Florida and US East Coast Beach Change Metrics Derived from JALBTCX LiDAR Data

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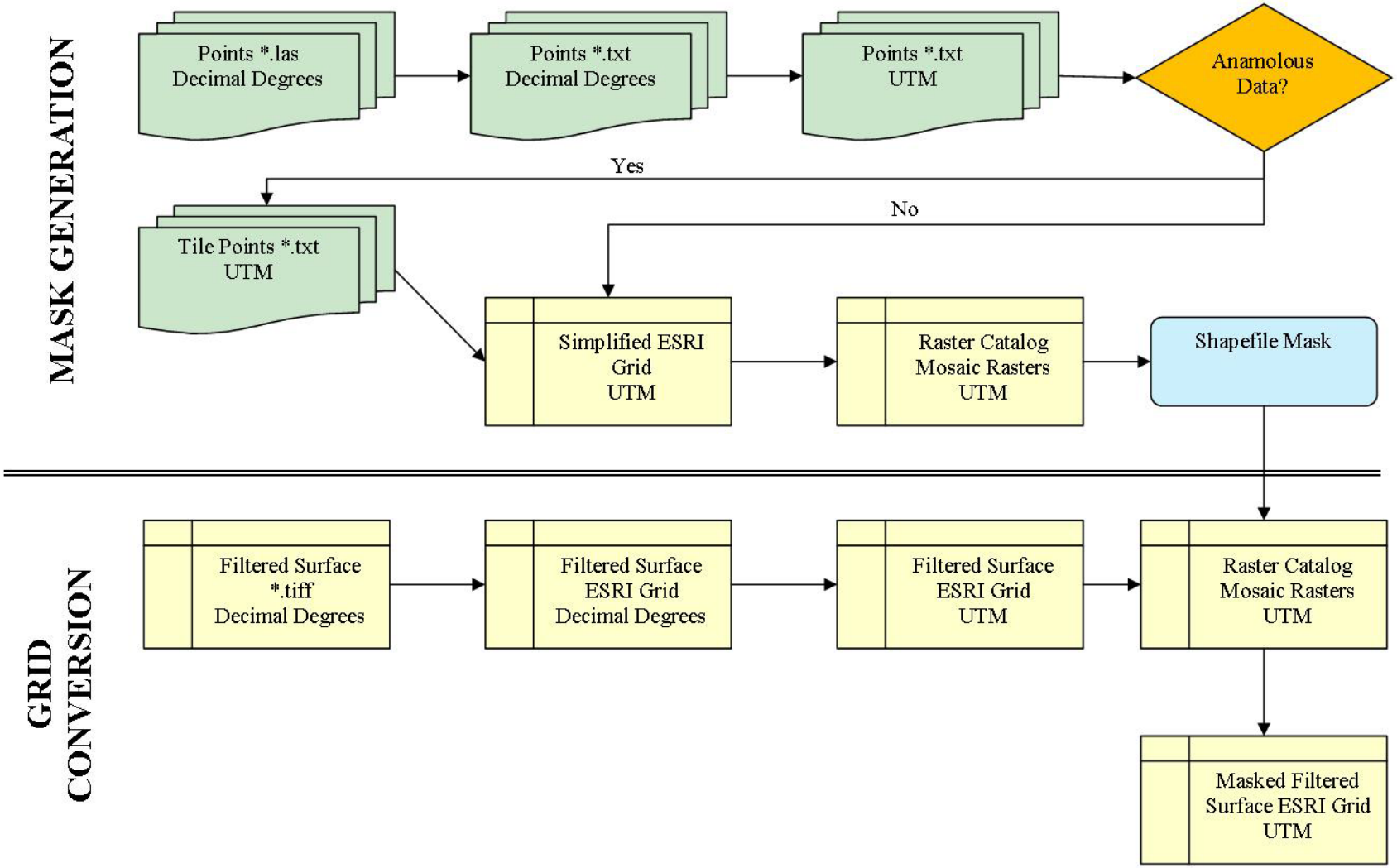
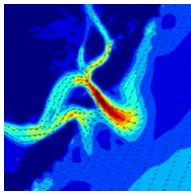
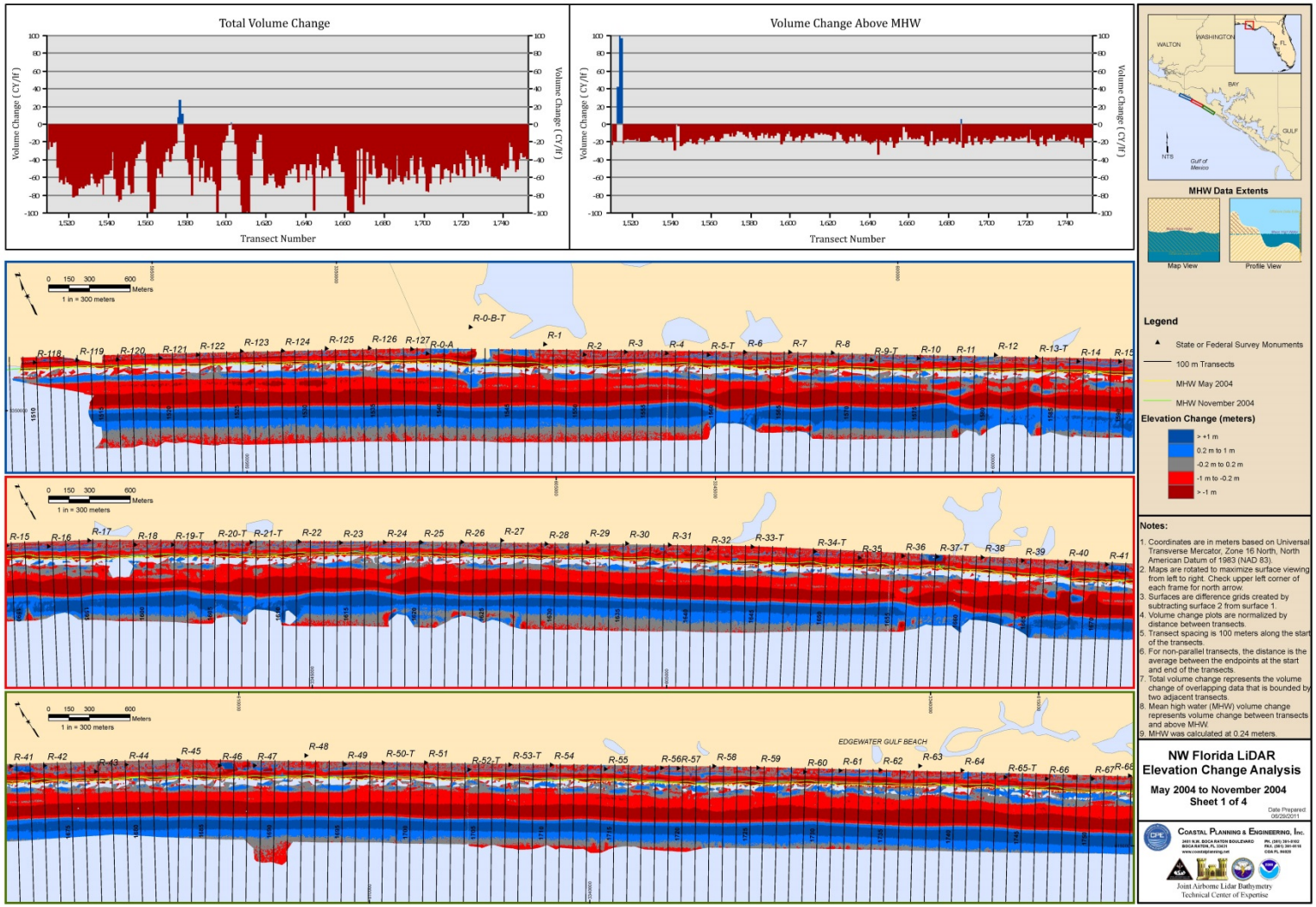
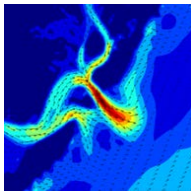
Phases I and II Pre-processing





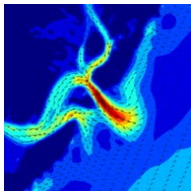
Phase II Volume Change Maps





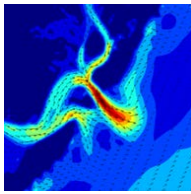
US East Coast Scope of Work

- Maine to Florida/Alabama Border
- Quantify change between repeat datasets on sandy coastlines
  - Total Volume
  - MHW Volume
  - Shoreline Change
- Describe wave environment that caused change
- Develop tools to aid in future incorporation of USGS metrics



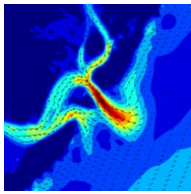
Existing Data

Geographic Area	Number of Overlapping 5 km Boxes	Start Date	End Date
Maine	22	10/19/2005	6/19/2010
New Hampshire	5	6/6/2007	6/20/2010
Massachusetts	66	11/11/2005	5/26/2010
New York	43	10/26/2005	8/13/2010
New Jersey	40	9/2/2005	8/28/2010
Delaware	7	9/3/2005	9/11/2010
Maryland	9	9/3/2005	8/2/2010
Virginia	17	9/8/2005	7/28/2010
Northern North Carolina	53	9/28/2005	8/16/2009
Southern North Carolina	50	9/28/2005	5/4/2010
South Carolina	59	1/13/2006	5/4/2010
Georgia	32	1/13/2006	5/4/2010
Northeast Florida	61	7/1/2004	5/4/2010
Southeast Florida	39	6/1/2004	8/31/2009
Florida West Coast	60	6/1/2004	6/20/2010
Eastern Northwest Florida	8	6/1/2004	2/26/2009
Western Northwest Florida	0	11/22/2004	6/20/2010

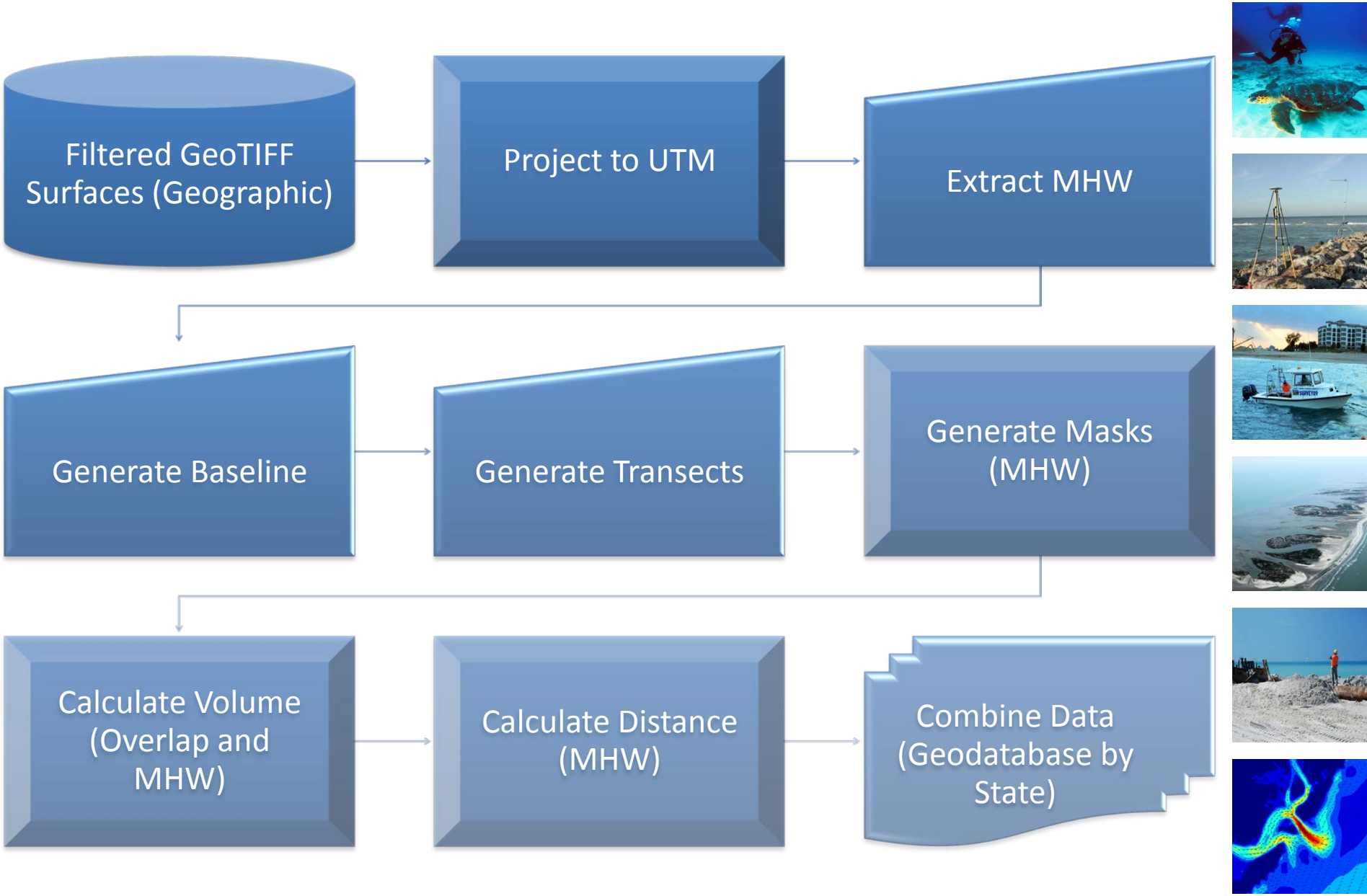


Phase II Limitations

- Point level
- Additional products – not utilizing JALBTCX final products
  - 5 km filtered surfaces
- Mosaic size prohibitive
- Black box
- No versioning
- Manual data tables
  - Difficult to QC
- VB – not ESRI supported
- Lazy
- NEED A CENTRALIZED QUANTIFICATION SYSTEM THAT TAKES ADVANTAGE OF ESRI'S SPATIAL AND DATABASE STRENGTHS



