A WQX-Enabled Decision Support Tool for Planners in the Northeast

Integrating WQX, IOOS and meteorological data to build a better beach tool

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Outline

- A bit of background
- Goals
- Partners
- What we did
- Outcomes
- Next steps

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Background

- 2008-2012: Northeast Coastal and Ocean Data Partnership worked on an EN project to stand up node and develop schema for “environmental data”
  - Installed and customized Open Node2 (ours stores data)
  - Developed ODPX flow, a standard based largely on WQX + OGC SOS* (Open Geospatial Consortium Sensor Observation Service) + bit more metadata
  - Developed a prototype geospatial tool to visualize monitoring locations, access data
    - Included state agencies with regulatory data requirements plus other citizen monitoring, state, nonprofit and federal entities

* SOS is an OGC standard for a web service to share real-time and continuous monitoring data

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Goals – High Level

- Develop standards-based transferrable processes for the EN community and general public to access, integrate and analyze information from sources across the network
  - Develop use case, identify data sources, develop requirements, build application
- Develop cookbooks and toolkits to enable EN partners to add OGC web services to existing and planned nodes
  - There are currently more REST services than OGC (i.e. SOS, WMS) for accessing EN data
- Share software and tools with end users
  - Code available on Github, software shared via meeting/webinar

Partners

- Maine Coastal Program - Maine's spatial planning entity
- Maine DEP – Hosts Maine Healthy Beaches
- NH DES – Runs NH's Beach WQ program
- NERACOOS – Northeast Regional Association of Coastal and Ocean Observing Systems, and host of NeCODP and source of IOOS data
- University of South Carolina Dept. of Environmental Health Sciences (the modelers)

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What we did first

- Worked with partners to define a use case:
  - Question: What data would you benefit most from having improved access to?
    - Answer: improved access to historic beach data and trends across region. Would be even better in context with precipitation and met data!
- Defined goals of tool to deliver data:
  - Need to access historic beach data from EN (beach monitoring WQ data, closure history)
  - Access and display in context of other relevant data (precip, meteorological, IOOS)
  - Make available via geospatial, web-based tool
  - Provide continuous data updates to keep it dynamic

Bonus!

- We learned that a long-time IOOS and NeCODP partner in South Carolina had developed and implemented an *Enterococcus* model that could help predict when conditions were likely to support a spike. They also would be working on a joint IOOS/EPA effort enhancing model during same time period.
  - Tool was already in production at SCDHEC to evaluate http://gisweb01.dhec.sc.gov/wsBeachAdvisory/Index.html

- Team quickly worked with SC to understand model, data and technical requirements to determine if we could implement this capacity into status and trends tool
  - Decided that yes, we can!

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What we did next

- Prepared node and database for new data
- Begin process of data acquisition (the longest part)
  - Beach WQ data (e.g. *Enterococcus*, salinity, water temp, closure history)
  - Precipitation (24, 48, 72, 168, rainfall intensity past 24 hours)
    *we collected 96, 120 and 144 hr increments, but they had little predictive value
  - IOOS data (real-time meteorological and oceanographic data from the buoys)
- Model installation
  - Written in R, simple linear regression model
- Software development
  - Developed map based tool using OpenLayers, Sencha ExtJS, GeoExt2, PHP, Highcharts
- Product testing/evaluation/release/next steps

Data acquisition: Beach WQ

- Evaluated node to node as starting point
  - Technical resources at state agencies are stretched very thin, difficult and costly to keep this going
- BEACON – EPA's Beach Advisory and Closing On-line Notification
  - Pros: have RESTlike (Representational State Transfer) services
    - In other words, can use URL to build request instead of interface
  - Cons: build URLs using interface, limits programmatic automation capacity, not in real-time
- Waterqualitydata.us ✔ (USGS/EPA/Nat WQ Mon Council)
  - Pros: had all the data we needed via STORET, REST URLs can be built programmatically
  - Cons: data lags, not in real-time (used state websites to import current data, which are not set up for machine to machine data exchange, i.e. no REST)
- Validate data via state websites (NH One Stop/Maine Healthy Beaches)

Data Acquisition: Precipitation

Needed: r… data

- NWS pr… **Rad**ar)
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    - Not … t (yet)!
- NWS re… ape files
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Index of /ridge2/Precip/qpehourlyshape/latest

