

SHOALS Toolbox

By

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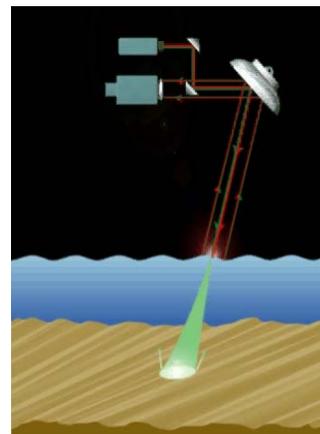
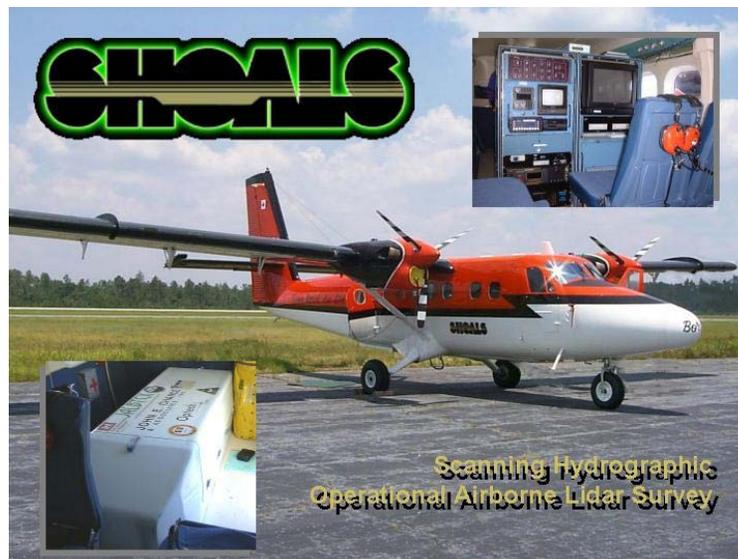
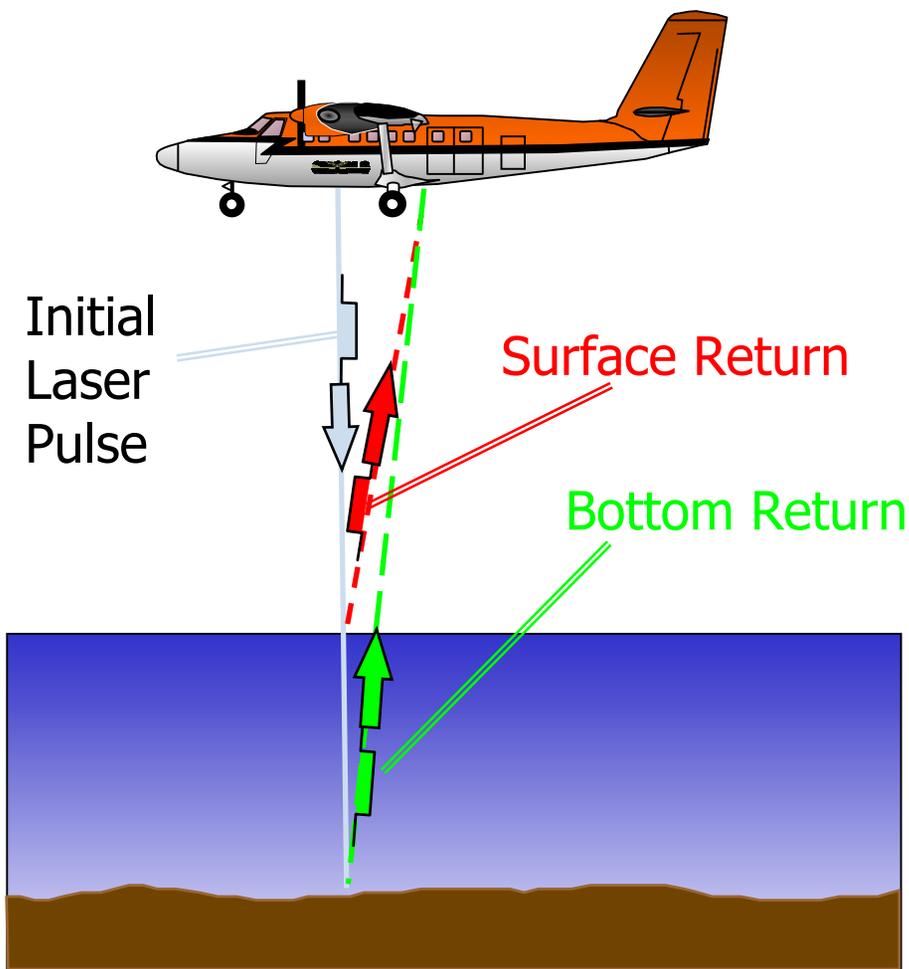
US Army Corps of Engineers

Mobile, AL

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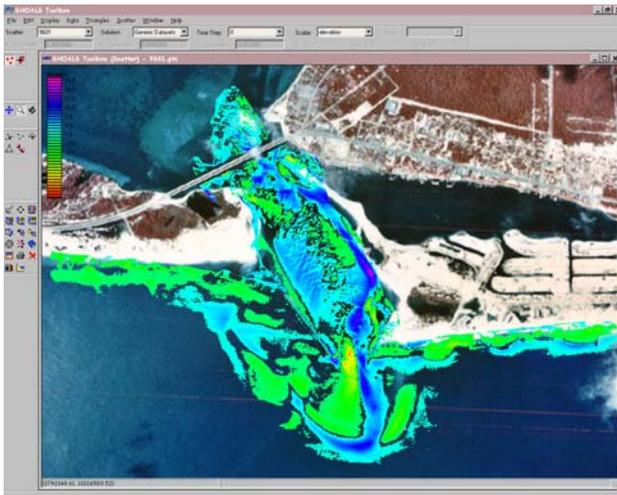
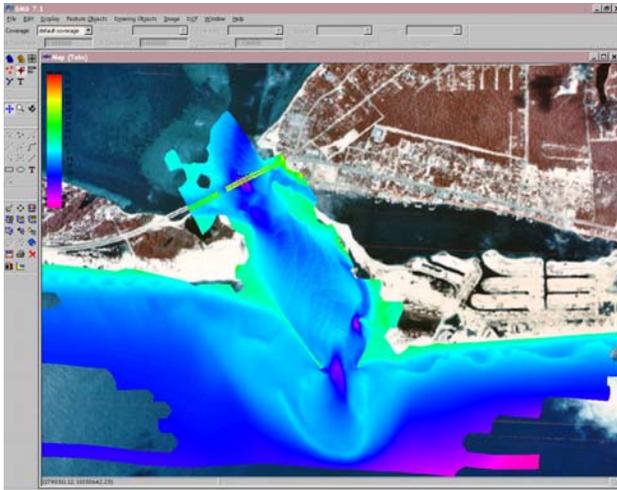
**SHOALS
Toolbox**

The SHOALS System



**SHOALS
Toolbox**

SHOALS Toolbox

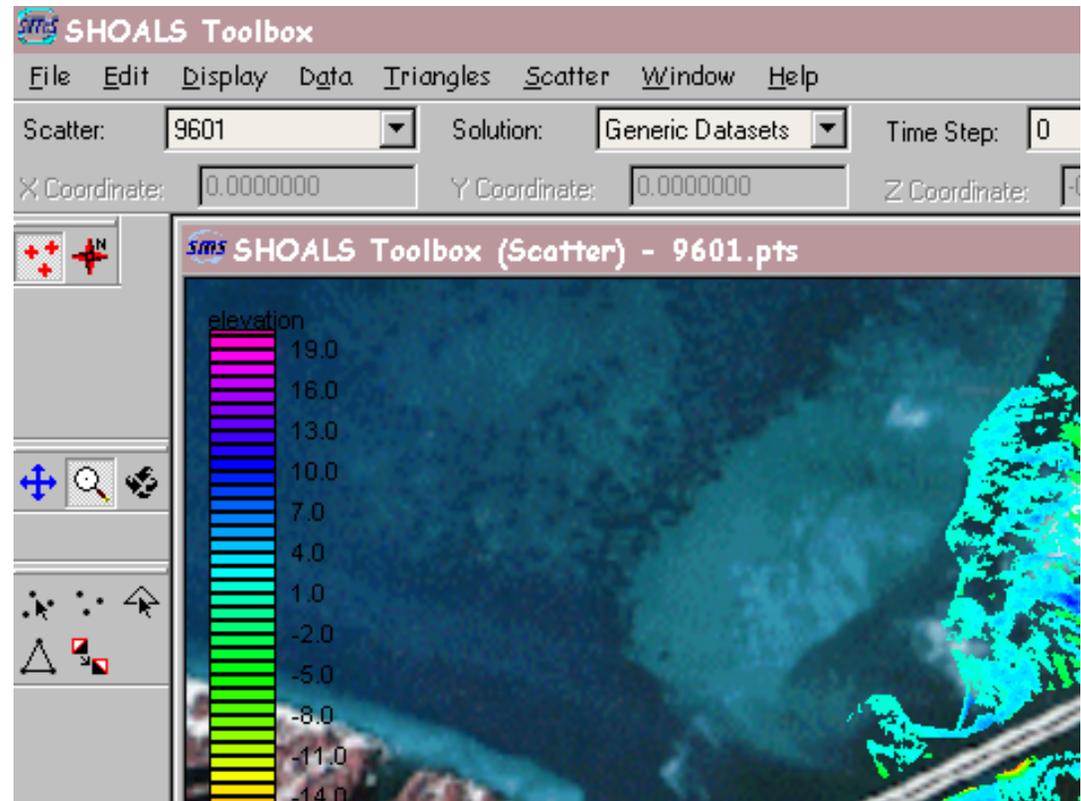


- Edit and Visualize SHOALS Data
- Decimate Large Data Sets
- Compute Volumes
- Extract Profiles
- Data Preparation for GIS

