

Materia: Ecología del Paisaje

III. LA COMPONENTE BIO-FÍSICO-QUÍMICA EN LA DINÁMICA DEL PAISAJE

a) Modelado del Paisaje. Dinámica fluvial

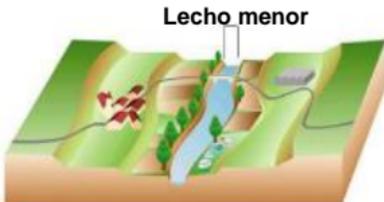
5 mayo 2025

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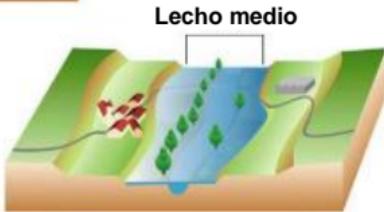
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**Espacio de libertad =
Espacio de movilidad +
Espacio de inundación**



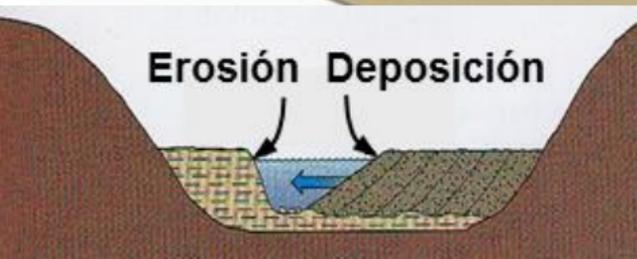
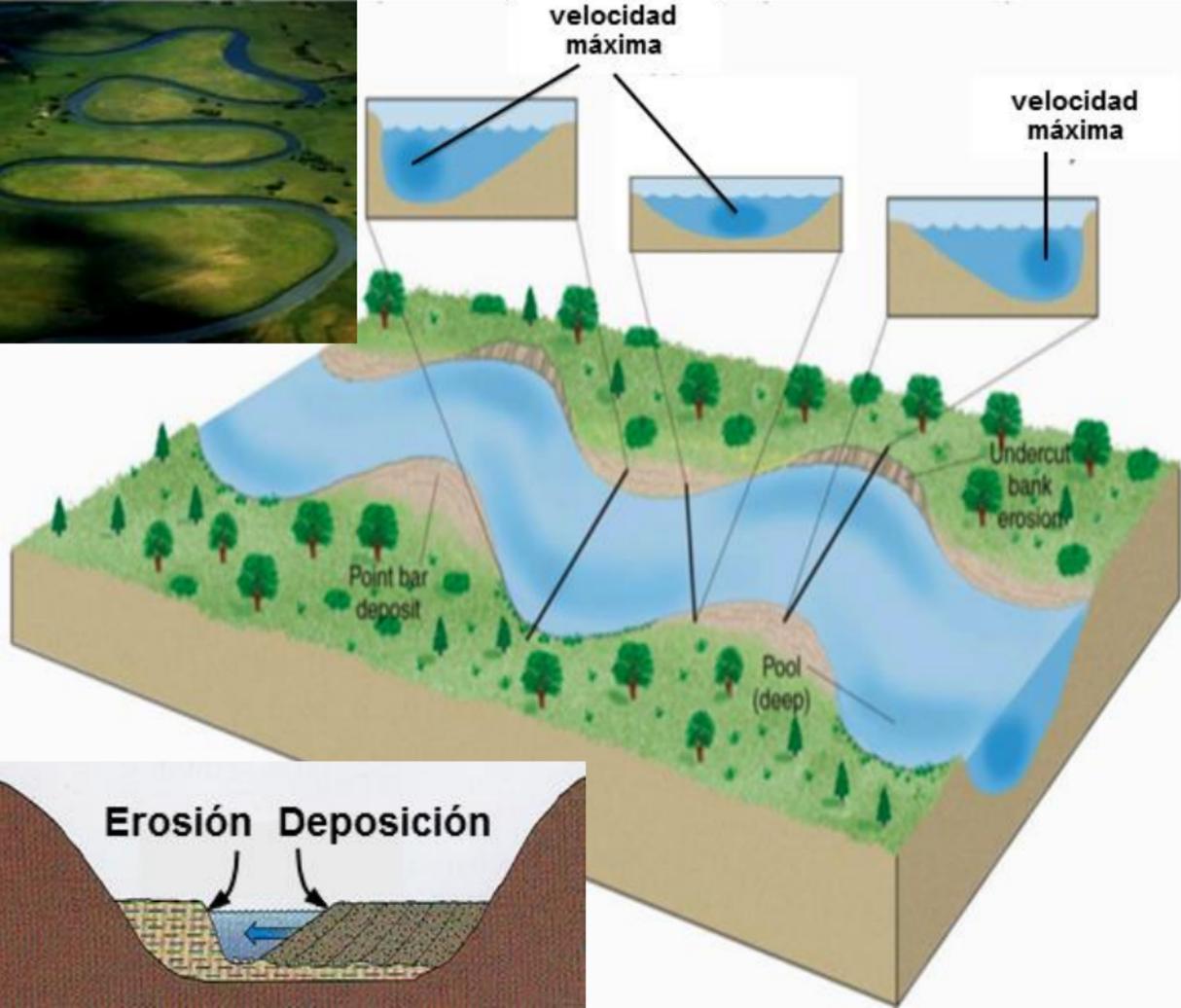
**+ medios húmedos
(espacio de integridad)**

