THE PREPROCESSOR OF THE NOAA UNIQUE CRIS/ATMS PROCESSING SYSTEM (NUCAPS)

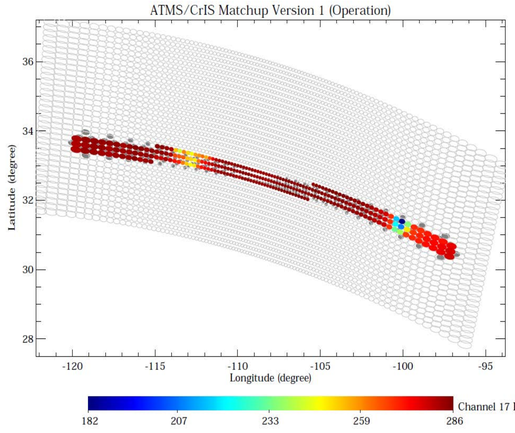
Changyi Tan[1], Quanhua Liu[2], A. Gambacorta[3], Nicholas R. Nalli[1], Flavio Iturbide-Sanchez[1], Kexin Zhang[1], Michael Wilson[1], and Walter Wolf[2]

[1]I.M. Systems Group, Inc., [2]NOAA/NESDIS/STAR, and [3]Science and Technology Corporation

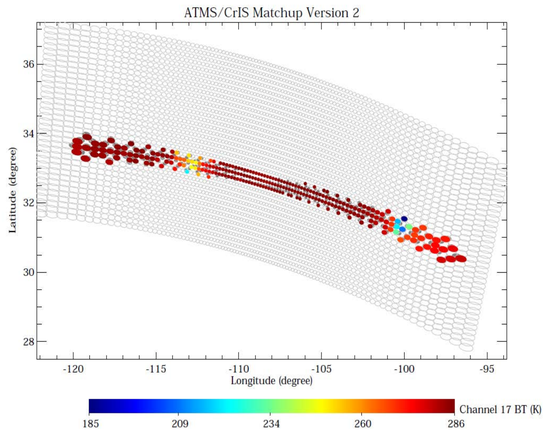
Abstract: The Cross-track Infrared Sounder (CrIS) and Advanced Technology Microwave Sounder (ATMS) are two critical sounding sensors onboard the Suomi National Polar-orbiting Partnership (S-NPP) satellite. The NOAA Unique CrIS/ATMS Processing System (NUCAPS) is an infrared (IR) and microwave (MW) hybrid atmospheric profile retrieval system which uses collocated CrIS and ATMS measurements. The NUCAPS algorithm uses the Stand-alone AIRS Radiative Transfer Algorithm (SARTA) forward model for IR and MIT MW forward model for MW sounding to retrieve atmospheric vertical profiles of temperature, moisture, trace gases and other geophysical parameters. From the hardware aspect, due to the ATMS oversampling, the geolocation pointings of S-NPP IR and MW sensors are mismatched. Therefore, the NUCAPS preprocessor, in software aspect, does the critical function of CrIS/ATMS footpoint collocation. The NUCAPS preprocessor is the module to match-up the two sensors of CrIS and ATMS. We proposed and implemented four versions of CrIS/ATMS footpoint match-up methods in our offline test bed, namely: 1) CrIS FOR center matchup method (NOAA operational version) --- Select the single ATMS FOV which is closest to the center of each CrIS FOR and average it with the surrounding 8 ATMS FOVs. 2) CrIS FOV matchup method --- Select 9 single ATMS FOVs which are closest to each CrIS FOV respectively and average the selected 9 ATMS FOVs. 3) Backus-Gilbert (B-G) remapping method --- Select ATMS FOVs around a CrIS FOR and multiply them with pre-calculated B-G coefficients (per scan position and per ATMS channel) to obtain the effective brightness temperature as it is measured by a single microwave antenna with the antenna gain pattern that matches the effective CrIS FOR. 4) Improved CrIS FOV matchup method --- Select 9 single ATMS FOVs which are closest to each CrIS FOV respectively and average the selected 9 ATMS FOVs. Plus, apply the ATOVS and AVHRR Preprocessing Package (AAPP) package on ATMS channels 1, 2 to resize the beam width from 5.2 degrees to 3.3 degrees.

