

Proposal for comparison of AIRS fast RT models

1. Background

There are now several fast RT models in use for simulating AIRS radiances and so it was recommended at the workshop on Sounding from High Spectral Resolution Infrared Observations in Madison to initiate an intercomparison along the lines of the recent ATOVS comparison co-ordinated by Louis Garand. This document provides the specification for such a comparison of AIRS fast RT models to be carried out as an ITWG activity. The methodology is based on the Garand comparison. The comparisons proposed are both of the forward model calculations and the Jacobians with respect to $T(p)$, $q(p)$ and $O_3(p)$.

2. Profiles and other input data to use

52 ECMWF model profiles on 101 AIRS levels available at:

<http://www.metoffice.com/research/interproj/nwpsaf/rtm/>

T (K), q (kg/kg) specific humidity, O_3 (kg/kg), and P_s are specified. For the surface the values (except P_s) are specified in a file with a separate link on the same web site. To convert from specific concentration q in kg/kg to volume mixing ratio v in ppmv use the following equation:

$$v = \frac{q \times M_{air}}{(1-q) \times M_{wv} + q \times M_{air}} 1 \times 10^6$$

where $M_{air} = 28.9644$ and $M_{wv} = 18.01528$ are the molecular weights of dry air and water vapour and r is their ratio $M_{wv}/M_{air} = 0.62198$. It is recommended to use software provided [here](#) to interpolate profiles to other levels. For the surface assume a constant emissivity of 0.99 and the radiance of space to be zero.

3. Channels to simulate

For the forward model comparison results for all AIRS channels using 18 August 02 ISRF version 1 from Larrabee Strowe should be used. They are available from the following web site: <http://asl.umbc.edu/pub/airs/srf/> . The URL's are:

<http://asl.umbc.edu/pub/airs/srf/srftables-020818v1.hdf> or <ftp://asl.umbc.edu/pub/airs/srf/srftables-020818v1.hdf> A document describing how to read this file is at

<http://asl.umbc.edu/pub/airs/srf/srfhdf.pdf> or <http://asl.umbc.edu/pub/airs/srf/srfhdf.html> .

If not all channels can be simulated then retain the same file format with 2378 channels but set those channels not simulated to have a brightness temperature of zero.

For level to space transmittance and Jacobians just 20 channels as defined in the table below should be submitted in order to make the file sizes manageable. The columns with a X in denote those elements of the state vector where transmittances and Jacobians will be compared but for simplicity it is suggested users submit results for all profile elements. In fact the temperature Jacobians for the water vapour channels are still of interest.

AIRS channel number	Frequency ¹ (cm ⁻¹)	Level to space transmittance	Temperature jacobian	Water vapour jacobian	Ozone jacobian
71	666.7	X	X		
77	668.2	X	X		
305	737.1	X	X		
453	793.1	X	X	X	
672	871.2	X	X	X	
787	917.2	X	X		
1021	1009.2	X	X		X
1090	1040.1	X			X
1142	1074.3	X		X	
1437	1323.8	X		X	
1449	1330.8	X		X	
1627	1427.1	X		X	
1766	1544.3	X		X	
1794	1563.5	X		X	
1812	1576.1	X		X	
1917	2229.3	X	X		
1958	2268.7	X	X		
1995	2305.5	X	X		
2107	2385.9	X	X		
2197	2500.3	X	X		

Table 1 Channels for Jacobian comparison.

4. Outputs required

See table below. For forward model runs 3 files are required for nadir, 45 deg and 60 deg local zenith angle from the surface.

Parameter	Units	Dimensions	Filenames	Status
TOA BT	K	2378x52	Fwd_nadir.dat Fwd_45deg.dat Fwd_60deg.dat	Mandatory
$\partial BT/\partial T$	K/K	20xjx52	Jac_nadir.dat Jac_45deg.dat Jac_60deg.dat	Optional
$\partial BT/\partial q$	K/(kg/kg)	20xjx52		Optional
$\partial BT/\partial O_3$	K/(kg/kg)	20xjx52		Optional
Level to space transmittance	0-1	20xjx52		Optional

Table 2 Output data required for comparison participants

For the Jacobians the temperature perturbation is +1K, for the specific humidity and ozone the perturbation is -1% of the layer mean concentration. For finite difference Jacobians it should be +/- 0.5K and +/- 0.5% of the layer mean concentration. If outputs are not on 101 levels provide on your own *j* levels and let the co-ordinator interpolate to the 101 levels. File formats are in ascii (see examples [here](#) for RTTOV-7 forward model results and [here](#) for jacobian results). The FORTRAN code to write out the fwd files is [here](#) and for Jacobians is [here](#). A record of the times taken to run the forward model computation for all channels and profiles and the Jacobians for 20 channels and all profiles should be given by email. When the results are compiled the details of the line by line model and spectroscopic datasets on which the fast model is based will also be required.

¹ Based on 18 August 02 ISRF

5. **Submission of results**

Roger Saunders will pull from designated ftp sites for each participant. Please email him with the details when you are ready to submit your results.

6. **Current participants and status**

- RTTOV-7 (Met Office) - Results submitted
- GENLN2 (Met Office)
- kCARTA (Met Office)
- OSS (AER)
- Bill Smith (SARTA?)
- SARTA (UMBC) - Results submitted
- Gastropod (NIWA) - Results submitted
- OPTRAN (NCEP)
- OPTRAN (NESDIS)
- σ -IASI (Univ Potenza)
- MSCFAST (MSC)
- FLBL (MSC)

7. **Timetable**

June 03 - Announce to ITWG

Sep 03 - Collect initial results

Oct 03 - Present preliminary results at ITSC-13

Jan 04 - Deadline for all participants