BLENDED VIIRS+MICROWAVE ICE CONCENTRATION

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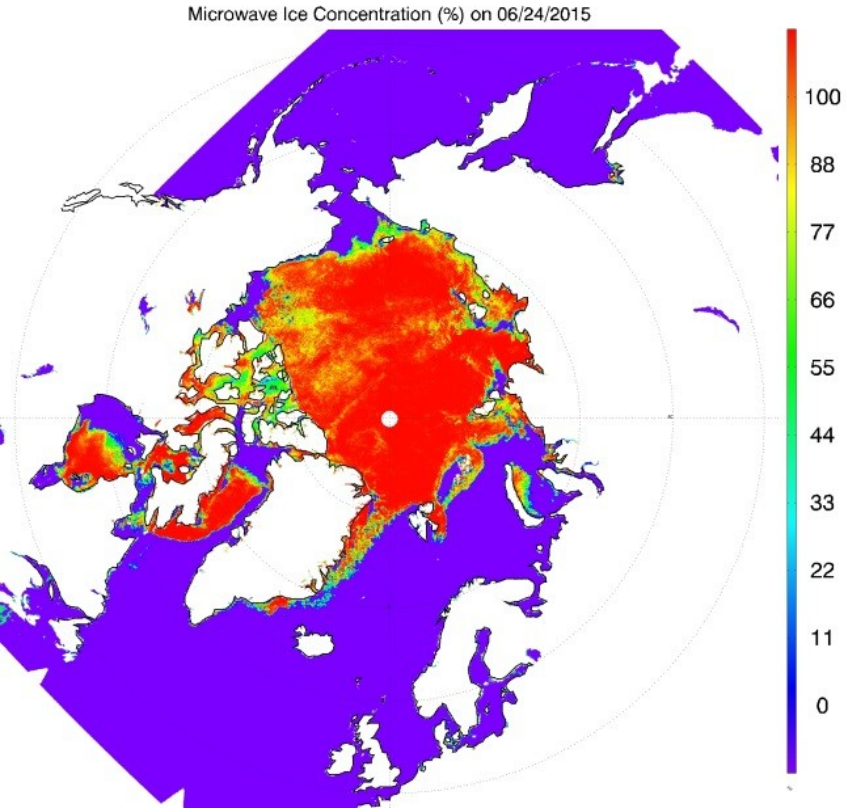
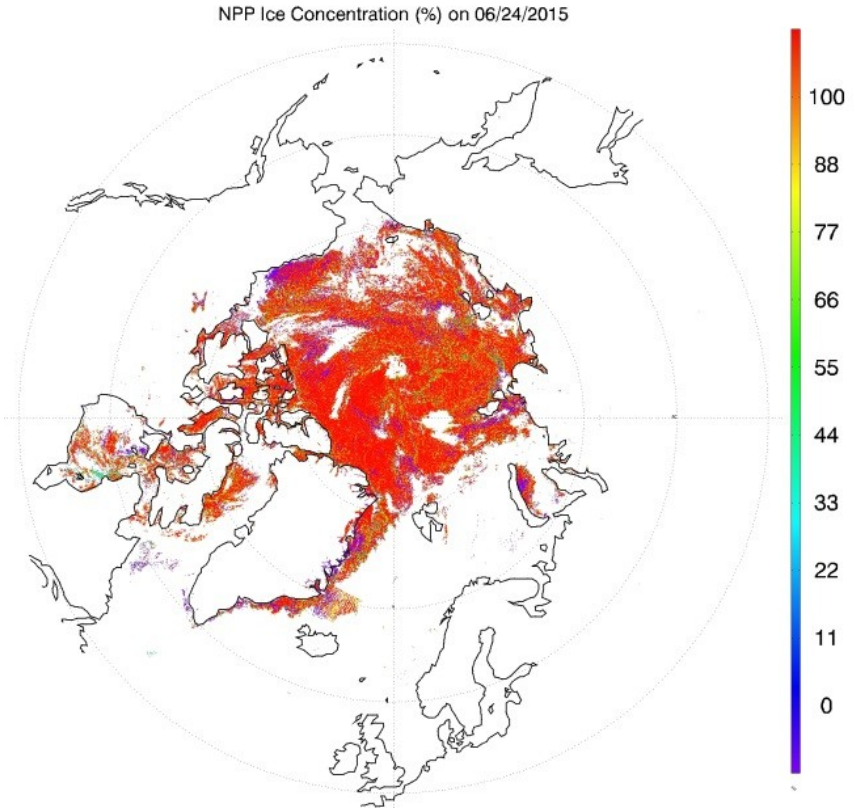
Motivation: all-sky high resolution

AMSR-2 ice concentration 06-24-2015



Passive microwave ice concentration:
Con: low spatial resolution
Pro: all-weather

S-NPP VIIRS ice concentration 06-24-2015



Passive infrared/visible ice concentration:
Con: clear-sky only
Pro: high spatial resolution