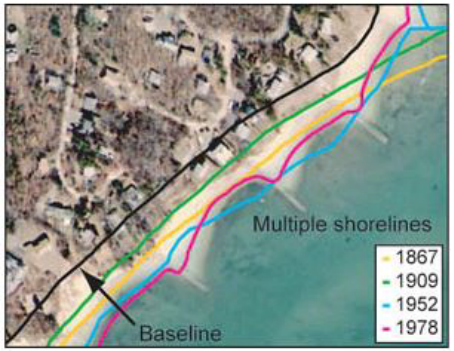
East Coast Data Model – Python JALBTCX Toolset



DSAS
DIGITAL SHORELINE ANALYSIS SYSTEM

DIGITAL SHORELINE ANALYSIS SYSTEM

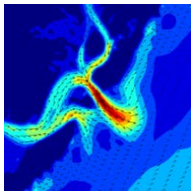
Computer Software for Calculating Shoreline Change (and other problems dealing with the positional change of a boundary over time)



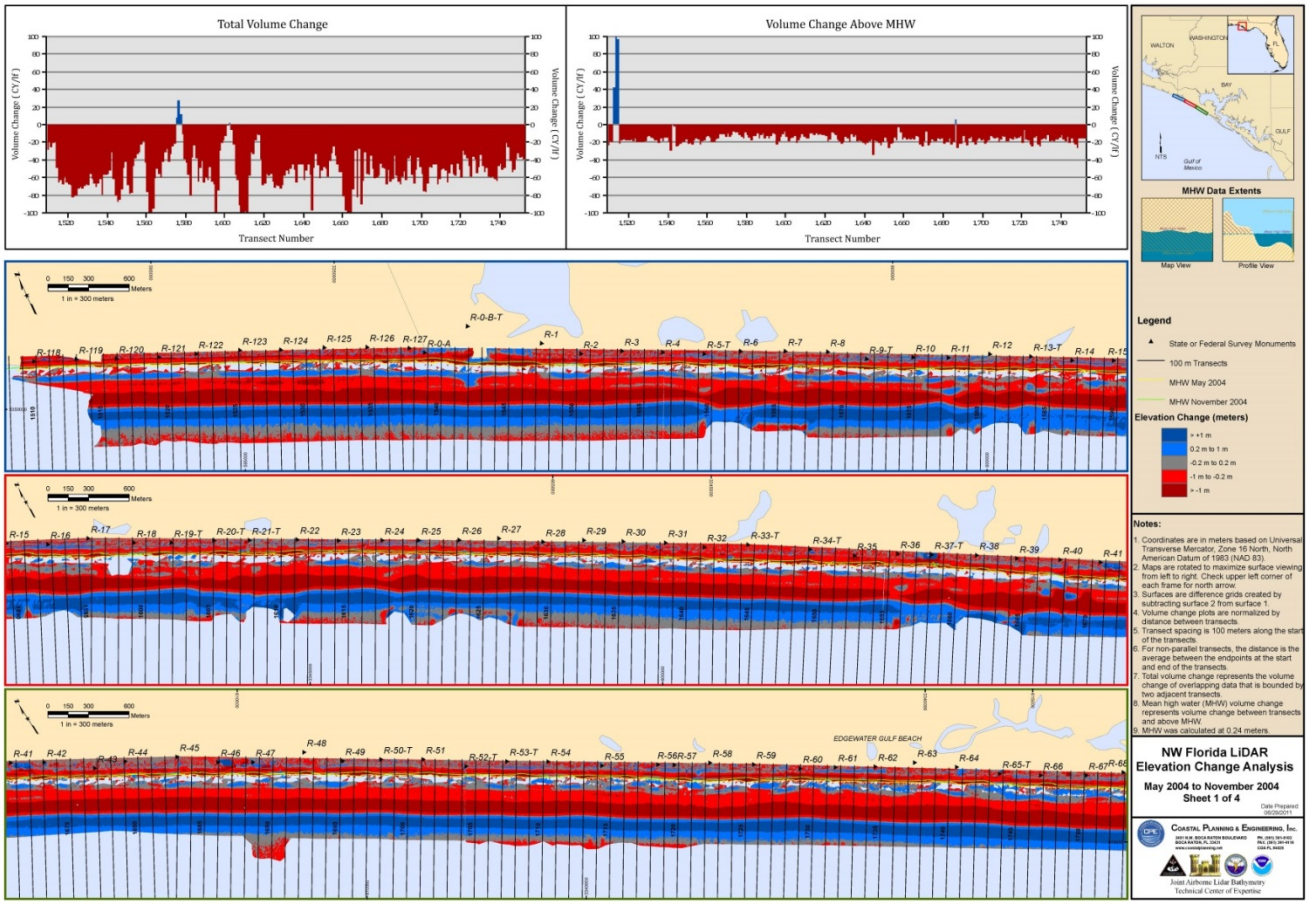
The Digital Shoreline Analysis System (DSAS) is computer software that computes rate-of-change statistics from multiple historic shoreline positions residing in a GIS. It is also useful for computing rates of change for just about any other boundary change problem that incorporates a clearly-identified feature position at discrete times.

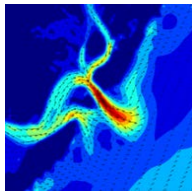
The DSAS software is freely available.

Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 4.0— An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-1278.



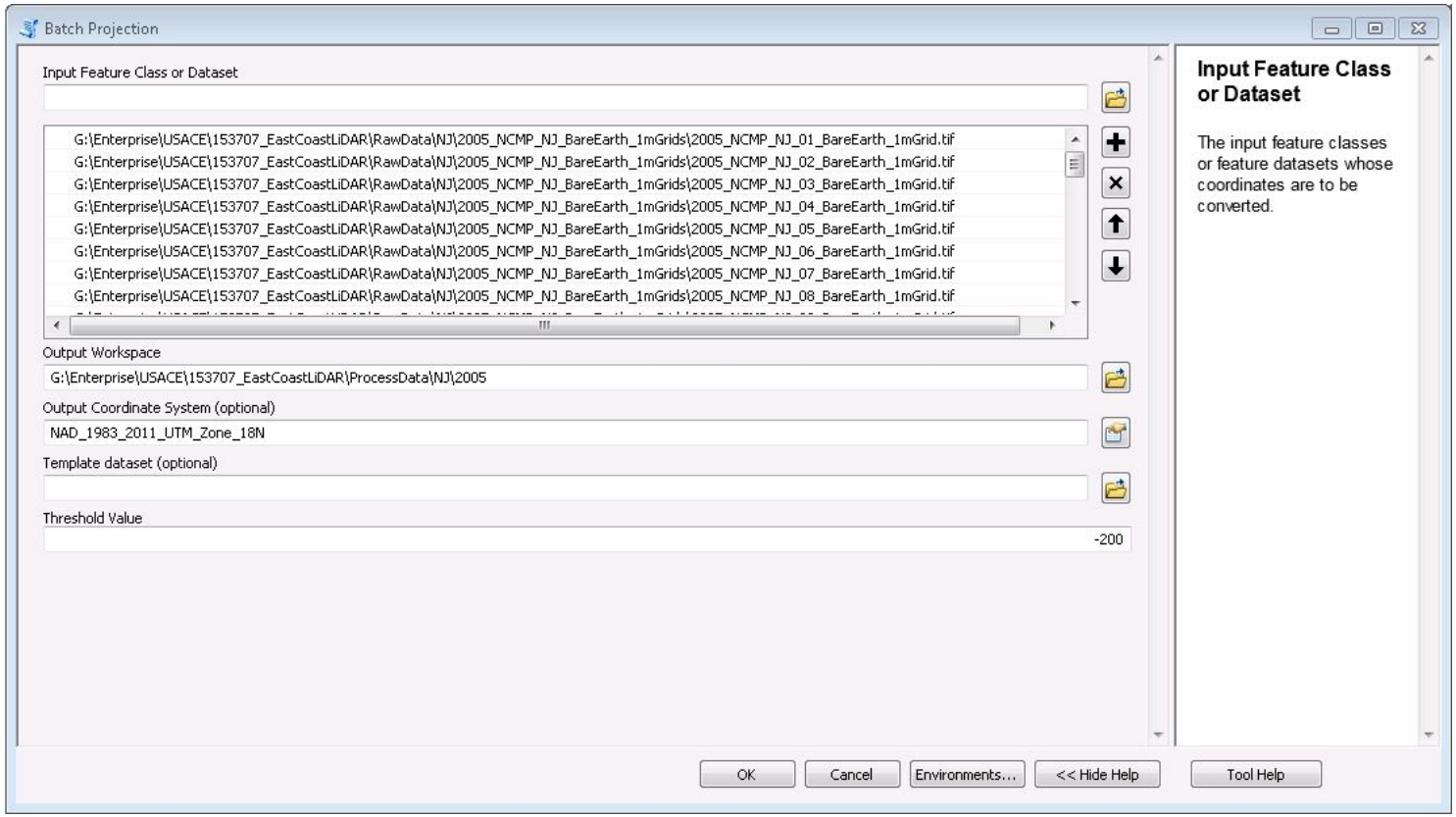
Previous Tools: Metric Mapping

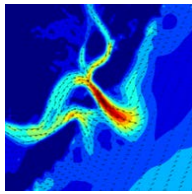




Python Toolkit

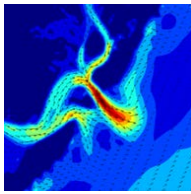
Batch Projection



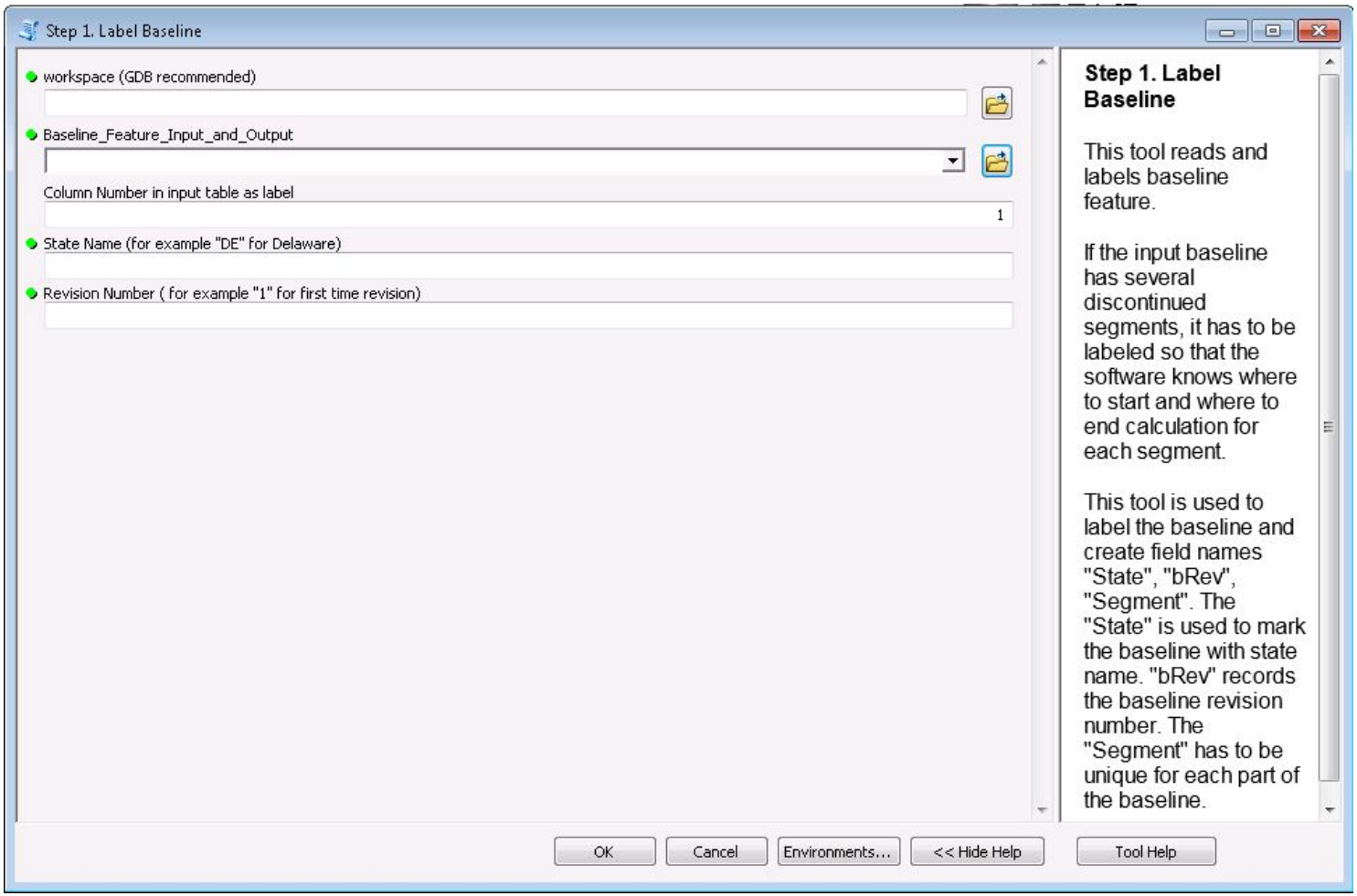


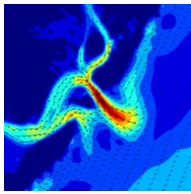
Digitize Baseline

- Manual Digitization
  - North to south
  - West to east
  - Straight lines yield more linear (equal area) results
  - Landward limit of quantification
  - Minimize buildings and vegetation
  - Capture active change profile including dunes
  - Landward to satisfy long term change
  - Reviewed/edited based on recent aerials
  - Confirmed with LiDAR data
  - Iterative process
- Automated Tool
  - No overlapping bins
  - Net volume accurate/maintained
  - Transects clipped by baselines or preceding transects

