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INTRODUCING

The most advanced solution for Airborne Hydrography

CZMIL nova

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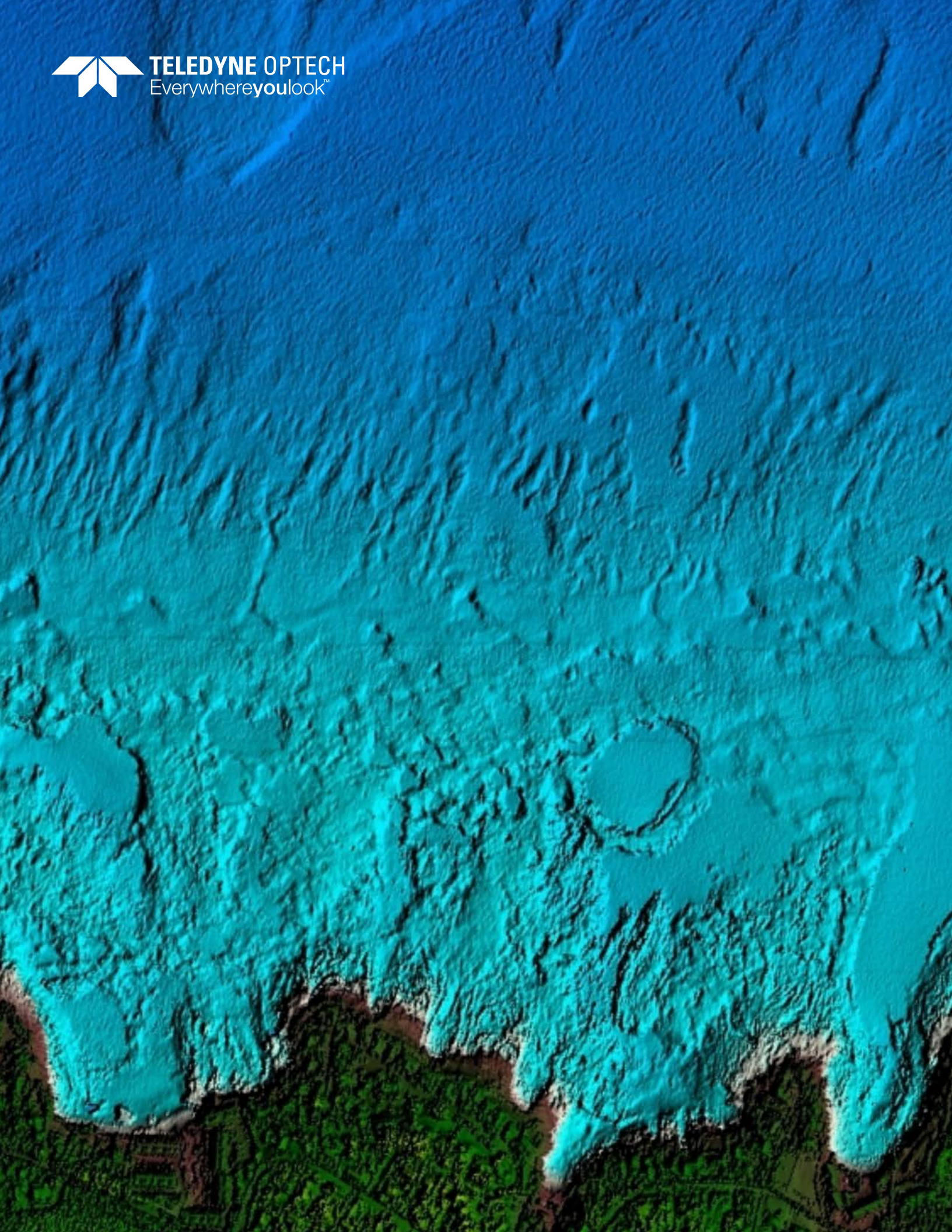

CZMIL Nova: Compact Redesign for Additional Efficiency and Versatile Operation

The Optech CZMIL Coastal Zone Mapping and Imaging Lidar is a breakthrough airborne multi-sensor system designed for highly automated generation of 3D topo/bathy information for coastal zones, especially in turbid and muddy water conditions. Building on Teledyne Optech's highly successful SHOALS program and over 25 years of industry-leading lidar expertise, CZMIL is the only airborne bathymetric system tested against military specifications such as shock, vibration and EMC, and validated and in use by multiple government agencies to map coastal areas on a regular basis.

Now Teledyne Optech continues its leadership in lidar bathymetry with the CZMIL Nova, which packages significant improvements to the original highly acclaimed CZMIL design and software in:

- Laser efficiency
- Performance
- Serviceability and durability
- Computer efficiency
- Size, weight and power (SWAP)
- HydroFusion processing features.

A smaller, lighter, lower-power consumption system that operates more efficiently with simplified maintenance – and fits in smaller aircraft for a more versatile and mobile deployment.

Figure 1: CZMIL Nova

Survey in Smaller Aircraft and Helicopters

The redesigned CZMIL Nova opens up bathymetric lidar surveying to new markets and new applications. No longer limited to aircraft such as the Beechcraft King Air B200, the compact and efficient CZMIL Nova opens up the use of the most advanced topobathymetry lidar system in smaller aircraft such as the Piper Navajo reducing acquisition costs by up to 58% and even helicopters. With a more flexible aircraft selection, you can significantly lower your operating costs and expand your range of operations, while keeping the same high level of performance.

The CZMIL Nova redesigns the Optech CZMIL with new versions of the operator rack, thermal management system and laser system, resulting in a system:

- Approximately 30% smaller and 25% lighter, with 15% less power required
- Simpler to install
- Easier to service and improved robustness

