SAA
SOCIETY FOR AMERICAN ARCHAEOLOGY

REPORT

A Closer Look at Classic Maya Urbanism at Dzibanche/Kaanu'l through Airborne Lidar Mapping

Francisco Estrada-Belli[1] (iD) and Sandra Balanzario[2]

[1]Middle American Research Institute, Tulane University, New Orleans, LA, USA and [2]Centro INAH-Quintana Roo, Chetumal, Quintana Roo, Mexico
Corresponding author: Francisco Estrada-Belli; email: festrad1@tulane.edu

Abstract

A 103 km^2 aerial lidar survey of Dzibanche/Kaanu'l, Mexico, reveals the city's settlement to be more populous and well-organized than previously thought. The sprawling settlement incorporated the early center of Ichkabal in a network of smaller peri-urban civic-ceremonial nodes. The density and complexity of the Kaanu'l settlement is consistent with its extraordinary political reach as a multiregional hegemonic state. The city and settlement grew to their maximum extent during the Early Classic period until AD 630. The lidar-derived data show that Dzibanche may have had the largest monumental zone and highest population density in the Maya Lowlands at that time. The Early Classic layout was unaltered by later construction, allowing us to document a well-developed system of causeways connecting an urban center and peripheral plaza groups with surrounding settlements and agricultural fields. The spatial organization and interconnectedness of this Early Classic settlement suggests a greater level of urban planning for optimal flow of goods and people across urban and peri-urban zones than previously thought.

Resumen

Un levantamiento lidar de 103 km^2 alrededor de la zona arqueológica de Dzibanche/Kaanu'l revela un asentamiento más denso y mejor organizado de lo que se pensaba anteriormente. El asentamiento periurbano incorporó el centro Preclásico de Ichkabal en una red de conjuntos cívico-ceremoniales periurbanos menores. La extensión, densidad y complejidad del asentamiento Kaanu'l son consistentes con su extraordinario alcance político como estado hegemónico multirregional. La ciudad y el asentamiento periférico alcanzaron su máxima extensión durante el período Clásico temprano hasta aproximadamente el año 630 dC. Los datos lidar y de excavación sugieren que en esa época Dzibanche fue la ciudad con la zona monumental y población más densa registradas en las tierras bajas mayas. La organización espacial y la interconexión de este asentamiento del Clásico temprano sugieren un nivel de planificación urbana de parte de las elites mayor a lo que se pensaba anteriormente para optimizar el flujo de bienes y personas tanto en zonas urbanas como periurbanas.

