STOQS

The Spatial Temporal Oceanographic Query System

Integration of X3D in a data-driven geospatial web application

25 March 2014
Web3D Emerging Technology Showcase

Mike McCann
Monterey Bay Aquarium Research Institute

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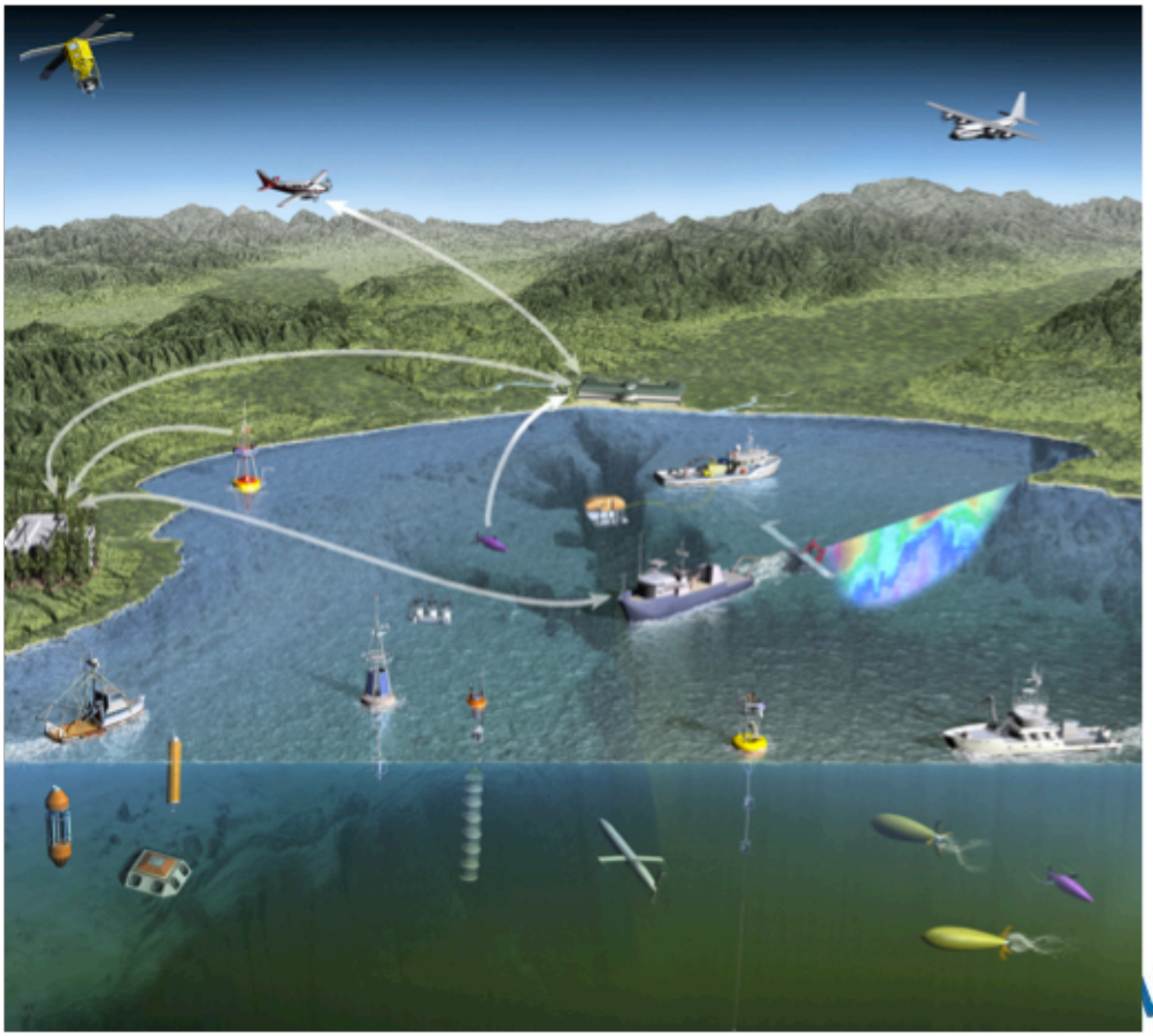
The Domain: Oceanographic Observation Campaigns



