Navigational Adjustment to Optimize Multibeam Bathymetry of the Mid-Atlantic Ridge "Popping Rocks Site"

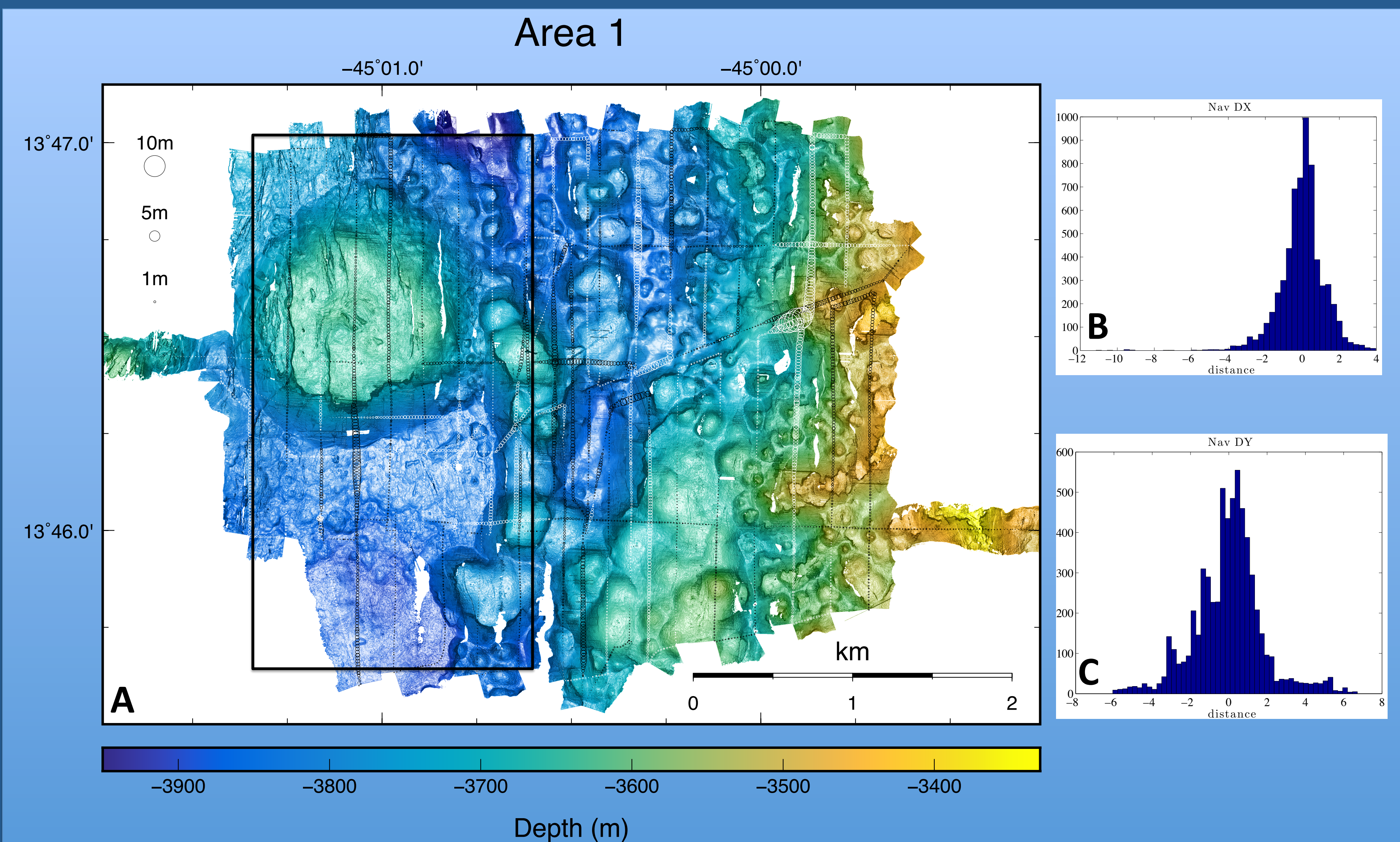Author: J. Ryan Hawsey and Adam Soule

Area 1

Figure 1. Track lines of the AUV Sentry and the adjusted navigational data are displayed in the circles transecting the gridded surface of study area 1(A). The circles represent the amount of adjustment done by MBNavadjust, and the graphs show the distribution of this change in X(B) and Y(C) direction to the navigational data.

