Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

ATMS Work at JPL

Bjorn Lambrigtsen, Evan Fishbein, Mathias Schreier
Jet Propulsion Laboratory, California Institute of Technology

NASA Sounder Science Team Meeting, Greenbelt, October 24-26, 2017

Part 1: ATMS L1b

- Motivation: NASA-controlled system to support research
  - Climate quality products
  - Independent of NOAA

- Development of NASA L1b processor
  - Initiated under ROSES'10 NPP Science Team
    - Per recommendation of NPP Science Team
    - ATBD and algorithms developed as extension of ROSES task w/existing funds
  - Implemented by Sounder SIPS (JPL)
    - Tested & verified by Schreier & Lambrigtsen
    - Code delivered to GES DISC for operations

- Maintenance
  - Funded @ 0.5 FTE by NASA NPP Project (Gleason)
  - Monitor ATMS instrument & calibration performance
  - Maintain calibration algorithms & coefficients
  - Develop improved calibration algorithms

L1b algorithms & code: Status

- Version 1: The goal was to minimize differences to operational IDPS, using IDPS-coefficients
- Tested in 2016, processing started in 2017
- However: Errors in the IDPS coefficient-files mandated a change in the code
- The current Version 2 version uses the updated coefficients

  Delivery and processing is supposed to start by End of September
- Re-processing is done for every year, the coefficient errors will therefore be recursively corrected in this data

L1b: Differences from NOAA IDPS

- Moon intrusion for cold-space calibration is calculated and flagged
- Slightly different use of box functions to average calibration
- Extensive quality flagging allows the user to filter the data specifically before use
- Backward reprocessing: errors, like coefficient mistakes, will be recursively corrected
- IDPS is changing to radiances instead of brightness temperatures

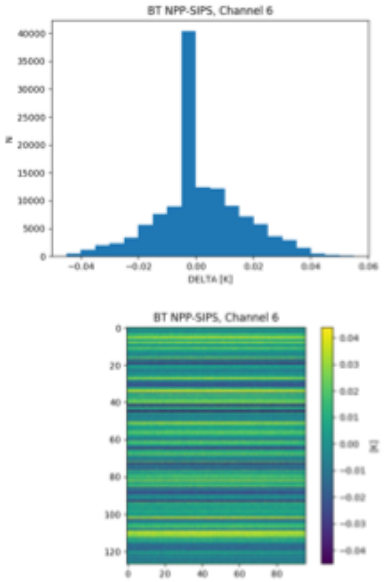
Compatibility with EOS, like AMSU-A on EOS Aqua:

The variable convention/format in the files is similar to other EOS datasets
Both, the NPP-data and the EOS data will be netcdf in the SIPS database

