

Chapter 7

The Tools of the Oregon Coastal Atlas

Tanya Haddad¹, Dawn Wright², Michele Dailey², Paul Klarin⁴, John Marra^{1,5}, Randy Dana¹, David Revell^{1,6}

¹ Oregon Ocean-Coastal Management Program, Department of Land Conservation and Development, 800 NE Oregon St # 18, Suite 1145, Portland, OR 97232;
Corresponding author: tanya.haddad@state.or.us

² Department of Geosciences, Oregon State University, Corvallis, OR 97331-5506

³ Ecotrust, Jean Vollum Natural Capital Center, Suite 200,
721 NW Ninth Avenue, Portland, OR 97209

⁴ Oregon Ocean-Coastal Management Program, Department of Land Conservation and Development, 635 Capitol St NE, Suite 150, Salem, OR 97301

⁵ now at NOAA Pacific Services Center, Honolulu, HI

⁶ now at Earth Sciences Department, University of California, Santa Cruz, CA

Abstract

The Oregon Coastal Atlas (<http://www.coastalatlus.net>), a collaboration of the Oregon Coastal Management Program, Oregon State University and Ecotrust, is an interactive map, data, and metadata portal targeted at coastal managers, scientists, and the general public. The site was developed to meet long-standing needs in the state for improving information retrieval, visualization and interpretation for decision-making relating to the coastal zone. It has the ambitious goal of being a useful resource for the various audiences that make up the management constituency of the Oregon Coastal Zone. The site provides background information for different coastal systems, as well as the expected access to interactive mapping, online geospatial analysis tools, and direct download access to an array of natural resource data sets relating to coastal zone management. Therefore as a portal, the Oregon Coastal Atlas enables users to search and find data, but also to understand its original context, and put it to use via online tools in order to solve a spatial problem. This chapter describes in detail the various online tools of the atlas, most of which can be used online, some of which need to be

downloaded to the user's desktop; some that are used for viewing data, some that are used for geospatial analysis; and tools for a diverse audience— some best suited for coastal planners and researchers, some for contributors to the atlas, and some for the general public.

Background

The Oregon Coastal Atlas (OCA), a collaboration of the Oregon Ocean-Coastal Management Program, Oregon State University and Ecotrust, is an interactive map, data, and metadata portal for coastal resources managers and scientists, with additional outreach sections for the general public. The portal enables users obtain data, but also to understand its original context, and to use it for solving a spatial problem via online tools. The design of the atlas draws from the reality that resource decision-making applications require much more than simple access to data. Resource managers commonly make decisions that involve modeling risk, assessing cumulative impacts and weighing proposed alterations to ecosystem functions and values. These decisions involve pulling together knowledge from disparate disciplines such as biology, geology, oceanography, hydrology, chemistry and engineering. Practitioners within each one of these disciplines are often vested in the technologies that dominate the market within their particular field. This presents significant data integration difficulties for investigators involved in management decisions that are as inherently interdisciplinary as those in the coastal zone. The goal of our proposed effort is to address these problems by incorporating a variety of geospatial data and * tools * within a common framework. The OCA was designed to meet long-standing needs in the state of Oregon for improving information retrieval, visualization and interpretation for decision-making relating to the

coastal zone, but is also one of a handful of major information gateway portals across the country that contribute to the U.S. Coastal National Spatial Data Infrastructure, and therefore service users from many states and countries (Goss, 2003; Wright et al.; 2003; Wright et al., 2004).

Without resorting to a dictionary definition, the OCA project team roughly defines a tool as “something used by someone to accomplish some task”. In this loose equation there are two variables for what ultimately constitutes the functionality of a given tool: the “someone” or audience that must use the tool, and the “task” or problem they are trying to solve or resolve. Of these two variables, the “someone” or audience is of particular importance. Different audiences have different problems, and also different levels of skill or resources available to resolve their problems. Tool providers need to be sensitive to the nature of their audiences, the specifics of the problems those audiences are faced with solving and the resources and abilities available for resolving them.

Early on in the project, the audiences that make up the constituency of the OCA were characterized as falling into four distinct groups. In no particular order they are: the public, researchers, planners and contributors. Simply by listing the names of these groups one begins to get a sense for the different types of tasks each group might need to accomplish. Not so simply, it was also determined that there would be instances where individuals would be members of more than one audience (e.g., a member of the public who also serves on a volunteer watershed council in a planning role). The task at hand was to build the OCA as a resource that would be of some use to each of these groups. It was to be the Swiss army knife of information tools for the Oregon coast.

Open Access Tools and Audience Diversity

As tool providers faced with such a diverse audience, we found that there was no way to simplify or standardize our task. Tools would have to be built audience specific, and as a result, every tool could not work for every group. In some cases it would even be necessary to make two versions of the same tool for different audiences. In this chapter we present a detailed explanation of our audience types and examples of tools created for each, in the process detailing how each tool resolves a common task characteristic of the audience it was created for.

Tools for the Public

Members of the public tend to be interested or have a stake in learning about places on the coast: places they have visited or are going to visit, places they live or would like to live. Sometimes this interest is general, sometimes specific. For example, coastal residents, both full and part-time, have special knowledge of and vested interest in local resources and economies, and can benefit from having accurate standardized inventories that raise awareness of local resources that provide community benefits. Coastal residents and homeowners are also at ground zero for risk from a host of hazards that can uniquely threaten life and property on the coast, and can thus also benefit from clear and concise information that clarifies levels of risk and outlines measures that homeowners can take to minimize danger to people and property. We will present examples of OCA tools that serve both the need for standardized information presentation and for specific information disbursement (Coastal Atlas Maps Tool, Coastal Access Inventory Tool, Marine Visioning Tool).

