Microwave Integrated Retrieval System (MIRS) Performances of Surface Properties

(NOAA-18 and METOP-A AMSU/MHS Configuration)

NOAA/NESDIS

Development Team

S-A. Boukabara (Lead), C. Kongoli, W. Chen, S. Hong, Q. Liu, B. Yan, N. Sun and T. Kleespies

MIRS Oversight Board

F. Weng (Chair), R. Ferraro, L. Zhao and T. Schott

Microwave Integrated Retrieval System (MIRS) Performances of Sea Ice Concentration

(NOAA-18 and METOP-A AMSU/MHS Configuration)

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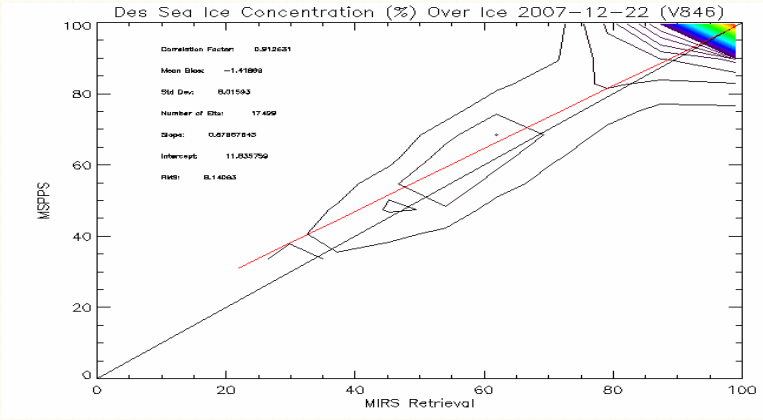
Validation of Sea-Ice for NOAA-18 AMSU-MHS

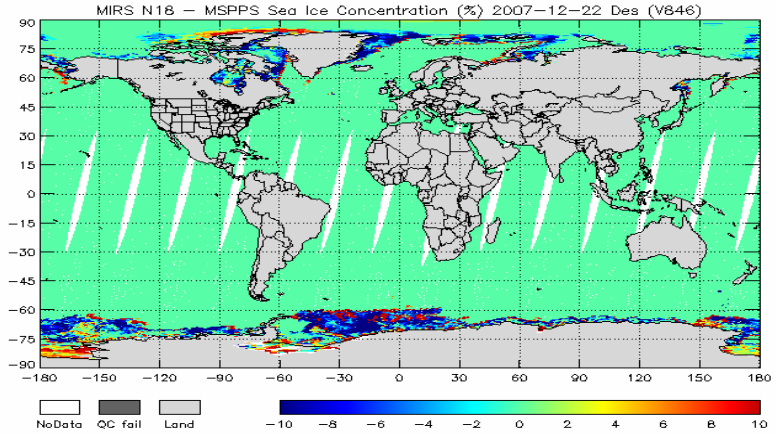
- Reference Data
  - MSPPS
  - High-resolution IMS
  - MIRS On-line Monitoring Tool

Inter-Comparison of MIRS and MSPPS Sea Ice Concentration

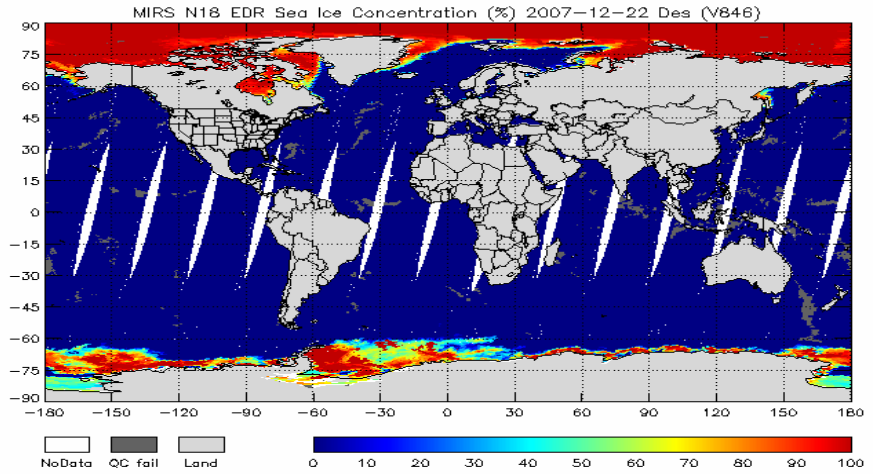
MIRS vs. MSPPS comparison and statistics



