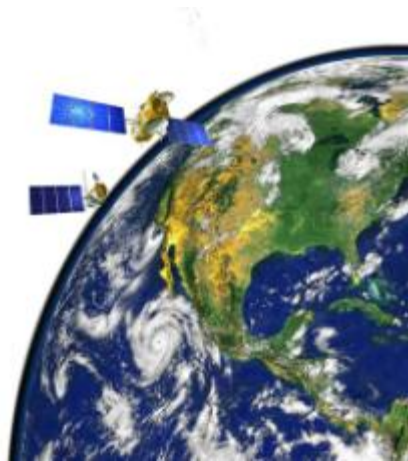


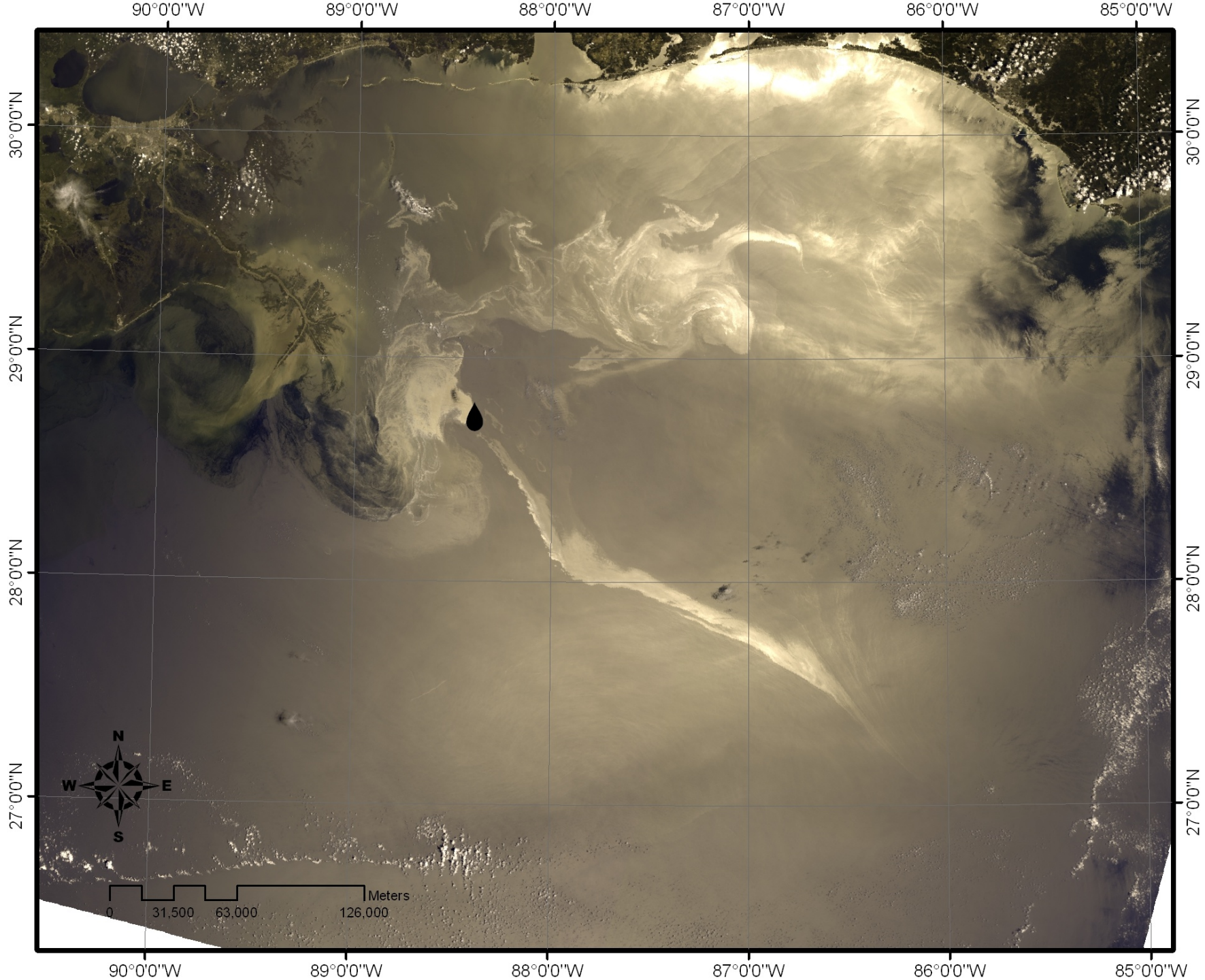


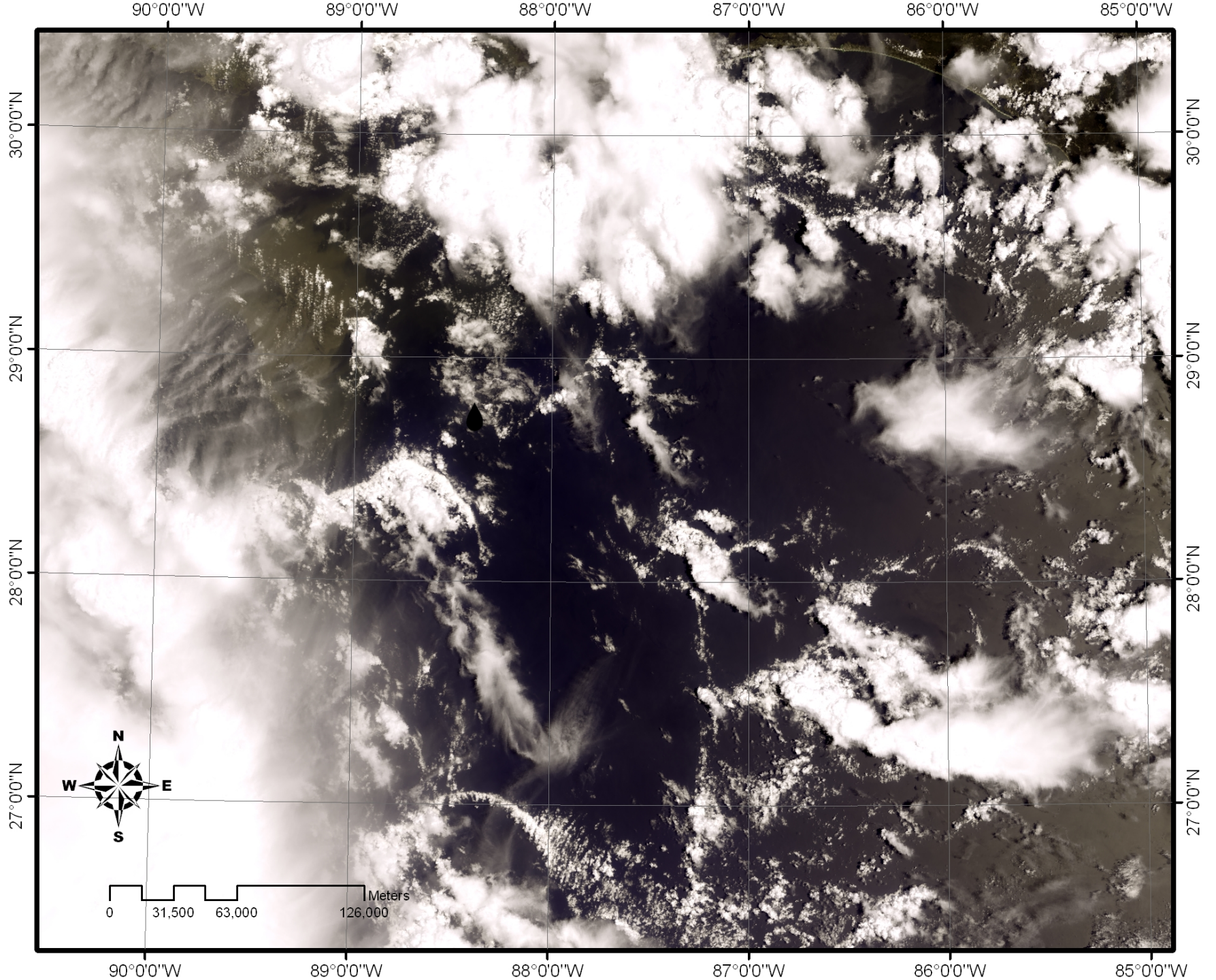
Mapping Oil Spills

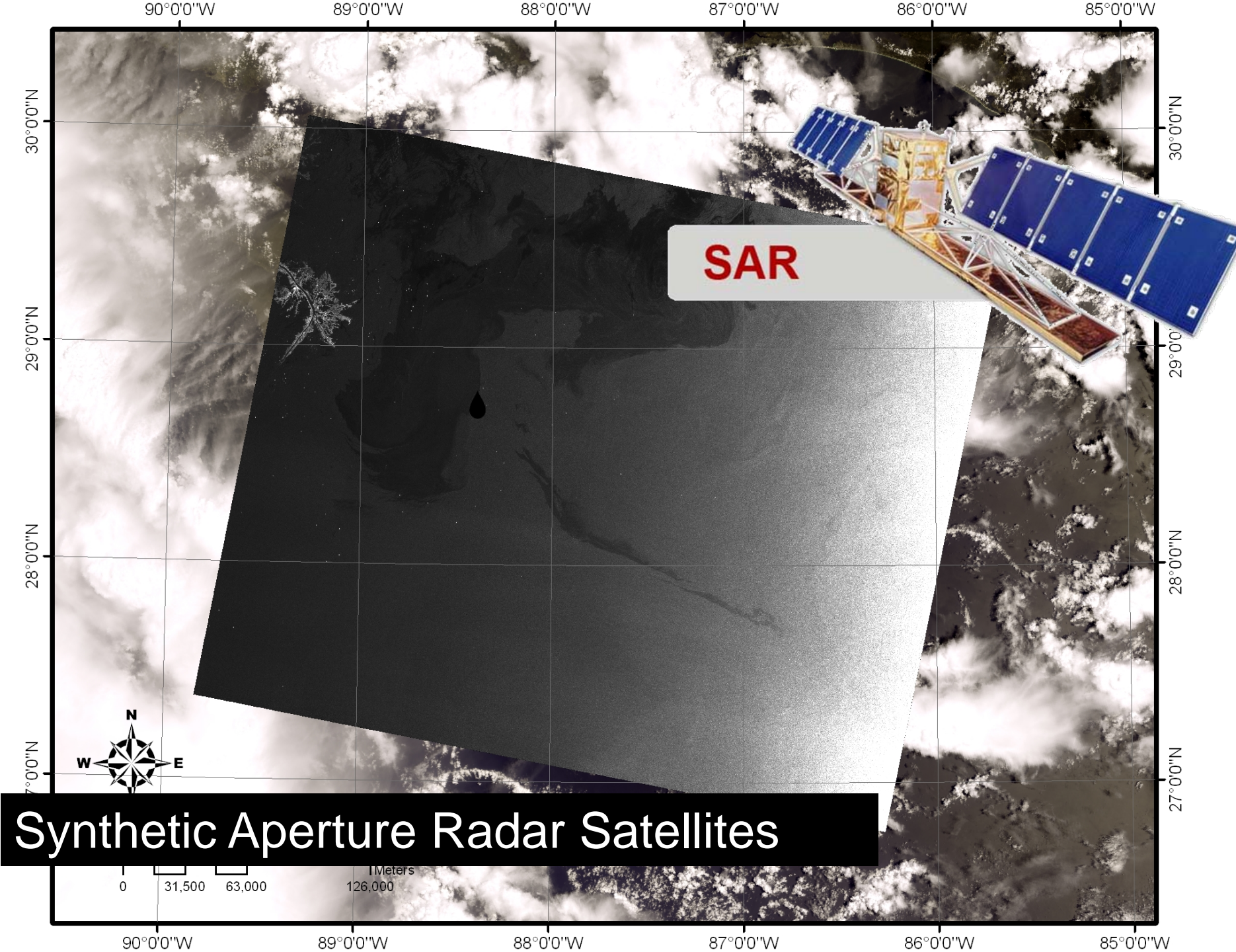


Oscar Garcia Pineda
Florida State University

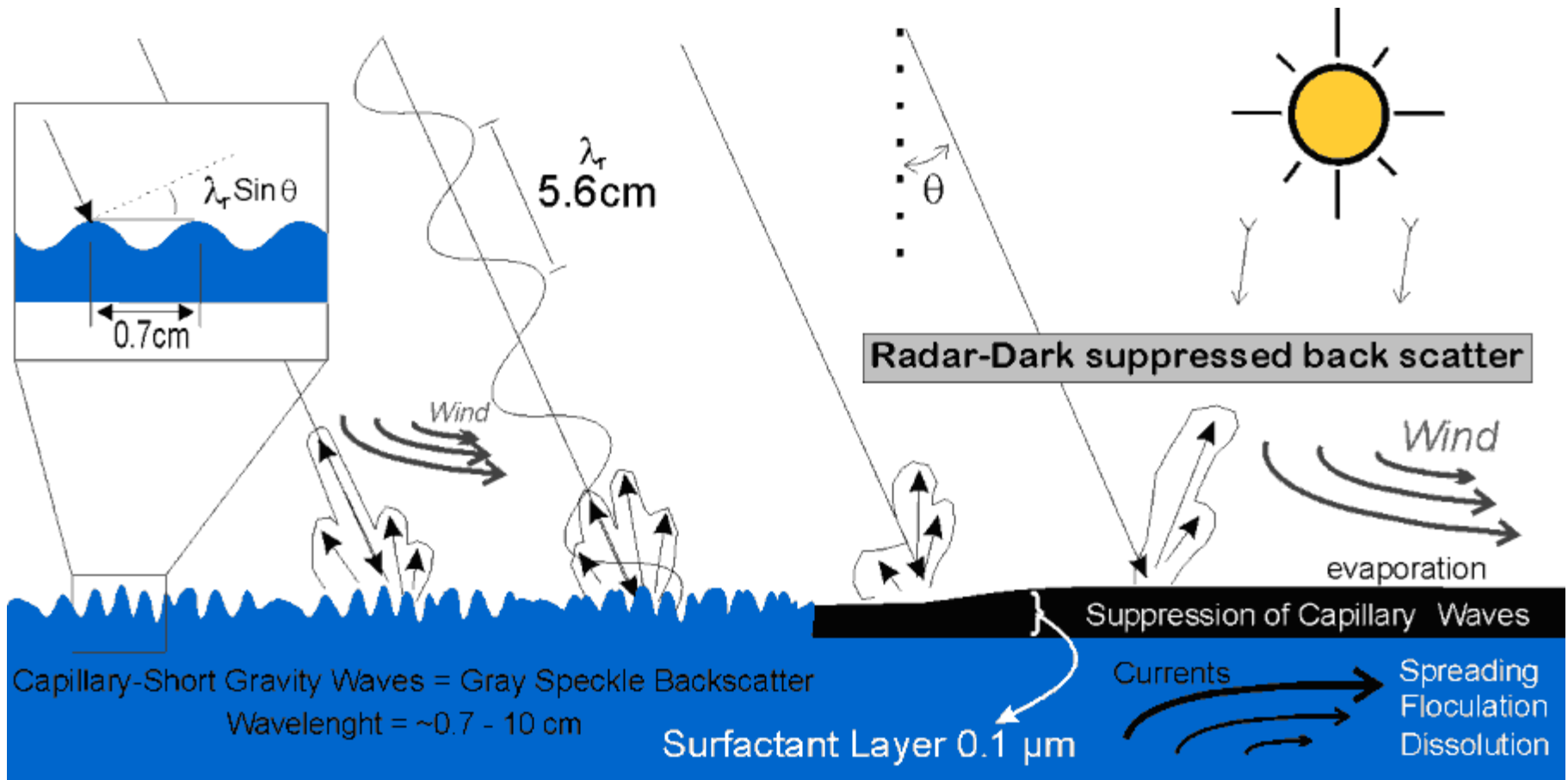




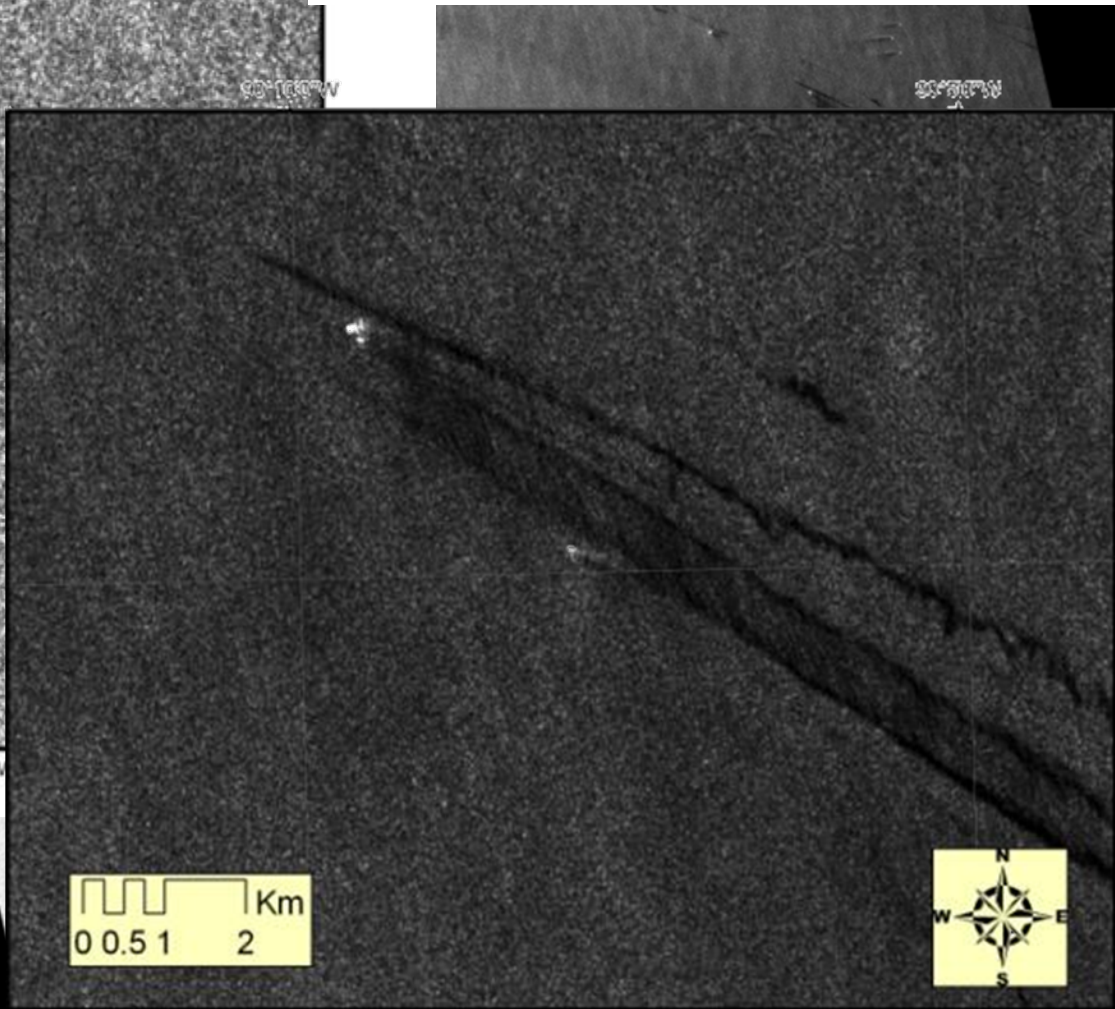
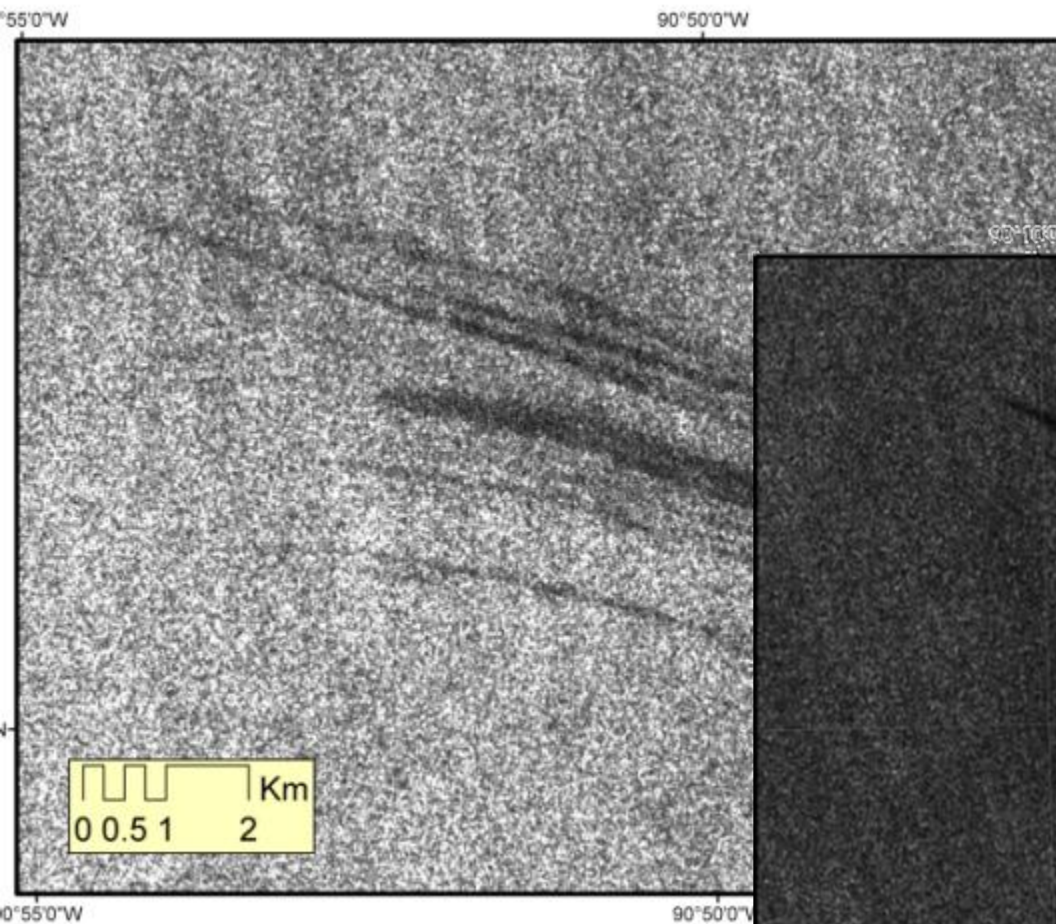
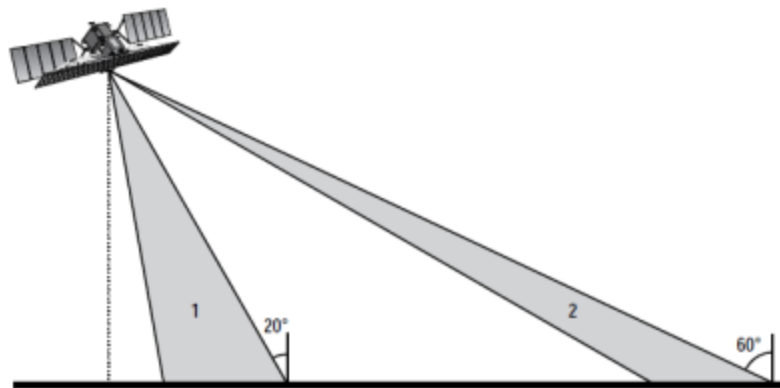




Oil Slicks in the Water and Related Processes



Complexity of SAR images



Integration of Satellite Remote Sensing Data with Ancillary Data

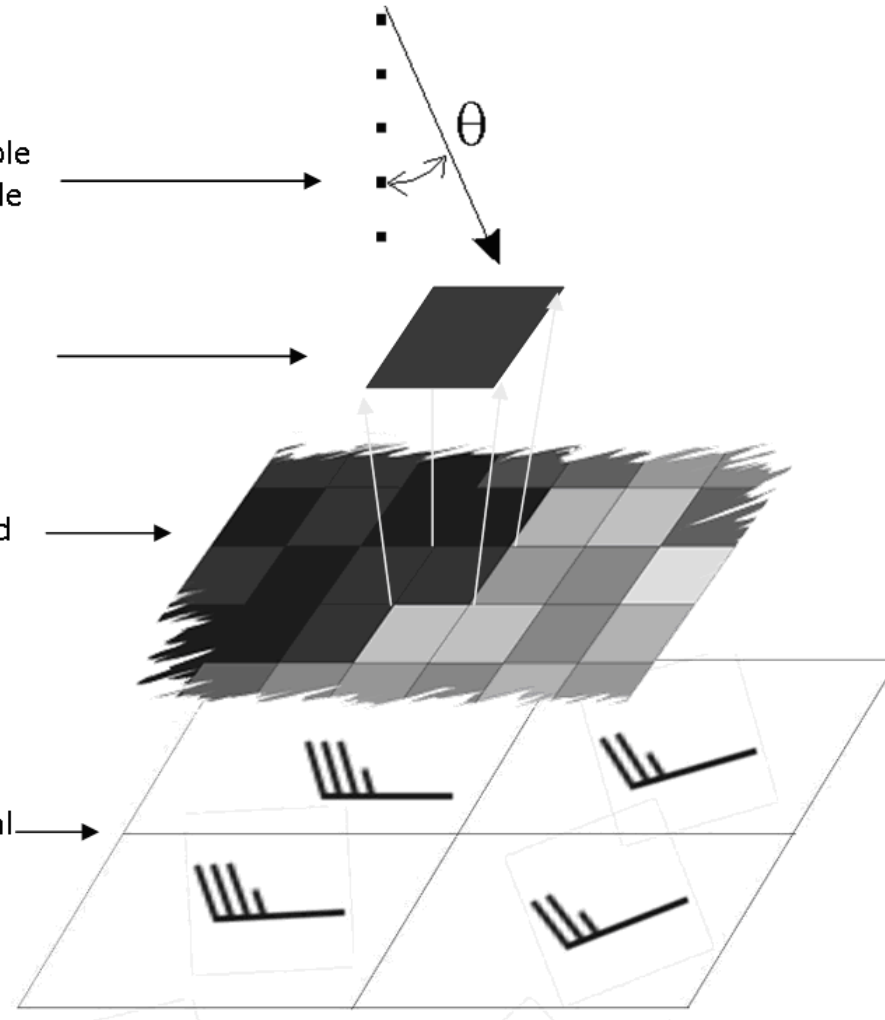
Four types of Data
Assimilated:

Satellite Variable
Incidence Angle

Pixel Values

Neighborhood

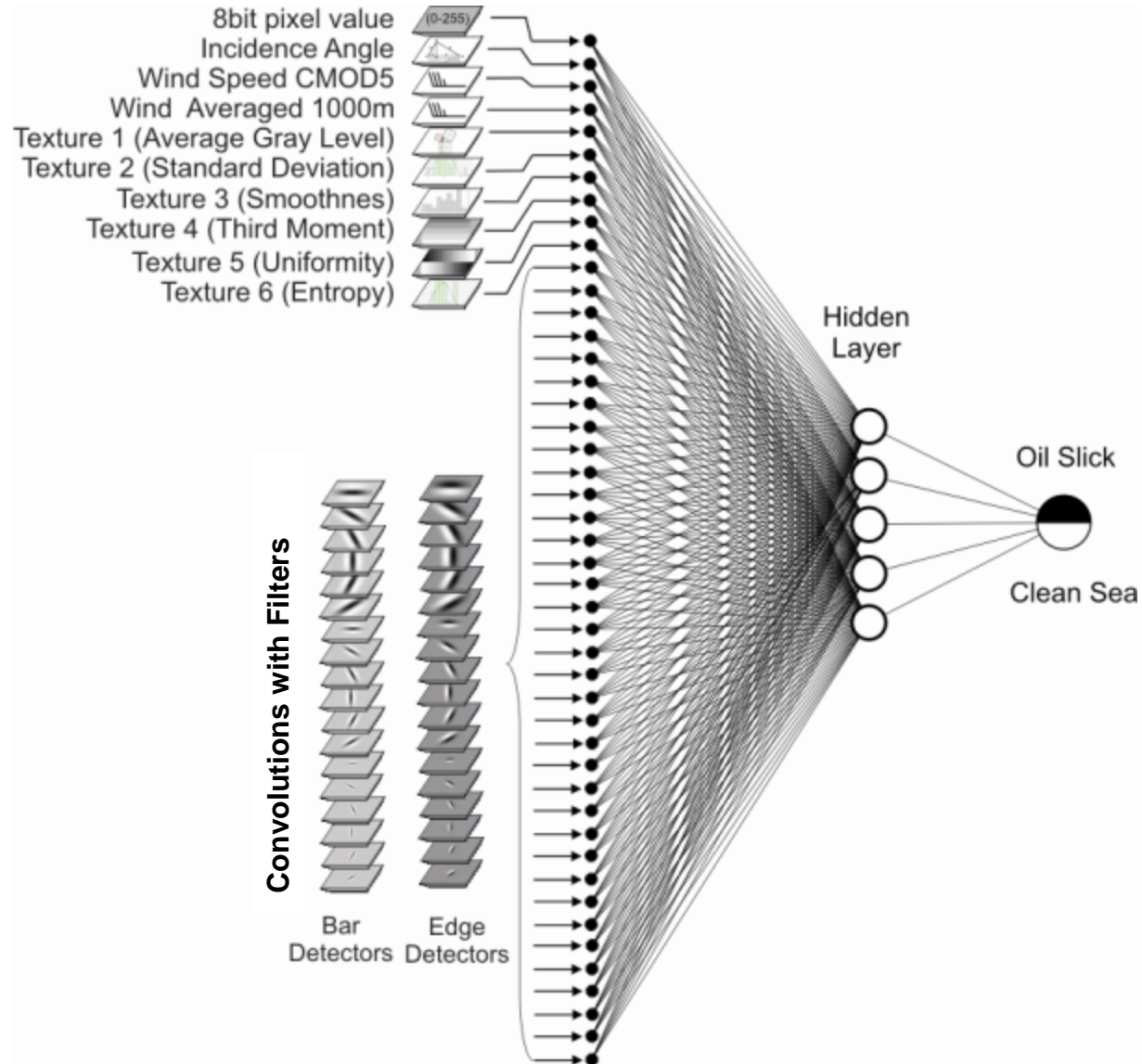
Environmental
Data



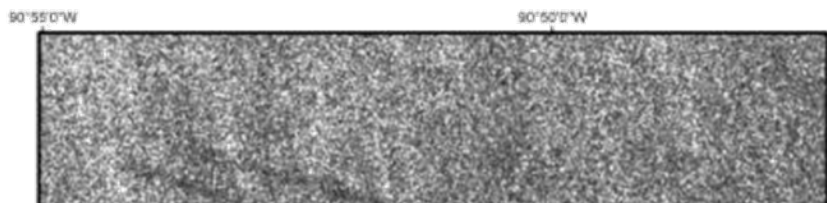
