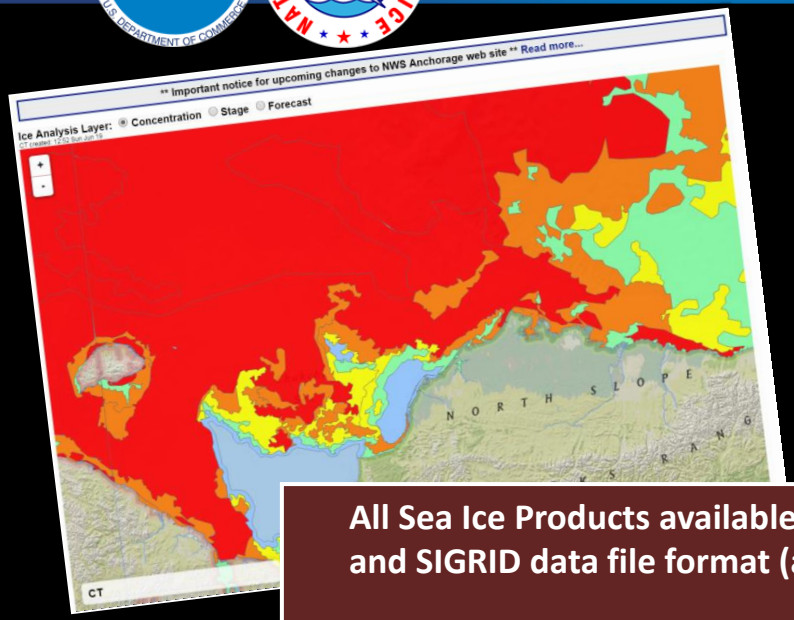
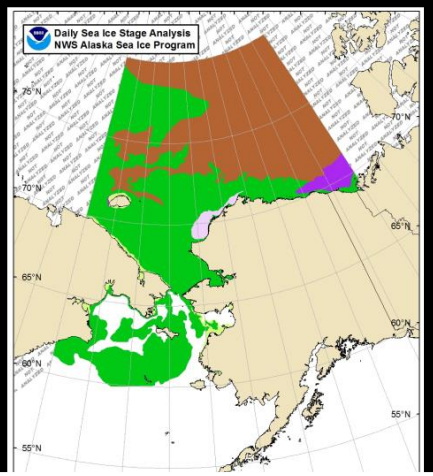
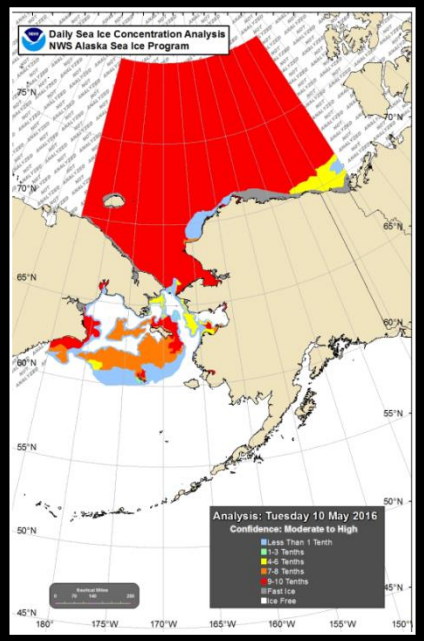
NWS Alaska Sea Ice Program (ASIP)

Evaluation of JPSS VIIRS and AMSR-2 Ice Products

Products – Issued Daily







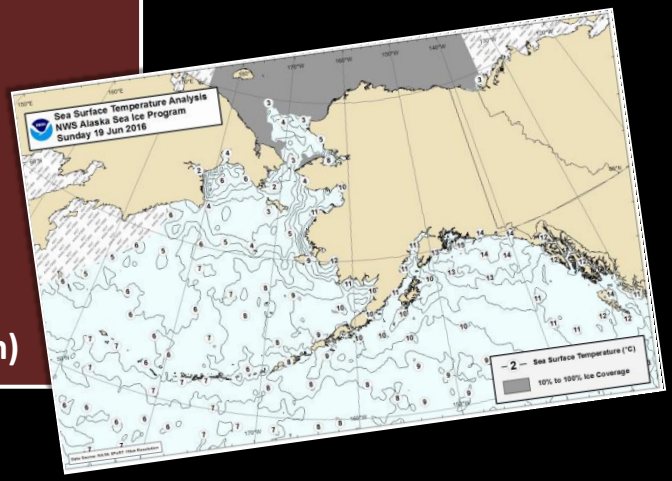
All Sea Ice Products available in WMO Standard color mapping and SIGRID data file format (as of Oct 2015)

Daily Sea Ice Products

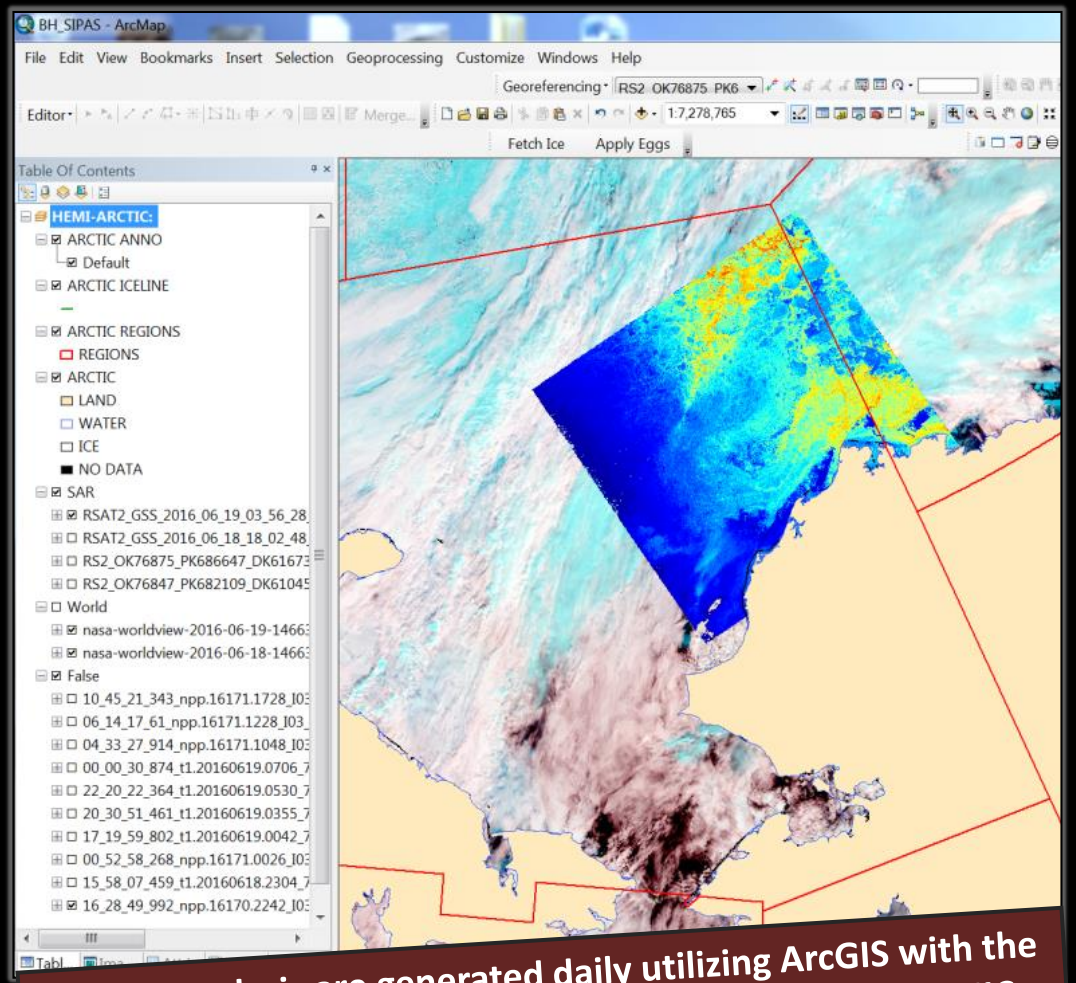
- Sea Ice Concentration Analysis Map
- Sea Ice Stage Analysis Map
- SIGRID shapefiles
- KMZ data files
- ESRI interactive map display (Concentration/Stage/Forecast)

Daily Sea Surface Temperature Maps

- Utilizing NASA SPoRT dataset (15km resolution)



Operations – Resources



Sea Ice Analysis are generated daily utilizing ArcGIS with the SIPAS application – Generously shared with us by the NIC

Primary Satellite Resources:

- RadarSAT2
- Sentinel-1a & Sentinel-1b
- Suomi NPP
  - Day-Night-Band
  - IR/Visible (True and False Color)
  - Obtained via GINA Puffin Feeder
- NASA Aqua & Terra
  - IR/Visible (True and False Color)
  - Obtained via NASA Worldview webpage & GINA Puffin Feeder

Sea Ice Forecasting Resources:

- Ice Analyst Experience & Knowledge
- ACNFS (soon to be GOFS 3.1)
  - Obtained via ftp with the NIC
- Weather Models in AWIPS
- Understanding of Local Currents and Bathymetry
- Buoy data and local observations
- MMAB Drift Model
- Seasonal Experimental Models:
  - ESRL-RASM
  - COAMPS
- Future: NGGPS

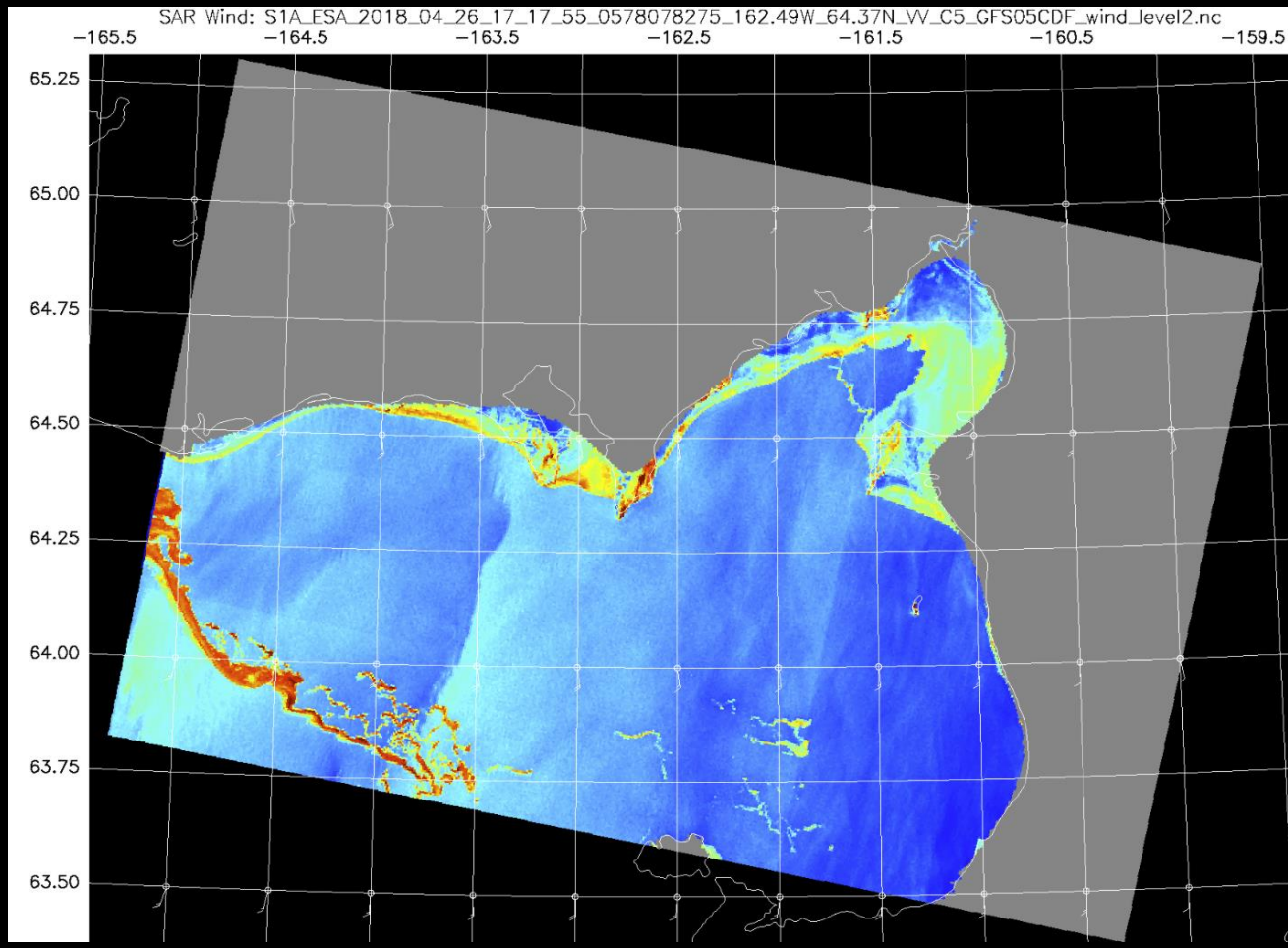
Synthetic Aperture Radar

Strengths:

- Highest resolution imagery
- Can see through clouds
- Best at sensing new ice
- Both color/B&W images

Limitations:

- Poor spatial/temporal coverage
- Individual floes within the pack become masked
- Wind/cloud “contamination”
- Degradation near swath edge



