



U.S. National Ice Center



USN



USCG



NOAA



U.S. National Ice Center Use of Satellite Cryosphere Products

2015 JPSS Annual Science Team Meeting - August 24-28, 2015
Speaker: Sean R. Helfrich

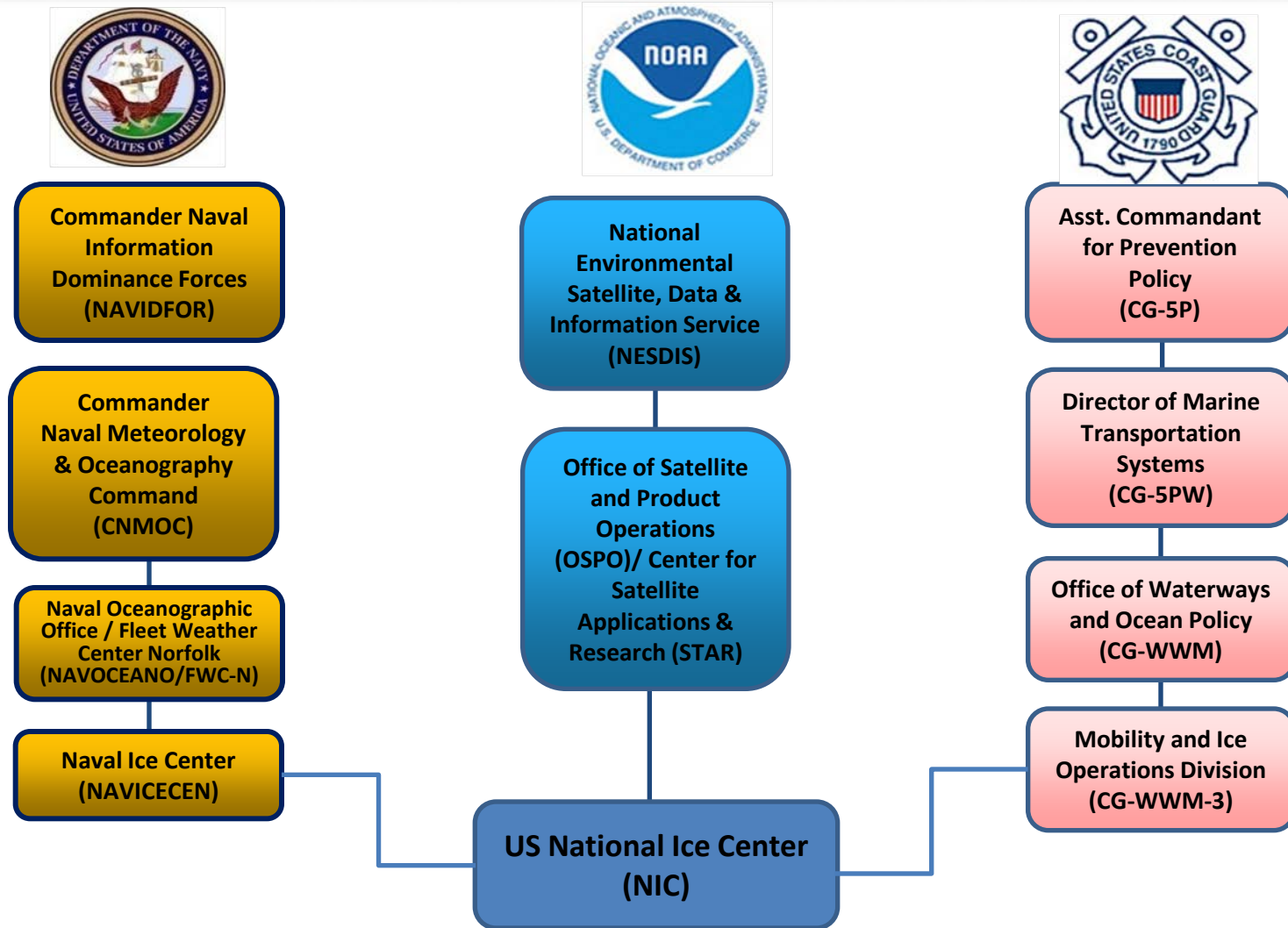
CDR Kelly Taylor
Director / Commanding Officer

Mr. Sean R. Helfrich
Acting Deputy Director

LCDR Robert Atkinson
Naval Ice Center Executive Officer



USNIC Organization

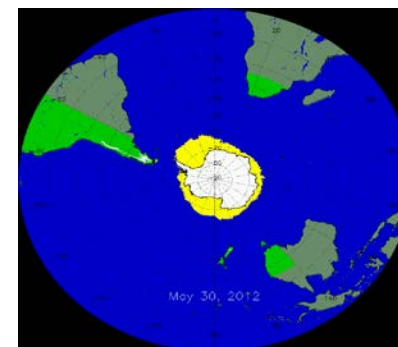
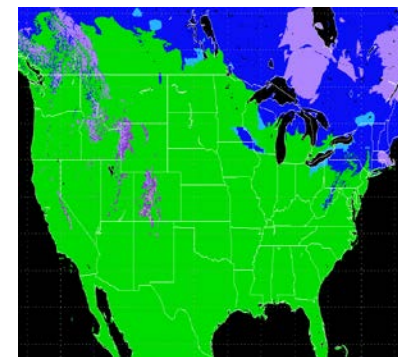
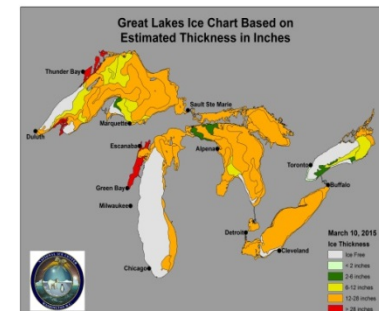


