


The EUMETSAT Network of Satellite Application Facilities	 NWP SAF Numerical Weather Prediction	A Graphical User Interface for RTTOV v11.2	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	--	---	---

A Graphical User Interface for RTTOV v11.2

Pascal Brunel, Jean-Luc Piriou,
Pascale Roquet, Jérôme Vidot

Météo-France

This documentation was developed within the context of the EUMETSAT Satellite Application Facility on Numerical Weather Prediction (NWP SAF), under the Cooperation Agreement dated 1 December, 2006, between EUMETSAT and the Met Office, UK, by one or more partners within the NWP SAF. The partners in the NWP SAF are the Met Office, ECMWF, KNMI and Météo France.

Copyright 2014, EUMETSAT, All Rights Reserved.

Change record			
Version	Date	Author / changed by	Remarks
1	2014-05-21	P.Roquet	Initial version
1.1	2014-06-06	J.Hocking	Minor updates for release.





 The EUMETSAT Network of Satellite Application Facilities	 Numerical Weather Prediction	A Graphical User Interface for RTTOV v11.2	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
--	---	---	---

Table of contents

1.Introduction.....	3
1.1.Installation	3
2.RTTOV GUI User Manual.....	4
2.1.Configuration files.....	4
2.2.Files created by the RTTOV GUI.....	5
2.3.Starting the GUI	5
2.4.Loading RTTOV coefficient files.....	6
2.5.Open a Profile.....	7
2.6.Modifying the options.....	9
2.7.Modifying the profile.....	11
2.8.Editing the surface.....	15
2.9.Running RTTOV Direct Model and working with the Radiance Frame.....	17
2.10.Running RTTOV K and working with the K-Matrix Frame.....	24
2.11.Running PC-RTTOV (Principal Components).....	26
2.12.Running PC-RTTOV K.....	27
3.Input Profile file format.....	28
3.1.HD5 profile file format.....	28
3.2.ASCII Text profile file.....	32
3.3.How to create an HDF5 profile file from Fortran.....	35
3.4.How to create an HDF5 profile file from ASCII text profile file.....	35
4.Reporting bugs and limitations.....	37

 	<h1 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h1>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

1. Introduction

This document explains how to install and run the graphical user interface of RTTOV. This interface allows the user to modify an atmospheric profile, run RTTOV for a given instrument to produce the radiances and brightness temperatures, and visualize the results instantly.

1.1. Installation

Using RTTOV GUI requires the following software to be installed :

- python2.7 (<http://www.python.org/download/>)
- wx python version 2.9.5 (<http://www.wxpython.org>)
- numpy (<http://scipy.org/Download>)
- matplotlib with backend_wxagg (<http://matplotlib.org/>)
- h5py version 2.0 or later (<http://www.h5py.org/>)
- HDF5 v1.8.8 or later (<http://www.hdfgroup.org/HDF5/>)
- NetCDF v3.6 or later (<http://www.unidata.ucar.edu/software/netcdf/>)
- RTTOV v11.2

The GUI also requires the f2py package to interface the Fortran and Python code. This is distributed as part of Numpy v1.6 and later.

The RTTOV GUI is provided as part of the RTTOV package in the gui/ directory.

Edit the file build/Makefile.local to point to your NetCDF and HDF5 installations (see section 5 of the RTTOV user guide for more information about this).

You must then generate the Makefiles for f2py and HDF5 and compile RTTOV. Change to the src/ directory and type:

```
$ ../build/Makefile.PL RTTOV_HDF=1 RTTOV_F2PY=1
$ make all
```



Be sure that the HDF5 library used for RTTOV is consistent with that used by h5py.

The rttov_gui_f2py.so symbolic link must point to the rttov_gui_f2py.so which is built in the RTTOV bin/ directory.

Update the rttov_gui.env environment file according to your installation (see next section).

Run the GUI :

```
$ source ./rttov_gui.env
$ ./rttovgui
```

 	<h1 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h1>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

2. RTTOV GUI User Manual

2.1. Configuration files

The `rttov_gui.env` contains mandatory environment variables which are used by RTTOV GUI.

This file must be customized to your specific installation.

Example of `rttov_gui.env` file :

```
# RTTOV GUI Environment
#
# Mandatory variables :
# -----

# RTTOV GUI installation directory

RTTOV_GUI_PREFIX=    # absolute path to the rttov/gui directory
export RTTOV_GUI_PREFIX

PATH=${RTTOV_GUI_PREFIX}:%PATH
export PATH

# Directory where wxPython is installed

WXPYTHON_PREFIX=

# PYTHONPATH and LD_LIBRARY_PATH: these must point to your wxPython installation

PYTHONPATH=${WXPYTHON_PREFIX}/lib/python2.7/site-packages/wx-3.0-gtk2:${WXPYTHON_PREFIX}/lib/python2.7/site-packages/:${RTTOV_GUI_PREFIX}:${PYTHONPATH}
export PYTHONPATH

LD_LIBRARY_PATH=${WXPYTHON_PREFIX}/wxpython/lib:${LD_LIBRARY_PATH}
export LD_LIBRARY_PATH



# Directory for rttov emissivity and BRDF atlases: this should be the directory
# containing the emis_data/ and brdf_data/ directories which hold the atlas
# datasets

RTTOV_GUI_EMISS_DIR=${RTTOV_GUI_PREFIX}/../
export RTTOV_GUI_EMISS_DIR

# Optional environment variables :
# -----

# Working directory (for rttov gui temporary files)

RTTOV_GUI_WRK_DIR=$HOME/.rttov
export RTTOV_GUI_WRK_DIR
```

		<h1>A Graphical User Interface for RTTOV v11.2</h1>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---	---

```
# Default directory for rttov coefficients files

RTTOV_GUI_COEFF_DIR=${RTTOV_GUI_PREFIX}/../rtcoef_rttov11
export RTTOV_GUI_COEFF_DIR

# Default directory for profile files

RTTOV_GUI_PROFILE_DIR=${RTTOV_GUI_PREFIX}/../rttov_test/profile-datasets-hdf
export RTTOV_GUI_PROFILE_DIR
```

2.2. Files created by the RTTOV GUI

The RTTOV GUI software will create various files in its working directory defined by the RTTOV_GUI_WRK_DIR environment variable (~/.rttov by default.).



Most of these files are encoded in the HDF5 format. It is possible to look at them using the hdfview software for instance. Exporting data to text file is also possible using the h5dump command.

These files are :

- profile.h5 : contains the profile and options.
- surface.h5 : contains information about the surface and emissivity / reflectance used as input and computed by RTTOV or modified by user.
- radr.h5 : contains radiances computed by a run of RTTOV.
- trns.h5 : contains transmittances computed by a run of RTTOV.
- kmat.h5 : contains the K matrix computed by a run of RTTOV K
- pc.h5 : contains the pcscores computed by a run of PC-RTTOV.
- pckmat.h5 : contains the K PC matrix computed by a run of PC-RTTOV K
- tmpFileErr.log : last RTTOV error log file.
- tmpFileOut.log : last RTTOV output log file
- rttovgui.log : RTTOVGUI log file.

2.3. Starting the GUI

```
$ source ./rttov_gui.env
$ ./rttovgui
```

The RTTOV GUI main window is launched (see Figure 2.3.1) : it allows you to load coefficient files (through the RTTOV menu), to open a profile (through the File menu), to modify options, profile and surface parameters if necessary (through the dedicated windows available through the Windows menu) and to run the RTTOV direct model (through the RTTOV menu). The application log is displayed in this main window.

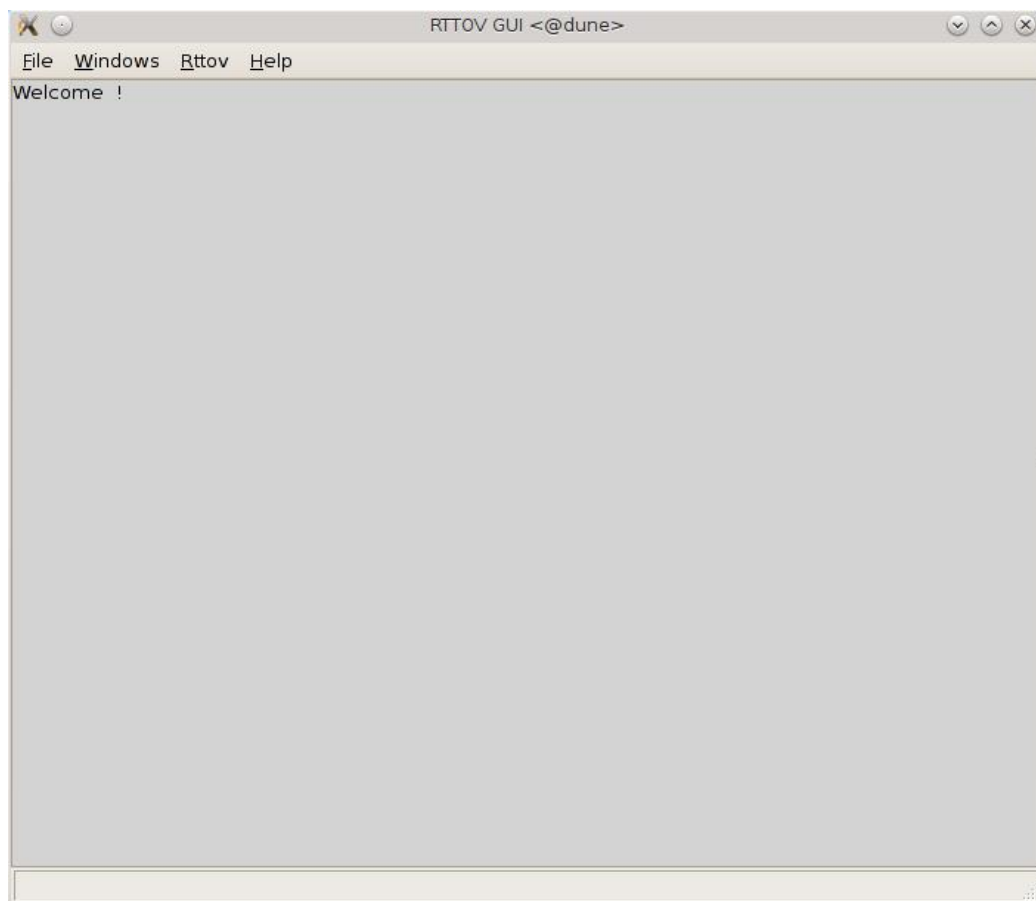


Figure 2.3.1 : main window

2.4. Loading RTTOV coefficient files

The first step is to choose an instrument you want to work with. For this purpose, you have to pick a coefficient file using the RTTOV menu “Load coefficient” (figure 2.4.1).

You must choose a file by clicking on the Choose button.

An RTTOV coefficient file is always mandatory. If you want to work with aerosols you must choose an aerosols coefficient file, and if you want to work with clouds, you must choose a cloud coefficient file. All these files must be compatible (i.e. they must be for the same instrument and contain coefficients for the same channel set).

Once your choices have been made, you can load the coefficient files by clicking on the “Load” button, or by clicking on the “File” menu and selecting the “Load coefficient” menu item.

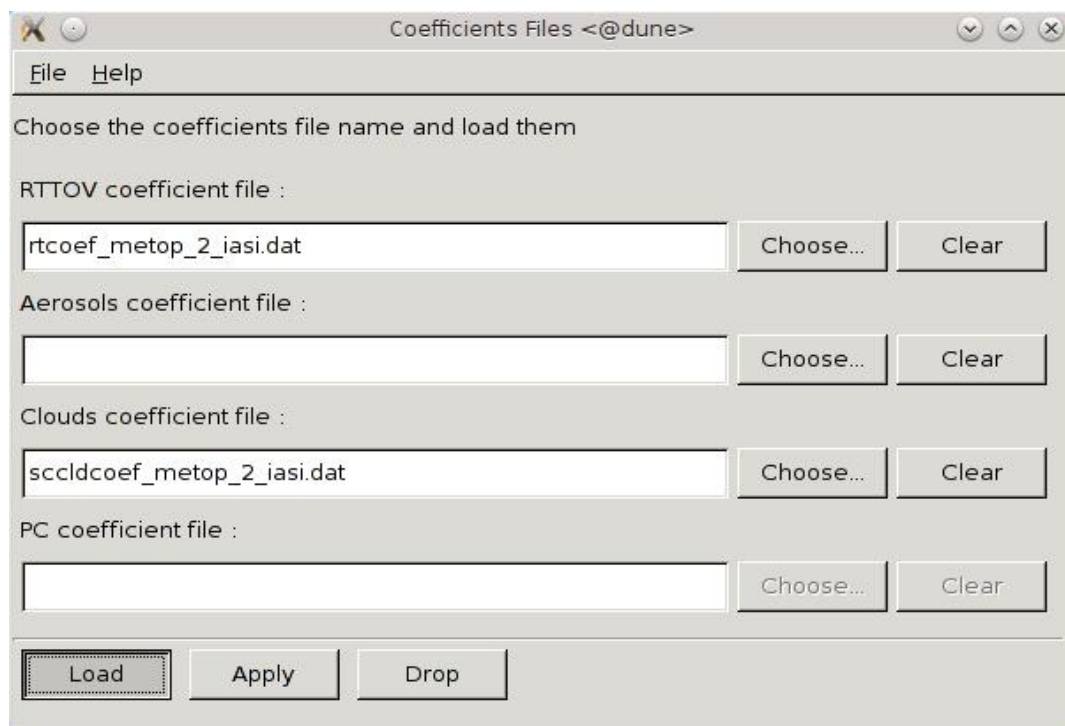


Figure 2.4.1 : choose a coefficient file

When the coefficient files are successfully loaded by RTTOV an information window appears (figure 2.4.2). The log in the main window provides some information from the coefficient files such as the wave numbers and the reference temperatures of the instrument.