A neural network program is used to fit a function of many variables

Textural Classifier Neural Network Algorithm

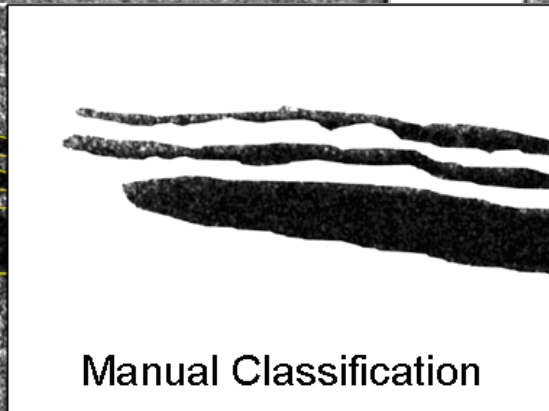
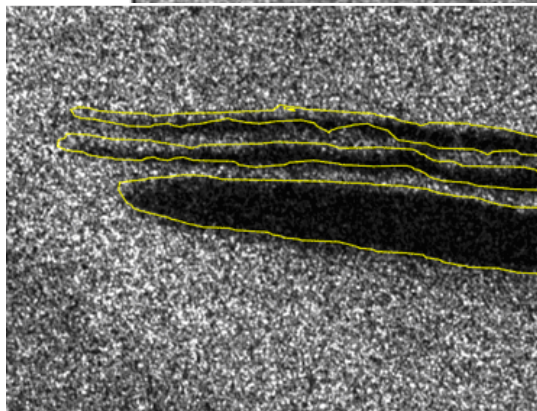
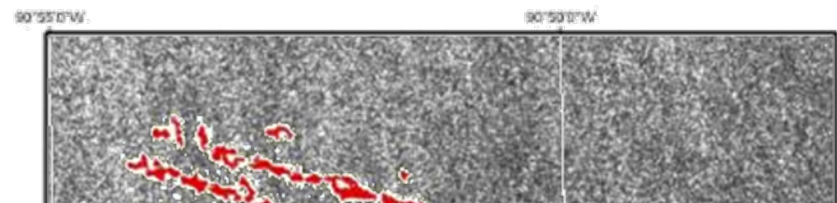
TCNNA



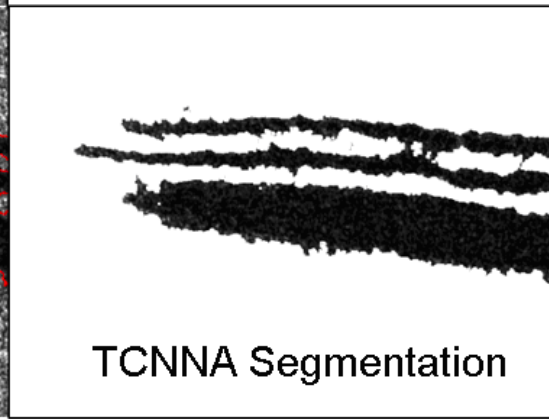
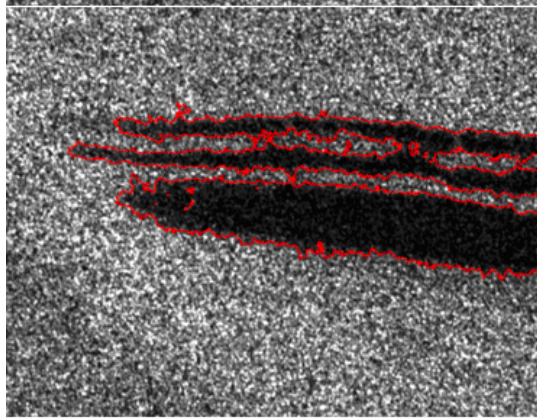
Original SAR Data



TCNNA Results

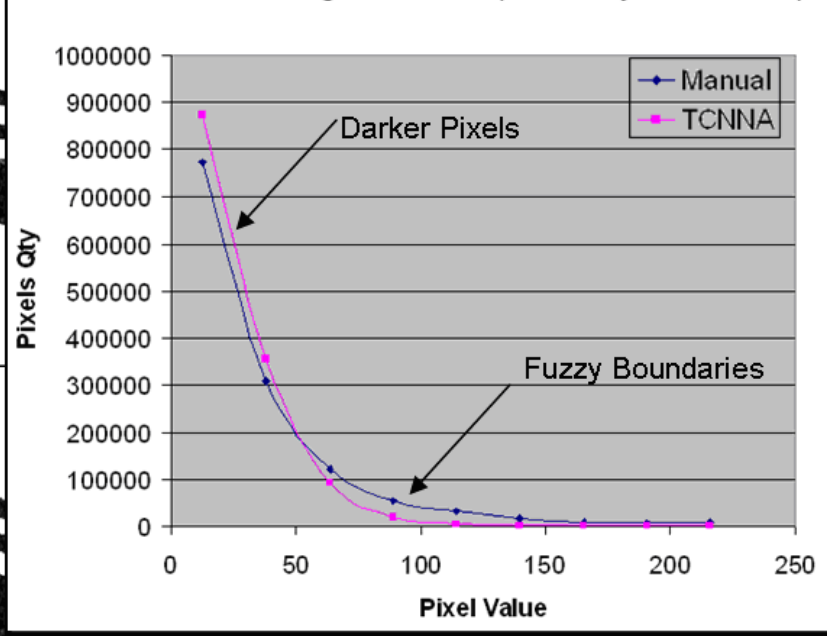


Manual Classification

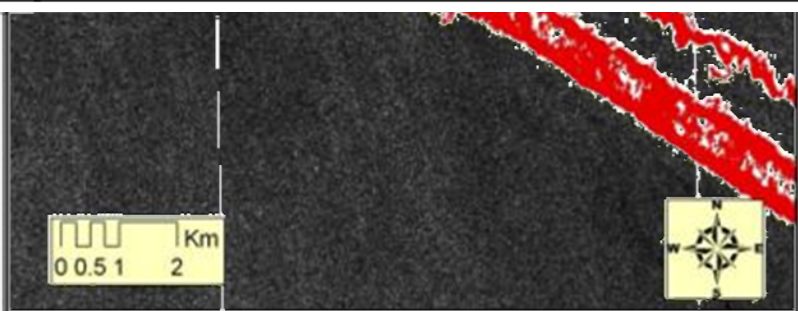
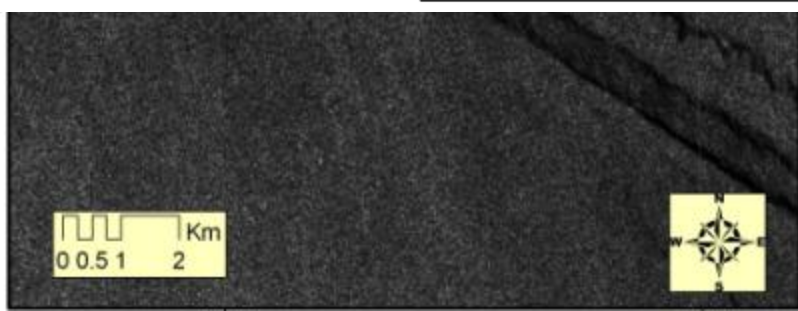


TCNNA Segmentation

Oil Slick Segmentation (Manually vs TCNNA)



	Mean	Std Dev	Max	Min	Total Pixels	Area
Manual	36.9563	49.4843	254	0	1172929	183.27km
TCNNA	30.6748	46.6957	254	0	1194703	186.67km



G:\wind

Step 1: Select Image Folder...

