

Synthetic Aperture Radar Applications Current Status in NOAA and Plans for Development as a Component of Operational Ocean Observing Systems

NESDIS/ORR Sea Surface Roughness Science Team
William G. Pichel and Pablo Clemente-Colón
September 17, 2003



Synthetic Aperture Radar Applications Current Status in NOAA and Plans for Development as a Component of Operational Ocean Observing Systems

Outline

1. Mission

2. Current Status

Routine Products

Research Products

FY 2003 Projects

3. Vision for Operational System Development
and Implementation



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Sea Surface Roughness (SSR) Science Team

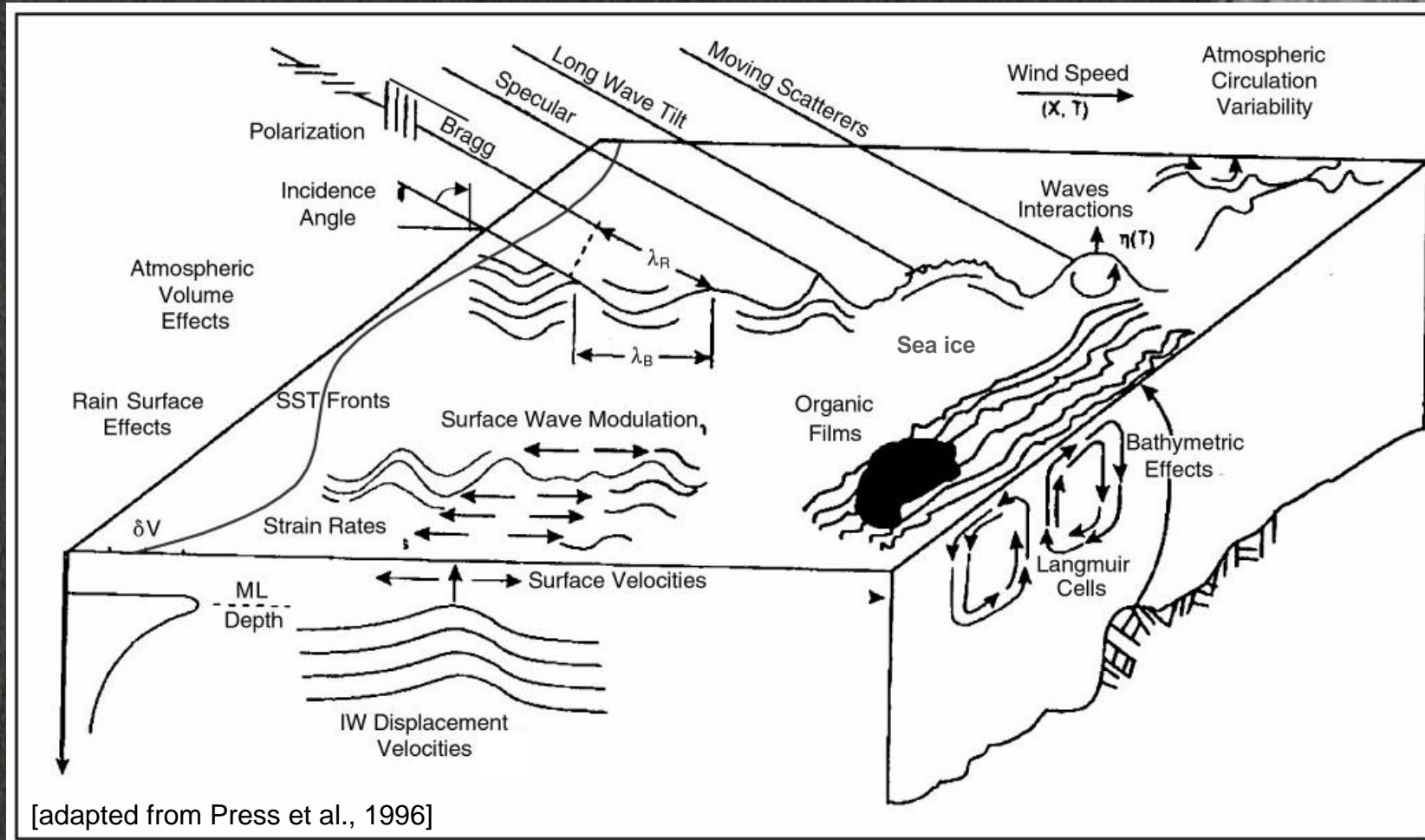
Mission

Develop an integrated end-to-end product system for operational generation of the sea-surface roughness products specified in the NPOESS Integrated Operational Requirements Document (IORD) II and the Ocean Observer User Requirements Document (URD).

Mission-Related Activities

- Requirements development
- Research
- Collaboration with academic, Government, and commercial partners
- Product development and validation
- User base development - including training
- Applications demonstration
- Operational code development, documentation and implementation.

Processes Involved in SAR Ocean Imaging



Main SAR response from the ocean is from resonance of the radar microwaves with capillary and small gravity surface waves (i.e. Bragg Waves), as well as modulation by longer waves.

$$k_B = 2 k_R \sin \theta$$

Satellite System	Country	Operational Dates (month and year)	SAR Band(s)
Seasat SAR	USA	6/78 - 10/78	L
SIR-A (Shuttle)	USA	11/81 - 11/81	L
SIR-B (Shuttle)	USA	10/84 - 10/84	L
KOSMOS 1870	Russia	7/87 - 7/89	S
ALMAZ-1	Russia	3/91 - 9/92	S
ERS-1	EU	7/91 - 3/00	C
JERS-1	Japan	2/92 - 11/98	L
SIR-C/XSAR (Shuttle)	USA	4/94- 4/94 and 10/94-10/94	L,C,X
ERS-2	EU	4/95 - present	C
RADARSAT-1	Canada	11/95 - present	C
SRTM (Shuttle)	USA	2/00 - 2/00	C,X
ENVISAT ASAR	EU	3/02 - present	C
ALOS PALSAR	Japan	2004	L
RADARSAT-2	Canada	2005	C
TerraSar-X1	Germany	2005	X
TerraSar -L1	Germany	2005	L
COSMO/SkyMed	Italy	2005	X
SAOCOM	Argentina	2006	L
TerraSar -L1	Germany	2005	L
RADARSAT-3 (?)	Canada	2007	C
NASA InSAR (?)	USA	2009	L
NPOESS Ocean Observer	USA	2012	L,C or L,X
Operational SAR (?)			

SAR Satellites

Past

Present

Future

Legend

 Current Satellites



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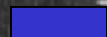
FY 2003 Projects

3. Vision for Operational System Development
and Implementation

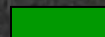
SAR-Related Environmental Data Requirements

#	<u>EDR TITLE</u>	IORD II	OO URD	ORAD
		Requirement	Requirement	Interest
	<u>OCEANIC</u>			
1	Coastal Sea Surface Winds & Wind Stress	4.1.6.8.8.5	2.1b, 2.2b	X
2	Wave Characteristics - Significant Wave Height	4.1.6.6.8	2.4a	X
3	Wave Characteristics. - Ocean Wave Dir./Wavelength	4.1.6.8.8.8	2.4b	X
4	All Weather Day/Night Imagery	4.1.6.8.6	2.5c	X
5	Oil Spill Location	4.1.6.8.8.12	2.6	X
6	Vessel Positions		2.7	X
7	Bathymetry (Near Shore)	4.1.6.8.8.10	2.8	X
8	Littoral Currents	4.1.6.8.8.1	2.16c	X
9	Surf Conditions	4.1.6.8.8.9	2.18	X
10	Ocean Mesoscale Features (Fronts/Eddies)		2.19	X
11	Mixed Layer Depth			X

Note: IORD = Integrated Operational Requirements Document
 OO URD = Ocean Observer User Requirements Document
 ORAD = Oceanic Research and Applications Division

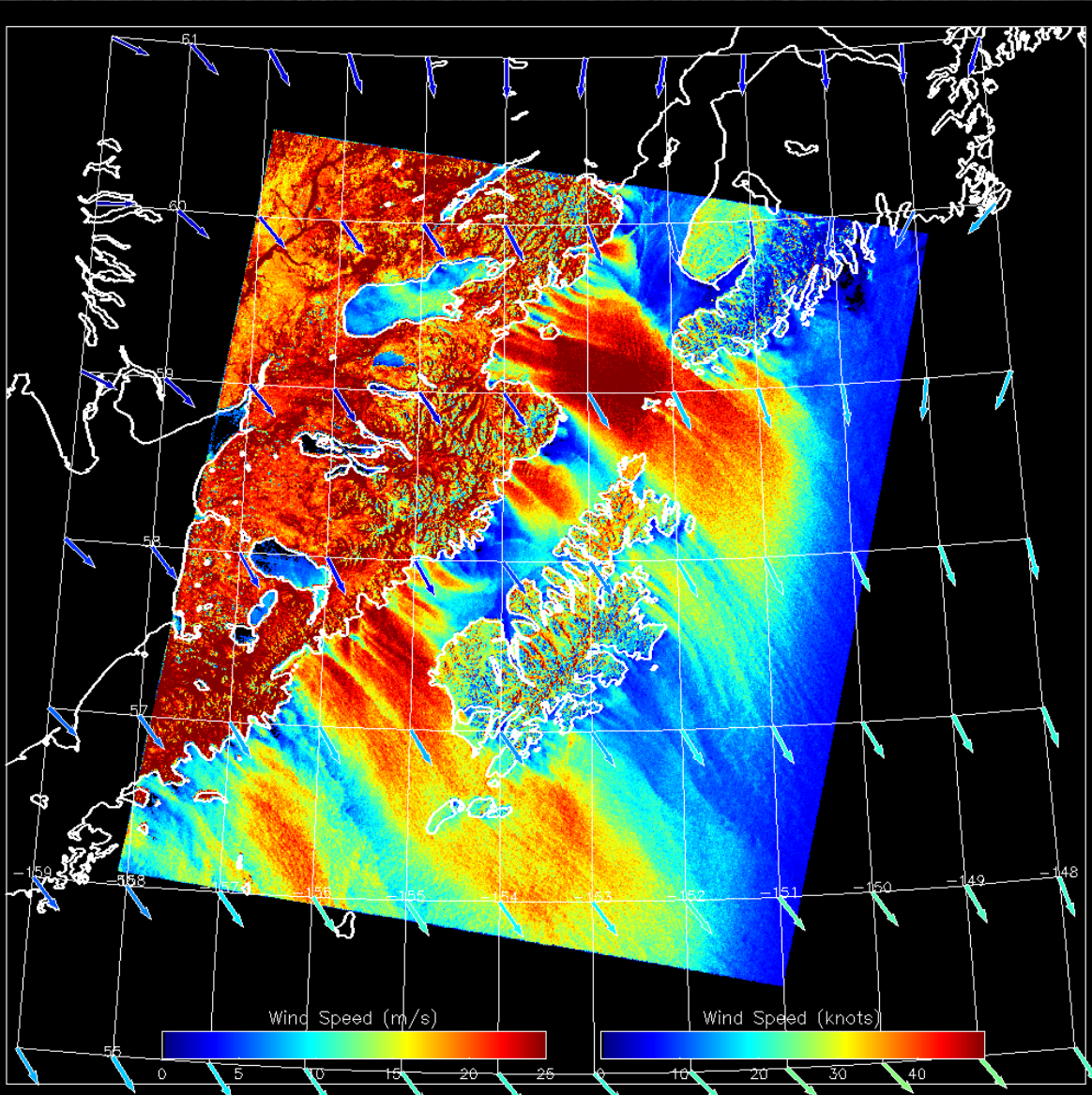


Routine NOAA Products



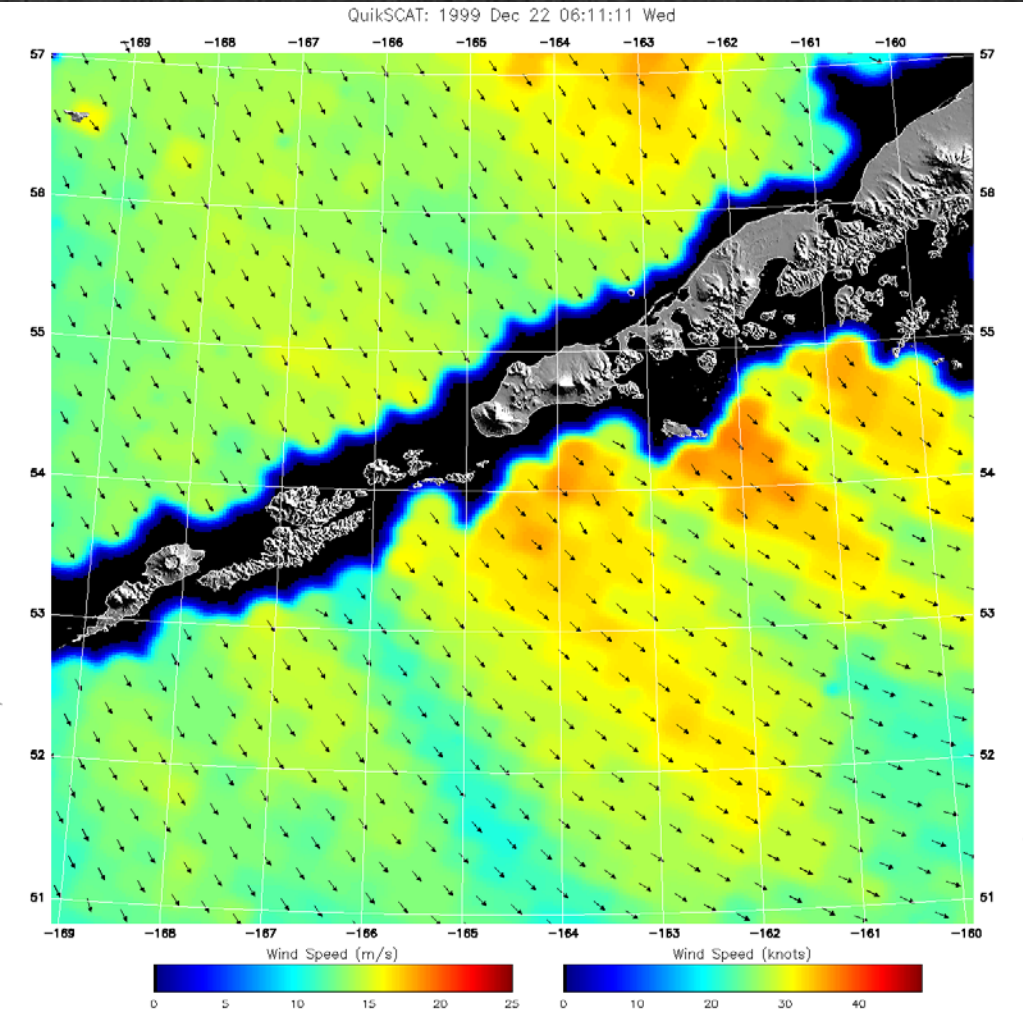
NESDIS Research Products

Oceanic SAR Products - High-Resolution Coastal Winds

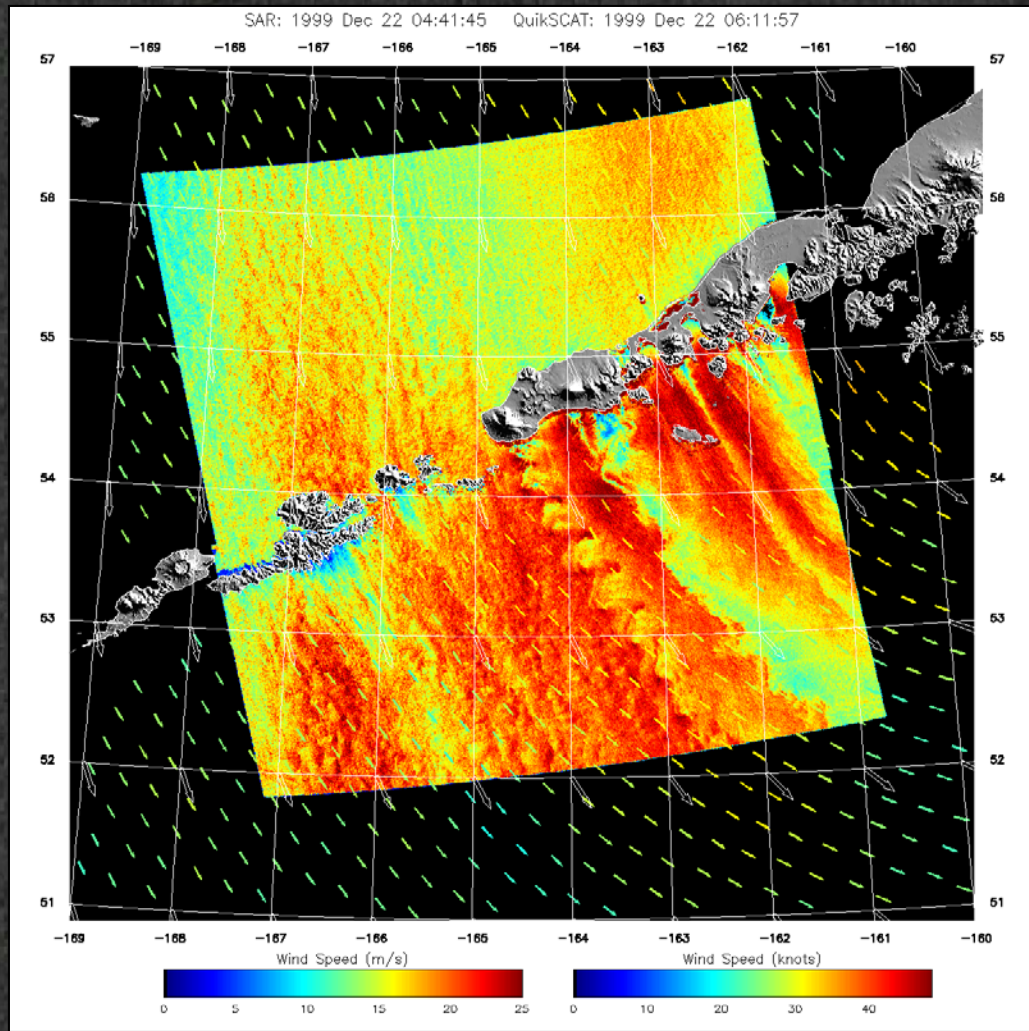


1 km Resolution Coastal Winds

Scatterometer/SAR Wind Comparison

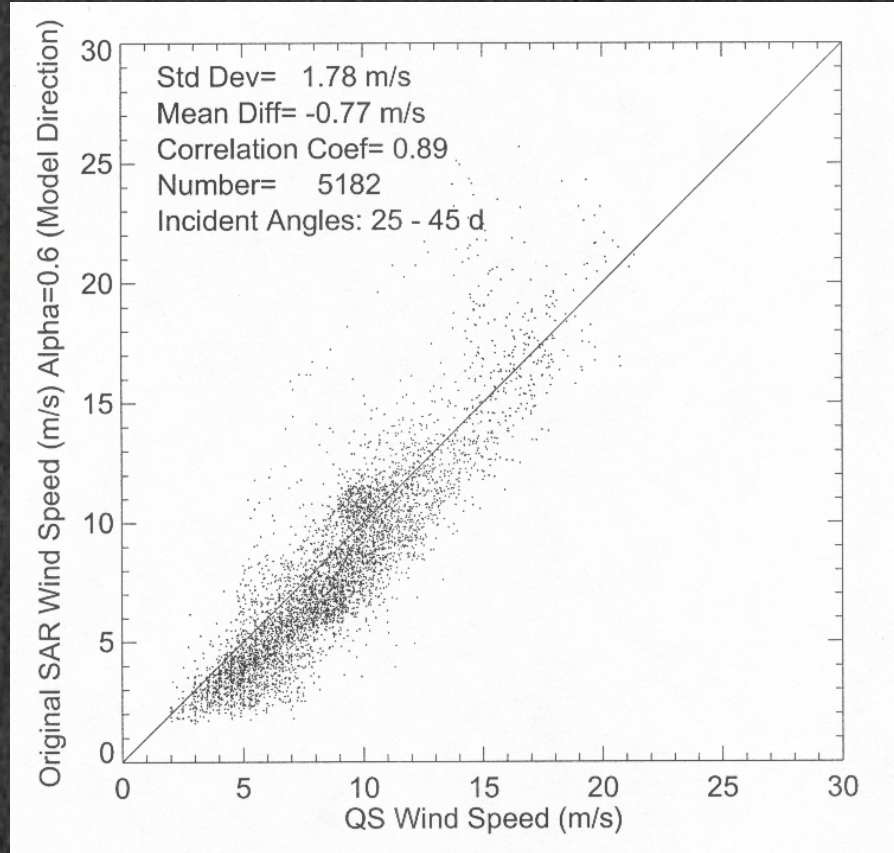


Scatterometer/SAR Wind Comparison

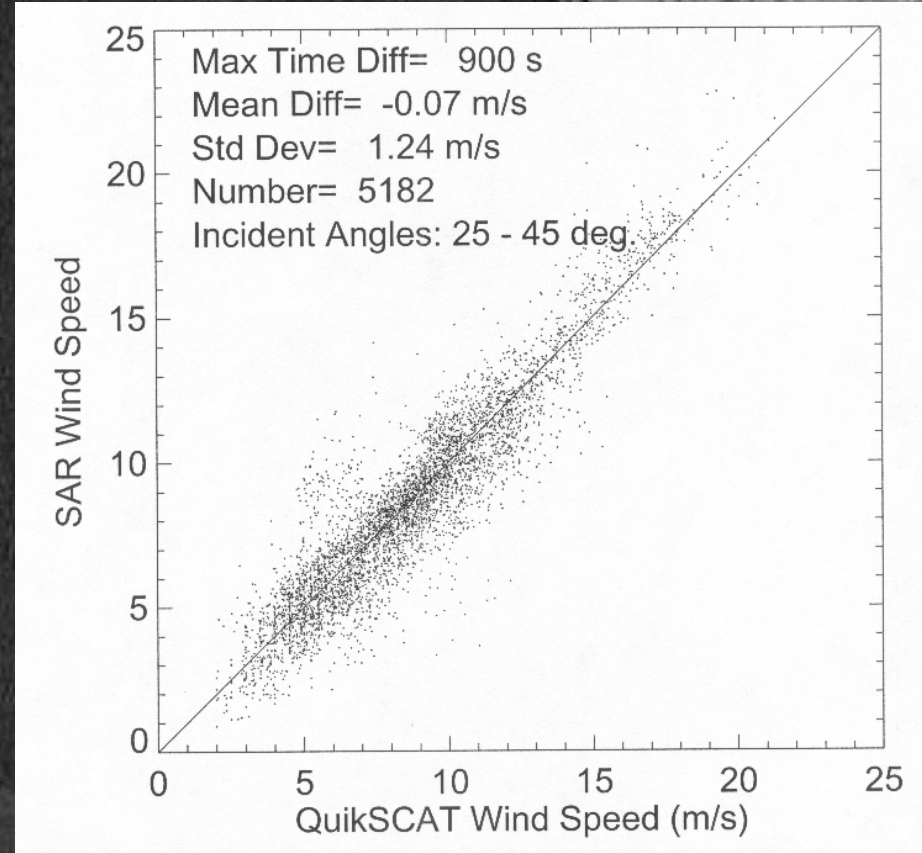


Scatterometer/SAR Wind Comparison

SAR Wind Versus QuikSCAT Wind (all comparisons within 15 min)

