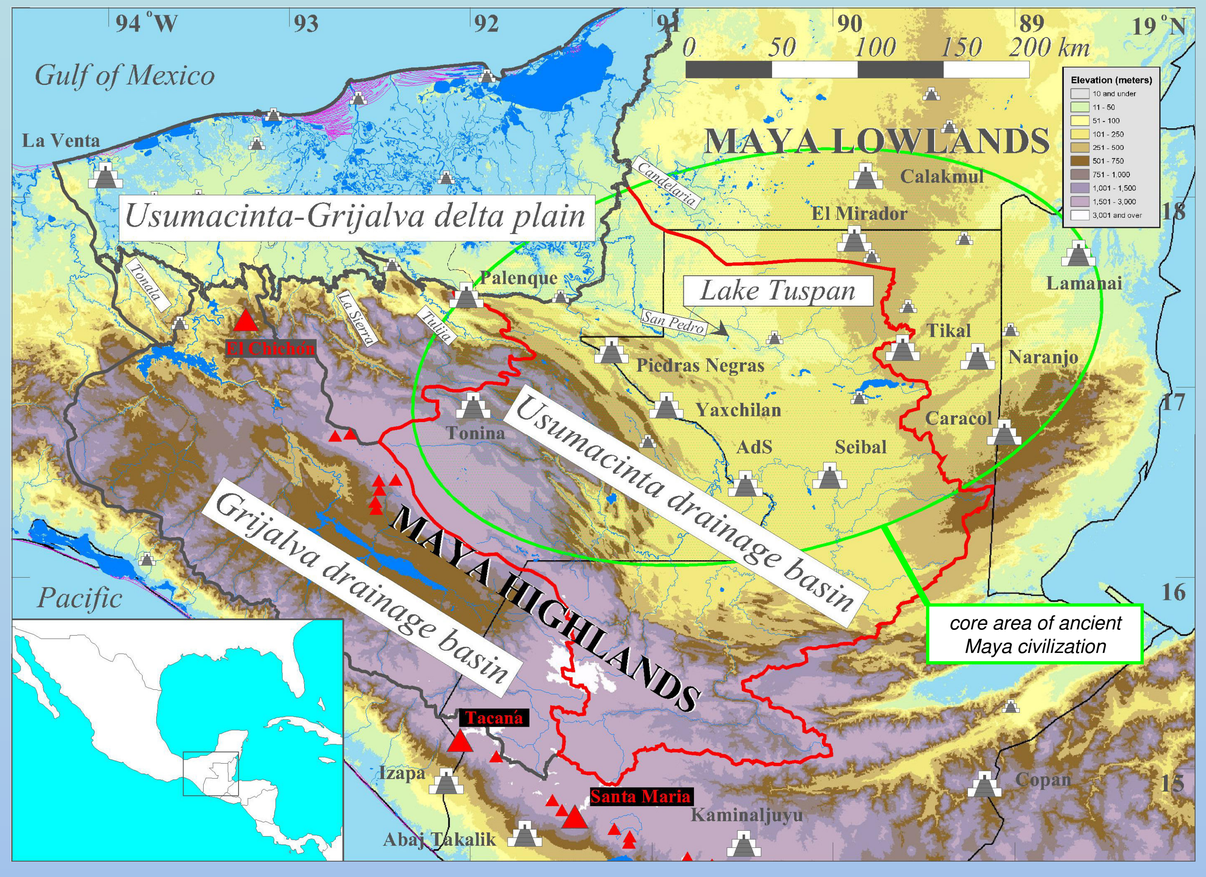
Five millennia of land use variability reconstructed from the world's largest beach ridge plain