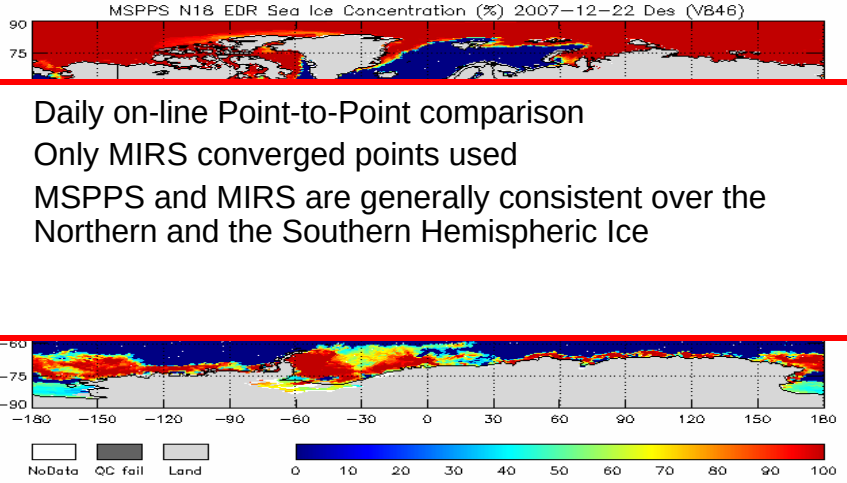
MIRS - MSPPS Difference Map



MIRS N18 Sea Ice



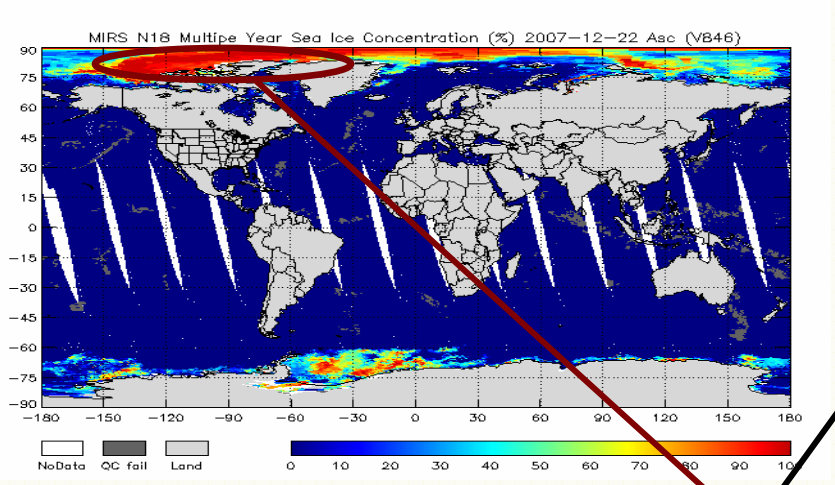
MSPPS N18 Sea Ice



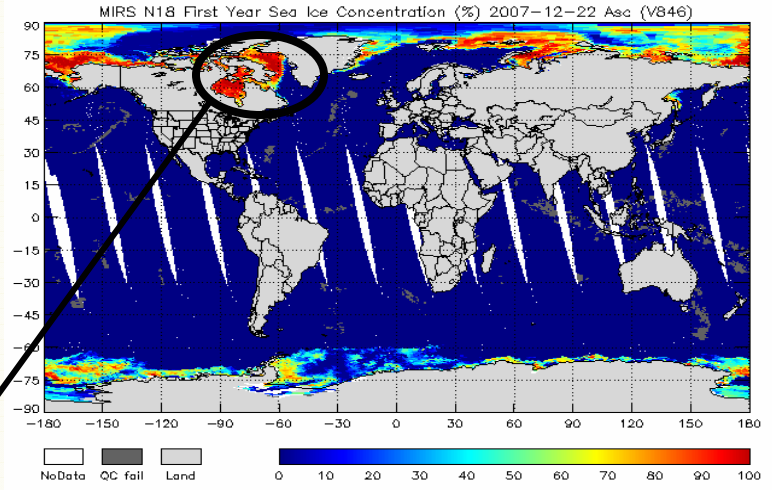
- Daily on-line Point-to-Point comparison
- Only MIRS converged points used
- MSPPS and MIRS are generally consistent over the Northern and the Southern Hemispheric Ice

MIRS Sea Ice Type Concentrations

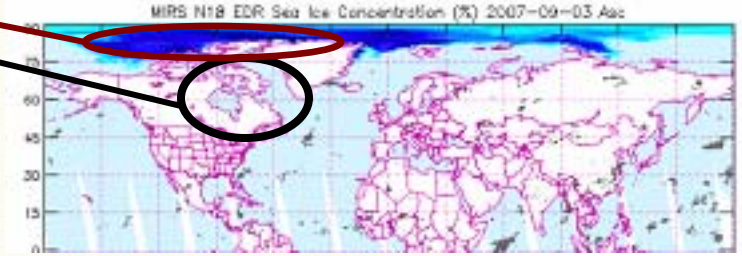
Multi-Year Sea Ice on December 22, 2007



First-Year Sea Ice on December 22, 2007

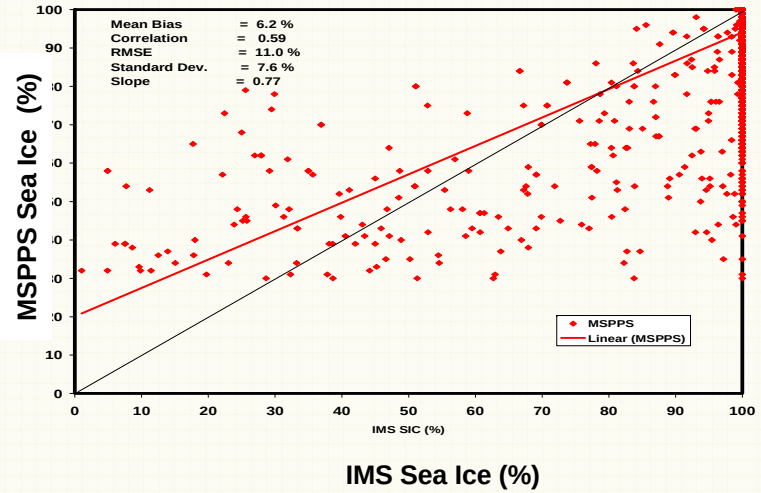


Total Artic Sea Ice on September 3, 2007



- MIRS retrieves Total, First-Year and Multi-year Sea Ice Concentrations
- Fist-Year and Multi-Year Sea Ice occurrences over the Artic display impressive consistency

Inter-comparisons with 4-km IMS



- 4-km Surface Type IMS foot-print-matched over AMSU FOV using accurate FP matching techniques (Tom Kleespies's code and algorithms)
- IMS Sea Ice Concentration computed at the AMSU-FOV and used as "ground truth"
- Only MIRS convergence points used
- Statistics shown for December 3, 2007: Bias, RMSE, correlation, Std. and slope
- Comparable stats between MIRS and MSPPS, underestimation of sea ice concentration as indicated by negative bias versus IMS

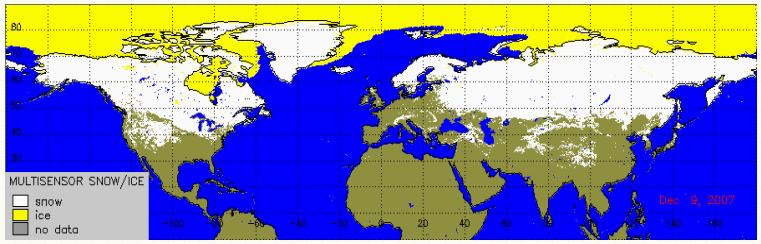
Comparison Statistics of MIRS and MSPPS Computed IMS Sea Ice as Reference