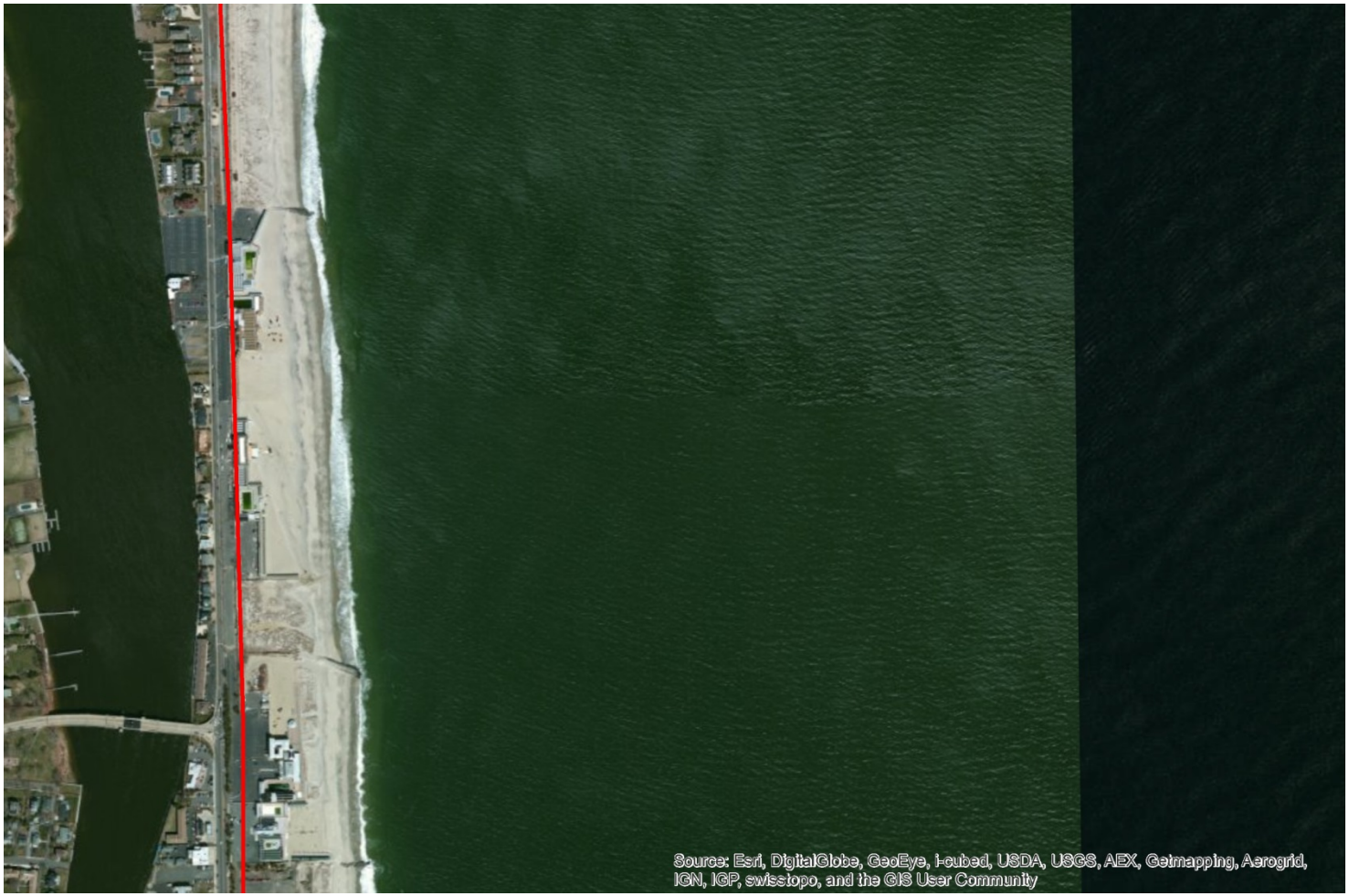


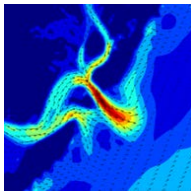
Label Baseline



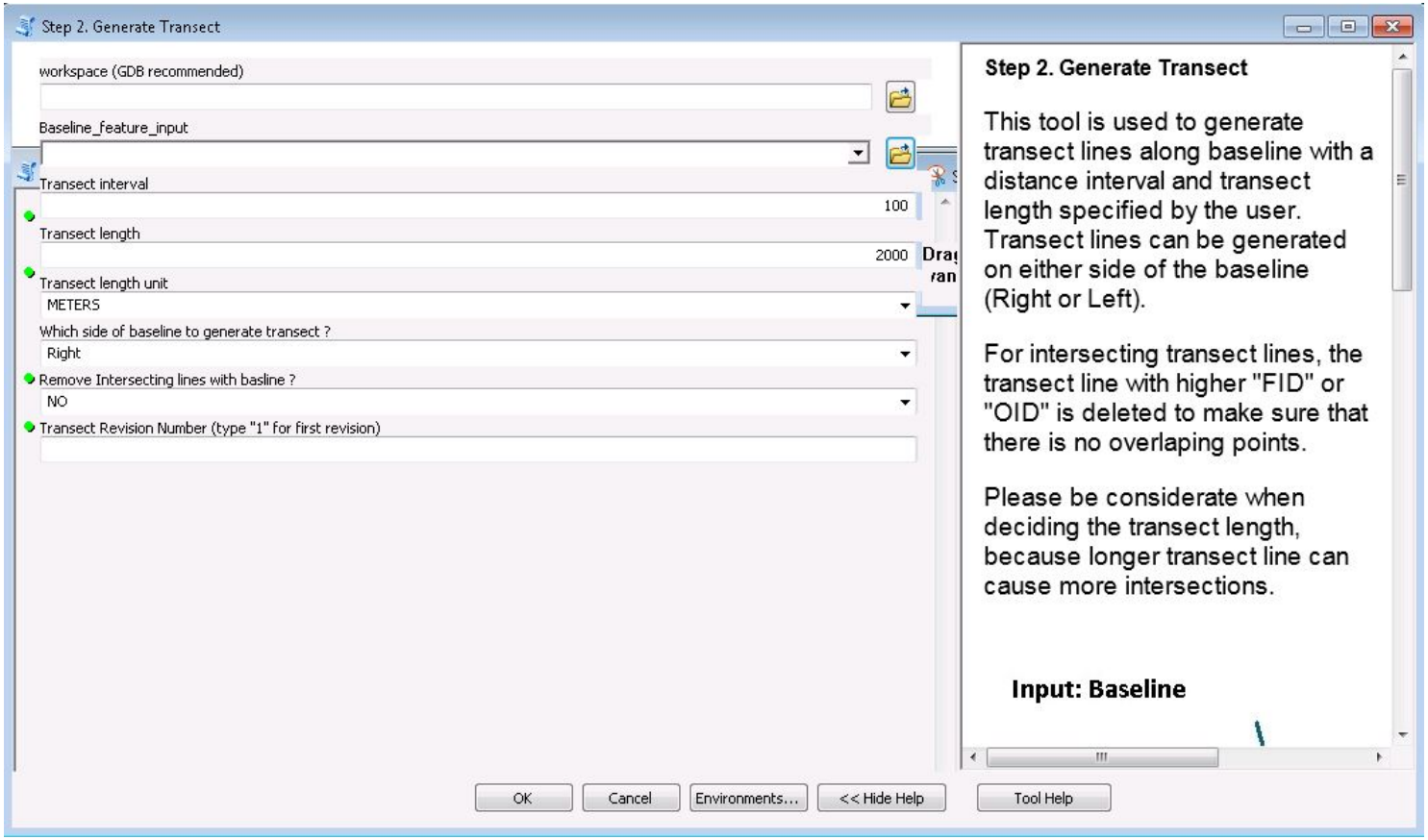


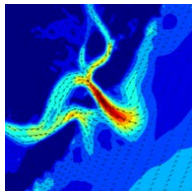
Digitize Baseline



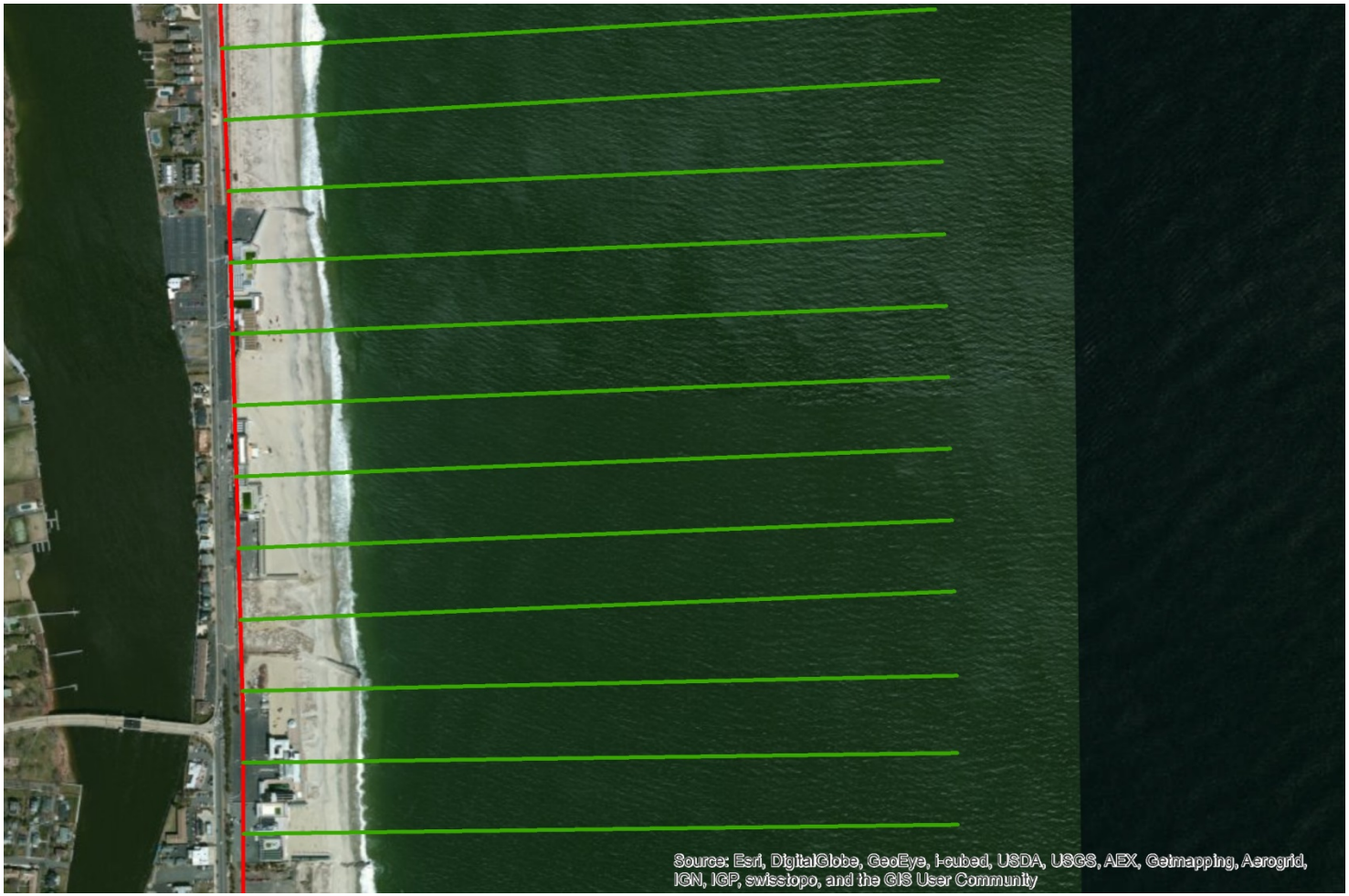


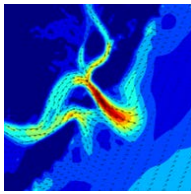
Generate Transect



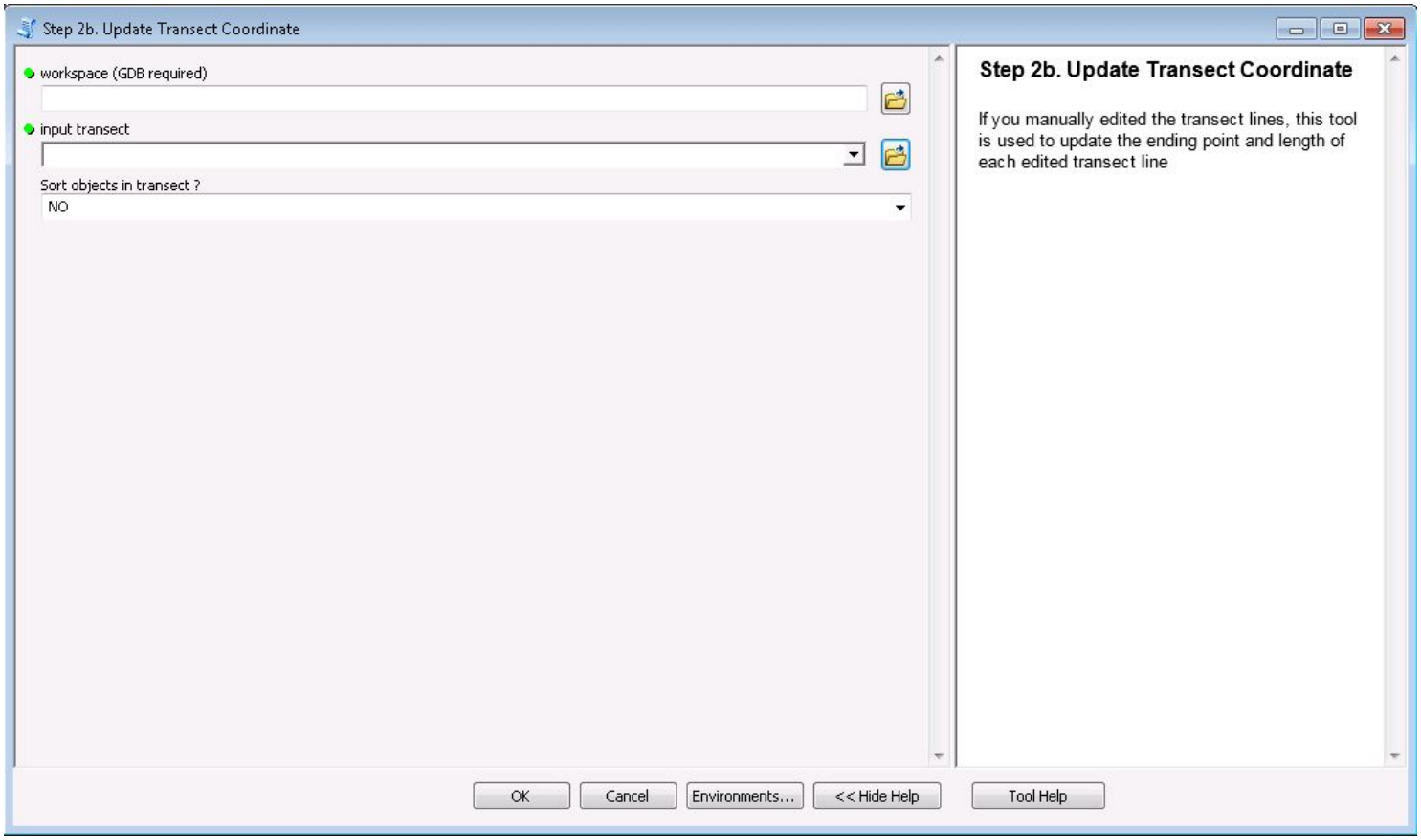


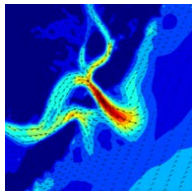
Transects


Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

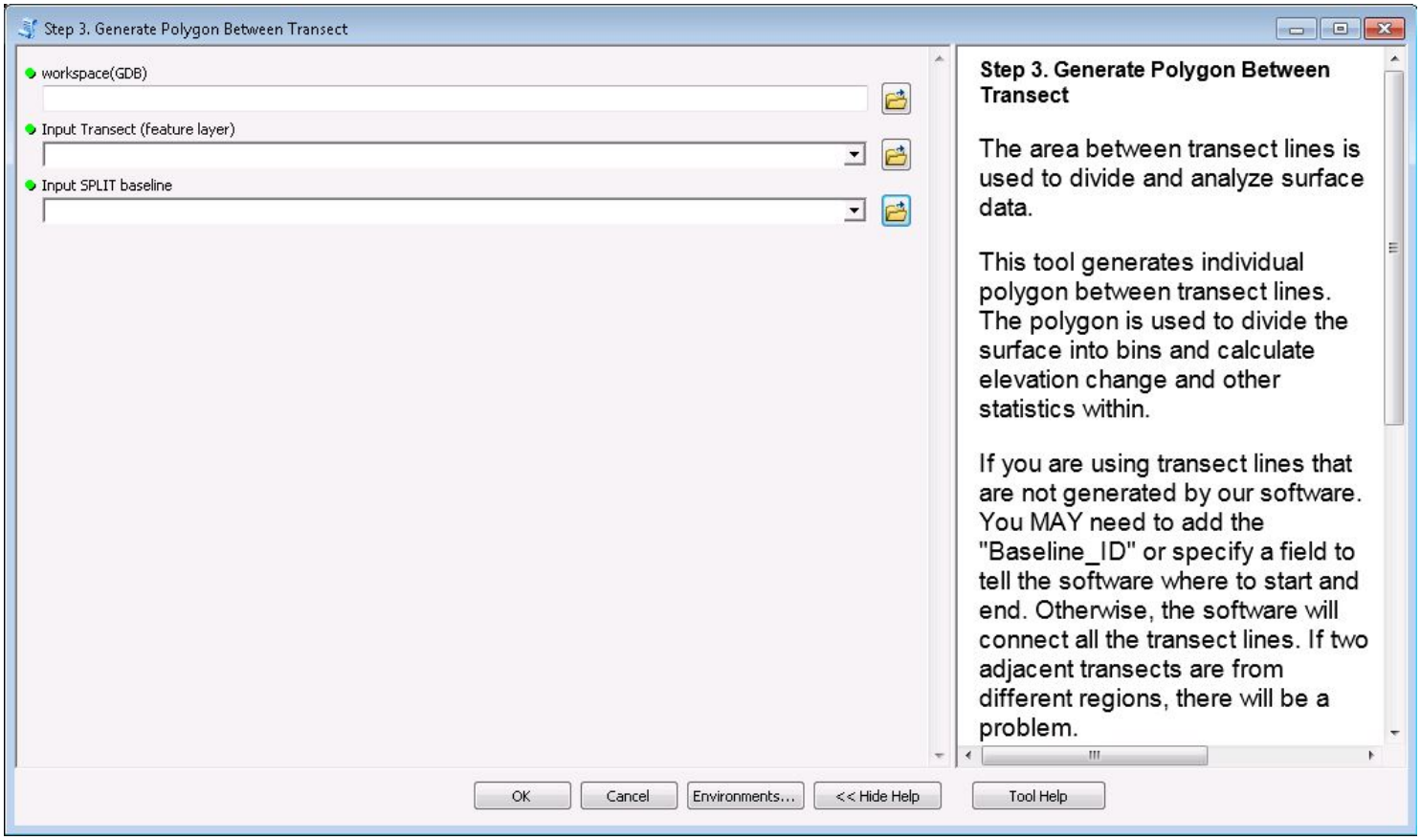


