

# RTTOV-6 Installation Guide

## 1. Introduction

This document describes how to install the RTTOV-6 FORTRAN-90 and FORTRAN-77 code on a UNIX platform (sec 2) or the FORTRAN-77 code on other platforms (sec 3). It also describes how to test the code once it is installed (sec 4). Before attempting to use the model the reader is strongly advised to read both the RTTOV-6 technical report for how to interface the code to your programs and the RTTOV-6 scientific and validation report which describes or gives links to the scientific basis of the model. These reports can be viewed at the NWP-SAF web site : <http://www.met-office.gov.uk/sec5/NWP/NWPSAF/>

Note, in all cases, if the user only requires the forward (or direct) model then all the routines ending in TL/K/AD are not required. Text in *italics* refers to specific commands to execute during the installation.

## 2. F90/F77 UNIX installation

Some basic information on running the RTTOV-6 Fortran 90/77 code in a UNIX environment follows. This assumes the code is obtained as a compressed unix tar file via ftp from ECMWF. The file name for either F90 or F77 should be *rttov6.tar.Z* and put in your 'top' RTTOV directory (e.g. *~user/rttov6* ) from which subdirectories will be created.

First uncompress the tar file:

```
uncompress rttov6.tar.Z
```

and expand it:

```
tar -xvf rttov6.tar
```

The top level fortran program *tstrad.f* (for testing the code) and the test scripts for running it *tstrad.scr* (forward model test only) and *tstrad\_full.scr* (test of forward code and TL/AD/K routines) + other test scripts all appear in the top directory. The fortran RTTOV code as subroutines are all in the subdirectory *rttovsrc/* and include files in subdirectory *rttovinc/*. The rt coef files (see Annex of technical report) and data files for running *tstrad.out* the test program are all in the subdirectory *rttovdata/* , sample input files in *rttovdata/*, sample output files are given in *rttovtest/* and documentation files in *rttovdoc/*. The files in *rttovtest/* can be compared with the output produced locally to check the installation has been successful. Once the code does reproduce the results in the sample files the code can then be linked into the users own particular applications. The subroutine interfaces and files structures are described in the RTTOV-6 technical report.

For the full model test (*tstrad\_full.scr*) compile as double precision (flag *-r8*) if you can (only necessary to check consistency of TL and AD/K gradient calculations) but the model will run fine as single precision. You can either use the makefile supplied (edited for your top directory and fortran compiler flags):

```
make PROG=tstrad
```

or issue a command like:

```
f90 -r8 -Irttovinc tstrad.f rttovsrc/*.f
```

which should build an *a.out* executable. Rename *a.out* to *tstrad.out*:

```
mv a.out tstrad.out (note already done by makefile)
```

### 3. Non unix installation from floppy disks

The code is provided on 2 floppy disks, one contains the source code, documentation, test files and the rt coefficient file for Meteosat and the contains the other rt coefficient files. Some of the files are zipped to reduce volume. The directory structure on the first floppy disk is:

*A:readme.txt* getting started file

*A:rttovsrsc* contains all source code in fortran 77

*A:rttovinc* contains all include files

*A:rttovdoc* contains this document in plain text format (also accessible from SAF web site)

*A:rttovdat* contains sample input files + Meteosat RT coef file (Meteosat-5 to 7, MSG-1)

*A:rttovtes* contains sample output files (zipped)

*A:rttovscr* contains test scripts (in unix zipped) + sample makefile

The other floppy disk contains the rt coefficient files (except Meteosat) zipped up in file:

*A:rtcoef.zip* ATOVS coef file (NOAA-11 to NOAA-15 supplied, full set available on request)

SSM/I&TMI coef file (TRMM, DMSP-F8 to F15), AVHRR coef file (NOAA-6 to NOAA-15),

GOES coef file (GOES-8 to GOES-12)

These files can be unzipped using *winzip* on a PC or *zip* on a unix system. Users should compile the F77 source code (*tstrad.f* is the main program) rename *a.out* to *tstrad.out* and then follow the instructions below.

### 4. Running RTTOV-6

The parameters in the include file *cparam.h* should be tailored for each individual's application to minimise array sizes. For the test run it is suggested you run with the settings provided and then edit the *cparam.h* file and recompile the code for your application. The parameters are defined in the RTTOV-6 technical report.