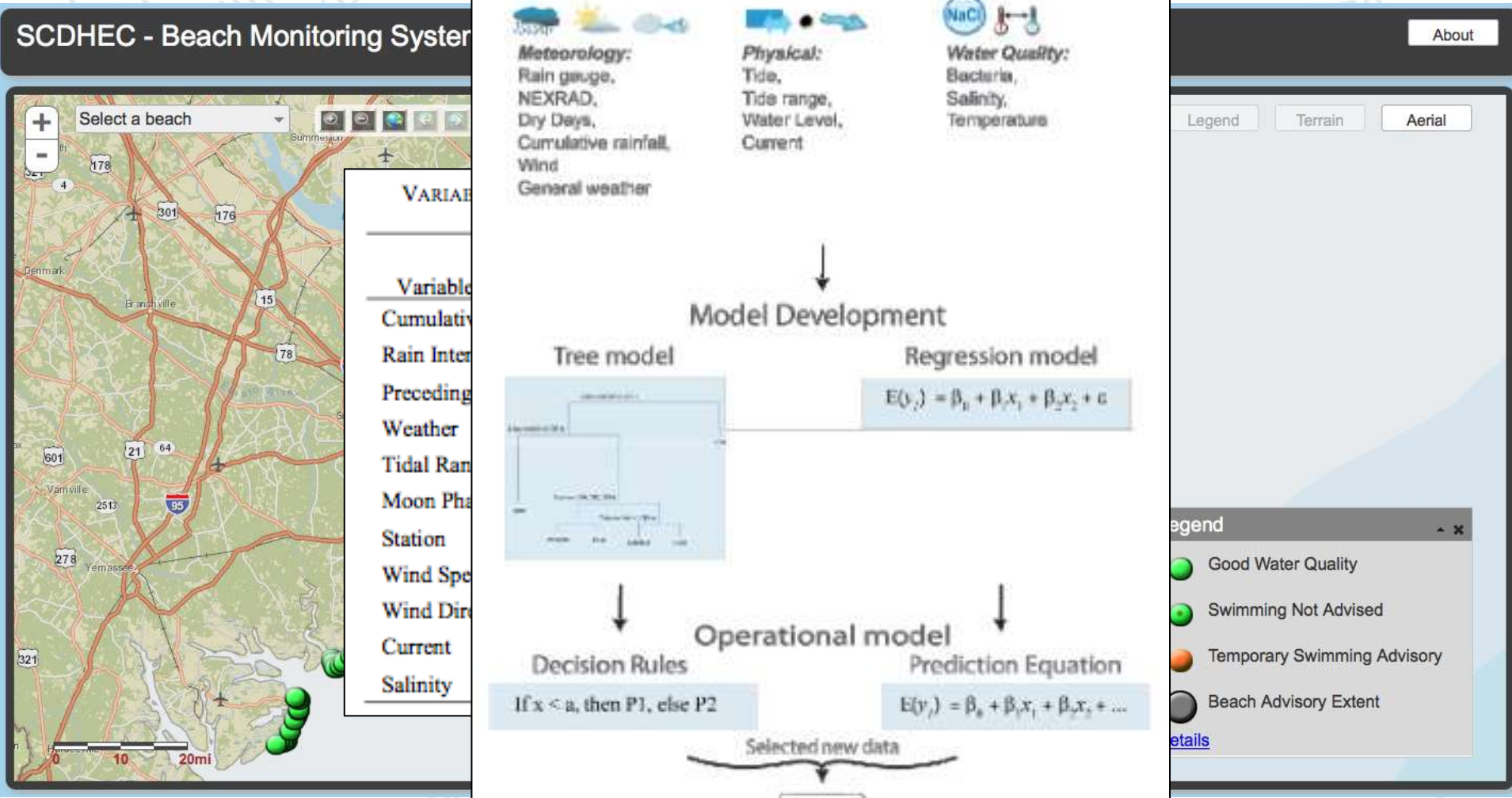
Name	Last modified	Size	Description
Parent Directory		-	
last_1_hours.tar.gz	18-Feb-2014 14:48	668K	
last_2_hours.tar.gz	18-Feb-2014 14:48	925K	
last_3_hours.tar.gz	18-Feb-2014 14:48	1.1M	
last_6_hours.tar.gz	18-Feb-2014 14:48	1.6M	
last_12_hours.tar.gz	18-Feb-2014 14:48	2.7M	
last_24_hours.tar.gz	18-Feb-2014 14:48	4.6M	
last_48_hours.tar.gz	18-Feb-2014 14:48	6.4M	
last_72_hours.tar.gz	18-Feb-2014 14:48	6.8M	
last_96_hours.tar.gz	18-Feb-2014 14:49	8.0M	
last_120_hours.tar.gz	18-Feb-2014 14:49	8.3M	
last_168_hours.tar.gz	18-Feb-2014 14:49	9.9M	
last_336_hours.tar.gz	18-Feb-2014 14:49	12M	
last_720_hours.tar.gz	18-Feb-2014 14:50	13M	
last_1440_hours.tar.gz	18-Feb-2014 14:52	14M	
last_2160_hours.tar.gz	18-Feb-2014 14:53	14M	
last_2880_hours.tar.gz	18-Feb-2014 14:54	14M	
since_12z.tar.gz	18-Feb-2014 14:48	925K	