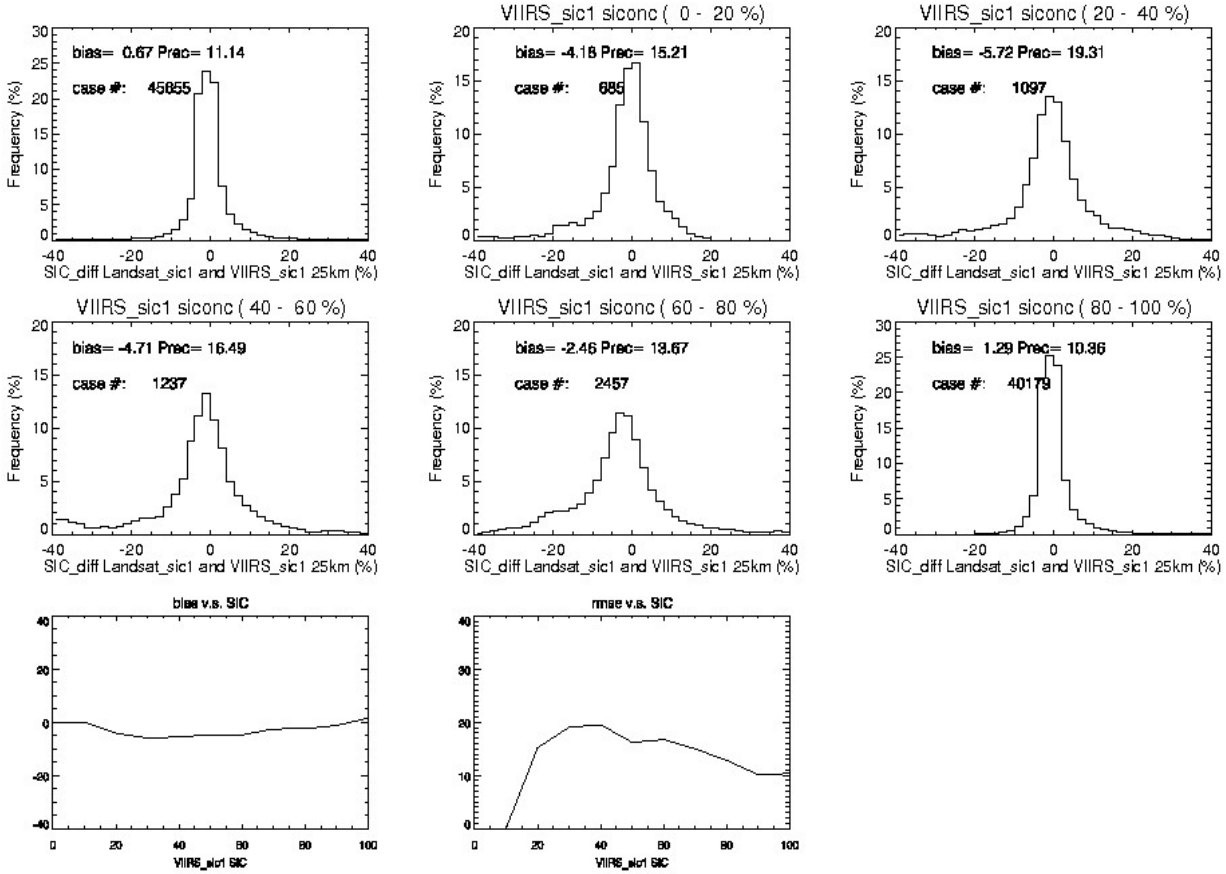
Algorithm Overview: approach

The Best Linear Unbiased Estimator (BLUE) is then applied to derive the final ice concentration under clear sky conditions:

$$ICE\_CONC = \left(\frac{\sigma_2^2}{\sigma_1^2 + \sigma_2^2}\right) \times (ICE\_CONC_1 - D_1) + \left(\frac{\sigma_1^2}{\sigma_1^2 + \sigma_2^2}\right) \times (ICE\_CONC_2 - D_2)$$

where ICE_CONC, ICE_CONC1, and ICE_CONC2, are optimized ice concentration, and ice concentrations from the two products; D1 and D2 are measurement accuracy; σ1 and σ2 are the measurement precision.

Algorithm Overview: parameters



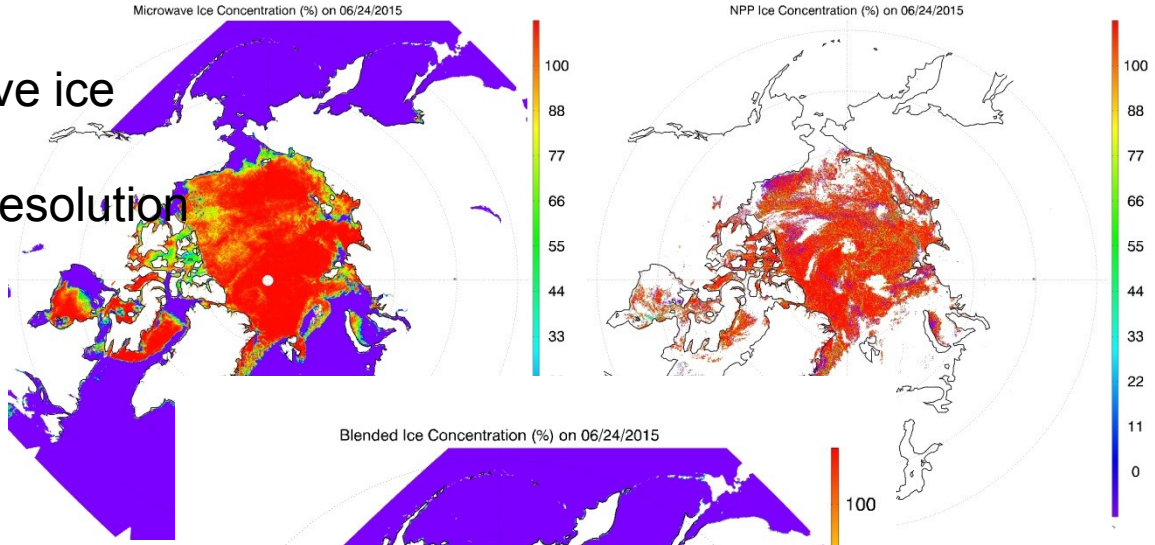
Comparison of VIIRS and Landsat ice concentrations for different concentration ranges/bins. Also shown are the differences overall (upper left) and the bias and root-mean-square (RMS) difference as a function of VIIRS ice concentration (bottom row).

Same comparisons are made for AMSR2 ice concentration.

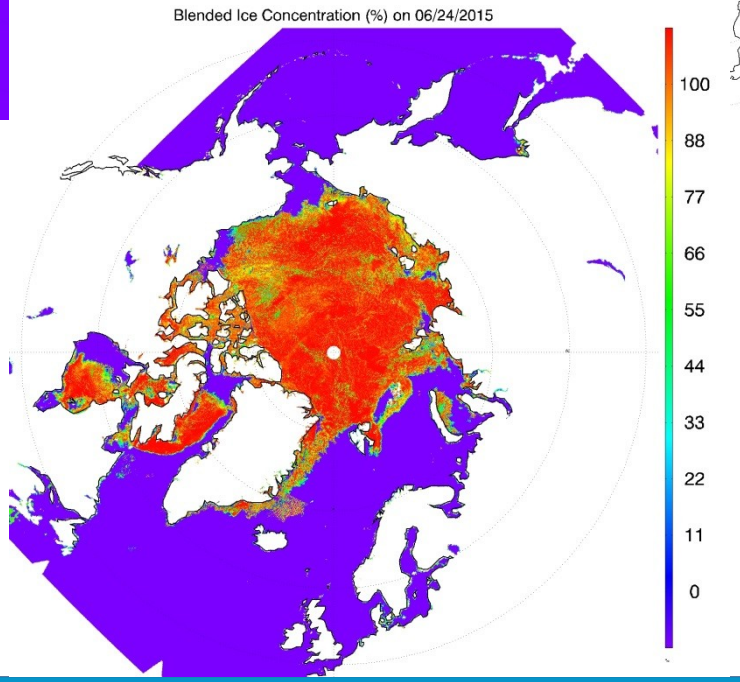
Algorithm Overview: case study

Blended sea ice concentration from Microwave and infrared/visible

Passive microwave ice concentration:
Con: low spatial resolution
Pro: all-weather



