Chapter 35
Fluvial Dynamics, Hypocycloids, and Hydro-Dynamic Cycles

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ABSTRACT

Complex hydrological models find adequate formalization in co-nodal systems, given the abundance, multiplication, dynamics, relations of elements (hubs and nodes) and systems (basins and rivers), as well as chronologies. Hydrological models function on the principle of nodes and orientations. Hypo-cycloids (in the text: h-Cycloids) are time-spatial categories; the subject of hydrodynamic nonlinear analysis, they do not exist entirely realistically as recent flows, but are present only partially, phased, as partial flows. Hypo-cycloids are formed by summing cycles with a combination of overlapping and alternating flows. Cycles are time-spatial categories of co-nodal reconstruction. Fluvial dynamics is logically composed of nodal sets, hub systems, and junctions that are polyvalues (polyvalent, multi-oriented, cyclic) of a diverse model rather than a single-oriented output of just a simple physical model. The chapter examines four of the world's largest interfluviums: Parana-Paraguay, Euphrates-Tigris, Mississippi-Ohio, Danube-Tisza.

INTRODUCTION

Complex hydrological models find adequate formalization in the co-nodal systems, given the abundance, multiplication, dynamics, relations of elements (hubs and nodes) and systems (basins and rivers) as well as chronologies. Hydrological models function on the principle of nodes and orientations. Temporal orientations are in paleo-hydrological analysis besides the spatial (geographical) and temporal categories. Geographic models are not only physical, spatial systems, but also complex and multi-dimensional, supra-geographical, linear compositions. The placement of geographic models is oriented in space and time, and therefore the basic geographical facts like the flow, orientation are not mono-dimensional but vector categories (Jerolmack & Paola, 2007; Kleinhans et al., 2008). Geographic elements are not physical but structured elements of a system. The contemporary theory involves a structured multidimensional, realistic, diffuse model versus a linear model in the classification of paleo-hydrological phenomena.

DOI: 10.4018/978-1-7998-7356-3.ch035

Paleohydrology and Remote Sensing

Certain postulates suggest that the co-nodal systems can generate, such as lower-flow/sequestration, the bifluvium - a counter-flow. The postulates are linear, model-logical, relative, causal, and acausal statements, relationships, structured facts of advanced systems. The co-nodal system is thus composed of nodes and branches. In cases of anastomosing, the flows reach inverse functions, abandoned channels become the channels of other rivers, through the co-nodal models the dynamics are quite readable (Paraguay river system, Mesopotamian bifluvial system). Hydro-geographical movements are effectively legible as branching, and the models that describe this and such branching are the most efficient models and the closest models that fit the approximate Remote Sensing data. Branches, networks, subset aggregations, circular systems effectively correspond to the field data, by Farr et al. (2010) generating the new maps of the paleohydrology, topography, geomorphology, and surficial deposits of the area and developing GIS-based models which use the Remote Sensing data.

The dynamics of water systems and flows is the formalization of dual, progressive systems. Remote Sensing data provide the material for formalizing hydrological models as river co-nodal systems, hubs and flows, as multi-oriented interactions and vector exchanges. Sub-alluvial bedrock, composed of erosion-resistant deposits, commonly forms the morphological protrusions within them. Their presence significantly affects both the course of flood flows and the valley floor relief. Effective forecasting of fluvial processes in such valley reaches requires conducting the research within the entire geomorphologically active zone, both in the channel and the floodplain. The effectiveness of such research should be enhanced by the simultaneous use of several different remote sensing methods, including short-range remote sensing (Ostrowski & Falkowski, 2020). As the focus of hydrologic research shifts to larger regional and global scales, the collection, management, distribution, and analysis of data will improve so that the models and data can drive and direct each other (Dozier, 1992).

Remote sensing has considerable potential to contribute to the identification and reconstruction of lost hydrological systems and networks. Remote sensing-based reconstructions of paleo river networks have commonly employed the single or limited time-span imagery, which limits their capacity to identify the features in complex and varied landscape contexts (Petrie & Orengo, 2017).

Hypocycloids are characteristic of large river systems and are shown in the complex dynamics of the middle and lower reaches of the largest rivers, in valleys and paleo plains. Fluvial dynamics is logically composed of the nodal sets, hub systems, and junctions that are poly values (polyvalent, multi-oriented, cyclic) of diverse models rather than a single-oriented output of just a simple physical model.

Cycloids consist of conta-currents, poly-currents, quadri-fluviums and bi-fluviums, sub-cycles and cycles, interfluviums. H-Cycloids are dynamic not prevailing physical categories, which means that the conclusions about them can be formed on the basis of special analysis which makes them the subject of nonlinear geography. That is why paleo-cycloids are so important because without them the nature and dynamics of the formation of large river systems cannot be understood, which makes them an irreplaceable segment of advanced geography.

Hydro-geographical analysis of poly-oriented systems is the basis of nonlinear and cyclic models. The paleo-cycle occurs in paleo-flows, interfluviums, and partial interfluviums. A cycloid is a time-spatial phenomenon of paleo-dynamics that forms an alternating cyclic movement of one (dominant) or two rivers (interfluvium) during different hydro-dynamic phases and chronological periods. A cycloid is a paleo-hydrological phenomenon formed by summing at least two cycles and several subcycles, consisting of a poly-confluent hub system and polyvalent flows (bifluvium, paleobifluvium, trifluvium, counter-