Earth science phenomena portal: from deep learning-based event detection to visual exploration

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Earth science researchers typically use event (an instance of an Earth science phenomenon) data for case study analysis. However, Earth science data search systems are currently limited to specifying a query parameter that includes the space and time of an event. Such an approach results in researchers spending a considerable amount of time sorting through data to conduct research studies on events. With the growing data volumes, it is imperative to investigate data-driven approaches to address this limitation in the data search system.

We describe several contributions towards alternative ways to accelerate event-based studies from large data archives.

The first contribution is the use of a machine learning-based approach, an enabling data-driven technology, to detect Earth science events from image archives. Specifically, the development of deep learning models to detect various Earth science phenomena is discussed. Deep learning includes machine learning algorithms that consist of multiple layers, where each layer performs feature detection. We leverage recent advancements in deep learning techniques (mostly using convolutional neural networks (CNNs) that have produced state-of-the-art image classification results in many domains.

The second contribution is the development of an event database and a phenomena portal. The phenomena portal utilizes the deep learning detected events cataloged in an event database. The portal provides a user interface with several features including display of events of the day, spatio-temporal characteristics of events, and integration of user feedback.

The third contribution is the development of a cloud-native framework to automate and scale the deep learning models in a production environment.

The paper also discusses the challenges in developing an end-to-end Earth science machine learning project and possible approaches to address those challenges.