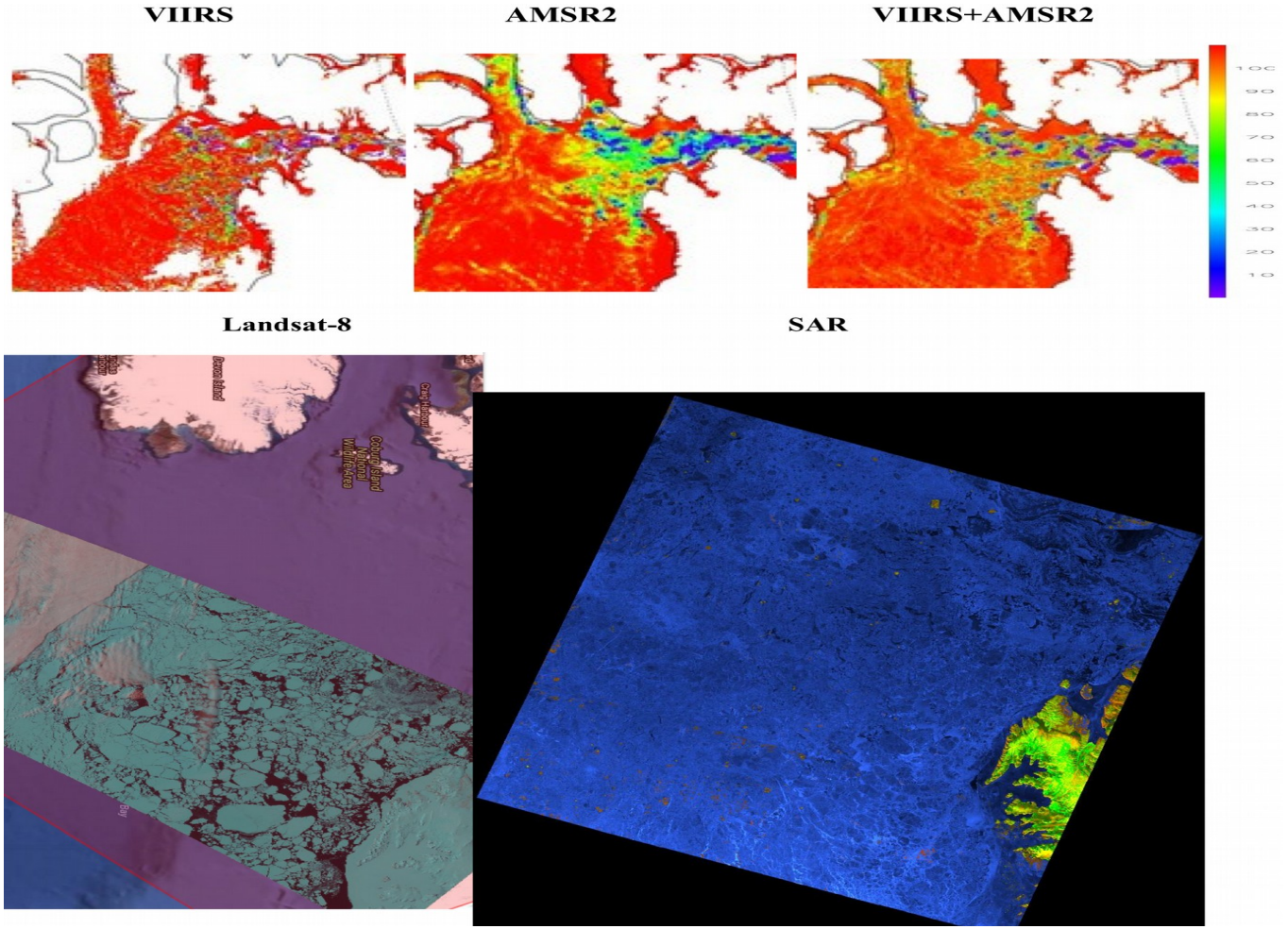
Passive infrared/visible ice concentration:
Con: clear-sky only
Pro: high spatial resolution



Blended sea ice concentration at 1 km resolution on June 24, 2015 using AMSR-2 and the Suomi NPP VIIRS ice concentration products

