Lidar Data Integration for Nautical Publication and SDI Workflows – Common Issues and Experiences at NOAA and CHS

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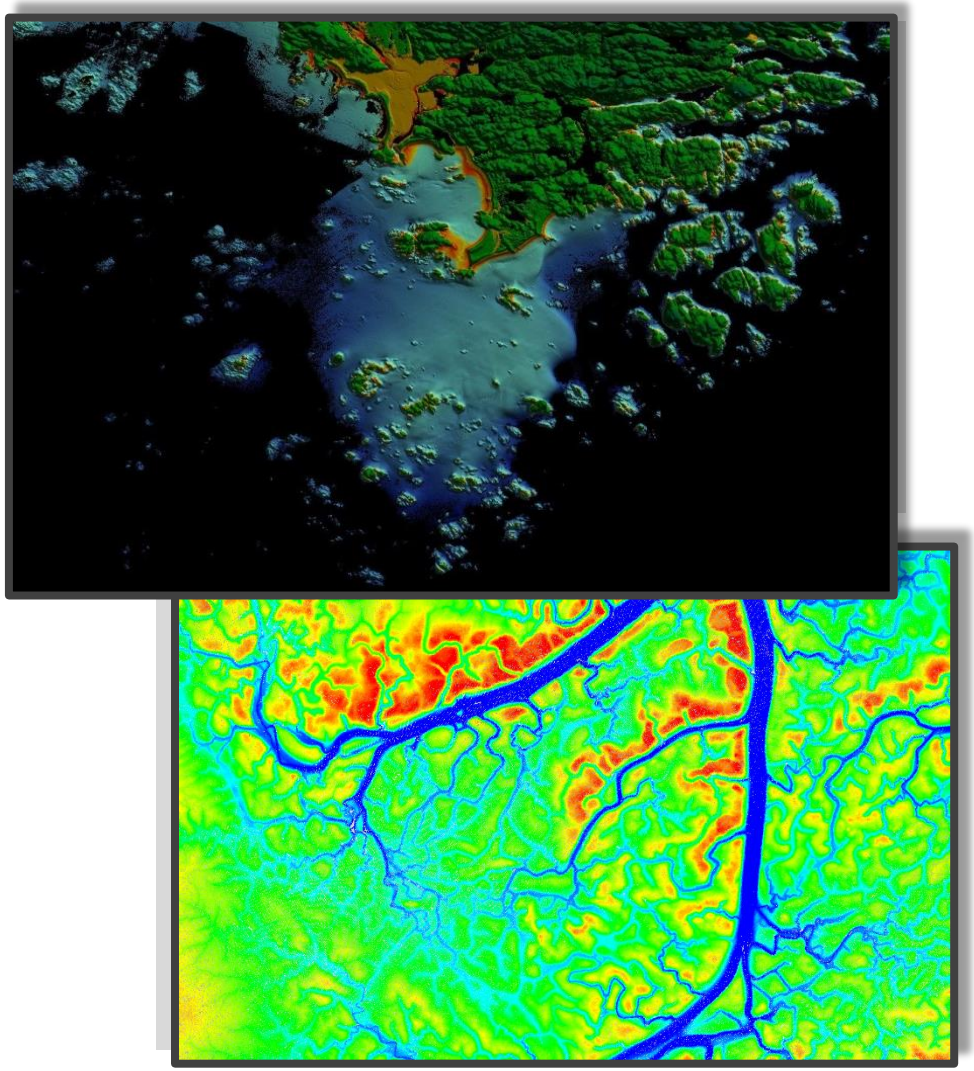


What is this paper about?
It is definitely a Discussion Paper.