Total manpower: 37 personnel; 65% Navy, 33% NOAA, 2% USGC



NOAA Requirements

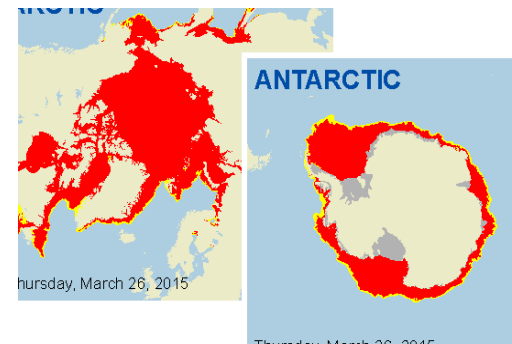
- **Great Lakes Ice Monitoring (Dec-May)**
 - Daily Ice Conc/thickness. 5 km res ,GRIB and ASCII
 - Weekly Ice Thickness & Form
 - 1-7 day forecast
 - NAVTEXT message (Dec-Mar)
- **CONUS Ice Monitoring (Dec-May)**
 - Weekly or bi Weekly - Chesapeake and Delaware Bays
- **Alaska Ice Monitoring**
 - Twice weekly ice charting
 - SAR Imagery support for NWS Alaska
 - Ice edge and GRIB format
- **Global Snow and Ice Monitoring**
 - 2x Daily Gridded Ice/Snow Extent for North America, 1km
 - Global Daily Snow Depth, 4km res
 - Northern Hemisphere Daily Ice Concentration, 4km res
 - Northern Hemisphere Daily Ice Thickness, 4km res
 - Days since last observation for Snow and Ice Analysis Data
- **Special Support of NOAA Vessels**





USN Requirements

- **Submarine Force (SUBFOR) Requirements (USN)**
 - Daily ice edge within 3NM
 - Daily MIZ within 3NM
 - 48HR ice edge forecast within 3NM
 - Sea ice routing/FLAP - as required (up to 2X daily) within 4NM
 - Estimated ice thickness bi-weekly or as required within 10cm
 - Iceberg location within 3NM (Arctic/Antarctica)
 - Climatological outlooks as required
- **Fleet Weather Center (FWC) Requirements (USN)**
 - Ice edge information (generic), 25 km res, daily.
 - Ice coverage (analysis and 24 hour forecast) 0.5km res, daily or as required in ports/waterways
 - Ice thickness information, 0.5 m res, or as required for tactical ops
 - Route specific at 0.5 km
 - OTSR ice annotated imagery





USCG Requirements

Arctic / Antarctic

Daily Sea Ice Edge – Daily during operations, 2x month off season.
Arctic – w/i 50m of edge; Antarctic w/i 2nm

Daily Sea Ice Concentration – Daily during operations, 2x month off season.
Arctic – w/i 50m and 2/10ths coverage

FLAP - As requested - daily during operations, 2x month off season.
Features >200m in length

Daily Estimated Sea Ice Thickness - Daily during operations, 2x month off season

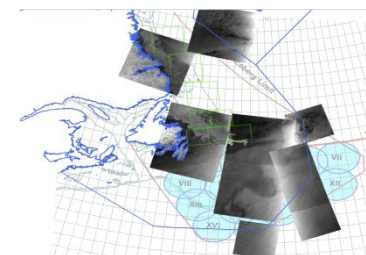
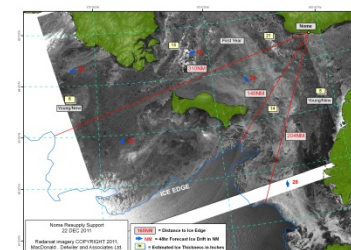
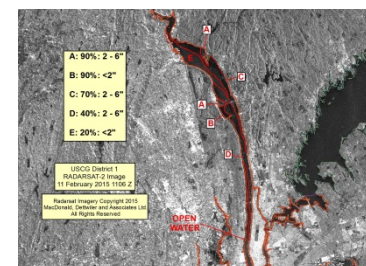
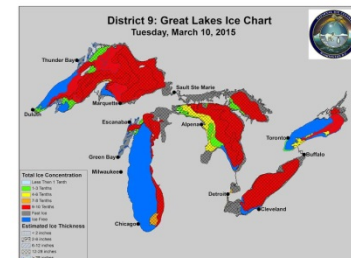
Daily Iceberg Location – Daily during operations, 2x month off season. w/i 2 km of actual; Imagery w/i 3 hrs of receipt

Daily Imagery Analysis/Forecast – As requested for operations/environmental awareness w/i 100nm radius of vessel

Climatological Outlooks - as requested
Arctic w/i 25nm; Antarctic w/i 20nm

Icebreakers or Aerial Recon

Embarked ice analysts or Aerial Recon for real time ice observations and analysis as requested
Annotated imagery analysis/forecasts





Product Generation

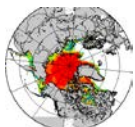
Arctic Maritime Domain Awareness



Satellites



Buoys



Models



Aircraft



Webcam



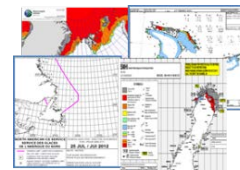
Radar



Ship Obs



Surface
Obs



International
Partners

**Interpretive
Snow and Ice
Analysis and Ice
Forecasting**

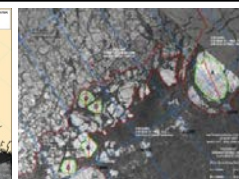
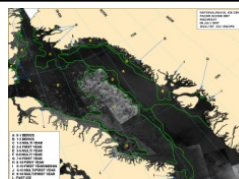
**Geographic
Information
System**

