Fleet Survey Team, NAVOCEANO

Unmanned Systems

Teledyne Z-Boat
FST Configuration

Odom MB2 MBES

- 1.8° x 1.8° beamwidth
- 100m maximum depth
- 200 – 460 kHz frequency
- 140° maximum swath

AP18 SurfMaster POSMV

- Fully integrated with MB2
- 1m baseline vector
- GNSS only aided by WAAS

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Operation Overview

- **Create line plan and autonomous mission plan using Hypack**
- **Setup base station and connect to USV using Remote Desktop**
- **Transfer line plan and autonomous mission plan to USV computer through Remote Desktop**
- **Activate Hypack, MB2 Sonar User Interface, Z-Boat Control, and POSMV on the USV computer**
- **Log data, execute line plan, and tune the MB2 sonar settings accordingly**

A chase boat, typically a small boat of opportunity or CRRC, will field the USV Operator and base station maintaining line of sight and a range of less than 100m from the USV.

Attempts to operate the USV from shore at the advertised telemetry ranges from Teledyne invite very significant gaps into the collected data. For example, at a range of ~700m from shore, we experienced multiple IMU gaps exceeding **60 seconds** while internally logging True Heave on the computer onboard the USV.

Teledyne is aware of this issue, and possible improvements are on the way.

Data Processing Overview

Using CARIS HIPS import bathymetry files from Hypack (*.hsx and *.raw) or Sonar User Interface (*.s7k)

Import True Heave

Load Tide

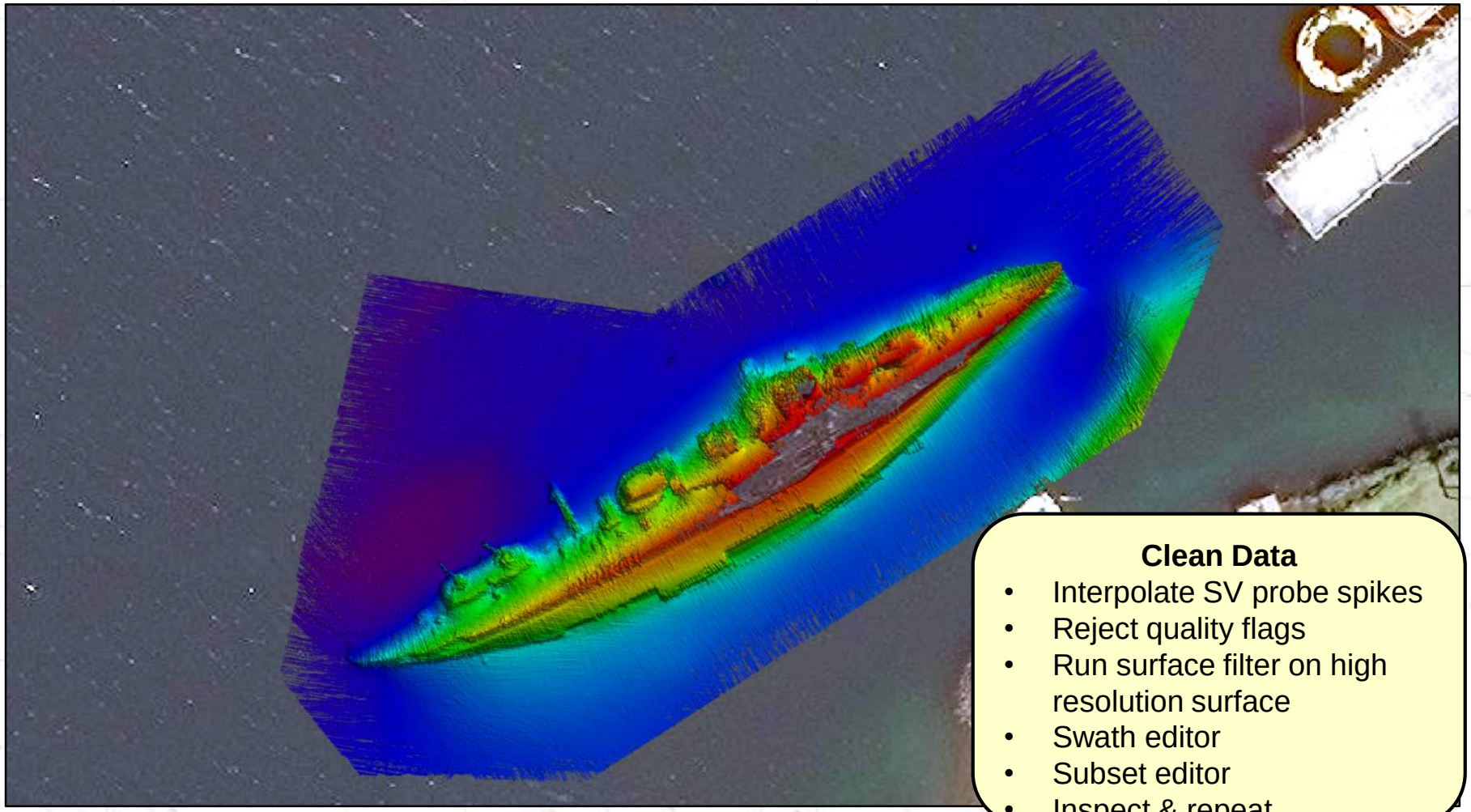
Import Sound Velocity Profiles

Using POSPac post process True Heave files, create *.sbet and *.smrmsg, then import