Tools for Researchers

Researchers tend to be well informed about their particular field of expertise, and are often looking for specific data sets or pieces of information that will inform or be of use in their research activities. They may know or suspect that research has been done in a particular location or on a particular topic and would like easy access to prior data products, published and unpublished results, metadata regarding how when and why data were collected, etc. They tend not to require, be interested (or even be impressed) with informational layout per se, but rather with ease of access to the information they are seeking, and certainly with adequate consistently presented documentation or informational pedigree to allow them to determine if what they have found is relevant to the inquiry they are pursuing at hand. We will present examples of two OCA tools that are built to serve up large archives of geospatial data and research products in ways that are quickly and easily searched (Coastal Atlas Geospatial Archive Search Tool and COMCI: Catalogue of Marine and Coastal Information), and one example of a specific research topic tool (Erosion Hazard Tool Suite).

Tools for Planners

Planners, characterized broadly as formal planners and other public managers whose responsibilities relate to planning and coordinating activities on the coast, are often faced with recurring management problems in different locations on the coast, and tend to need ways to help integrate the variability of issues and geographies into consistent decision-making processes. In many ways this audience is the most challenging to serve, and presents the greatest potential for improvement in service. We will demonstrate two coastal atlas tools that attempt to take specific recurrent coastal

management tasks (relative hazard vulnerability and watershed assessment) and present standardized processes for working through completing such tasks.

Tools for Contributors

Contributors to the Atlas consist of current and future coastal atlas project partners who are dispersed throughout a wide geography and need ways to be able to add their own particular data / information / tools to the collective project in a way that is easy and consistent with the common interface that the other audiences are acquainted with.

While not specifically addressing the needs of the more public audiences of the coastal atlas project, the thought here is that by making it easy to participate as a contributor to the atlas, more contributors can be recruited over time, which in turn will increase the odds that the content of the site will serve the needs of a particular audience member.

Two OCA tools that simplify a contributor task are the Glossary Linking and Bug Reporting Tools. Future directions for such tools include tools that allow contributors to input geospatial, bibliography, and photo data, and even to build Internet map server (IMS) templates.

Tools, Tools and More Tools.....

Coastal Atlas Geospatial Archive Search Tool

<http://www.coastalatlant.net/search/>

Audience: Planners, Researchers

The heart of the OCA is an archive of geospatial data collected over the years by various program partners of the Oregon Ocean-Coastal Management Program. The data range from point based species data through shore type delineation line data, offshore geology polygon data, to raster products such as digital nautical charts,

orthophoto quadrangles, and Landsat TM (thematic mapper) imagery. Typically the data were originally collected as part of a specific planning project that a partner agency was involved with, and once that original project was completed the data became part of the published projects products, sometimes never to be seen again. Rather than allow such data to gather dust on shelves and in storage boxes, the Atlas project team made a concerted effort to mine existing partner hardcopy archives for any digital data that could be preserved and brought into the future via the new OCA archive. The intent was to create a one-stop shop for finding the fruits of past data collection efforts.

To accomplish this, all archive data media formats (floppy disk, digital tape, CD etc) were acquired, opened and any data contained within them were matched with documentation from accompanying hard-copy reports. Federal Geographic Data Committee (FGDC) compliant metadata were then created for individual datasets, and all datasets were brought into a common coordinate projection, so that all OCA archive products could easily be used together. Individually documented datasets were entered into a database and a web search interface was constructed which allowed users to search for geospatial data based on coastal locations, data originator, data scale, or even keyword. Search results are provided in list form with links to the respective metadata and download files, and should the user wish to view the data pre-download, a link to the Atlas interactive map interface is provided so that the data can be browsed via the built-in IMS (Fig. 7.1).

Oregon Coastal Atlas Home - Microsoft Internet Explorer

File Edit View Favorites Tools Help

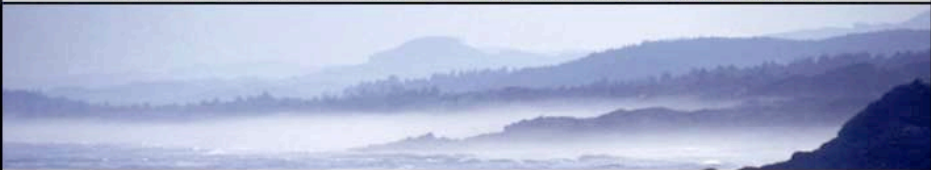
Back Forward Stop Refresh Home Search Favorites History Mail Print

Address <http://www.coastalatlus.net/search/index.asp> Go

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Search Coastal Atlas Archives

The Coastal Atlas will have links to many different archives which can be searched to help you find the data and information you are looking for. For now, simple searching of the GIS datasets that are documented and downloadable is available below. More data and metadata are being added every day.

 **Search GIS Data by Coastal Setting**

Select a Setting and a Site Name

 **Search GIS Data by Keyword, Source or Scale**

Fill in only the fields you would like to limit in your search

Keyword: or Originator or Scale

[There are 492 searchable GIS data sets]

Disclaimer: Understand Before You Download Data..