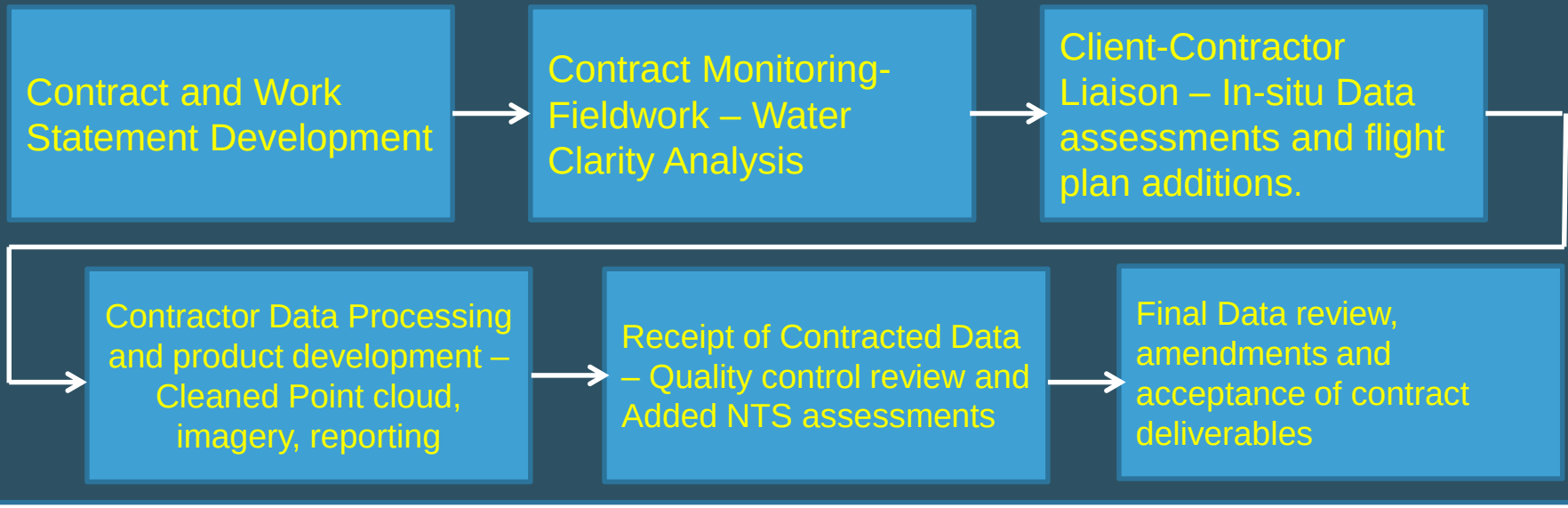
This paper is the result of the initial working level discussions that NOAA and CHS have been partaking in. The goal is to better understand the issues facing our 2 organizations as we look at ways to better integrate topo-bathymetric Lidar into our operational workflows.

This Presentation has 3 parts

1) An Introduction to the Lidar workflow in CHS
2) An Introduction to the Lidar workflow at NOAA
3) Shared Issues and Experiences at NOAA and CHS

CHS LiDAR Workflow

Externally Contracted Lidar



Deliverables

- Cleaned LiDAR Bathymetric Point Clouds in HIPS format
- LAS, XYZ and DEM files of Corresponding Bathymetry
- Ortho-rectifed Mosaics of RGB(+IR) Imagery
- Reflectivity, other multispectral/hyperspectral imagery
- Point Line Area Files of S-57 objects and various Metadata

CHS LiDAR Workflow (Internal)

CHS Processing and Products

The CHS uses contract product deliveries as archival sources and/or it may supplement contractor data to enhance or customize products for various Internal uses.

- **Validated Sources- Shoal biased Surfaces**
- **S-57 PLA Files – Objects and Metadata**
- **Imagery and Reflectivity files**
- **Project Source Data Archive and Metadata**

Additional Internal Lidar Data Products

- Validated sources are often customize to Specific Nautical Publication needs (cut to Chart or Inset areas, higher density).
- Additional S-57 objects are added as source layer input into HPD.
- Detailed Validation against other existing data sources (MBES, charts).

Questions still remain on how to best represent bathy lidar for comparison with other bathy data for chart production (apples vs. oranges)

