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**CLIMATE, CHANGE & PEOPLE**

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from multiple perspectives within and beyond the academy.

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The cover image is a view of the Chixoy River, Guatemala. Image courtesy of Brent K. S. Woodfill.

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PRIMARY SOURCES

# WATER AND THE PRECLASSIC MAYA AT EL TINTAL, PETÉN, GUATEMALA

By Mary Jane Acuña and Carlos R. Chiriboga

## Introduction

As part of the 1931 Carnegie Institution of Washington's Uaxactun expedition, geologist C.W. Cooke (1931: 286) noted, "If the *bajos* were restored to their former condition, the Petén would be a region of many beautiful lakes. Travel in it would be easy, for one could go from place to place by boat, with only short journeys overland, from one lake to another, across country that offers little impediment to travel at any season." These *bajos* mentioned by Cooke, low-lying swampy areas prone to flooding, are spread throughout most of the northern lowlands of Petén, Guatemala, characterizing the region with seasonal and perennial wetland systems. Ancient Maya settlement that dates back roughly to 800 B.C. through A.D. 1000, varying depending on the specific area, is also spread densely throughout the entire region on the slightly higher, non-flooding topographic promontories.

Explaining the development of the Maya civilization in a world of beautiful lakes is appealing, and we believe that, at least to some degree, this might be possible.

Burgeoning archaeological investigations, coupled with increased interdisciplinary research and significant advances in technology are making headway in our understanding of the relationship between the ancient Maya and the lowland environment in which they flourished. As a result, our knowledge on the environmental and climatic contexts in which the Maya civilization arose in a subtropical rainforest with presumed limited potential for intensive agriculture continues to evolve (c.f. Dahlin and Dahlin 1994; Dunning et al. 1998; Lundell 1938; Meggers 1954; Pohl et al. 1996). One notable contribution to this rapidly developing perspective is the application of Light



*Panoramic photograph of Nacimiento. Photograph courtesy of C. R. Chiriboga.*

Detection and Ranging, or lidar, technology to survey large swaths of land and acquire precise topographic surface models that reveal natural features and cultural modifications to the landscape (Fernandez-Diaz et al. 2014). The method employs a small aircraft to fly over targeted areas and collect elevation data using laser pulses which bounce back from a variety of targets, providing accurate distance and georeferenced coordinate information for the surface they hit. As a result, it is a much faster way of acquiring accurate maps in comparison with traditional pedestrian, or on-the-ground, surveys.

It is very difficult to really appreciate the intricacies of how an ancient settlement was integrated with the natural landscape from walking on the ground today. Equally challenging is being able to contextualize the features we do see within a broader scope, thus we risk often missing their significance entirely. Lidar changes that by providing a digital, high-resolution image of the integrated landscape with all its features so we

can better appreciate their context. As a tool, lidar complements archaeological and environmental data, contributing directly to our interpretations about the cultural and natural past.

Although lidar has been used in the Maya region before, Proyecto Arqueológico El Tintal (PAET) only gained access to lidar coverage around El Tintal, the site where we conduct research (Figures 1 and 2) in 2017 as a result of our participation in the Pacunam Lidar Initiative (PLI). The PLI survey encompassed about 2,100 square kilometers of noncontiguous area in Petén, and analysis has produced evidence for very dense settlement, communication routes, terracing, and wetland agricultural and defensive features among other characteristics that reveal the sophisticated knowledge the Maya population had of their environment and geography (Canuto et al. 2018; Garrison et al. 2019). Our project received 97 square kilometers of lidar survey around El Tintal, exposing a complex, integrated cultural landscape. Among various

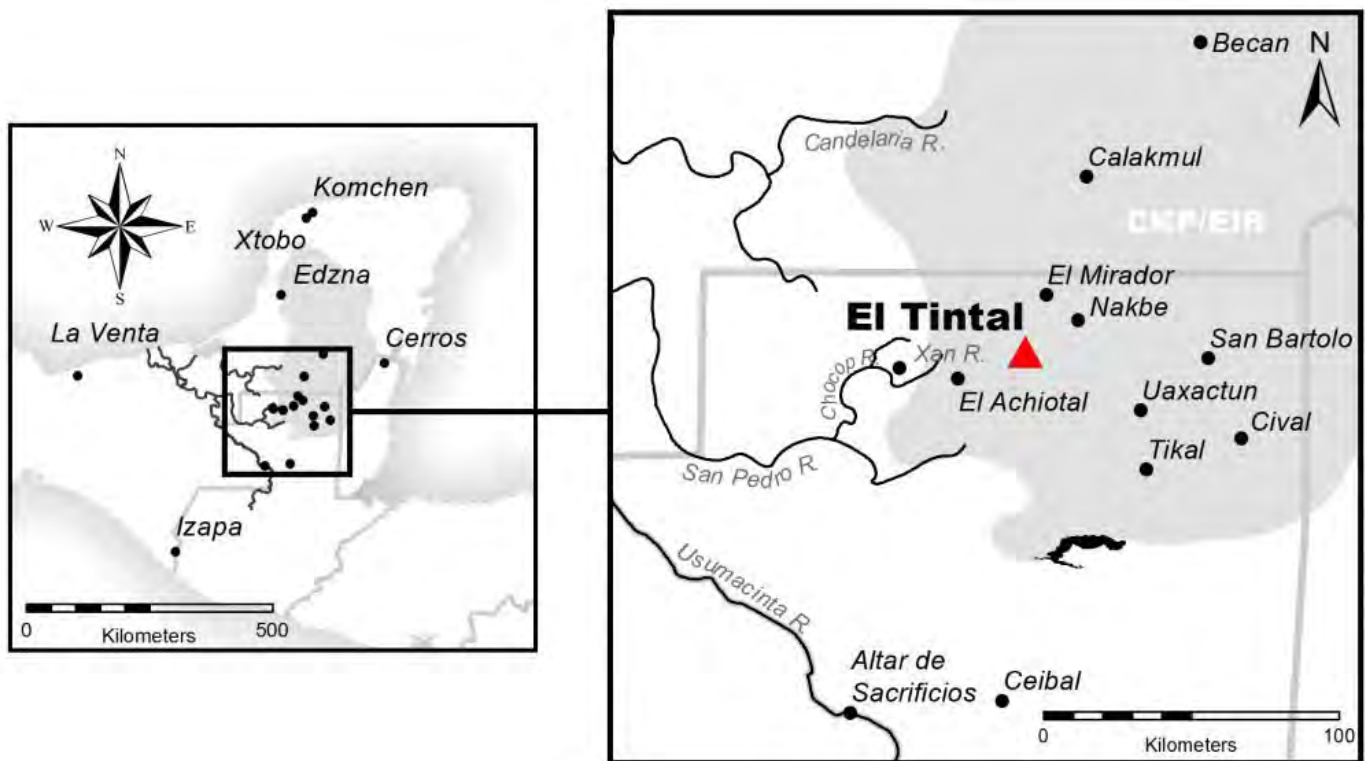


Figure 1. Location of El Tintal in the Maya lowlands of northern Petén, Guatemala. Map by C.R. Chiriboga/PAET.



*Figure 2. Map of the Central Karstic Uplands of Petén, Guatemala, showing location of El Tintal. Map by C.R. Chiriboga/PAET.*

features, such as buildings, causeways, potential bridge embankments, terraces, and quarries, what has stood out the most at El Tintal are the complex hydraulic features. Most striking was the discovery that El Tintal was settled around a well-defined natural depression that we propose was an ancient lagoon, not unlike what Cooke had imagined for the region.

Archaeology and lidar-derived evidence from El Tintal support the premise of a wetter environment in northern Petén, already suggested by paleoenvironmental studies, which significantly changes our understanding of the cultural processes that favored the emergence and development of socio-political complexity. For example, this offers a different understanding of how

people moved across the landscape or why they would choose to settle in a specific location. The data is of particular significance for the period between 400 B.C. and A.D. 200 during which there was increased humidity as well as a notable growth in cultural manifestations in the region of northern Petén. Evidence from paleoenvironmental studies, archaeological excavation, and lidar more recently, have provided multiple lines of evidence suggestive of a wetter environment at the apogee of the large cities in northern Petén during the Preclassic Period. This has significant impacts in the field of Maya archaeology as it requires a reevaluation of previous models that have struggled, to different extents, in providing a coherent explanation for how the population thrived in such an environment.

