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Point clouds and Hydroinformatics

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Point cloud is made up of a multitude of three-dimensional (3D) points with one or more attributes attached. Point cloud is the third data paradigm in addition to the well-established object (vector) and gridded (raster) representations, since point cloud data can be directly collected, computed, stored, and analyzed without converting to other types. Modern ways of data acquisition, including laser scanning from airborne, mobile, or static platforms, multi-beam echo-sounding, and dense image matching from photos, generate millions to trillions of 3D points with attached attributes. If the collection is carried out in different periods, one of the essential attributes is precisely time, allowing spatiotemporal analysis to be performed. Its use is widespread in some fields such as metrology and quality inspection, virtual reality, indoor/outdoor navigation, object detection, vegetation monitoring, building modeling, cultural heritage, and diverse visualization applications. There are some examples in fields related to hydroinformatics, mainly related to terrain modeling. Due to its nature of big data, over the past decades, a series of developments have been carried out in the different processing chains for the optimal use of point cloud. This research seeks to introduce the various point cloud developments from which the hydroinformatics community and research could benefit. A review of recent advances is made, mainly including the analysis and visualization of point cloud for dealing with water-related problems. Potential areas of application and development in hydroinformatics are identified. These include, for example, the topics of coastal monitoring, coastal erosion, shallow water assessment, ice sheet change analysis, sea-level rise assessment, monitoring of levels in water bodies, crop and vegetation monitoring, analysis of the effects of groundwater depletion, detail tracing of basins and channels, analysis of floods with detailed terrain models, and drought monitoring in crops and forests. The challenges to overcome and ongoing developments regarding point cloud application in hydroinformatics are also discussed.