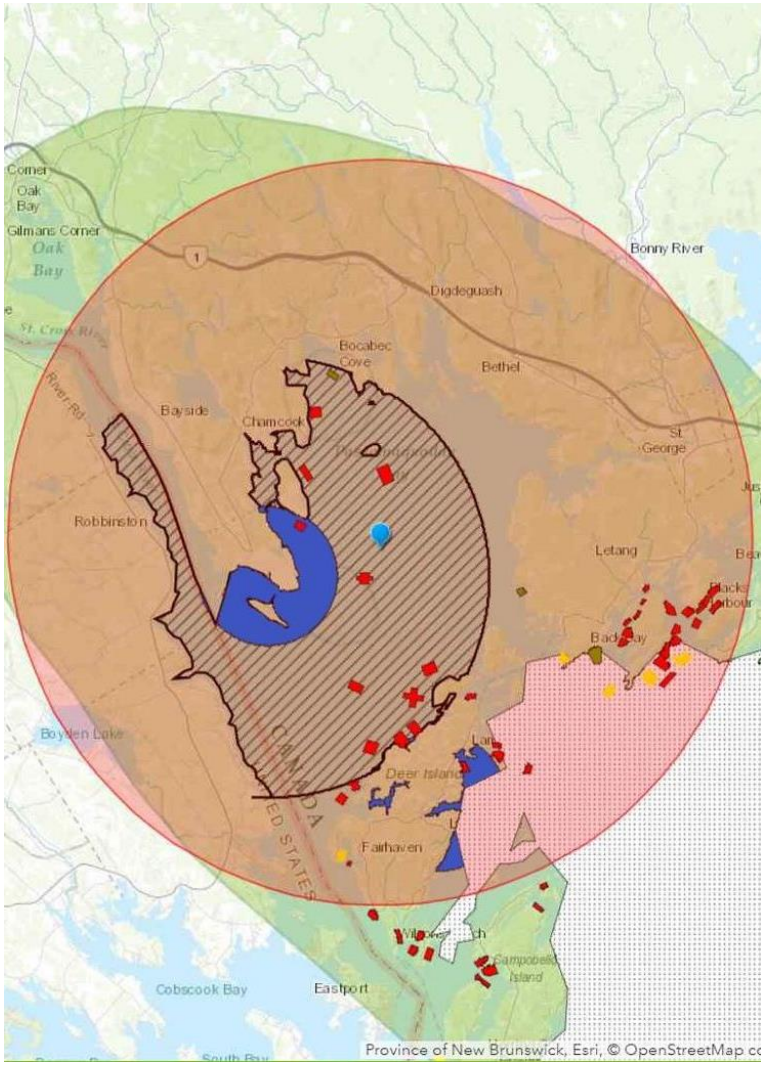
LAS and Other Data Exchange for MSDI

The Marine Spatial Data Infrastructure (MSDI)

In Canada this is a project to provide governance, standardization, infrastructure and access to various form of spatial data.

Lidar will be a significant contributor to the coastal mapping data within an MSDI. Lidar projects provide more than just a point cloud of bathymetry other products are derived.

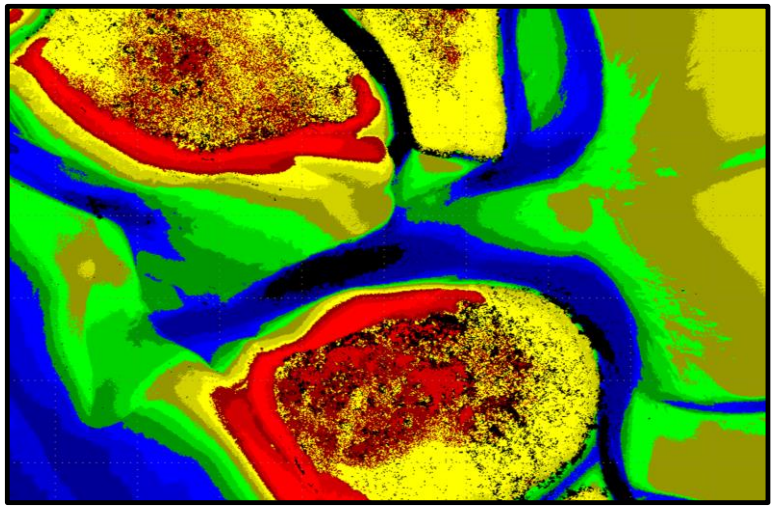
- Topographic, intertidal and Bathymetric Lidar Points clouds.
- Classification is possible, the points within the cloud can be identified. (e.g. seafloor, aquatic vegetation, water surface, man-made structures, etc.)
- Imagery (RGB, IR, Multi and Hyperspectral) composed into Orthorectified Mosaics.
- Reflectance
- Water column analysis data.



