Alaska Sea Ice Program

An Introduction to Operations

NOAA VIIRS virtual user workshop

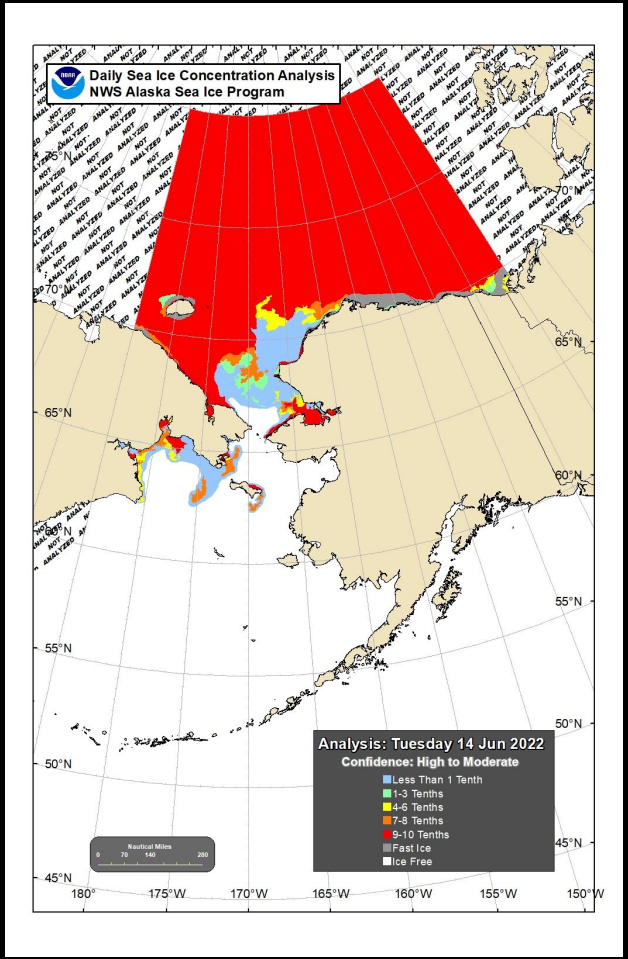
Michael Lawson

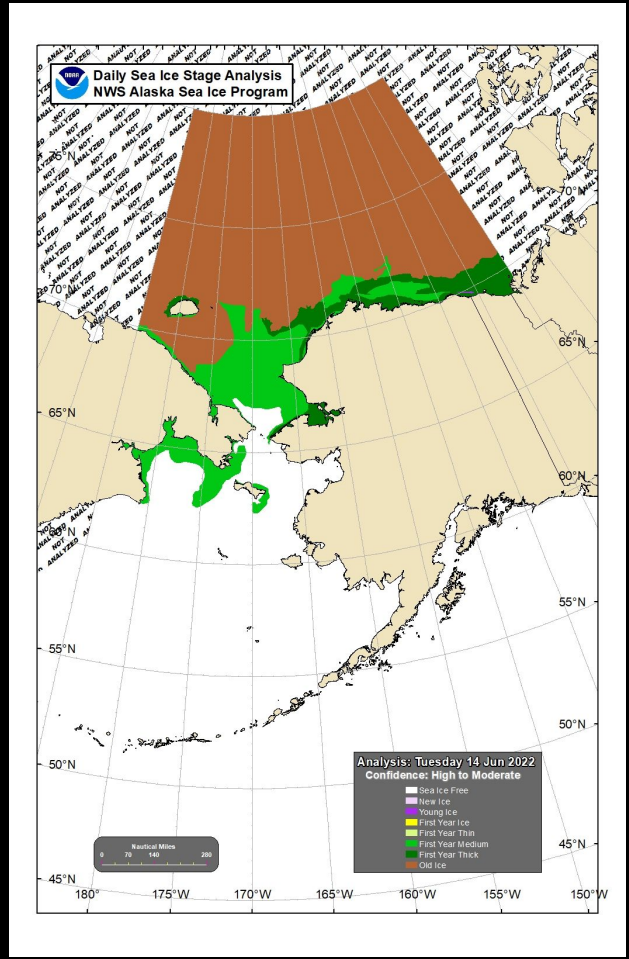
June 29, 2022

7 Day Operations
NWS Ice Desk Products

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Sea Ice Analysis	Sea Ice Analysis	Sea Ice Analysis	Sea Ice Analysis	Sea Ice Analysis	Sea Ice Analysis	Sea Ice Analysis
SST Analysis	SST Analysis	SST Analysis	SST Analysis	SST Analysis	SST Analysis	SST Analysis
	5 Day Sea Ice Forecast		5 Day Sea Ice Forecast		5 Day Sea Ice Forecast	
				Monthly Sea Ice Outlook 4th Thursday of the Month		