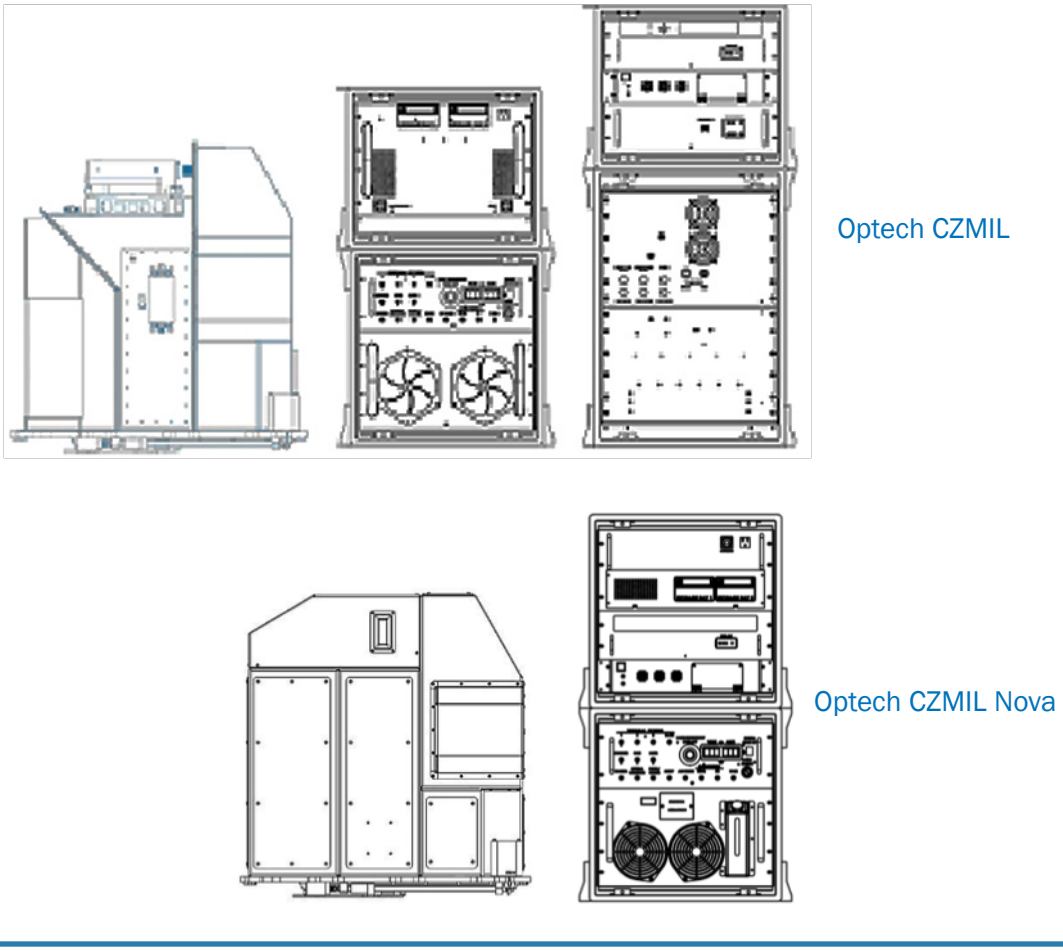

Figure 2: Smaller footprint with 30% more compact system

Operator Nova Operator Unit: Compact, lighter and more serviceable

Original

- The operator unit housed the three main CZMIL computers for system control, real-time operator feedback, and data storage, and included the gigabit Ethernet switch.
- Maintenance was time-consuming, as units had to be disassembled to be serviced.

Nova

- Three computers are incorporated into one high-performance Intel Core I7 computer.
- A smaller and more efficient gigabit Ethernet switch replaces the larger original switch.
- The new unit is lower by 2U and lighter by 7 kg.
- The new computer slides out from the front of the unit and can be replaced within minutes.

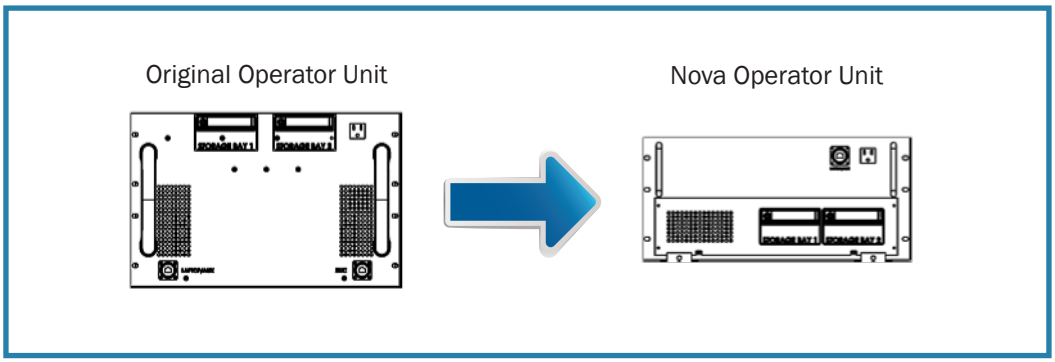

Figure 3: Single high-performance computer, easily accessible, in compact operator unit

Table 1: Comparison of original operator unit specifications vs. Nova operator unit

Operator Unit Specifications	Original Unit	Nova Unit
Size	7U	5U
Weight	28 kg (61 lb.)	21 kg (46 lb.)
Power consumption	154 W	154 W

CZMIL Nova Thermal Management System (TMS): 70% smaller and lighter, simpler and more durable design

The CZMIL TMS is a precisely controlled active Peltier element heating and cooling system capable of maintaining a constant coolant temperature to within ±0.1°C. The extraordinary improvements of the Nova TMS make it much more practical to operate CZMIL in helicopters and small aircraft.

Original

- Bulky system was required to manage the laser temperature.
- Three plumbing loops made system coolant leaks more likely.

Nova

- Advances in laser efficiency have reduced the number of liquid loops from 3 to 1. The simpler plumbing design reduces the potential for developing leaks.
- Size and weight are reduced by 70%, so that the TMS fits into a standard 6U rack while weighing only 26 kg (57 lb.).
- Power requirement is reduced by 25%.