## El Tintal, brief introduction and timeline

The archaeological site of El Tintal is an extensive, ancient Maya city that spreads over an area of approximately 11.6 sq km. With the aid of lidar, Chiriboga has identified and mapped over 2,000 structures that comprised the settlement (Figure 3). These structures, along with numerous other archaeological features, represent an accumulation of cultural activity spanning a bit over a millennium of human occupation. As part of a team of researchers working at El Tintal, our excavations (Figure 4) have revealed the earliest construction activities at the site dating to between the first and third centuries B.C., although there is some evidence indicating a human presence in the area as early as the fourth century B.C. At the beginning, the population used the natural bedrock as surface in many parts of the site, and we have found evidence to suggest it was cleared, used, and quarried in the early periods of the city's occupation (Figure 5), then later covered by subsequent layers of stone and rubble construction. We do not know the size of the population that first settled, or even how gradual its growth was, but by the Late Preclassic Period (300/250 B.C.–A.D. 250), the population

had built pyramidal-style structures rising high above the forest canopy (Figure 6). The size and monumentality of these construction efforts suggest the presence of a large population that was socially and politically organized by that time. Large pyramids such as these were typically associated with ritual and political significance in Preclassic Maya society, and were characteristically early in northern Petén at sites like El Tintal and its neighbors to the north, El Mirador and Nakbe, among others. While these pyramids dominate the constructed landscape at El Tintal, the settlement is also dotted with residential compounds, administrative buildings, as well as other features such as causeways and canals. The material culture, city layout, and management features indicate that during the Late Preclassic Period, El Tintal was a fluid and bustling city with regional connections.

Coinciding with paleoenvironmental data that suggests the beginning of a dry period that began around A.D. 200, cultural activity at El Tintal also appears to have waned considerably, a decline that is recognized in the site's archaeology. The

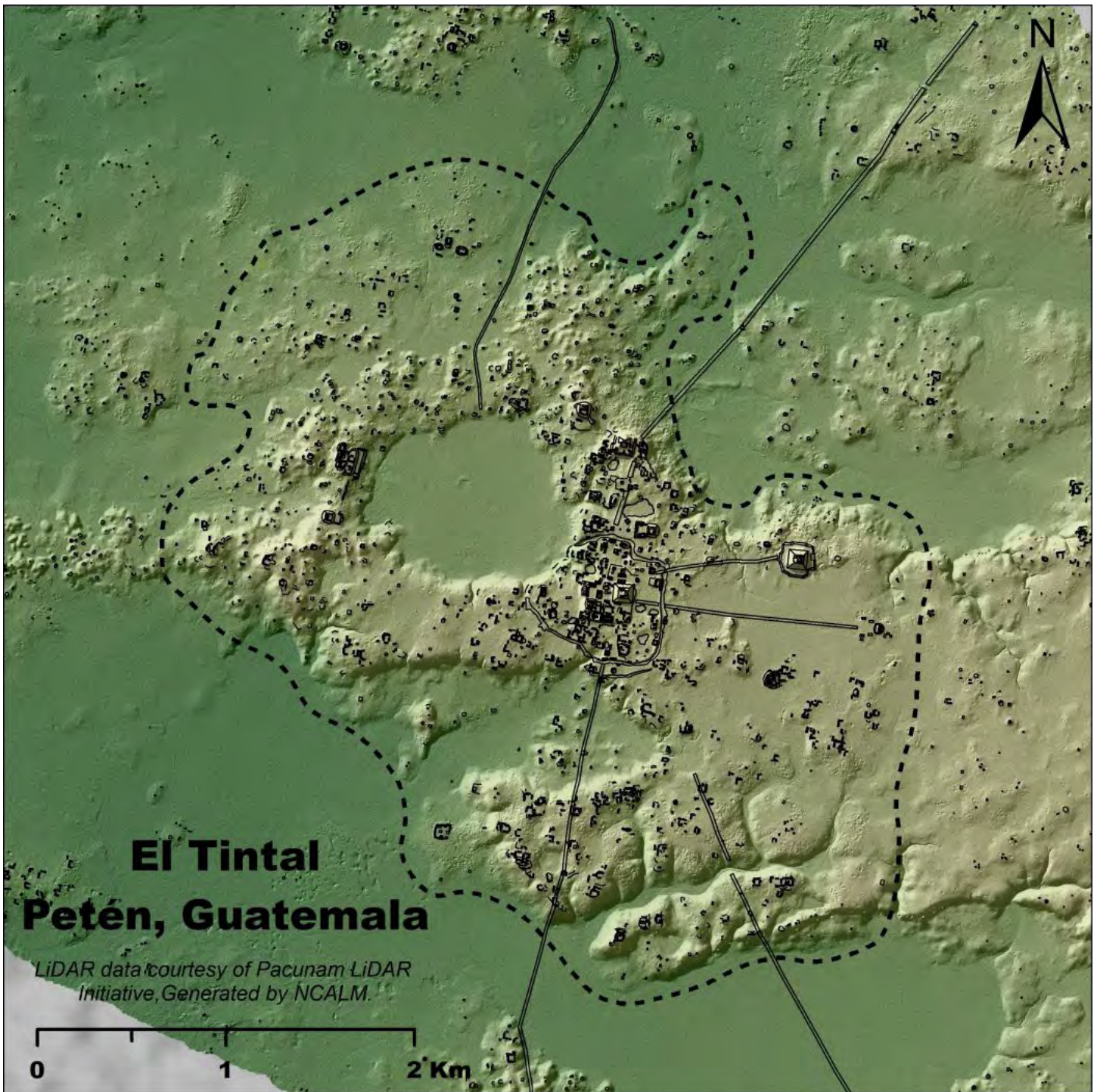
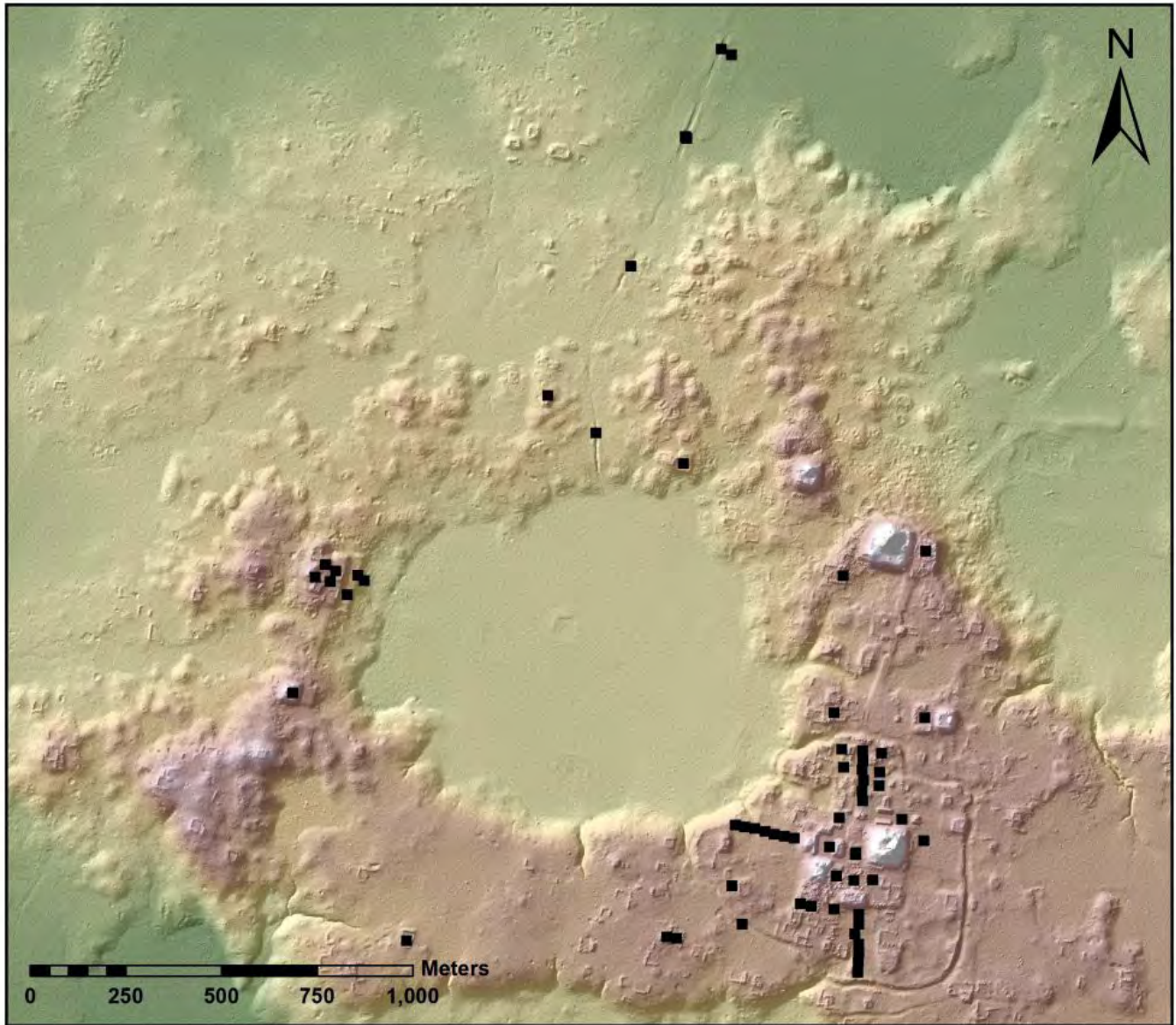


