2012 CRLC Open Coast Beach Data Collection, Analysis, and Archiving to Support Coastal and Marine Spatial Planning

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Photo by Andrew Stevens

Nearshore Bathymetry Survey

During the weeks of 16 July2012, 13 August 2012, and 16 November 2012 Oregon State University, with assistance from the US Geological Survey and the Washington State Department of Ecology, performed nearshore bathymetric surveys along the outer coast beaches of the Columbia River Littoral Cell (CRLC) (Figure 1) using the Coastal Profiling System (high-speed maneuverable personal water-craft (PWC) equipped with an echo-sounder and Global Positioning System, see Figure 3). The complete 2012 CRLC survey coverage is shown in Figure 2. Each survey was performed with at least 2 PWCs, ranging up to 3 PWCs depending on available personnel and equipment. The monitoring program served as part of the Southwest Washington Coastal Erosion Study (SWCES) project in which the aim was to assess the long-term viability of coastal evolution, processes, and geomorphology within the Columbia River Littoral Cell (CRLC). The surveys also provide annual estimates of sediment transport throughout the two littoral cells, highlighting areas of morphological change and quantifying the influence of human interventions on sediment transport apparent throughout the extent of archived data. The primary goals of this report are to provide data that will serve in developing a regional-scale understanding of the coastal processes and their associated shoreline changes over a variety of temporal and spatial scales throughout the CRLC to facilitate future land use planning and resource management decisions.