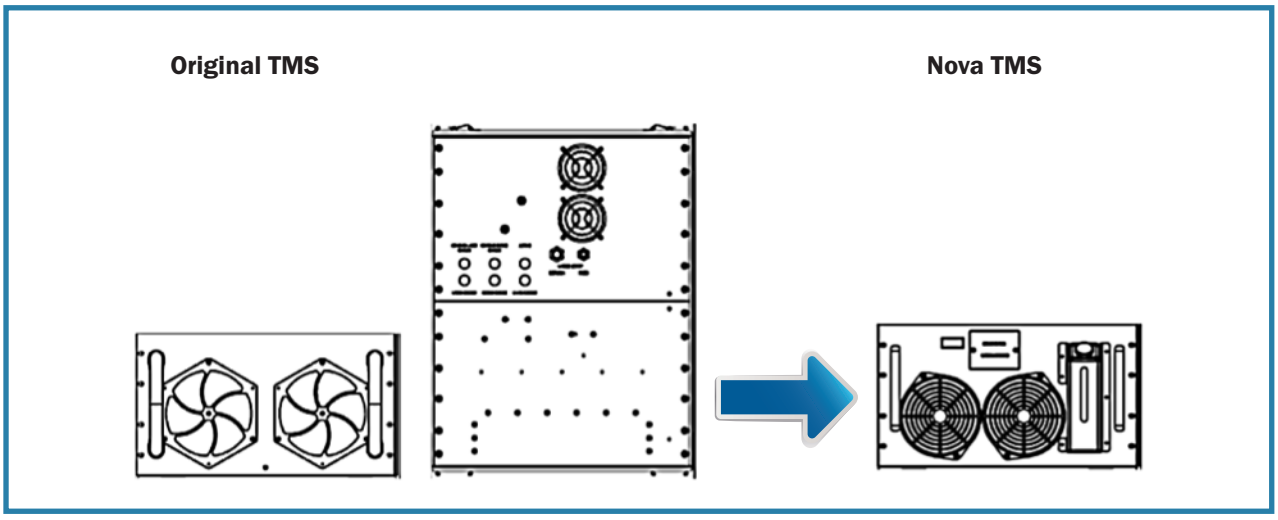

Figure 4: Compact, more efficient, and more durable thermal management system

Table 2: Comparison of original TMS specifications vs. Nova TMS

TMS Specifications	Original TMS	Nova TMS
Size (# of rack units)	20U	6U
Weight	83 kg (182 lb.)	26 kg (57 lb.)
Power consumption	1680 W	1260 W
Hydraulic loops	3	1
Cold warm-up time from 0˚C	60 minutes	15 minutes

Nova Laser: Single unit with simpler installation and improved pulse control

CZMIL uses a powerful Class 4 laser that produces very short pulses with a high power per pulse.

Original

- Two-piece design with a laser diode pumping rack unit and the laser head mounted on the CZMIL sensor head.
- During installation, laser fibers had to be connected carefully.

Nova

- Single enclosure incorporates the laser diodes in the laser head, which eliminates the rack-mounted unit completely.
- Laser fibers no longer need to be connected during installation, so the possibility of error disappears.
- Laser pulse parameters are more precisely controlled by the manufacturer in a single package.

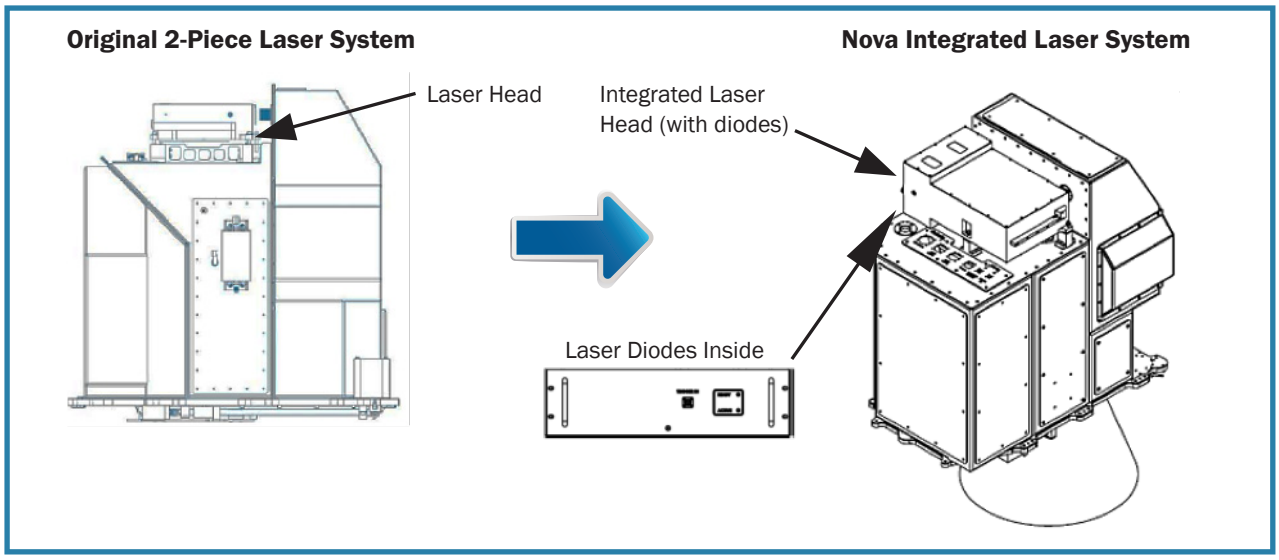

Figure 5: Single laser unit with simpler installation

Process Data and Imagery Faster and More Efficiently

Optech HydroFusion is a powerful end-to-end software suite that automatically produces high-resolution 3D data and environmental image products by combining data from three sensors—bathymetric lidar, hyperspectral imaging system and digital metric camera—within a data fusion paradigm. Optech HydroFusion includes mission planning, data processing and the generation of the final product in one easy-to-use interface.

HydroFusion 1.2

HydroFusion Ver 1.2 includes significant improvements that focus on faster processing, enhanced accuracy, and versatility:

- A robust surface detection tool accurately measures the water surface in non-ideal surface conditions, which improves the data coverage and point accuracy.
- An improved geo-calibrator tool handles the automatic geo-calibration and validation of lidar data.
- A new color balancing tool improves the color for camera image mosaics, delivering more accurate and useful imagery.
- Automatic spatial filters eliminate most data outliers in processing, which reduces the time needed for manual point cloud editing.
- For each shot, a range of valuable attributes is now stored along with the XYZ data. This metadata is easily accessed by a user query. For example, a point can be queried to determine why it was deleted during processing.
- An optimized tool downloads raw lidar data to the local workspace in <50% of the actual data collection time.
- Mission plans can now be imported from and exported to popular file formats such as ESRI SHP and Google KML files.

New Re-processing Feature Eliminates Near-shore Gaps

Automatic classification of land and water shots is standard for Optech HydroFusion, and with the new re-processing feature data gaps near the shoreline can be eliminated.

- In environments where automatic shoreline delineation is challenging, misclassified shots can be re-labeled and reprocessed on-the-fly.
- Highly valuable in the QA/QC process and is tightly integrated in the processing workflow.

The page that follows illustrates the results of re-processing.

