Maine Geologic Facts and Localities

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The Maine Geological Survey's Nearshore Survey System

Photo by Stephen M. Dickson

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System Components

In 2003, the Maine Geological Survey developed a Nearshore Survey System, or NSS, that uses a personal watercraft with high precision positioning depth sounding capabilities. Since then, MGS upgraded the NSS capabilities with new and improved equipment. The NSS helps MGS scientists keep track of how sand is shifting in the nearshore beach environment in order to better understand how to manage certain beaches. The NSS is currently comprised of the following major components:

1. **A LEICA GS-14 antenna (1a) and CS-15 controller (1b) RTK-GPS network rover system**, used for positioning the system with a ~2cm accuracy and sampling rate of 20 points per second.

2. **A CEE HydroSystems CEE ECHO single-beam transducer** which sends out acoustic signals at 20 readings per second.

3. Within the enclosed front compartment of the NSS is the **CEE-ECHO single beam echosounder** and a **SmallPC ruggedized, waterproof computer** which is used to multiplex and store collected data in **Eye4Software HydroMagic**, a navigation and bathymetric data collection and processing software.

Photo by Peter A. Slovinsky

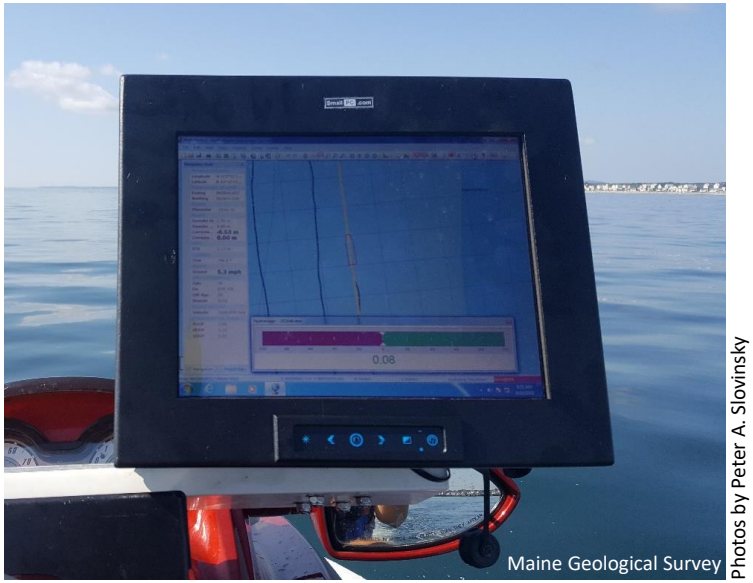
Figure 1. Nearshore Survey System components.

4. **A customized and ruggedized SmallPC touchscreen monitor** which displays **Eye4Software HydroMagic** navigation and data collection software. This displays the position of the NSS in relation to pre-set track lines, and provides information on navigation and data collection.

Data Collection

Before the NSS is launched at a site, pre-mission planning is completed using the Hydromagic software. Pre-set track lines are created for a study area so that the same lines can be revisited in subsequent surveys. Once a survey is initiated, the Leica CS-15 controller and SmallPC ruggedized monitor are mounted on the handlebars for ease in viewing all positional and RTK-GPS data during the survey. Hydromagic software shows the driver a variety of positional and navigational information, including a map of where they are in reference to the pre-set tracklines, and a "steering indicator" which can be used to ensure that the driver stays as close as possible to a track line.

Figure 2a. Leica CS-15 controller and SmallPC ruggedized monitor mounted on the handlebars of the NSS.



Photos by Peter A. Slovinsky

Figure 2b. Positional information and steering indicator shown on the NSS monitor.

Processing Data

Once the nearshore bathymetry is collected, it is processed and analyzed using Hydromagic:

1. Raw collected echosounder data is viewed and processed in Hydromagic to remove noise and unwanted/bad return data. This is done for each collected survey transect, as shown in Figure 3a.