- R138937072G1S006.png
- R138937072G1S006.tif
- R138937072G1S006w.png
- R139623069G1S010.png
- R139623069G1S010.tif
- R139623069G1S010w.png
- R139623070G1S011.png
- R139623070G1S011.tif
- R139623070G1S011w.png
- R140995069G1S018.tif
- R143053070G1S030.tif
- R144032068G1S014.tif
- R155058068G1S005.tif
- R155058068G1S005w.png
- R160853380G1S013.tif

Batch Mode

SAR Image Description

Select an Image to display properties

Enter suffix for the output file name (e.g. 'GC_600a')

Suffix...

Step 2: Select Folder to Save Output

Step 2: Subset to Process

Select Specific Training Set to use

RADARSAT STD1

Step 5: Extract Oil Spill

Last Step: Exit



Results

TCNNA - SAR Image processing toolbox.

By Oscar Garcia-Pineda, Ph.D
 garcia@ocean.fsu.edu
 Florida State University
 Geography Department

E:\Monitoring Hydrocarbons Sar Project\Sar Backun\SARWind software\ST2

Step 1: Select Image Folder...

- R144082070G1S015.tif
- R144082070G1S015_overlay.png
- R144425068G1S021.tif
- R144425068G1S021_overlay.png
- R144425070G1S020.tif
- R144425070G1S020_overlay.png
- R144525068G1S012.tif
- R144525068G1S012_overlay.png
- R144525070G1S015.tif
- R144525070G1S015_overlay.png
- R144768066G1S016.tif
- R144768066G1S016_overlay.png
- R144768068G1S015.tif

Batch Mode

SAR Image Description

Image Tag
 R144525068G1S012.tif

12-Mar-2010 13:31:54

WGS 84 / UTM zone 15N

Resolution (meters):
 12.5

Center Image X(meters):
 612474.23

Center Image Y(meters):
 3072255.036

Enter suffix for the output file name
 (e.g. 'GC_600a')

Suffix...

Step 2: Select Folder to Save Output

Step 2: Subset to Process

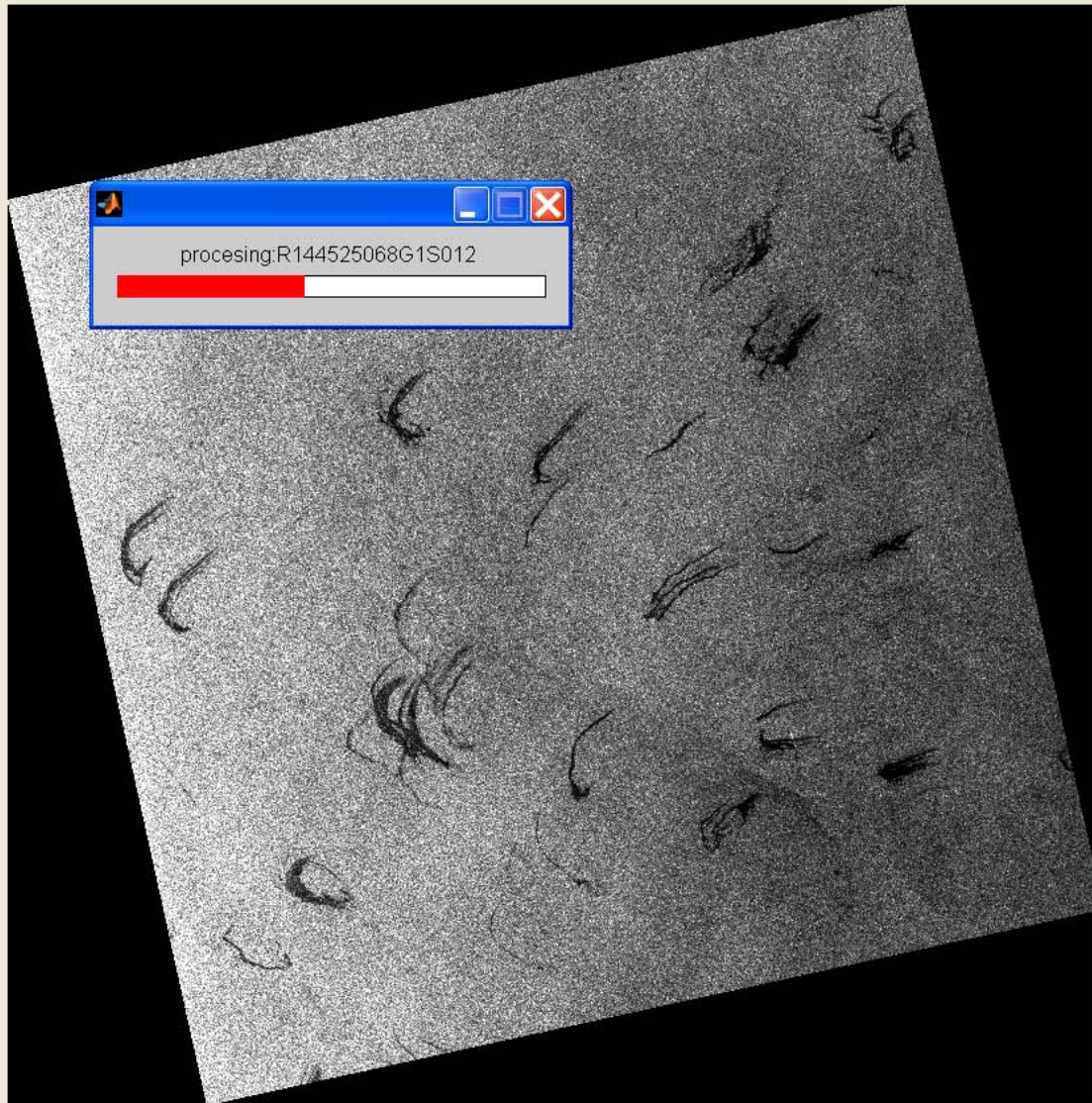
R144525068G1S012.tif

Select Specific Training Set to use

RADARSAT STD1

Step 5: Extract Oil Spill

Last Step: Exit



processing:R144525068G1S012

Progress bar: [Red segment] [White segment]

Results

TCNNA - SAR Image processing toolbox.
 MacDonald Image Lab. Florida State University
 Contact: Oscar Garcia-Pineda, Ph.D
 garcia@ocean.fsu.edu
 Oceanography Department

Search

Fly To Find Businesses Directions

Fly to e.g., New York, NY

Search input field with a magnifying glass icon

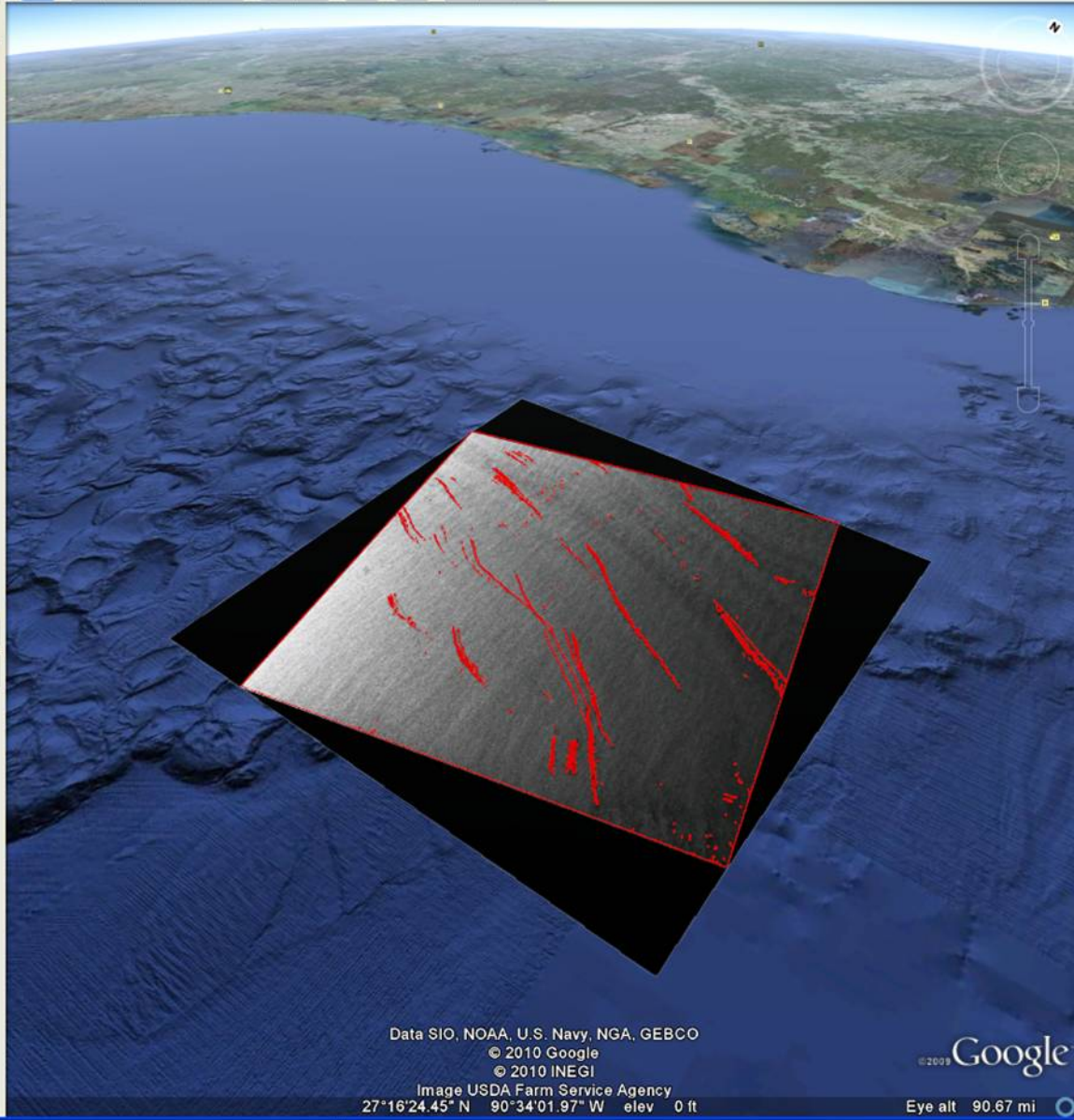
Places

Add Content

- My Places
- Sightseeing Tour
 - Make sure 3D Buildings layer is checked
- Temporary Places
- New TCNNA
 - Features
 - R.154915068G1S016.tif

Layers

- Primary Database
- Borders and Labels
- Places of Interest
- Panoramio
- Roads
- 3D Buildings
- Street View
- Weather
- Gallery
- Global Awareness
- Ocean
- More
- Terrain



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
 © 2010 Google
 © 2010 INEGI
 Image USDA Farm Service Agency
 27°16'24.45" N 90°34'01.97" W elev 0 ft





Step 1: Select Image Folder...

E:\New Workind D\TCNNA_CNESDIS\ISAR samples\ALOS

- ALPSRS226043000-W1.5_UD.tif
- ALPSRS226773000-W1.5_UD.tif
- ALPSRS228813000-W1.5_UD.tif
- ALPSRS228813050-W1.5_UD.tif
- ALPSRS229103000-W1.5_UD.tif
- ALPSRS229103050-W1.5_UD.tif
- ALPSRS229543000-W1.5_UD.tif
- ALPSRS229543050-W1.5_UD.tif
- ALPSRS230563000-W1.5_UD.tif
- ALPSRS230563050-W1.5_UD.tif
- ALPSRS231293000-W1.5_UD.tif
- ALPSRS231293050-W1.5_UD.tif
- ALPSRS232023000-W1.5_UD.tif
- ALPSRS232023050-W1.5_UD.tif
- ALPSRS233043000-W1.5_UD.tif
- ALPSRS233043050-W1.5_UD.tif
- ALPSRS233773000-W1.5_UD.tif

SAR Image Description

Image Tag
ALPSRS230563050-W1.5_UD.tif
27-Oct-2010 14:21:20
WGS 84 / UTM zone 16N
Resolution (meters): 100.0
Center Image X(meters): 213653.64
Center Image Y(meters): 3333658.798
3766 lines vertically
4237 columns across

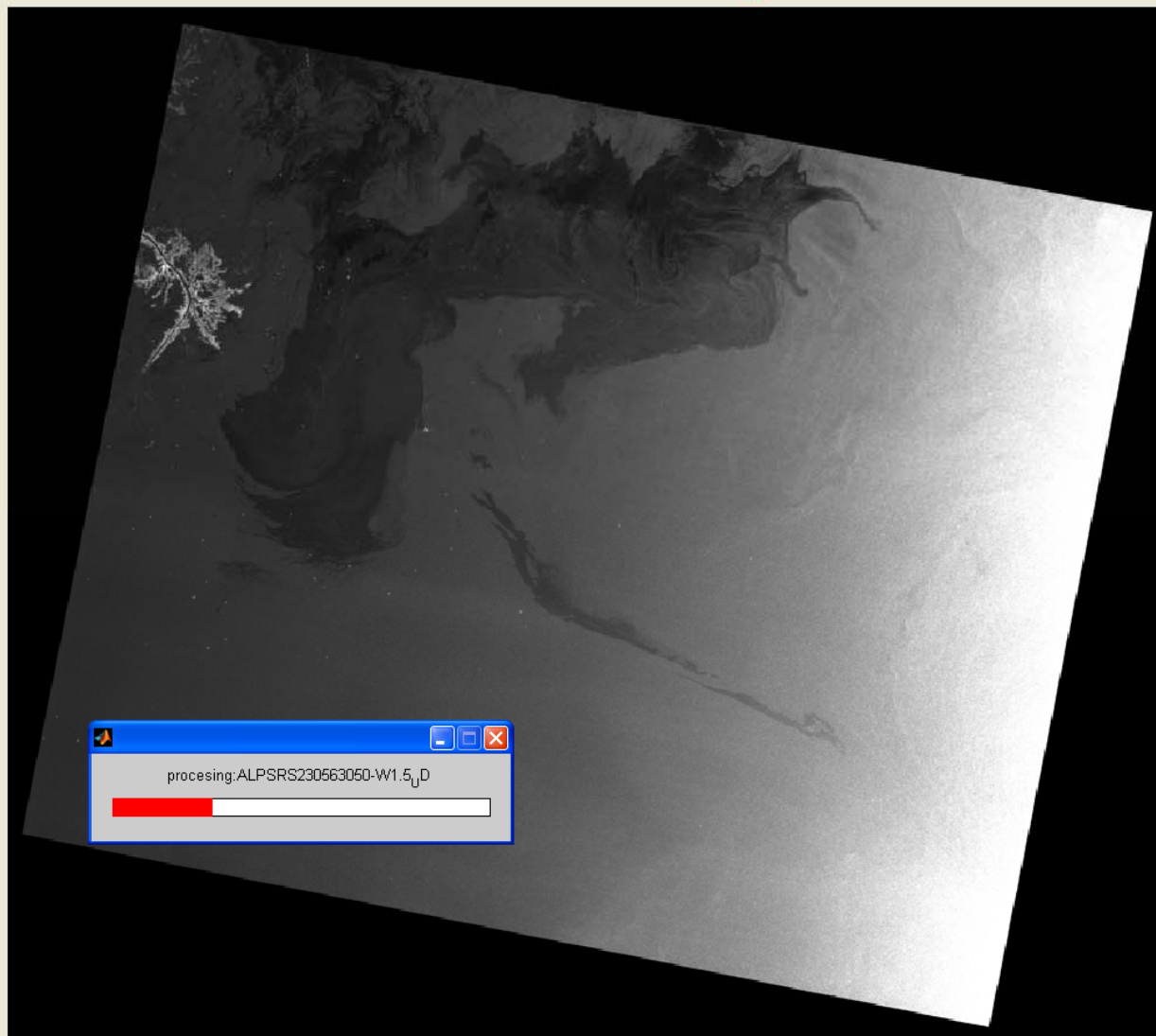
Step 2: Select Satellite and Beam Mode...

ALOS

Im

Step 3: Process with TCNNA

ALPSRS230563050-W1.5_UD.tif



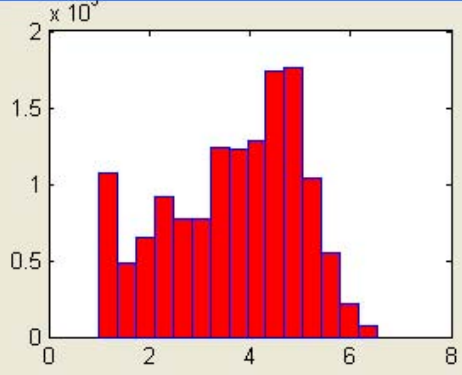
processing:ALPSRS230563050-W1.5_UD

Mask Low Wind Off

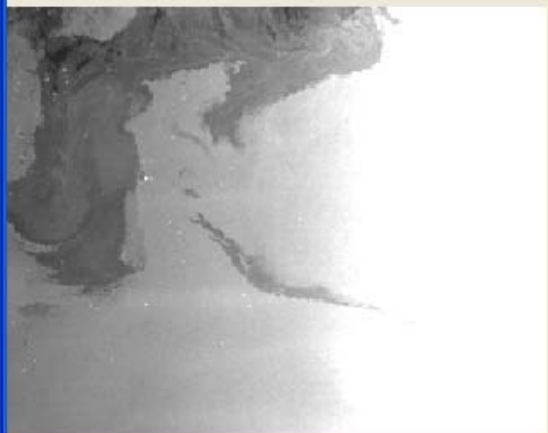
Set Low Wind Area

Set High Wind Area

Generate Fit Mask



RESET



Vertical sliders for parameter adjustment:

- Sd6
- 1.08
- Sd4
- Sd3
- 1.08
- 1.08

Clean Hand Free

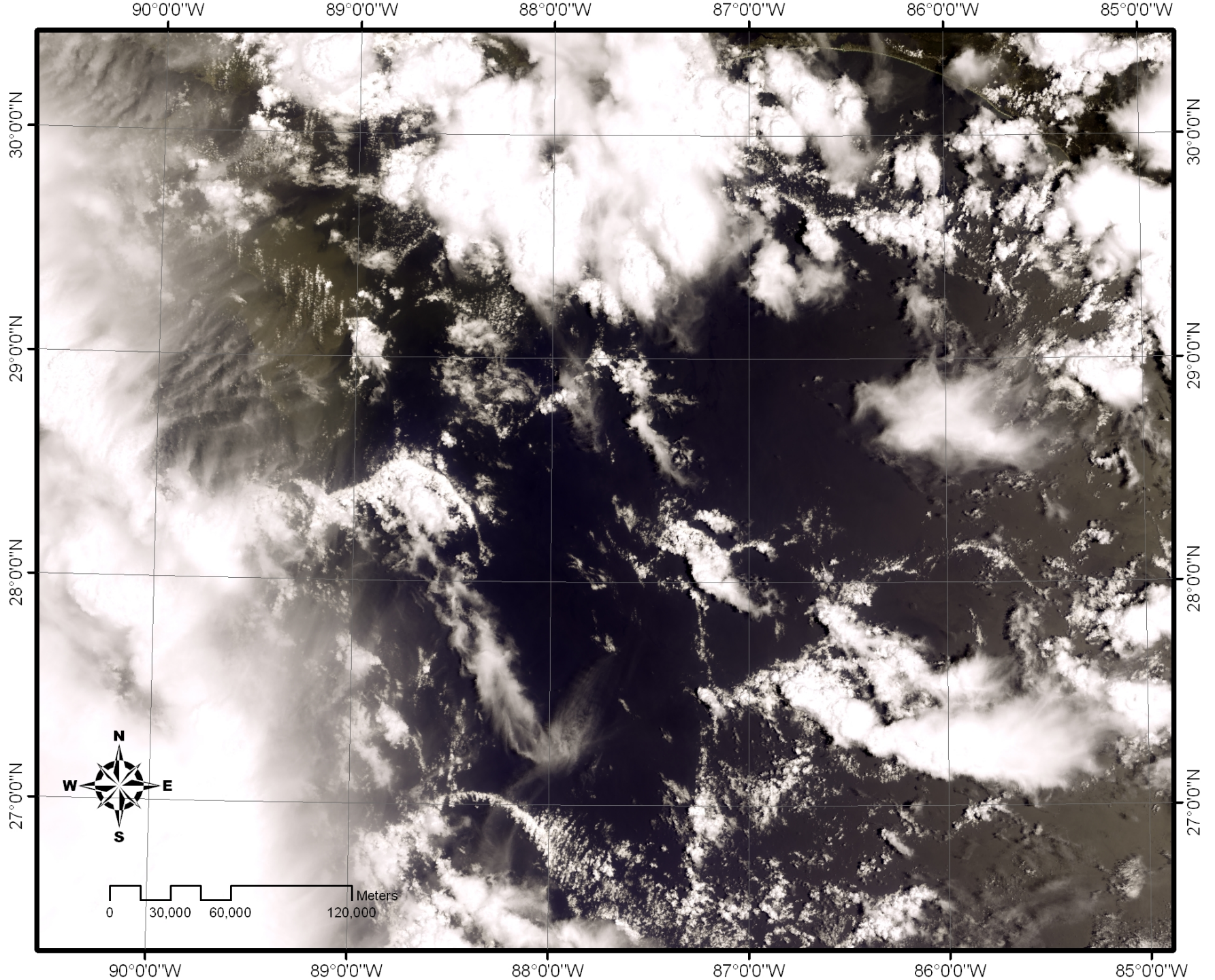
TCNNA Process

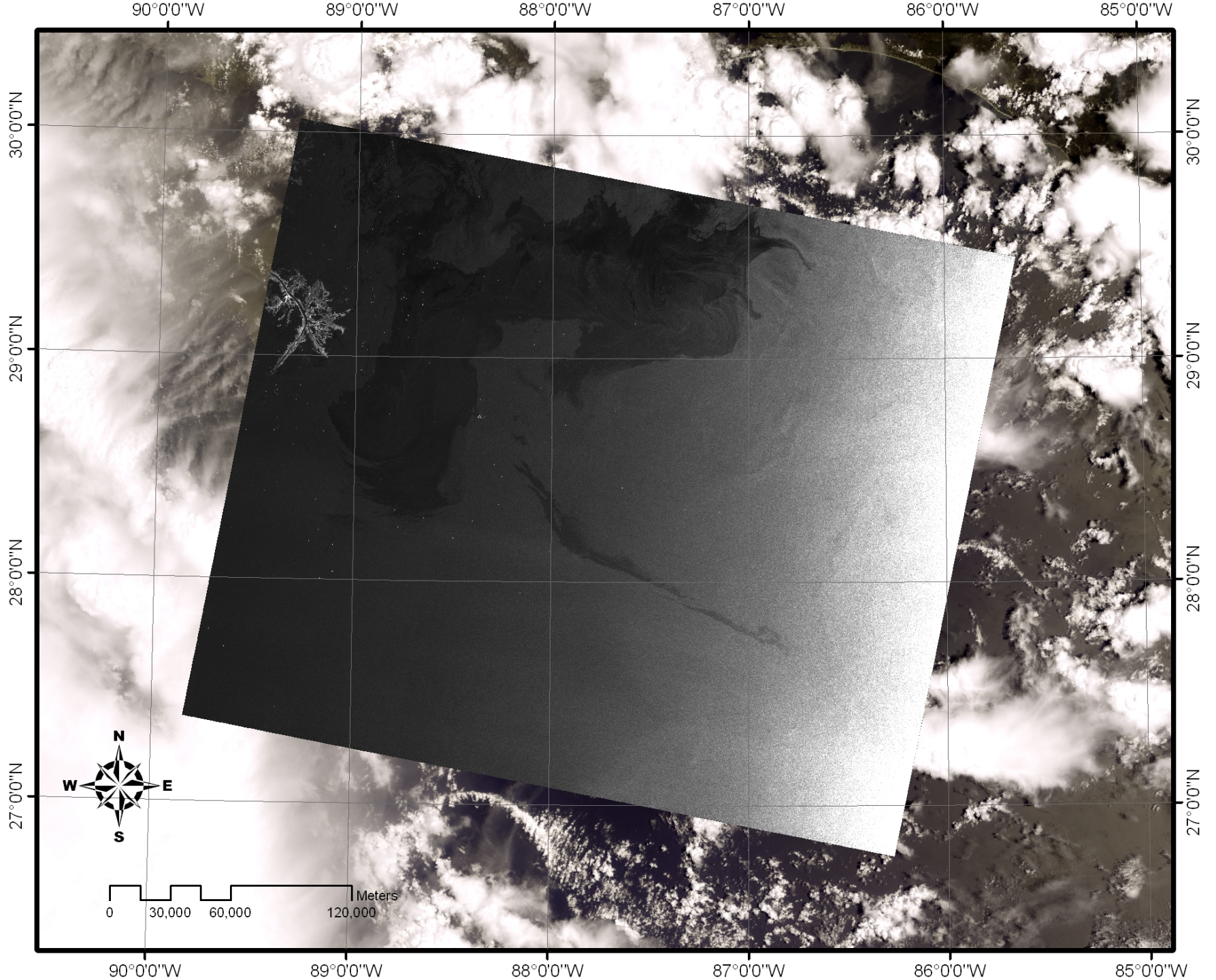
Enter the output folder

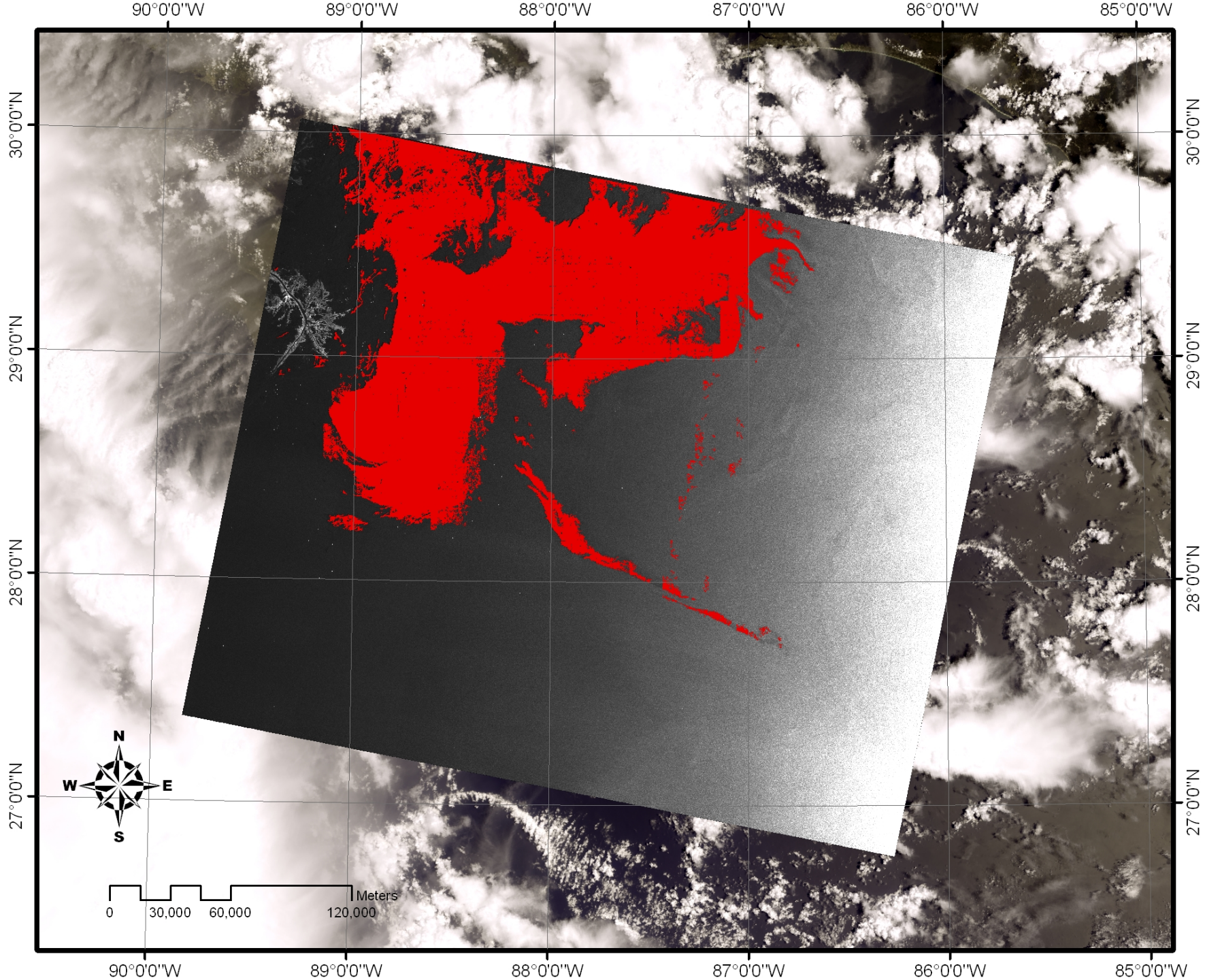
C:\...

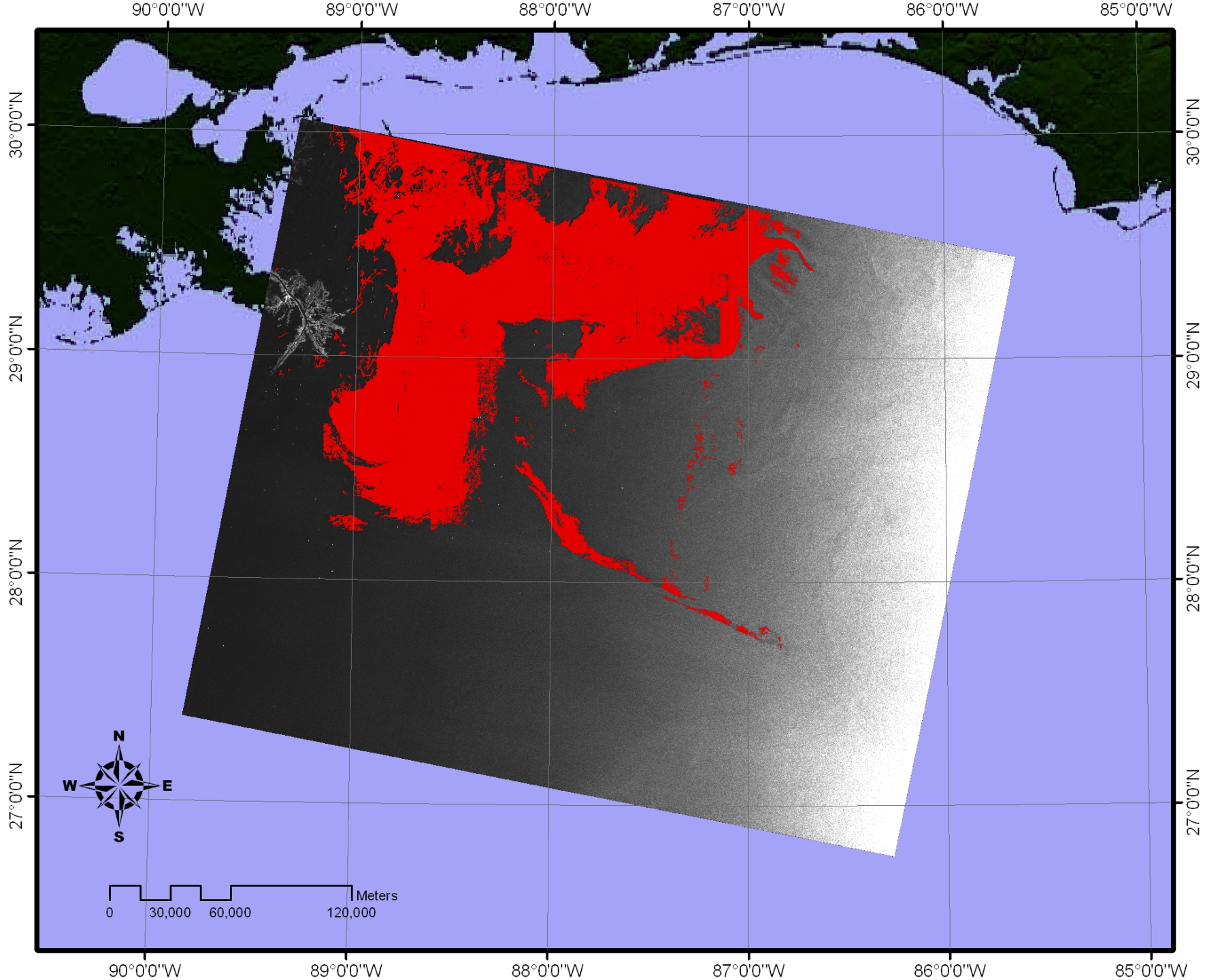
suffix

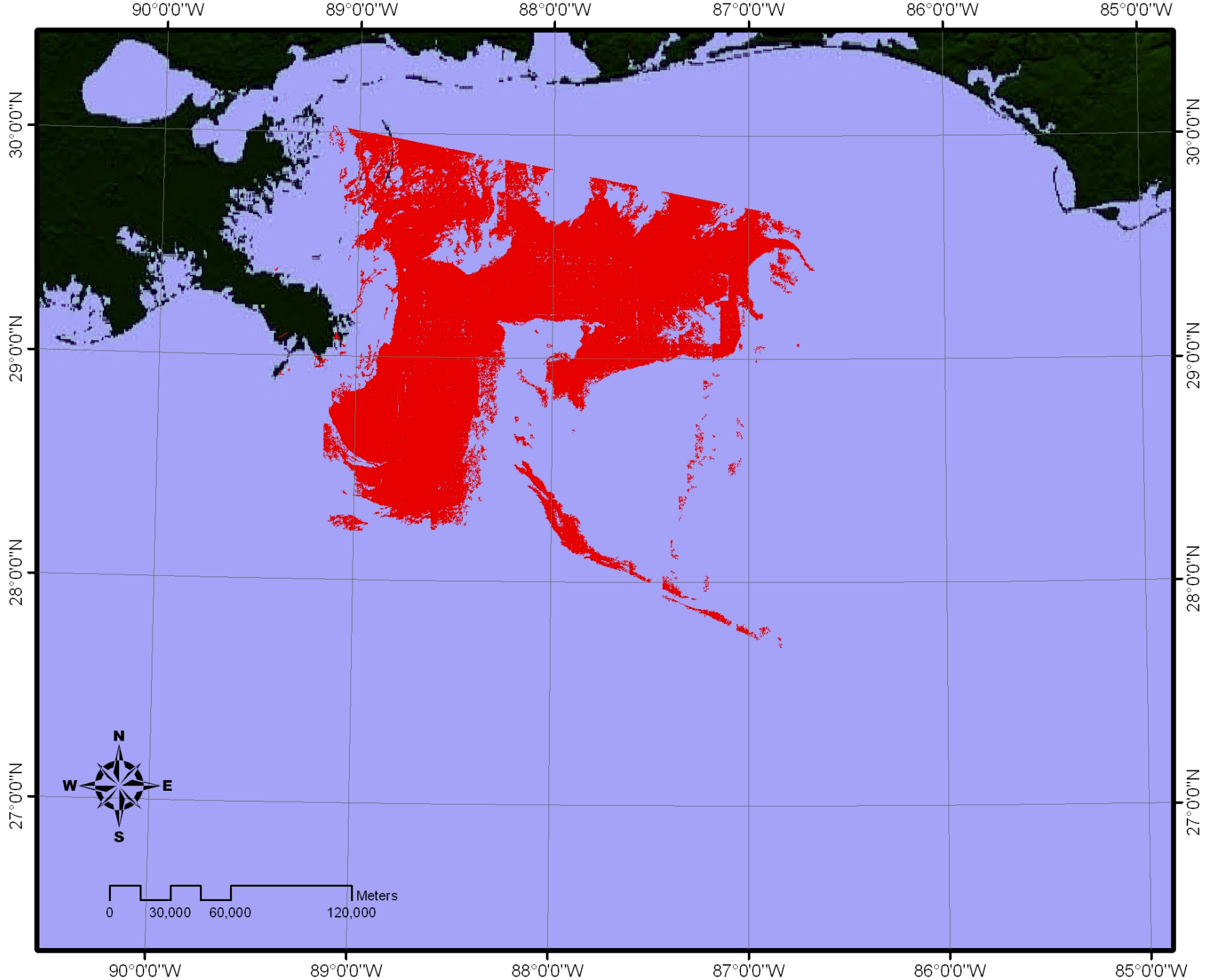
Export TCNNA output



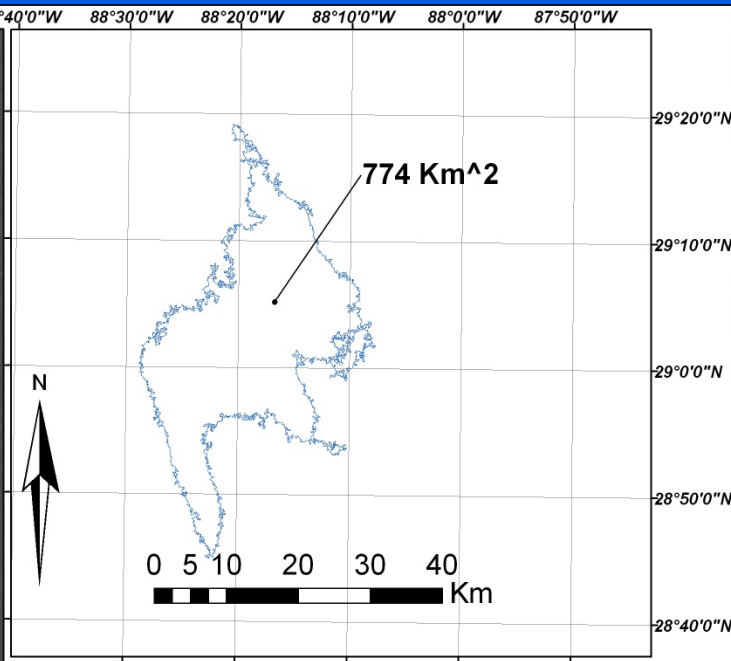
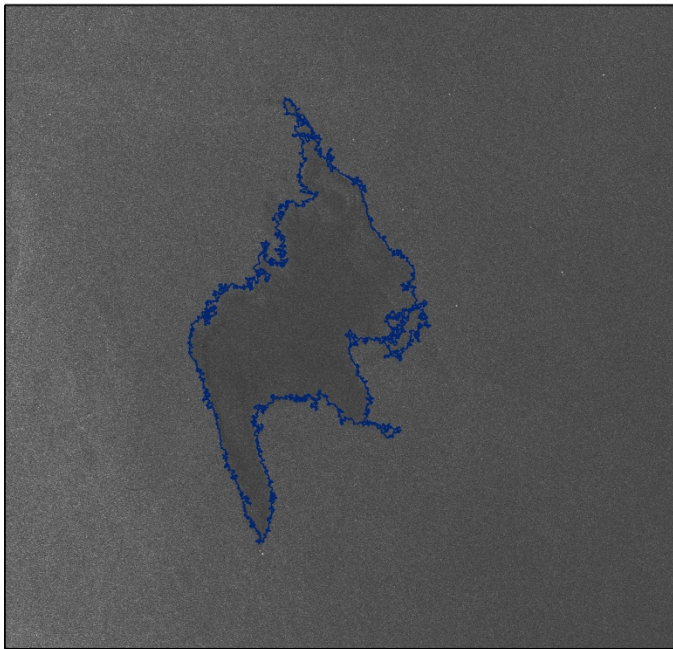