SHOALS Toolbox



**Comprised of
Scatter and Map
Modules**



**Always available
in SMS**

**Also available
standalone**

**SHOALS
Toolbox**

Scatter Module



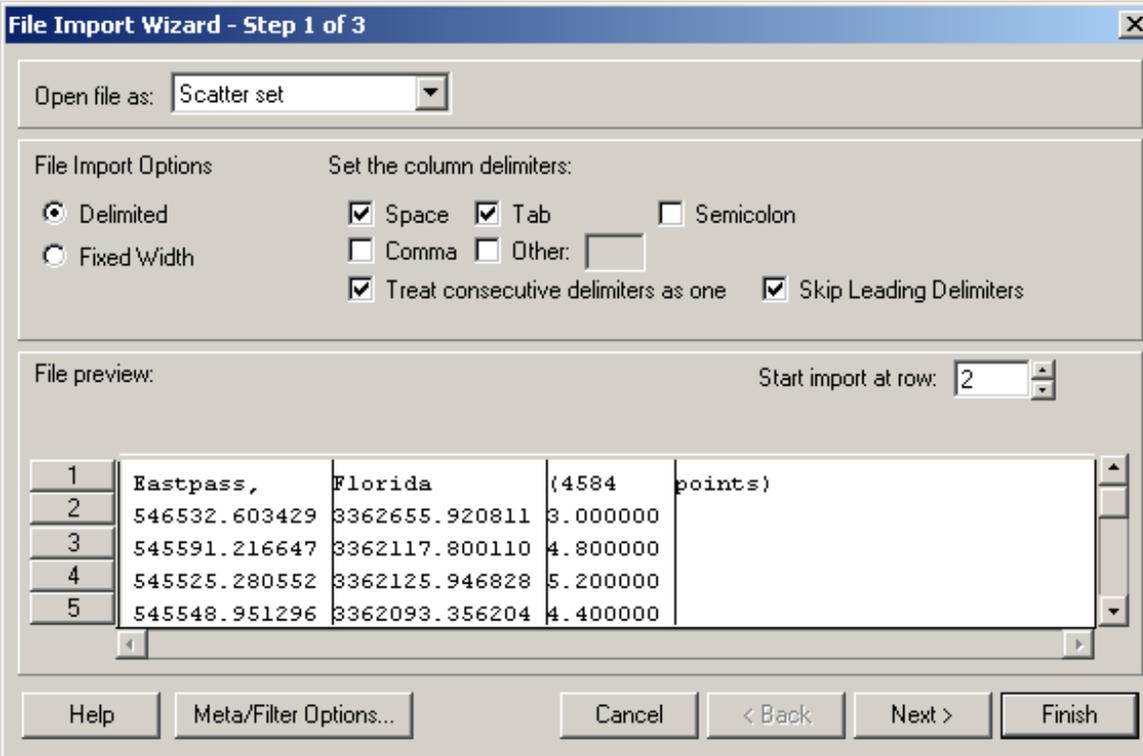
- Edit and Visualize SHOALS Data
- Data Decimation
- Volume Change



File Import Wizard

Opens any ASCII columnar file

Step 1



File Import Wizard - Step 1 of 3

Open file as: Scatter set

File Import Options

Set the column delimiters:

Delimited
 Fixed Width

Space Tab Semicolon
 Comma Other:

Treat consecutive delimiters as one Skip Leading Delimiters

File preview: Start import at row: 2

1	Eastpass,	Florida	(4584	points)
2	546532.603429	8362655.920811	3.000000	
3	545591.216647	8362117.800110	4.800000	
4	545525.280552	8362125.946828	5.200000	
5	545548.951296	8362093.356204	4.400000	

Help Meta/Filter Options... Cancel < Back Next > Finish

File Import Wizard

Set what each column of the data represents

Step 2

File Import Wizard - Step 2 of 3

Columns:
 X/Easting: 1
 Y/Northing: 2
 Z/Depth: 3

Functions:
 Scalar
 Vector X, Y
 Vector Mag, Dir
 Add Delete
 Name:

Other Options:
 Scatter Options...
 Scatter Name: eastpass

File preview:

	1	2	3	4
1	Eastpass,	Florida	(4584	points)
2	546532.603429	8362655.920811	3.000000	
3	545591.216647	8362117.800110	4.800000	
4	545525.280552	8362125.946828	5.200000	
5	545548.951296	8362093.356204	4.400000	

Help Meta/Filter Options... Cancel < Back Next > Finish

File Import Wizard

Convert between coordinate systems

Step 3

File Import Wizard - Step 3 of 3

Current Horizontal System: State Plane (Florida North - 903), NAD 83, U.S. Survey Feet
Current Vertical System: NGVD 29, U.S. Survey Feet

Current Options for Existing Data...

Convert the incoming data from:

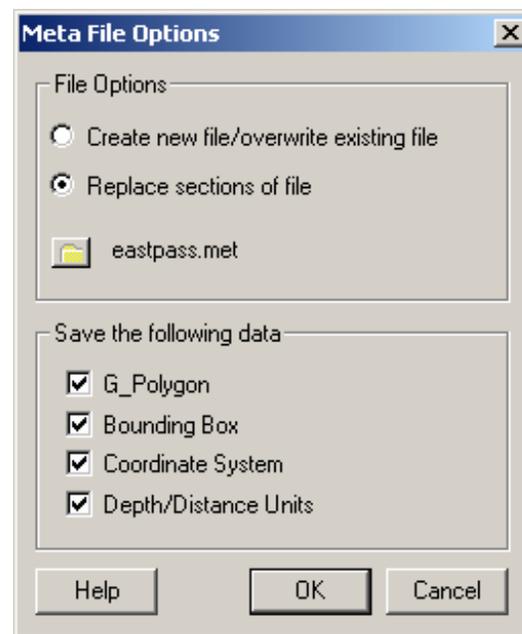
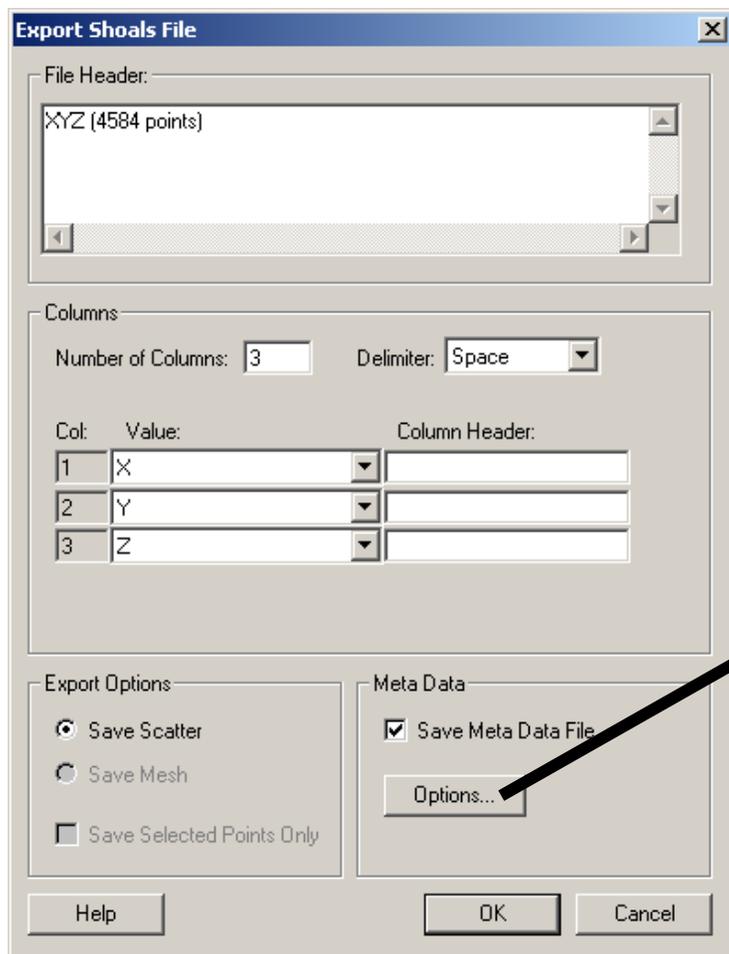
Horizontal System:	UTM NAD 83 (US)	UTM Zone:	16 90W to 84W
Ellipsoid:	GRS 1980	Hemisphere:	Northern
Units:	Meters		