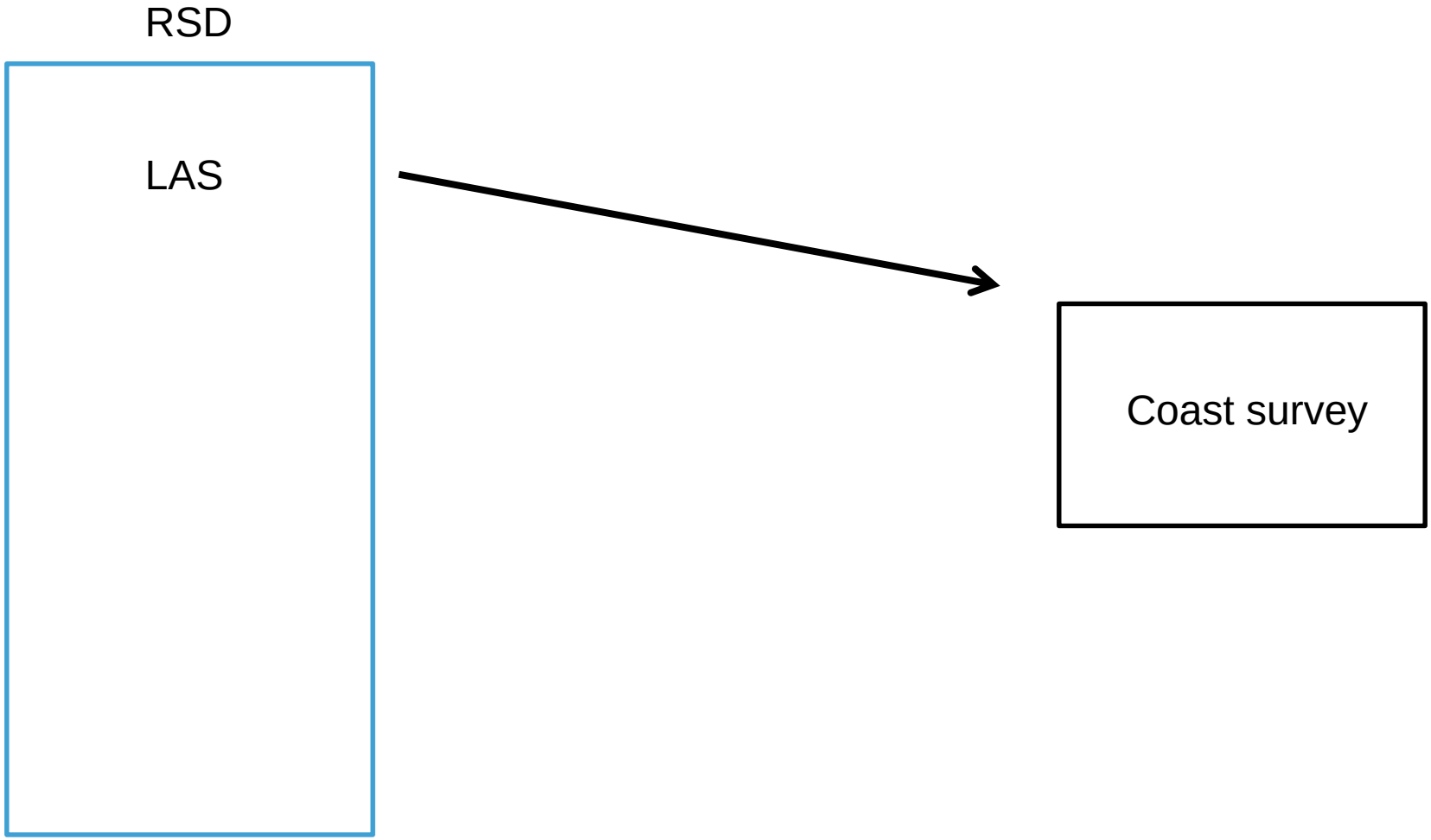
NOAA's Remote Sensing Division

Coastal Mapping Program

- **Define the National Shoreline and nearshore elevation data**
- **NOAA nautical charts**
- **Other important applications:**
  - Used in defining the United States' territorial limits
  - Coastal resource management
  - Storm surge and coastal flooding modeling
  - GIS analysis
  - Benthic habitat mapping
- **Coastal Intelligence and Resiliency…**