Estado natural original



<https://www.redalyc.org/jatsRepo/721/72157132006/movil/index.html>

El área de libertad es un concepto reciente, que gana popularidad en diferentes partes del mundo (Biron et al., 2013). Bajo reconocimiento del concepto por parte de las autoridades gubernamentales, por lo que no se incluye en ninguna regulación. Por el contrario, los estándares existentes están relacionados con el mantenimiento del banco y la prevención de la erosión en lugar de liberar estos espacios (Belleau y Robert, 2014). En Quebec, el área de libertad se ha mapeado en ciertos ríos como parte de proyectos de investigación, pero actualmente no hay ningún proyecto implementado (Marcoux, 2015).



PRECURSORES

Einstein, Albert, 1926. [The cause of the formation of meanders in the courses of rivers and of the so-called Baer's Law]. Publicado en *Die Naturwissenschaften*, Vol 14.

Leído antes en "Prussian Academy" (7/2/1926).

[Traducción al inglés en "Ideas and Opinions," by Albert Einstein, Modern Library, 1994]

back in question, or rather the river simply falls to zero at any particular point of the meandering wall. This is equally true under circumstances, whether the current originates as mechanical or as an physico-chemical factor (disintegration of the ground). We must therefore concentrate our attention on the circumstances which affect the response of the velocity gradient at the wall.

In both cases the asymmetry as regards the fall in velocity in question is induced by the formation of a circular motion to which we will now draw attention.

I begin with a little experiment which anybody can easily repeat. Imagine a glass tumbler cut off at top. On the bottom there are some ten lines, which step down because they are not parallel but the liquid they have displaced. If by aid of leads to make by steps, the lines will soon collect in the corners of the bottom of the cup. The separation of the phenomenon is as follows: the excess of the liquid causes a centrifugal force to act on it. This in itself will give rise to an change in the flow of the liquid if the latter started like a solid body. Due to the neighborhood of the walls of the cup the liquid is retarded by friction, so that the angular velocity with which it rotates is less there than in other places nearer the center. In particular, the angular velocity of centers is less than that of centrifugal force, will be



FIG. 1

will rise the bottom than higher up. The result of this will be a circular current of the liquid of the type indicated in Fig. 1, which goes on increasing until, under the

influence of ground friction, it becomes stationary. The two lines are swept into the center by the circular movement and set up a great of an eddy.

The same sort of thing happens with a curving stream (Fig. 2). In every cross-section of the current, where it is bent, a centrifugal force operates in the direction of the outside of the curve (from A to B). This force is less near the bottom, where the speed of the current is reduced by friction, than higher above the bottom. This causes a circular movement of the liquid illustrated in the diagram. Even where there is no



FIG. 2

land in the river, a circular movement of the kind shown in Fig. 2 will still take place, if only on a small scale, as a result of the earth's rotation. The latter produces a Coriolis force, acting transversely to the direction of the current, whose right-hand horizontal component amounts to 2 $\times 10^{-8}$ per cent of mass of the liquid, where ω is the velocity of the rotation, and θ is the geographical latitude. An equal friction causes a diminution of this force toward the bottom, thus force also gives rise to a circular movement of the type indicated in Fig. 2.