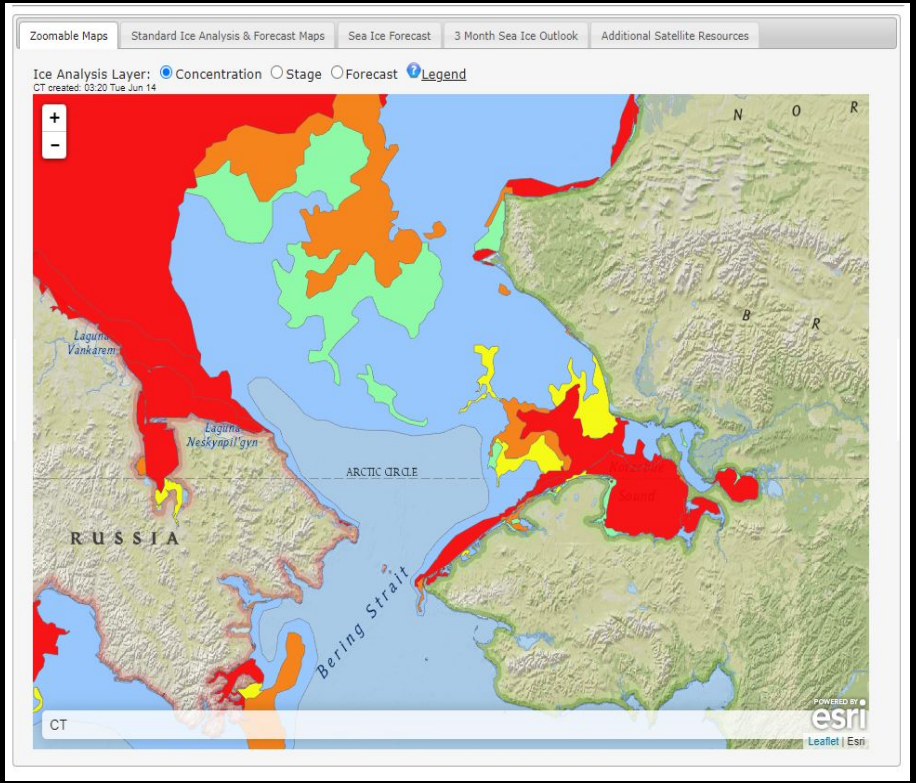
Sea Ice Analysis



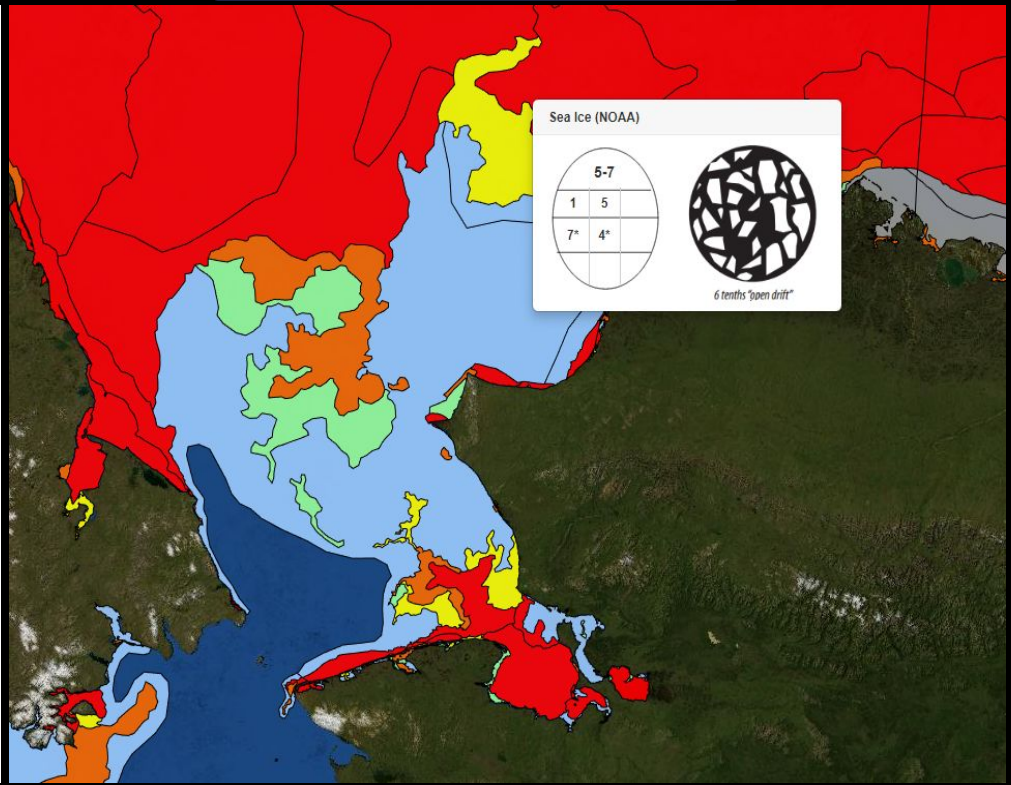


Sea Ice Analysis

NWS Webpage



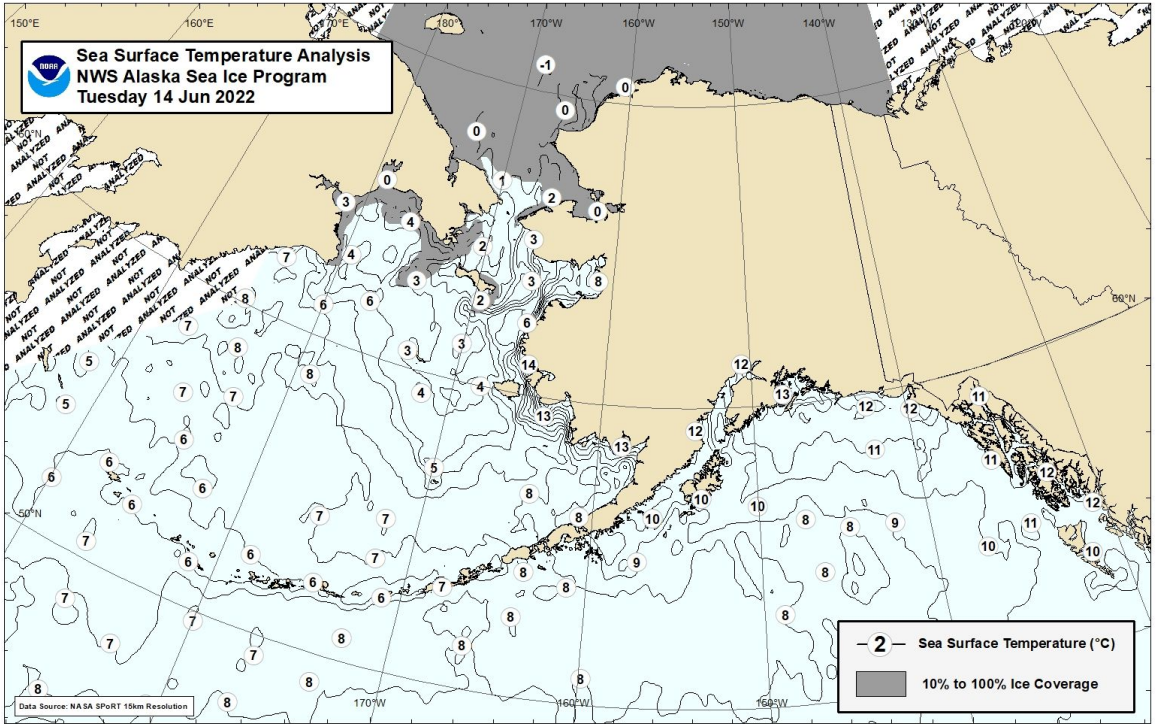
Alaska Ocean Observing System



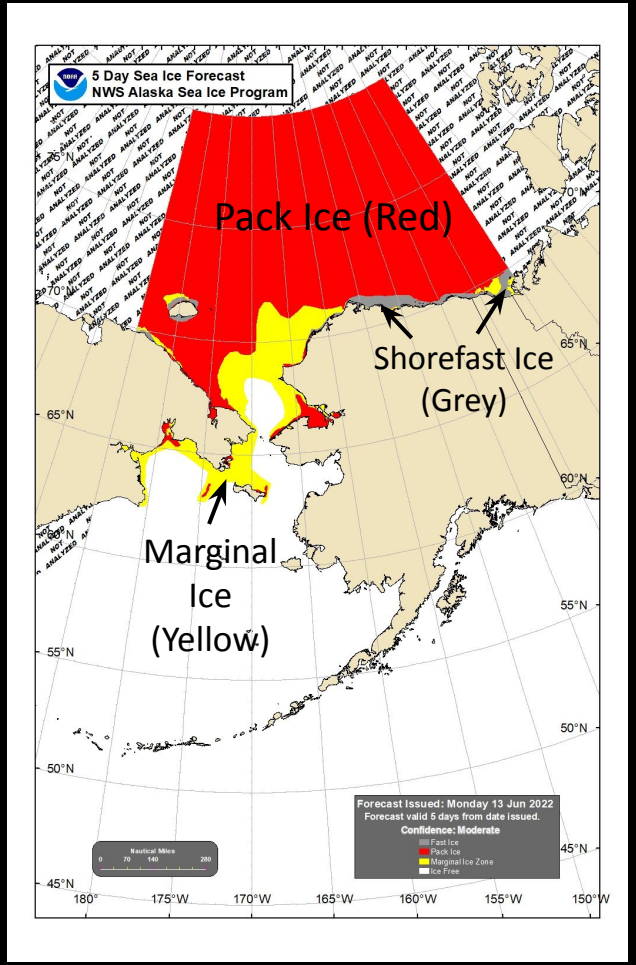
Sea Surface Temperature Analysis

NASA SPoRT SST data (15km resolution) via ftp

- **Run a script in ArcMap to create SST Products**
  - Takes just a few seconds!
  - Black & White SST contour map
  - GIS shapefile of the SST analysis
  - AWIPS SST grid contours



Sea Ice Advisory & Forecast



Sea Ice Advisory & Forecast

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FZAK80 PAFC 152318
ICEAFC

Sea Ice Forecast for Western and Arctic Alaskan Coastal Waters
National Weather Service Anchorage Alaska
318 PM AKDT Wednesday 15 June 2022

FORECAST VALID...Monday 20 June 2022

ANALYSIS CONFIDENCE...High.

SYNOPSIS...A low will move north through the Chukchi Sea into the
high Arctic through Saturday as high pressure moves off to the east.
High pressure will reestablish over the southern Beaufort Sea Sunday
and Monday.


-Beaufort Sea-
-Chukchi Sea-

PKZ235-Point Franklin to Cape Halkett-
PKZ240-Cape Halkett to Flaxman Island-
PKZ245-Flaxman Island to Demarcation Point-
PKZ505-Central U.S. Arctic Offshore-
PKZ510-Eastern U.S. Arctic Offshore-

Ice covered.

-Chukchi Sea-
-Bering Sea-

PKZ210-Dall Point to Wales-
PKZ215-Kotzebue Sound-
PKZ220-Wales to Cape Thompson-
PKZ225-Cape Thompson to Cape Beaufort-
PKZ230-Cape Beaufort to Point Franklin-
PKZ500-Western U.S. Arctic Offshore-

The main ice edge extends from near Wales to 66 31'N 166 4'W to 67
6'N 166 27'W to 68 45'N 173 24'W to 66 8'N 169 39'W. There are also
areas of sea ice along the northeast and east sides of Saint
Lawrence Island, to the northwest of Saint Lawrence Island, and to
the southwest of Saint Lawrence Island.

From land-based points in Alaska, the main ice edge extends from
near Wales to 20 nm northeast of Shishmaref to 63 nm north of
Shishmaref to 200 nm northwest of Diomede to 29 nm northwest of
Diomede. There are also areas of sea ice along the northeast and
east sides of Saint Lawrence Island, to the northwest of Saint
Lawrence Island, and to the southwest of Saint Lawrence Island.

FORECAST FOR THE BERING SEA (Days 1 through 5)...Southerly winds
will persist through Friday, so expect sea ice to drift northward and
spread out as well as gradually melt during that time. Saturday
through Monday winds will be light and variable so sea ice will move
with local currents and continue to melt.

FORECAST FOR THE CHUKCHI SEA (Days 1 through 5)...Southerly winds
through Friday will allow sea ice to continue drifting northward.
Generally light and variable winds will then persist through Monday,
allowing sea ice to move with local currents as it continues to
gradually melt. Shorefast ice will continue to break off at times
through the forecast period.

&&
Schreck
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Analysis Confidence

Brief Wx Synopsis

Ice Covered Marine Zones

Ice Edge Marine Zones

Description of Ice Edge position & ice type/concentration

5 Day Ice Edge forecast

FZAK30 PAFC 262141
ICOAFC

Sea Ice Outlook for Western and Arctic Alaskan Coastal Waters
National Weather Service Anchorage Alaska
141 PM AKDT Thursday 26 May 2022

...MAY 2022 MONTHLY SEA ICE OUTLOOK…

The past few weeks have seen a significant decrease in sea ice throughout the Bering Sea and just north of the Bering Strait into the southern Chukchi Sea. After the most significant ice pack in nearly a decade into April, the drastic retreat in the past month has resulted in much less ice coverage than is common in late May in the Bering Sea.