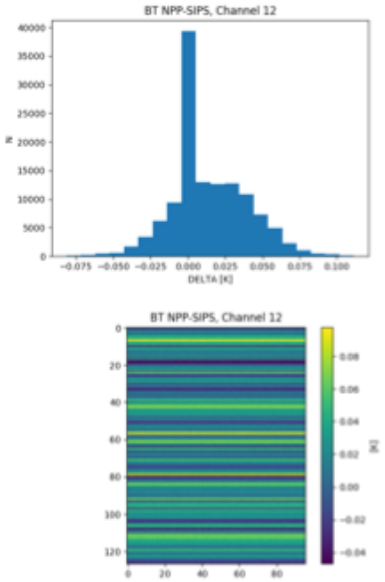
L1b: Comparisons with IDPS SDR

Upper panel: histogram of differences
Lowe panel: scene difference

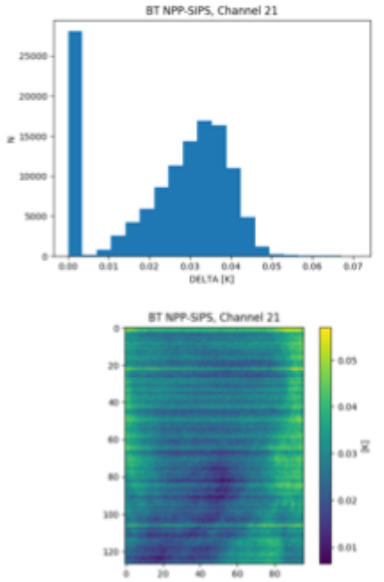
54.4 Ghz



57.3 Ghz



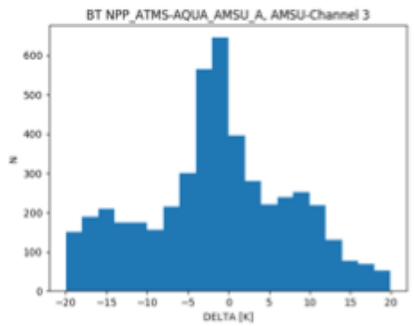
183.3 Ghz



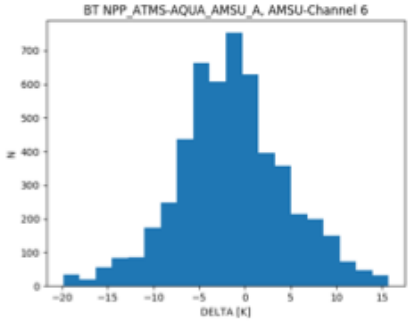
- Most channels (left and middle) show negligible deviations - the pattern of the scene difference is just a result of the difference in the box-averaging
- However, some channels (right) show a small bias and a obvious atmospheric pattern in the channel difference. Reason unknown, but it might be an artifact of the radiance conversion (under investigation)