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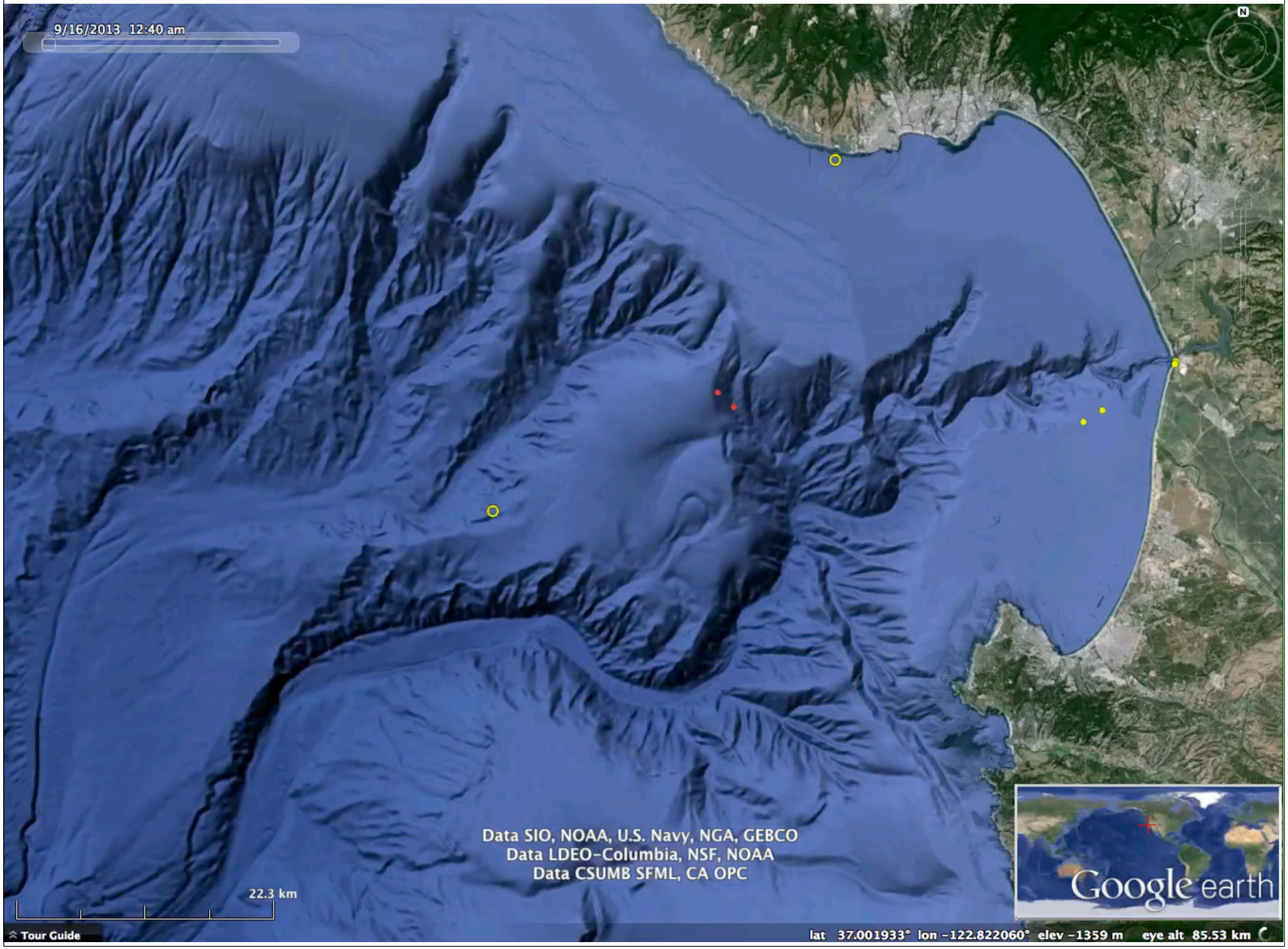
9/16/2013 12:40 am
N
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Data CSUMB SFML, CA OPC
22.3 km
Google earth
Tour Guide
lat 37.001933° lon -122.822060° elev -1359 m eye alt 85.53 km