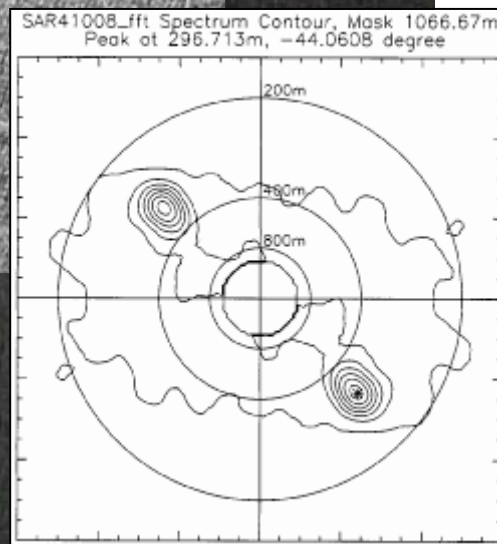
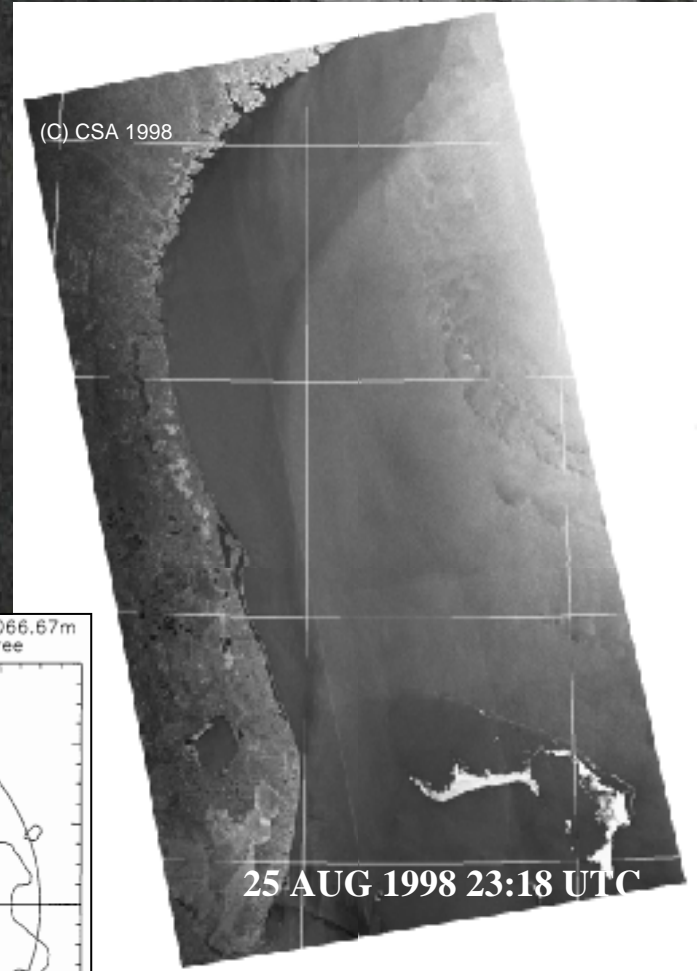
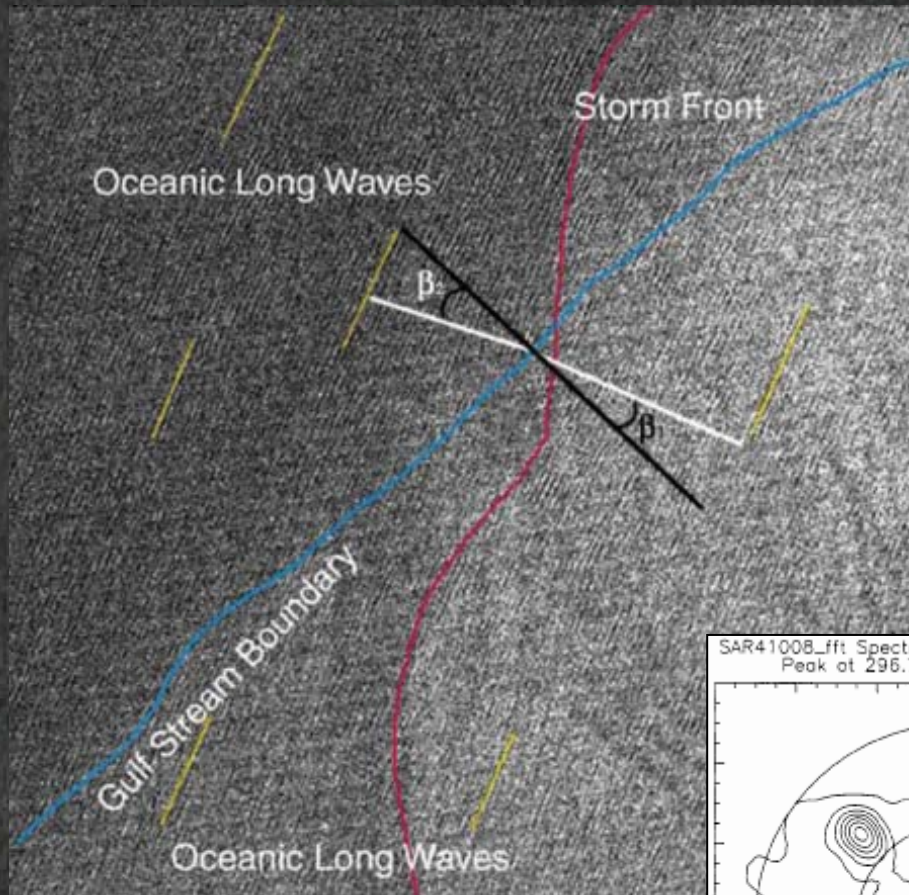


SAR winds with wind direction from NOGAPS



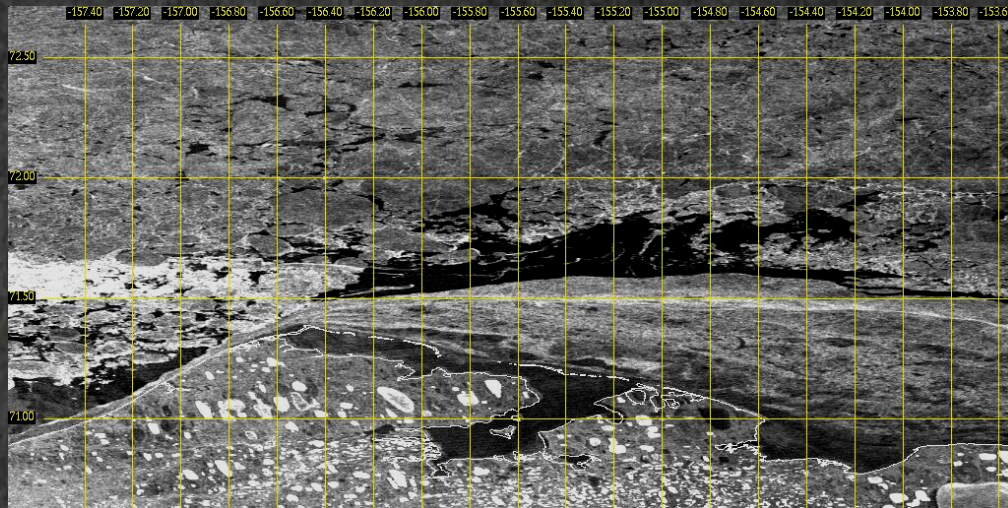
SAR winds with wind direction from QuikSCAT model function

Oceanic SAR Products - Ocean Swell Direction and Wavelength



Dual SAR monitoring role
for storm-generated swell
and associated coastal
flooding

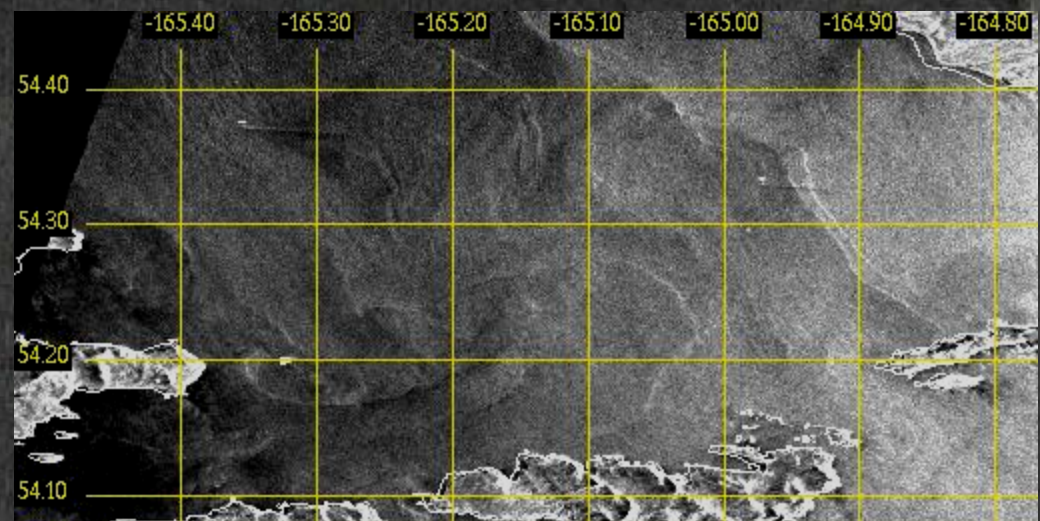
Oceanic SAR Products - All-Weather Day/Night Imagery



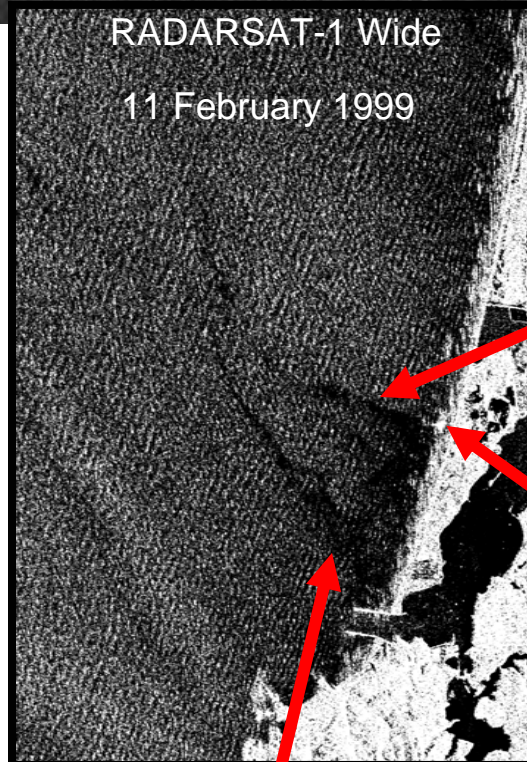
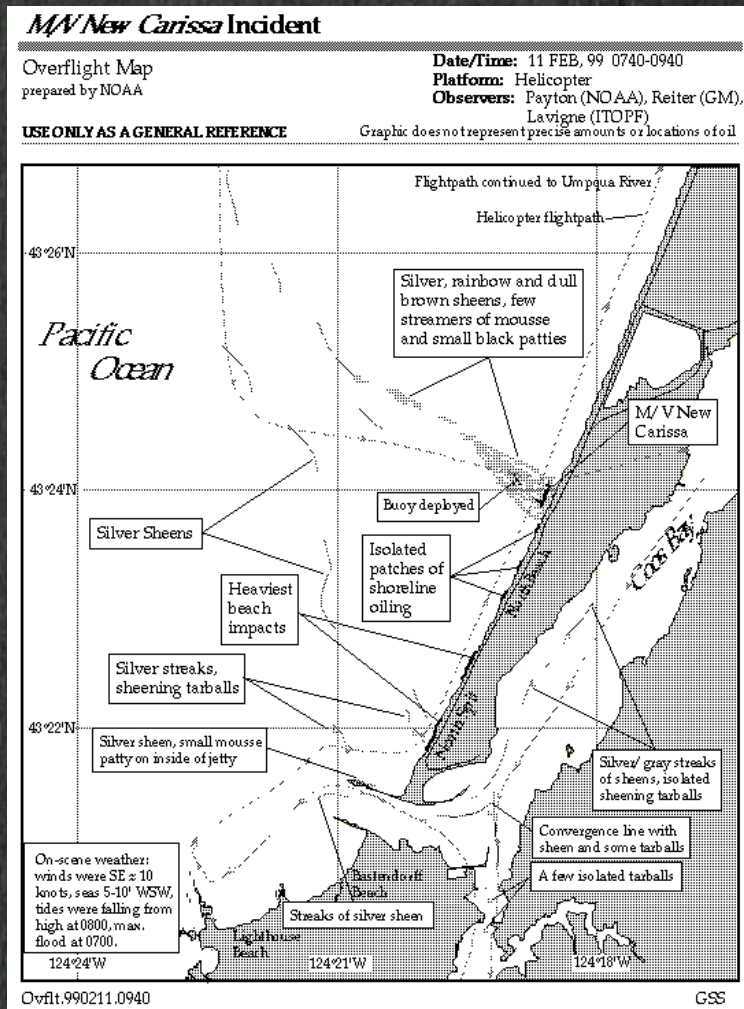
**Radarsat-1 Ice Image
Pt. Barrow AK**

© Canadian Space Agency, 2003

Radarsat-1 Ocean Features - Aleutian Islands



Oceanic SAR Products - Oil Spill Location



Spill slick



Vessel

Biogenic slick

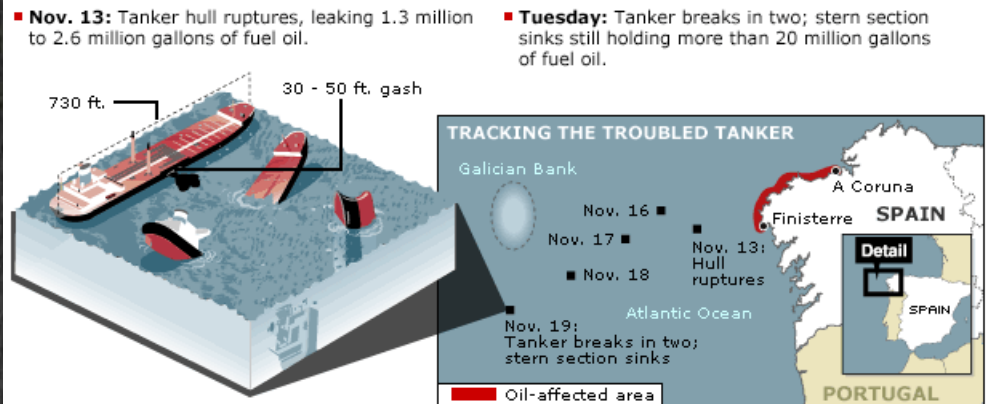
M/V New Carissa Spill - Coos Bay, Oregon

Prestige Oil Spill in La Coruña

14 NOV



AP PHOTO

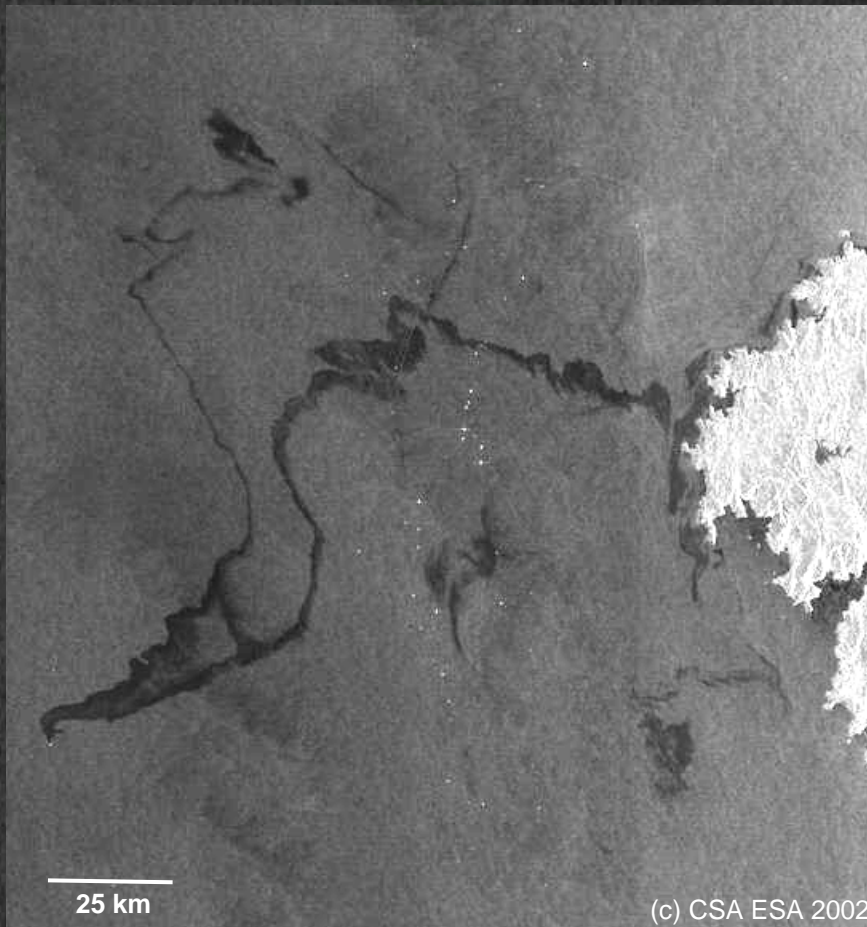


SOURCES: AP; PORTUGUESE NAVY HYDROGRAPHIC INSTITUTE; JANE'S INFORMATION GROUP; SMIT SALVAGE; WORLD WILDLIFE FUND

19 NOV



AP PHOTO

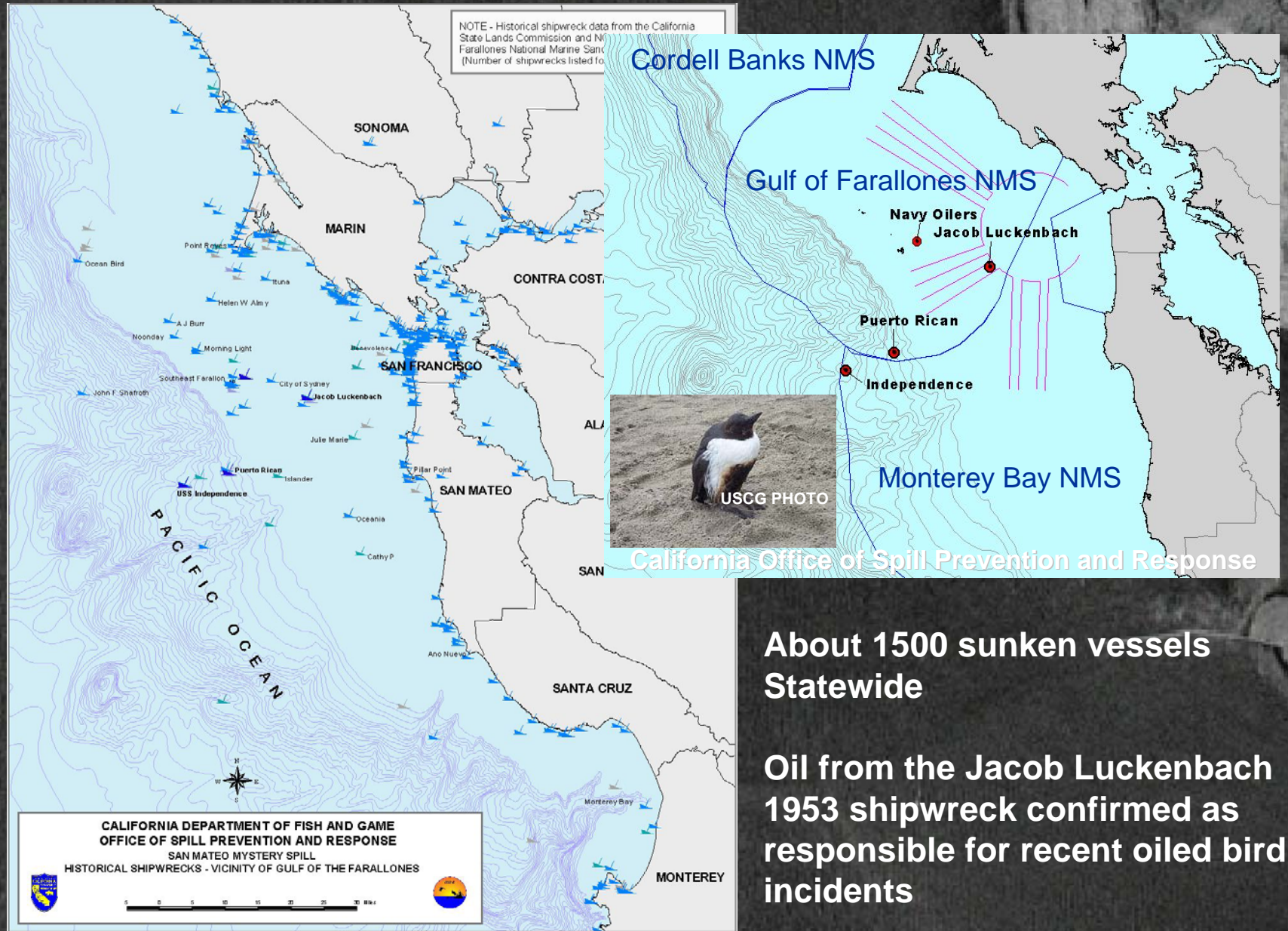


25 km

(c) CSA ESA 2002

ENVISAT ASAR Wide Swath,
17 November 2002 10:45 UTC

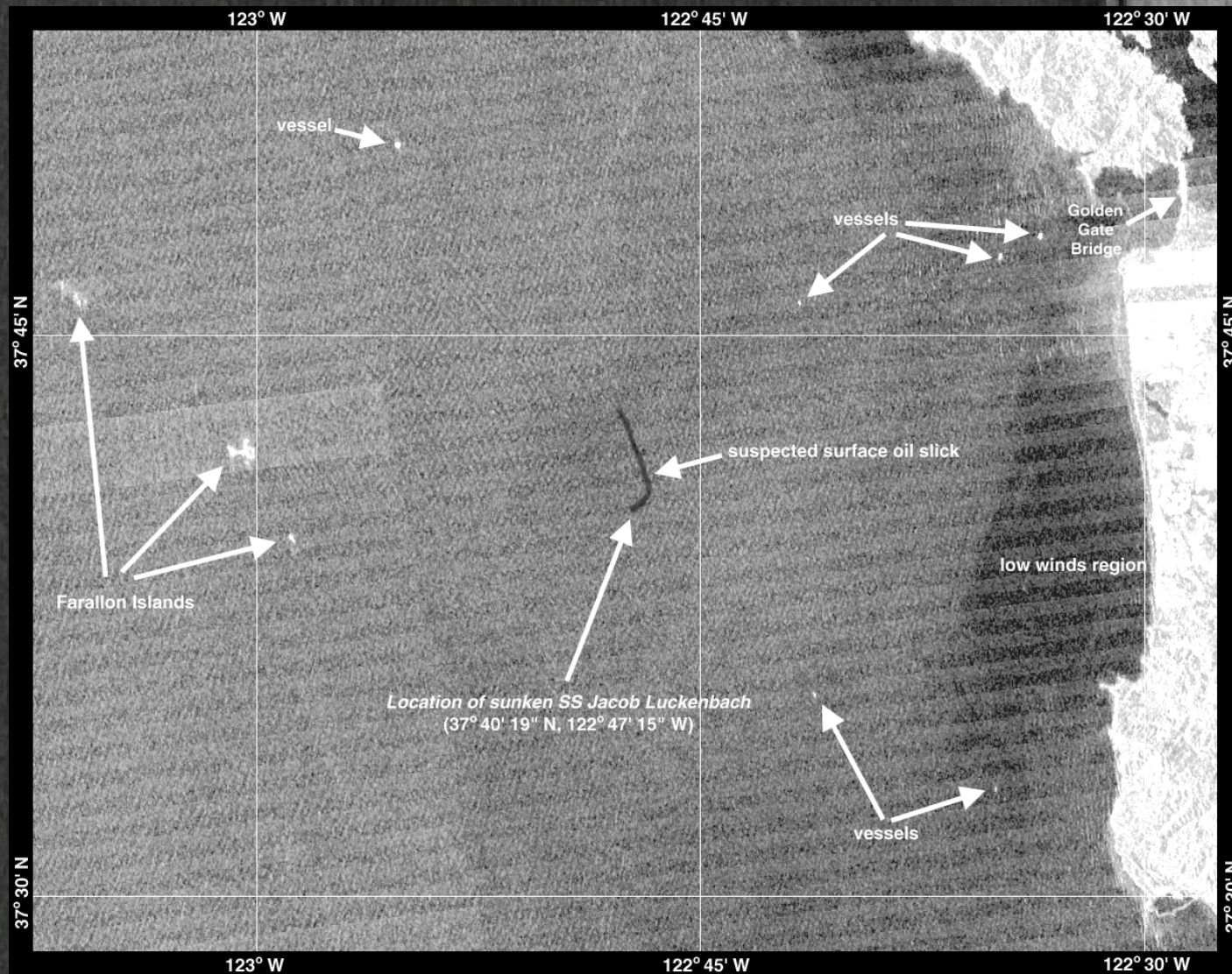
San Francisco Bay Oiled Birds Mystery



About 1500 sunken vessels
Statewide

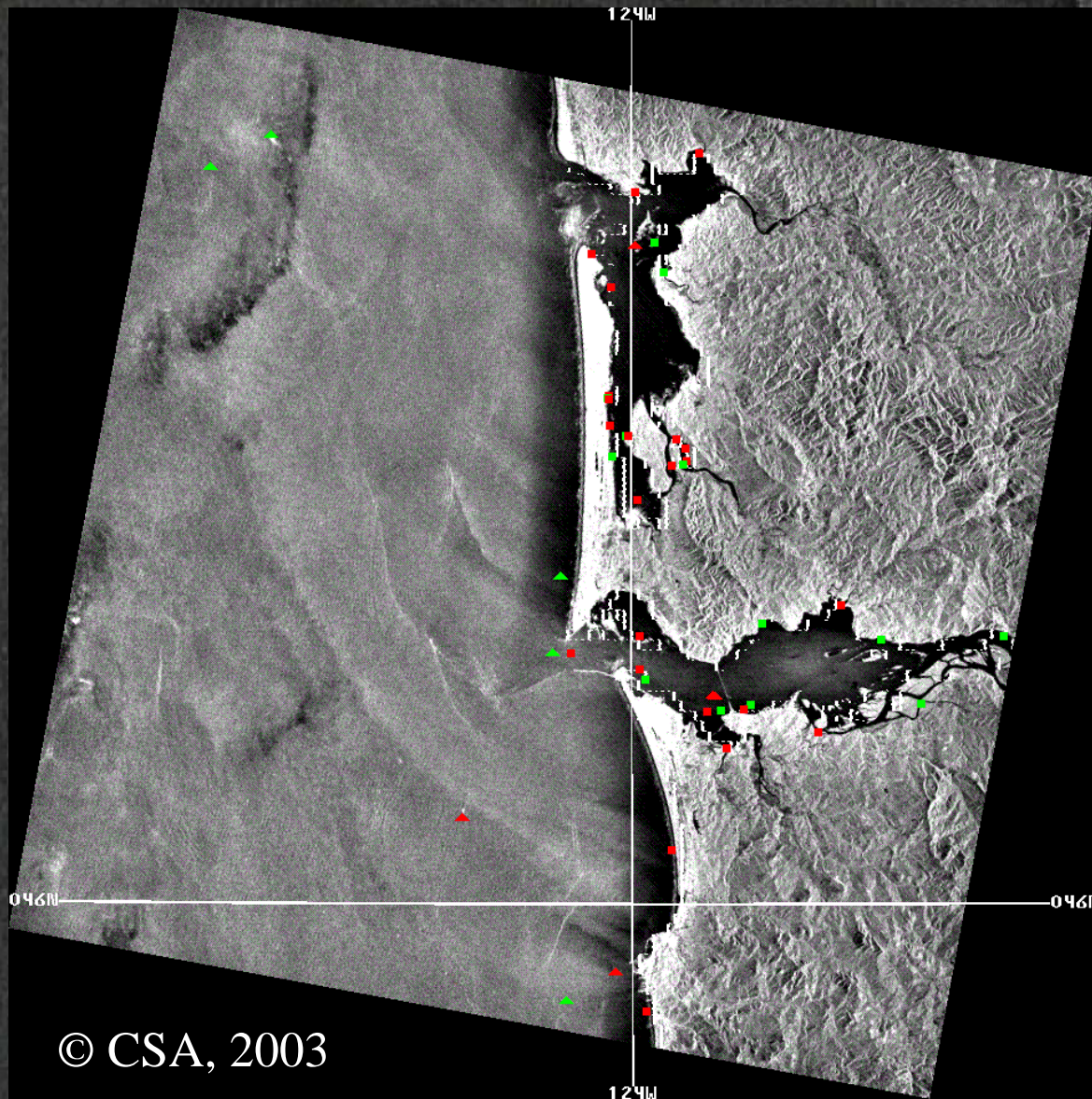
Oil from the Jacob Luckenbach
1953 shipwreck confirmed as
responsible for recent oiled bird
incidents

