

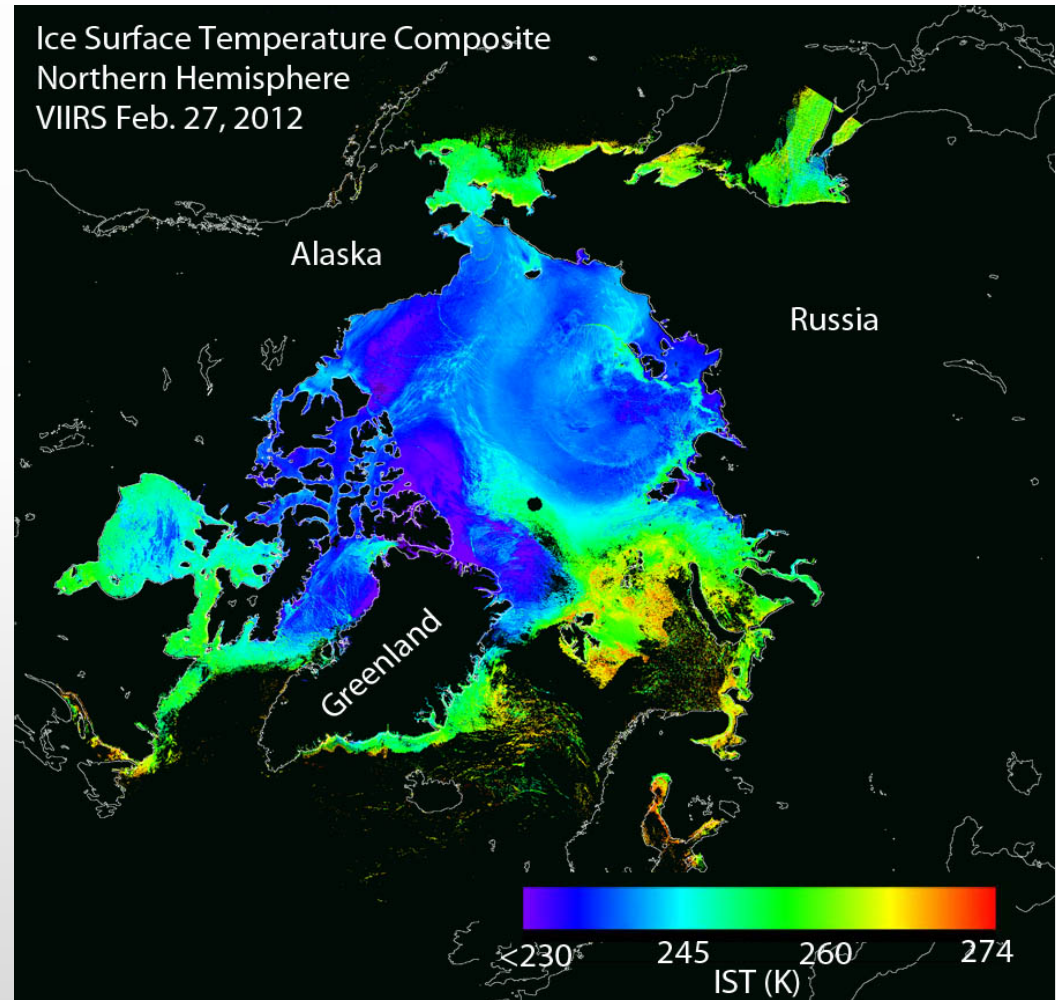
# Suomi- NPP VIIRS Ice Surface Temperature EDR Status

Mark Tschudi (CU)\*

Yinghui Liu (UWisc), Richard Dworak (UWisc), Dan Baldwin (CU), Robert Mahoney (NG)

# VIIRS Ice Surface Temperature

IST is the radiating, or "skin", temperature at the ice surface. It includes the aggregate temperature of objects comprising the ice surface, including snow and melt water on the ice.

