

Background

Belize, on the Caribbean coast of Yucatan (Fig. 1), has suffered the impact of climate extremes in the archaeological and recent past, from droughts and hurricanes.

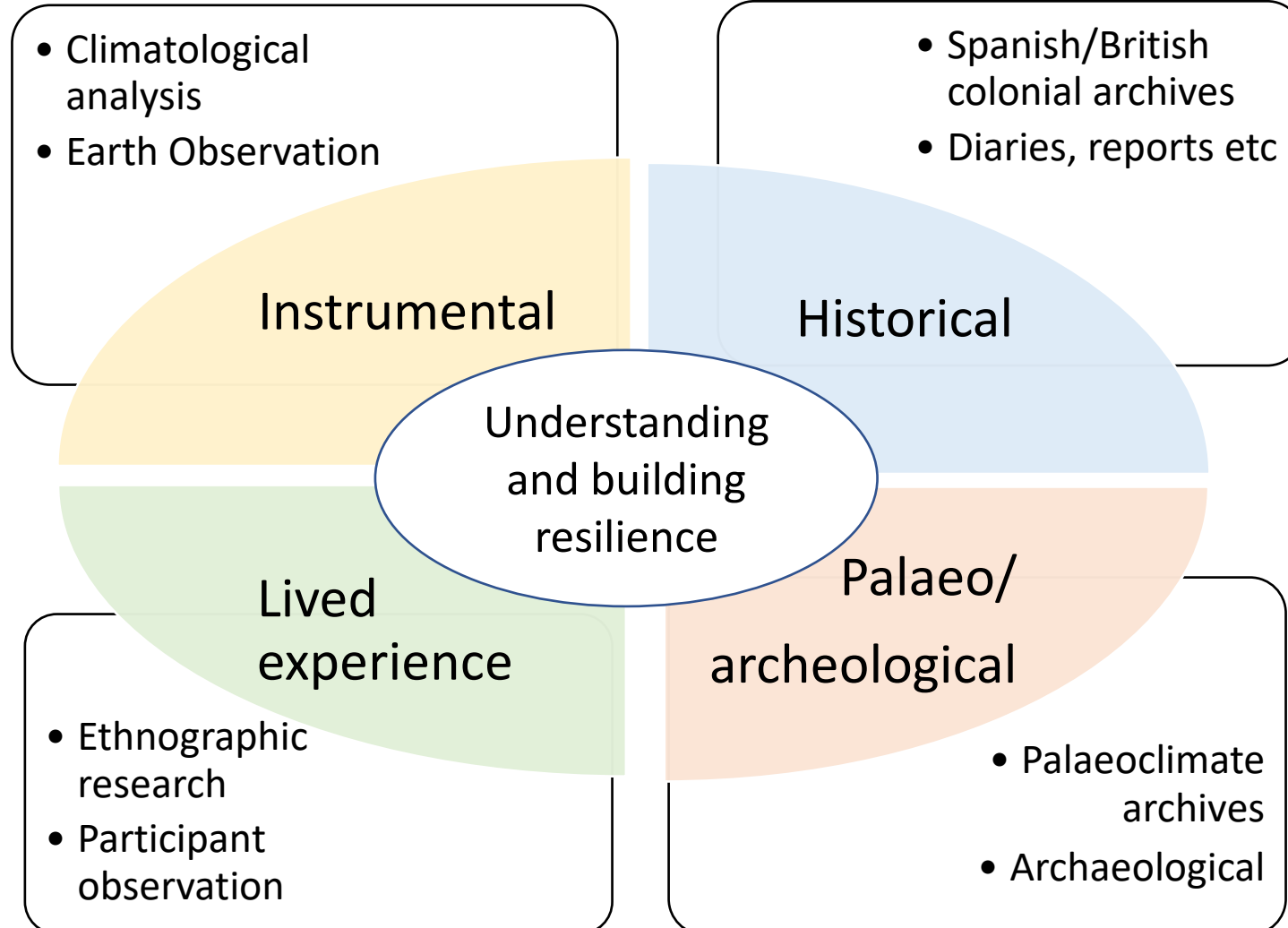
It is now experiencing increasing temperatures, variable rainfall, more intense tropical storms, and droughts. These events pose a significant threat to communities and farming systems, as well as having long-term impacts on the environment and the economy.