San Francisco Bay Oiled Birds Mystery



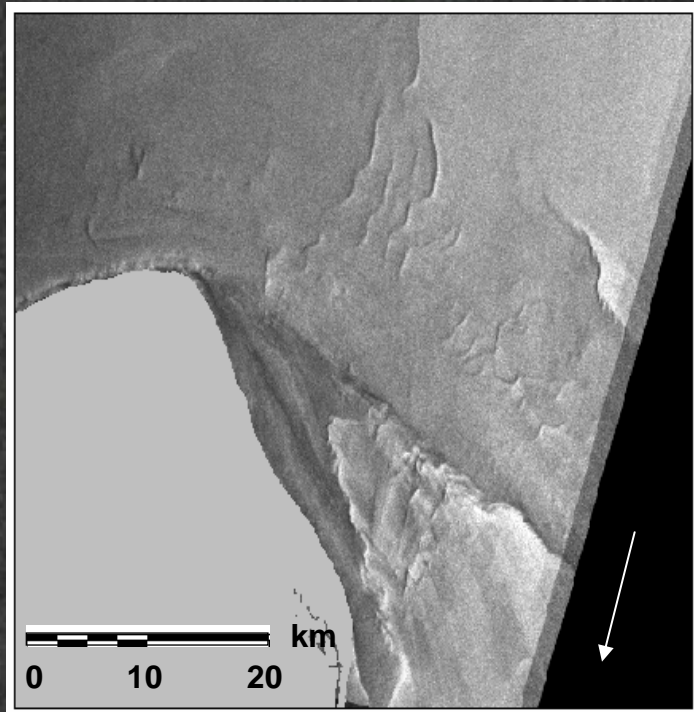
RADARSAT-1 ScanSAR Wide, 9 January 2002 02:09 UTC

Oceanic SAR Products - Vessel Positions

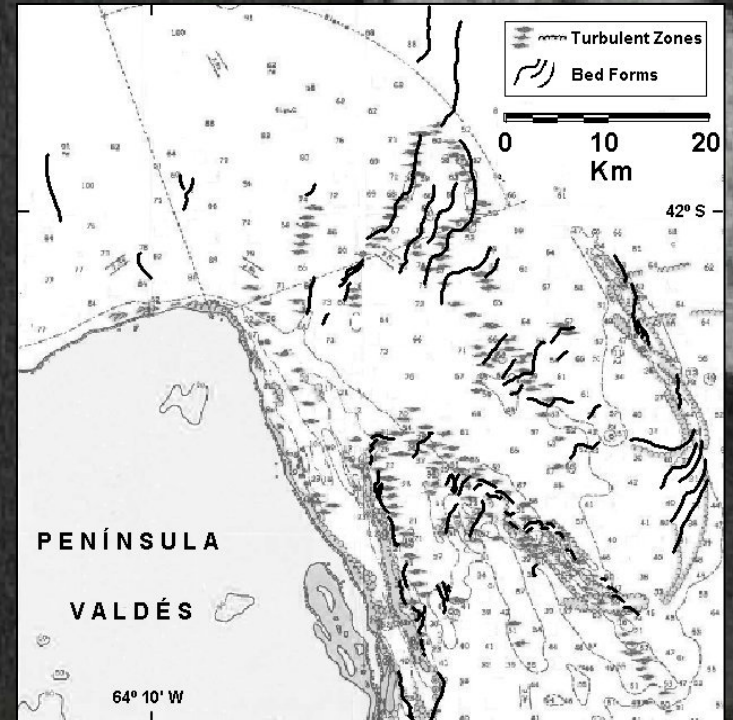


Ship Detection Product April 27, 2003 14:25 UTC

Oceanic SAR Products - Near Shore Bathymetric Features



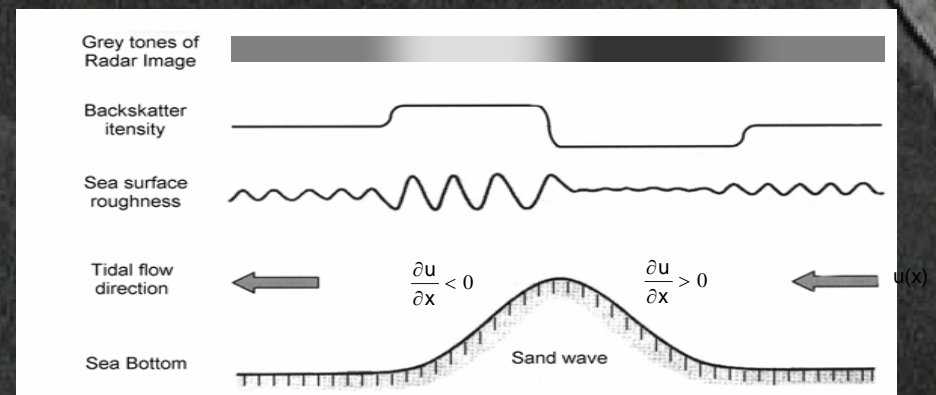
- Identified bed forms in SAR imagery of the southern area of the San Matías Gulf entrance overlaid on the Argentine Navy Hydrography Service standard nautical chart



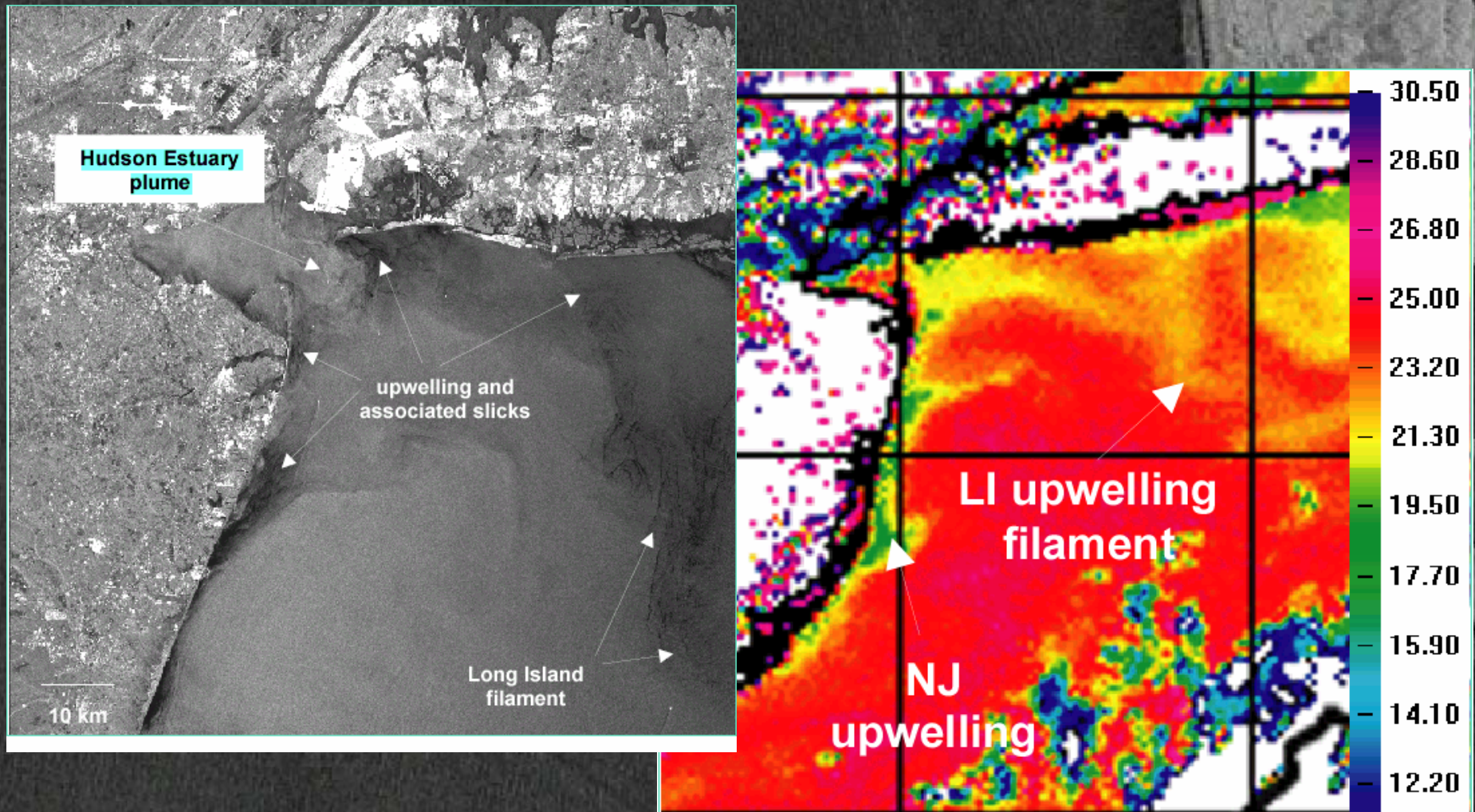
[adapted from Kasischke (1983)]

- Multitemporal ERS1/2 SAR composite image (July 9, 1992, February 22, 1998, and September 5, 1999)

- Modulations generated when tidal currents encounter an obstacle.

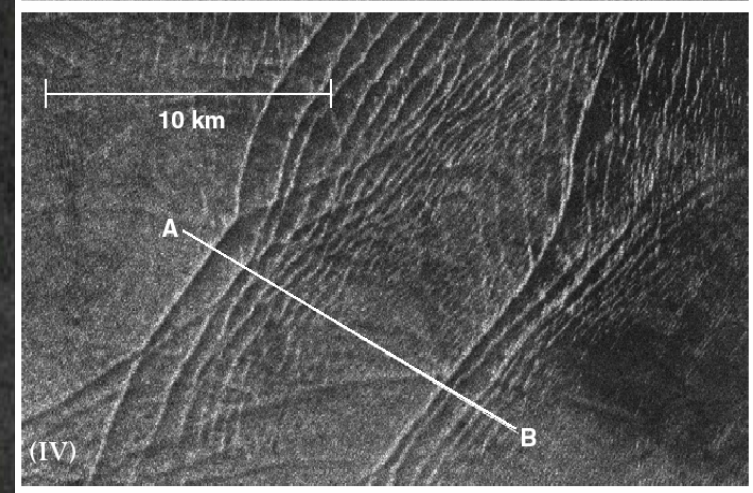
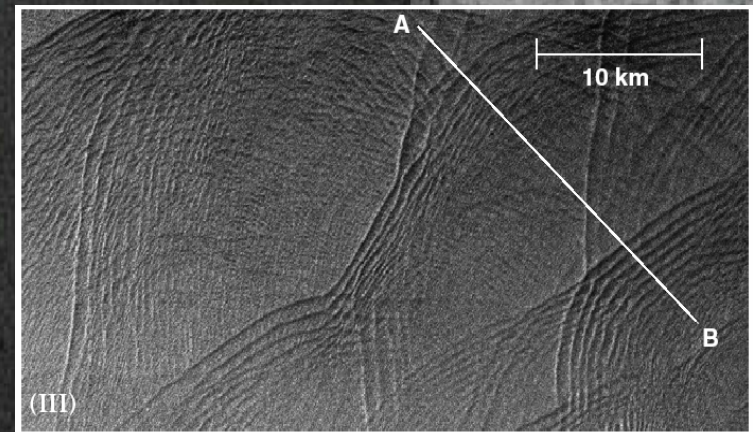
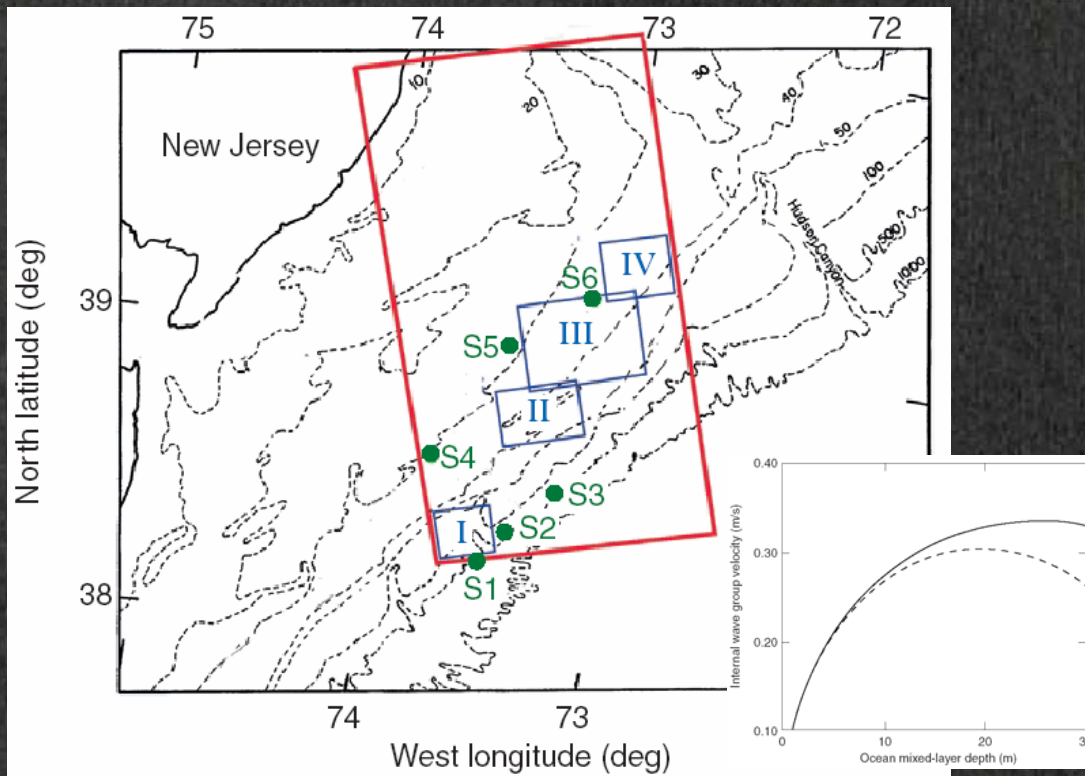


Oceanic SAR Products - Ocean Mesoscale Features



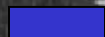
RADARSAT-1 Standard SAR frame and near-coincident AVHRR SST showing upwelling conditions off New Jersey, the Hudson River Estuary, and Long Island on 30 July 1998.

Oceanic SAR Products - Mixed Layer Depth from Internal Wave Measurements

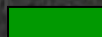


SAR-Related Environmental Data Requirements

#	<u>EDR TITLE</u>	<u>IORD II</u>	<u>OO URD</u>	<u>SOD</u>
		Requirement	Requirement	Interest
	<u>CRYOSPHERIC</u>			
11	Sea & Lake Ice Concentration/Age/Motion/Edge Location	4.1.6.8.7	3.1	X
12	Ice of Land Origin (Icebergs)		3.2	X
13	River Ice Location/Condition		3.5	X
	<u>HYDROLOGIC</u>			
14	Flood Mapping		4.1	X
15	Coastal Wetland Mapping		4.4	X
	<u>LAND</u>			
16	Coastal Change		5.5	X
	<u>ATMOSPHERIC</u>			
17	Mesoscale Atmospheric Features		6.1	X
18	Microscale Atmospheric Features		6.2	X



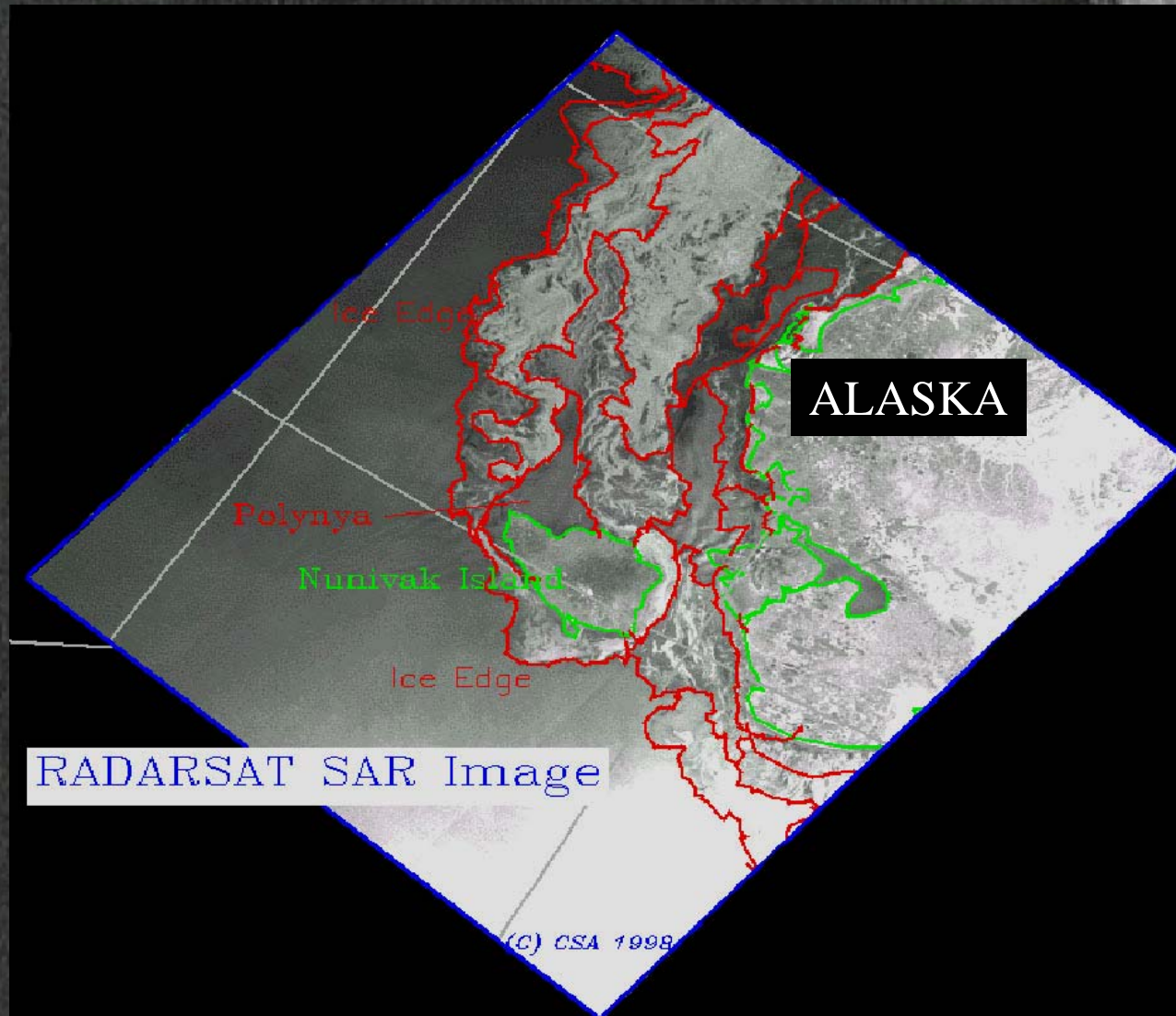
Routine NOAA Products



NESDIS Research Products

Note: IORD = Integrated Operational Requirements Document
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Cryospheric SAR Products - Sea Ice



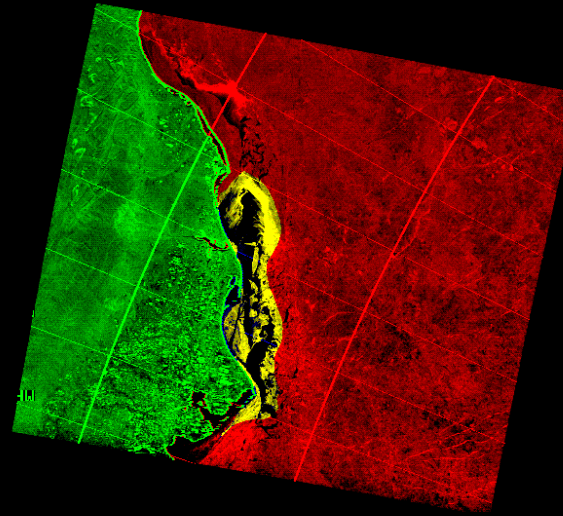
National Ice Center Alaska Ice Analysis

Cryospheric SAR Products - Ice Mask

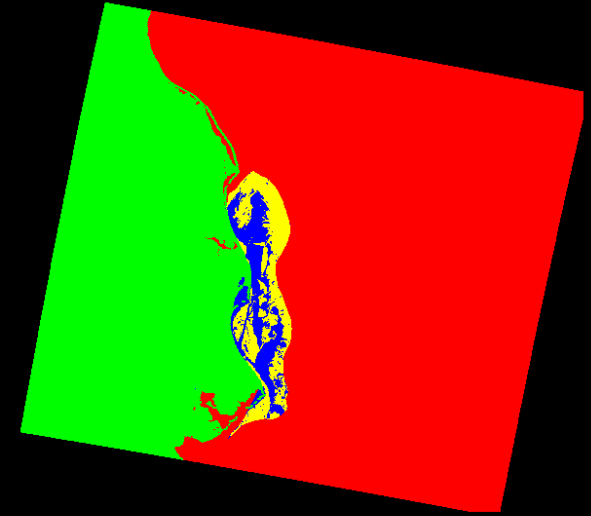
SAR Image



Ice Map Image



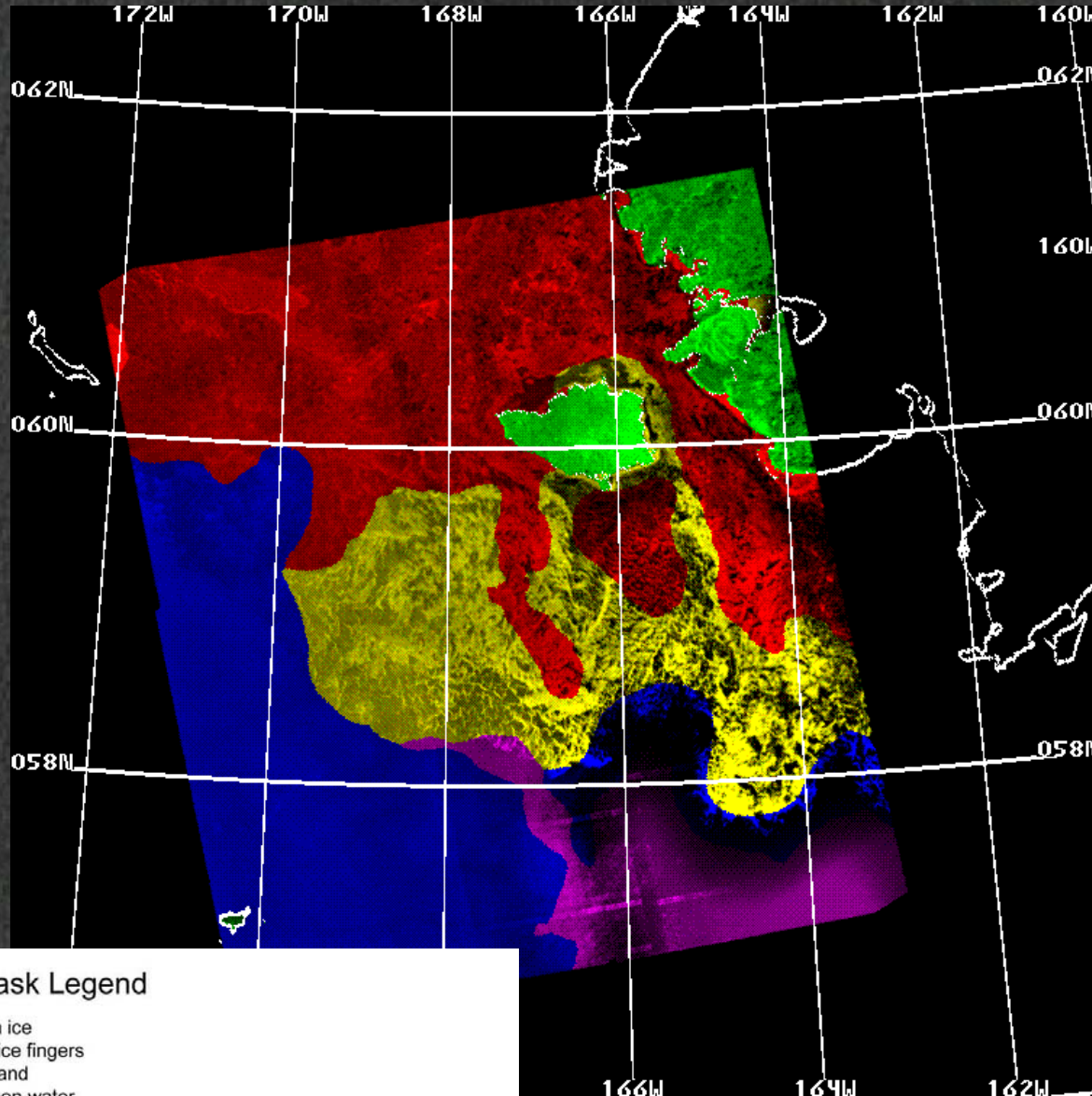
Ice Map Mask



Ice Mask is used to filter out ice in ship detection and coastal winds products in the Alaska SAR Demonstration