Figure 2.4.2 : information window

2.5. Open a Profile

The item “Open Profile” of the “File” menu of the main window permits you to open a profile stored in HDF5 format (figure 2.5.1). If a profile file contains several profiles, you will be asked to choose the profile number (figure 2.5.2). A selection of HDF5 profiles from the RTTOV test suite can be found in `rttov_tests/profile-datasets-hdf/`.

The “File” menu item “Open ASCII Profile” allows you to read profiles stored in Python-formatted ASCII files. Section 3 below contains more information about the HDF5 and ASCII profile file formats.

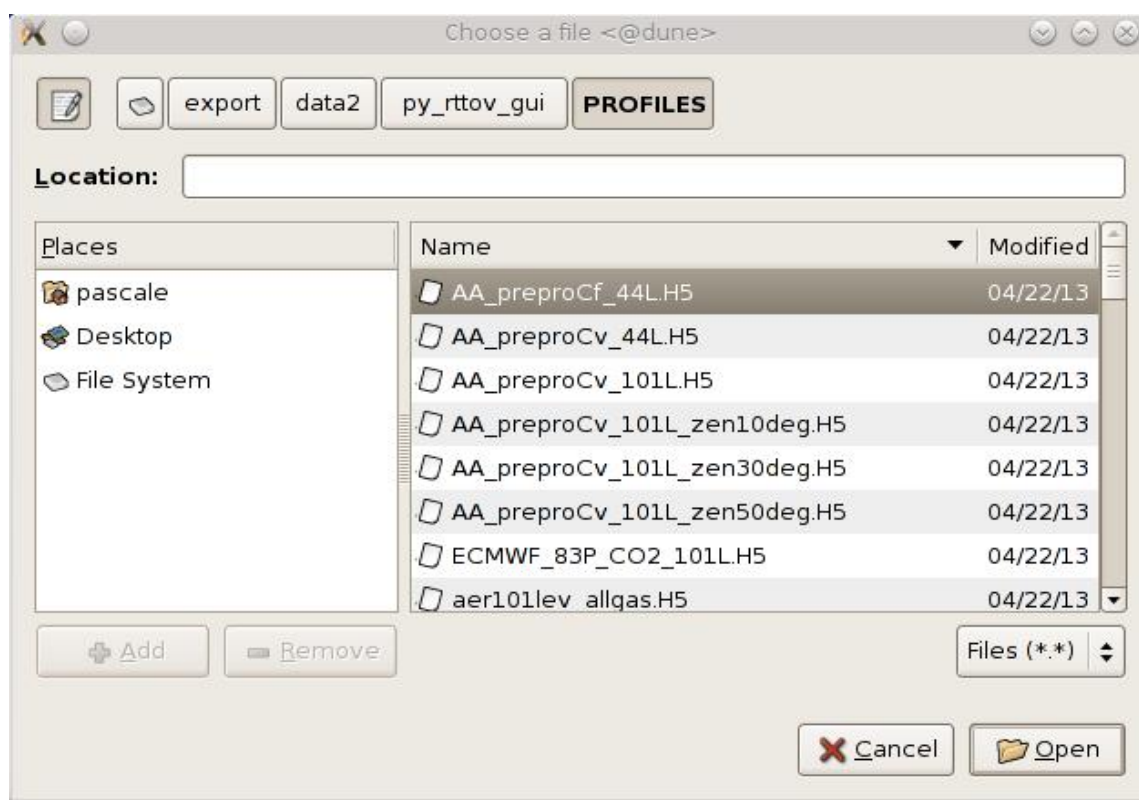


Figure 2.5.1 : select a profile

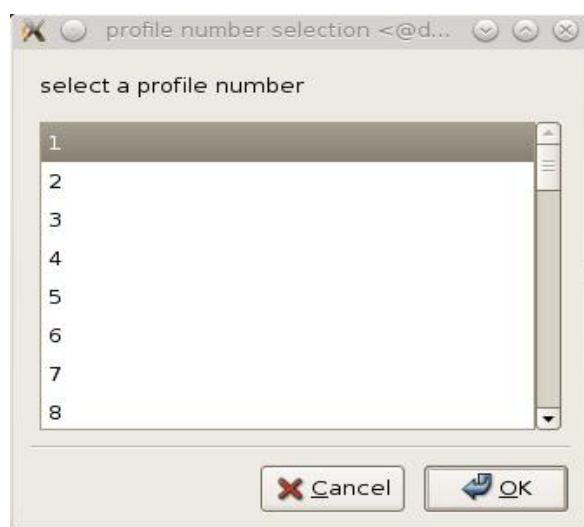



Figure 2.5.2 : choose a profile number

<div data-bbox="135 181 252 237"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="280 192 547 262">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

2.6. *Modifying the options*

The RTTOV options can be modified through the Options editor window. Select “Options Editor Window” from the “Windows” menu of the main window (fig 2.6.1).

The RTTOV options which can be modified are part of the option structure of RTTOV, described in the RTTOV v11 User Guide (Annex O). The help menu of the Options editor windows gives you some information. Some options are unavailable depending to the loaded coefficient files or the profile content. For example, the “addclouds” option can only be checked if you have loaded a cloud coefficient file. The “addaerosl” option can also only be checked if an aerosols coefficient file is loaded. PC-RTTOV options can be modified only if you have loaded a PC RTTOV coefficient file. Once you have made your choices you have to save them for the run by clicking the “Apply” button.

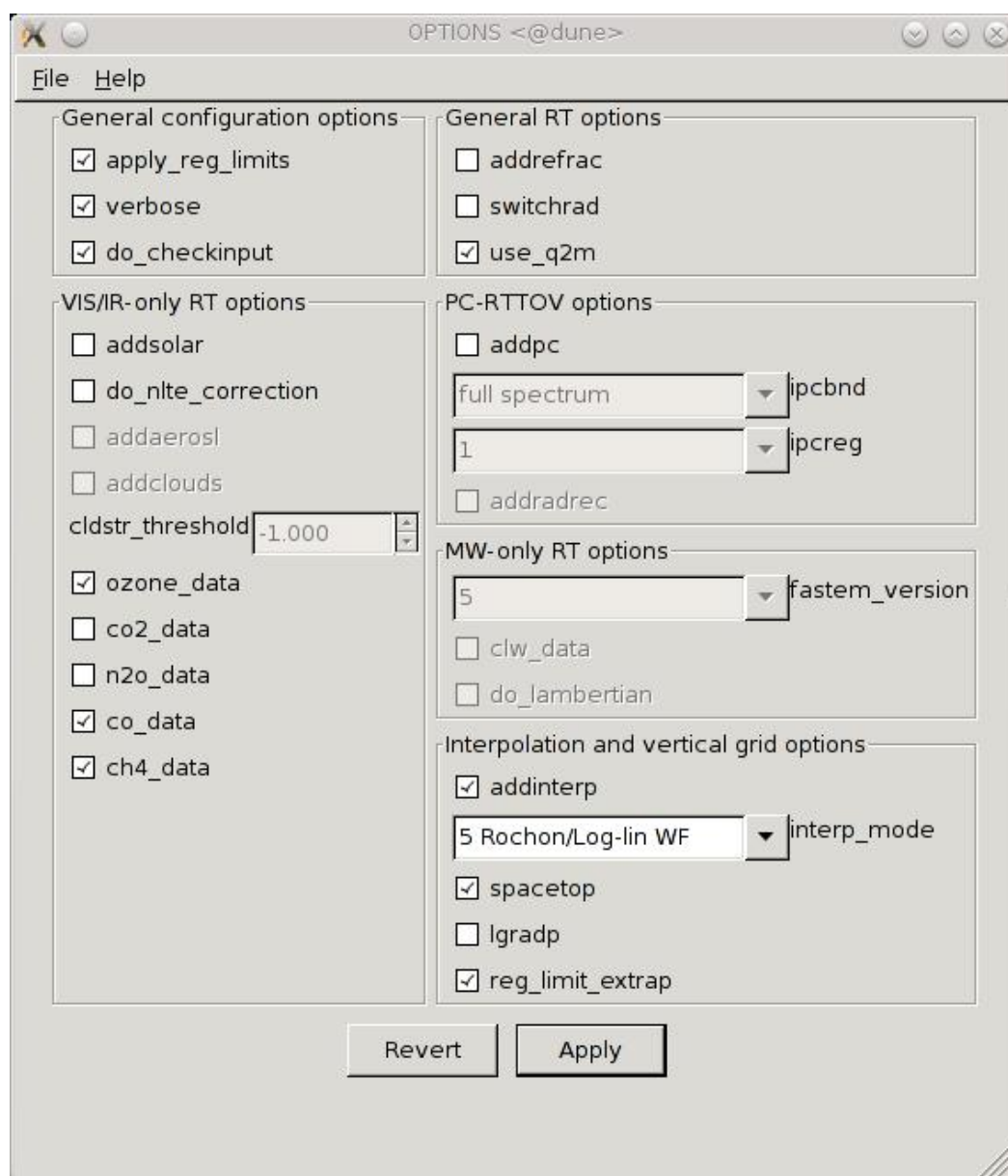


Figure 2.6.1 : Option Editor window

2.7. Modifying the profile

The profile can be modified through the profile editor window. Select “Profile Editor Window” from the “Windows” menu of the main windows.

Figure 2.7.1 displays an example of the profile editor window showing the atmospheric gas profiles.

Figures 2.7.2 and 2.7.3 display examples for aerosol and cloud profiles respectively. Aerosol components and cloud types are described in the RTTOV v11 users guide in table 21 in section 8.6 and in table 18 in section 8.5 respectively.