RADARSAT-2 (04/24/2010) & TerraSAR-X (04/25/2010)



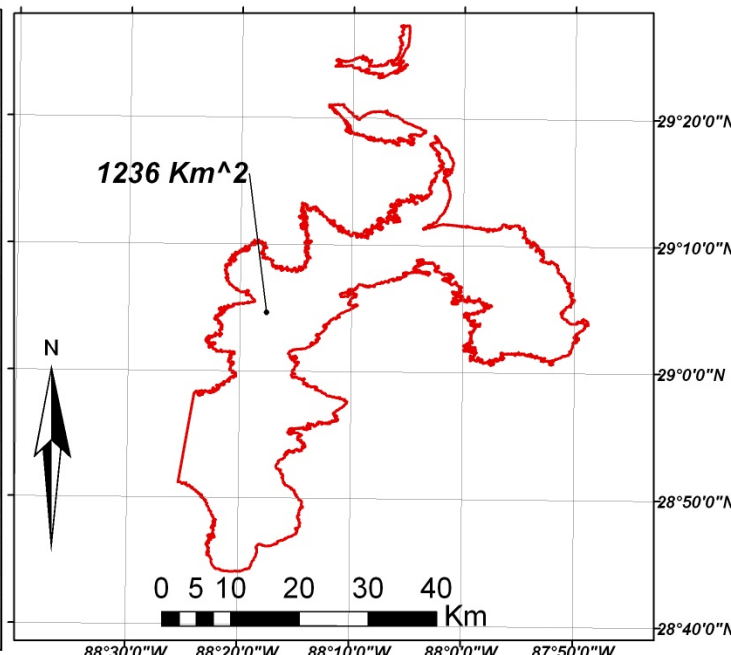
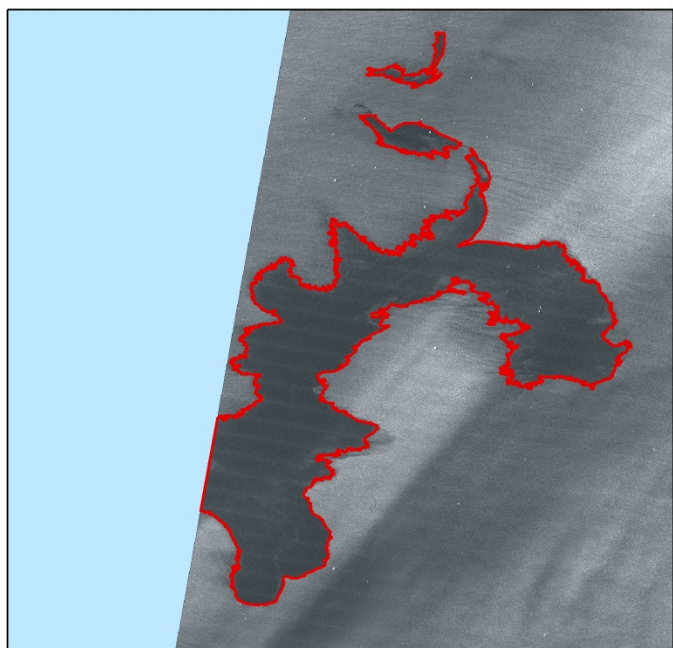
Symbology

- Oil Spill 4/24/2010
- Oil Spill 4/25/2010

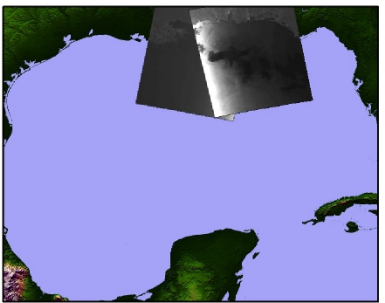
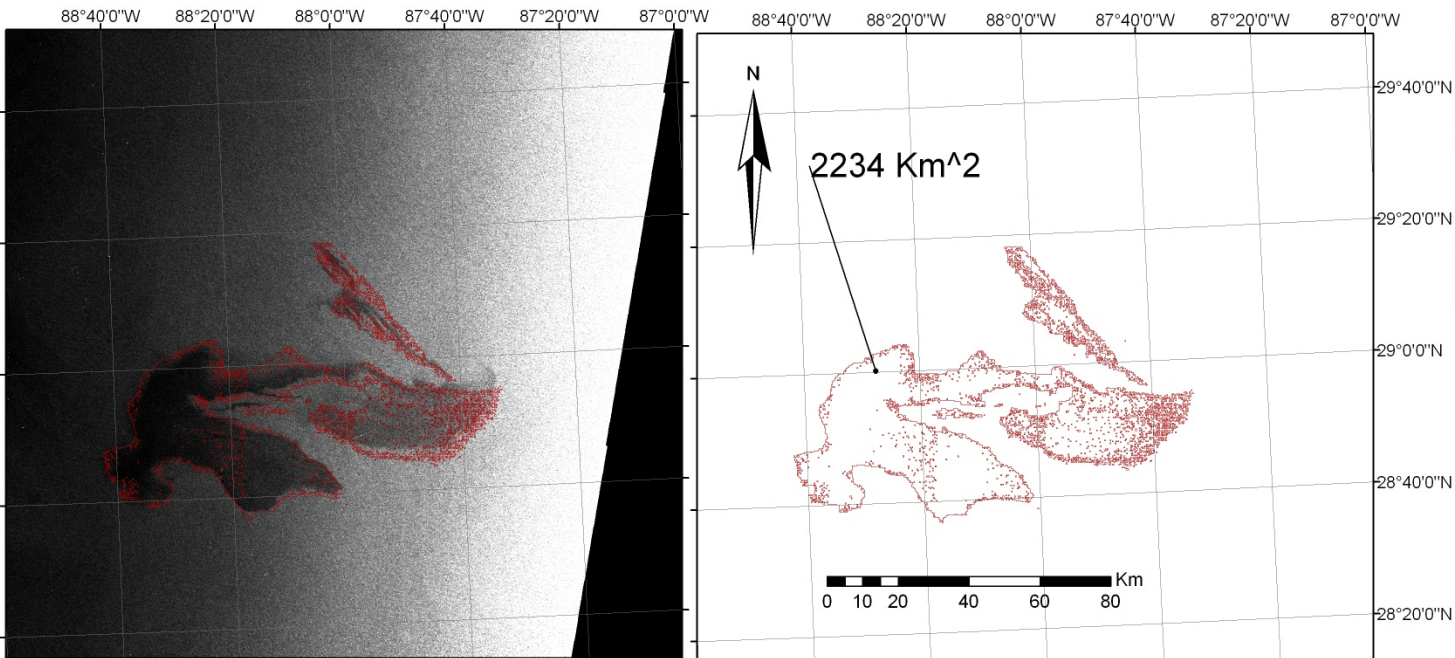
TCNNA Analysis

On April 24 2010, at 23:49hrs,
Using TCNNA on a RADARSAT-2
Scan SAR Beam Mode
774 Km² were classified as
surface waters containing Oil.

On April 25 2010, at 11:50hrs,
Using TCNNA on a TerraSAR-X
SC HH Beam Mode
1236 Km² were classified as
surface waters containing Oil.



TCNNA Analysis on ENVISAT SAR (04/26/2010 & 04/29/2010)



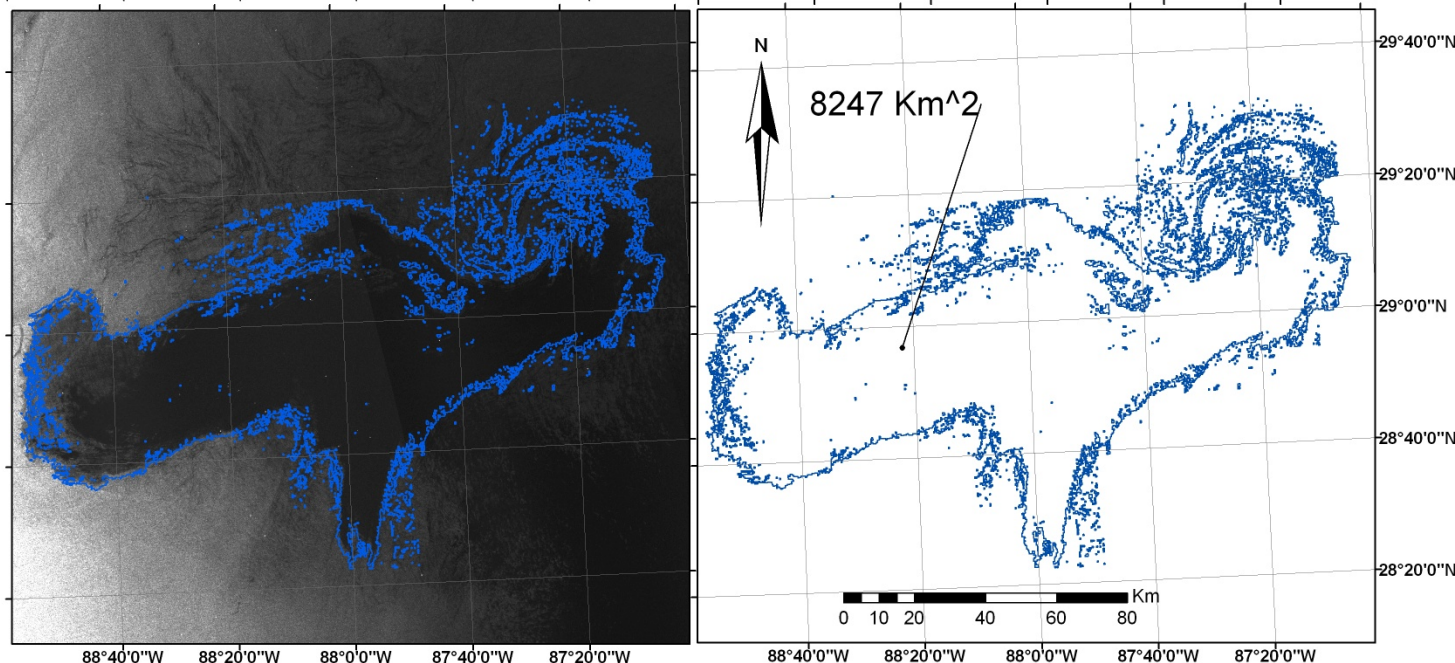
Symbology

- Oil Spill 4/26/2009
- Oil Spill 4/29/2009

TCNNA Analysis

On April 26 2010, at 15:58 hrs, Using TCNNA on a ENVISAT SAR Image ASAR WSM Mode 2234 Km² were classified as sea surface waters containing Oil.

On April 29 2010, at 03:45 hrs, Using TCNNA on an ENVISAT SAR Image ASAR WSM Mode 8247 Km² were classified as sea surface waters containing Oil.

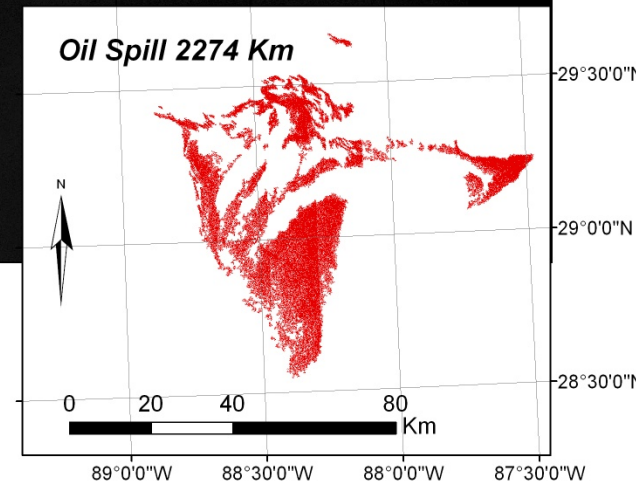
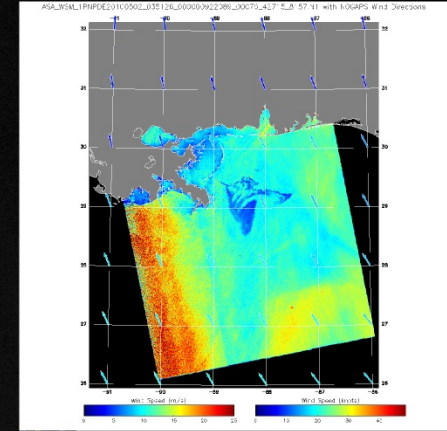
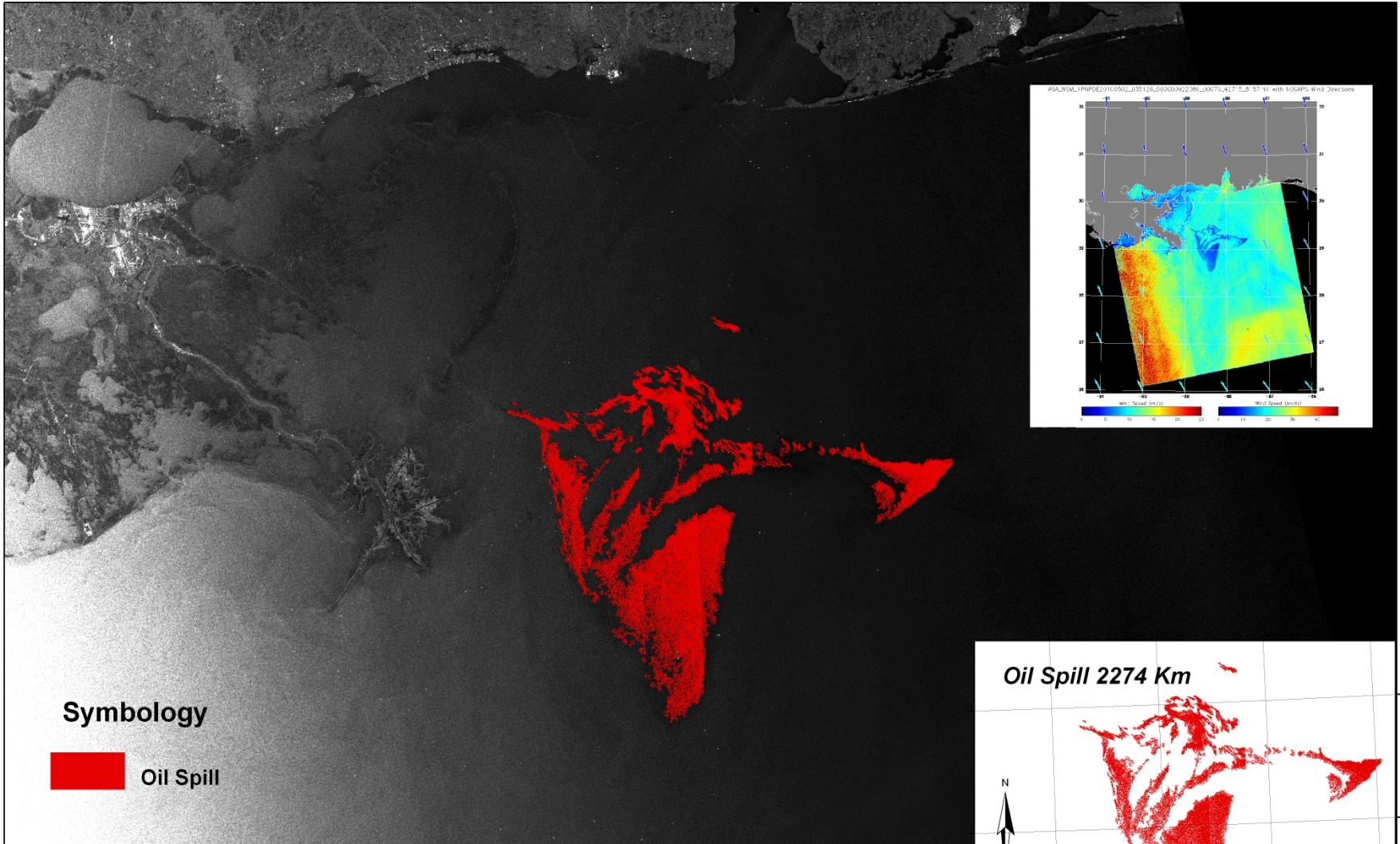