Red = solid ice
Yellow = ice filaments
Blue = water
Green = land

Ice Mask Product - January 2003



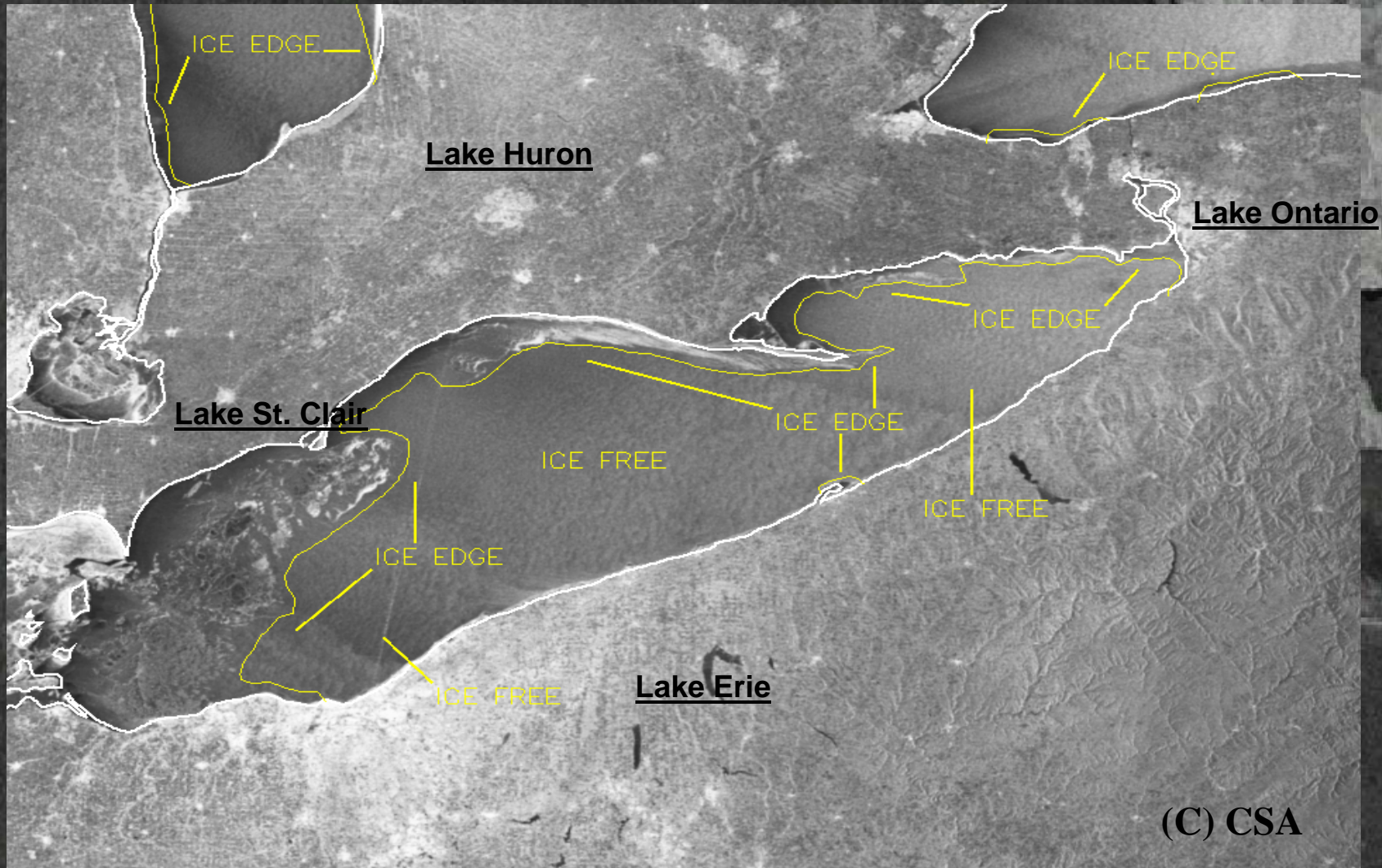
Veridian Ice
Mask
3/29/03 0445Z

Ice Mask Legend

- red = sea ice
- yellow = ice fingers
- green = land
- blue = open water
- purple = rough open water (due to high winds and/or currents/fronts)

VERIDIAN

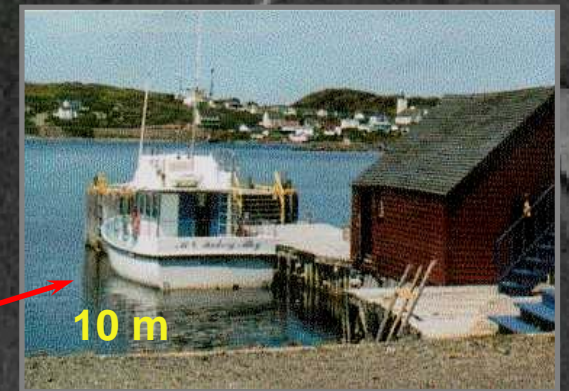
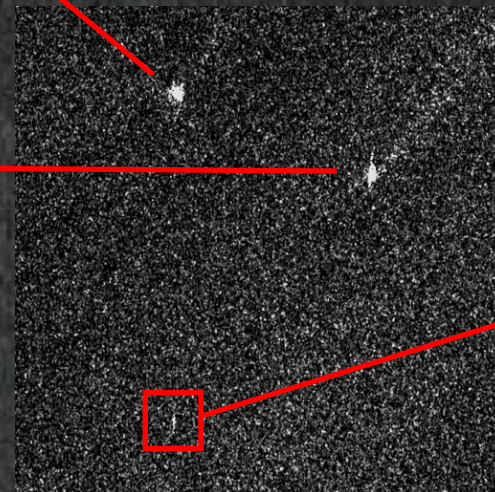
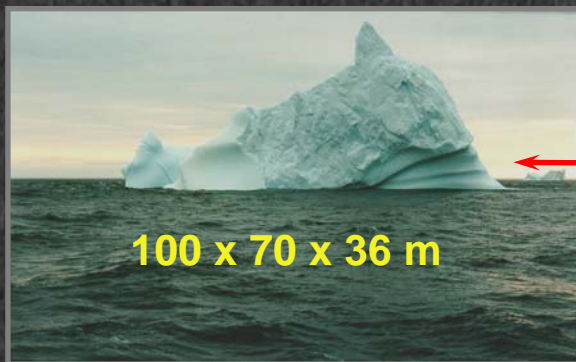
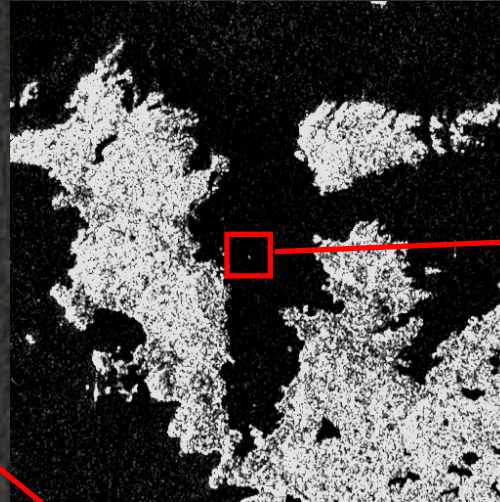
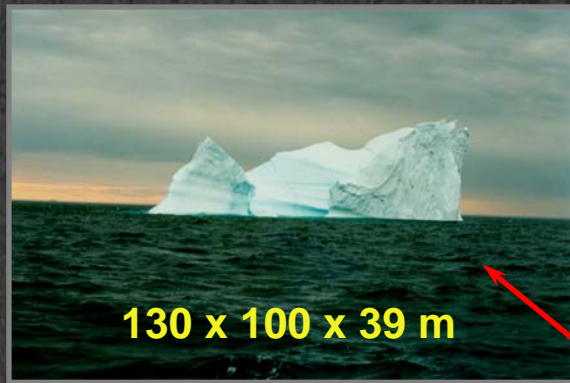
Cryospheric SAR Products - Lake Ice



National Ice Center Great Lakes Ice Analysis

Cryospheric SAR Products - Icebergs

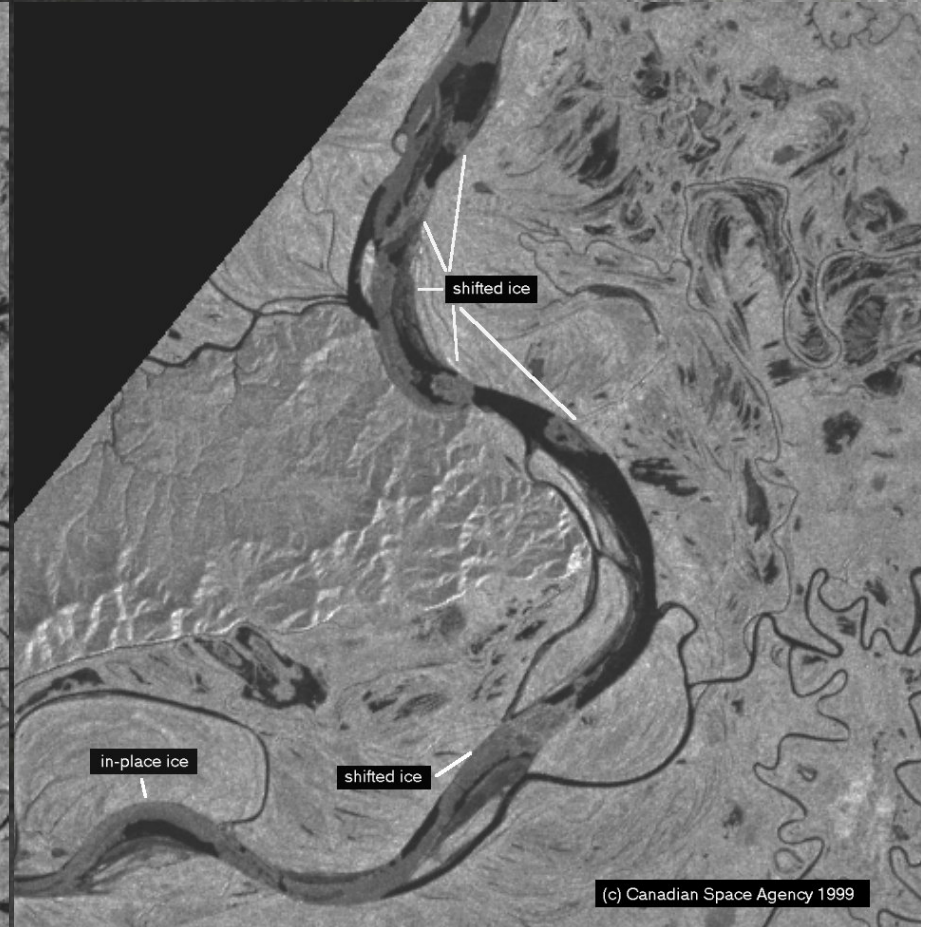
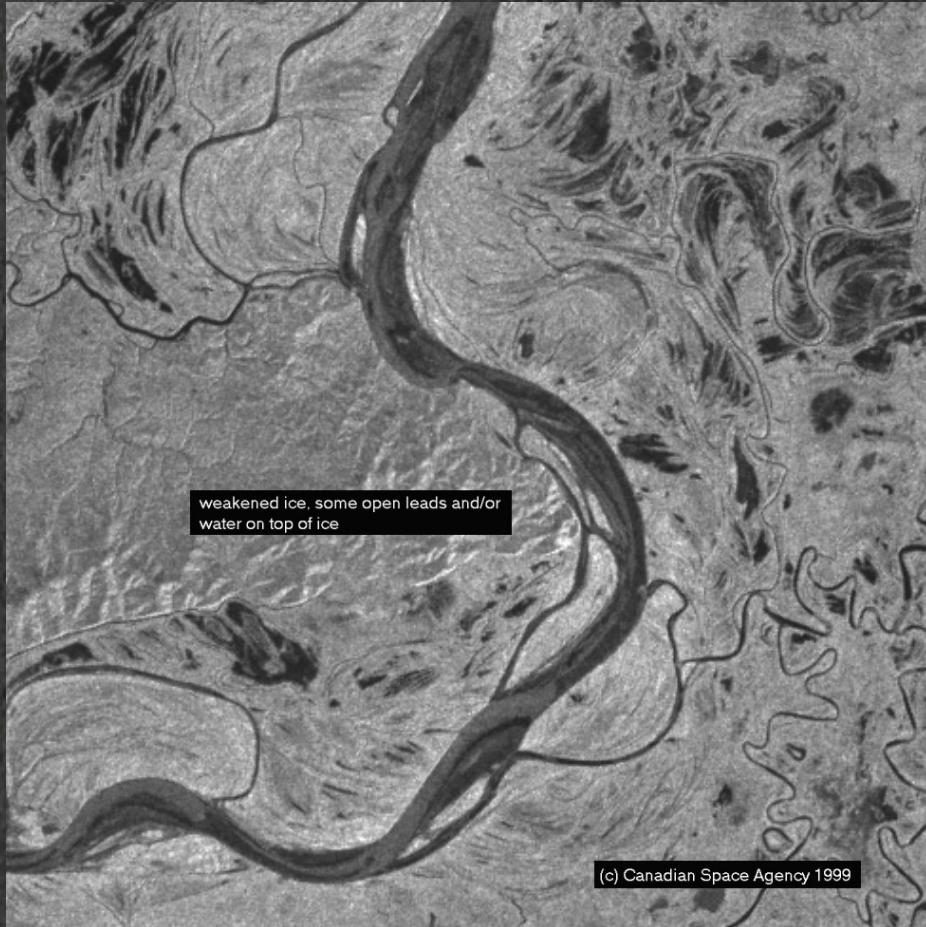
RADARSAT-1 Wide 3: Swath: 150 km - Resolution: 25 m



Cryospheric SAR Products - River Ice

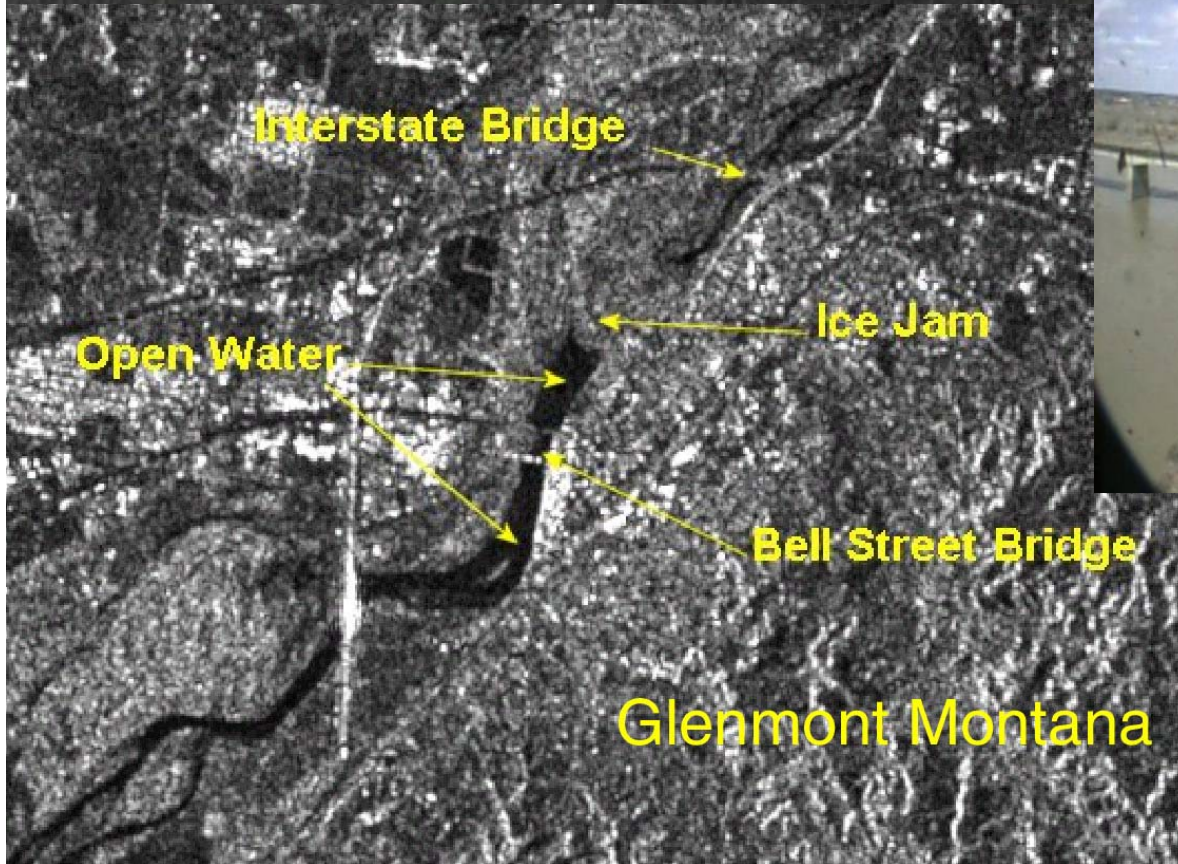
Lower Yukon River
16 May 1999

Lower Yukon River
19 May 1999



River ice breakup and jamming is routinely monitored for the development of potential flooding conditions

Monitoring Spring Ice Break-up on the Yellowstone River, Montana



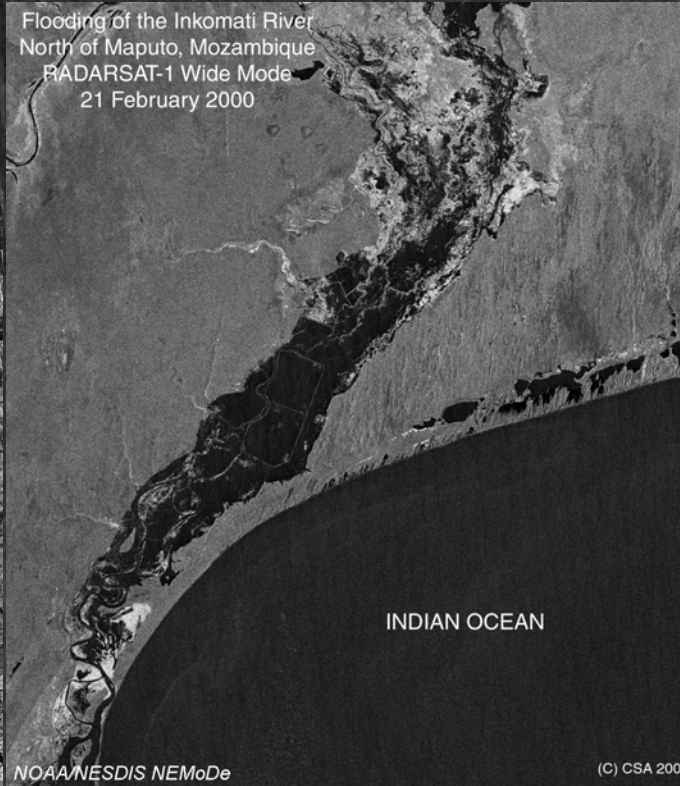
**Ice Jam North of
Bell Street Bridge
Glenmont, Montana**

