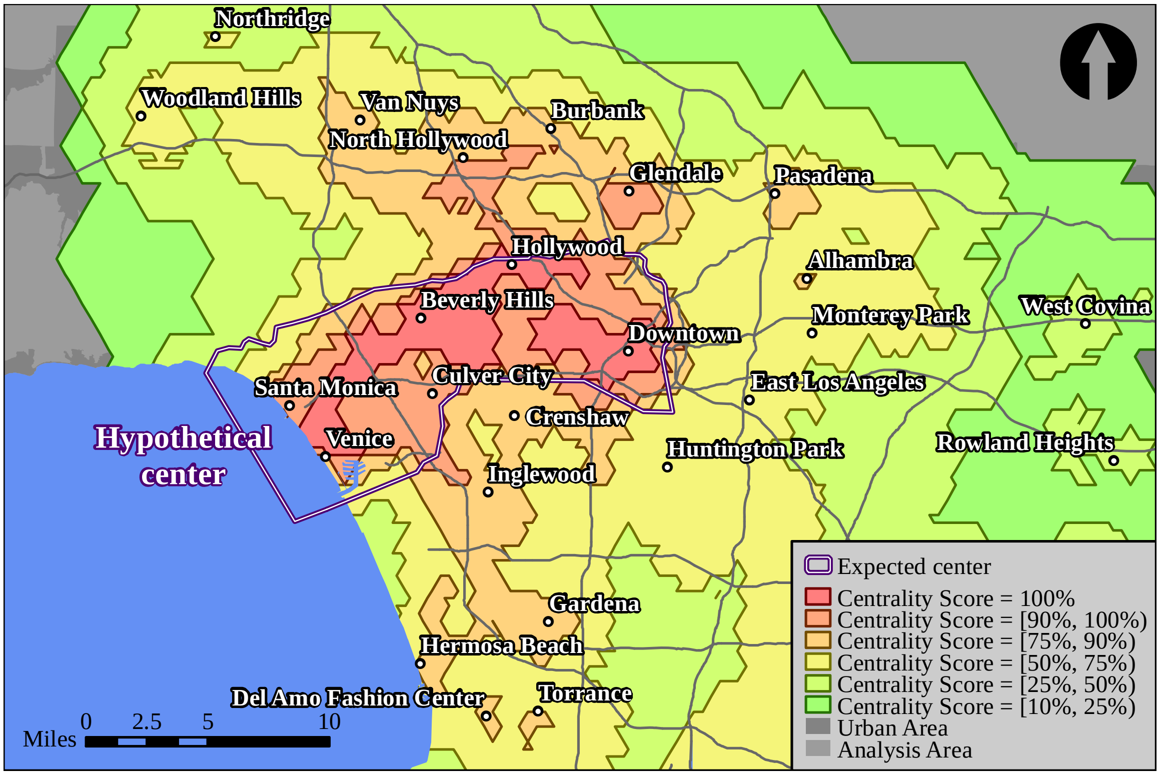

Figure 52: Los Angeles centrality score under the union analysis array in the central area (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

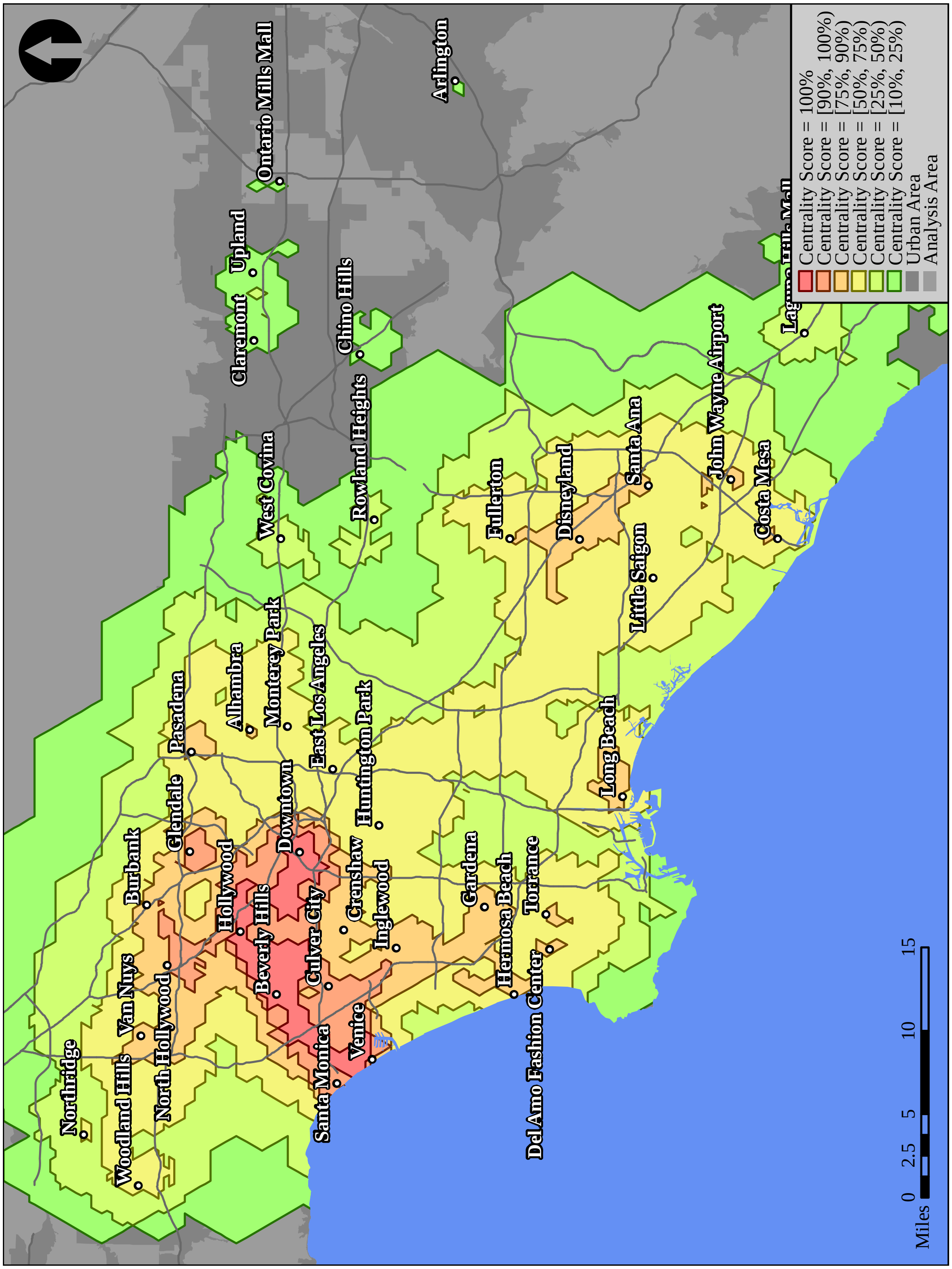

Figure 53: Los Angeles centrality score under the union analysis array in the main region of high scores (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

5.2 Questions of precision

5.2.1 MAUP artifacts persist

Upon closer inspection, the centrality score classes reveal a lack of precision at narrower scales. For example, the 100% class for Los Angeles appears to exhibit an error in the area between Santa Monica and Venice (Figure 52 above). First-hand knowledge of the area, or an examination of restaurant locations (Figure 29 above), suggests that the 100% centrality class should extend more or less directly from Beverly Hills to Santa Monica before turning south to Venice. Instead, it deviates away from Santa Monica, traversing a less amenity-rich area (Mar Vista) on its way to Venice.

An examination of the input clusters suggests a reason for this discrepancy. It appears from Figure 36 (above) that one of the 13km analysis arrays placed downtown Santa Monica in the edge of a cell cut off from the other central areas (see MAUP discussion above). Since this cell contained mostly ocean (to the southwest) and mountains (to the northwest) it scored considerably lower than its neighbors to the east. Additionally, its neighbors in other directions also covered mostly sea or mountains. Consequently, this cell was not included in the core of the restaurant amenity category cluster, even though downtown Santa Monica did participate in the core restaurant cluster under the other 13km analysis array (Figure 35 above). Even though this is only one of six sets of cells, being left out under this one array was enough to keep Santa Monica out of the final 100% class. The deviation of the class boundary here matches the boundary of the cell in question.

Some MAUP artifacts, then, persist in the union array. This persistence should not invalidate the endeavor, though, because MAUP artifacts do seem to have been reduced by the union array. Continuing with the example of downtown Santa Monica, the MAUP artifact in the overall centrality score there is only discernible in the 100% score class, which is a highly restrictive threshold to reach. Because the smaller cell sizes all placed downtown Santa Monica in their restaurant cluster cores (figures 31 through 34 above), the place still scores very highly in the union array. If the analysis had been conducted using only the 13km array B alone (Figure 36 above), this particular MAUP artifact would have been much more significant to the final result. The combination of different arrays, then, was useful in reducing the effects of MAUP even though those effects were not completely eliminated.

5.2.2 Smaller cells yield greater detail

The 2km cell array alone appears to be better at delineating the bounds of the central area in greater detail, since it is not influenced by artifacts of the larger cell sizes. Since the 2km clusters work only on the detailed local level, they are better at delineating the true extent of the cluster at that scale. Under the 2km analysis alone, Santa Monica is included in the 100% class, and the rest of the class seems to have a slightly more realistic delineation as well (Figure 54). Peripheral centers are delineated with greater detail and definition as well under this analysis scale.

However, the increased detail under the 2km array comes at a cost. Figure 54 shows new 100% peaks in Burbank and Glendale, as well as higher centrality scores in other peripheral areas such as Woodland Hills and Hermosa Beach, compared to the union analysis in Figure 53. The 2km analysis, then, yields better definition in peripheral centers at the expense of clarity about their relative importance to the overall region.

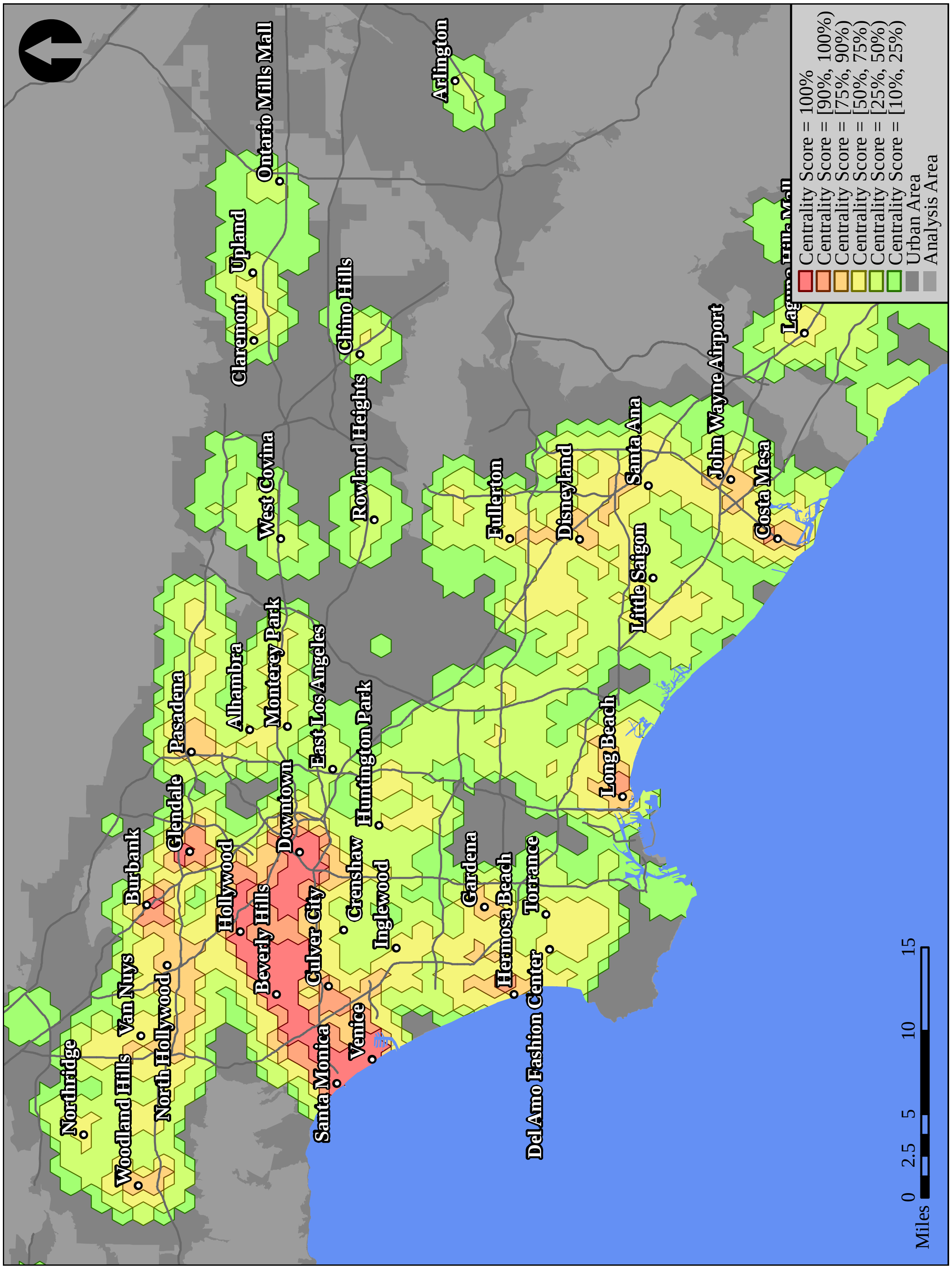

Figure 54: Los Angeles centrality score under the 2km analysis cells in the main region of high scores (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

5.2.3 Larger cells indicate regional significance

The discrepancy in the specific delineations under different analysis scales indicates a lack of precision in the union analysis array, but it does not invalidate the overall results. To the contrary, the union array excels at identifying the strong regional center. The large cell arrays operate at a wide scale, identifying the broad regional center, while the smaller cells identify local centers in more detail. Thus, all scales are useful because the larger cell clusters indicate which smaller cell clusters are central to the region rather than only to their immediate environment. Under the union array, the multiple input scales make the delineated central area robust and strong: the centrality score decays quickly with distance from the center.