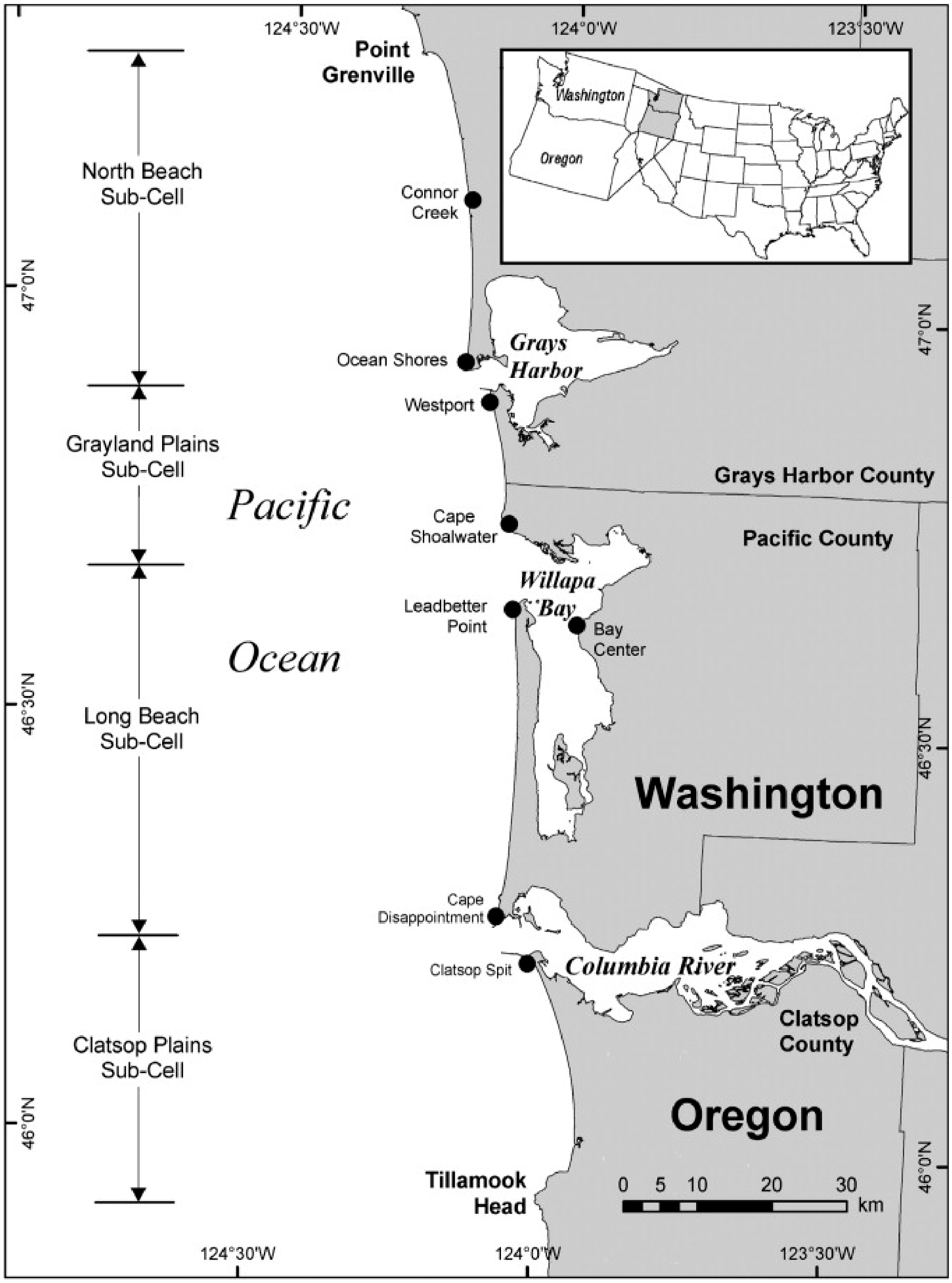

Figure 1) Map of the Columbia River Littoral Cell, showing the division of the four subcells in which the Southwest Washington Coastal Erosion Study focuses. Bathymetry and Topography data are collected along various extents of each subcell within the CRLC.

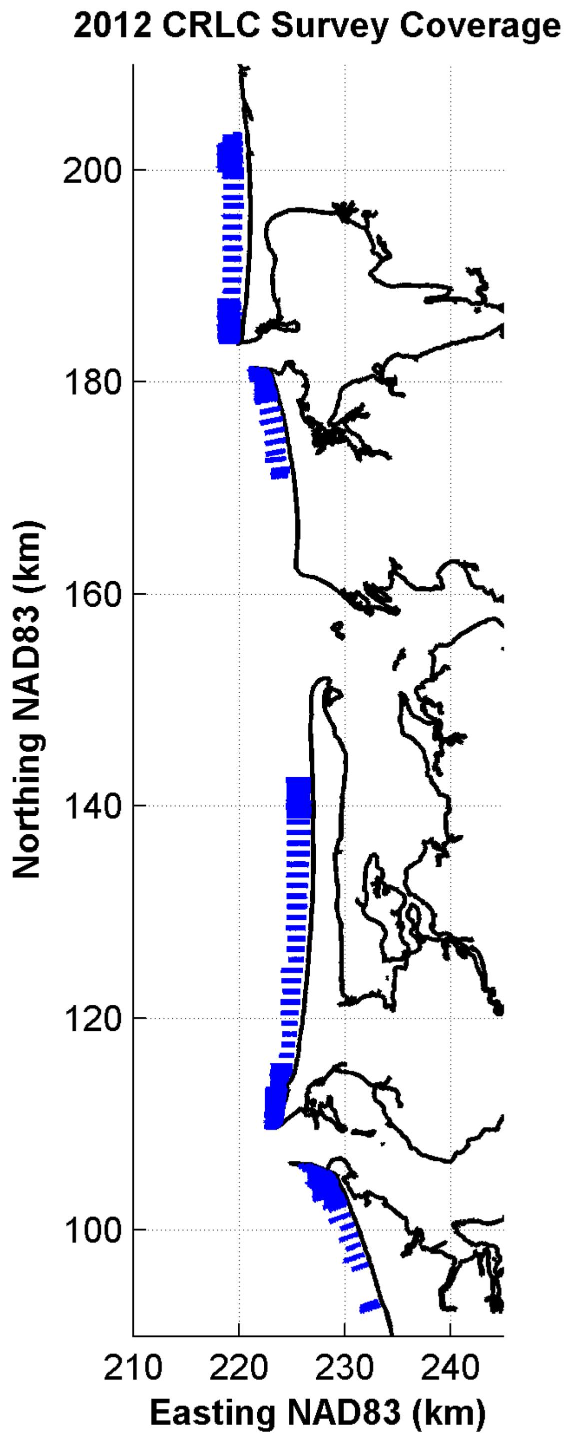

Figure 2) CRLC nearshore bathymetry (blue) and topographic (red) survey profiles collected in the 2012 within each of the four defined subcells.