	Product	Bias (%)	RMSE (%)	Correlation Factor	Std. (%)	Slope
Compared to IMS	MIRS	-7.2	11.5	0.63	7.3	0.85
	MSPPS	-6.2	11.0	0.59	7.6	0.77

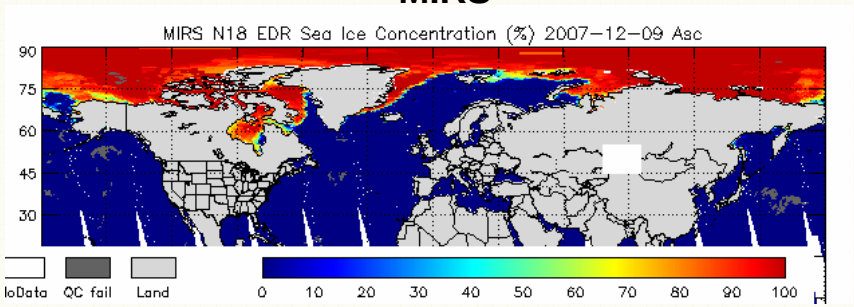
- Comparable statistics of MIRS and MSPPS with respect to IMS
- Further examination is expected to improve bias and RMSE

Inter-comparisons with other sea ice products

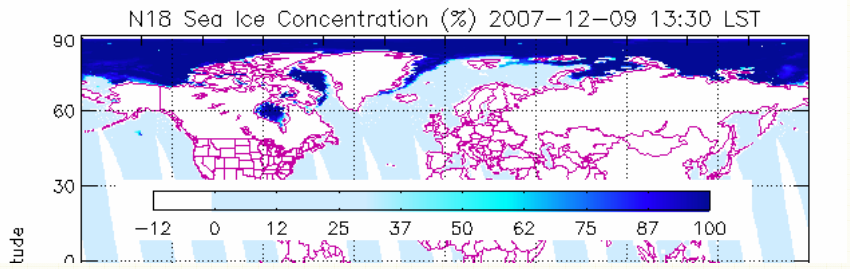
Multi-sensor



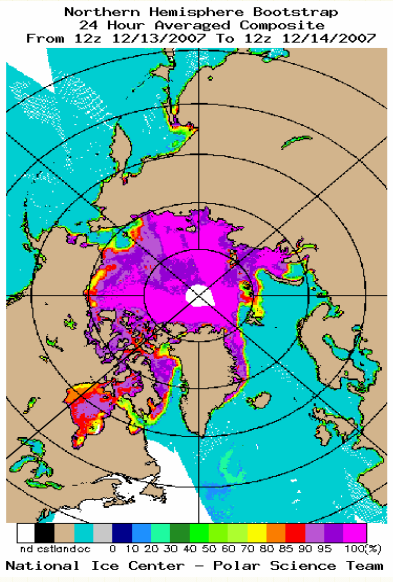
MIRS



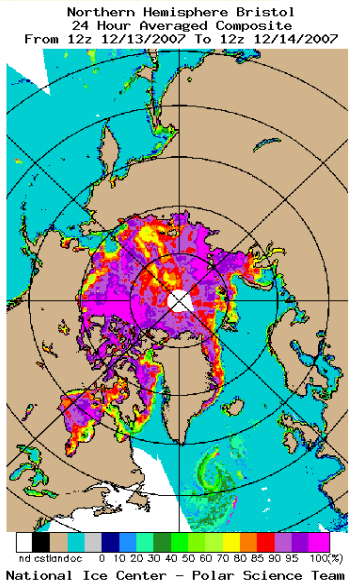
MSPPS



NASA Team-2



Bristol



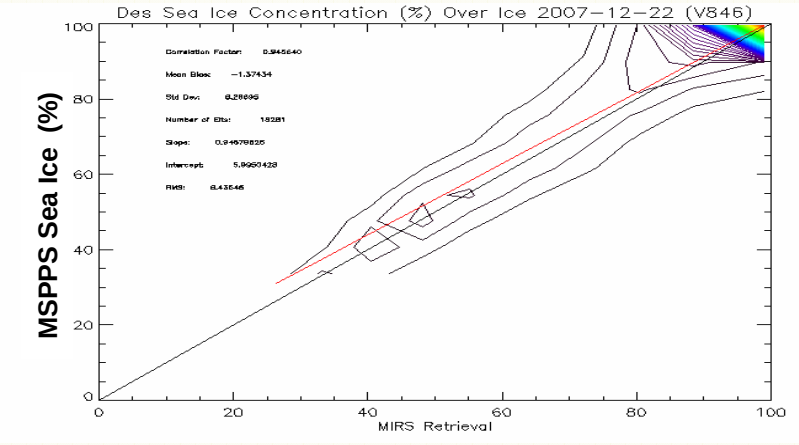
- Consistent MIRS Sea Ice Retrievals
- Low detection threshold of MIRS (at 5%) with no apparent false alarm

Validation of Sea-Ice for METOP-A AMSU-MHS

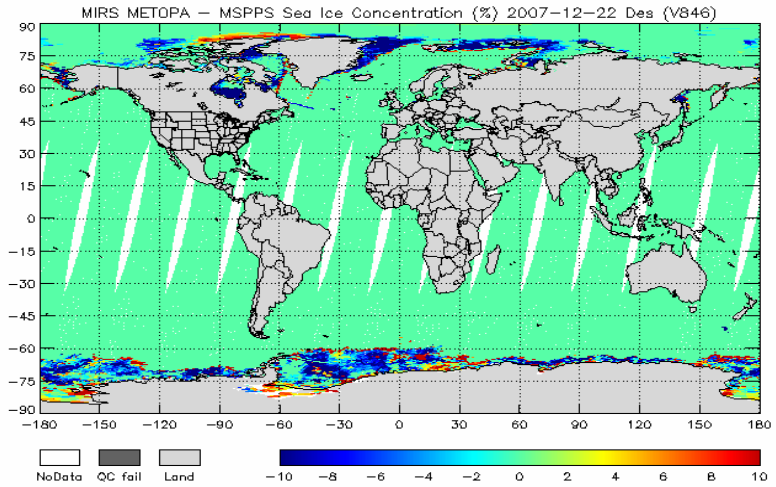
- Reference Data
  - MSPPS
  - MIRS On-line Monitoring Tool