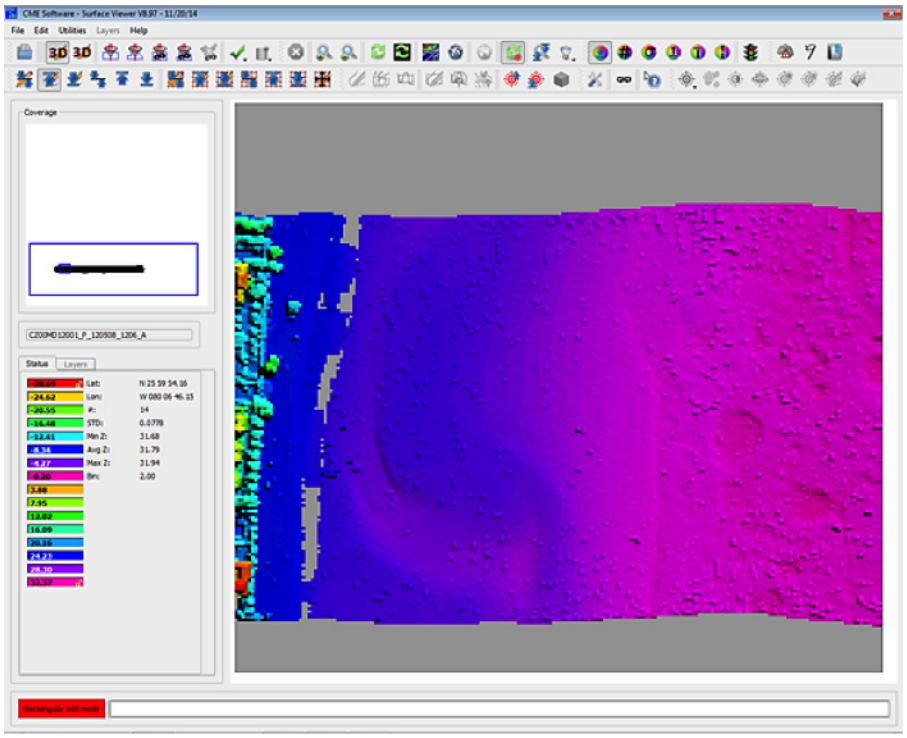

Figure 6: Before re-processing

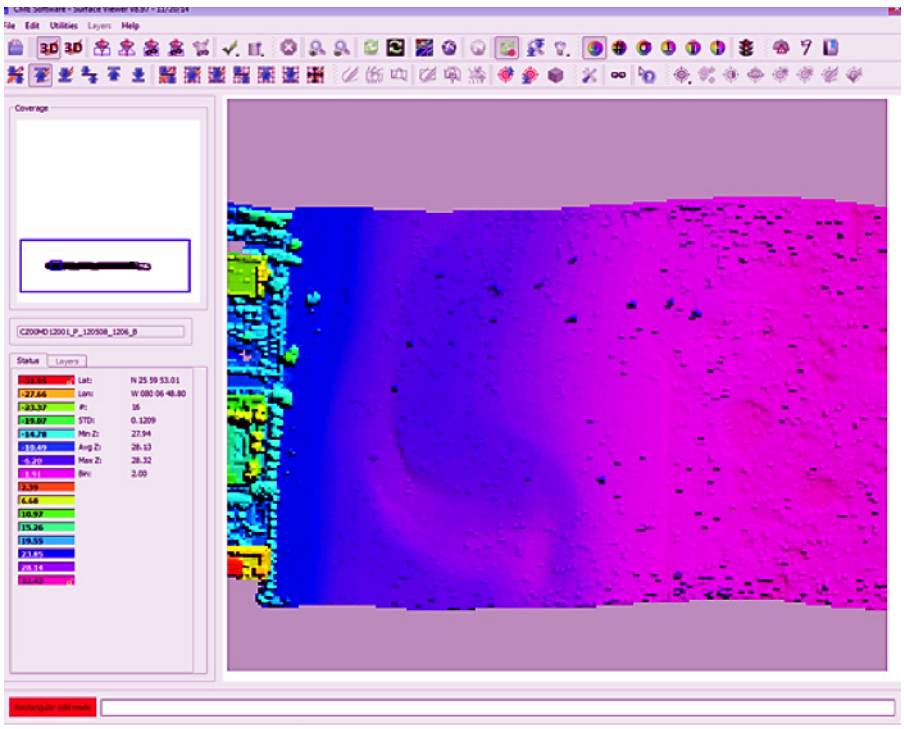

Figure 7: After re-processing

Surface detection tool: Improved data coverage and point accuracy

Original

- Lidar points from sea spray and other spurious returns were included in the data set.

HydroFusion 1.2

- Invalid points are automatically invalidated, which improves the surface and seafloor detection.

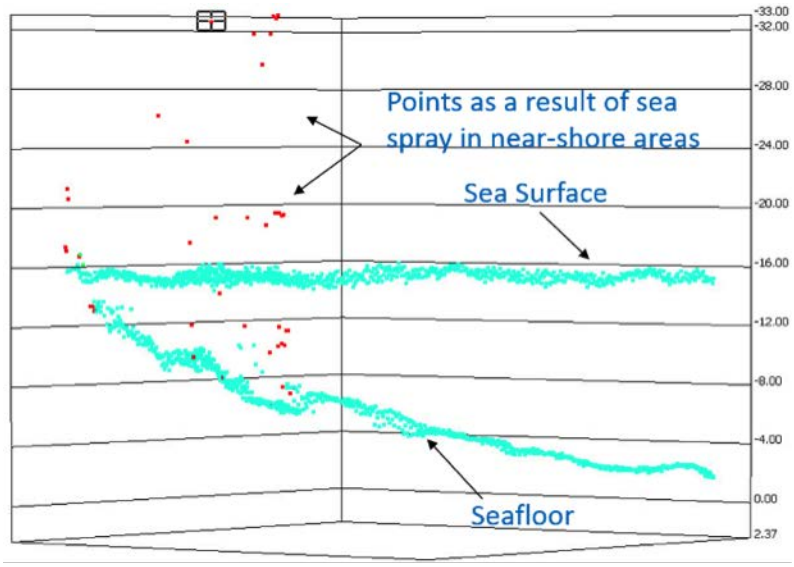

Figure 8: Original: Invalid lidar points are included in water surface measurements