Vertical System:	NGVD 29 (US)
Units:	Meters

Help Meta/Filter Options... Cancel < Back Next > Finish

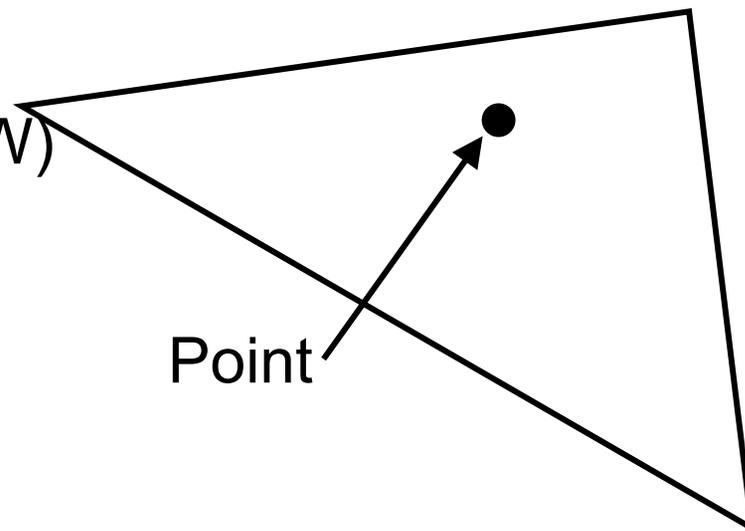
Saving SHOALS

- Save data in any format
- Update metadata files

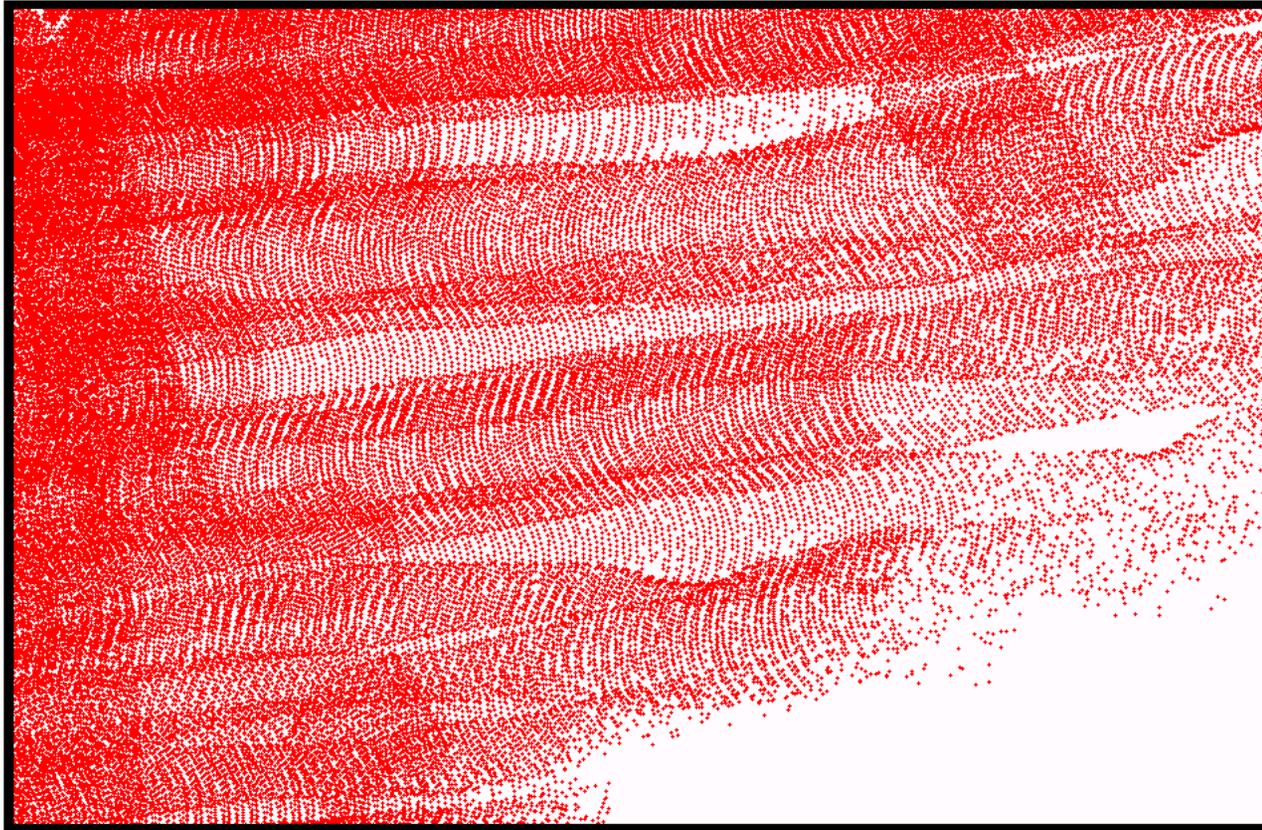


Interpolation

- Based on Triangulation
- Linear Interpolation in Triangle
 $ax + by + cz + d = 0$
- Inverse Distance Weighted (IDW)
- Natural Neighbor



