# RTTOV v12 Graphical User Interface

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This documentation was developed within the context of the EUMETSAT Satellite Application Facility on Numerical Weather Prediction (NWP SAF), under the Cooperation Agreement dated 7 December 2016, 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, DWD and Météo France.

| Change record | | | |
|---|---|---|---|
| Version | Date | Author / changed by | Remarks |
| 1 | 06/09/2016 | P. Roquet | First version |
| 2 | 02/05/2017 | P. Roquet | note about matplotlib version |
| 3 | 07/03/2018 | P. Roquet | Updates for version 12.2 |
| 4 | 11/02/2019 | P. Roquet | Updates for version 12.3 |

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# 1. Introduction

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

With RTTOV GUI, the user will be able to:

- load and modify an atmospheric profile (gas content, aerosol content, cloud content)
- change surface parameters and options
- load an emissivity and a BRDF atlas
- run the direct model and display the results (simulated radiances, brightness temperatures and, if computed, reflectances).
- run the Jacobian model (RTTOV-K) and display the results (derived T and gas content and Tskin only)
- run PC-RTTOV (direct and Jacobian model)
- perform an 1-D VAR retrieval

What users cannot not do with RTTOV GUI:

- run the adjoint model (AD) or tangent linear model (TL)
- enter/modify cloud or aerosol optical parameters profile for each channel (rttov_cld_opt_param and rttov_aer_opt_param options)
- enter/modify the cloud liquid water content of a profile for MW simulations
- run RTTOV-SCATT (the MW scattering model)

A large enough screen (at least 1400x900) is strongly recommended, as RTTOV GUI produces many windows and some of them can be large.

We also encourage users to refer the RTTOV User Guide.

## 1.1. Installation

Using RTTOV GUI requires the following software to be installed:

- python version 2.7

- wx python version 2.9.5, 3 (http://www.wxpython.org/download.php)

- numpy (http://www.scipy.org/)

- matplotlib with backend_wxagg (http://matplotlib.org/)

- h5py (http://www.h5py.org/)

The easiest way to get these is to use the conda package manager. Download and install miniconda2 (http://conda.pydata.org/miniconda.html) and then the following command will install all required packages:

```
conda install numpy scipy matplotlib=3.0.0 h5py wxpython
```

Compile RTTOV with the the rttov_compile.sh script as explained in the RTTOV v12 users guide and answer “yes” to the question asking if you want RTTOV GUI to be compiled.
If you specify an installation directory relative to top-level RTTOV directoy different than default, change the symbolic link to the rttov_gui_f2py.so library in the `<PATH_TO_RTTOV>/`gui directoy.

Modify the gui/rttov_gui.env configuration file (see next section).

Then you can run the RTTOV GUI with the following commands:

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

RTTOV GUI is still not compatible with python3 and wxpython version 4. If you want to use python3 for the python wrapper, it is possible to create a dedicaded python 2.7 environment just for the gui. This can be made this way if you use the miniconda distribution of python:

```
conda create -n rttovgui python=2.7
conda activate rttovgui
conda install wxpython=3.0.0 matplotlib h5py
```

In this case, if RTTOV is already compiled, you must also regenerate the rttov_gui_f2py.so library:

```
cd <PATH_TO_RTTOV>/src
rm <PATH_TO_RTTOV>/<INSTALL_DIR>/lib/rttov_gui_f2py.so
../build/Makefile.PL RTTOV_HDF=1 RTTOV_F2PY=1
make all ARCH=<arch> INSTALLDIR=<INSTALL_DIR>
```

Using miniconda instead of anaconda is recommanded. If you want to use anaconda, make sure to compile rttov with exactly the same version of hdf5 library as used by anaconda.

On MacOS, it is recommanded to add to your ~/.bash_profile:

```
export LC_ALL=en_US.UTF-8
export LANG=en_US.UTF-8
```

in order to avoid problems with matplotlib (unknown locale:UTF-8)

# 2. RTTOV GUI User Manual

## *2.1. Configuration files*

The rttov_gui.env file 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 e.g. 
/home/user/rttov12/gui
export RTTOV_GUI_PREFIX

PATH=${RTTOV_GUI_PREFIX}:$PATH
export PATH

PYTHONPATH=${RTTOV_GUI_PREFIX}:${PYTHONPATH}
export PYTHONPATH



# Optional environment variables: (the defaults are usually OK)
# ------------------------------

# 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


# Working directory (for rttov gui temporary files)

RTTOV_GUI_WRK_DIR=$HOME/.rttov
export RTTOV_GUI_WRK_DIR


# Default directory for rttov coefficient files

RTTOV_GUI_COEFF_DIR=${RTTOV_GUI_PREFIX}/../rtcoef_rttov12
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

system_info=`uname -s`
if [ ${system_info} = "Linux" ]
then
  export cmdpython=python
else
  echo "It seems that Linux is not your system..."
  echo "for python we will use pythonw"
  echo "correct this if necessary"
  export cmdpython=pythonw
fi