This special section brings together new archaeological and epigraphical data on the Classic Maya Kaanu'l kingdom, a hegemonic state in the Maya Lowlands between AD 400 and AD 751. This collection of articles is the outcome of a symposium on the Kaanu'l held in April 2024 at the 89th Annual Meeting of the Society for American Archaeology in New Orleans. Much of the information presented here updates recently published material (e.g., Estrada Belli et al. 2024).
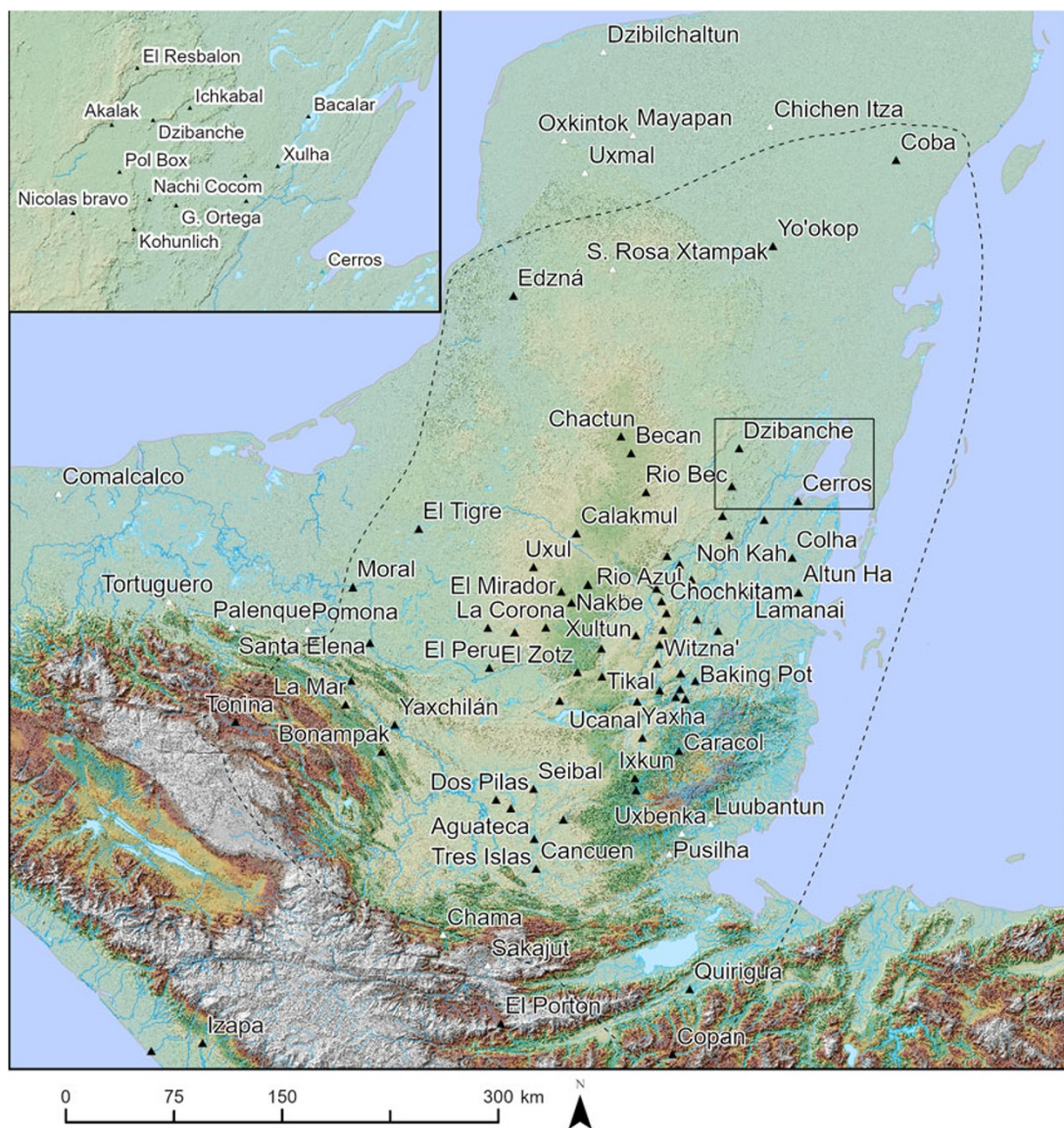
Figure 1. Map of the Maya Lowlands showing the putative extent of the Kaanu'l hegemony at its peak in AD 700–750 (dotted line; image by Francisco Estrada-Belli). (Color online)

A large corpus of inscriptions mentions the Kaanu'l as overlords of other lowland kings. Texts at Dzibanche reveal that the Kaanu'l dynasty began establishing hegemonic relationships with other lowland kingdoms as early as AD 400 (Tokovinine et al. 2024; Velásquez 2004), although the economic implications of such relationships remain obscure. By AD 700 the Kaanu'l had extended their reach, either by diplomacy or military incursion, over much of the Yucatán Peninsula, including among their vassals some of the most powerful southern kingdoms, such as Caracol in Belize and Waka, Naranjo, and Tikal in northern Guatemala. Their kings were also mentioned for relatively brief periods as far north as Coba, as far south as Quirigua and Copan, and as far west as Palenque (Canuto and Barrientos 2011; Martin 2020; Martin and Grube 1995, 2008; Sharer and Traxler 2006; Tsukamoto and Esparza Olguín 2015; Figure 1).

Figure 2. The Cormoranes pyramid platform is decorated with talud-tablero and temple walls with double semi-columns. The three open tombs were covered by a late stairway, later demolished (image from photogrammetry by Francisco Estrada-Belli). (Color online)

Textual data on the Kaanu'l kingdom come largely from the last century of the hegemony, between AD 630 and 730, when the capital was located at Oxtetun Chiknab, the archaeological site of Calakmul (Martin 1997; Stuart and Houston 1994). As a result, much information about the hegemony is skewed toward this late period and to Calakmul as its capital. Much less is known about the initial period, between AD 300 and 600.