After this preliminary discussion we come back to the question of the distribution of velocities over the cross-section of the stream, which is the corresponding factor in stream. For this purpose we must first make the (unrealistic) distribution of velocities derive and its maximum. If the water which was present at all at one cross-section set in

motion by the action of a uniformly distributed accelerating force, the distribution of velocities over the cross-section would be as follows. A distribution of velocities gradually increasing from the confining walls toward the center of the cross-section would only establish itself after a time, under the influence of friction at the walls. A disturbance of the (usually quiescent) stationary distribution of velocities over the cross-section would only gradually set in again under the influence of fluid friction.

Hydrodynamic pressure the process by which this stationary distribution of velocities is established in the following way. In a place (potentially) free of the cross-section an obstruction at the walls. They detach themselves and slowly move toward the center of the cross-section of the stream, distributing themselves over a layer of increasing thickness. The velocity gradient at the walls thereby gradually diminishes. Under the action of the internal friction of the liquid the velocity diameters at the interior of the cross-section are gradually advanced, their place being taken by new ones which form at the wall. A pure stationary distribution of velocities is thus produced. The important thing for us is that the attainment of the stationary distribution of velocities is a slow process. This is why relatively insignificant, constantly operative causes are able to exert a considerable influence on the distribution of velocities over the cross-section. Let us now consider what we set up advance the circular motion due to a bend in the river or the Coriolis force, as illustrated in Fig. 3. In bend to start on the disturbance of velocities over the cross-section of the river.

Let us assume that the water which was present at the outer wall, that is to say, in the upper part above the center of the bottom. There the speed of the water will be slowed by the circulation toward the right-hand wall, while the left-hand wall will get the water which comes from the region near the bottom, and so especially low velocity.

Here in the case depicted in Fig. 2 the motion is necessarily stronger on the right side than on the left. It should be noted that this experiment is essentially based on the fact that the size circulating momentum of the water exerts a considerable influence on the distribution of velocities. Because the adjustment of velocities by internal friction which causes this consequence of the circulating momentum is also a slow process.

We have now revealed the cause of the formation of meanders. Certain details can, however, also be deduced without difficulty from these facts. Events will be comparatively common not merely on the right-hand wall but also on the left-hand wall of the bend, so that there will be a tendency to assume a profile as illustrated in Fig. 3.

Moreover, the water at the surface will come from the left-hand wall, and will therefore, on the left-hand side especially, be moving less rapidly than the water nearer below

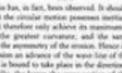


FIG. 3

down. This, in fact, has been observed. It should further be noted that the circular motion possesses inertia. The circulation will therefore only where its maximum beyond the place of the greatest curvature, and the same naturally applies to the asymmetry of the course. Since in the course of the stream an advance of the water line of the meander channel is bound to take place in the direction of the current. Finally, the larger the curvature of the bend, the more slowly will the circular movement be distributed in the water, the more slow of the meander formation will therefore increase with the cross-section of the river.

Einstein hipotetizaba que los meandros se forman debido a un balance entre las fuerzas de inercia y de fricción en una dirección perpendicular al flujo principal. A la fecha no se conoce exactamente el proceso, pero una cosa es muy cierta: las enseñanzas de Einstein nos han ayudado a comprender el misterio de los meandros.