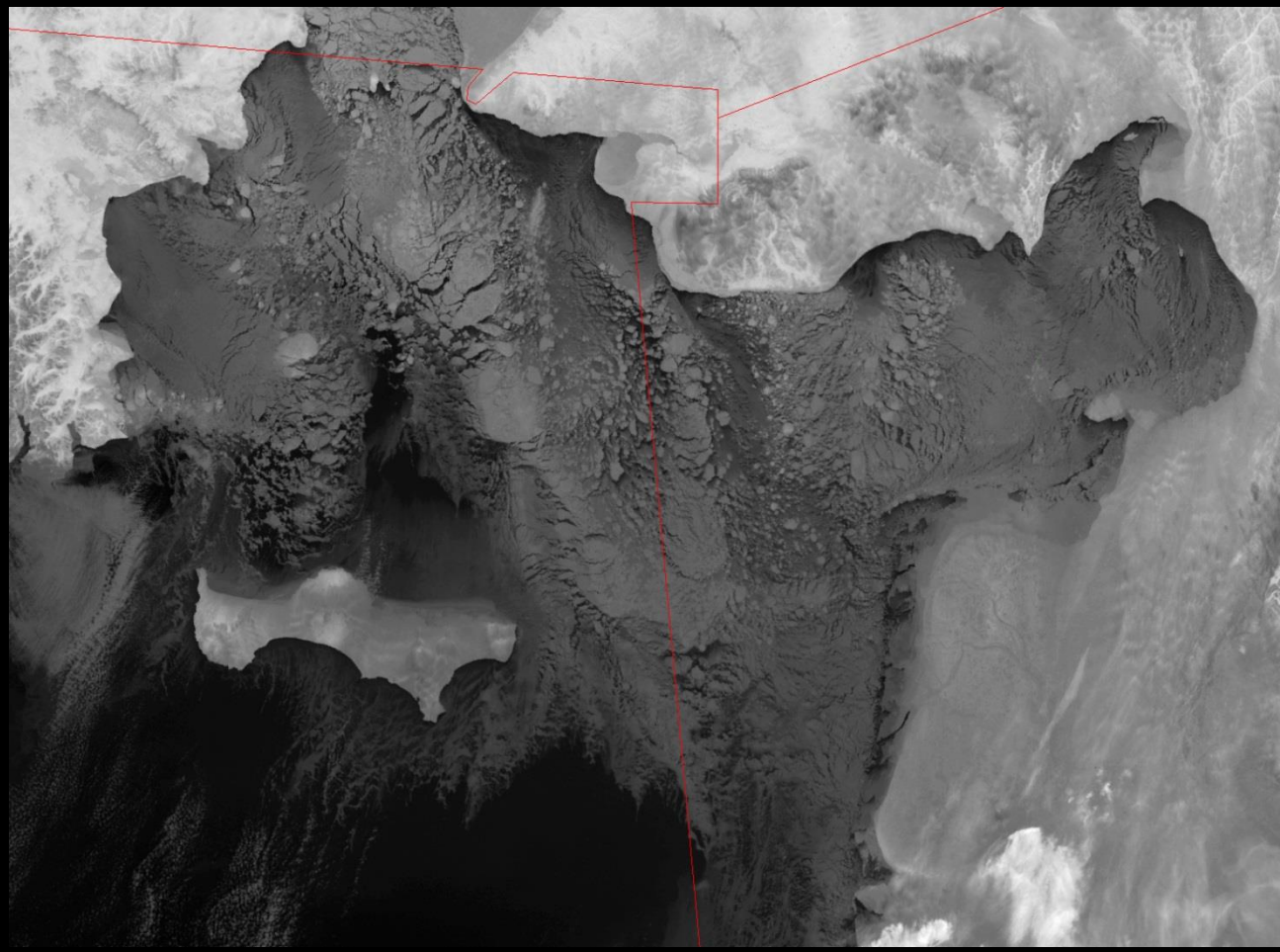
Longwave Infrared

Strengths:

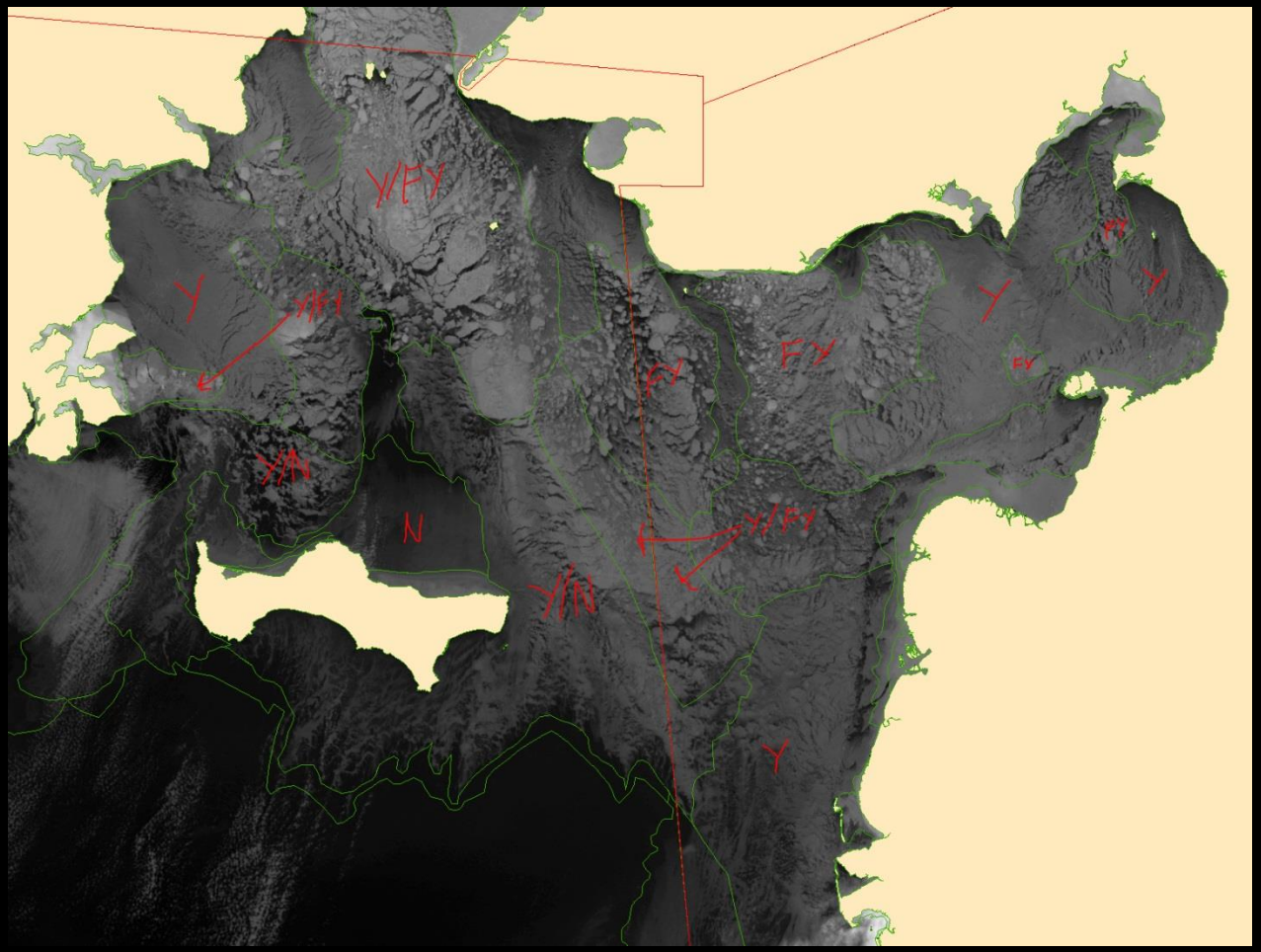
- Older/colder ice easily identifiable
- Nighttime use
- Resolution
- Increasing usefulness in winter

Limitations:

- Cloud cover
- Unable to detect new ice



Longwave Infrared



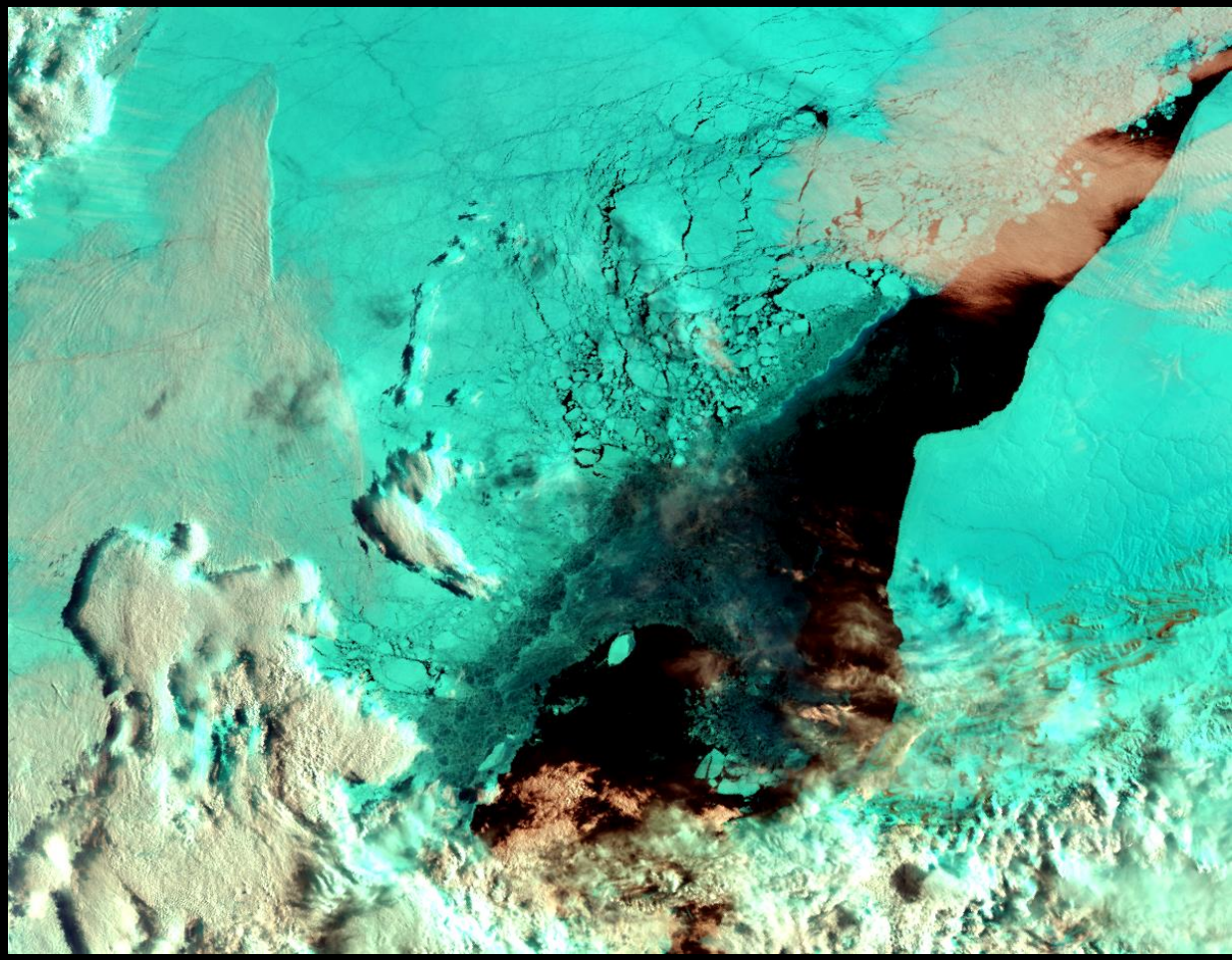
False color

Strengths:

- Ice contrasts vs. clouds in partly cloudy scenes
- Can make ice visible through thin clouds

Weaknesses:

- Daytime only
- New ice
- Contrast only shows vs. water clouds
- Ice clouds will look similar to ice below
- Can't distinguish between ice/mudflats



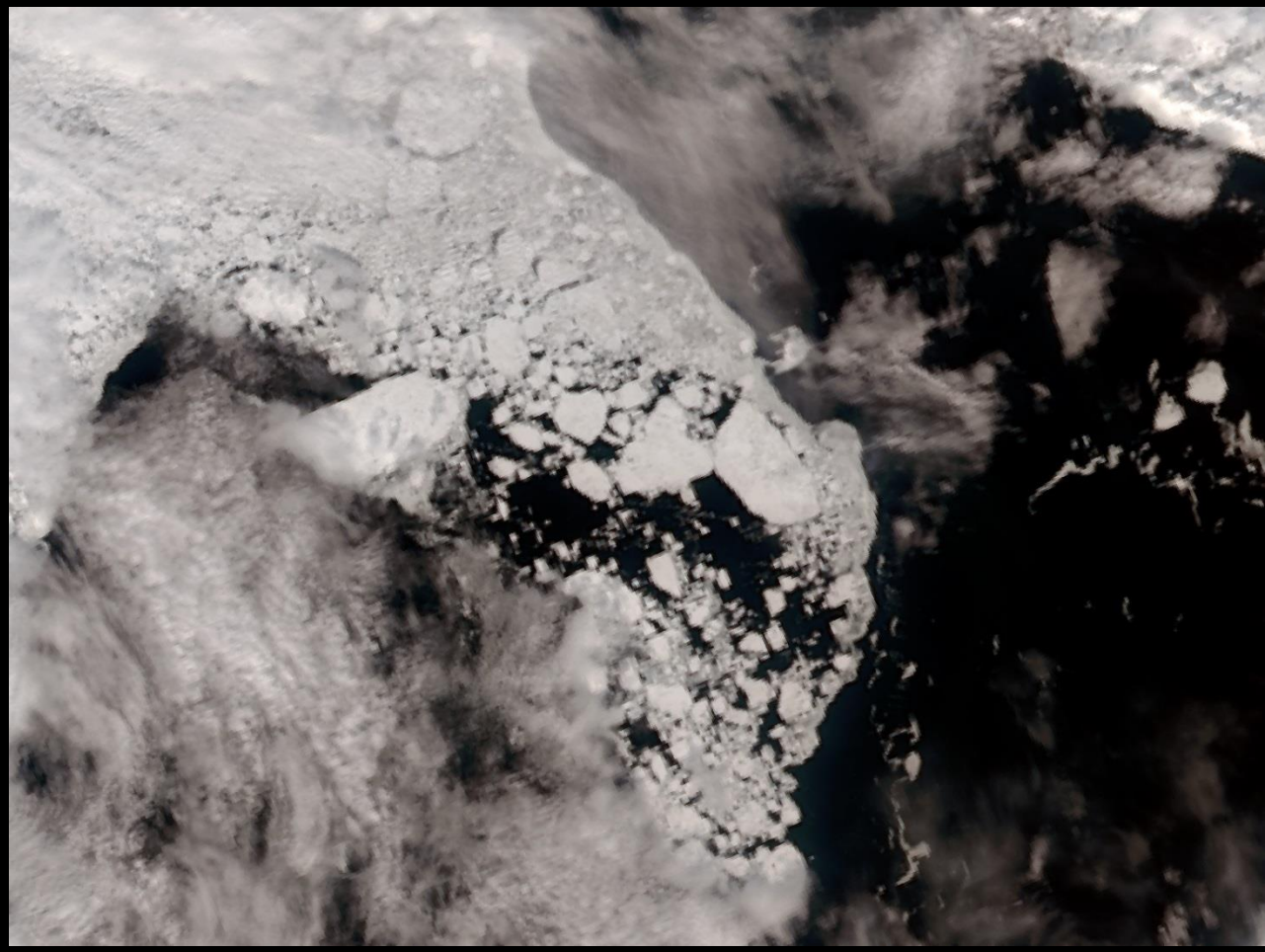
True color/visible

Strengths:

- Concentration and floe size easily identifiable
- Resolution
- Can ID mudflats vs ice if not ice/snow covered

Limitations:

- Daytime only
- Cloud cover
- Hard to distinguish ice from cloud in partly cloudy scenes
- New ice



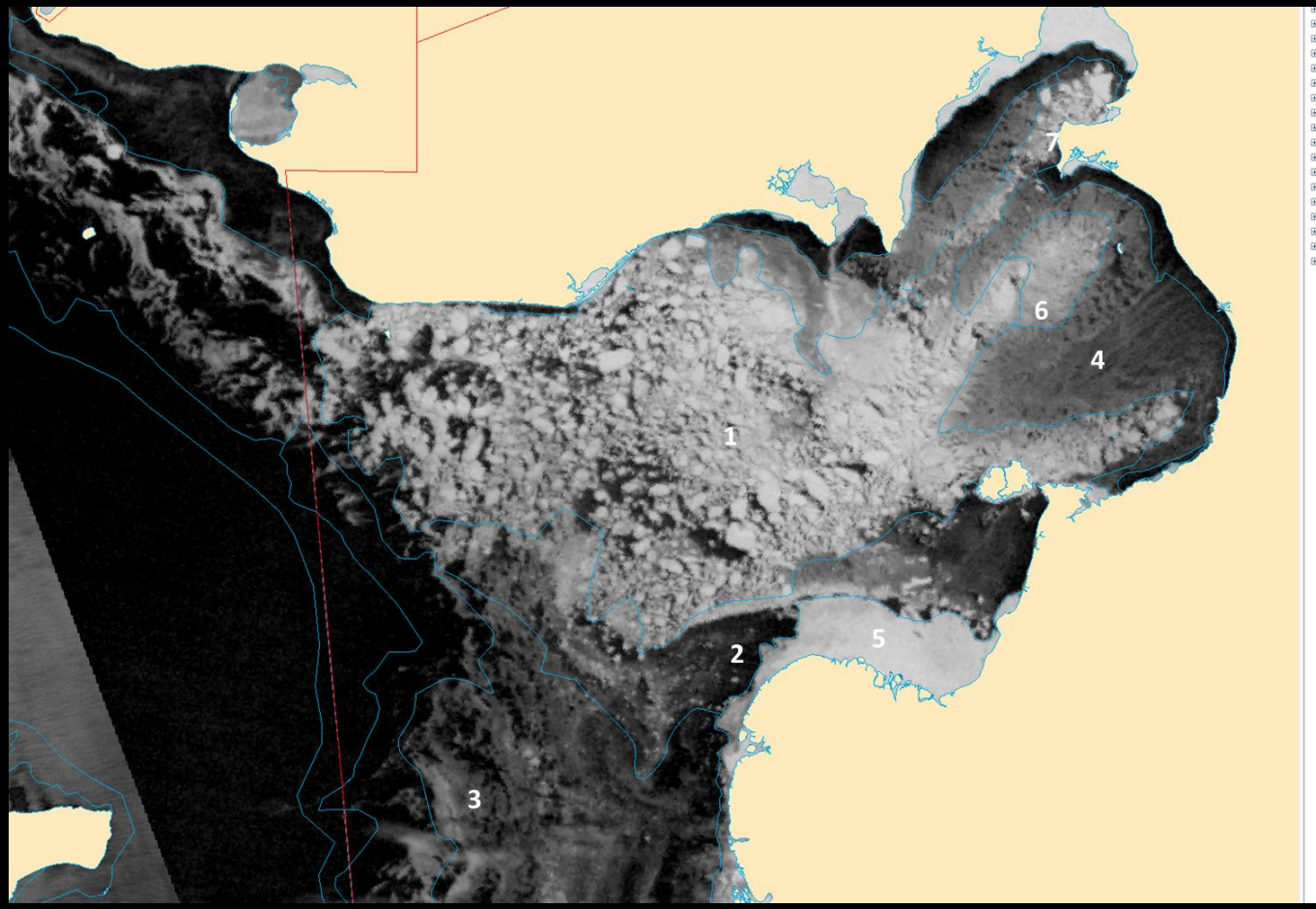
Day Night Band

Strengths:

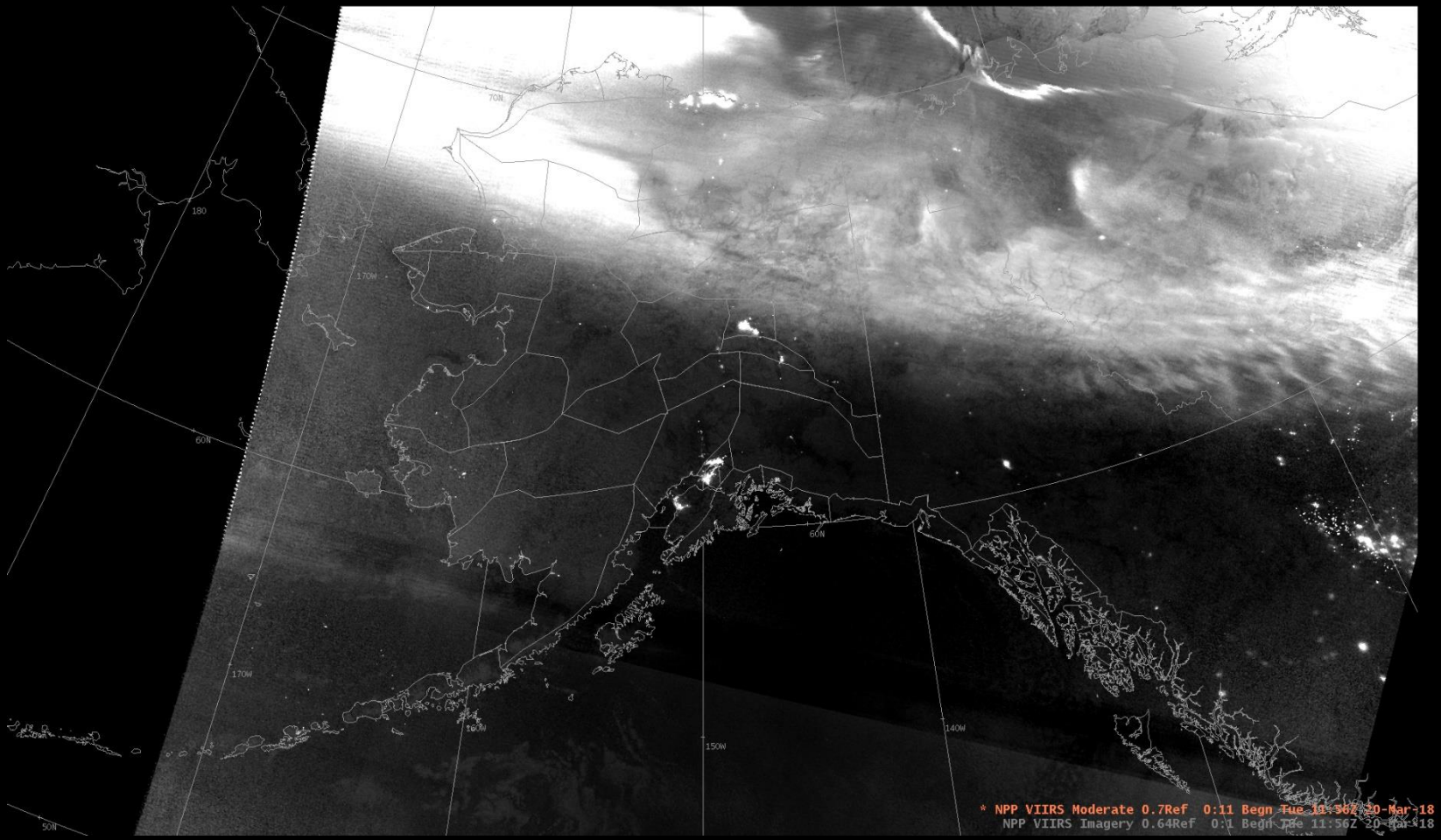
- Continuity with visible imagery
- Older ice very identifiable
- Nighttime use

Limitations:

- Cloud cover
- Lower resolution vs. visible or IR
- Artifacts in image (horizontal lines in swath)
- Less useful in summer
- Obscuration by aurora



Day Night Band



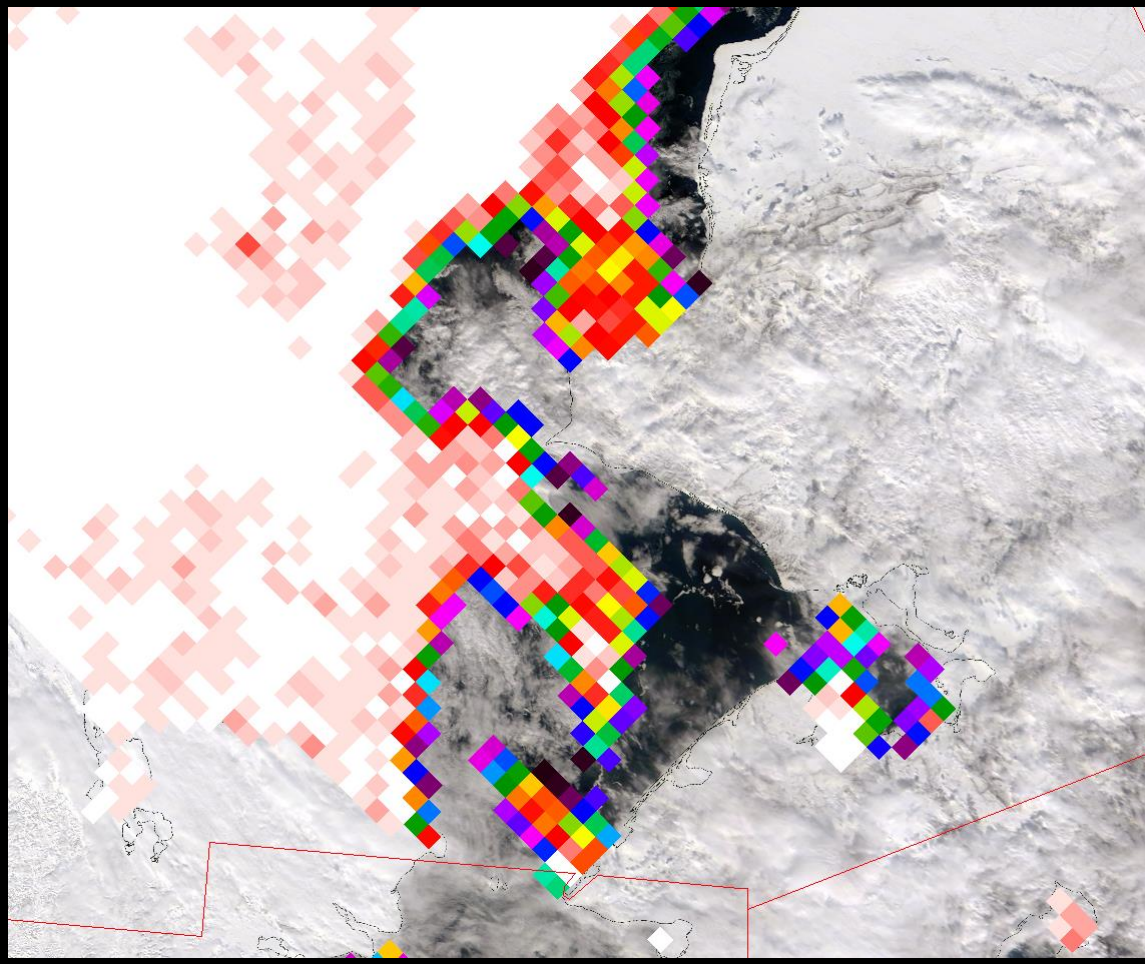
AMSR2 Sea Ice Concentration

Strengths:

- High concentration/pack ice
- Sees through clouds
- Useful for interpolation between SAR images
- Good for low-image days

Limitations:

- Resolution relative to other imagery
- Low concentration ice
- Analysis is more detailed than product resolution



Observations

Strengths:

- “Ground” truth
- Can provide thickness observations

Limitations:

- Point observation (limited representation)

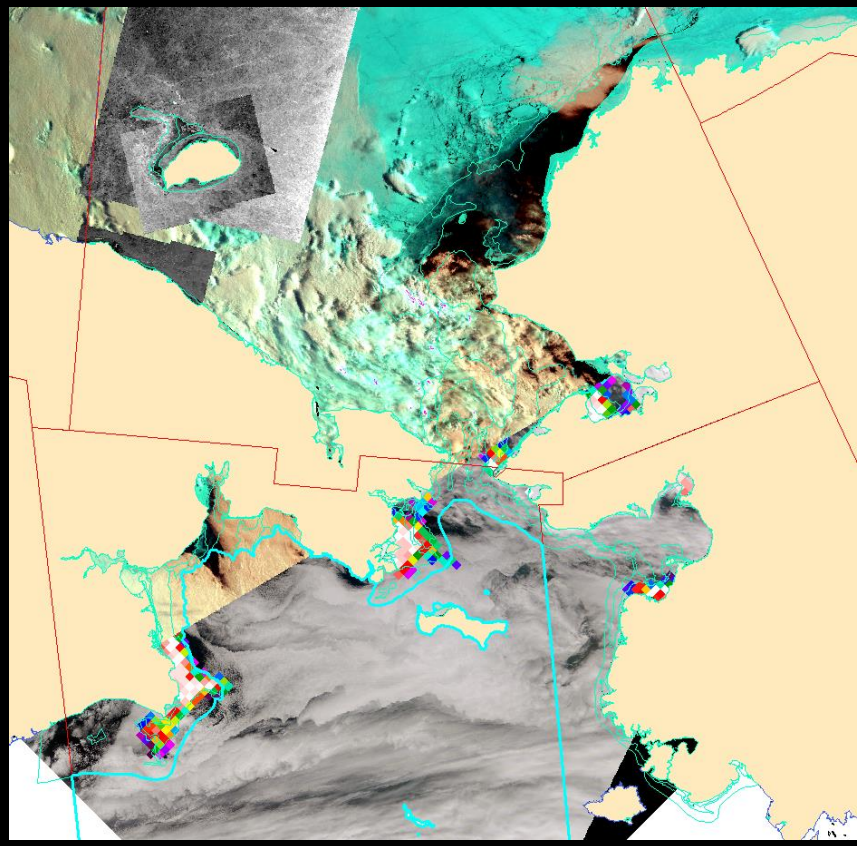
Imagery/analysis in general

Strengths:

- 24 hours worth of images from a variety of sources make up a mosaic.