Inter-Comparison of MIRS and MSPPS Sea Ice Concentration

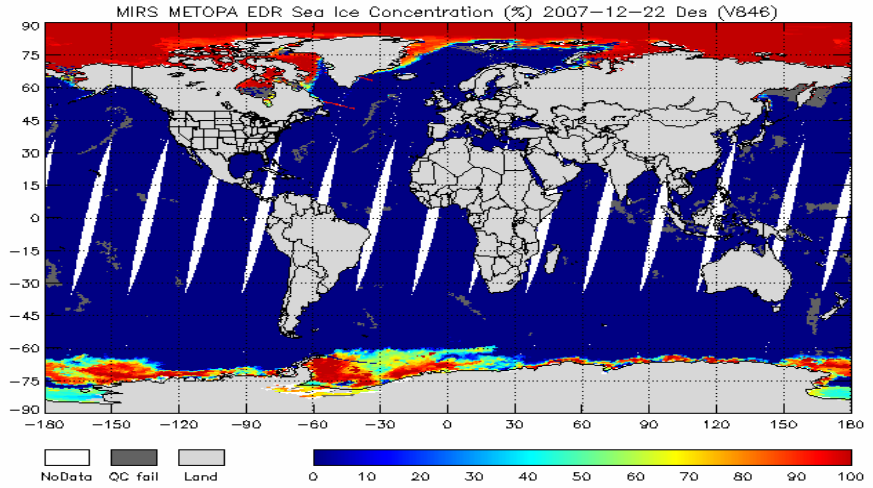
MIRS vs. MSPPS comparison and statistics



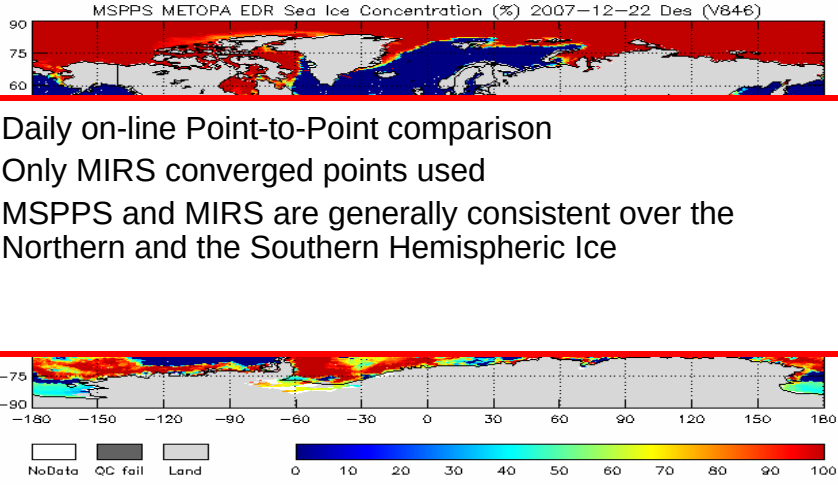
MIRS Sea Ice (%)



MIRS METOP-A Sea Ice



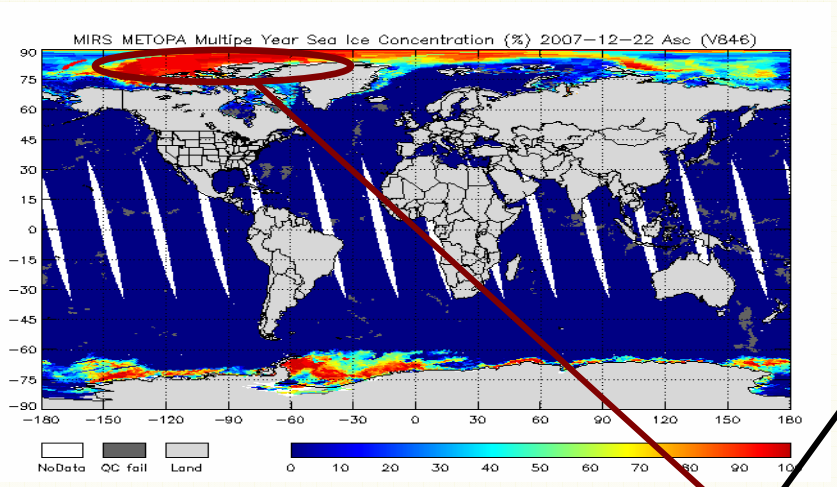
MSPPS METOP-A Sea Ice



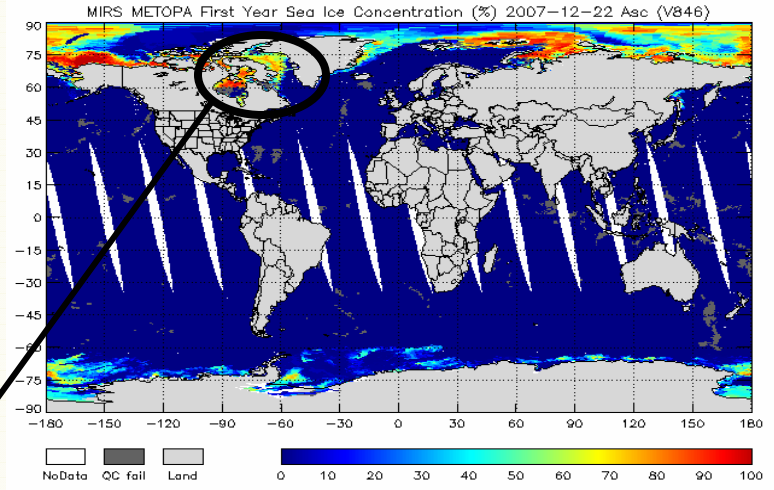
- Daily on-line Point-to-Point comparison
- Only MIRS converged points used
- MSPPS and MIRS are generally consistent over the Northern and the Southern Hemispheric Ice