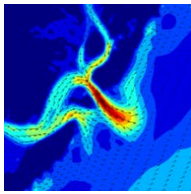
Update Transects



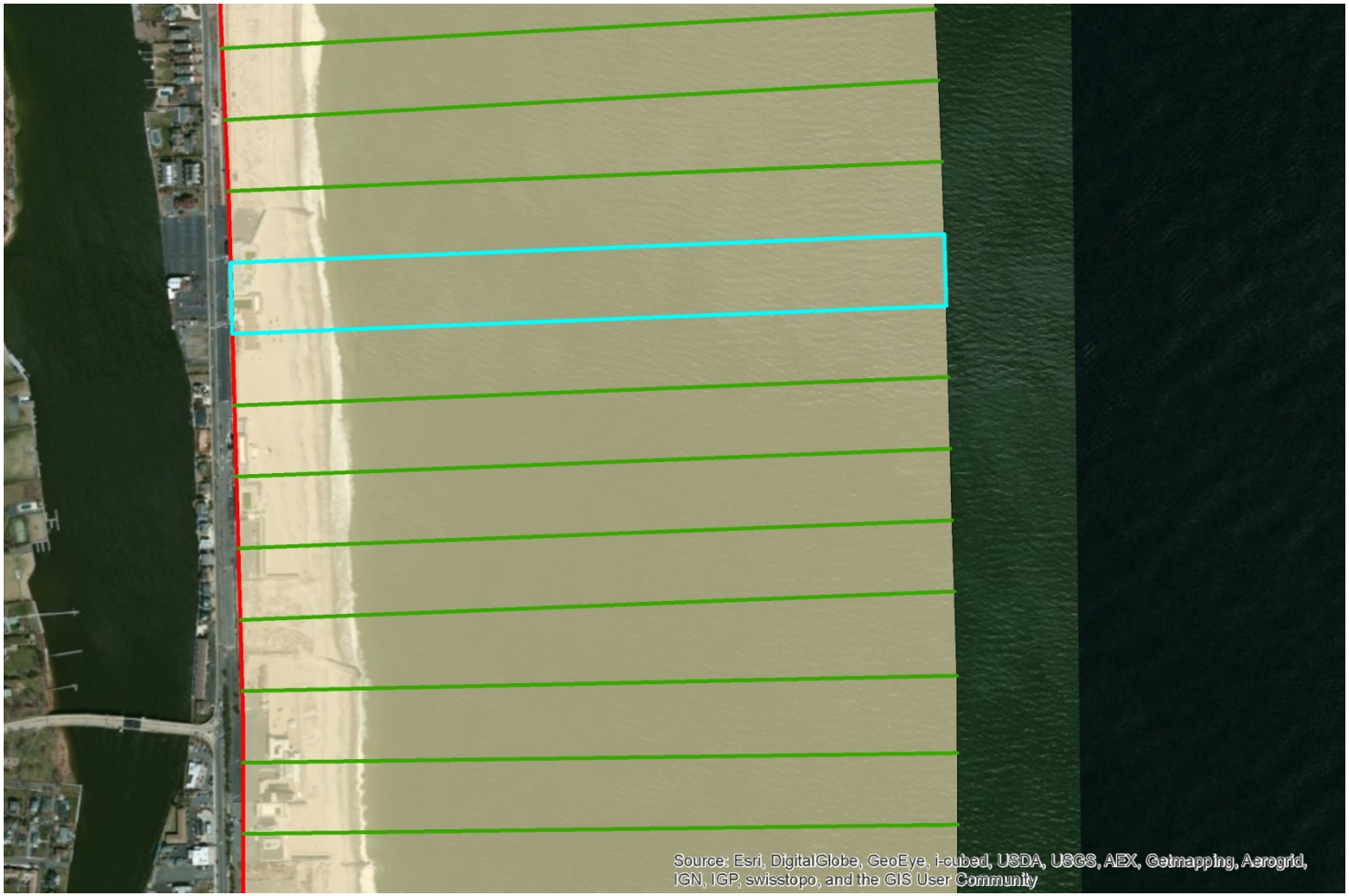


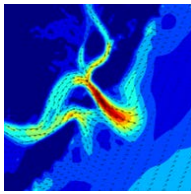
Generate Mask



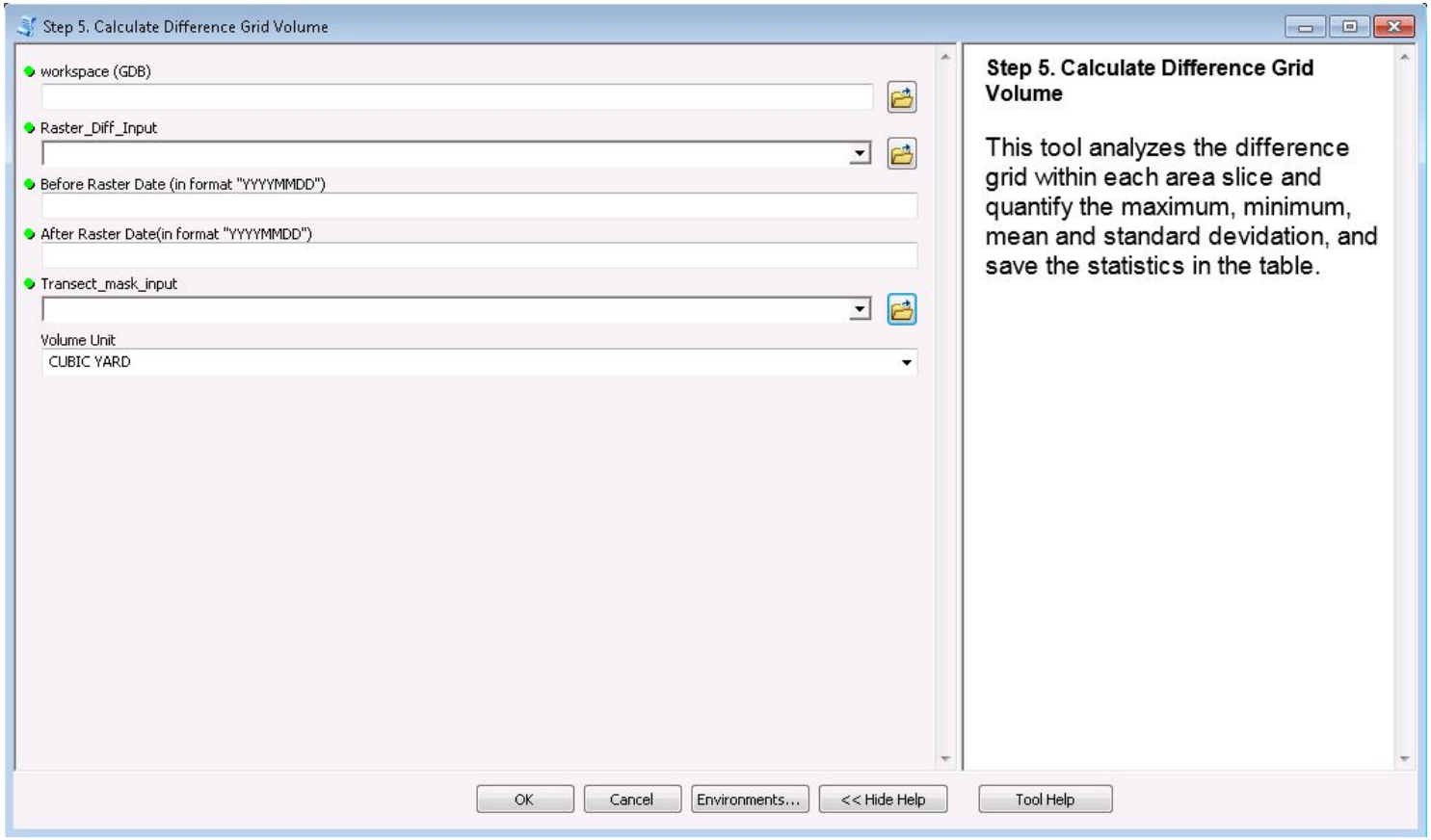


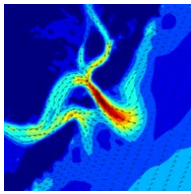
Transect Mask



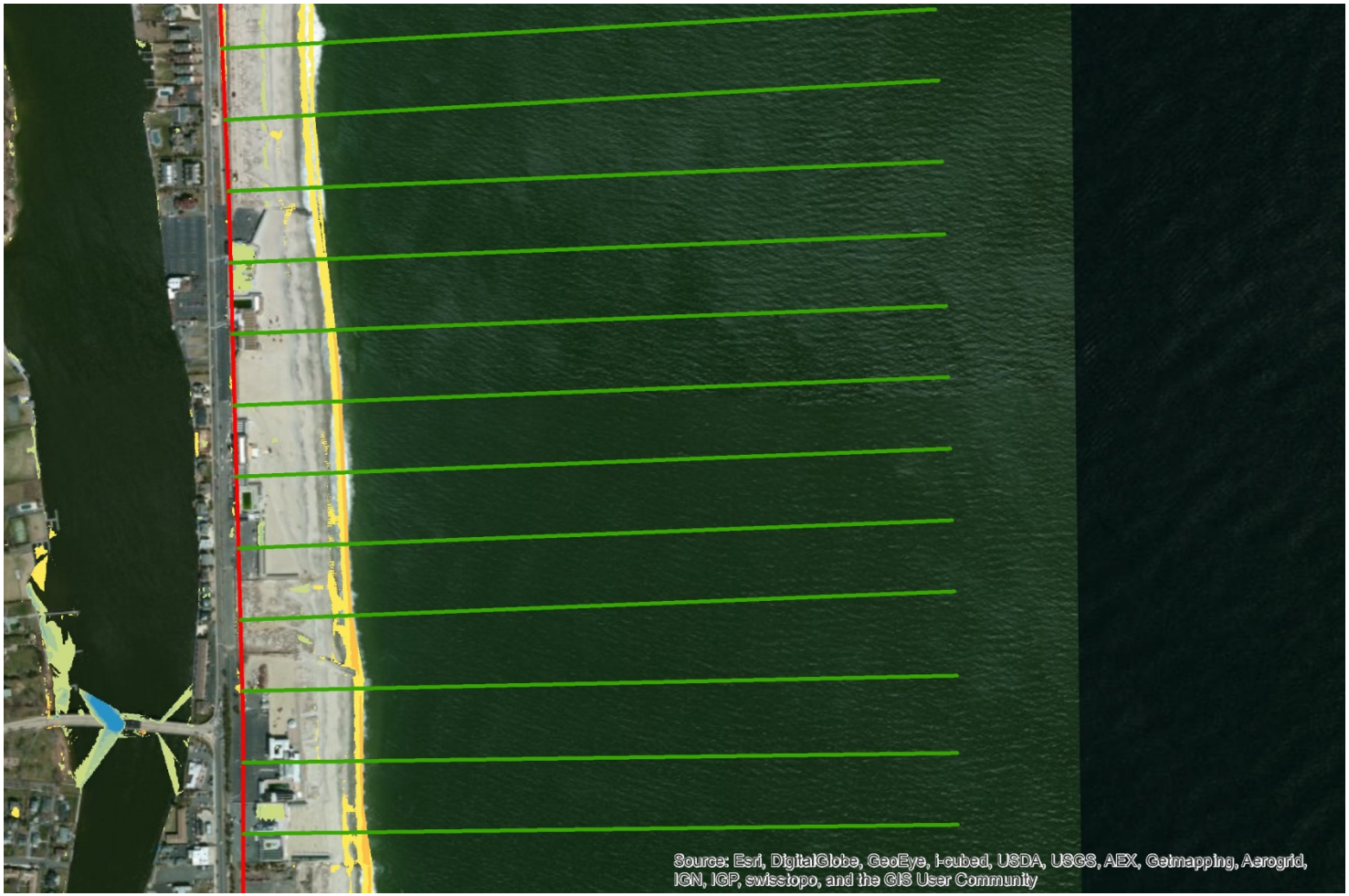


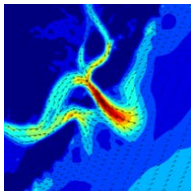
Overlap Volume Change

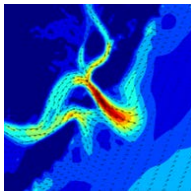




Overlap Difference





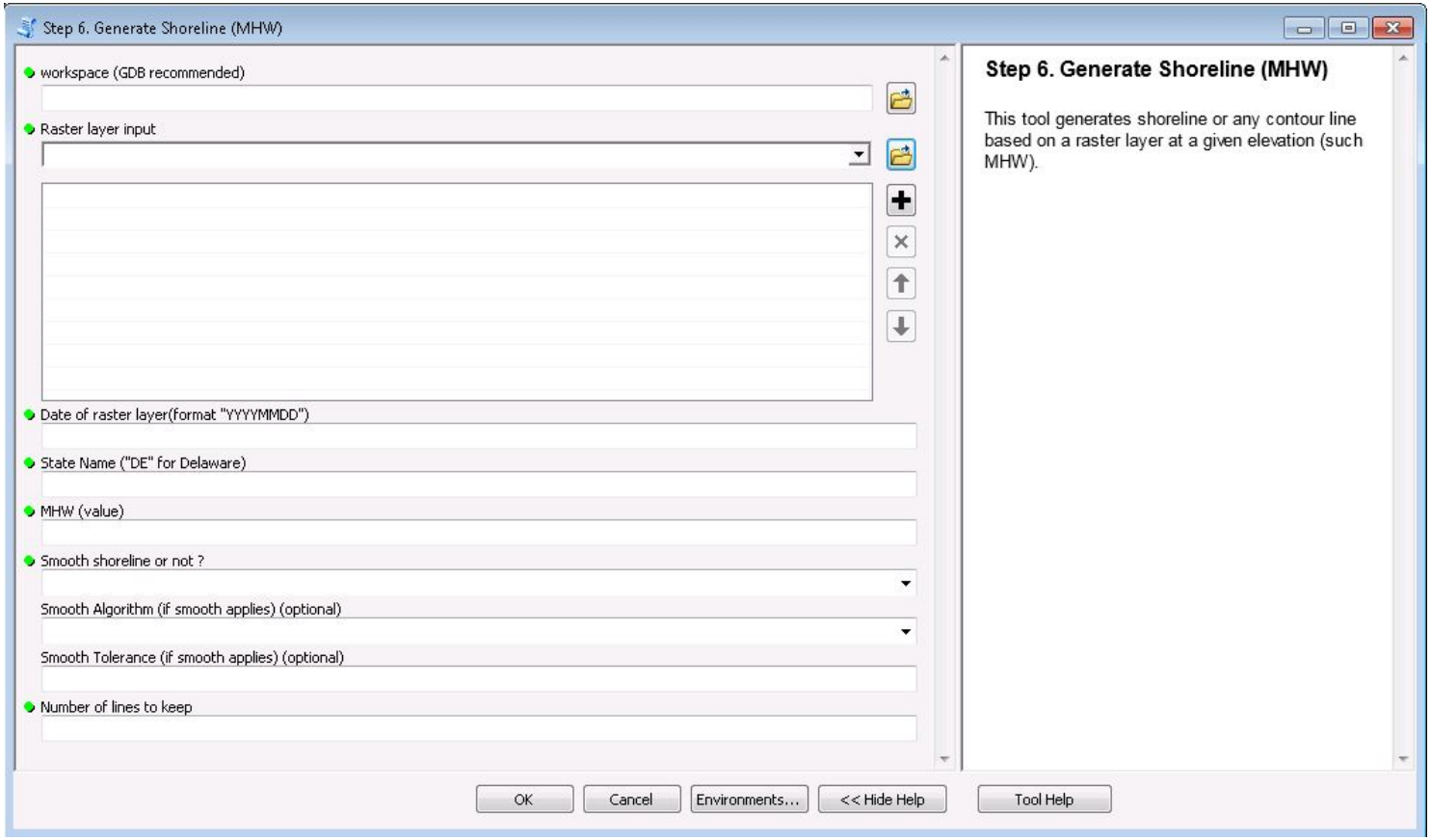