Apache/2.2.15 (Red Hat) Server at www.srh.noaa.gov Port 80

Data Acquisition: Other

- IOOS data – data from buoys in the Northeast region
  - For model, data comes from buoy closest to monitoring location
- Develop processes using node to acquire data from buoys in real-time and add to model data table
  - Salinity, water temperature, current speed and direction, wind speed and direction

The SC Mod


SCDHEC - Beach Monitoring Syster
About
Select a beach
Legend
Terrain
Aerial
Database
Meteorology:
Rain gauge,
NEXRAD,
Dry Days,
Cumulative rainfall,
Wind
General weather
Physical:
Tide,
Tide range,
Water Level,
Current
Water Quality:
Bacteria,
Salinity,
Temperature
Model Development
Tree model
Regression model
$E(y_i) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$
Operational model
Decision Rules
If x < a, then P1, else P2
Prediction Equation
$E(y_i) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$
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Beach Advisory Extent
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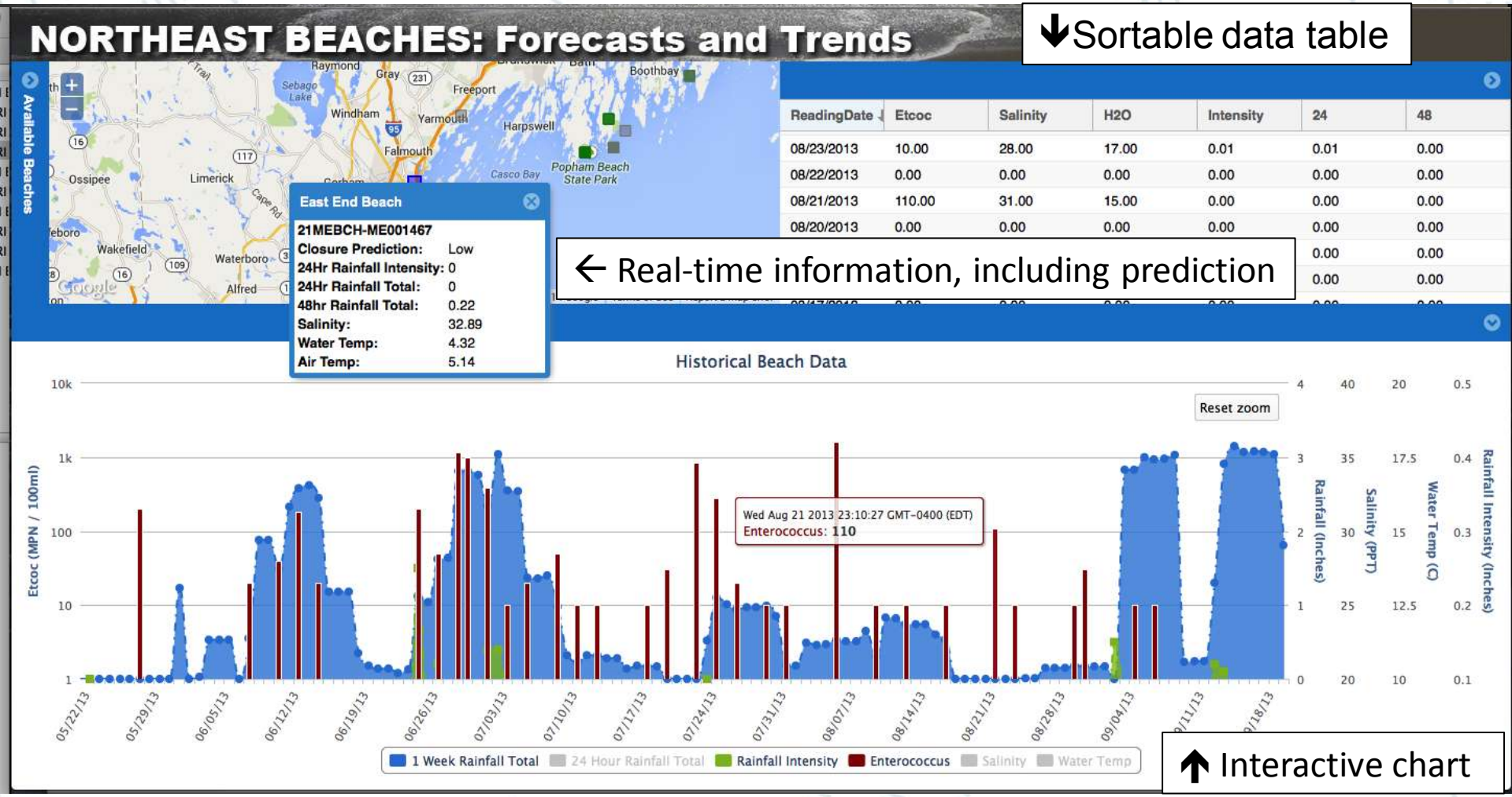
Software development