Meteorology

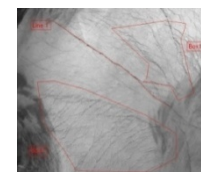
**Semi-
automation**

**Subject
Matter
Expertise**

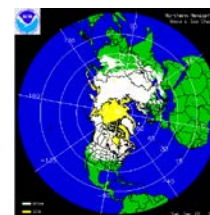
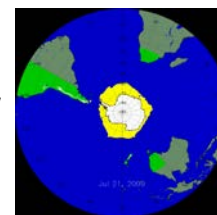
Annotated
Images



Fractures,
Leads and
Polynyas
(FLAP)

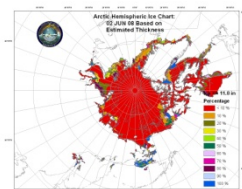


Automated Snow
and Ice products



Blended Snow
and ice cover

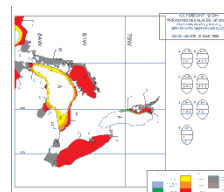
Ice Thickness
Estimations



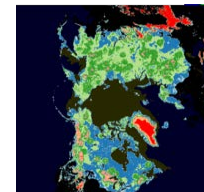
Antarctic
Icebergs



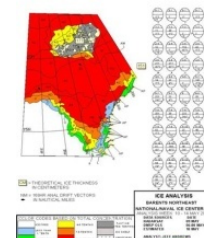
Ice Outlooks



Blended
Snow
Depth



Hemispheric and
Regional Ice
Charts





Current SNPP Utility in NIC Products

1. Imagery (I1, I2, I3, I5, DNB) (**AII**)

2. VIIRS Sea ice characterization (**IMS**)

Only used for Ice/No Ice (inaccurate ice typing), Cloud Mask issues

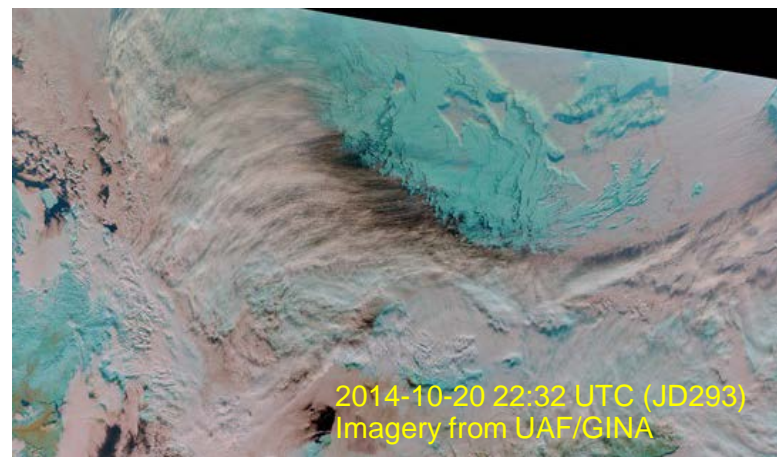
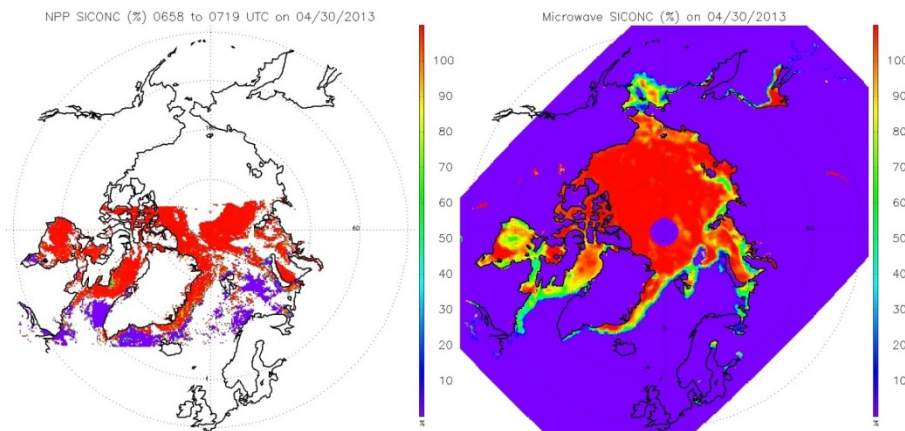
3. VIIRS Sea Ice concentration IP (**Working on IMS, Hemi Ice Charts, & MIZ**)

Data format (HDF5 to Geotiff conversion being built)

Will be helpful in IMS Blended Ice Con.