As we look forward through break-up in August, we expect that break-up will continue to be faster than initially forecasted. While La Nina is expected to continue through Northern Hemisphere summer, it will likely weaken a bit during that time before strengthening again late this year.

Detailed information can be found in each pertinent section below.

…BREAK-UP OUTLOOK FOR THE BERING SEA…

Coastal waters from Kwikpak to Unalakleet are expected to be sea ice free for the season by the end of May.

Sea ice concentrations within Norton Bay will decrease to 3 tenths then be sea ice free by the end of May or first week of June.

For Golovin Bay, sea ice is expected to reach 3 tenths concentration during the last week of May and is expected to become sea ice free by the end of May.

For the Nome area from Port Safety to Cape Rodney, the only remaining sea ice is near Cape Rodney and within Safety Sound. This remaining sea ice will likely be completely melted by the end of May.

Norton Sound is expected to become sea ice free for the season during the first week of June.

For the Port Clarence area, 3 tenths coverage is expected during the second week of June. Ice free conditions are expected during the second or 3rd week of June.

The Bering Sea south of St. Lawrence Island is expected to be ice free around the middle of June.

For 20 nm N/S of Center Line, ice free conditions are expected during the third week of June.

The Bering Sea is expected to be ice free during the first or second week of July, though much of Alaska waters will likely be sea ice free by the 3rd week of June.

…BREAK-UP OUTLOOK FOR THE CHUKCHI SEA…

Sea ice is expected to no longer be shorefast along the coast from Wales to Espenberg by the end of May. Three tenths coverage is expected around the middle of June. Ice free conditions are expected by the end of June.

For Kotzebue Sound, ice is expected to no longer be shorefast during the first week of June. Three tenths coverage is expected during the fourth week of June, and sea ice free conditions by the end of June.

Monthly Outlook

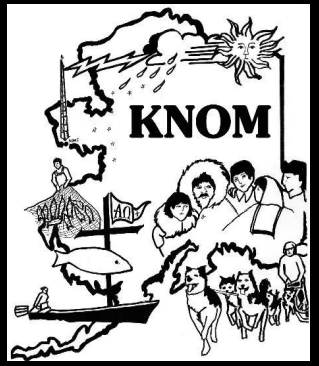
- Broken into coastal segments
- Looks out three months
- Focus on ice free, three tenths, seven tenths coverage

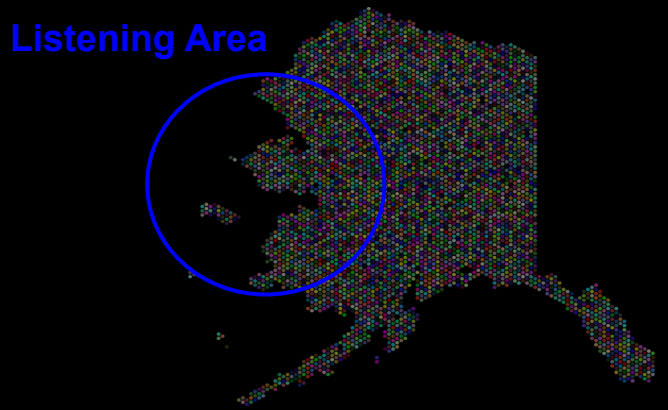
Sea Ice Outlook

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cook Inlet		◆	◆	◆	◆	◆	◆					
Bering Sea		◆	◆	◆	◆	◆	◆	◆	◆			
Crab Fishery		◆	◆	◆	◆	◆	◆	◆				
Cod Fishery		◆	◆									
Herring Fishery							◆	◆				
Subsistence Hunting					◆	◆	◆	◆	◆	◆	◆	
Kuskokwim Bay	◆	◆					◆	◆				
West Coast Re-supply	◆							◆	◆	◆	◆	◆
Yukon River	◆							◆	◆			
Norton Sound Fish/Supply								◆	◆			
St. Lawrence Subsistence						◆	◆	◆	◆			
Kivalina – Red Dog Mine	◆	◆							◆	◆		
Chukchi Sea – Subsistence							◆	◆	◆	◆	◆	
Chukchi Sea – Commercial	◆	◆								◆	◆	◆
North Coast Supply/Crossing	◆	◆							◆	◆	◆	◆
Tourism & Recreation	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

KNOM Radio Sea Ice Briefings

- Listening area extends from Kotzebue to Yukon-Kuskokwim Valley to Saint Lawrence Island and points within
- ASIP Provides sea ice briefings to KNOM on Mondays, Wednesdays, and Fridays



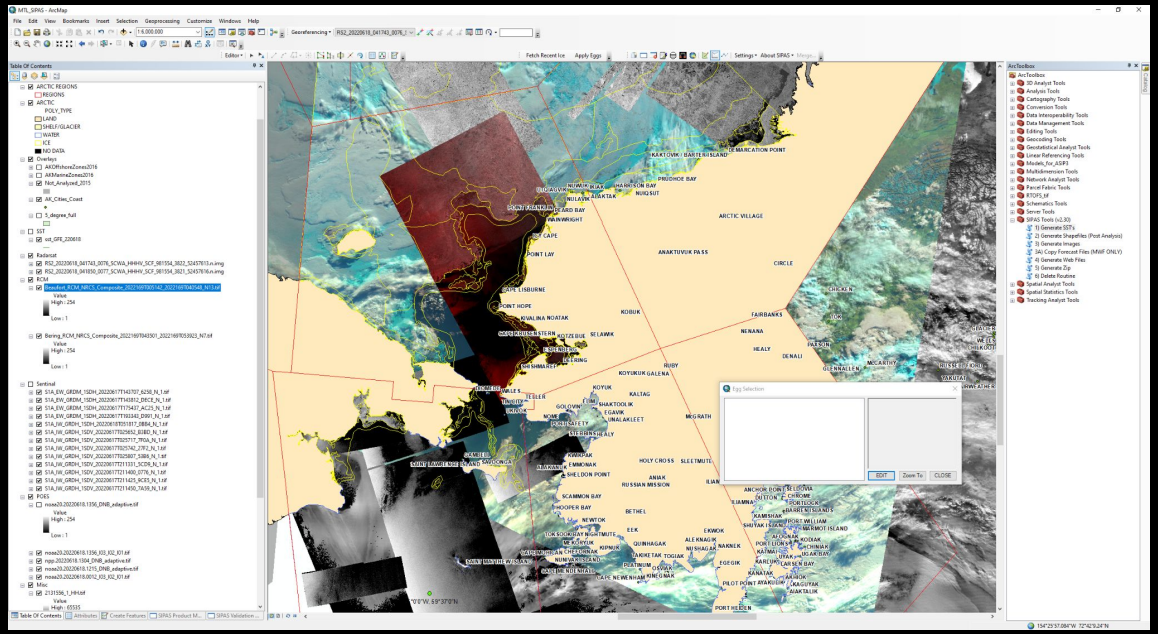


NWS Mission

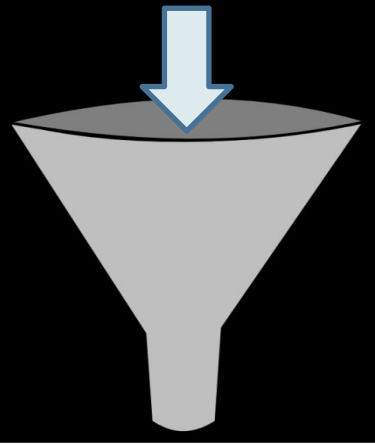
Provide weather, water and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy.

