SEACAST – HTTPS://WWW.SEACAST.ORG
A Python Web Application to Display High Resolution Weather and Ocean Forecast Models for Ocean Consumers
Miles A. Curry – Summer 2017 Space Grant Intern
OUTLINE

1. Project Background
2. Technical Details
3. Summer Implementations
   1. Code Refactor
   2. Forecast extensions
4. Future Work & Current Projects
PROJECT BACKGROUND

- College of Earth Ocean and Atmospheric Sciences (CEOAS)
- Sea Grant Funded
- Grabs a number High Resolution forecasting models Oregon Coast and displays them at Seacast.org
  - High resolution models produced at OSU by CEOAS faculty (More Later)
  - Some models produced nationally (More Later)
- Viewable for Desktop and Mobile displays
- User base mainly local small commercial fisherman
- Developers: Computer Science Capstone groups with Space Grant Interns over the Summer
MAIN TECHNICAL DETAILS

• Python Based Web App
• Django web-framework
• Matplotlib & SciPy Stack for generated overlays
• Google Map API
• Automation by Celery
• JavaScript and a little HTML/CSS the Front End
APPLICATION LAYOUT

- Contains routes for `index.html`
- Contains `do_pipeline()` - Heart of the system
  - Downloads Models
  - Generates task lists that is given to Celery
- Contains logic for `index.html`

- Configuration settings
- Contains the image tiler
- Contains the DataFileManager
  - In charge of downloading and storing model datafiles

- Contains CSS, JS, images etc.

- Contains HTML template

- Installation and Deployment Functions
  - Shell Access

- Contains the OverlayManager
  - In charge of creating, storing and serving Overlays
  - Contains plotting functions
  - Contains model plotters
    - Is used to grab metadata from Datafiles
DRYER TECHNICAL DETAILS...

• Celery Beat Every 6 Hours
  • Models are Downloaded
  • Plots are generated from downloaded Data files
  • Overlays are tiled

• Front end serves up tiled overlays via Google maps API and Java script

OSU ROMS Sea Surface Temperature
Nov 11th @ 2am and 4pm
FORECASTING MODELS

• OSU High Resolution Group:
  • OSU Regional Ocean Mapping (ROMS) – Dr. Alexander Kurapov
  • OSU Wave Watch 3 (WW3) – Dr. Tuba Özkan-Haller

• Outside OSU
  • North American Mesoscale Model – NOAA
  • Extended WW3 – NCEP
  • Hybrid Coordinate Ocean Model (HYCOM) – NOAA

OSU WW3 Wave Height on Nov 4\textsuperscript{th} at 4am
SUMMER IMPROVEMENTS

1. Code Refactor
2. Extended Forecasts
CODE REFACTOR

- Removed unused and unnecessary functions
- Created a uniform settings file to standardize naming formats and increase readability across the code base
- Documented all important and regularly used functions and removed unnecessary, wordy comments
- Rewrote a number of functions to be clearer and easier to understand
- Created a stable release version on GitHub (Stable)
- Simplified the installation process
- Updated existing documentation and created new documentation for developer reference
- Made things look a lot nicer!

```python
if overlay_definition_id == 3:
    zoom_levels = zoom_levels_for_currents
elif overlay_definition_id == 5:
    zoom_levels = zoom_levels_for_winds
else:
    zoom_levels = zoom_levels_for_others
```
```python
if overlay_definition_id == settings.OSU_ROMS_SUR_CUR:
    zoom_levels = zoom_levels_for_currents
elif overlay_definition_id == settings.NAMS_WIND:
    zoom_levels = zoom_levels_for_winds
else:
    zoom_levels = zoom_levels_for_others
```
FUTURE SETTINGS FILE

```python
if overlay_id in settings.OSU_ROMS:
    if file_id is None:
        datafile = DataFile.objects.filter(type='NCDF').latest('model_date')
    else:
        datafile = DataFile.objects.get(pk=file_id)
    plotter = Plotter(datafile.file_name)
    zoom_levels = plotter.get_zoom_level(overlay_id)

elif overlay_id == settings.NAMS_WIND:
    if file_id is None:
        datafile = DataFile.objects.filter(type='WIND').latest('model_date')
    else:
        datafile = DataFile.objects.get(pk=file_id)
    plotter = WindPlotter(datafile.file_name)
    zoom_levels = plotter.get_zoom_level(overlay_id)

# T-Cline Settings
MIN_TCLINE_DEPTH = 10 # Meters
MAX_TCLINE_DEPTH = 75 # Meters
```

Ah Much Better!
EXTENDED FORECASTS

- Added HYCOM Sea Surface Temperature (SST) and Sea Surface Currents (SSC) to extend OSU ROMS SST and SSC
- Added NCEP Wave Watch III to extend OSU Wave Watch III
- Both Forecasts extend further into the future, but are lower resolution and predictions that are far out contain greater uncertainty
- Our users desired longer forecasts
  - They know that uncertainty exists, but it's still requested
<table>
<thead>
<tr>
<th>Model</th>
<th>Fields</th>
<th>Extended forecast</th>
<th>Resolution</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSU ROMS</td>
<td>Surface Temperature</td>
<td>No</td>
<td>High Resolution 2 km</td>
<td>2 Hours 4 Days</td>
</tr>
<tr>
<td></td>
<td>Bottom Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surface Currents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sea Surface Salinity</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Bottom Salinity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sea Surface ‘Height’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSU WW3</td>
<td>Wave Height</td>
<td>No</td>
<td>High Resolution 2 km</td>
<td>1 Hour 4 Days</td>
</tr>
<tr>
<td></td>
<td>Wave Direction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wave Period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAMS</td>
<td>Sea Surface Wind</td>
<td>No</td>
<td></td>
<td>1 Hour 3 Days</td>
</tr>
<tr>
<td>NCEP WW3</td>
<td>Wave Height</td>
<td>Yes</td>
<td>Low 22 km</td>
<td>Every 3 Hours 8 Days out</td>
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<tr>
<td></td>
<td>Wave Direction</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Wave Period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYCOM</td>
<td>Surface Temperature</td>
<td>Yes</td>
<td>Low 12 km</td>
<td>6 Hours 6 Days out</td>
</tr>
<tr>
<td></td>
<td>Surface Currents</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OSU ROMS VS HYCOM

OSU ROM

HYCOM

46.0 48.4 50.7 53.1 55.5 57.9 60.2 62.6 65.0

Fahrenheit
OSU WW3 VS NCEP WW3

NCEP WW3

OSU WW3

Wave Height (feet)

0.0  1.9  3.8  5.7  7.7  9.6  11.5  13.4  15.3  17.2  19.1  21.0  23.0
FUTURE IMPROVEMENTS & CURRENT PROJECTS

- Improved Logging System – New logging system to generate cleaner, and more human readable logs to allow quicker response to outages
- OSU ROMS Thermocline Field – Depth at which the sea temperature changes most rapidly – Soon to be complete
- Finish Extending Forecast and determine the best way to display forecasts with high uncertainty
- Bug Fixes (As always)
- More Refactors (As always)
- Create new and better software development documentation for future developers
THANKS TO:

- Ted Strub
- Flaxen Conway
- Craig Risen
- Jessica Kuonen
- Anthony Dunaway

QUESTIONS?

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