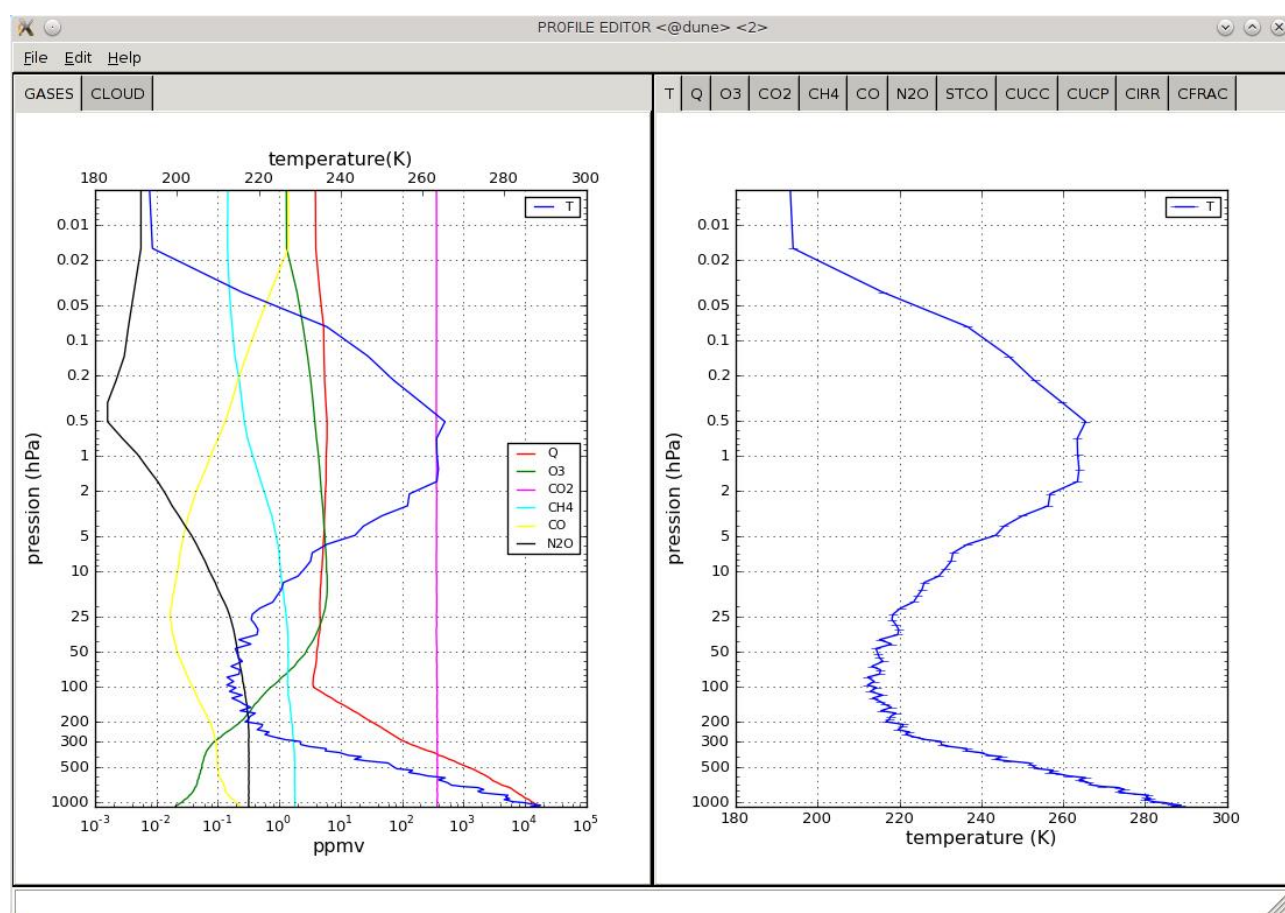


Figure 2.7.1 : Profile Editor window

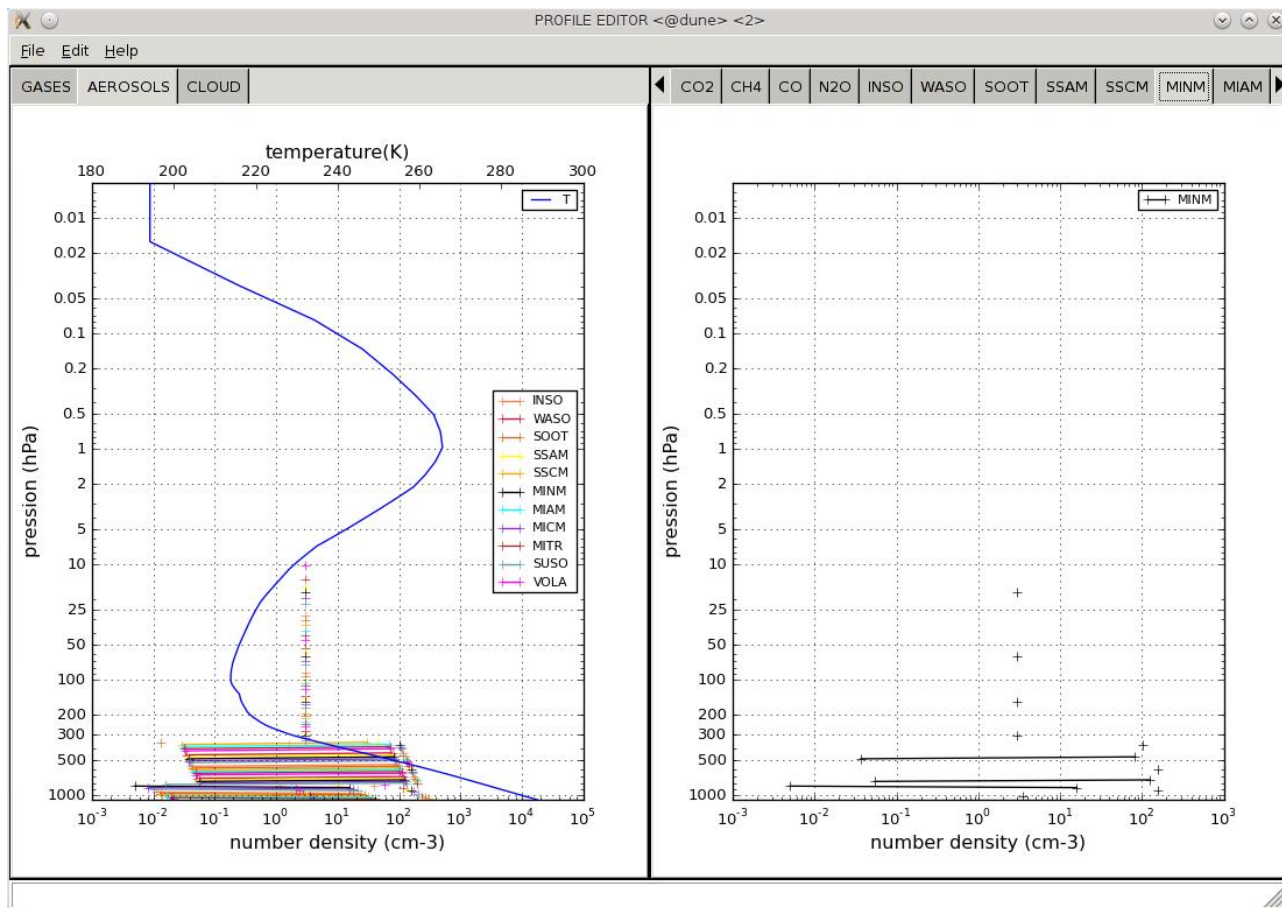


Figure 2.7.2 : Profile Editor window with aerosols

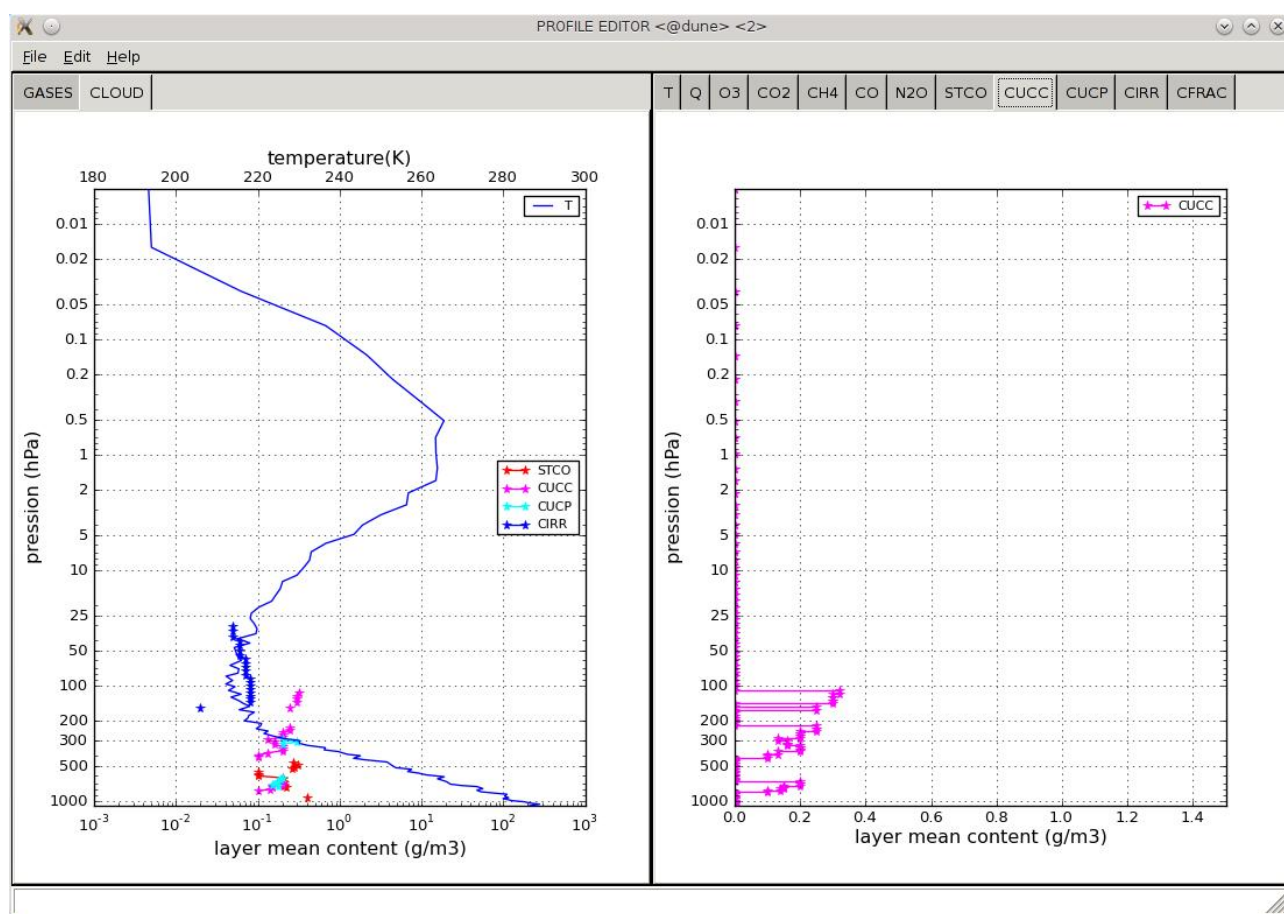


Figure 2.7.3 : Profile Editor window with clouds

The left hand panel of the window shows the atmospheric components profiles grouped by type : Gases, Aerosols and Clouds. The Temperature profile is always drawn on the three types of panel. On the right hand panel of the window, the different components profiles are drawn separately. You can modify the profile by hand by clicking in the panel. For that, select and visualize a component profile on the right panel. Click the middle mouse button to modify the profile. The closest point on a profile pressure level or layer is moved to the new value. The corresponding curve in the left hand panel is also updated. In the right hand panel you can also click with the left mouse button and drag a zone to zoom in. Click the right button to zoom out. Finally, apply your changes or save the profile for the next run of RTTOV using the File menu.

Edit menu options :

Undo : undo the last modification of the curve.

Redo : redo the last modification of the curve.

Insert : For aerosols or clouds only, clicking in the right hand panel moves or creates a new point.

Remove : For aerosols or clouds only, clicking in the right hand panel removes the nearest point (sets the nearest layer concentration to zero).

Edit x axe : Change the X axis bounds.

Add gas : Add a gas.

Remove gas : Remove a gas.

Add aerosol : Add an aerosol particle type.

Remove aerosol : Remove an aerosol particle type.

Add cloud : Add a cloud particle type.

Remove cloud : Remove a cloud particle type.

Replace aerosol by clim : Replace all aerosol profiles with a climatological aerosol selection. The user can choose between different types of climatology (see fig 2.7.4)



Figure 2.7.4 : Climatology choices for aerosols

2.8. Editing the surface

The Surface Editor Windows allows you to modify the surface parameters of the profile. Select the Surface Editor Window menu item from the windows menu of the main window.(Fig 2.8.1).