Hydrologic SAR Products - Flood Mapping

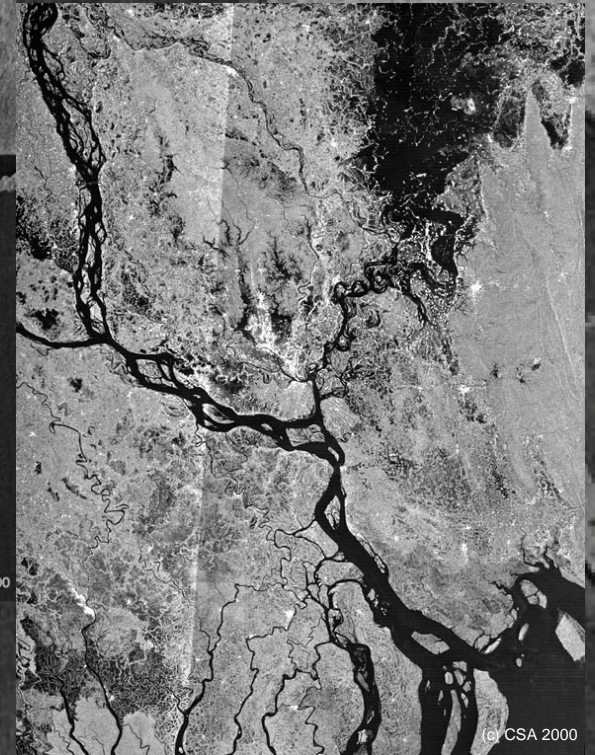
Red River – 4 MAY 97



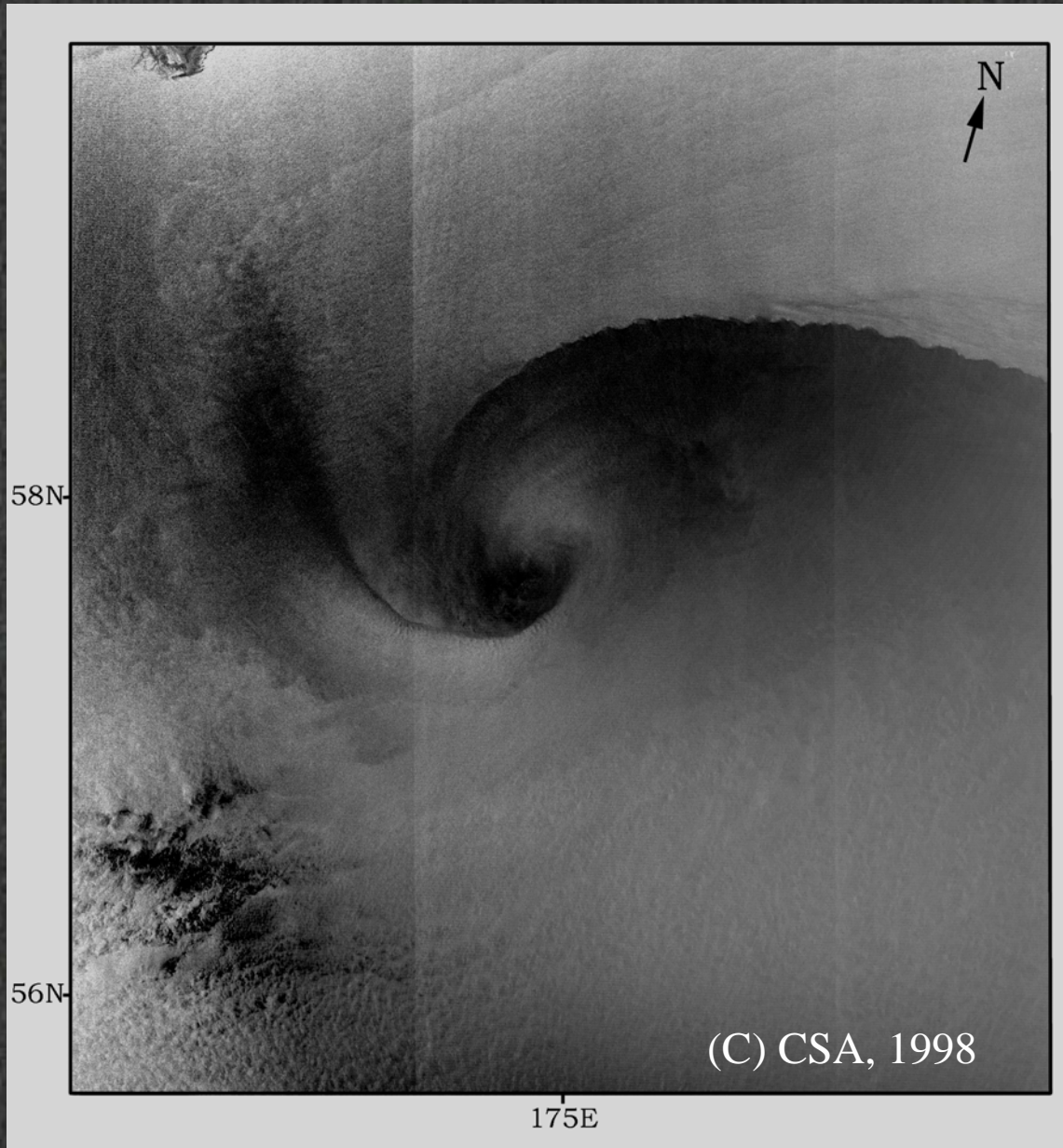
Inkomati River – 21 FEB 00



Ganges River – 21 AUG 00

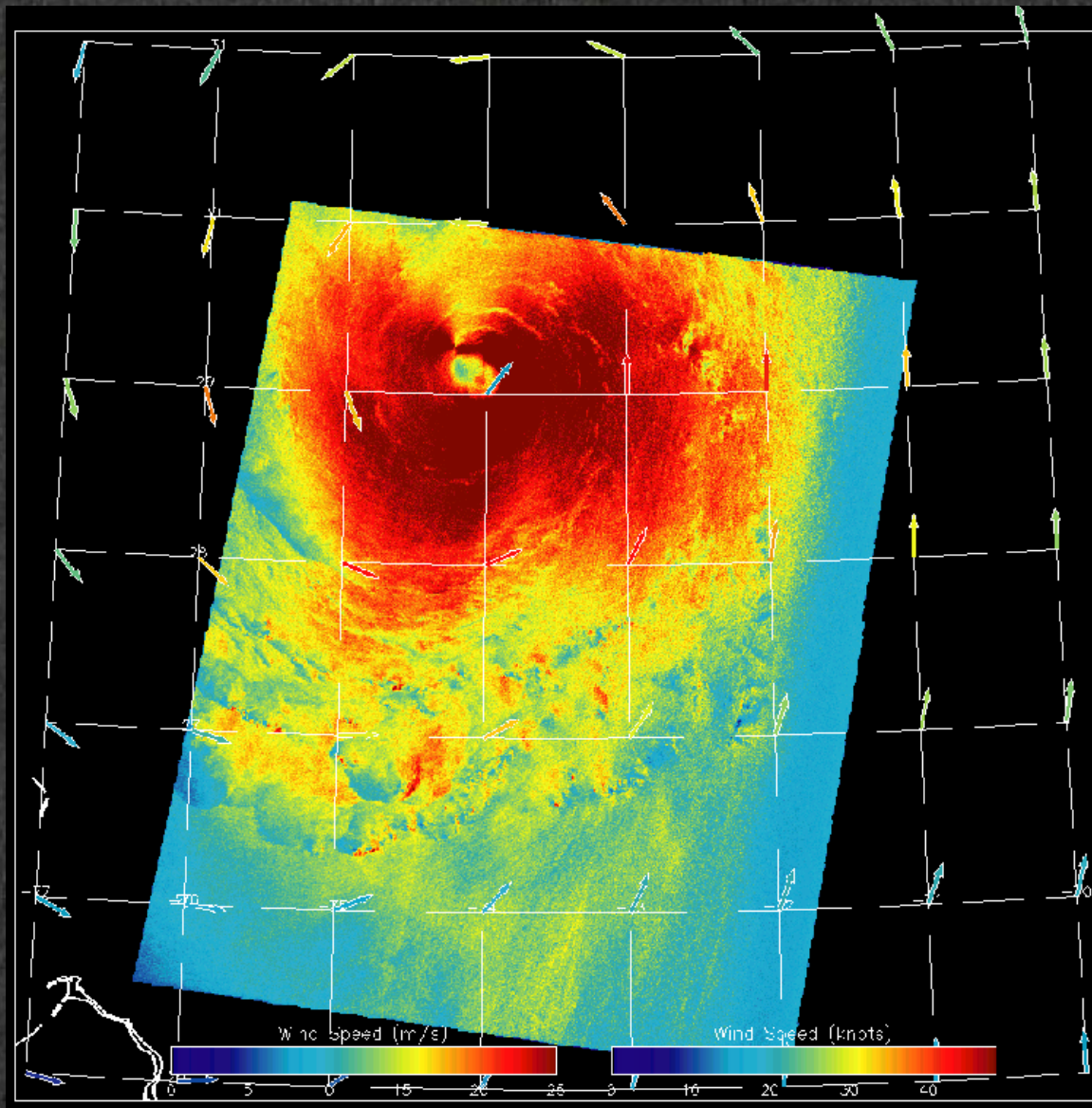


Atmospheric SAR Products - Atmospheric Mesoscale Features



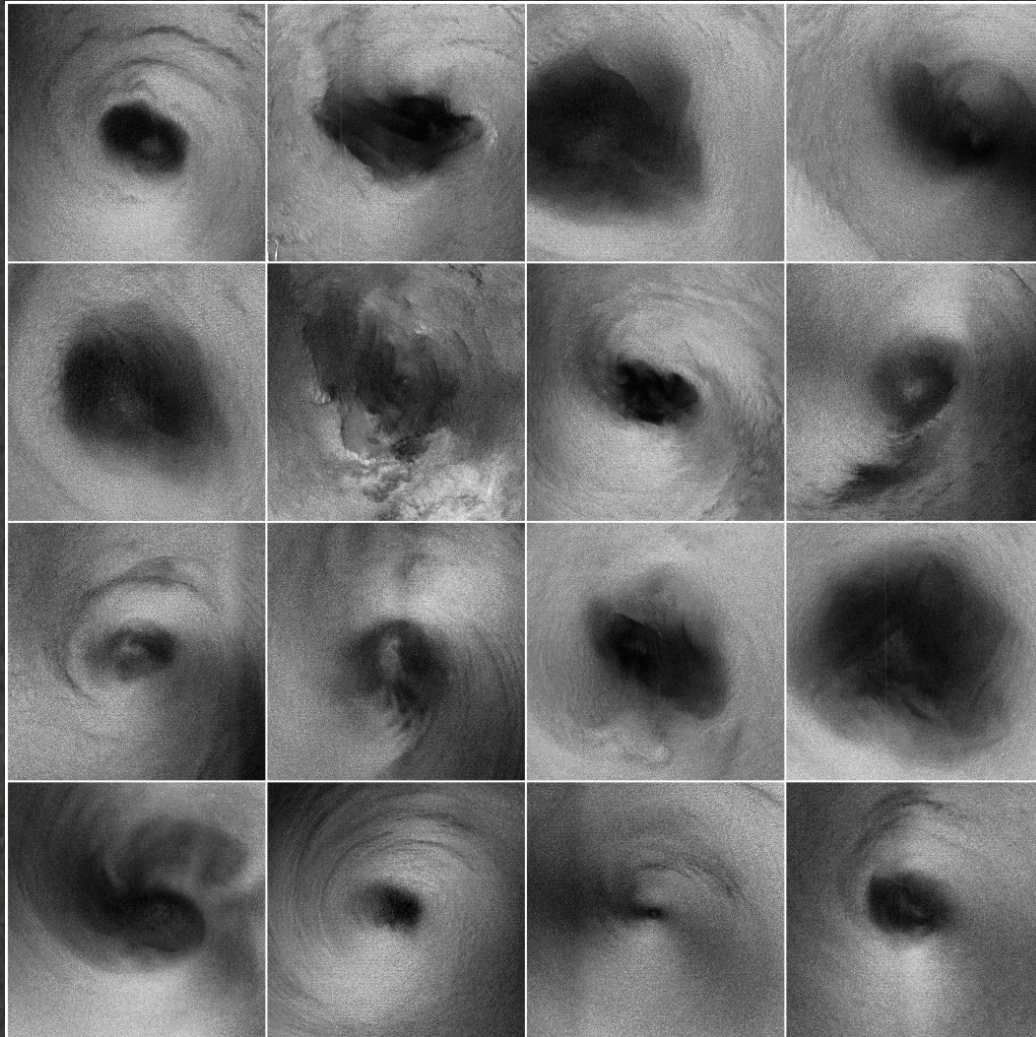
**Polar Mesoscale
Cyclone in Bering Sea
February 5, 1998**

Hurricane Studies



**RADARSAT-1 SWB
wind image capturing
Hurricane Danielle
on 31 August 1998.**

Atmospheric SAR Products - Atmospheric Mesoscale Features



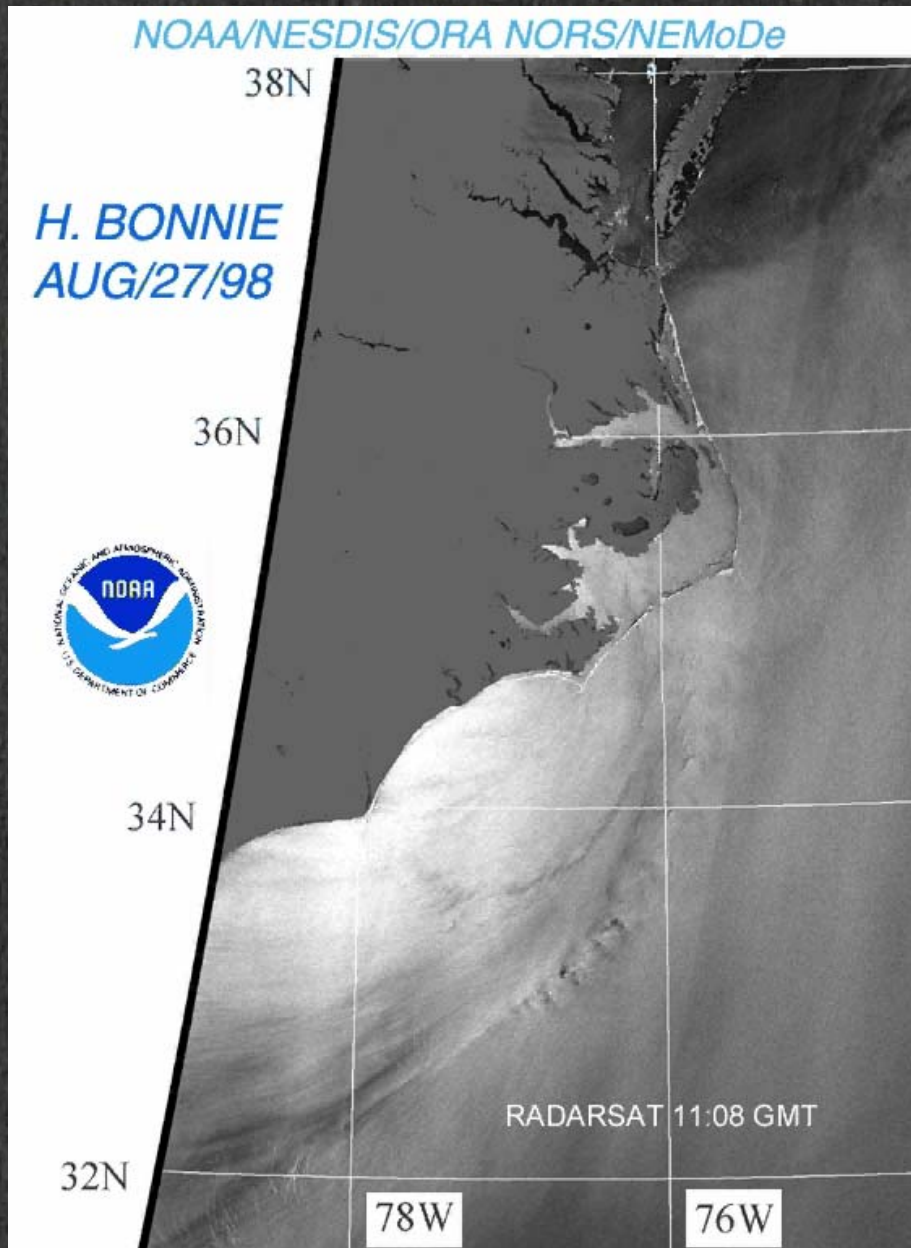
Danielle 31 Aug '98	Dennis 27 Aug '99	Dennis 29 Aug '99	Dennis 31 Aug '99
Floyd 15 Sep '99	Alberto 17 Aug '00	Florence 13 Sep '00	Dalila 26 Jul '01
Flossie 29 Aug '01	Flossie 1 Sep '01	Erin 11 Sep '01	Erin 13 Sep '01
Felix 17 Sep '01	Humberto 26 Sep '01	Juliette 27 Sep '01	Olga 28 Nov '01

100 km

**Hurricane
Eye Wall
Studies**

[CSA Hurricane Watch Project]

Atmospheric SAR Products - Atmospheric Mesoscale Features



**Hurricane
Precipitation
Studies**



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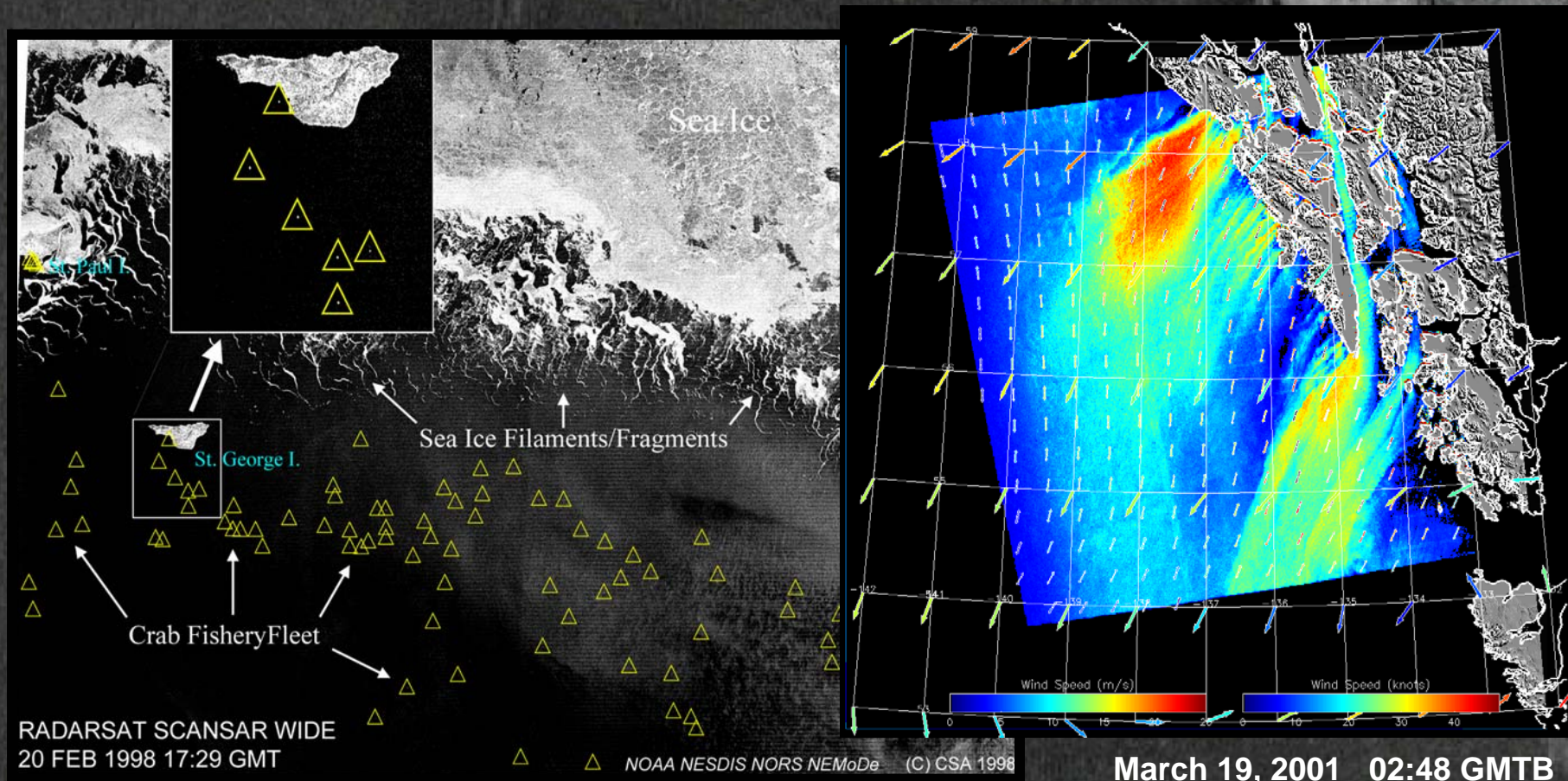
Routine Products

Research Products

FY 2003 Projects

3. Vision for Operational System Development
and Implementation

SSR Project 1 - Alaska SAR Demonstration



GOAL: Applications Demonstration of Automated SAR

Applications in Alaska Waters for Operational Agencies

COLLABORATORS: JHU/APL, Veridian, ACT

**PRODUCTS: Coastal Winds, Vessel Positions, Ice Masks, SAR Imagery
(used for Sea Ice and River Ice Analyses)**

Alaska SAR Demonstration

Initial Product Implementation - October 1999

WEB
SITE



INDEX

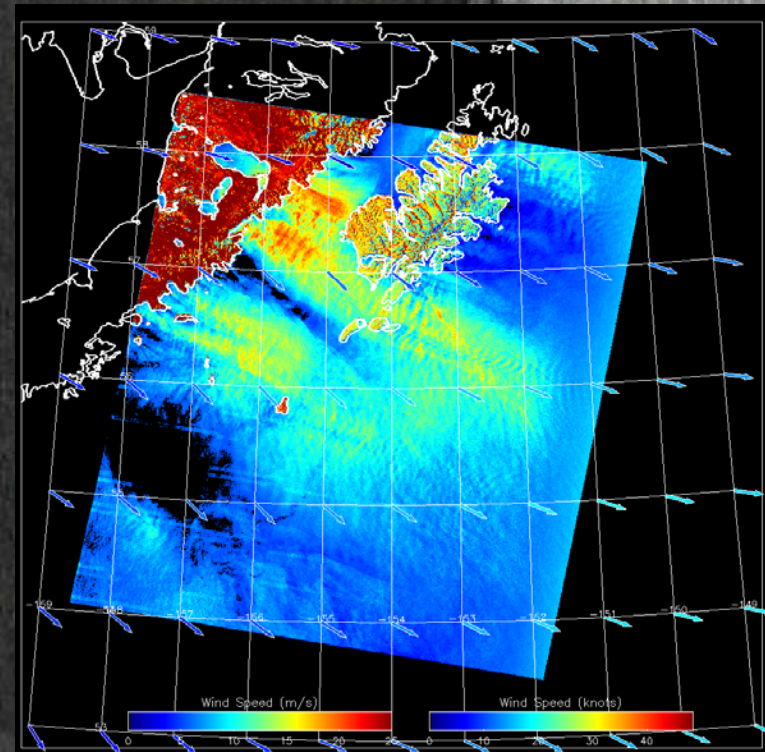
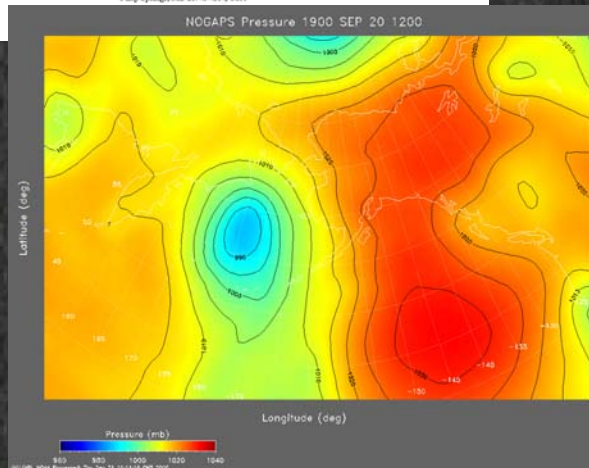
- Home Page
- Documentation
- SAR Products
- WPE System
- Scientific Papers
- Ancillary Products
- Feedback

ALASKA SAR DEMONSTRATION

A demonstration of near real-time SAR applications in Alaska began in the fall of 1999, with an anticipated duration of at least 2 years. The areas of interest are coastal Alaska waters of the Bering Sea, Beaufort Sea, Chukchi Sea, and Northern Gulf of Alaska (42° N - 76° N, 122° W - 155° E). Goals for the demonstration include: 1) Validate and test prototype SAR products that respond to critical needs not satisfied with present observational data in the Alaska region; 2) Provide SAR imagery and derived products in near real-time via the Internet for trial use by operational agencies; and 3) Familiarize operational agencies with SAR image data and products.