The union array was meant to mitigate against the MAUP artifacts arising from different aggregation schemes, but it still shows some signs of MAUP distortion. This indicates that while the union array is good at portraying the overall picture, its specific boundary lines cannot be taken as being very precise: certainly no more precise than the width of the smallest input cell, 2 km. To achieve both the advantages of strong definition and clarity on regional importance, the outputs of each analysis scale could perhaps be considered separately, while understanding that the central areas identified by the more detailed analyses which fall within the central areas identified by the broader analyses are more regionally significant.

To this end, Figure 55 presents the 100% centrality score areas separately resulting from each of the three analysis scales for Los Angeles. While Glendale and Burbank reach a 100% score under the 2km analysis, this visualization reveals that they are slightly less significant to the overall region than the primary center (from Santa Monica to Downtown) because they do not score 100% under all analysis scales.

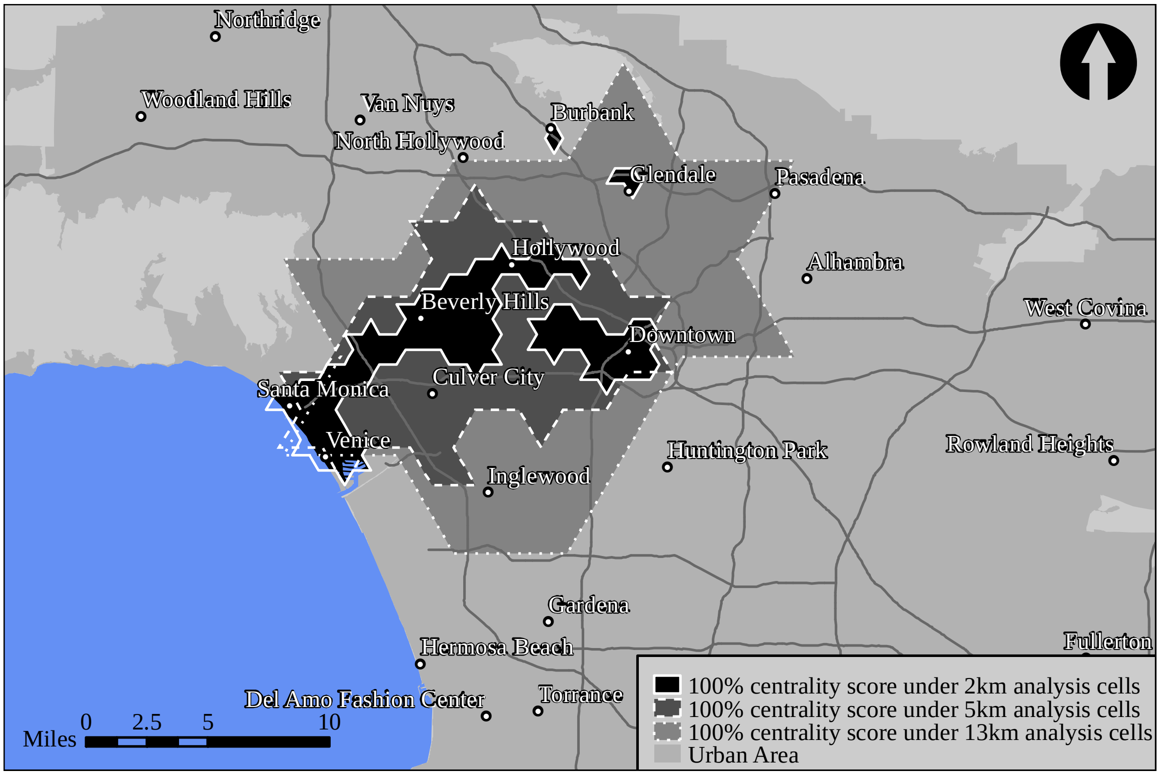

Figure 55: Los Angeles 100% centrality score areas under each of the three analysis cell scales (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

5.3 A more detailed analysis of the central areas

Since the 2km array yields better detail in the central area, it is reasonable to expect that an even smaller cell size might find an even more detailed border for delimiting the true urban center. Thus, a more detailed analysis was run using 0.8km cell widths, a width selected to continue the 2/5 proportional steps in cell sizes. This new analysis was not intended to add to or replace the union array, but to delimit in greater detail the central area already identified by the union array. As such, the extents of this analysis were limited to a 5km buffer around the union array's 90% centrality score class in each city. This limitation on the analysis extent precludes the direct combination of these results with those of the union analysis. Since most of the space in this narrow territory exhibits high amenity counts, cells must exhibit especially high counts in order to be delimited as clusters by this detailed LISA analysis.

As with the original cell sizes, this 0.8km analysis again used two arrays of the same cell size offset by half a cell width, and combined both to produce a centrality score. This analysis yields a fine level of detail in its delimitations, but it should not be interpreted as possessing any more precision than the size of its input cells: 0.8km (roughly one half mile). Thus, some places that are very near to a centrality score class but not contained by it might in reality actually attain that level of centrality, and some places within the classes might not actually attain levels of centrality in line with their immediate surroundings.

The centrality scores resulting from this 0.8km analysis are presented in Figure 56 for Chicago, Figure 57 for New York, and Figure 58 for Los Angeles. These figures share the same scale to facilitate comparison.

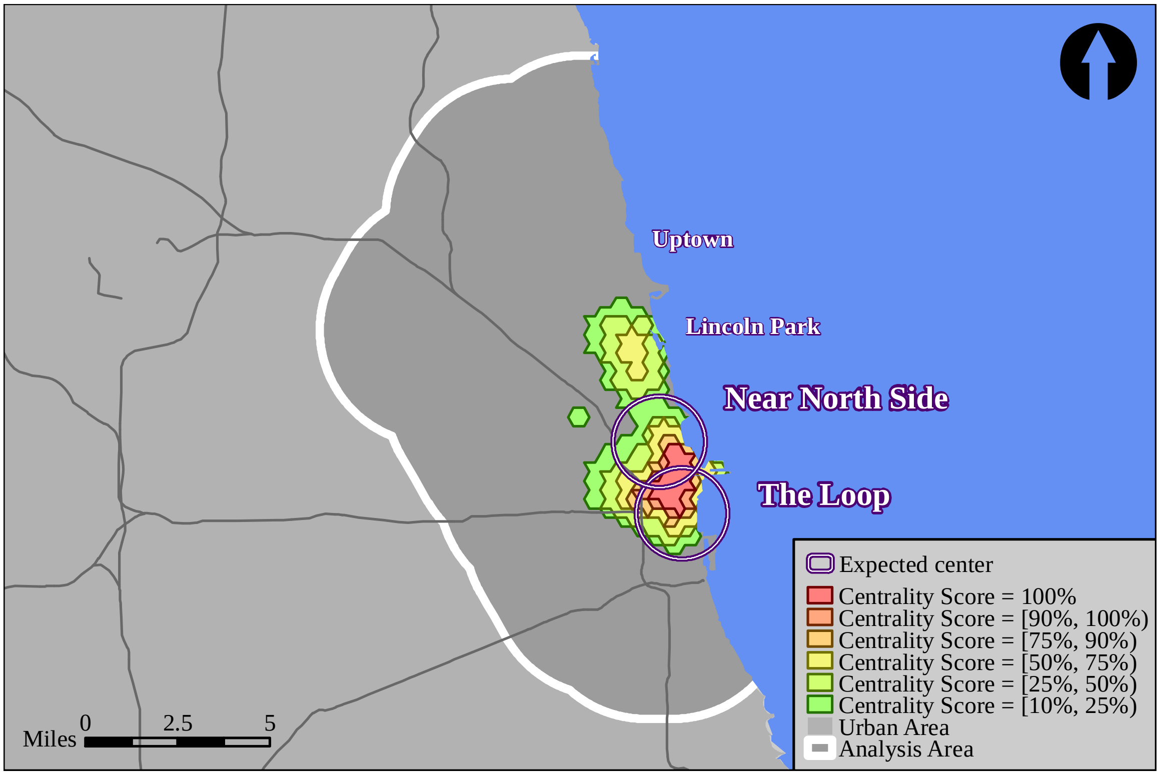

Figure 56: Chicago centrality score under the 0.8km analysis cells (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

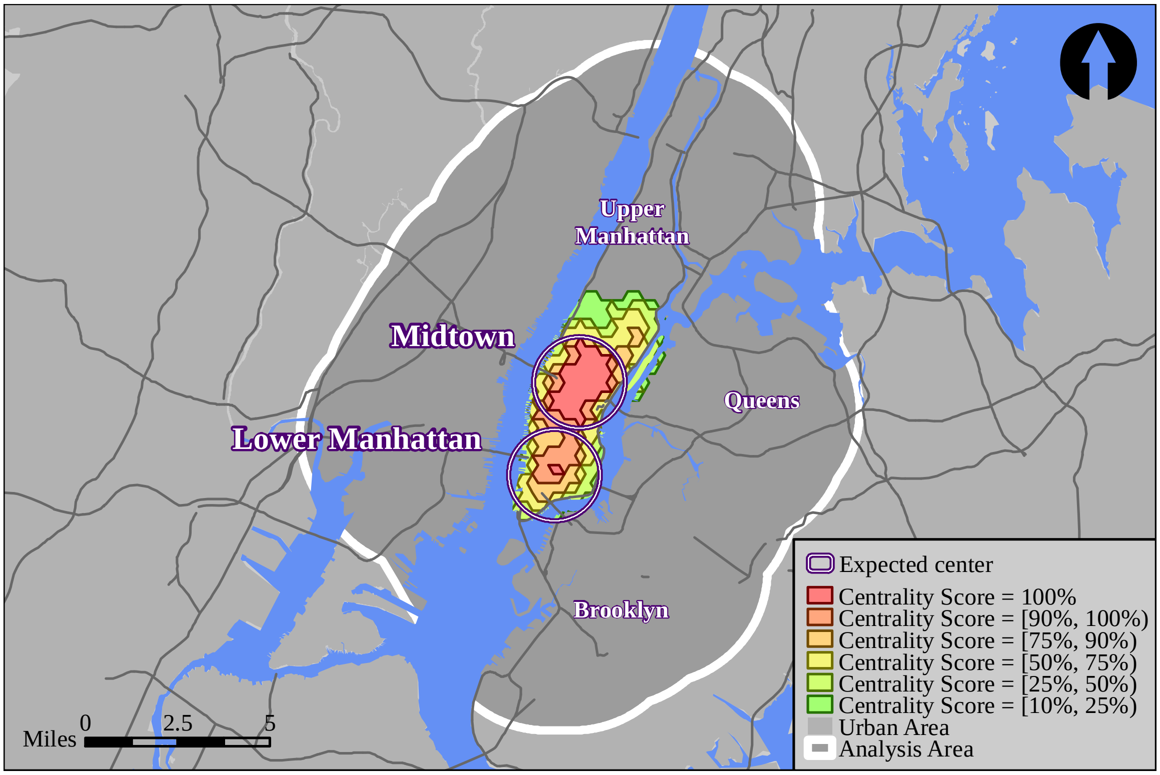

Figure 57: New York centrality score under the 0.8km analysis cells (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