Table 1. The 2012 CRLC survey participants and their affiliations.

Participant	Responsibility	Affiliation
Peter Ruggiero	Chief Scientist	Oregon State University
Jeff Wood	Faculty Research Assistant	Oregon State University
Karl Schmidt	Undergraduate Research Assistant	Oregon State University
Diana Di Leonardo	Graduate Research Assistant	Oregon State University
Katy Serafin	Graduate Research Assistant	Oregon State University
Nick Cohn	Graduate Research Assistant	Oregon State University
Michael Berry	Graduate Research Assistant	Oregon State University
Jantine Rutten	Research Intern	NW Research Associates
Guy Gelfenbaum	Chief Scientist	U.S. Geological Survey
Andrew Stevens	Oceanographer	U.S. Geological Survey
Josh Logan	Geographer	U.S. Geological Survey
George Kaminsky	Chief Scientist	Wash. State Dept. of Ecology
Heather Baron	Coastal Scientist	Wash. State Dept. of Ecology
Diana McCandless	Coastal Scientist	Wash. State Dept. of Ecology
Rebecca Sexton	Field Technician	Wash. State Dept. of Ecology

Field Equipment and Data Quality

The Coastal Profiling System (CPS), mounted on a Personal Watercraft (PWC), consists of a single beam echo sounder, survey grade GPS receiver and antenna, and an onboard computer system running Hypack hydrographic survey software (Figure 3). This system is capable of measuring water depths from approximately 0.5m to approximately 50m. The survey-grade GPS equipment to be used in this project have manufacturer reported RMS accuracies of approximately ±3cm + 2ppm of baseline length (typically 10km or less from the base station) in the horizontal and approximately ±5cm + 2ppm in the vertical while operating in Real Time Kinematic (RTK) surveying mode. These reported accuracies are, however, additionally subject to multi-path errors, satellite obstructions, poor satellite geometry, and atmospheric conditions that can combine to cause a vertical GPS drift that can be as much as 10cm.

While the horizontal uncertainty of individual data points is approximately 0.05m, the CPS operators cannot stay “on line” in waves and currents to this level of accuracy. Typically, mean offsets are less than 2.0m from the preprogrammed track lines and maximum offsets along the approximately 2km long transects are typically less than 10.0m. While repeatability tests and merges with topographic data collected with an all-terrain survey vehicle or a backpack rover unit suggest sub-decimeter vertical accuracy, significant variability in seawater temperature (~10 degrees Celsius) can affect depth estimates by as much as 20*cm* in 12*m* of water. However, water temperatures usually remain within a few degrees of the temperature associated with the preset sound velocity estimate of 1500 *m/s* and attempts are made to correct for variations in sound velocity depending on environmental conditions. Therefore, a conservative estimate of the total vertical uncertainty for these nearshore bathymetry measurements is approximately 0.15*m*.

For more information regarding equipment, field techniques, and data quality please refer Ruggiero et al., 2005 and Ruggiero et al., 2007.