Talk Outline

- CF-NetCDF Discrete Sampling Geometries
- STOQS Architecture and User Interface
- AJAX JSON data update to scene graph
- Terrain data representation

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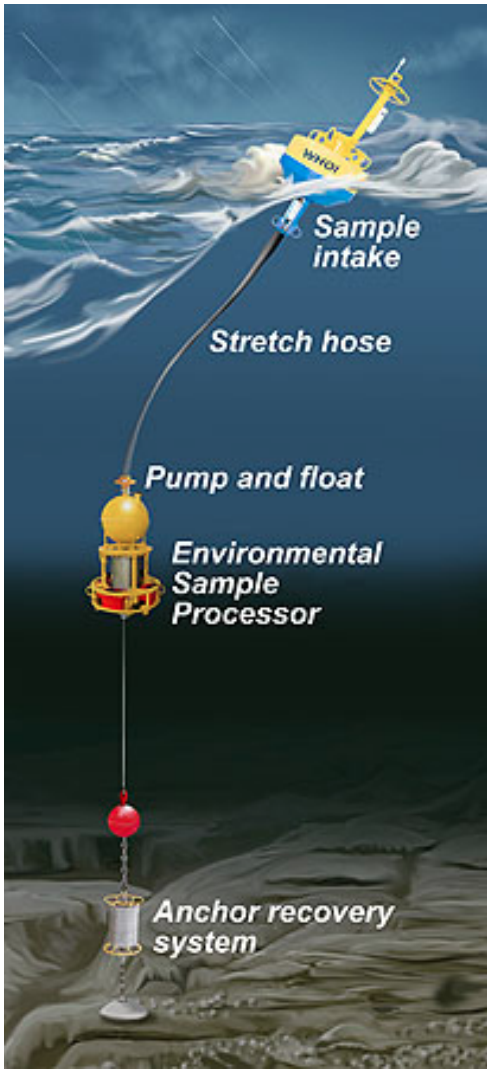
CF-NetCDF Discrete Sampling Geometries

- featureType
  timeSeries
  - Stationary platform measures parameters from single depth over time



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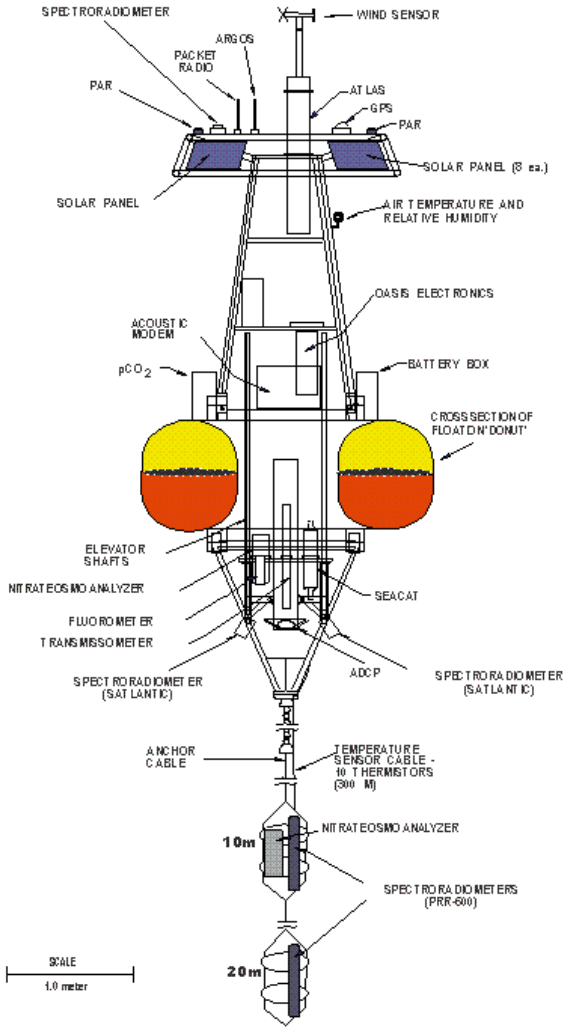
CF-NetCDF Discrete Sampling Geometries