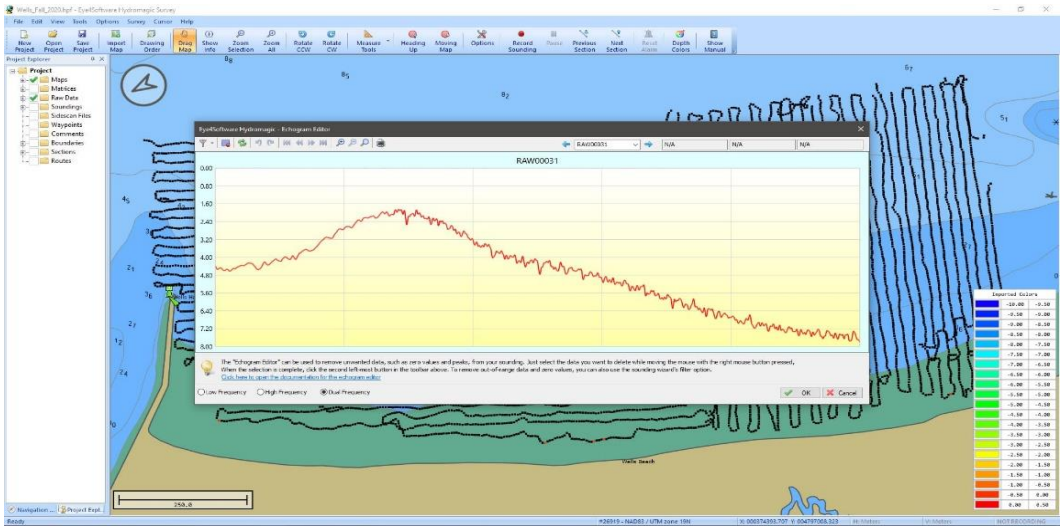


Figure 3a. Processing echosounder data using Hydromagic.

2. Processed raw data is then converted into 1 point-per-second soundings using Hydromagic. Output soundings are referenced to NAD83 UTM Zone 19 and elevations referenced to the North American Vertical Datum of 1988 (meters, Figure 3b).

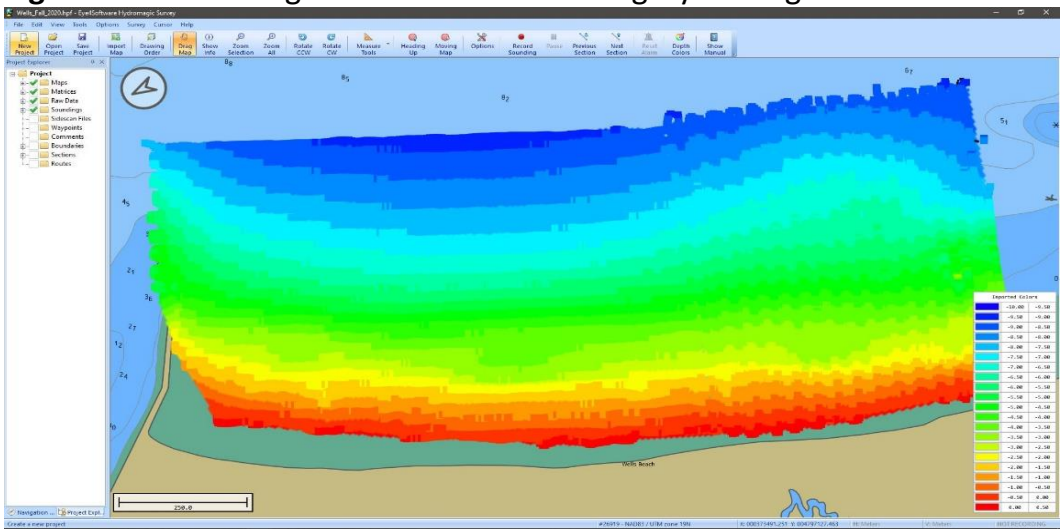


Figure 3b. Converting echosounder data into soundings using Hydromagic.

Processing Data

3. Sounding data is then imported into ArcGIS ArcMap, where data is converted into a digital elevation and hillshade model, where prominent features can be seen (Figure 4).