NOAA Testing and Evaluation



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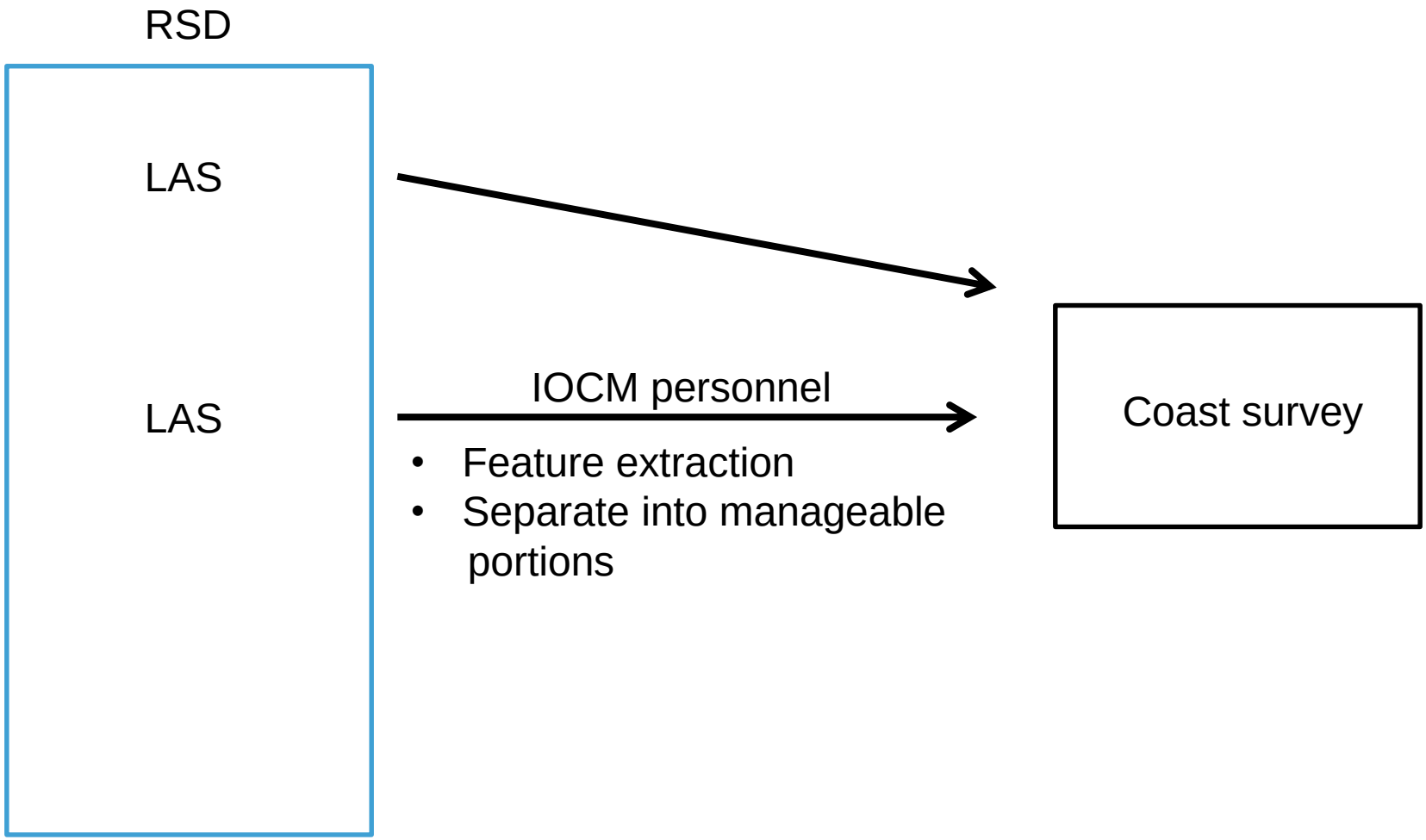