MIRS Sea Ice Type Concentrations

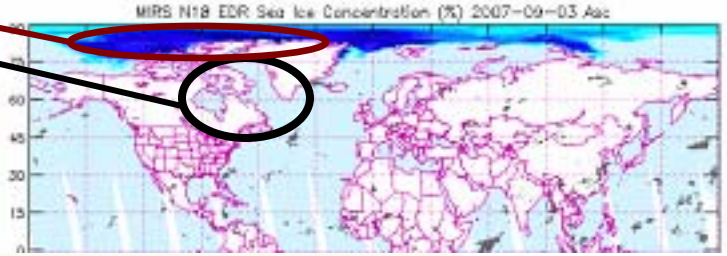
Multi-Year Sea Ice on December 22, 2007



First-Year Sea Ice on December 22, 2007



Total Artic Sea Ice on September 3, 2007



- MIRS retrieves Total, First-Year and multi-year Ice Concentrations
- Fist-Year and Multi-Year Sea Ice occurrences over the Artic overall consistent; However, in some areas not as consistent as N18 retrievals, e.g., First-Year Sea Ice

Future Work/Improvements

- Investigate METOP-A surface type pre-classification algorithm over ocean
- Stratification of sea ice retrievals by Scan Angle
- Stratification of sea ice retrievals by Season and Hemisphere
- Expand sea ice emissivity catalog to include other major sea ice type emissivity spectra

Microwave Integrated Retrieval System (MIRS) Performances of SWE

(NOAA-18 and METOP-A AMSU/MHS Configuration)

NOAA/NESDIS

Development Team

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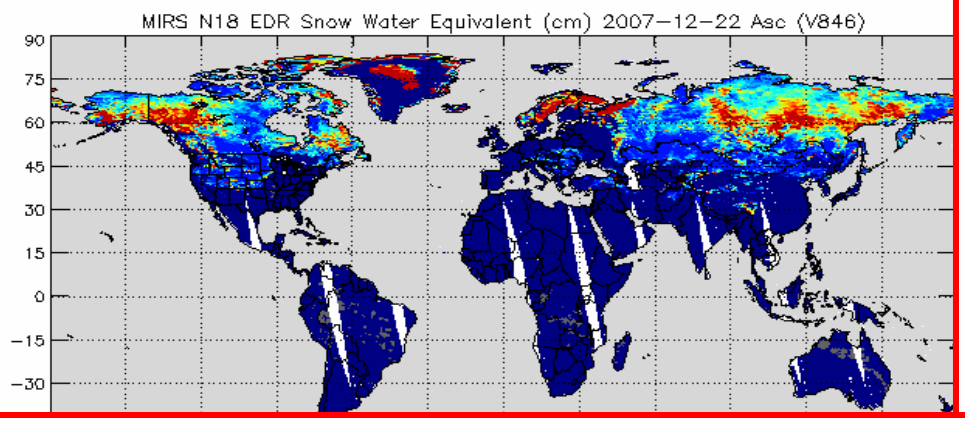
Validation of SWE for NOAA-18 AMSU-MHS

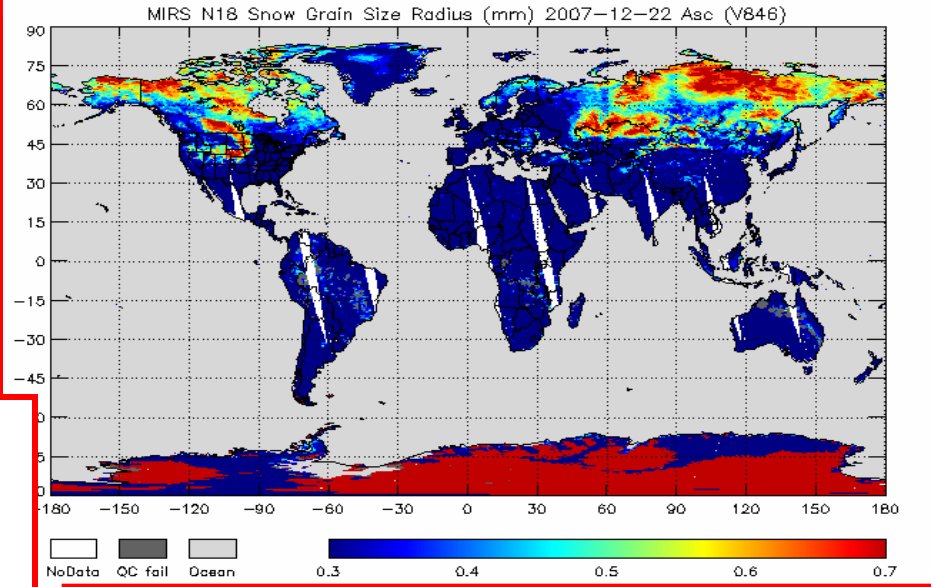
- Reference Data
  - MSPPS
  - Ground-based measurements
  - MIRS On-line Monitoring Tool