NOAA/NESDIS
Xiaofeng Li
William Pichel
Christopher Jackson



EOAS Department
MacDonald Image Lab
Oscar Garcia-Pineda
Ian MacDonald

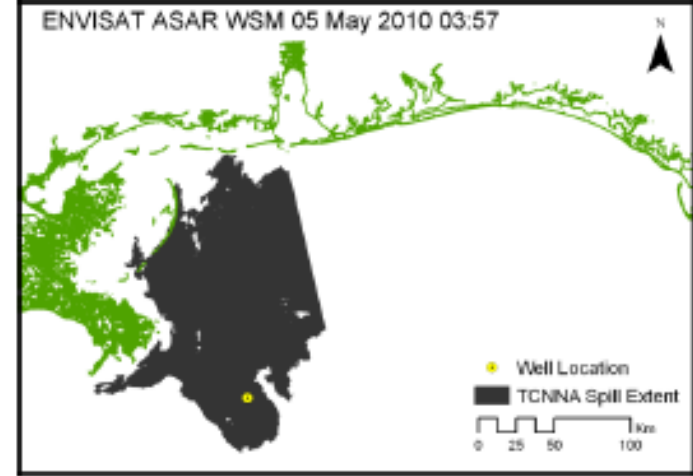
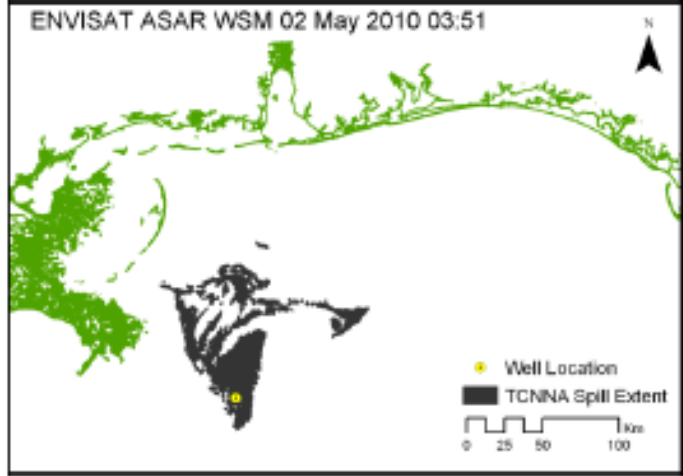
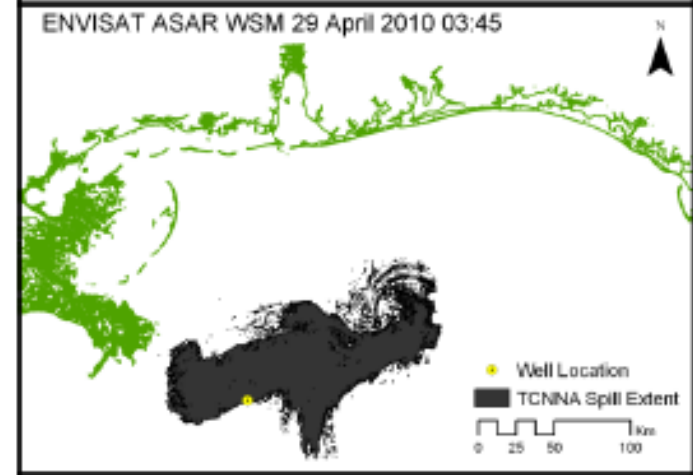
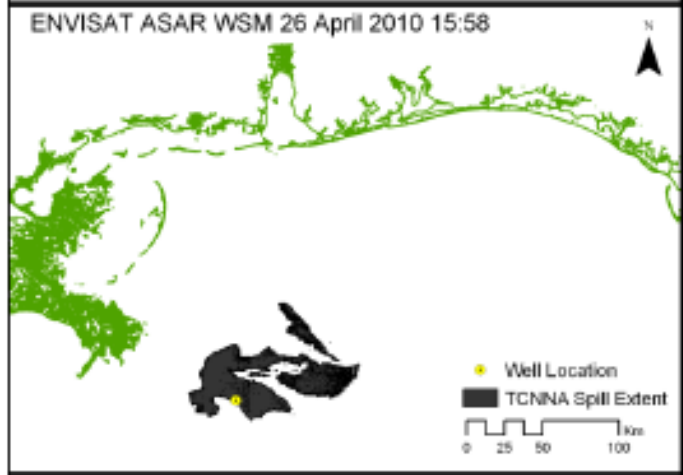
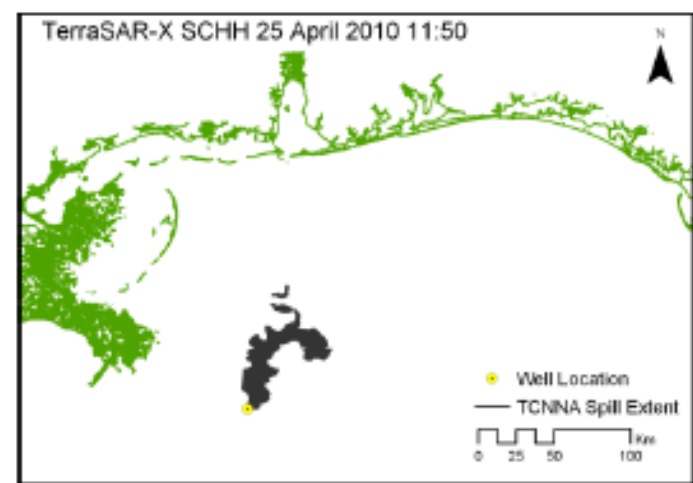
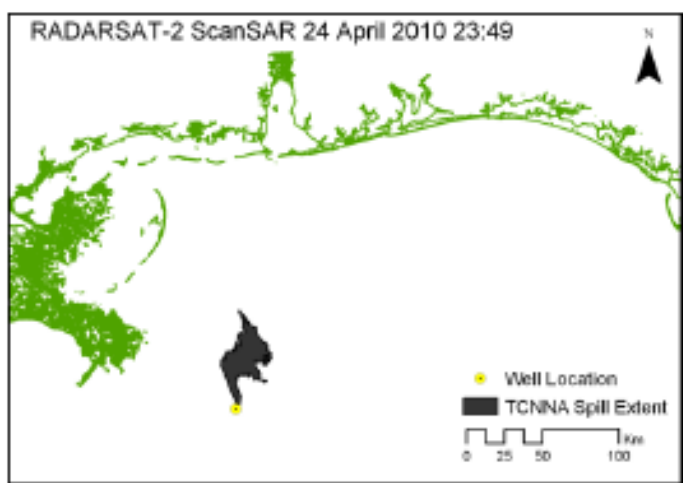
TCNNA Analysis GOM Oil Spill. Envisat May 2

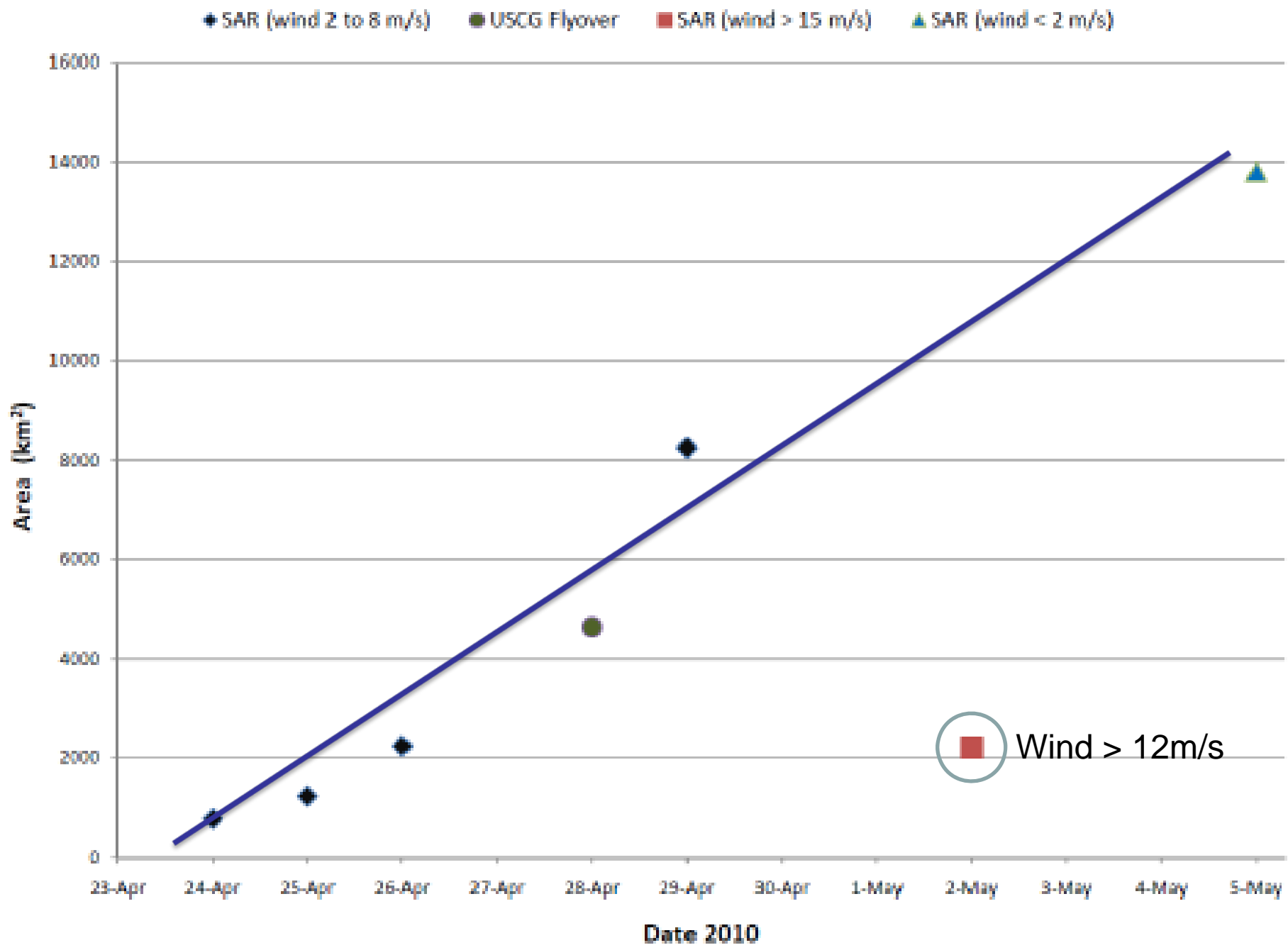


Analysis
TCNNA Output on May 2, 2010 ENVISAT SAR
2274 Km² were detected as surface waters containing oil.

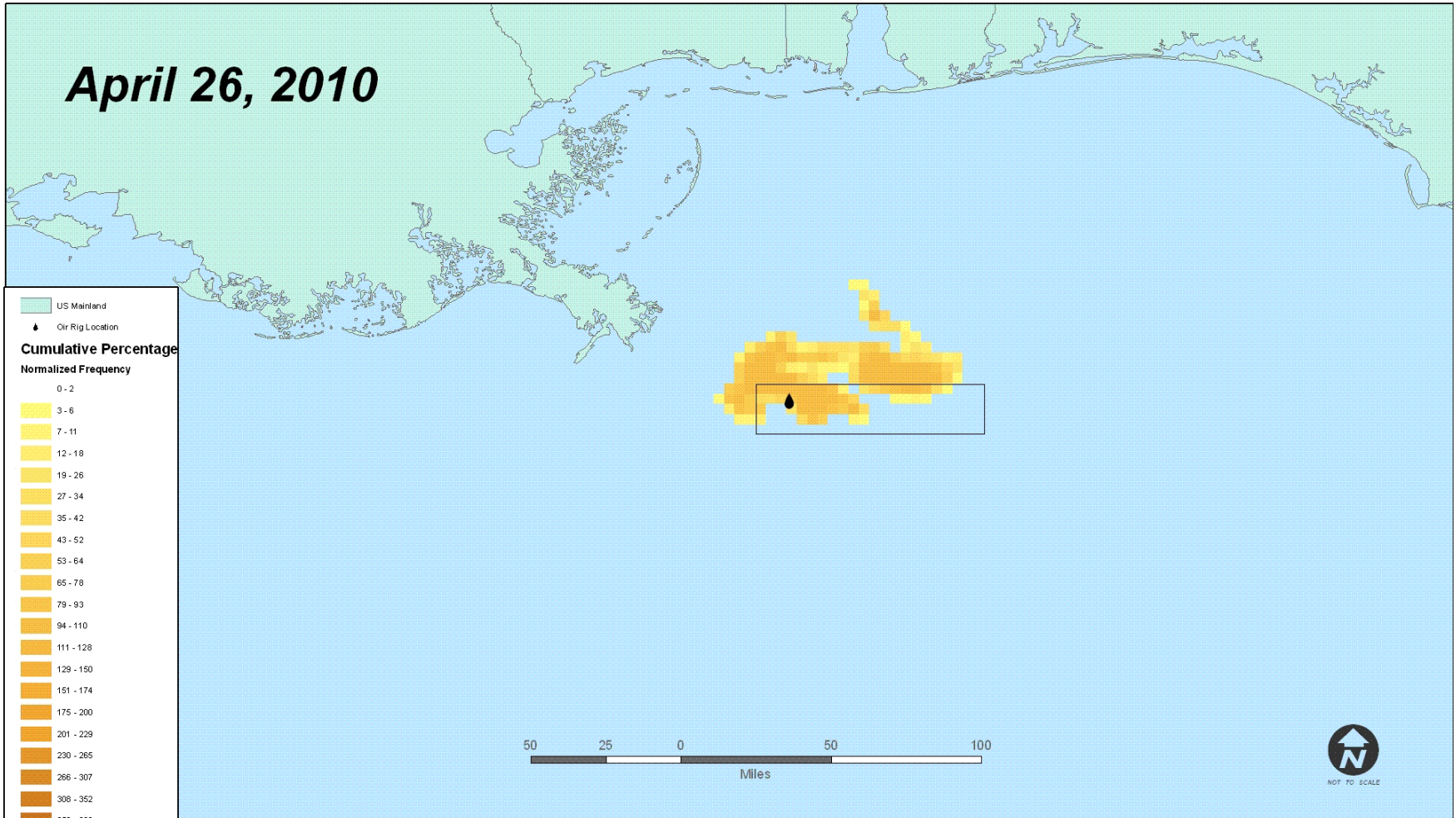
Strong winds indicates that this area contains very heavy hydrocarbons that still damps capillary waves. It is possible to infer that a larger area contains oil that is not detected due the high winds








BP Oil Spill Monitoring. Cumulative Detection of Oil per Unit Area



100	100	100	100	100	99	79	11	0	21	52	76	91	99	97	93	27	4	0	0	0	0	0	0	0	0	0	
28	52	87	100	100	100	100	87	48	1	0	0	3	4	6	5	0	0	0	0	0	0	0	0	0	0	0	0
2	0	21	99	100	100	80	69	98	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	39	82	60	1	0	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

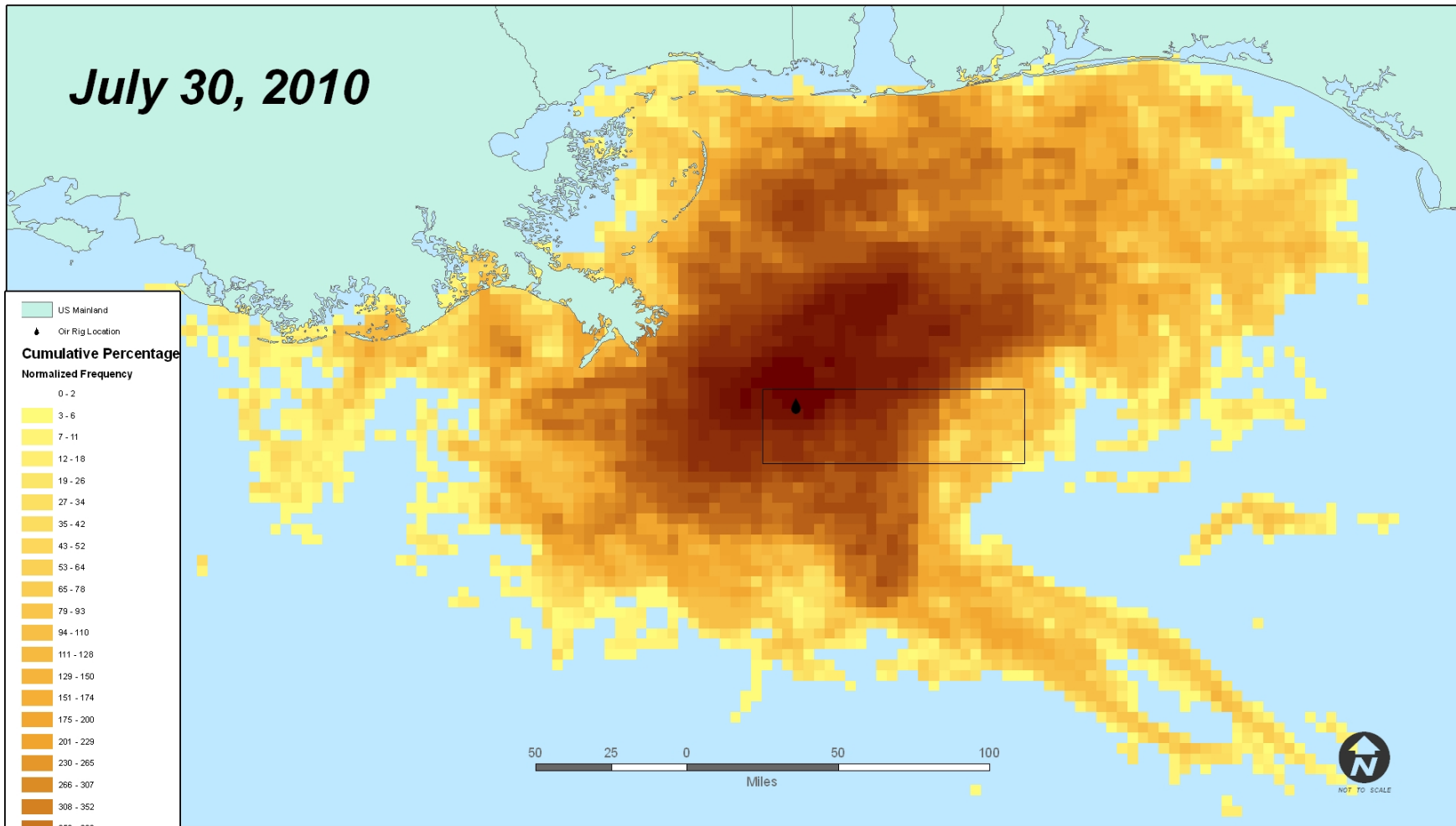
Source: TCNNA

Projection: WGS_1984
Date: September 22, 2010



Dr. Oscar Garcia-Pineda
MacDonald Image Lab
EOAS-Department
Florida State University

BP Oil Spill Monitoring. Cumulative Detection of Oil per Unit Area



1765	2086	2126	2022	1876	1715	1560	1570	1289	1219	1283	1177	1144	1054	879	740	453	336	287	123	41	100	103	87	107
1606	1918	1966	1936	1883	1473	1276	1422	1239	1195	1137	994	745	714	659	529	249	287	209	172	149	135	107	122	86
1640	1647	1683	1738	1643	1224	1052	1156	1139	1190	1024	815	717	469	492	424	226	261	248	135	114	102	102	106	56
1327	1380	1447	1467	1248	1001	911	1002	879	939	971	765	594	451	435	414	241	79	125	119	135	117	118	67	94
1089	1049	1128	1116	958	884	771	839	858	907	830	703	517	406	393	272	149	29	36	98	99	73	84	108	
1026	1083	1018	808	864	854	624	701	903	939	813	778	541	413	331	137	37	19	100	105	134	70	69	38	23
1006	1064	1023	890	809	770	750	840	801	824	779	787	510	381	311	121	69	23	144	137	88	43	3	36	33