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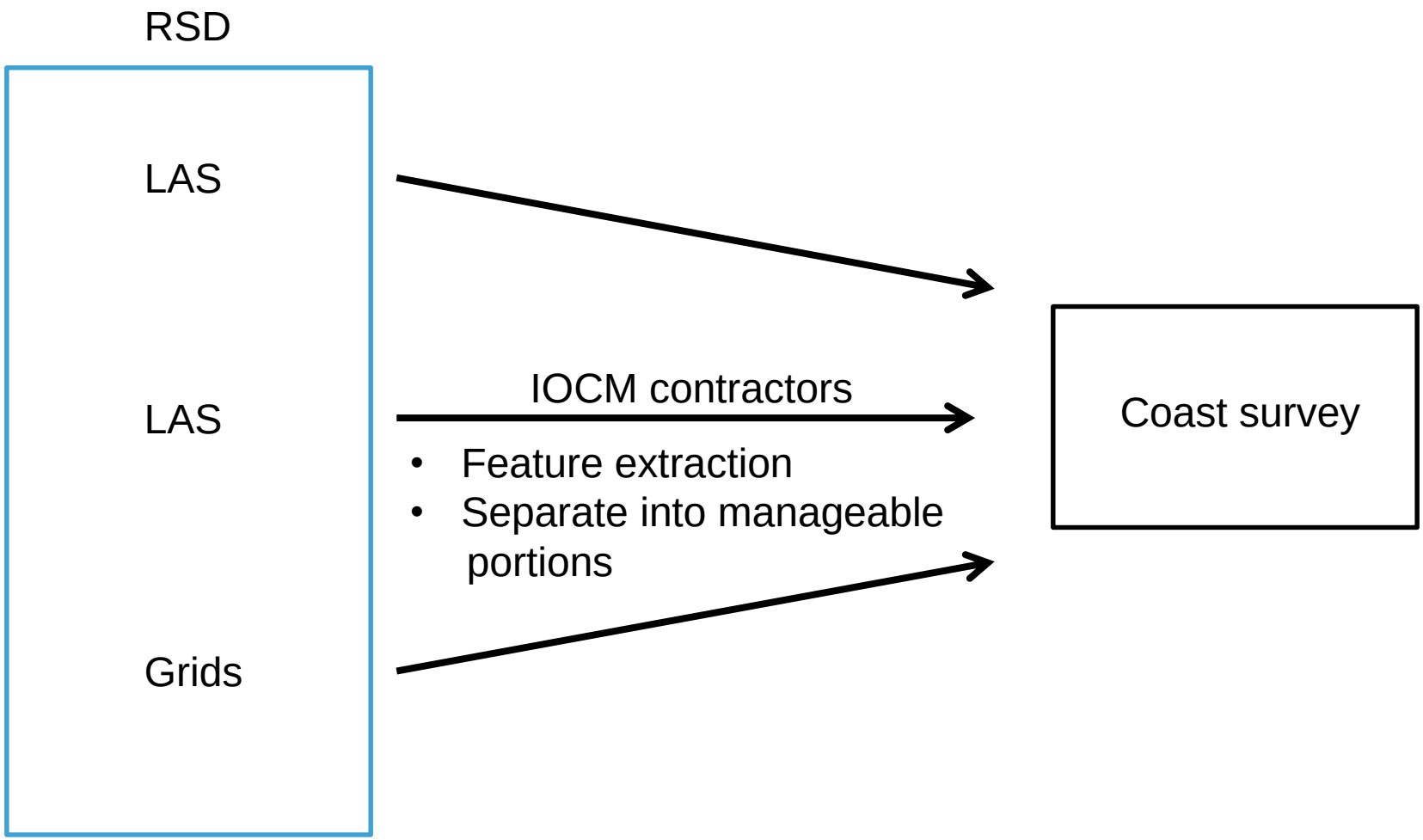