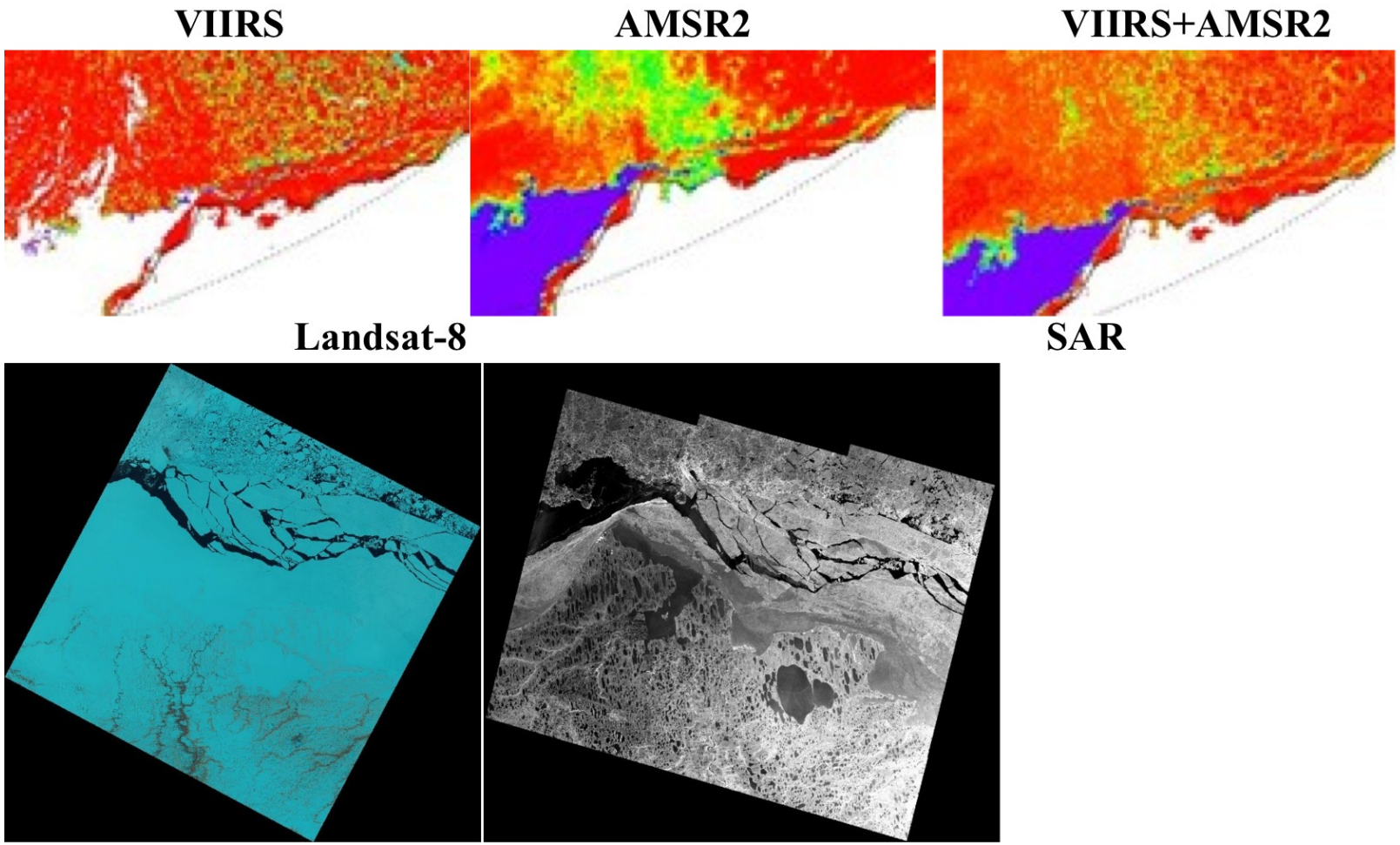
Blended ice concentration: high spatial resolution under all-weather conditions

Performance



On May 11, 2017 over Baffin Bay VIIRS, AMSR2 and Blended SIC on top. Landsat-8 OLI/TIRS and SAR Sentinel-1B imagery on bottom

