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Nov 17th, 2:50 PM - 2:55 PM

Field Expedient Water Level Measurements to Support the Exploitation of Hyperspectral Imagery (Extended Abstract)

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1. Introduction

The Remote Sensing Division at the Naval Research Laboratory has conducted several recent coastal studies to assess shallow water bathymetry in remote coastal locations [1] and [2]. Fundamental to exploiting hyperspectral imagery (HSI) along various coast types was the measurement of waves, tides, and nearshore processes. Understanding waves and currents was especially important since these factors are important contributors to the development of cliffs, dunes, wetlands, scarps, beach gradients, shoreline shape, and surf zones. These example coast type features are considered in designing remote sensing campaigns and in exploiting HSI. Also, understanding water level fluctuations helps with flood control and identifying trafficability changes associated with very narrow changes in elevation. For these reasons, calibration and validation data included the measurements of meteorological (wind speed and direction) and oceanographic (waves and tides) parameters in synchronization with the collection of airborne HSI.

2. Method

For these types of coastal studies a buoy was constructed and deployed to measure water levels at various sites within the study area (Fig. 1). The buoy was constructed from a frame of PVC piping filled with floatation material and a wooden base for positioning of a kinematic GPS unit. The primary payload consisted of an Ashtech® Z-Xtreme™ dual-frequency GPS receiver to measure water level fluctuations with centimeter scale accuracies. The GPS unit was located inside a water tight plastic container while the receiver was positioned on top of a wooden base above the container. A GPS base station was erected and deployed on the shore, which allowed differential corrections to be made with the "kinematic" or mobile GPS receiver. Buoy water level time series are then used to de-tide hydrographic surveys, to tide-synchronize images, and to determine retrieved water levels referenced to a vertical datum.

3. Results and Conclusions

The resultant buoy-derived water levels were of sufficient resolution to help calibrate and evaluate the accuracy of airborne HSI. The GPS data was also used to bring topographic data, such as beach profiles measured with a kinematic GPS, into a common reference frame. Geodetic and water level information were integrated to produce imagery-derived bathymetric charts. Data from this buoy is essential to the study of waterlines, developing tidal flat digital elevation models, and making imagery-derived soundings for very shallow water charts

Figure 1. Water level buoy off a volcanic sand beach in the Mariana Islands. This manually deployed water level buoy was used to accurately determine water levels at the time of imaging.

4. References

[1] Bachmann, C.M., M.J. Montes, R.A. Fusina, C. Parrish, J. Sellars, A. Weidemann, W. Goode, C. R. Nichols, P. K. Woodward, K. McIlhany, V. Hill, R. Zimmerman, D. Korwan, B. Truitt, and A. Schwarzschild, 2010, Bathymetry Retrieval from Hyperspectral Imagery in the Very Shallow Water Limit: A Case Study from the 2007 Virginia Coast Reserve (VCR'07) Multi-Sensor Campaign, Marine Geodesy, Volume 33, Issue 1, pages 53 – 75.

[2] Bachmann, C. M., C.R. Nichols, M.J. Montes, R.-R. Li, P.K. Woodward, R.A. Fusina, W. Chen, V. Mishra, W. Kim, J. Monty, K. McIlhany, K. Kessler, D. Korwan, D. Miller, E. Bennert, G. Smith, D. Gillis, J. Sellars, C. Parrish, A. Weidemann, W. Goode, A. Schwarzschild, and B. Truitt, 2009, Airborne Remote Sensing of Trafficability in the Coastal Zone. *NRL Review*, Washington, D.C.: Naval Research Laboratory, pages 223-228.