Sea Ice Analysis

Sea Ice Analysis in ArcMap 10.6 /10.7



All Data



ArcMap/SIPAS
Sea Ice Analysis

Sea Ice Analysis – Gathering Satellite Data

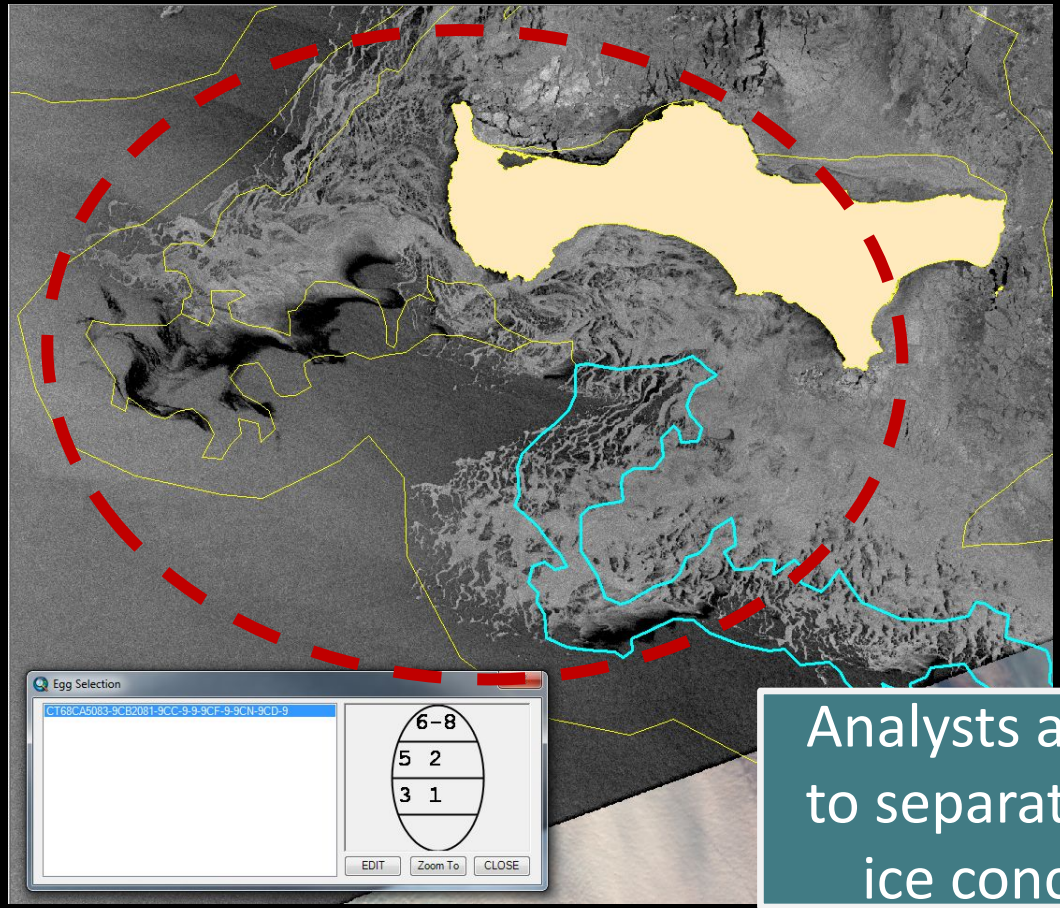
Primary Data Sources

- Synthetic Aperture Radar
  - Radarsat-2/Radarsat Constellation Mission via USNIC/Canadian gov't
  - Sentinel-1 via NESDIS/Polarview
- SNPP/NOAA-20 VIIRS via Geographic Information Network of Alaska (GINA) and NASA Worldview
- AMSR2 via GINA

Additional Data Sources

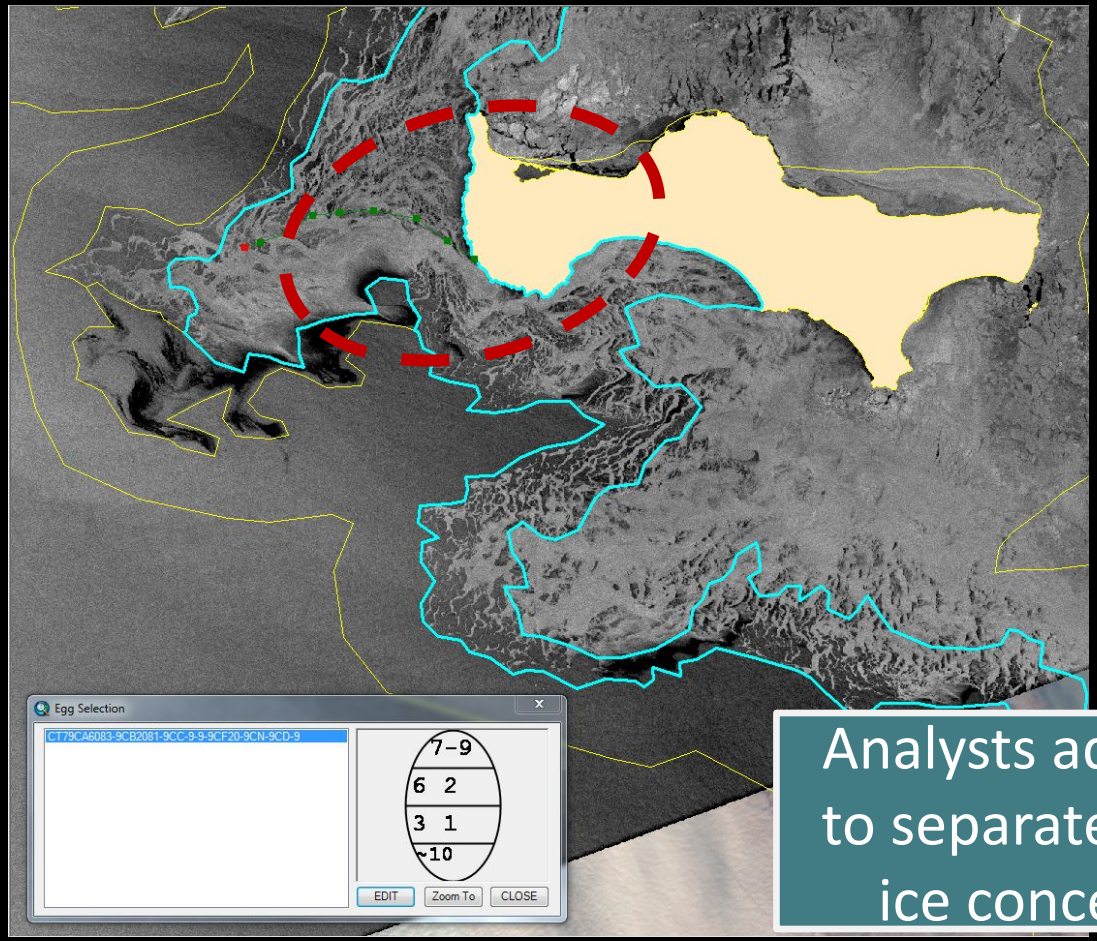
- USCG Healy & other vessel observations
- Barrow sea ice webcam & radar
- Canadian Ice Service graphical ice analysis (seasonal)
- Seasonal field research work observations

Working on the Sea Ice Analysis



Analysts adjust polygon shapes to separate regions of different ice concentration and type

Working on the Sea Ice Analysis



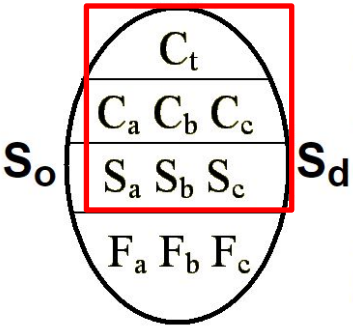
Analysts adjust polygon shapes to separate regions of different ice concentration and type

Decoding Ice Concentration & Type

- Ice areas are characterized by:
  - Concentration (in tenths)
  - Stage (Thickness)
  - Form (Strips, Shorefast, etc.)

ICE CHART SYMBOLOGY

The World Meteorology Organization (WMO) system for sea ice symbology is more frequently referred to as the "Egg Code" due to the oval shape of the symbol.



C_t - Total concentration of ice in area, reported in tenths. May be expressed as a single number or as a range, not to exceed two tenths (3-5, 5-7 etc.)

$C_a\ C_b\ C_c$ - Partial concentration (C_a, C_b, C_c) are reported in tenths, as a single digit. These are reported in order of decreasing thickness. C_a is the concentration of the thickest ice and C_c is the concentration of the thinnest ice.

$S_a\ S_b\ S_c$ - Stages of development (S_a, S_b, S_c) are listed using the code shown in Table 1 below, in decreasing order of thickness. (NOTE: If there is a dot (.), all stages of development codes to the left of the dot (.) are assumed to carry the dot (.)) These codes correspond directly with the partial concentrations above. C_a is the concentration of stage S_a, C_b is the concentration of stage S_b, and C_c is the concentration of S_c.

$S_o\ S_d$ - Development stage (age) of remaining ice types. S_o if reported is a trace of ice type thicker/older than S_a, S_d is a thinner ice type which is reported when there are four or more ice thickness types.

$F_a\ F_b\ F_c$ - Predominant form of ice (floe size) corresponding to S_a, S_b and S_c respectively. Table 2 below shows the codes used to express this information.