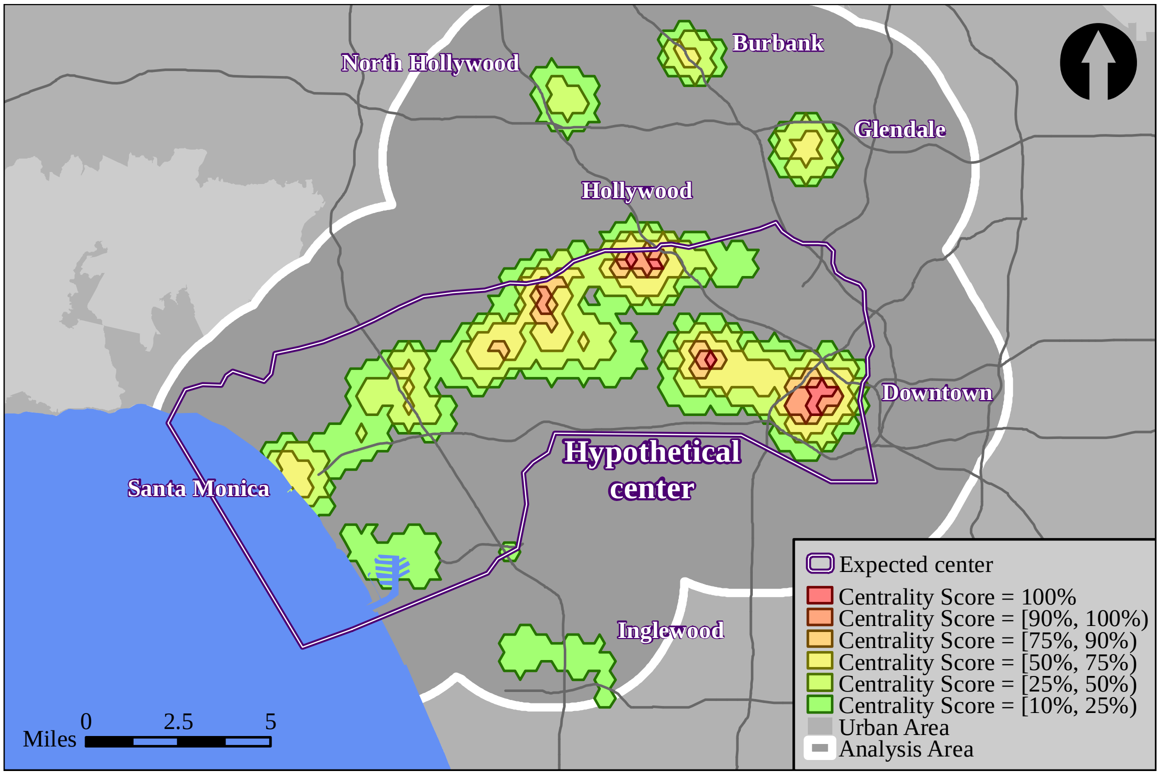

Figure 58: Los Angeles centrality score under the 0.8km analysis cells (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

5.4 Implications for delimiting city centers

5.4.1 Control validation

The union analysis performed well in the control cities, identifying centers in Chicago and in New York that spatially coincided, roughly, with expectations (figures 48 & 50 above). In both cities, the identified centers have a thick area of 100% centrality score matching the expectation graphics plus a thin tail extending to the north about as far again as the height of the expected centers themselves.

In Chicago this center includes not only the expected Loop and Near North Side, but it also extends further north into Lincoln Park and Uptown. The New York center includes not just Lower and Midtown Manhattan, as anticipated, but nearly all of Manhattan Island plus adjacent slivers of Queens and Brooklyn.

The thickness of the central area at the expected centers indicates a good correlation with expectations; since the central area is thickest there, that seems to be the primary center. The tails indicate that there might be an interesting phenomenon worth exploring here, perhaps one corresponding with Greene's High Amenity Zone (HAZ). But this deviation from the expectations is not especially significant since the expectations were only roughly defined and the difference in question is small when compared to the entire analysis area.

In both cities the center is clear and unambiguous, and the radial pattern of gradual decay in centrality scores across distance outward from the center is pronounced. This radial pattern reinforces the dominance of the central areas. If the delimited centers do not precisely match the expected centers in detail, it is at least clear from the overall radial pattern that the city centers are located roughly as expected.

The 0.8km analysis matches expectations even more closely than the union analysis does (figures 56 & 57 above). This analysis refines the delimited centers of Chicago and New York down to coincide almost exactly with the expectations for those cities.

The delimited Chicago center consists of a single 100% centrality score area which straddles the two expectation circles (over The Loop and the Near North Side). A subsidiary centrality score peak is evident in Lincoln Park, which reaches the 50% centrality score class. The delimited New York center consists of two 100% centrality score peaks which fall in the centers of each of the two expectation circles (over Lower Manhattan and Midtown), with little bleeding beyond them.

The centrality score classes in the union analysis hint at a small number of subcenters outside the main central areas, but the expected centers remain dominant in both the union analysis and, especially, the 08.km analysis. Since this study clearly identified strong and well-defined urban centers in the expected locations in Chicago and New York, there can be a high degree of confidence that the methodology is sound.

5.4.2 Interpretation

The centrality score for an individual cell indicates how many of the individual amenity category clusters coincide in that space. The score therefore places each cell on a scale between more central and less central. Rather than a binary, modernist, in-or-out definition of the central region, then, this method's results are more vague and ambiguous. The method gives an indication of the location of the central region, rather than a definitive or absolute 'truth'.

This method yields useful results. The delimited central areas are clear and unambiguous, while also being more nuanced than many employment-based analyses. The union approach reveals clear regional centrality while the more detailed cell arrays on their own produce more detailed boundaries of the primary and peripheral centers.

The small cell fragments of the union array create a false sense of precision, though, which must be kept in mind while interpreting its results. The example of restaurants in Santa Monica (as discussed above) shows that the larger cell arrays can create deviations from reality in the spatial extents of the centrality score classes. More thorough examinations of the results have revealed many more questionable class delimitations at close scales in other areas too. For example, in many cases a centrality score class peak will delimit a space between two real amenity centers in close proximity (such as less than one mile) without actually overlapping either of them. These discrepancies result from the overlapping hexagonal inputs which are too coarse to be interpreted under such close examinations.

But while the union array may not be especially precise, it does appear to be accurate. Its delimited centers fall in the expected locations in all three analyzed cities. Furthermore, the peripheral centers it identifies in the Los Angeles region fit with assumptions based on local familiarity as well as corresponding well with the Edge Cities and employment centers identified by other analyses, including Redfearn's (Figure 2 above), Giuliano & Small's (Figure 8 above), and Garreau's (Figure 12 above).

While lacking clarity on overall regional importance, the 0.8km analysis yields a remarkably precise delineation of the urban center, as discussed regarding the control cities above. Under the Los Angeles 0.8km analysis, the delimited boundaries and the internal variation fit well with expectations based on local familiarity. Also, the delimited boundaries of the main central area under this analysis seem to correlate well with the centers identified in the same general location by several other studies, including Redfearn's (Figure 2 above), Greene's (Figure 5 above), Giuliano & Small's (Figure 8 above), Giuliano & Redfearn's (Figure 9 above), Gordon & Richardson's (Figure 11 above), and Garreau's (Figure 12above).

If employment truly is increasingly becoming an unreliable indicator of urban centrality, perhaps this amenity-based method can continue to provide good spatial definition for postmodern urban centers. It is at least a useful additional point of view.

5.5 Implications for Los Angeles

5.5.1 Primary center

As with Chicago and New York, the union analysis clearly reveals a strong center in Los Angeles. Like the controls, the Los Angeles center lies roughly as hypothesized, from Santa Monica to Downtown along the base of the mountains through Beverly Hills and Hollywood (Figure 51 above).

The region attaining a100% centrality score in Los Angeles under the union analysis is 94 km^2 in area, significantly larger than either Chicago's or New York's central areas: 25 km^2 and 51 km^2 respectively. The Los Angeles metropolitan area is about twice as populous as that of Chicago but its central area is nearly four times as large in area. New York's metropolitan population is significantly larger than Los Angeles's despite its smaller central area. The greater area of Los Angeles's center indicates less concentration of amenities in Los Angeles.

5.5.2 Peripheral centers

Los Angeles exhibits considerably more variation in its centrality scores outside the primary central area when compared to the controls (figures 51 & 53 above). For one thing, the 90% centrality score class shows greater independence from the 100% class in Los Angeles, suggesting that the primary center may be weaker, less organized, or at least more dispersed. The 90% class extends notably beyond the 100% class northeast into Glendale, north through the Cahuenga Pass into Studio City, North Hollywood, and Burbank, and south along the 405 through Culver City and the Fox Hills Mall towards Inglewood.

Los Angeles also exhibits peaks in its 75% class that are far from the primary center, another difference from the controls. These peaks occur in five areas: in Pasadena and Alhambra; around Gardena, Hermosa Beach, and Torrance; in downtown Long Beach; in the Fullerton – Disneyland – Santa Ana corridor; and in the region around John Wayne Airport and Costa Mesa.

This spatial dispersion of high centrality scores indicates polycentrism in the Los Angeles area. While some peaks in the centrality score are well-defined and occur at traditional city centers (such as Pasadena or Long Beach), most regions of high scores show more dispersed patterns. These regions are primarily centered around shopping malls (multiple malls in each case) and freeway corridors, although they also include some more traditional city centers as well. Their uneven spatial patterns may indicate a lower degree of spatial organization, or they may indicate organization at an automobile-oriented scale.

In either case, Los Angeles appears to exhibit greater polycentrism in its urban structure than either Chicago or New York. The San Fernando Valley (Woodland Hills to Burbank), San Gabriel Valley (Pasadena to West Covina), and South Bay (Inglewood to Torrance) regions appear to play a part in extending the region's main center over a wider area, while Orange County (Fullerton to Costa Mesa) seems to exhibit a sense of its own centrality.

In fact, one possible reading of figures 53 and, especially, 54 (both above), suggests that Orange County may be in the process of organizing a central corridor of its own with a similar size and arc-like shape (but with a different orientation) to that of the primary central Wilshire/Santa Monica Corridor. This proto-corridor runs from Fullerton and the Disneyland area through Santa Ana and the John Wayne Airport area to Costa Mesa and Newport Beach. It appears to be structurally supported in its northern half (from Disneyland to Santa Ana) by the route of the Santa Ana Freeway (Interstate 5) and in its southern half (from Santa Ana to Costa Mesa) by the Costa Mesa Freeway (California State Route 55). In addition to traditional downtowns in Fullerton, Anaheim, Santa Ana, and Costa Mesa, this corridor's peak centrality score classes include two major mall & office complexes around the Outlets at Orange and the South Coast Plaza shopping malls.

The reduced concentration of the region's primary center (the Wilshire/Santa Monica Corridor), in combination with the increased strength and independence of its peripheral centers, indicates that Los Angeles's urban structure is different from that of Chicago or New York. Its primary center is less coherent and its region exhibits greater polycentrism.

But polycentrism is not the same as non-centrism, and the primary Los Angeles center remains both clearly-defined and dominant. A clear center roughly corresponding to the hypothesized extent of the Wilshire/Santa Monica Corridor is identified under all analysis scales, including under the union analysis. In each case, this center attains much higher centrality scores than any of the peripheral areas and exhibits a tight and consistent spatial definition. Therefore, Los Angeles has a center.

5.6 The Wilshire/Santa Monica Corridor

The 0.8km analysis greatly refines the delimited centers of Chicago and New York down to a compact central area with almost no ambiguity and no peripheral peaks within the narrowed analysis area (figures 56 & 57 above), but its results are somewhat more ambiguous for Los Angeles (Figure 58 above). For Los Angeles, there are several independent regions of contiguous significant (over the 10% threshold for visualization) centrality scores within the 0.8km analysis area, some of which are quite small.

This spatial ambiguity might seem to indicate a disorganized center in Los Angeles, but it is important to remember that the LISA analysis at this scale cannot take the overall regional significance of its clusters into account. The area of Burbank scoring over 50% under this localized analysis, for example, might not be as regionally significant as the area of Santa Monica which also scores over 50%, because the LISA clusters are based on the immediate neighborhood of each cell and on their relative significance within this narrowed analysis extent.

In this case, the central areas separately identified by each of the three larger-cell analyses can be helpful in narrowing down the true center. These three centers, the areas attaining 100% centrality scores under each of the three larger cell sizes, were presented in Figure 55 above. The 0.8km analysis results are overlaid on these three centers in Figure 59.