To run *tstrad.out* interactively you also need to set up symbolic links to several ascii data files listed below which are in the *rttovdata/* directory. These links (or the files themselves) must be in the same directory as the executable program. They are listed below. One of the various *input\_xx.dat* and *prof\_xxx.dat* files must be renamed to *input.dat* and *prof.dat* in the top directory but the *rt\_coef\_xxxx.dat* files should not be renamed. The *tstrad.scr* file sets all these links up for you and so can be used as an example if you are not sure. The filenames which must have a link from the top directory or be present for *tstrad.out* to work are:

<u>filenames</u>	<u>contents</u>
<i>input.dat</i>	Input file to define which channels to be computed and surface emissivity (several examples supplied for different instruments). See table 1 below for example. Note channel numbers for each instrument are defined in the coefficient file by their central wavenumber.
<i>prof.dat</i>	Input atmospheric profile (2 examples are supplied tropical and arctic) see table 2 below for their format/units.
<i>rt_coef_xxxx.dat</i>	Radiative transfer coeffs for satellite/sensor required
<i>refprof.dat</i>	reference profile data

Note that when running the model within a user application only the radiative transfer coefficient files for the satellites to be simulated are required. If you are running tstrad.out interactively then the following dialogue will appear (answers for GOES-11):

*tstrad.out*

```
Which satellite series do you want?
NOAA=1, DMSP=2, METEOSAT=3 ,GOES imager=4, AVHRR=5: 4
Which satellite id do you want for this series? 11
Which instrument type do you want for this series?
NOAA (TOVS = 1, RTOVS = 2), DMSP(1), METEOSAT(1), GOES(1), AVHRR(1) 1
Forward model only (0) or full gradient test (1)? 0
Number of profiles to test code? 1
Surface type (0=land, 1=sea, 2=ice/snow)? 1
GOESIMCF now reading ascii-file
Goes- 11
Zenith angle (degrees)? 50.1
```

Satellite series (1-5 depending on which you want see RTTOV-6 Tech report)  
 Satellite id (see RTTOV-6 technical report Annex Tables 1 & 2 for their exact definition)  
 Data sub-type (not used at present always set to 1)  
 Number of profiles must not exceed JPPF set in *cparam.h* file).  
 Local satellite zenith angle *not* nadir view angle.

Having run *tstrad.out* an output file called *print.dat* is created which contains the output values from RTTOV-6. For the *tstrad.scr* runs you can compare with sample output reference values provided in the tar file and put in the *rttovtest/* directory. The unix *diff* command is used to produce files of the differences in your *test/* directory. Note for the full (ie TL/AD/K tests) you will see some differences in the gradient part of the code where machine precision becomes important but don't worry about this. Typical differences between different computer platforms are (if compiled with *-r8* flag) for the full test:

```
< 0.082 0.049 0.046 0.045 0.046 0.045 0.045 0.041 0.038 0.036
---
> 0.082 0.049 0.045 0.045 0.045 0.045 0.045 0.041 0.038 0.036
< BRUTE FORCE: -0.2829711887E+02 0.1000000381E+01 6
< BRUTE FORCE: -0.2829710928E+02 0.1000000043E+01 7
< BRUTE FORCE: -0.2829711349E+02 0.1000000191E+01 8
< BRUTE FORCE: -0.2829712571E+02 0.1000000623E+01 9
< BRUTE FORCE: -0.2829696655E+02 0.9999949986E+00 10
< BRUTE FORCE: -0.2829438017E+02 0.9999035979E+00 11
< BRUTE FORCE: -0.2829665391E+02 0.9999839502E+00 12
< BRUTE FORCE: -0.2862066140E+02 0.1011434148E+01 13
< BRUTE FORCE: -0.3012701200E+02 0.1064667524E+01 14
< BRUTE FORCE: -0.2273736754E+02 0.8035226599E+00 15
---
> BRUTE FORCE: -0.2829711886E+02 0.1000000381E+01 6
> BRUTE FORCE: -0.2829710937E+02 0.1000000046E+01 7
> BRUTE FORCE: -0.2829711178E+02 0.1000000131E+01 8
> BRUTE FORCE: -0.2829712855E+02 0.1000000724E+01 9
> BRUTE FORCE: -0.2829702339E+02 0.9999970074E+00 10
> BRUTE FORCE: -0.2829381174E+02 0.9998835099E+00 11
> BRUTE FORCE: -0.2828812740E+02 0.9996826292E+00 12
> BRUTE FORCE: -0.2859223969E+02 0.1010429745E+01 13
> BRUTE FORCE: -0.3069544618E+02 0.1084755591E+01 14
> BRUTE FORCE: -0.1136868377E+02 0.4017613299E+00 15
872,873c872,873
< PROFILE= 1 SUMRAD= -0.7225097989E+01 SUMPROF= -0.7225097989E+01
< PROFILE= 2 SUMRAD= -0.5618514327E+01 SUMPROF= -0.5618514327E+01
---
> PROFILE= 1 SUMRAD= -0.7074762965E+01 SUMPROF= -0.7074762965E+01
```

> PROFILE= 2 SUMRAD= -0.1075604858E+02 SUMPROF= -0.1075604858E+02

If not compiled with a `-r8` flag then the difference output from `tstrad_full.scr` after the words :  
PROFILE= 1 TL=xxxx

is meaningless and the TL arrays are more different due to the reduced precision.  
Again don't worry about this UNLESS you want to run the TL/AD/K model.