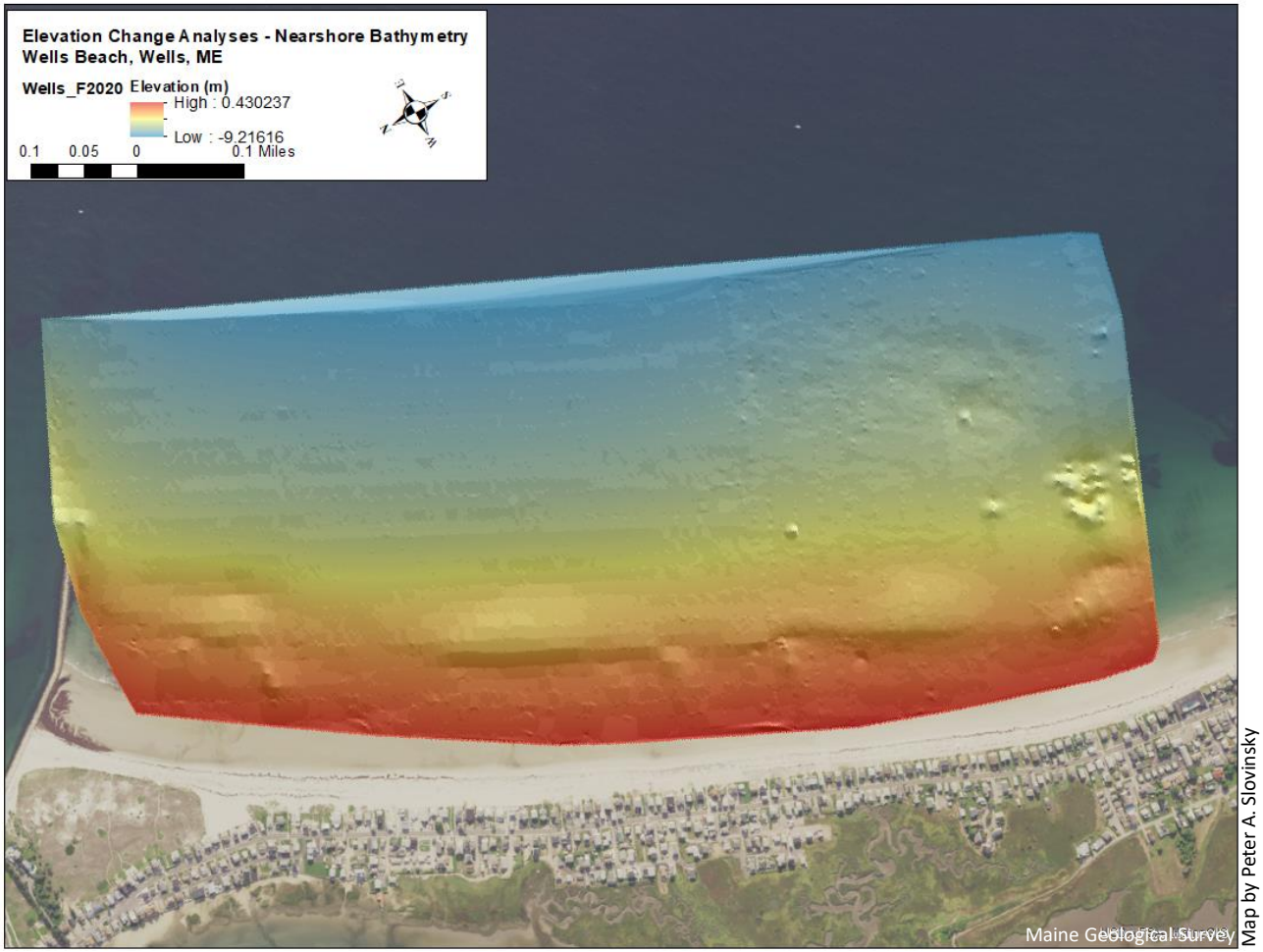


Figure 4. Nearshore Bathymetry DEM and hillshade for Wells Beach, Wells, ME from Fall 2020.

Processing Data

4. **Riverscapes Geomorphic Change Detection (GCD) ArcMap extension** is then used to compare subsequent surveys and develop bathymetric change maps. An example is provided in Figure 5.