Figure 3. Map of El Tintal delineating 11.6 km<sup>2</sup> of settlement. Map by C.R. Chiriboga/PAET.





**Test-Pitting Program  
Ops. TIN-500A-D  
El Tintal, Guatemala**

■ Test Units

Scale 1:20,000  
True North  
LiDAR data courtesy of Pacuman  
LiDAR Initiative, Generated by NCALM.

Proyecto Arqueológico El Tintal (PAET), 2018  
Surveyed and prepared by: CR Chiriboga

*Figure 4. Map of the central zone of El Tintal showing the location of test-pits excavated since 2014. Map by C.R. Chiriboga/PAET.*

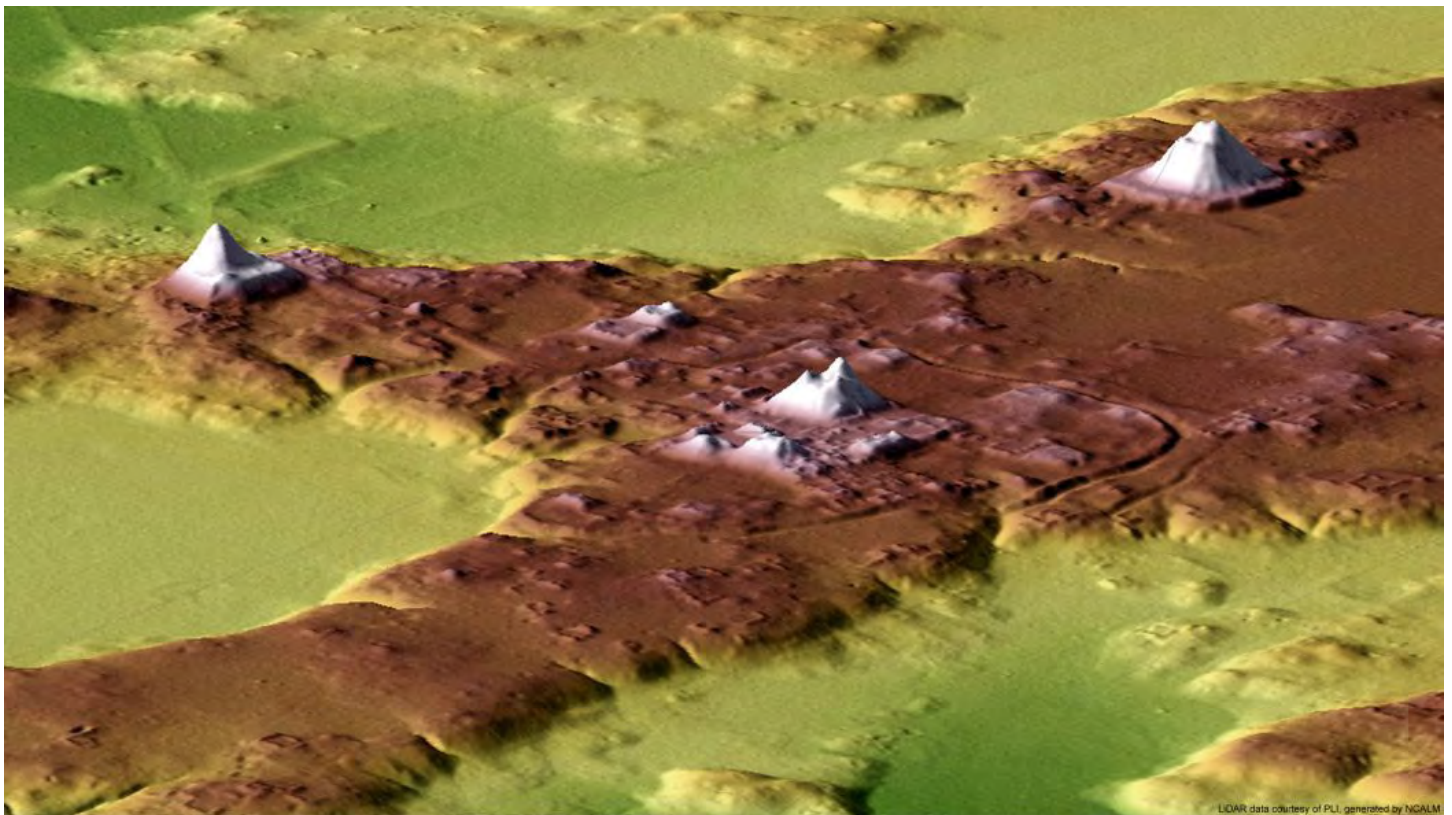


*Figure 5. Example of a unit with shallow stratigraphy and exposure of bedrock. Photograph by M.J. Acuña/PAET.*

Early Classic (A.D. 250–550/600) is the period of which we know the least about the population and settlement at El Tintal. Towards the end of the sixth century there is another shift toward population growth, settlement expansion, and a renewal of cultural manifestations in portable materials such as pottery and stone tools. This Classic Period (A.D. 550/600–900/1000) occupation blanketed the earlier settlement, reaching its maximum extension over the landscape.

During both the Preclassic and Classic Periods, the settlement and population of El Tintal experienced great cultural achievements that were geopolitically significant within the broader Maya civilization. Yet each period was significant

within distinct sociopolitical contexts that require exploring individually. The Preclassic Period was important because it was a critical moment in time when the Maya were developing complex social, political, and economic forms of organization. Our research at El Tintal is shedding light on some of the cultural processes that took place in order for that organizational shift to occur. It was not in a vacuum and there are regional conditions that play key roles, but for this article we wish to highlight some of our recent findings that illustrate what made El Tintal such a significant settlement in the Late Preclassic Period and how it is of consequence for the broader study of early Maya settlements in northern Petén as they increased in complexity.



*Figure 6. Northeasterly 3D view of El Tintal's central zone. Map by C.R. Chiriboga/PAET.*

# Environment and climate

It is important to review some of the geological conditions of the area that can help us appreciate the landscape being discussed. While climate can fluctuate more frequently, the geology changes at a much slower pace and can provide valuable insights.

As part of the Yucatan Peninsula, the geology of northern Petén consists of limestones, dolomites, and evaporites overlaying igneous and metamorphic rocks, and is considered one of the most extensive karst aquifers on the planet (Bauer-Gottwein et al. 2011: 507-508). More specifically, northern Petén is located in the area of what is known as the Central Karst Uplands (Reese-Taylor et al. 2011), also known as the Petén Karst Plateau (Dunning et al. 1998), at the southern end of the Elevated Interior Region (Dunning et al. 2013; Dunning et al. 2012) roughly in the center of the Yucatan Peninsula (Figure 2). The uplands are characterized by a raised relief of karst hills that are well drained, interspaced with *bajos* (Dunning et al. 1998). Groundwater dominates as a source of water in general, but the southern area of the peninsula benefits from a lot more surface water than the northern half given the dominance of evaporites (Dunning et al. 1998: 88; Gondwe et al. 2010). The regional geology suggests the presence of perched and confined aquifers (Bauer-Gottwein et al. 2011; Gondwe et al. 2010), which can also be inferred by the occurrence of sinking streams, swallow holes, blind valleys, and *bajos*, among other features of karsts. As a result, 40 percent to 60 percent of the southern and central Maya lowlands are covered in wetlands and *bajos* (Dunning et al. 2002: 269; Hansen et al. 2002: 290; Wahl, Schreiner et al. 2007: 214). The southern limit of the Yucatan Peninsula is also framed by large lakes and some rivers that acted as major communication routes between the coastlines and the interior ancient Maya sites

in Petén (Bauer-Gottwein et al. 2011). El Tintal is located in the region of the central karst uplands of Petén, far away from modern rivers and lakes (Figure 2). Today, the area is characterized by *bajos* with vertisol soils that can flood six to seven months out of a year, making movement across the terrain very challenging. Visitors traveling through the area must walk in knee- to waist-deep water and marsh as they traverse the many kilometers-long *bajos* in the rainy season.