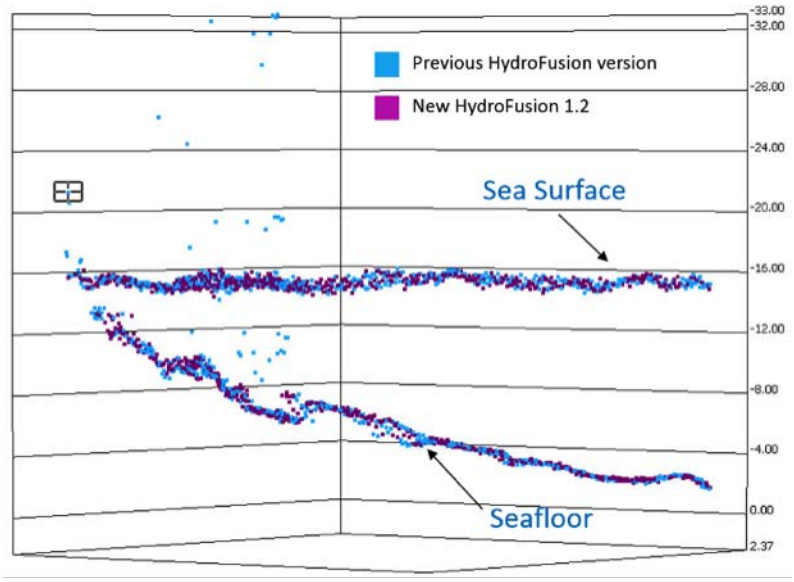

Figure 9: CZMIL Nova removes invalid points automatically

Geo-calibrator tool: Automatic validation and geo-calibration of lidar data

Original

- Variations among flight lines were common and required additional editing.

HydroFusion 1.2

- Geo-calibration is improved and automated, for faster processing with less effort.
- Automated calibration performance has been validated against ground truth data.

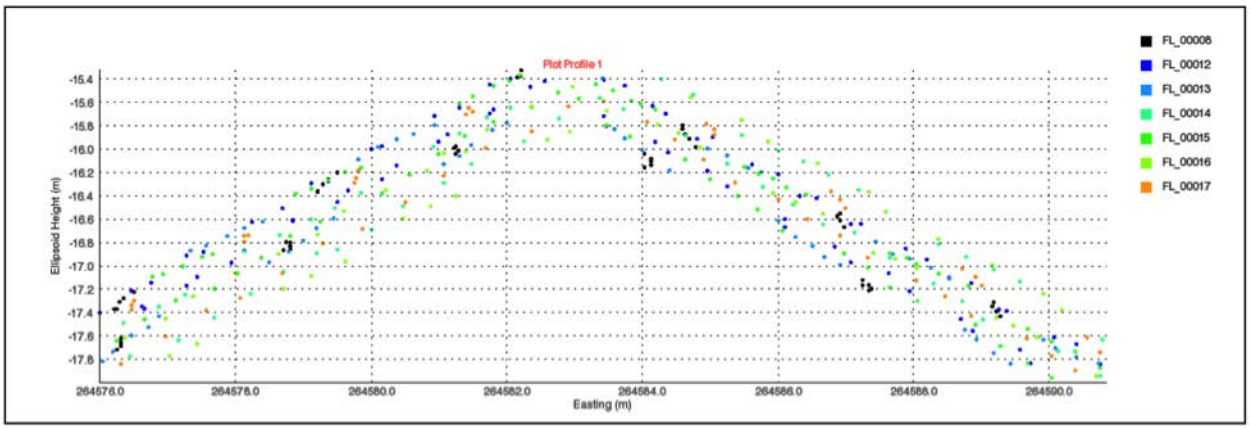

Figure 10: Uncorrected point cloud of points over a roof, colored by the flight line. Note the variations among the lines.

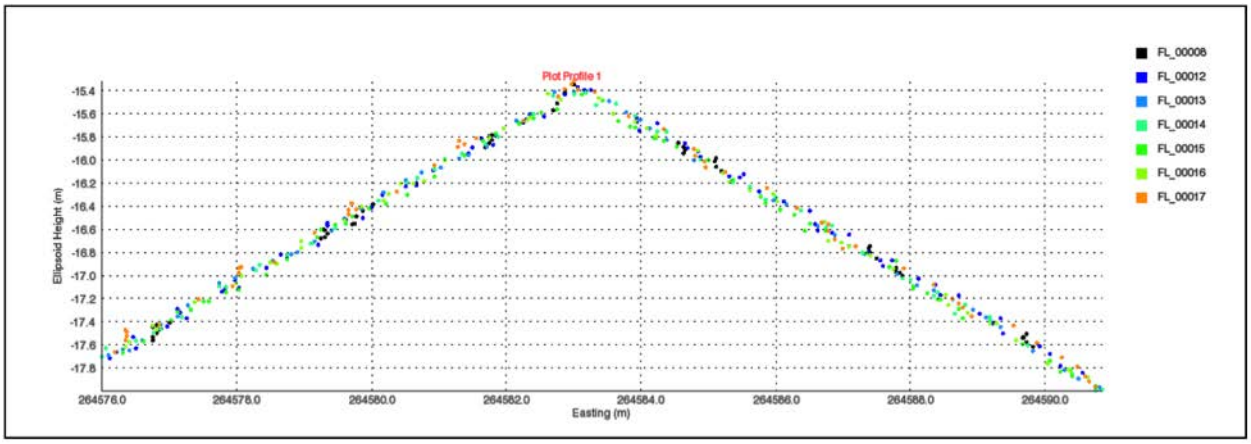

Figure 11: Automatically geo-calibrated points over the roof, colored by the flight line