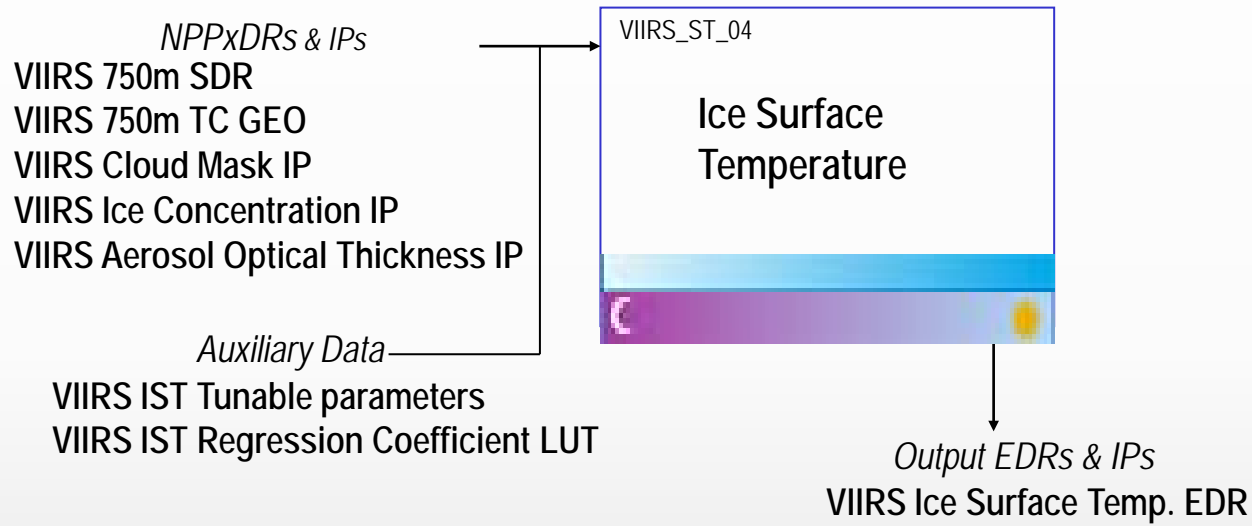


# Summary of the VIIRS IST EDR

- The VIIRS Ice Surface Temperature (IST) EDR provides surface temperatures retrieved at VIIRS moderate resolution (750m), for snow/ice covered oceans for both day and night.
- The baseline split window algorithm statistical regression method uses two VIIRS Infrared bands, 10.76  $\mu\text{m}$  (M15) and 12.01  $\mu\text{m}$  (M16) for both day and night and is based on the AVHRR heritage IST algorithm (Yu *et al.*, 1995).
- Threshold Measurement Uncertainty = **1K**

*Yu, Y., D.A. Rothrock and R.W. Lindsay, 1995, Accuracy of sea ice temperature derived from the Advanced Very High Resolution Radiometer. J. Geophys. Res., 100(C3), 4525-4532*

# Summary of the VIIRS IST EDR Algorithm Inputs





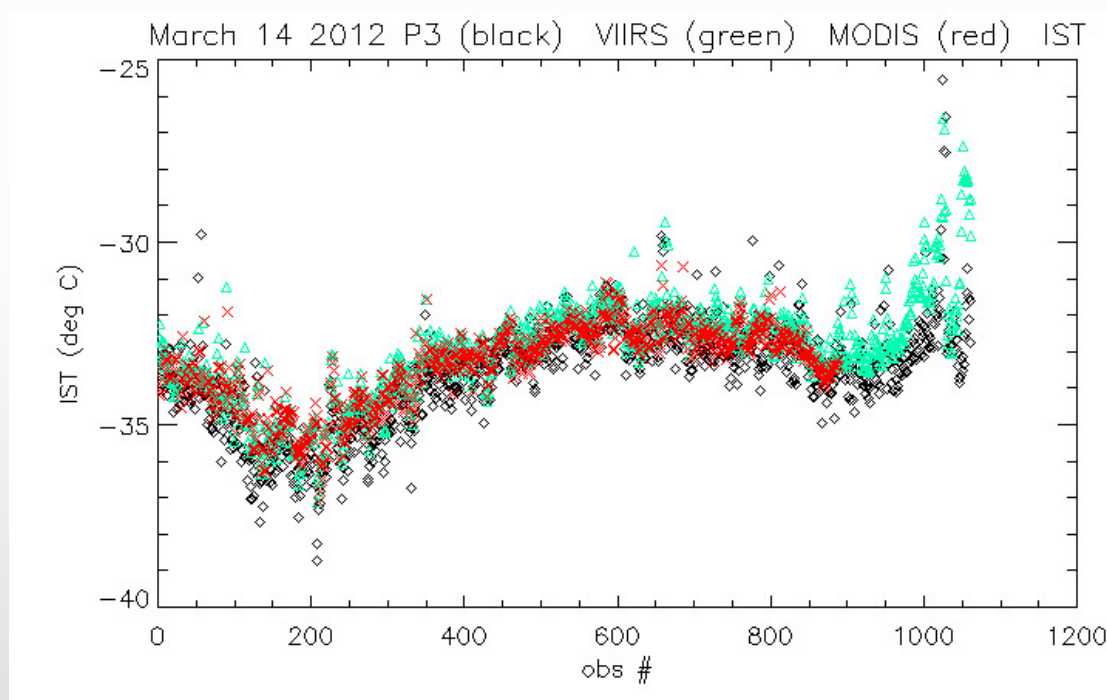
# VIIRS IST EDR and IceBridge Flight IST

NASA's Land PEATE re-processed portions of the VIIRS IST EDR that are co-incident with IceBridge flights over sea ice during March and April 2012.

mean VIIRS =  $-33.2^{\circ}\text{C}$   
mean KT-19 =  $-33.7^{\circ}\text{C}$   
mean MODIS =  $-33.4^{\circ}\text{C}$   
BIAS VIIRS-MODIS =  $+0.2^{\circ}\text{C}$

RMS differences:

VIIRS - KT-19 =  $0.6^{\circ}\text{C}$   
MODIS - KT-19 =  $1.2^{\circ}\text{C}$   
VIIRS - MODIS =  $1.1^{\circ}\text{C}$