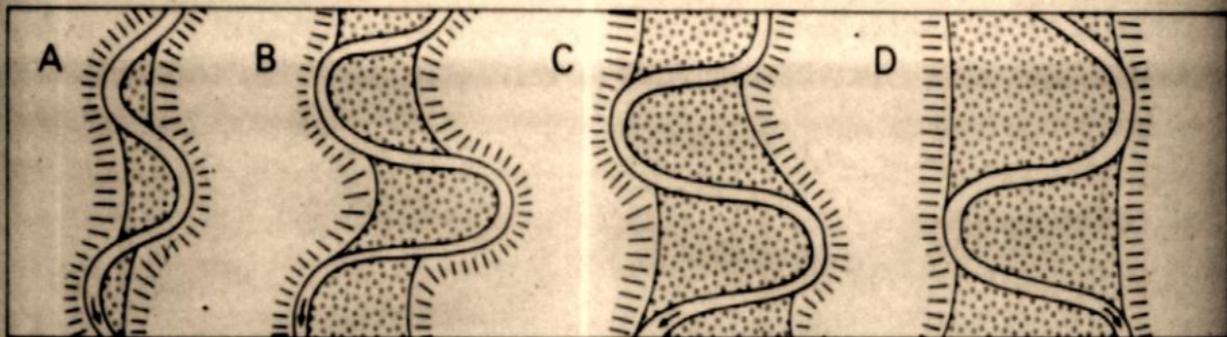


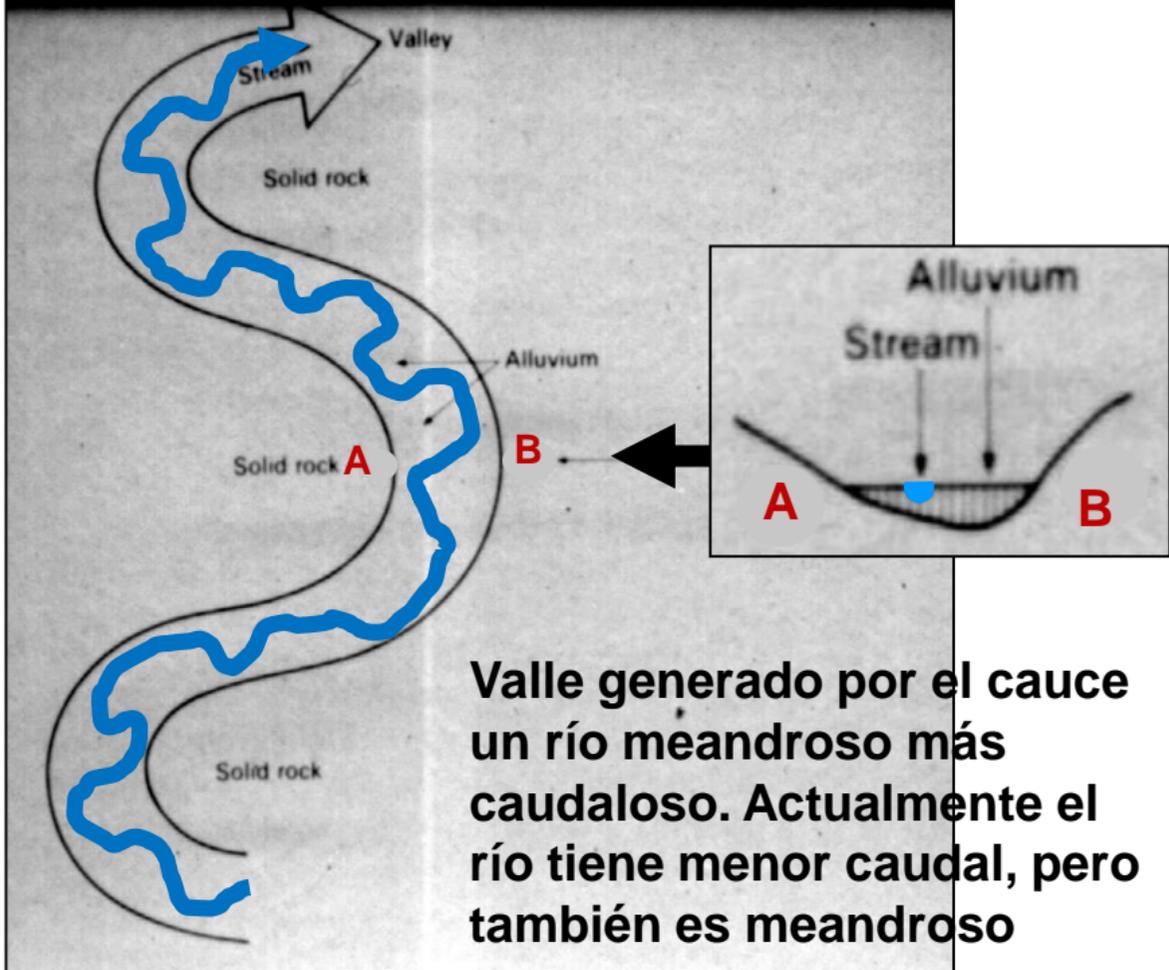
FIG. 2.5. Successive stages in development of a floodplain