Introduction

The AUV Sentry Collected bathymetric data at 1m resolution over the "Popping Rocks Site" around 14N on the Mid-Atlantic Ridge. The goal of this project is improve the data quality in order to be able to automatically locate and characterize the 3D fault populations throughout the two study areas. The gridded surfaces produced from the multibeam data must be very high quality, without any artifacts, to optimize the amount of real faults found and not artifacts in the data. The AUV Sentry uses an Inertial Navigation Unit (INU) along with navigational aiding from the surface ship to estimate AUV position. The navigation data is then paired with the bathymetric data in order to produce bathymetric maps. This navigation data must be refined and processed to increase the quality of the gridded surfaces.
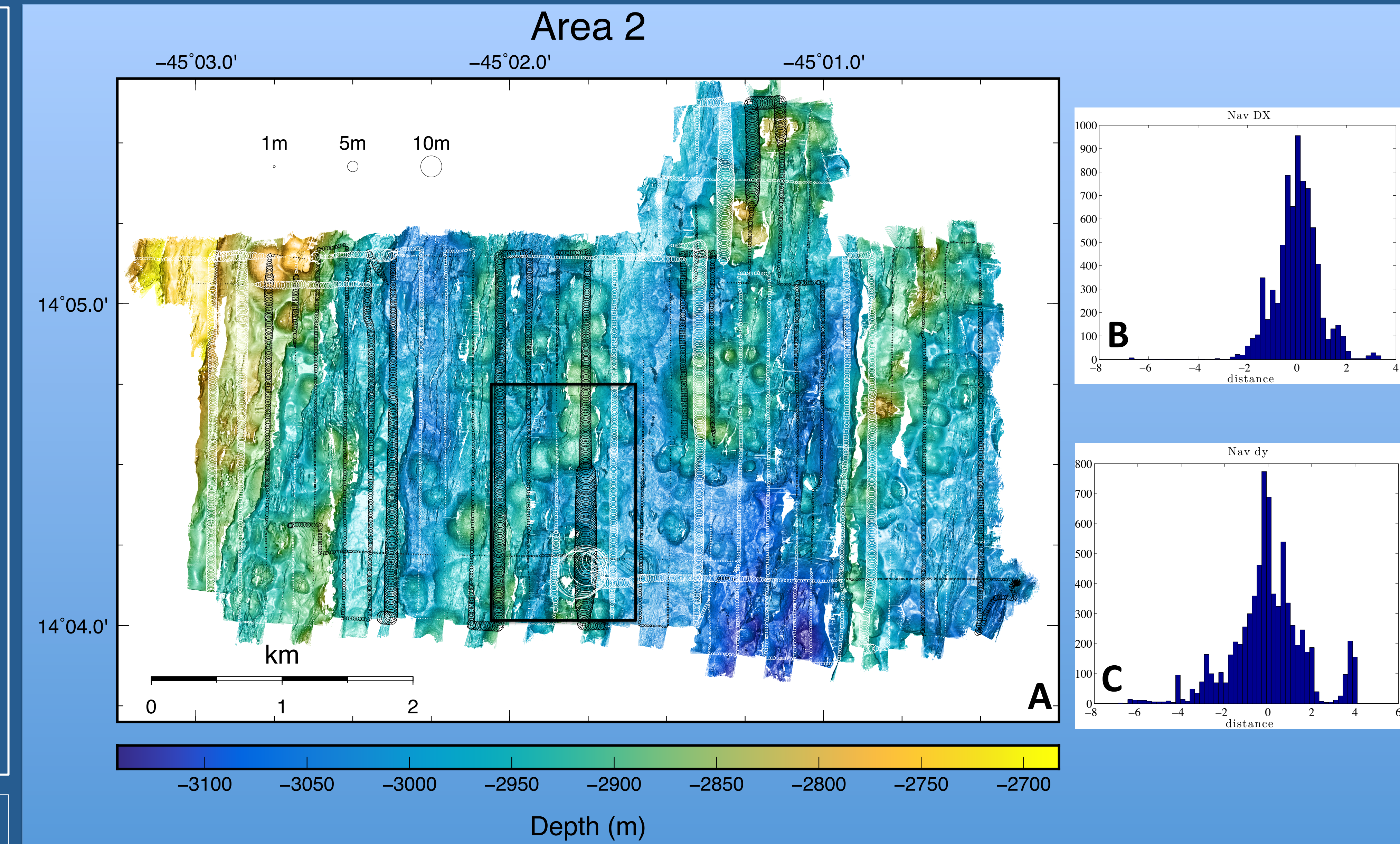
MBNavAdjust

MBNavadjust uses navigation tracklines and known swath widths to determine where bathymetric swaths intersect or overlap. If it can be determined that the two contour maps contain the same feature (e.g., mound), they will be adjusted so that the features align perfectly (Fig. 5). Once aligned a "Tie" is added to record how much the original navigation must be offset. After the entire study area has been analyzed and ties have been added the navigation can be inverted to produce better navigation data for the entire area.