- The application:
  - A geospatially-enabled tool that allows user to select a beach, view real-time data and prediction as well as charts of historic trends
- How it's made:
  - Built in Ext JS (a JavaScript framework with MVC architecture and modern UI widgets)
  - Map built with OpenLayers
    - Used GeoExt2 Library to integrate OpenLayers into Ext JS
  - Charts built using JavaScript based Highcharts
  - Data handling in PHP
    - Pulls real-time and historic data into application
    - Accesses model output in real-time

Application Functionality



Next Steps

- Status of project
  - Model, software, data largely complete
- Remaining work
  - Clean up application interface
  - User feedback/testing
  - Hindcast validation (some beaches are better than others)
  - Finalize documentation/cookbooks
- Future interests
  - Can this model work on shellfish closure data?
    - Data challenge: in ME, not part of EN regulatory data
  - Ongoing support of application

Resources

Northeast Program/Data Resources

- http://www.exchangenetwork.net/data-exchange/ocean-data-partnership-exchange/
  Northeast Coastal and Ocean Data Partnership Exchange
- http://www.neracoos.org
  Northeast Regional Association for Coastal and Ocean Observing Systems
- *https://github.com/neracoos-open*
- *Github/Wiki for this project*

Software tools

- http://www.sencha.com/products/extjs/
  Sencha Ext JS – JavaScript framework
- http://www.highcharts.com/
  Highcharts JS, interactive JavaScript charts for web applications
- http://www.opengeospatial.org
  The Open Geospatial Consortium
- http://geoext.github.io/geoext2/
  s 2 — JavaScript Toolkit for Rich Web Mapping Applications

Data Resources

- National Mosaic NAT (NEXRAD shape files) - http://www.srh.noaa.gov/ridge2/ and http://www.srh.noaa.gov/ridge2/Precip/qpehourlyshape/latest/
- EPA BEACON 2.0 – Beach Advisory and Closing On-line Notification - http://watersgeo.epa.gov/beacon2/
- National Water Quality Monitoring Network: waterqualitydata.us

South Carolina model effort

- http://code.google.com/p/wqportlet/wiki
  South Carolina code repository for model
- http://www.environ.sc.edu/sites/default/files/files/Pournelle/PID982259.pdf
  Paper describing development of predictive model in South Carolina
- http://media.clemson.edu/public/restoration/scwrc/2010/manuscripts/t1/porterd_10scwrcpaper.pdf
  Paper by SC modelers describing value of modeling and forecasting

Thank you for your time!

Questions?

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