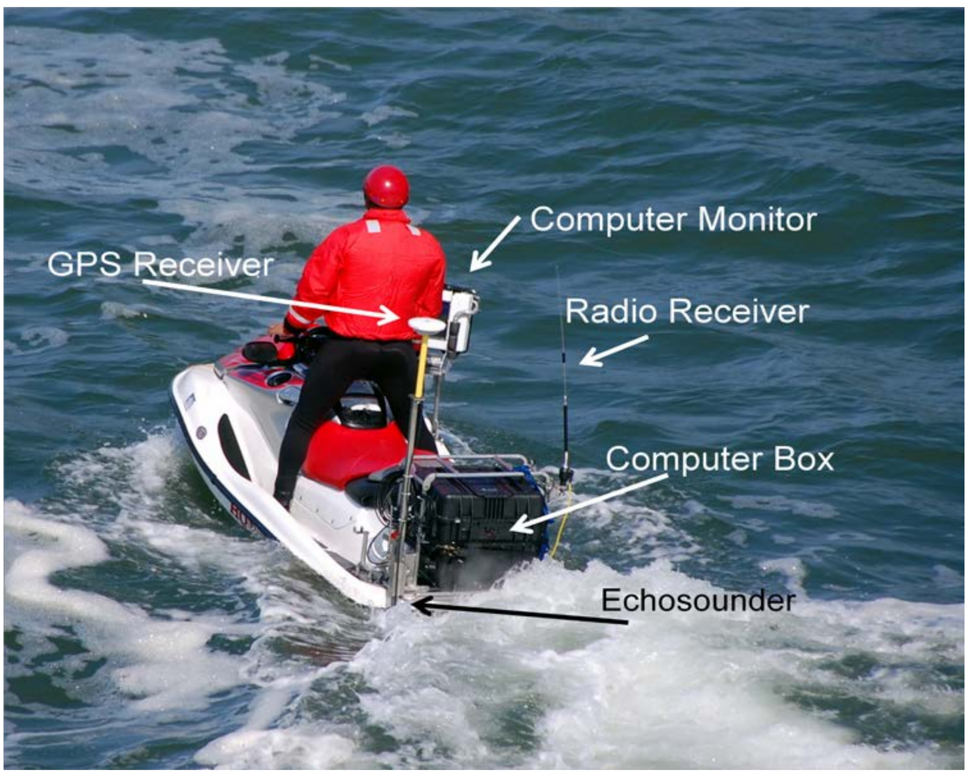

Figure 3) Data acquisition vessel and onboard equipment.

Data Processing and Archiving

Our survey data was collected in the horizontal datum Washington State Plane South, NAD83 (m) and the vertical datum NAVD88 (m) using the Southwest Washington Coastal geodetic control network, a series of monuments providing RTK measurements relative to a base station positioned on a geodetically measured landmark.

Data processing was carried out using the Matlab script *transectViewer.m* developed by Andrew Stevens from the US Geological Survey in coordination with Peter Ruggiero of OSU. This code loads and displays the digitized data files and allows the user to navigate through the data and perform appropriate filtering and smoothing. Echosounder digitized depths can be compared to the raw acoustic backscatter signal, collected by the echosounder, to ensure accuracy of the data and proper digitization of the bottom profile. Obvious bad, or noisy, data due to echosounder dropouts or poor returns can be easily eliminated from the data record, which is common while collecting data in shallow depths. Various smoothing operations can be applied to eliminate scales of morphological variability below which the user is not interested. Small variations in depth measurements due to the pitch and roll of the CPS vessel from wave activity are also eliminated through data smoothing. Due to the high quality of the raw data only very moderate smoothing was performed (10 point median average, Figure 4).