A. Floodplain fragments form on inner sides of bends

B. Fragments enlarge and meanders move downstream

C. Movement of meanders downstream leads to continuous narrow floodplain

D. Floodplain as wide as the meander belt develops





Perfil de equilibrio (*graded river*)

- Cuando transcurre un tiempo t se da un ajuste en las variables que controlan el equilibrio tal que la velocidad de la corriente es la adecuada para el transporte de la carga fluvial
- En estas circunstancias, el río ha alcanzado su perfil de equilibrio



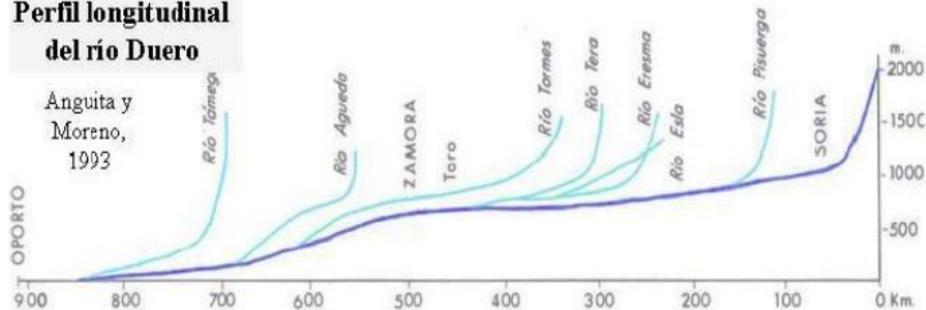
- Cualquier variación de los factores se traduce en un desplazamiento del equilibrio para absorber su efecto

Perfil longitudinal y nivel de base en un curso fluvial

- Perfil longitudinal: $h = f(d)$

Perfil longitudinal del río Duero

Anguita y
Moreno,
1993



Perfil longitudinal de zonas áridas o tropicales húmedas

Perfil de equilibrio

Sistema fluvial y
energía:

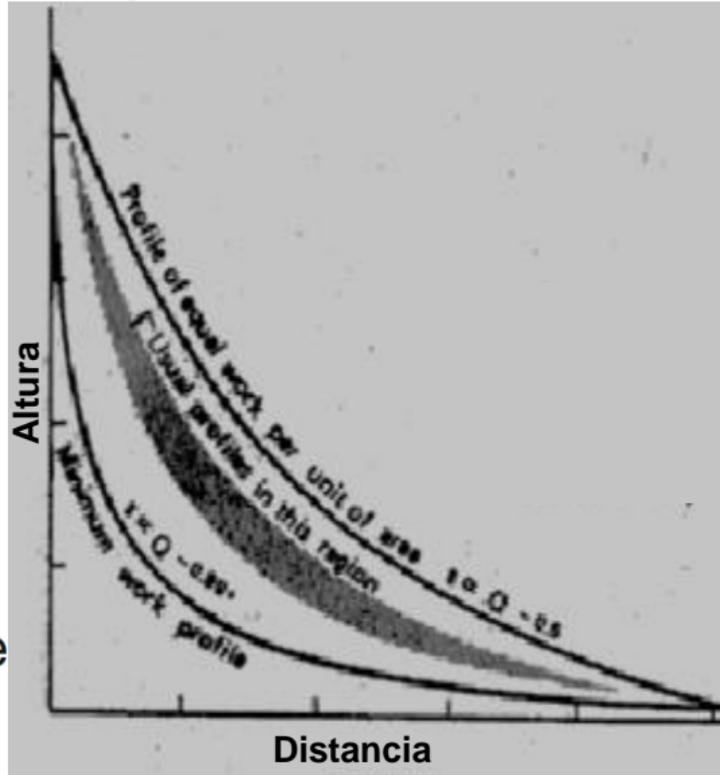
Energía potencial



Energía cinética

Equilibrio → Tendencia :