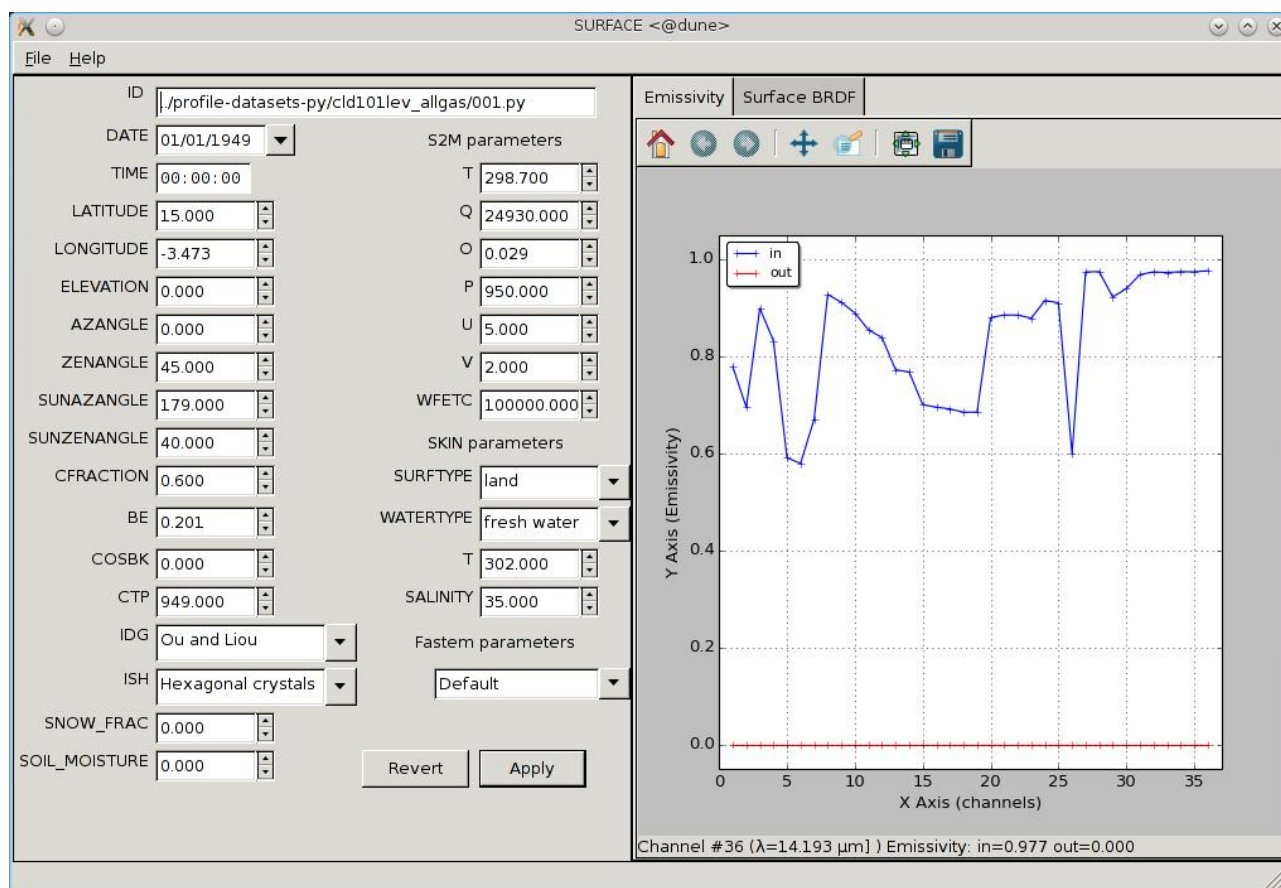
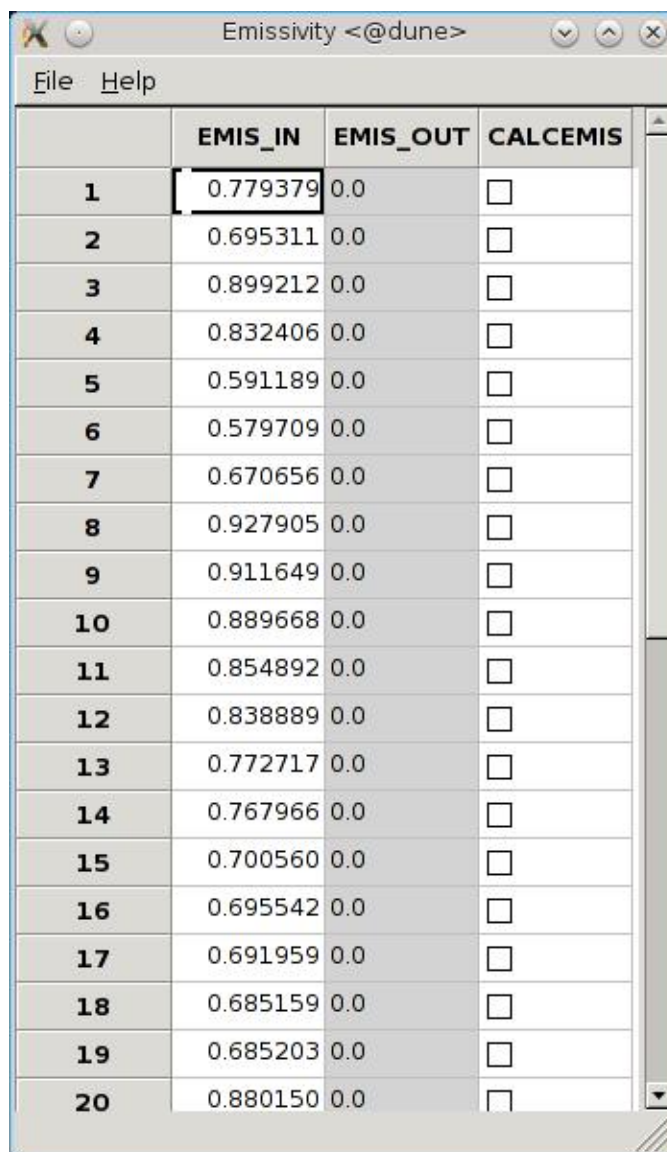


Figure 2.8.1 : Surface Editor Window

The File Menu of the Surface Editor Window allows you to load an atlas, or to modify the value of emissivity or reflectance, channel by channel (Fig 2.8.2). After making changes you must select “Apply changes” from the File menu.

The computed emissivity/reflectance values appear in red on the right hand panel. The input values are in blue. If an atlas is loaded, the RTTOV model does not compute the emissivity or reflectance values.



	EMIS_IN	EMIS_OUT	CALCEMIS
1	0.779379	0.0	<input type="checkbox"/>
2	0.695311	0.0	<input type="checkbox"/>
3	0.899212	0.0	<input type="checkbox"/>
4	0.832406	0.0	<input type="checkbox"/>
5	0.591189	0.0	<input type="checkbox"/>
6	0.579709	0.0	<input type="checkbox"/>
7	0.670656	0.0	<input type="checkbox"/>
8	0.927905	0.0	<input type="checkbox"/>
9	0.911649	0.0	<input type="checkbox"/>
10	0.889668	0.0	<input type="checkbox"/>
11	0.854892	0.0	<input type="checkbox"/>
12	0.838889	0.0	<input type="checkbox"/>
13	0.772717	0.0	<input type="checkbox"/>
14	0.767966	0.0	<input type="checkbox"/>
15	0.700560	0.0	<input type="checkbox"/>
16	0.695542	0.0	<input type="checkbox"/>
17	0.691959	0.0	<input type="checkbox"/>
18	0.685159	0.0	<input type="checkbox"/>
19	0.685203	0.0	<input type="checkbox"/>
20	0.880150	0.0	<input type="checkbox"/>

Figure 2.8.2 : Edit Input Emissivity or BRDF Values. (Tip for check boxes : write 1 to check the box and 0 or nothing to un-check the box)

2.9. Running RTTOV Direct Model and working with the Radiance Frame

To run the direct model of RTTOV select “Run direct” from the RTTOV menu in the main GUI window. This will save and overwrite the profile being edited and run the direct model (the profile is saved before each run in the RTTOV GUI working directory: it does not overwrite the original input profile file).

If the run is successful, a new window appears : the radiance window which displays the result of the RTTOV direct model. (Fig 2.9.1)

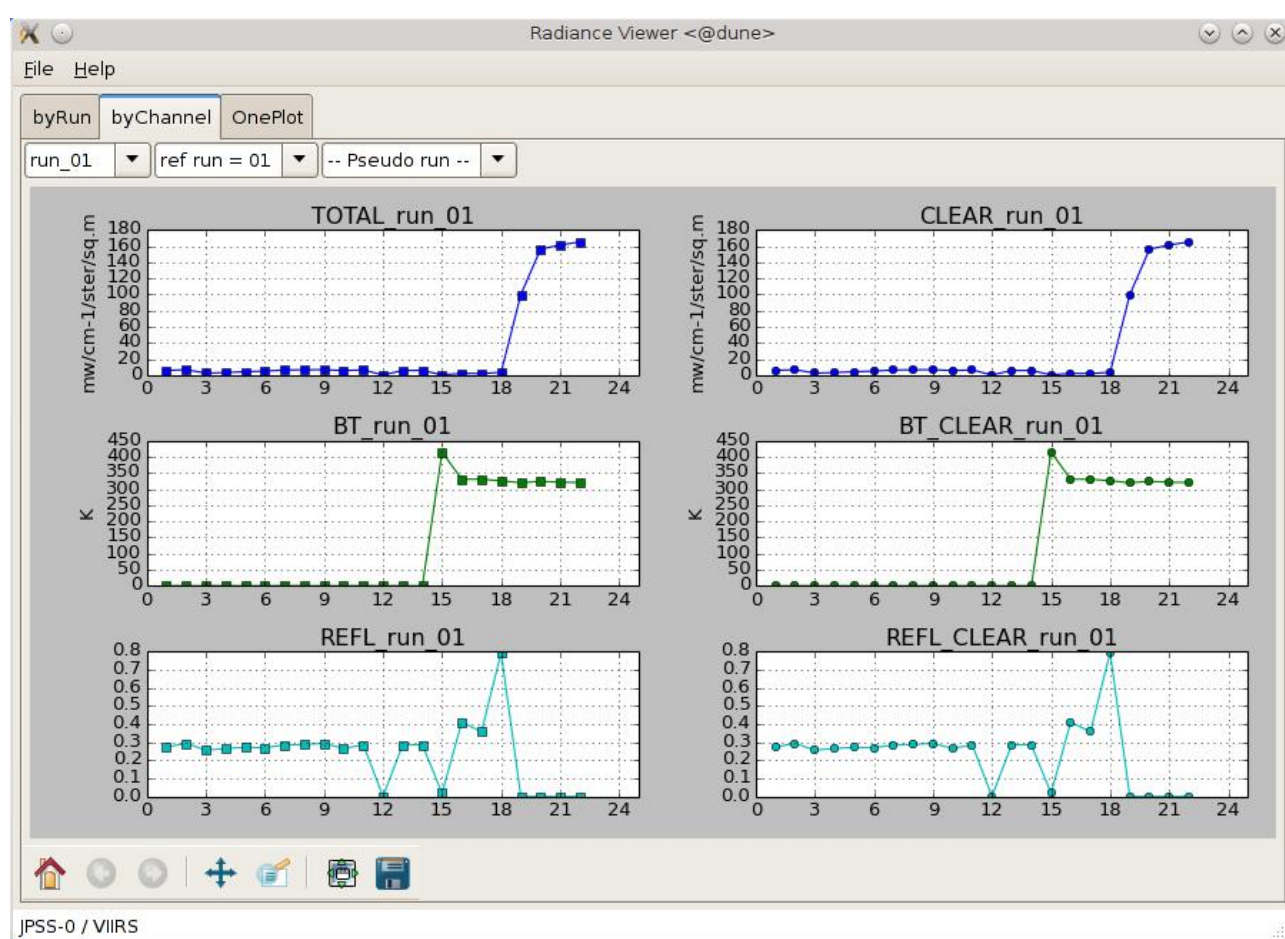



Figure 2.9.1 : Radiance window

<div data-bbox="135 179 252 235">The EUMETSAT Network of Satellite Application Facilities</div> <div data-bbox="279 190 545 264">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

The charts displayed in the radiance window are :

- **TOTAL** : Clear+cloudy top of atmosphere radiance for given cloud top pressure and fraction [mw/cm-1/ster/sq.m]
- **CLEAR** : Clear sky top of atmosphere radiance (channels) [mw/cm-1/ster/sq.m]
- **BT** : Brightness temperature equivalent to total radiance [Kelvin]
- **BT_CLEAR** : Brightness temperature equivalent to clear radiance [Kelvin]
- **REFL** : Reflectance calculated from total radiance [N/A]
- **REFL_CLEAR** : Reflectance calculated from clear radiance [N/A]

It is possible to choose different types of visualisation :

byChannel : For each run, view of all charts with all channels values (fig 2.9.1)

In this view you can select :

- -- **Run** -- : to choose a run (needs at least 2 different runs)
- -- **Pseudo Run** -- : To see the difference between two successive runs (needs at least 2 different runs) (fig 2.9.2)

byRun : For each channel, view of all charts with all runs values

In this view you can select :

- -- **Channel** -- : to choose a channel
- -- **Pseudo Channel** -- : for channel combinations

OnePlot : View of one chart (fig 2.9.3)

In this view you can select :

- **The parameter** : TOTAL BT REFL +CLEAR : choose a chart type
- -- **Run** -- : to choose a run
- -- **Pseudo Run** -- : difference between two successive runs
- -- **Channel** -- : to choose a channel
- -- **Pseudo Channel** -- : for channel combinations