Limitations:

- **CLOUDS**
- Temporal continuity



ASIP analysts

Strengths:

- Analyzing sea ice concentration in cloud free scenes
- Interpolating data from image sources of varying spatial coverage, and temporal resolution

Limitations:

- Judging ice stage/thickness
  - Our gauge of thickness is a proxy based on shape/ empirical knowledge of stage residence time

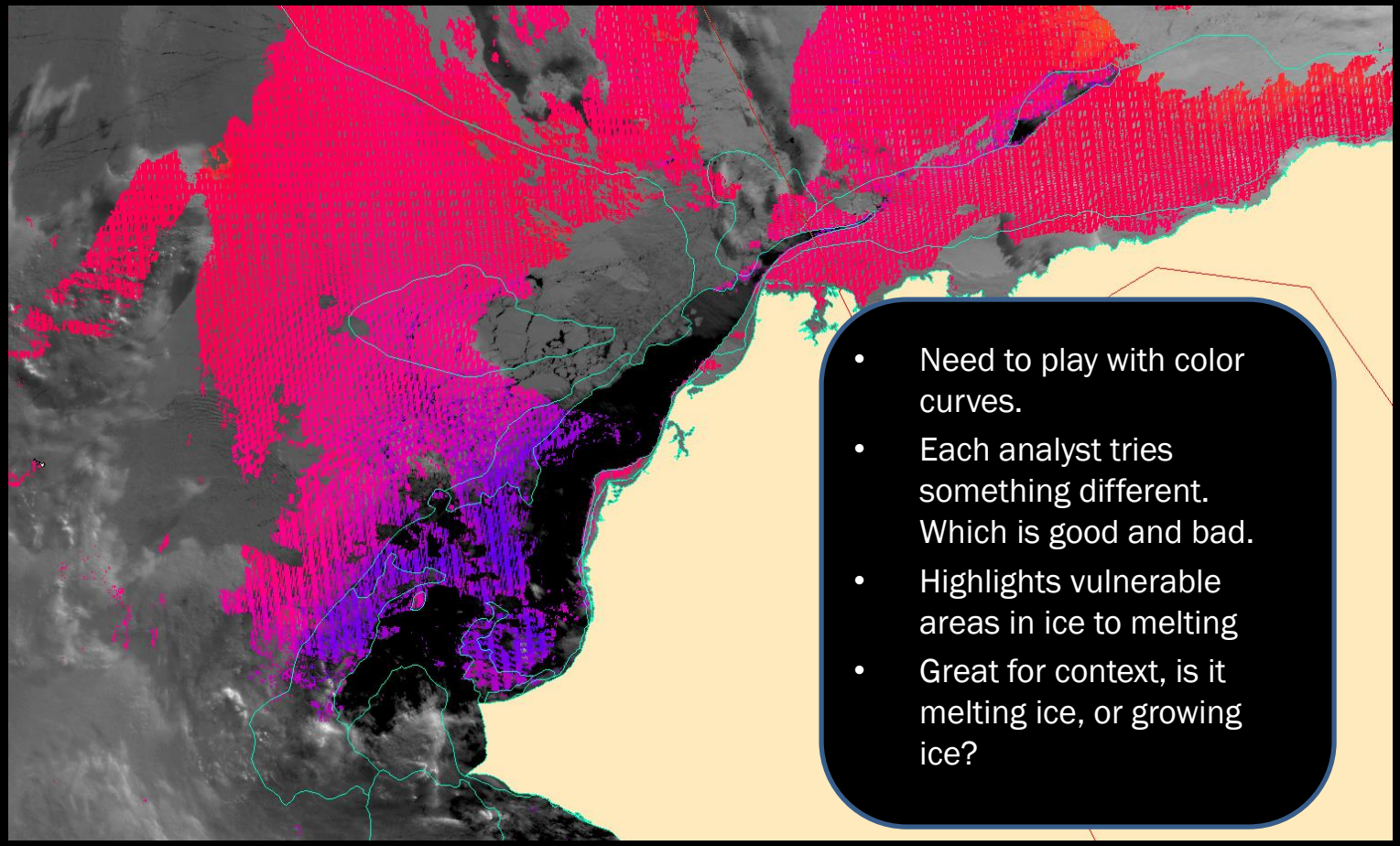
What do we need?

- Our biggest need as a program is ice thickness/stage data
- Short term drift/growth data
- Modelling

Ice Surface Temperature - Feedback

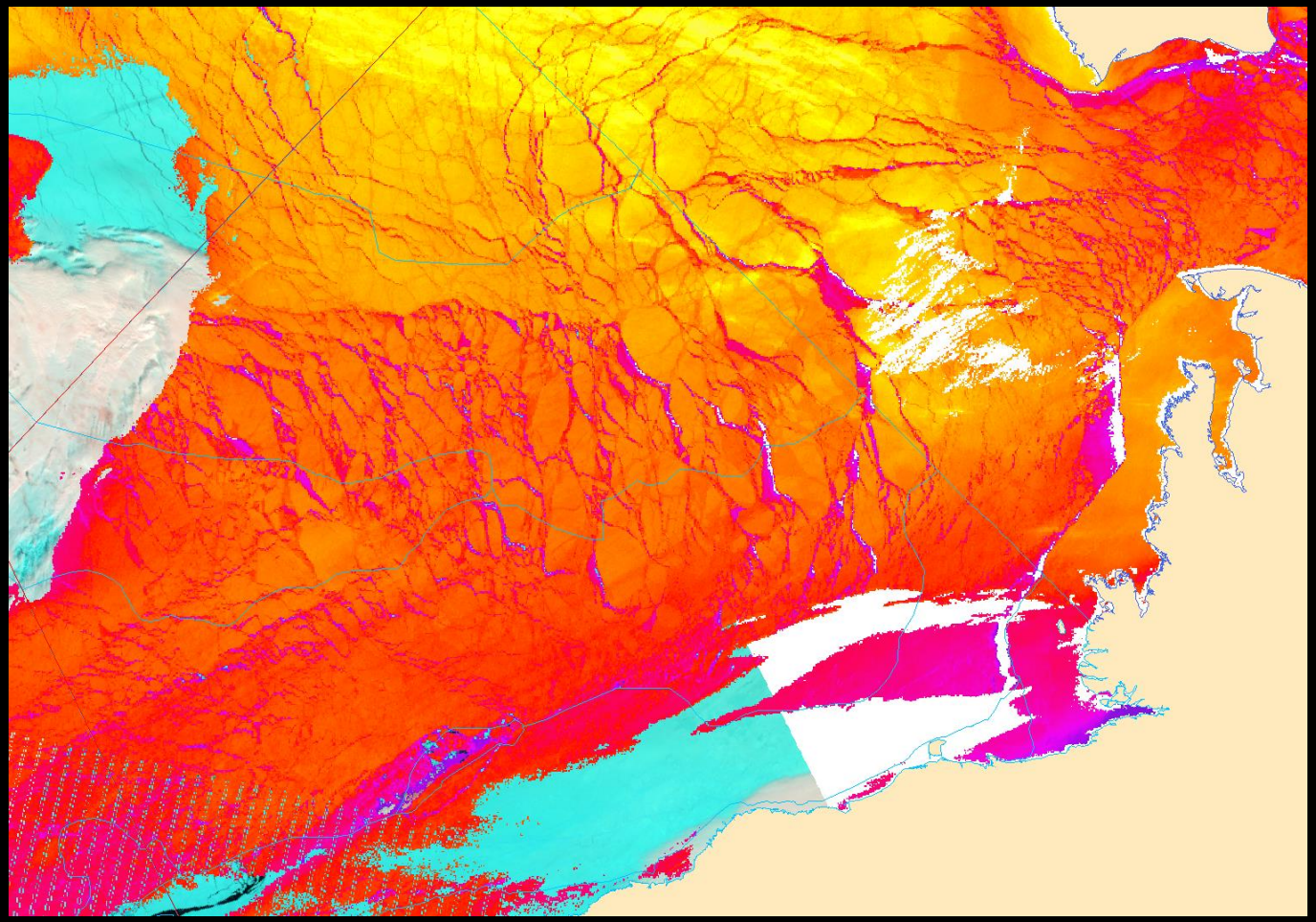
- IST looks to be of great resolution to see details
- Data plotting where clouds are
- Generally shows what I would expect
- Continued issues due to cloud contamination
- Fairly uniform, but great detail shown in leads
- Helps ID areas vulnerable to melting ice
- Great context for the new analyst
- Needs to be sampled to be useful
- Data artifacts make interpretation difficult

Ice Surface Temperature

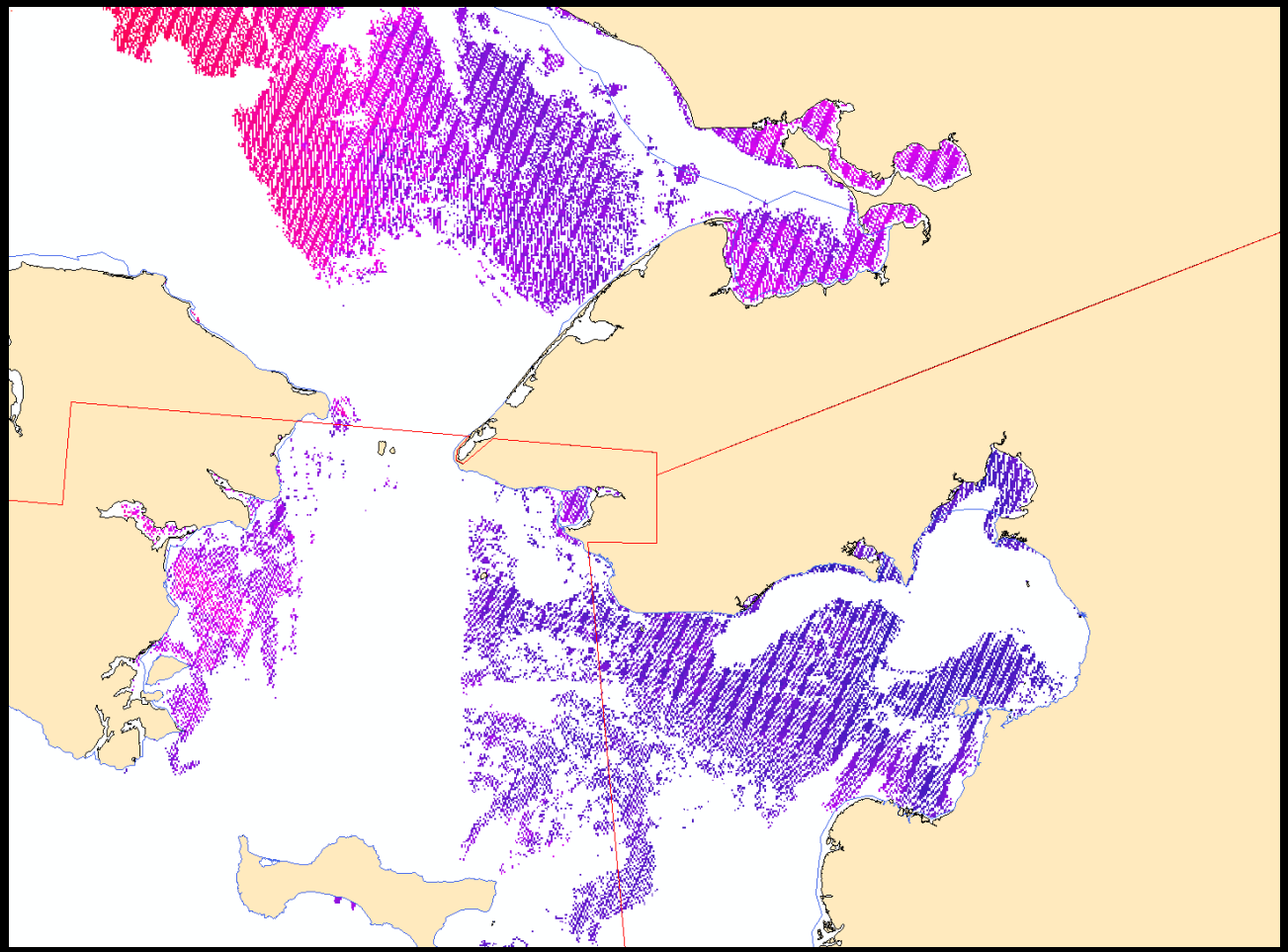


- Need to play with color curves.
- Each analyst tries something different. Which is good and bad.
- Highlights vulnerable areas in ice to melting
- Great for context, is it melting ice, or growing ice?