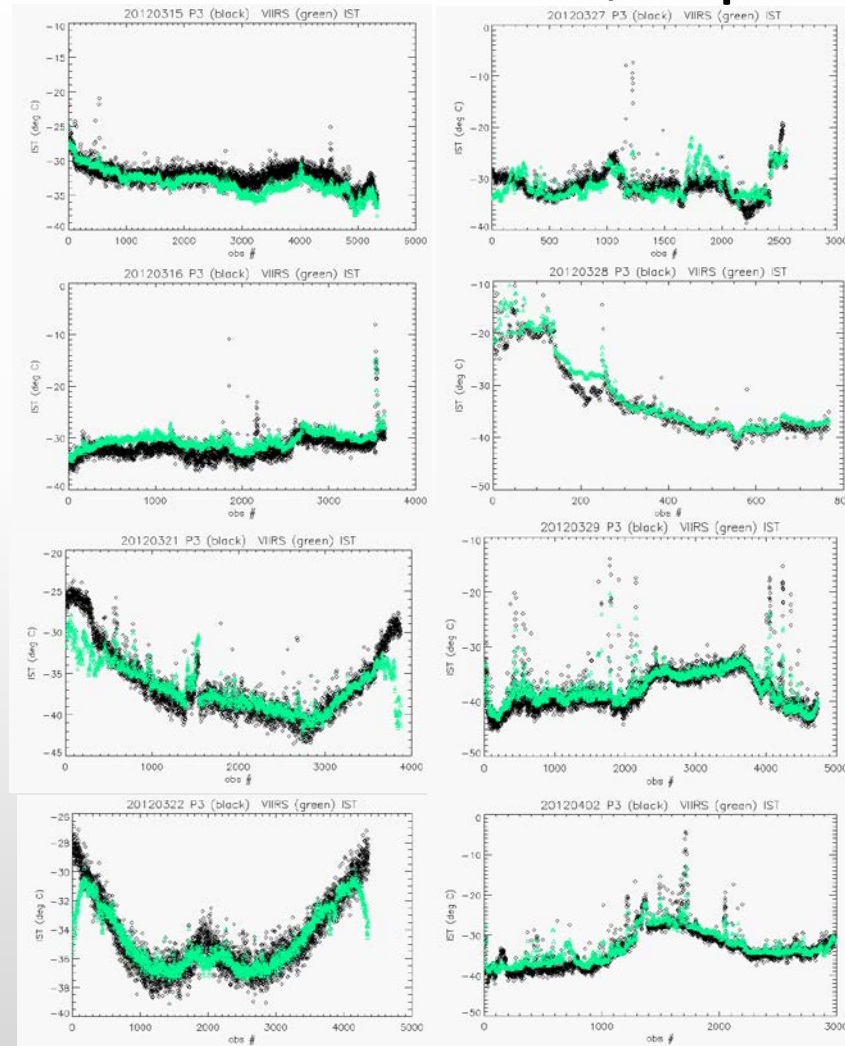
*Comparison between the IST (in deg C) measured by the KT-19 (in black, smoothed over 100 points), the nearest VIIRS IST measurement (in green) and MODIS observation (red).*

# IceBridge KT19 vs VIIRS IST, Spring 2012

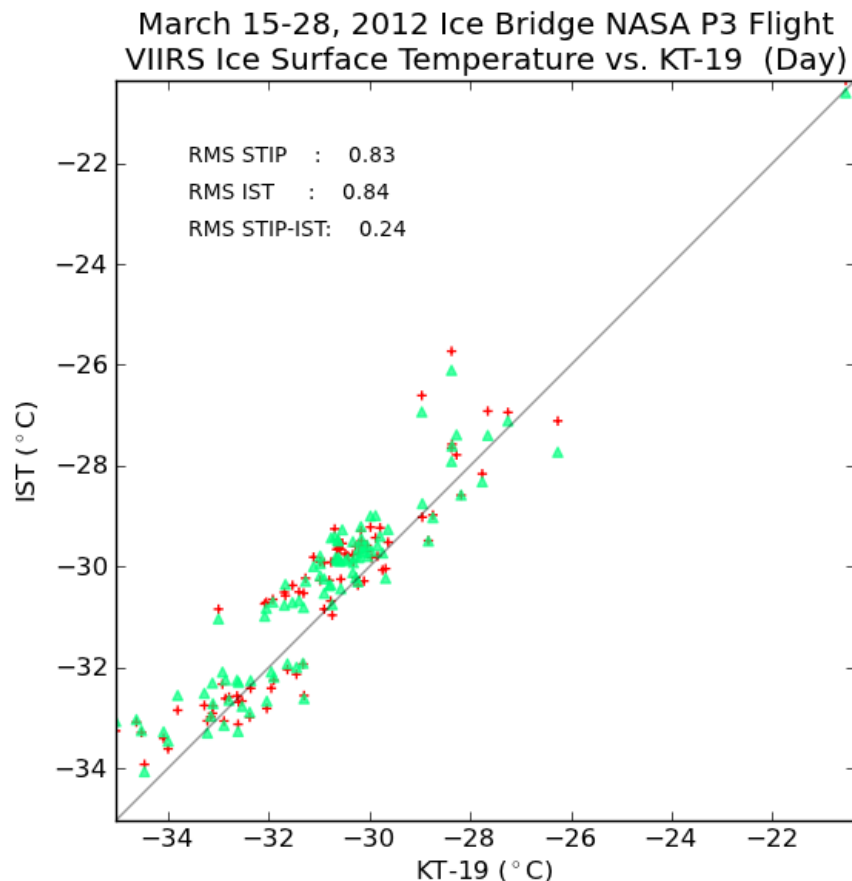
BIAS = VIIRS - KT19

DATE	KT19	VIIRS	BIAS	RMS
3/14	-33.71	-33.15	0.56	0.08
3/15	-32.22	-33.05	-0.84	0.63
3/16	-29.88	-28.87	1.01	0.71
3/21	-36.01	-36.56	-0.55	0.41
3/22	-34.45	-34.66	-0.21	0.14
3/27	-31.15	-31.02	0.12	0.21
3/28	-32.61	-31.49	1.12	0.53
3/29	-37.85	-37.39	0.46	0.10
4/02	-33.36	-32.70	0.66	0.19