Overlapping Data



Data Decimation

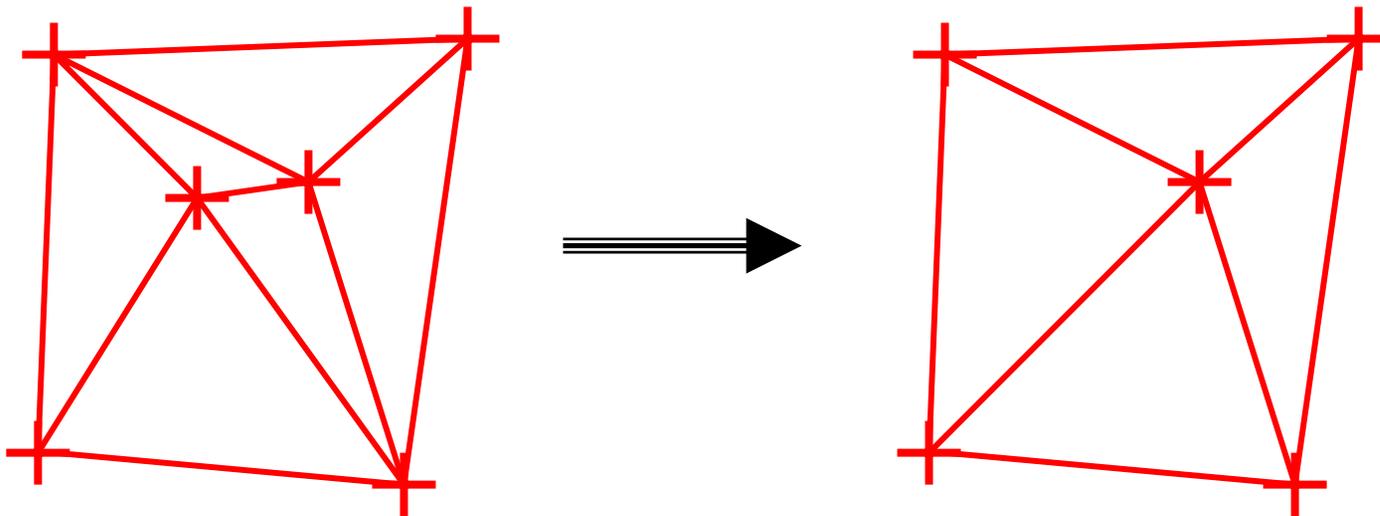


1. Duplicate Points
2. Binning
3. Filtering

Duplicate Points

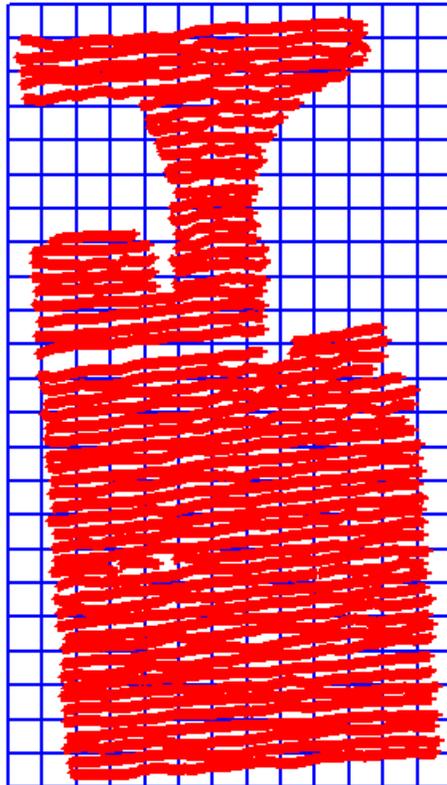
- **User Specified Tolerance**

- Point with higher ID deleted
- Triangulation updated to fill void

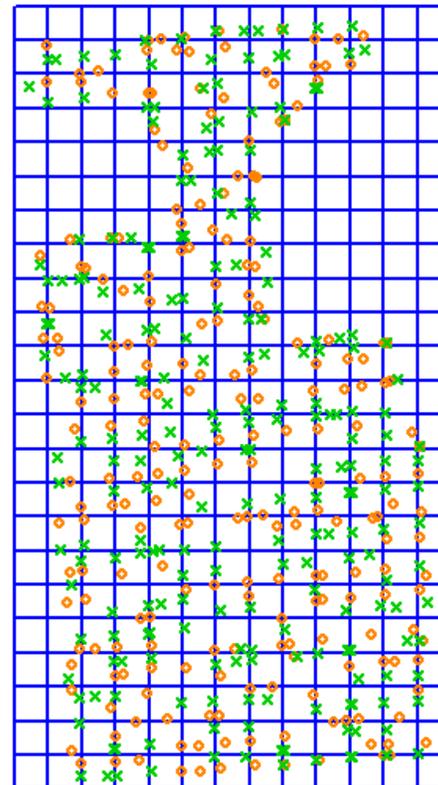


Bins / Nautical Chart

Divide Set Into Bins

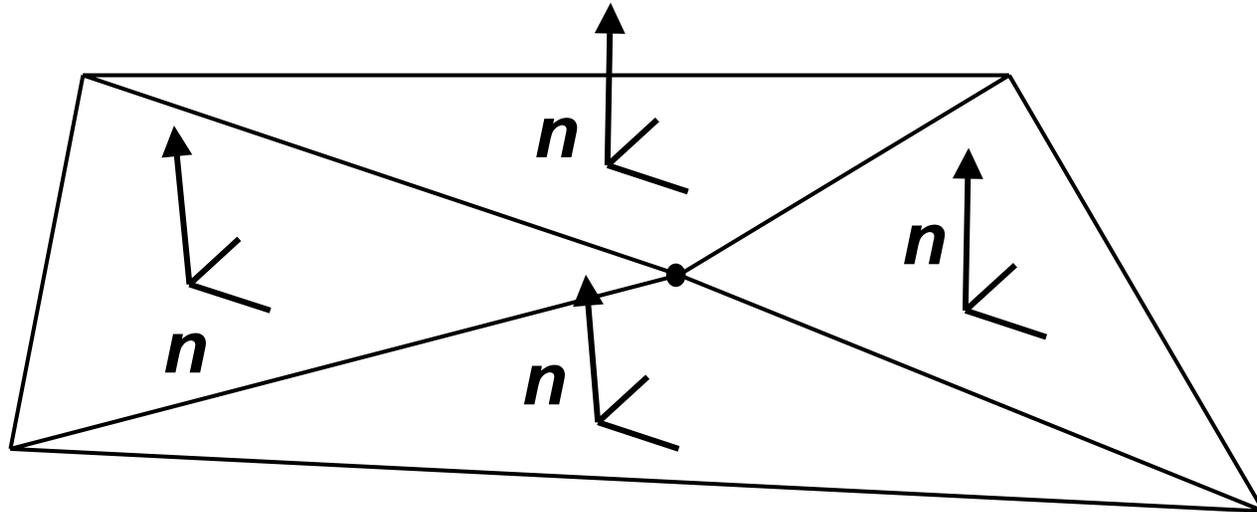


**Create new data sets:
Min, Max, Average**



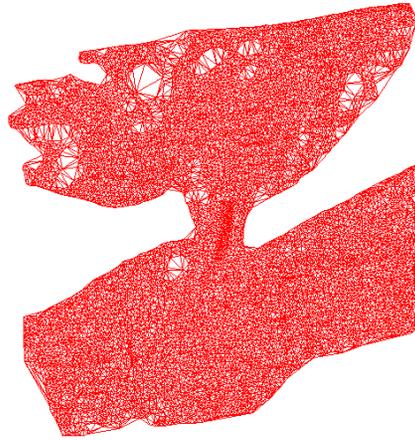
Filtering

- Dot Normals: $n_i \cdot n_j$
- Delete point if all normals within user specified angle



Filtering

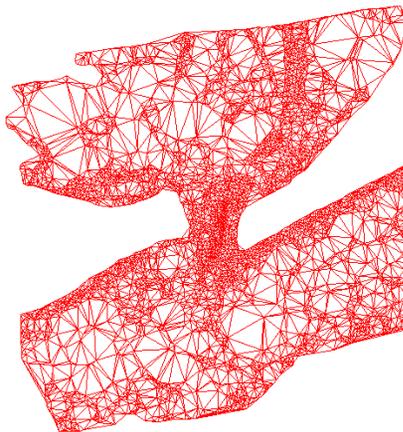
**18,813
points**



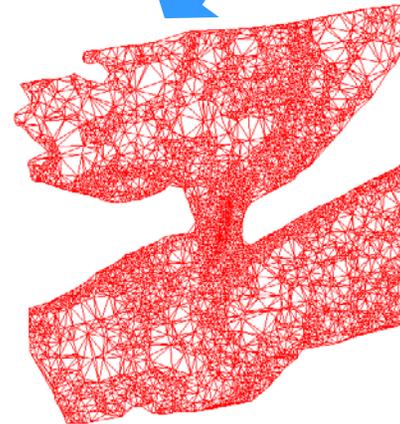
**2° =
15,468
points**



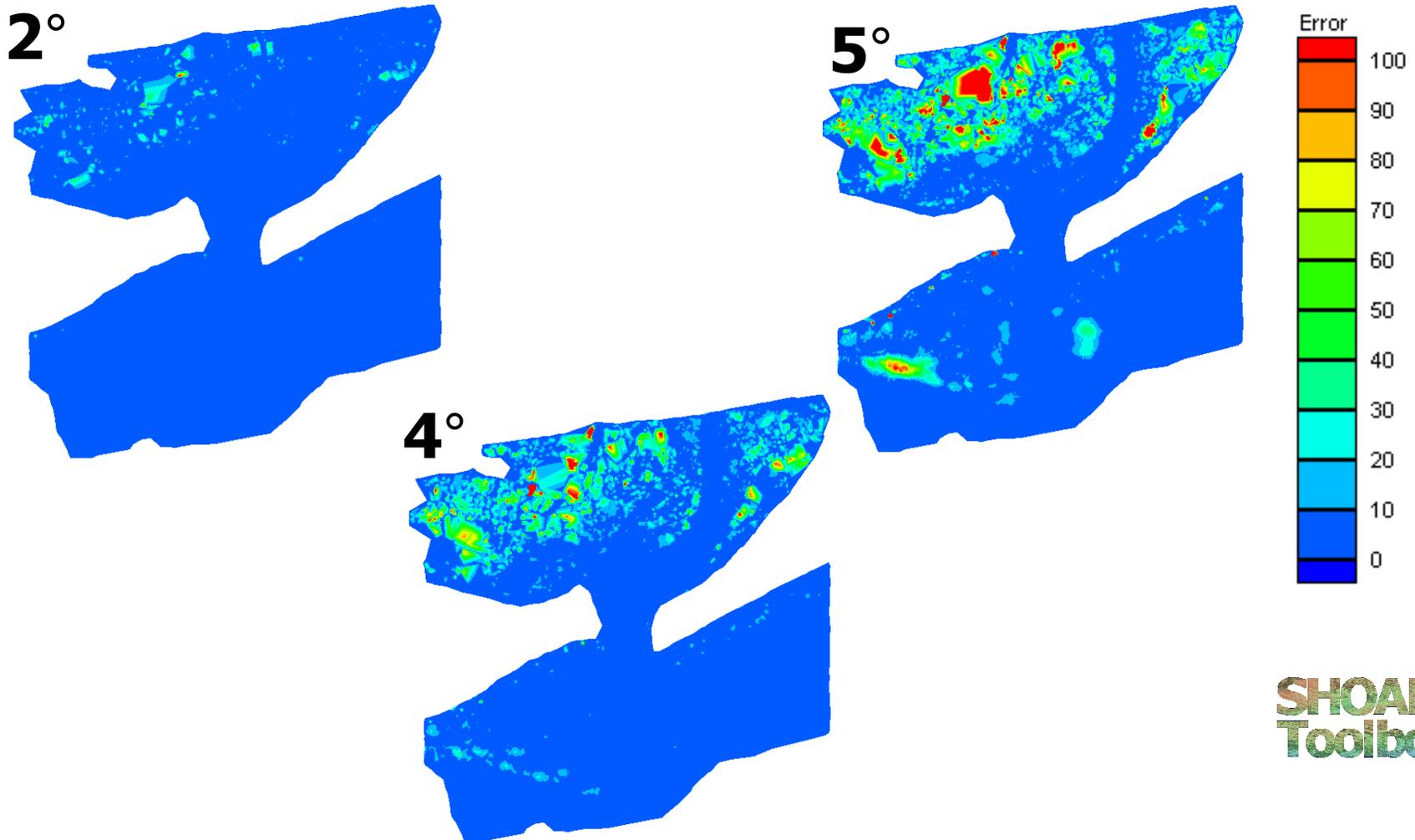
**5° =
5,227
points**



**4° =
7,660
points**



Filtering Error

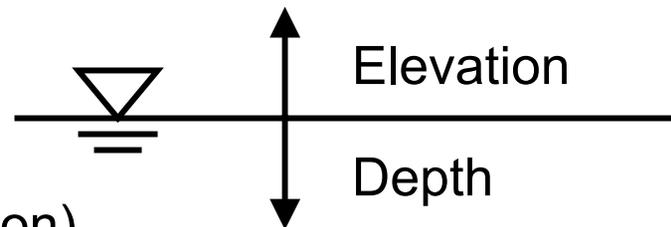


**SHOALS
Toolbox**

Data Transformations

- Supported Transformations

- Translation
- Scale
- Rotation
- Datum Shift (Depth \leftrightarrow Elevation)