ICARUS Aims

- To develop a new approach to understanding resilience by combining methods over a range of disciplines and timescales
- To build more resilience to extreme climate events based on that understanding

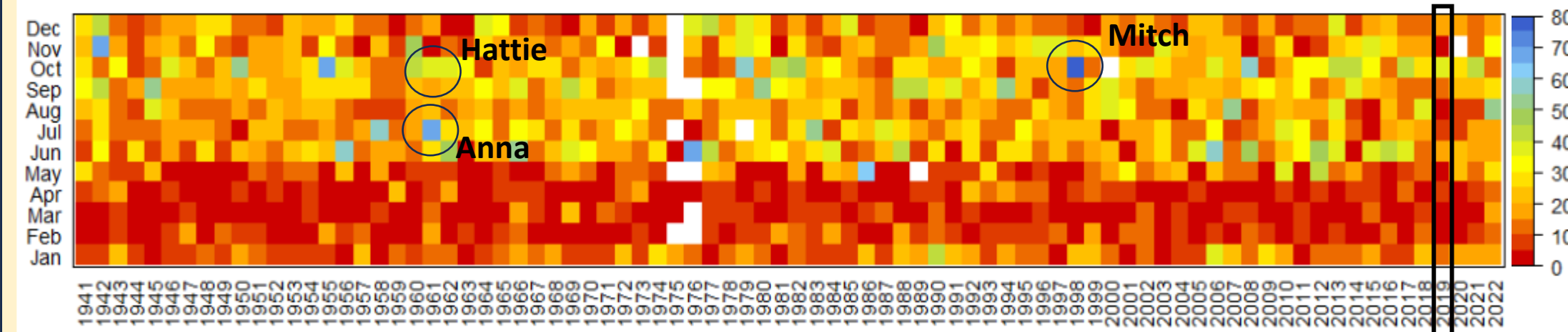
Approach



Instrumental records

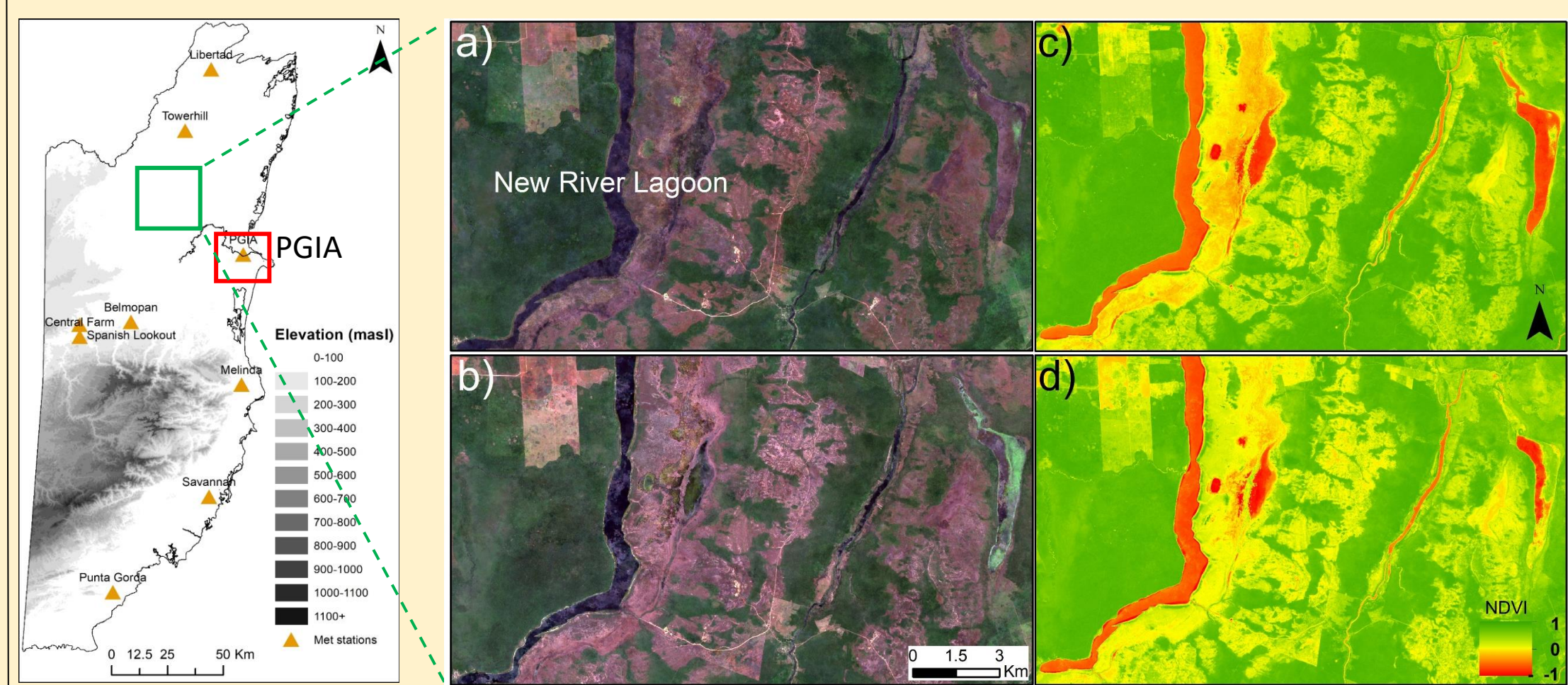
Modern meteorological records are short, collected at few locations (Fig. 2) and often discontinuous.