Using data re-processed by  
NASA Land PEATE, Jan 2013



# IST and ST IP Performance for Day Matchups (corrected ST IP coefficients)

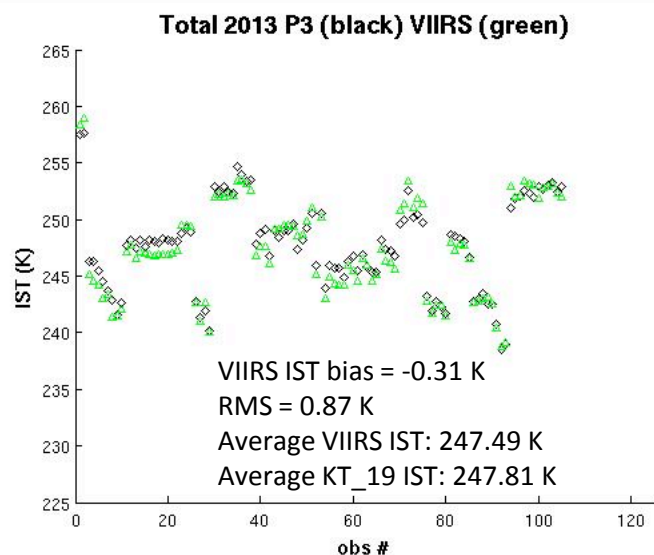


STIP-KT19 Bias = 0.48C  
IST EDR-KT19 Bias = 0.47C

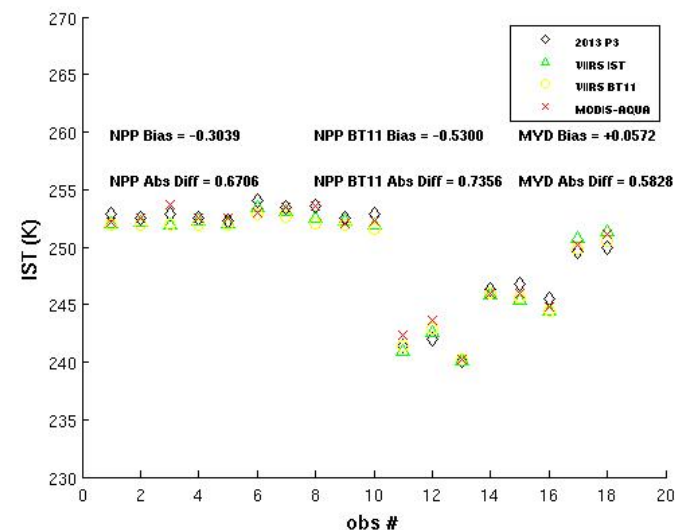
IST and ST IP performance for day matchups for ST IP computed using the corrected ST IP regression coefficients and reprocessed IST EDR to reflect current IDPS operational coefficients. A 15 minute matchup time window is used.