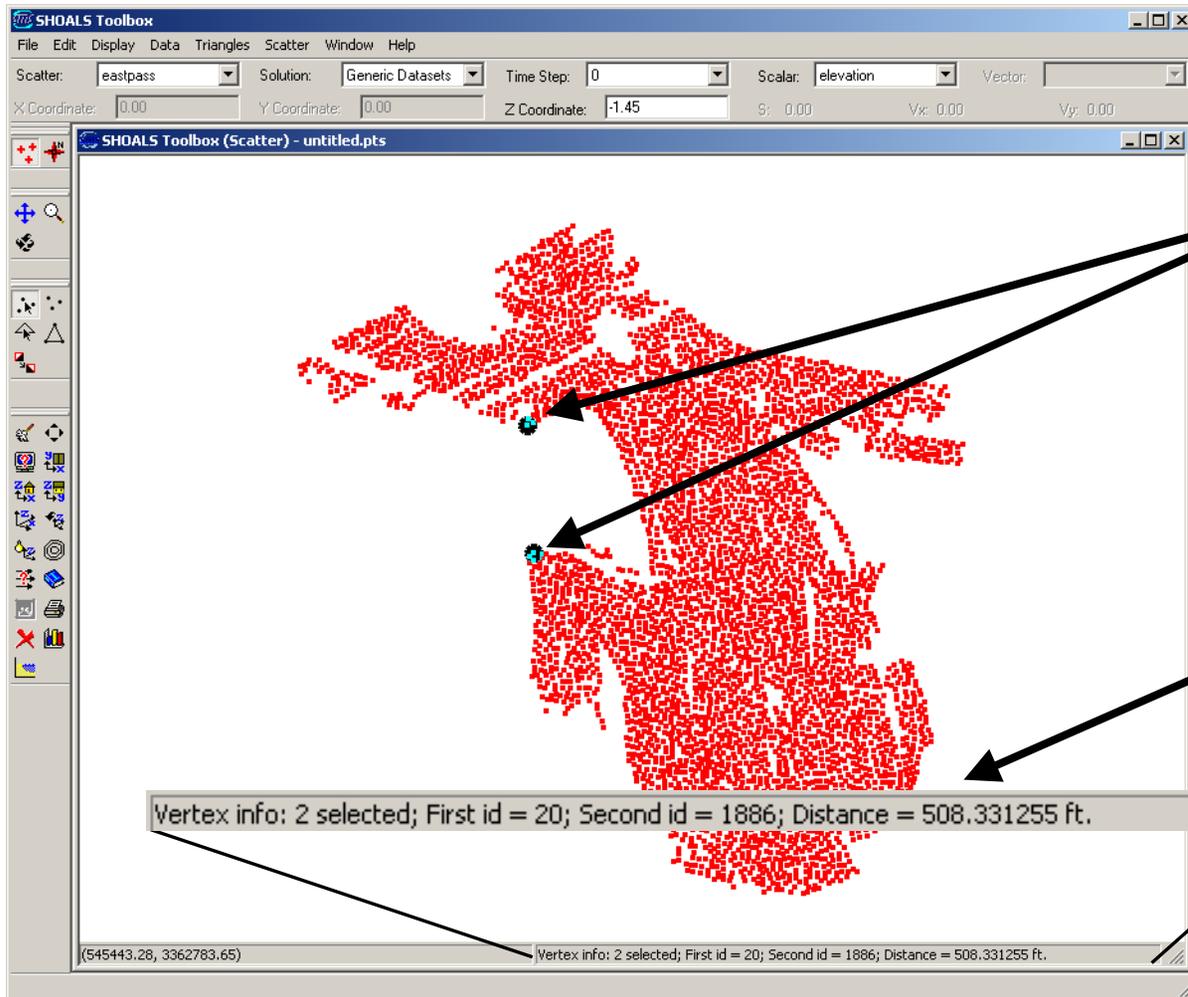
- Applied to selected scatter points or active scatter set

Distance



- Distances between any two selected points
- Based on horizontal coordinate system and units
 - Doesn't mean much in Geographic Coordinates

Distance



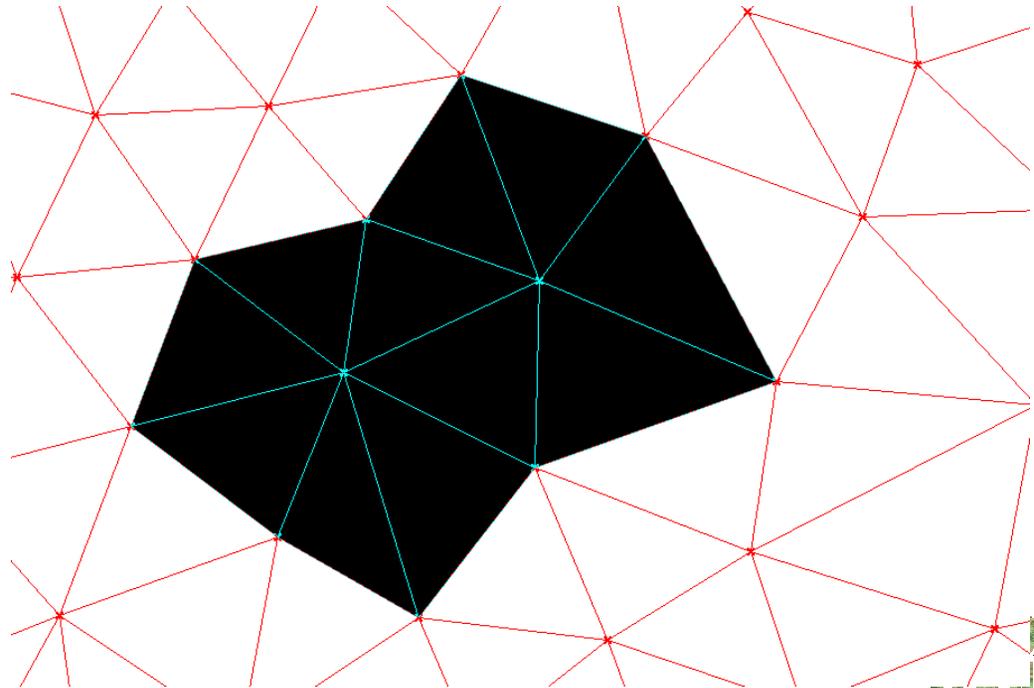
**Points
Selected**

**Distance
Reported**

**SHOALS
Toolbox**

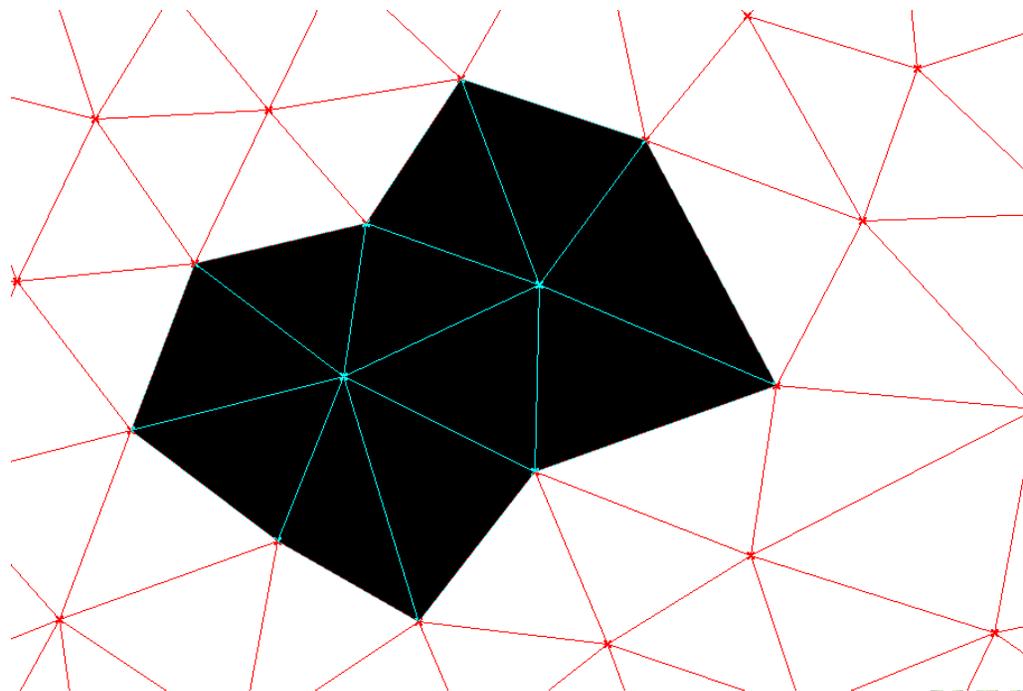
Area

- Calculated from area of selected triangles
- Based on coordinate system

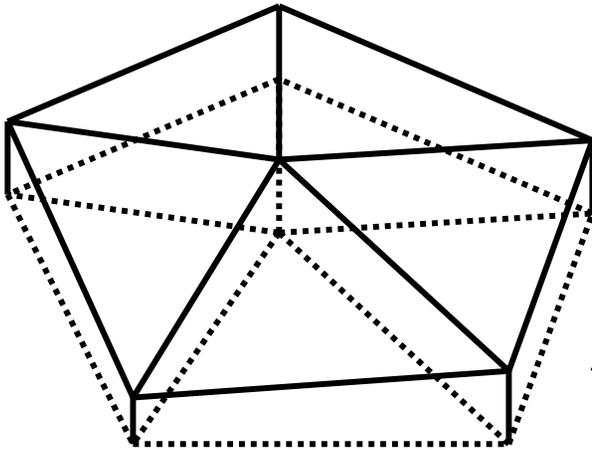


Volume

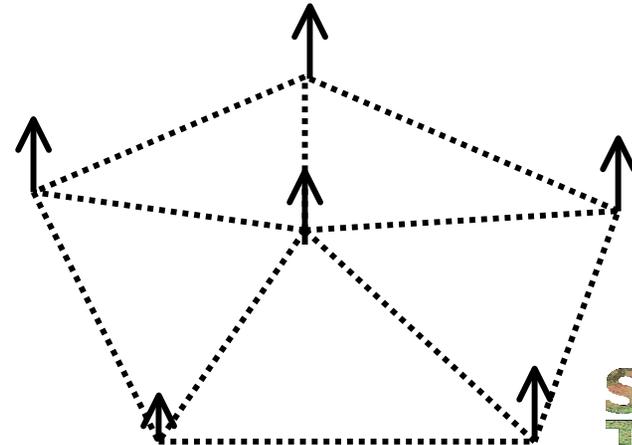
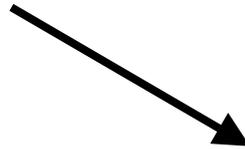
- From selected triangles
- Area from horizontal coordinate system
- Depth
 - from vertical coordinate system
 - average of 3 points on triangle