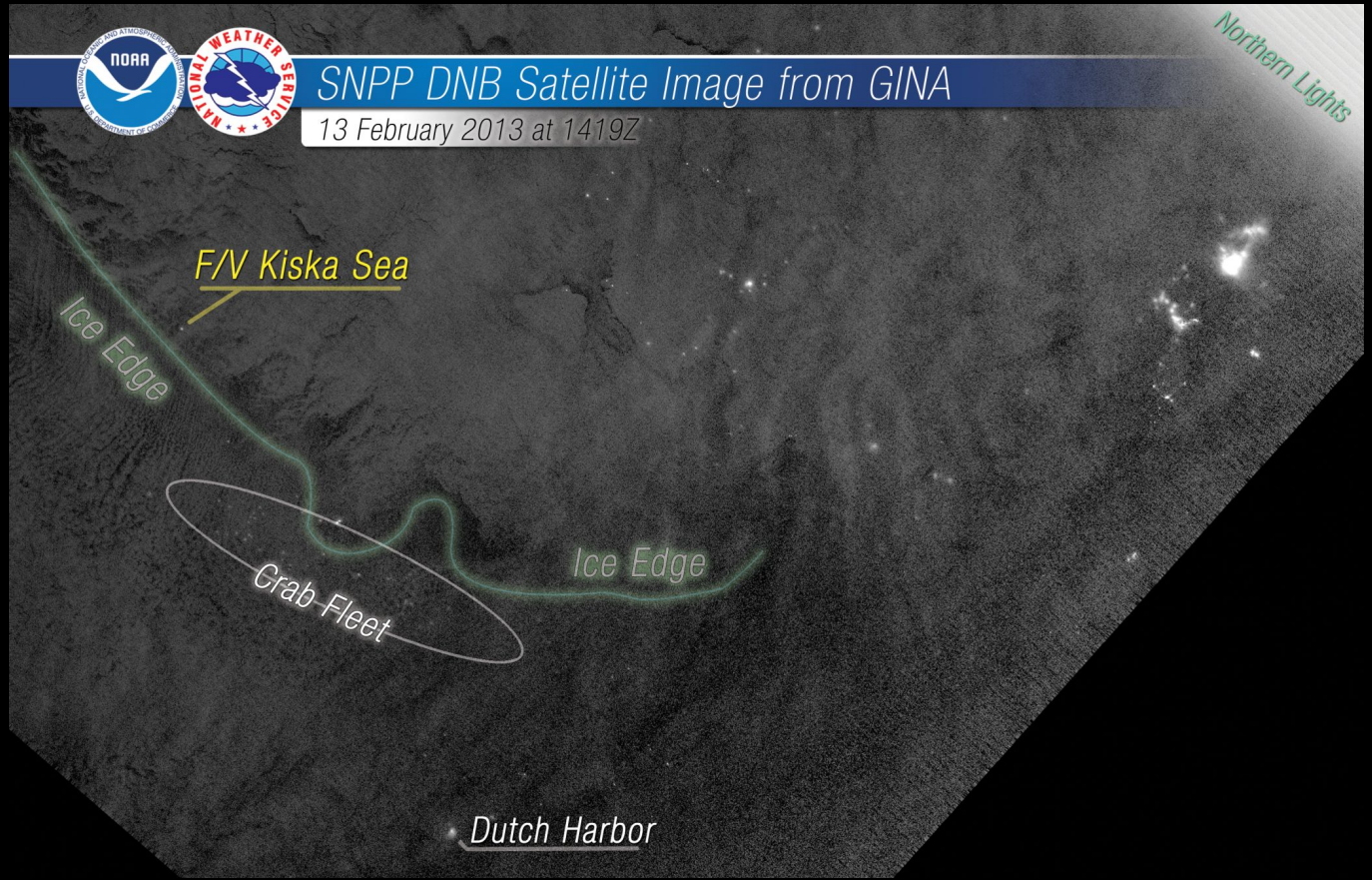
Table 1. Egg Codes for Stages of Ice Development (S_x Codes)

S= Stage of Development for Sea Ice	Code Figure	Stage of Development for Fresh Water Ice
New Ice-Frazil, Grease, Slush, Shuga (0-10 cm)	1	New Ice (0 - 5 cm)
Nilas, Ice Rind (0 - 10 cm)	2	
Young (10 - 30 cm)	3	
Gray (10 - 15 cm)	4	Thin Ice (5 - 15 cm)
Gray - White (15 - 30 cm)	5	Medium Ice (15 - 30 cm)
First Year (30 - 200 cm)	6	
First Year Thin (30 - 70 cm)	7	Thick Ice (30 - 70 cm)
First Year Thin - First Stage (30 - 70 cm)	8	First Stage Thick Ice (30 - 50 cm)
First Year Thin - Second Stage (30 - 70 cm)	9	Second Stage Thick Ice (50 - 70 cm)
Medium First Year (70 - 120 cm)	1.	Very Thick Ice (70 - 120 cm)
Thick First Year (>120 cm)	4.	
Old - Survived at least one season's melt (>2 m)	7.	
Second Year (>2 m)	8.	
Multi-Year (>2 m)	9.	
Ice of Land Origin	▲	

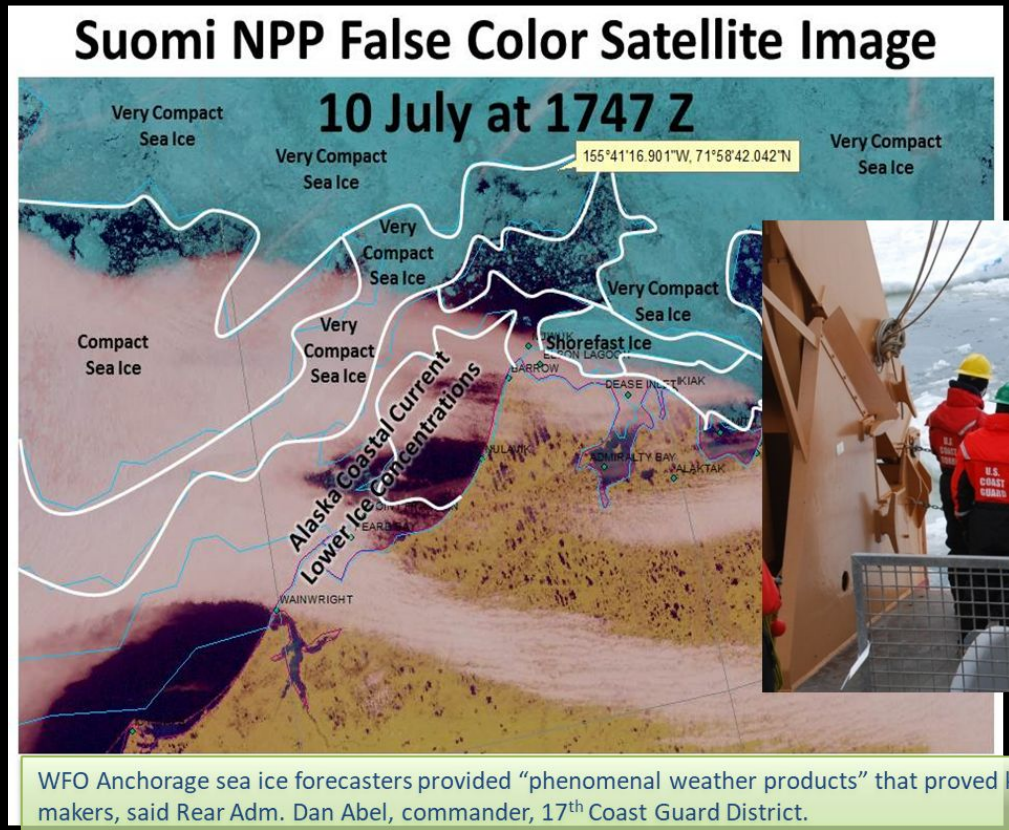
How does the ASIP use VIIRS to fulfill agency goals?

- VIIRS data is used in operations EVERYDAY
- Spring through Fall is Falsecolor(DayLandCloud) Season
  Winter is IR season
- Given a clear scene as an analyst I will default to VIIRS over SAR nearly every time due to recency
- While we can share SAR data, standard vis/IR is much more easily explained to the public
- Even with expanded SAR coverage (RCM) best practice is to validate an image against a different source