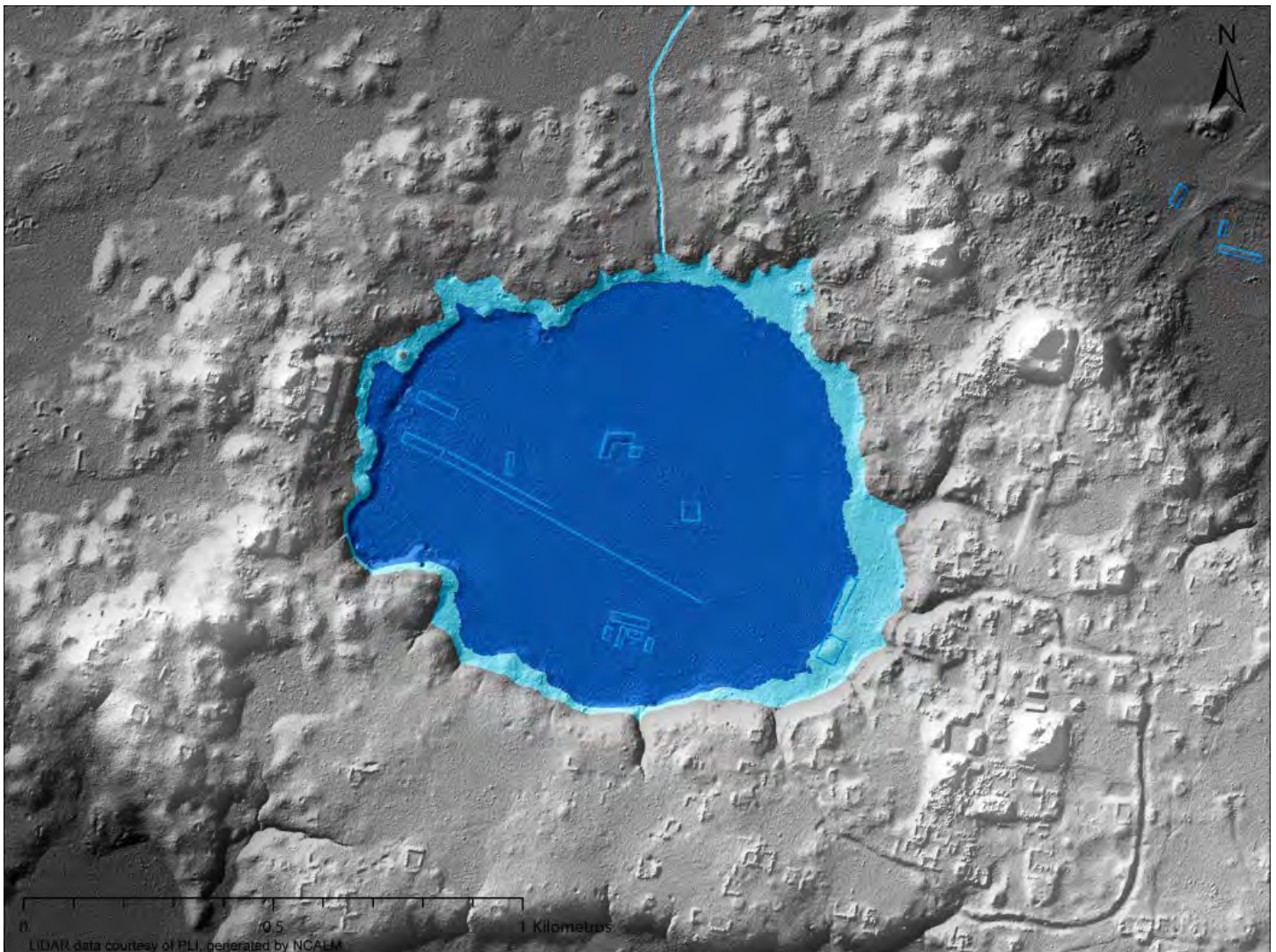
It was assumed at one point in time that climate had remained stable throughout the Preclassic (1000 B.C.–A.D. 250) and Classic (A.D. 250–900/1000) Periods in the Maya lowlands (Dahlin 1983). However, in the 1970s, Maya archaeologists began taking earnest interest in the impact of climate on past cultural development (Gunn et al. 2002: 81), leading to numerous investigations that evolved into interdisciplinary approaches to try to explain the past environment in which the Maya civilization developed. In the area of northern Petén, some of the results of paleoenvironmental studies indicated that there were fluctuating periods of wetness and dryness, many of which we have been able to correlate with cultural peaks and declines using archaeological data. At Lake Puerto Arturo, located about 20 km west-southwest from El Tintal, coring provided data that suggested there were wetter regimes in the Late Preclassic (300 B.C. – A.D. 250) and Postclassic (A.D. 900/1000–ca. 1450) Periods, with a moderate regime in the Classic Period (Wahl et al. 2014; Wahl et al. 2006; Wahl, Byrne et al. 2007). The study carried out with data from Lake Puerto Arturo by Wahl et al. (2014: 22-23) reflected wetter conditions in the area around 3000 B.P. (1050 B.C.) and then transitioning to dryer conditions once again around 1750 B.P. (A.D. 200). This period of wetness coincides with the emergence and development of major cities in northern Petén, including El Tintal.

## Lidar

The lidar survey acquired for El Tintal and its immediate surroundings (Canuto et al. 2018) revealed a regional settlement much more dense and continuous than previously known. As expected though, regional settlement, including El Tintal, follows a pattern observed elsewhere in the Maya lowlands with most building construction concentrated on elevated terrain due to the extensive system of natural drainages and *bajos* that remain as seasonally inundated areas. This settlement pattern is suggestive of similar flood zones in the past, although we

currently lack the data to compare seasonal or annual variations between time periods.

The core settlement of El Tintal emerged and developed around a natural depression typical of the regional geology and which is currently known as Bajo El Juleque. El Tintal's pioneering Preclassic population designed and built formal architecture characterized by large supporting platforms, structures of various types, and elevated causeways that helped shape its ceremonial center. Additionally, El Tintal's early planning



*Figure 7. El Tintal's core settlement around Chacamatz Lagoon. Map by C.R. Chiriboga/PAET.*

and construction also included several hydraulic features, such as canals, reservoirs, and a lagoon. Several of these features were known to us from reconnaissance and previous maps that covered parts of the settlement. But lidar has provided us with a regional perspective of how all these features are integrated into the cultural and natural landscapes. In particular, the discoveries made with lidar images highlight the significant role water played in shaping the Preclassic settlement of El Tintal.