# IceBridge KT-19, March/April 2013

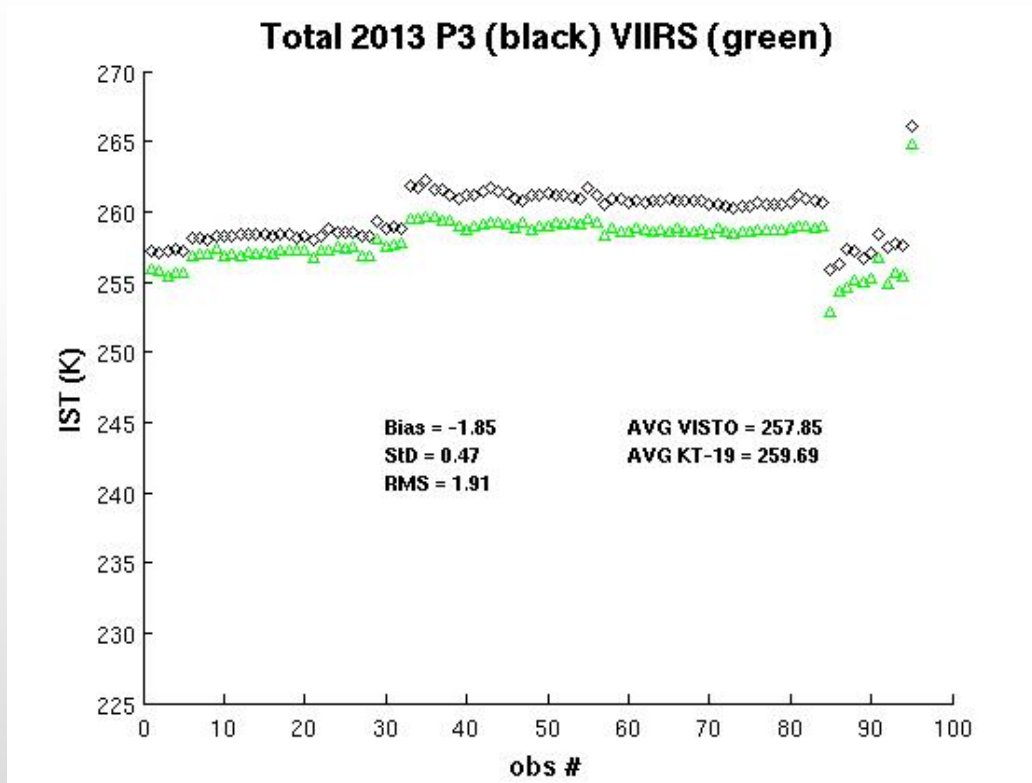


KT-19 vs VIIRS



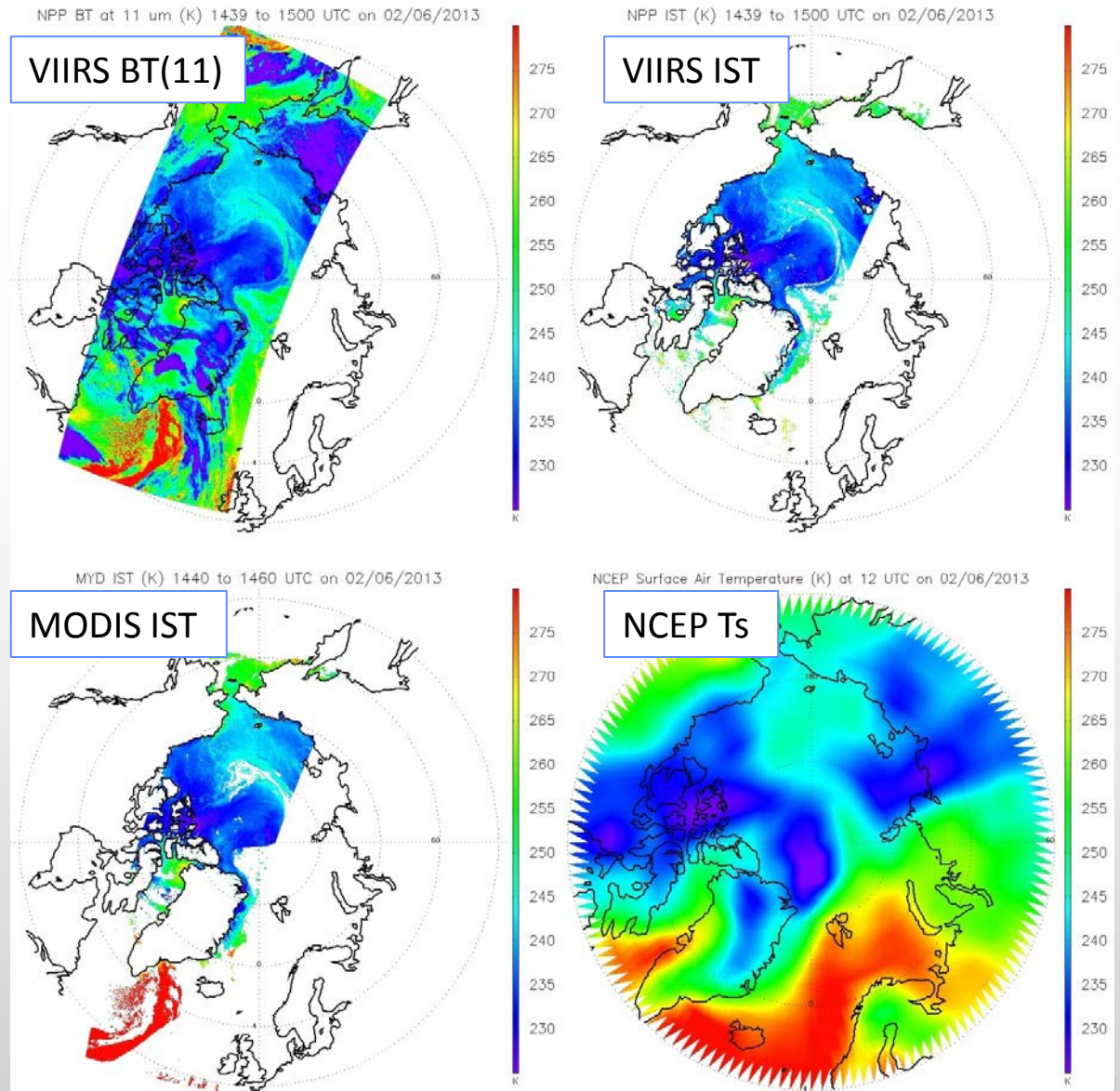
KT-19 vs VIIRS (BT & IST) vs MODIS

# Antarctic, VIIRS vs KT-19

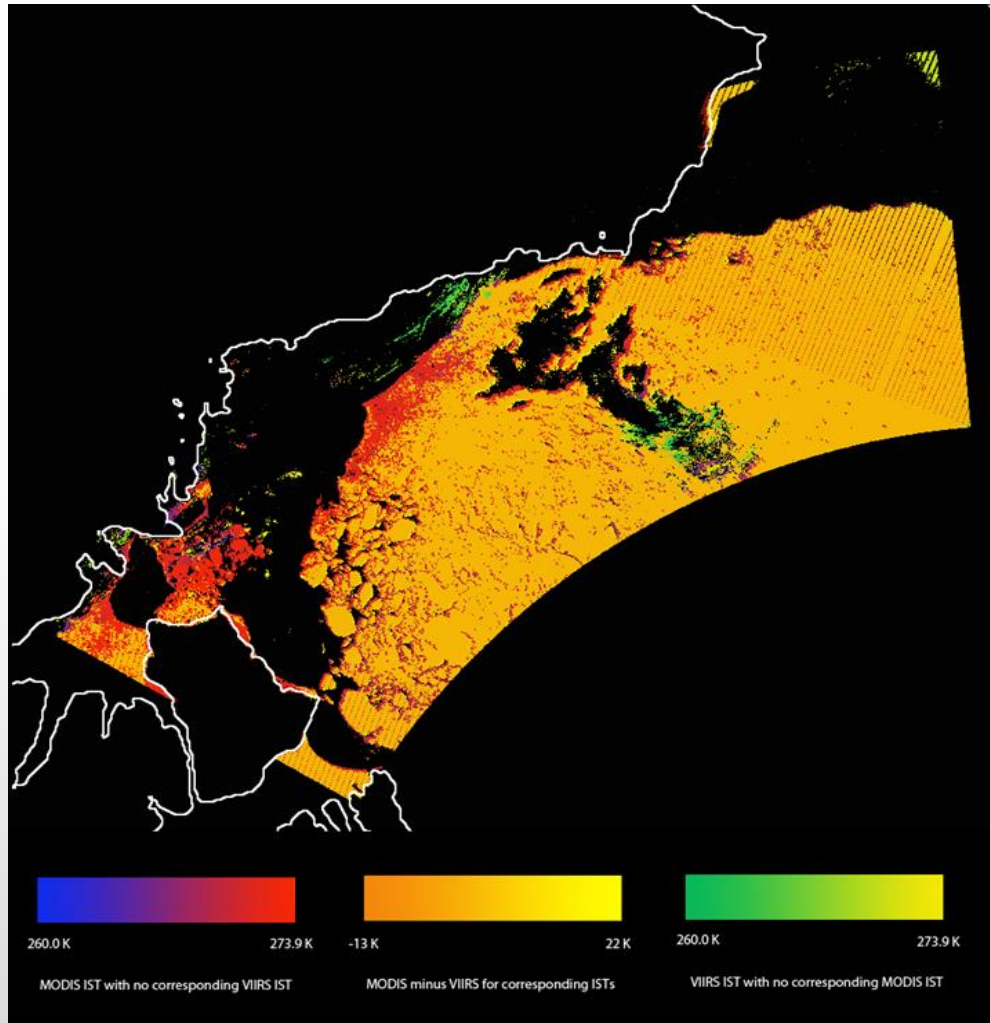


# VIIRS IST, MODIS, and NCEP: 2/6/2013

- VIIRS IST has a 0.5-2 K *cold bias* relative to the MODIS Ice Surface Temperature product.
- Bias for VIIRS Land Surface Temperature vs MODIS over the ice sheet (not shown) is still cold but less than the sea ice IST.