# -----------------------------------------------------------------------------

# If you installed the Python dependencies using conda the following can be
ignored.
# Otherwise you may need to specify the location of your wxPython installation:

# WXPYTHON_PREFIX=   # Directory where wxPython is installed


# 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/:${PYTHONPATH}
# export PYTHONPATH

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

## *2.2. File created by the RTTOV GUI*

The RTTOV GUI software will create hdf5 files in its working directory defined by the RTTOV_GUI_WRK_DIR environment variable (~/.rttov by default.). Be aware that if you want to run several instances of RTTOV GUI at the same time, you have to use a different working directory for each instance.

All 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 feasible using the h5dump command.

These files are:

- profile.h5: contains the profile (gas content, aerosol content, cloud content), surface information and RTTOV options.
- surface.h5: contains information about the surface emissivity / reflectance used as input and computed by RTTOV or modified by user.

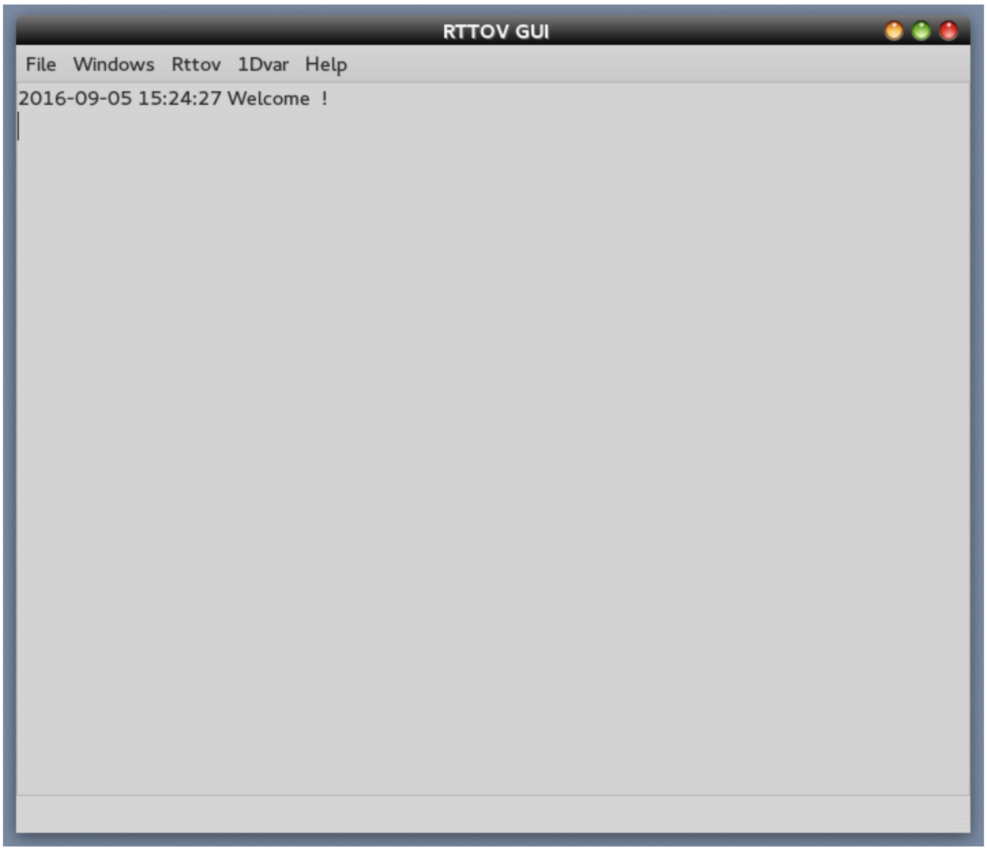
- radr.h5: contains radiances computed by a run of RTTOV.
- trns.h5: contains transmittance computed by a run of RTTOV.
- kmat.h5: contains the K matrix computed by a run of RTTOV_K
- pc.h5: contains the pcscores computed by a run of RTTOV_PC.
- pckmat.h5: contains the K_PC matrix computed by a run of RTTOV_PC_K
- tmpFileErr.log: error log file from the last run of RTTOV.
- tmpFileOut.log: output log file from the last run of RTTOV.
- rttovgui.log: RTTOV GUI log file.

## *2.3. Starting the GUI*

As explained in section 1.1, RTTOV GUI can be started by the following commands:

```
source ./rttov_gui.env
./rttovgui&
```

The RTTOV 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 wanted (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.



2016-09-05 15:24:27 Welcome !

