

AIRBORNE LASER HYDROGRAPHY II

ACKNOWLEDGEMENTS

The Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) is acknowledged for its leadership role in airborne coastal mapping and charting and for creating a community of practice through its annual technical workshop that directly led to writing this book. JALBTCX is a partnership between the US Navy Meteorology and Oceanography Command's Naval Oceanographic Office, the National Oceanic and Atmospheric Administration, the US Geological Survey, and the US Army Corps of Engineers. Through 20 annual workshops (so far!) national and international government representatives, academics, lidar manufacturers, and lidar survey companies have a forum to meet one another, evolve topo/bathy lidar and ancillary technologies, and grow the global airborne coastal mapping and charting market. This compendium of worldwide knowledge is possible only through the JALBTCX collaboration and community.

Dr. William Philpot, the co-authors, and the reviewers Yves Pastol, Shachak Pe'eri, Michael Starek are acknowledged and thanked for their many hours and selfless contribution to share their knowledge and lessons learned, which makes this book so valuable. Without everyone's hard work and dedication, this book could not have been written.

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FOREWORD

Gary Guenther

What is a Foreword? I guess it's typically a brief summary of the content to come. If that's true, then this should honestly be called a Backword, because you can read this new book for yourselves. I'd like to give you some background on how the original came to be. I believe in history and in people. Why are you reading this? I like to think it's because a fairly small number of dedicated people started something good a long time ago, and it is continuing today with fairly broad acceptance and support in the survey community. Given that this is a rather arcane topic, you, as a reader, are probably also a participant, contributing your interest, your labor, and hopefully your love.

This is the 32nd anniversary of the 1985 publication of the original Blue Book (a.k.a. "Airborne Laser Hydrography: System Design and Performance Factors"). It's actually a 385-page NOAA Professional Paper that I was able to get published under hard (navy blue) covers (as well as a second run of sky blue soft covers). Now you know why it's just called "The Blue Book"! Honestly, I wrote it as much for myself to refer to, as a memory device, as for anyone else. It's filled with ideas and equations and data and systems and experimental results and analyses, but if you look at the voluminous references, you can easily see that it's really about the people – the pioneers, at U.S. Navy, NASA, WRE Salisbury, NOAA, and Optech Inc., who dared to think out of the box and act. That was important to me, and it still is.

Let's begin with a little perspective here. Some of you reading this were probably not even born then! I began writing the Blue Book in 1981 – the same year the IBM PC was released to the public. I wrote it on a dedicated, table-sized word processor with an 8" floppy drive for storage. And don't you just love all those hand-drawn graphics? If I'm not mistaken, NOAA's on-board survey computer software at that time was still loaded from paper tapes! The first Nd:YAG laser was designed and demonstrated at Bell Labs in 1964, only 12 years before I started playing -- and I was a newbie, far from the first!

Those were exciting times. I would be remiss in not mentioning some of the original source material I learned the trade from. The U.S. Navy were "working with lasers" in the mid-1960s, virtually as soon as they were invented. That was very interesting reading – with particular kudos to the work done at NADC/Warminster. Dan Hickman did work at Syracuse University, specifically for bathymetry, in the late 60s. I spent many hours poring over Dan's subsequent SPARCOM reports from the early 70s of tank tests and thoughtful design criteria for ALB systems. I actually still have them in my files. In 1973, NASA Wallops sponsored a Symposium on the use of airborne, pulsed lasers for bathymetry and fluorosensing. I read every word of that many times. This was the basis for the 1975 design of the Airborne Oceanographic Lidar (AOL), subsequently built by Avco Everett. In Canada, in 1974, Optech, Inc. was created by Prof. Allan Carswell of York University and his grad student, Sebastian Sizgoric, and they started testing lasers and building systems with sponsorship from the Canada Centre for Remote Sensing. Down Under, things were also busy in the mid-70s at WRE Salisbury, forming the basis for WRELADS II and, subsequently, LADS. At NOAA, LCDR Lowell Goodman set up Workshops in 1975 and 1976 (labeled as First and Second, thereby relegating the 1973 NASA Workshop to 'Zeroth'). And that's where I entered the picture myself. It changed my life forever.

In 1976, I was working in a little techie enclave in NOAA's National Ocean Service created by Maurice (Mo) Ringenback. High tech for us was acoustics and radio positioning. But we wanted more. As noted above, one of my colleagues, Lowell Goodman, had spent some time at NASA Wallops where, purely as an aside, he met Frank Hoge and his AOL crew and came back with amazing tales of measuring water depth from aircraft. Who knew? I can still hear Mo's voice, as if it were yesterday, when he came back to my cube and asked: "Gary, what happens when light goes through water?" In all honesty, absurd

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bravado, and colossal ignorance, I said, “Give me a few hours.” I picked up my pen and started drawing pulses and writing equations on a piece of paper. (What, you wanted me to use my Post Versalog slide rule or my brand-new HP-35 hand calculator? Seriously?) The rest is history. Needless to say, instead of a couple hours, I was still working on it 30 years later, and it’s still an area of active research today, as you know if you’re reading this.

