Integrated Web-Based Immersive Exploration of the Coordinated Canyon Experiment Data using Open Source STOQS Software

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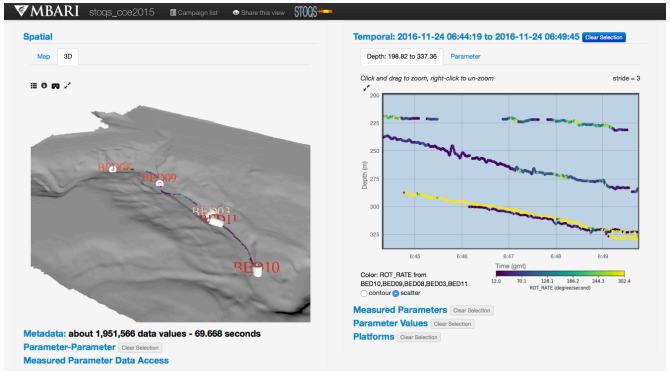
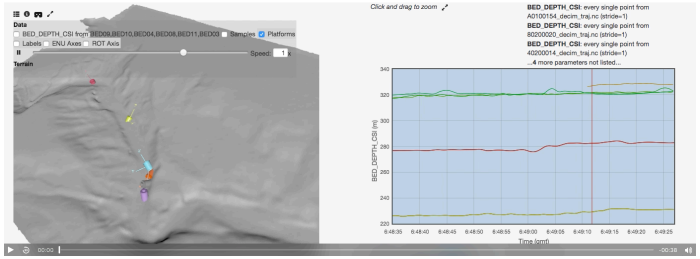
Abstract

The Coordinated Canyon Experiment (CCE) in Monterey Submarine Canyon has produced a wealth of oceanographic measurements whose analysis will improve understanding of turbidity current processes. Exploration of this data set, consisting of over 60 parameters from 15 platforms, is facilitated by using the open source Spatial Temporal Oceanographic Query System (STOQS) software (https://github.com/stoqs/stoqs). The Monterey Bay Aquarium Research Institute (MBARI) originally developed STOQS to help manage and visualize upper water column oceanographic measurements, but the generality of its data model permits effective use for any kind of spatial/ temporal measurement data.

STOQS consists of a PostgreSQL database and server-side Python/Django software; the client-side is jQuery JavaScript supporting AJAX requests to update a single page web application. The User Interface (UI) is optimized to provide a quick overview of data in spatial and temporal dimensions, as well as in parameter, platform, and data value space. A user may zoom into any feature of interest and select it, initiating a filter operation that updates the UI with an overview of all the data in the new filtered selection. When details are desired, radio buttons and checkboxes are selected to generate a number of different types of visualizations. These include color-filled temporal section and line plots, parameter-parameter plots, 2D map plots, and interactive 3D spatial visualizations. The Extensible 3D (X3D) standard and X3DOM JavaScript library provide the technology for presenting animated 3D data directly within the web browser.

Most of the oceanographic measurements from the CCE (e.g. mooring mounted ADCP and CTD data) are easily visualized using established methods. However, unified integration and multiparameter display of several concurrently deployed sensors across a network of platforms is a challenge we hope to solve. Moreover, STOQS also allows display of data from a new instrument – the Benthic Event Detector (BED). The BED records 50Hz samples of orientation and acceleration when it moves. These data are converted to the CF-NetCDF format and then loaded into a STOQS database. Using the Spatial-3D view a user may interact with a virtual playback of BED motions, giving new insight into submarine canyon sediment density flows.