- featureType
  timeSeriesProfile
  - Stationary platform measures parameters from multiple depths over time



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CF-NetCDF Discrete Sampling Geometries

- featureType
  trajectory
  - Mobile platform measures parameters while moving through the water

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Application Architecture

HTML5 | jQuery & AJAX | Flot | OpenLayers | X3DOM | Twitter Bootstrap

Client

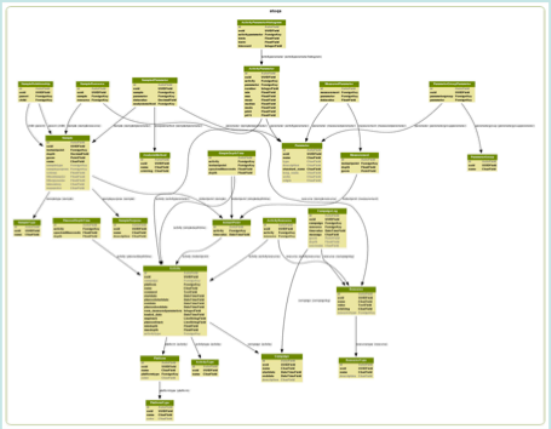
Server

Python with pydap, numpy, …

Minnesota Mapserver

GeoDjango ORM & web framework

Postgres + PostGIS



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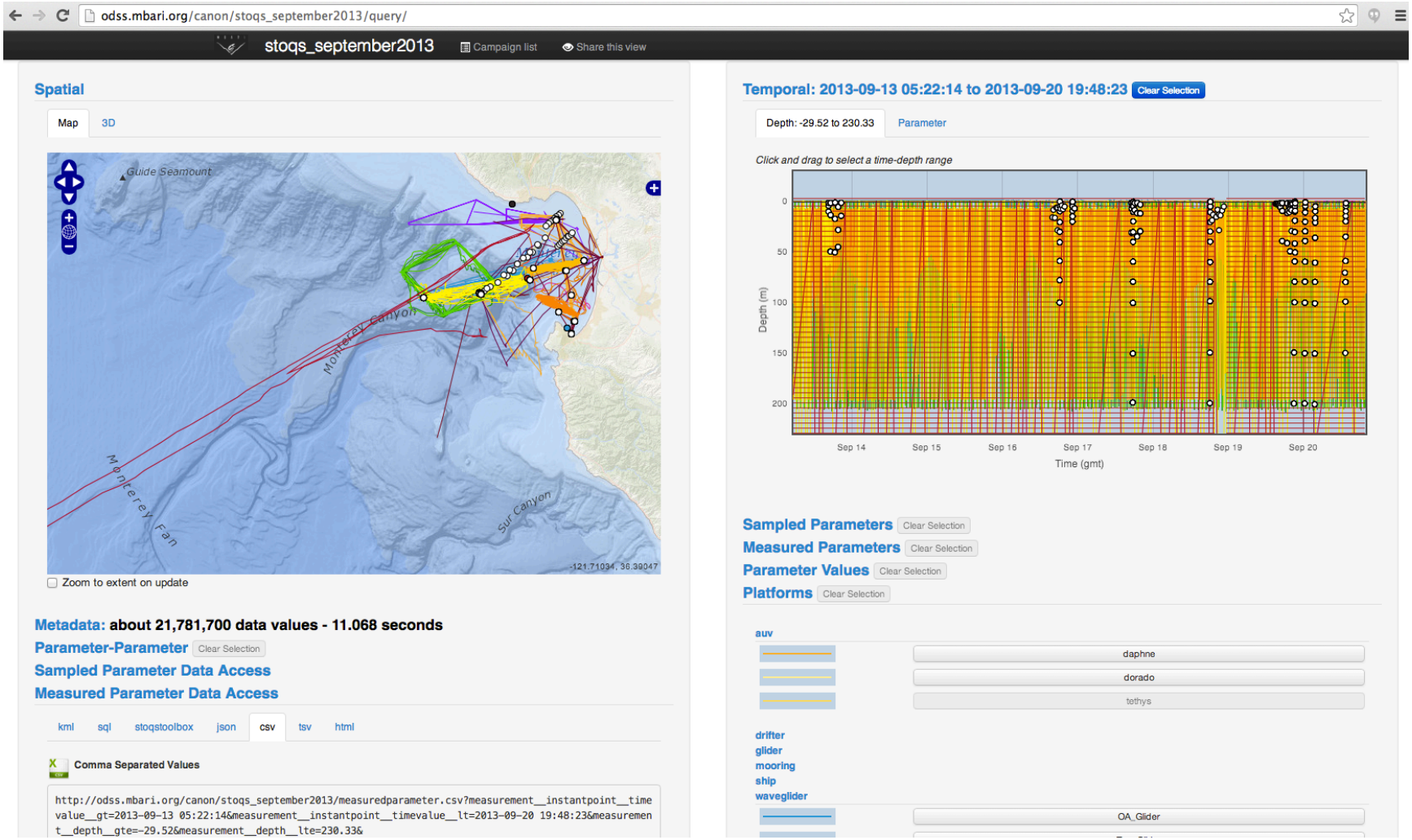
User Interface



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AJAX X3D Update (1)

```
▶ <div class="row-fluid">…</div>
▼ <div>
  ▼ <x3d id="geo_x3d" style="width:100%; height:100%; margin: 0px auto; display:block; border:
  none;" width="727px" height="500px">
    ▼ <scene render="true" bboxcenter="0,0,0" bboxsize="-1,-1,-1" pickmode="idBuf" dopickpass=
    "true">
        <shape id="mp-x3d-track" render="true" bboxcenter="0,0,0" bboxsize="-1,-1,-1"
        ispickable="true"></shape>
        <viewpoint id="mp-x3d-viewpoint1" centerofrotation="-2711557.9403829873
        -4331414.329506527 3801353.4691465236" position="-2822317.31255 -4438600.53640
        3786150.85474" orientation="0.89575 -0.31076 -0.31791 1.63772" fieldofview="0.785398"
        znear="-1" zfar="-1"></viewpoint>
        <inline id="mp-x3d-terrain1" url="/stoqs/static/x3d/Monterey25_256.x3d" render="true"
        bboxcenter="0,0,0" bboxsize="-1,-1,-1" load="true" namespacename></inline>
      </scene>
      <canvas class="x3dom-canvas" id="x3dom-geo_x3d-canvas" tabindex="0" width="727px" height=
      "500px">
    ▶ <div id="x3dom-state-viewer" style="display: none;">…</div>
    ▶ <div class="x3dom-progress" style="display: none;">…</div>
    </x3d>
  </div>
</div>
```