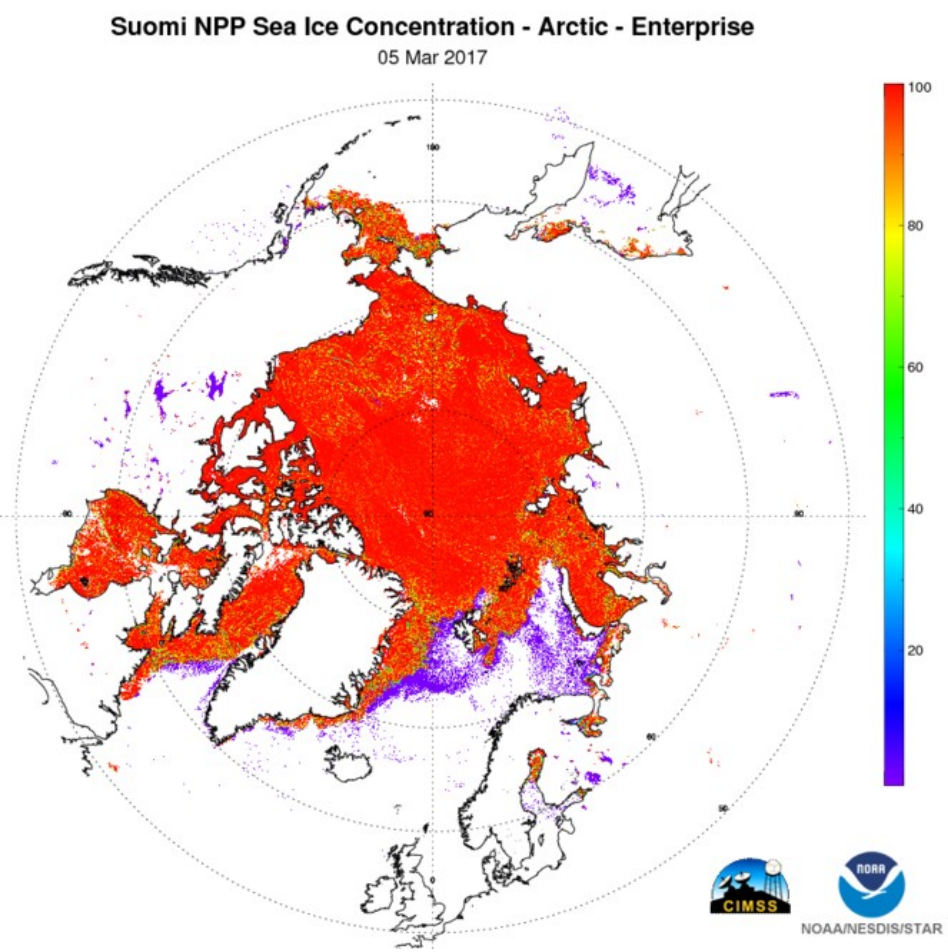
Performance

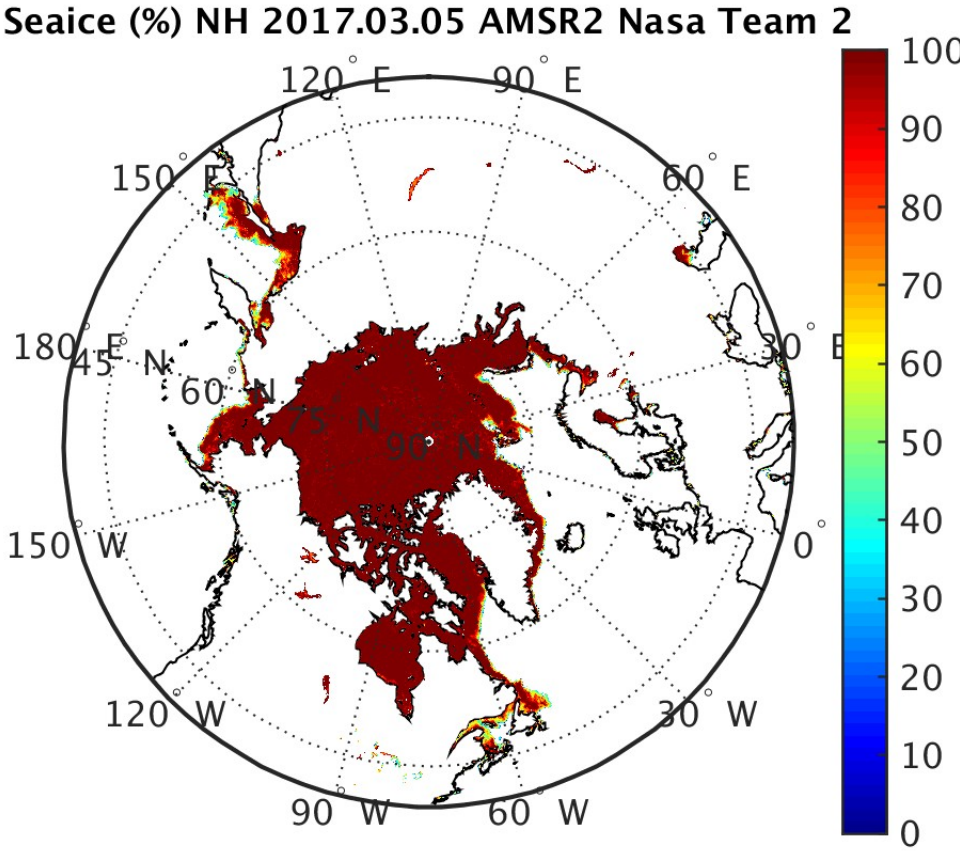


On May 27, 2017 near Alaskan Beaufort Sea Coast VIIRS, AMSR2 and Blended SIC on top. Landsat-8 OLI/TIRS and SAR Sentinel-1A imagery on bottom

Current Status

- Blended ice concentration is being generated daily for National Ice Center
- Data is in GeoTIFF format, over both Arctic and Antarctic





Daily Ice concentration composite from VIIRS (**left**); and AMSR2 (**right**) over the Arctic on March 5th 2017.

Current Status

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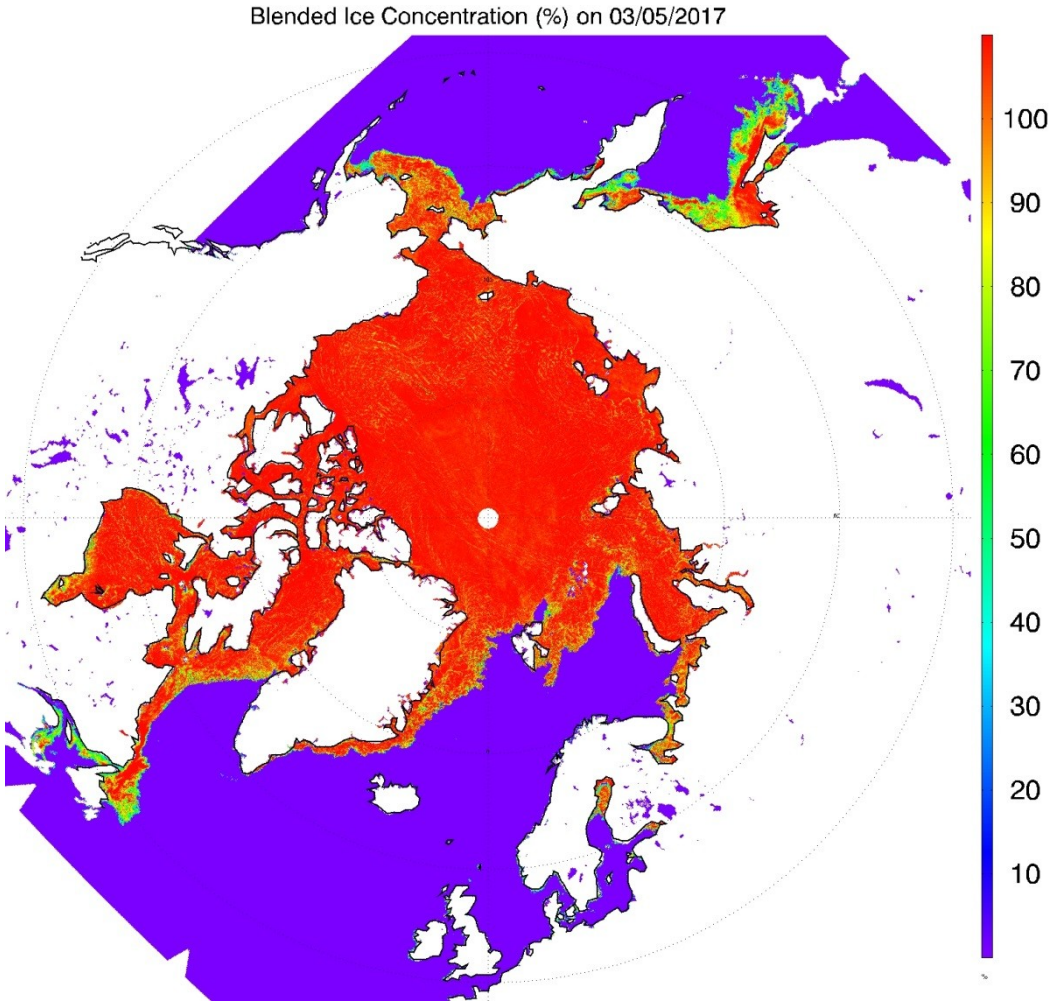


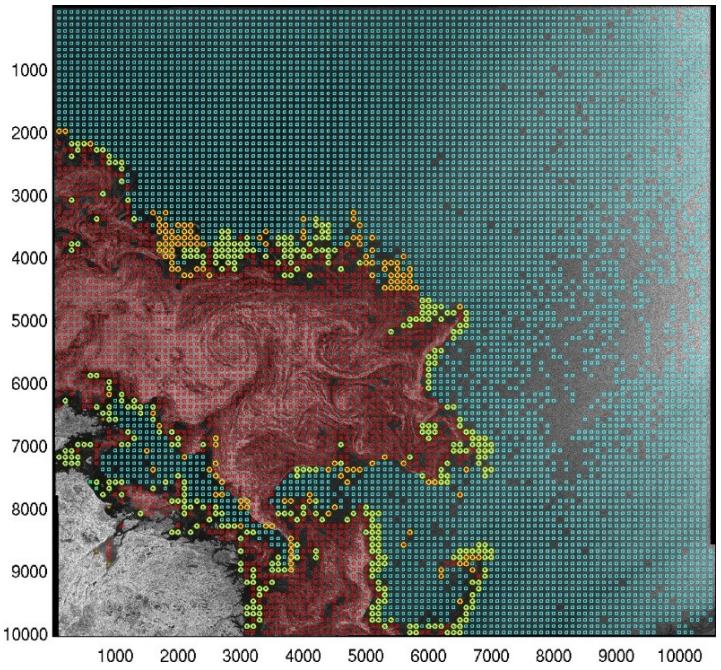
Blended Daily Ice concentration (IC) over the Arctic on March 5th 2017.