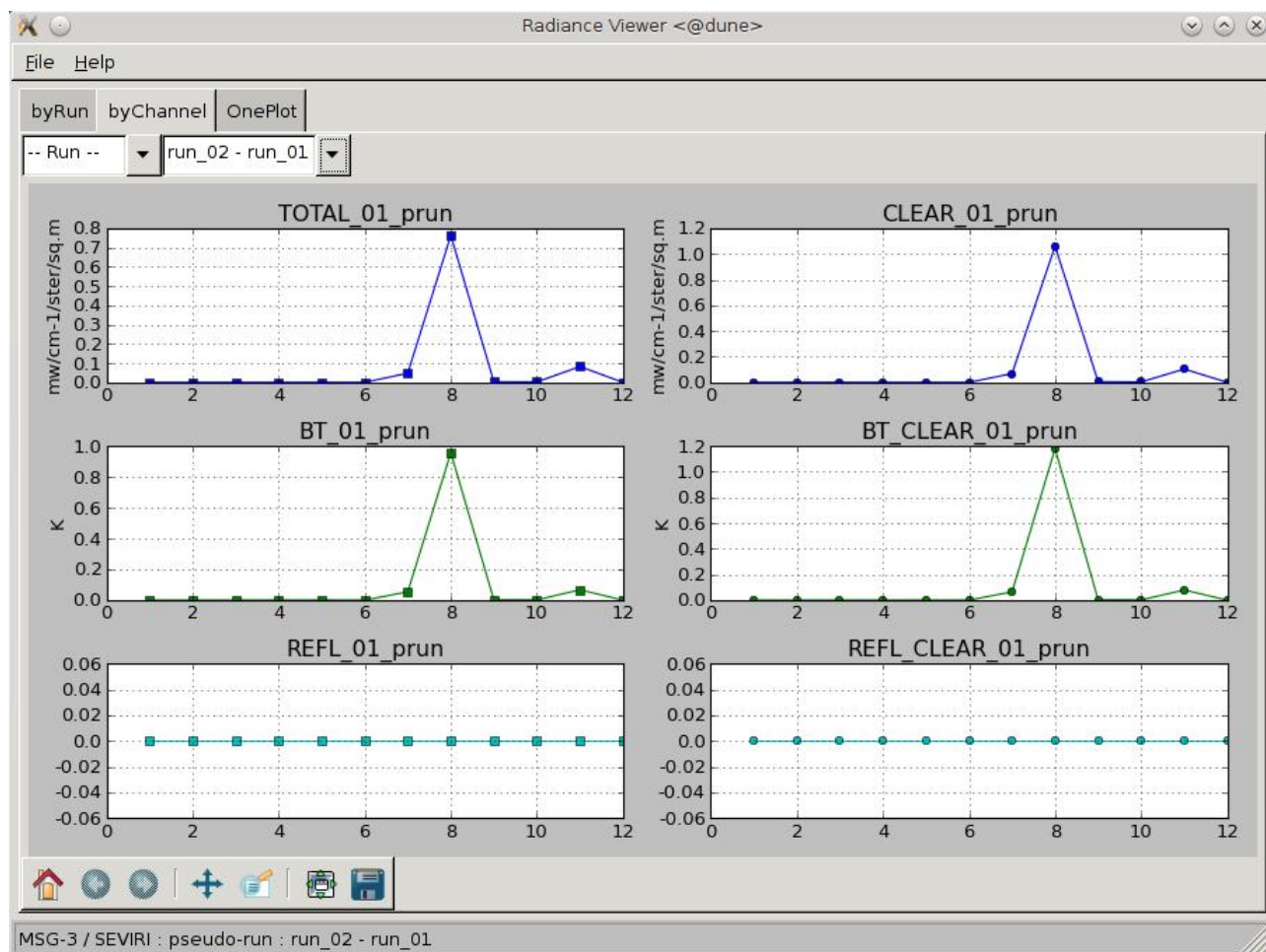


Figure 2.9.2 : Radiance window (by Channel view : pseudo run [run 02 – run 01] display)

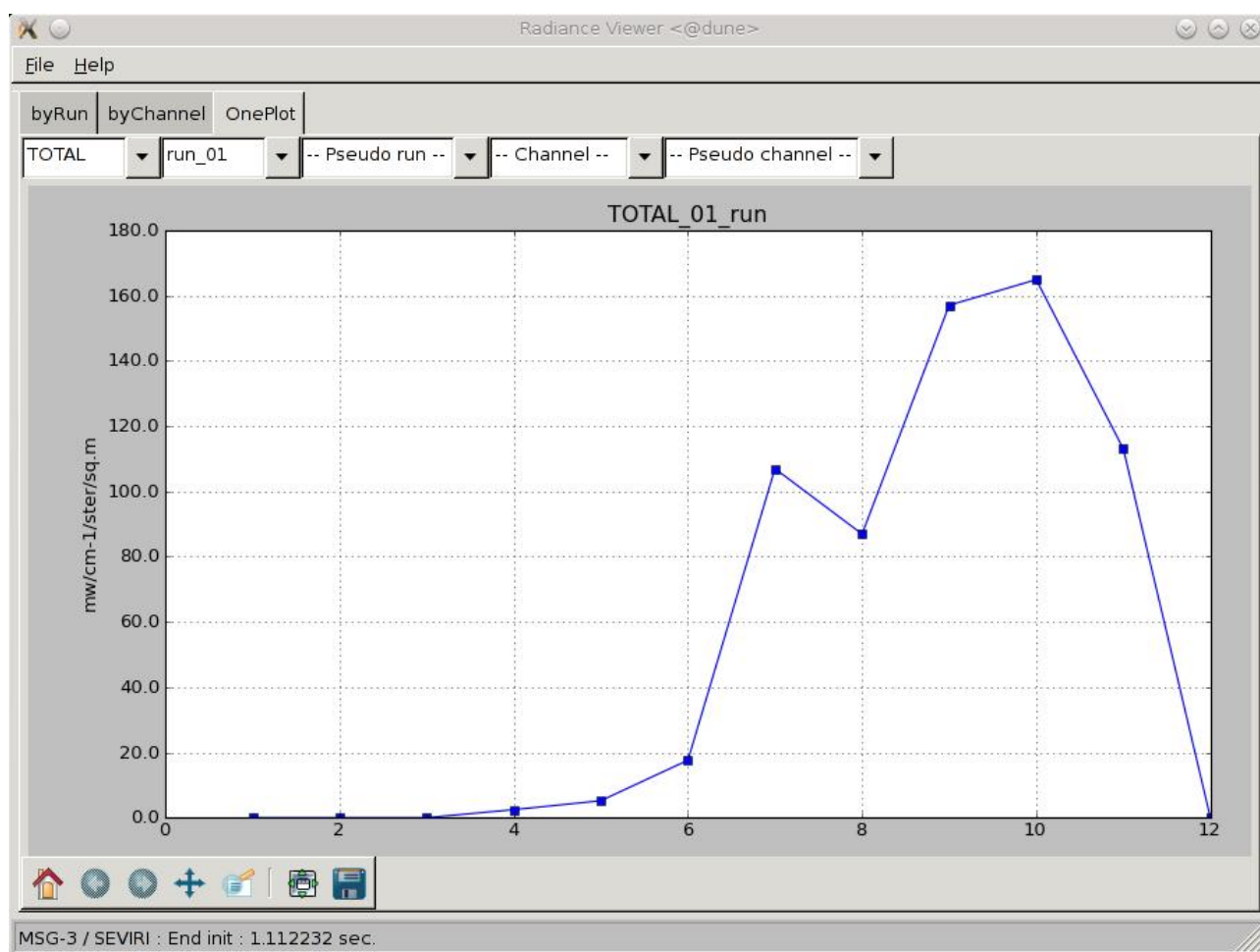


Figure 2.9.3 : Radiance window (One Plot view)

In the “byRun” view you may enter your own formula to compute a “pseudo channel”, for example you can compute the difference between two channels, or more complicated formula. Your formula will then appear in the “–Pseudo Channel –” list. (fig 2.9.4)

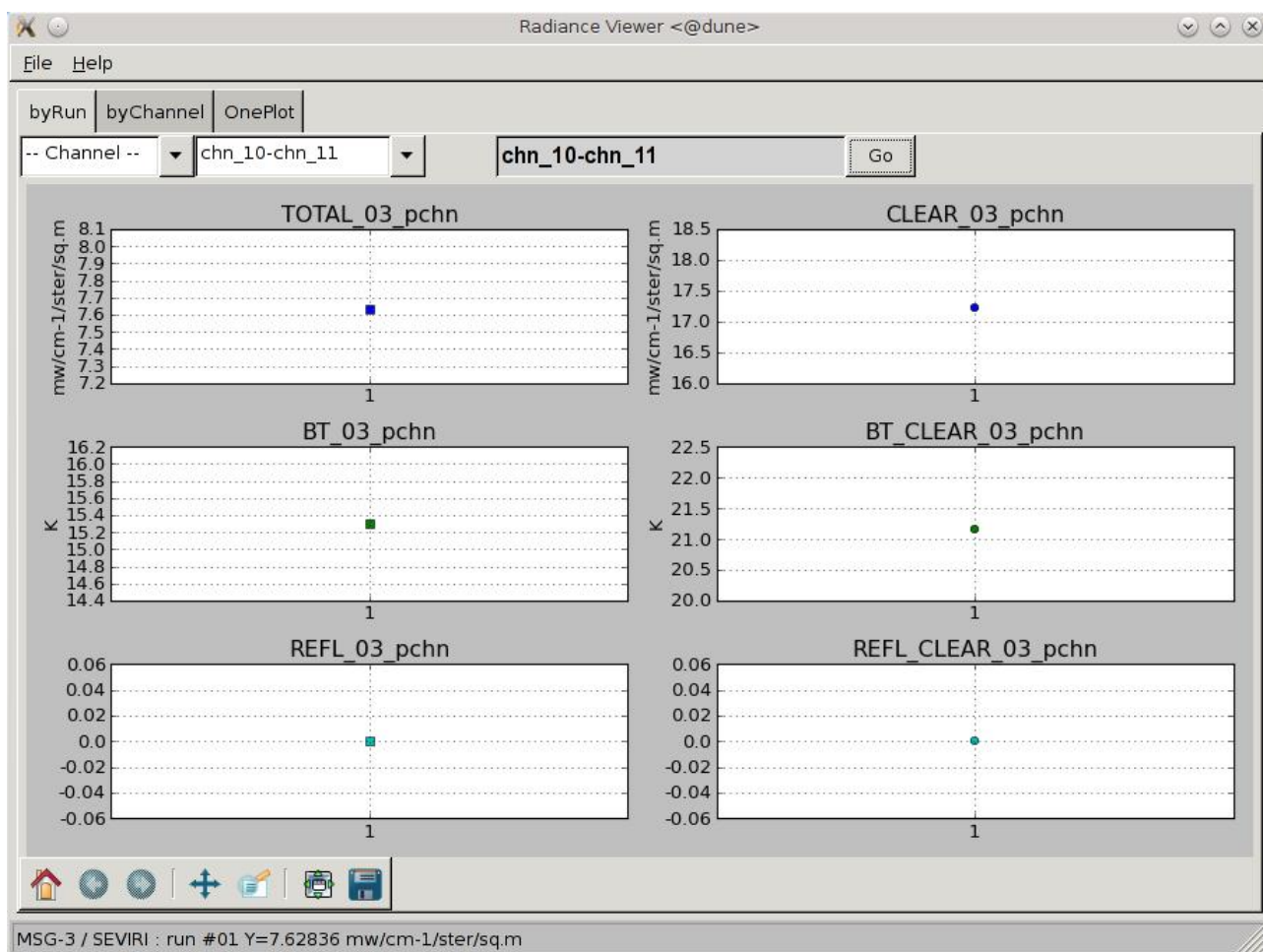


Figure 2.9.4 : Radiance window (Compute a pseudo channel)

For high-resolution sounders such as IASI, AIRS or CrIS, a spectrum is displayed when the direct model is run (fig. 2.9.5)