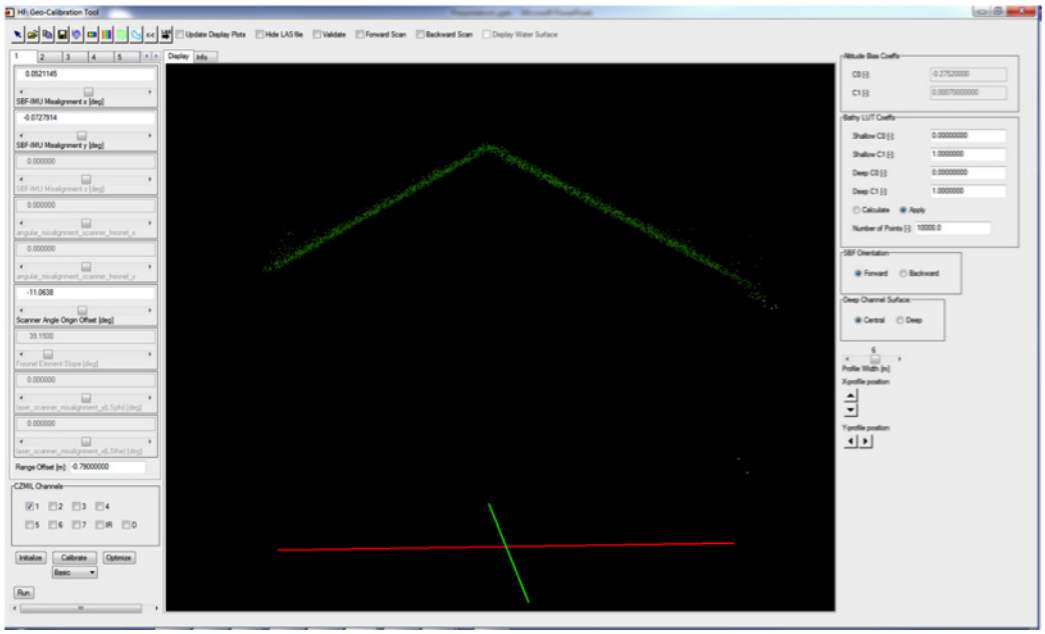

Figure 12: Automatically geo-calibrated point cloud in HydroFusion 1.2, showing improved agreement among flight lines

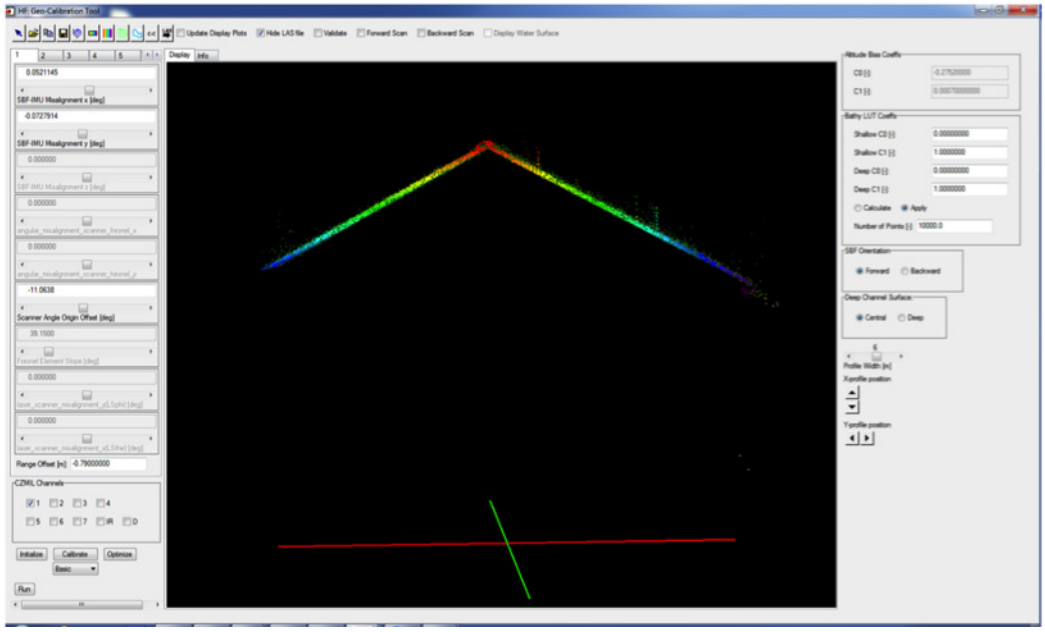

Figure 13: Automatically geo-calibrated point cloud overlaid with ground-truth data in HydroFusion 1.2, validating the calibration

Color-balancing tool: Improved balancing for more useful imagery

Original

- Color balancing was less efficient and required more operator intervention.

HydroFusion 1.2

- Enhanced color balancing improves image fidelity, leading to simpler and more accurate image mosaics.

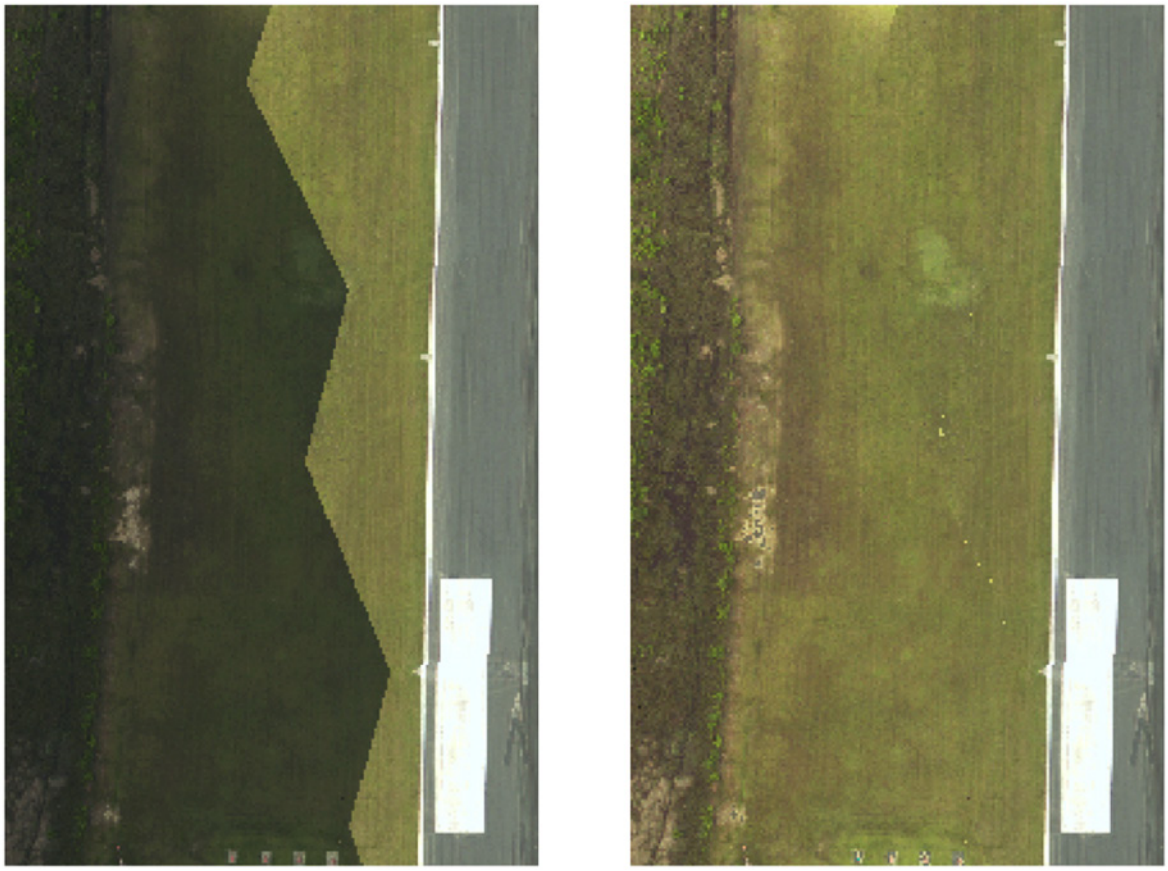

Figure 14: Example 1: Color balancing of image mosaics in HydroFusion 1.2, before balancing is applied (left) and after (right)