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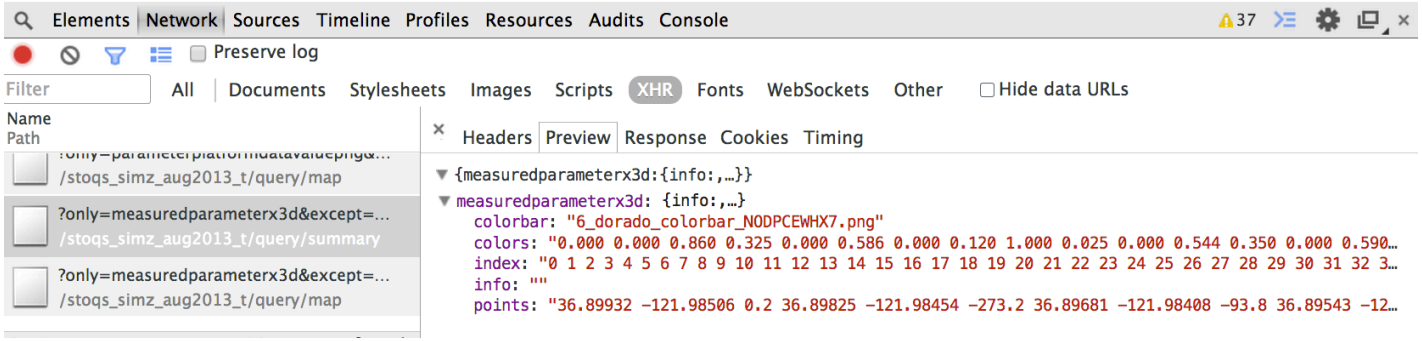
AJAX X3D Update (2)




```
$('#mp-x3d-track').append('<indexedlineset coordIndex="' +
                  data[key]['index'] + '"> <color color="' +
                  data[key]['colors'] + '"></color> <geocoordinate point="' +
                  data[key]['points'] + '"></geocoordinate> </indexedlineset>');
```

```
▼ <x3d id="geo_x3d" style="width:100%; height:100%; margin: 0px auto; display:block; border:
none;" width="727px" height="500px">
  ▼ <scene render="true" bboxcenter="0,0,0" bboxsize="-1,-1,-1" pickmode="idBuf" dopickpass=
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    ispickable="true">
      ▶ <indexedlineset coordindex="0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
      23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
      52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
      81 82 83 84 85 86 87 88 89 90 91 92 93 -1 94 95 96 97 98 99 100 101 102 103 104 105 106
      107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128
      129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
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    </shape>
    <viewpoint id="mp-x3d-viewpoint1" centerofrotation="-2711557.9403829873
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    3786150.85474" orientation="0.89575 -0.31076 -0.31791 1.63772" fieldofview="0.785398"
    znear="-1" zfar="-1"></viewpoint>
    <inline id="mp-x3d-terrain1" url="/stoqs/static/x3d/Monterey25_256.x3d" render="true"
    bboxcenter="0,0,0" bboxsize="-1,-1,-1" load="true" namespacename></inline>
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  "500px">
▶ <div id="x3dom-state-viewer" style="display: none;">…</div>
▶ <div class="x3dom-progress" style="display: none;">…</div>
</x3d>
```