*Figure 2.3.1: main window*

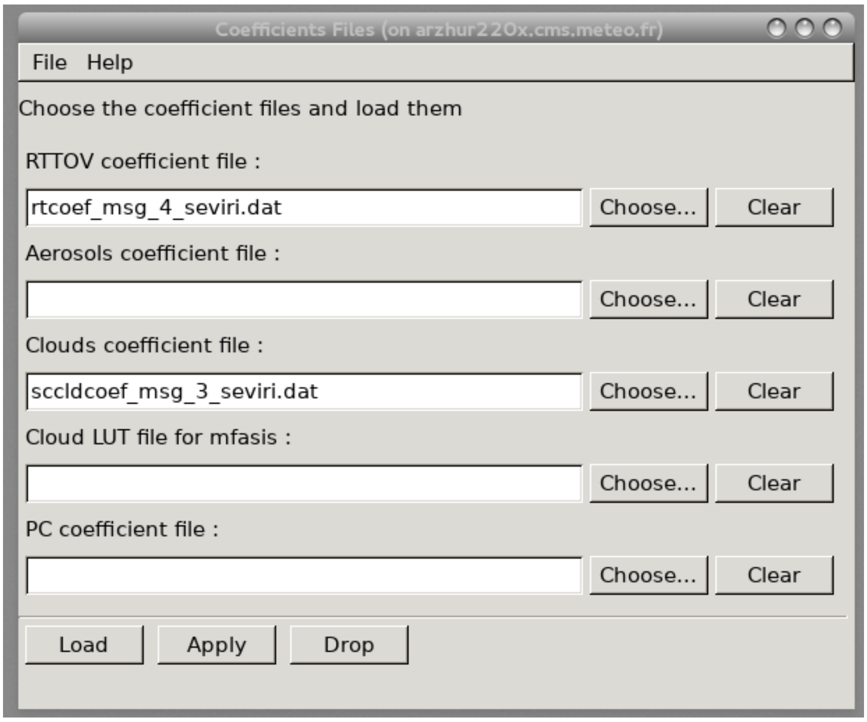
## 2.4. Loading RTTOV coefficient files

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

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

A 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 clouds coefficient file. All these files must be compatible (an error message will be displayed if it is not the case).

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 coefficients” menu item.



Choose the coefficient files and load them

RTTOV coefficient file : rtcoef_msg_4_seviri.dat

Aerosols coefficient file :

Clouds coefficient file : sccldcoef_msg_3_seviri.dat

Cloud LUT file for mfasis :

PC coefficient file :

*Figure 2.4.1: coefficient files window*

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.

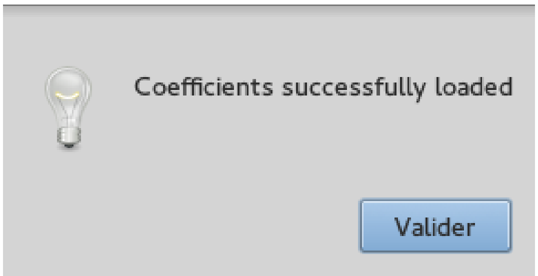
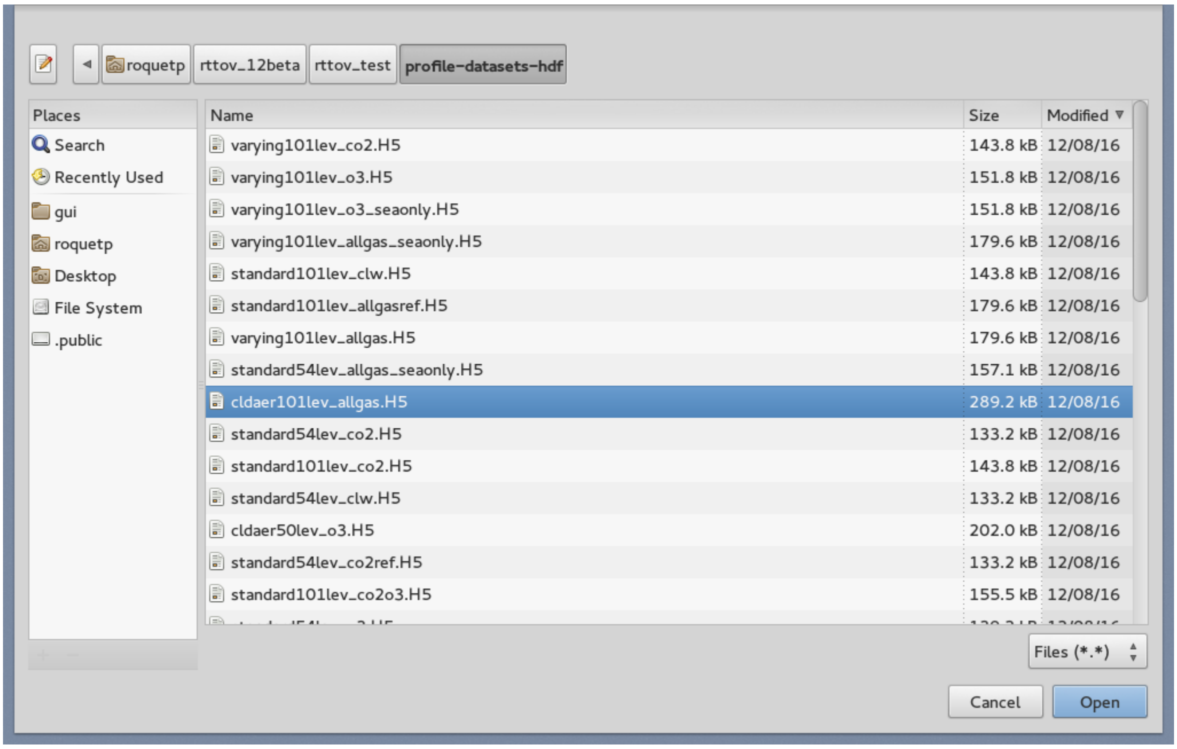

