Interoperable Map Services with Performance Tuning for Earth Science Data through API-Tiles and Dynamic API-Styles

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Abstract

NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC) provides access to a wide range of global climate data from various satellite missions and models. However, the visualization and analysis of these data can be challenging due to their large volume, complex structure, and diverse formats. This study presents the implementation of interoperable map services (API-Maps) with performance tuning using API-Tiles and dynamic API-Styles. API-Maps is a standard for defining and exposing map services through RESTful (representational state transfer) APIs (application programming interfaces). API-Tiles is a technique for generating and delivering map tiles on demand from any data source. API-Styles is a method for dynamically applying styles to map tiles based on user preferences or data attributes. The use of API-Tiles and dynamic API-Styles enhances the performance and scalability of the map services, allowing for smooth and interactive visualization of large datasets. Two types of Earth Science data sources from the NASA GES DISC are used in the experiment: regularly gridded data, such as Global Precipitation Measurement (GPM) precipitation data, and low processing level data, such as low-level data of atmospheric composite measurements from the TROPOspheric Monitoring Instrument (TROPOMI) mission. Re-gridding of swath data (low level data - e.g. Level 2) of atmospheric composites (e.g. TROPOMI products, such as nitrogen dioxide, ozone and aerosol optical depth) is applied to enable the Web-based, interoperable, tiled, and styled mapping (rendering) services of such data. The results demonstrate the effectiveness of the proposed approach in providing fast and efficient access to Earth science data through interoperable map services.

Keywords: API-Maps, API-Tiles, API-Styles, Earth Science Data, Visualization, Performance Tuning

Introduction

NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC) provides access to a wide range of global climate data from various satellite missions and models. These data are essential for understanding the Earth's climate system and for developing predictive models of future climate change. However, the visualization and analysis of these data can be challenging due to their large volume, complex structure, and diverse formats.

Earth Science Data Sources:

- Regularly gridded data: Global Precipitation Measurement (GPM) precipitation data
- Low processing level data: Low-level data of atmospheric composite measurements from the TROPOspheric Monitoring Instrument (TROPOMI) mission

API-Maps

API-Maps is a standard for defining and exposing map services through RESTful APIs (application programming interfaces). API-Maps provides a consistent and interoperable interface for accessing and visualizing data and maps. API-Maps defines a set of API endpoints for retrieving map tiles, styles, and other metadata. API-Maps clients can use these endpoints to render maps and interact with the data.

API-Tiles

API-Tiles is a technique for generating and delivering map tiles on demand from any data source. API-Tiles divides a map into a grid of tiles, and each tile is generated on demand from the underlying data source. API-Tiles can be used to improve the performance and scalability of map services, as tiles can be cached and reused for multiple requests.

API-Styles

API-Styles is a method for dynamically applying styles to map tiles based on user preferences or data attributes. API-Styles allows users to customize the appearance of their maps by selecting different styles. API-Styles can also be used to apply different styles to different parts of the map, based on the underlying data.

Experiment

In this study, we implemented API-Maps, API-Tiles, and API-Styles to provide fast and efficient access to Earth science data from NASA's GES DISC. We used two types of Earth Science data sources: regularly gridded data, such as Global Precipitation Measurement (GPM) precipitation data, and low processing level data, such as low-level data of atmospheric composite measurements from the TROPOspheric Monitoring Instrument (TROPOMI) mission.

For regularly gridded data, we used API-Tiles to generate map tiles on demand. For low processing level data, we first re-gridded the data to a regular grid, and then used API-Tiles to generate map tiles. We used API-Styles to apply different styles to the map tiles, based on the underlying data.

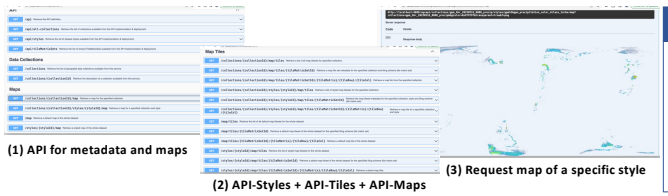

Figure 1. Stacks of API-Styles and API-Tiles with API-Maps.

Results

The results of our experiment demonstrate the effectiveness of the proposed approach in providing fast and efficient access to Earth science data through interoperable map services. We were able to generate and render maps of large datasets quickly and smoothly. We were also able to apply different styles to the maps, based on the underlying data.

Benefits:

- Enhanced performance and scalability of map services
- Smooth and interactive visualization of large datasets
- Fast and efficient access to Earth science data

Re-gridding of Swath Data:

Re-gridding of swath data (low level data - e.g. Level 2) of atmospheric composites (e.g. TROPOMI products, such as nitrogen dioxide, ozone and aerosol optical depth) is applied to enable the Web-based, interoperable, tiled, and styled mapping (rendering) services of such data.

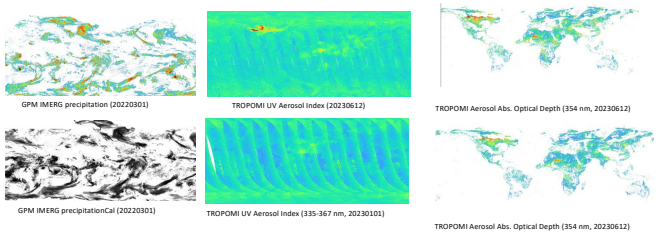

Figure 2. Support of different products at different processing levels.

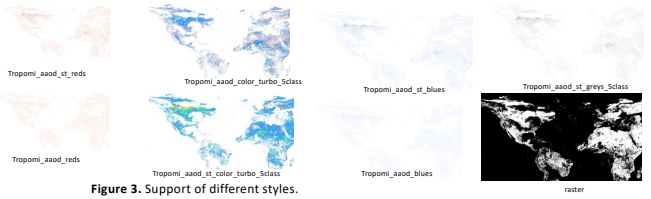

Figure 3. Support of different styles.

Conclusions

In this study, we presented the implementation of interoperable map services (API-Maps) with performance tuning using API-Tiles and dynamic API-Styles. The results of our experiment demonstrate the effectiveness of the proposed approach in providing fast and efficient access to Earth science data through interoperable map services. API-Maps, API-Tiles, and API-Styles are valuable tools for visualizing and analyzing large datasets of Earth science data.

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