Due to this bias in our data, the terms Kaanu'l and Calakmul have been used interchangeably, obscuring the fact that Dzibanche was the capital of the Kaanu'l dynasty long before and after Calakmul. This special section brings together recently unearthed evidence from Dzibanche and other lowland sites to correct this bias. The Kaanu'l, also known as the Snake dynasty, owes its name to a snake-head emblem glyph, which Marcus (1973) first associated with the archaeological site of Calakmul.

Decades later, a hieroglyphic stairway bearing the name of a ruler associated with the snake-head glyph was unearthed at Dzibanche by Instituto Nacional de Antropología e Historia (INAH) archaeologist Enrique Nalda (2004; Velásquez 2004). In 2016, epigraphic work by Martin and Velásquez (2016) demonstrated that the snake emblem glyph, read as Kaanu'l ("place of snakes"), served as the dynasty's title and as a place name for its city, Dzibanche.

Additional work at Dzibanche and elsewhere further challenged previous theories that placed the origin of the dynasty elsewhere (Barrientos et al. 2024). An early Classic stela, unearthed by Nalda's project at Dzibanche, places the Kaanu'l eighth ruler at Dzibanche around AD 380, earlier than at any other lowland site (Tokovinine et al. 2024). This report will focus on Dzibanche/Kaanu'l's urban features through the analysis of aerial lidar maps.

Previous Work

In 1987, INAH's archaeologist Enrique Nalda, initiated the first large-scale excavations at Dzibanche, Kohunlich, and Ichkabal (Nalda 2000; Nalda and Balanzario 2001–2009, 2010; Nalda and Balanzario Granados 2014; Nalda et al. 1999). His excavations, while extensive, focused on only a few of the major buildings at Dzibanche and its residential zone. This research revealed a distinctive architectural style associated with the dynasty combining tall roof combs, exterior walls decorated with semicolumns, and Teotihuacan-style talud-tablero terraces (Figure 2; Nalda and Balanzario Granados 2008).

