Isobase reconstitution technique for paleo-landscapes: Geoarchaeology approaches for archaeological sites spatial organization in southeast Brazil quaternary

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Abstract

The paper discusses the creation of isobases to reconstitute paleo-landscapes, aiding the understanding of geomorphological, climatic, environmental processes and forms, and preterits human settlements. Reconstitution of a watershed in the southeastern portion of Brazil is used as an example.

Keywords

Landscape reconstitution, Isobase, Geoarchaeology.

Introduction

The isobases are lines that delineate an erosion surface (Golts *et al.*, 1993) can be understood as a type derived from the surface trend maps, as defined by Chorley and Haggett (1965). According to "Filosofov (1960), the isobase surface is the hypothetical plane formed by connecting stream profiles of a similar stream order" (Golts *et al.*, 1993, p. 307). The new tools GIS have enabled wider

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use of isobases (Leverington *et al.*, 2002), and these have been presented as a way to assist the reconstruction of paleoenvironments (Smith *et al.*, 1969), allowing the study of paleolandscapes and landscape archeology as a way to understand geomorphological, climatic and biodiversity's preterit processes and auxiliary spatial studies of archaeological sites (Andrews *et al.*, 1971).

Research procedures

As from image SRTM (16-bit, datum WGS84) ASTER GDEM (product of METI and NASA) obtained at 1 arc second (30m equator) provided by the United States Geologycal Survey - USGS, was bounded the study area (watershed of Piracicaba river, State of São Paulo, Brazil).
Before the identification of network and drainage flows, depressions correction is required (Martz *et al.*, 1992), for inhibiting failures, to this, is used in the software ArcGis (v10) the tool "sink", that identifies the depressions, generating a raster, in which applies the "fill tool", to fill the depressions and eliminate DEM imperfections.
The next step is the identification of the drainage flow ("flow direction" tool). The hydrological model to define the direction of drainage uses each cell individually, 8 paths for the flow are possible (O'Callaghan *et al.*, 1984), allowing to generate the accumulation flow (tool "flow accumulation") and thus set the order of drainage. For the drainage ordering, is set the threshold of how many pixels are required for the formation of streams, as higher threshold chosen, more drainage elements will be omitted.
After these steps is possible to trace the order of drainage, in this case following the Strahler (1957) classification. With the defined channel orders, it is finally possible to identify the isobases. Each drainage must be separated according to

your order, and each must be interpolated from the DEM SRTM, in this manner, the surfaces of isobases are generated for each altimetric information contained in the SRTM.

Results

Eight streams orders channels were identified by Strahler method for Piracicaba river watershed. For example purposes, the isobases from the 4th order with dating back to the end of the Paleogene landscape will be taken.
In fig. 1 is possible to observe the paleo reliefs, as from the isobase 4, wet phase the beginning of the excavation of São Paulo peripheral depression. The 3rd Order Isobase dates back to the end of the Neogene landscape identified as dry climate that produced the original floor of the basin subsequently dissected in the wet phase (Penteado, 1974), active in the period of 2nd Order Isobase. To the north, the *cuestas* relief starts to increasing the incline level.
In the early period of the 2nd Order Isobase the wet phase allows the notching of the rivers and expansion of forests with intense pedogenesis (Penteado, 1974). The 2°Order Isobase phase, intersperses wet and dry climatic periods, where in the dry climate pulses around to 11,000 BP, 9000 BP and 6000 BP with forest retraction and disappearance of pampas fauna (Miller, 1968), coincide with the dating of some archaeological sites located at the northern end of the basin. Figure 2 shows expansion of this area with the location of some archaeological sites recorded. The position of lithic sites in the valleys is bordered by major *cuestas* relief northwest. The dating of ceramic site approaches the wetter climate oscillation at 2500 BP with expansion of forests.

Discussion

The isobases present practicality and accuracy to remodel paleolandscapes, the results have been close to those found in the literature and in the field.

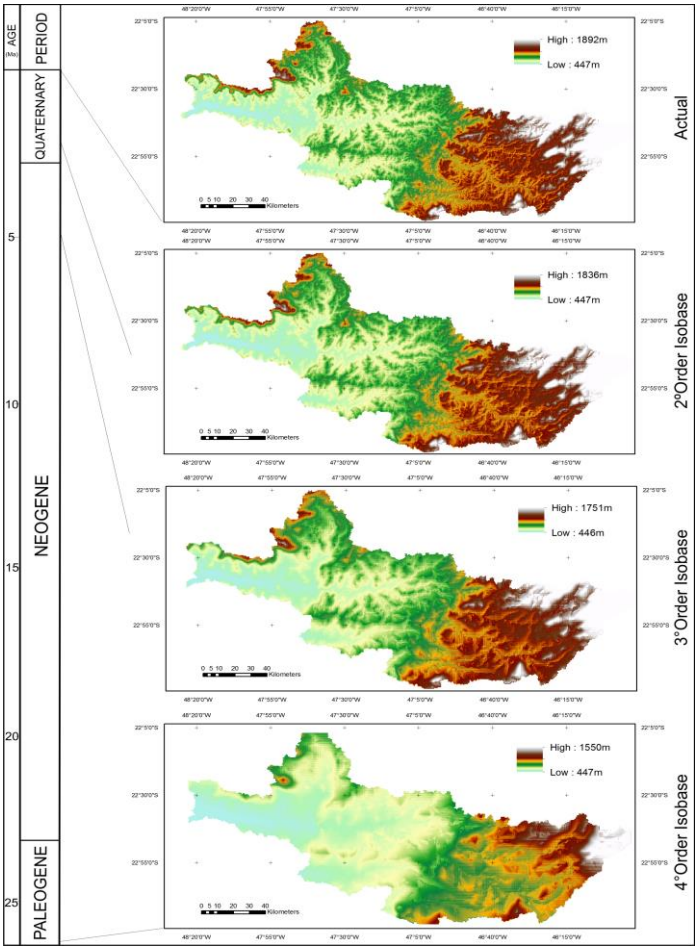

Figure 1 - Isobases Maps And Paleolandscapes Reconstitution

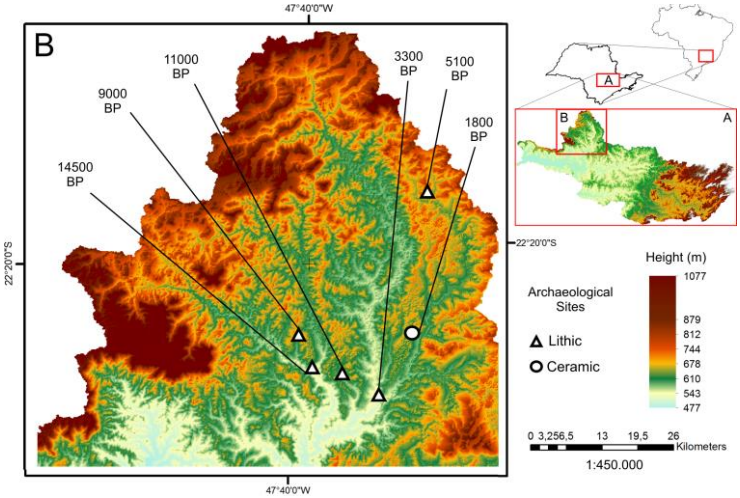

Figure 2 - Archaeological Sites Spatial Organization

In geoarchaeology, the isobases can provide starting points for landscape modeling and environmental components of the initial conditions to better understand the spatial arrangement of sites. The drainage in wet tropical climates require additional contribution for interpreting small changes in the channels and possible human interference in the landscape.

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