Enhancement to the JPSS Snowfall Rate Product

Huan Meng[1,2] (Huan.Meng@noaa.gov), Jun Dong[2], Yalei You[2], Cezar Kongoli[2], Ralph Ferraro[1,2], Banghua Yan[1], Limin Zhao[3]
[1]NOAA/NESDIS/STAR; [2]ESSIC/CISESS/University of Maryland; [3]NOAA/NESDIS/OSPO

Introduction

The NESDIS operational Snowfall Rate (SFR) product is retrieved from measurements from passive microwave sensors aboard polar-orbiting satellites (Meng *et al.*, 2017; Kongoli *et al*., 2015, 2018).

- **Sensors**: **ATMS**, AMSU/MHS, GMI, and SSMIS
- **Satellites**: **S-NPP, JPSS**, POES, Metop, GPM, and DMSP
- **Coverage**: Global land
- **Near real-time production from 10 satellites**; 20 snowfall rate estimates per day on average in mid-latitudes and more in high latitudes
- **Algorithm**:
  - ✓ Logistic regression model for snowfall detection
  - ✓ 1 DVAR-based snowfall rate retrieval

Bias Correction

- **Bias sources**

✓Uncertainties with radiative transfer model
✓Biases from NWP model predictions
✓Algorithm assumptions, e.g. ice water content profile follows linear distribution

- **Correction approach**

✓'Truth': Stage IV hourly radar and gauge combined precipitation analysis
✓Previous correction: histogram matching
✓New approach: Regression between SFR bias and a selected set of Tbs, retrieved parameters, and GFS predictions.

• Ferraro, R., H. Meng, B. Zavodsky, S. Kusselson, D. Kann, B. Guyer, A. Jacobs, S. Perfater, M. Folmer, J. Dong, C. Kongoli, B. Yan, N. Wang, and L. Zhao, 2018. Snowfall rates from satellite data help weather forecasters, Eos, 99, https://doi.org/10.1029/2018EO096715.

• Kongoli, C., H. Meng, J. Dong and R. Ferraro, 2018. A Hybrid snowfall detection method from satellite passive microwave measurements and global weather forecast models, Quarterly Journal of Royal meteorological Society, 144(S1), 120-132, DOI:10.2002/qj3270.

• Kongoli, C., H.Meng, J. Dong and R. Ferraro. 2015. A Snowfall detection algorithm over land utilizing high-frequency passive microwave measurements – Application to ATMS. *J. Geophys. Res. – Atmospheres*, 120(5), 1918-1932. DOI: 10.1002/2014JD022427.

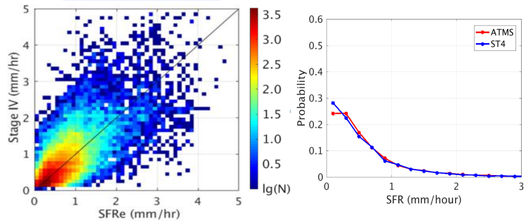
• Meng, H., J., Dong, R., Ferraro, B., Yan, L., Zhao, C., Kongoli, N.-Y., Wang, and B., Zavodsky (2017), A 1DVAR-based snowfall rate retrieval algorithm for passive microwave radiometers, J. Geophys. Res. Atmos., 122, doi:10.1002/2016JD026325.

The support from the JPSS Proving Ground and Risk Reduction and NOAA/NESDIS/STAR JPSS was crucial to the development of the ATMS SFR algorithm. This research has been supported by NOAA and the JPSS Program through grant NA09NES4400006 (Cooperative Institute for Climate and Satellites-CICS) at the University of Maryland, Earth System Science Interdisciplinary Center (ESSIC). The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official National Oceanic and Atmospheric Administration or U.S. Government position, policy, or decision.