4. VIIRS Snow cover (**IMS**)

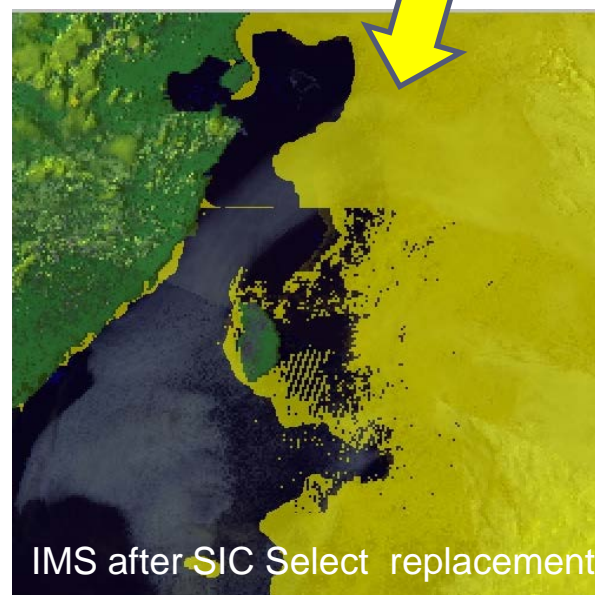
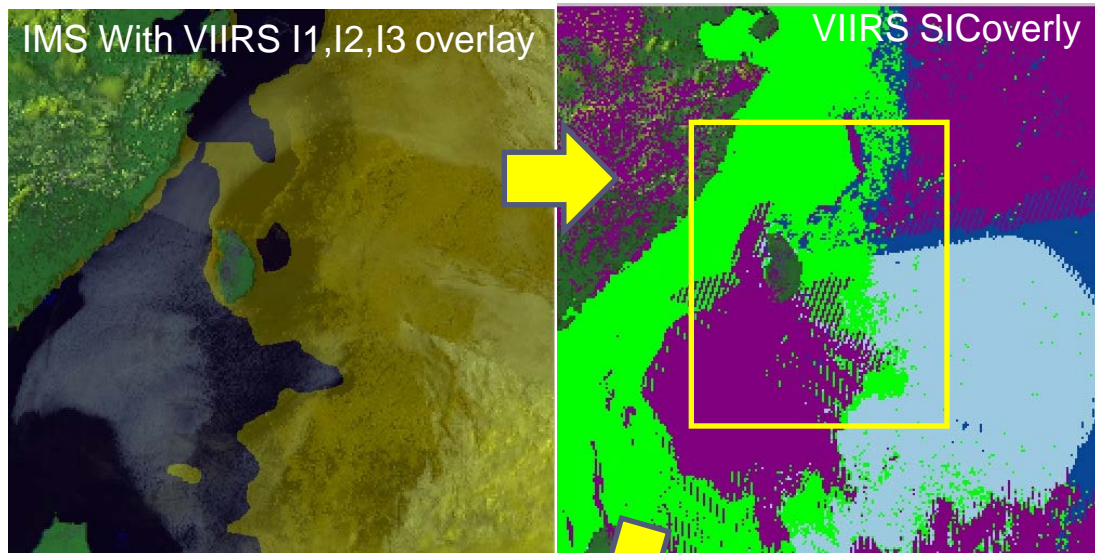
OK, but conservative cloud mask





Direct Import of Automated Snow & Ice Cover

- Analysts will be able to selectively import the data from satellite derived products directly into the Blended Analysis
- Analysis will have selection box to select snow cover and ice cover from the VIIRS, NOHRSC, and NH AutoSnowIce.
- Human data selection to optimize product use based on expert knowledge and imagery interpretation
- Combines the speed and reliability of automated products with the QC and flexibility of Human Analysts





Current SNPP Utility in NIC Products

5. AMSR2 Ice Concentration (**MIZ**, **Hemispheric Ice Charts**)

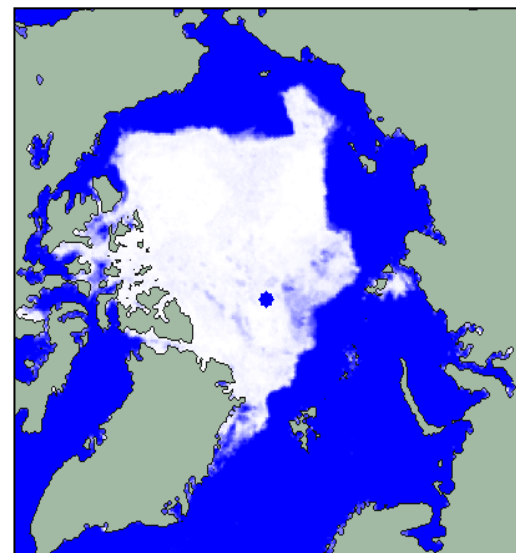
Applied in IMS Blended Ice Concentration

Using ASI (Univ Bremen), last resort data source,

6. ATMS Snow Water Equivalent (**IMS**)

Used to make IMS Snow Depth

Release of Version 11.1 – better agreement with AMSR 2 except in
boreal forest areas