Contact Information:
William O. Fisher and Pablo Clemente-Collin
ER&L, Rm. 102, WWVB
NOAA/NESDIS/CI/CIAD
3200 Annapolis Rd.
Camp Springs, MD 20746-6304, USA

ANCILLARY
FIELDS



JHU/APL
WIND IMAGES

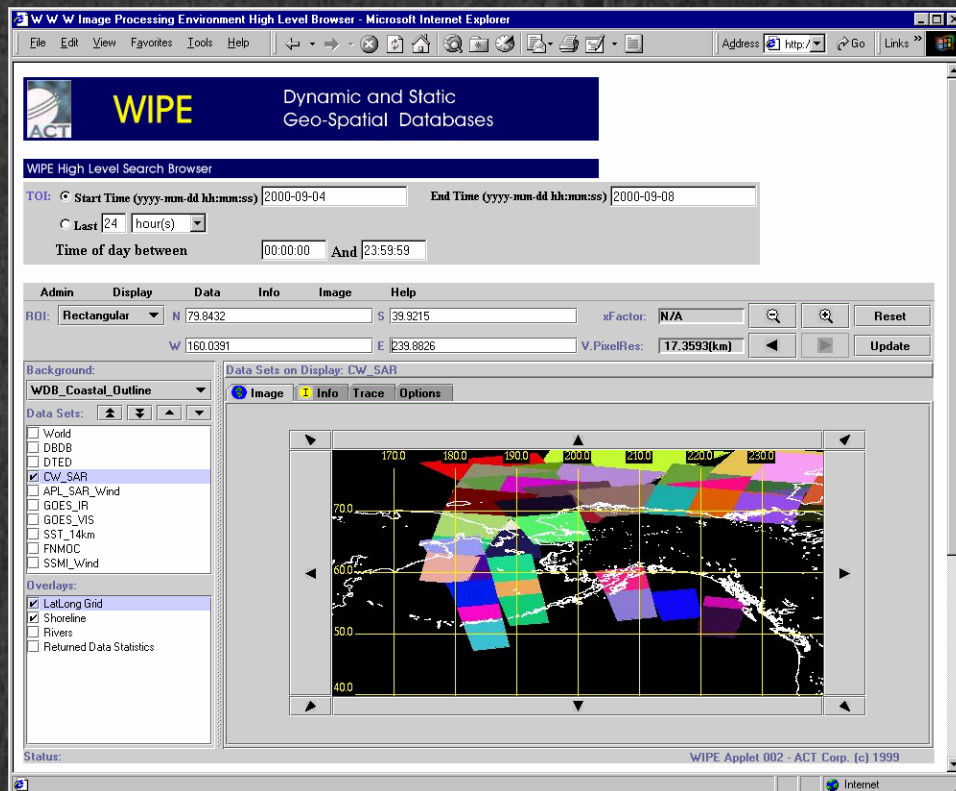
8/8/00 16:37 GMT

<http://radarsatpc3.web.noaa.gov/akdemo/index.html>

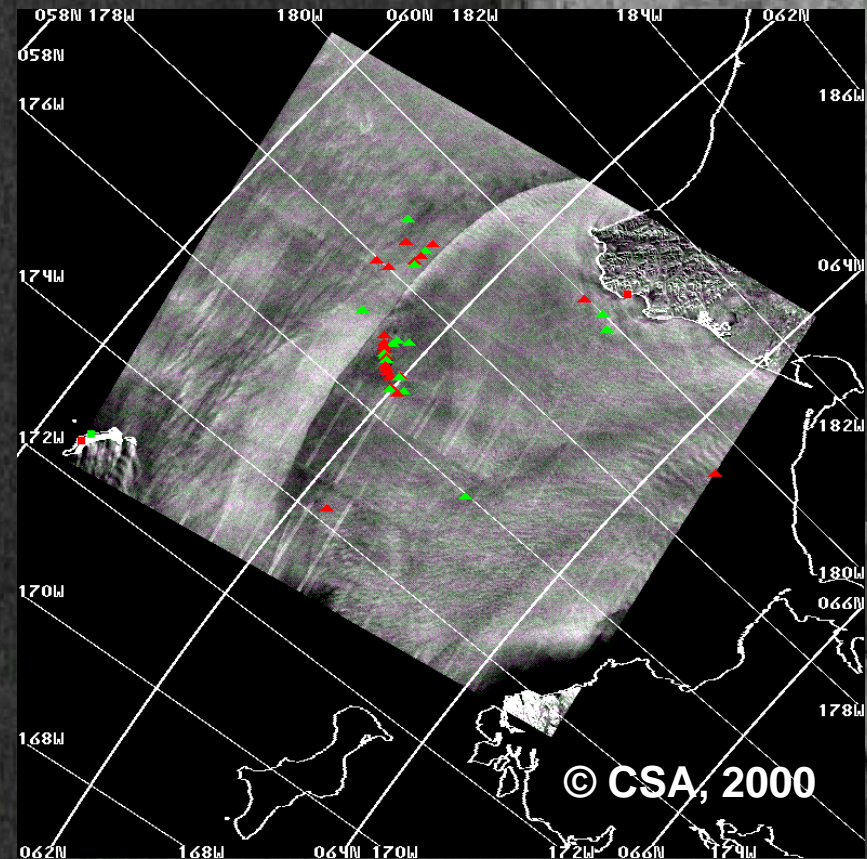


Alaska SAR Demonstration

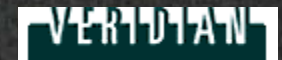
Additional Products - March 2000



APPLIED COHERENT TECHNOLOGY CORP.
WWW IMAGE PROCESSING ENVIRONMENT
(WIPE)



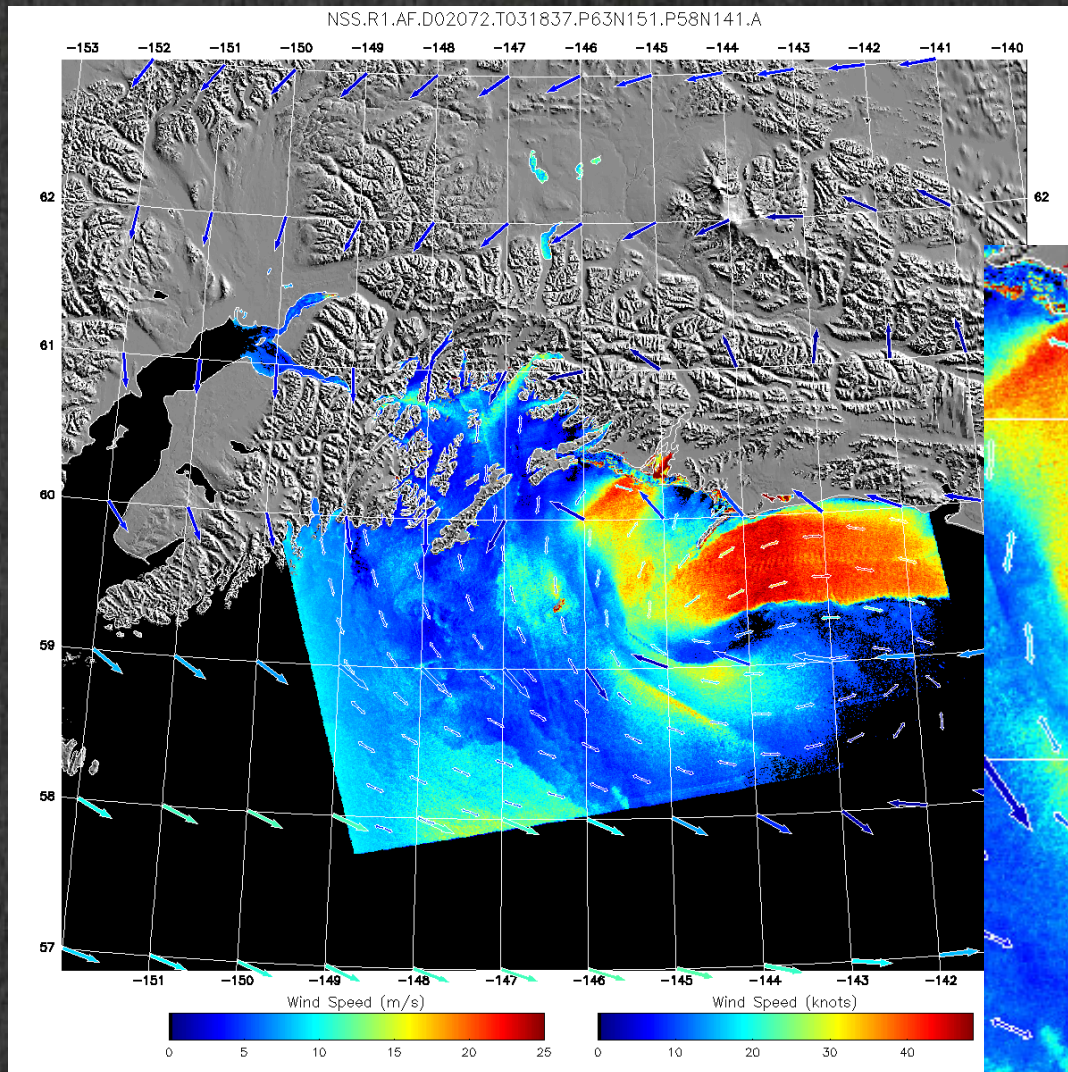
VERIDIAN
VESSEL DETECTION PRODUCTS
WIND VECTOR PRODUCTS
ICE IMAGERY



Alaska SAR Demonstration

New Formats - 2001

Fusion of Both Wind Products

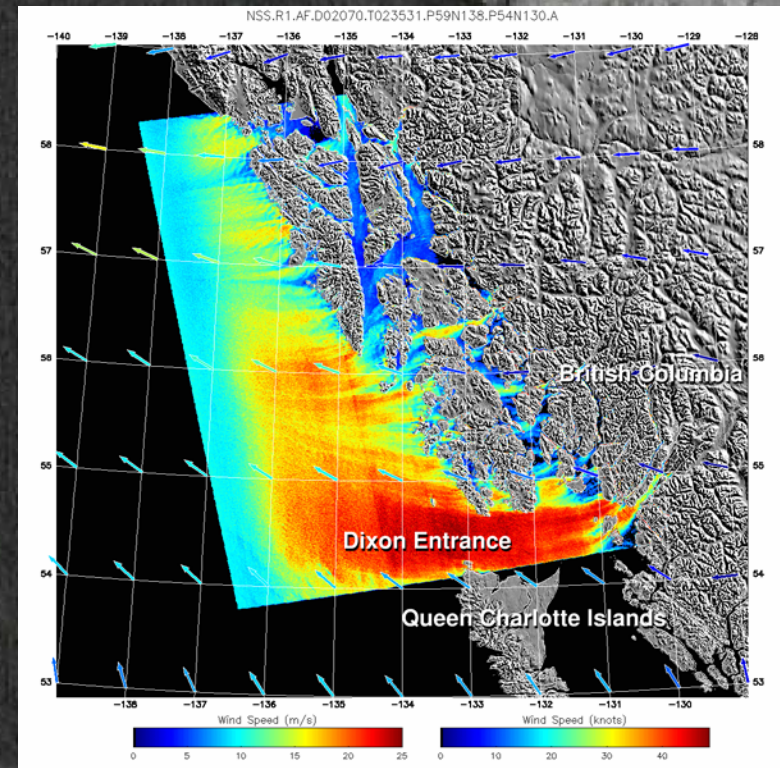


Barrier Jet March 13, 2002

Alaska SAR Demonstration

Major AKDEMO Upgrade - January 2003

- Data timeliness improved to 2-3 hours down from 4-6
 - Migration to faster Linux product processors
 - New WIPE server PCs
 - Faster SAR processing at ASF
- Experimental Wind Merged Product
- New Ice Mask Product
- Product Scheduling Graphics
- WIPE Upgrade
- AWIPS formatted wind images available



AWIPS Formatted Wind Images

Alaska SAR Demonstration

WIPE Upgrade - January 2003


WIPE High Level Search Browser

Time of Interest: (Year-Month-Day HH:MM:SS UTC)

Start: 2003 May 17 00 00 00 **End:** 2003 May 19 00 00 00

Relative Time: Last 24 hour(s) UTC


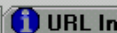

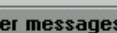
Preferences **TimeSeries** **Access** **Info** **Animation** **Help**

Back Forward Zoom out Zoom in Reset Update 

ROI: **Box** N 79.8432 S 39.9215 xFactor: N/A
W 160.0391 E 239.8826 V.PixelRes: 17.3593(km)

Background: None

Data Sets on Display: CW_SAR

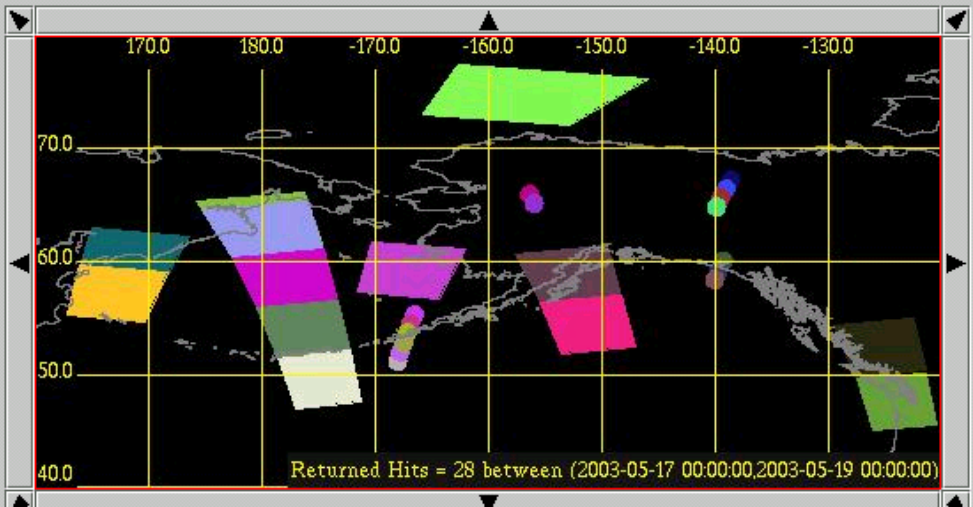
   

Data Sets(19):

- APL_SAR_Wind
- BATHY
- CW_SAR
- DBDB
- DTED
- EcohapCruise
- ERS_Wind
- GOES_IR

Overlays:

- Coverage per Pixel
- LatLong Grid
- Returned Data Statistics
- Rivers
- Shoreline



Returned Hits = 28 between (2003-05-17 00:00:00,2003-05-19 00:00:00)

Alaska SAR Demonstration

WIPE Upgrade - January 2003

WIPE High Level Search Browser

Time of Interest: (Year-Month-Day HH:MM:SS UTC)

Start: 2003 May 17 00 00 00 **End:** 2003 May 19 00 00 00

Relative Time: Last 24 hour(s) UTC

Preferences **TimeSeries** **Access** **Info** **Animation** **Help**

Back Forward Zoom out Zoom in Reset Update

ROI: Box N 56.673 S 50.2542 xFactor: N/A
W 186.8234 E 199.6609 V.PixelRes: 2.7911[km]

Background: None

Data Sets on Display: CW_SAR

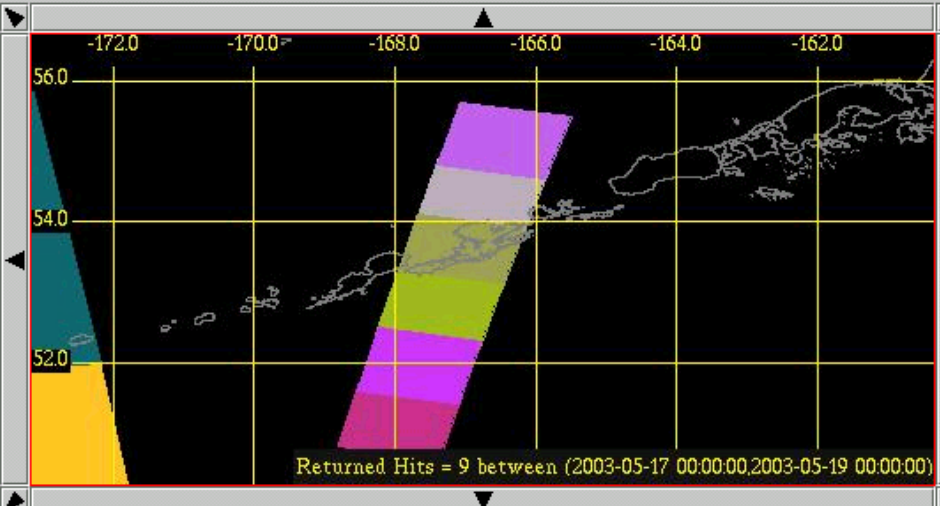
Image URL Info Server messages Options

Data Sets(19):

- APL_SAR_Wind
- BATHY
- CW_SAR
- DBDB
- DTED
- EcohapCruise
- ERS_Wind
- GOES_IR

Overlays:

- Coverage per Pixel
- LatLong Grid
- Returned Data Statistics
- Rivers
- Shoreline



Returned Hits = 9 between (2003-05-17 00:00:00,2003-05-19 00:00:00)

Alaska SAR Demonstration

WIPE Upgrade - January 2003

The screenshot displays the WIPE Data Browser interface. At the top, the logo for ACT and the text "WIPE Dynamic and Static Geo-Spatial Databases" are visible. Below this is a navigation bar with "WIPE Data Browser" and a menu with options: Preferences, Image, Legend, Plot, Download, Info, Animation, Execute, and Help. The main interface includes a toolbar with Back, Forward, Zoom out, Zoom in, and Reset buttons, along with an Update button and a small globe icon. The ROI (Region of Interest) is defined by a box with coordinates: N 56.673, S 50.2542, W 186.8233, and E 199.6609. The xFactor is N/A and the V.PixelRes is 2.7911(km). The Background is set to None. The Data Sets(9) list includes several CW_SAR datasets, with the second one selected. The Layers list shows 0 layers. The Overlays list includes various wind vector datasets and a checked LatLong Grid. The main display area shows a SAR image of a coastal region with a grid overlay. The grid has latitude values 52.0, 54.0, and 56.0 on the y-axis, and longitude values -172.0, -170.0, -168.0, -166.0, -164.0, and -162.0 on the x-axis. The SAR image shows a bright, elongated feature, likely a coastline or ice edge, with a small inset image showing a zoomed-in view of a specific area.

WIPE Dynamic and Static Geo-Spatial Databases

WIPE Data Browser

Preferences Image Legend Plot Download Info Animation Execute Help

Back Forward Zoom out Zoom in Reset Update

ROI: **Box** N 56.673 S 50.2542 xFactor: N/A
W 186.8233 E 199.6609 V.PixelRes: 2.7911(km)

Background: None

Data Sets(9):

<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173152.P54N168.P53N166.A
<input checked="" type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173138.P55N168.P54N166.A
<input checked="" type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173124.P56N167.P55N165.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173026.P62N171.P57N162.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T052624.P57P180.P51N172.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T052509.P52N179.P47N171.A

Layers: 0

Overlays:

- ERIM_SAR_Wind_Vec_Peak
- FNMOC(00)_Wind_Vec
- FNMOC(00)_Wind_Vec (Sparse)
- FNMOC(12)_Wind_Vec
- FNMOC(12)_Wind_Vec (Sparse)
- LatLong Grid

Data Sets on Display: CW_SAR|NSS.R1.AF.D03138.T173138.P55N168.P54...

DataSet Control Custom Script Options

Image URL Info Server messages

-172.0 -170.0 -168.0 -166.0 -164.0 -162.0

56.0

54.0

52.0

Alaska SAR Demonstration

WIPE Upgrade - January 2003

The screenshot displays the WIPE Data Browser interface. At the top, the logo for ACT and the text "WIPE Dynamic and Static Geo-Spatial Databases" are visible. Below this is a navigation bar with tabs for Preferences, Image, Legend, Plot, Download, Info, Animation, Execute, and Help. The main window is divided into several sections:

- Navigation:** Includes buttons for Back, Forward, Zoom out, Zoom in, and Reset, along with an Update button.
- ROI (Region of Interest):** A box selection with coordinates: N 55.6661, S 53.7782, W 191.4547, E 195.2305. The xFactor is N/A and V.PixelRes is 0.8209(km).
- Background:** Currently set to None.
- Data Sets(9):** A list of data sets with checkboxes. The second item is checked: CW_SAR NSS.R1.AF.D03138.T173138.P55N168.P54N166.A.
- Layers:** A list of layers, currently showing 0.
- Overlays:** A list of overlays, with LatLong.Grid selected.
- Data Sets on Display:** CW_SARINSS.R1.AF.D03138.T173138.P55N168.P54...
- Image View:** A main window showing a SAR image of a coastal area with a yellow grid overlay. The grid has latitude labels (54.00, 54.50, 55.00, 55.50) and longitude labels (-168.00, -167.50, -167.00, -166.50, -166.00, -165.50).
- Image View Controls:** Includes tabs for DataSet Control, Custom Script, and Options, and buttons for Image, URL Info, and Server messages.

Alaska SAR Demonstration

WIPE Upgrade - January 2003

The screenshot displays the WIPE Data Browser application. At the top, the title bar reads "WIPE Dynamic and Static Geo-Spatial Databases". Below this is a "WIPE Data Browser" header. The main interface includes a menu bar with "Preferences", "Image", "Legend", "Plot", "Download", "Info", "Animation", "Execute", and "Help". A toolbar contains navigation buttons: "Back", "Forward", "Zoom out", "Zoom in", and "Reset", along with an "Update" button and a small globe icon.

Key parameters are displayed in the center: ROI: **Box**, N: 54.8739, S: 54.1114, W: 192.0296, E: 193.5547, xFactor: N/A, and V.PixelRes: 0.3316[km].

The interface is divided into several panels:

- Background:** Set to "None".
- Data Sets(9):** A list of data sets with checkboxes. The second and third items are checked: "Cw_SAR NSS.R1.AF.D03138.T173138.P55N168.P54N166.A" and "Cw_SAR NSS.R1.AF.D03138.T173124.P56N167.P55N165.A".
- Layers:** Currently empty, showing "0".
- Overlays:** A list of overlays with checkboxes. "LatLong Grid" is checked.
- Data Sets on Display:** Shows the active data set: "CW_SARINSS.R1.AF.D03138.T173138.P55N168.P54...".
- DataSet Control:** Includes tabs for "Image", "URL Info", and "Server messages".

The main display area shows a grayscale SAR image of a coastal region, overlaid with a yellow grid. The grid's x-axis (longitude) ranges from -167.80 to -166.60, and the y-axis (latitude) ranges from 54.20 to 54.80.

Alaska SAR Demonstration

WIPE Upgrade - January 2003

The screenshot displays the WIPE (Dynamic and Static Geo-Spatial Databases) software interface. The title bar reads "WIPE Dynamic and Static Geo-Spatial Databases". Below the title bar is a "WIPE Data Browser" header. The main interface features a menu bar with "Preferences", "Image", "Legend", "Plot", "Download", "Info", "Animation", "Execute", and "Help". A toolbar contains "Back", "Forward", "Zoom out", "Zoom in", "Reset", and "Update" buttons. The "ROI" (Region of Interest) is defined by a box with coordinates: N 54.853, S 54.4343, W 192.4988, and E 193.3362. The "xFactor" is set to "N/A" and "V.PixelRes" is "0.1820[km]". The "Background" is set to "None". The "Data Sets(9)" list includes several SAR datasets, with the first two checked: "CW_SAR NSS.R1.AF.D03138.T173138.P55N168.P54N166.A" and "CW_SAR NSS.R1.AF.D03138.T173124.P56N167.P55N165.A". The "Layers" section shows "0" layers. The "Overlays" section includes "ERIM_SAR_Wind_Vec_Peak", "FNMOC(00)_Wind_Vec", "FNMOC(00)_Wind_Vec (Sparse)", "FNMOC(12)_Wind_Vec", "FNMOC(12)_Wind_Vec (Sparse)", and "LatLong Grid" (checked). The main display area shows a SAR image with a yellow grid overlay. The grid is labeled with coordinates: -167.40, -167.30, -167.20, -167.10, -167.00, -166.90, -166.80 on the x-axis and 54.80, 54.70, 54.60, 54.50 on the y-axis. The image shows a grayscale SAR scan of a coastal area with a grid overlay.

WIPE Dynamic and Static Geo-Spatial Databases

WIPE Data Browser

Preferences Image Legend Plot Download Info Animation Execute Help

Back Forward Zoom out Zoom in Reset Update

ROI: Box N 54.853 S 54.4343 xFactor: N/A
W 192.4988 E 193.3362 V.PixelRes: 0.1820[km]

Background: None

Data Sets(9):

<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173152.P54N168.P53N166.A
<input checked="" type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173138.P55N168.P54N166.A
<input checked="" type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173124.P56N167.P55N165.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T173026.P62N171.P57N162.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T052624.P57P180.P51N172.A
<input type="checkbox"/>	CW_SAR	NSS.R1.AF.D03138.T052509.P52N179.P47N171.A

Layers: 0

Overlays:

- ERIM_SAR_Wind_Vec_Peak
- FNMOC(00)_Wind_Vec
- FNMOC(00)_Wind_Vec (Sparse)
- FNMOC(12)_Wind_Vec
- FNMOC(12)_Wind_Vec (Sparse)
- LatLong Grid

Data Sets on Display: CW_SAR|NSS.R1.AF.D03138.T173138.P55N168.P54...