Universiteit Utrecht
Faculty of Geosciences

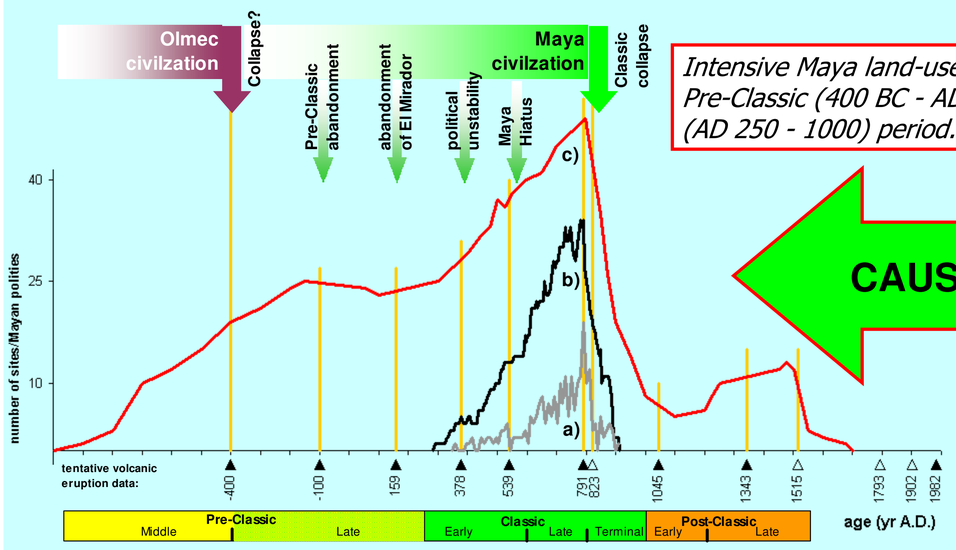
C.A.M. (Kees) Nooren, W.Z. Hoek and H. Middelkoop
Department of Physical Geography, Utrecht University, The Netherlands, k.nooren@geo.uu.nl

INQUA BERN 2011



The beach ridge plain of the Usumacinta-Grijalva delta in southern Mexico is a highly sensitive recorder of combined sea level rise, subsidence, storm and hurricane impact, and changes in climate and upstream land use since the dawn of Olmec and Maya cultures circa 5000 years ago.

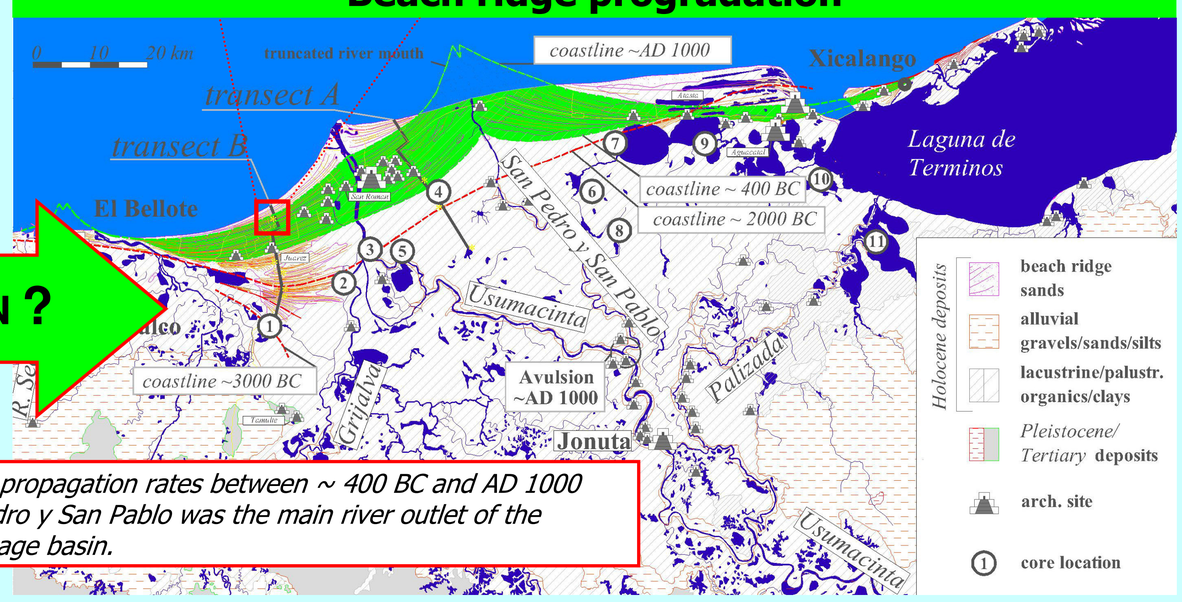
Human land-use intensity



Intensive Maya land-use during the Late Pre-Classic (400 BC - AD 250) and Classic (AD 250 - 1000) period.