Frame from user-generated movie of "man-made boulders" transported by violent turbidity current

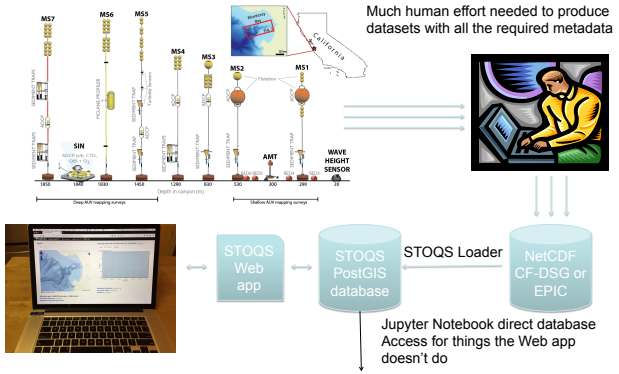
Spatial Temporal Oceanographic Query System

STOQS

Overview first, zoom and filter, then details-on-demand

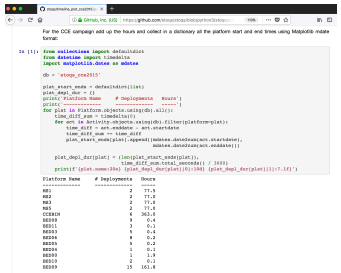
- Shneiderman's mantra

Data Flow

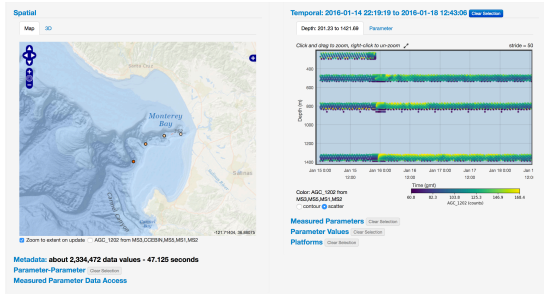


User testimony

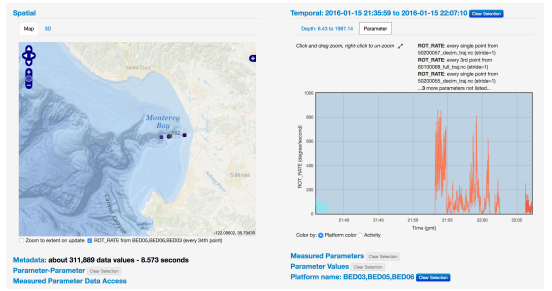
"….as a user I find the STOQS interface the only mechanism that allows me to visualize rotational motion of an object and simultaneously evaluate the terrain variables that may control the rotation rate. STOQS also permits to observe the movements of one or more objects real time, as if we were peering into the deep ocean while these man-made boulders are violently transported by very fast sediment laden bottom currents. There is no other user interface that through its visualization of rotation and transport is so capable of providing the user with a very intuitive feel for the physical process at play. The interface also allows for a very quick survey of multitude of variables through an easy to use 2D and 3D plotting platform with associated mathematical regression capabilities. In addition, the data of interest can be easily downloaded in a variety of formats for further analysis…"



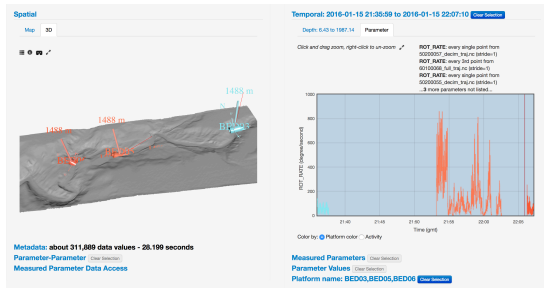
100% Open Source



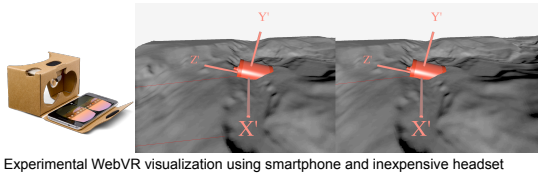
Scatter plot of ADCP AGC data from 4 moorings



Time series plot of rotation rate from 3 Benthic Event Detectors



Animated interactive playback of BEDs data directly in the browser



Experimental WebVR visualization using smartphone and inexpensive headset

Acknowledgments

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