DataSet Control Custom Script Options

Image URL Info Server messages

-167.40 -167.30 -167.20 -167.10 -167.00 -166.90 -166.80

54.80 54.70 54.60 54.50

Alaska SAR Demonstration

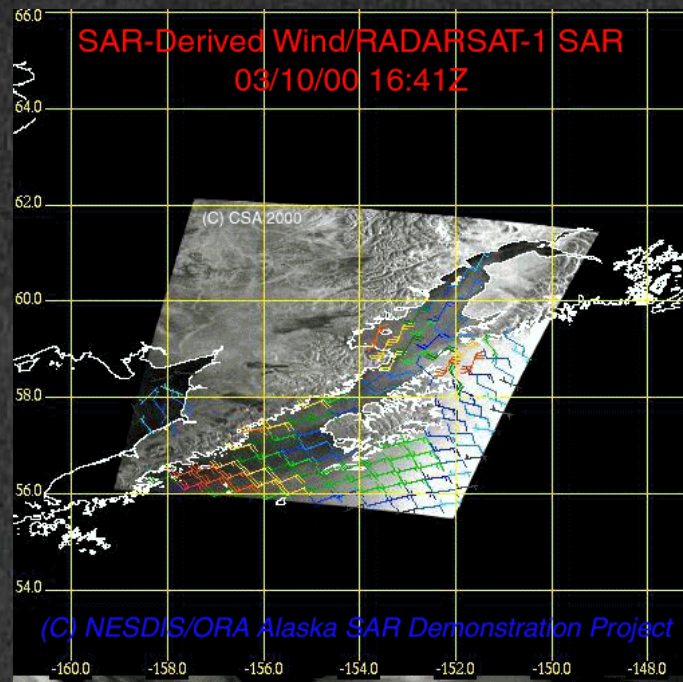
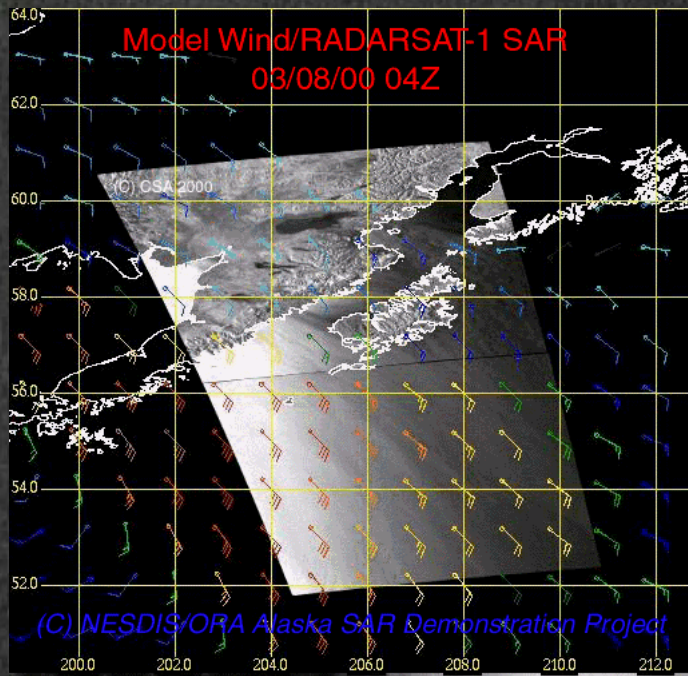
WIPE Upgrade - January 2003



© Canadian Space Agency, 2003

WIPE Output - JPEG Format

Alaska SAR Demonstration



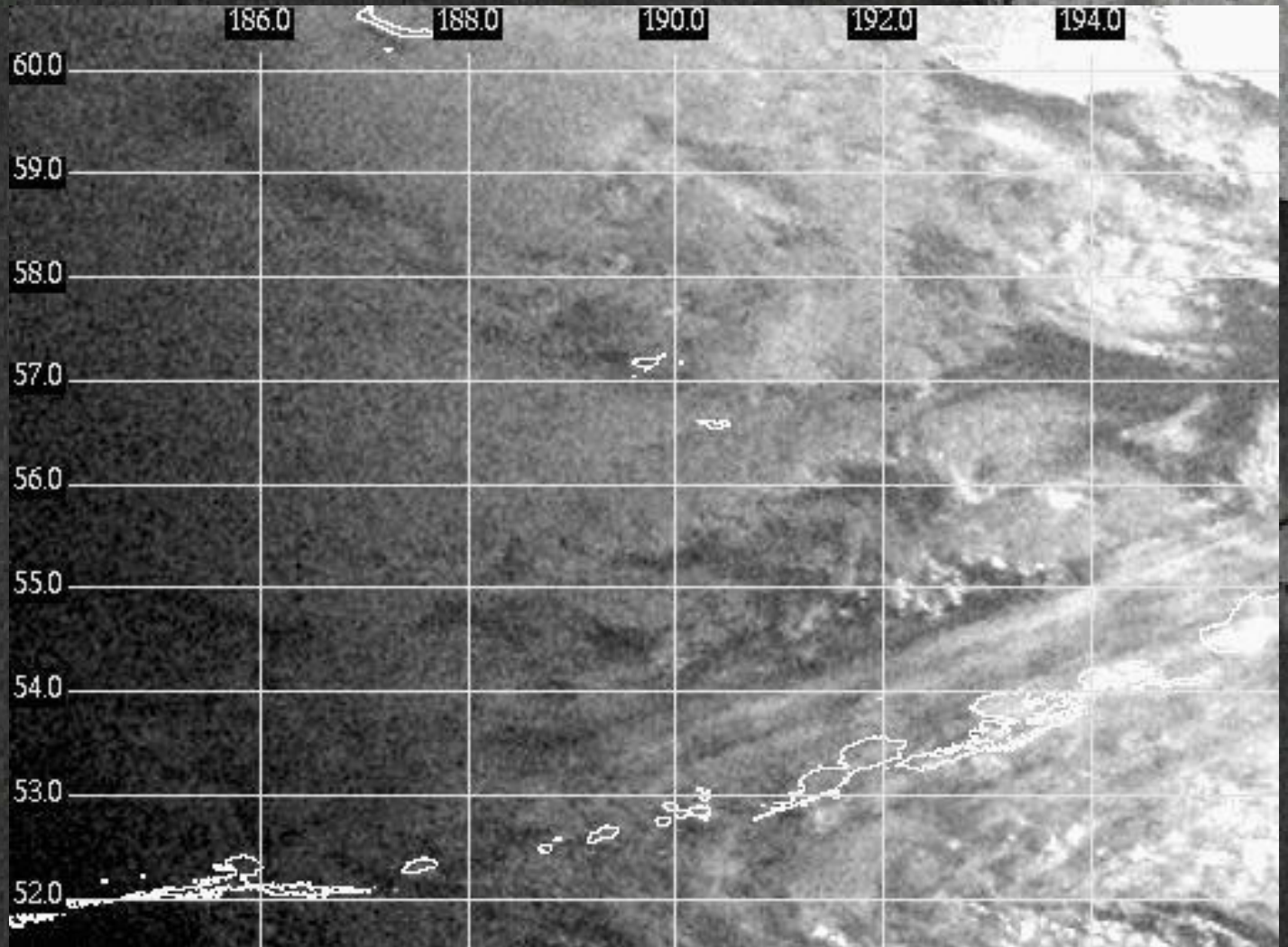
WWW Image Processing Environment

- Display of coincident image and overlay products
- On-line analyses
- Data output into scientific and GIS formats



WIPE Animation

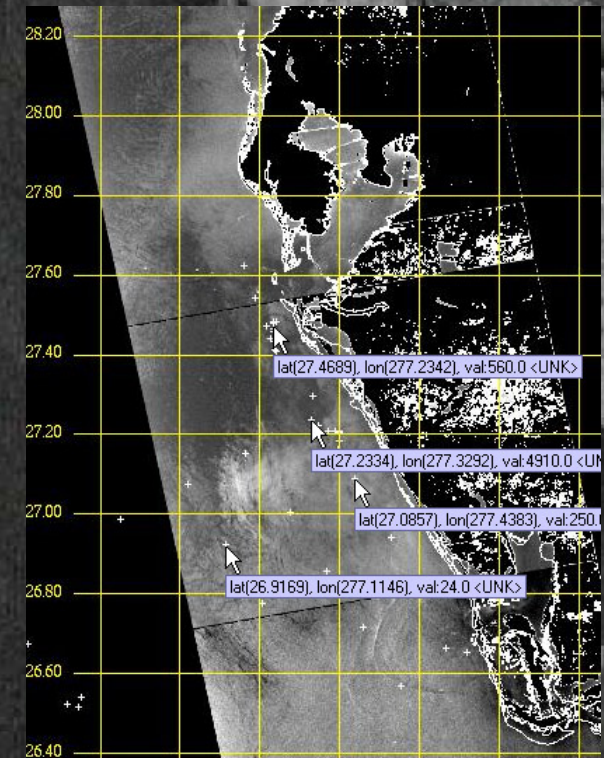
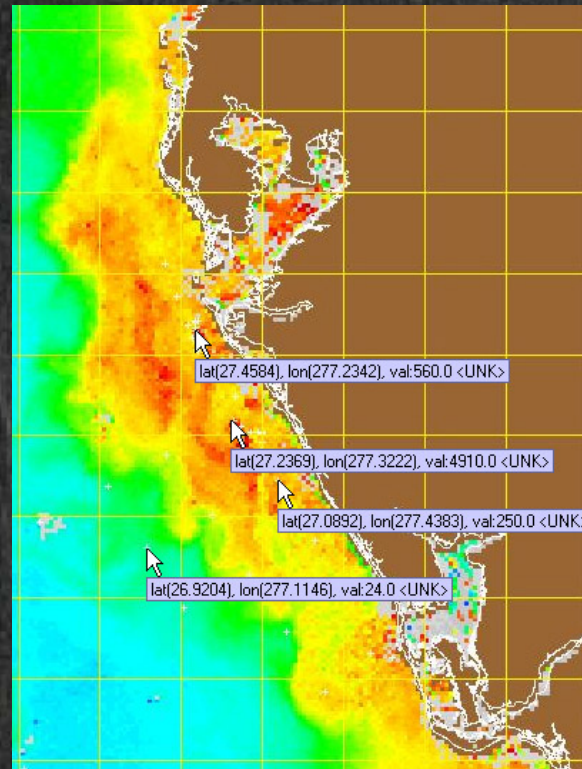
Animation of
Mesoscale
Cyclone in the
Bering Sea
GOES West 1 km
Visible 4/8/00
1700Z - 4/9/00
0600 Z
RADARSAT
ScanSAR Wide B
100 m 4/8/00
1807Z & 4/9/00
0503Z



SSR Project 2 - Gulf of Mexico Experiment



Mississippi plume front
R-1 Standard Mode
6/3/02



HAB West Florida Shelf

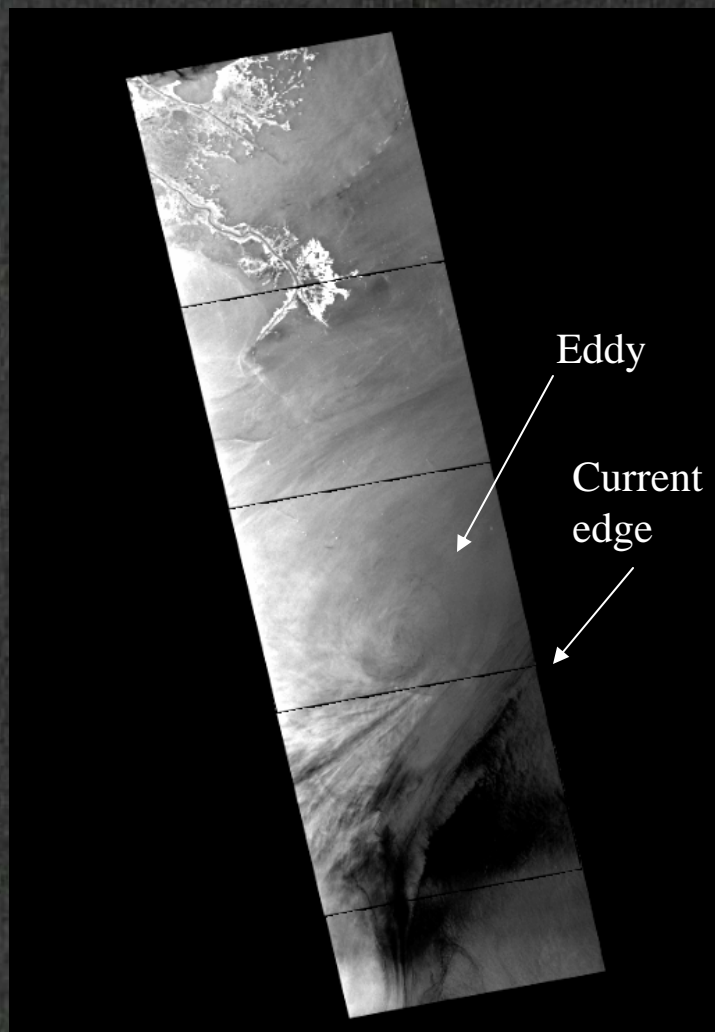
GOAL: Retrospective Applications Demonstration of SAR applications
in the Gulf of Mexico

COLLABORATORS: LSU Coastal Studies Institute, NOS Beaufort Laboratory

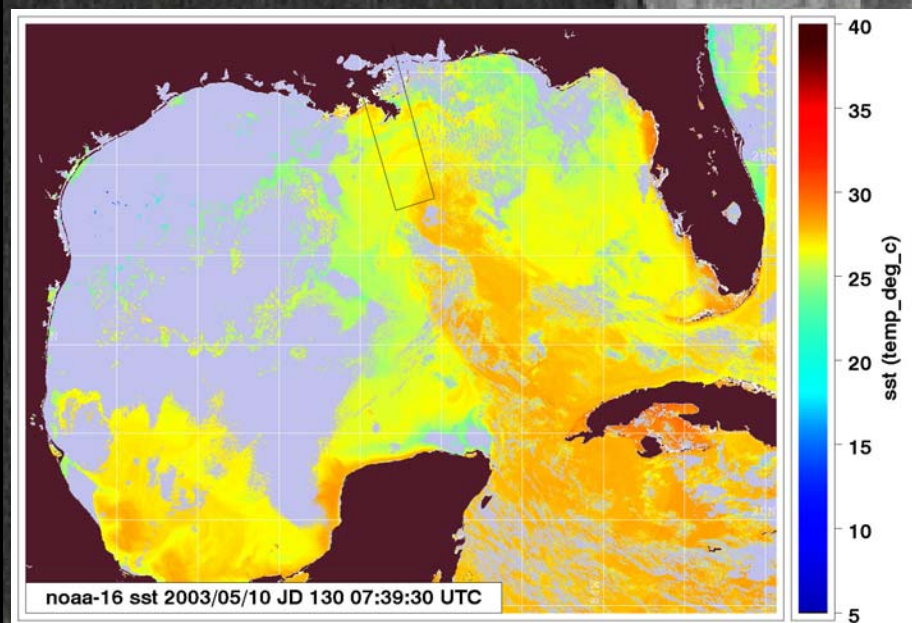
PRODUCTS: Hazardous Algal Blooms, Current Features, Spills and Seeps

SSR Project 2 - Gulf of Mexico Experiment

SAR 5/11/03 23:52:33 GMT

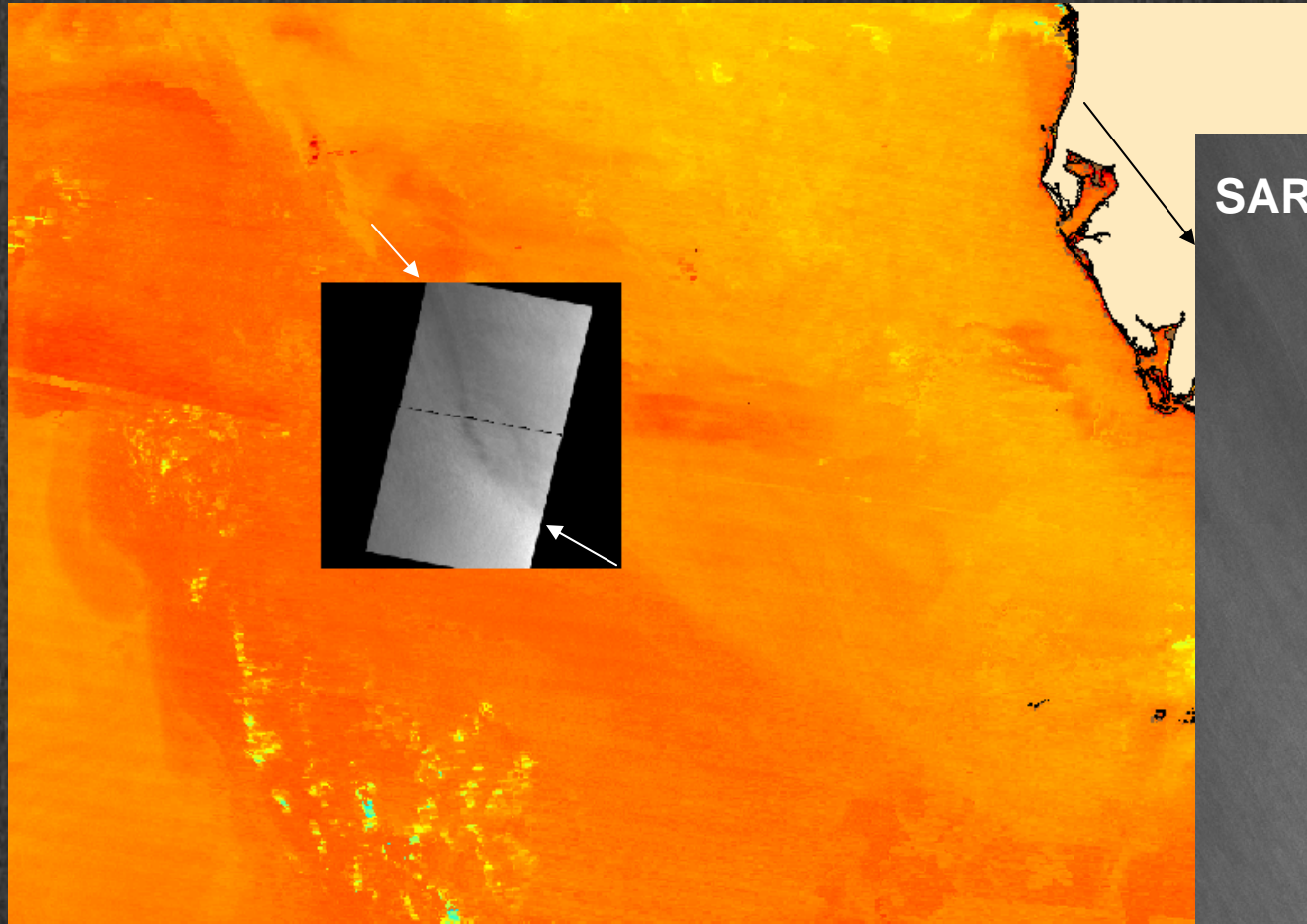


AVHRR

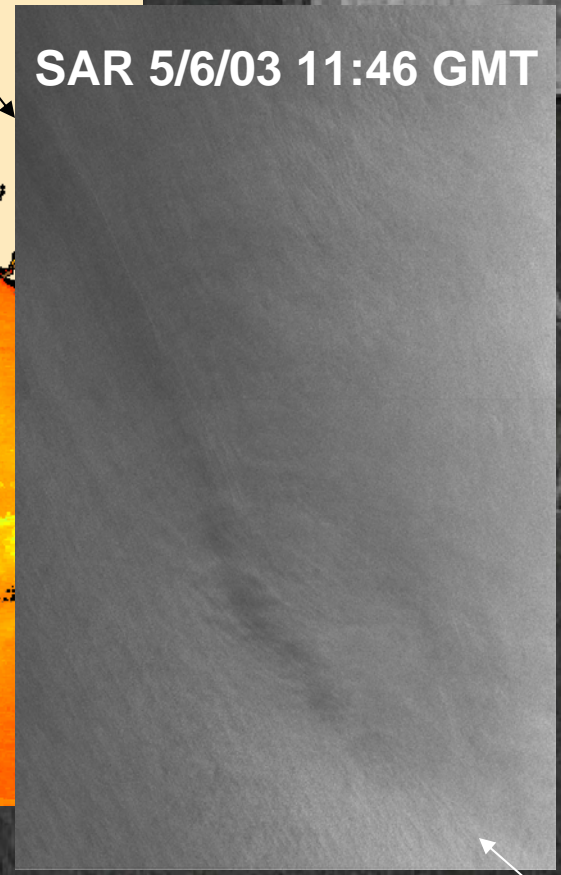


SSR Project 2 - Gulf of Mexico Experiment

SAR and MODIS Terra SST week 18 composite



SAR 5/6/03 11:46 GMT

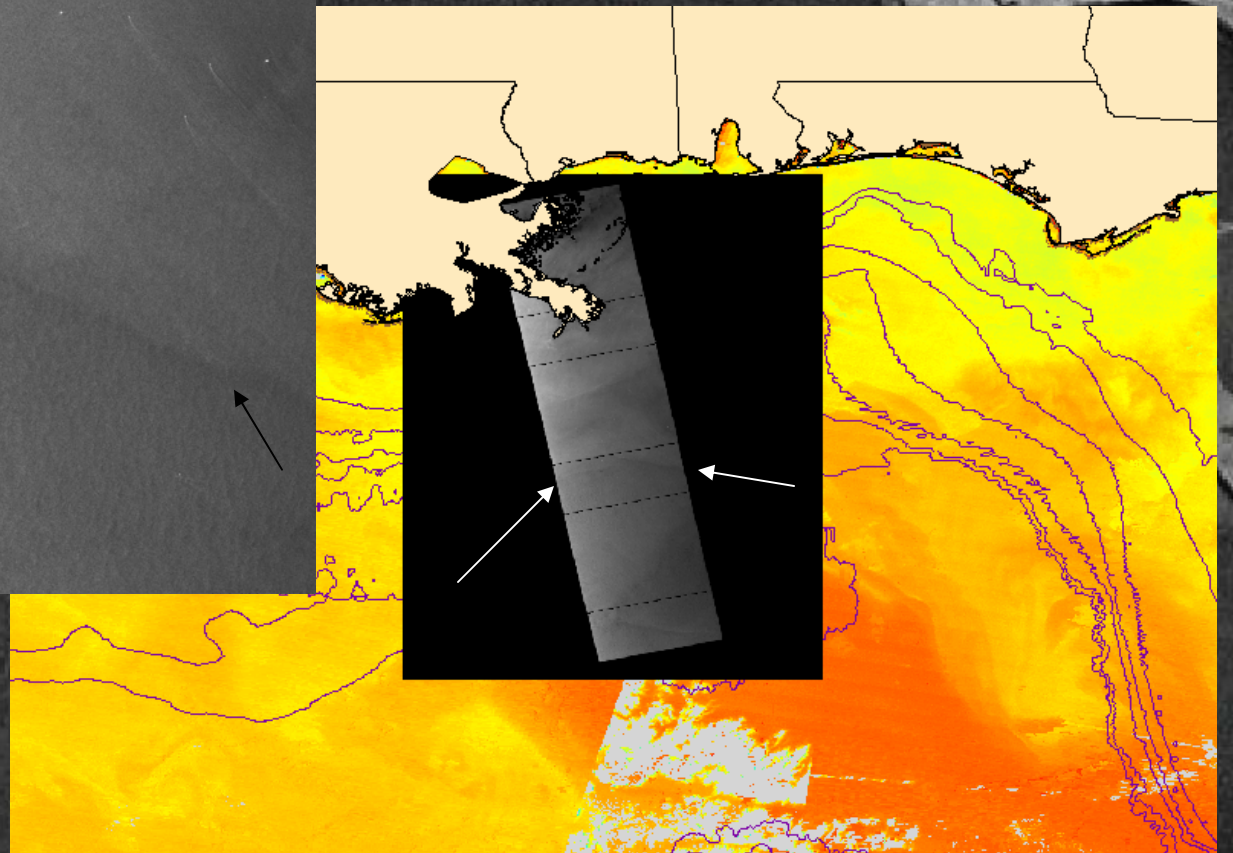


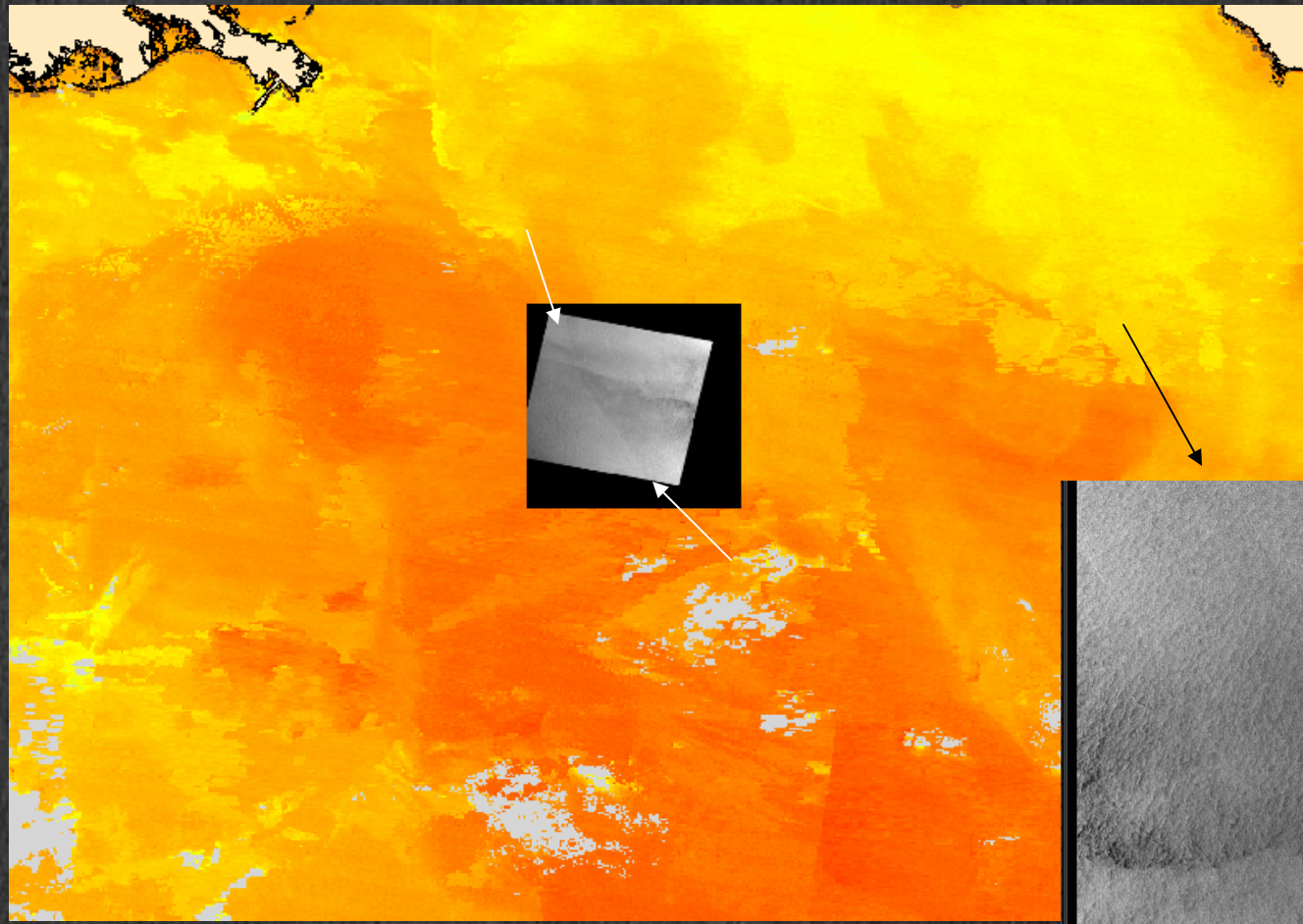
SSR Project 2 - Gulf of Mexico Experiment