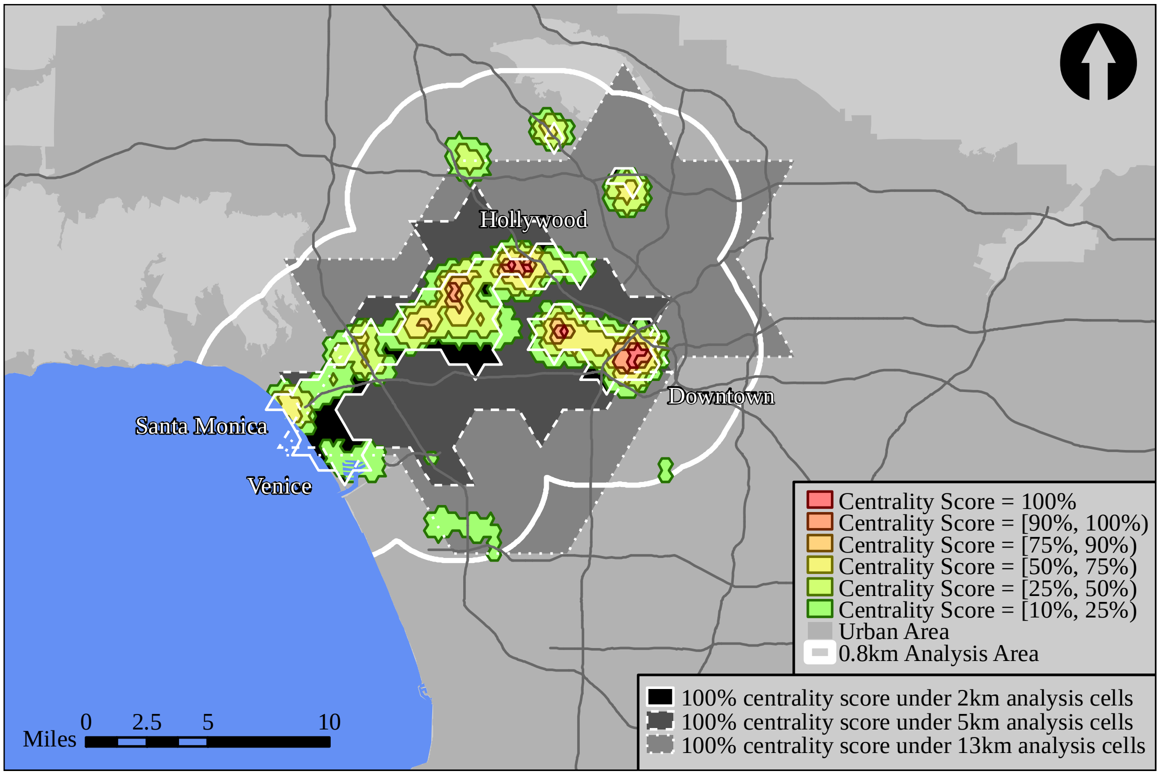

Figure 59: Los Angeles centrality score under the 0.8 analysis cells, overlaid on the 100% centrality score areas from each of the three larger analysis cell scales (freeways and shoreline: U.S. Dept. of Transportation; urban area: U.S. Census).

Figure 59 reveals that many of the smaller centers identified by the 0.8km analysis do not overlap all of the 100% centers identified by the other three analyses. Using this information, the delimited center of Los Angeles can be narrowed down to include just the areas of contiguous significant (over the 10% threshold for visualization) centrality scores from the 0.8km analysis which overlap all three of the larger-cell analysis centers. In other words: the place where the centers of all four analysis scales overlap. This overlapping center includes the large area stretching from Santa Monica to Hollywood, the medium-sized area covering Downtown, and the small area at Venice.

These central areas together comprise the Wilshire/Santa Monica Corridor – the core center of Los Angeles – which is depicted in greater detail in Figure 60.

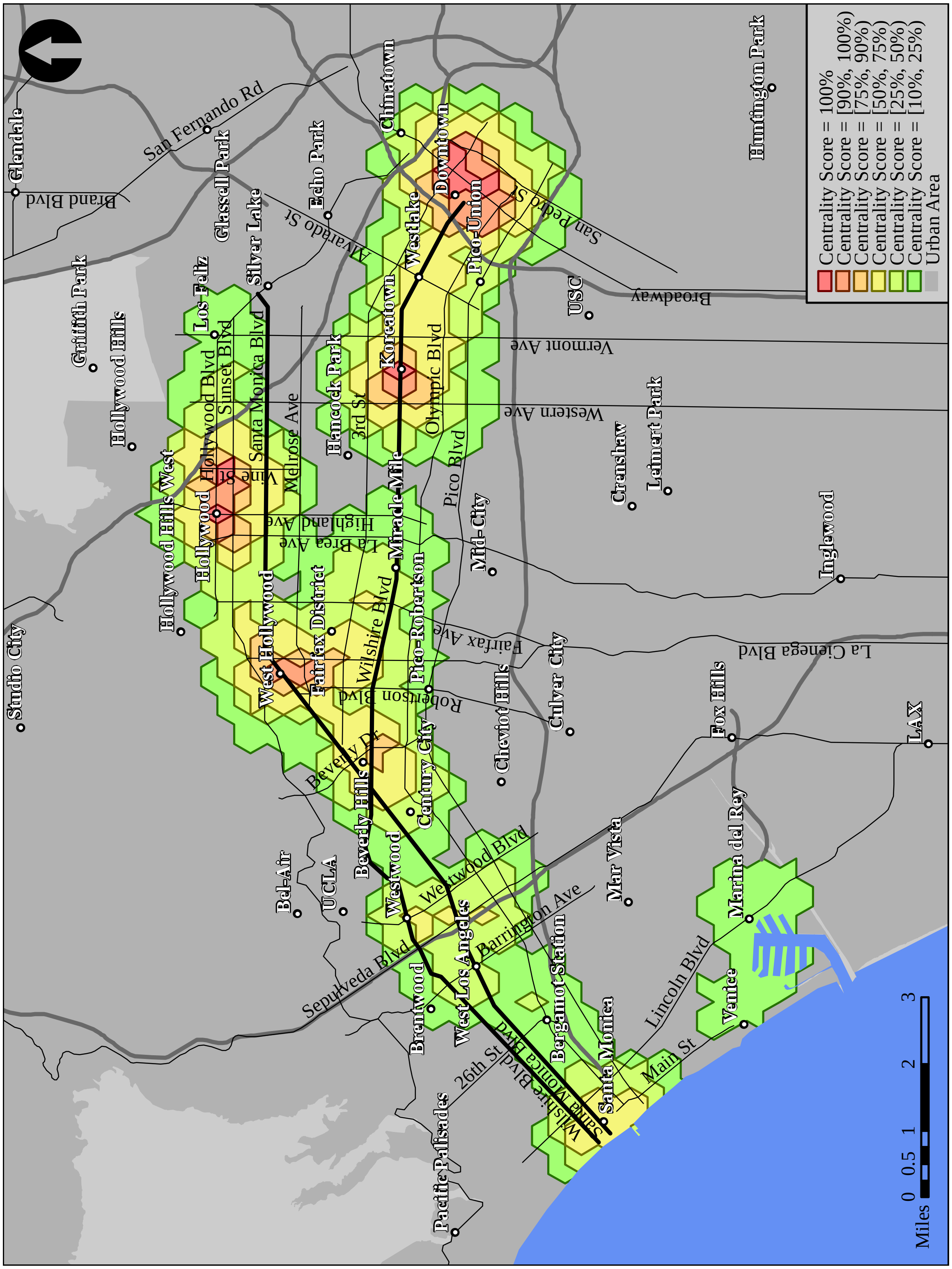

Figure 60: The Wilshire/Santa Monica Corridor: Los Angeles centrality score under the 0.8km analysis cells in the area attaining 100% centrality scores under all three larger-scale analyses (freeways and shoreline: U.S. Dept. of Transportation; streets traced from Esri basemaps; urban area: U.S. Census).

It would not be appropriate to trim the 0.8km analysis results according to the shapes of the three wider analysis centers, since these other centers have been shown to contain MAUP artifacts. The union analysis has effectively performed this operation already while this 0.8km analysis, on the other hand, provides greater precision at this detailed scale. Its extents should therefore not be modified according to the analyses which operate at wider scales.

Since even the lowest-scoring portions of the Wilshire/Santa Monica Corridor as depicted in the 0.8km analysis attain the highest scores under the three wider analyses, Figure 60 should be understood as depicting internal variation within the Wilshire/Santa Monica Corridor rather than as indicating a lack of importance in its lower-scoring classes. Put another way, the 10% centrality score class of the 0.8km analysis (in Figure 60) delimits the external bounds of the Wilshire/Santa Monica Corridor while the higher centrality score classes depict its internal structure.

As mentioned above, areas near to a class but not contained by it might in reality be as central as areas within that class because of the limits on precision inherent in the analysis cell sizes. Conversely, the central region as depicted here should be assumed to contain areas within it that are not especially central but which are too small to be excluded by this level of detail. In short, the central place is ambiguously bounded, internally inconsistent, and spatially discontinuous – in keeping with the theories of Allan, Massey, and Cochrane. The delimited area is nevertheless useful information, as these spatial ambiguities are expected attributes of the postmodern urban center.

Since cartographic visualization is the only output from this analysis, the maps presented thus far, including Figure 60, depict centrality score class polygons made directly from the analysis cells without further modification; the maps are truthful representations of the actual data resulting from the analysis. However, given the spatial imprecision involved, these maps are not entirely truthful in a cartographic sense; their sharp edges and small cell sizes convey a false sense of precision, especially when presented at the detailed scale of Figure 60.

The map of centrality score classes within the Wilshire/Santa Monica Corridor (Figure 60) is therefore reproduced in Figure 61 with its class polygons buffered outwards by 0.4km, half the width of an input analysis cell. This buffering allows the classes to bleed onto the surrounding area and softens their edges, producing a more cartographically honest depiction of the analysis results: a depiction that better conveys the sense of ambiguous boundaries and spatial imprecision. The qualifications mentioned above regarding places that fall near to a class boundary, though, still apply to its interpretation. It is interesting to note that the application of this small buffer now makes the Wilshire/Santa Monica Corridor singularly contiguous.

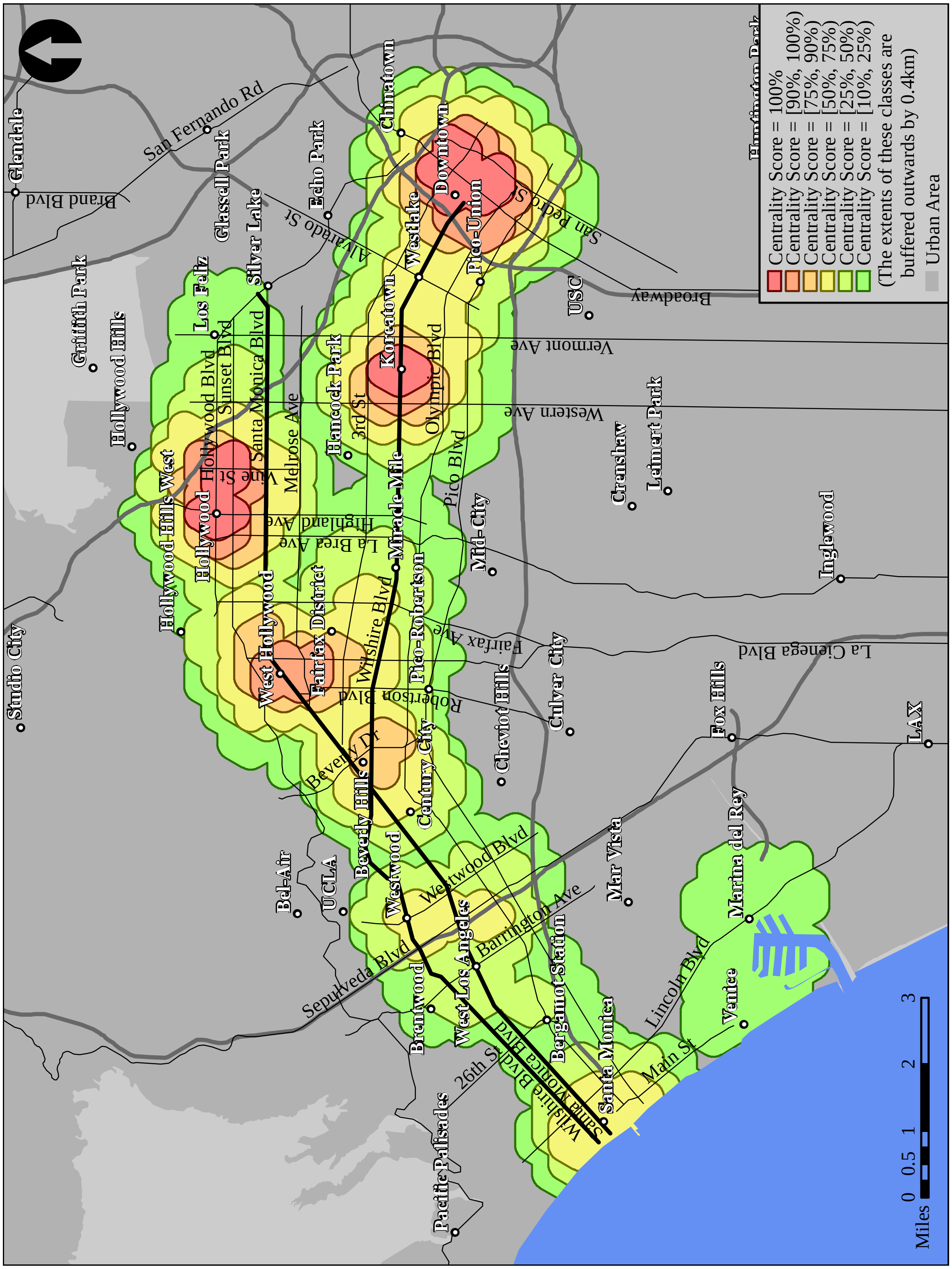

Figure 61: The Wilshire/Santa Monica Corridor (cartographic depiction): centrality score classes from Figure 60 buffered outwards by 0.4km each (freeways and shoreline: U.S. Dept. of Transportation; streets traced from Esri basemaps; urban area: U.S. Census).