- Mínimo trabajo
- Distribución uniforme del trabajo

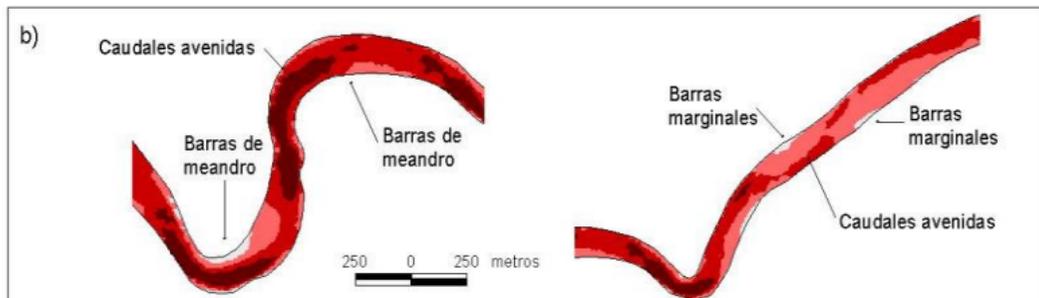
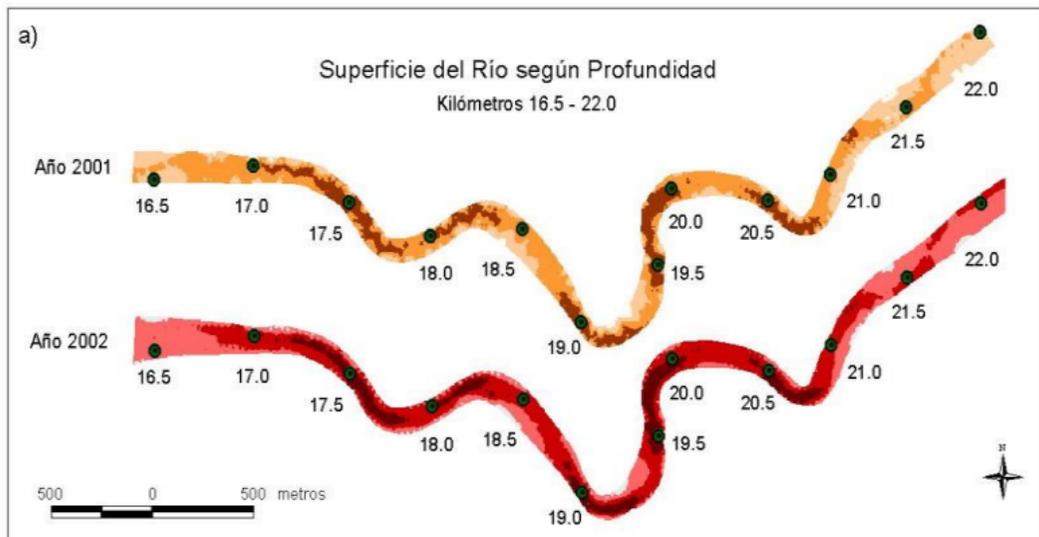


Causas que modifican el perfil de equilibrio de un curso fluvial

1. **Modificaciones de la relación caudal/carga:**
 - Climáticas (oscilaciones glaciario-interglaciario)
 - Locales (infiltración, capturas)

2. **Variaciones en el nivel de base (y/o pendiente curso fluvial):**
 - Tectónicas
 - Eustáticas
 - Locales (presas)



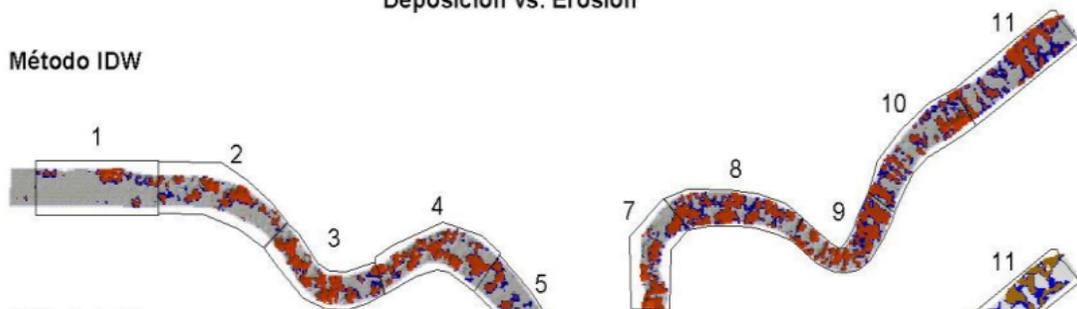


Fernández Sbarbaro, C., D. Panario. 2003. Cambios en la dinámica de sedimentos producidos en el Río San Salvador como consecuencia de la extracción de áridos. Período considerado: Octubre, 2001 - Diciembre, 2002. UNCIEP, Facultad de Ciencias. Noviembre. 21 pp.