User Interaction

- Blended ice concentration is currently archived for National Ice Center for evaluation

Summary and Path Forward

- Blended ice concentration from VIIRS and passive microwave provides high spatial resolution ice concentration under all-weather conditions;
- This product can benefit operational applications, and long-term scientific studies;
- Further improvement and evaluation is needed with new ice concentration products from sensors with very high spatial resolution, e.g. SAR.



Labrador Sea, May 3, 2013

Ice/water retrievals at 5 km spacing

Ice agrees with IMS
Water agrees with IMS
Ice disagrees with IMS
Water disagrees with IMS

Acknowledgement:
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BLENDED AMSR2+VIIRS SEA ICE MOTION

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Algorithm Overview

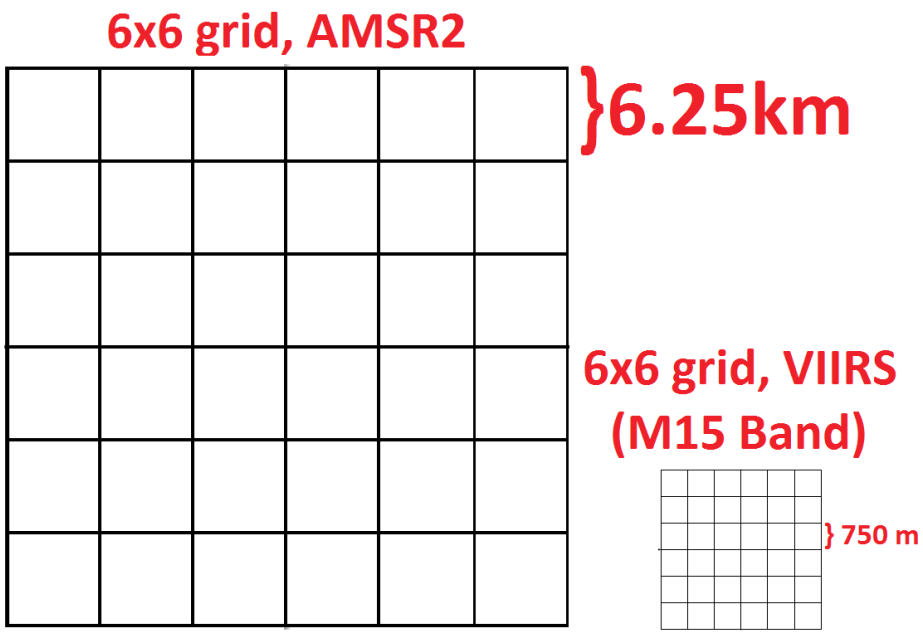
- Automated sea ice motion uses a pair of satellite images to determine the displacement of ice features under clear sky conditions.

- The algorithm outputs motion as a velocity in the u- or v-direction. Velocity is based on the number of grid cells "travelled" between the image pair.

- Grid cell size is based on the spatial resolution of the imagery

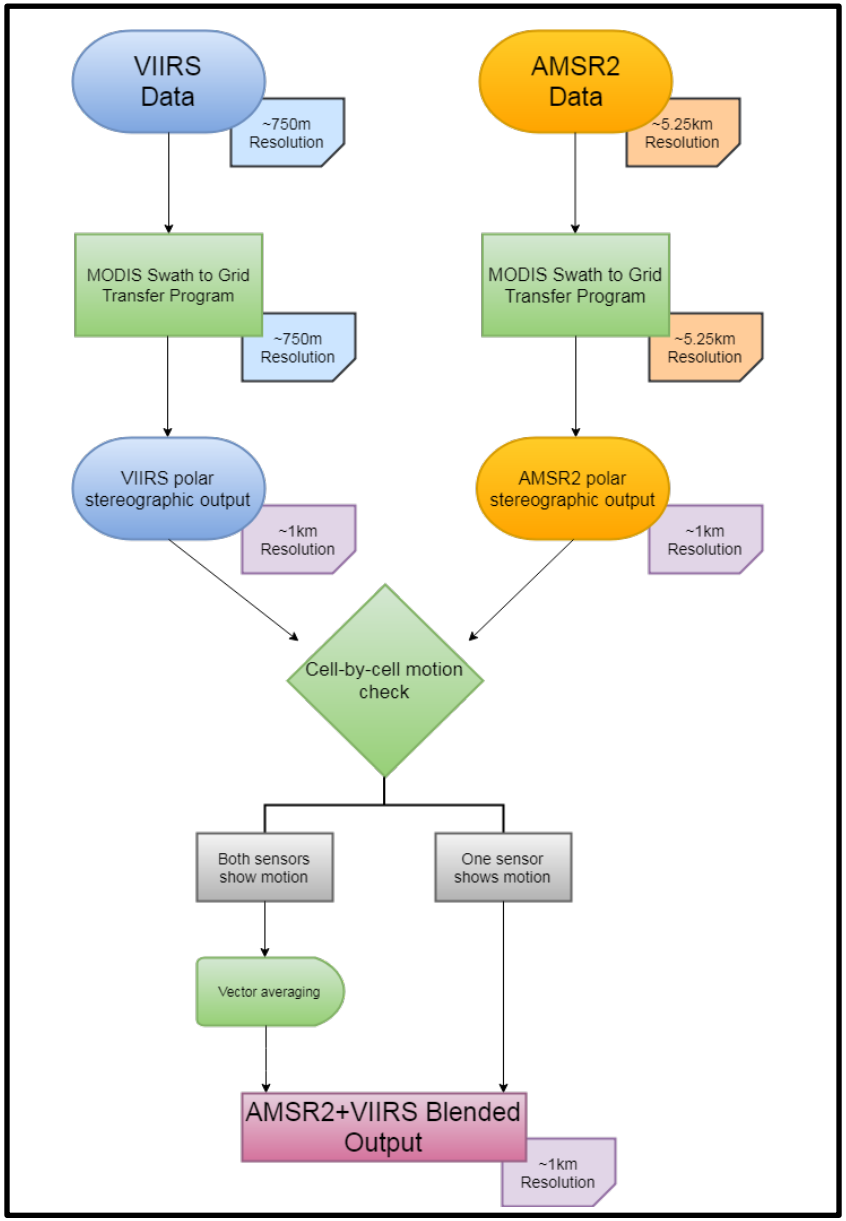
- **Blended sea ice motion combines information from multiple sensors at different resolutions**