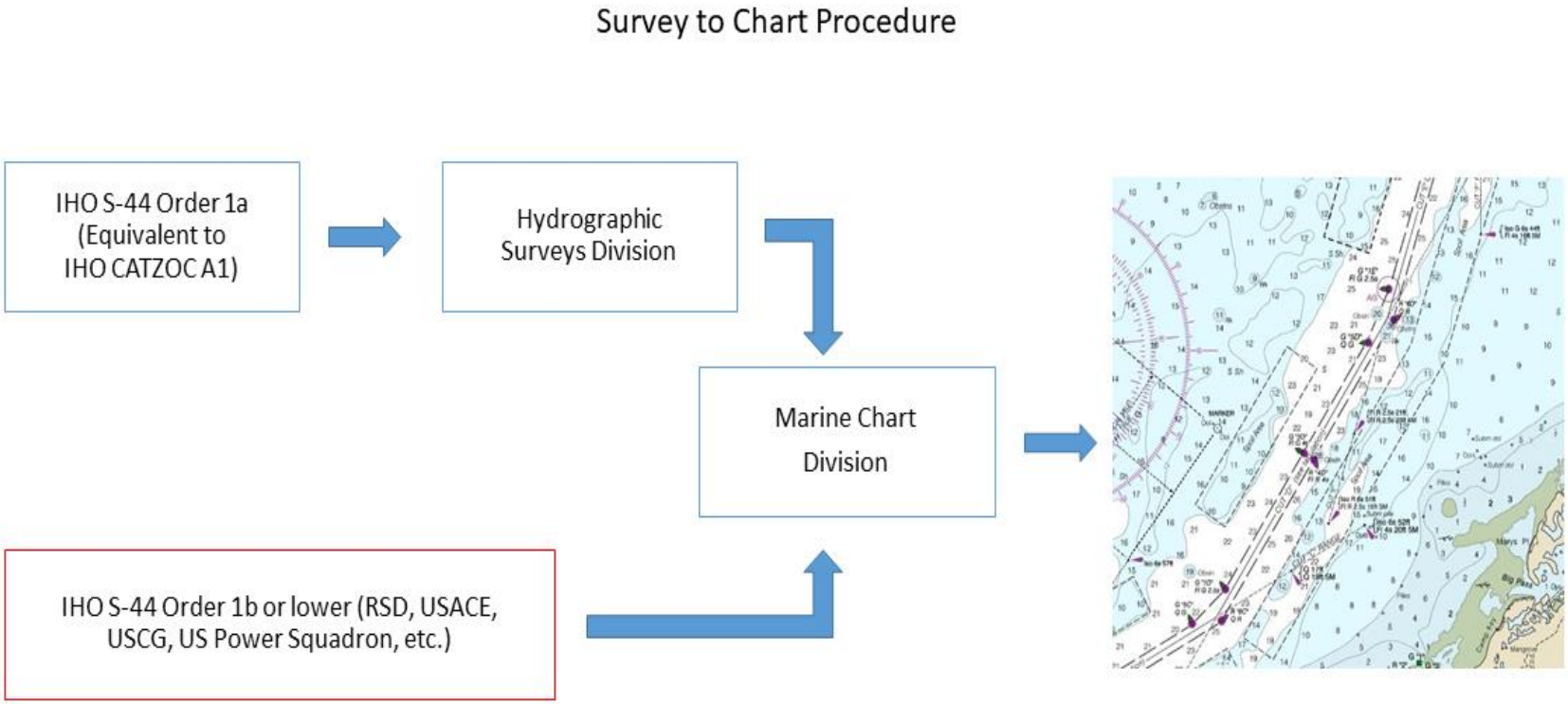
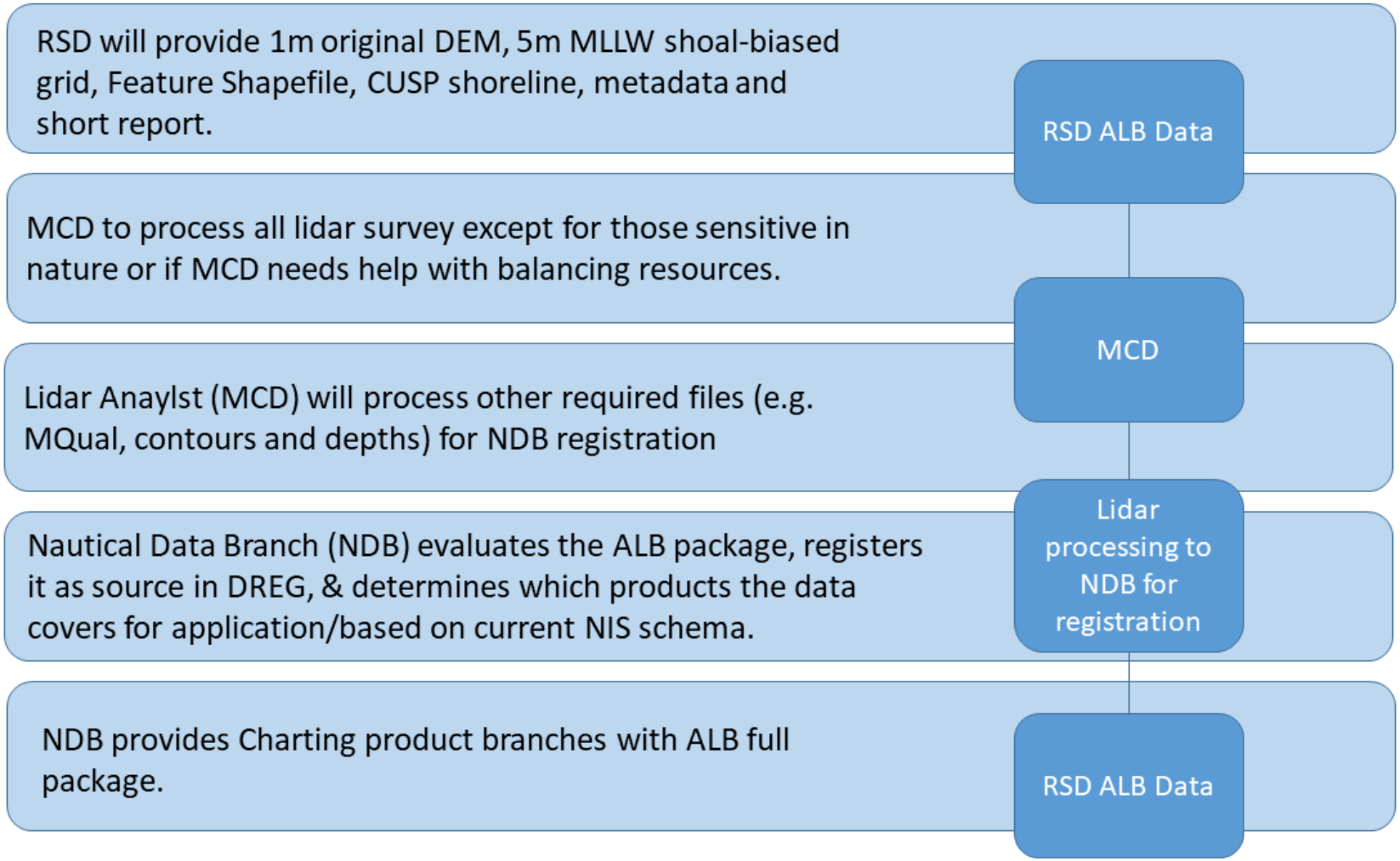