The longest record is from Belize City Airport (PGIA) 1941 to date (Fig. 2, red box). Rainfall data from PGIA show that although hurricane Hattie (see photo above) was destructive, it was not as wet as July 1961 (Hurricane Anna).

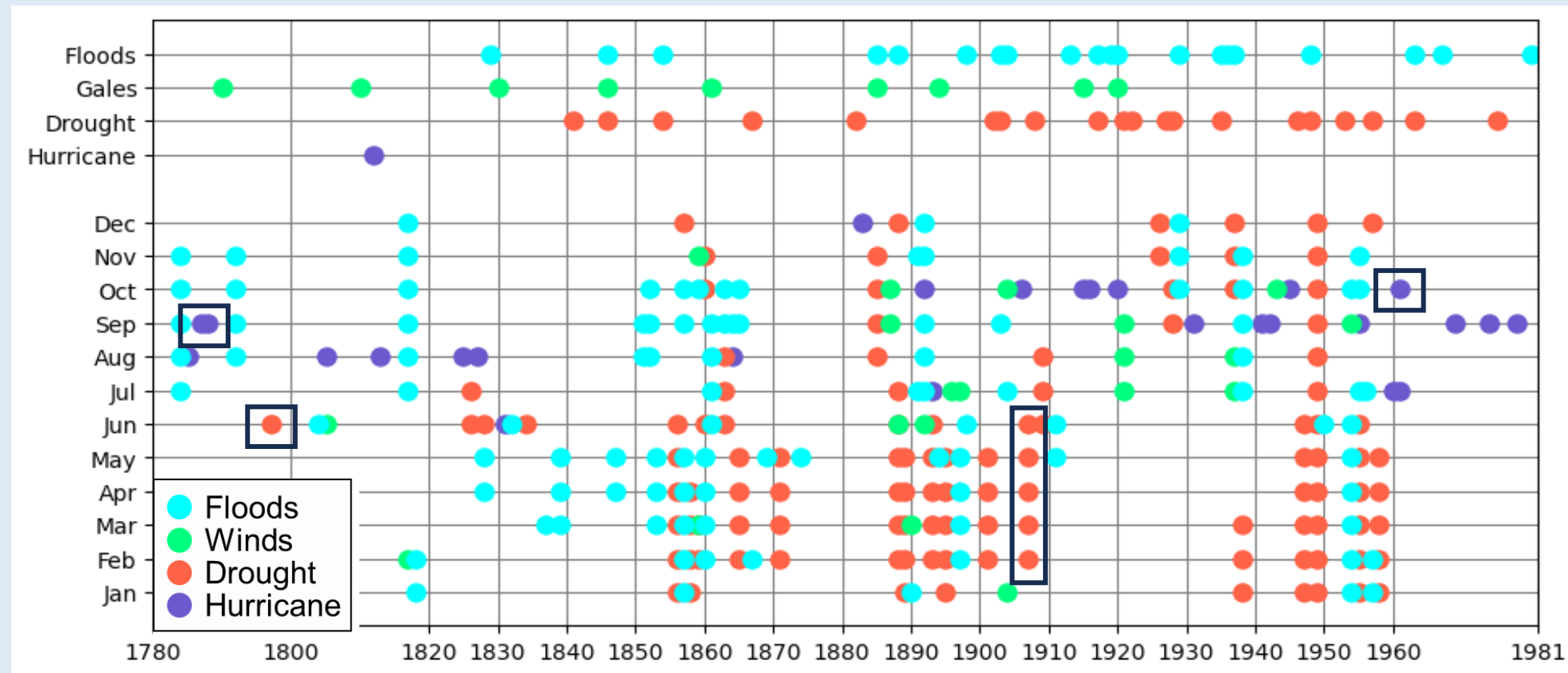


Colour coded plots of monthly precipitation (Fig. 3) reveal the spring/early summer dry season, some major hurricanes (Mitch October 1998) and highlight particularly dry years e.g. 1944, 1949, 2019 (black box). 2019 was a year of drought across Belize.

Impacts/imagery



Historical records



Historical archives have revealed multiple episodes of extreme climate events (Fig. 5) such as 1787 and 1961 (Hattie) hurricanes and 1797 and 1907 droughts

Events/Impacts

Event/year	Impacts	Historical description
Hurricane 1787	High winds, flooding, >100 deaths, 95% building destroyed, domestic animals drowned	"A dreadful hurricane came on in the country, which caused a violent inundation of the sea, and was productive of a very heavy and destructive land flood".
Drought 1797	Famine, fear of slave rebellion due to lack of food supply, provisions shipped from Jamaica	"An uncommon drought had destroyed all the plantations. Famine had already made its approach and the situation of the country was deplorable beyond description"
Drought 1907	Belize City water supplies ran out, water imported from New Orleans and Mobile. Corn crops greatly damaged	"The longest drought known to anyone living in Belize is upon us"
Hurricane Hattie 1961	370 km/hr gusts, 10 ft. high tidal wave, 400 deaths, 3,200 km ² of forest blown down, damage to plantations	"The capital, Belize City, was flooded to a depth of 5 to 15 feet for several days, and 75% of all the houses were wrecked"

Lived Experience

The aim is to record peoples' perceptions of climate and climate impacts and adaptations made.

- 20 interviews/meetings (2022)
- Farms with the most important crops per district (Fig. 6), covering small scale and commercial producers
- Discussions with Ya'axché Conservation Trust and the Caribbean Community Climate Change Centre
- Visit to the National Meteorological Service of Belize
- Ground truth data collected for satellite imagery
- More work planned for 2023