Recognizing how “under water” I was, I asked Bob Thomas, then of Wolf Research (soon to be bought out by EG&G) for some help, which was the start of one of those “beautiful friendships”. Bob’s Monte Carlo work is one of the main features in the Blue Book. Bob, I couldn’t have done it without you. Thank you! You are the best!

The bulk of the content in the original Blue Book was based primarily on my relationships with two systems: NASA’s AOL and the U.S. Navy’s Hydrographic Airborne Laser Sounder (“HALS”, then being built at Avco Everett after their success supplying the AOL). In 1977, NOAA and the U.S. Navy (via the newly-formed NORDA at Stennis) funded a survey of the brand-new AOL in Chesapeake Bay, for which I wrote the Field Test Plan. Heady times. That was great fun. In processing that data (day and night for many months, even analyzing the oversized outputs from the high-speed printers on my pool table at home), I was able to recognize two major, independent depth biases (tricky devils!) that are based purely on physics – surface uncertainty (flip flop), and propagation-induced pulse-stretching effects. The latter led to analytic approximations and then the Monte Carlo propagation simulations written by Bob Thomas. This was certainly part of the answer to Mo’s original question! These results were originally reported at the 4th Symposium in 1980 in Salisbury, SA, and they got some attention! That was a real blowout (“a bursting of a container by pressure of the contents”) conference with a huge number of papers, where the origins of much of what we take for granted today were first published. Get a copy of it – it will put a smile on your face, for all the obvious reasons.

Algorithm development was pressed by the needs of HALS, which, as described in the Blue Book, was originally designed to report accurate depths in the air in real time with a hardware processor. The biases changed that and forced us to find better, more accurate ways of processing with software on the ground. And what a ride that was! Basic software design concepts generated for HALS data processing were the basis for the subsequent SHOALS “Brown Book” ground-based waveform processor and the “Green Book” airborne processor. Colors are so much easier than formal names! The point is that it all began with the algorithm analyses -- precision and accuracy studies --reported in the Blue Book.

In terms of the hardware, we were constantly pushing hard, working a bit beyond the boundaries of available technology, and were concerned about things like the performance capabilities and limitations of detectors, digitizers, lasers, and scanners. Sound familiar? Some things never change. I am proud of the fact that most of the information in the original Blue Book is still valid, even though some of it has been outdated by the advance of technology, which has thankfully come a long way, baby!

Even after the successful AOL surveys, NOAA wouldn’t build a system (up-front costs were too much for them, regardless of the ultimate operational payoffs), but they knew they should have access to one somehow, when the time came, so they supported my continuing work in this field. I owe the faith and resources invested in me in these critical years, by several understanding NOAA bosses, for my ability to complete the original volume.

Ultimately, after Bob and I worked on a shipboard positioning project for 18 months in the mid-80s, during a bit of a lull in ALB, serendipity won out. Shortly after the Blue Book came out, I was contacted by a brash young dude in the Army Corps of Engineers from Vicksburg, MS who claimed he not only *wanted* to build a new airborne lidar hydrography system but thought he could actually *do* it (with my help, of course). I believed in him, and the rest is SHOALS history. Thanks for the great ride, Jeff, and Paul and all.

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I stopped working and contributing over ten years ago (yes, some days I really do miss it, but my head is now filled with wood art), so I am not up to speed on all the new hardware and politics (yes, the politics was always there), but at the 2016 JALBTCX Workshop (my 40th anniversary in this field), I was both happy to see some faces I was familiar with, and encouraged to see so many young people participating and contributing. We got it off to a good start, and on it goes.

I was very encouraged at the 2016 Workshop to see so many impressive, fascinating things happening. But a word of caution: I was also concerned to see that some things may be being underserved for commercial purposes. Caveat Emptor. The hardware and software may change, but the physics doesn't.

I want to sincerely thank Bill and all the contributors to this new volume, from concept to fruition, who have put into it their force of will, time, energy, insights, perseverance, and passion. These are the spirits of the original. It's really nice to see how far we have come and what you have achieved. This book is full of exciting stories. I am honored, and I honor you, in turn.

I've had casual opportunities to reexamine my life and to recognize those forks in the road that forever changed who I was and who I have become. I would enjoy seeing some of those other outcomes, just for fun, but I've enjoyed this road thoroughly. Professionally, it's because of our ALB community at large -- the people I've worked with directly and indirectly, colleagues and competitors alike, and the successes we've shared and continue to have.

I wish I could personally thank and acknowledge, in these lines, each and every person (you know how I love references) that I worked with or taught (be it in a trailer, a university classroom, or a hotel lobby with a bottomless bourbon in my hand), but that is obviously not possible. You know who you are. I have a long memory; I know who you are.

Passages: Sebastian, Mike, Peter. Too soon.

It's undoubtedly not proper to dedicate a Foreword, even if it's a Backword, but with Bill's kind permission, I want to devote this brief look back at where we came from to my great friend, our friend, Sebastian Sizgoric -- for many reasons, but mainly because of his large love of life, his laugh, his questions, and how he made it all so much fun for those around him. It was real. We miss you. Cheers.

Turn the page, enjoy, and make your own history.

Gary C. Guenther
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March 2017