Figure 15: Example 2: Color balancing of image mosaics in HydroFusion 1.2, before balancing is applied (left) and after (right)

Turbid Water Module: Refined processing

Further improvements were made to HydroFusion's Turbid Water Module, a powerful tool that is specifically designed to detect and extract bathymetry measurements from turbid, shallow waters and muddy, less reflective seafloors.

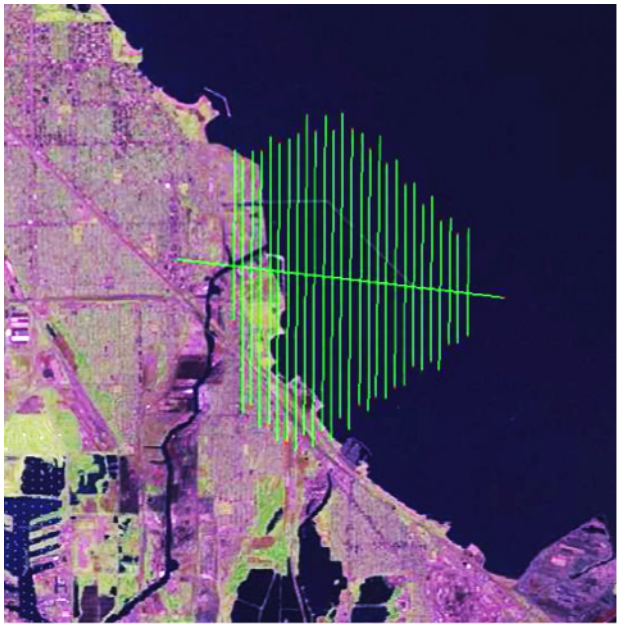

Figure 16: Calumet Harbor, Lake Michigan, 2012; survey area of 35 km²

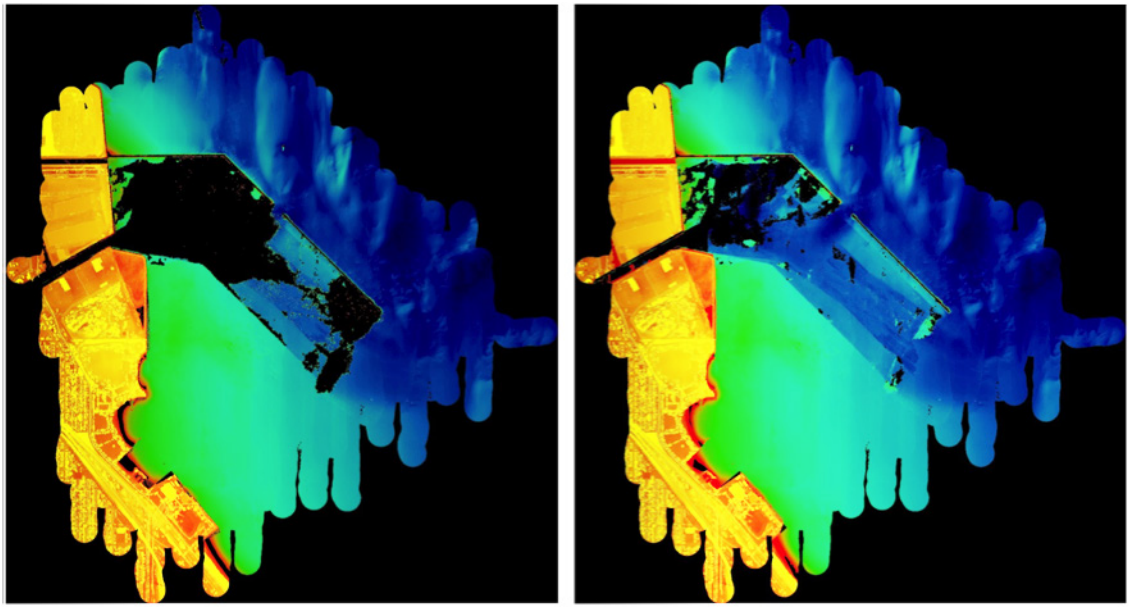

Figure 17: Survey area before processing with Turbid Water Module (left) and after processing (right)