Using lidar data corroborated with archaeological research and verification of features in the field, we recently proposed that Bajo El Juleque had been, at least during the site's early occupation, a permanent waterbody that we dubbed Chacamat Lagoon in order to differentiate this ancient water feature from its current analogue (Figure 7). We propose that this lagoon was what likely attracted the population to settle in this location sometime between the fourth and third centuries B.C. Our

preliminary hydrological modeling shows that the lagoon would have covered an area of 0.85 sq km, with an average depth of just under 6 meters and reaching a maximum depth of 9.5 meters in its southwestern side. The modeled ancient water levels in Chacamat correspond with the location of structures and terraces along its edges. Targeted field survey has been able to verify the absence of structures built below this inferred waterline. The main architectural group of El Juleque Complex, located on the western edge of the lagoon, has wide terraces that descend to the proposed waterline (Figure 8). Recent excavations revealed that the southern sections of the terraces were carved out of bedrock, while the northern part was constructed with thick muck likely extracted from the *bajos*, all of which was subsequently covered in plaster. We hypothesized that these terraces might have functioned as a place to dock canoes. At this time we do not have physical evidence of canoes at El Tintal and our hypothesis is based on circumstantial evidence,

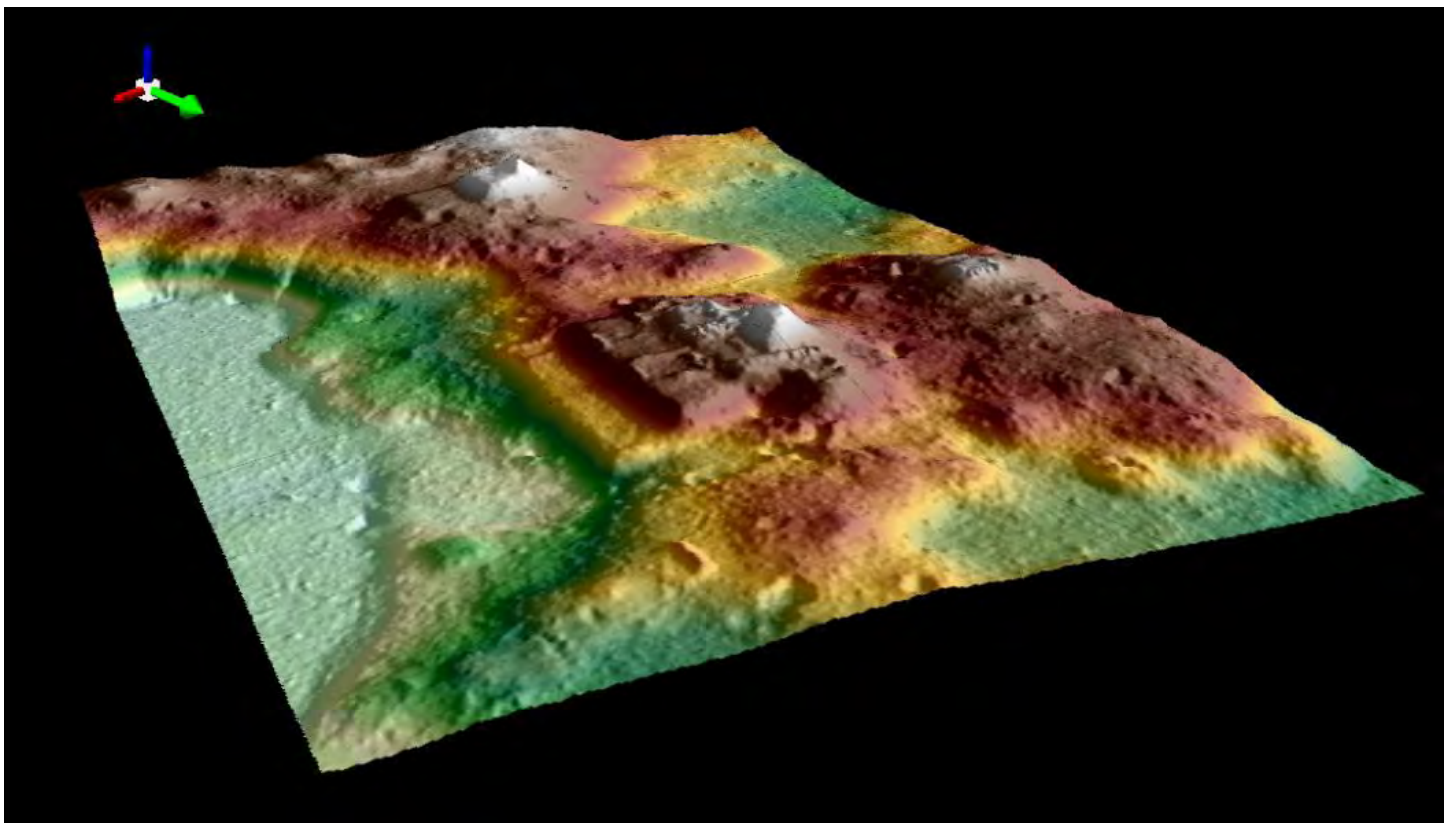
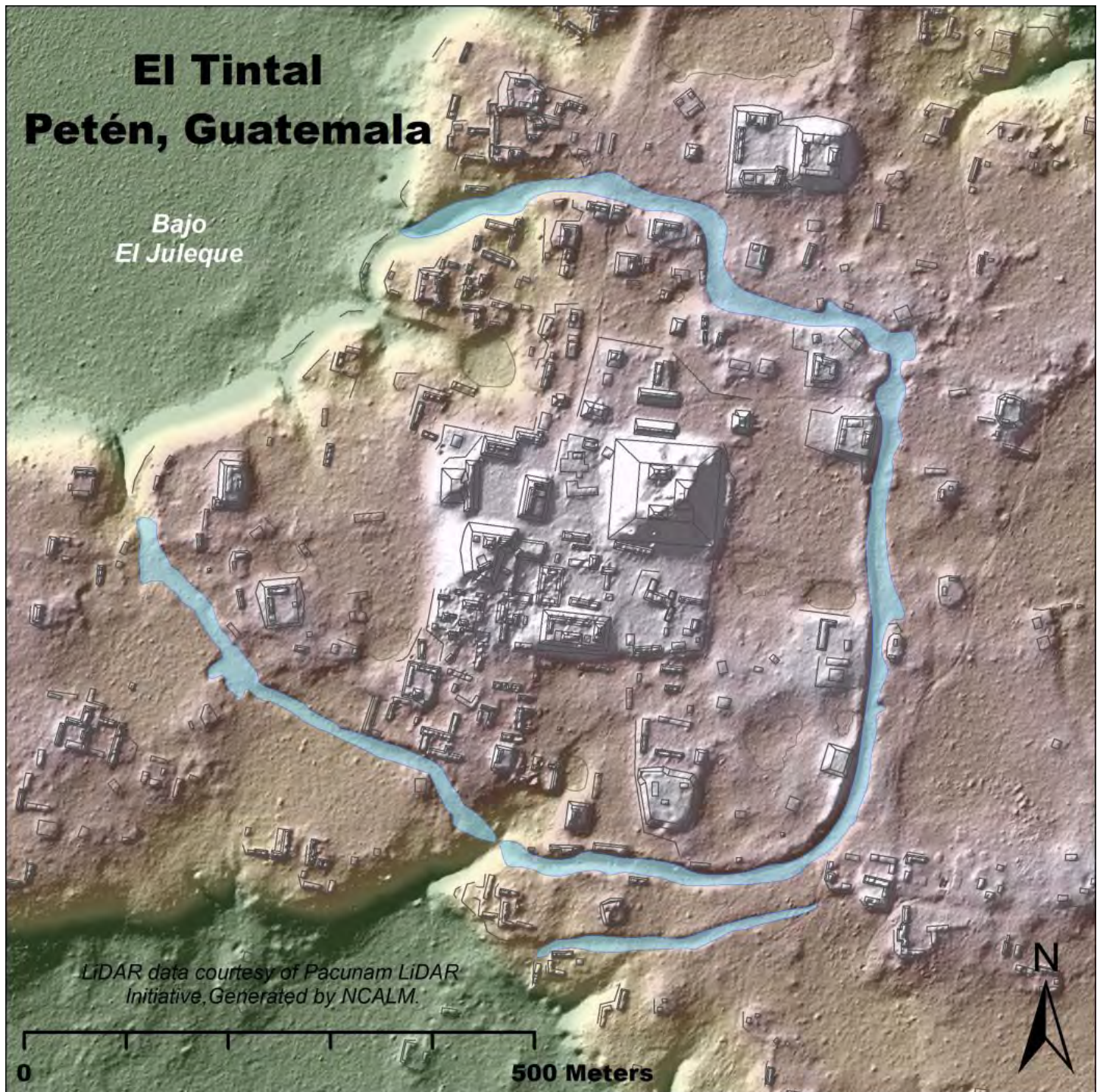


Figure 8. Perspective of the El Juleque Complex on the west side of Chacamat and view of its terraces descending to inferred water level. Map by C.R. Chiriboga/PAET.

but it is a question still under investigation as part of our ongoing research.