Merge

Compute TPU

Create CUBE Surface(s)



Clean Data

- Interpolate SV probe spikes
- Reject quality flags
- Run surface filter on high resolution surface
- Swath editor
- Subset editor
- Inspect & repeat

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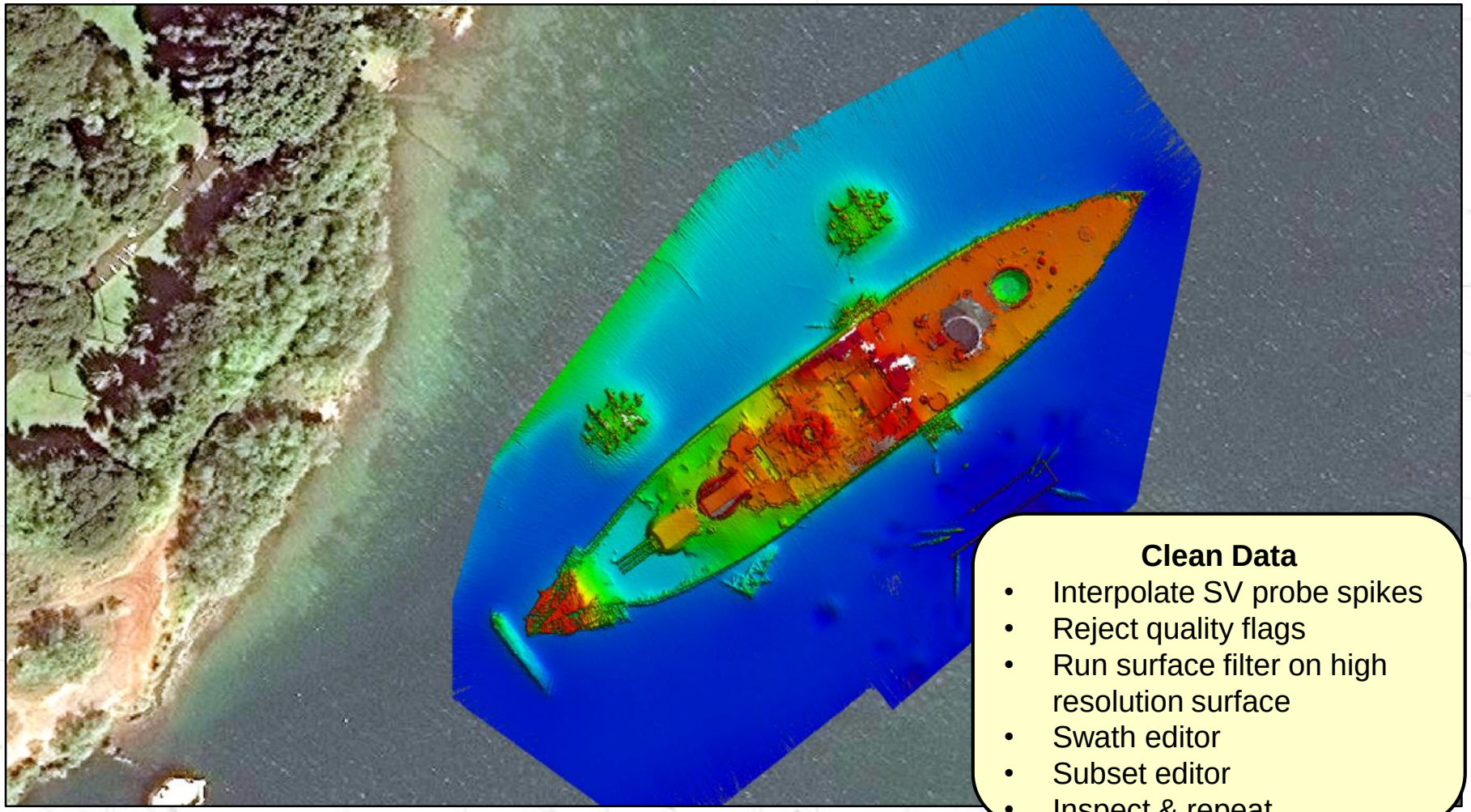

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Operational Limitations

- **Battery life**
  - < 4 hours with NiMH
  - May hot swap batteries in calm seas absent precipitation
  - Survey speeds exceeding 3 knots will greatly reduce the battery life
- **Sea state**
  - 2-3 feet maximum, largely dependent on wave period
- **Telemetry range**
  - Keep the USV a *stone's throw* distance for ideal performance
  - Source of data gap problems is unknown, but additional contributing factors may be the USV's computer limitations or MB2's software engineering
- **1m Baseline vector**
  - Short baseline vector increases heading uncertainty

Proven Capabilities

- **Expedite survey time**
  - FST conducted a survey using one traditional survey vessel with two USVs operating simultaneously, completing the survey in half the estimated time with seamless integration
- **Agility of Operations**
  - Man portable and highly precise survey platform
  - Very cheap and simple to mobilize and quickly respond to emerging mission requirements
- **Minimize Risk**
  - Small USV can operate with just a few centimeters of water depth
  - No risk to humans and almost no risk to USV to survey over extremely shoal features
- **Deepest water surveyed to date by FST with the Odom MB2 are 78m**