SNPP Imagery Example



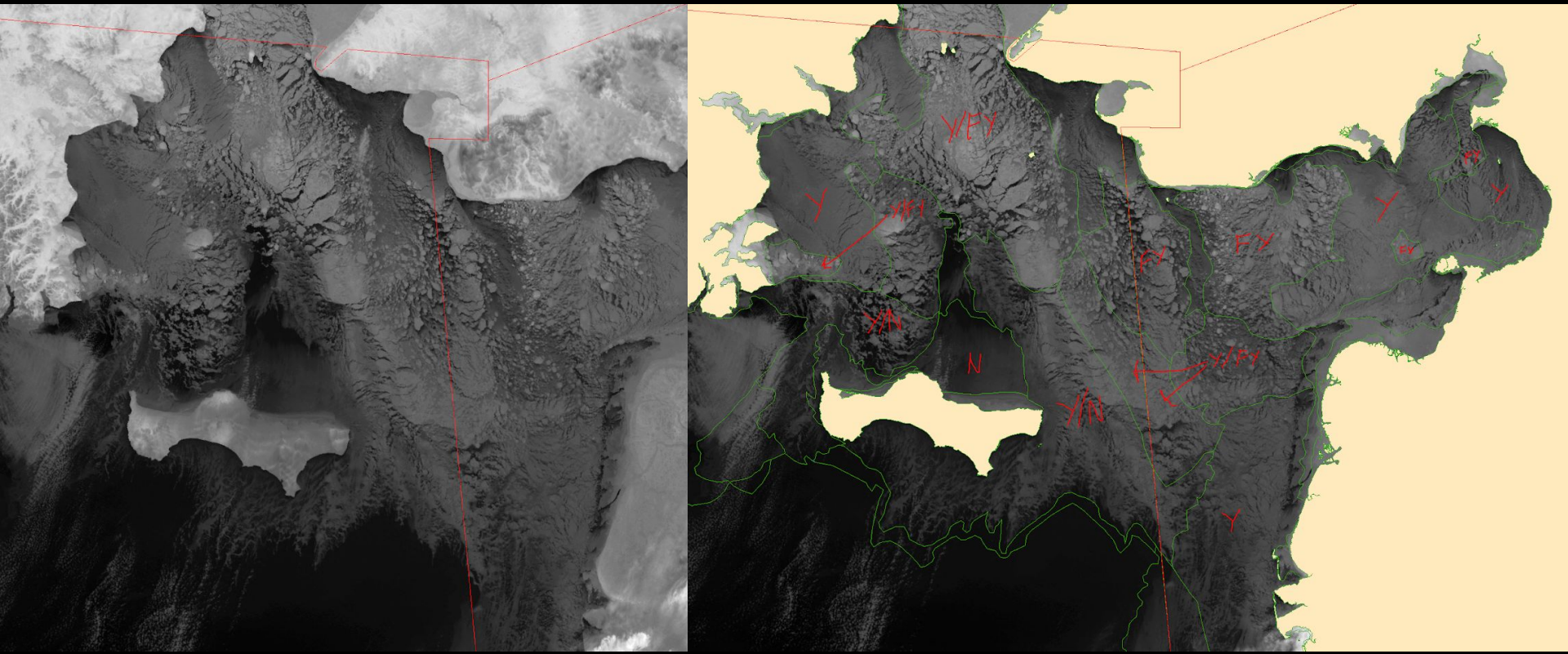
NWS Alaska Region Ice Services



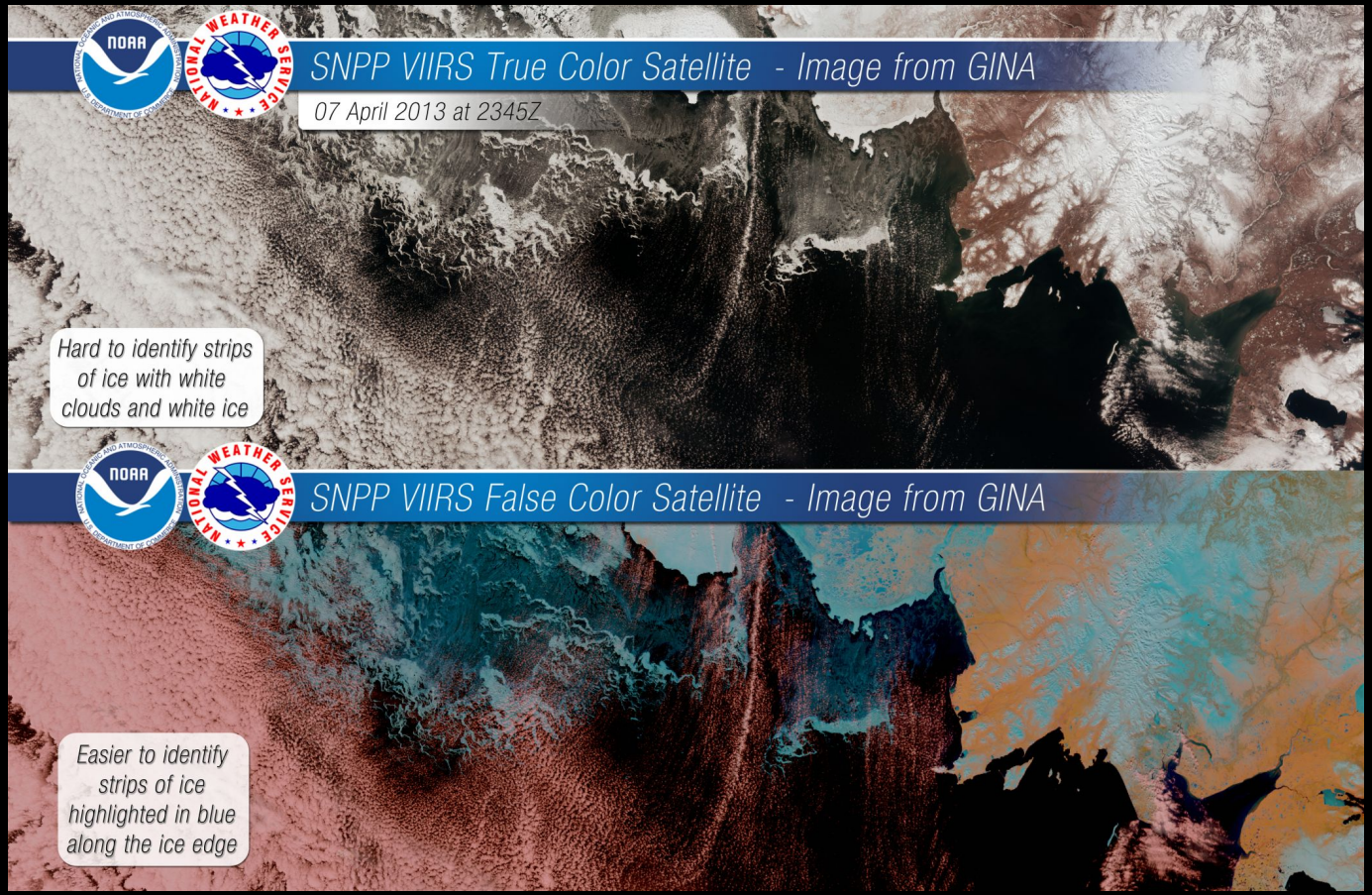
USCG rescues sailboat trapped in ice

WFO Anchorage sea ice forecasters provided "phenomenal weather products" that proved key to USCG decision makers, said Rear Adm. Dan Abel, commander, 17th Coast Guard District.

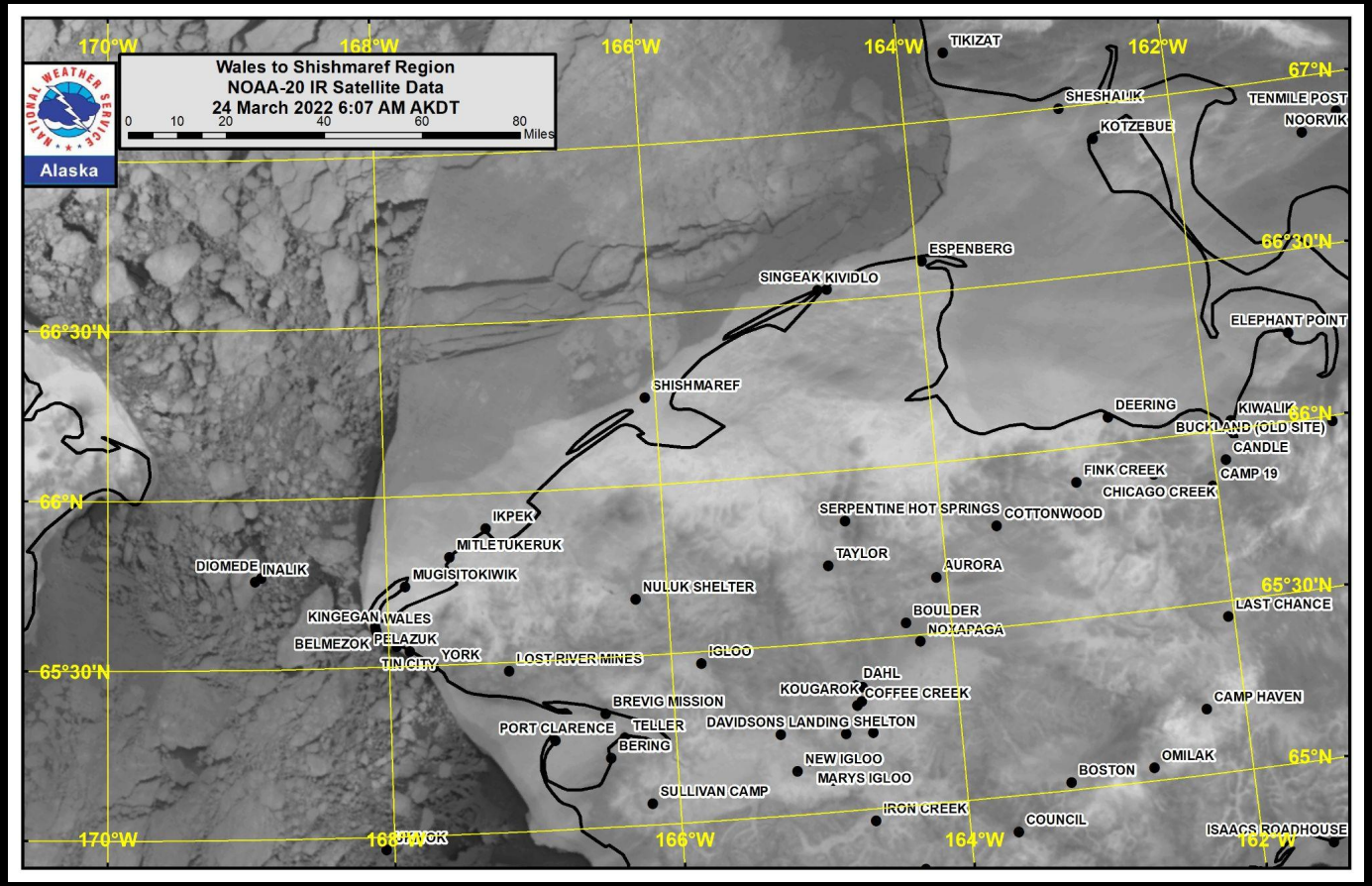
VIIRS in daily operations



SNPP Imagery Example



Sea Ice for Walrus Outlook (SIWO)