Ice Surface Temperature



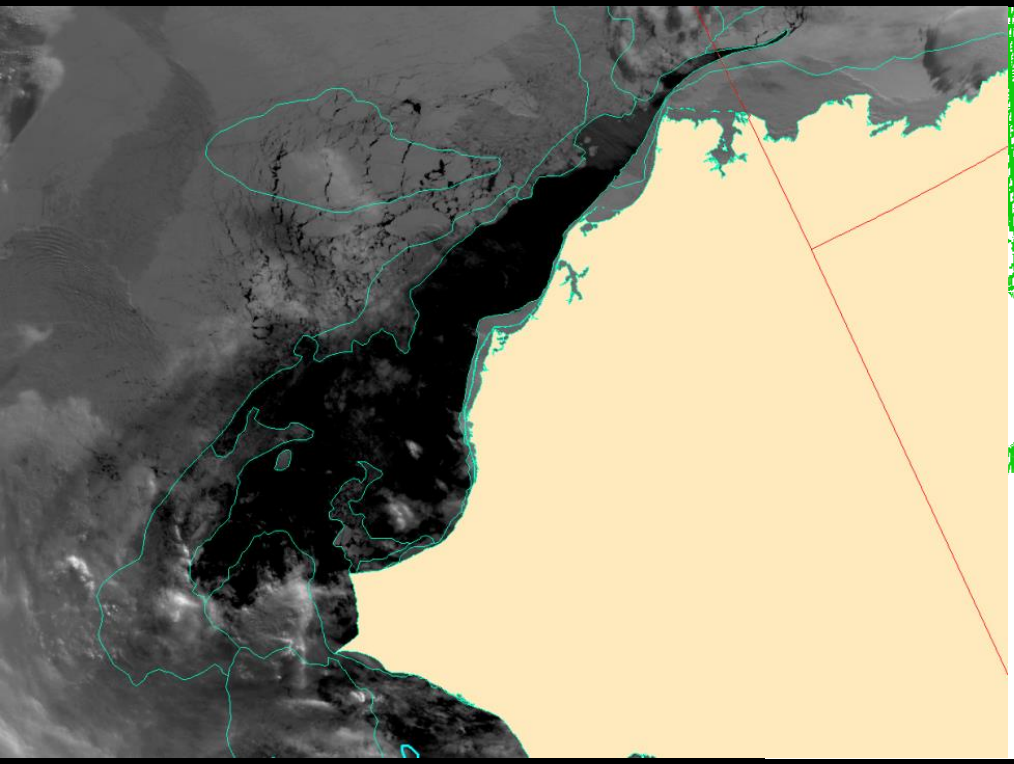
Ice Surface Temperature

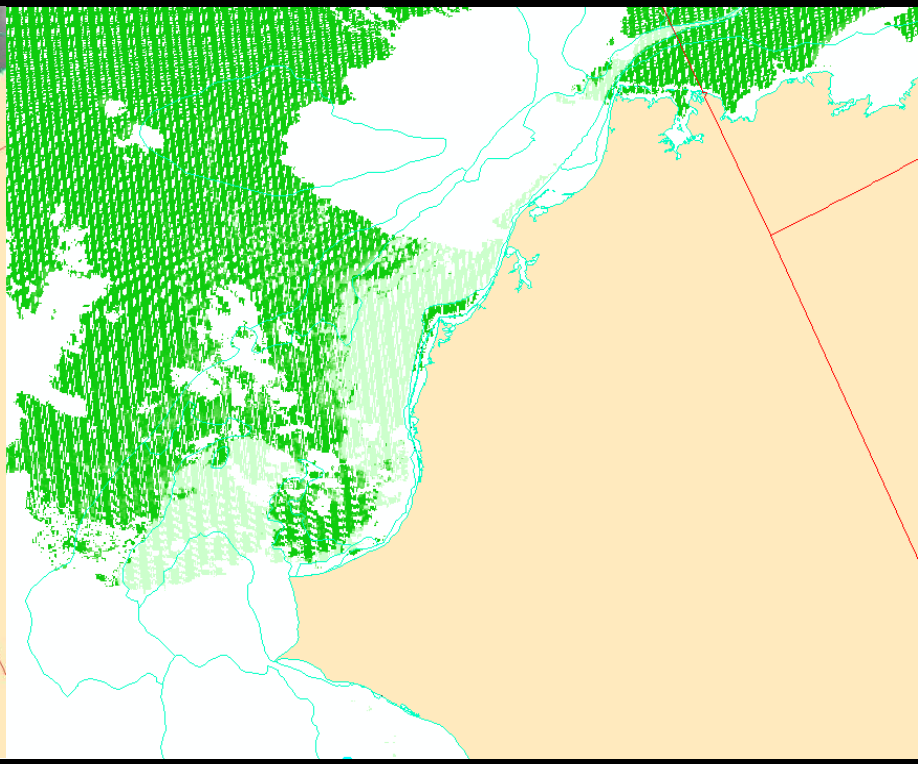


Ice Concentration - Feedback

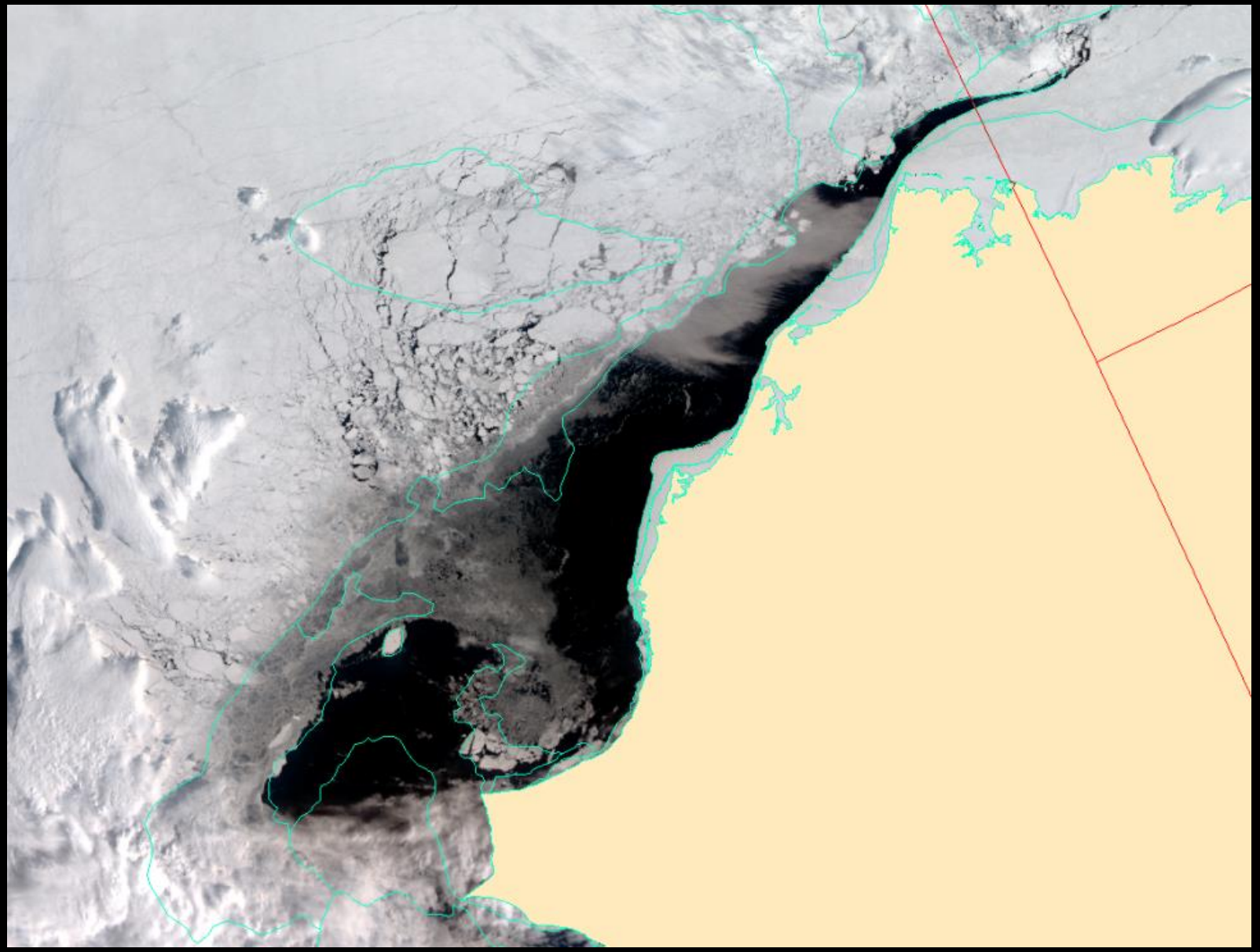
- Need to be careful in areas of thin clouds where the product tries to discern ice concentration
- Not helpful for our purposes since we have more detail in visible/IR for cloud-free areas
- Data seems to be backwards, most of the detailed data is where there is minimal to no sea ice or very thin ice, over the main pack it is not very useful
- Seems to do a decent job delineating between the main pack and areas of brash along the ice edge on a broad scale. Hard to discern details when focusing on smaller areas where larger changes have taken place.
- Most useful as a supplement to other types of imagery.
- Seems to be great for 100% concentration. While it nails the low concentration/high concentration boundaries it seems to be too “binary” as the low concentration areas looked uniform. No detail other than “low concentration.” (Example on next slide)