Source: TCNNA

Projection: WGS_1984
Date: September 22, 2010

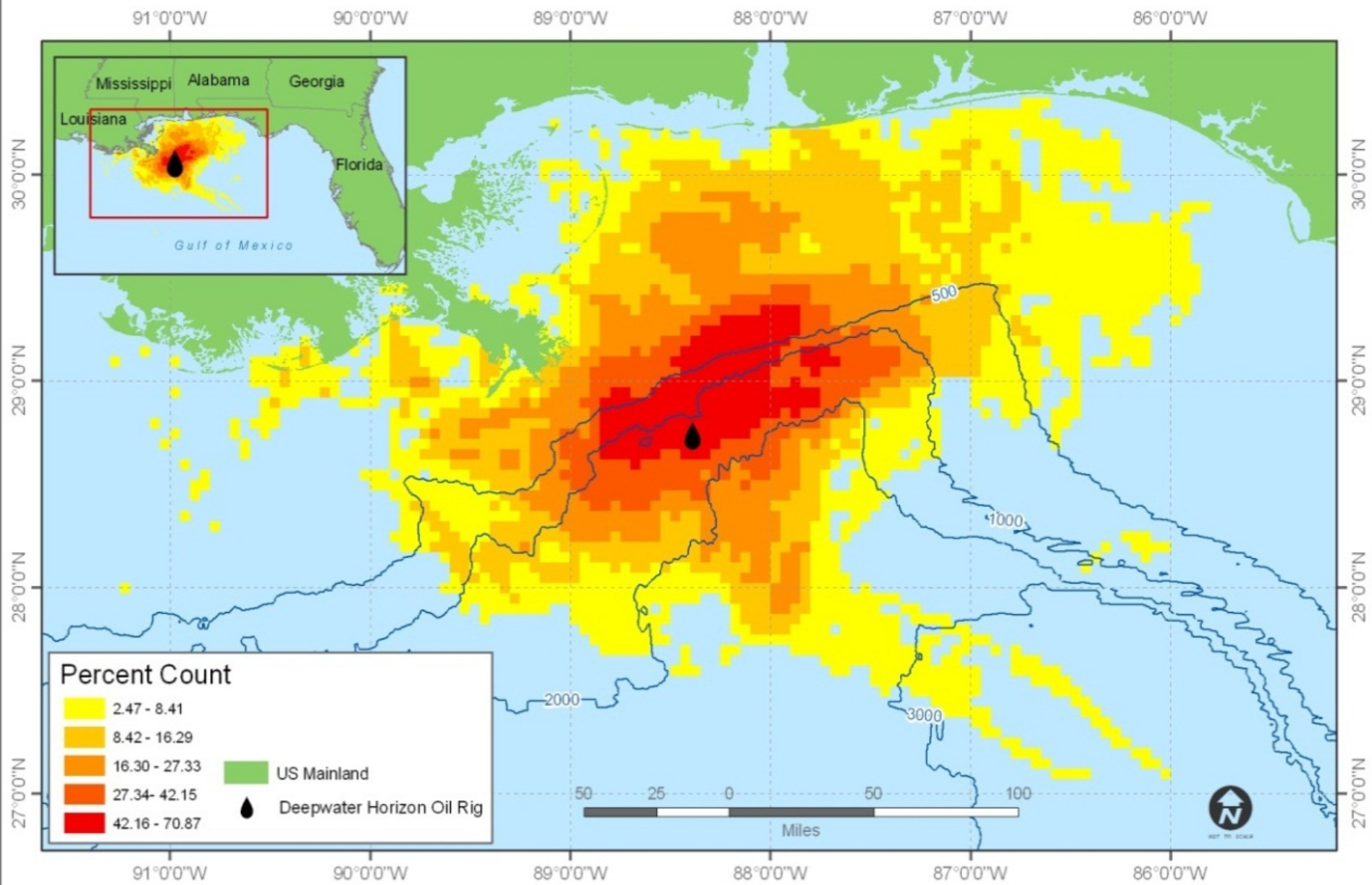


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MacDonald Image Lab
EOAS-Department
Florida State University

BP's Oil Spill Analysis. Normalized Detection of Surface Oil.



MacDonald Image Lab
Dr. Oscar Garcia-Pineda
EOAS Department

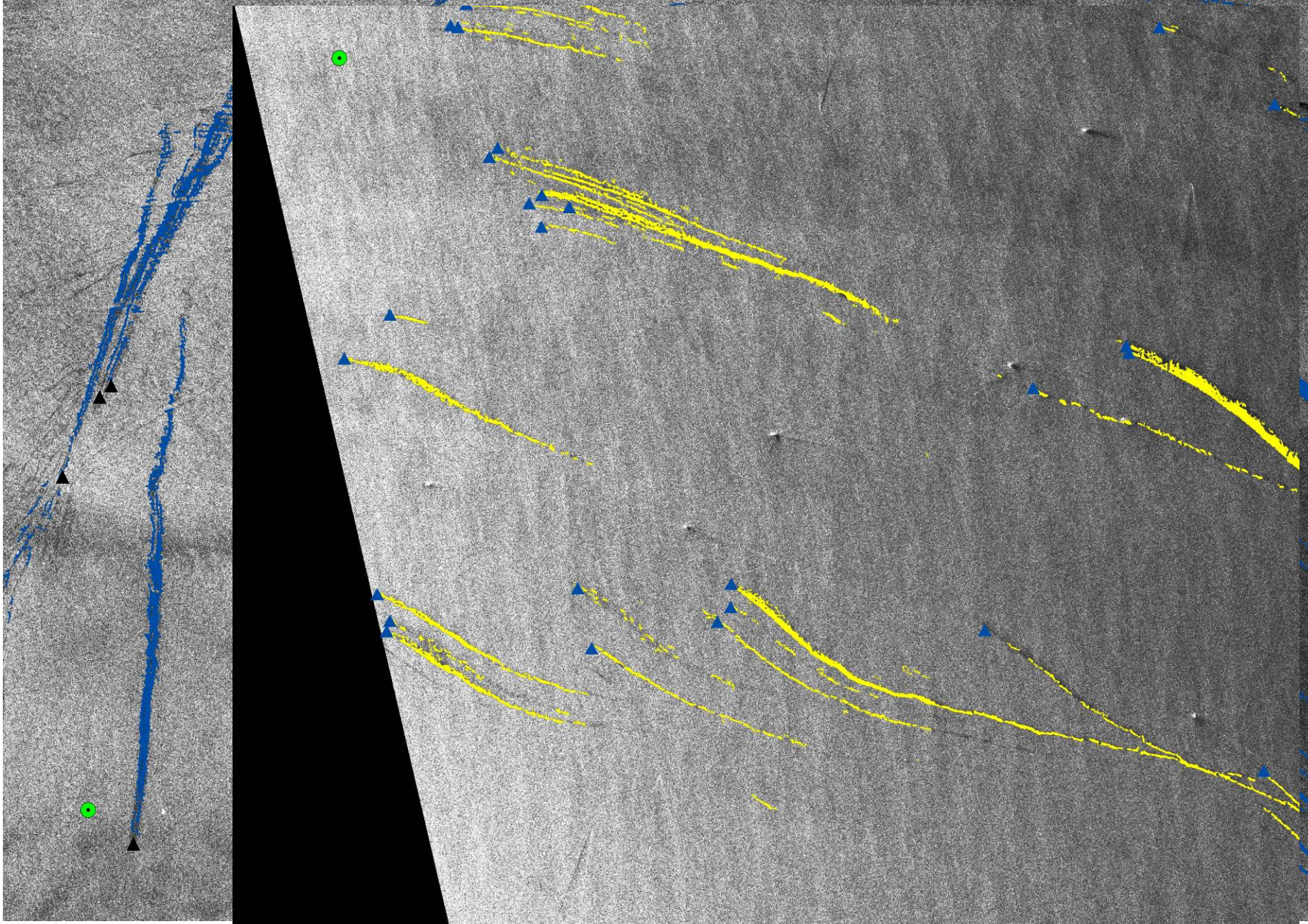


Natural Hydrocarbon seeps are natural springs where liquid and gaseous hydrocarbons leak out of the ground

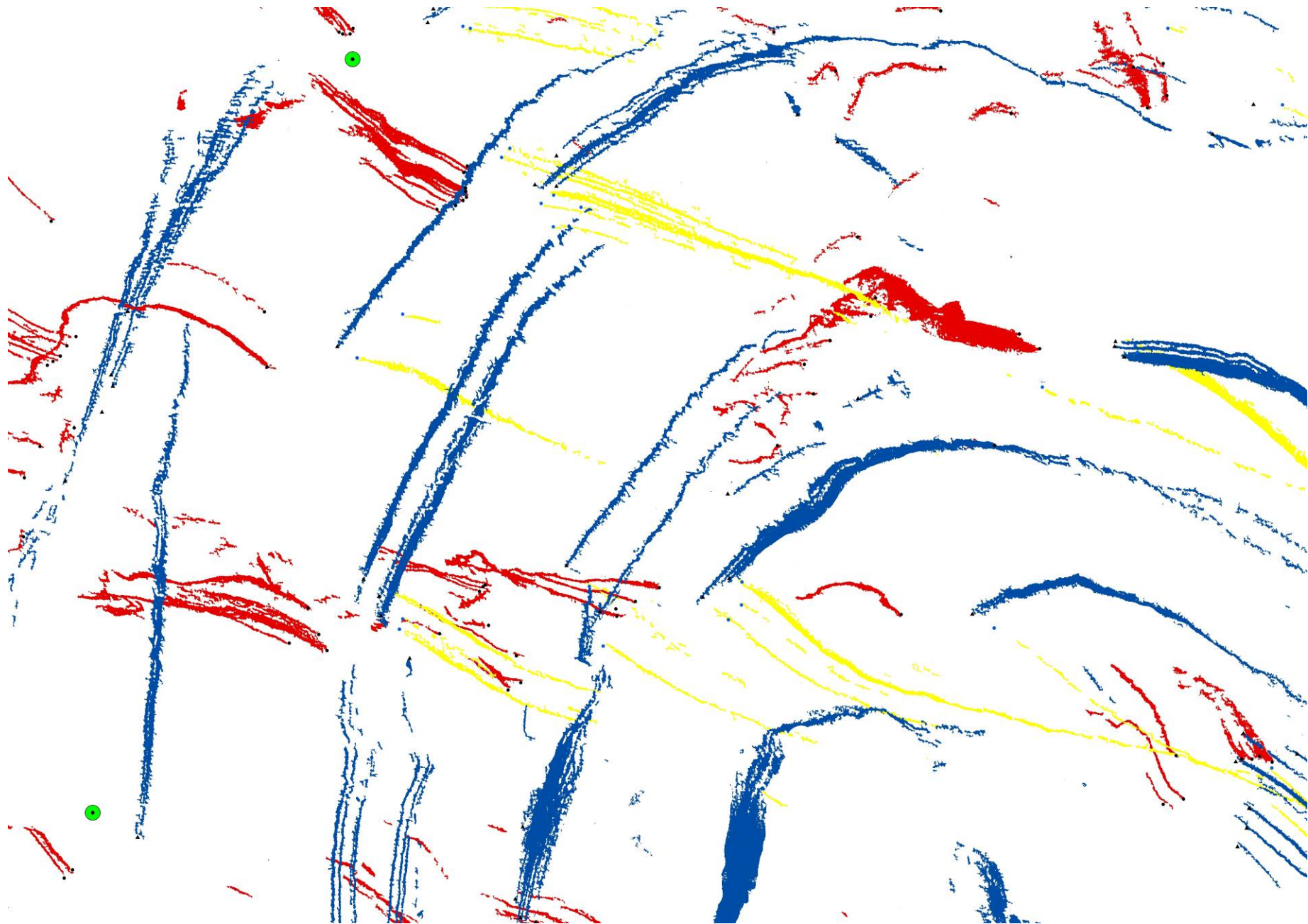


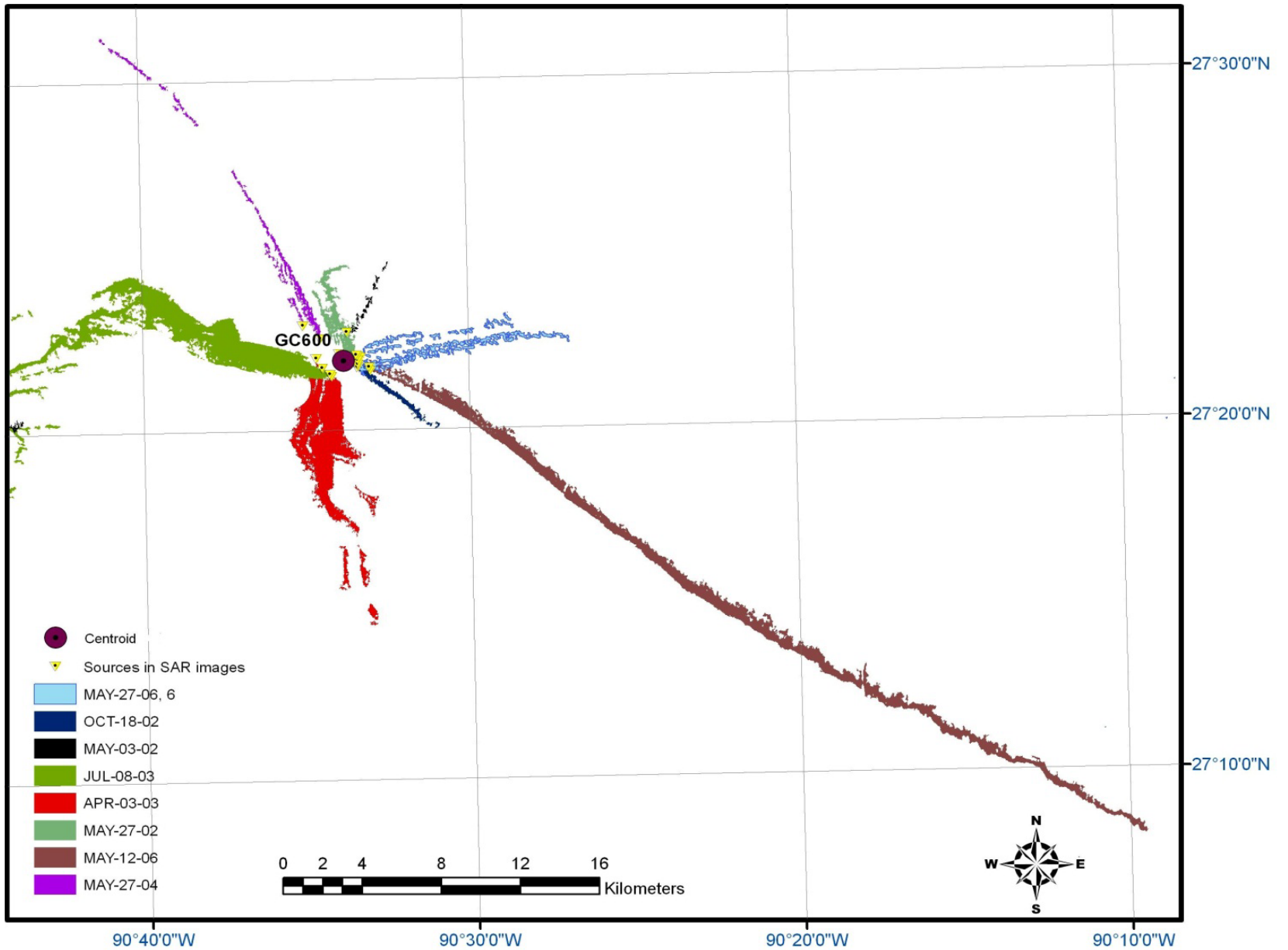
Oil Slicks Analysis

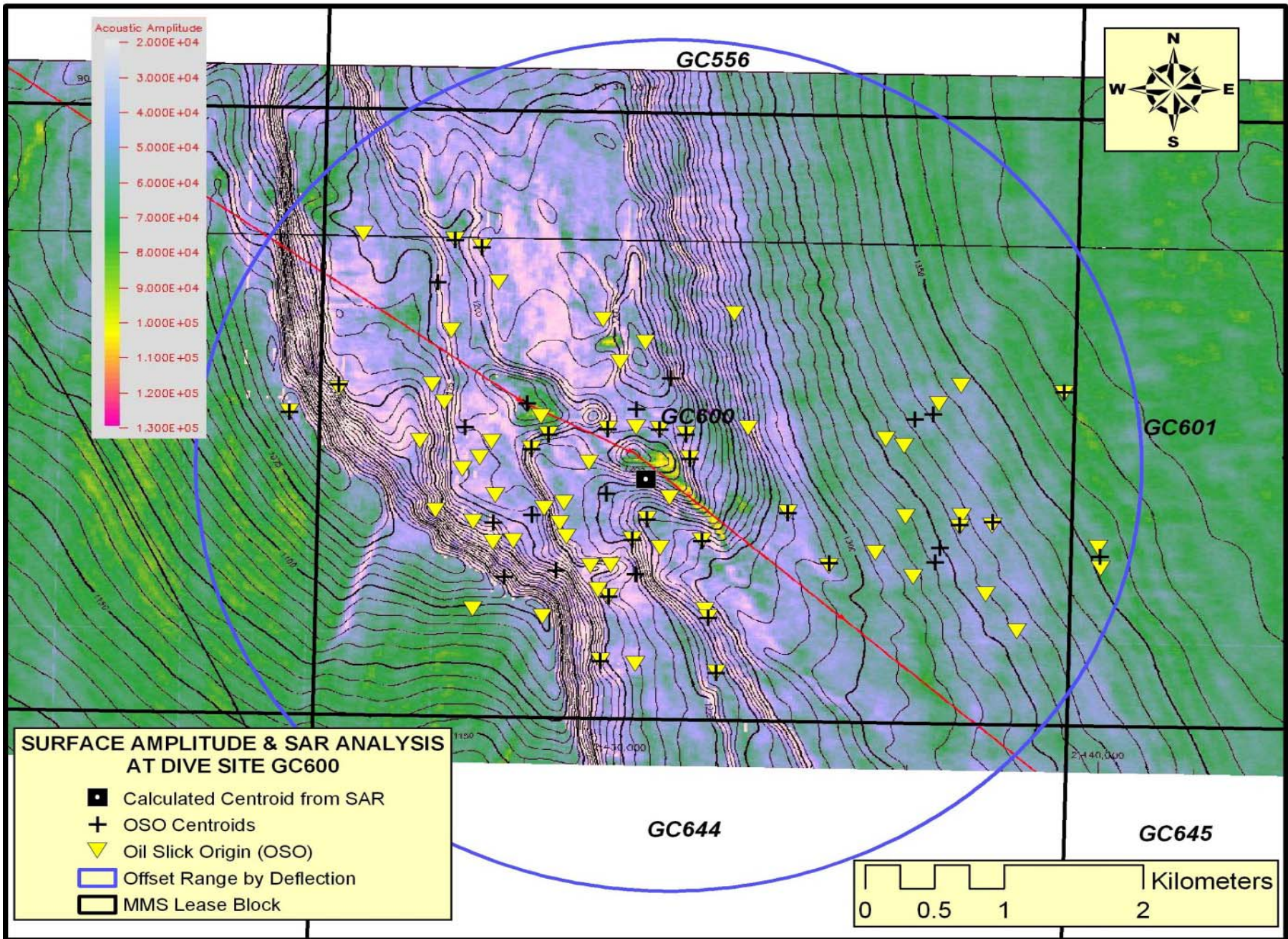
Oil Slick Origins (OSO)