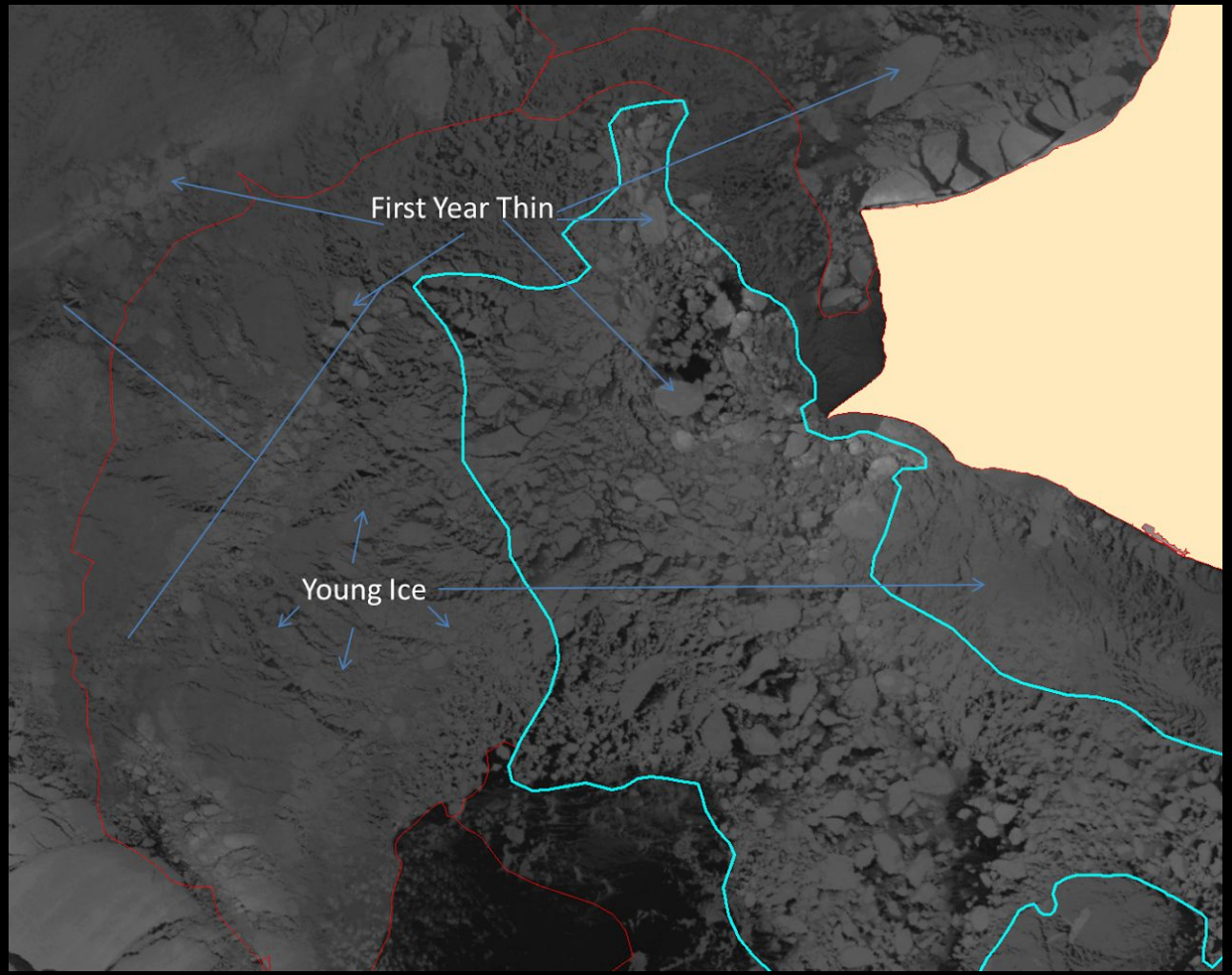


Sea Ice for Walrus Outlook

No shorefast ice is left around St. Lawrence Island. There is an area of compacted ice against the coast between Gambell and Savoonga up to 1.3 miles (0.5 km) offshore with mostly open water beyond. An area of close pack ice sits 20 miles (32 km) northwest of Gambell as well as 45 miles (72 km) southwest of Gambell. Waters around Savoonga are open, with two small areas of close pack ice 15 miles (24 km) to the north and 25 miles (40 km) to the northeast. There remains a large area of compacted ice between Ataakas Camp and Camp Kulowiye that extends up to 22 miles (35 km) offshore. Beyond is open water. An area of close pack ice is streaming off the compact ice 5 miles (8 km) off the east side of the island. Sea ice free conditions exist on the south side of the island. Most remaining ice in the area appears to be brash ice to ice cakes with very few small to medium floes left.

Internal training and discussion

Standard channels (vis/IR) provide imagery consistency that SAR does not

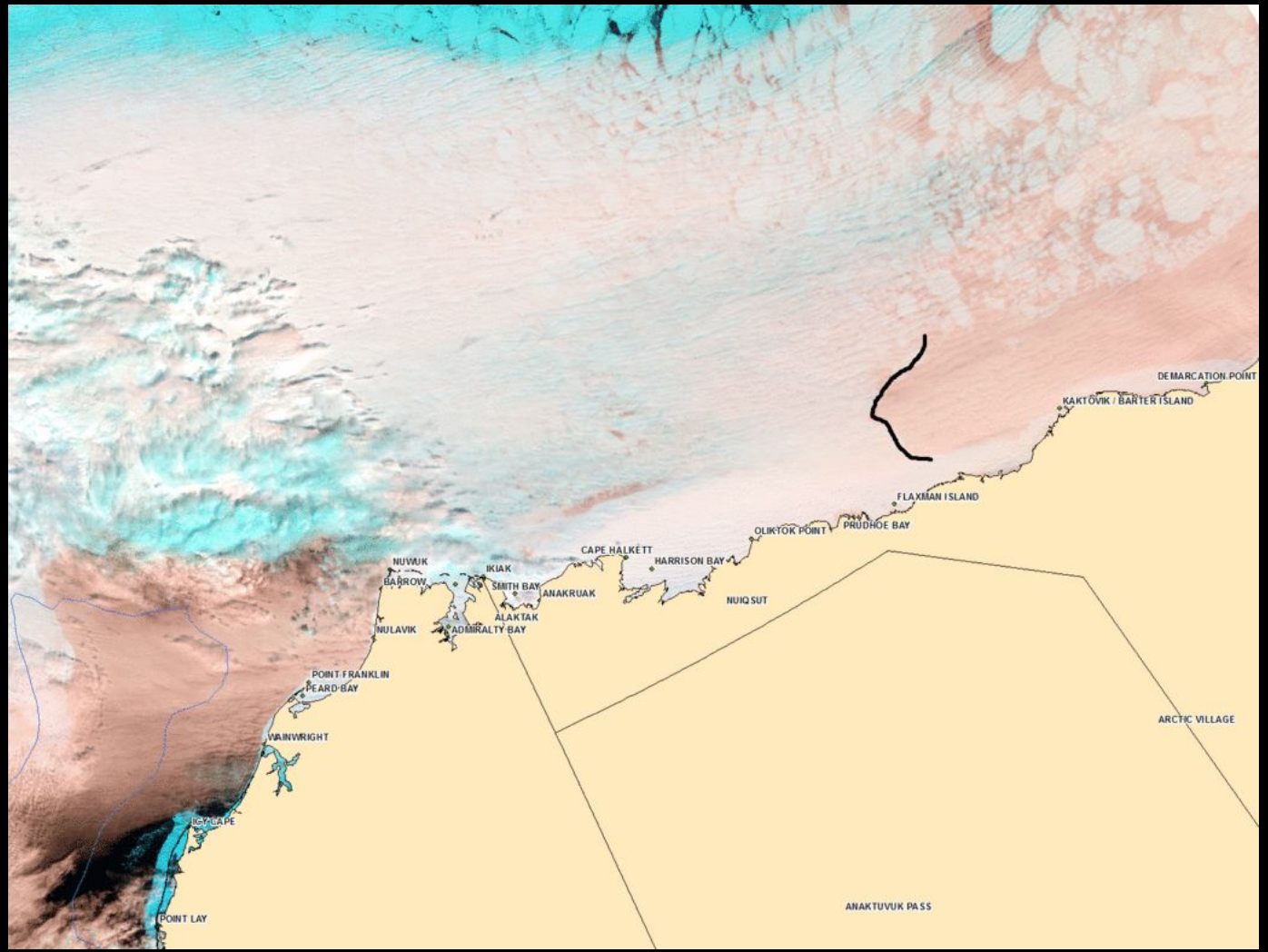


5 hour VIS loop

Identification of shear zone between shorefast ice and pack ice, including shorefast fracture/break-off.