Ice Concentration

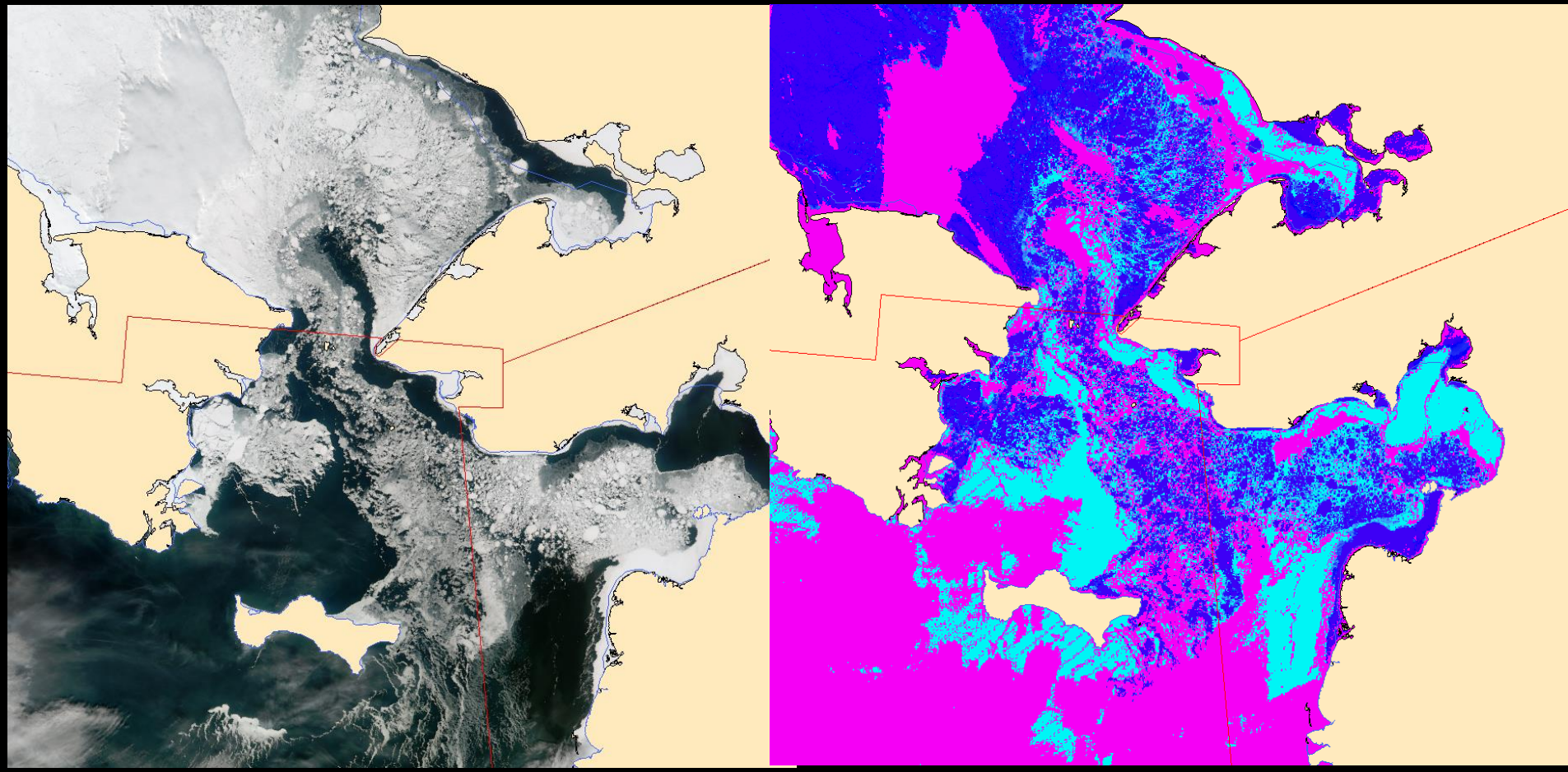




Ice Concentration



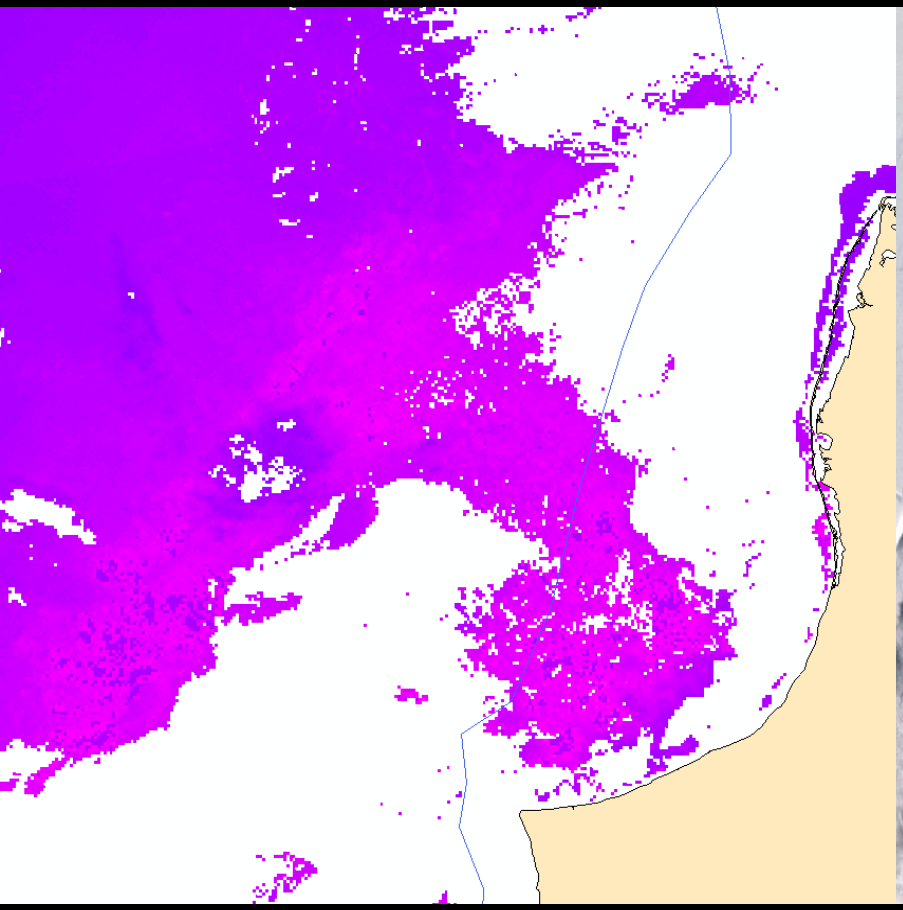
Sea Ice Concentration

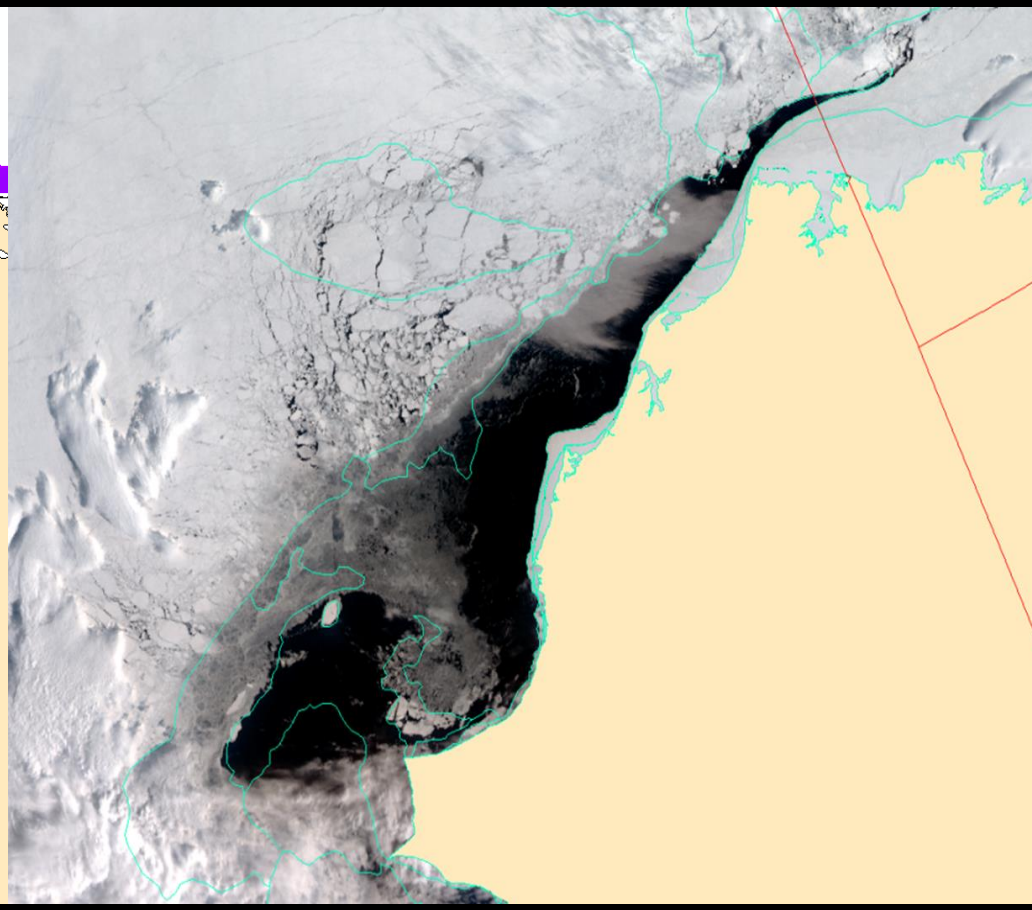


Ice Age/Thickness - Feedback

- Useful in areas of varying thickness, but no way to actually confirm the data (actual ice thickness). Enough of a gradient in the product to make some general assumptions about the analysis in the area of data
- Doesn't seem to pick up thicknesses less than 1.2 m, we need to know thickness data much less than that.