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<http://www.coastalatlus.net/search/index.asp> Internet

Figure 7.1. Searching for metadata and data in the Oregon Coastal Atlas. (a, top) Screen shot of the Search tool inviting the user to search either by coastal setting, keyword, source of the data (by agency), or map scale. At the time of publication, the atlas held nearly 1100 searchable data sets. (b, bottom) Search results are provided in list form with links to the respective metadata and download files. The user may also view the data set in map form before downloading. For most data sets a link to the Atlas interactive map interface is provided so that the data can be browsed via the built-in Internet map server.

Coastal Atlas Map Tool

<http://www.coastalatlant.net/maps/>

Audience: Public, Planners

The OCA includes a stock IMS as top-level tool which can be used by visitors to view a variety of standard, preformatted and commonly requested data served in the OCA archives. The Map Tool is powered by the open source software known as Minnesota Mapserver (see: <http://mapserver.gis.umn.edu/>) with offers unparalleled interface customization to tool providers. In the OCA interface we chose to provide common IMS utilities such as Data Display, Quick Zoom, Zoom In, Zoom Out, Pan, Identify, and Print (Fig. 7.2). The purpose of this tool is to allow users such as coastal planners and

members of the public who do not have access to a desktop geographic information system (GIS) to build simple personalized maps using data relevant to the coast.



Figure 7.2. Map tool, for users who want to see a landscape/seascape context. They may choose from prepared maps, make their own custom maps, add detailed information from the OCA archives, and create their own resulting PDF.

Commonly requested data such as various base layers (orthophotos, digital topographic quads, shaded elevation, shaded bathymetry, land cover) as well as common overlay groups (transportation networks, hydrography, jurisdiction / administrative boundary lines, landmarks) and common coastal specific layers (coastal zone Boundary, territorial sea line, locations of estuaries, rocky shore sites, sandy shore sites, and important ocean areas) are provided in easy to use switchboard lists which allow a high degree of user customization in personalized map content design. In addition to the stock layers provided, users can also search the entire OCA geospatial data archive (see above) and add any layers of specialized interest to their maps. Maps can be given personalized titles and output to portable document format (PDF) format for use in printed reports, email, etc.

Of special interest in this tool is the “Info” utility provided in the main navigation bar. As in most IMS implementations this tool will return basic identifying information for any feature clicked. However a special feature of this tool is that when used in conjunction with the coast specific data layers provided in the “Info Layers” switchboard, the tool will return a pop-up window presenting a database template that displays a range of location specific information stored in the Atlas about that site. This one-page layout includes one or more site photos, a text-based informational narrative, a current weather report and a listing of any geospatial datasets relevant to that specific site. This feature allows the Map Tool to essentially provide an alternative route to an easy-to-read, compound data layout which gives the user a summary of whatever the OCA has to offer for their site of concern.

Coastal Access Tool

http://www.coastalatlantool.net/tools/public/coastal_access.asp

Audience: Public, Planners

Both coastal planners and members of the public are interested in information about beach access points on the Oregon coast. Typically the public consists of frequent practical users of the access points, and the planners are tasked with maintaining the sites, and preventing their loss. The Oregon Ocean-Coastal Management Program maintains a Coastal Access Information System containing location and inventory information about each of the access sites on the open ocean coast. This Oregon Coastal Access Information System contains valuable information pertaining to Oregon's public beach access locations including characteristic information such as access availability, type, presence of man-made and natural features and services and activities available at each location. Supplemental data have been provided including orthophotography, boat ramp data, line work indicating the Pacific coast trail and other base data layers.

While this original Coastal Access Inventory is a wealth of good information, the sheer quantity of data itself is cumbersome to navigate, and in its original GIS form (ArcView project) the data were really only available to users with ArcView and access to one of the originally published inventory CDs. The Coastal Atlas Access Tool was therefore created to provide much more widespread access to the inventory (via the web, and with no need for proprietary software), and was designed to present a simple way to search the data and return the results of searching the inventory in an easy to read, printable format (Fig. 7.3).