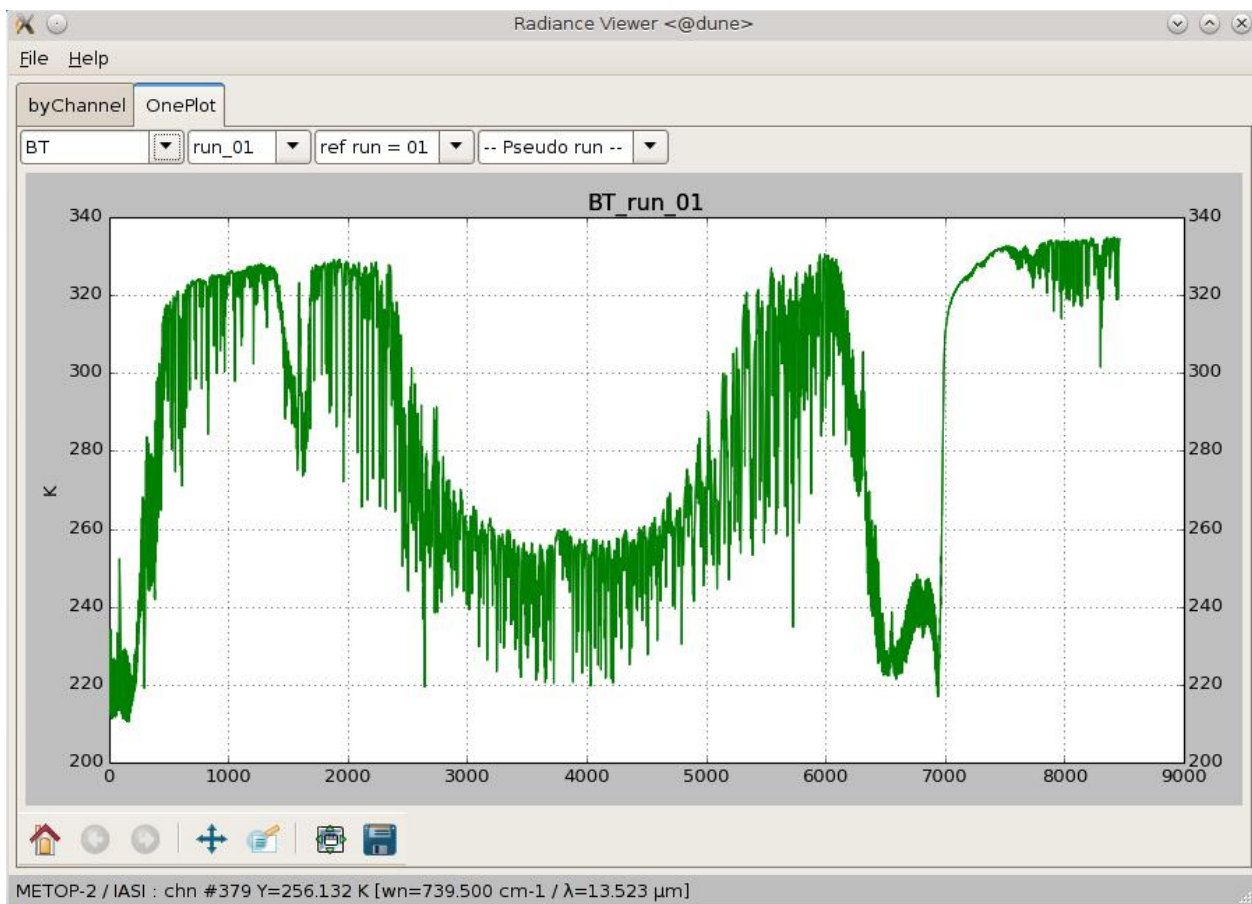


Figure 2.9.5 : Radiance window for hyperspectral instruments

For any subsequent run you can select pseudo run such as run 02 – run 01 to see the spectrum differences (see fig. 2.9.6 spectrum difference between run 02 (with clouds) and run 01 (without clouds)).

NB : to perform a run of the RTTOV model with cloud you have to load a Cloud coefficient file and to check the “addclouds” option with the Options Editor Window, and of course your profile must have clouds !

You must keep the Radiance Viewer window open between runs in order to compare results from multiple runs. Once the Radiance Viewer window has been closed previous results are lost.

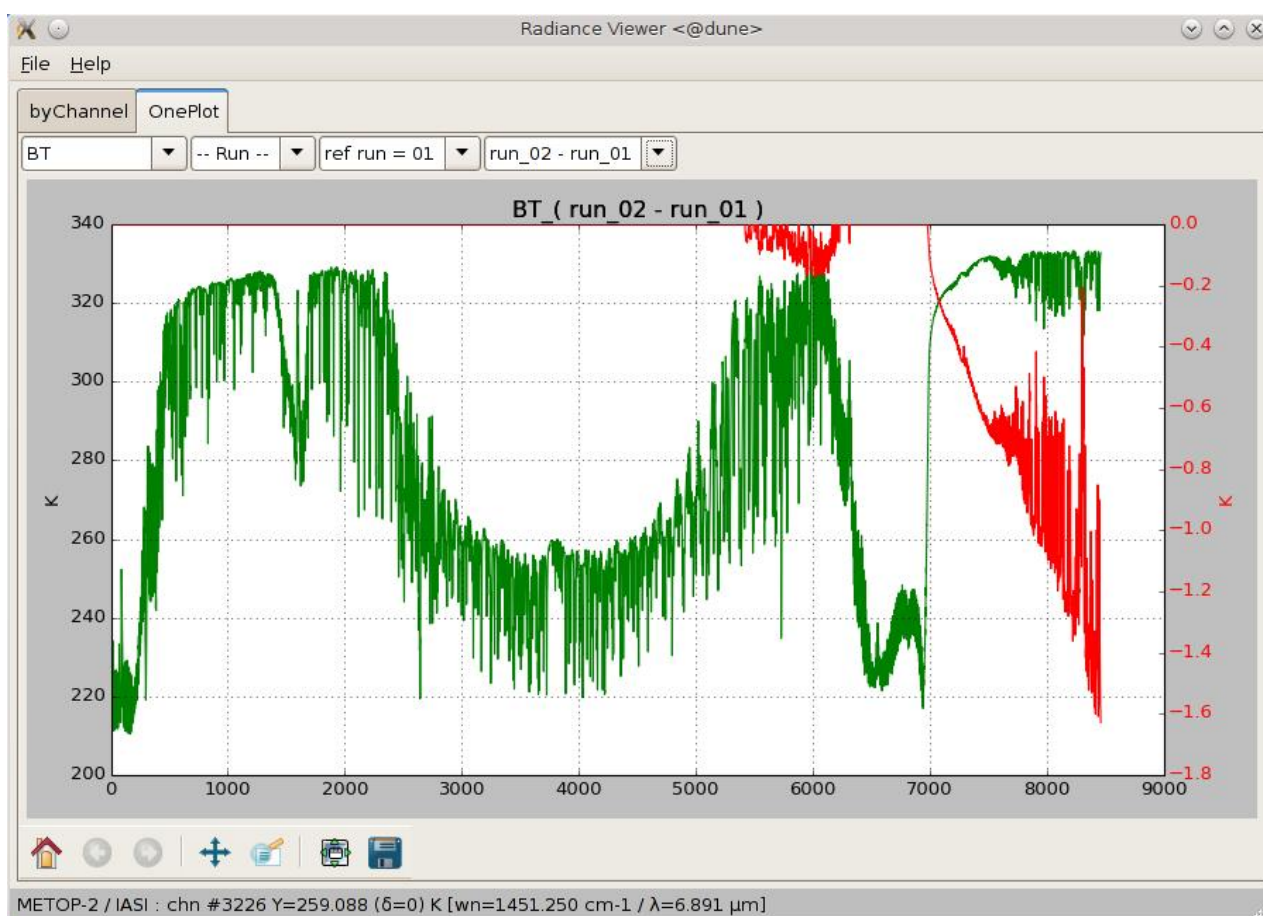


Figure 2.9.6 : Radiance window for hyperspectral instruments : difference between 2 runs (with and without addsolar)

Instrument change :

If you want to run RTTOV with a new instrument by loading a new coefficient file, with an active radiance window displaying the results of a previous RTTOV run, the status bar at the bottom of the radiance window is highlighted in red, warning you that the instrument has changed. To display the results of a new RTTOV run, you must close the radiance window and to launch the RTTOV direct model run again.

Radiance window command line functionality :

It is also possible to launch the radiance window separately from the RTTOV GUI with the `radr.h5` file containing the results of a RTTOV run (this file are kept by default in the `$HOME/.rttov` directory) :

```
$ python rview/radianceframe.py radr.h5 [radr2.h5 ...]
```

Interactive navigation :

The toolbar at the bottom of the radiance window is the standard matplotlib tool bar : it allows you to zoom and navigate the figure and save plots as image files.

2.10. Running RTTOV K and working with the K-Matrix Frame

It is possible to run the K model of RTTOV. For this purpose, select the RTTOV menu from the main window and then select “Run RTTOV K”. This will save and overwrite the profile and run the K model.

If the run is successful, a new window appears : the K-Matrix Window which display the result of the RTTOV K-Model (Fig 2.10.1). With every RTTOV K run, a new window is displayed.

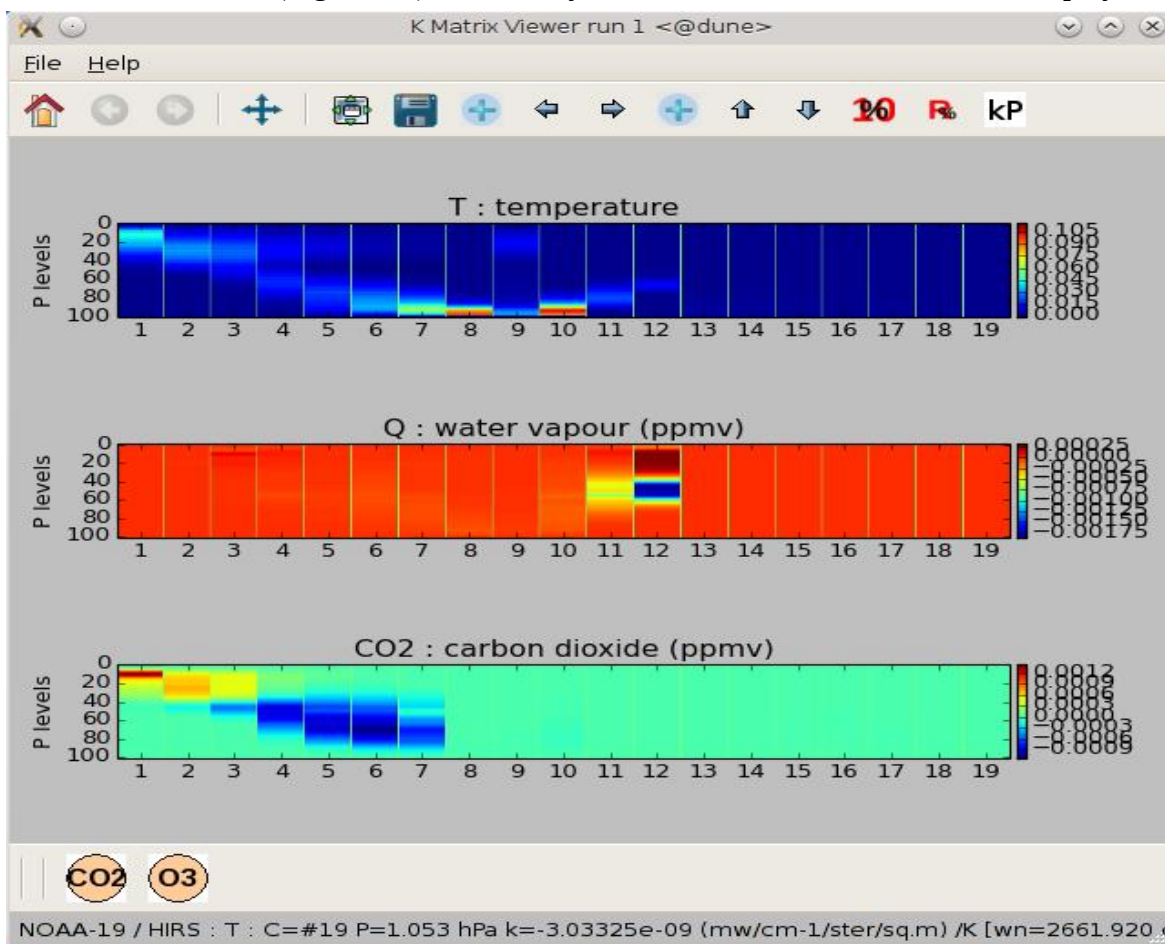


Figure 2.10.1 : K-Matrix window

Move the mouse on a channel and hit 'P' on your keyboard to display the K profile (Fig 2.10.2)

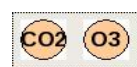
Icon toolbar :



You can also use the Kp icon to choose the channel of the K profile to be displayed.



This icon permits you to multiply all values by 0.1.



If present these icons permit you to display the K matrix for different gases in the bottom plot.

