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# Comparing geostatistical analyses for the identification of neighborhoods, districts, and social communities in archaeological contexts: A case study from two ancient Maya centers in southern Belize

Amy E. Thompson*, Clayton R. Meredith, Keith M. Prufer

*Department of Anthropology, University of New Mexico, United States of America*

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ABSTRACT

Ancient communities are composed of social units at varying scales although these units and the geospatial methods used to define them are rarely discussed in the archaeological literature. Recent studies emphasize the presence of neighborhoods and districts in low density urban communities, increasing the need for more discussion on how these units are defined and measured. We use new and previous field and remote sensing settlement survey data of two Classic Period (AD 300–900) Maya centers located in southern Belize, Uxbenká and Ix Kuku'il, and compare several geostatistical and geospatial methods to identify the presence of neighborhoods and districts. We found that results vary based on the method and linkages they use, therefore the methods used in similar analyses will significantly impact the archaeological interpretations of settlement distributions. Using multiple methods for the identification of neighborhoods, districts, and social units within archaeological contexts enables more holistic interpretations of settlement distributions.

## 1. Introduction

Using geostatistical analyses to recognize social groups in the archaeological record has increased our understanding of how people organized themselves across the landscape. Identifying neighborhoods and districts, as well as smaller social units (i.e. kin-groups) within ancient communities represents a challenge to reconstructing social relationships (Hare and Masson, 2012) but remains significant to understanding and interpreting ancient social organization as communities were "usually divided into small and larger units directly under the control of certain individuals" (Kurjack, 1974: 6). Analyses of larger scale settlement patterns integrated with household archaeology allow archaeologists to form a more complete picture of the complex society evolution (Ashmore, 1981; Earle and Kolb, 2010; Tourtellot, 1983) and to comparatively examine the spatial and temporal relationships between communities (Bevan and Conolly, 2006; Bevan et al., 2013a; Canuto and Bell, 2013; Fash, 1983; Hassan, 1978; Hutson et al., 2016b). The study of interactions between residential groups and sociopolitical organization is an integral part of understanding modern urban landscapes and is relevant to ancient and modern societies alike.

In this study, we employ several geostatistical methods for the identification of clustered settlements that we interpret as social communities including neighborhoods and districts, using datasets from two well documented ancient Maya centers in southern Belize, Uxbenká and Ix Kuku'il. We use survey and geospatial data to analyze differences in settlement patterns and distributions of households across a landscape and link them to potential reasons for why such differences may occur within similar geographic and temporal settings. Specifically, we ask, 1) *How do different geostatistical analyses reflect scales of community interactions and distributions?* And, 2) *Are there differences in settlement distributions across the landscape at two contemporary Late Classic communities? If so, what causes the differences in settlement patterns?* Differences in settlement patterns reflect variations and changes in community development and organization across both space and time, which are influenced by both local environments, shifts in leadership strategies, and the time of site foundation; through the comparison of intraregional settlement patterns, we explore variations and diversity in semi-urban developments between two ancient Maya communities located only 6.7 km apart in similar geophysical landscapes in the southern foothills of the Maya Mountains (Fig. 1).

### 1.1. Settlement density and neighborhood analyses in Mesoamerica

The observance of socially and spatially defined neighborhoods and districts in archaeological contexts is relatively recent (Arnauld et al., 2012a; Hutson et al., 2016b; Smith and Novic, 2012; Smith, 2010,

* Corresponding author.
*E-mail address:* athomp04@unm.edu (A.E. Thompson).

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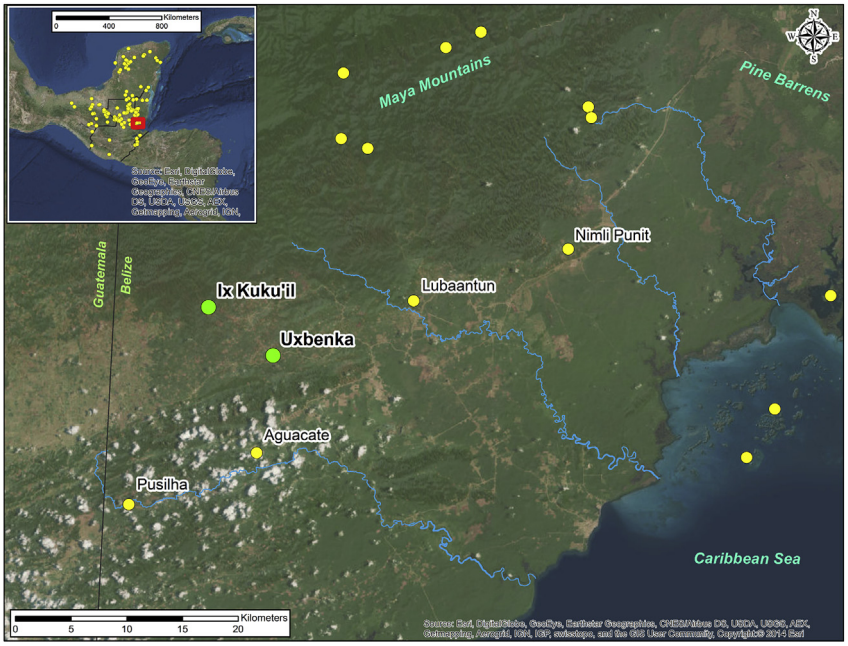


**Fig. 1.** Map of southern Belize showing regional ancient Maya centers. Sites mentioned in the text are labelled with an emphasis on Ix Kuku'il and Uxbenká.