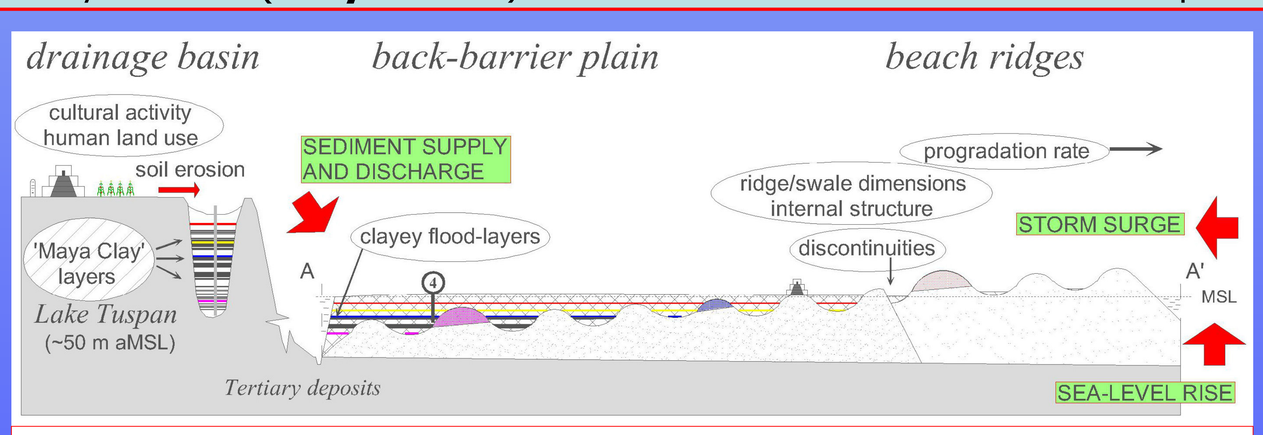
CAUSAL RELATION ?

Beach ridge progradation



High beach ridge propagation rates between ~ 400 BC and AD 1000 when the San Pedro y San Pablo was the main river outlet of the Usumacinta drainage basin.

Hypothesis: Deforestation and periods of intensive land use in the watershed accelerated soil erosion and increased sediment supply to inland lakes and depressions. In the hinterland eroded soil forms marked beds of so called **'Maya Clay'** in many lake records. We hypothesise that human induced soil erosion also resulted in large supply of sandy sediment (**'Maya Sand'**) to the rivers and contributed to the development of the extensive beach ridge plain.

