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Editorial

ISPRS journal of photogrammetry and remote sensing theme issue "remote sensing of the coastal ecosystems"

Coastal areas, by virtual of their position at the interface between truly terrestrial ecosystems and aquatic systems, belong to the most dynamic and important ecosystems on Earth (Yang et al., 1999). They are also the foci of human settlement, industry, and tourism. Large coastal population and intense development are exacerbating environmental stress and degradation of the coastal ecosystems, thus placing an elevated burden on organizations responsible for the planning and management of these highly sensitive areas (Hobbie, 2000; National Research Council, 2000; Burke et al., 2001).

Coastal ecosystem management involves the procedure of monitoring that is based on a reliable information base. Conventional field-based survey and mapping methods are still vital but often logistically constrained. Because of its cost-effectiveness and technological soundness, remote sensing has increasingly been used to develop useful sources of information supporting decision making as related to many coastal applications (Yang, 2005a). But the coastal environment, because of its complex and dynamic landscapes, challenges the applicability and robustness of remote sensing. Encouragingly, recent innovations in data, technologies, and theories in the wider arena of remote sensing have permitted scientists with invaluable opportunities to advance the studies on the coastal environment.

Within the above context, a theme issue on coastal remote sensing seems to be timely. This issue is the second focus issue on the coastal ecosystems published by a major remote sensing journal within recent years. The first one was published by the *International Journal of Remote Sensing* (Yang, 2005b), and highlighted the remote sensing research conducted by scientists affiliated to the Estuarine and Great Lakes Program, jointly funded by the US Environmental Protection Agency and NASA. The current issue showcases some of the latest research on coastal remote sensing with seven major research papers selected from the submissions in response to an open call for contributions. It seeks to contribute to the following major aspects: coastal water quality; benthic habitat mapping; bathymetry, shoreline erosion, and coastal morphologic change; and coastal wetland mapping and change detection.

The first article is authored by Kabbara et al., and represents a continued effort in deriving empirical algorithms to estimate chlorophyll-a concentration, Secchi disk depth and turbidity of coastal waters from Enhanced Thematic Mapper Plus (ETM+) imagery. They conducted a field campaign to collect *in situ* water quality data from 45 locations in the coastal area of Tripoli, Lebanon within six hours before or after the Landsat 7 overpass on 27 March 2003. The logarithmically transformed sea-truth data were used as the dependent variables and the logarithmically transformed image bands as the independent variables in their multivariate regression models. They found that the combination of spectral and spatial resolution of the ETM+ data was valuable for coastal water quality monitoring, which can potentially help to derive a national database; they also detected a moderate level of eutrophication conditions along most of the shoreline in their study site.

Lucieer and Pederson investigated fine-scale lobster movement pattern in relation to morphometric characterization of rocky reefs derived from a seabed digital terrain model (DTM). Their two study sites were in eastern Tasmania, Australia, and the DTMs were created by using bathymetric data collected with a single beam acoustic depth sounder in combination with a differential Global Positioning System (DGPS) receiver.

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By measuring the slope and curvature, each cell in the DTMs was classified into one of the six landform feature classes: peak, ridge, pass, plane, channel, and pit. Lobsters were tagged using acoustic transmitters and tracked using a radio acoustic positioning system, and the lobsters' home range was estimated by using a kernel-based method. By relating the home range data with the landform classification, they found that lobsters established home ranges in areas with high habitat complexity, most likely for shelter from other predators and to utilise the diversity of prey items available. Their findings will not only help improve the prediction of habitat preferences of individual species but also help design future marine protected areas.

To support coastal morphologic change characterization, Brzank et al. proposed an improved workflow that is particularly suitable for DTM production from LIDAR data in coastal lowlands under strong tidal influence. Their study site was in the Wadden Sea, a unique coastal habitat formed by the permanent influence of semidiurnal tidal currents; water often remains within tidal channels and depressions even at low tide. Because of the poor water penetration capability, point clouds acquired by near infrared LIDAR contain a mixture of ground and water surfaces, which makes standard DTM generation workflow less effective. The proposed DTM production workflow contains two core components: water point classification and structure line detection. By using feature height, intensity and 2D point density, LIDAR measurements from the water surface were detected through supervised fuzzy classification; structure lines were extracted through a piecewise reconstruction of the surface from the LIDAR data with a hyperbolic tangent function. These two components as the backbone of this proposed workflow were found to considerably improve the accuracy of DTM production from LIDAR data in their test area.