S-NPP Bias Correction

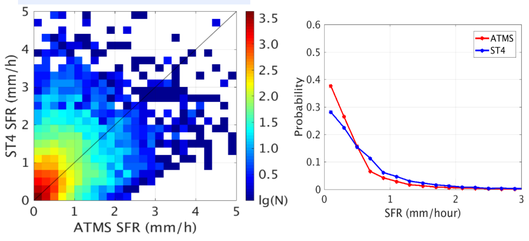
Regression

Correlation Coeff.	0.71
Accuracy (mm/hr)	-0.04
Precision (mm/hr)	0.44



Histogram Matching

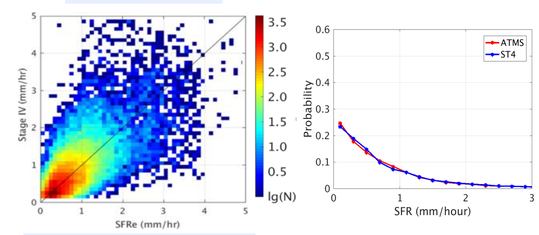
Correlation Coeff.	0.52
Accuracy (mm/hr)	-0.15
Precision (mm/hr)	0.63



NOAA-20 Bias Correction

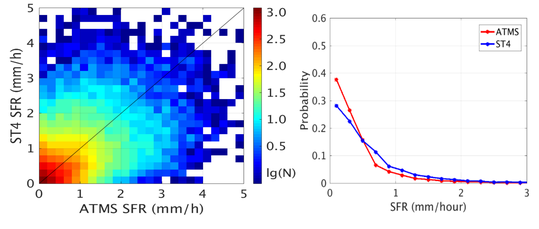
Regression

Correlation Coeff.	0.70
Accuracy (mm/hr)	-0.04
Precision (mm/hr)	0.48



Histogram Matching

Correlation Coeff.	0.49
Accuracy (mm/hr)	-0.26
Precision (mm/hr)	0.84



SFR over Ocean/Coast/Sea Ice

- **JPSS PGRR project**

✓Develop S-NPP and NOAA-20 SFR over ocean/coast/sea ice

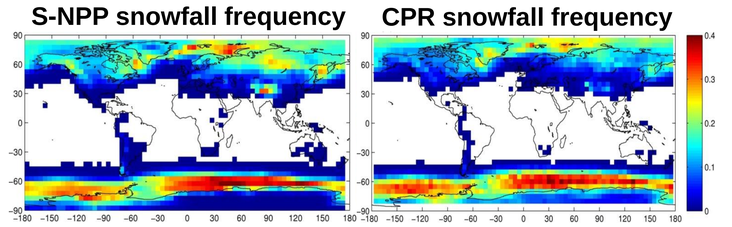
- **Same algorithm framework as land SFR**

✓Logistic regression trained Snowfall Detection
✓1DVAR-based Snowfall Rate

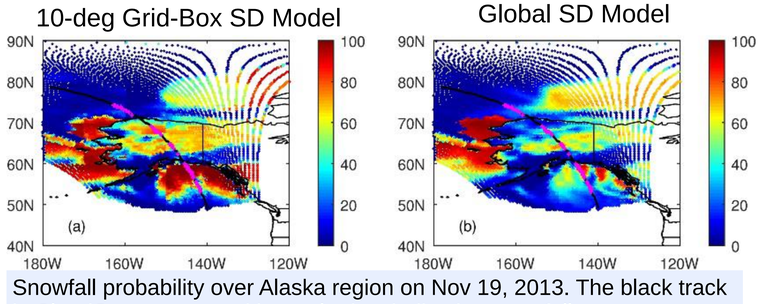
- **Truth' data: snowfall rate from Spaceborne radars**

✓CloudSat CPR
✓GPM DPR

- **Snowfall Detection models have been developed**



Snowfall Probability



Snowfall probability over Alaska region on Nov 19, 2013. The black track is CloudSat overpass with purple dots indicating snowfall occurrences.

Northeast Snowstorm on February 7, 2020