Algorithm: Blending AMSR2+ VIIRS



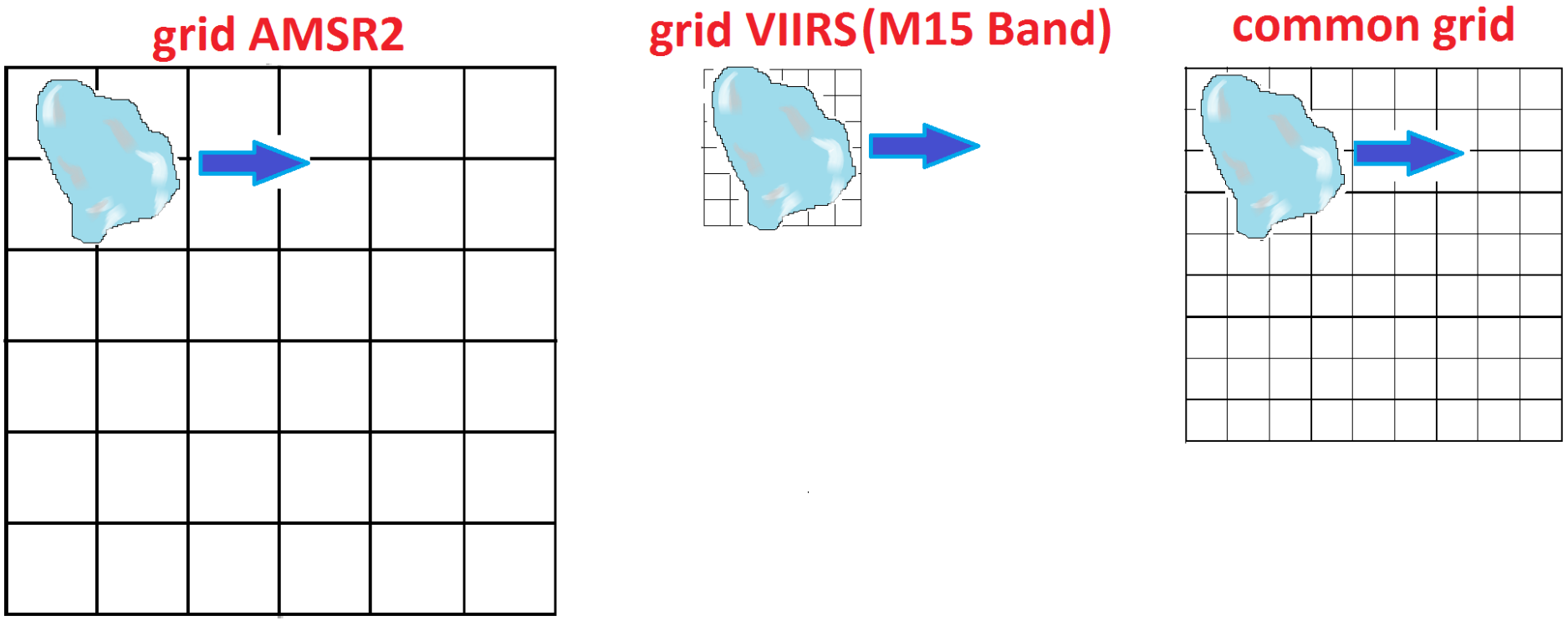
- Objective: Combine the all-weather capabilities of AMSR2 89GHz channel with the precision of VIIRS M-bands
- Difficulties: Spatial resolution of AMSR2 ~9x more coarse (6.25km) than VIIRS (0.75km)
- Solution: Regrid both images to a shared resolution (~1km) so that motion output can be combined

Algorithm: Blending AMSR2+VIIRS



- Input from both sensors is regrid from swaths onto a polar stereographic grid
- MODIS Swath to Grid Transfer (MS2GT) does the hard work
- Once the inputs are at the same resolution, ice motion is calculated, then combined
- Simple combination technique (arithmetic mean)