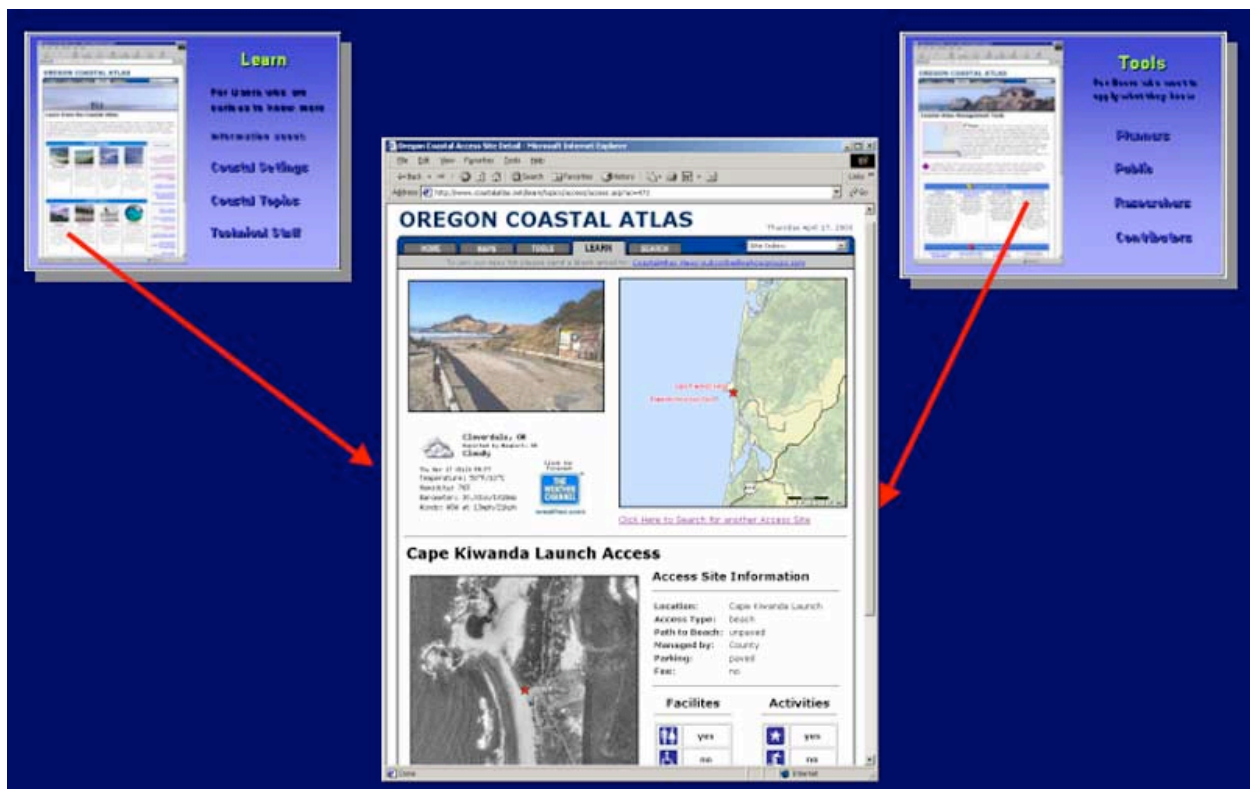


Figure 7.3. Users may browse through a coastal encyclopedia within the Learn section of the OCA, and then focus on a coastal setting or topic by way of the online Coastal Access Information tool containing location and inventory information about each of the access sites on the Oregon coast.

COMCI: A Coastal and Marine Bibliography Tool

<http://terrene.geo.oregonstate.edu/coastalatlus.net/search/comci/> [3/13/04 - under construction]

Audience: Researchers, Planners

COMCI, the Catalogue of Oregon Marine and Coastal Information, was developed by a collaboration of groups at Oregon State University: the Partnership for Interdisciplinary Studies of Coastal Oceans, Oregon Sea Grant, the Department of Zoology, and the Northwest Alliance for Computational Science and Engineering. Originally intended as a stand-alone resource that would provide policymakers, resource managers, and interested members of the public (planners and researchers) with information about the coastal and marine environment, it became evident after it's inception that COMCI contained a natural compliment to the geospatial data archive of the OCA. As such, a

partnership was formed which allowed the COMCI searchable archive to be incorporated into the structure of the OCA, making it easy for users of the OCA to access results relevant to their area of interest from COMCI and vice versa. This work is ongoing.

When completed, COMCI will allow users to quickly and efficiently search for information about Oregon's coast and ocean using either a text or map based interface. Sources referenced in COMCI range from articles, proceedings, and other documents that provide background information about oceanography and ecology, to those that include specific details about particular regions of the Oregon coast, such as habitat maps and local economic statistics. The six different, detailed subject areas contained within COMCI are: coastal zone management, marine fisheries, marine species, marine habitats, oceanography, and nearshore and open-ocean activities. If and when the referenced information is available in an online form, users can access it directly through a hot link in the meta-database.

COMCI is intended as a valuable tool for informing ocean and coastal decision-makers in Oregon as they strive to develop scientifically sound and integrated marine policy, management, and conservation measures. For this reason, the original architects included a description of how the data are or can be relevant to area-based management in Oregon's marine environment.

Watershed Assessment Tool

<http://www.inforain.org/coastalatlus.net/tools/watershed/intro.asp>

Audience: Planners

The Coastal Atlas Watershed Assessment Tool is based on the Oregon Watershed Enhancement Board (OWEB) assessment manual: a very large paper document used by volunteer watershed councils as a “cookbook” of how to go about doing a watershed assessment. Due to the technical capacity of many Oregon watershed councils, the OWEB manual did not focus on providing instruction on assessment procedures using GIS when it was last published in 1999. However, GIS is critical to preserving field data, monitoring restoration success or failure, and modeling priorities and conditions, and is increasingly available to non-profit groups such as watershed councils. Therefore, the purpose of the Coastal Atlas Watershed Assessment Tool is to provide GIS data, instruction, and an IMS to facilitate the use of GIS in the watershed assessment process (Fig. 7.4).

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Watershed Tool

OVERVIEW | METHODS | GIS

UTILITIES

START-UP AND IDENTIFICATION OF WATERSHED ISSUES

Purpose of Watershed Tool

The purpose of this tool is to assist resource managers and planners in the implementation of actions needed to protect and restore watershed habitat pursuant to the [Oregon Plan for Salmon and Watersheds](#). The Oregon Plan is a long-term, ongoing effort that involves state, local, tribal and private organizations and individuals to restore Oregon's wild salmon populations and fisheries to sustainable and productive levels and to improve water quality. The program has enabled the creation of watershed councils who undertake efforts to improve fish habitat and water quality conditions within their watersheds, usually by first conducting a watershed assessment. Under the plan, all state resource agencies and local jurisdictions have roles in protecting and enhancing water quality and fish habitat.