- Comparisons to NCEP and IABP buoy air temperatures show a similar spatial pattern but yield a VIIRS *warm bias* of 1 K or more



# MODIS/VIIRS IST comparison June 8, 2012



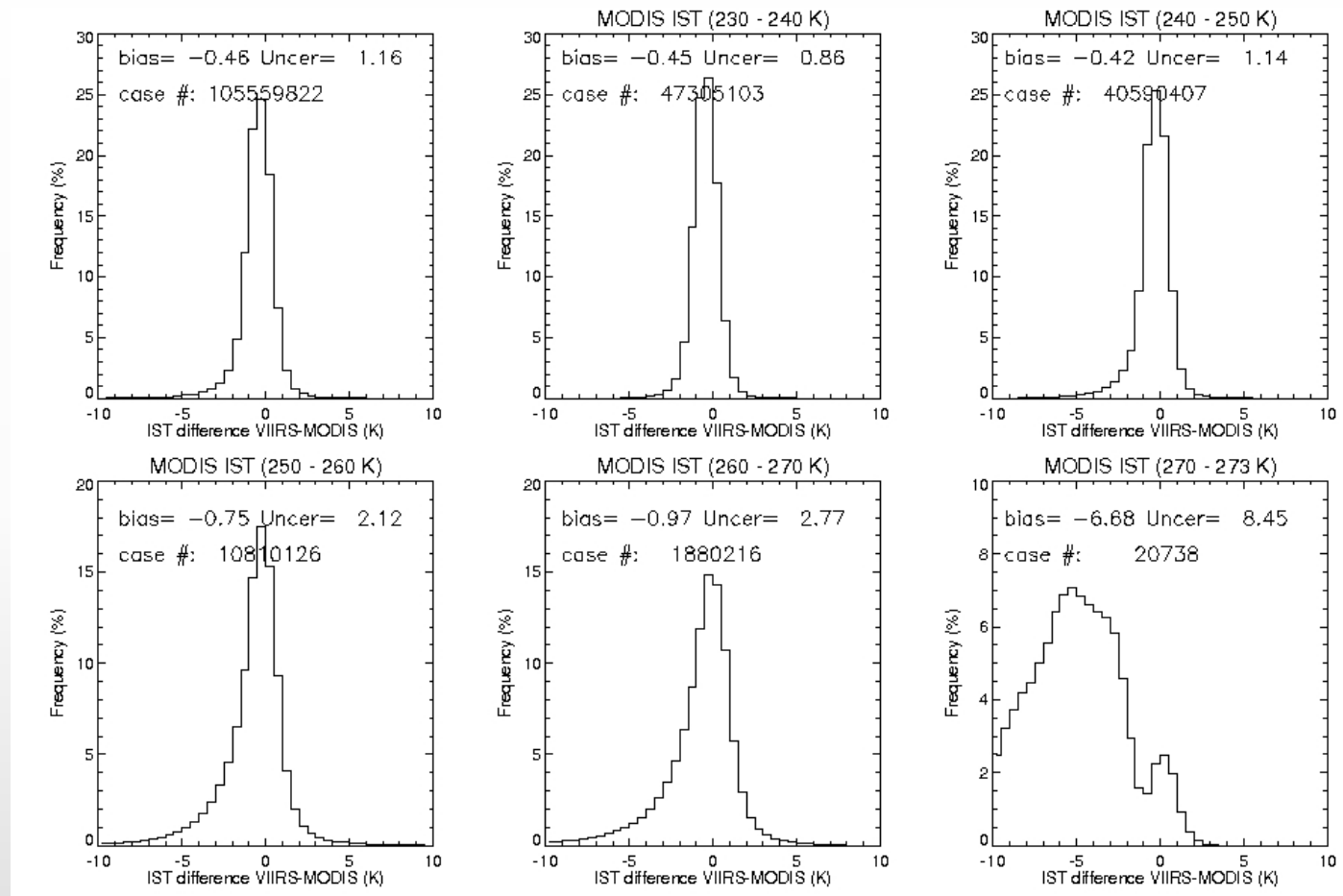
Bias (VIIRS-MODIS) = -0.181 K  
(VIIRS cold bias)

Variance: 1.086 K

# VIIRS IST vs MODIS IST

**VIIRS is biased low (too cold) relative to MODIS**, though the bias is relatively small for most of the temperature range.