Since we set out to find an ambiguously bounded, internally inconsistent, and spatially discontinuous region, and since the Wilshire/Santa Monica Corridor is contiguous within a tolerance of one cell width, I assert that the Wilshire/Santa Monica Corridor functions as a single spatial unit.

5.6.1 General extents and characteristics

As depicted in Figure 61 (above), the Wilshire/Santa Monica Corridor extends in a narrow band from Santa Monica to Downtown Los Angeles. Along the way, it passes through Westwood, Beverly Hills, Hollywood, and Koreatown. Venice and the Marina del Rey, south of Santa Monica, are also part of the Wilshire/Santa Monica Corridor, since they also partially overlap the 100% centrality score areas under all three wider-scale analyses (shown in Figure 55 above). Glendale, as a side note, is quite central as well since it overlaps 100% areas in two of the three wider analyses (2km and 13km) and attains a 50% centrality score under the 0.8km analysis (Figure 59 above). Because it fails to reach a 100% score under the 5km analysis, though, Glendale is not considered to be a part of the Wilshire/Santa Monica Corridor under this interpretation.

As defined by the extents of the centrality score classes of 10% or higher under the 0.8km analysis which overlap the 100% centrality score areas of the larger-cell analyses (all of the classes shown in Figure 60 above), the Wilshire/Santa Monica Corridor had a population of 797,000 at the time of the 2010 census (calculated by selecting Census Blocks with centroids within the delimited areas). When more broadly defined as the 90% or higher centrality score area of the main union analysis, the Wilshire/Santa Monica Corridor’s 2010 population was 1,394,000. The population of the entire metropolitan area at that time was 17,877,000 (Los Angeles, Orange, San Bernardino, Riverside, and Ventura counties), meaning that the Wilshire/Santa Monica Corridor holds between 4% and 8% of the Los Angeles metropolitan population. For comparison, Manhattan Island (New York County: 1,586,000 people) held 7% of New York's metropolitan population (22,086,000 people) at that same census.

While the Wilshire/Santa Monica Corridor is significantly larger in area than Manhattan Island, New York's generally-acknowledged center, the difference is not so large as to make a comparison unwarranted. Thus, in order to convey a sense of the scale of the Wilshire/Santa Monica Corridor, it is depicted alongside Manhattan Island in Figure 62.

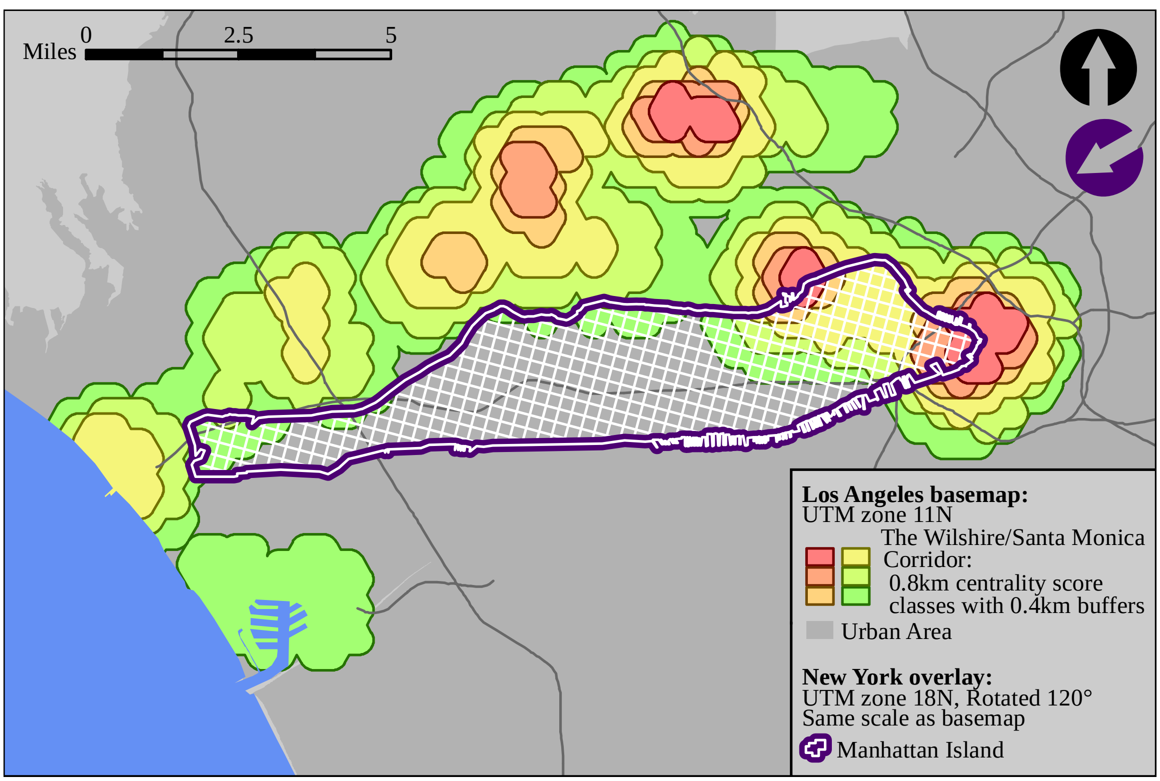

Figure 62: Comparison of the Wilshire/Santa Monica Corridor (cartographic depiction) with Manhattan Island (freeways, shoreline, and Manhattan Island: U.S. Dept. of Transportation; urban area: U.S. Census).

In addition to scoring highly in this amenity analysis and correlating well with the extents of employment centers identified by other analyses, the Wilshire/Santa Monica Corridor contains or nearly contains most of the metropolitan region's busiest and most well-known tourism destinations, including: the Venice Boardwalk, the Santa Monica Pier, the Getty Center, Rodeo Drive, the Sunset Strip, the Melrose Avenue shopping area, the Farmers Market (3^{rd} & Fairfax), the La Brea Tar Pits, the Chinese Theater, the Hollywood Walk of Fame, Universal Studios, the Griffith Observatory, the Walt Disney Concert Hall, and Olvera Street (Figure 63). Only a few major Los Angeles tourist destinations, notably Disneyland, the Queen Mary, and the region's many beach cities, lie outside the Wilshire/Santa Monica Corridor. This concentration of tourism spots within the corridor implies that visitors to the region perceive, at least indirectly, the same center that this study reveals.

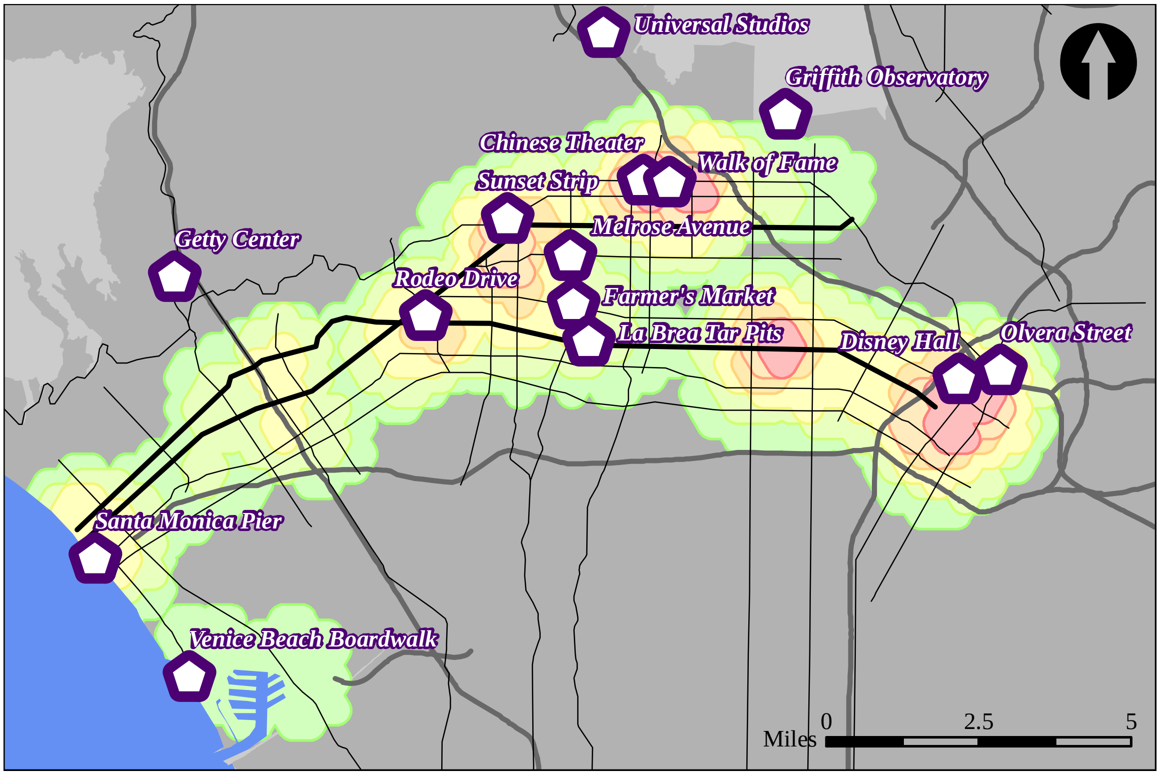

Figure 63: Primary Los Angeles tourism destinations in and around the Wilshire/Santa Monica Corridor (freeways and shoreline: U.S. Dept. of Transportation; streets traced from Esri basemaps; urban area: U.S. Census).

Although the locations of clusters of tall buildings are subject to many external forces including politically-motivated land use constraints and are therefore not generally a reliable indicator of true centrality, it is worth noting that the string of towers shown in the photograph of the Wilshire/Santa Monica Corridor in Figure 4 (above) generally matches the centrality score classes of the corridor as depicted in Figure 61 (also above) in both building height and clustering tendencies. Thus it is revealed that Parcerisa's focus on the visual cityscape does roughly correlate with centrality as revealed by this study, at least in Los Angeles.

In addition to correlating well with population measures, tourism centers, and visual forms, the corridor of amenity clusters identified by this analysis also correlates well with the results of several previous employment-based analyses, as described above. The Wilshire/Santa Monica Corridor, then, simultaneously exhibits signs of centrality under many different ways of seeing. It is a postmodern urban center, one which dominates the surrounding landscape. The Wilshire/Santa Monica Corridor, therefore, is functionally equivalent to The Loop in Chicago and to Midtown and Lower Manhattan in New York.

5.6.2 A hierarchy of neighborhoods

A list of central neighborhoods would be a useful descriptive output of this analysis, but there exists no useful governmental definition of neighborhoods within the city of Los Angeles. City council districts, zip codes, and the various city service districts all exhibit irrational boundaries with unhelpful names. The recent official neighborhood council system may one day prove useful but its boundaries do not presently correlate well with popular conceptions of place (the Hollywood Walk of Fame, for example, is divided among three councils) nor are some of its defined neighborhoods attributed with useful official place names (“Empowerment Congress Central Area”, for example).

The Los Angeles Times has delimited a set of Los Angeles neighborhoods using a mix of editorial direction and community input, resulting in a set of neighborhoods which is both rational and useful (http://projects.latimes.com/mapping-la/neighborhoods/). These neighborhoods are listed in Table 4 according to their highest intersecting true (unbuffered) centrality score class under the 0.8km analysis within the Wilshire/Santa Monica Corridor (Figure 60 above). They are mapped in Figure 64.

Only the classes of the Wilshire/Santa Monica Corridor – the area scoring 100% under the wider-scale analyses – were used for this selection, leaving out the cities of Glendale and Burbank, and the Los Angeles neighborhood of North Hollywood. Since neighborhoods can be bumped to higher class levels by the tiniest sliver of an intersecting class (Hollywood Hills, for example), a problem familiar to all spatial analyses, this list should be taken as suggestive rather than as authoritative.

Table 4: Hierarchy of central neighborhoods in the Wilshire/Santa Monica Corridor (neighborhood names and spatial extents: Los Angeles Times).

Highest intersecting centrality score class	**Neighborhood**	**Type of place**
100%	Downtown	Neighborhood of the City of Los Angeles
	Hollywood	Neighborhood of the City of Los Angeles
	Hollywood Hills	Neighborhood of the City of Los Angeles
	Koreatown	Neighborhood of the City of Los Angeles
90%	Beverly Grove	Neighborhood of the City of Los Angeles
	West Hollywood	Incorporated city
75%	Beverly Hills	Incorporated city
	Echo Park	Neighborhood of the City of Los Angeles
	Hollywood Hills West	Neighborhood of the City of Los Angeles
	Westlake	Neighborhood of the City of Los Angeles
50%	Century City	Neighborhood of the City of Los Angeles
	Chinatown	Neighborhood of the City of Los Angeles
	Fairfax	Neighborhood of the City of Los Angeles
	Harvard Heights	Neighborhood of the City of Los Angeles
	Mid-Wilshire	Neighborhood of the City of Los Angeles
	Pico-Union	Neighborhood of the City of Los Angeles
	Santa Monica	Incorporated city
	Sawtelle	Neighborhood of the City of Los Angeles
	Veterans Administration	Unincorporated place
	West Los Angeles	Neighborhood of the City of Los Angeles
	Westwood	Neighborhood of the City of Los Angeles
	Windsor Square	Neighborhood of the City of Los Angeles

(table continues. . .)