MIRS Retrievals of Snow Properties

MIRS SWE Product

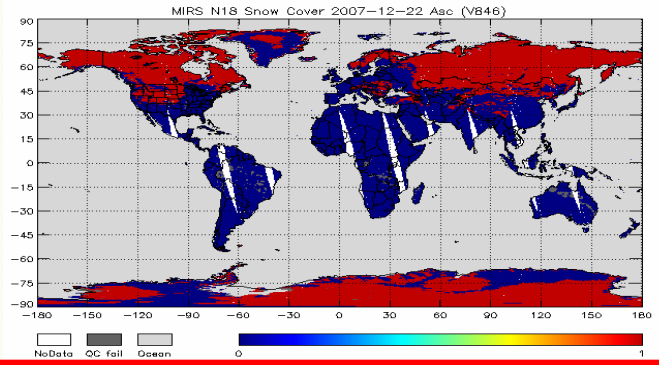


MIRS Effective Grain Size product



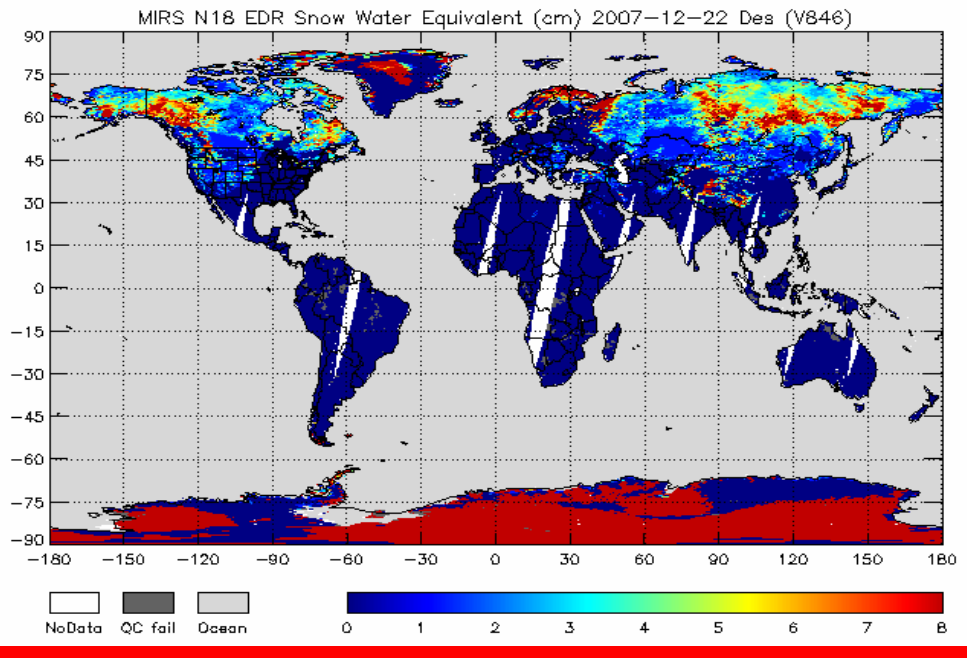
- MIRS retrieves snow properties based on the interpretation of retrieved emissivity spectra and the skin temperature
- The interpretation of emissivities is physically-based, i.e., from a catalog of snow physical and radiometric parameters derived from a 1-layer snow emissivity model