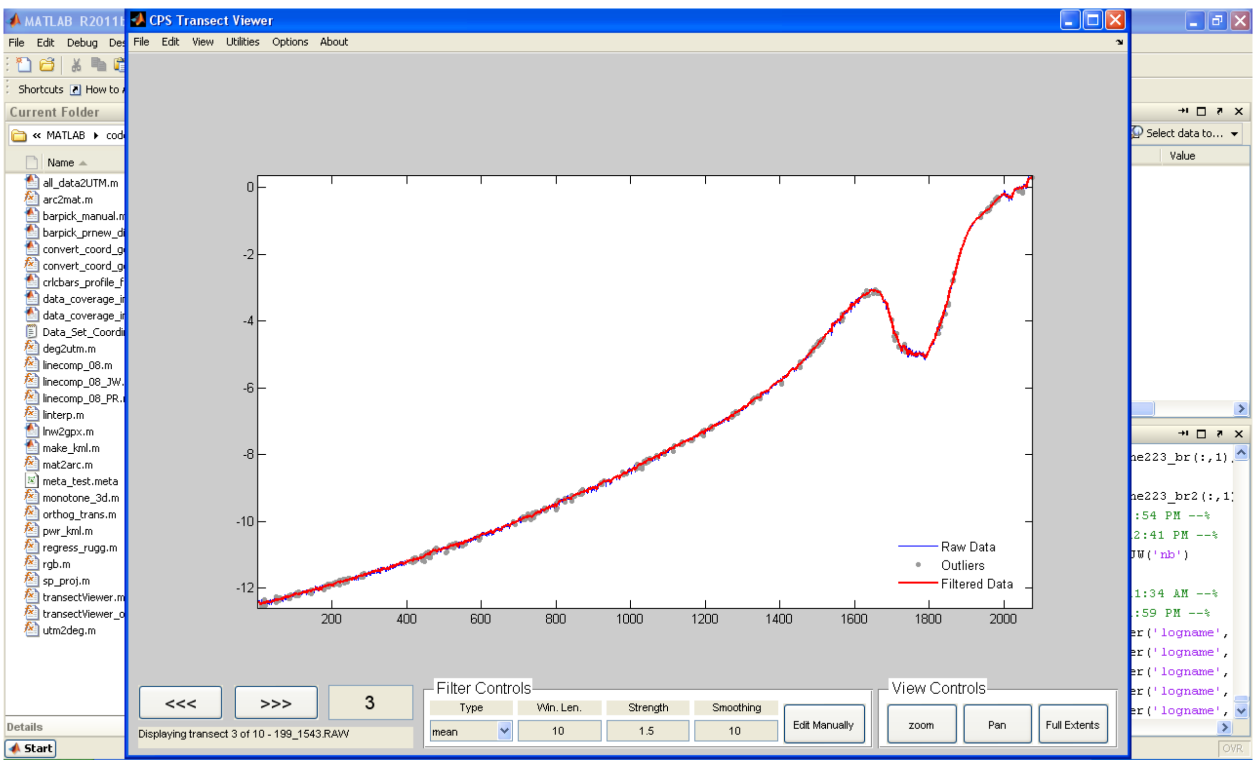

Figure 4) Example profile collected off of the study region displayed in transectViewer.

Nearshore Bathymetry and Topography

In order to maximize coverage of each transect, bathymetric profiles were collected during high tides while topographic profiles were collected during low tides. Surveying in the summer months during spring tides allowed the largest degree of overlap between the bathymetric and topographic profiles for each line collected. Figures 5 and 6 show typical merged nearshore bathymetric and topographic profiles from different subcells within the study region. Figures 7, 8, 9, and 10 show maps of the bathymetric and topographic measurements collected during individual surveys for each of the subcells within the CRLC.

Figure5) Example cross-shore transect in Long Beach (above). Bathymetric profiles are plotted as a solid line and topographic profiles are plotted as a dashed line with diamond shaped markers. A close-up view of overlapping bathymetric and topographic profiles is provided (below).

Figure6) Example cross-shore transect in North Beach (above). Bathymetric profiles are plotted as a solid line and topographic profiles are plotted as a dashed line with diamond shaped markers. A close-up view of overlapping bathymetric and topographic profiles is provided (below).

