Paleoenvironments: Geosciences

Estimating Pleistocene Shorelines and Land Elevations for North America

J. Christopher Gillam, David G. Anderson, Stephen J. Yerka, and Shane Miller

Estimating paleo-shoreline extents for the late Pleistocene and early Holocene has traditionally been a difficult task to accomplish even at local scales. This fact is highlighted by the common use of the approximate Last Glacial Maximum (LGM) shoreline contour in the literature when regional or continental scale distributions are illustrated. While useful as a heuristic, the LGM shoreline is not accurate for most of the Paleoindian Period and can present problems for geographic information system (GIS) and other spatial analyses of site distribution and land use.

Fortunately, GIS data and sea-level depth estimations are now available that make modeling ancient shorelines and land elevations more practical at the continental scale. The ETOPO2 dataset of the National Geophysical Data Center (NGDC) is a 2-minute latitude/longitude grid (approximately 3.7-km spatial resolution at the equator) representing land elevations and seafloor bathymetry derived from the Global Land One-km Base Elevation (GLOBE) digital elevation model (Hastings and Dunbar 1998) and satellite altimetry and ship depth soundings for bathymetry (Jakobsson et al. 2000; Smith and Sandwell 1997). These data, which are easily integrated into a raster GIS environment for analysis, are distributed free online as raw data or customizable grids for specific areas (http://www.ngdc.noaa.gov/mgg/image/2minrelief.html).

Using published sea-level curve estimates (Lambeck et al. 2002), it is relatively simple to use map algebra techniques in a raster GIS to reclassify the ETOPO2 grids to represent paleo-shorelines and land elevations. For example, the digital elevation model (DEM) for 13,000 CALYBP uses the sea level depth estimate of -75 m (Figure 1). To adjust the ETOPO2 DEM data, you

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simply add 75 to the *z*-values of the DEM and then reclassify all negative values to zero or "no data" to represent the oceans and water bodies. An obvious caveat to the use of sea-level curve estimates is that local variation in sea level due to glacio-isostatic deformation and other glacial influences are not accounted for in higher latitudes and could be a source of error at local scales of analysis in affected regions. However, most of the habitable landscape of the Pleistocene was not affected by such localized processes, and the scales of analysis appropriate for a 4-km resolution grid are regional to continental in scope.

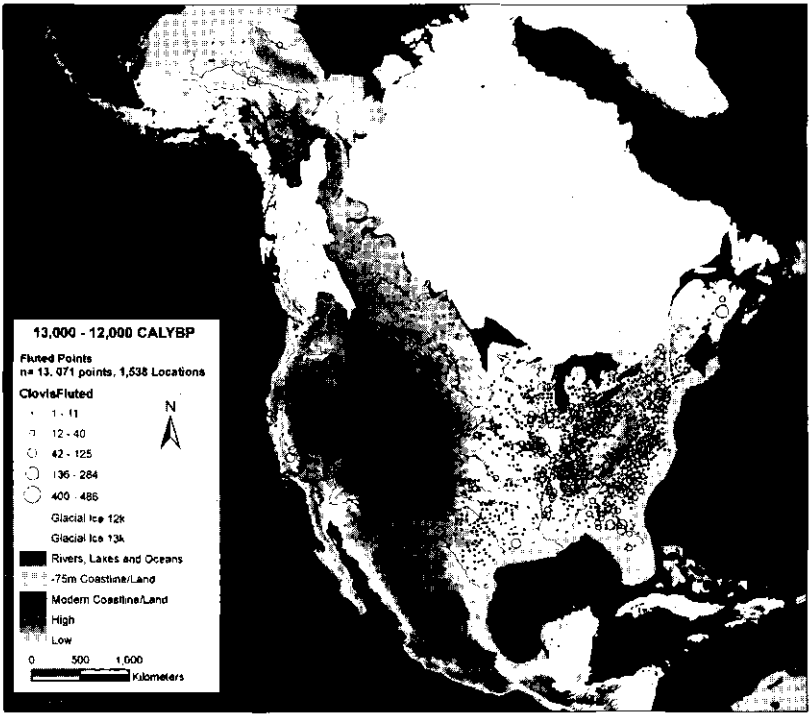

Figure 1. Paleo-shoreline for 13,000 CALYBP with fluted-point density distributions, excluding known post-Clovis types, in North America.

The authors have estimated paleo-shorelines and land elevation models for the late Pleistocene and early Holocene from 14,000 to 9000 CALYBP in 1000-year intervals for use with the Paleoindian Database of the Americas (PIDBA) and other research projects in North America (Anderson et al. 2005a, 2005b; Gillam et al. 2005). Example maps with archaeological distributions are available for viewing and downloading at the PIDBA Web site (http://pidba.utk.edu/maps.htm). The time-sliced DEMs for the late Pleistocene and early Holocene have many applications beyond heuristic distribution maps. For example, the DEMs may be used to improve extant models of Paleoindian migration, interaction, and exchange networks across North America (Anderson and Gillam 2000). Mapping the paleo-coastal zone also illustrates how

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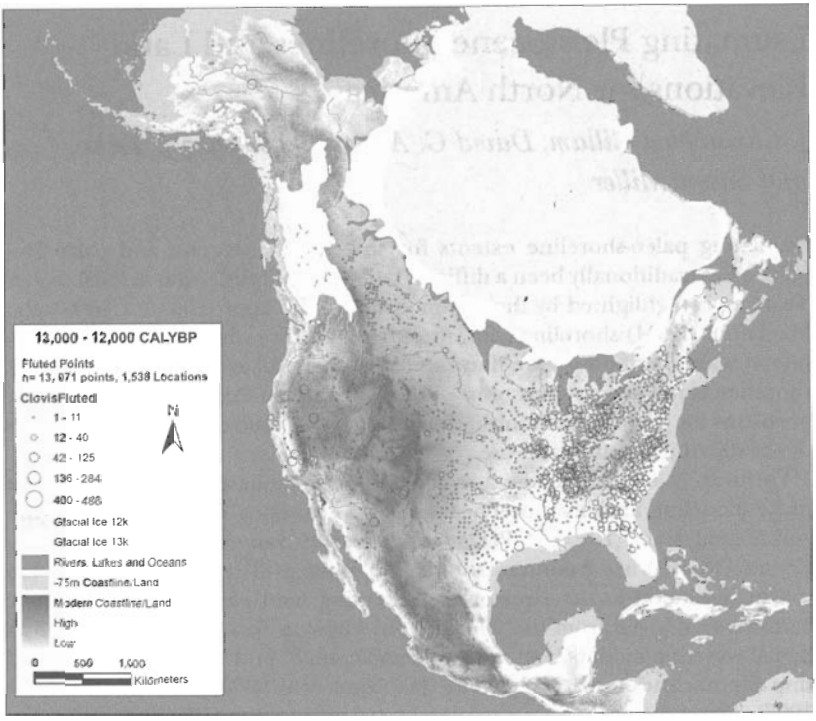

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extensive and changing it was and how little we currently know about the coastal adaptations of early hunter-gatherers in North America (Faught 2004).

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Magnetic Expression of the Late-Pleistocene La Sena Mammoth Site, Southwestern Nebraska

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The La Sena mammoth site (25FT177) (Holen 2006; Holen and May 2002), located in a wave-cut bluff of Medicine Creek Reservoir (SW Nebraska), has been ^{14}C-dated and has undergone taphonomic analysis. A partial adult mam-

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