Descriptions of CrIS/ATMS Collocation Methods

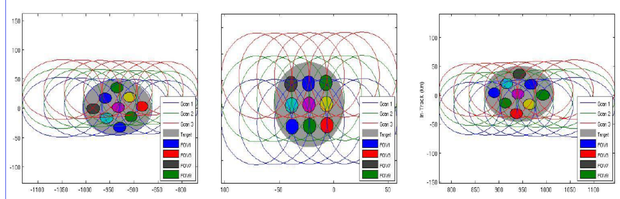
1, CrIS FOR center match-up method

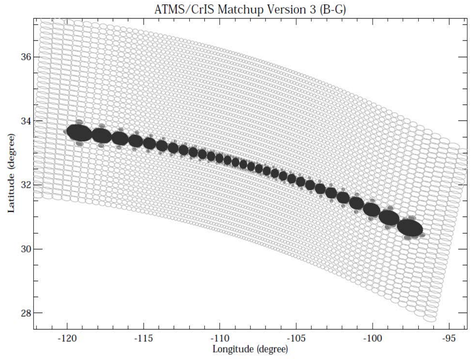


2, CrIS FOV matchup method

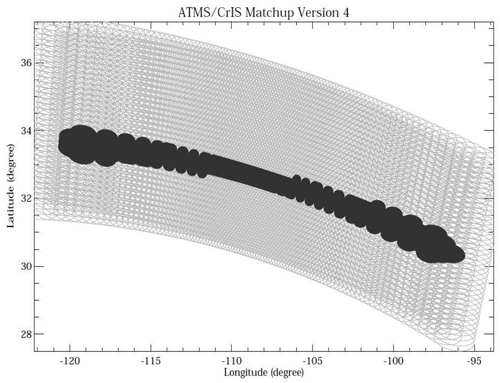


3, Backus-Gillbert (B-G) method

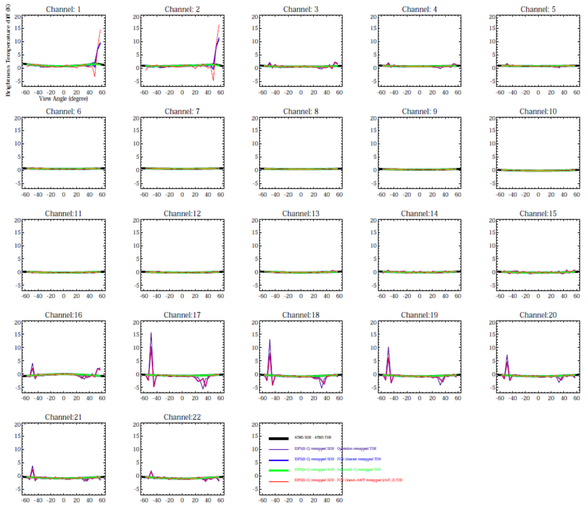




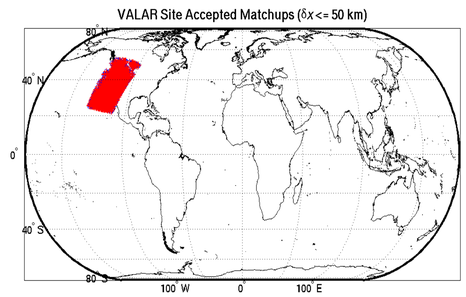
4, Improved CrIS FOV matchup method



Differences between the preprocessed ATMS brightness temperatures via different preprocessors (in one given scan line).

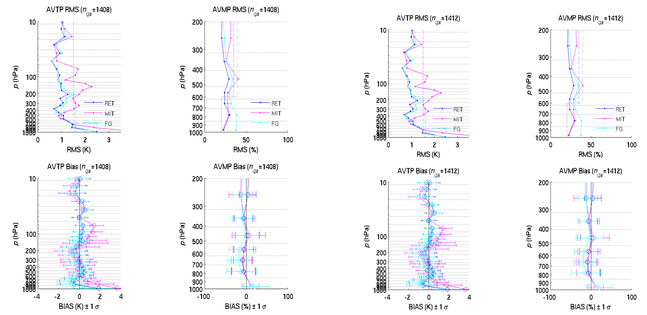


Performance Assessment (granule samples in "red" area, 5/30/2013)



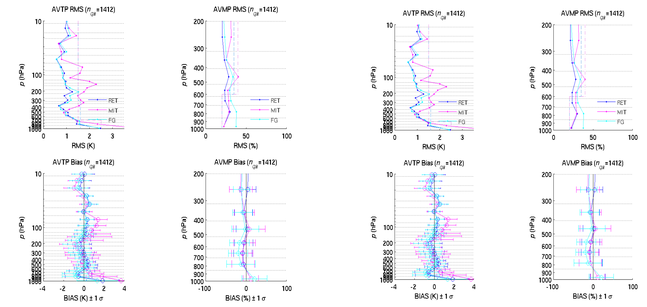
Performance Assessment

With Method 1



With Method 2

With Method 3



With Method 4

Summary

- All the four CrIS/ATMS match-up methods are computationally efficient enough to meet the real time operational requirements.
- The B-G method shows remarkable systematic corrections and positive impacts on the final retrieval products with an improved yield rate.
- We will focus on the B-G method improvements in the path forward and apply this method on the Joint Polar Satellite System (JPSS) series satellites.

References

[1] C. Barnet, M. Goldberg, L.E. Gumley, A. Gambacorta, E. Maddy, and T. King, "Implementation of the NOAA Unique CrIS/ATMS processing System (NUCAPS) within the Community Satellite Processing Package (CSPP)," *American Meteorological Society*, Atlanta GA, February 2014.

[2] A. Gambacorta, C. Barnet, W. Wolf, T. King, N. Nalli, K. Zhang, X. Xiong, E. Maddy, F. Iturbide Sanchez, C. Tan and M. Goldberg, "The NOAA Unique CrIS/ATMS Processing System (NUCAPS): algorithm description and validation results after 2 years in orbit," *American Meteorological Society*, Atlanta GA, February 2014.

[3] C. Wang, D. Gu, A. Foo, G. De Amici, F. Weng, N. Sun, B. Li, and R. V. Leslie, "Remapped ATMS Radiance and its Validation for NPP Mission," *American Meteorological Society*, Atlanta GA, February 2014.

Poster # 6, STAR JPSS Annual Science Team Meeting, August 25, 2015, College Park, MD

Corresponding Author: Changyi.Tan@noaa.gov