Good Luck and please provide me with any feedback on your experiences. There is a RTTOV email news group list which you can subscribe to by sending an email to R. Saunders. Remember do not pass this code on to anyone else without the permission of EUMETSAT. The code is provided to you on an "as is" basis and there is no commitment to maintain it.

Roger Saunders  
NWP Division  
Met. Office  
London Rd  
Bracknell RG12 1SZ  
U.K.

Tel: +44-1344-856295  
Fax: +44-1344-854026  
email: [rwsaunders@meto.gov.uk](mailto:rwsaunders@meto.gov.uk)  
NWP-SAF web page: <http://www.met-office.gov.uk/sec5/NWP/NWPSAF/>

*Table 1; Sample input.dat file for tstrad.out for computing HIRS channels 1-15 (but not 9) with specified surface emissivities*

```
! ATOVS Channel number, Channel Selection (0=off,1=on) & Surface emissivity
1 1 1.0      (1-20=HIRS)                (0.0=use model default)
2 1 1.0      (21-24=MSU)
3 1 1.0      (25-27=SSU)
4 1 1.0      (28-47=AMSU)
5 1 1.0
6 1 1.0
7 1 0.99
8 1 0.99
9 0 0.99
10 1 0.98
11 1 0.98
12 1 0.98
13 1 0.97
14 1 0.97
15 1 0.97
16 0 1.0
17 0 1.0
18 0 1.0
19 0 1.0
20 0 1.0
21 0 0.6
22 0 0.6
23 0 0.6
24 0 0.6
25 0 1.0
26 0 1.0
27 0 1.0
28 0 0.6
29 0 0.6
30 0 0.6
31 0 0.6
32 0 0.6
33 0 0.6
34 0 0.6
35 0 0.6
36 0 0.6
37 0 0.6
38 0 0.6
39 0 0.6
40 0 0.6
41 0 0.6
42 0 0.6
43 0 0.6
44 0 0.6
45 0 0.6
46 0 0.6
47 0 0.6
```

Table 2 Sample Input Profile file for tstrad. (Note units differ from RTTOV input for ease of formatting)

```

-----
Temp profile at 43 levels in degK
 219.10  249.82  255.99  257.54  251.72  243.48  235.02  229.33  226.62  223.05
 218.62  215.08  212.13  207.95  202.51  194.34  193.15  198.05  205.49  212.48
 219.84  226.74  233.39  240.02  246.66  253.05  258.76  263.40  267.21  271.02
 275.13  278.31  281.06  283.33  285.48  287.82  290.44  292.76  294.82  296.76
 299.19  300.97  301.64
Specific humidity at 43 levels in lnq (g/kg)
 -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81
 -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81  -5.81
 -5.81  -5.81  -4.07  -1.41  -0.98  -0.96  -1.14  -0.15  0.82  1.07
 0.98   1.64   1.94   2.08   2.28   2.41   2.47   2.54   2.64   2.81
 2.87   2.90   2.91
Ozone profile at 43 levels in ppmv
 1.0000  1.2573  1.7804  2.8865  3.2868  3.2444  3.1582  2.9850  2.8164  2.0530
 1.4848  1.3399  1.2732  1.0438  0.8993  0.7404  0.5553  0.3604  0.2674  0.1596
 0.0818  0.0490  0.0455  0.0451  0.0455  0.0454  0.0451  0.0414  0.0377  0.0358
 0.0350  0.0341  0.0332  0.0324  0.0308  0.0291  0.0274  0.0260  0.0250  0.0264
 0.0293  0.0316  0.0324
LWC profile(set to zero in this example with top level negative to disable calc)
 -.1000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
 0.0000  0.0000  0.0000
Surface (2metre) parameters: T (K),lnq (g/kg), Ps (hPa), u,v (m/sec)
 301.64   2.91 1007.30  5.000  2.0000
Surface skin variables: Tskin (K)
 301.64
Cloud top parameters: top pressure (hPa), effective IR fractional amount (0-1.)
 500.00   0.00

```

*Last updated on 23/3/2000 by Roger Saunders*