Of greater concern is the uncertainty, which is large at higher temperatures.

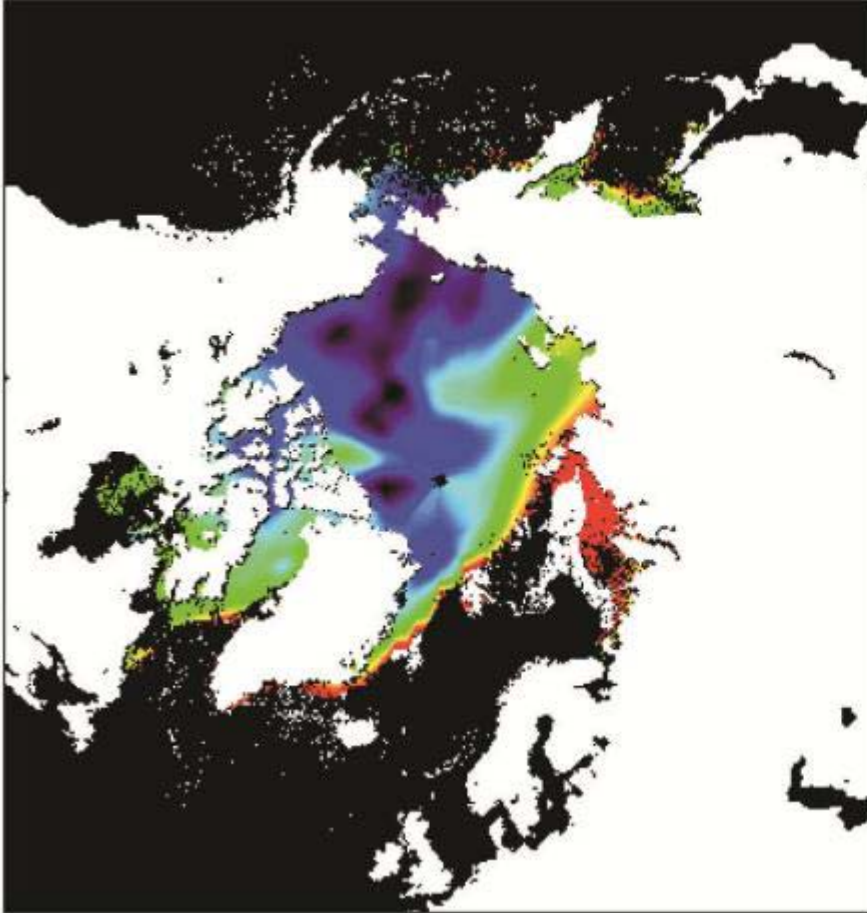


Histogram of ice surface temperature differences of NPP VIIRS and MODIS (Aqua and Terra) in February 2013 in the Arctic for all cases (upper left), and for cases with MODIS ice surface temperature in the ranges 230-240 K, 240-250 K, 250-260 K, 260-270 K, and 270-273 K. Measurement bias and uncertainty are indicated for each bin.