Volume



Data Calculator



Volume

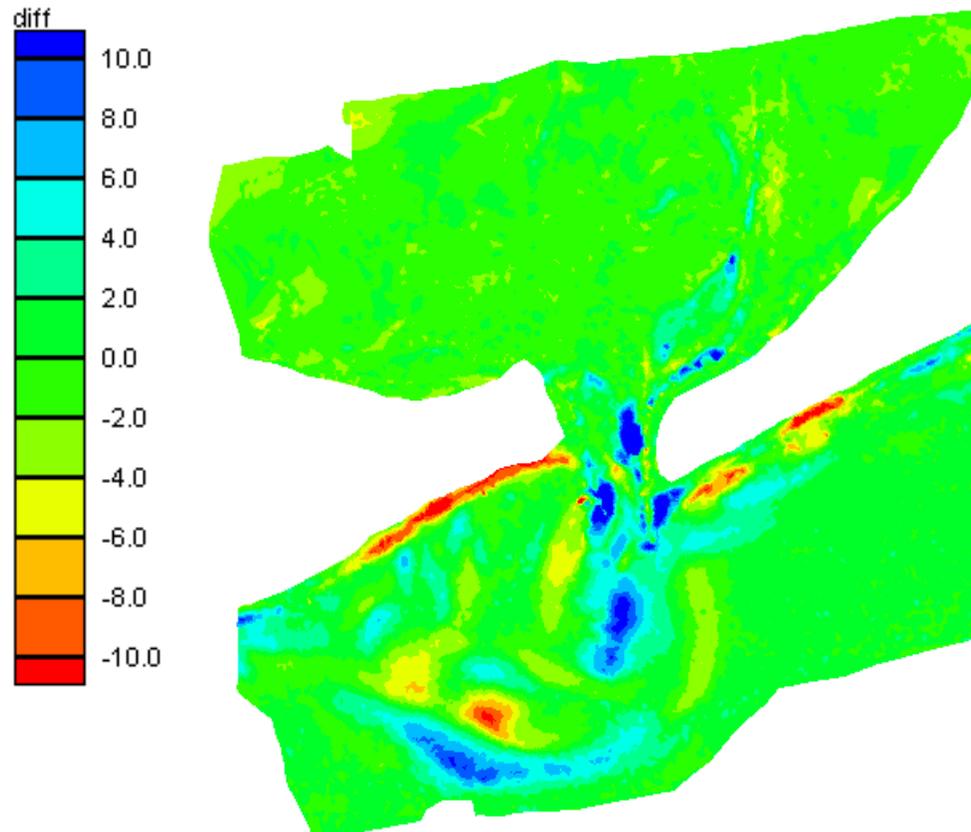


- Two scatter sets
- Interpolate from one set to the other
 - Results in new dataset
- Volume change calculated from difference between datasets

Volume



Subtract two SHOALS sets using Data Calculator



SHOALS
Toolbox

Calculations at Data Points

Create Functions [X]

Geometry Function name:

Grid Spacing

Gradient

Gradient Angle

Directional Derivative

Coastal Function name:

Shallow Wavelength/Celerity Period:

Transition Wavelength/Celerity Period:

Gravity Wave Courant # Timestep:

Gravity Wave Timesteps Courant Number:

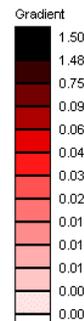
Advective Courant # Timestep:

Advective Timesteps Courant Number:

Harmonic

Gravity:

- Derivatives
- Gradients
- Wavelength
- Spacing (Density)
- Courant Number



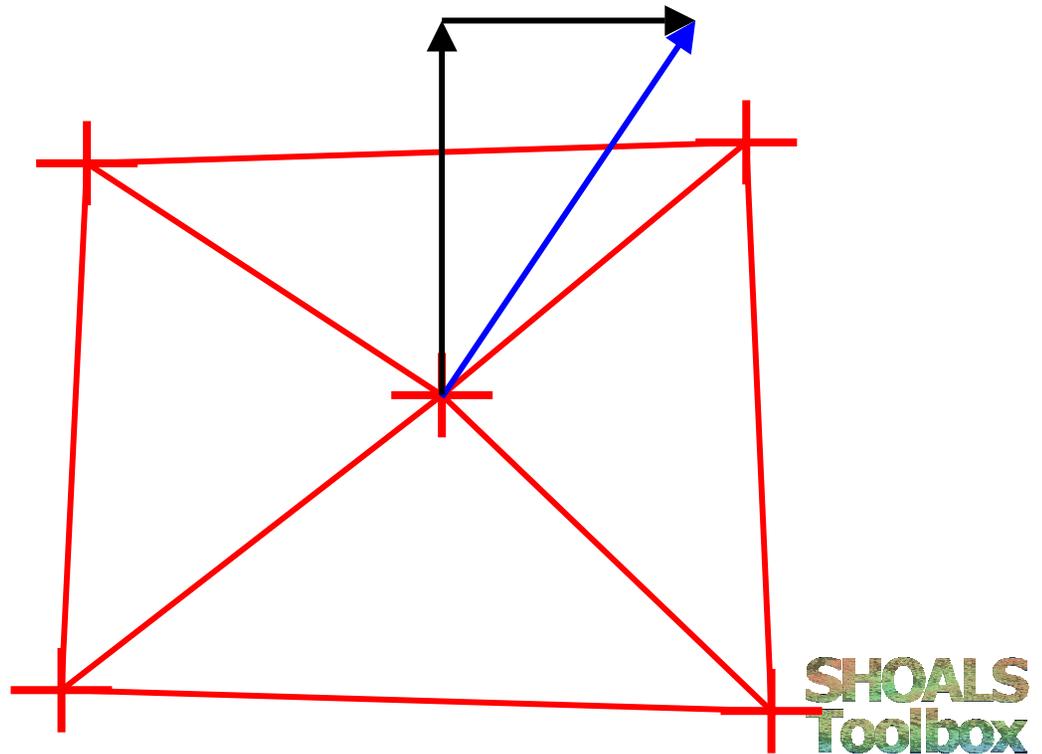
Normal at Scattered Point



- Find equation of plane of surrounding triangles
 - $ax + by + cz + d = 0$
- Get normals (a,b,c)
- Average normals
- Renormalize

