

From whence we've come and where we may be going

Larry Mayer
Professor and Director
Center for Coastal and Ocean Mapping /NOAA Joint Hydrographic Center
University of New Hampshire
Durham, N.H. USA 03824

I have been asked to speculate on where our field may be heading. In light of the long history of seafloor mapping, we have come a remarkable way in a very short time. After 4000 years of seafloor mapping with variations of lead lines, acoustic systems became common after the Second World War. Since the introduction of multibeam sonars to the general public about 40 years ago we have seen rapid advances in sonar technology along with concomitant advances in positioning systems, motion sensors, computer processing and data visualization. Within the context of the Shallow Survey conferences, a comparison of the systems used for Shallow Survey 2001 to those used Shallow Survey 2012 sets the scene for the trends of the future. The trends are clear. In 2001 there we saw the introduction of focused sonars with a clear distinction between beam-forming multibeam sonars and multi-row phase-measuring sidescan systems. All of the systems used had relatively narrow bandwidths, single sectors, and single swath ping cycles. Now we have broadband systems that can chirp or operate at multiple frequencies. The distinction between phase measuring and beam-forming systems is disappearing and we now have multiple sectors and multiple swaths per ping cycle. Acquisition systems can now easily handle data rates of many megabytes per minute and some systems are doing the processing on the sonar (wet) end. Since 2001 we have greatly enhanced editing and cleaning algorithms, evolved to grid-based data products and can attribute bathymetric products with uncertainty. Backscatter processing tools are also being developed that may, with improved understanding of the behavior of the sonar and the effects of the environment, someday provide quantitative seafloor characterization and monitoring. Most exciting is our ability to now capture water column data opening up worlds of opportunities for hydrographic and other applications. Along with these improvements in data rates, bandwidth, data density, etc., have come remarkable advances in our ability to display and interact with these data sets in three and four dimensions.

These trends will continue – always limited by the laws of physics – but there is still much room for improvement. Military needs will drive the development of better and broader-band transducers and with the bandwidth will come not only increased temporal resolution but the ability to put more pings in the water (in several directions) allowing much higher data density. Increased bandwidth and multi-frequency operation offers a new and yet untapped dimension for seafloor characterization. Synthetic aperture approaches will be applied to multibeam sonars. Software defined sonars will provide much greater flexibility and the ability to dynamically adapt to changing conditions or situations. New tools will be developed that automatically detect problems with data collection and perhaps even

offer suggestions for their solution. One of the most serious constraints on high-quality data collection today is often our ability to capture environmental (temp and salinity) changes at needed resolution. New approaches (both sensors and analyses) for defining the temporal and spatial variability are required and these need to be integrated directly into acquisition tools. Simultaneous mapping of the water column and the seafloor will greatly increase survey efficiency allowing the collection of multiple data sets (fisheries, seafloor and oceanographic) during a single survey. New software tools will be developed that will integrate and fuse these and other data sets in real-time producing an interactive 4-D environment and will offer the user unprecedented views of complex process and, with the addition of an analytic layer, the potential for addressing key scientific, engineering, management or policy questions.