



# Assessment of different data modelling approaches in temporal GIS

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## Abstract

Spatio-Temporal data models are the core of a Temporal Geographic Information System (TGIS). They define object data types, relationships, operations and rules to maintain database integrity. Rigorous data model must anticipate spatio-temporal queries and analytical methods to be performed in the TGIS. Spatio-temporal database models are intended to deal with real world applications, where spatial changes occur over the time line. A serious weakness of existing models is that each of them deals with few common characteristics found across a number of specific applications. Thus the applicability of the model to different cases, fails on spatio-temporal behaviors not anticipated by the application used for the initial model development. This paper reviews the different types of spatio-temporal data models and provides an overview of previous achievements within the domain and critically evaluates the various approaches.

**Keywords:** Spatio-temporal data, Modeling, GIS, Data model, Moving object data model

## 1 introduction

In the past, research in spatial and temporal data models and database systems has mostly been done independently. Spatial database research has focused on supporting modeling and querying of the geometry associated with objects in a database. Several spatial access methods (e.g., transformation, overlapping regions, clipping or multiple layers) have been proposed in the literature for storing multi-dimensional object (e.g. points, line segments, areas, volumes, and hyper-volumes) without considering the notion of time. A survey by Gaede and Guenther on spatial access methods provides excellent information sources. On the other side, temporal database have focused on extending the knowledge kept in a database about the current state of the real world to include the past, in the two senses of transaction time and valid time. Transaction time is defined as the time when a fact is stored in the database. Valid time is defined as the time when a fact becomes effective (valid) in reality. Temporal access methods have been proposed to index data varying over time without considering space at all.

Spatio-temporal databases deal with applications where data types are characterized by both spatial and temporal semantics. Development and research in this area started decades ago, when management and manipulation of data, relating to both spatial and temporal changes, was recognized as an indispensable assignment. However, spatio-temporal data handling was not a straightforward task due to the complexity of the data structures requiring careful analysis in structuring the dimensions, together with the representation and manipulation of the data involved. Therefore, the earlier work in this area began from separate research in both temporal and spatial databases. This effort later became the basis for spatio-temporal database models.

The remainder of this paper is structured as follows: Section 2 and its subsections discuss the concepts related to spatio-temporal data modeling. Section 3 deals with to study different type of changes in spatio-temporal data. Section 4 Review some spatio-temporal data models. Section5 compare these data models in terms of their query capabilities. Section 6 concludes the paper and gives future works.

## 2 Concepts Related to Spatio-Temporal Data Modeling

### 2-1 Definition of Spatio-Temporal Data Model

Spatio-Temporal data models are the core of a spatio-temporal Information System (STIS). They define object data types, relationships, operations and rules to maintain database integrity [1]. A rigorous data model must