Directional Derivative

- X direction = a/c
- Y direction = b/c

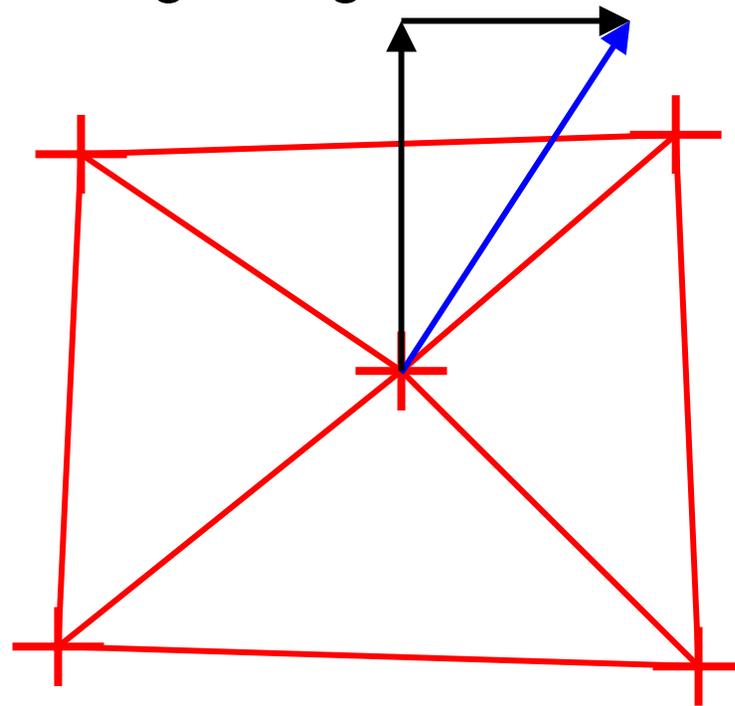


Directional Derivative

- Find equation of plane of surrounding triangles

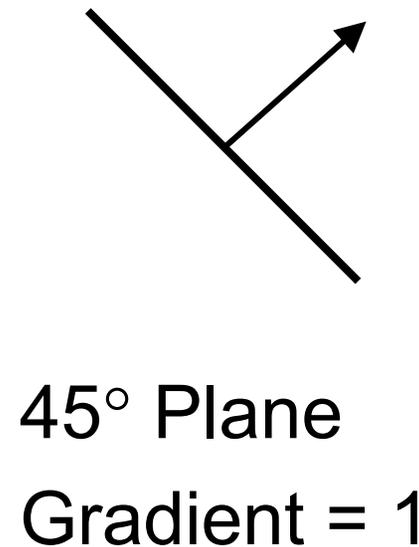
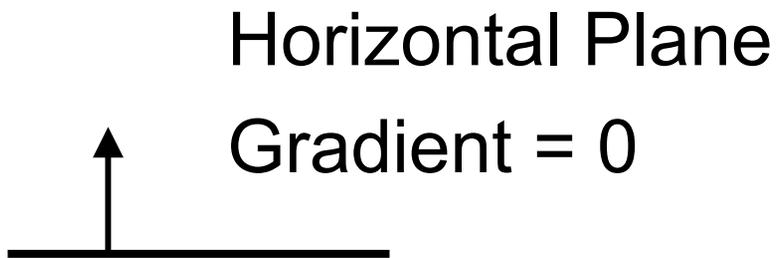
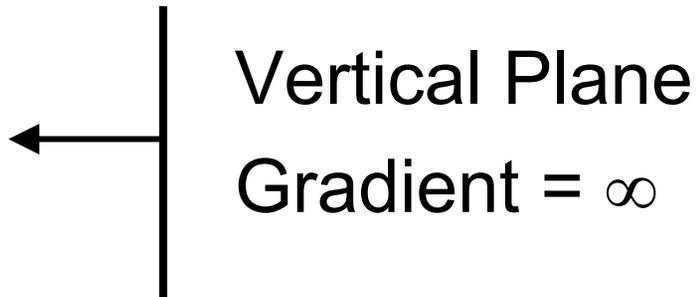
$$ax + by + cz + d = 0$$

- Get normals (a,b,c)
- X direction = a/c
- Y direction = b/c



Gradient

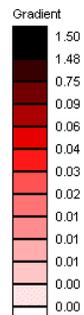
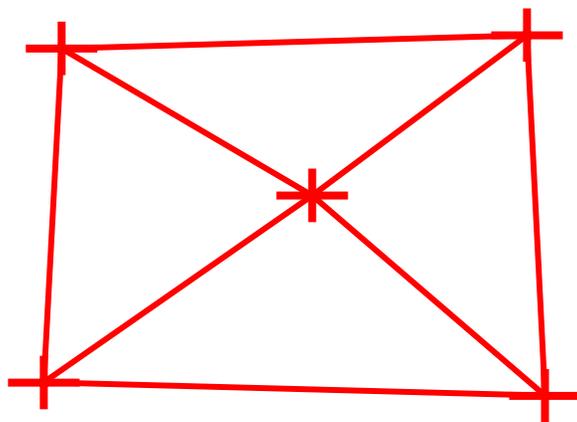
- Run / Rise



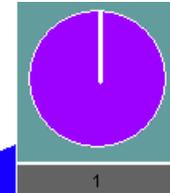
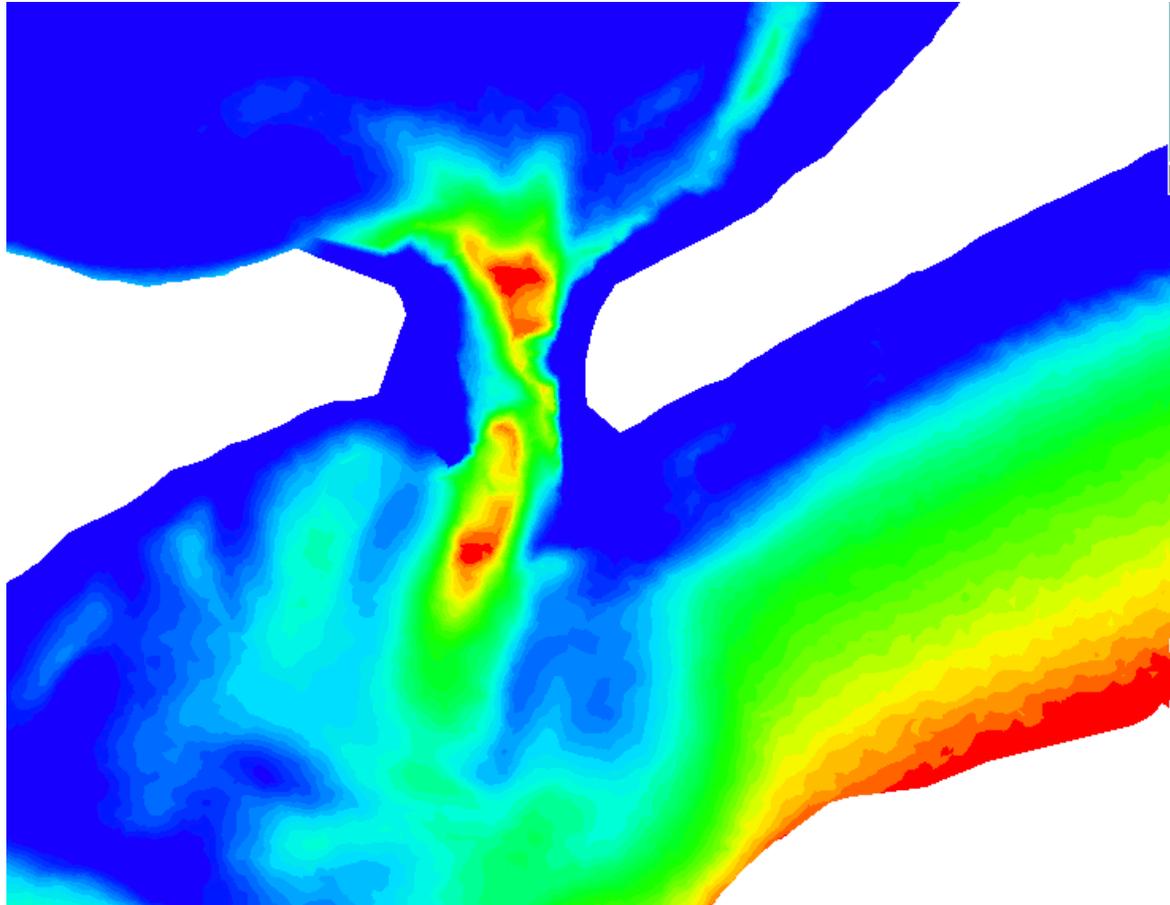
Gradient

- Steepest slope of tangent plane
- Magnitude of Directional Derivative

$$\sqrt{\text{derivative}_x^2 + \text{derivative}_y^2}$$



Film Loop



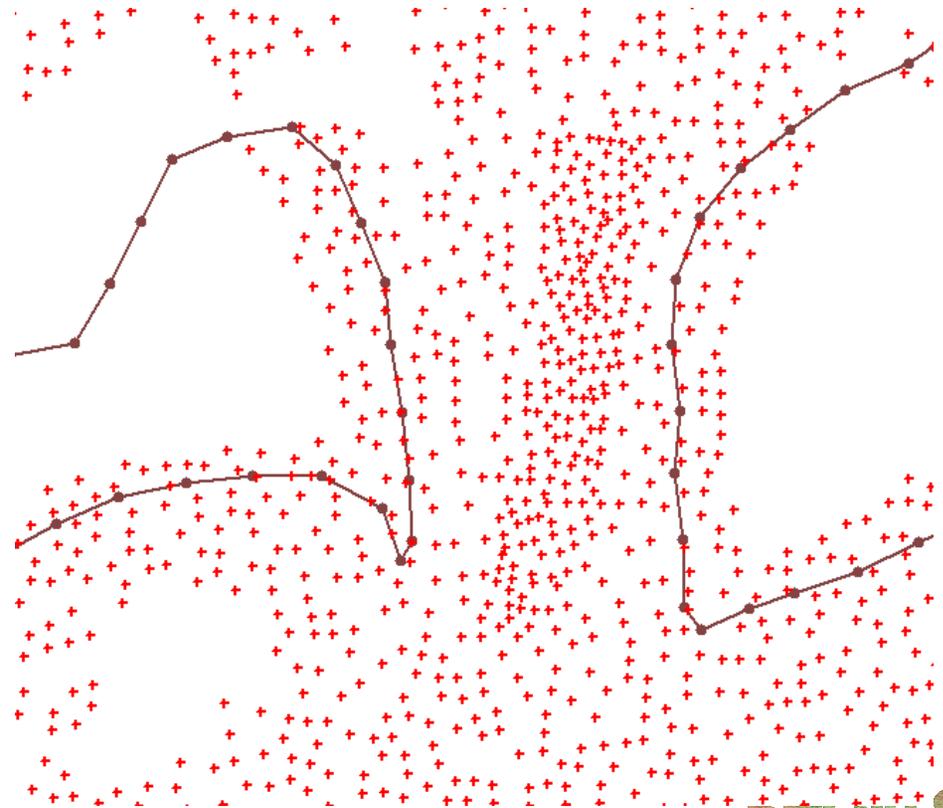
SHOALS Coverage



- Attributes
 - Arc types
 - Coastline
 - Profile
 - Channel / Embankment
 - Points (no attributes)
 - Polygons (no attributes)