- Area 1 has 97 True Crossings and 2750 total crossings that can be analyzed.
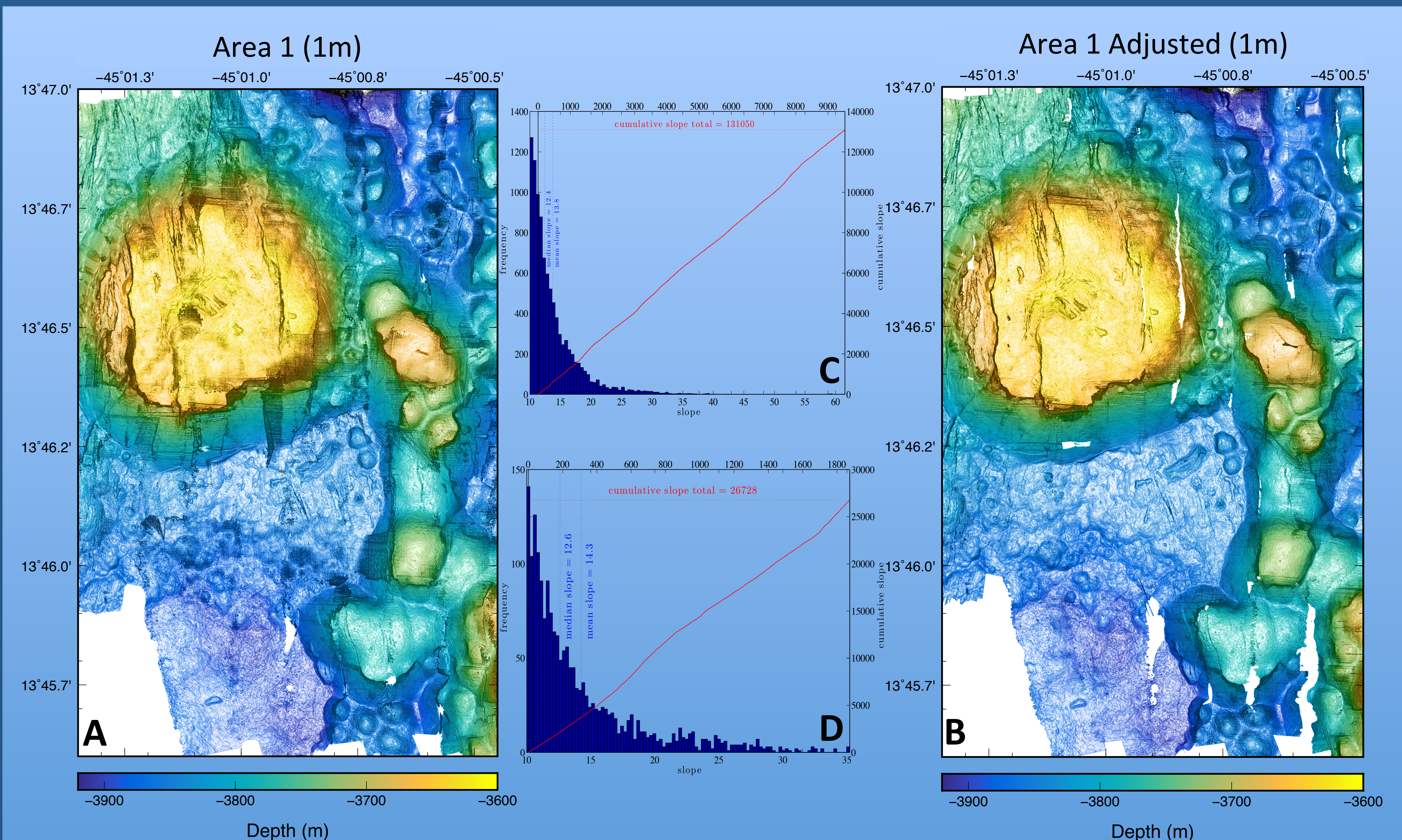- Area 2 has 75 true crossings and 2867 of total crossings that can be analyzed.

Figure 5. MBNavAdjust crossings analysis window

Area 2

Figure 2. Track lines of the AUV Sentry and the adjusted navigational data are displayed in the circles transecting the gridded surface of study area 2(A). The circles represent the amount of adjustment done by MBNavadjust, and the graphs show the distribution of this change in X(B) and Y(C) direction to the navigational data.