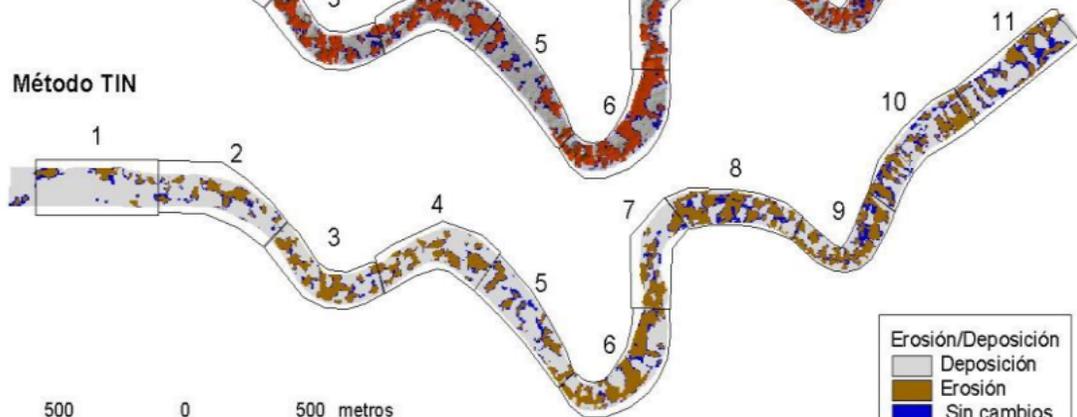


Deposición vs. Erosión

Método IDW

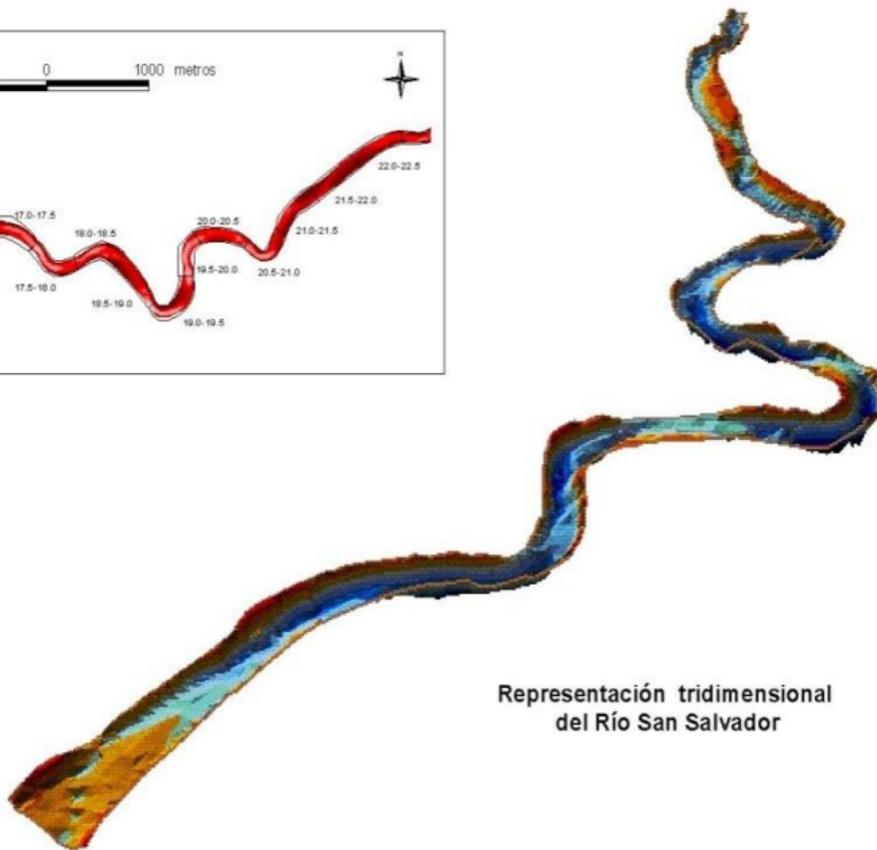
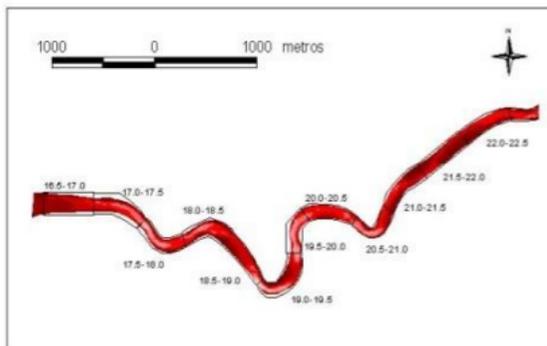


