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SCI-WMS: A PYTHON-BASED WEB MAP SERVICE FOR VISUALIZING GEOSPATIAL DATA

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***Abstract*—sci-wms is used as an extensible visualization tool for qualitativly assessing society-critical oceanagraphic applications including: forecasts, risk assessment, model comparison and algorithmic/parameter selection. This abstract outlines the implementation and technology stack for visualizing geospatial coastal forecasting (CF) data using sci-wms [1].[1] Specifically, discussing the use case for deploying sci-wms for visualizing model data and simulations within the scope of the U.S. IOOS Coastal and Ocean Modeling Testbed project. [2]**

I. MOTIVATION

The U.S. Integrated Ocean Observing System (IOOS) Coastal and Ocean Modeling Testbed (COMT) was formed to unify otherwise disparate entities in government, academia and industry to leverage ubiquity of computing hardware and the proliferation of coastal data and modeling techniques to combat natural and man-made stressors by accelerating the turnaround from research and development to operational application of society-critical applications including forecasting, model comparison, model skill assessment, and algorithmic/parameterization improvements [2]. Key to the U.S. IOOS COMT mission is an extensible and universally available tool for quickly visualizing and assessing coastal modeling data.

II. SCI-WMS

Sci-wms was designed is an implementation of the Open Geospatial Consortium's (OGC) Web Map Service (WMS) standard, that describes an http interface for generating rasterized visualizations of geospatial data [1]. Sci-wms is implemented in python using the Django[2] web frame work and standard cross-platform numerical software, NumPy and Matplotlib [3], [4] for generating visual content. Vital to the real-time performance of sci-wms is the abstraction of a oceanagraphic dataset into two entities: a topology, defined as a geo-referenced spatial structure and model data as visualized in figure 2. Sci-wms creates a local topology cache for efficient computing of spatial neighborhoods with respect to topology structures. For storage efficiency, model data is not replicated when hosted externally, but reference via web-enabled endpoints and subsequently retrieves only the fraction of data needed to fulfill a WMS request. Queries for data required for generating visualizations can be constrained by requesting only subsets of data according to the portion of the earth that is visible for a given geospatial WMS http request. Furthermore, by classifying topologies as either regular or unstructured, efficient algorithms and data structures are utilized to optimize the response time for each request.

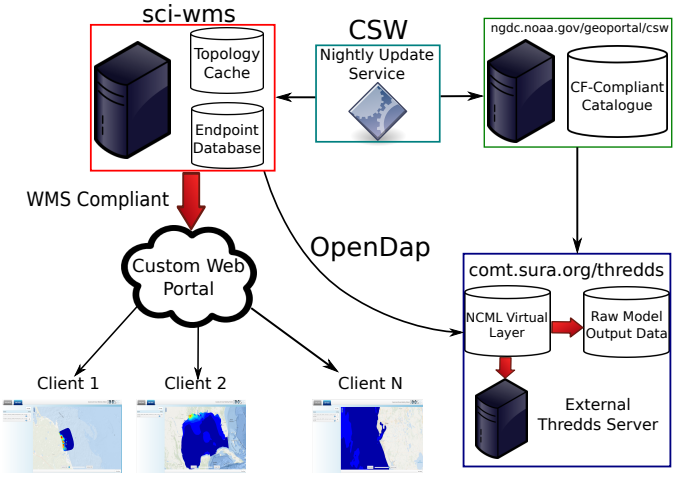

Fig. 1. Overview of the sci-wms deployment for the U.S. IOOS COMT project. Sci-wms updates its topology and endpoint database via a nightly service which queries CF-Compliant datasets cataloged by the NGDC. Model data is hosted on an external web server through an NCML facade accessible to sci-wms through OpenDAP as a single NetCDFdata structure. Sci-wmsthen responds to http requests made simultaneously by multiple clients interfacing through a custom built web-portal.

III. DEPLOYING SCI-WMS FOR THE U.S. IOOS COMT TESTBED

While sci-wms is a general software solution for geospatial visualization, it is a key component in re-

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[1]https://github.com/asascience-open/sci-wms

[2]https://www.djangoproject.com/

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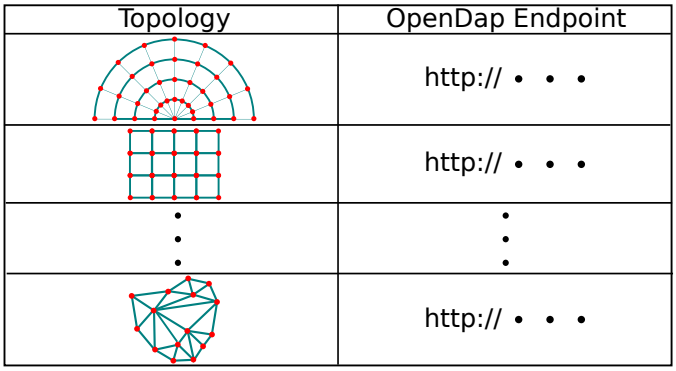

Fig. 2. Sci-wms topology and endpoint data store. Typologies are classified as u-grid or c-grid for efficient geospatial queries and remote data access.

alizing the U.S. IOOS COMT mission by facilitating qualitative model comparisons and aggregation through a unified visualization framework. Figure 1 outlines the cyberinfrastructre behind the deployment of sci-wms for the COMT project.

Raw coastal data is hosted by the Southeastern Universities Research Association (SURA) on a dedicated server for COMT project [5]. Each data set may consist of multiple files in different formats, and may be the results of very different models run different institutions using technologies. However, each dataset is unified by an NcML virtual layer which exposes each dataset as a single NetCDF object. Furthermore, the NcMLfacade presents each dataset with a consistent set of meta data in accordance to the CF-Conventions specification [6] so that services like sci-wms can access the data through a uniform interface.

Once an NcML file is confirmed to be CF-Compliant, the dataset is indexed by NOAA[3] NGDC[4] accessible by an OGC catalogue web service (CSW). A nightly script queries the NGDC catalogue for new or modified datasets and automatically updates both the topologies and OpenDAP links in the sci-wms database. At any time sci-wms is able to respond to queries for visualizations of any registered dataset by multiple users simultaneously.

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[6] CF Conventions Document, http://cfconventions.org/latest.html.

[3]National Oceanic and Atmospheric Administration

[4]National Geophysical Data Center