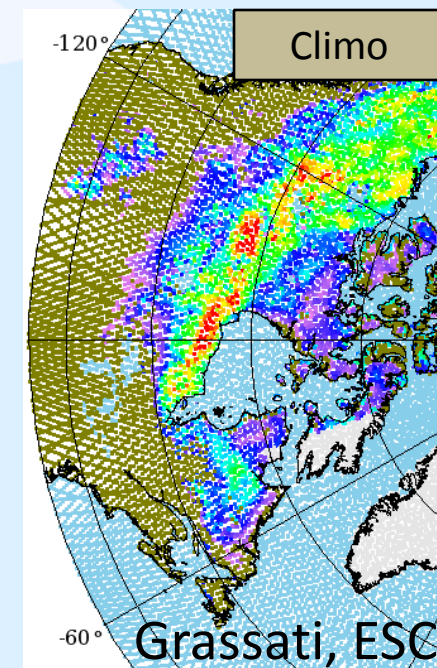
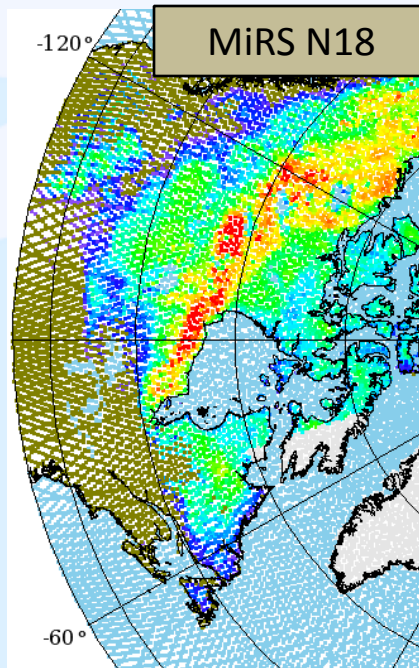
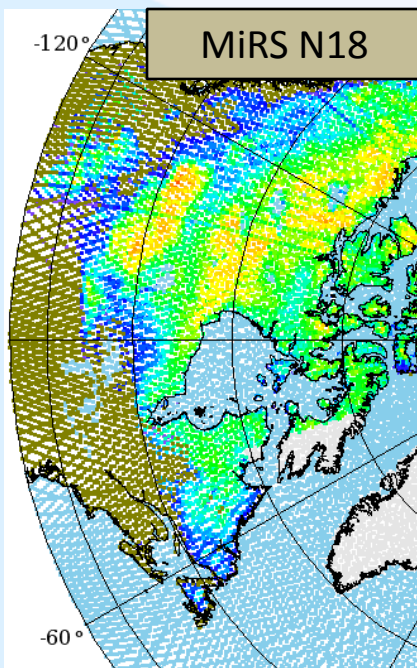
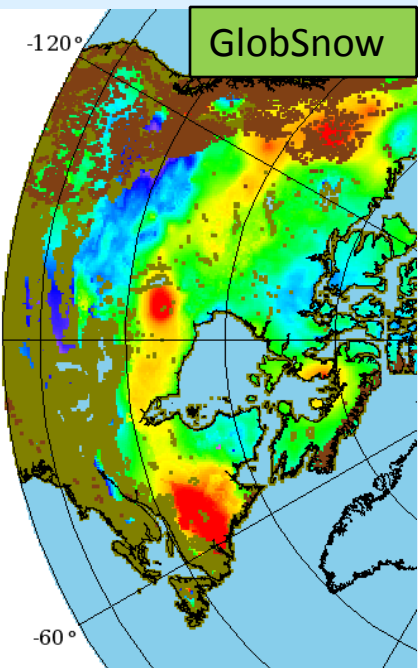
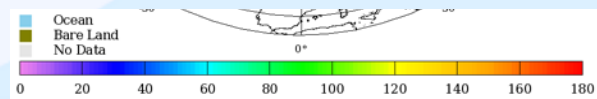
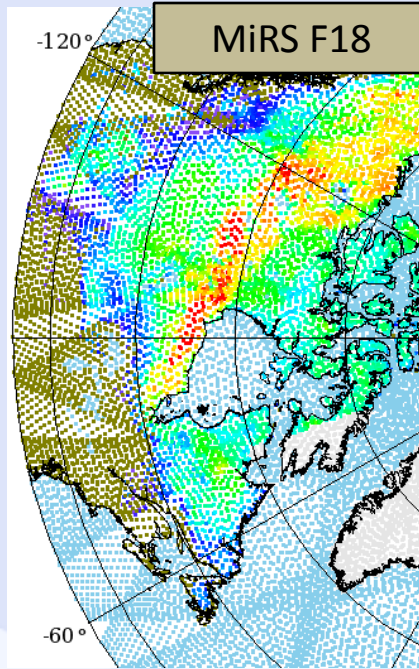
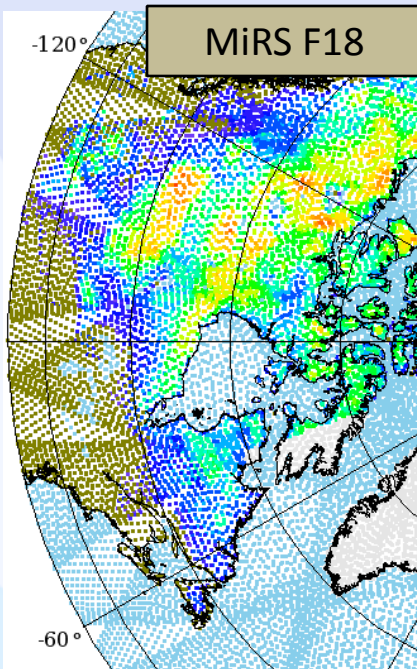
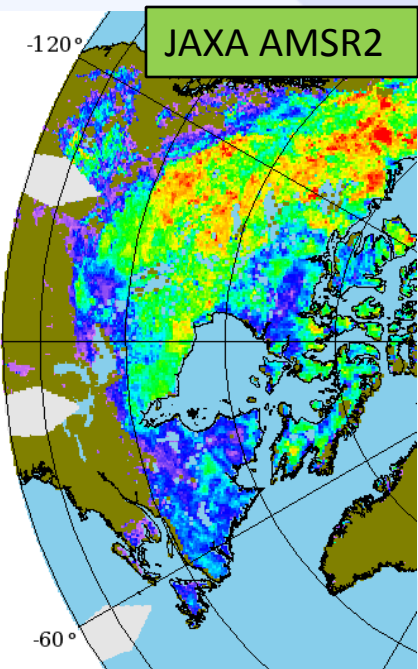
0 Concentration 100

Oper (v11)

Bkg=SWE Climo (v11.1)

Snow Water Equiv. (mm)