NOAA Basic Workflow

Revised NOAA Charting policies allow the incorporation of surveys collected using new CATZOC B technologies (i.e. SDB and ALB)



NOAA Current RSD ALB Workflow to MCD

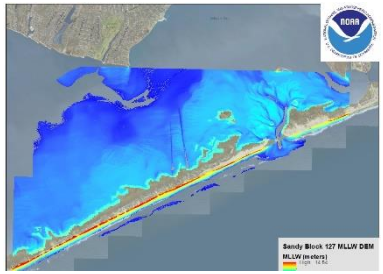


NOAA's Digital Coast

- RSD sends all of its ALB and imagery data to NOAA's Digital Coast where it is freely accessible to the public and provides easy access to the data

- Automated (for the most part) and data is stored in a common format, projection, and datum. NAD83 geographic is the standard storage datum and projection while outputs can be in either NAD83 or WGS84 and in a multitude of projections.

- Pre-made DEMs are now available



- Requests are limited to 1.5 billion points per job (for point cloud data), however there is no limit on the number of jobs.

- If an entire large data set is required, recommend bulk download, do your needed conversions; it's a lot faster this way.

Challenges for CHS and NOAA

- Issue of Gaining Trust and Acceptance
- Standardizing Workflow Approaches
- Storage and Analysis of Massive Data Quantities
- Training, Expertise and Turnover
- Data representations (Grids, Surfaces, Point Clouds). Which is best to use?
- TPU and Uncertainty Improvements
- Incompatibilities with Traditional Hydrographic and Lidar Software. The handling of LAS and Point Classification.

Future Steps

- Look forward from the Grid
- Continue to work with hydrographic software to improve its utilization and functionality w.r.t ALB
- Plan for increased capacity to meet changing requirements and leverage resources with our partners
- Lidar training course
- LAS Standard – TPU

One Last Word on Classification

Classification has been a fundamental part of Topo Lidar data processes for a long time.

Much of topographic lidar's value comes from the ability to auto classify many different types of data (e.g. tree, building, roadways, powerlines, etc.)

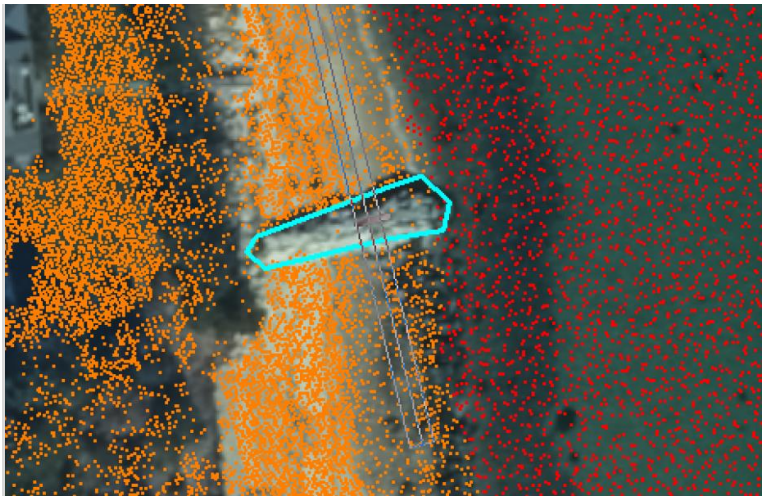
On the Bathymetric side the standard has primarily been on accepting the seafloor and rejecting the everything else.

There is now far more focus on water column. The hydrographers rejected noise is the scientists valued data.

How about new Paradigm where we look at bathymetry from the perspective of full data classification, (no accepted or rejected data anymore).

Let's classify seafloor as seafloor, classify a wharf face as a pier, a piling as a piling, etc.

This would make Lidar point cloud handling and MBES point cloud handling more compliant.



- ☐ 0 Created, Unclassified
- ☐ 1 Default, Unclassified
- ☐ 2 Ground
- ☐ 3 Low vegetation
- ☐ 4 Medium vegetation
- ☐ 5 High vegetation
- ☐ 6 Building
- ☐ 7 Noise (low or high)