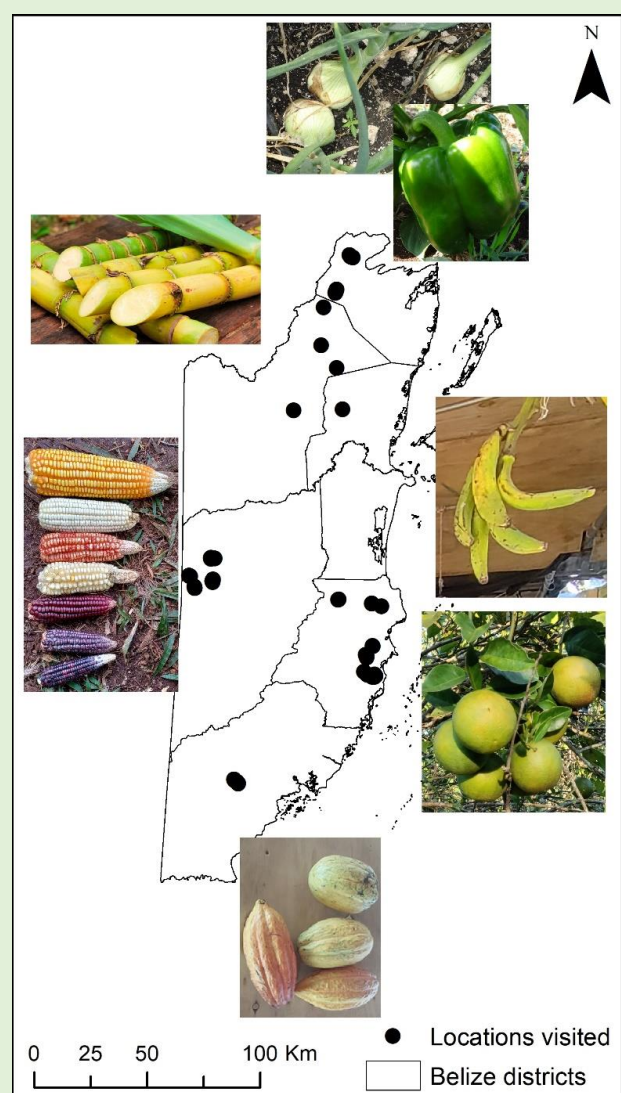


Fig. 6 Locations visited and main crops

Impacts and adaptations

Crop	General impacts	Specific impacts
Bananas	Droughts and excessive rainfall create ideal conditions for disease (Panama disease, Sigakota)	2022, 90,000 bunches lost due to excessive rainfall and pests
Sugar cane	Usually very resilient. Very wet conditions followed by high temperatures result in the proliferation of Pinta fly	2019 32% crop lost due to drought. 2022, hurricane Lisa some producers lost 80% of planted area
Citrus	Climate change and diseases (e.g. greening disease) affecting productivity and quality	2022, losses of pineapples due to water logging, generally good
Cocoa	A longer rainy season (more winter rain) beneficial > one harvest per year	2019, fires during drought destroyed some farms. 2022, good crop due to more rain

Key adaptations: more irrigation; crop diversification; more use of agrochemicals

Palaeo/archaeological

Will collate information on extreme climate (mainly drought) and its impacts before written/instrumental records.