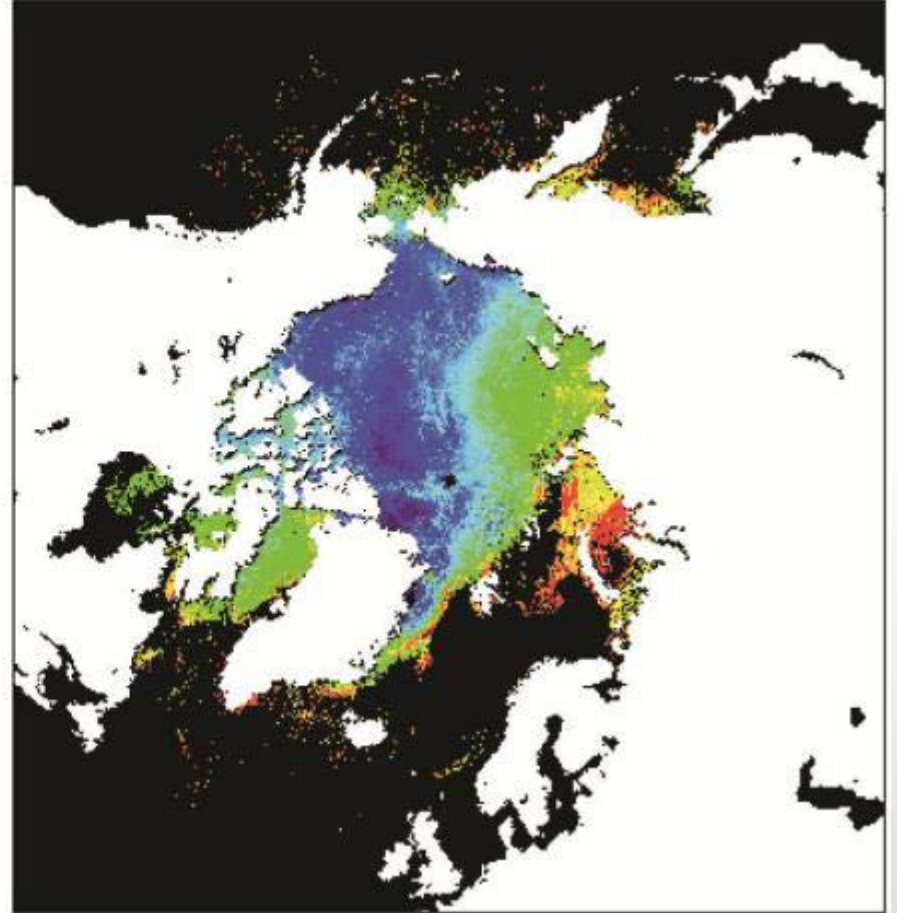


# NCEP NH comparison

NCEP surface temperature (range = 220K to 270K)



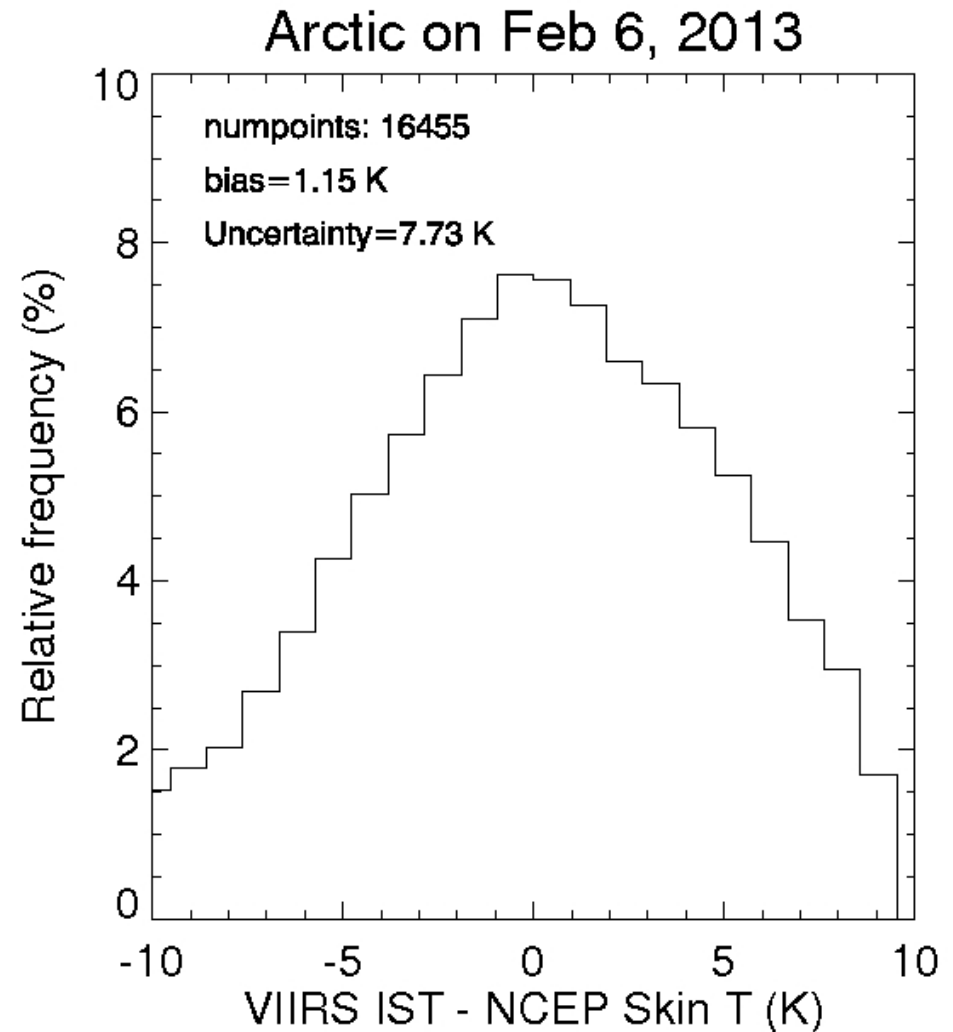
VIIRS IST (range = 220K to 270K)



NCEP vs. VIIRS IST, Feb 27, 2012. Spatial patterns are similar.

# Global comparison to NCEP

- **VIIRS is biased high (warm)** compared to NCEP reanalysis.
- Note that the NCEP skin temperature used in this analysis is a forecast, not an analysis
- Also note that the spatial resolution difference of NCEP and VIIRS is significant
- This result is the opposite of the MODIS & IceBridge results.



# VIIRS IST EDR Conclusions

- VIIRS IST EDR in several but not all cases meets the requirement of 1K measurement uncertainty
- VIIRS IST EDR shows a *cold* bias compared to MODIS and to several IceBridge KT-19 measurements, typically <1K but higher for some comparisons
- Some issues, such as higher uncertainty for warmer temperatures, have been uncovered during validation and solutions are being evaluated.
- Improvements in IST EDR performance have been realized as the VIIRS Cloud Mask IP matures
- More IST improvement is expected as additional quality flags become available in the VIIRS Ice Concentration IP to avoid IST retrievals near clouds.



# Future Plans and Issues

- No code changes currently planned
- Update IST regression coefficients based on matchup with MODIS and airborne/other IST sources
- Improvements anticipated with continued upgrades to the VIIRS cloud mask
- Additional quality checks in the VIIRS Ice Concentration IP (e.g. for cloud shadowing) will be passed to the IST IP & EDR