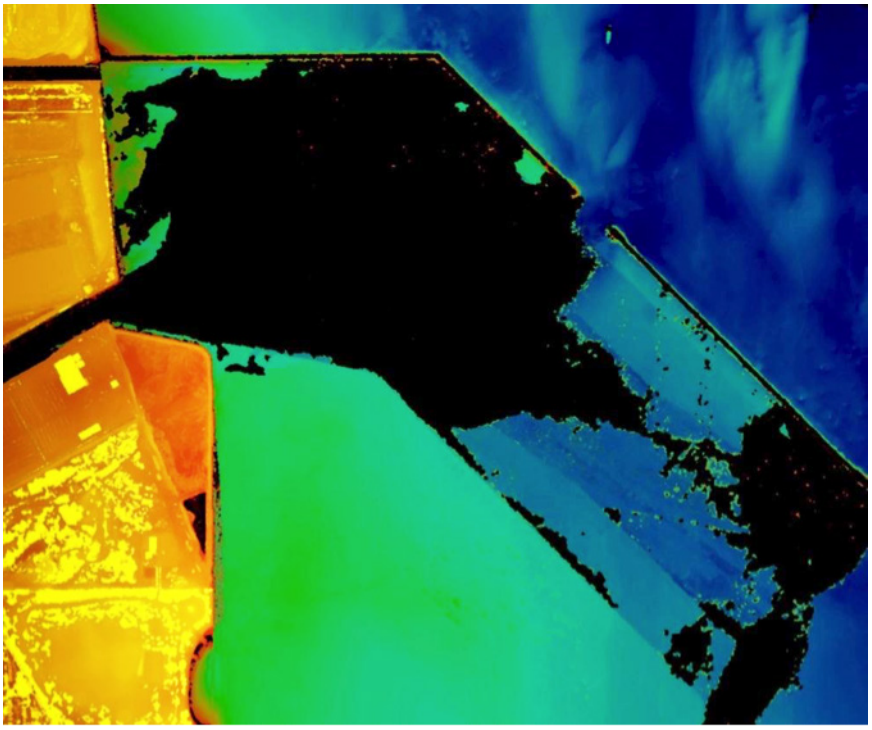

Figure 18: Close-up of problem area before processing with Turbid Water Module

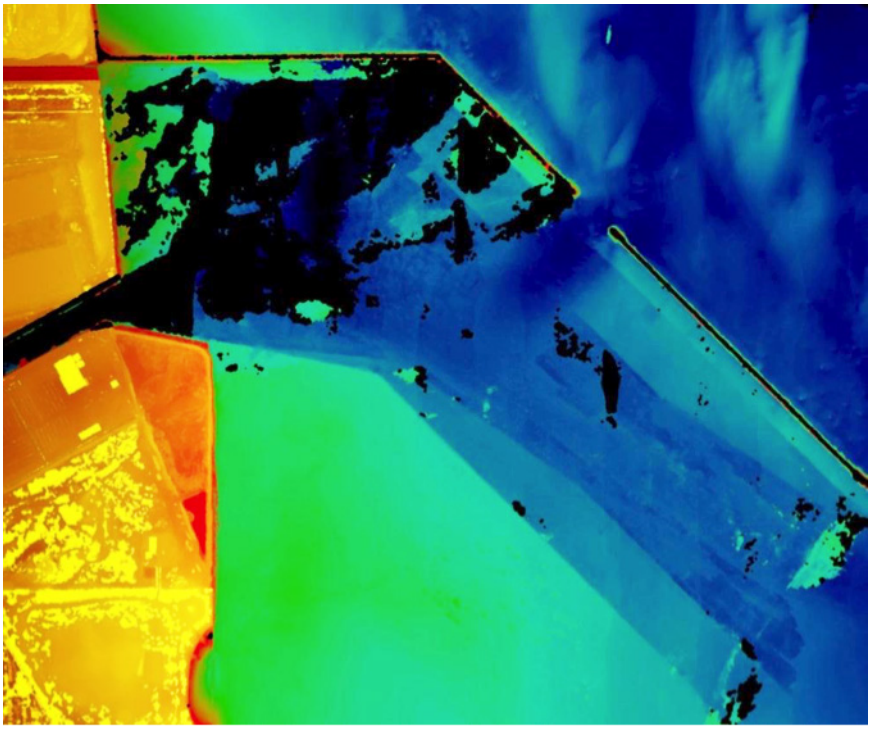

Figure 19: Close-up of problem area after processing with Turbid Water Module

Optech CZMIL Nova

Compact and Efficient Deployment

	Parameters	Specifications
General Specifications	Operating altitude	400 m (nominal), up to 1,000 m
	Aircraft speed	140 kts (nominal)
	Hyperspectral sensor	CASI-1500H
	Digital cameras	T4800i
	Positioning & GPS/GNSS	Applanix POS AV™
	Positioning system	OmniSTAR capable (subscription required)
Lidar Hydrographic Mode	Shallow channels measurement rate	70 kHz
	Shallow channels maximum depth	$2/K_d$ (bottom reflectivity > 15%)
	Deep channel measurement rate	10 kHz
	Deep channel maximum depth	$4.2/K_d$ (bottom reflectivity > 15%)
	Depth measurement accuracy	$\sqrt{(0.3^2+(0.013d)^2)}$ m, 2σ, 0 – 30 m
	Horizontal accuracy	(3.5 + 0.05d) m, 2σ
	Scan angle	20° circular
	Swath width	70% of operating altitude
	Laser classification	Class 4 laser product: IEC 60825-1 Ed. 3.0 2014
Lidar Topographic Mode	Measurement rate	80 kHz
	Horizontal accuracy	±1 m, 2σ
	Vertical accuracy	±15 cm, 2σ
Physical	Power requirements	85 A for Lidar/camera @ 28 VDC and 95A @28VDC with CASI
	Operating temperature	0°C to 40°C
	Storage temperature	-10°C to +60°C
	Humidity	0-95% non-condensing
	Sensor head	89 W x 60 D x 90 H cm; 175 kg
	Control & operations rack	59 W x 56.5 D x 106 H cm; 112 kg
	Data processing software	CZMIL HydroFusion (Windows-based)

Notes

The following computer specifications are recommended for CZMIL HydroFusion:

- 8 CPUs
- 32GB RAM
- 2 TB Hard drive
- 1 GB Graphic Cards with GPU
- Windows 7 or 8.1 - 64 bit OS
- ENVI/IDL 4.7
- 1 SSD reader

To meet its stated accuracy, CZMIL Nova must receive GPS data of sufficient quality. GPS data quality shall be viable only when all of the following conditions are met: At least 6 satellites are in lock (tracked by the receiver) throughout the survey. Elevation of the satellites is above 10°. Geometry of the satellites is good (PDOP <4). Aircraft stays within 30 km of the GPS base station.If one or more of these conditions is not met, or if any source of electromagnetic interference causes the GPS receivers to lose lock repeatedly, the specified accuracy of the CZMIL Nova system will be compromised.

Optech CZMIL Nova

Compact and Efficient Deployment

Further Information

Please contact the **Teledyne Optech Sales Manager** for your region. They will be glad to answer any questions you may have about the new **CZMIL Nova**. To find your **Regional Sales Manager**, please go to **www.teledyneoptech.com** and from the main menu select **Contact/ Sales & Representatives**, then select **Coastal & Marine Systems**.

You can also call **+1 228 252 1004** or send an email to: inquiries@teledyneoptech.com

Please specify "CZMIL Nova" in the subject line of your email

About Teledyne Optech

Teledyne Optech is the world leader in high-accuracy lidar 3D survey systems, integrated cameras, and productivity-enhancing workflows. With operations and staff worldwide, Teledyne Optech offers both standalone and fully integrated lidar and camera solutions in airborne mapping, airborne lidar bathymetry, mobile mapping, terrestrial laser scanning, mine cavity monitoring, and industrial process control, as well as space-proven sensors.

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