HISTORICAL CONDITIONS

CHANNEL HABITAT TYPE CLASSIFICATION

HYDROLOGY AND WATER USE

RIPARIAN WETLAND ASSESSMENT

SEDIMENT SOURCES ASSESSMENT

CHANNEL MODIFICATION ASSESSMENT

WATER QUALITY ASSESSMENT

FISH AND FISH HABITAT ASSESSMENT

ESTUARY ASSESSMENT

WATERSHED CONDITION EVALUATION

MONITORING PLAN

The overall reason for performing a watershed assessment is to find out where, within a given watershed, restoration of natural processes or features related to fish habitat and water quality needs to occur. Specifically, watershed assessments help accomplish the following goals:

- Identify features and processes important to fish habitat and water quality.
- Determine how natural processes are influencing those resources.
- Understand how human activities are affecting fish habitat and water quality.
- Evaluate the cumulative effects of land management practices over time.

The assessments help determine which processes in the watershed are working well and which are not. An assessment can't give site-specific prescriptions for fixing problems, but it can direct the development of action plans and monitoring strategies for protecting and improving fish habitat and water quality.

[How this Tool Works](#)

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Figure 7.4. Opening page of the online Watershed Assessment Tool, step-by-step GIS decision-making tool that provides guidelines, instructions, and then access to GIS data, and an Internet map service to aid the user in a watershed assessment process.

The Watershed Tool uses the components of the OWEB manual to develop parallel online chapters addressing certain aspects of an assessment for which GIS is appropriate. The manual has eleven modules from Start-up to Monitoring. Included also is a chapter placeholder on Estuary Assessment that is being developed by OWEB for inclusion in the manual in 2004. Each chapter has three sections: Overview, Methods, and GIS. "Overview" reviews the reason for that component in an assessment. Additionally, it asks the "critical questions" that are part of each manual component.

“Methods” discusses the steps and final products identified in the manual. “GIS” focuses on those steps and products that can be accomplished through the use of GIS.

To further enhance the range of user abilities addressed by the tool, there are three components of the GIS section: data, procedures and tools. These three components were developed to serve three tiers of GIS users: those with GIS software and skills who only need data, those with GIS software and few skills who need data and instruction in GIS software, and those users with no software who benefit from an IMS concentrating on each OWEB manual component.

With regard to data, it is not presumed that all the spatial data necessary for a complete watershed assessment will always be available. However, well-documented, standardized data, commonly needed for an assessment are being provided. The data download feature in the GIS section therefore links the user to standard best available data that has been prepared and clipped for each watershed. The procedures feature of the GIS section provides links to the GIS data as well as general instruction in how to use the GIS to accomplish assessment tasks and instruction on how to create and incorporate new data into the assessment process. Last but not least, the IMS tools feature of the GIS section uses consistent, best available data for the coastal watersheds of Oregon to create maps for those users without GIS software, allowing them to browse and print maps of their choosing

Marine Visioning Tool

<http://www.inforain.org/coastalatlas.net/tools/marine/intro.asp>

Audience: Public, Planners

The Marine Visioning tool was designed to give the user a better understanding of the complex nature of the marine landscape. In a way it is the least “tool-like” of all the tools described in this chapter. That is to say, rather than being a step-by-step GIS decision-making tool, the marine visioning tool is designed more in a fashion that illustrates the web of interconnections between various components of the marine landscape, thereby abandoning the “step-by-step” model. With the help of Bob Bailey, Oregon Coastal Management Program Manager and one of the original authors of *The Oregon Ocean Book*, a template of marine landscape subjects was developed that fell within the headings of time scale, fluid, physical, plankton, benthos, nekton, and human. With the help of a steering committee that included Bob Bailey, Hamilton Smillie, physical scientist, GIS analyst, and program manager at the NOAA Coastal Services Center in Charleston, SC, and Peter Huhtala, acting executive director of the Pacific Marine Conservation Council in Astoria, OR, the tool was further developed to include more categories under these headings.

The tool functions by providing an overview of a main topic such as time scales of oceanographic processes, and then goes on to describe in more detail the individual subjects within that, such as Pacific Decadal Oscillation, El Niño Southern Oscillation, and winter/summer effects (Fig. 7.5). Once the user enters the description of a subject they can then look at the connection between that subject and another subject within any of the headings. The content for these descriptions and interconnections was developed from an extensive literature review, during the course of which an expansive

bibliography and glossary of specialized terms was created. The contents of the bibliography have been incorporated into COMCI and by virtue of that tool's incorporation into the wider OCA project, are available to any user using COMCI as a bibliographic search tool. Similarly, the glossary of scientific and technical terms was incorporated into the larger atlas wide glossary, and relevant phrases imbedded throughout the narrative text are linked to their definitions via pop-up windows.

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Marine Visioning Tool

TIME SCALES FLUIDS PHYSICAL PLANKTON BENTHOS NEKTON HUMAN

The Marine Visioning Tool has been developed so that the user may achieve a greater understanding of the complex marine landscape. This landscape has been divided into the following seven major categories: Time Scales, Fluids, Physical, Plankton, Benthos, Nekton, and Human. Within each of these categories are two to three subjects. This is shown in the flowchart to the right. The tool has been designed to allow the user to learn about a category or subject and to read about the interconnectedness of subjects by navigating the flowchart.