Table 4, continued.

Highest intersecting centrality score class	**Neighborhood**	**Type of place**
25%	Arlington Heights	Neighborhood of the City of Los Angeles
	Boyle Heights	Neighborhood of the City of Los Angeles
	Brentwood	Neighborhood of the City of Los Angeles
	Carthay	Neighborhood of the City of Los Angeles
	Cheviot Hills	Neighborhood of the City of Los Angeles
	East Hollywood	Neighborhood of the City of Los Angeles
	Hancock Park	Neighborhood of the City of Los Angeles
	Larchmont	Neighborhood of the City of Los Angeles
	Los Feliz	Neighborhood of the City of Los Angeles
	Pico-Robertson	Neighborhood of the City of Los Angeles
	Rancho Park	Neighborhood of the City of Los Angeles
10%	Beverlywood	Neighborhood of the City of Los Angeles
	Central-Alameda	Neighborhood of the City of Los Angeles
	Del Rey	Neighborhood of the City of Los Angeles
	Elysian Park	Neighborhood of the City of Los Angeles
	Historic South-Central	Neighborhood of the City of Los Angeles
	Lincoln Heights	Neighborhood of the City of Los Angeles
	Mar Vista	Neighborhood of the City of Los Angeles
	Marina del Rey	Unincorporated place
	Mid-City	Neighborhood of the City of Los Angeles
	Playa Vista	Neighborhood of the City of Los Angeles
	Playa del Rey	Neighborhood of the City of Los Angeles
	Silver Lake	Neighborhood of the City of Los Angeles
	Venice	Neighborhood of the City of Los Angeles

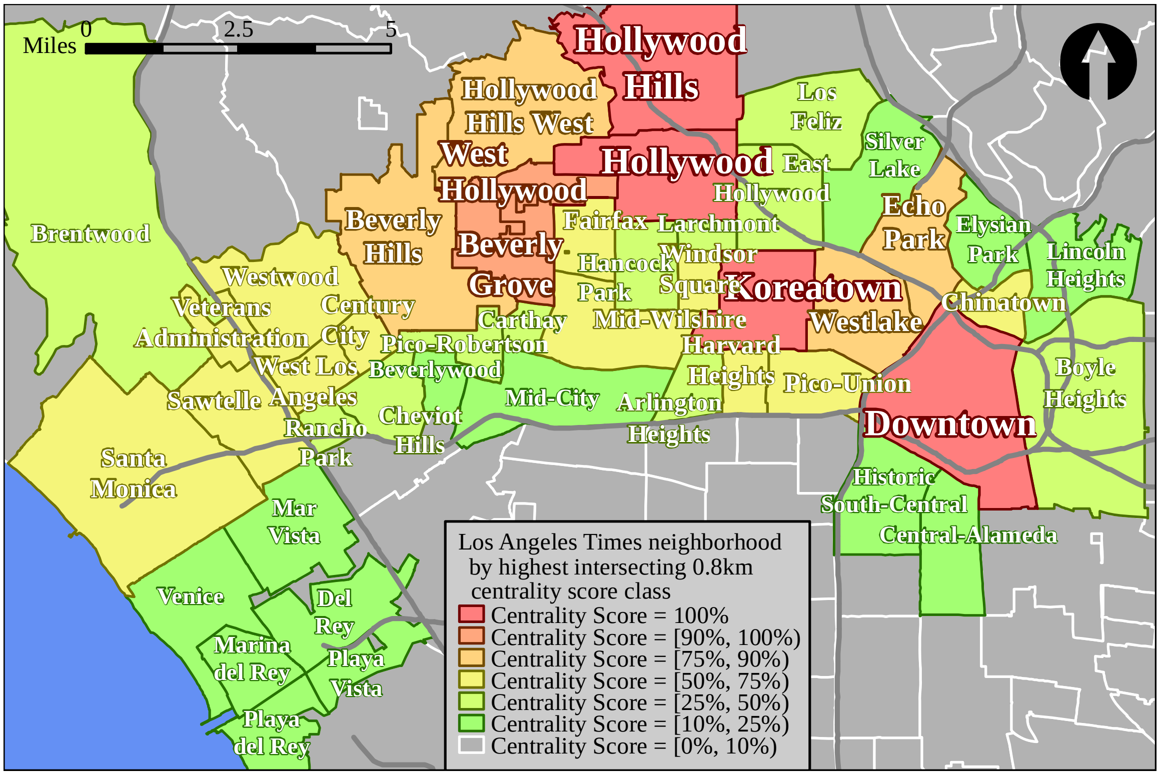

Figure 64: Hierarchy of central neighborhoods in the Wilshire/Santa Monica Corridor (neighborhood names & outlines, including shoreline: Los Angeles Times; freeways: U.S. Dept. of Transportation).

Table 4, particularly the ‘type of place’ column, sheds some light on the question of why the center of Los Angeles has gone largely unrecognized. The Wilshire/Santa Monica Corridor includes not only multiple neighborhoods but also some unincorporated areas and some incorporated cities distinct from the City of Los Angeles. Perhaps a preoccupation with administrative boundaries has clouded awareness of the corridor. It is certainly unusual (though not unique) for the center of a city to consist of so many independent administrative districts.

Also, although Downtown, Hollywood, and Koreatown reach the highest scores, the West Hollywood - Fairfax District region scores nearly as high and is much wider in area when all score classes are considered. This region encompasses the Sunset Strip nightclub area, the Melrose Avenue fashion district, and the Farmer's Market (Figure 63 above), as well as the stretches of 3rd Street, Beverly Boulevard, and Robertson Boulevard where the city's most popular restaurants are found (Figure 61 above; Beverly is parallel to and north of 3rd St but not shown on the map). It also lies immediately between the Rodeo Drive area and the Hollywood Walk of Fame area. Taken together, this contiguous region is not only where the Wilshire/Santa Monica Corridor is thickest, but it also contains most of Los Angeles's most iconic districts. These aspects, along with its central location along the path of the corridor, mean that the Beverly Hills - West Hollywood - Fairfax - Hollywood area arguably vies for importance with Downtown.

5.6.3 A hierarchy of nodes

In addition to seeing the Wilshire/Santa Monica Corridor as a collection of neighborhoods, it can be seen as a collection of structural nodes or poles. The detail provided by the 0.8km analysis enables some fairly precise assertions to be made about where the central nodes of Los Angeles can be found. The Wilshire/Santa Monica Corridor has already scored at 100% centrality under the unified analysis, and there are four places within the corridor which also attain centrality scores of 100% under this more detailed analysis. As shown in Figure 60 (the unbuffered centrality score classes; above), the largest of these 100% zones by far, in terms of the area scoring 100%, is Downtown Los Angeles: specifically, an area centered along Broadway from 2nd St to 8th St. The other three 100% places are at Hollywood Blvd & Vine St and Hollywood Blvd & Highland Ave in Hollywood, and at Wilshire Blvd & Normandie Ave in Koreatown.

One place scores in the 90% range: West Hollywood. The center of this place appears to be the stretch of Santa Monica Blvd between San Vicente Blvd and La Cienega Blvd, but it is shaped as a tall rectangle which, including its fringe cells, also reaches north to the Sunset Strip and south to the Beverly Center mall (at La Cienega Blvd & Beverly Blvd). The next step down the hierarchy is Beverly Hills, which scores over 75% around Wilshire Blvd & Beverly Dr (the Rodeo Drive area).

Finally, there are four distinct places scoring over 50%. In descending order of the size of the area achieving this score, they are: downtown Santa Monica (a broad area extending several blocks in all directions around the Third Street Promenade and the Santa Monica Pier), Westlake (around MacArthur Park at Wilshire Blvd & Alvarado St), Westwood (mainly at Wilshire Blvd & Westwood Blvd but also thinly extending south to include the intersection of Santa Monica Blvd & Sepulveda Blvd as well as Olympic Blvd & Sawtelle Blvd), and at 3rd St & Fairfax Ave (the location of the Farmer's Market and The Grove mall).

Given the limited precision of this analysis, the 3rd & Fairfax peak could alternatively be interpreted as elevating the intersection of Wilshire Blvd & Fairfax Ave (at “Museum Row” in the Miracle Mile, which includes the Los Angeles County Museum of Art and the La Brea Tar Pits). It should also be noted that, within Koreatown, the intersections of both Vermont Ave and Western Ave with Wilshire Blvd are probably more truly significant than the intersection of Wilshire & Normandie (while it is a through street, Normandie is not a commercial street). But since Normandie lies at the center of Koreatown its intersection with Wilshire is the single point where all of the various input clusters overlap.

The specific intersections mentioned above, then, are the point locations that are most central to the region's center; they are the primary central nodes of the Wilshire/Santa Monica Corridor and therefore of the wider Los Angeles metropolis as well. These nodes are listed in Table 5 and mapped in Figure 65. The most major intersection falling within each local centrality score peak class of Figure 60 (the unbuffered centrality score classes; above) was selected for inclusion in the table. Most of the centrality score peaks are so small as to include only one major intersection. In the few cases where the data presented no clear choice, a nearby intersection was arbitrarily selected based on subjective local familiarity. The map and table should therefore (again) not be interpreted as being authoritative, but rather as being simply suggestive.

Table 5: Hierarchy of central nodes in the Wilshire/Santa Monica Corridor.

Peak centrality score class	**Node (intersection)**	**Place**
100% (largest area)	Broadway & 7th St	Downtown
100% (other areas)	Hollywood Blvd & Highland Ave	Hollywood
	Hollywood Blvd & Vine St	Hollywood
	Wilshire Blvd & Normandie Ave	Koreatown
90%	Santa Monica Blvd & La Cienega Blvd	West Hollywood
	La Cienega Blvd & Beverly Blvd	Fairfax District
75%	Wilshire Blvd & Beverly Dr (or Rodeo Dr)	Beverly Hills
50%	3rd St Promenade & Broadway	Santa Monica
	Wilshire Blvd & Alvarado St	Westlake
	Wilshire Blvd & Westwood Blvd	Westwood
	Santa Monica Blvd & Sepulveda Blvd	West L.A.
	Olympic Blvd & Sawtelle Blvd	West L.A.
	3rd St & Fairfax Ave	Fairfax District
25%	Olympic Blvd & 26th St	Santa Monica
10%	Lincoln Blvd & Marina Exwy	Marina del Rey
	Pacific Ave & Windward Ave	Venice
	Sunset Blvd & Vermont Ave	East Hollywood

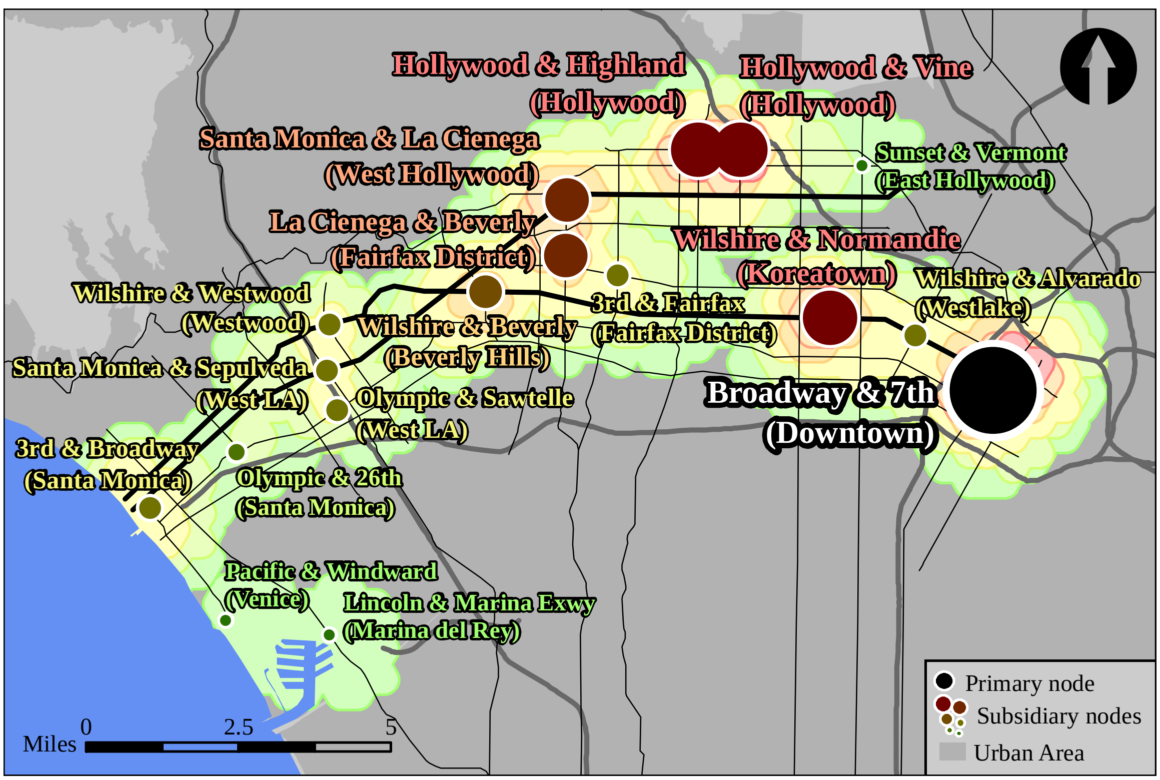

Figure 65: Hierarchy of central nodes in the Wilshire/Santa Monica Corridor (freeways and shoreline: U.S. Dept. of Transportation; streets traced from Esri basemaps; urban area: U.S. Census).