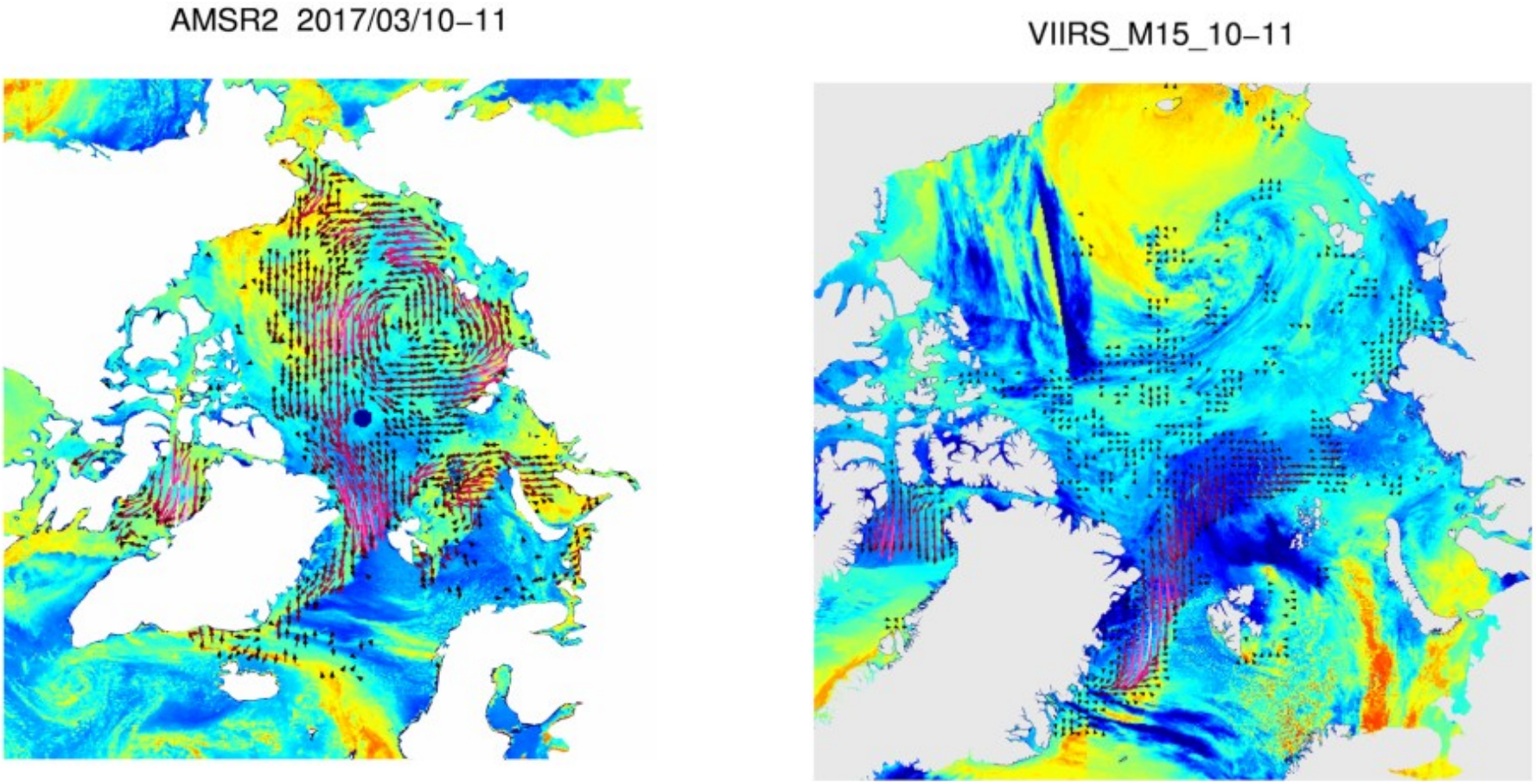
Algorithm: Blending AMSR2+ VIIRS



- Once both grids have been remapped to a common grid, features and motion can be compared and combined

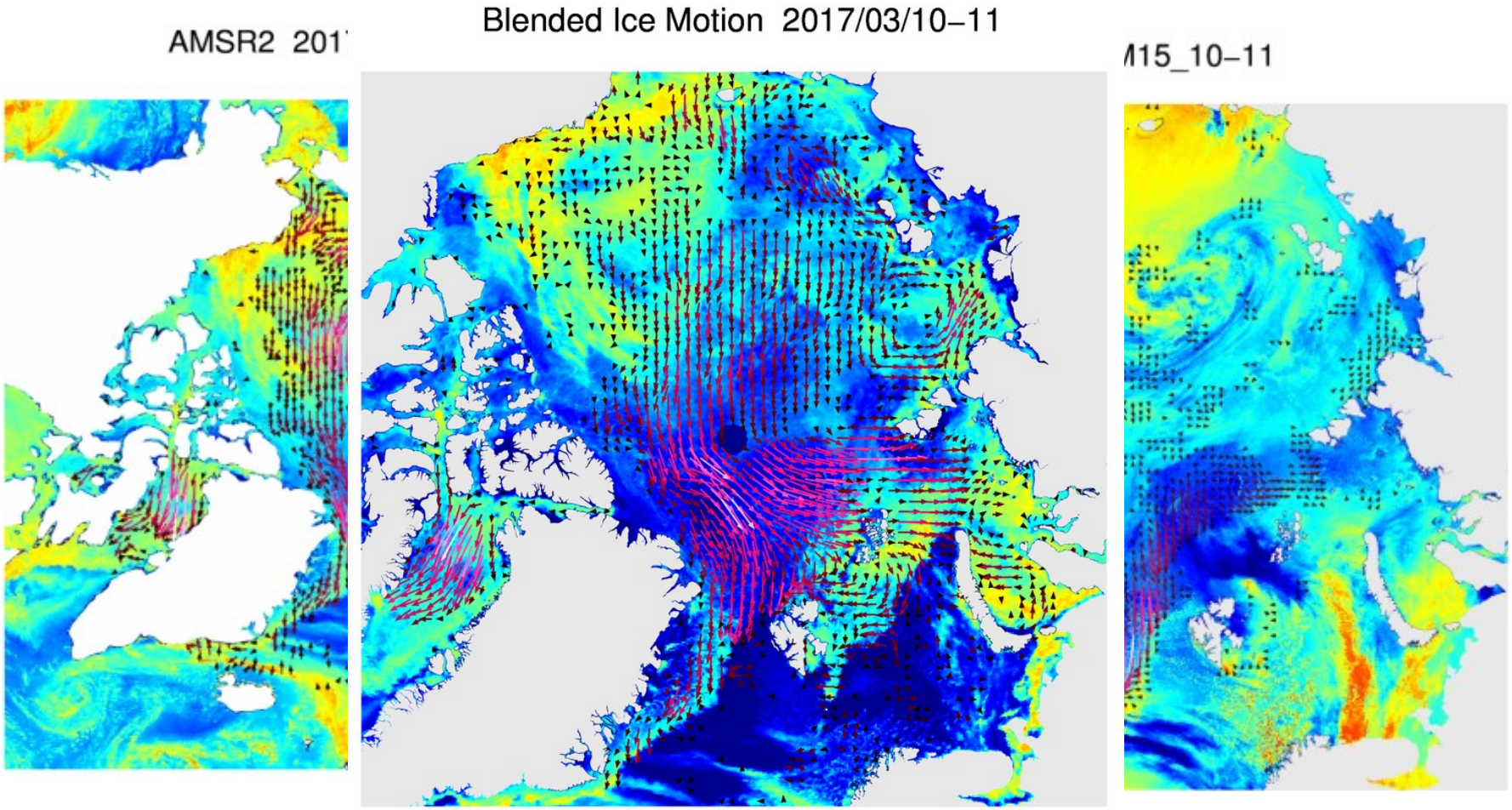
- Adding in a third input (SAR) could provide more information, greater challenges

Performance: Blending AMSR2+ VIIRS



Motion from all-weather AMSR2 output (left) and high-resolution VIIRS M15 output (right)

Performance: Blending AMSR2+ VIIRS



Blended product provides high spatial resolution under all-weather conditions, spatially coherent vectors

Summary and Path Forward

- Blended ice motion from VIIRS and AMSR2 provides high spatial resolution ice motion under all-weather conditions
- Demonstrate capabilities of multi-channel VIIRS ice motion (Day-Night Band) and include data from SAR (at 250m resolution!)
- Product benefits operational applications, and more sensor input can provide a more consistent record of ice motion
- Procedure for combining vectors is too simplistic. Known error and sensitivity of ice motion from each sensor input should computed and considered for future applications