To begin, click on a general category on the bar at the top of this frame or on a category or subject in the flowchart. From there, clicking on another subject will explain the connection between the two subjects.



TIME SCALES

- PDO
- ENSO
- winter/summer

FLUIDS

- water/currents
- air/weather

PHYSICAL

- depth
- geology
- substrate

PLANKTON

- phytoplankton
- zooplankton

BENTHOS

- crabs
- rocky bottom communities
- soft bottom communities

NEKTON

- coastal pelagics
- ground fish
- salmon
- marine mammals
- seabirds

HUMAN

- economy
- management/conservation
- recreation

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Figure 7.5. Opening page of the online Marine Visioning Tool which allows the user to explore various topics about oceanographic processes, including time scales, fluids, physical parameters, benthic communities, pelagic communities, and human activities.

Erosion Hazards Tool Suite

One of the most chronic of hazards that Oregon coastal communities face is that of erosion, which occurs over relatively short time periods in focus geographic areas, greatly affecting shoreline stability. The Oregon Department of Land Conservation and Development created a dune and bluff hazards decision support tool based on existing foredune erosion models (Marra, 1998; Ruggiero et al., 2001) and traditional ground survey beach elevation data. Since its initial development, this tool has been up-dated once through a partnership with NOAA Coastal Services Center to take advantage of newly available light detection and ranging (LIDAR) data for the Oregon coast, creating a combination of a science-based decision support tool and a cutting edge remote sensing technology. This union resulted in an initial product, the Dune Hazard Assessment Tool (DHAT) that can help coastal managers identify the relative risk to properties from coastal erosion.

The system being modeled by the tool is quite complex. Dune Hazard Zones (DHZ) occur within segments of shoreline backed by a sandy beach and dune. They refer to the area landward of a reference feature such as the existing line of vegetation that is subject to coastal hazards. Along dune-backed shorelines the extent of short-term shoreline change attributable to episodic wave attack events is the primary factor affecting shoreline stability and thus determining the landward extent of the zone. Long-term trends of shoreline change, attributable to factors such as the sediment budget or relative sea level rise, may also need to be accounted for in this environment. A typical analysis will involve assigning a range of actual values to the individual terms in a formula that relates all the relevant environmental parameters (Fig. 7.6). By in effect

'bracketing the truth', the dune hazard assessment formula provides a rational basis for assessing the relative risk to life and property posed by coastal hazards. In creating a tool for managers, parameters such as significant wave height, wave period, and mean water level are embedded in a Storm Event Magnitude drop-down list, which can draw from actual geospatial data sets. Other parameters could be derived from choices or entries made by the user.

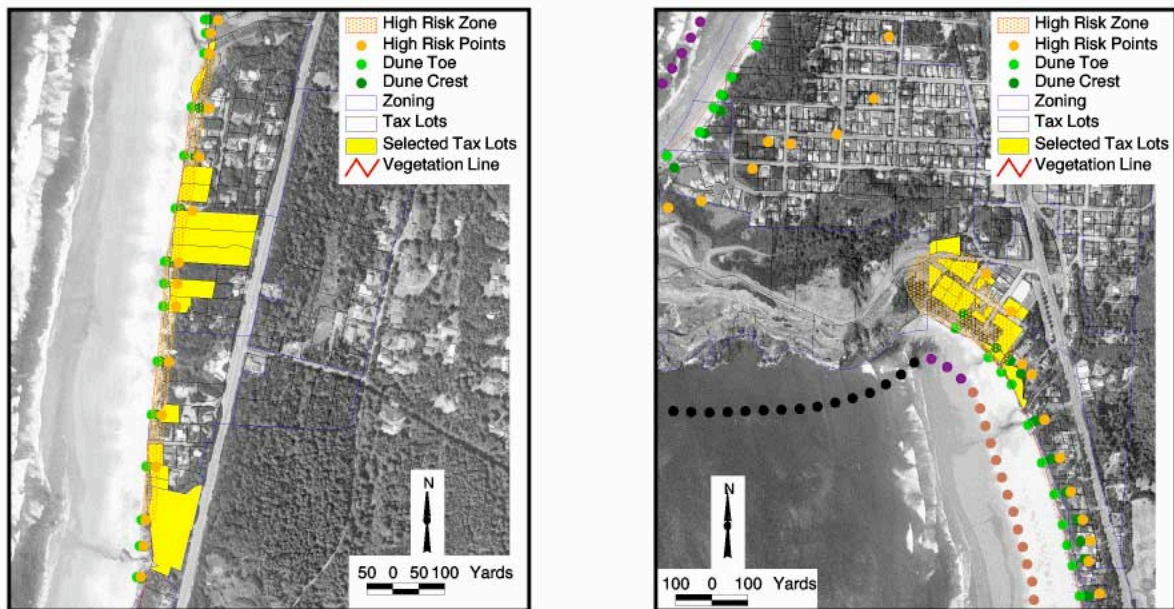


Figure 7.6. Two views that show the results of a GIS query to locate vacant parcels in private ownership within a high-risk zone. Assuming that the landward boundary of the zone of high relative risk represents a oceanfront construction setback line, then it is readily apparent how many property owners (i.e., tax lots) are affected different segments of shoreline. For policy development purposes this visualization tool makes it readily apparent that a construction setback may be effective along the central portion of the segment of shoreline depicted on the left, but unlikely to be effective in the segment depicted on the right. However, a review of additional attribute information provided by the tool suggests that other hazard avoidance measures may be viable. For example, an examination of the zoning designation of the affected lots indicates that they are zoned medium density residential and high density residential. Consideration may be given to downzoning as a means of reducing risk. An examination of the ownership of adjacent lots indicates that many are in public ownership. Land acquisition may be a viable, if not the preferred, alternative in this instance. By moving along segments of shoreline within a littoral cell and conducting the types of analyses illustrated above, a suite of preferred hazard avoidance measures can be identified for various segments of shoreline. When taken together they constitute a hazard avoidance strategy for a given littoral cell.

