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Dynamics and sustainability of the Maya socio-ecosystem of the hinterland of Naachtun, between 1500 BCE and 1000 CE (Southern Maya Lowlands, Petén, Guatemala).

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In the Southern Maya Lowlands (SML), several scientific and technical obstacles hinder the knowledge of environmental and socio-environmental dynamics, that have occurred at the scale of the territories of the cities. This includes the research topic itself (nature-culture interface), the tropical forest (morphological studies and access to the field) and the morphological and sedimentary archives (taphonomy and discontinuity). The study of the socio-ecosystem of Naachtun (150-950 CE), a Maya city of the Classic period, is not exempt from these constraints. Recently, large-scale work in SML was conducted based on LiDAR analyses and fieldwork. They have profoundly renewed our knowledge of the complexity of landscape transformation and natural environments through the action of the ancient Maya (Canuto et al. 2018). They have provided new research perspectives which allow us to examine the following questions.

How did natural resource availability (water, soil and biological resources) change in the territory

of the city, with respect to climate change and social demand? How did the ancient Maya adapt their resource management strategies to these changes? How important were socio-environmental risks to the resilience and sustainability of the socio-ecosystem? In order to answer these questions, a new systemic, interdisciplinary and multiscale research program has been implemented. It includes geoarchaeology (alluvial and agrarian), archaeogeography (LiDAR analysis, spatial analysis), palaeoecology and bioarchaeology [archaeobotany (study of phytoliths, anthracology, pedoanthracology) zooarchaeology (vertebrate and conchyological fauna remains)], spatial archaeology (agglomeration processes, power relays), palaeodemography and geochronology (^{14}C , OSL). Current and pre-anthropogenic reference frames (hydrological, pedological and ecological) have also been established.

Our results reveal the complexity of the Maya palimpsest territories produced during the ~ 1500 BCE - 1000 CE period (Preclassic and Classic periods). Hydrosedimentary flows have fluctuated in response to climate change and anthropogenic impacts, controlling the spatiotemporal dynamics of resources (water and soils). Lake levels and erosion have fluctuated according to pluricentennial-scale periods. All compartments of the hydrosystem and the sediment system were subject to transformations, to manage water and soils. A mosaic of agricultural and agroforestry strategies was developed throughout the micro-region (morphologies, practices, cropping systems, fuel economy). Intensive wetland systems and irrigated farming systems were established in poljes, sinkholes and valleys (raised fields and drained fields). In addition, in the hilly areas, agrarian systems based on terraced agriculture, rain-fed farming systems, slash-and-burn, arboriculture and horticulture systems were established. The Maya socio-ecosystem which emerged in this micro-region lasted for more than 2500 years. It experienced shifts and continuities and its dynamics are framed around six main multi-secular periods. Its decline was part of the profound changes that took place in the territories of the SML cities between 750 and 1050 CE. The sustainability of this socio-ecosystem during the demographic peak of the Late and Terminal Classic (750-950 CE), before the abandonment of the epicenter of the city of Naachtun (~950 CE), is estimated and discussed in relation to the environmental carrying capacity, social demand, climate and its own resilience.