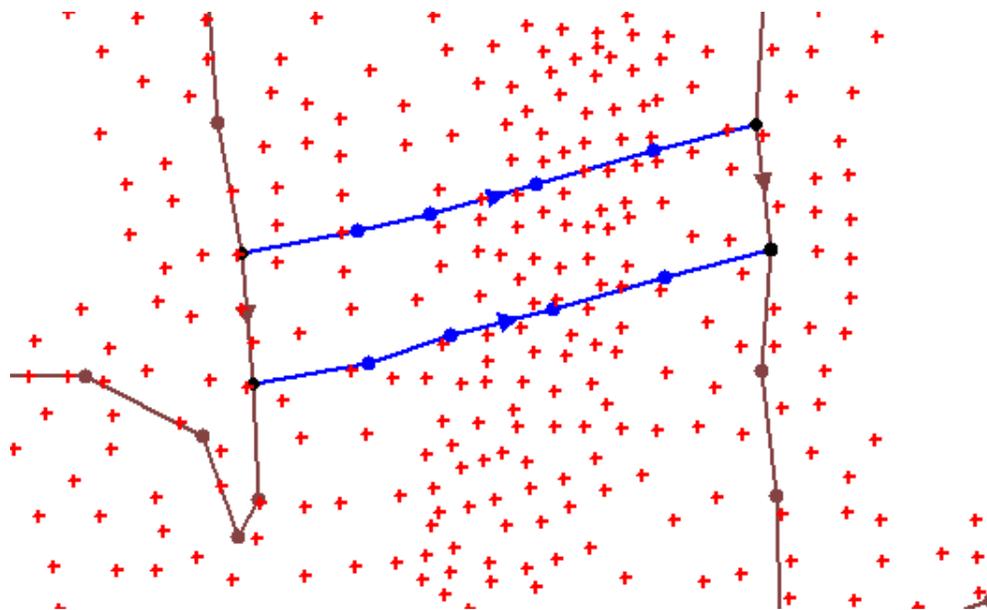
Coastline Generation

- Extracted along a contour at specified depth (0.0)
- Arc created
 - Coastline attribute



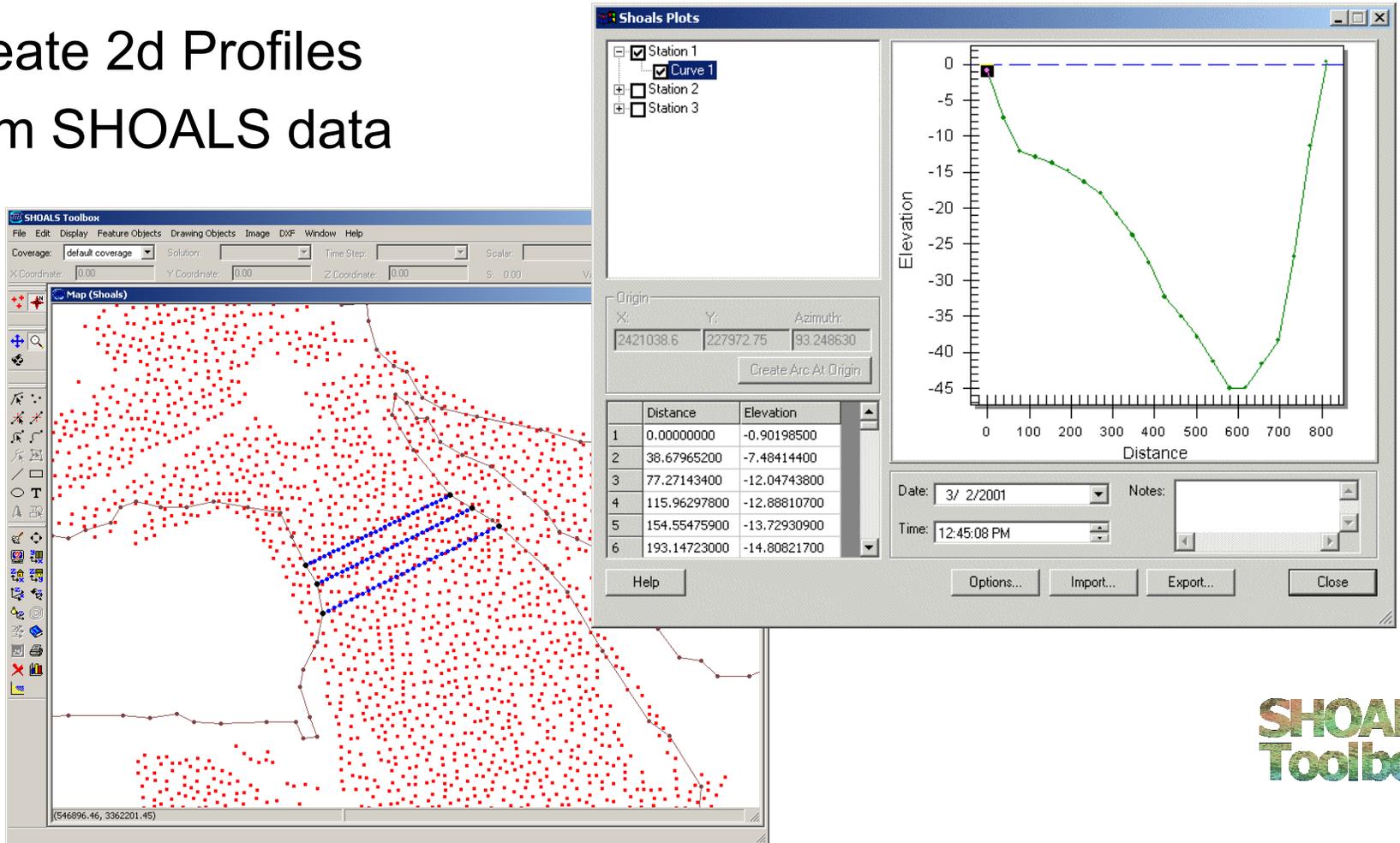
Profiles

- Read from/save to file
- Extract from/compare with SHOALS data
- Plot



Plots

Create 2d Profiles
from SHOALS data





Profile Files

- Contain one or more profiles
- Specify
 - Starting Point
 - Bearing
 - Number of Points
 - Distance, Depths



Profile File Format

PROFILE

2

2421012.612441 228135.682450 356.048536 22

0.0 -0.901985

38.679652 -7.484144

.

.

811.394642 0.328476

2421025.984545 228061.691208 356.895545 21



Profiles in SMS

- Stored in Map Module
 - Process
 - Create SHOALS Coverage if needed
 - Read profiles and create arcs
- Uses
 - Visualization (plots)
 - Map Arcs->SHOALS (2D to 3D)
 - Combine with profiles extracted from 3D data.

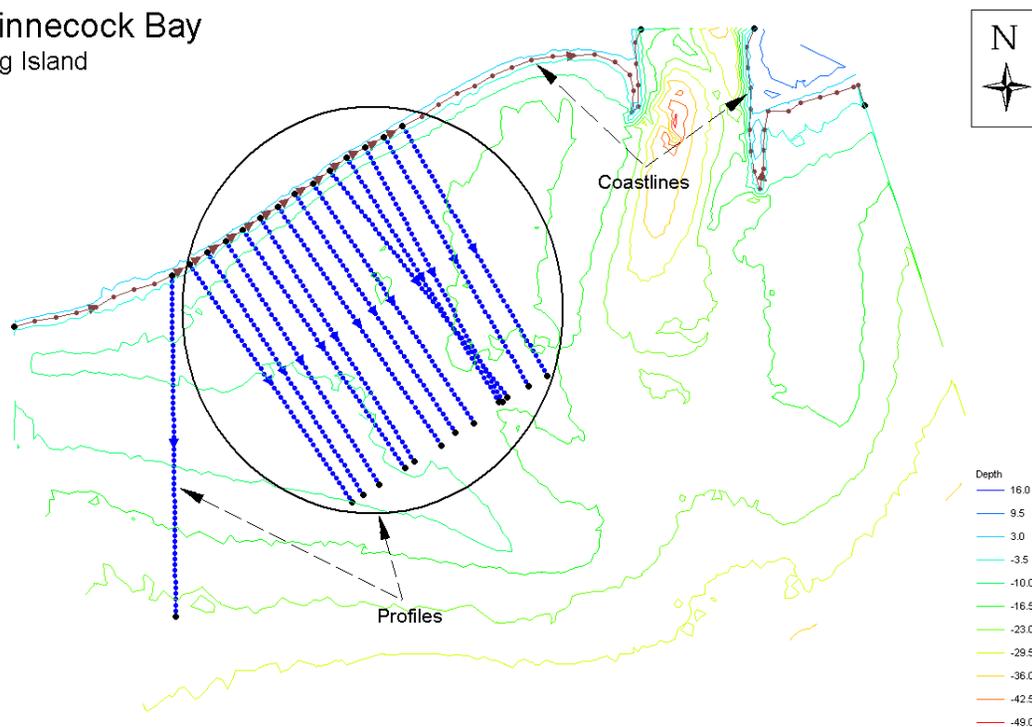
Arcs -> SHOALS



- Scatter data points created at:
 - Node and vertex locations
 - Grid points (interpolation)
- Compare with existing SHOALS data:
 - Map new scatter set to old
 - Find volume change . . .

Drawing Objects

Shinnecock Bay
Long Island



- Annotations
 - Text
 - Lines
 - Circles
 - Squares
 - Symbols

Exporting



- TIF Files - (May be geo-referenced)
 - Aerial photograph
 - Quad sheet
 - Nautical chart
- TIF World Files (TFW)
 - Geo-referencing information
- Image Files
 - Used only by SMS - contains tif data, geo-referencing data, sampling information