L1b: Comparisons with Aqua AMSU-A

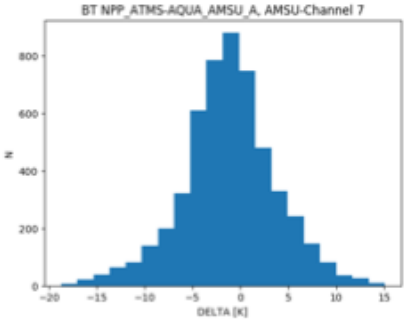
50.3 Ghz



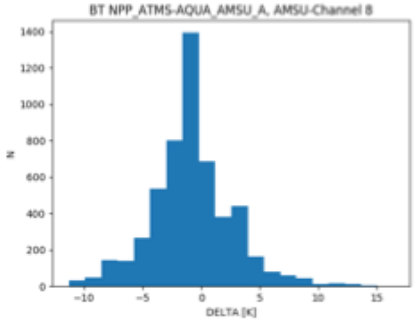
54.4 Ghz



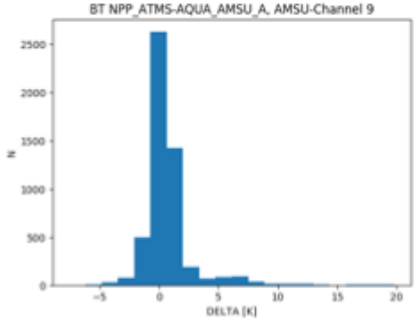
54.9 Ghz



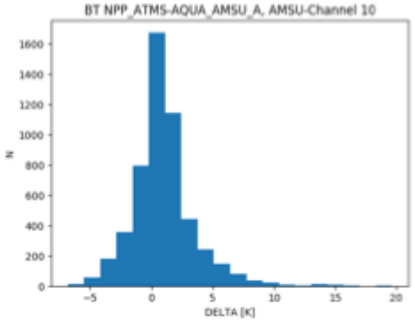
55.5 Ghz



57.3 Ghz



57.3 Ghz +/- 0.27



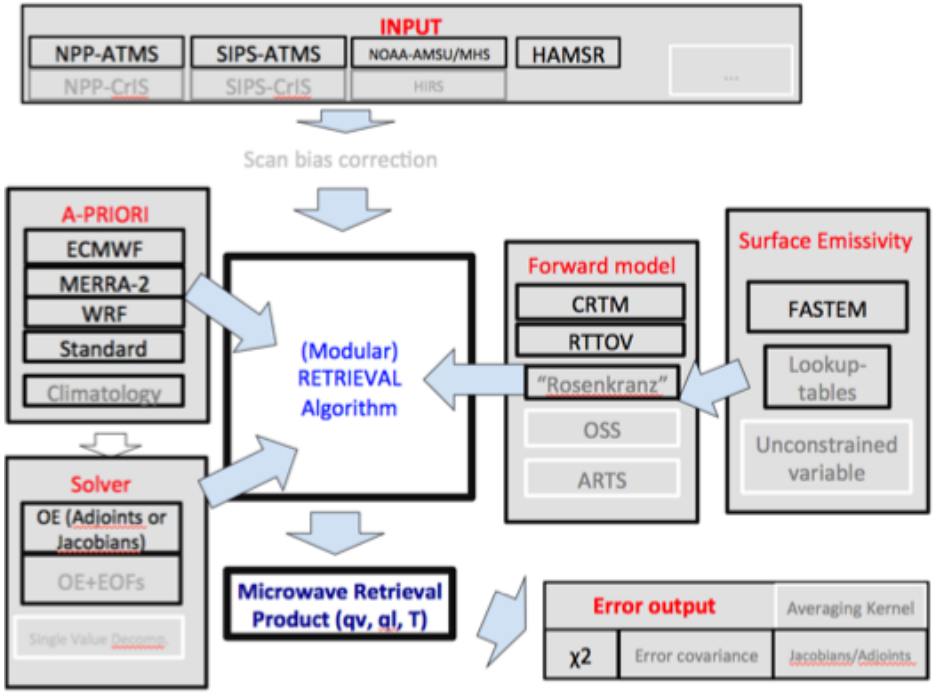
- Suomi NPP and EOS Aqua have similar orbits, allowing a comparison of observations and a possible continuation of EOS AMSU-A observations
- The plots above show a crude comparison of selected channels for collocated observations (no time restrictions, time variation can be +-1 hour)
- 57 GHz channels show good agreement - however a skewness is visible, indicating warmer AMSU-A observations

Part 2: ATMS retrieval system

- Motivation: NASA-sponsored system to support research
  - Climate quality products
  - Independent of NOAA
  - Sponsored under ROSES'13/S-NPP
- Algorithm testbed (Schreier): Complete and functional
  - Used to develop advanced retrieval system accounting for scattering
    - Produces valid retrievals in the presence of precipitation
    - Applied to HAMSR aircraft sounder
    - Applied to ATMS (experimental)
- Baseline retrieval system (Fishbein): Undergoing integration and testing
  - Based on AIRS/AMSU retrieval system
  - Accounts for instrument differences, including polarization
  - Table based: Can be used on AMSU, ATMS and others
  - Delivery to SIPS expected in FY18Q1

Modular Retrieval Testbed

(RATATOUILLE) **R**etrieval **A**lgorithm **T**estbed with **A** variety of **T**ransmutable **O**ptions to **U**nderstand **I**mpacts of **L**imiting components and **L**imitations from too high **E**xpectations

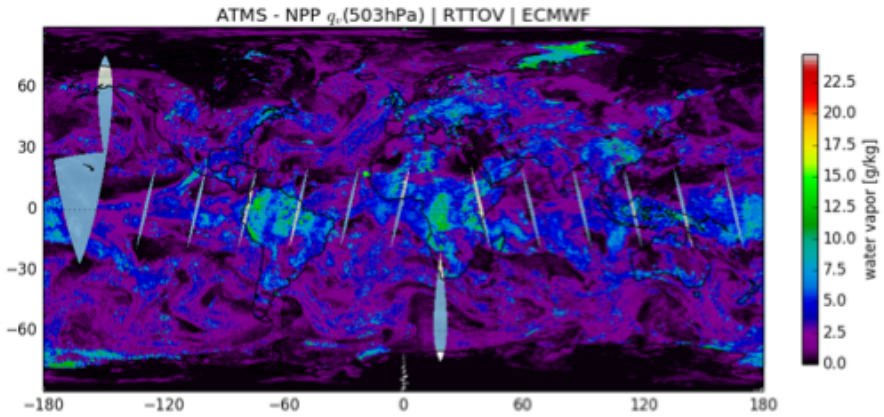


Testing Components:

- INPUT:
  - ATMS (h5,nc-SIPS)
  - AMSU-A/B (binary)
  - HAMSR (nc)
- Background:
  - MERRA-2
  - ECMWF
  - WRF
  - Standard
- Solver:
  - Optimal Estimation (Adj or Jacobians)
- Forward Model:
  - CRTM
  - RTTOV
- Others:
  - Channel selection
  - Covariances