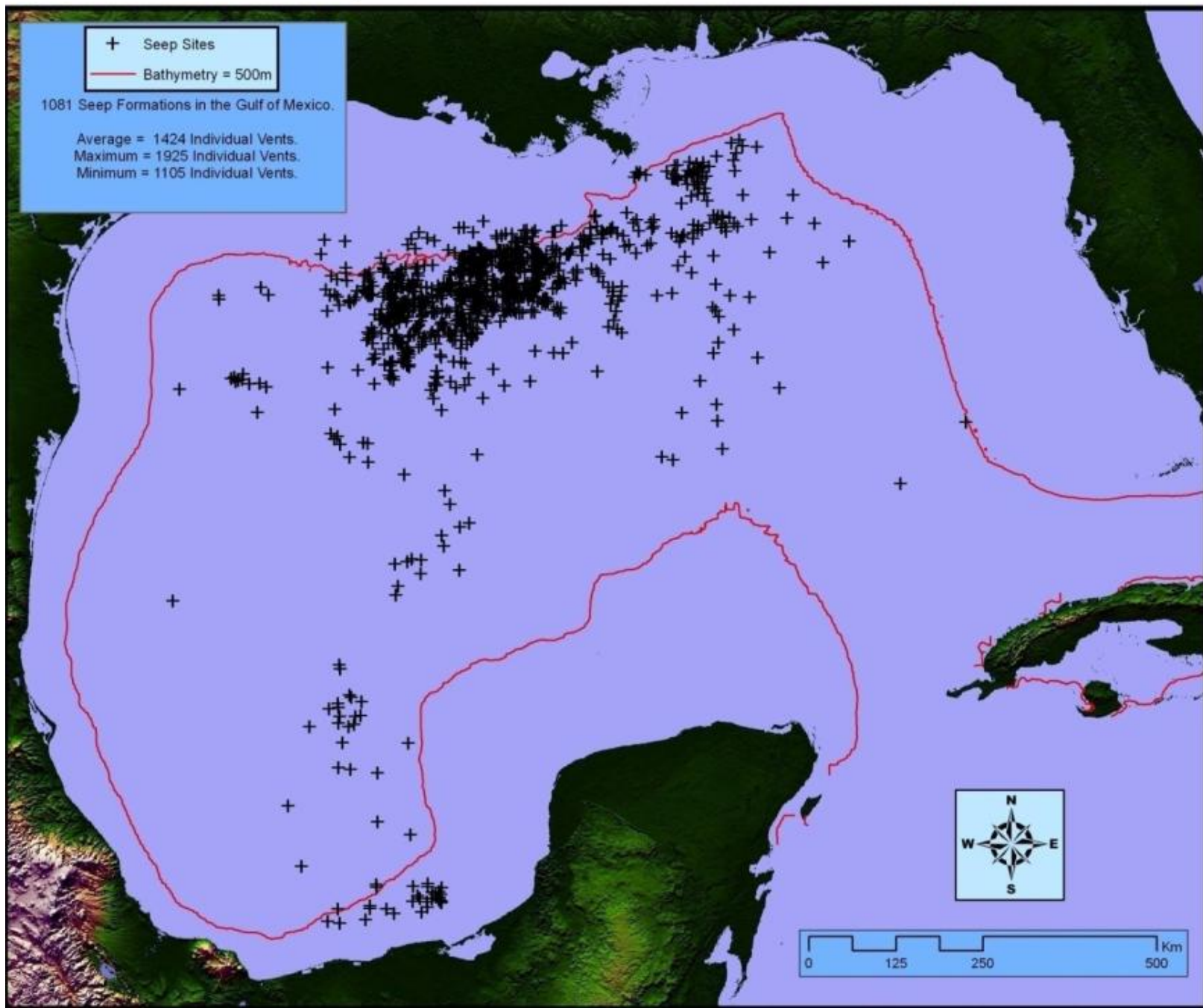
The challenge of estimating the location of the active seeps, is that each sar image provides a different location of the OSO generated by the same seep formation



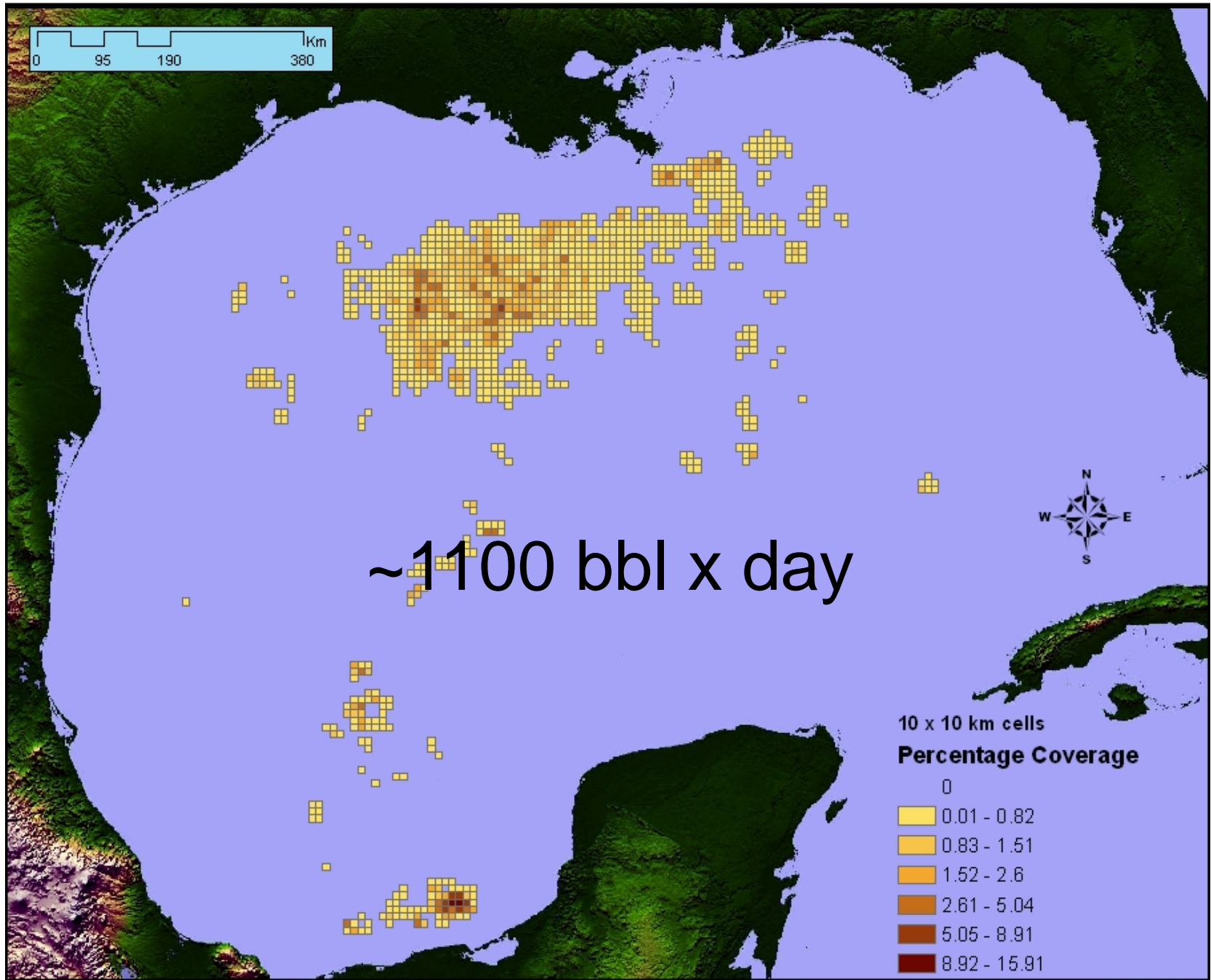




Natural Seep Formations in the Gulf of Mexico



Percentage Average of Oil Coverage



Facts

1. Daily Natural Seepage ~1100 bbl
2. Daily BP discharged oil ~60,000 bbl
3. Natural Seepage dosage ~ 400,000 bbl x year (in geological time)
4. BP oil spill ~ 5,000,000 bbl in 84 days.

OIL THICKNESS WORK

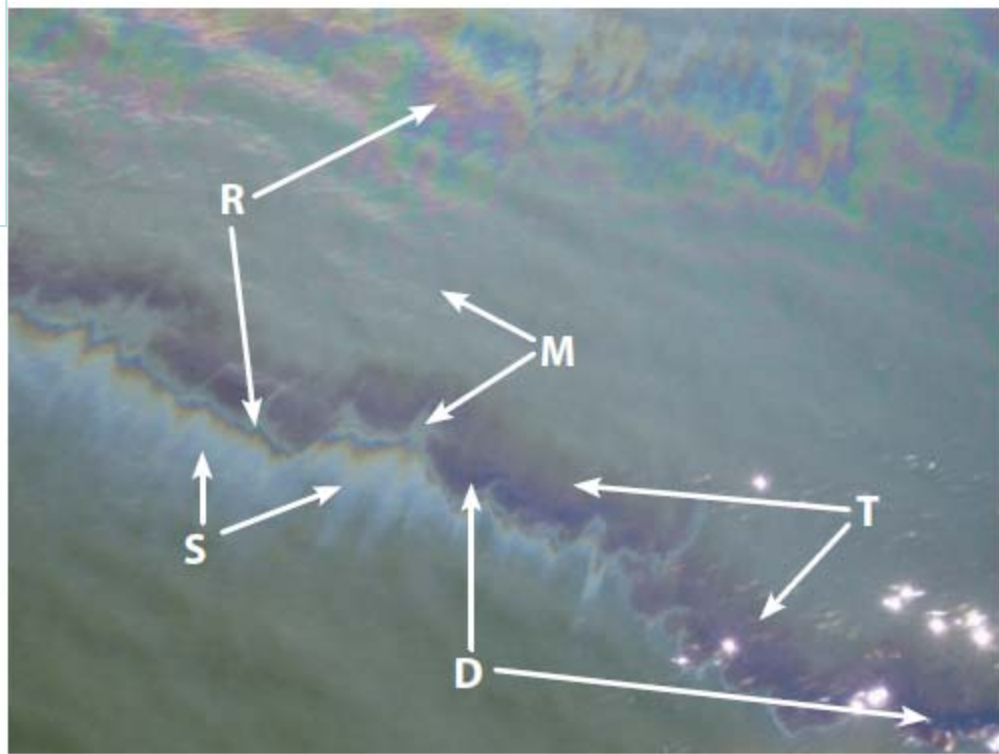






Bonn Standards for assessing oil on water

- Treaty among North Sea States
- Relates oil thickness to color
- U.S. not a signatory, but NOAA adopts for its field

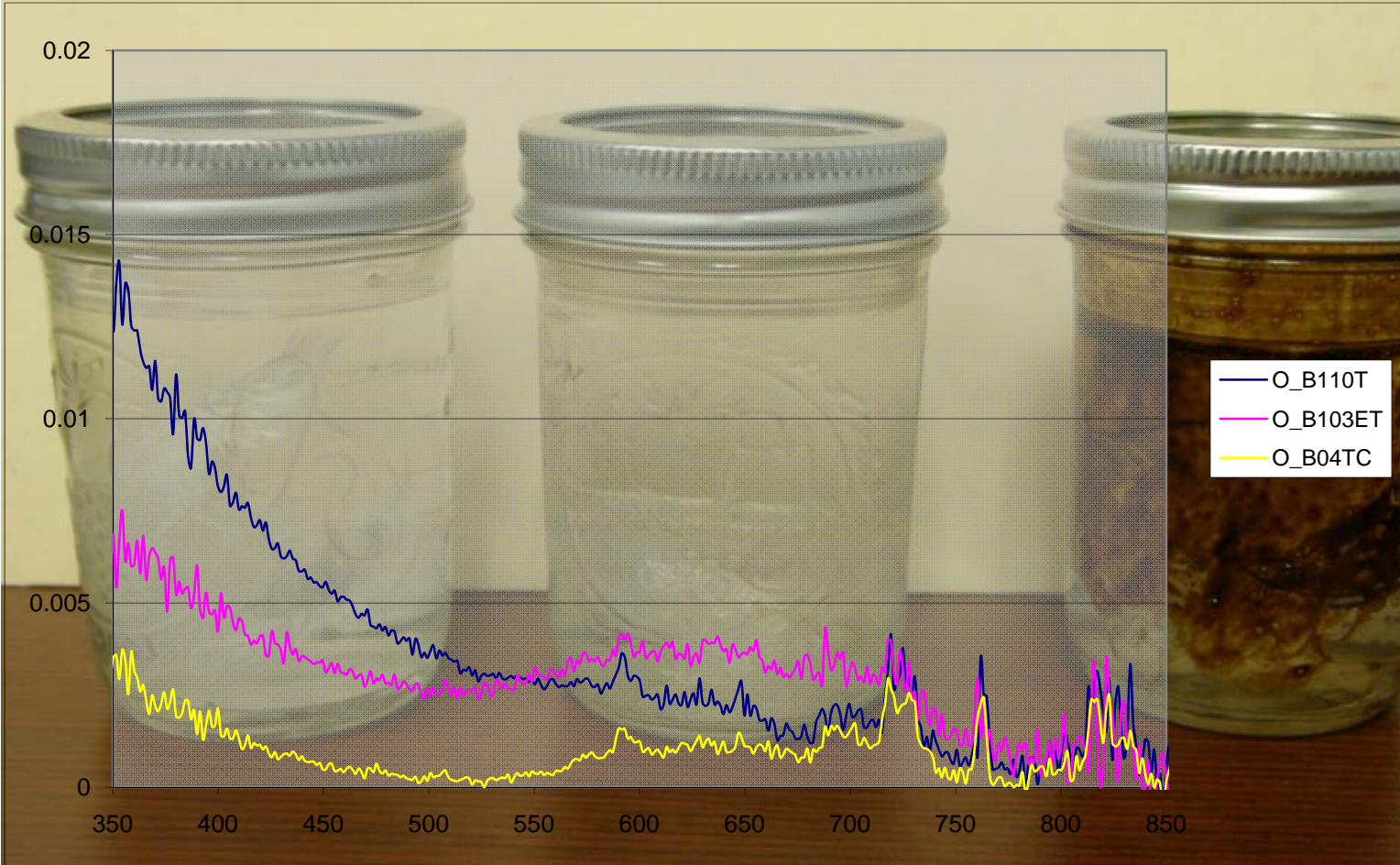


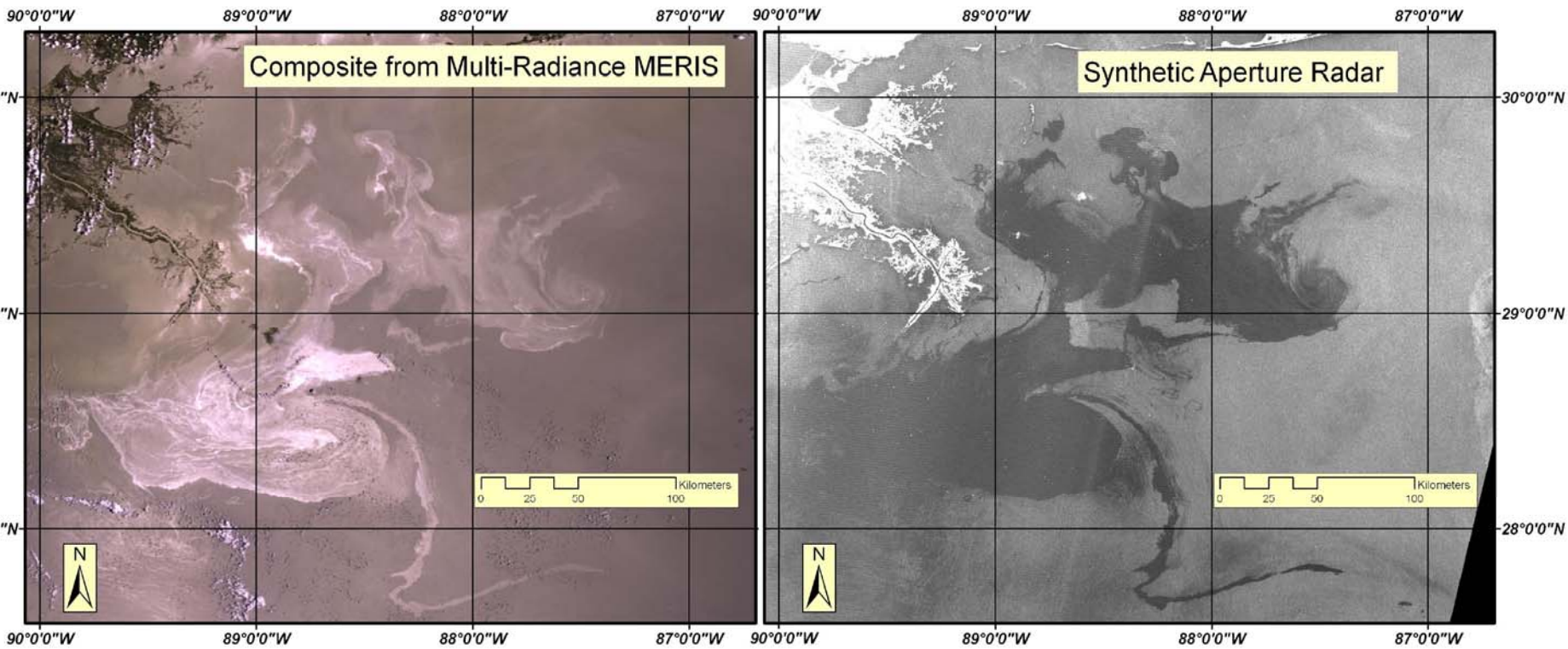
NOAA 2007, Open Water Oil Identification Lab AIC

Code	Description	Layer-Thickness Interval		Concentration	
		microns (μm)	inches (in.)	m^3 per Km^2	bbl/acre
S	Sheen (silver/gray)	0.04 - 0.30	1.6×10^{-6} - 1.2×10^{-5}	0.04 - 0.30	1×10^{-3} - 7.8×10^{-3}
R	Rainbow	0.30 - 5.0	1.2×10^{-5} - 2.0×10^{-4}	0.30 - 5.0	7.8×10^{-3} - 1.28×10^{-1}
M	Metallic	5.0 - 50	2.0×10^{-4} - 2.0×10^{-3}	5.0 - 50	1.28×10^{-1} - 1.28
T	Transitional Dark (or True) Color	50 - 200	2.0×10^{-3} - 8×10^{-3}	50 - 200	1.28 - 5.1
D	Dark (or True) Color	>200	$> 8 \times 10^{-3}$	>200	> 5.1

Chart modified by A. Allen from Bonn Agreement Oil Appearance Code (BAOAC) 02 May, 2006.







A photograph of a dolphin leaping from the water, with the word 'THANKS' overlaid in large black letters. The dolphin is captured mid-leap, its dark body arched above the water's surface. The water is a mix of blue and brownish tones, with many small ripples and reflections. The text 'THANKS' is positioned in the upper left quadrant of the image.

THANKS

Questions, Complaints?