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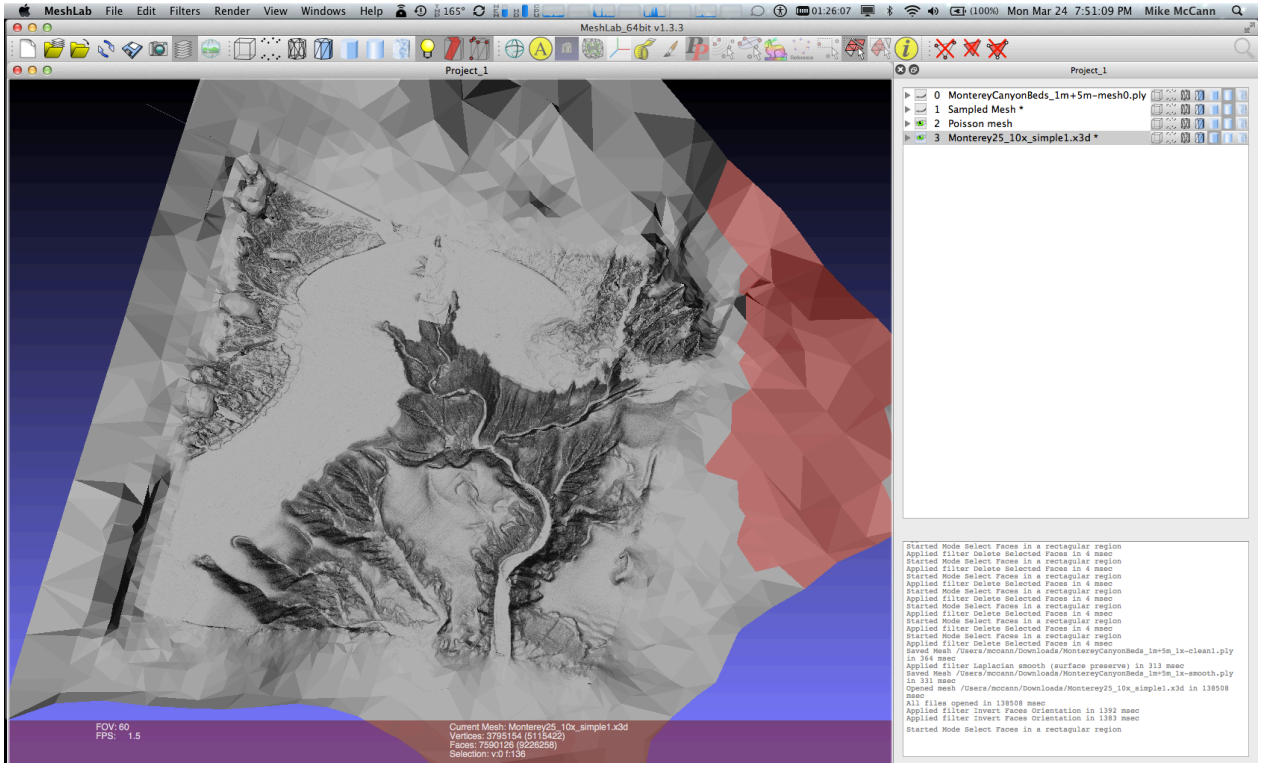
Terrain Generation (1)

A. GMT .grd file to point cloud

```
grd2xyz Monterey25.grd --D_FORMAT=%f | sed '/NaN/d' | awk '{print $1, $2, 10 * $3}' | mapproject -E > Monterey25_10x.asc
```

B. Process and edit in Meshlab



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Terrain Generation (2)

C. InstantReality aopt tool processing to POP Geometry

```
aopt -i /Users/mccann/Downloads/Monterey25_10x-clean.ply -F Scene -b /Users/mccann/Downloads/Monterey25_10x-opt.x3db
aopt -i /Users/mccann/Downloads/Monterey25_10x-opt.x3db -f PrimitiveSet:creaseAngle:4 -V -K \
          "/Users/mccann/Downloads/binGeo/:ib" -N /Users/mccann/Downloads/Monterey25_10x.html
```

D. Include Geometry in web page

```
<scene DEF='scene'>
  <shape DEF='_G_0'>
    <appearance DEF='AOPT_Appearance_196988928'>
      <material diffuseColor='0.7 0.7 0.7' specularColor='0.1 0.1 0.1'></material>
    </appearance>
    <popGeometry DEF='PG_2' vertexCount='382281' primType='"TRIANGLES"' position='-2734134.5 -4329145 3761846.5' size='34225.87
56903.4 40624.4725' attributeStride='12' normalOffset='8' vertexBufferSize='65533' indexedRendering='true' bbMinModF='0.709272547345
0.467095112067 0.348620649782' bbMaxModF='0.520669014403 0.375221867235 0.852387190997' bbMin='-2748020 -4354982.5 3751614'
numAnchorVertices='3772' tightSize='27770.75 51675.5 20465.25'>
      <popGeometryLevel src='/stoqs/static/x3d/Monterey25/binGeo/PG_2_level0.bin' numIndices='11409' vertexDataBufferOffset='0'></
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popGeometryLevel>
      ....
```