The DHAT tool is an example of an effort to aid local managers with a complex but not uncommon technical task encountered in the coastal zone on a routine basis. For the OCA, this tool has essentially been ported into an Internet accessible form such that it is seamlessly available to users alongside the available data archives in OCA. The result is a actually suite of three erosion hazard tools for the OCA: Overtopping Hazards, Undercutting Hazards, and Bluff Recession Hazards. Each of the tools steps the users through a process that explains points of relevant science, and then asks the user to make a selection or input a value. All values selected or entered are stored and used to calculate and/or populate variable parameters in a mathematical model that is designed to estimate hazard recession based on the values entered and the appropriate model for the specified geomorphology of the relevant section of shoreline. All three tools are designed for users with a reasonably high level of understanding of coastal processes, and existing coastal geomorphology, and this is reflected in the tool steps. In the case of one tool (Overtopping Hazards) a simplified version of the tools was also constructed to cater to interest from more average lay users.

Overtopping Hazards Tool

<http://www.inforain.org/coastalatlantools/overtopping/intro.asp>

Audience: Planners, Researchers

The primary determining factor as to whether a location on the coast will be inundated during a storm is the amount of water expected to hit the site as calculated from a variety of factors. These contributing factors range from water level values resulting from sea level, storm size, wave size, presence, absence or strength of El Nino etc. The Coastal Atlas Overtopping Tool allows the user to input parameters to determine the

final total water level, and apply it to a specific section of coastline (area of interest). The ultimate output of the tool is a map that illustrates the extent of inland flooding.

This tool was developed in both amateur and professional versions, in order to appeal to a wide variety of user abilities. Both versions begin by asking the user to select an area of interest from an IMS map or a dropdown list of site names. The amateur version performs the same analysis as the professional version however it eliminates many user choices and asks for input on only three parameters: sea level scenario, beach slope, and storm scenario. In contrast, the professional version asks the user to input a wide variety of parameters beginning with mean water levels associated with return intervals ranging from 5 to 100 years for a selected tide gauge, and progressing to those associated with elevated water levels resulting from storm surges, El Nino, and global sea level rise. Shorter term variations in water levels resulting from storms are considered when the user is asked for storm scenarios associated with return intervals ranging from 5 to 100 yr for a selected wave buoy as well as an elevated wave height trend in winter. The user is asked finally to input beach slope as a parameter of beach morphology.

Regardless of which version of the tool a user is engaged in, after all selections regarding locations and water level components are made, the choices made thus far are displayed on a summary page that shows the parameters the user has chosen as well as the model calculation of total water level. This final water level as well as the coordinates of the area of interest is passed to an IMS that zooms into that area and queries the processed LIDAR contours for the relevant water level value. The LIDAR

contours are then drawn on the map with all contours falling below the “flood level” being drawn in blue. This resultant map shows the tool user the approximate potential level of ocean flooding for that area under circumstances based on input parameters.

Undercutting Tool

<http://www.inforain.org/coastalatlantools/undercutting/intro.asp>

Audience: Planners, Researchers

The undercutting tool allows the user to model foredune retreat – an indicator of the potential for ocean erosion or “wave-undercutting”. There is only one version of this tool and it assumes the user has a good understanding of the subject.

Similar to the Overtopping Tool the Undercutting Tool has a step that asks the user to select an area of interest using an IMS or dropdown menu. Because Undercutting is also partly a function of total water level, many of the initial steps in the Overtopping tool are repeated here such as choosing the mean water level value associated with 5 to 100 year intervals for the South Beach tide gauge, Storm Surge, El Nino, and Global Sea Level rise, and short term storm scenarios as defined by wave buoy values and elevated wave height trend. In addition, the Undercutting Tool asks for two beach slope parameters: mid-beach and upper-beach. The mid-beach slope is used in total water level calculations and the upper-beach slope is used in the wave undercutting calculation. A beach-dune junction value is also requested before the user is directed to the summary page that displays user input parameters and calculated total water levels and potential extent of landward foredune retreat due to wave undercutting. The area of interest coordinates and the potential retreat value are passed to the IMS where the LIDAR contour equal to the retreat value is highlighted.

Bluff Recession Tool

<http://www.inforain.org/coastalatlas.net/tools/bluff/intro.asp>

Audience: Planners, Researchers

The Bluff Recession Tool departs from the approach explained above for Overtopping and Undercutting scenarios by offering users a choice between two methodologies for estimating potential bluff recession. These methods are the Recession Rate and Planning Period method, and the Slope Stability method, respectively. Because both methods require knowledge of hazard related science, the overall tool is written with the assumption that the user has a hazards background.