It is worth noting that both Glendale (at Brand Blvd & Broadway, near the Glendale Galleria and Americana at Brand malls) and Burbank (at San Fernando Blvd & Magnolia Blvd, in Burbank's downtown) also score above 50% in the 0.8km analysis. Although these two places are not within the 100% centrality zones of the union analysis or the 5km analysis, they are within the union array's 90% zone as well as the 2km array's 100% zone (Glendale is also within the 13km array's 100% zone but Burbank is not). These discrepancies indicate that the primary nodes in Glendale and Burbank are not quite as regionally central as those of the Wilshire/Santa Monica Corridor, although only slightly less so.

5.6.4 Structural backbones

Los Angeles's boulevards are the essential elements of its urban structure and identity (Suisman, 1989). Bearing this importance in mind, Wilshire Boulevard is clearly the backbone of the Wilshire/Santa Monica Corridor since it runs the corridor's entire distance from Santa Monica to Downtown while passing through most of the centrality score peaks along the way (Figure 61 above). However, the corridor widens at West Hollywood and the Fairfax District, with an additional sub-corridor of high centrality scores branching off to the north of Wilshire.

Santa Monica Boulevard would seem to be the backbone of this sub-corridor, since it runs through or adjacent to the highest scoring places and since this northern centrality score corridor ends where Santa Monica Boulevard ends. Sunset and Hollywood Boulevards are closer than Santa Monica Blvd to the centrality peaks in the Hollywood area, but Hollywood Blvd does not extend beyond this area and Sunset Blvd veers away from the Wilshire/Santa Monica Corridor once it is west of West Hollywood. Santa Monica Blvd, though, reconnects the Hollywood area to the western half of the Wilshire/Santa Monica Corridor and can therefore be seen as the secondary corridor backbone.

Since Santa Monica Boulevard merges into Sunset Boulevard at its eastern terminus to continue into Downtown, the overall shape of the Wilshire/Santa Monica Corridor could be described as a dual corridor with common east and west endpoints at Downtown and Santa Monica, which is bifurcated in its midsection through Koreatown, Hollywood, and the Fairfax District. The depression in centrality scores which creates the hole in the middle of this bifurcation is caused by the Hancock Park neighborhood, a wealthy and historic residential area.

While the internal structure of the Wilshire/Santa Monica Corridor is clearly more complicated than simple corridors along backbone boulevards would suggest, a one mile buffer around the routes of these two boulevards would very closely match the external limits of the corridor itself. It therefore seems reasonable to assert that Wilshire and Santa Monica Boulevards act as the most fundamental structural elements within the corridor and are therefore the region's most important major streets. They are consequently depicted in bold in these maps of the corridor (figures 60 & 61 above).

5.6.5 A single central point?

Since it is often said that Los Angeles has no center, I now offer two alternative specific center point suggestions: the intersection of Broadway & 7th Street in Downtown, or the intersection of Wilshire & Santa Monica Boulevards in Beverly Hills. The first suggestion is based on the internal centrality score variation within the Wilshire/Santa Monica Corridor, and the second suggestion is based on the overall backbone structure of the corridor. If the Wilshire/Santa Monica Corridor, as a single spatial unit, is the center of Los Angeles, then the central point of the corridor itself, if such a point exists, could be considered to be the central point of Los Angeles.

Based on centrality score variation within the Wilshire/Santa Monica Corridor

As to the first suggestion, Broadway and 7th: the largest contiguous area of 100% centrality identified under the most detailed (0.8km) analysis is centered along Broadway roughly from 2nd to 8th Streets in Downtown (Figure 60 above). From among the several cross streets to Broadway in this area, I suggest 7th Street as the ‘most central’ intersection because it is the best fit for symbolically carrying the Wilshire corridor through to Broadway. Wilshire Boulevard, which is, as described above, the region's most important structural element, terminates just three blocks west of Broadway. Up to this point it runs parallel to and in-between 6th and 7th Streets.

If one of these two streets is to carry Wilshire's baton the final three blocks to Broadway, I would suggest 7th Street for two reasons. First, 6th Street is unavailable for the task. 6th Street is a major through-route in its own right outside of Downtown. To the west it extends to La Cienega, and to the east it ultimately becomes Whittier Boulevard, a primary through corridor with cultural and historical significance. Within Downtown, 6th forms half of a one-way couplet with 5th Street (long-standing traffic controls merge 5th back into 6th on either side of Downtown). Therefore, 6th Street here is too much its own corridor to act as a surrogate for Wilshire. 7th Street, on the other hand, is two-way in downtown (like Wilshire) and is not a major regional through route. Thus 7th Street is available to act as Wilshire's symbolic and practical extension to Broadway.

Second, while 5th and 6th Streets are both busy and visually impressive, 7th Street is anecdotally Broadway's busiest cross street in terms of pedestrian traffic and retail storefronts, and it leads west from Broadway into the heart of the financial district with striking visual monumentality (Figure 66). That being said, all three streets (5th, 6th, and 7th) are in close enough proximity (a quarter mile), are sufficiently significant to the wider region, and possess sufficient visual monumentality at their intersections with Broadway (Figure 67) to collectively function as the metropolis's single primary central point.

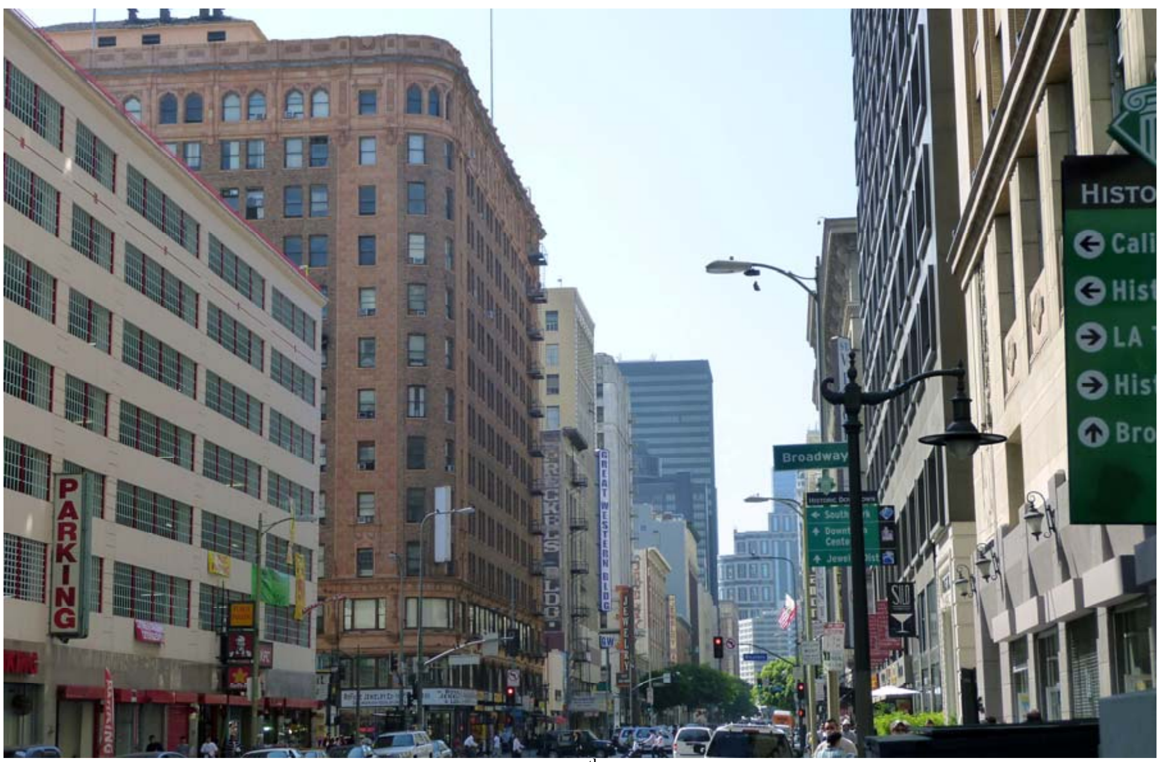

Figure 66: Looking west into the financial district on 7th Street from just east of Broadway, Los Angeles (author's photograph, May 13, 2012).

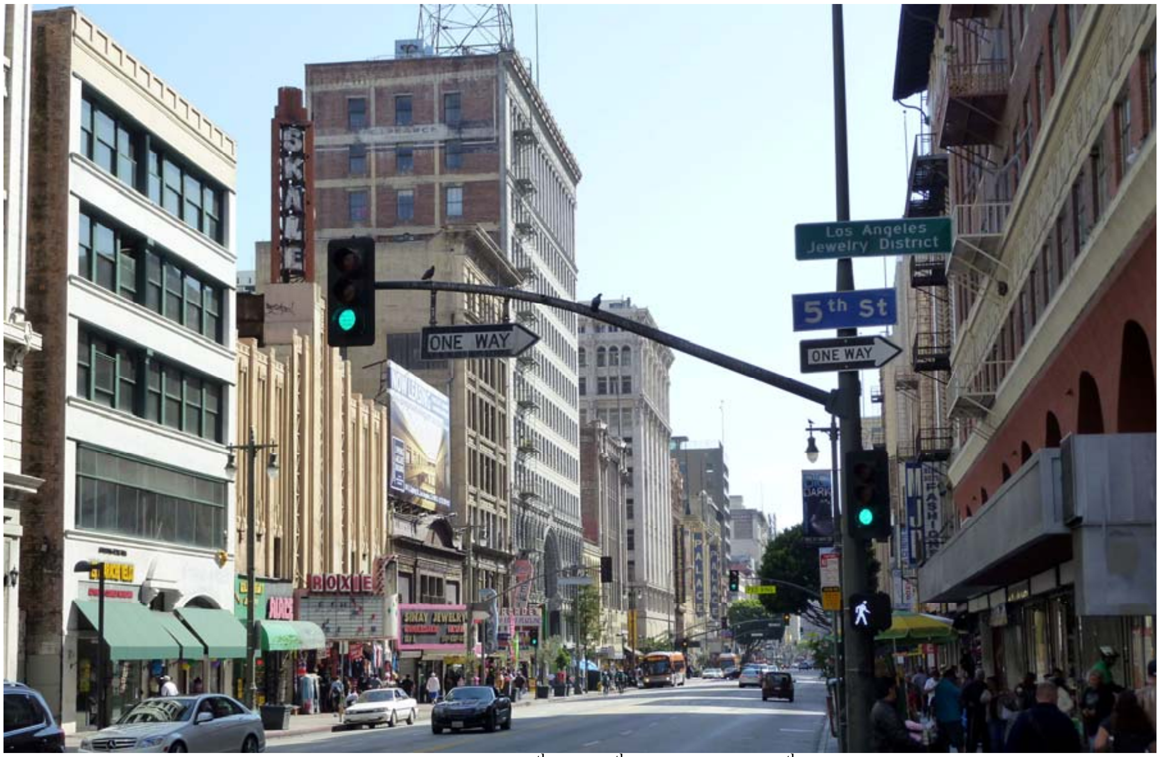

Figure 67: Looking south on Broadway towards 6th and 7th Streets from 5th Street, Los Angeles (author's photograph, May 13, 2012).

Since the intersection of Broadway and 7th Street is the most important point within the largest area of 100% centrality scores under the most detailed analysis of the Wilshire/Santa Monica Corridor, itself the only region scoring at 100% centrality under the metropolitan-wide analysis, I therefore assert that Broadway and 7th is the most central point in Los Angeles.

Based on the underlying structure of the Wilshire/Santa Monica Corridor

The second suggestion, Wilshire and Santa Monica, is based on the fundamental structure of the Wilshire/Santa Monica Corridor as a singular unit, rather than on a consideration of centrality score variation within the corridor. As described above, it is clear that the primary structural backbones of the Wilshire/Santa Monica Corridor are provided by Wilshire and Santa Monica Boulevards. Since these streets do intersect, their intersection could be seen as the most important point in the center of Los Angeles, structurally.

I speculate that the importance of this point has been overlooked since it falls outside the city limits of Los Angeles - it is in the city of Beverly Hills. But falling in Beverly Hills is not necessarily a detriment to its centrality, since Beverly Hills arguably serves as the metropolitan region's most significant and well-known retail center. The intersection is also adjacent to Century City, which is one of the region's major employment centers.