Dzibanche/Kaanu'l's Urban and Peri-urban Settlement Features

In the settlement zone to the north and east of the urban core, Nalda (2000:65) noted an extensive zone of walled enclosures that he believed represented land partitions. These enclosures range in size between 0.5 and 1.0 ha near the urban zone and have long been associated with household agriculture (e.g., Hutson et al. 2021; Turner 1974). Their average area increases in the outer, less densely settled areas to 2 ha or more in some cases (Figure 3). The absence of such features and spaces for cultivation within Dzibanche's urban zone (Figure 4) further supports the notion that agricultural fields in the peri-urban
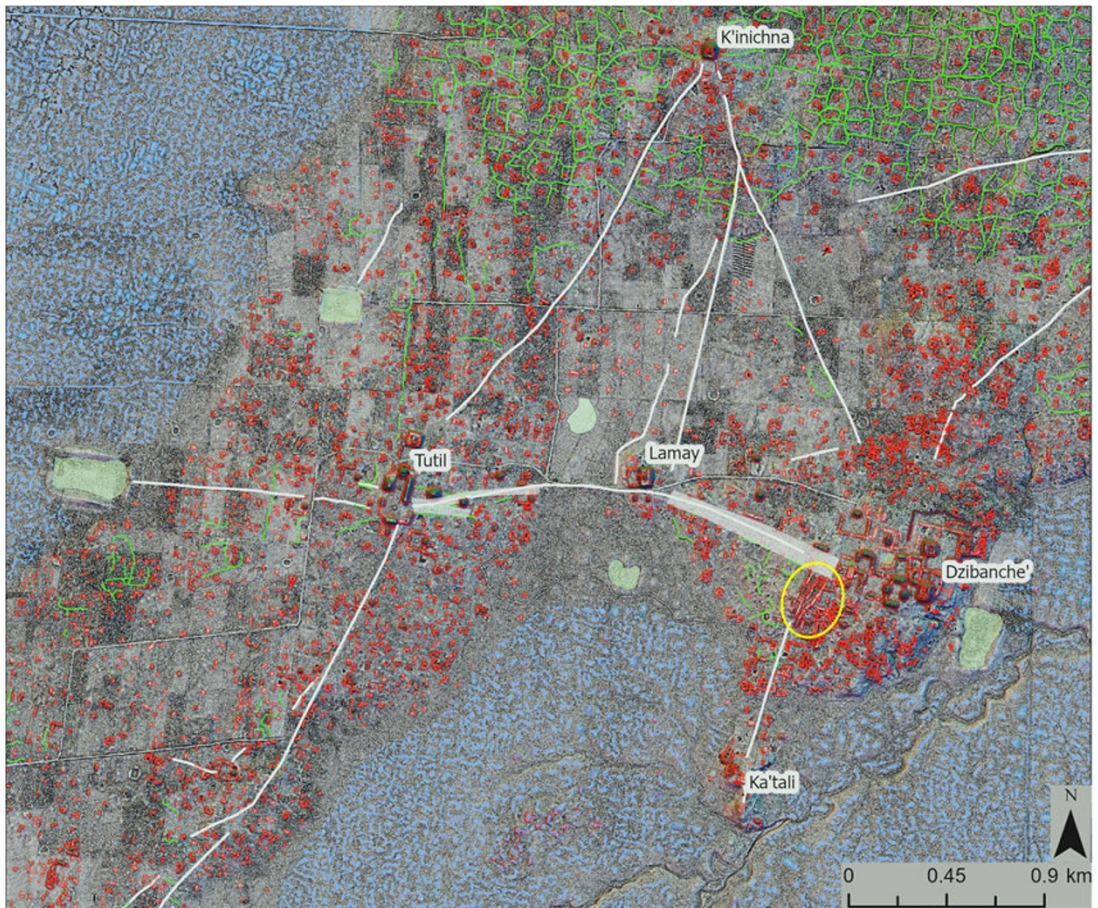
Figure 3. Lidar map of Dzibanche's urban core. Key: structures (red), causeways (white), field enclosures (green lines), monumental reservoirs (green polygons), wetland fields (blue), and central market (yellow oval) (lidar data by INAH, digital features and image by Francisco Estrada-Belli). (Color online)

and rural zones, including wetland cultivation, likely supported the population of adjacent urban centers (Canuto et al. 2018).

Dzibanche's settlement occupies an upland ridge surrounded by two seasonal wetlands. The Cerro de la Tortuga stands halfway between Dzibanche and the large Preclassic center of Ichkabal. A lidar survey carried out in 2017 for INAH over a rectangular area of 103 km² revealed several causeways connecting the two major monumental centers with other minor ceremonial plaza groups and associated settlement clusters as far east as Mario Ancona 15 km to the northeast of Dzibanche, and Pol Box, the seat of a separate Early Classic kingdom, 12 km to the southwest (Balanzario and Estrada-Belli 2021; Estrada Belli et al. 2024). El Resbalon, located 15 km to the north and not connected by causeway, was an early Kaanu'l vassal as well.

Additional causeways formed a network of well-connected minor ceremonial centers around Dzibanche. We believe that the Kaanu'l heartland may have extended further afield to include the minor centers of Nicholas Bravo, Gonzales Ortega, and Ucum about 30 kms away, based on similarity in ceremonial architecture.