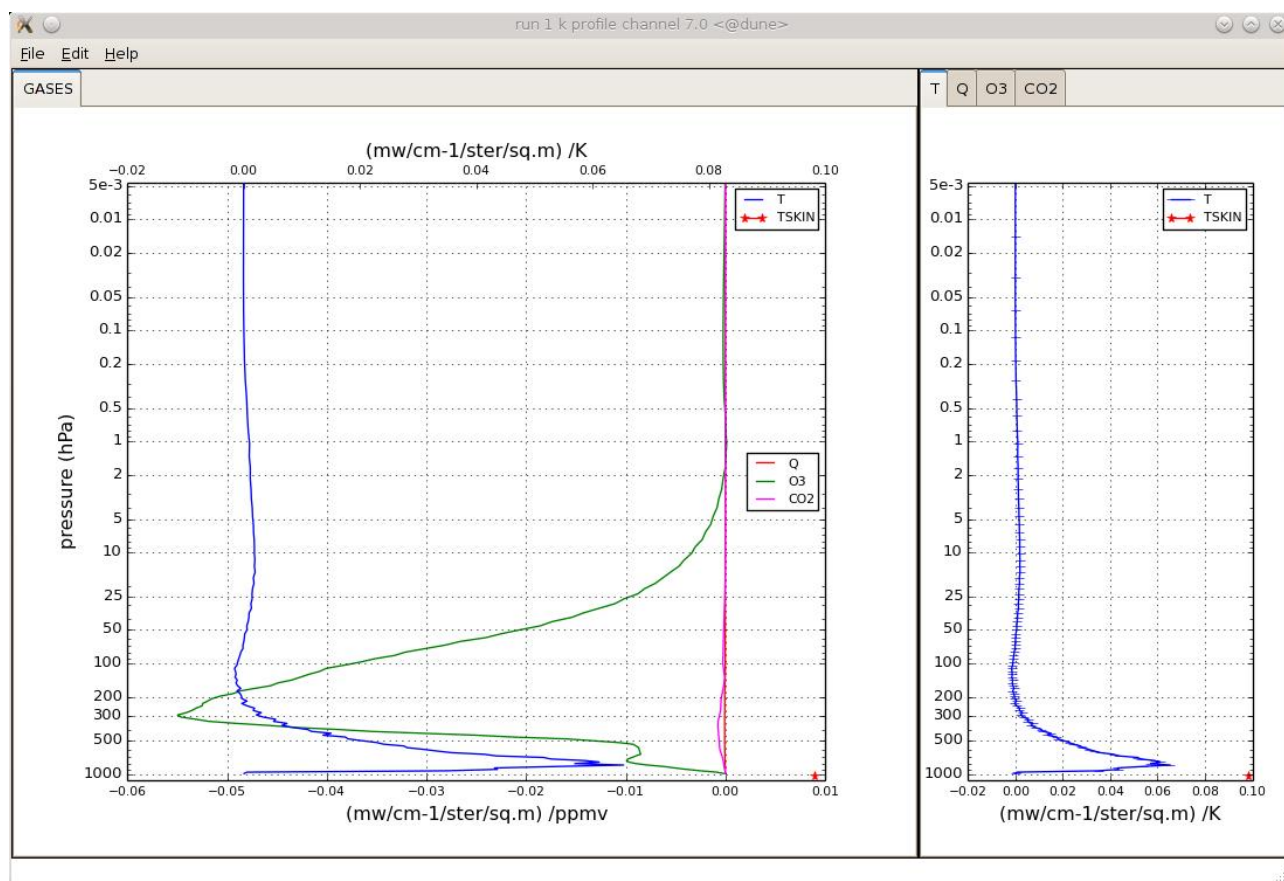


Figure 2.10.2 : The K profile window

2.11. Running PC-RTTOV (Principal Components)

It is possible to run PC-RTTOV. For this purpose you have to load a PC coefficient file and select the “addpc” option in the Option Window.

Then select “Run RTTOV”. You will be asked to enter the number of Principal Components.

After the run a new window is displayed : the PC SCORES window (Fig 2.11.1).

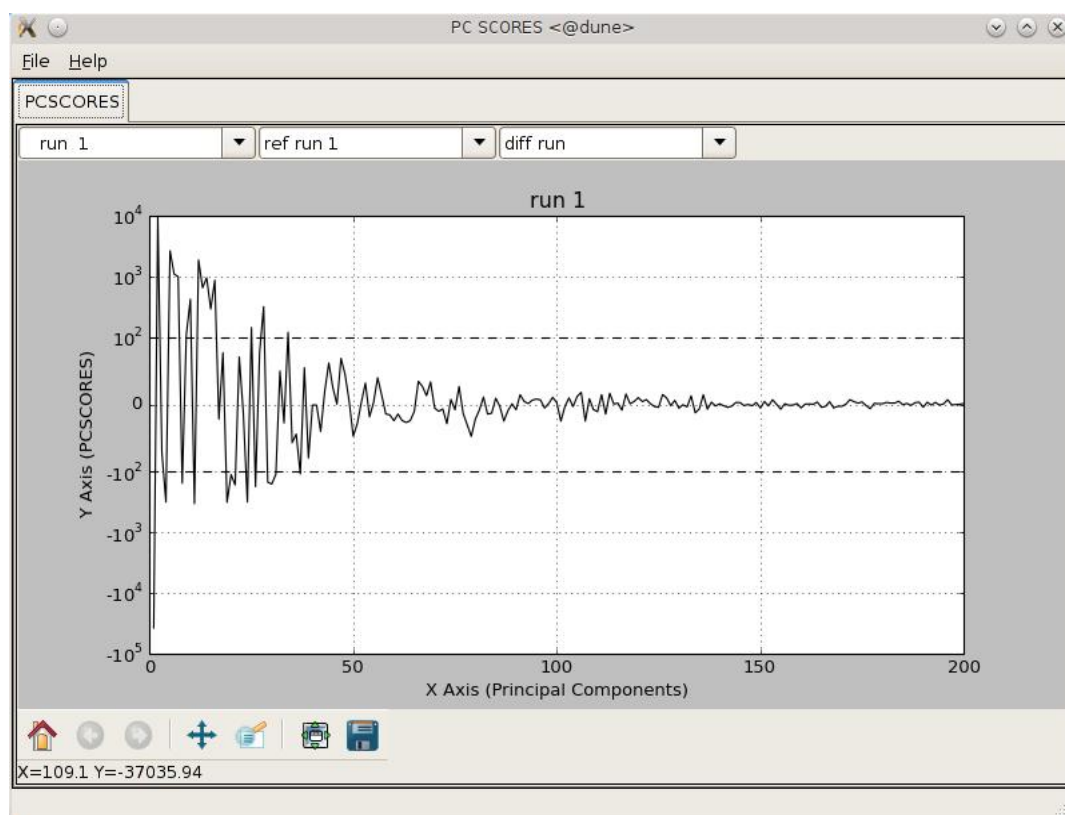


Figure 2.11.1: The PC SCORES window. Note the symmetrical log axis for pc scores. (range [-100,100] is linear)

If you choose the “addradrec” option in the option window, the result of the RTTOV Run PC is also displayed in the Radiance Window.

2.12. Running PC-RTTOV K

If you choose to run PC-RTTOV K , two windows are displayed : the KPCMatrix Window and the KPC profile window.

The KPC profile window (Fig 2.12.1) allows you to visualize the KPC profiles. You can use the sliders in order to modify the plot (first curve to be displayed and the number of curves displayed). With every K PC run, new windows are displayed.

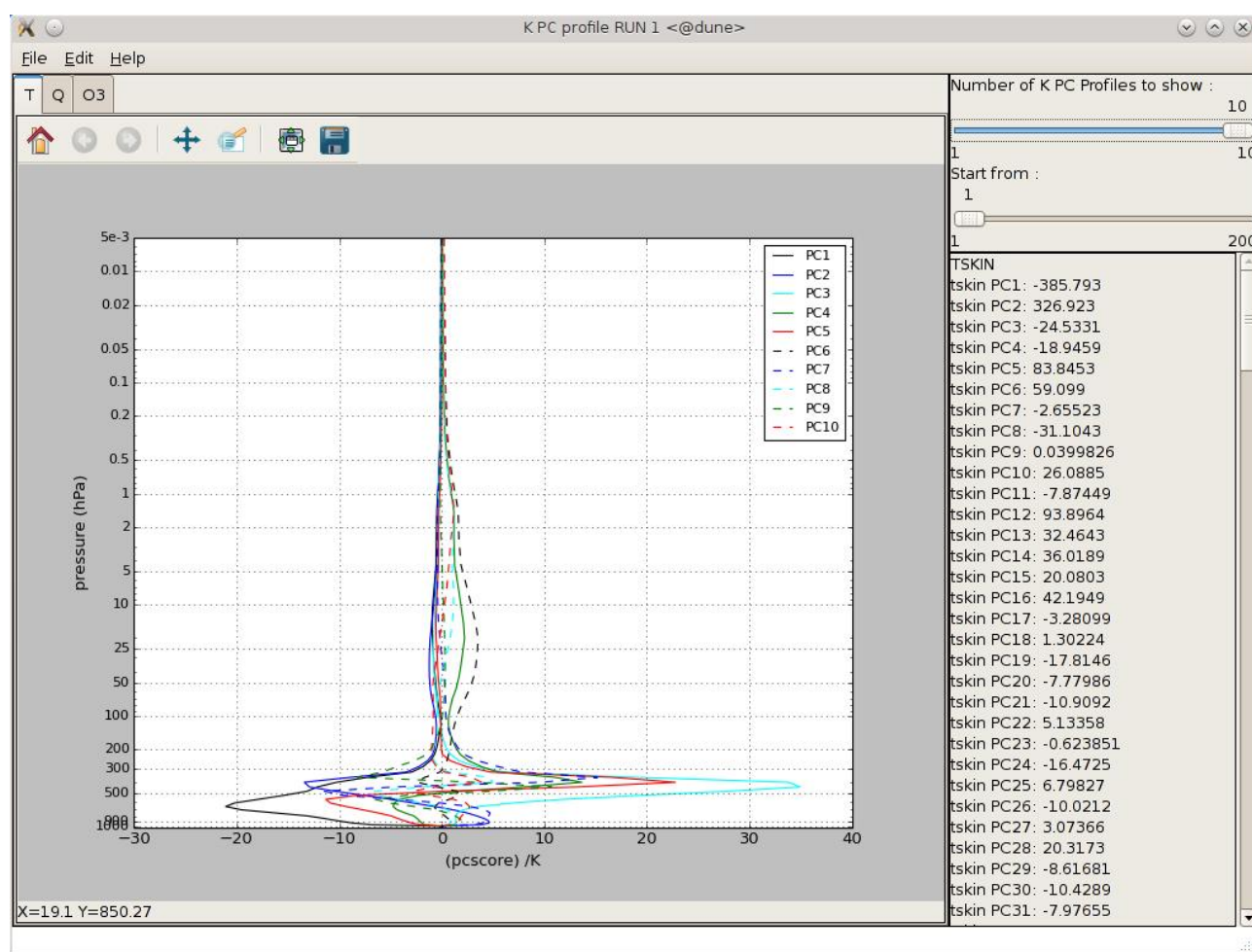


Fig 2.12.1 : The K PC profile window

3. Input Profile file format

The input profiles for the RTTOV GUI can be of two different kind formats. The “native” profile format is HDF5, as the Fortran executable GUI command will only read such format. The other format is an ASCII format made of Python statements for the required variables. The two formats are described below.

3.1. HD5 profile file format

The HDF5 profile format can store a single profile or a profile dataset such as the ECMWF diverse 83 profile set. It also allows RTTOV options to be stored in the same file.

The HDF5 top level structure is as follows (note all groups and datasets are in capital letters):


```

/PROFILES                                Group
/PROFILES/0001                          Group    First profile
/PROFILES/0002                          Group    Optional
. . . .
/PROFILES/9999                          Group    Optional
/OPTIONS                                Group    Optional

```

The /PROFILES/0001 group contains a copy of the RTTOV profile structure (see the module src/main/rttov_type.F90 and RTTOV user's guide). If the HDF5 file contains several profiles they should be numbered continuously and the group name is made of 4 digits with leading zeros. Under the profile number group the variable names are HDF5 datasets (capital letters). The skin and s2m sub-structures are HDF5 subgroups which contain the variables corresponding to those sub-types of the RTTOV profile structure; see the table below.