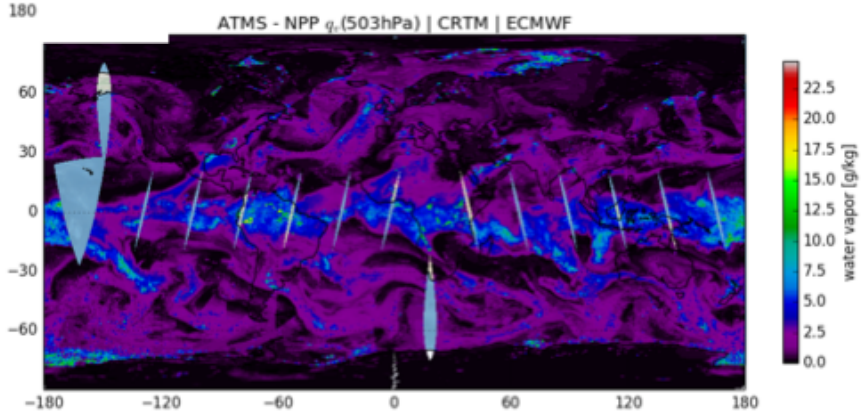
L2 testbed: Test examples (1)

- The testbed allows the comparison of the radiative transfer on the retrieval
- This becomes especially interesting, when scattering is involved, as different RTAs have different implementations of scattering



ATMS Retrieval with different RTAs

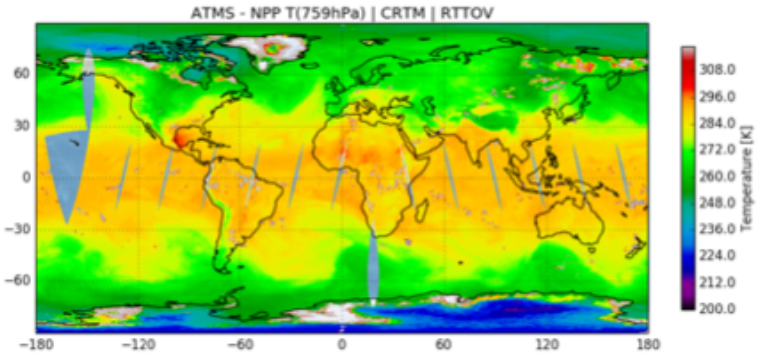
Comparison of 2016/04/01 for
water vapor at 500hPa
Left : RTTOV
Below: CRTM



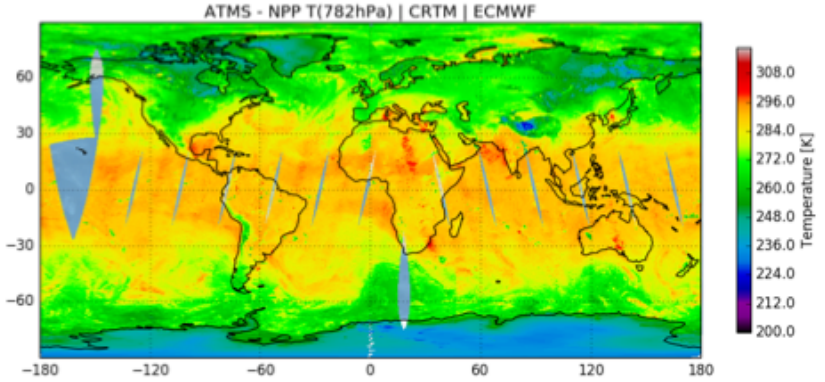
L2 testbed: Test examples (2)

- The testbed allows the comparison of the background information on the retrieval
- With the need of higher accuracy, we can test, in how far climatologies or re-analysis impacts the the results

ATMS Retrieval with different Backgrounds



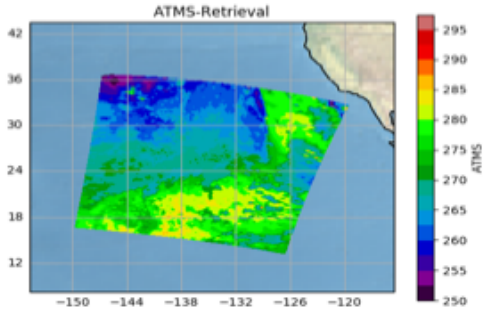
Comparison of 2016/04/01
for temperature at 770hPa
Left : MERRA-2
Below: CRTM