Quantitative analysis of the 2017 lidar-derived structure data provides a preliminary baseline to place Dzibanche in a comparative context with Tikal, one of the largest Classic Maya cities for which compatible data are available. The 2017 lidar-derived structure data show the highest density ranging between
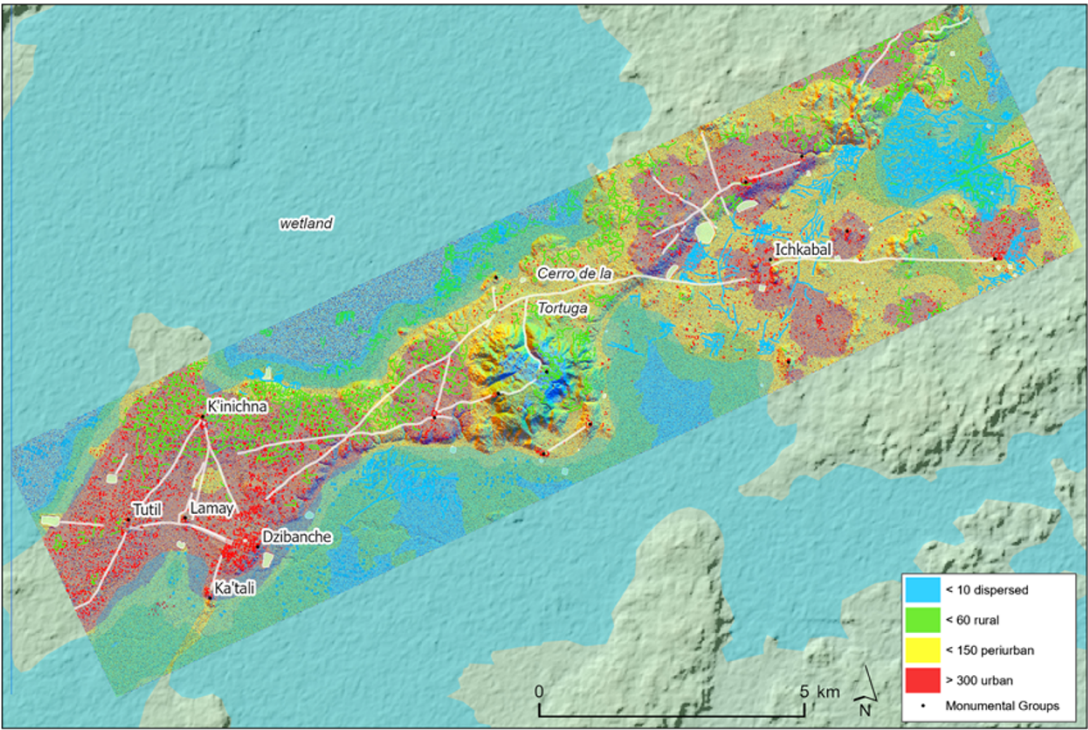
Figure 4. Structure density zones and upland (green lines) and wetland (blue lines) features identified on lidar maps in the Dzibanche/Ichkabal survey zone. The two upper categories of urban and urban core used in Canuto et alia (2018) have been conflated for simplicity (lidar data by INAH image by Francisco Estrada-Belli). (Color online)

Table 1. Dzibanche and Tikal's Structure Density and Population Estimates Compared (when considering only upland terrain, Dzibanche exhibits approximately three times the structure density of Tikal).

City	Survey area (km^2)	Structures	Avg. (str/km^2)	Upland area (km^2)	Structures in uplands	Avg. upland (str/km^2)	Low pop. estimate (Pop. Index 2.55)	High pop. estimate (Pop. Index 3.97)
Dzibanche	103	**13,928**	**136**	40	11,764	**294**	35,516	55,294
Tikal	102	**9,347**	**91**	84	9,312	**111**	23,834	37,107

300 and 797 strs/km^2 around Dzibanche's four monumental complexes (Figure 4). This urban zone measures 15 km^2 in area, while Tikal's urban-density zone measures 11 km^2, with a peak spot density of 550 strs/km^2 (Canuto et al. 2018:Table 8).

Overall, there are 13,928 structures in the 103 km^2 Dzibanche lidar survey resulting in an average overall density of 136 strs/km^2. By comparison, in an equivalent area of the 2016 lidar survey of Tikal we identified 9,347 structures and an average density of 91 strs/km^2. As shown in Table 1, the topography of Tikal includes primarily uplands suitable for settlement. In the Early Classic period, Dzibanche was apparently much denser and more populous, with a population between 36,000 and 55,000 estimated with standardized parameters widely used in pre-lidar surveys (Canuto et al. 2018:Tables 5 and 8). In both cases broader lidar coverage will be necessary to assess the full extent of each city.

