Analysis of CrIS/ATMS Data Using an AIRS Science Team Version 6 – Like Retrieval Algorithm

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CrIS/ATMS is flying on NPP and is scheduled to fly on JPSS-1. CrIS/ATMS has roughly equivalent capabilities to AIRS/AMSU. The AIRS Science Team Version 6 retrieval algorithm is currently producing very high quality level-3 Climate Data Records (CDR’s) that will be critical for understanding climate processes. AIRS CDRs should eventually cover the period September 2002 through at least 2020. CrIS/ATMS is the only scheduled follow on to AIRS AMSU. I have been asked by Ramesh Kakar if CrIS/ATMS can be counted on to adequately continue the AIRS/AMSU CDRs beyond 2020, or is something better needed? This research is being done to answer that question. A minimum requirement to obtain a yes answer is that CrIS/ATMS be analyzed using an AIRS Version 6 – like algorithm. NOAA is currently generating CrIS/ATMS products using 2 algorithms: IDPS and NUCAPS.
The IDPS Algorithm

IDPS products are generated using improved versions of the heritage NGAS retrieval algorithm.

IDPS generates surface skin temperature ($T_s$), temperature profile $T(p)$, moisture profile $q(p)$, and pressure profile.

IDPS does not have a product dependent QC flag.

IDPS has no requirement for, and does not generate, Level 3 products.

There is no plan for reprocessing CrIS/ATMS as the IDPS algorithm improves.

The current version is IDPS Mx 6.7, which became operational March 2013.

Mx 7.0 is expected to be better and become operational in June.

We have been able to read and evaluate IDPS Mx 6.7 level-2 products and also generate level-3 products using the IDPS QC flag: IR and MW retrievals both converge.
The NUCAPS retrieval algorithm was developed by Chris Barnet and co-workers at NOAA/NESDIS/STAR.

NUCAPS is based on AIRS Science Team retrieval algorithms and produces all products AIRS does.

Possible limitations in NUCAPS with regard to generation of optimal CDRs:

NUCAPS is a hybrid AIRS Version-4/Version-5 algorithm.
- Channels used and QC methodology are not up to date with AIRS Version-6.

NUCAPS does not use a Neural-Net guess.

NUCAPS does not generate a level-3 product.

Current NUCAPS products are only stored at NOAA for the latest 2-week period.
We have not yet successfully processed NUCAPS

When able to, we plan to evaluate level-2 products and generate level-3 products from NUCAPS

We will compare monthly mean level-3 products of NUCAPS and IDPS with those of AIRS Version-6 as well as with our own Version-6 like CrIS/ATMS retrievals
SRT Research Using CrIS/ATMS

**Approach**
- Use as closely as possible the AIRS Version-6 retrieval methodology to analyze CrIS/ATMS data
- “Validate” monthly mean CrIS/ATMS products by comparison with AIRS products

**Status of AIRS Version-6**
AIRS Version-6 is running at JPL and SRT
We have not yet obtained CrIS/ATMS Neural-Net coefficients for CrIS/ATMS from Bill Blackwell
We plan to optimize and run Version-6 like CRIS/ATMS retrievals when we get these coefficients

**AIRS Version-5.56**
- SRT AIRS Version-5.56 is otherwise like AIRS Version-6 but uses a regression start-up with coefficients provided by NOAA many years ago – the performance of these coefficients is degrading
SRT AIRS Version-5.56 has been adapted to run with CrIS/ATMS data: called CrIS/ATMS Version-5.54

CrIS/ATMS Version-5.54 does not allow for CrIS FOV dependent NEΔN this is sub-optimal

We use the mean IFOV NEΔN given by NGAS TVAC4, November 2011

We have generated CrIS and ATMS tuning and regression coefficients using observations on July 10, 2012 and September 14, 2012

We have been testing retrievals for April 1, 2013

Results have been compared with AIRS Version-5.56 and AIRS Version-6
Surface skin temperature $T_s$, temperature profile $T(p)$, water vapor profile $q(p)$

- First comparisons show AIRS/AMSU Version-6, AIRS/AMSU Version-5.56, and CrIS/ATMS Version-5.54
  
  Results are shown using both tight Data Assimilation QC and looser Climate QC thresholds

  Achieving AIRS/AMSU Version-6 quality results is the goal for CrIS/ATMS

- Second comparisons show AIRS/AMSU Version-6, CrIS/ATMS Version-5.54, and IDPS CrIS/ATMS
  
  SRT results shown use climate QC

  The purpose of the study is for generation of climate data sets

  Level-2 and level-3 IDPS results both use IDPS QC flag
CrIS results are reasonable but poorer than AIRS V5.56. AIRS V6 is the best.
IDPS results are very poor.
IDPS coverage is poor—especially over hot and cold land.
IDPS retrievals are biased cold – especially IDPS.
Global
Percent of All Cases Accepted

Temperature Profile
1 km Layer Mean RMS (°K)
Difference from ECMWF

April 1, 2013
1 km Layer Mean Bias (°K)
Difference from ECMWF

CrIS T(p) results are roughly comparable to AIRS V5.56; AIRS V6 is much better.
Global
Percent of All Cases
Accepted

Temperature Profile
1 km Layer Mean RMS (°K)
Difference from ECMWF

April 1, 2013
1 km Layer Mean Bias (°K)
Difference from ECMWF

IDPS results have poorest quality and very low yield.
CrIS V5.54 is comparable to AIRS V5.56 and poorer than AIRS V6. IDPS is very poor.
IDPS accuracy is reasonable but coverage is poor.

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Global
Percent Yield

Water Vapor April 1, 2013
1 km Layer Mean
Precipitable Water RMS
% Difference from ECMWF

Precipitable Water Bias
% Difference from ECMWF

V6        AIRS/AMSU   Climate QC
V5.56  AIRS/AMSU    Climate QC
V5.54  CrIS/ATMS      Climate QC
IDPS     CrIS/ATMS      IDPS QC

IDPS results are again poorest with very low yield.
Summary and Plans

- IDPS Mx 6.7 is currently performing very poorly and is not a satisfactory follow-on to AIRS Version-6
- We will begin to generate monthly mean NUCAPS level-3 products and compare with AIRS Version-6 when we are capable to do it
- SRT V5.54 CrIS/ATMS retrievals are currently of significantly poorer quality than Version-6 AIRS/AMSU
  - This is not a fair comparison because V5.54 does not use a Neural-Net guess
  - V5.54 CrIS/ATMS T(p) and q(p) is only slightly poorer than AIRS/AMSU V5.56
  - We hope to begin testing CrIS/ATMS Version-6 shortly after obtaining CrIS/ATMS Neural-Net coefficients

GOAL

Once Version-6 CrIS/ATMS is optimized, we hope to generate monthly mean level-3 products for a number of months and compare with AIRS Version-6, NUCAPS, and IDPS

Hopefully, CrIS/ATMS Version-6 processing for a few months can be done in collaboration with Sounder PEATE or Goddard DISC