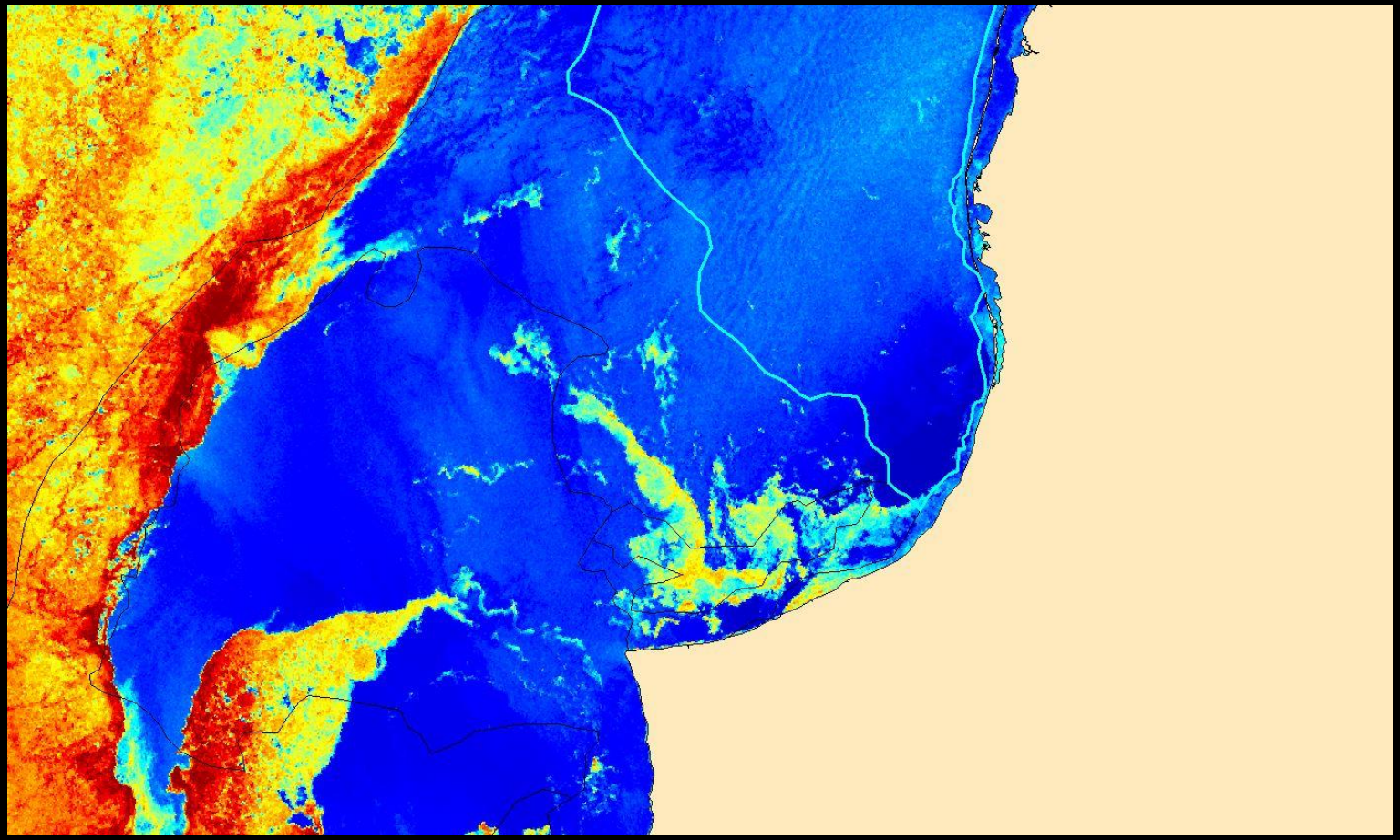
Ice Age/Thickness





Ice Age/Thickness

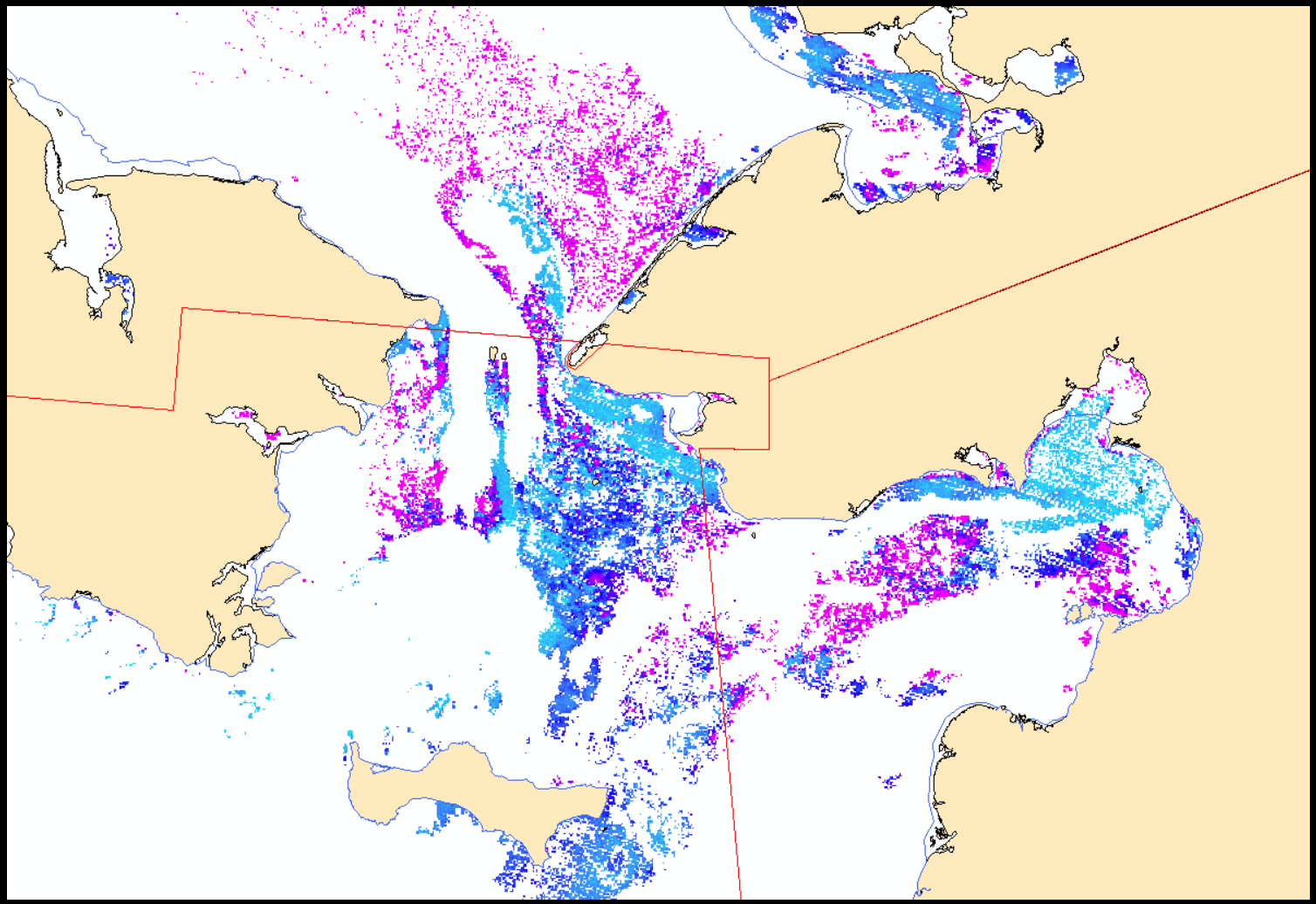
A few days later…



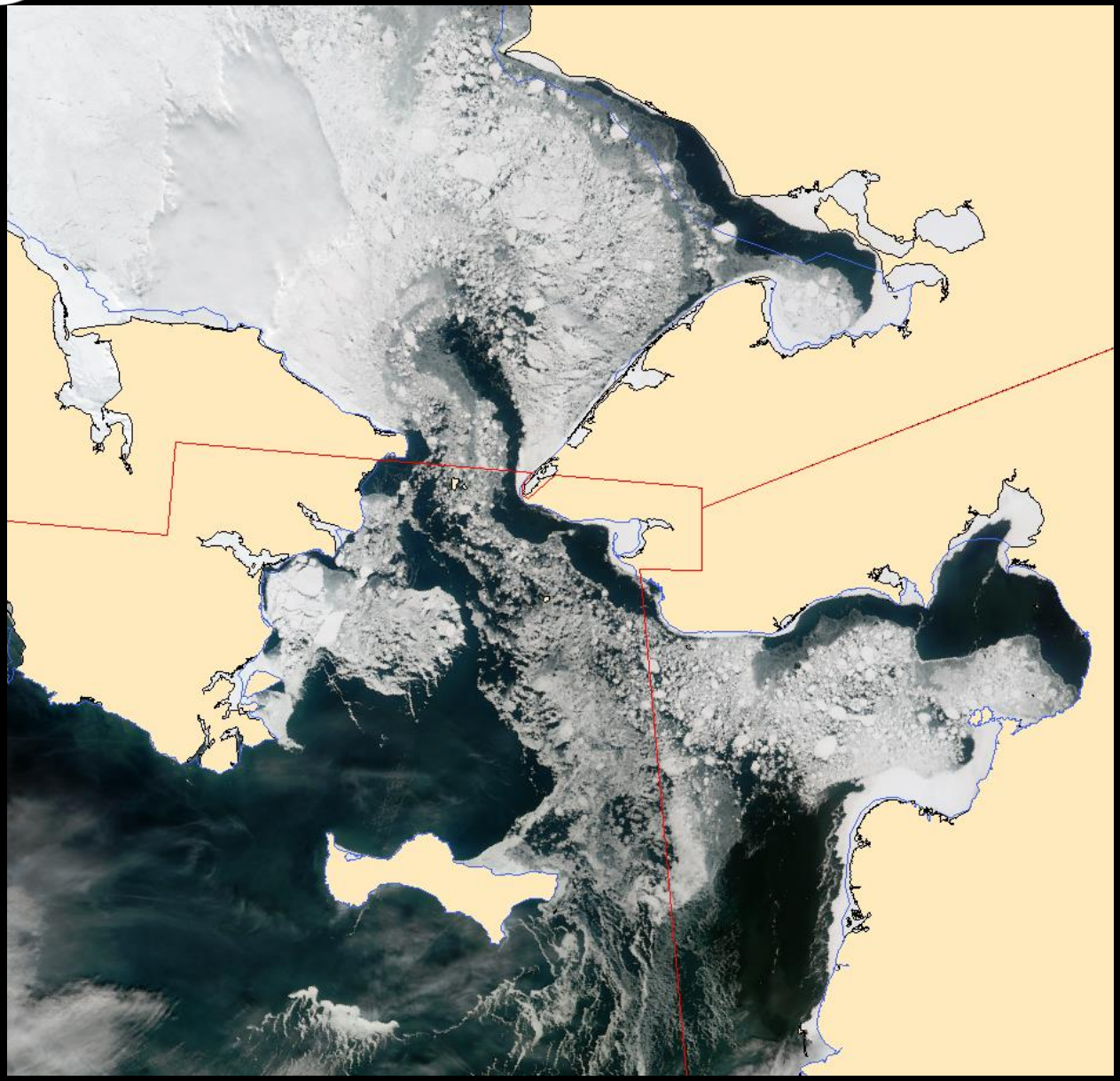
Radarsat image courtesy OSPO

Ice Age/Thickness

Same as Sea Ice Concentration example



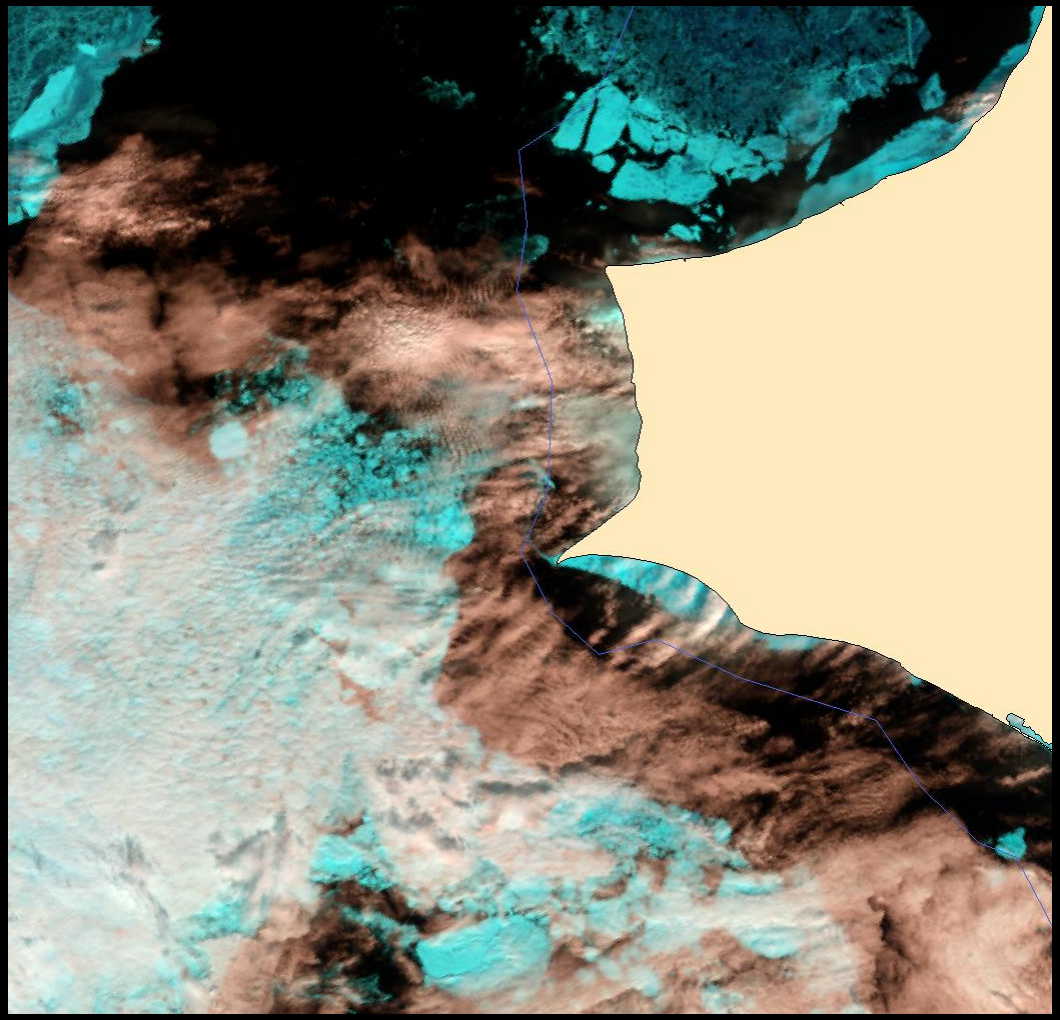
Ice Age/Thickness



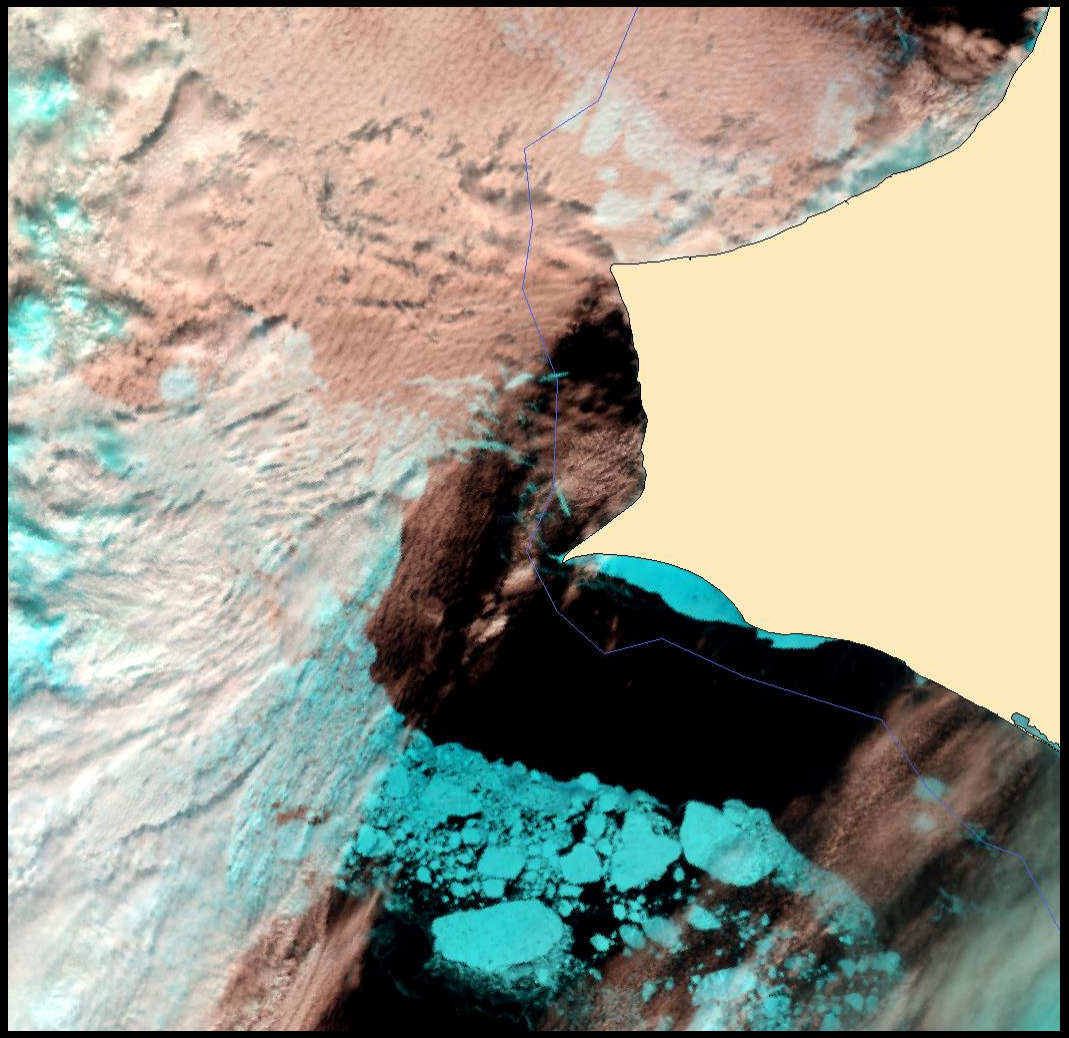
Blended Ice Motion - Feedback

- Data looks good, I can see this data being very helpful especially for our forecasts and special projects
- Useful for forecast purposes and for conceptualizing changes noted in a given area when a day or two passes between good images
- Great context for the new analyst coming on duty.