Other hydraulic features at the site include a previously known network of canals enclosing the city-center that was preliminarily studied by the

Mirador Basin Project (López 2015; López and Schreiner 2014), and is still undergoing investigation by our project. This network consists of three segments of varying lengths, referred to as the perimetric canal (Figure 9). Analysis of lidar data suggests that these canals channeled water

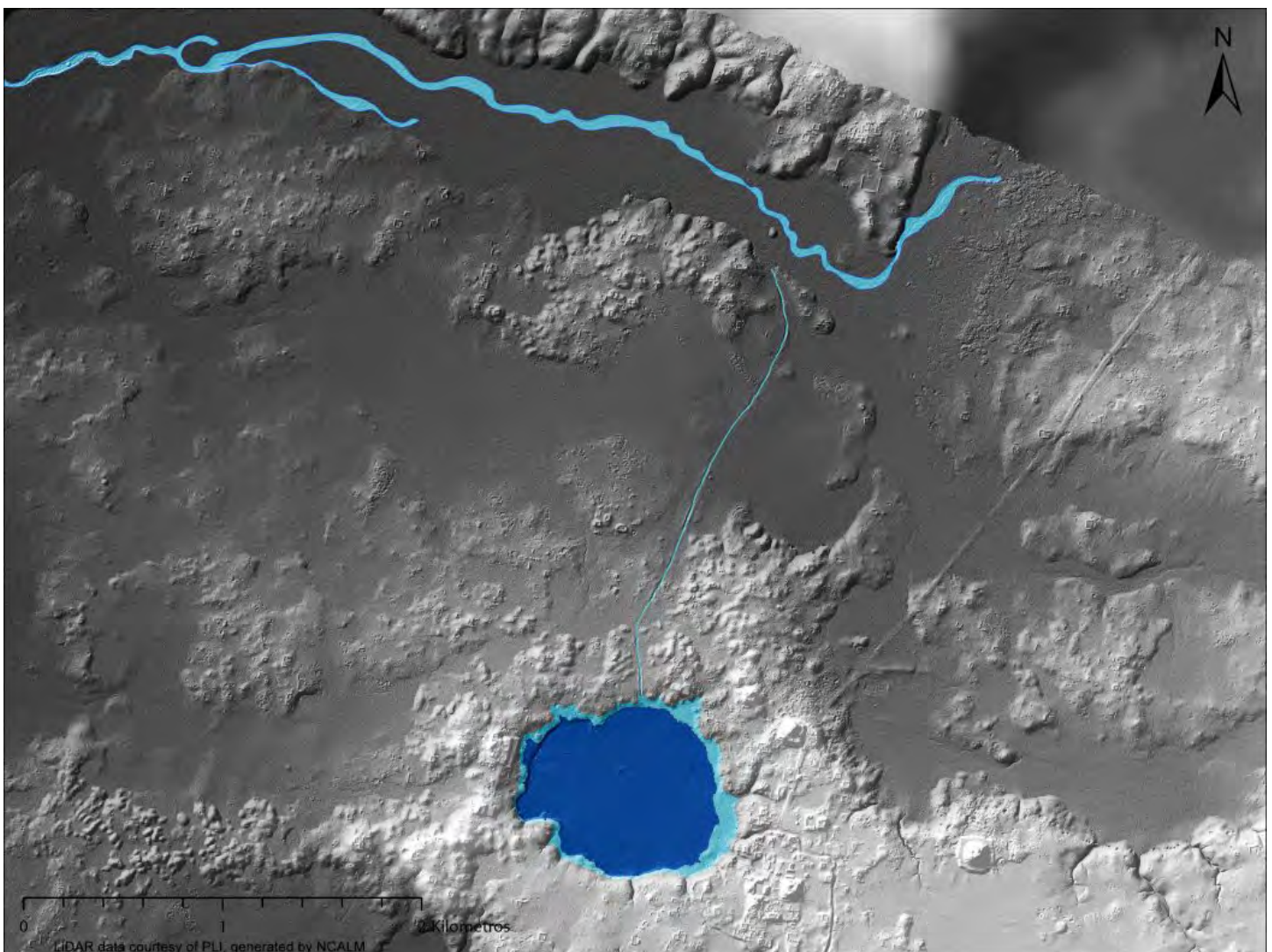


*Figure 9. Network of canals surrounding El Tintal's main ritual and administrative settlement. Map by C.R. Chiriboga/PAET.*

toward the *bajos* and lagoon. The perimetric canal is still under investigation in order to understand its chronology and function over time as it is possible that in dryer periods, rather than channel water, it might have held a defensive purpose.

Our research in the southwestern canal segment suggests the bottom of this feature lies almost two meters below modern surface, over which are layers of silt and post-use sediment accumulation. We took soil samples from different depths in this excavation to perform palynological analysis—that is, to look for and identify plant pollen and spore remains. Knowing the kinds of plants that were present at different depths (which

correlate with time), we can have a better idea of the environment and determine if the feature held water and functioned as a canal. This study was carried out in collaboration with Leonel Hernández and the final results will be published in the project's 2018 report, thus we will only summarize those that are relevant to our discussion. In the deepest level of the excavation unit, dated to the Preclassic Period, we found evidence for freshwater algae (class Bacillariophyceae) mixed with an abundance of cyanobacteria (class Cyanophyceae). Both of these classes are indicators of the presence of standing bodies of water, such as lakes or lagoons. These results support the hypothesis that Bajo El Juleque was a lagoon and the canal feature where this excavation



*Figure 10. El Tintal's North Canal connecting Chacamat and the city center with a broader drainage system. Map by C.R. Chiriboga/PAET.*



took place likely held water and functioned as a canal. We also found a grain of pollen pertaining to *Cecropia peltata*, a plant that indicates environmental disturbances resulting from anthropic activities and that commonly appears in areas of vegetation recovery. In the level immediately above that, we found pollen pertaining to the species *Euphorbia graminea*, a plant which is commonly found in shrubs and altered forests also resulting from anthropic activities. These remains found in the sedimentation of the canal are indicative of the kind of changing environment caused by cultural activities. As we moved closer to the surface, we encountered more samples of algae typical of bodies of water with ecological disturbances followed by a sample pertaining to the Selaginellaceae family, which grow in humid areas no longer perennially flooded, like modern-day *bajos*. Finally, the more superficial layers contained samples from the Asteraceae family, pollen of the species *Euphorbia graminea*, *Acalypha costaricensis* Kuntze, and *Piper psilorhachis* C., all of which grow in secondary forests and would naturally be found in the post-abandonment strata. The stratigraphic sequence of botanical samples in the canal context supports the corresponding cultural evidence for the presence of standing water but also begins to shed light on the effects cultural activities

## A new vision

The data from El Tintal allow us to envision what Cooke idealized for the past environment in the Maya lowlands: a region with lakes. Perhaps the region was not as inhospitable as today's environment alludes. Growing paleoenvironmental and climatic data indicate periods of increased humidity, suggesting the northern Petén likely had many more waterbodies and perennial wetlands than we previously thought. As described above, preliminary results from palynology at El Tintal also support the existence of bodies of water during the Late Preclassic Period. Archaeological evidence from settlement pattern studies and

had over time on the environment. In this case, we found evidence for a wet environment that coincided with El Tintal's early settlement and development and that later changed toward dryer conditions and eventual abandonment.

Lidar also revealed the presence of a 2.4 km-long canal that runs north from Chacamat lagoon (Figure 10). Topographic analysis of the North Canal's trajectory showed that it probably functioned by draining the overflow of the lagoon into a larger, regional drainage network that eventually connects with the San Pedro Mártir River, one of the major flows of water that limits the southern border of the Yucatan Peninsula (Bauer-Gottwein et al. 2011; Freidel et al. 2015). Archaeological exploration of parts of the canal place its construction and use during the Late Preclassic Period, coinciding with the wetter conditions in the area as revealed by paleoclimatic data from the immediate region (Wahl et al. 2014). As a canal that drained water north, it also reveals that the lagoon was recharged with rainwater, surface runoff, and groundwater, likely a feature of the natural aquifer that characterizes the Yucatan Peninsula as described above. The Maya of El Tintal built the canal to connect the city with a broader regional fluvial communication network during a time of wetter climate.