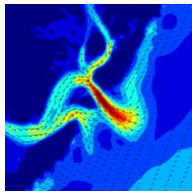
- **U.S. Geological Survey Open-File Report 2005-1027**

  2005
- **An Operational Mean High Water Datum for Determination of Shoreline Position from Topographic Lidar Data**
- *by* Kathryn M. Weber[1], Jeffrey H. List[1], and Karen L. M. Morgan[2]

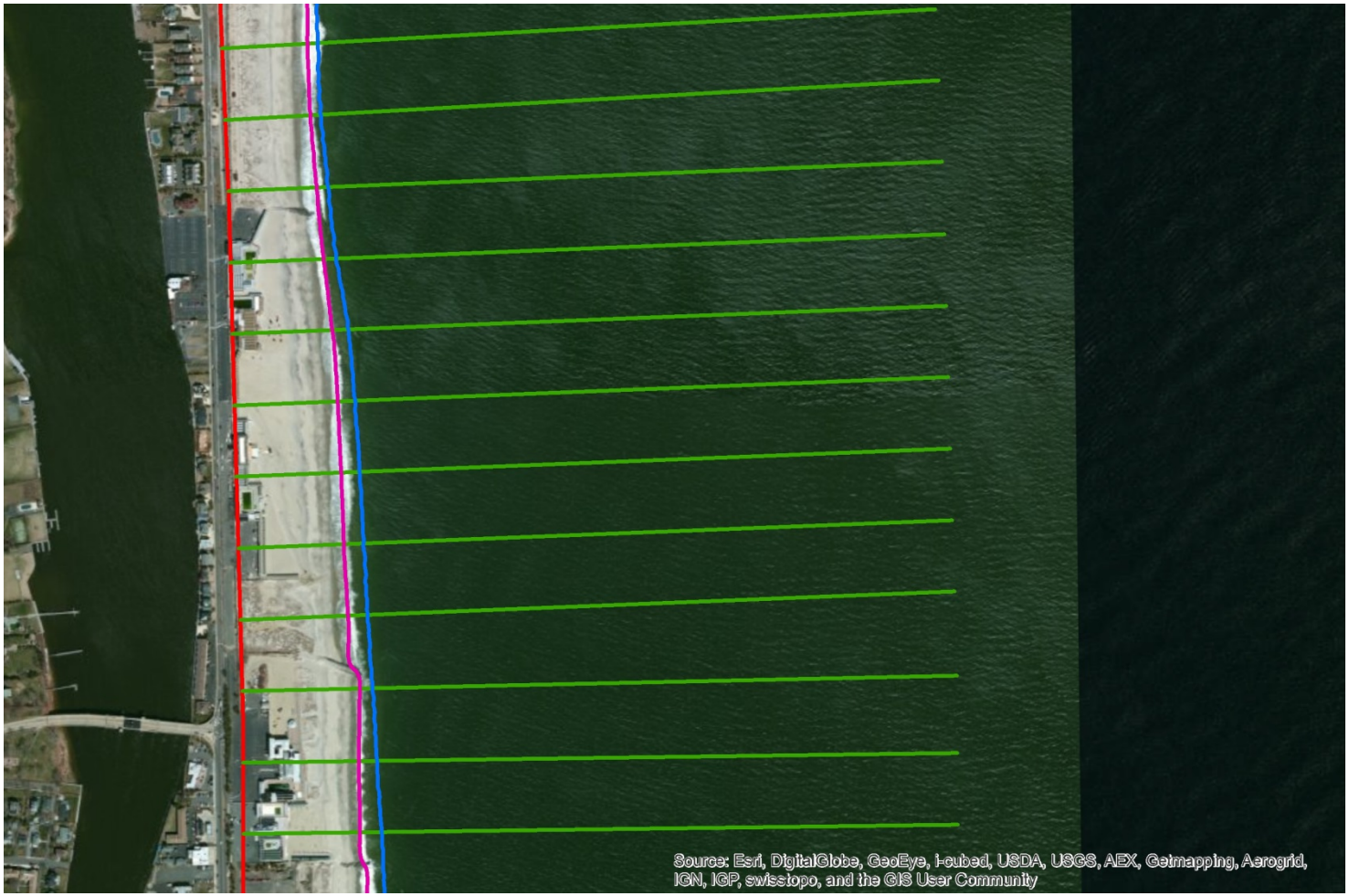
[1] U.S. Geological Survey, 384 Woods Hole Road Woods Hole, Massachusetts 02543
[2] U.S. Geological Survey, Center for Coastal Geology, 600 4th Street South, St. Petersburg, Florida 33701