Based on Nalda's and more recent excavations by Balanzario, Dzibanche reached its peak in construction activity in the monumental and residential areas in the mid-seventh century, until AD 636 when the dynasty moved to Calakmul. Tikal, however, did not reach its population peak until AD 700–750. Based on what is known today about Tikal's Early Classic settlement and monumental zone, it was significantly smaller than Dzibanche during that period.
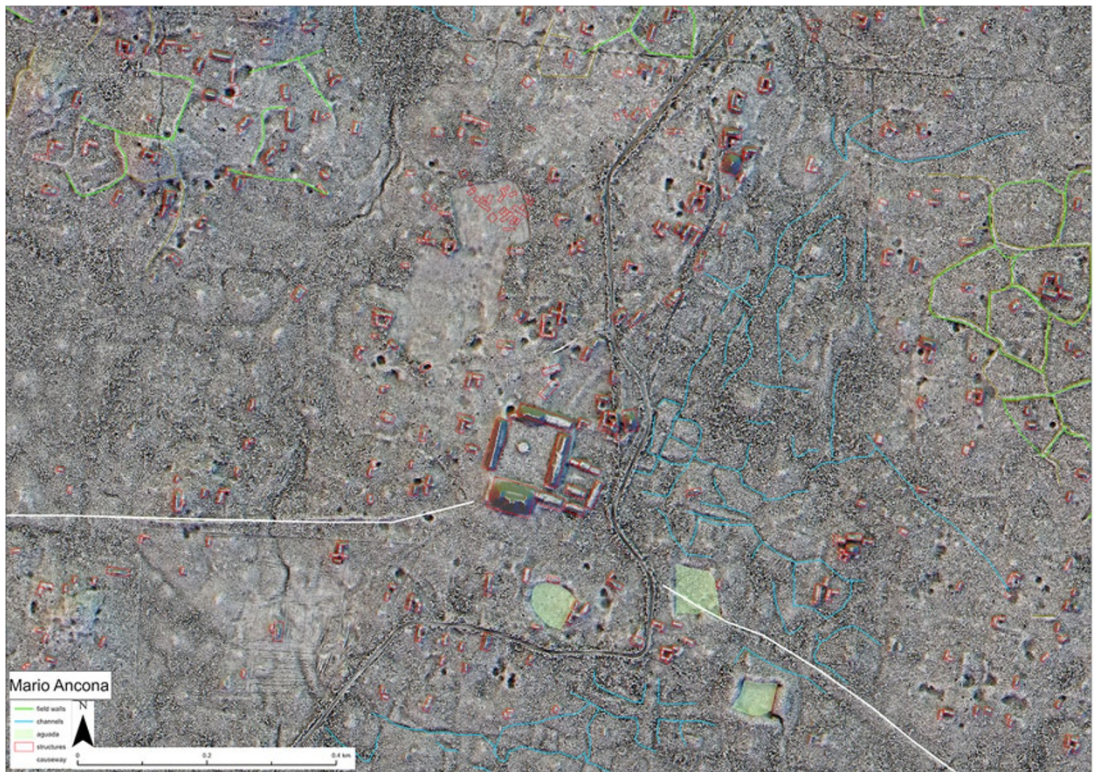
Figure 5. The elite plaza group of Mario Ancona with possible market next to the plaza, associated clustered settlement, and upland and wetland fields. (Color online)

A direct comparison of Dzibanche's Early Classic and Tikal's Late Classic monumental zones and causeway systems reveals similar triangular layouts but also a staggering difference in scale of 2:1 (Estrada Belli et al. 2024:Figure 6). The Dzibanche layout dates to the Early Classic so it is likely that Tikal's Late Classic (AD 600–900) triangular causeway-and-monumental complex layout may have been inspired by the rival city plan.

Dzibanche had at least one major market, identified by a collection of elongated low-profile platforms arranged in parallel rows at the terminus of the Avenue of the Kings, the 100 m wide causeway entering the Main Group (Figure 3; Estrada Belli et al. 2024:Figure 8). Two ball courts were adjacent to it. In addition to this central point of exchange for the city, there were several large elite plazas scattered throughout the hinterland that may also have served as local markets.

Recent lidar-aided settlement analyses at Caracol and elsewhere in the Maya Lowlands have revealed networks of plaza groups that may have functioned as marketplaces hosted by local elites, as well as administrative centers (Chase et al. 2020; see also Ruhl et al. 2018). Around Dzibanche there are 17 plaza groups that qualify as potential district marketplaces with large plaza areas, elite architecture, ball courts, causeways, and associated settlement clusters.