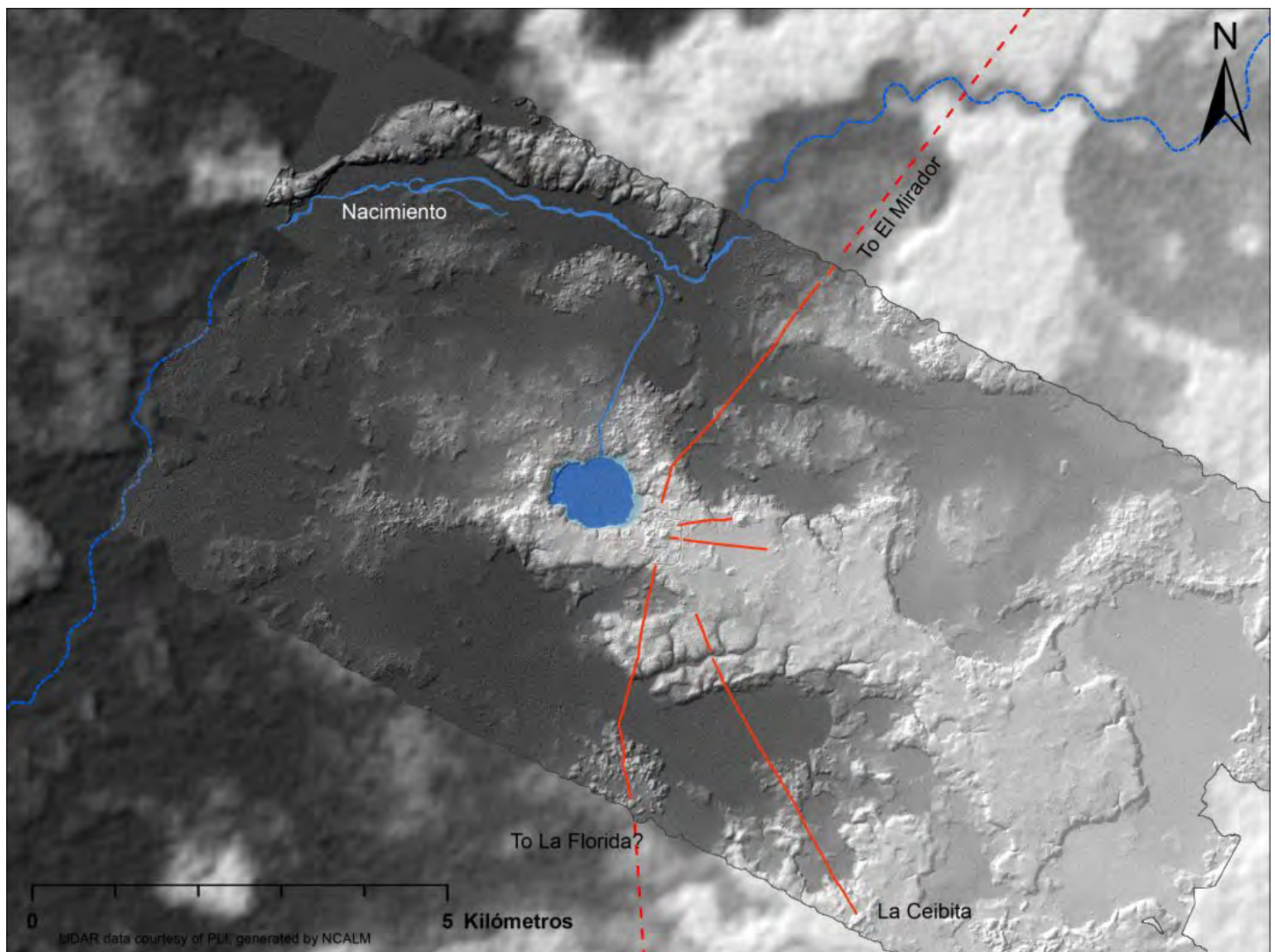
excavations reflect population growth and the emergence of cultural complexity in the same humid period.

Lidar has facilitated how we approach the study of cultural landscapes in the past. In the case of El Tintal specifically, lidar revealed the presence of a canal that appears to connect with a broader regional drainage system, which traditional, on-the-ground foot survey would have likely missed. It also enabled us to determine that settlement was restricted to higher ground, away from flood zones.

All the datasets briefly discussed—archaeological, lidar-derived, paleoenvironmental, geographical, and climatic—point us in the direction of a reimagined environment in which the Preclassic Maya civilization developed in northern Petén. The more extensive and perennial water features suggest we need to consider other sociocultural patterns that shaped those populations and settlements, including the use of canoes. Previous models cautiously relied on the notion that the populations of northern Petén depended on foot porters for regional interaction. The cultural implications that result from the new convergence of evidence are significant for how we explain the rise of sociopolitical complexity

in the region, for how we approach the study of settlement patterns, and for how we understand regional interactions.

The North Canal at El Tintal flowed into what today is called Nacimiento and then into the San Juan drainage that flowed into the larger San Pedro Mártir River. At its simplest level, this evidence suggests the presence of a long-distance fluvial route. The possible use of canoes changes the social, cultural, political, and economic dynamics completely; we must consider new ways that people moved over the landscape, transported larger quantities of materials and bulk items for construction, subsisted, and even



*Figure 11. Regional view of El Tintal with causeways in red and the North Canal in blue flowing into the Nacimiento drainage. Map by C.R. Chiriboga/PAET.*

created a growing market economy. At this time, we cannot confirm that canoe transport between the San Pedro Mártir River and El Tintal was possible without sections of portage. In fact, there were likely many parts along the way that required transfers and portages as a result of the westward gradient of the landscape with sections of exposed escarpment, the climate driven fluctuations in water levels, and the elevated ground separating lagoons. Nonetheless, we must entertain the possibility of canoe transportation as a variable when explaining the emergence and organization of populations settling in northern Petén.

The people who founded El Tintal were likely drawn to that location because of the existence of abundant fresh water in Chacamat lagoon, its proximity and accessibility to a broader communication network by water and land, and because of the elevated terrain on which they could plan and build their city. Based on the hydraulic features briefly discussed and the series of causeways radiating outward towards El Mirador to the north, La Ceibita to the southeast, and possibly to La Florida to the south, we envision El Tintal as a regional nexus (Figure 11). Between the fourth century B.C. and the second A.D., the settlement flourished into a major political center with



*Figure 12. Photograph looking north from the top of Henequén Pyramid at El Tintal. The large buildings of El Mirador and Nakbe rise above the horizon. Photo by M.J. Acuña/PAET.*

civic and ceremonial architecture, as well as an extensive residential area. The urban landscape was dominated by three very large pyramids from which you can see far into the horizon, as far as the contemporaneous centers of El Mirador and Nakbe, for instance (Figure 12). As a hallmark of ancient Maya ritual architecture, the Triadic Group was built in the center of the city, surrounded by the perimetric canal and facing west onto Chacamat lagoon.

We cannot know the decadal fluctuations of climate in the past, but major events that are recognizable in the paleoclimatic record indicate the onset of drier conditions at the beginning of the third century (A.D. 200) (Wahl et al. 2014). We also cannot yet determine the speed in which the lagoon and other water sources dried up, but preliminary archaeological evidence in the North Canal does corroborate that its usage ceased sometime in the third century, based on pottery offerings found on the interior surface that were subsequently covered by post-abandonment sedimentation. Some features visible in the lidar image for Chacamat also indicate potential attempts by the population to divert water to the deeper end through the construction of ramparts, which will be part of our upcoming investigations.

Previously, scholars have suggested that large sites like El Tintal, El Mirador, Nakbe, among others in northern Petén were abandoned at this time as a result of this major change in climate (Dahlin 1983; Hansen 2012). Although El Tintal was not abandoned completely, our investigations have produced evidence that indicates a significant reduction in construction activities in the center. We do perceive changes in the archaeological record that reflect effects on the social and political fabric during the Early Classic Period (AD 250–550/600), which cannot be explained clearly with current

evidence. Interestingly, recent excavations have discovered higher concentrations of Early Classic pottery on the western side of the lagoon, the area which would have held water up through its final desiccation, and where water could have been maintained through the construction of water diversion features. In fact, a section on the western side still retains water today when the rest of the lagoon is dry. Paleoenvironmental data indicate that dry conditions persisted through the ninth century; however, in the late sixth century, archaeological evidence and settlement patterns indicate a growth in population over the next three centuries in which sites like El Tintal reached their maximum extent. While the North Canal does not appear to have ever been used after the Preclassic Period, other types of regional networks were clearly established, along with increased social, political, and economic affairs that brought life back to El Tintal and that persisted through the final abandonment in the Terminal Classic Period sometime during or after the ninth century.