2011), but is gaining popularity and driving settlement research to holistically discuss changes in ancient urban and peri-urban landscapes. Neighborhoods are defined as social groups that interact face-to-face on a daily basis and have distinct social and physical characteristics (Smith, 2010, 2011), or have "day-to-day socioeconomic relationships" (Arnauld et al., 2012b: 205). Densely-settled urban centers with multi-room buildings in Mesoamerica, such as Teotihuacán (Gomez-Chavez, 2012; Manzanilla, 2012; Millon et al., 1973; Widmer and Storey, 2012) and Tenochtitlan (Smith, 2010), as well as neighborhood studies across larger landscapes within low-density urban communities have been focal areas of recent studies (e.g., Rio Bec [Arnauld et al., 2012b], Copan Valley [Hendon, 2012], La Joyanca [Lemonnier, 2012], Mayapan [Hare and Masson, 2012], Uxbenká [Prufer et al., 2017a; Prufer and Thompson, 2014], Buena Vista del Cayo [Peuramaki-Brown, 2014], Baking Pot [Bevan et al., 2013a; Hoggarth, 2012], Blue Creek [Houk and Zaro, 2015], Chan Chich [Houk and Zaro, 2015], Chunchucmil [Hutson et al., 2016b], and Caracol [Chase, 2016]). However, with few exceptions such as recent research at Chunchucmil (Hutson et al., 2016b), these studies rarely describe which methods were used to identify or classify archaeological neighborhoods nor compare the distribution to contemporaneous settlements associated with other political centers located within the larger geophysical/geopolitical landscape or incorporate discussions of multi-scalar communities, such as districts which are composed of multiple neighborhoods.

Districts can include higher-status residences and typically incorporate significant investments in landscape alteration, and/or public political or religious architecture (Chase, 2016; Prufer et al., 2017a; Smith, 2010, 2011). Districts have political, economic, and religious functions and are sociopolitical centers of gravity for nearby neighborhoods. A few studies have compared material culture (Jordan and Prufer, 2017) including architectural variation (Fash, 1983; HutsoHutson et al., 2016b; Lemonnier, 2012) between neighborhoods and districts. Similarly, comparative geostatistical analytical methods in these regards are not often discussed.

In archaeological research, the spatial identification of neighborhoods and districts are used in discussions of social groupings; however, in general, neighborhood analysis is still relatively understudied with little in-depth analysis or interpretation (Smith, 2011: 52). Although neighborhoods have been identified at several ancient Maya centers (see above), the presence of distinct district centers has seldom been discussed in the Maya region, with the exception of Caracol (Chase, 2016), Chunchucmil (Hutson et al., 2016b) and Uxbenká (Prufer et al., 2017a) [though other scholars allude to these ideas]. Studies of settlements as social units in the Maya lowlands are increasingly common (Arnauld et al., 2012a; Ashmore, 1981; Ford and Fedick, 1992; Healy et al., 2007; Lohse and Valdez, 2004; Montmollin, 1995; Robin, 2003; Willey, 1965), however, they uncommonly incorporate geospatial and geostatistical analyses of neighborhoods and districts to illustrate settlement histories, or to link those locations to critical resources in their local environment. The dearth of geostatistical data on emerging neighborhoods may be, in part, due to the lack of robust chronological histories among settlement groups, full-coverage settlement survey in the region (see Prufer et al., 2017a), or the fact that temporal equivalency often does not directly correlate with spatial proximity (Hare and Masson, 2012; Hendon, 2012); however, advances in remote sensing technology, such as lidar, have the ability to rapidly change survey coverage and the identification of archaeological features across the landscape (Chase et al., 2011, 2012, 2014, 2016; Chase and Weishampel, 2016; Doneus et al., 2008; Ebert et al., 2016; Evans et al., 2013; Golden et al., 2016; Harmon et al., 2006; Hutson et al., 2016a; Lasaponara et al., 2011; Loughlin et al., 2016; Macrae and Iannone, 2016; Magnoni et al., 2016; Prufer et al., 2015; Reese-Taylor et al., 2016; Rosenswig et al., 2013; Štular et al., 2012; Thompson and Prufer, 2015; Yaeger et al., 2016).

In contrast, we test for the presence of clustering of ancient households using several different statistical analyses in our study. None of these analyses directly accounts for the chronology of the settlement groups, but rather focuses on their broader geospatial location across the larger geopolitical landscape during the same broader time period. All households at both Classic Period Maya centers, Uxbenká and Ix Kuku'il, have Late Classic (AD 600–800) components (Prufer et al., 2017a,b; Thompson and Prufer, 2016). Thus these analyses are focused on geospatial differences between centers based on the Late Classic landscape.

### 1.2. Regional background

Southern Belize is located in the southeastern Petén and is geographically circumscribed with swampy *bajos* to the south, the Caribbean Sea to the east, unfavorable pine forests to the northeast, and