SAR 4/17/03 23:51 GMT

SAR and MODIS Terra SST
week 15 Composite

Northern Boundary
of Loop Current



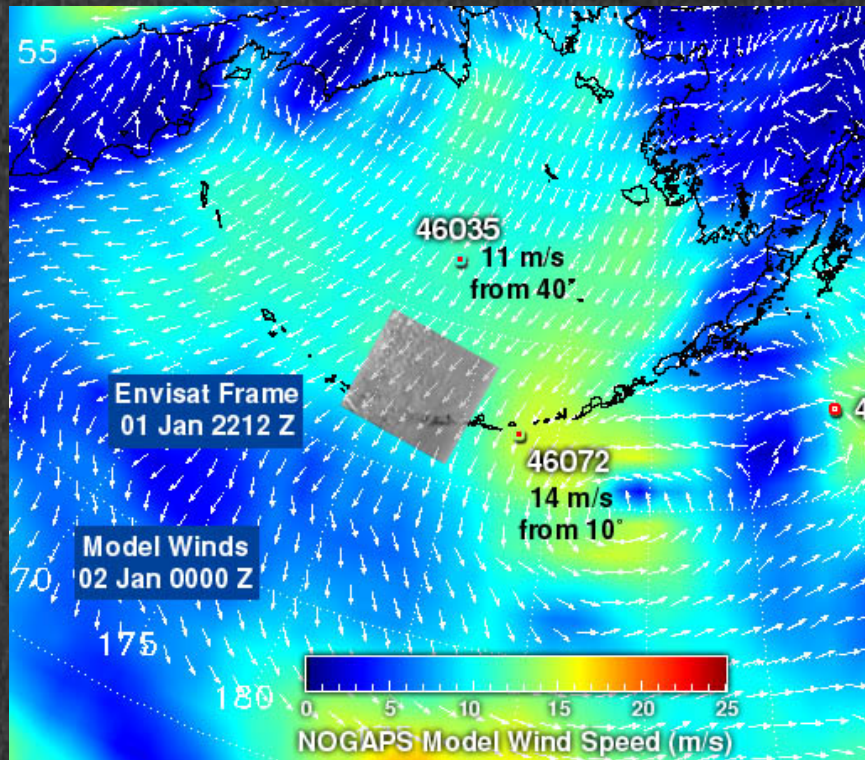


SAR 4/29/03
11:50 GMT



SAR and MODIS Terra
SST week 17 composite

SSR Project 3 - ESA ENVISAT Project

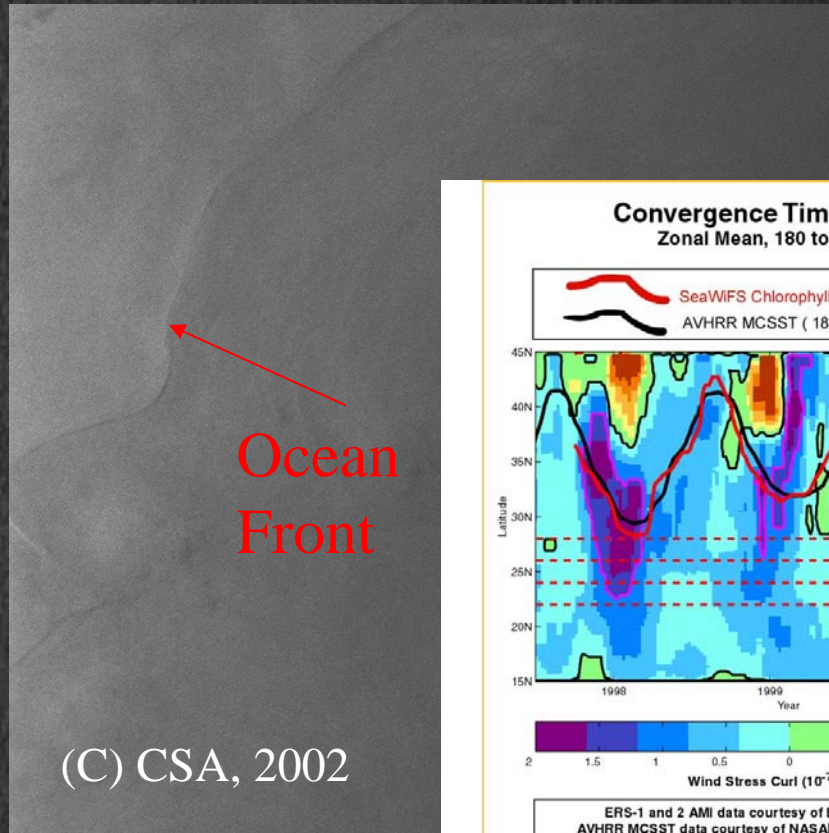


GOAL: Operational Demonstration of CoastWatch Coastal Oceanographic and Hydrologic Applications of ENVISAT ASAR Imagery.

COLLABORATORS: JHU/APL, SSARGASSO, Veridian, ACT

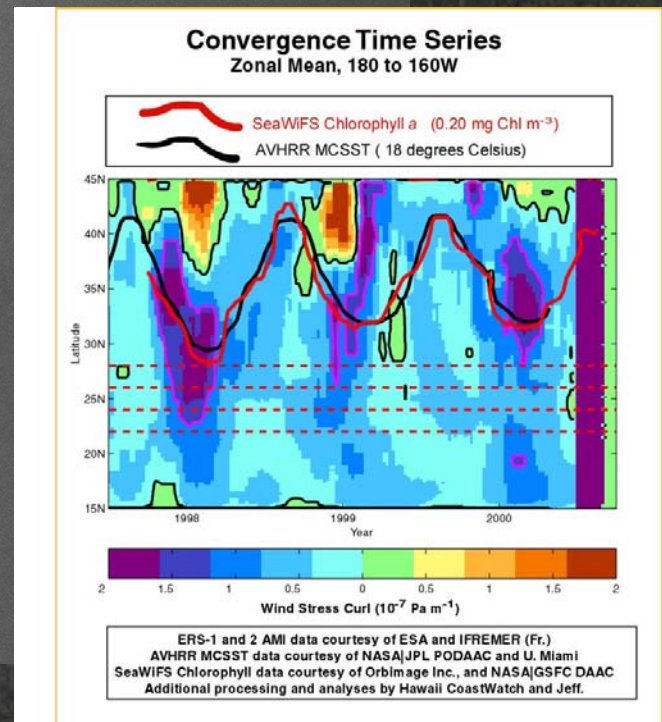
PRODUCTS: Winds, Vessels, Ocean Features

SSR Project 4 - GhostNet Project



(C) CSA, 2002

R-1 10 April 2002



GOAL: Detection of Derelict Nets at Sea using Airborne LIDAR and Satellite Remote Sensing

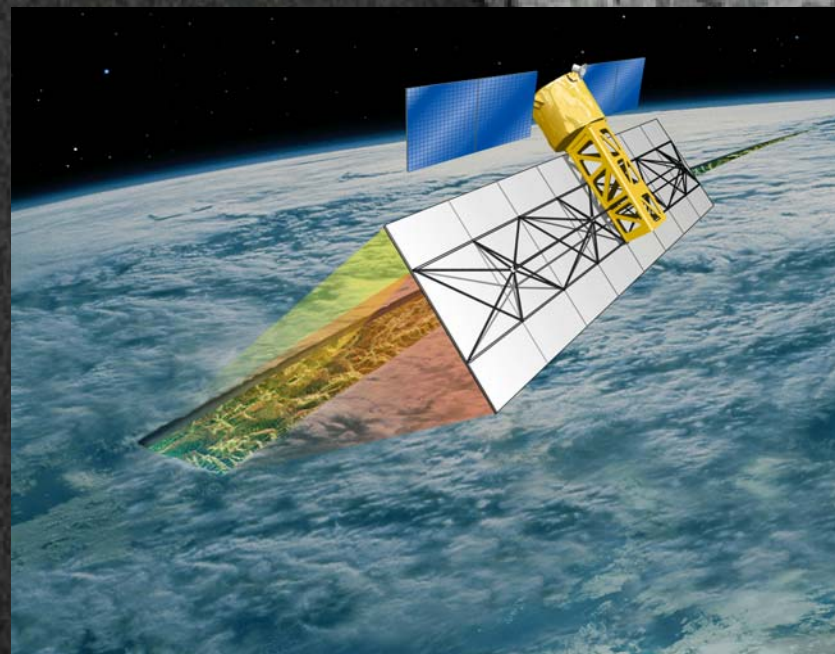
COLLABORATORS: Airborne Technologies, NOAA ETL, NMFS, ASF, USC

PRODUCTS: Convergence Zones, LIDAR signatures, buoy network

SSR Project 5 - Ocean Observer Study



Wide Swath &
Delayed Doppler Altimeters



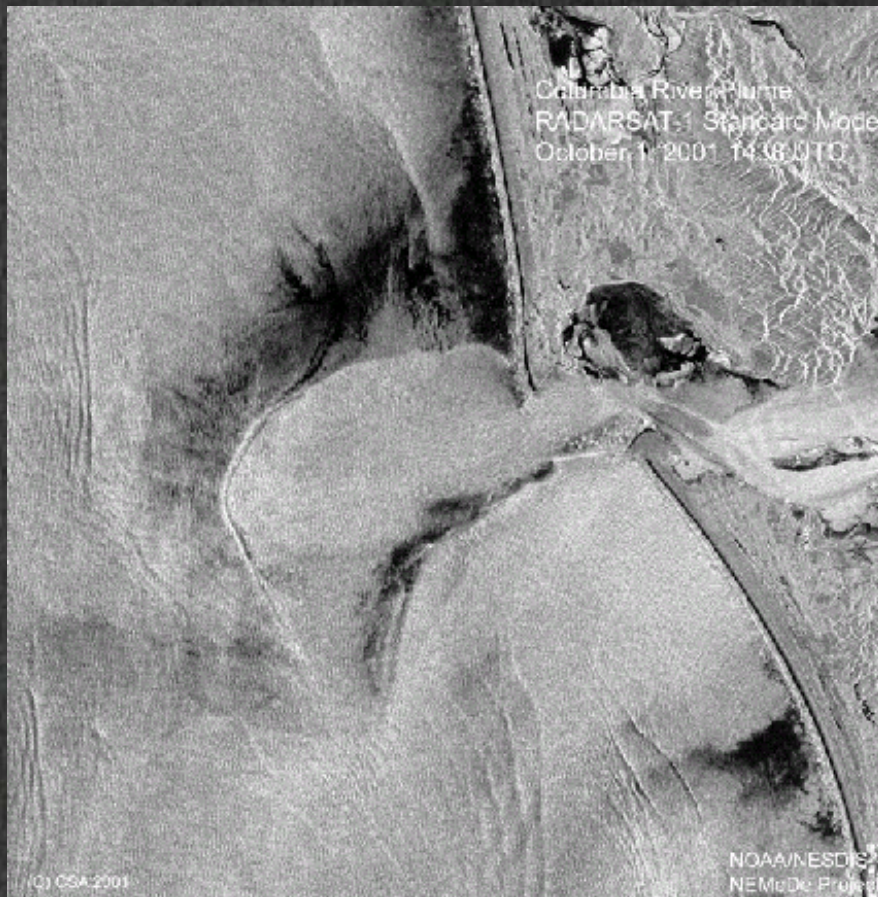
L & C Band Interferometric SAR

GOAL: Define and Develop Cost Estimates for U.S. Operational Satellite System to meet U.S. Ocean Data Requirements

COLLABORATORS: IPO, NASA/JPL

PRODUCTS: Ocean Observer User Requirements Document,
Ocean Observer Instrument and Satellite Study

SSR Project 6a - NeMoDe: Grant to Oregon Health and Science University



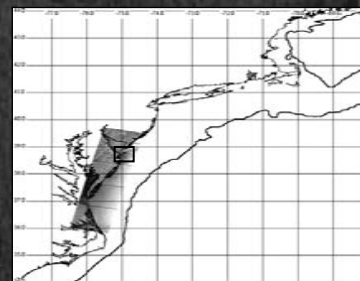
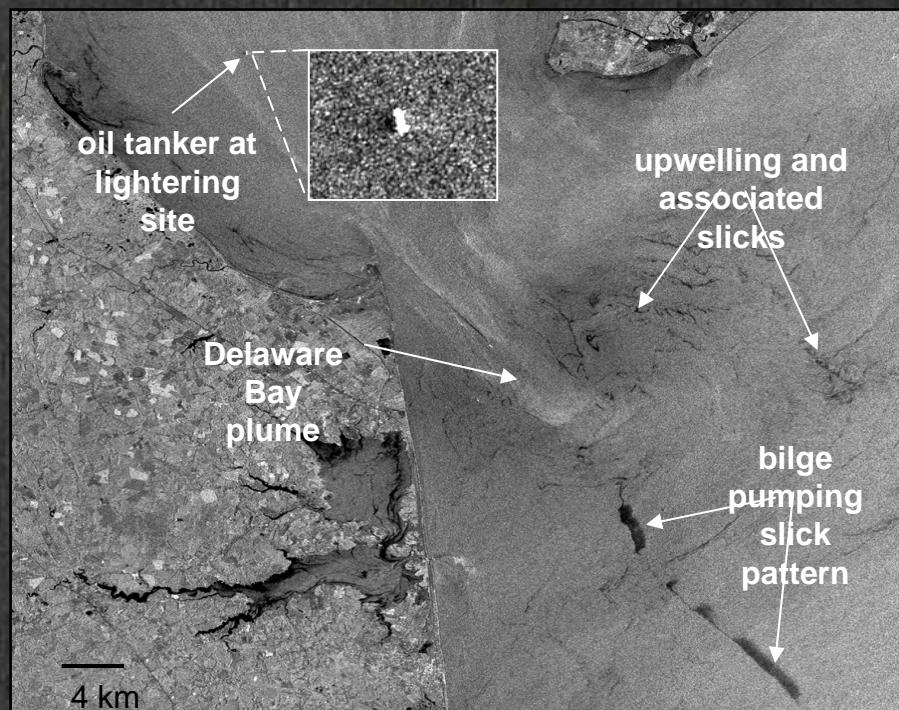
**RADARSAT-1 Standard SAR
subimage showing the Columbia
River plume and coastal ocean
conditions on 1 October 2001.**

GOAL: Satellite Ocean Front Mapping in Support of Salmonid Resource Management (David Jay and Todd Sanders)

COLLABORATORS: Oregon Health and Science Univ., NMFS, Univ. of RI

PRODUCTS: Field support, Plume front maps

SSR Project 6b - NeMoDe: Grant to University of Delaware



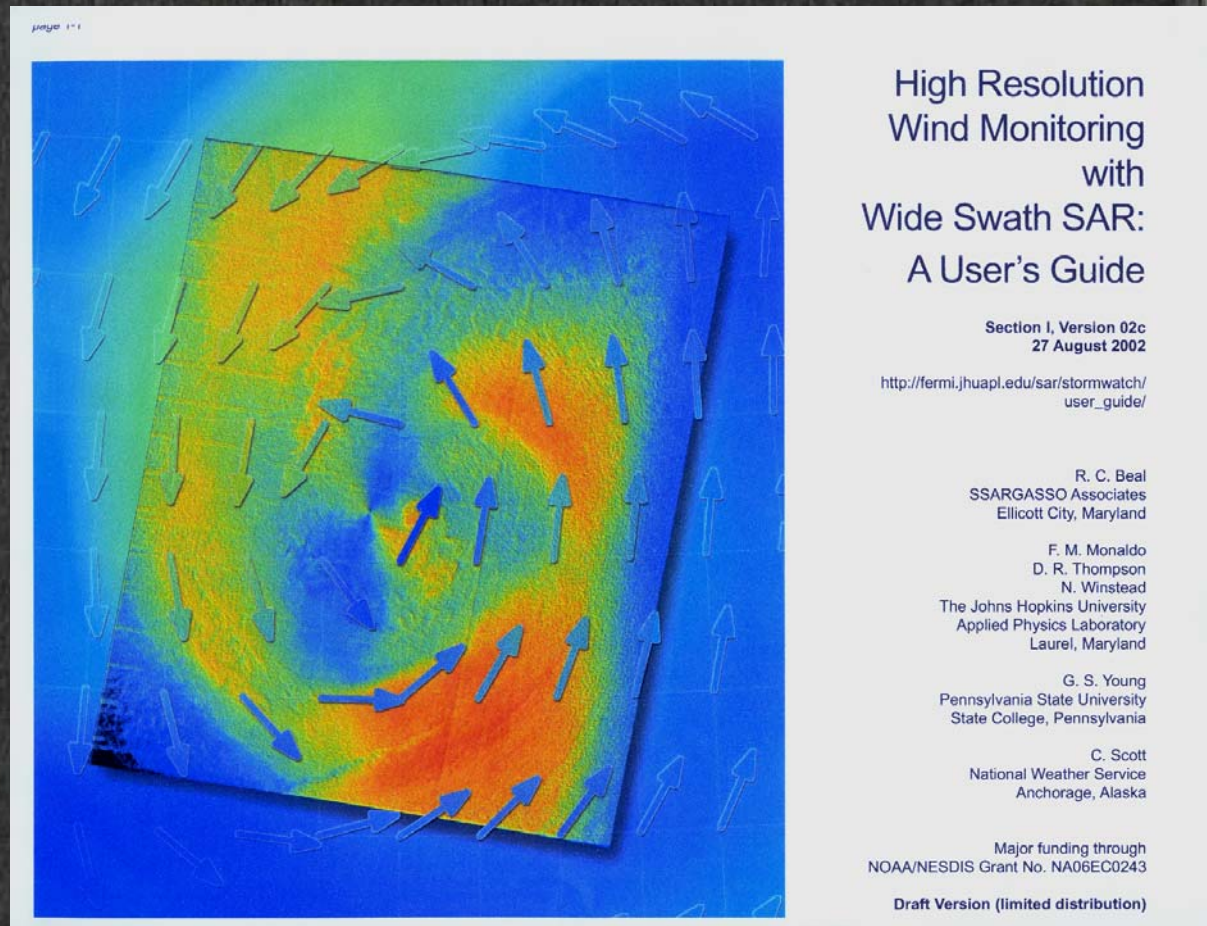
**RADARSAT-1 Standard Mode
13 August 1998 11:15 - ebb tide**

GOAL: Using satellite imagery for modeling and monitoring the circulation in Delaware Bay and adjacent coastal ocean (Richard Garvine and Xiao-Hai Yan)

COLLABORATORS: Univ. of Delaware, NRL, State of Delaware, Delaware Bay and River Cooperative

PRODUCTS: Public web site of coastal imagery, circulation model, Model/ocean feature studies

SSR Project 6c - NeMoDe: Grant to SSARGASSO Associates



GOAL: User Guide to SAR Wind Field Interpretation (Robert Beal)
COLLABORATORS: SSARGASSO Associates, JHU/APL, NWS Alaska
PRODUCTS: User Guide to SAR Wind Field Interpretation

SSR Project 6d - NeMoDe: Contract to Global Ocean Associates



Synthetic Aperture Radar Marine User's Manual



GOAL: Synthetic Aperture Radar Marine User's Manual (Chris Jackson Editor)

COLLABORATORS: Global Ocean Associates , Chapter Authors

PRODUCTS: SAR Marine User's Manual (20 Chapters)



Synthetic Aperture Radar Applications Current Status in NOAA and Plans for Development as a Component of Operational Ocean Observing Systems

Outline

1. Mission

2. Current Status

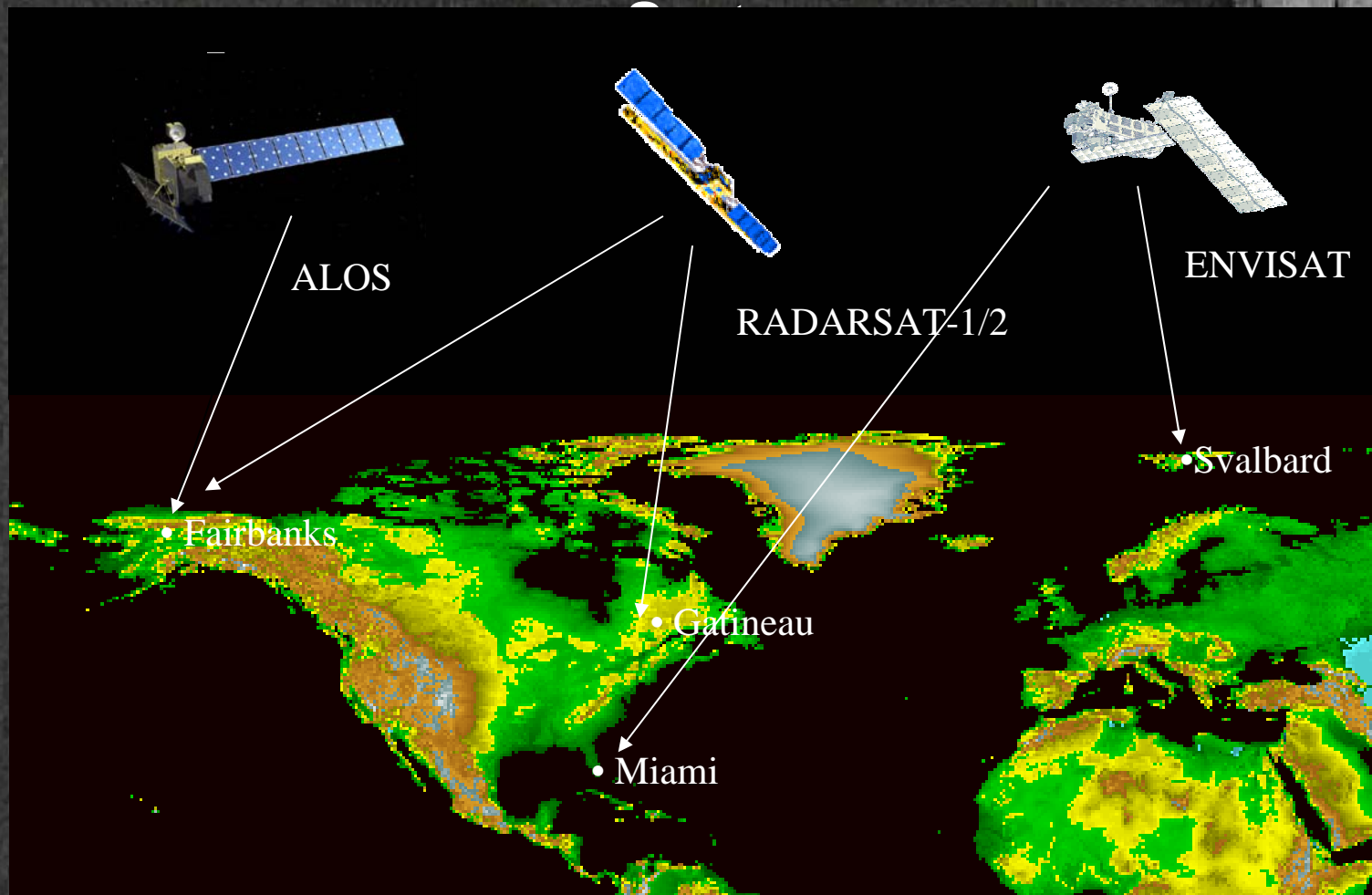
Routine Products

Research Products

FY 2003 Projects

3. Vision for Operational System Development
and Implementation

SSR Project 7 - International SAR Ocean Products



GOAL: Develop international SAR ocean products processor to be installed at readout stations to produce near real-time SAR products for the operational community

COLLABORATORS: NERSC, NSA, Veridian, JHU/APL, RSI, ASF, RSMAS

PRODUCTS: Multiple - winds, waves, vessels, features, etc.

1st Step – Svalbard Workshop

2nd Workshop on Coastal and Marine Applications of SAR

September 8-12, 2003
Longyearbyen,
Spitzbergen, Norway



GOAL: Assess operational readiness of algorithms for winds, waves, current features, and sea ice

SAR Products System Development Vision/Strategy

1. Decide on best algorithms at Svalbard conference
2. Work with Norwegians, Canadians, and ASF to refine automated versions of these algorithms
3. Continue wind product development with JHU/APL and Veridian - merge SAR winds with scatterometer and passive polarimeter winds for validation and improved direction information
4. Extend existing algorithms to ENVISAT & ALOS
5. Prototype a portable automated operational SAR wind system for CSTARs
6. Based on CSTARs wind system and Alaska SAR Demo, work with international partners to develop fully automated operational SAR ocean products system
7. Install this system at acquisition stations and/or centrally

Sea Surface Roughness Web Sites

1. Alaska SAR Demonstration - NOAA site:
<http://radarsatpc3.wwb.noaa.gov/akdemo/index.html>
2. Alaska SAR Demonstration - The Johns Hopkins Univ.
Applied Physics Lab site: <http://fermi.jhuapl.edu/sar>
3. GhostNet Home Page:
<http://www.highseasghost.net>
4. SAR Marine Users Manual - Global Ocean Associates
site: <http://sarusermanual.com>
5. User Guide to SAR Wind Field Interpretation -
SSARGASSO site:
http://fermi.jhuapl.edu/sar/stormwatch/user_guide/