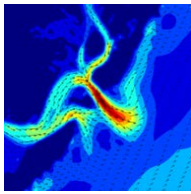
Generate Shoreline



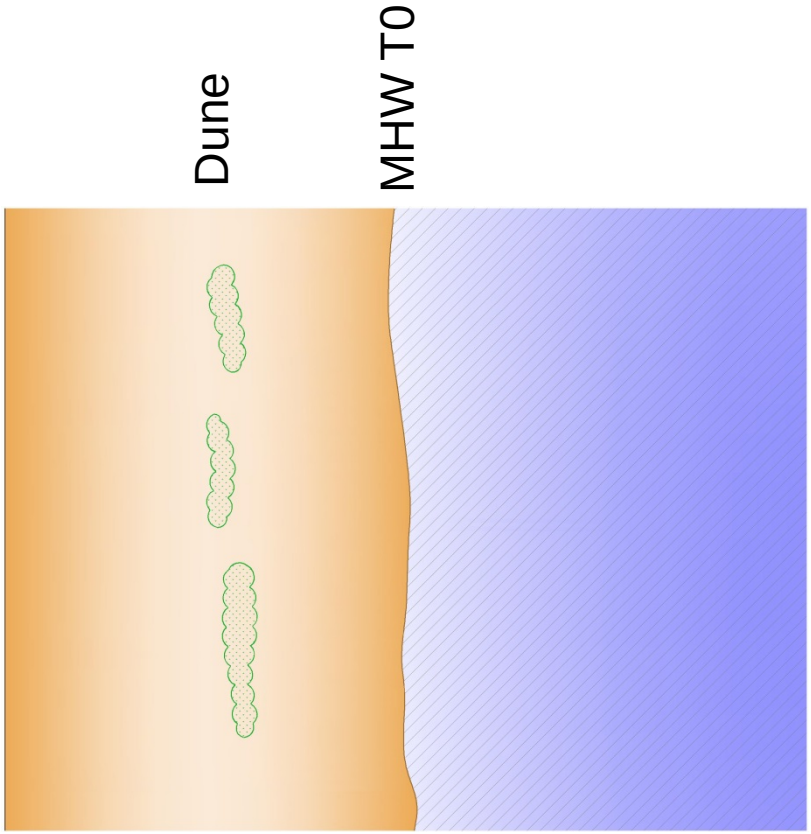


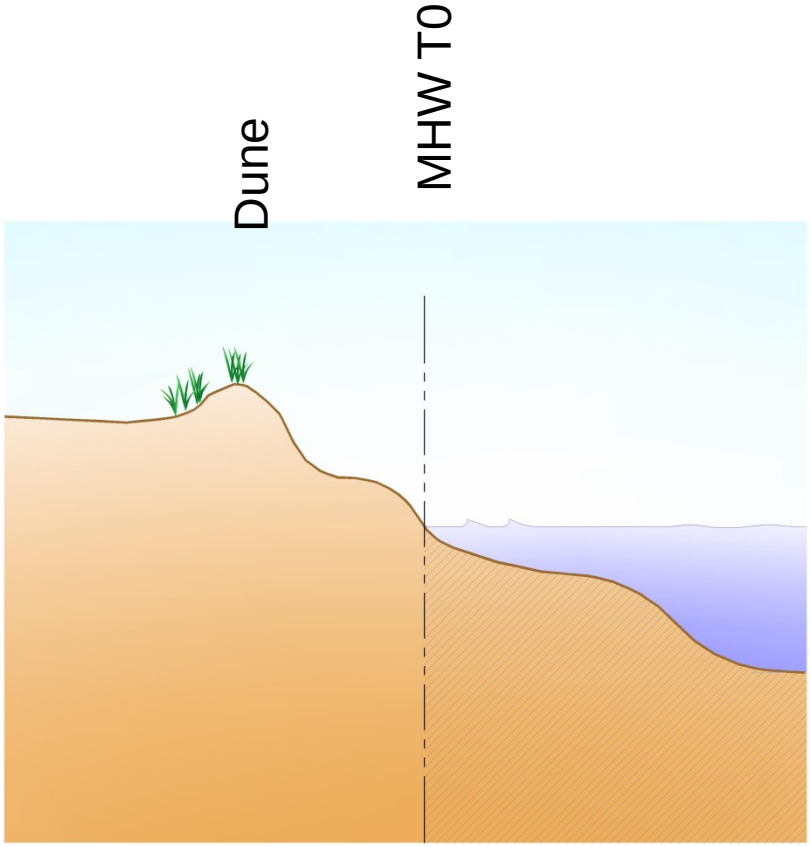
MHW Shorelines

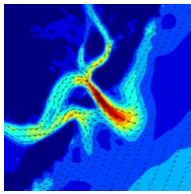




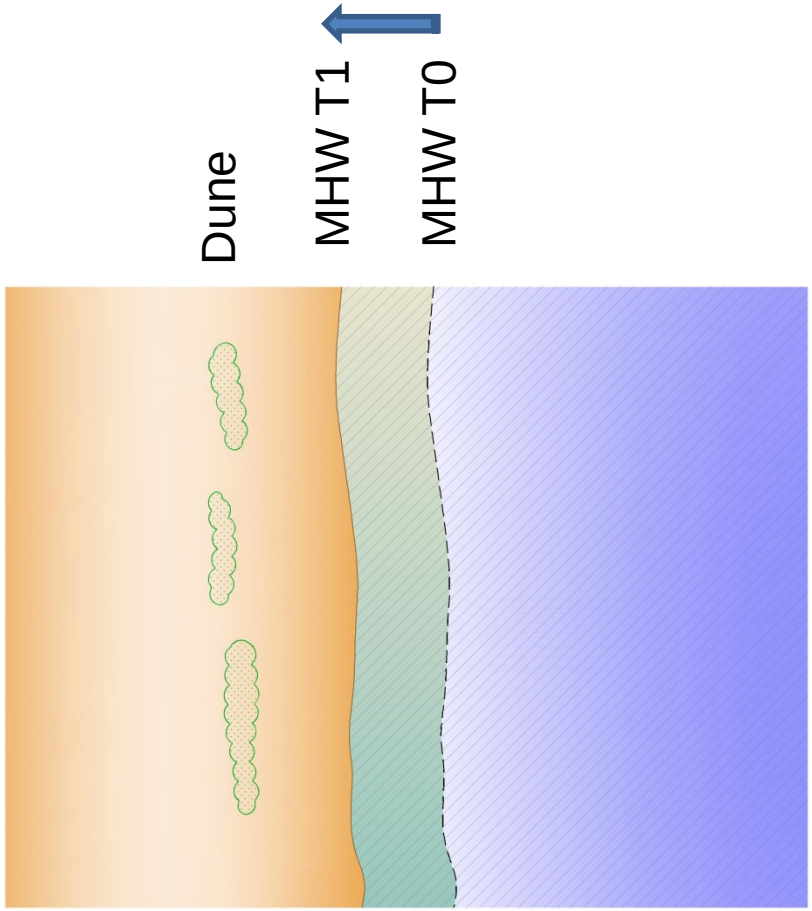
MHW T0

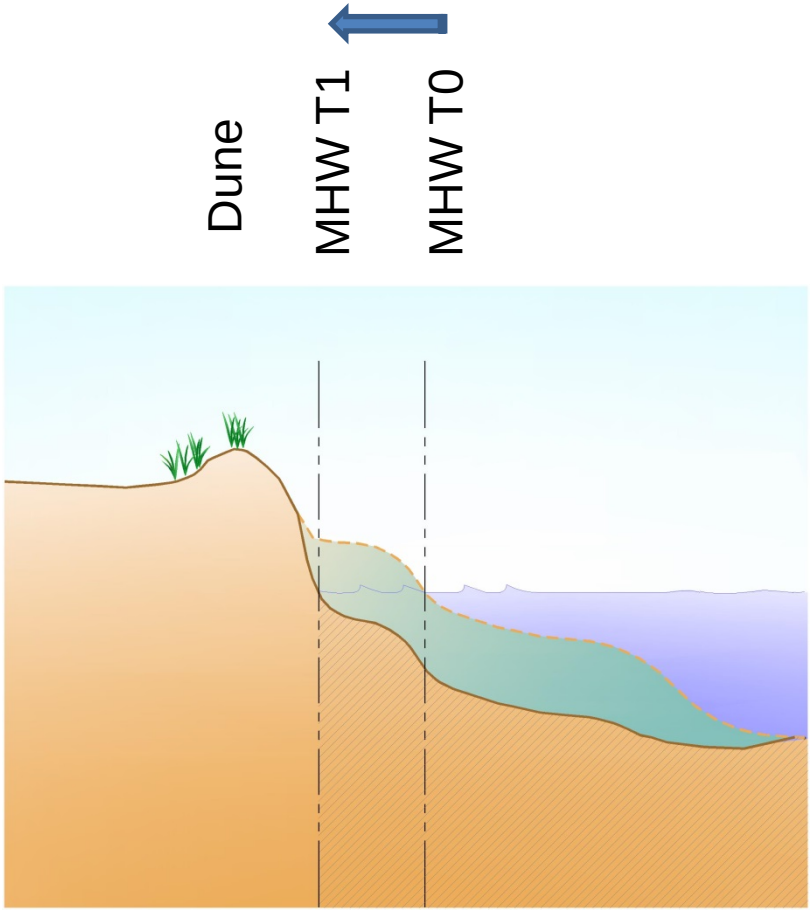


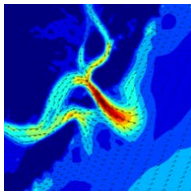




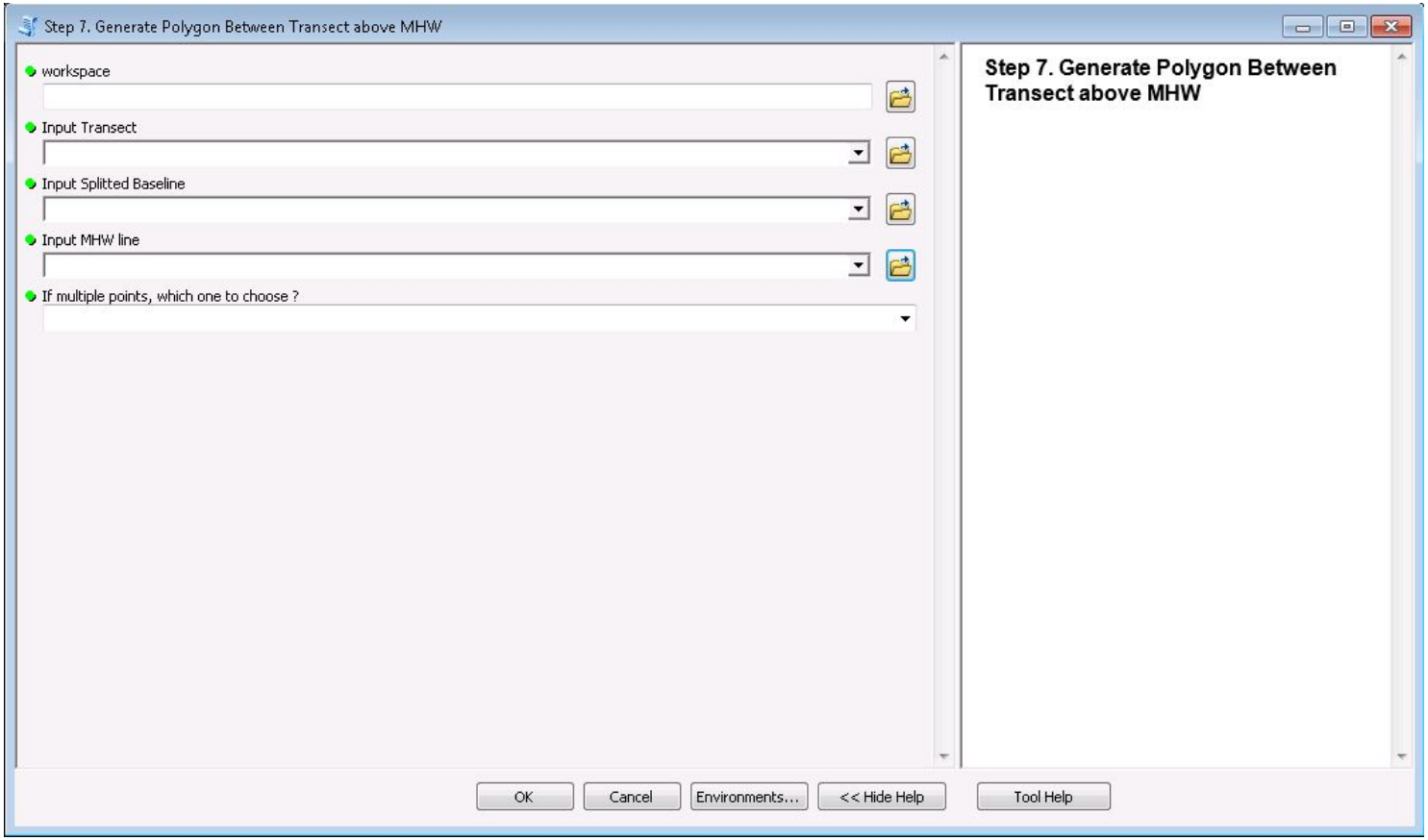
MHW T1

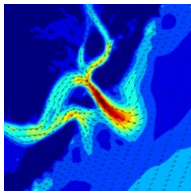




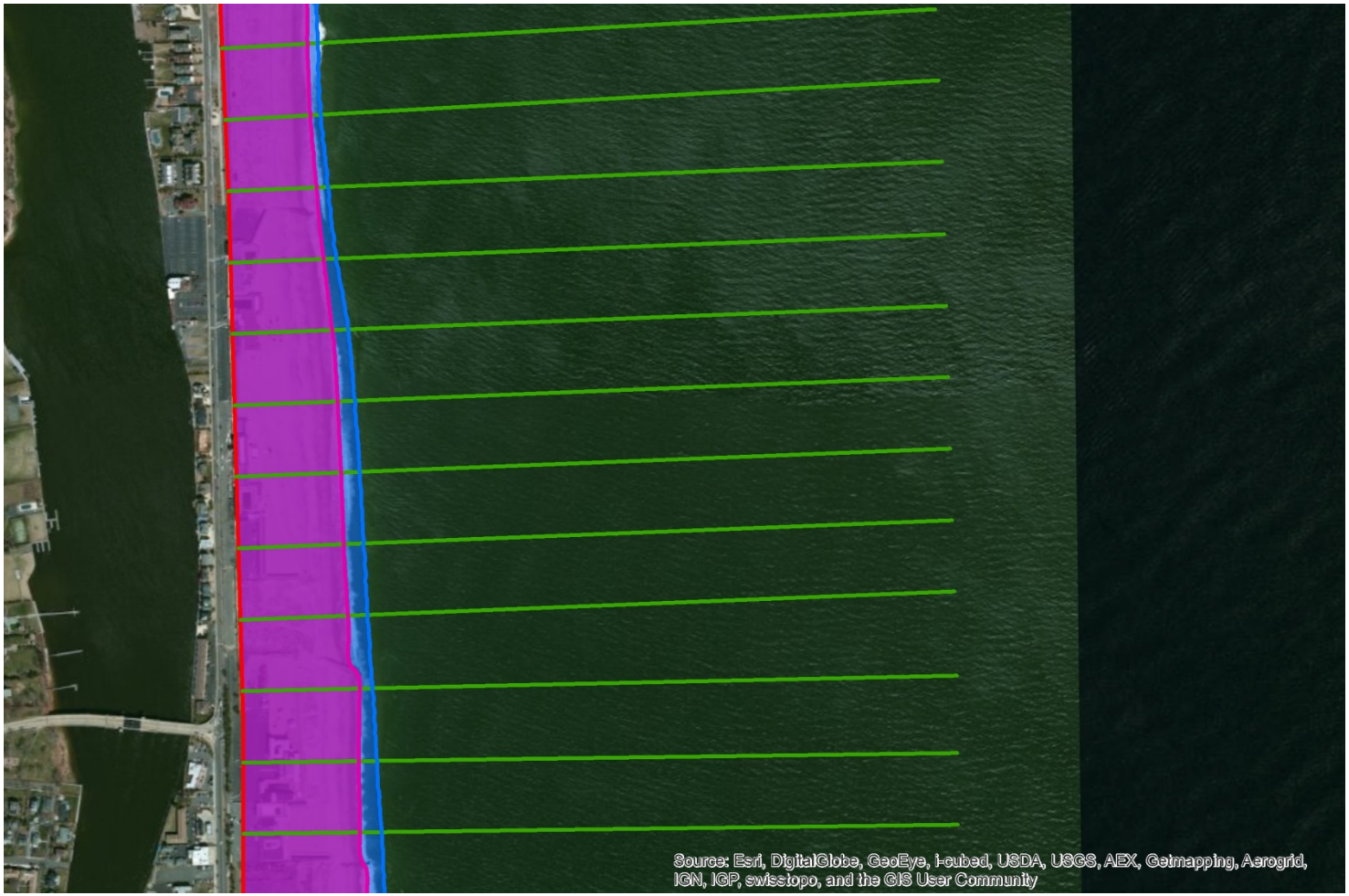


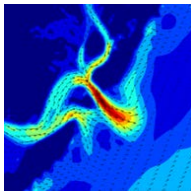
Generate Mask Above MHW



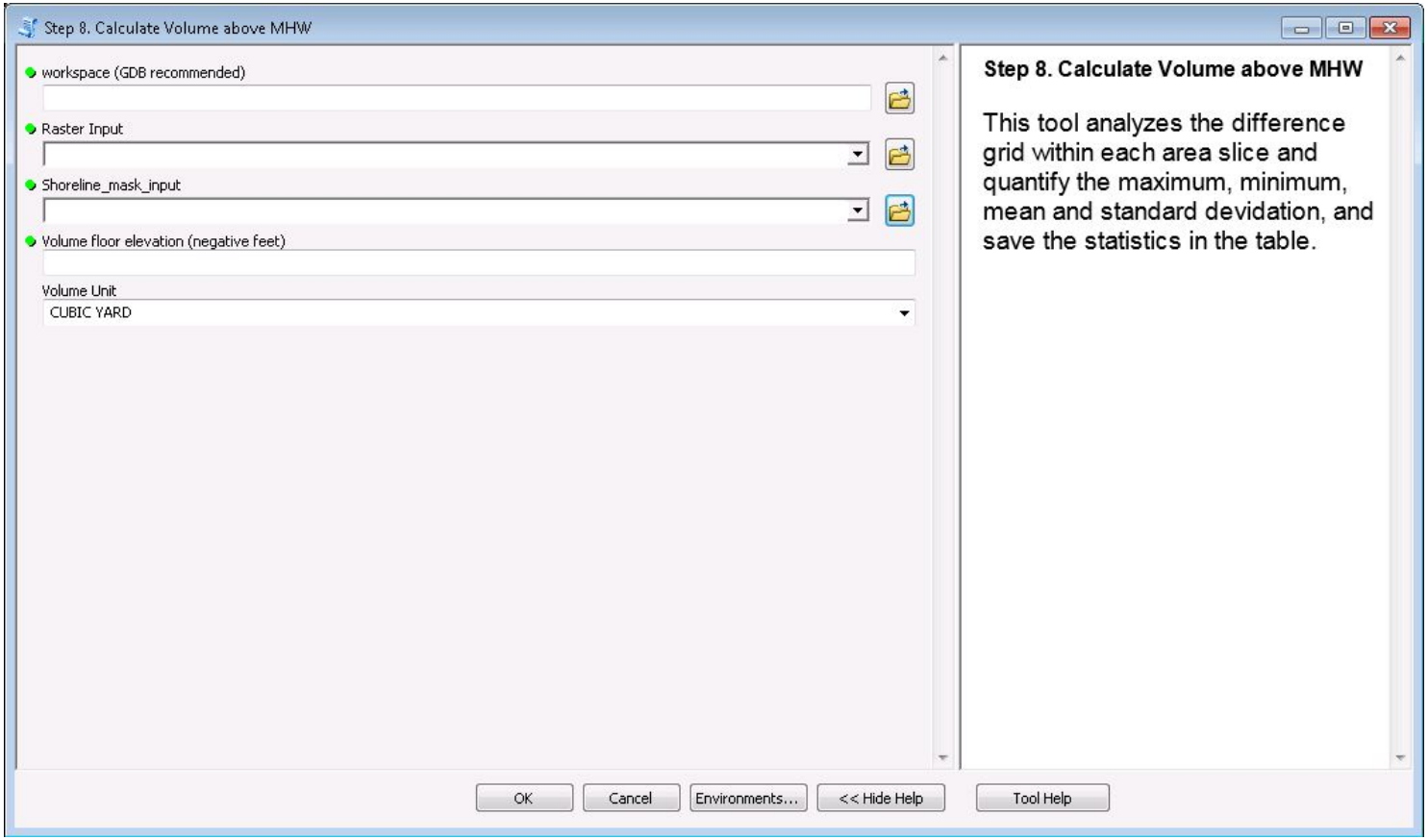


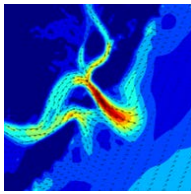
MHW Mask (2005 & 2010)



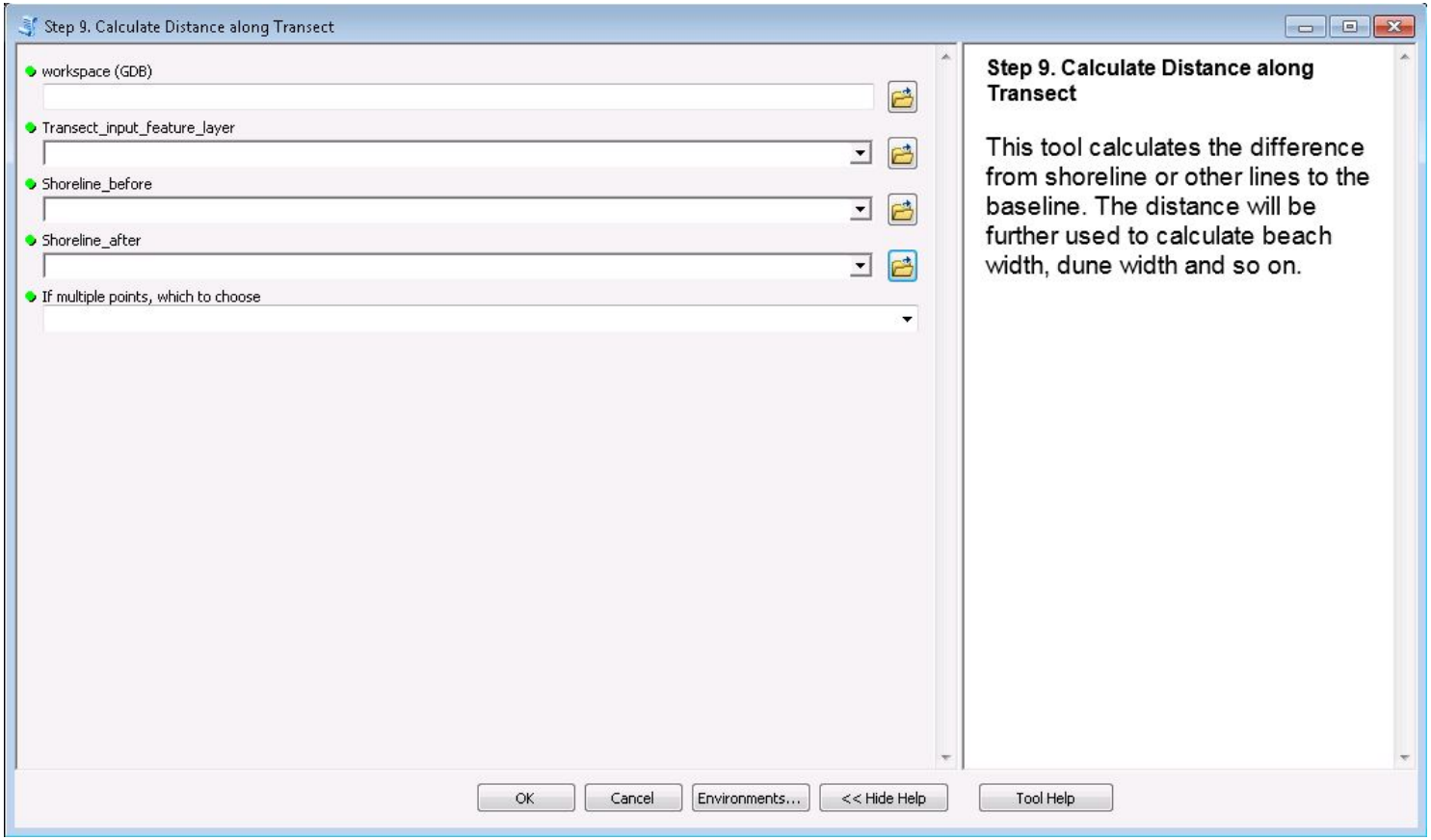


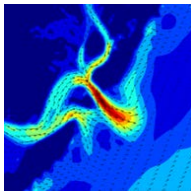
Volume Above MHW Statistics





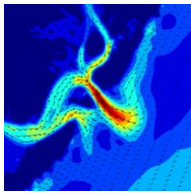
Distance Along Transect





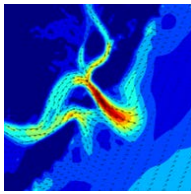
Project Summary

Geographic Area	Baseline Length (km)	Number of Transects
ME	62	620
NH	15	150
MA	381	3,810
NY	192	1,920
NJ	203	2,030
DE	44	440
MD	50	500
VA	183	1,830
NC	508	5,080
SC	277	2,770
GA	145	1,450
FL	1,230	12,300
Total	3,290	32,900



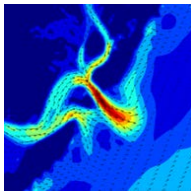
NH Summary Statistics

- 2005 to 2010
- 146 transects/bins analyzed
- Shoreline Change
  - Range: -5.1 to 3.5 m