At 70N, looping can be utilized

Tracking the breakup front from the Mackenzie River Delta. The loop was used in a social media post



Alaska Sea Ice Program (ASIP) DSS

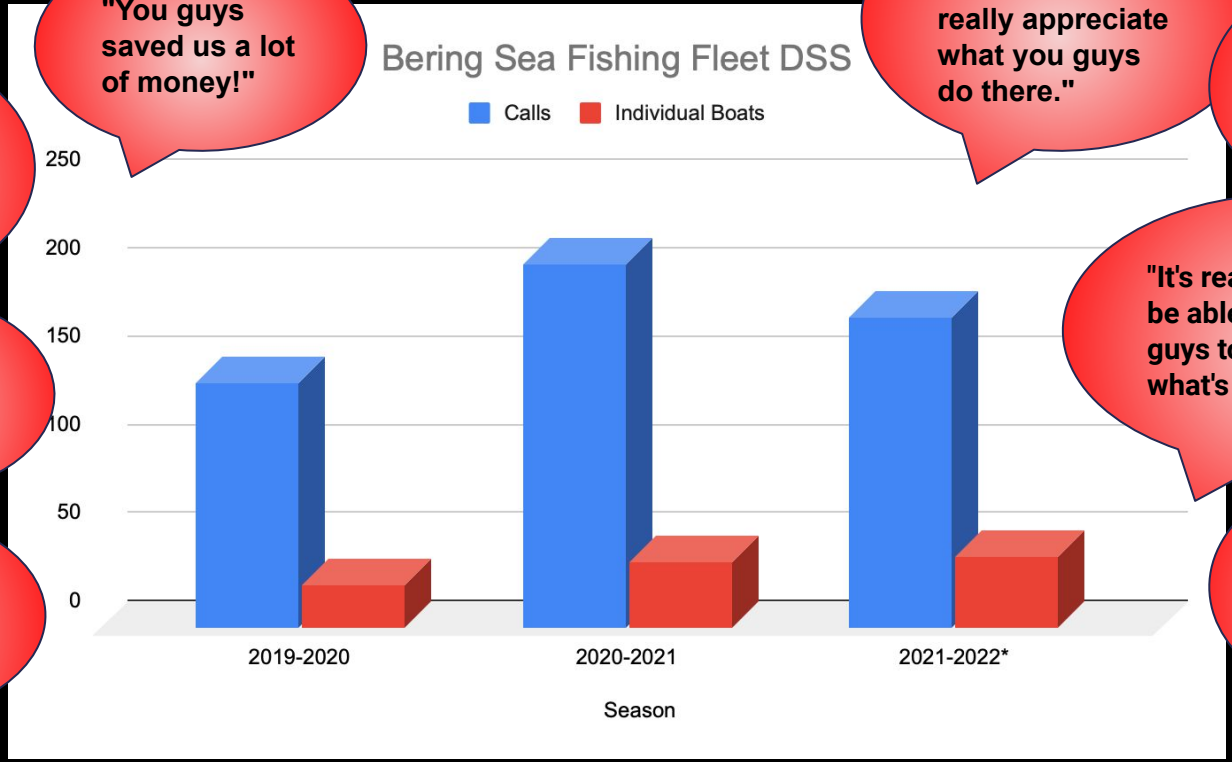
Bering Sea Crab Fleet

"You guys saved us a lot of money!"

"We appreciate the work you guys do to help us make decisions out here."

"First time caller, will definitely call you folks in the future."

"You guys are god sends to us out here! I really appreciate your help."



"Thanks for taking the time, really appreciate what you guys do there."

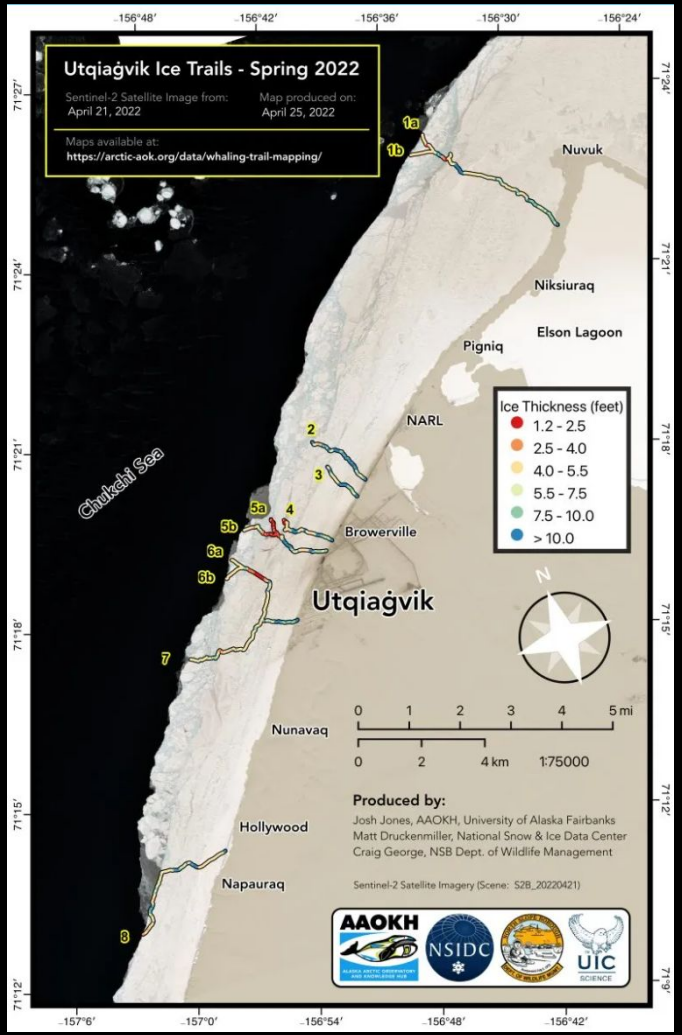
"Your website is our favorite bookmark here. You all do a great job!"

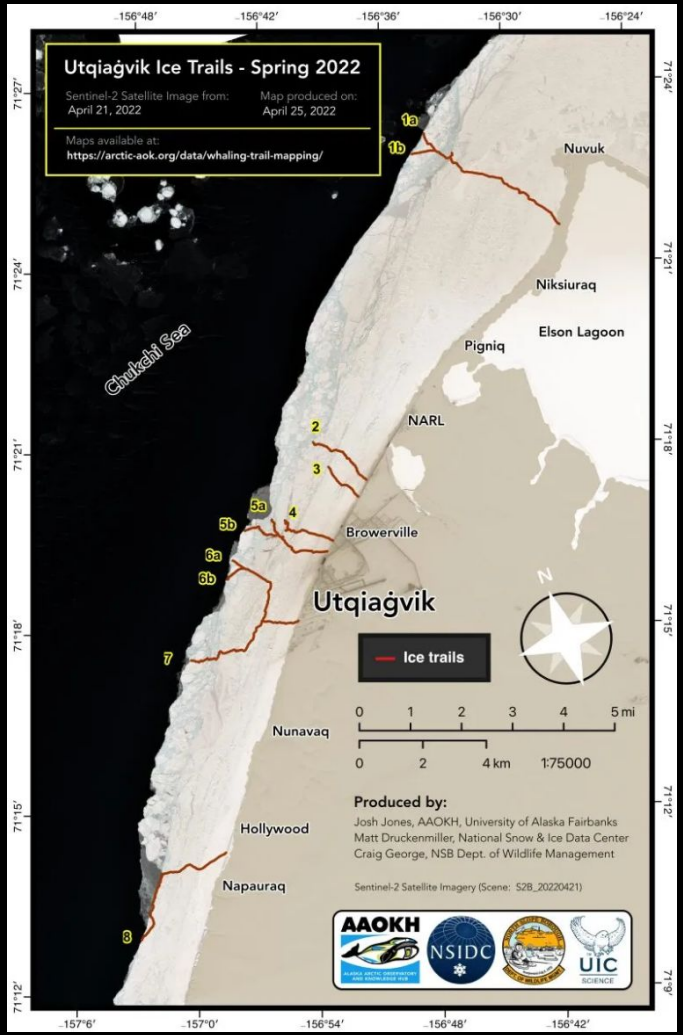
"It's really helpful to be able to talk to you guys to get an idea of what's going on."

"You guys are GREAT. It's a big deal, the information you provide us!"

Increased resolution can help in local scale decision support. Can we product maps like this for public safety (coastal communities), or commerce (crab/fishing fleet)?

Credit:
Alaska Arctic Observatory & Knowledge Hub





Needs for next generation

- Increased resolution never goes out of style. With each successive increase in resolution we see things that we did not notice previously
- More temporal frequency will generate more useful scenes
- Ice related RGB composites? Are there wavelengths that will tease out more details within ice?

Thank you! Questions?

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