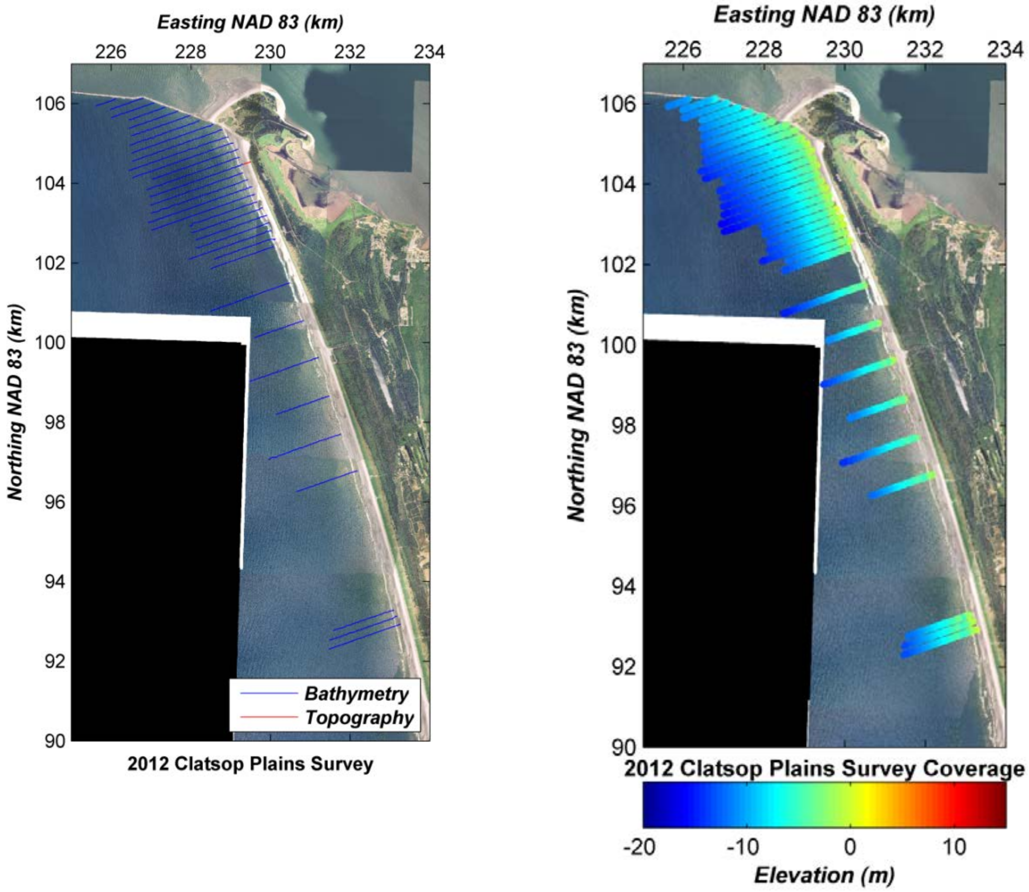

Figure7) (LEFT) Aerial image of the Clatsop subcell with bathymetric and topographic measurements collected during the 2012 Clatsop Plains survey. (RIGHT) Processed elevation data collected during the survey are shown in the panel at right. Elevations are reported in meters and the vertical datum is NAVD88.

Deliverables

CRLC survey data are provided in 2 folders bathy and topo for each of the 4 subcell locations. Bathymetry data is provided in four different formats within the ‘bathy’ folder: the ‘GoogleEarth’ folder contains Google Earth files (.kml) for each transect collected; the ‘InfoBank’ folder contains text files (.txt) with elevation data reported corresponding to geographic coordinates; the ‘Meta’ folder contains spreadsheet style metadata files (.meta) with various information for each individual transect; the ‘output_fin’ folder contains ASCII text files (.xyz) with the final elevation measurements reported corresponding to the state plane coordinates in which the data were collected.

The naming format for bathymetric data is lb12_line###_b.xyz for the Long Beach subcell, and cp12_line###_b.xyz for the Clatsop subcell, gp12_line###_b.xyz for the Grayland Plains subcell, and nb12_line###_b.xyz for the North Beach subcell. The naming format for topographic data is lb12_line###_t.xyz, cp12_line###_t.xyz, gp12_line###_t.xyz, and nb12_line###_t.xyz respectively. “###” corresponds to the three digit transect number for each profile collected. Each transect file, in the ‘output_fin’ folder for bathymetry and the ‘topo’ folder for topography, is composed of 3 columns of data: Eastings, Northings, and elevation (depth in meters) with reference to NAD 88 (m) in the horizontal and NAVD 88 (m) in the vertical.

References:

Ruggiero, P., Eshleman, J., Kingsley, E., Kaminsky, G., Thompson, D.M , Voigt, B., Kaminsky, G., and Gelfenbaum, G., 2007. Beach monitoring in the Columbia River littoral cell: 1997-2005., U. S. Geological Survey Data Series 260.

Ruggiero, P., Kaminsky, G.M., Gelfenbaum, G., and Voigt, B., 2005. Seasonal to interannual morphodynamics along a high-energy dissipative littoral cell, *Journal of Coastal Research*, 21(3), 553-578.