MIRS Snow Cover Product

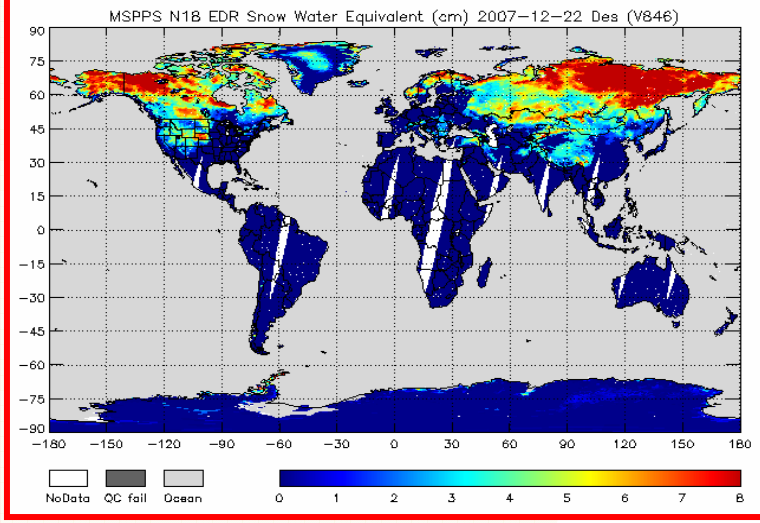


Inter-comparison of MIRS with MSPPS

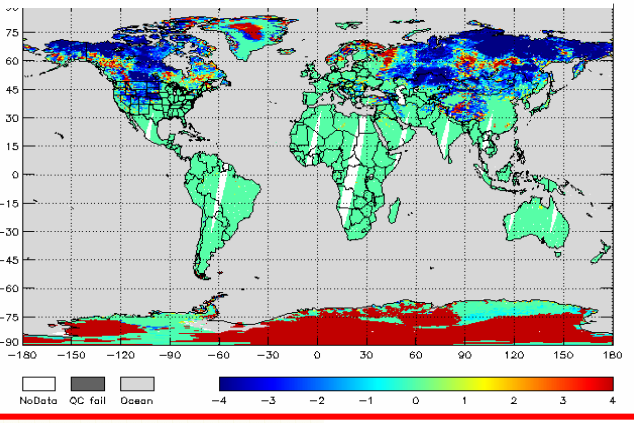
MIRS SWE



MSPPS SWE



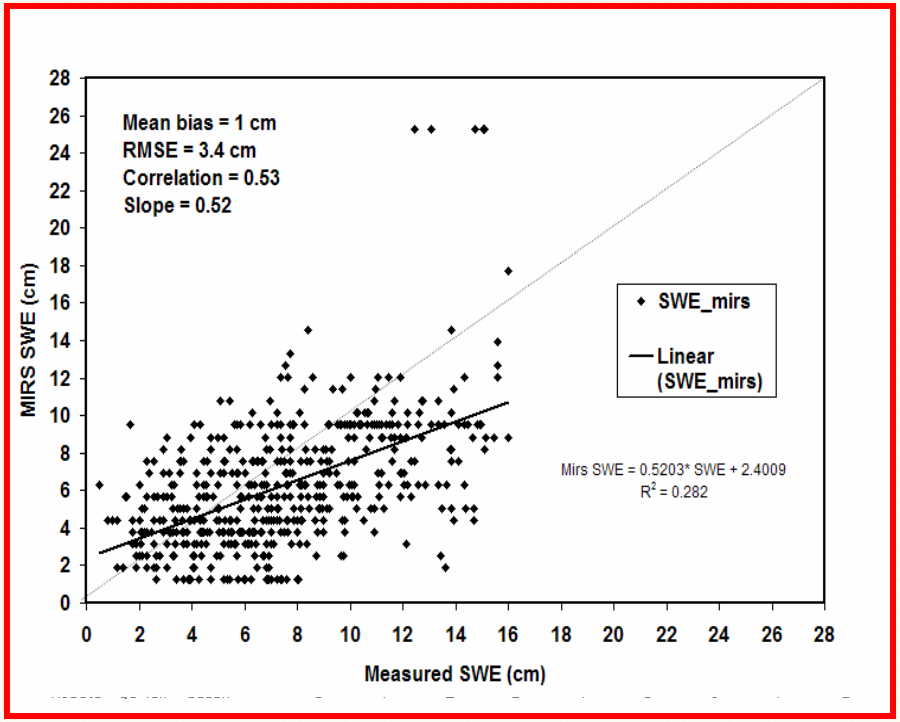
MIRS – MSPPS



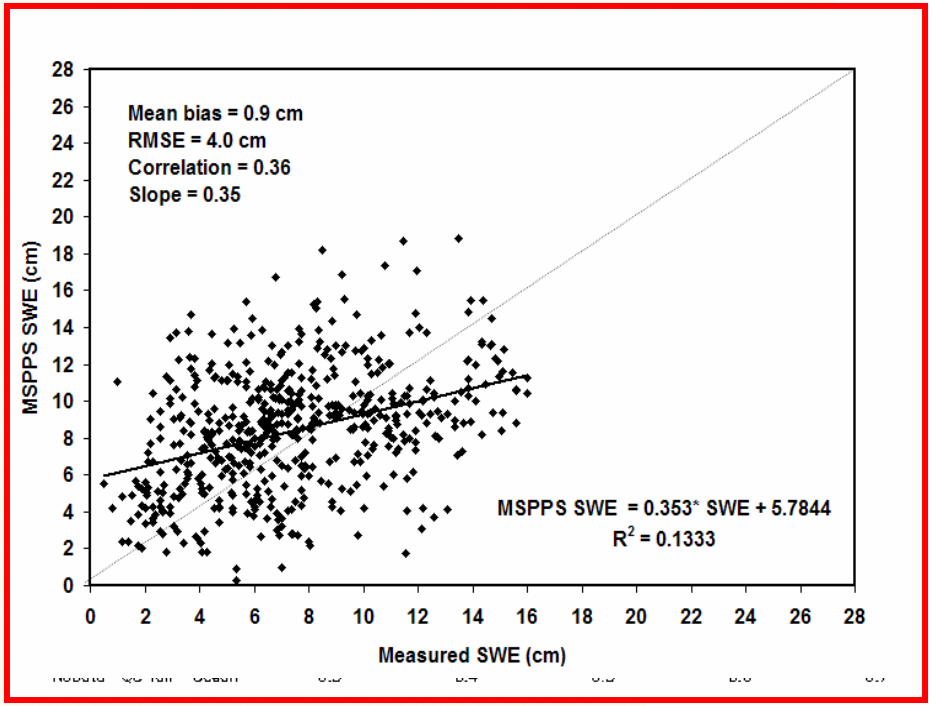
- **MIRS and MSPPS SWE show inconsistencies over seasonal snow-covers**
- **MIRS generally displays lower SWE over seasonal snow covers than MSPPS with a few exceptions**

Inter-comparison of MIRS and MSPPS Ground-based SWE Measurements as Reference

MIRS vs. measured SWE



MSPPS vs. measured SWE



- SWE measurements taken over a 5-year period between 2001-2005 in US and Canadian Prairie regions
- SWE measurements were collocated with NOAA-16 AMSU data
- Only convergent points were compared
- MIRS displays higher correlation and lower RMSE than MSPPS

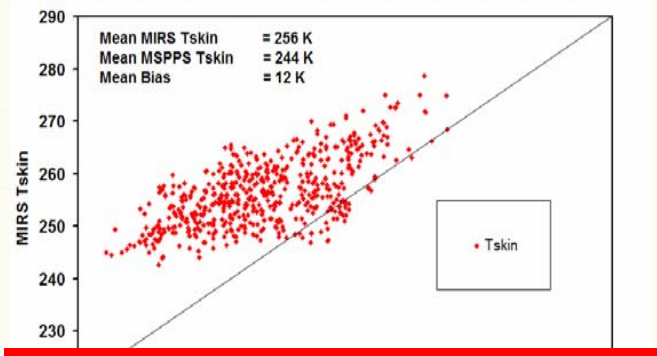
Comparison Statistics of MIRS and MSPPS Measured SWE as Reference

	Product	Bias (cm)	RMSE (cm)	Correlation Factor	Std. (cm)	Slope
Compared to measured SWE	MIRS	1.0	3.4	0.53	2.8	0.52
	MSPPS	0.9	4.0	0.36	3.1	0.36

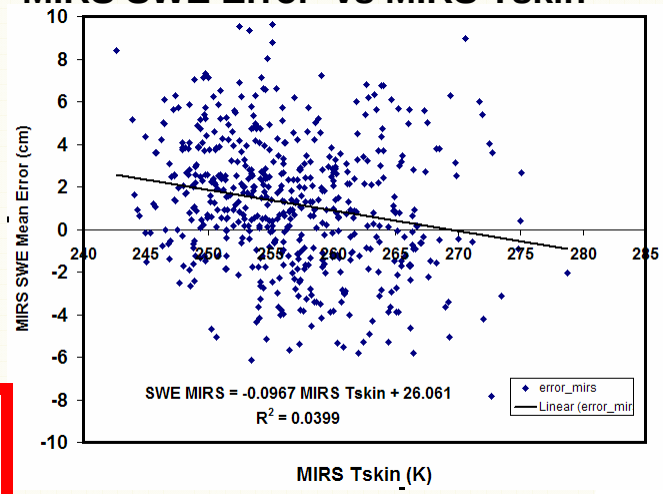
- Improved performance for MIRS
- RMSE of 3.4 cm or 40% relative to the mean SWE of the dataset is still high