Name	HDF5 type	Dimension	Comment
ID	Dataset	{SCALAR}	
DATE	Dataset	{3}	
TIME	Dataset	{3}	
NLAYERS	Dataset	{1}	
NLEVELS	Dataset	{1}	
CTP	Dataset	{1}	
CFRACTION	Dataset	{1}	
CLOUD	Dataset	{nlayers,6}	optional

<div> <div>The EUMETSAT Network of Satellite Application Facilities</div> <div>  NWP SAF Numerical Weather Prediction </div> </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
--	---	---


CFRAC	Dataset	{nlayers}	optional
ICEDE	Dataset	{nlayers}	optional
IDG	Dataset	{1}	
ISH	Dataset	{1}	
CLW			optional, never used in GUI
AEROSOLS	Dataset	{nlayers,13}	optional
P	Dataset	{nlevels}	
T	Dataset	{nlevels}	
Q	Dataset	{nlevels}	
O3	Dataset	{nlevels}	optional
CO2	Dataset	{nlevels}	optional
N2O	Dataset	{nlevels}	optional
CO	Dataset	{nlevels}	optional
CH4	Dataset	{nlevels}	optional
BE	Dataset	{1}	
COSBK	Dataset	{1}	
SNOW_FRAC	Dataset	{1}	
SOIL_MOISTURE	Dataset	{1}	
LATITUDE	Dataset	{1}	
LONGITUDE	Dataset	{1}	
AZANGLE	Dataset	{1}	
ZENANGLE	Dataset	{1}	
SUNAZANGLE	Dataset	{1}	
SUNZENANGLE	Dataset	{1}	
ELEVATION	Dataset	{1}	

S2M	Group		
S2M/O	Dataset	{1}	
S2M/P	Dataset	{1}	
S2M/Q	Dataset	{1}	
S2M/T	Dataset	{1}	
S2M/U	Dataset	{1}	
S2M/V	Dataset	{1}	
S2M/WFETC	Dataset	{1}	
SKIN	Group		
SKIN/FASTEM	Dataset	{5}	
SKIN/SALINITY	Dataset	{1}	
SKIN/SURFTYPE	Dataset	{1}	
SKIN/T	Dataset	{1}	
SKIN/WATERTYPE	Dataset	{1}	

The /OPTIONS group contains a copy of the RTTOV option structure (see the module src/main/rttov_type.F90 and RTTOV user's guide). There is only one option structure in the HDF5 file even if several profiles are stored in. This /OPTIONS group is optional. All RTTOV options variables should be present. The logical variables are converted to integer datasets where “true” is converted to 1 and “false” converted to 0. Note that the RTTOV options substructures are packed all together in the same group.

Name	HDF5 type	Dimension
APPLY_REG_LIMITS	Dataset	{1}
VERBOSE	Dataset	{1}
DO_CHECKINPUT	Dataset	{1}
ADDPC	Dataset	{1}
ADDRADREC	Dataset	{1}

IPCBND	Dataset	{1}
IPCREG	Dataset	{1}
ADDREFRAC	Dataset	{1}
SWITCHRAD	Dataset	{1}
USE_Q2M	Dataset	{1}
ADDSSOLAR	Dataset	{1}
DO_NLTE_CORRECTION	Dataset	{1}
ADDAEROSL	Dataset	{1}
ADDCLOUDS	Dataset	{1}
USER_AER_OPT_PARAM	Dataset	{1}
USER_CLD_OPT_PARAM	Dataset	{1}
CLDSTR_THRESHOLD	Dataset	{1}
OZONE_DATA	Dataset	{1}
CO2_DATA	Dataset	{1}
N2O_DATA	Dataset	{1}
CO_DATA	Dataset	{1}
CH4_DATA	Dataset	{1}
FASTEM_VERSION	Dataset	{1}
CLW_DATA	Dataset	{1}
DO_LAMBERTIAN	Dataset	{1}
ADDINTERP	Dataset	{1}
INTERP_MODE	Dataset	{1}
LGRADP	Dataset	{1}
REG_LIMIT_EXTRAP	Dataset	{1}
SPACETOP	Dataset	{1}

<div data-bbox="137 185 252 241"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="280 197 545 266">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

3.2. ASCII Text profile file

The RTTOV GUI is able to read an ASCII text profile file. This kind of file is made of Python statements for the required variables. Thus the format should respect the Python language syntax. The arrays should be defined as NumPy arrays, the scalars can be pure Python scalars or NumPy variables.

The variable names are the ones described in the RTTOV users guide for the profile structure (Annex O), capital letters; except for:

- clouds where 2D cloud array is replaced by 1D cloud arrays, one for each cloud short name (table 18 of users guide)
- aerosols where 2D aerosols array is replaced by 1D aerosol arrays, one for each aerosol short name (table 21 of users guide)

Units are as described in RTTOV users guide for profile structure (Annex O).

Pressure, temperature and water vapour arrays are mandatory; all other RTTOV profile variables are optional, they will be set to default values when the profile is read.


The list of profile variables that can be set by the user is given below with the default values. Omitted values default to a clear atmosphere. The number of levels and layers are deduced from array sizes.

```
#" Mandatory arrays: P (hPa), T(K), Q(ppmv) on levels"
self["P"] = numpy.array([...])
self["T"] = numpy.array([...])
self["Q"] = numpy.array([...])

#"-----"
#" Optional profile variables "
#"-----"

#" Other Gases (ppmv on levels)"
self["O3"] = numpy.array([...])
self["CO2"] = numpy.array([...])
self["CH4"] = numpy.array([...])
self["CO"] = numpy.array([...])
self["N2O"] = numpy.array([...])

#" Aerosols (1/cm3 on layers)"
self["INSO"] = numpy.array([...]) # Insoluble
```


<div data-bbox="135 181 252 235"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="279 190 545 262">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

```


self["WASO"] = numpy.array([...]) # Water soluble
self["SOOT"] = numpy.array([...]) # Soot
self["SSAM"] = numpy.array([...]) # Sea salt (acc mode)
self["SSCM"] = numpy.array([...]) # Sea salt (coa mode)
self["MINM"] = numpy.array([...]) # Mineral (nuc mode)
self["MIAM"] = numpy.array([...]) # Mineral (acc mode)
self["MICM"] = numpy.array([...]) # Mineral (coa mode)
self["MITR"] = numpy.array([...]) # Mineral transported
self["SUSO"] = numpy.array([...]) # Sulphated droplets
self["VOLA"] = numpy.array([...]) # OPAC Volcanic ash
self["VAPO"] = numpy.array([...]) # New Volcanic ash
self["ASDU"] = numpy.array([...]) # Asian dust

#" Clouds (g/m3 on layers)"
self["STCO"] = numpy.array([...]) # Stratus Continental
self["STMA"] = numpy.array([...]) # Stratus Maritime
self["CUCC"] = numpy.array([...]) # Cumulus Continental Clean
self["CUCP"] = numpy.array([...]) # Cumulus Continental Polluted
self["CUMA"] = numpy.array([...]) # Cumulus Maritime
self["CIRR"] = numpy.array([...]) # Cirrus
self["CFRAC"] = numpy.array([...]) # Cloud Fraction (should be set if any cloud)
self["IDG"] = 1 # Scheme for Ice water content
self["ISH"] = 1 # Ice cristal shape

#" Skin variables "
self["SKIN"]["T"] = self["T"][-1] # (K)
self["SKIN"]["SURFTYPE"] = 1 # (0=Land, 1=Sea, 2=sea-ice)
self["SKIN"]["WATERTYPE"] = 1 # (0=fresh water, 1=ocean water)
self["SKIN"]["SALINITY"] = 37 # (‰)
self["SKIN"]["FASTEM"] = numpy.array([0., 0., 0., 0., 0.]) # (5 parameters
Land/sea-ice)

#" 2m and 10m air variables "
self["S2M"]["T"] = self["T"][-1] # (K)
self["S2M"]["Q"] = self["Q"][-1] # (ppmv)
self["S2M"]["P"] = self["P"][-1] # (hPa)

```

<div data-bbox="135 181 252 237"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="279 190 545 262">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
--	---	---

```

self["S2M"]["U"] = 0 # (m/s)
self["S2M"]["V"] = 0 # (m/s)
self["S2M"]["WFETC"] = 100000 # (m)

#" Simple cloud "
self["CTP"] = 500.0 # (hPa)
self["CFRACTION"] = 0.0 # [0,1] Clear sky is the default


#" Viewing geometry "
self["AZANGLE"] = 0. # (deg)
self["ELEVATION"] = 0. # (km)
self["LATITUDE"] = 49.738 # (deg) Lannion is 48.750, -3.470
self["LONGITUDE"] = -3.473 # (deg) Exeter is 50.726, -3.476

self["SUNAZANGLE"] = 0. # (deg)
self["SUNZENANGLE"] = 0. # (deg)
self["ZENANGLE"] = 0. # (deg)
self["SNOW_FRAC"] = 0. # [0,1]

#" Magnetic field "
self["BE"] = 0.3 # (Gauss)
self["COSBK"] = 1.

#" Mislaneous "
self["ID"]="This is my profile"
self["DATE"] = numpy.array([2014, 04, 30], dtype=int) # Year, Month, Day
self["TIME"] = numpy.array([12, 0, 0], dtype=int) # Hour, Minute, Second

```

<div data-bbox="137 185 252 241"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="280 197 545 266">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

3.3. How to create an HDF5 profile file from Fortran

RTTOV users can create an HDF5 profile file for use in the RTTOV GUI using the RTTOV subroutine `RTTOV_HDF_SAVE` contained in `src/hdf/rttov_hdf_mod.F90`. This subroutine can write any RTTOV structure to an HDF5 file.

For example a main Fortran program that can store a profile dataset and options in the same file would contain the following statements:

```


Use hdf5
Use rttov_hdf_mod
Type(profile_type),      Pointer :: profiles(:)           => NULL()
Type(rttov_options) :: opts

CALL OPEN_HDF( .TRUE., ERR )
!... statements that creates the profiles array
!... and statements that fills the options opts
CALL RTTOV_HDF_SAVE( ERR, "PROFILES.H5", '/PROFILES', &
    CREATE=.true., PROFILES = profiles(1:nprofiles))
CALL RTTOV_HDF_SAVE( ERR, "PROFILES.H5", '/OPTIONS', CREATE=.false., &
    OPTIONS = opts )
CALL CLOSE_HDF( ERR )

```

3.4. How to create an HDF5 profile file from ASCII text profile file

The ASCII text profile files are Python files. A Python script named `convert_python2hdf.py` in the `rttov_test/profile-datasets/` directory allows the user to convert an ASCII text profile to an HDF5 profile file. This script makes use of RTTOV GUI Python software (Profile class), so cannot be used outside this framework.

<div data-bbox="135 181 252 237"> The EUMETSAT Network of Satellite Application Facilities </div> <div data-bbox="279 190 545 262">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
--	---	---

```
usage: convert_python2hdf5.py [-h] -i INPUTF [-o OUTPUTF]
                               [-g GROUP] [-v]

Import ASCII profile to HDF5 for RTTOV GUI


optional arguments:
  -h, --help            show this help message and exit
  -i INPUTF, --input-file INPUTF
                        input file name
  -o OUTPUTF, --output-file OUTPUTF
                        output file name
  -g GROUP, --group GROUP
                        internal HDF5 default is /PROFILES/0001/
  -v, --verbose          display profile variables
```

It is possible to convert all of the RTTOV test suite profile datasets contained in `rttov_test/profile-datasets/` to ASCII and HDF5 format quite easily. Navigate to the `rttov_test/profile-datasets/` directory and then run:

```
$ ./run_convert_test2python.sh
$ ./run_convert_python2hdf5.sh
```

These scripts create `profile-datasets-py/` and `profile-datasets-hdf/` directories within `rttov_test/` containing all of the RTTOV test suite profiles in Python ASCII and HDF5 formats for input to the GUI.

Note that the second of these two scripts requires the `gui/rttov/` directory to be in your `PYTHONPATH` and `rttov_gui_f2py.so` must be linked in the `profile-datasets/` directory.

<div data-bbox="137 181 252 237">The EUMETSAT Network of Satellite Application Facilities</div> <div data-bbox="280 192 547 262">  NWP SAF Numerical Weather Prediction </div>	<h2 style="text-align: center;">A Graphical User Interface for RTTOV v11.2</h2>	Doc ID : NWPSAF-MF-UD-010 Version : 1.1 Date : 2014 06 06
---	---	---

4. Reporting bugs and limitations

All main RTTOV GUI actions are logged in a file named "rttovgui.log" in the RTTOV_GUI_WRK_DIR directory. If the user encounters an issue during the RTTOV GUI usage, he should exit the program and copy the log file to a new name. This log file should be attached to any request to the help-desk or forum. We encourage the users to share experiences through the RTTOV forum at <http://www.nwpsaf.eu/forum/>

Restrictions:

- It is not possible to enter explicit cloud/aerosol optical parameters profiles for each channel.
- The RTTOV GUI is not compatible with RTTOV-SCATT.

Known bugs or current limitations:

- For the K calculations : only atmospheric gases, atmospheric temperature and TSkin variables are displayed.