As with the erosion suite tools explained above the user is first asked to choose an area of interest via an IMS or dropdown list. The progression is then to the selection of either the recession rate method or the slope stability method. The Recession Rate method relies on an estimate of the average annual rate of bluff recession. This rate is often determined by analyzing changes in bluff crest position over time using aerial photographs. The Slope Stability method requires an understanding of the type of slope movement as expressed in terms of the “effective angle of internal friction”.

If the Recession Rate method is selected the tool first asks the user for elevation of the bluff top. It then asks for the estimated recession rate and planning period to be either entered by hand or selected from provided lists of common rates and common planning periods. Users are then directed to the standard summary of selections page, and the Recession Buffer calculation result— simply (rate x planning period) is presented. The calculated value is the recession distance from the bluff top edge. The corresponding

LIDAR contour and area of interest are reflected in the next page containing the IMS which displays the tools resultant map product.

The Slope Stability method asks for the bluff top elevation as well as for the elevation of the bluff toe. It then asks for input of the “effective angle of internal friction” from either a list of common values or a user input text box. This angle value used to represent the potential type of slope movement or mode of bluff failure, which is determined by material type, geologic structure, moisture content, and vegetative cover of the bluff itself. The next step directs the user to the summary page and the resulting calculated effective angle of internal friction –simply the tangent of bluff face slope. This value is multiplied by the bluff height to determine the recession distance inland from the bluff top, which is passed to the IMS with the area of interest coordinates to construct the resultant tool map product.

Coastal Atlas Glossary Tool

<http://www.coastalatlantool.net/glossary/>

Audience: Contributors, Public, Planners

The Coastal Atlas Glossary Tool is primarily a Contributors tool, but as with any tool that contributes value to the overall OCA, the glossary itself benefits any user of the atlas who encounters an unfamiliar word or term of coastal science or policy.

The tool is very simple in form, essentially presenting a contributor to the atlas with two methods for linking any word in their content pages to a centralized coastal glossary. Contributors using the tool simply follow instructions for how to embed their preferred type of glossary links into their HTML pages and ensure that the links point to the appropriate definition. The most common implementation is via a link that results in a

small pop-up window containing the word, definition, and definition source citation. The central glossary itself was compiled from a variety of public sources, and contains over 1000 definitions. Contributors can add new definitions to the central glossary simply by emailing the OCA Project Team.

Coastal Atlas Bug Reporting Tool

<http://www.coastalatlant.net/glossary/>

Audience: Contributors, anyone else that spots a bug!

The Coastal Atlas Bug Reporting Tool is primarily a Contributors tool, originally implemented in the beta-testing phase of the Atlas as a way to centrally report all the quirky items that contributors and testers encountered while playing with the system as the project took form. As with any networked web-based project, the “under construction” light could be perennially lit above our URL, and hence the continued relevance of this tool.

The tool works as a simple database input form, requesting that users enter information about the offending page, the particulars of the problem they saw, and relevant information about their particular operating system environment in case this proves to be a contributing factor in the manifestations of the bug. Upon submitting the form users are thanked and shown a list of the most recent bugs submitted to confirm that their finding has been successfully registered. On the back end, Atlas project partners can view the lists of bugs submitted and take appropriate action to remedy the identified problem. The database archive of submitted bugs becomes a record of improvements and progress in the overall OCA effort.

Conclusion

Technologies such as GIS could make it easier for resource managers, planners, scientists and even elected officials to process and use different sources of information. However, the current process of integrating such technology into daily activities is typically carried out in a different manner from locality to locality, which results in a vast array of system choices and further complicates data sharing on a regional or coast-wide level. This makes development and application of tools that can integrate data sets and increase efficiency more important.

Effectively sharing data means more than just the ability to download a file. Many data sets and analytical tools available on the web are underused, and thus do not fulfill their potential for advancing research. One primary reason for this situation is unfamiliarity of investigators with the methods required to use the web-based tools and data sets. The research presented has addressed issues in the development and use of analytical tools for *web*-based data, an area that has been underutilized. We have built a broad suite of decision-specific tools to facilitate both access to and use of data by local level resource managers and scientists and the public, using the web as the common gateway interface for access. These tools need to be continually adapted so that they serve different levels of needs according to user community. For example, a hazards tool for the general public will be quite generic in its input and outputs, while one for planners is much more sophisticated (enabling queries such as in the Erosion Hazard Suite), while one serving the explicit needs of scientists must entail the highest levels of intricacy. All should draw from and operate off of the same data archives, however, but to varying levels of complexity in interaction. In the continued evolution and adaptation

of tools, one user community that is extremely important is the contributor community, those with new, emerging tools and relevant data sets. The infrastructure of the OCA is built upon a foundation of tools that facilitates continued contribution and feedback from the Oregon coastal management and GIS communities.

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Related Web Sites

Ecotrust : <http://www.ecotrust.org/>

InfoRain: Ecotrust's Bioregional Information System for North America's coastal temperate rain forest, <http://www.inforain.org>

Minnesota Mapserver: <http://mapserver.gis.umn.edu/>

NOAA Coastal Services Center <http://www.csc.noaa.gov/>

Oregon Ocean-Coastal Management Program: <http://www.lcd.state.or.us/coast/>

OSU Geosciences, Davey Jones Locker Lab: <http://dusk.geo.orst.edu/djl/>

PISCO: Partnership for Interdisciplinary Studies of Coastal Oceans,

<http://www.piscoweb.org/>

Writing for the Web, John Morkes and Jakob Nielsen,

<http://www.useit.com/papers/webwriting/>