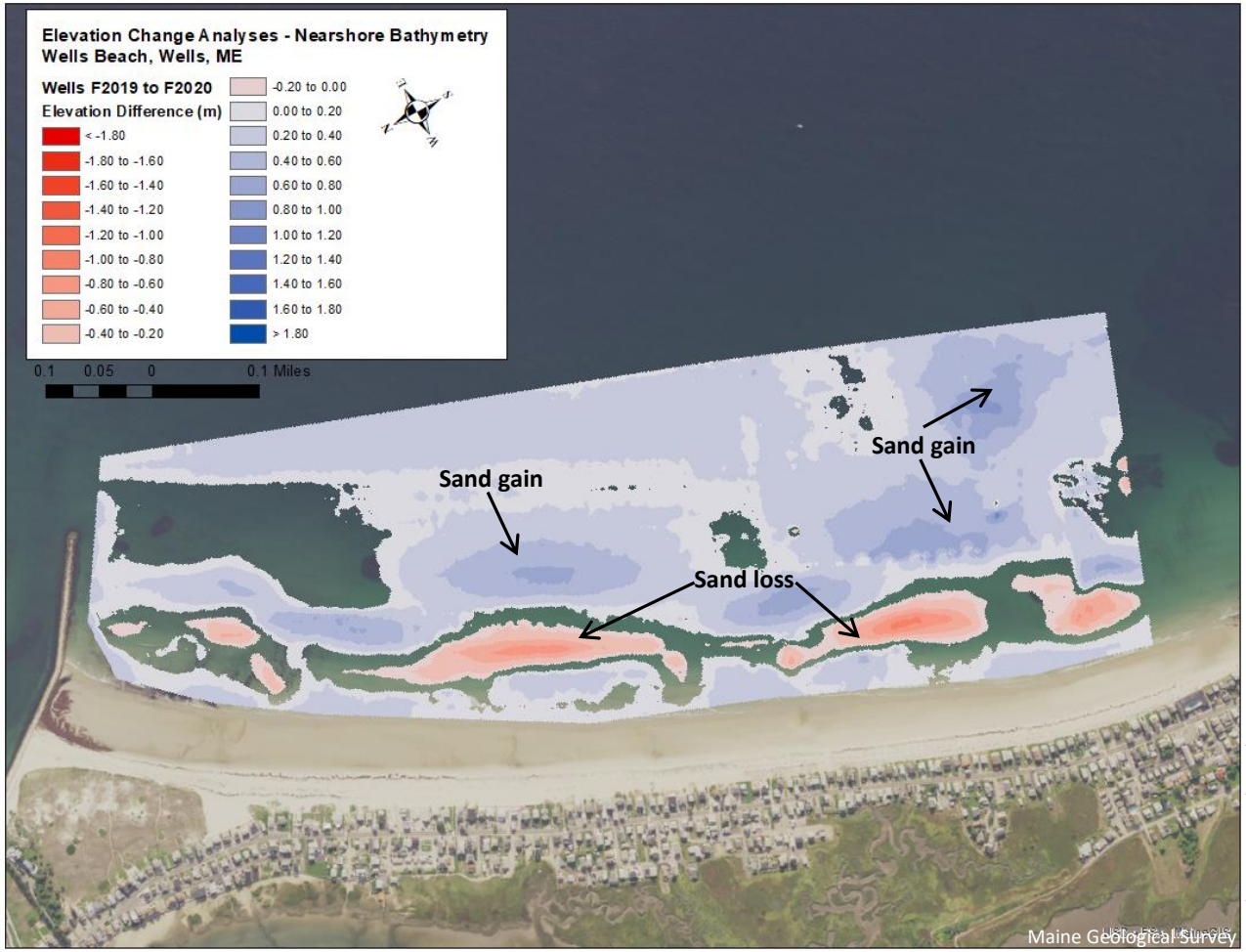


Figure 5. Volumetric change analysis for Fall 2019 to Fall 2020 along Wells Beach, Wells, ME.

What is the NSS used for?

The MGS NSS is being used to help track how sands are shifting adjacent to 3 federal harbor dredging and beach nourishment projects: Wells Beach, Wells; Saco beaches, Saco; and near the Scarborough River, Scarborough. The NSS is being used in conjunction with Unmanned Aircraft Systems (UAS) and offshore multi-beam bathymetric mapping in these areas to better understand sediment migration patterns at these locations.

In addition, the NSS has been used for a variety of other purposes, including:

- Ground-truthing elevation data collected by new technologies such as water-penetrating Light Detection and Ranging (LiDAR) data (Blue Hill Bay, Saco Bay);
- Mapping the extent of eel-grass beds (Casco Bay, Scarborough River);
- Mapping bathymetry near potential dam removal projects (Kennebec River, Leonard Lake);
- Mapping bathymetry near bridge reconstruction projects for the Maine DOT (Kennebec River, Boothbay Harbor);
- Mapping current patterns in the vicinity of beaches and inlets which have high bacteria counts for the Maine Healthy Beaches Program (Ogunquit Beach, Goose Rocks Beach); and
- Mapping current patterns in support of oil spill response programs (Presumpscot River).