  - Mean: -0.3 m
- Volume Change
  - Range: -12,784 to 2,408 cy
  - Mean: -2,728 cy
  - Density: -8.5 cy/lf



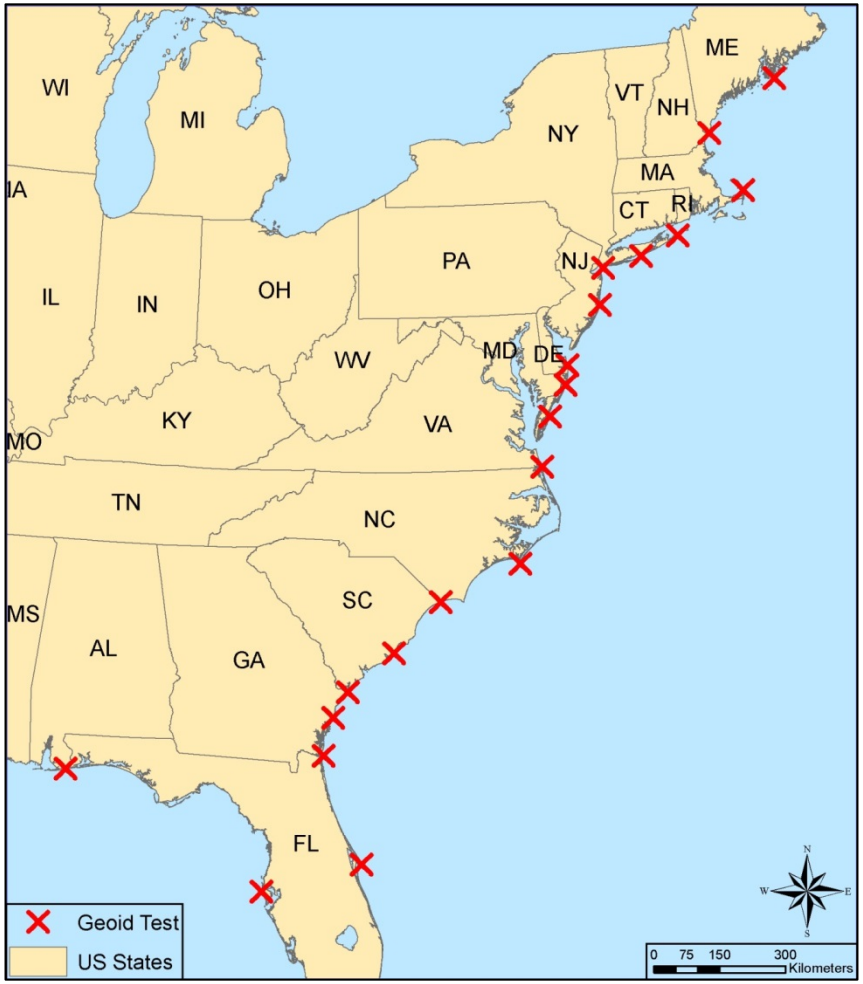
Output Geodatabase Sample

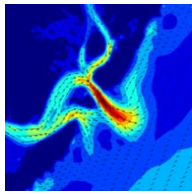
Field Name	Field Alias	Generic Data Type	Description	Specific GIS Data Type	If numeric, Precision	If numeric, Scale	If text, Length	Default Value
State	US State	Text	State where transects are located	Text			5	XX
bRev	Baseline revision number	Numeric	Revision number of baseline used to draw transects	Short Integer	5	0		-99999
tRev	Transect revision number	Numeric	Revision number when generated	Short Integer	5	0		-99999
stTranNum	Transect Number	Numeric	Transect number within the State	Short Integer	10	0		-99999
MHW	Mean High Water Elevation	Numeric	Elevation of MHW in NAVD88 meters	Double	5	2		-99999
dVol	Mean Difference	Numeric	Average value of difference within bin in cubic yards	Double	10	2		-99999
dDensity	Volume Change Density	Numeric	Volume change in cubic yards per linear foot	Double	10	2		-99999
dMHW	Difference in Mean High Water Distances	Numeric	Difference between bDistMHW and aDistMHW in meters	Double	10	2		-99999
dDensityMHW	MHW Volume Change Density	Numeric	MHW volume change in cubic yards per linear foot	Double	10	2		-99999