Within the 2017 survey zone, 91% of the population resided within 2 km of a large plaza group, allowing for daily access (Figures 4 and 5). The surrounding land parcels, averaging 1 ha, were arranged in radiating patterns, suggesting the elite may have played a role in land allocation within their settlement clusters or neighborhoods

Finally, Dzibanche's remarkable urban planning is further highlighted by the spatial distribution of its monumental reservoirs. Across the entire surveyed settlement, 100% of the population lived within 1.5 km of one of 36 monumental reservoirs. This suggests that the reservoirs, averaging 4.5 ha in area, were built to supply water for the entire community, not just the urban elite as may have been the case at

Tikal (Scarborough and Gallopin 1991:661). Constructing these required the coordination of massive labor efforts.

Conclusions

INAH's 2017 lidar survey reveals that the Kaanu'l capital may have been the largest urban settlement in the Maya Lowlands in the Early Classic period. While long-lived, the city and settlement were left relatively unchanged by later occupation. As Nalda's excavations showed, only part of the monumental zone continued to be occupied in the Late Classic and even sporadically in the Postclassic periods. The settlement zone did not see much architectural overburden nor modification in later periods. This fortunate circumstance reveals several features designed to optimize access to resources and services (e.g., markets, ceremonial plazas, causeways, and reservoirs) not only in the urban zone but also throughout the hinterland in ways that are rarely so clear at other sites. The city's urban planning hints to a relatively more prominent role played by the Maya elite in managing people and resources in and around the urban center than previously thought (see also Estrada-Belli et al. 2023).

Data Availability Statement.   Lidar and lidar-derived data presented in this work are available in accordance with the norms set by INAH-Mexico regarding access to archaeological data owned by INAH.

Competing Interests.   The authors declare none.

References Cited

Balanzario, Sandra, and Francisco Estrada-Belli. 2021. Dzibanche e Ichkabal: Grandes ciudades mayas reveladas por la nueva tecnologia lidar. *Arqueología Mexicana* 170:62–67.

Barrientos, Tomás, Marcello A. Canuto, and David Stuart. 2024. The Rise, Expansion, and Endurance of Kaanul: The View from Northwestern Peten. *Ancient Mesoamerica* 35(3):689–707. https://doi.org/10.1017/S0956536122000189.

Canuto, Marcello A., and Tomás Barrientos. 2011. La Corona: An Approach to Politics in the Kingdom of Kaan from a Secondary Center in Northwest Petén. *Estudios de Cultura Maya* 37(40):11–43.

Canuto, Marcello A., Francisco Estrada-Belli, Thomas G. Garrison, Stephen D. Houston, Mary Jane Acuña, Milan Kováč, Damien Marken, et al. 2018. Ancient Lowland Maya Complexity as Revealed by Airborne Laser Scanning of Northern Guatemala. *Science* 361(6409):eaau0137. https://doi.org/10.1126/science.aau0137.

Chase, Arlen F., Diane Z. Chase, and Adrian S. Z. Chase. 2020. The Maya City of Caracol, Belize: The Integration of an Anthropogenic Landscape. In *The Maya World*, edited by Scott R. Hutson and Traci Ardren, pp. 344–363. Routledge, London.

Estrada Belli, Francisco, Sandra Balanzario, and Erik Velásquez. 2024. The Rise of the Kaanu'l Kingdom and the City of Dzibanche. *Ancient Mesoamerica* 35(3):726–747. https://doi.org/10.1017/S0956536122000207.

Estrada-Belli, Francisco, Laura Gilabert-Sansalvador, Marcello A. Canuto, Ivan Šprajc, and Juan Carlos Fernandez-Diaz. 2023. Architecture, Wealth and Status in Classic Maya Urbanism Revealed by Airborne Lidar Mapping. *Journal of Archaeological Science* 157:105835. https://doi.org/10.1016/j.jas.2023.105835.

Hutson, Scott R., Timothy S. Hare, Travis W. Stanton, Marilyn A. Masson, Nicolas C. Barth, Traci Ardren, and Aline Magnoni. 2021. A Space of One's Own: Houselot Size among the Ancient Maya. *Journal of Anthropological Archaeology* 64:101362. https://doi.org/10.1016/j.jaa.2021.101362.

Marcus, Joyce. 1973. Territorial Organization of the Lowland Classic Maya. *Science* 180(4089):911–916.

