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SCI-WMS:PYTHON BASED WEB MAPPING 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, detailing 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 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 is an implementation of the Open Geospatial Consortium's (OGC) Web Map Service (WMS) standard which specifies a http interface for generating rasterized visualizations of geospatial data [1]. Sci-wms is implemented in python using the Django[2] web framework and standard cross-platform numerical software, NumPy and Matplotlib [3], [4] for generating visual content. Vital to the efficiency of sci-wms is the abstraction of an 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 efficiently computing spatial neighborhoods with respect to topology structure. For storage efficiency, model data is not replicated when hosted externally but reference via web-enabled endpoints. Because geospatial WMS requests are commonly restricted to a subset of the earth surface, sci-wms uses the local topology to compute the subset of model data needed to fulfill each request prior to accessing the external data. Furthermore, by classifying topologies as either regular or unstructured, efficient algorithms and data structures are exploited to optimize the computation of relevant model data subsets.

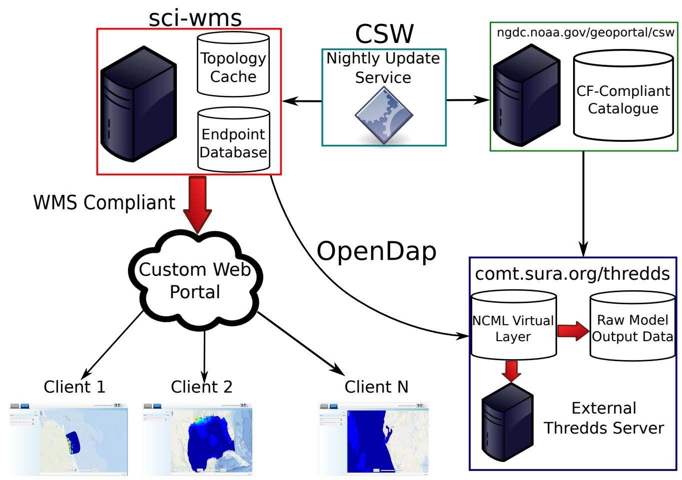

Fig. 1. Overview of the sci-wms deployment for the U.S. IOOS COMT project. Sci-wms updates its topology and endpoint database via a nightly service which queries CF-Compliant datasets cataloged by NGDC. Model data is hosted on an external web server through an NcML facade accessible to sci-wms through 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 realizing the U.S. IOOS COMT mission, facilitating qualitative model comparisons and aggregation through a

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

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

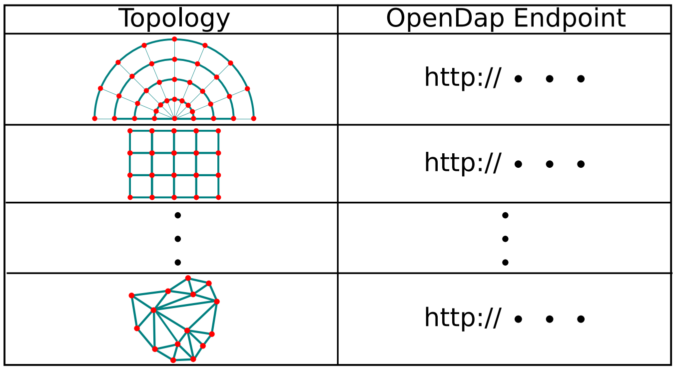

Fig. 2. Sci-wms topology and endpoint data store. Typologies are classified as u-grid or c-grid for efficient geospatial queries and remote model data access.

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 the COMT project [5]. Each data set may consist of multiple files in different formats, and may be the result of very different models run by various institutions with disparate computing resources. However, accompanying each dataset is an NcML virtual layer which exposes each dataset as a single NetCDF object which may be accessed via OpenDAP. Furthermore, the NcMLfacade presents a consistent set of meta information in accordance to CF-Conventions [6] so 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] and made accessible via an OGC catalogue web service (CSW). A executable queries the NGDC catalogue at regular intervals 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.

Sci-wms is capable of visualizing data associated with the first phase of COMT coastal and ocean prediction: *estuarine hypoxia, shelf hypoxia and coastal inundation* [2]. For each coastal modeling challenge, sci-wms is successfully generating visualizations resulting from ADCIRC, FVCOM, SELFE and SLOSH models run by scientists at MDL, UND, USF, VIMS, UMASS, DAL, TAMU and NOAA. The IOOS COMT use case is an example of how sci-wms can be leveraged as an effective tool for delivering consistent visualizations of scientific data to a diverse community utilizing various sophisticated modeling technologies.

[3]National Oceanic and Atmospheric Administration
[4]National Geophysical Data Center

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