The most detailed palaeoclimate records for Belize are from speleothems. Kennett et al. 2012 (Fig. 7) combines climate reconstruction and evidence for cultural change.

Other information comes from lake and bog sediment cores and archaeological sites.

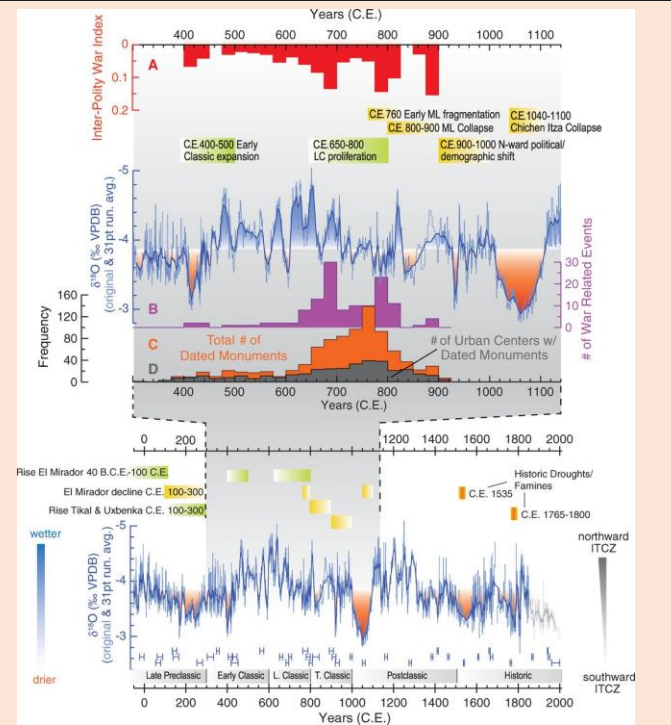


Fig. 7 Yok Balum (Kennett et al. 2012)

Initial findings

- Identification of extreme climate events from 18th century to now, palaeo records show long drought history
- Meteorological records are challenging to use
- Historical records valuable, but can be partial
- Changes in vegetation, agricultural practices and socio-economic systems caused by hurricanes and droughts
- Different practices (e.g. crop diversification, adoption or irrigation systems) have been developed in response to increasing rainfall variability and higher temperatures

Thanks to our partners:

- Caribbean Community Climate Change Centre (Dr. Donnell Cain)
- Ya'axché Conservation Trust (Christina Garcia)
- Ministry of Agriculture, Food Security and Enterprise (Dr. Ina Sanchez)
- ECOSUR (Dr. Birgit Schmoock)
- Baylor University (Dr. Julie Hoggarth)
- Northumbria University (Prof. Brownen Whitney)