MIRS and MSPPS SWE error dependence on retrieved Tskin

MIRS vs MSPPS Tskin

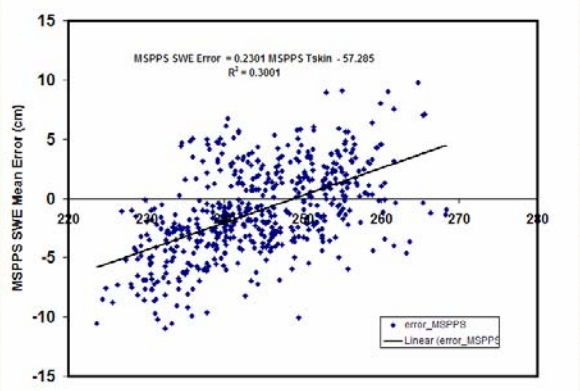


MIRS SWE Error vs MIRS Tskin

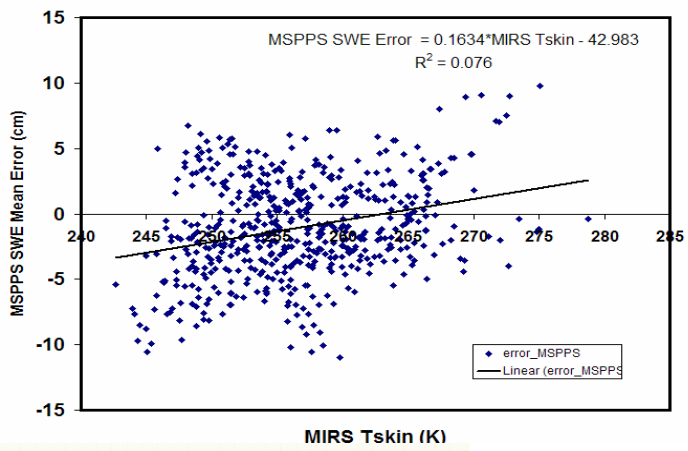


❖MIRS SWE error shows less dependence on retrieved Tskin than that of MSPPS

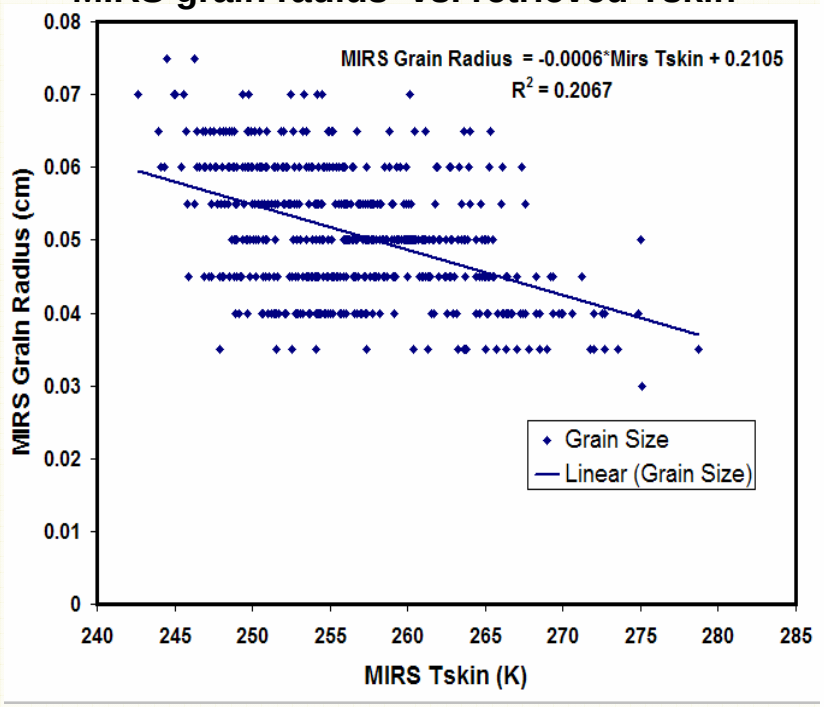
MSPPS SWE Error vs MSPPS Tskin

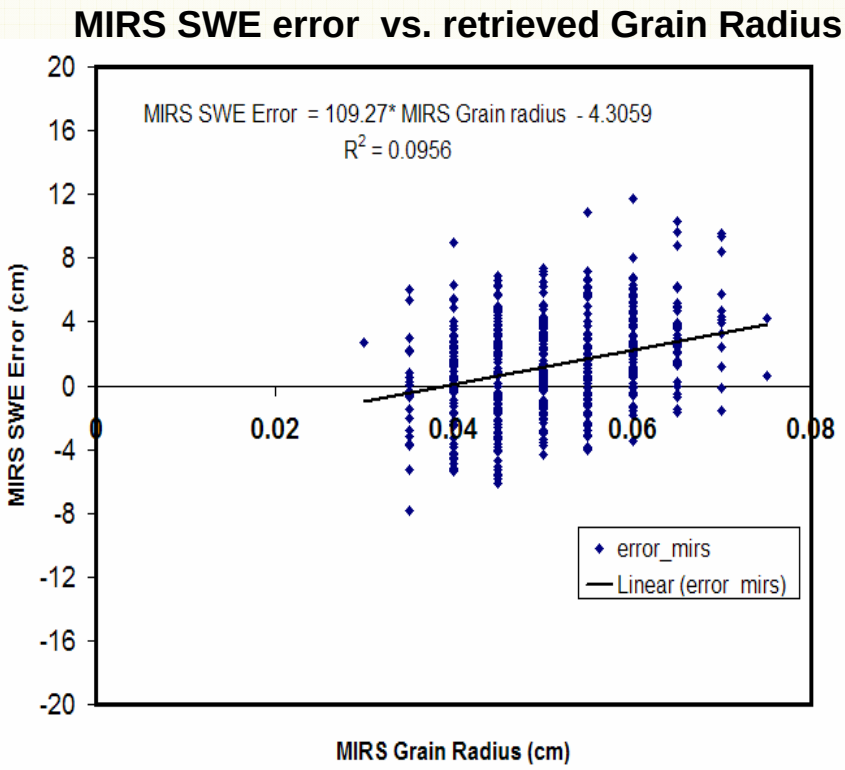


MSPPS SWE Error vs MIRS Tskin



MIRS SWE error dependence and Cross-talk





- **MIRS Grain radius inverse dependence on Tskin has physical basis and thus is considered consistent**
- **MIRS SWE error increases as grain size increases, so deterioration of performance for larger grain sizes**

Future Work/Improvements

- Investigate SWE error sources/extend evaluation work
- Stratification of SWE retrievals by Scan Angle
- Incorporation of forest effects
- Extend evaluation of snow extent and grain size retrievals