Método TIN

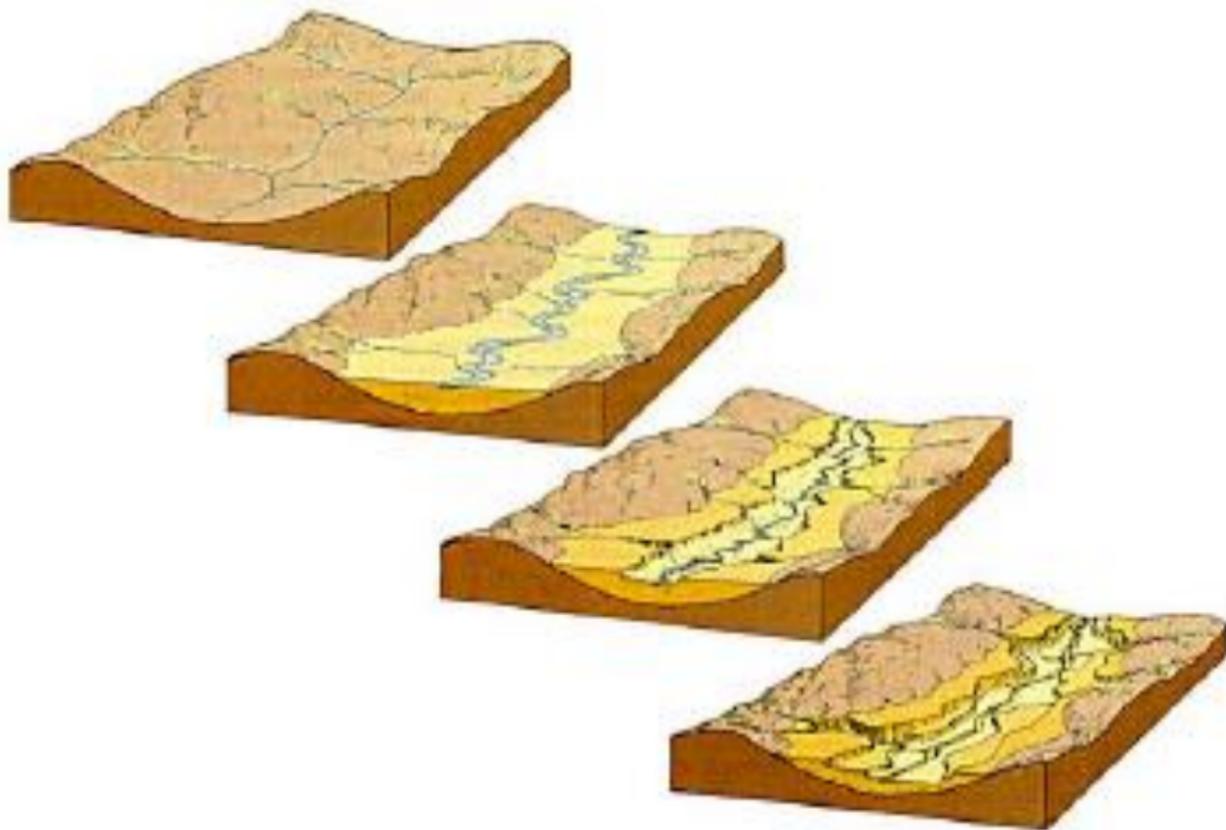


500 0 500 metros





Representación tridimensional
del Río San Salvador









13/08/2005



13/08/2005



13/08/2005



13/08/2005



24/08/2005



24/08/2005



24/08/2005



24/08/2005



¿Cuánto sedimento viene de las márgenes de los arroyos?



Arroyo Sopas







No todo es lo que parece...

Arcilla transportada en terrones de tamaño gravilla... Obsérvese las pisadas como se entierran y compacta la supuesta “gravilla”