2013-01-30



Grassati, ESC 2015



Potential JPSS Utility in NIC Products

7. ATMS Snow Grain Size (IMS)

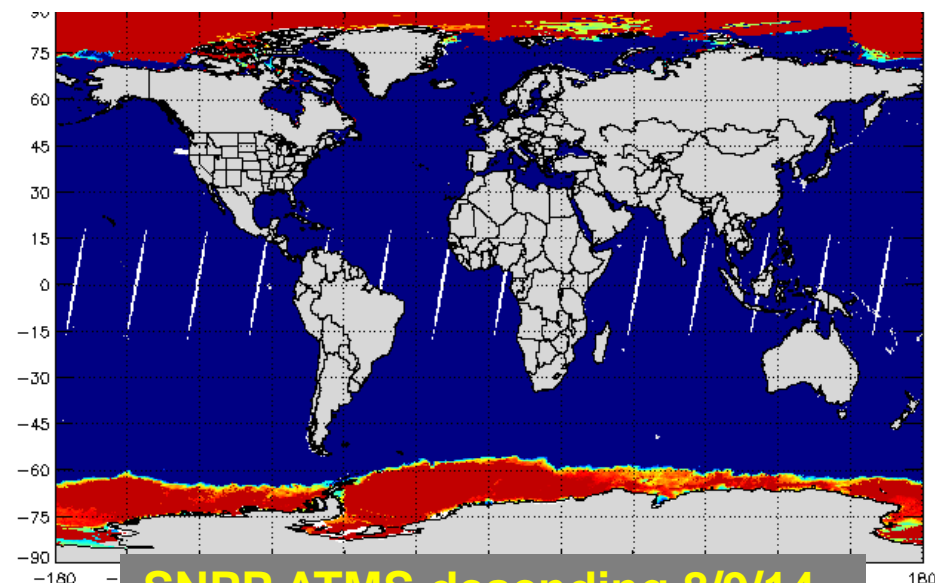
Desired to adjust IMS Snow Depth

8. ATMS First Year Ice Concentration (IMS, Hemispheric Ice Charts)

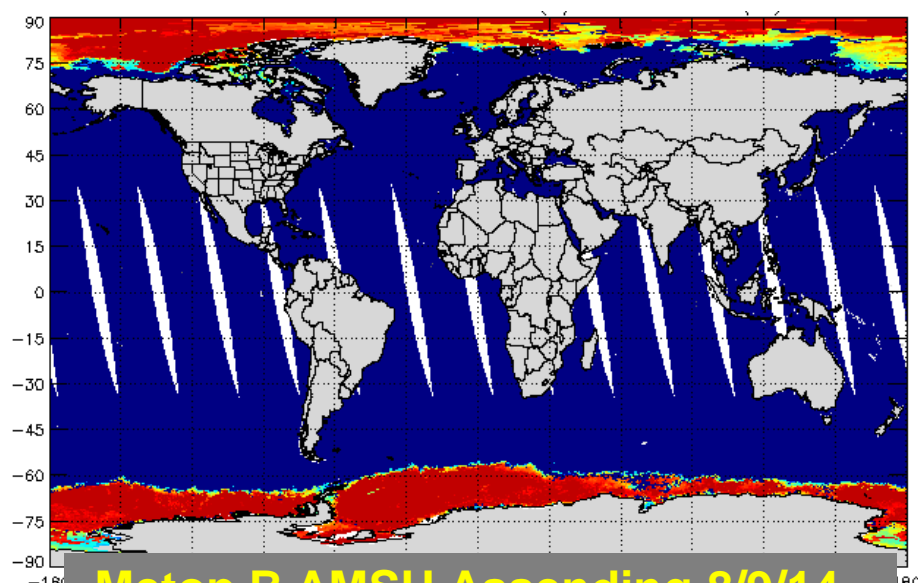
Could be used in IMS Blended Ice Con

9. ATMS Multi-Year Ice Concentration (IMS, Hemi Ice Charts)

Will be helpful in IMS Blended Ice Con



SNPP ATMS desending 8/9/14



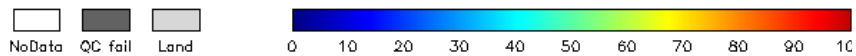
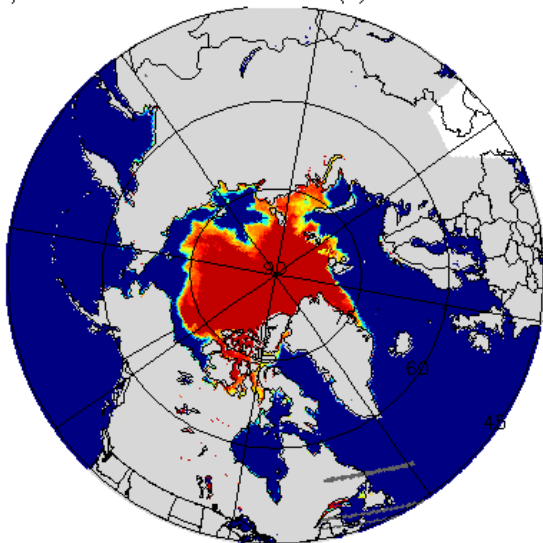
Metop B AMSU Assending 8/9/14



MIRS ATMS Sea Ice

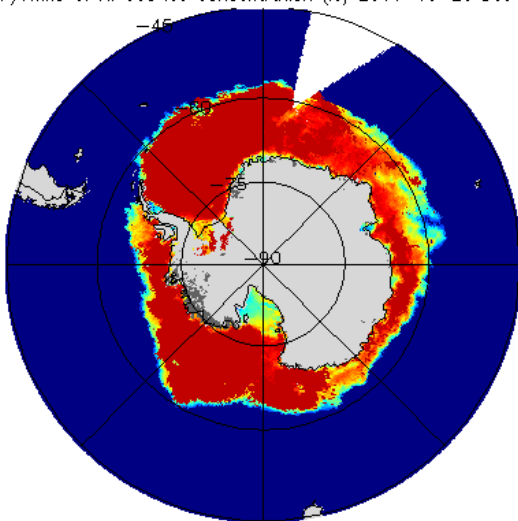
MIRS NPP/ATMS N. H. Sea Ice Concentration (%) 2014-10-20 Des (V3259)

