AIRS Real-Time Sounding Profile Retrieval for IMAPP (International MODIS/AIRS Processing Package) Users

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- Introduction
- IMAPP AIRS Retrieval (RTV) Algorithm
- Global, Granule and single Profile RTV Results
  (Comparison with Operational AIRS RTV Product, ECMWF Analysis, MODIS and GOES RTV)
- Conclusions

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The Atmospheric Infrared Sounder on AQUA

- 2378 channels, spectral ranges: 3.7 - 4.61 \(\mu\text{m}\), 6.2 - 8.22 \(\mu\text{m}\), 8.8 - 15.4 \(\mu\text{m}\);
- Spectral resolution: \(\lambda/d\lambda >1200\)
- Altitude: 705 km, Swath: 1650 km, 90 Ground Footprints, 1.1° IFOV
- 6 min and 125 MB per Granule (135x90 pixels), 240 granules per day

6–Sept–2002, Brightness Temperature [K] at 1000 cm\(^{-1}\)
Ascending Granules

Descending Granules
AIRS Clear-Sky Retrieval (RTV) at CIMSS

- Regression Retrieval of T, q, Ts, TPW, O3, and $\varepsilon_s$ under clear conditions
  
  Regression Model
  \[ X = C \ Y \]
  
  Least squares regression solution
  \[ C = X (Y^T Y)^{-1} \]

- Preparation of multiple Trainingsets
- Forward Model Calculations using SARTA
- Application of BT/scanang-classification scheme
- Use of MODIS Cloudmask product for AIRS FOVs cloud detection
- Retrieval Validation/Comparison: ECMWF analysis, global RAOBs, MODIS and GOES Retrievals

→ SelChans RTV, nch=337
→ PC regression RTV, npc=30

→ TIGR3 & Noaa88 & special desert and polar cases
→ Ecosystem assigned to each point to get realistic surface pressure, surface skin temperature and surface emissivity.

<table>
<thead>
<tr>
<th>Class</th>
<th>BT@1000 cm$^{-1}$ training</th>
<th>BT@1000 cm$^{-1}$ observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BT ≤ 260</td>
<td>BT ≤ 255</td>
</tr>
<tr>
<td>2</td>
<td>250 &lt; BT ≤ 270</td>
<td>255 &lt; BT ≤ 265</td>
</tr>
<tr>
<td>3</td>
<td>260 &lt; BT ≤ 280</td>
<td>265 &lt; BT ≤ 275</td>
</tr>
<tr>
<td>4</td>
<td>270 &lt; BT ≤ 290</td>
<td>275 &lt; BT ≤ 285</td>
</tr>
<tr>
<td>5</td>
<td>280 &lt; BT ≤ 300</td>
<td>285 &lt; BT ≤ 295</td>
</tr>
<tr>
<td>6</td>
<td>290 &lt; BT</td>
<td>295 &lt; BT</td>
</tr>
</tbody>
</table>
Global IMAPP AIRS Single FOV RTV Results:
Temperature [K] at 850 mbar (09-06-2002)
Global IMAPP AIRS Single FOV RTV Results:
Humidity [g/kg] at 850 mbar (09-06-2002)

With Cloudmask
Without Cloudmask
IMAPP AIRS Single FOV RTV: CIMSS Direct Broadcast Area (10-23-2003, Day)

Surface Skin Temperature [K] (no cloudmask)

Total Precipitable Water [cm] (no cloudmask)
IMAPP AIRS Single FOV RTV: CIMSS Direct Broadcast Area (10-23-2003, Day)

Total Ozone [DU] (no cloudmask)

Surface Emissivity @926 cm⁻¹ (no cloudmask)
IMAPP AIRS Single FOV RTV vs. ECMWF Analysis:
Temperature at 850 mbar (09-02-2003, 192, Day)
IMAPP AIRS Single FOV RTV vs. ECMWF Analysis: Humidity at 850 mbar (09-02-2003, 192, Day)
IMAPP AIRS Single FOV RTV vs. ECMWF Analysis:
TPW (09-02-2003,192,Day)
IMAPP AIRS Single FOV BT Residual vs. ECMWF: Spectral Mean (09-02-3003, 192, Day)
IMAPP AIRS Single FOV BT Residual vs. ECMWF: Spatial Mean (09-02-3003,192,Day)

RTV (no BT-class)

RTV (with BT-class)

ECMWF ANL

RMS of Residual
Stddev of Residual
Mean of Residual
IMAPP AIRS Single FOV RTV vs MODIS and GOES RTV: T and q at 620 mbar (09-02-2003, 192, Day)
Operational L2 Cloud-Cleared Std Product (Ocean): Case 1 (09-02-2003,8,Day)
IMAPP AIRS FOR 3x3 Retrieval vs Op AIRS RTV and ECMWF ANL: Case 1 (09-02-2003,8,Day)

Temperature @850

L2 STD
Temperature at 850 mbar

AIRS RTV Granule 8
Temperature at 852.788 mbar

ECMWF Analysis Temperature [K] at 852.79 mbar

Humidity @850

L2 STD
Humidity at 850 mbar

RTV NPC30 10118 class
Humidity at 852.788 mbar

ECMWF Analysis Humidity [g/kg] at 852.79 mbar

Op AIRS RTV

AIRS FOR RTV

ECMWF ANL
Operational L2 Cloud-Cleared (CC) Std Product (Ocean): Case 2 (09-02-2003, 175, Day)
IMAPP AIRS FOR 3x3 Retrieval vs Op AIRS RTV and ECMWF ANL: Case 2 (09-02-2003, 175, Day)

Temperature @600

L2 STD
Temperature at 600 mbar

AIRS RTV Granule 175
Temperature at 596.306 mbar

ECMWF Analysis Temperature [K] at 596.31 mbar

Humidity @850

L2 STD
Humidity at 850 mbar

RTV NPC30 10118 class
Humidity at 852.798 mbar

ECMWF Analysis Humidity [g/kg] at 852.79 mbar

Op AIRS RTV
AIRS FOR RTV
ECMWF ANL
Single FOV Retrieval 1: (09-02-2003,192)
Single FOV Retrieval 2: (09-02-2003, 192)
Conclusions

• Clear-Sky Regression Retrieval Algorithm (pre-release version 0) has been tested using AIRS measurements under various conditions and considered stable.

• Validation/Comparison with various data sets: results are convincing and encouraging.

• Version 1 Real-Time DB global retrieval algorithm available in near-future (as part of IMAPP).

• Further Investigation and preparation of training and validation data is ongoing.

• Current statistical retrieval approach to be complemented by a non-linear iterative physical approach (version 2).