In addition to marking the intersection of the region's two most important streets, this point also marks a major break in surface-street continuity within the Wilshire/Santa Monica Corridor. The street grid west of this intersection is generally oriented at an oblique angle while streets east of here are generally oriented to the compass. Furthermore, the Century City area, in conjunction with the golf courses to the north and south of it, creates a major break in east-west street continuity through which this intersection is one of only a small number of gateways (Figure 68).

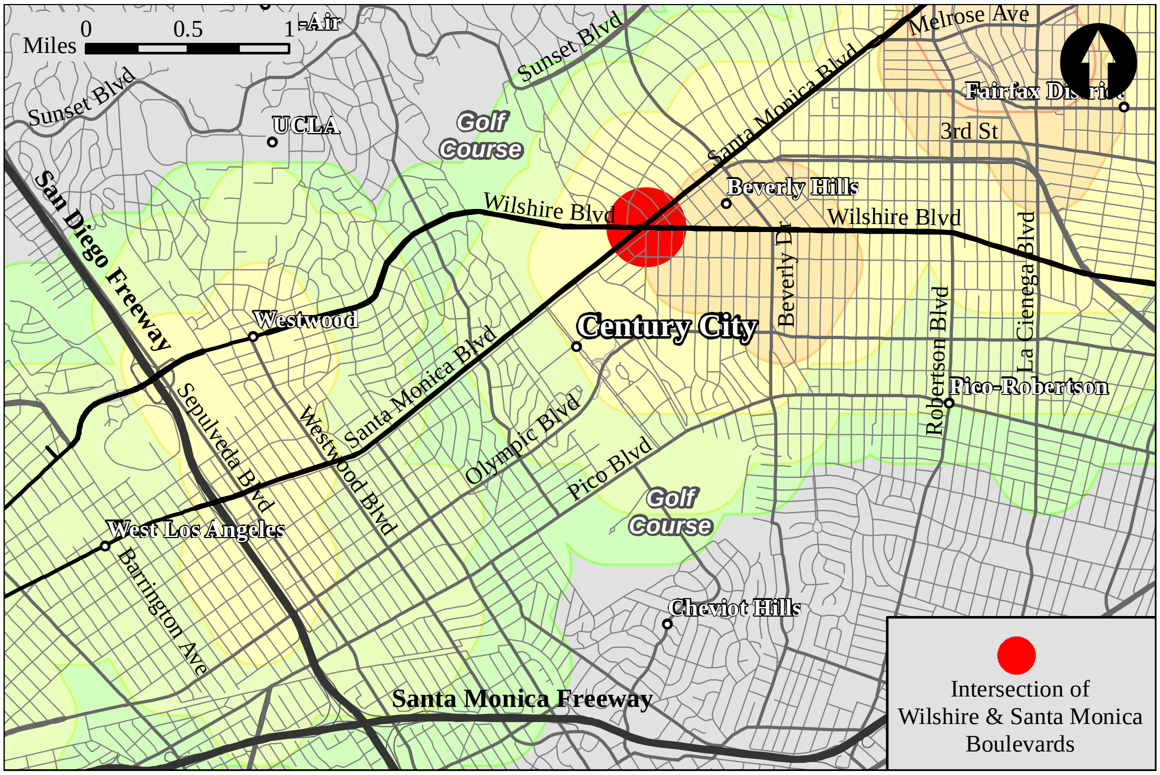

Figure 68: A major break in east-west street grid continuity at Century City (streets & freeways: Esri).

The only other gateways through this break and within the Wilshire/Santa Monica Corridor are along Olympic Blvd and along Pico Blvd; there are no minor streets within the corridor which breech the break in continuity, and the nearest routes around the break to the north and south are along Sunset Blvd or on the Santa Monica Freeway (there are a few convoluted minor residential street routes through the Cheviot Hills between Pico and the freeway).

Since the Wilshire/Santa Monica Corridor exhibits a narrow east-west shape which passes directly through this major break in street continuity, and since the break occurs near the center of that east-west extent, the few gateways through the break are especially structurally important. Therefore, while also considering Wilshire and Santa Monica Boulevards' overall structural importance to the corridor, I assert that the intersection of Wilshire and Santa Monica Boulevards is structurally the most important point in the Wilshire/Santa Monica Corridor, and by extension the most central structural point in Los Angeles as a whole.

5.7 Further research

5.7.1 Analysis arrays

Constituents of the union array

The union analysis appears to be sensitive to the number of cell array inputs and to their cell sizes. Adding the 0.8km analysis to the union array, for example, might have drastically reduced the areas with the highest centrality scores. It would be useful to experiment with different cell sizes and with differing numbers of analysis arrays in order to find the most appropriate mix. It would also be useful to more formally explore the spatial relationships between the centrality score and facts on the ground in order to better understand its meaning and to more carefully select centrality score class levels for visualization.

Amenity corridors

This analysis method seems to capture regions of amenities well but not corridors of amenities. For example, Ventura Boulevard, which is indicated by the dense corridor of restaurant points beginning between Hollywood and North Hollywood and extending to the northwest in Figure 29 above, is an important corridor for the San Fernando

Valley. It is arguably the Valley’s center, albeit a linear center rather than a point center. But Ventura Blvd did not register very well under this analysis.

The 2km analysis array seems detailed enough to have captured the Ventura corridor (figures 31, 32, & 54 above) but it drops out of some of the larger analysis cell results (figures 33 & 36, also above) and consequently shows up with limited clarity in the union analysis (Figure 52, again, above). It also does not register at all under the 0.8km analysis (Figure 59 above), probably because the cells are too small to form clusters with other amenity-rich areas across the river and freeway to the north. It would seem, then, that the ability of hexagonal cells to capture a linear cluster depends on the size and arrangement of the cells.

Another important amenity corridor which failed to register under the 0.8km analysis is that of Sunset Boulevard through Silver Lake and Echo Park. The gap in centrality scores here is shown in Figure 61 (above), but the existence of a corridor of amenities is implied by the trail of restaurants shown in Figure 29 (above). In practice, this corridor along Sunset Boulevard seems to connect the upper (Santa Monica Blvd) branch of the Wilshire/Santa Monica Corridor through the hills in those neighborhoods and into Downtown, thus closing the amenity corridor loop at both ends. If Sunset Boulevard truly does serve this function, its absence from these results is notable. Since amenity corridors are important structural elements in any city, it would be useful to devise a better method of capturing them.

5.7.2 Amenity inputs

Amenity categorizations

Informal experiments conducted before and during this analysis indicate that differing groupings of particular amenity types into amenity categories have little impact on the final centrality score, even though they can yield interesting spatial variations in the category-specific cluster scores. It would be useful to explore the spatial patterns of these category-specific cluster scores in order to gain a more nuanced understanding of how amenity clusters combine to create centrality.

For example, one place with a 75% centrality score may have achieved that score mostly through clusters of restaurants and high culture while another place with the same score may have participated mostly in clusters of hotels and entertainment. Exploring these spatial variations would increase our understanding of urban centrality and help us to construct more useful categories of amenities.

Institutions

This analysis did not account for the role of institutions in urban structure, but institutions arguably serve as vital a role as other amenities in attracting visitors, propagating local culture, and defining a sense of place. Some examples of institutions that could be included in future analyses are: churches, hospitals, colleges, and movie studios. For example, the gap in centrality scores found in the Wilshire/Santa Monica Corridor north of Koreatown and south of Los Feliz (Figure 61 above) occurs over an area of East Hollywood containing some large institutions, including Paramount Studios, Raleigh Studios, Los Angeles City College, and the Braille Institute. These physically-large institutions preclude clusters of other amenities from forming there, which may account for the gap in centrality scores under this analysis. If institutions were included in the analysis, the Wilshire/Santa Monica Corridor might be shown to be contiguous through that area.

Consumerism

While not considered as an urban amenity input under this analysis, the experience of discretionary shopping trips is arguably a similar activity to that of enjoying urban amenities, one which may even have more of an impact on the subjects of the experience. Given this similarity in experience, the importance of retail trade to cities, and the significance of consumerism and consumption to our culture, it would be useful to add discretionary shopping to the analysis. Experiments with the broad NAICS category of 448, “Clothing and Clothing Accessories Stores”, indicate broadly similar spatial patterns to the amenity categories in this analysis which nevertheless differ in notable ways. Adding discretionary retail to the mix of amenities would therefore strengthen this analysis.

For example, there is a small gap in the Wilshire/Santa Monica Corridor on Melrose Avenue between La Brea and Fairfax Avenues (Figure 60 above). In person, this stretch of Melrose seems far from non-central; it is one of the most active streets in the area. Instead, this portion of Melrose is so saturated with clothing stores that there are virtually no other amenities there.

This lack of other amenities caused this part of Melrose to drop out of all the clusters in the 0.8km analysis. Since centrality was defined as coincident clusters of differing amenities, it is probably appropriate that this area was not highly represented. But given its high activity and cultural significance, it probably should not be excluded altogether from the Wilshire/Santa Monica Corridor. Experiments with NAICS category 448 show that this part of Melrose would have been included in the final center had category 448 been a part of the analysis. Interestingly, category 448 also strengthens the centrality of the Fairfax District more broadly, as well as that of Downtown, relative to other parts of the Wilshire/Santa Monica Corridor. This category was not included in this analysis because none of the cited amenity-focused authors specifically mentioned clothing stores, but there is much available research that would support such an inclusion.

Employment and other indicators

Although I suspect that employment may no longer be a reliable indicator of centrality, it would be interesting to attempt to add employment to this analysis as another clustering amenity category or to somehow overlay amenity clusters on the employment centers defined by others, given the wide body of knowledge on using employment to delimit urban centrality. It would also be interesting to combine these amenity- and employment-centered approaches with the industry agglomeration, edge city, and visual methods (such as using topography and building heights) also mentioned above in order to achieve a broad and inclusive vision of urban centrality as seen from multiple viewpoints.

5.7.3 Ethnic centers in Los Angeles

One of Los Angeles’s greatest strengths is its vast array of large and vibrant ‘ethnic’ centers such as Koreatown and East Los Angeles. Many of these ethnic centers are important participants in the formation of the Wilshire/Santa Monica Corridor (Figure 61 above), including Koreatown, Westlake (a Central American center), Little Tokyo (in Downtown), Chinatown, Thai Town (along Hollywood Blvd just west of Los Feliz), and the Jewish neighborhoods in Fairfax and Pico-Robertson. Since Whites are also a minority in the Los Angeles metropolitan area (quickfacts.census.gov), much of the rest of the Wilshire/Santa Monica Corridor, notably Santa Monica, Westwood, Beverly Hills, and the Fairfax District, could be described as White ethnic centers (for a comprehensive set of maps and descriptions of Los Angeles's ethnic neighborhoods, see Allen & Turner, 2002).

Aside from these places in the Wilshire/Santa Monica Corridor, some ethnic centers in other areas attain high centrality scores under the union analysis as well (Figure 53 above), including Crenshaw and Leimert Park (Black), Glendale (Armenian), Santa Ana (Mexican), and North Hollywood and Van Nuys (Central American). However, many more of the region's ethnic neighborhoods do not score particularly highly under the union array and do not register well at all under the 2km array (Figure 54 above). These underrepresented ethnic centers notably include Monterey Park and Alhambra (Chinese), Little Saigon, and East Los Angeles (Mexican).

As mentioned in the context section above, there are presumably different core centers for different ethnic groups, but the theoretical framework for this analysis also presumes there to be a common center which may not be 'primary' from everyone's point of view but which is at least a small shared part of most metropolitan residents' common experience. Bearing this concept of centrality in mind, it stands to reason that some ethnic centers would score less highly overall than others. It is also not especially surprising, given this nation's history of racial power dynamics, that the overall regional center would significantly coincide with a White center.

But it is still troubling that the analysis results do not represent all of the ethnic neighborhoods as well as might have been expected. It is possible that the methodology precludes the identification of certain ethnic centers which may be constituted by a different set of amenities or which may operate on a different kind of centrality altogether. It would be useful, then, to explore the ways in which different ethnic neighborhoods are structured in order to develop methods that could better capture the diversity of centrality in Los Angeles.

5.7.4 Further applications

Peripheral centers in Los Angeles

I have offered only a cursory discussion of the peripheral centers identified by this study in Los Angeles, but there is much detail and nuance to be found in the centrality score classes in the peripheral areas under both the union array (Figure 53 above) and the 2km array (Figure 54 above). These details could support a full discussion of the region's subcenters, especially if they were to be discussed in conjunction with an accounting of the region's many ethnic centers as mentioned above.

Delimiting the centers of other cities

Once this methodology is refined a bit according to the suggestions put forward above, it would be useful to make a programmatic application of the analysis to all of the nation's metropolitan areas. The resulting catalogue of spatially-delimited postmodern urban centers would provide a base for enhancing our present understanding of urban structure and sense of place, and would offer a useful alternative narrative to that of the prevailing employment-centered approaches. It would also be useful to adapt this technique for application in other regions of the world whose cities may function slightly differently and where the available data is sure to be differently structured, in order that we might enhance our understanding of urban structure from a more global point of view.

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