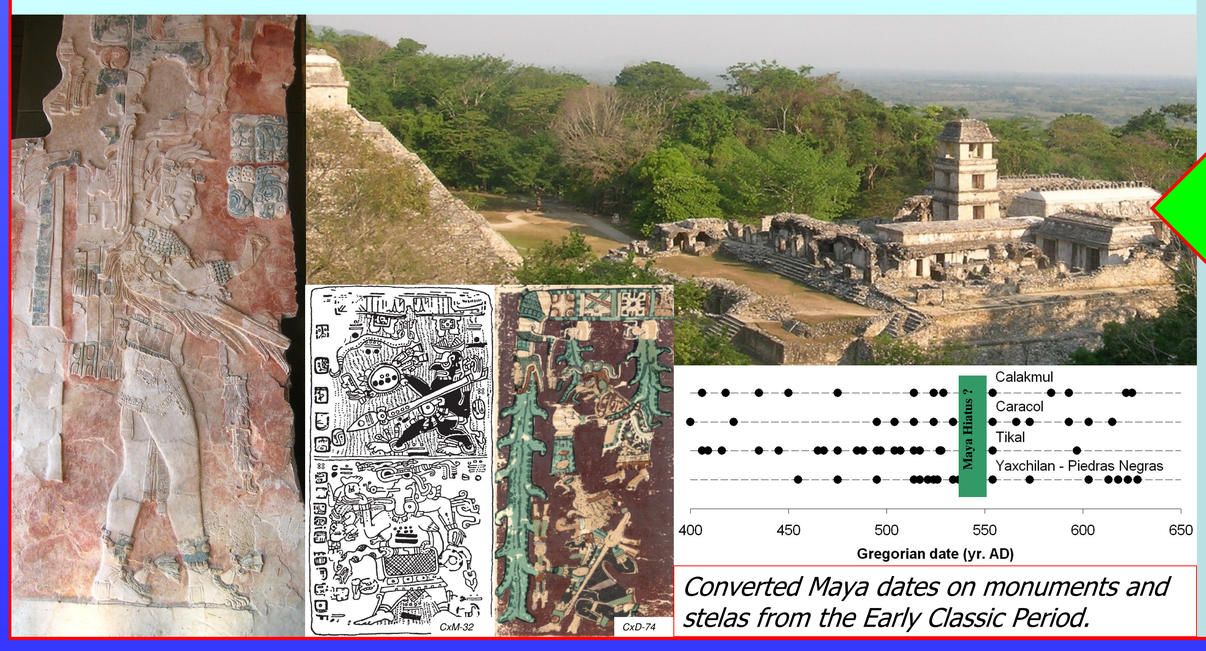


Schematic cross section of transect A with the main forcing factors (red arrows) and related parameters (encircled) controlled by changes in climate and land use.

Strategy (hinterland)

2011 - 2014

Multiproxy study of a sediment core from Lake Tuspán.
High-resolution (50-yr interval) archaeological/historical reconstruction of human cultural activity for the last 3000 years.
In collaboration with the Universities of Campeche (Mexico), Toulouse, and Bordeaux.



Converted Maya dates on monuments and stelas from the Early Classic Period.

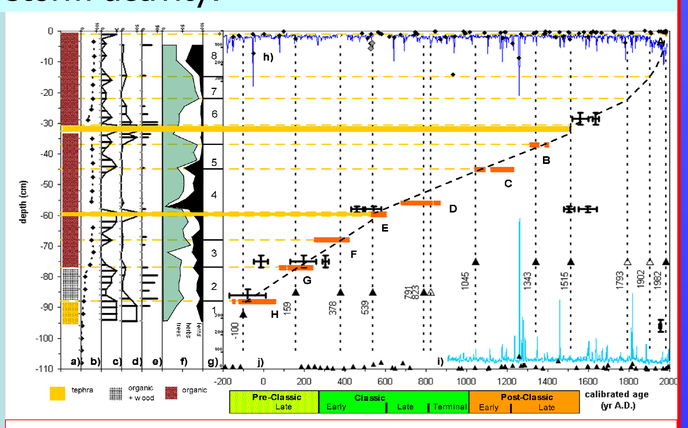
Beach ridge volume changes will be compared to upstream land-use changes to verify correlations.

Strategy (beach ridge plain)

2012 - 2015

Transect survey and coring (dGPS, GPR, and palynology).
Geochronology (^{14}C, OSL, tephrostratigraphy and archaeology).
In collaboration with the University of Campeche, ECOSUR (Mexico), and Michigan State University.

We use the beach ridge progradation rate as a proxy-measure of received sediment fluxes. These rates are transformed to fluxes using the 3D geometry of the beach ridges to account for the effects of changes in accommodation space and palaeostorm activity.



Preliminary tephrochronological framework based on the POZPETR (nr. 4) core (Nooren et al., 2009).

Reference: Nooren, C.A.M., Hoek, W.Z., Tebbens, L.A. and Martin del Pozzo, A.L., 2009. Tephrochronological evidence for the late Holocene eruption history of el Chichón Volcano, Mexico. *Geofisica Internacional* **48**, 97-112.

NWO Netherlands Organisation for Scientific Research
grant 821.01.007