Geoid Variations

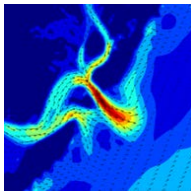
Geoid Variations





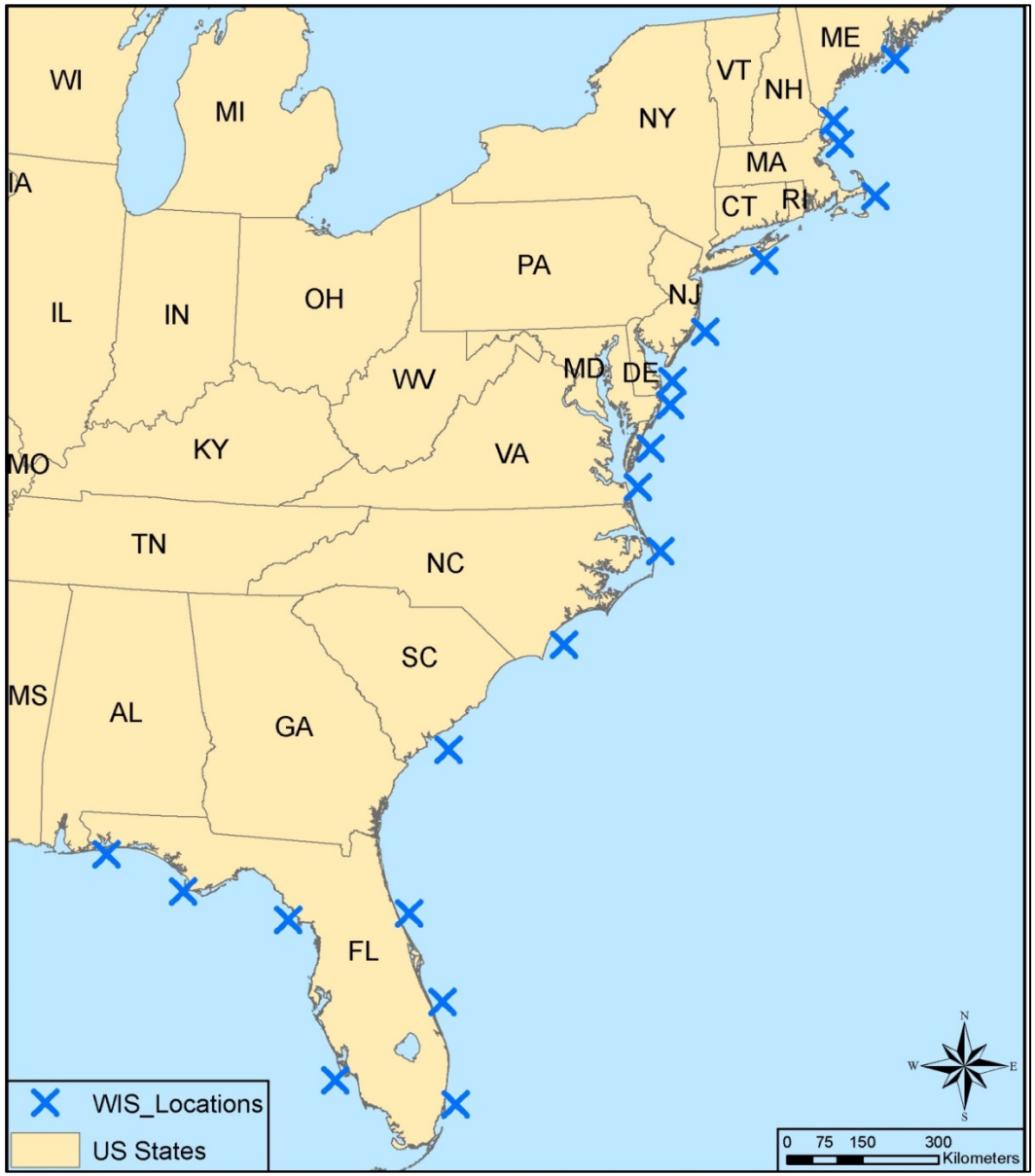
Geoid Vertical Difference

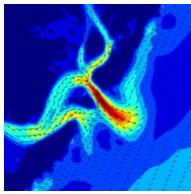
Location	Geoid12A (m)	Geoid99 (m)	Difference (m)
FL/AL Border	-27.534	-27.340	-0.194
Clearwater Beach, FL	-24.415	-24.261	-0.154
Cape Canaveral, FL	-28.327	-28.207	-0.120
FL/GA Border	-28.531	-28.604	0.073
Blackbeard Island, GA	-30.584	-30.559	-0.025
GA/SC Border	-31.610	-31.522	-0.088
Isle of Palms, SC	-33.550	-33.490	-0.060
SC/NC Border	-35.373	-35.391	0.018
Cape Lookout, NC	-37.602	-37.621	0.019
NC/VA Border	-38.399	-38.402	0.003
Hog Island, VA	-36.861	-36.848	-0.013
Assateague Island, MD	-36.199	-36.142	-0.057
Indian River Inlet, DE	-35.741	-35.727	-0.014
Island Beach State Park, NJ	-33.257	-33.240	-0.017
Breezy Point, NY	-32.347	-32.285	-0.062
Fire Island, NY	-31.716	-31.689	-0.027
Montauk Point, New York	-30.992	-30.979	-0.013
Cape Cod, MA	-27.868	-27.914	0.046
NH/ME Border	-26.546	-26.497	-0.049
Isle Au Haut, ME	-24.645	-24.783	0.138



Wave Data

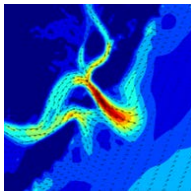
Selected WIS Stations



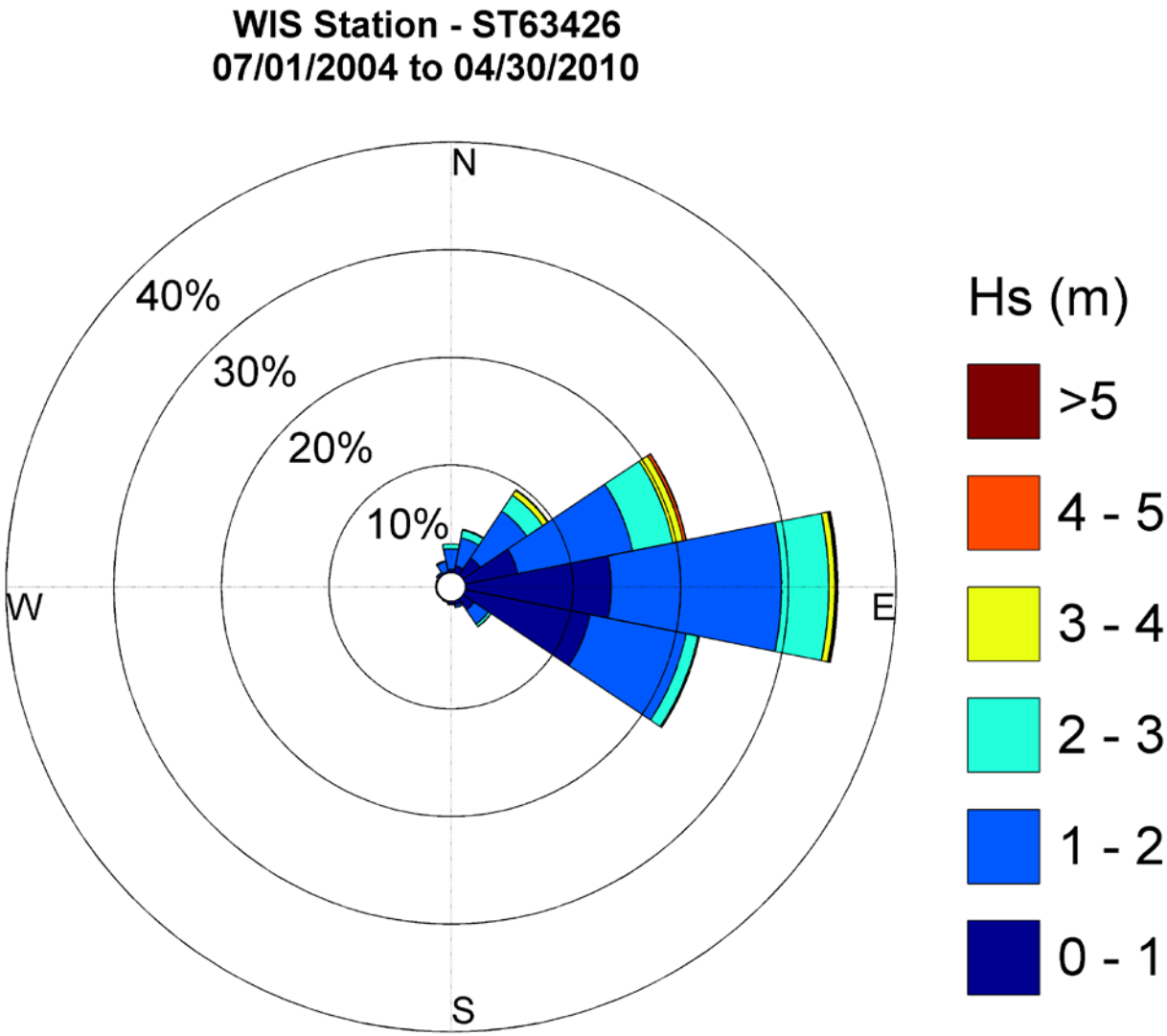


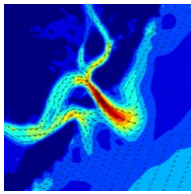
Selected WIS Stations

Geographic Area	WIS Station(s)	Start Date	End Date
Maine	63021	10/19/2005	6/19/2010
New Hampshire	63043	6/6/2007	6/20/2010
Massachusetts	63049, 63068	11/11/2005	5/26/2010
New York	63110	10/26/2005	8/13/2010
New Jersey	63138	9/2/2005	8/28/2010
Delaware	63155	9/3/2005	9/11/2010
Maryland	63166	9/3/2005	8/2/2010
Virginia North	63183	9/8/2005	7/28/2010
Virginia South	63199	9/8/2005	8/16/2009
Northern North Carolina	63225	9/28/2005	8/16/2009
Southern North Carolina	63297	9/28/2005	5/4/2010
South Carolina and Georgia	63359	1/13/2006	5/4/2010
Northeast Florida	63426	7/1/2004	5/4/2010
Southeast Florida	63447, 63469	6/1/2004	8/31/2009
Florida West Coast	73237, 73293	6/1/2004	6/20/2010
Eastern Northwest Florida	73193	6/1/2004	2/26/2009
Western Northwest Florida	73169	11/22/2004	6/20/2010



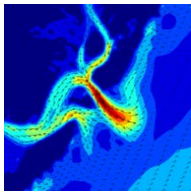
Wave Rose


WIS Station - ST63426
07/01/2004 to 04/30/2010
N
E
S
W
10%
20%
30%
40%
Hs (m)
>5
4 - 5
3 - 4
2 - 3
1 - 2
0 - 1



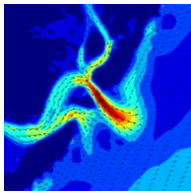
Deliverables

- Digital files in geodatabase format
- MHW shorelines for each year
- Difference surfaces in GeoTIFF format
- Shoreline change by transect in geodatabase format
- Volume change by transect in geodatabase format
  - Overlapping
  - MHW
- FGDC compatible metadata for each GIS dataset
- Wave roses
- Python toolbox

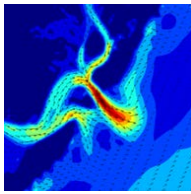


Future Work

- Complete Deliverables
  - Shoreline Change
  - Volume change
    - Overlap
    - MHW
- Investigate Geoid Variation
- Develop query tool
- Investigate Automating Map Generation
- Incorporate USGS Metrics
  - Dune Height
  - Beach Width



Thank You!



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