Total
Ice



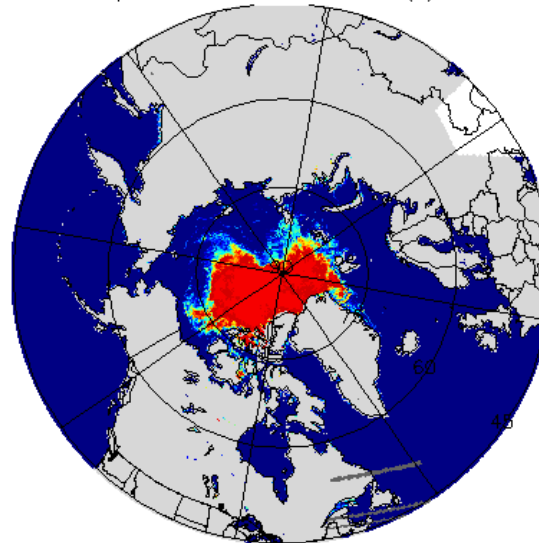
MIRS NPP/ATMS S. H. Sea Ice Concentration (%) 2014-10-20 Des (V3259)

Total
Ice



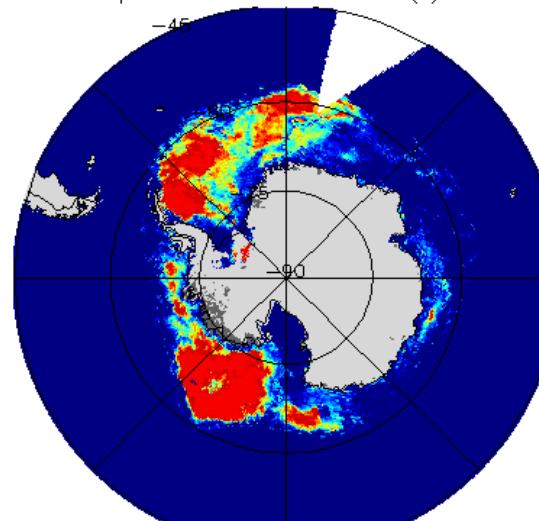
MIRS NPP/ATMS N. H. Multiple Year Sea Ice Concentration (%) 2014-10-20 Des (V3259)

MYI



MIRS NPP/ATMS S. H. Multiple Year Sea Ice Concentration (%) 2014-10-20 Des (V3259)

MYI





NIC JPSS Wish list for Future Work

(1) Geotiff formats (All)

NIC spends much of its infrastructure, bandwidth and processing on file conversion from HDF formats from VIIRS and MODIS leaving the majority of the content

(1) Include Lake ice in the Ice products (IMS, Great Lakes Analysis)

(2) Product Composites at 1km (IMS, Hemispheric Ice Charts)

Difficulty stitching multiple swath and resampling to lower resolution

(3) Ice Edge (Marginal Ice Zone)

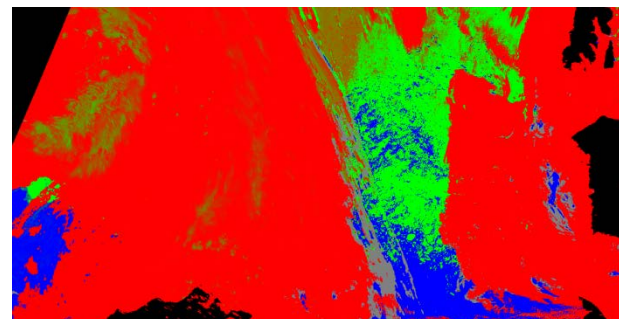
(4) Ice Drift (Ice Forecasting, IMS, annotated imagery)

(5) Ice Lead Detection (FLAP, Annotated Imagery)

(6) Snow Fraction (IMS, ASI)

(7) Blended products (All)

(8) Optional Cloud masks (All)



CREST experimental Ice Cover 7/31/13



IMS Blended Sea Ice Concentrations

BLENDED ICE CONCENTRATIONS: STAR and NIC are developing a Blended Ice Concentration primarily for modeling

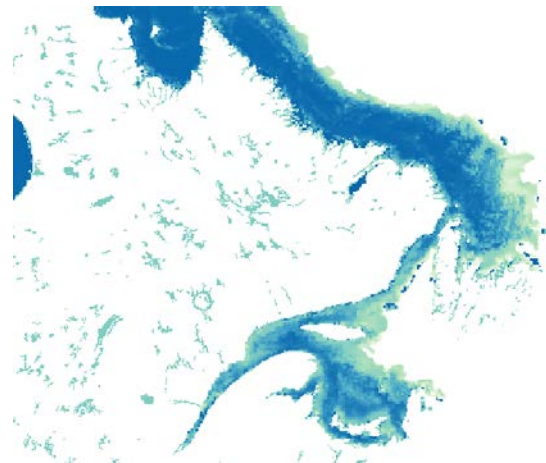
- **Using Optimal Interpolation to blend ice concentrations**
- **New “replacement” using:**
 - *SAR*
 - *Ice Charts*
 - *Other ice/no ice products (CREST, VIIRS RR, GOES R)*
- **Date since last ob and source tracking**
- **Ice Concentrations determined from:**
 - *IMS Ice Cover*
 - *AMSR 2*
 - *ATMS MIRS*
 - *VIIRS Ice Con*
 - *Ice Charts (NIC, CIS, DMI, MetNo, NWS Alaska, etc)*
 - *Analyst “tie Points”*
 - *NWP models*
- **2016 Release?**



