A web-based and data-driven approach to paleogeographic reconstructions

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Paleogeographic maps illustrate the distribution of land and sea, as well as the topography of the Earth’s surface during different geological periods based on the compilation of a wide range of geological and geophysical datasets. These maps provide boundary conditions for various models of the Earth’s systems, including climate, mantle convection, and land surface evolution. A number of software programs and computer algorithms have been developed in the past three decades to reconstruct either the past positions of continents and oceans or their elevation and depth. We recently developed the open-source and user friendly “Terra Antiqua”, allowing users to create digital paleogeographic maps in a Geographic Information System (GIS) environment (QGIS), using various tools that are easy to operate in combination with Gplates, a widely used software for plate tectonic reconstructions. The next step is to develop a comprehensive and integrated solution easily accessible on the web that can automate most of the steps involved in reconstructing past plate configurations and topography. We present here a web application (“Terra Antiqua online”) that we are developing for the creation of digital paleogeographic maps. The web application has two parts: (1) The front-end uses CesiumJS, an open-source JavaScript library for making 3D globes and maps, to visualize the databases and let the users interact with it. (2) The back-end uses Python algorithms and libraries such as GDAL and pyGPlates to process the data and perform tectonic and hypsometric reconstructions. Terra Antiqua online uses pyGplates API to access existing tectonic models and apply them to rotate plate positions and datasets to their past position. New developments are allowing it to estimate the elevation, depth and distribution of the land and sea by automatically processing various geological proxy data (e.g. paleofacies maps, paleo-elevation proxies, fossils databases etc...) according to physically based algorithms. The project further aims to incorporate web-based landscape modeling tools and develop a community around a geological database and paleogeographic reconstruction methods and standards.