To conclude, our investigations at El Tintal have highlighted the essential role water played in the development of that settlement, as well as the significant impact these data have on the broader interpretations made about the Preclassic Maya of northern Petén. Individually, none of the lines of evidence discussed here would have enabled us to draw these conclusions. We have demonstrated the benefit and success of integrating different sources of evidence that complement each other. In doing so, we have been able to illustrate a more holistic perspective of the integration of the cultural and natural landscapes by the ancient Maya when establishing and developing a major city and regional nexus.

*All maps and images courtesy of the authors.*

## References Cited

- Bauer-Gottwein, Peter, Bibi R. N. Gondwe, G. Charvet, Luis E. Marín, Mario Rebolledo-Vieyra, and Gonzalo Merediz-Alonso. 2011. Review: The Yucatán Peninsula Karst Aquifer, Mexico. *Hydrogeology Journal* 19(3): 507-524.
- Canuto, Marcello A., Francisco Estrada-Belli, Thomas G. Garrison, Stephen D. Houston, Mary Jane Acuña, Milan Kováč, Damien Marken, Philippe Nondédéo, Luke Auld-Thomas, Cyril Castanet, David Chatelain, Carlos R. Chiriboga, Tomáš Drápela, Tibor Leskovský, Alexandre Tokovinine, Antolín Velasquez, Juan Carlos Fernández-Díaz, and Ramesh L. Shrestha. 2018. Ancient lowland Maya complexity as revealed by airborne laser scanning of northern Guatemala. *Science* 361.
- Cooke, C. Wythe. 1931. Why the Mayan cities of the Petén District, Guatemala, were abandoned. *Journal of the Washington Academy of Sciences* 21(13): 283-287.
- Dahlin, Bruce H. 1983. Climate and Prehistory on the Yucatan Peninsula. *Climatic Change* 5(3): 245-263.
- Dahlin, Bruce H., and Andrea Dahlin. 1994. Platforms in the Akalche at El Mirador, Petén, Guatemala and Their Implications. *Geoarchaeology* 9(3): 203-237.
- Dunning, Nicholas, Timothy Beach, Pat Farrell, and Sheryl Luzzadder-Beach. 1998. Prehispanic Agrosystems and Adaptive Regions in the Maya Lowlands. *Culture & Agriculture* 20(2/3): 87-101.
- Dunning, Nicholas P., Timothy P. Beach, L. Grasiozo Sierra, J.H. Jones, David L. Lentz, Sheryl Luzzadder-Beach, Vernon L. Scarborough, and M.P. Smyth. 2013. A Tale of Two Collapses: Environmental Variability and Cultural Disruption in the Maya Lowlands. *Diálogo Andino* 41: 171-183.
- Dunning, Nicholas P., Timothy P. Beach, and Sheryl Luzzadder-Beach. 2012. Kax and kol: Collapse and resilience in lowland Maya civilization. *Proceedings of the National Academy of Sciences* 109(10): 3652-3657.
- Dunning, Nicholas P., Sheryl Luzzadder-Beach, Timothy Beach, John G. Jones, Vernon Scarborough, and Patrick Culbert. 2002. Arising from the Bajos: The Evolution of a Neotropical Landscape and the Rise of Maya Civilization. *Annals of the Association of American Geographers* 92(2): 267-283.
- Fernandez-Diaz, Juan Carlos, William E. Carter, Ramesh L. Shrestha, and Graig L. Glennie. 2014. Now You See It... Now You Don't: Understanding Airborne Mapping LiDAR Collection and Data Production Generation for Archaeological Research in Mesoamerica. *Remote Sensing* 6: 9951-10001.
- Freidel, David A., Carlos R. Chiriboga, and Mary Jane Acuña. 2015. Inland Ports in Northwestern Petén, Guatemala: A preliminary assessment. 80th Annual Meeting of the Society for American Archaeology, San Francisco, CA.
- Garrison, Thomas G., Stephen Houston, and Omar Alcover Firpi. 2019. Recentering the rural: Lidar and articulated landscapes among the Maya. *Journal of Anthropological Archaeology* 53: 133-146.

Gondwe, Bibi R.N., Simon Stisen, Mario Rebolledo-Vieyra, Peter Bauer-Gottwein, Sara Lerer, Luis Marín, and Gonzalo Merediz-Alonso. 2010. Hydrogeology of the south-eastern Yucatan Peninsula: New insights from water level measurements, geochemistry, geophysics and remote sensing. *Journal of Hydrology* 389: 1-17.

Gunn, Joel D., Ray T. Matheny, and William J. Folan. 2002. Climate-Change Studies in the Maya Area. *Ancient Mesoamerica* 13: 79-84.

Hansen, Richard D. 2012. The Beginning of the End: Consumption and Environmental Impact of the Preclassic Lowland Maya. In *An Archaeological Legacy: Essays in Honor of Ray T. Matheny*, edited by Deanne G. Matheny, Joel C. Janetski and Glenna Nielsen, pp. 241-285. Brigham Young University, Provo.

Hansen, Richard D., Steven Bozarth, John Jacob, David Wahl, and Thomas Schreiner. 2002. Climatic and Environmental Variability in the Rise of the Maya Civilization: A preliminary perspective from northern Peten. *Ancient Mesoamerica* 13(02): 273-295.

López, Francisco. 2015. Excavaciones en el sitio arqueológico "Tintal." Temporada 2014. In *Proyecto Cuenca Mirador: Investigaciones en la Cuenca Mirador, Temporada 2014. Tomo II*, edited by Richard Hansen and Edgar Suyuc, pp. 556-582. Report submitted to the Dirección General del Patrimonio Cultural y Natural, Guatemala.

López, Francisco, and Thomas Schreiner. 2014. Excavaciones de Sondeo en el Sitio de Tintal, Proyecto Cuenca Mirador Temporada de Campo 2013. In *Investigaciones Arqueológicas en la Cuenca Mirador: Informe Final de Temporada 2013, Proyecto Arqueológico Cuenca Mirador*, edited by Richard D. Hansen and Edgar Suyuc, pp. 412-423. Report submitted to Dirección General del Patrimonio Cultural y Natural, Guatemala.

Lundell, Cyrus Longworth. 1938. Plants Probably Utilized by the Old Empire Maya of Peten and Adjacent Lowlands, Vol. 24, pp. 37-56. Papers of the Michigan Academy of Science Arts and Letters.

Meggers, Betty J. 1954. Environmental Limitation on the Development of Culture. *American Anthropologist* 56(5): 801-824.

Pohl, Mary D., Kevin O. Pope, John G. Jones, John Jacob, Dolores Piperno, Susan D. deFrance, David Lentz, John A. Gifford, Marie E. Danforth, and J. Kathryn Josserand. 1996. Early Agriculture in the Maya Lowlands. *Latin American Antiquity* 7(4): 355-372.

Reese-Taylor, Kathryn, Mary Jane Acuña, and Marcello A. Canuto. 2011. Introducción, 25 Años de Investigaciones Arqueológicas sobre el Preclásico en la Meseta Cárstica Central, Paper presented in the XXV Simposio de Investigaciones Arqueológicas en Guatemala, July 18-22, Guatemala City.

Wahl, David, Roger Byrne, and Lysanna Anderson. 2014. An 8700 year paleoclimate reconstruction from the southern Maya lowlands. *Quaternary Science Reviews* 103:19-25.

Wahl, David, Roger Byrne, Thomas Schreiner, and Richard Hansen. 2006. Holocene vegetation change in the northern Peten and its implications for Maya prehistory. *Quaternary Research* 65: 380-389.

———. 2007. Palaeolimnological evidence of late-Holocene settlement and abandonment in the Mirador Basin, Peten, Guatemala. *The Holocene* 17(6): 813-820.

Wahl, David, Thomas Schreiner, Roger Byrne, and Richard Hansen. 2007. A Paleoecological Record from a Late Classic Maya Reservoir in the North Petén. *Latin American Antiquity* 18(2): 212-222.

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