Miller et al. demonstrated the use of LIDAR data as a control surface, enabling robust registration of archival photogrammetric datasets and subsequent assessment of coastal geohazard activities. The conventional method for multi-temporal dataset registration requires the use of physical control points that are difficult to obtain in the coastal environment due to its dynamic nature. To overcome this problem, Miller et al. developed a least squares surface matching technique deriving control directly from digital elevation model (DEM) surfaces. Central to this technique was the incorporation of a robust estimation function allowing the effects of surface discrepancies to be mitigated through outlier handling. They applied this matching method to test sites along the eastern coast of England. Photogrammetric DEMs were approximately oriented before matching to control surfaces generated from higher order datasets, including LIDAR-derived DEMs. The least squares surface matching technique was found to significantly outperform ordinary surface matching. This surface matching method has been quite effective for exploitation of the archival datasets, which revealed extensive geohazard activities over a period of 20 years; robust matching of the LIDAR-generated DEMs also enabled the quantification of short-term geohazard activities in their study sites.

Addo et al. report their effort to quantify historical and future shoreline erosion in an area where reliable historical shoreline position data are scarce. Their study site was in the coast around Accra, Ghana, where uncertainties, due to the inconsistence in reported erosion rates, have undermined the police formulation toward sustainable coastal management. Spanning a period of nearly 100 years, their data included a bathymetric map obtained by using planetable surveys and echo sounding and three topographic maps generated by using photogrammetric methods. The shoreline position on the most recent map was verified with GPS-based field surveys, and used as a reference to measure the planimetric positional errors for three other maps. Historical shoreline changes were further quantified along some transects through linear regression. By using historical change data, future shoreline changes in the next 250 years were projected through both process-based modelling and geometric approaches; uncertainties associated with the input data were also accounted for, including historical change rate and sea-level rise under different climate change scenarios. Their study indicates that reliable statistical information on past and future shoreline changes can be derived when a suitable predictive model is selected and the uncertainties involved when working with limited datasets are appropriately dealt with.

Slatton et al. investigated the scattering behaviour of coastal marshes, as related to climatic and tidal conditions, by synthesizing polarimetric Synthetic Aperture Radar (SAR) and LIDAR data. Their study sites were along the Texas portion of the Gulf of Mexico, and consisted of herbaceous salt marshes and vegetated upland flats. By using a LIDAR-derived DEM and climatic and tidal measurements, changes in the multi-polarization SAR responses over a three-year period were related to specific scattering models in the marsh. They found that the variations in polarization preference of herbaceous marshes were more pronounced than those observed over upland areas. They also found that succulent halophytic plants in the high marsh responded strongly to tidal inundation but only mildly to climatic factors such as average daily temperature; on the contrary, the response of non-succulent halophytic plants in the low marsh was quite sensitive to climate. Their findings are potentially useful for the interpretation of multi-temporal SAR data over coastal wetlands.

The last paper included in this theme issue is authored by Conchedda et al., and presents a continued effort to investigate the utility of object-based approaches for mangrove mapping and change detection. Their study site was in Low Casamance, Senegal, and the primary data used were two years of multispectral SPOT scenes spanning two decades. The object-based method for mangrove mapping was based on the use of multi-resolution segmentation and class-specific rules incorporating both spectral and spatial properties at different hierarchical levels; different classes of land cover within the mangrove ecosystems were clearly separated from the SPOT scenes with good overall accuracy and very high user and producer accuracies for the mangroves class. Both the post-classification comparison and an object-based approach were used to quantify the change of the mangrove class; the former used the two classified maps and the latter was based on the determination of transition classes using a nearest neighbour classifier from the output of a regional-growing segmentation on a two-year composite of the SPOT scenes. They found that the post-classification comparison outperformed the object-based method in detecting unchanged mangrove areas; the object-based method was able to capture the general changing pattern quite well but not some scattered patterns of the mangrove class. This suggests that further research is needed to improve change detection of fragmented patterns in the mangrove ecosystem.

Collectively, these papers report some of the most exciting development of remote sensing and related geospatial technologies for the characterization, analysis, and modelling in the coastal environment. We hope the remote sensing and geospatial communities continue such efforts that will eventually help improve our knowledge of the coastal ecosystems; this knowledge is deemed as critical for managing and protecting these sensitive areas.

Needless to say, the publication of this theme issue was a team effort from many different parties including contributing authors, manuscript reviewers, and editorial staff, among others. We wish to express our special thanks to Professor George Vosselman, Editor-in-Chief of the *ISPRS Journal of Photogrammetry and Remote Sensing*, for providing us this rare opportunity to showcase some of the latest coastal remote sensing research. We would like to thank all of those who contributed papers, those who revised their papers one or more times, and those who contributed their time, talents and energies to manuscript review that helped improve the scholarly quality of papers.

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