

# Influence of data sources and processing methods on theoretical river network quality

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## ABSTRACT

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Stream ecosystem research and water resource management need to be considered over broad spatial scales. Moreover, the investigation of the spatial configuration and habitat characteristics of streams requires an accurate and precise spatial framework to reflect a catchment's physical reality that can successfully explain observed patterns at smaller scales. In this sense, geographic information systems represent an essential tool to satisfy the needs of researchers and managers. Specifically, theoretical river networks (TRNs) extracted from digital elevation models (DEMs) have become much more common in recent years, as they can provide a suitable spatial network and hierarchical organisation to sort out river ecosystem information from reach to catchment levels. Nevertheless the quality of the extracted TRN depends greatly on the spatial resolution of the DEM and the methodology used in the network extraction processes.

In this study, we compare the quality of 9 TRNs extracted from DEMs with different spatial resolutions ranging from regional (5 m) to national (25 m) and global scales (90 m) using the ArcHydro, Hec-GeoHMS and Netstream software packages. To achieve our goal, we compared (i) the DEM-derived slope; (ii) the spatial accuracy of the TRNs in relation to a control river network; (iii) the structure of the TRNs through analysis of the number of river segments, average river segment length and total river length by stream order, drainage density and the mean upstream slope throughout the TRN; and (iv) the ability of variables derived from TRNs to discriminate among stream types classified according to flow type and substrate composition. We demonstrated that not only DEM spatial resolution but also the DEM data source and raster creation process exert an important influence on terrain characteristics derived from DEMs and TRN properties. Moreover, TRNs extracted with NetStream generally showed better performance than those extracted with ArcHydro and HecGeoHMS. Nevertheless, river network extraction quality, DEM spatial resolution and extraction algorithms exhibit complex relationships due to the large number of interacting factors.

**Key words:** Fluvial ecosystems, spatial hierarchy, Theoretical River Networks, Digital Elevation Models, extraction algorithm.

## RESUMEN

### Influencia de las fuentes de datos y los métodos de extracción en la calidad de las redes fluviales teóricas

La investigación de los ecosistemas acuáticos continentales y la gestión de recursos hídricos necesitan ser considerados a escalas espaciales que abarquen grandes territorios. Así mismo, el estudio de la configuración espacial de los sistemas fluviales y las características del hábitat requieren de un marco espacial preciso con el que explicar los patrones observados a pequeña escala a partir de las características físicas de la cuenca. En este sentido, los sistemas de información geográfica representan una herramienta esencial. Específicamente, la extracción de redes fluviales teóricas (RFT) a partir de modelos digitales de elevación (MDEs) ha sufrido una importante expansión y desarrollo en los últimos años. Las RFT, proporcionan un marco espacial adecuado e integran la estructura jerárquica de los ecosistemas fluviales, de tal modo que pueden englobar información a diferentes escalas espaciales, desde el nivel de cuenca al de tramo. Sin embargo, la calidad de las RFTs depende, en gran medida, de la resolución espacial de los MDE y de los métodos utilizados en el proceso de extracción de la red. En este estudio hemos comparado la calidad de 9 RFTs obtenidas a partir de MDEs con diferentes resoluciones espaciales, que van desde la escala regional (5 m), nacional (25 m) hasta global (90 m) mediante ArcHydro, Hec-GeoHMS y NetStream.