Martin, Simon. 1997. Painted King List: A Commentary on Codex-Style Dynastic Vases. In *The Maya Vase Book,* Vol. 5., edited by Justin Kerr, pp. 847–867. Kerr Associates, New York.

Martin, Simon. 2020. *Ancient Maya Politics: A Political Anthropology of the Classic Period 150–900 CE*. Cambridge University Press, New York.

Martin, Simon, and Nikolai Grube. 1995. Maya Superstates. *Archaeology* 48(6):41–46.

Martin, Simon, and Nikolai Grube. 2008. *Chronicle of the Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya*. Rev. ed. Thames & Hudson, London.

Martin, Simon, and Erik Velásquez. 2016. Polities and Palaces: Tracing the Toponyms of the Snake Dynasty. *PARI Journal* 17(2):23–33

Nalda, Enrique. 2000. Dzibanche: Un primer acercamiento a su complejidad. in *Guardianes del tiempo*, edited by Adriana Velásquez Morlet, pp. 37–71. Universidad de Quintana Roo, Instituto Nacional de Antropologıá e Historia, Mexico, Chetumal.

Nalda, Enrique. 2004. *Los cautivos de Dzibanché*. Instituto Nacional de Antropología e Historia, Mexico City.

Nalda, Enrique, and Sandra Balanzario. 2001–2009. *Proyecto Arqueologico Dzibanche. Temporadas de campo 2001–2009*. Informes al Consejo de Arqueologia. Instituto Nacional de Antropología e Historia, Mexico City.

Nalda, Enrique, and Sandra Balanzario. 2010. Nuevas consideraciones sobre la fase Lobil. *Arqueología* 43(1):182–197.

Nalda, Enrique, and Sandra Balanzario Granados. 2008. Un estilo arquitectónico peculiar en Dzibanché y su posible correlato territorial. In *El territorio maya*, edited by Rodrigo Liendo Stuardo, pp. 303–321. Instituto National de Antropologia e Historia, Mexico City.

Nalda, Enrique, and Sandra Balanzario Granados. 2014. El estilo Río Bec visto desde Dzibanché y Kohunlich. *Journal de la Société des Américanistes* 100(2):179–210.

Nalda, Enrique, Lux Evelia Campaña, and Javier López. 1999. *Proyecto Arqueológico Sur De Quintana Roo, 1993–1994*: *Dzibanche, Volume 1*. Informe al Consejo de Arqueologia-INAH.

Ruhl, Thomas, Nicholas Dunning, and Christopher Carr. 2018. Lidar Reveals Possible Network of Ancient Maya Marketplaces in Southwestern Campeche, Mexico. *Mexicon* 40(3):83–91.

Scarborough, Vernon L., and Gary G. Gallopin. 1991. A Water Storage Adaptation in the Maya Lowlands. *Science* 251(4994):658–662.

Sharer, Robert J., and Loa P. Traxler. 2006. *The Ancient Maya*. 6th ed. Stanford University Press, Stanford.

Stuart, David, and Stephen D. Houston. 1994. *Classic Maya Place Names*. Studies in Pre-Columbian Art and Archaeology. Dumbarton Oaks, Washington, DC.

Tokovinine, Alexandre, Dmitri Beliaev, Sandra Balanzario Granados, and Sandra Khorkhriakova. 2024. New Data, New Interpretations: Dzibanche Monuments through the Lenses of a 3D Scanner. *Ancient Mesoamerica* 35(3):708–725.

Tsukamoto, Kenichiro, and Octavio Q. Esparza Olguín. 2015. Ajpach' Waal: The Hieroglyphic Stairway of the Guzmán Group of El Palmar, Campeche, Mexico. In *Maya Archaeology 3*, edited by Charles Golden, Stephen Houston, and Joel Skidmore, pp. 30–55. Precolumbia Mesoweb Press, San Francisco, California.

Turner, Billie L., II. 1974. Prehistoric Intensive Agriculture in the Mayan Lowlands. *Science* 185(4146):118–124.

Velásquez, Erik. 2004. Los Escalones jeroglíficos de Dzibanché. In *Los cautivos de Dzibanché*, edited by Enrique Nalda, pp. 78–103. Instituto Nacional de Antropologia e Historia, Mexico City.