Figure 3. The gridded surfaces show the quality of data prior to navigational adjustment in MBNavAdjust (A) and the increase in quality after navigation inversion (B). The two graphs show the slope range in this specific area above a 10 degree slope. Prior to MBNavAdjust (C) there are 9250 pixels with a slope greater than 10 degrees and this area has slopes up to 60 degrees. This is due to the high volume of noise and artifacts in the data. Post MBNavAdjust this number drops to 1850 pixels above a 10 degrees slope and only has slopes up to 35 degrees. This is due to the inversion creating a much cleaner surface.
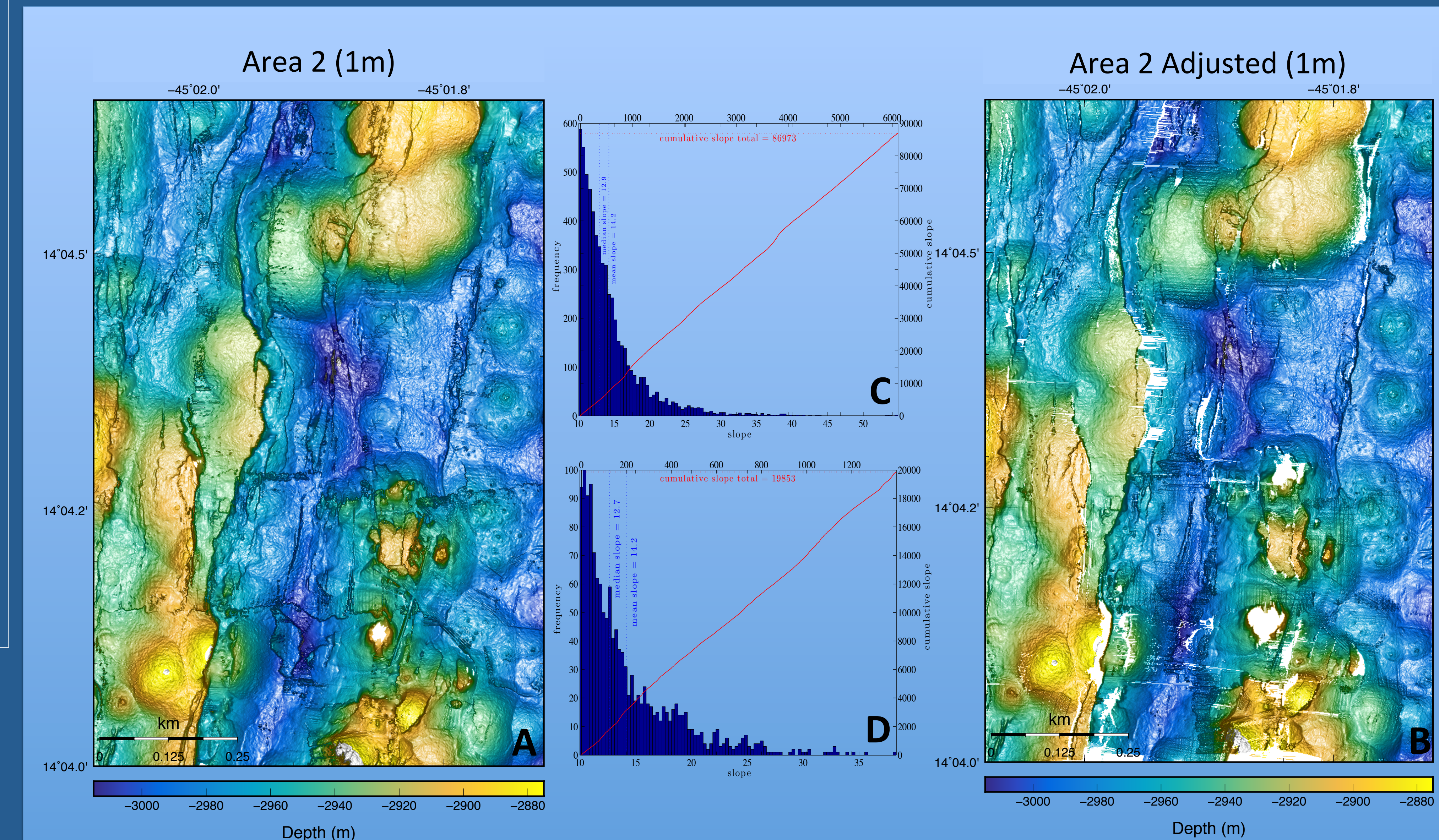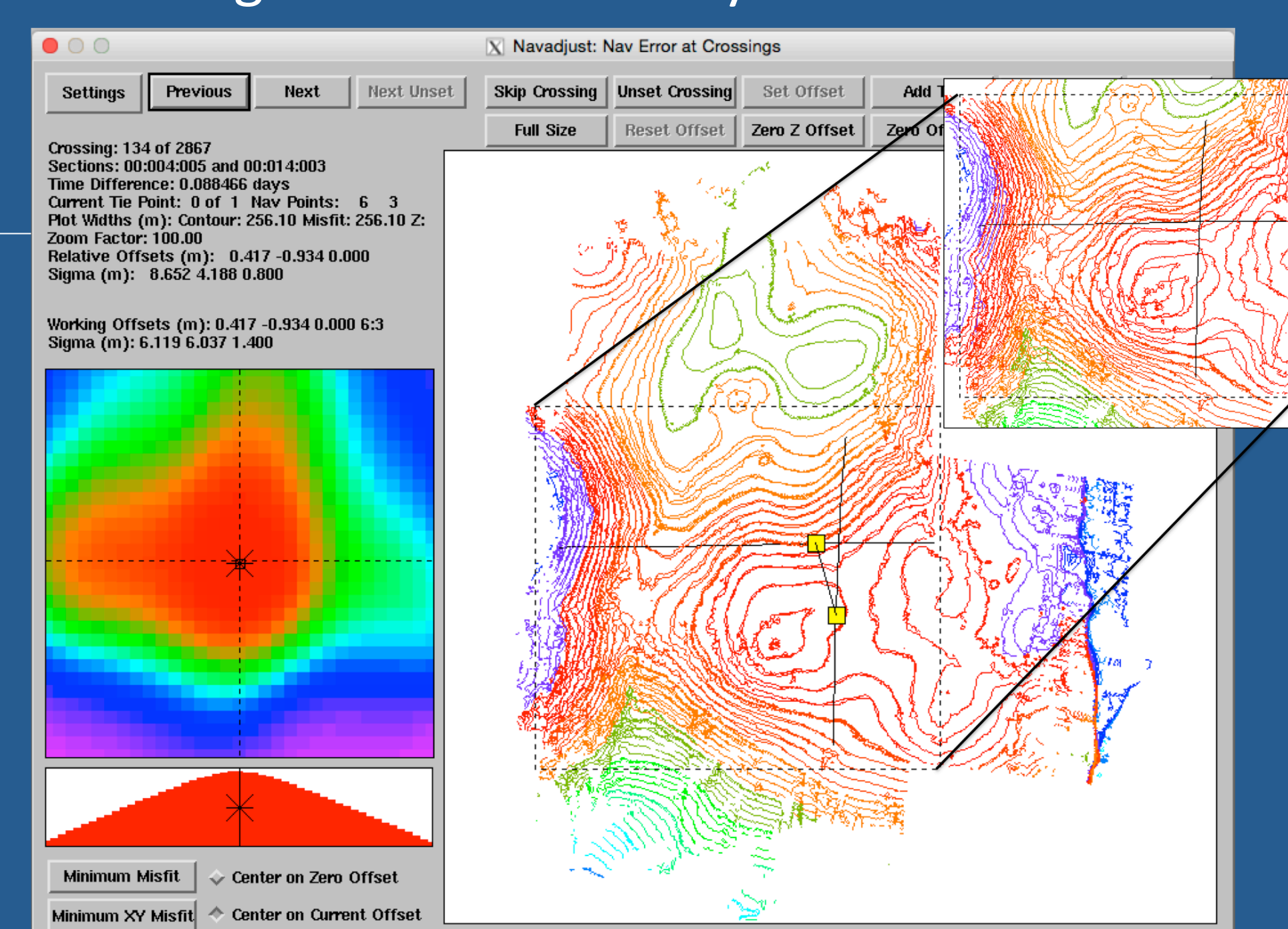

Figure 4. The gridded surfaces show the quality of data prior to navigational adjustment in MBNavAdjust (A) and the increase in quality after navigation inversion (B). The two graphs show the slope range in this specific area above a 10 degree slope. Prior to MBNavAdjust (C) there are 6100 pixels with a slope greater than 10 degrees and this area has slopes up to 60 degrees. This is due to the high volume of noise and artifacts in the data. Post MBNavAdjust this number drops to 1300 pixels above a 10 degrees slope and only has slopes up to 40 degrees. This is due to the inversion creating a much cleaner surface.