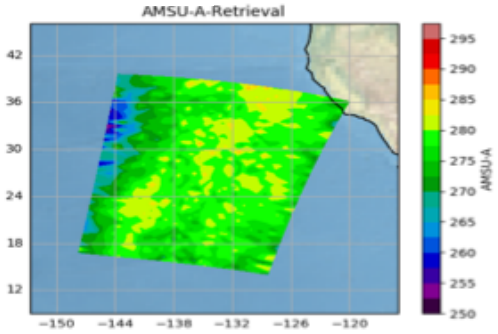


L2 testbed: Test examples (3)

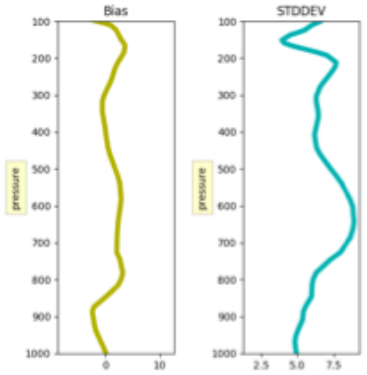
- The testbed allows the comparison of the different instrument retrievals under the same conditions
- This makes collocated comparisons interesting, especially with NOAA-19, SNPP and EOS Aqua flying similar orbits et the moment

Collocated AMSU-A and ATMS retrievals





Temperature at 600hPa for a random granule in the Pacific
Left : ATMS
Left Below: AMSU-A NOAA-19 (3h later)
Below: difference in collocated temperature-profiles

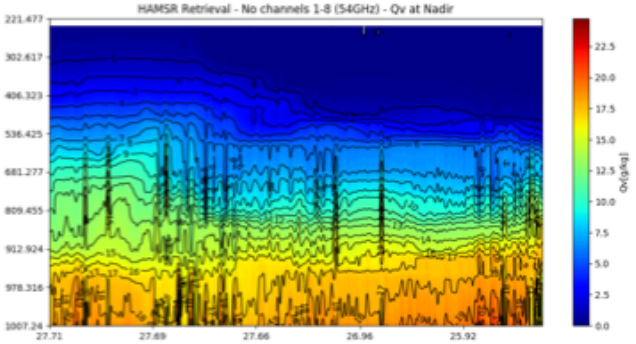


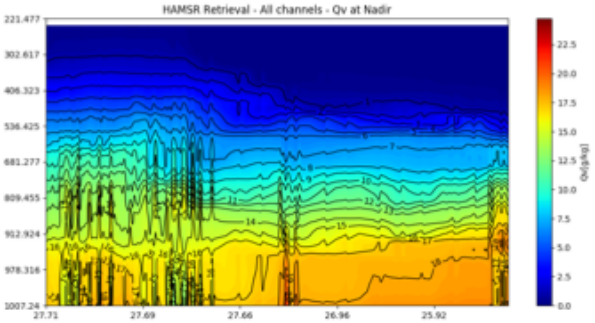
L2 testbed: Test examples (4)

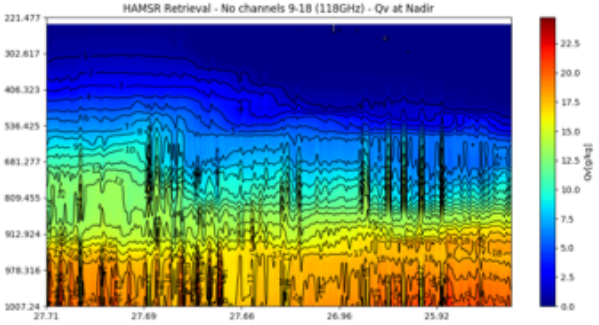
- The testbed allows the “de-activation” of channels
- This allows to estimate the impact of channel loss on the retrieval and to estimate the increasing impact of background information

HAMSR Retrieval with different channels

A vertical retrieval comparison (temperature) for CPEX, with all channels (Fig. below), excluding 54Ghz (right) and excluding 118GHz (right below)







L2 baseline system

Baseline System Block Diagram