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The ECOHAB experiment – A first step toward predicting harmful algal blooms

www.mbari.org/news/homepage/2013/ecohab/ecohab.html

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The ECOHAB experiment – A first step toward predicting harmful algal blooms

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20 March 2013

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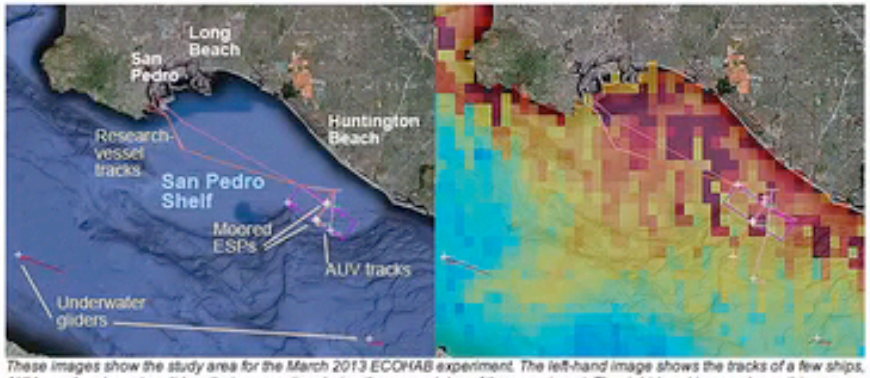
The ECOHAB experiment—A first step toward predicting harmful algal blooms

Killing wildlife and occasionally sickening people, harmful algal blooms can be more than just a nuisance. But predicting these blooms is difficult—even more difficult than predicting the weather—because blooms result from a dynamic interaction between both physical and biological processes. Human activities, such as agricultural runoff and sewage discharges into the ocean, may also play a role.

The ECOHAB (Ecology and Oceanography of Harmful Algal Blooms) research program, sponsored by the National Oceanic and Atmospheric Administration (NOAA), is providing key information that may one day allow researchers to overcome these challenges and predict when and where blooms are likely to occur.

Since 2010, ECOHAB researchers have been conducting field experiments at two harmful algal bloom "hot spots"—Monterey Bay, in Central California, and San Pedro Bay, in Southern California. During March 2013, researchers will be conducting a month-long study of at the southern site in San Pedro Bay.

The ECOHAB research grant is overseen by Raphael Kudela of the University of California, Santa Cruz, but the field program involves a number of MBARI researchers, as well as MBARI's autonomous underwater vehicles (AUVs) and robotic DNA labs known as Environmental Sample Processors. Many of the tools and research strategies used in the ECOHAB experiment were developed as part of MBARI's Controlled, Agile, and Novel Observing Network (CANON) initiative.



These images show the study area for the March 2013 ECOHAB experiment. The left-hand image shows the tracks of a few ships, AUVs, and underwater gliders that were active during the second day of the experiment. The right-hand image shows this same area overlain by a satellite-derived map of chlorophyll, an indicator of marine algae near the sea surface (dark red areas have the highest amounts of chlorophyll). Real-time tracking of ships, robots, drifters, and ocean-conditions helps ECOHAB researchers monitor and plan their experiments from offices on shore. Base image: Google Maps

In pursuit of microscopic prey

During the March 2013 experiment, researchers are on the hunt for a microscopic alga (a diatom) called *Pseudo-nitzschia australis*. *Pseudo-nitzschia* diatoms sometimes produce a neurotoxin that can become concentrated in the bodies of small fish such as anchovies. When predators such as sea lions, pelicans, or other sea birds eat these fish, they may experience seizures and organ damage. The

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