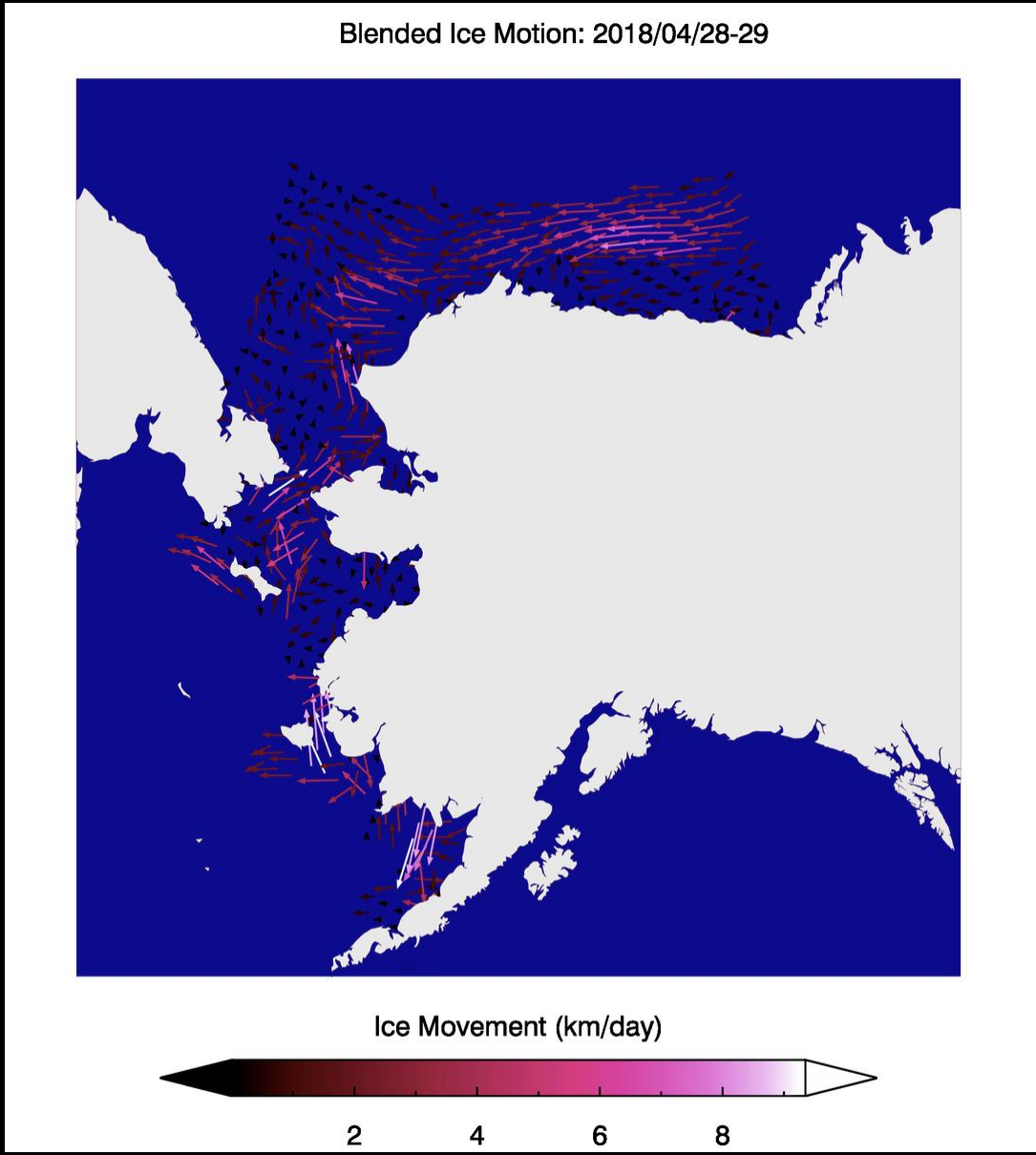
24 hours between images



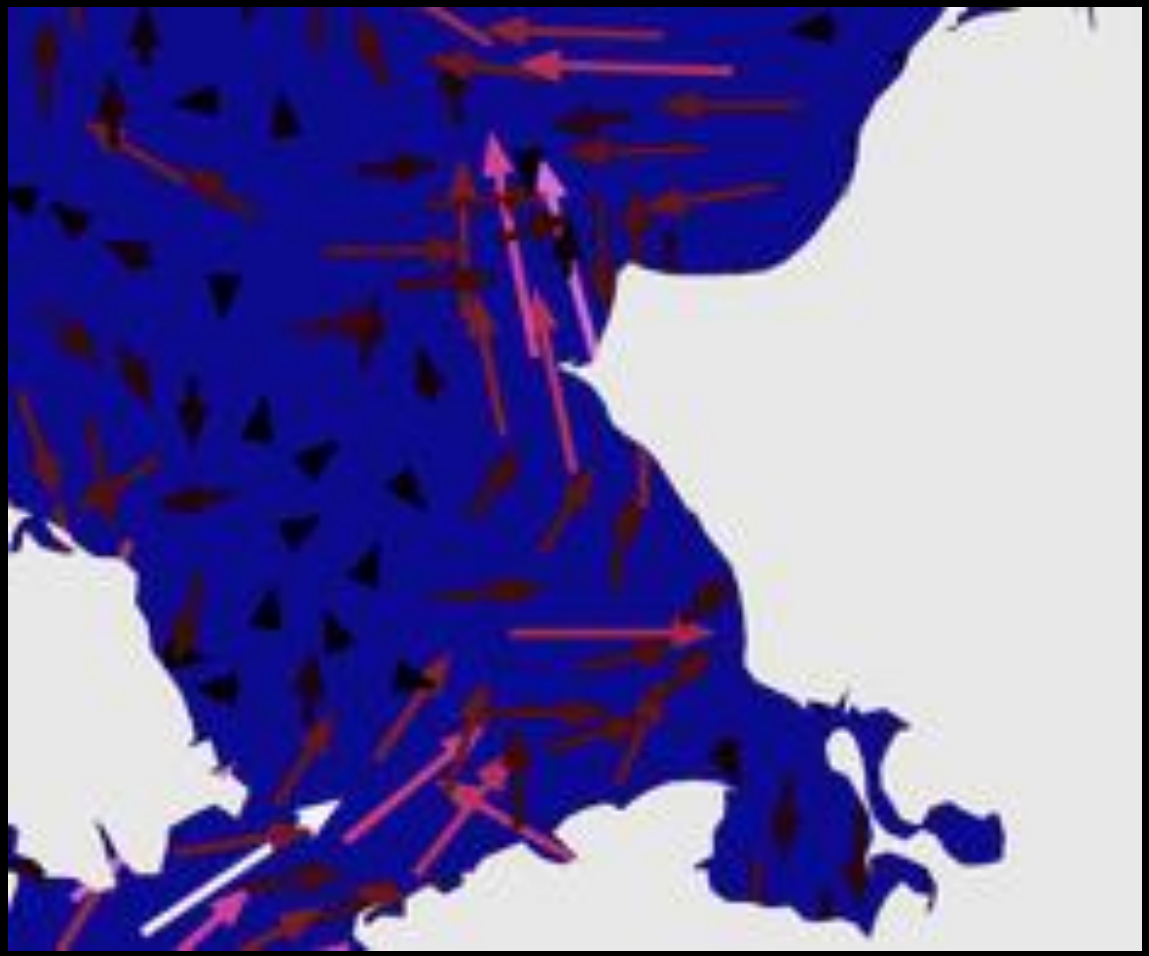
Blended Ice Motion



24 hours between images

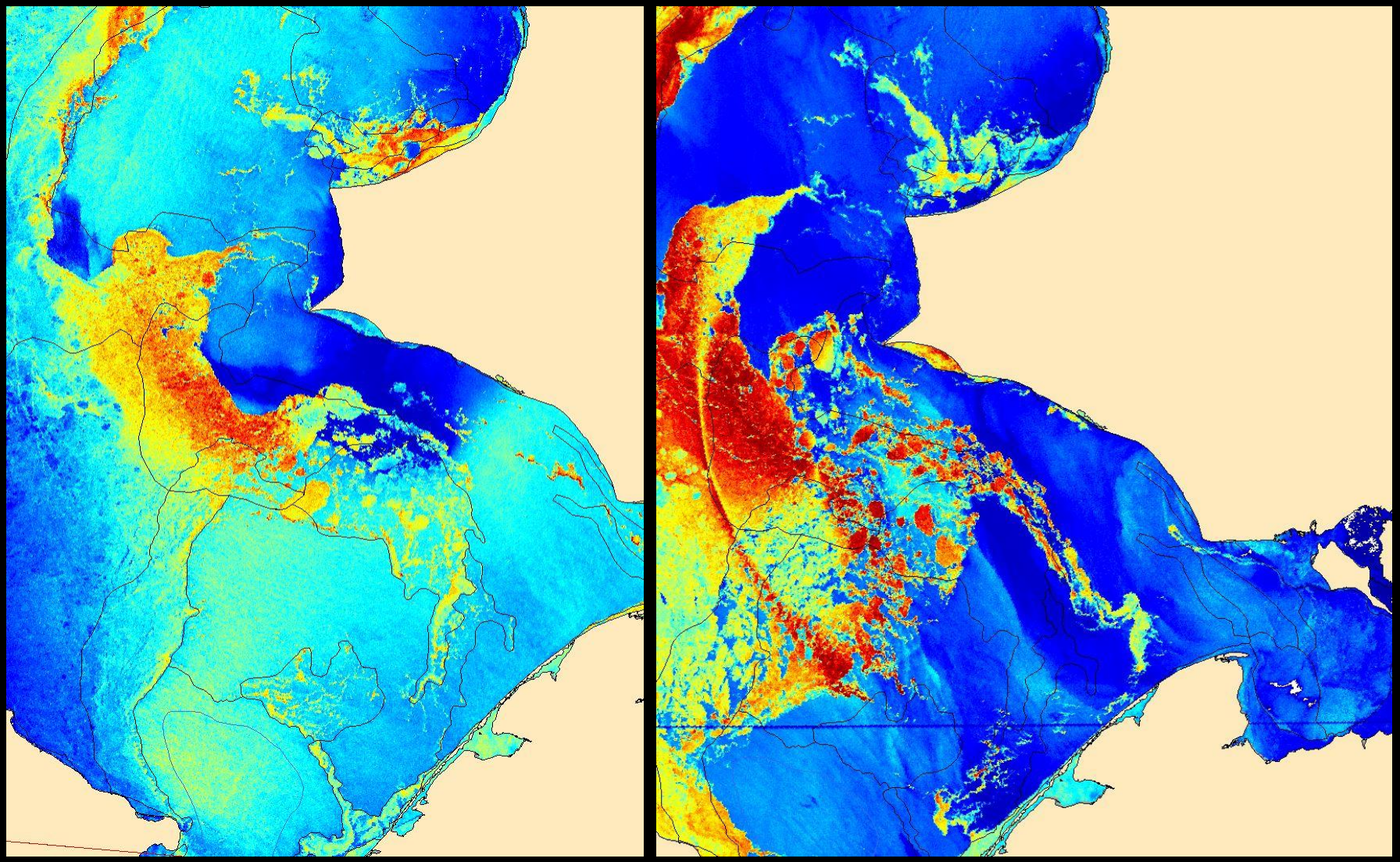


Blended Ice Motion



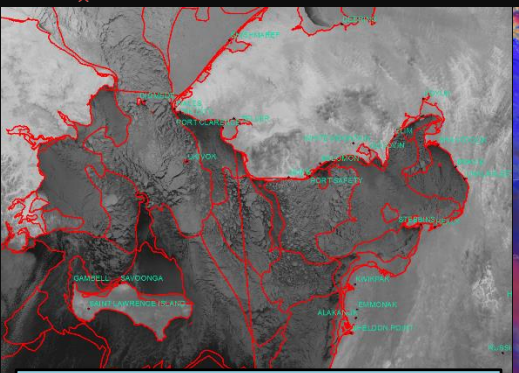
Blended Ice Motion

36 hours between images

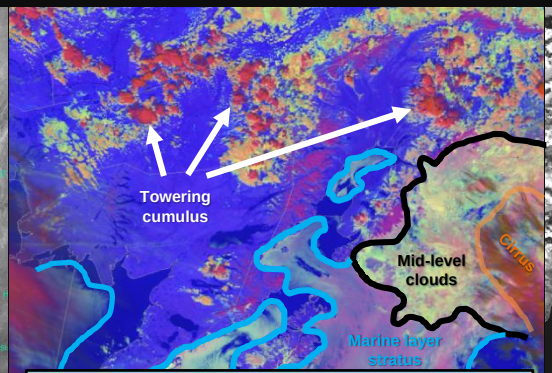


Integration of Polar-Orbiting and Geostationary Satellite Information in Forecast and Sea Ice Operations

Michael Lawson, General Forecaster/Satellite focal point, NWS Anchorage Forecast Office

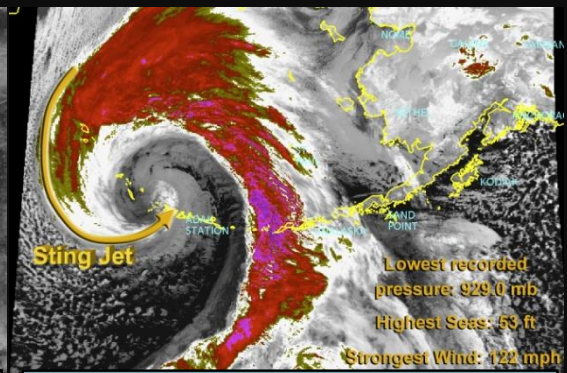


S-NPP VIIRS 11.45 µm in ArcGIS. Bering Strait / Norton Sound ice 1/19/18. Each shape represents different concentrations/stage.

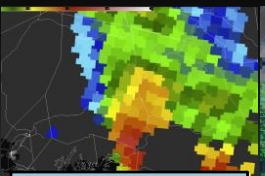


NASA SPoRT Daytime microphysics RGB S-NPP VIIRS. Southern Alaska

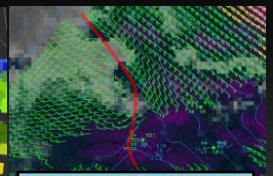
NOAA-20 .64 µm visible. Sea ice/Cook Inlet



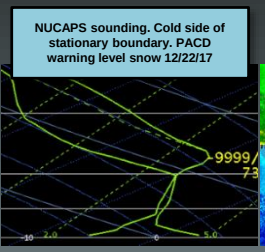
S-NPP VIIRS 11.45 µm/longwave IR. Western Bering Sea 12/13/15: Social media



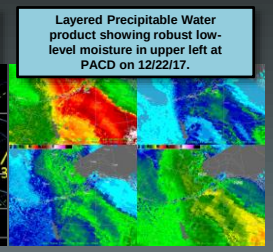
Snowfall Rate Product. Atmospheric river snow event. Thompson Pass 12/06/17



ASCAT Scatterometer winds. Stationary boundary. PACD warning level snow event 12/22/17

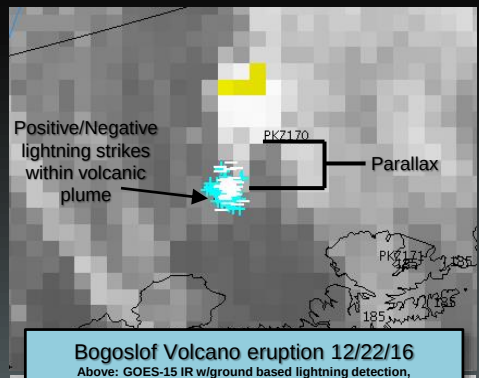


NUCAPS sounding. Cold side of stationary boundary. PACD warning level snow 12/22/17

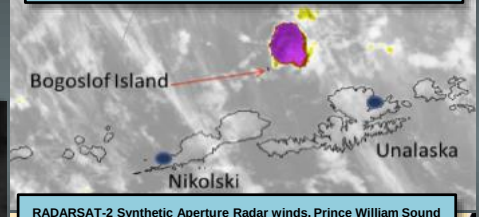


Layered Precipitable Water product showing robust low-level moisture in upper left at PACD on 12/22/17.

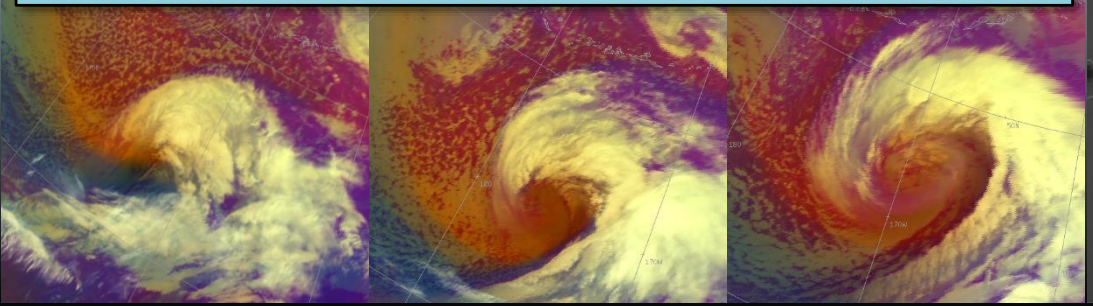
Polar-orbiting satellite products are increasingly useful at high latitudes, where the amount of imagery is significantly greater than lower latitudes. Data sparse locations, such as Alaska, benefit from the pole-to-pole coverage these satellites provide. Imagery from Himiwari-8 also gives Alaska forecasters a look into the future of high spatial/temporal resolution geostationary satellite products. NWS Anchorage uses a diverse selection of products to monitor a variety of meteorological conditions including cyclogenesis, low stratus/fog, blowing dust, volcanic as, winds, and sea ice. Forecasters at NWS Anchorage continually collaborate with agency partners on evaluation of new satellite products. In addition, the combination of geostationary and polar-orbiting imagery, including the newly launched NOAA-20, gives forecasters a glimpse of single and multi-channel products that are expected with the operational capability of GOES-17. An evaluation of these proxy data conducted by NWS Anchorage has given forecasters advanced knowledge of product interpretation, so they can be prepared for GOES-17 on day one.



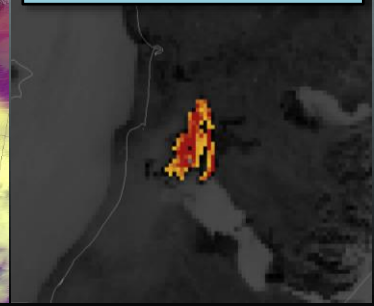
Bogoslof Volcano eruption 12/22/16
Above: GOES-15 IR w/ground based lightning detection, highlighting parallax at high latitude
Below: AVHRR 11µm



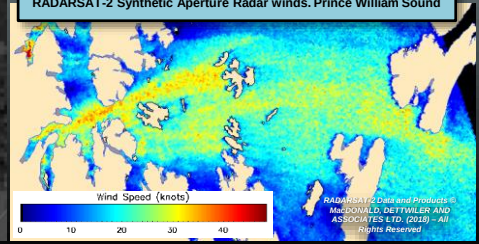
Progression of rapid cyclogenesis from Himiwari-8 Air Mass RGB 1/18/18. North Pacific Ocean/Aleutians. Yellows in the image depict high potential vorticity stratospheric air aiding in rapid deepening of the system.



Funny River fire, 5/20/14
S-NPP VIIRS 3.74 µm



RADARSAT-2 Synthetic Aperture Radar winds. Prince William Sound



AMS Poster Collaboration?

Use of High Resolution Polar-Orbiter Imagery and Evaluation of JPSS Ice Products in Sea Ice Analysis and Forecasting

The amount of detail required to track and analyze the concentrations and stage of sea ice is best provided by high-resolution polar-orbiting satellite imagery. The diminished temporal frequency of imagery, as compared to geostationary satellites, is balanced by the superior spatial resolution they provide. High-resolution imagery is capable of providing a plethora of information on sea ice. Concentration of ice is the most apparent data from the two dimensional top-down view, however, the appearance of ice over time can be used as a proxy for stage (thickness/age). The National Weather Service Alaska Sea Ice Program (ASIP) makes use of a multitude of satellite platforms and imagery to construct the daily analysis of ice concentration and stage from the Bering Sea through the Beaufort and Chukchi Seas as well as Cook Inlet. Visible and true color imagery from MODIS and VIIRS continue to serve well, sensing ice in cloud-free scenes. Infrared imagery becomes increasingly useful during the long winter as daylight is scarce while the Near Constant Contrast product (formerly known as the day/night band) allows for a consistent and comparable view with respect to visible imagery. Multi-channel RGB imagery combinations help discern ice from clouds and other land features. Synthetic aperture radar (SAR) and the Advanced Microwave Scanning Radiometer (AMSR-2) provide much needed microwave data coverage during prolonged cloudy periods as the signal is unaffected by clouds and precipitation. Despite the many and varying types of imagery available, there are still many days in which the imagery is insufficient for current meteorological conditions. The lack of data facilitates a need to collaborate with other agency partners for new analysis and forecasting techniques. In April of 2018 the Alaska Sea Ice Program participated in an evaluation of ice products from the Joint Polar Satellite System (JPSS). Products provided to the ASIP included analysis of Sea Ice Concentration, Ice Surface Temperature, Ice Thickness, and Blended Ice Motion. Examples intended for display will include the JPSS evaluation products, S-NPP Truecolor imagery, S-NPP Landcover, synthetic aperture radar, AMSR-2 Sea Ice Concentration, infrared and Near Constant Contrast.

JPSS sea ice evaluation

Comments/Questions?

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