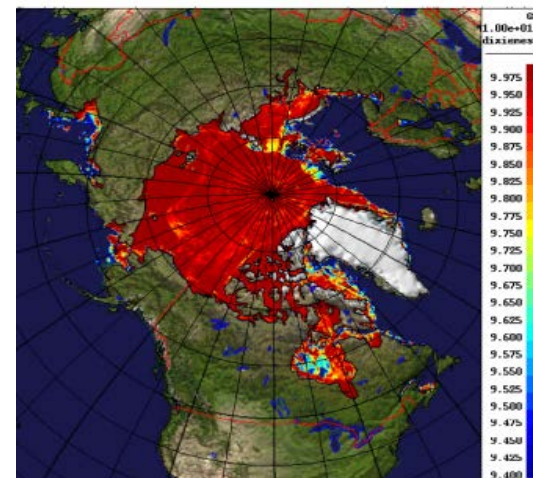
NIC & NOAA Arctic Action Plan (2012)

- **Improve ice, weather and water forecasts and warnings**
 - Improve snow depth, snow cover, ice cover, and ice thickness analysis for operational model initialization or assimilation
 - Integrate new satellite-derived sea ice information into National Ice Center operations, such as ice thickness, ice concentration, and size of leads (fractures) in ice
 - Advance our sea ice services through the addition of more observational data sets to our analysis and forecasting techniques, evaluations of coupled model output from Environment Canada and the Naval Research Laboratory, and the expansion of product suites with new and more frequent services.
 - Establish foundational components of a Regional Operations Center and Arctic Test Bed to strengthen NOAA's ability to be responsive to emerging service requirements in the Arctic and leverage new science and technology capabilities.

Blended IMS Ice Concentrations



GIOPS CMC Ice Concentrations





NIC & NOAA Arctic Action Plan (2012)

- **Strengthen foundational science to understand and detect Arctic climate and ecosystem changes**
 - Conduct coordinated calibration and validation of satellite measurements of the cryosphere through in-situ and airborne missions in collaboration with national and international partners
- **Enhance international and national partnerships**
 - IICWG, NAIS, NASA, U of Washington, IABP, WMO Cryosphere Watch
 - Coordinating with national and international partners to broaden geographic coverage of Arctic sea ice analysis and forecasting





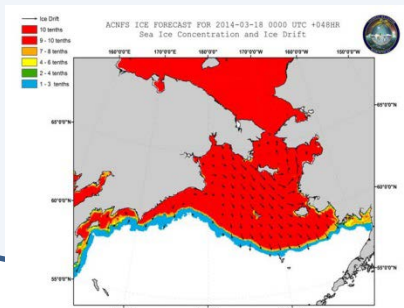
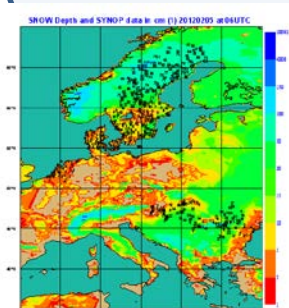
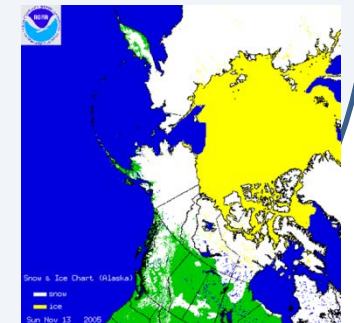
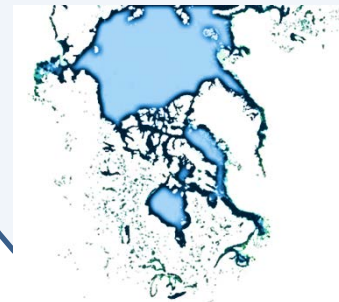
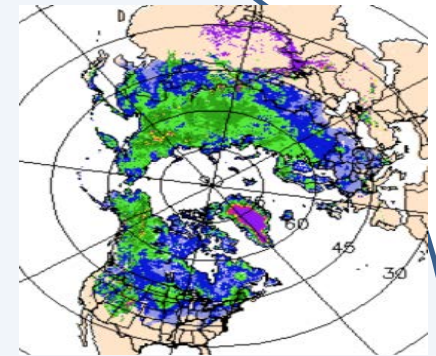
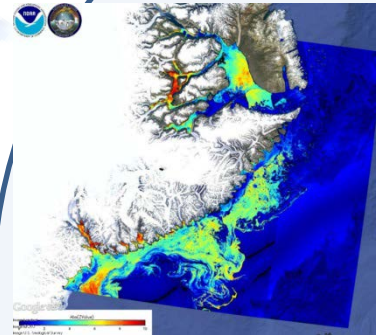
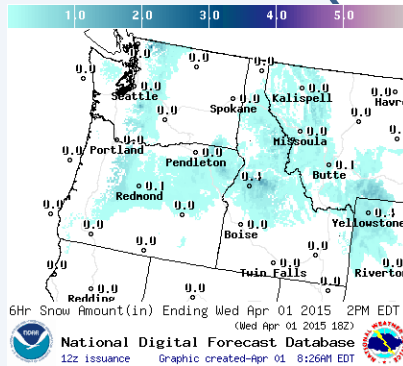
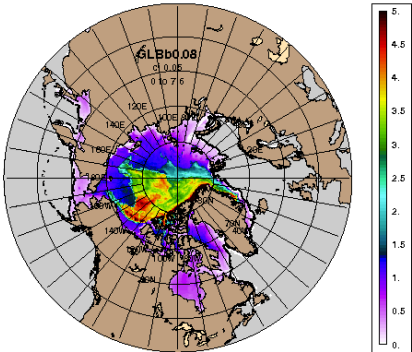
Integration with Models

CUSTOMERS & PUBLIC

NIC Analysis

**Navy and NOAA Models
(and others)**

GLBb0.08-18.1 Ice Thickness: 2012_001



Models provide forecasts for
NIC forecasters which apply NIC
analysis data.



Thank You!