Coefficients successfully loaded

*Figure 2.4.2: successful coefficient files loading message*

## 2.5. *Open a Profile*

The item “Open Profile” of the “File” menu of the main window allows you to open a profile (Figure 2.5.1). You must first select an appropriate file. If a profile file contains several profiles, you will be asked to choose the profile number (Figure 2.5.2)



| Name | Size | Modified ▾ |
|---|---|---|
| varying101lev_co2.H5 | 143.8 kB | 12/08/16 |
| varying101lev_o3.H5 | 151.8 kB | 12/08/16 |
| varying101lev_o3_seaonly.H5 | 151.8 kB | 12/08/16 |
| varying101lev_allgas_seaonly.H5 | 179.6 kB | 12/08/16 |
| standard101lev_clw.H5 | 143.8 kB | 12/08/16 |
| standard101lev_allgasref.H5 | 179.6 kB | 12/08/16 |
| varying101lev_allgas.H5 | 179.6 kB | 12/08/16 |
| standard54lev_allgas_seaonly.H5 | 157.1 kB | 12/08/16 |
| cldaer101lev_allgas.H5 | 289.2 kB | 12/08/16 |
| standard54lev_co2.H5 | 133.2 kB | 12/08/16 |
| standard101lev_co2.H5 | 143.8 kB | 12/08/16 |
| standard54lev_clw.H5 | 133.2 kB | 12/08/16 |
| cldaer50lev_o3.H5 | 202.0 kB | 12/08/16 |
| standard54lev_co2ref.H5 | 133.2 kB | 12/08/16 |
| standard101lev_co2o3.H5 | 155.5 kB | 12/08/16 |

*Figure 2.5.1: select a profile*

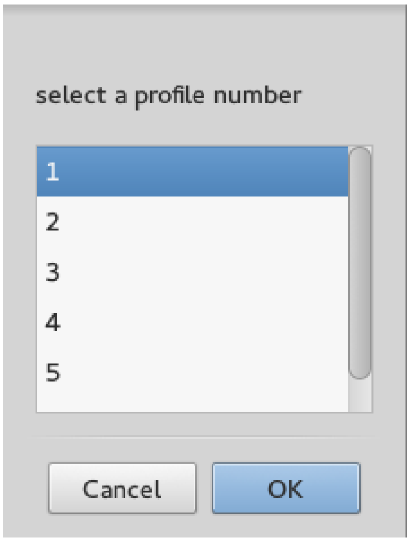


*Figure 2.5.2: selection window*

## 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 (Figure 2.6.1).

The RTTOV options which can be modified are part of the option structure of RTTOV, described in the RTTOV v12 User Guide (Annex O). The help menu of the Options editor window gives you some information. Some options are unavailable depending to the loaded coefficient files or the profile content.

**VIS/IR-only RT options:**

These options are available only for VIS/IR instruments.

The "addsolar" option is disabled if the standard coefficient file does not contain solar channels.

The "addclouds" option is enabled if a cloud coefficient file has been loaded and the profile holds cloud content.

The "addaerosl" option is enabled if an aerosols coefficient file has been loaded and the profile holds aerosol content.

"ir_scatt_model" is enabled only if addclouds or addaerosl option has been selected.

"vis_scatt_model"  is enabled only if addclouds or addaerosl option has been selected and addsolar option has been selected.

The "dom" options ("dom_nstreams", "dom_accuracy" and "dom_opdep_threshold") are enabled only if the ir_scatt_model and/or vis_scatt_model options are enabled and the DOM model is selected for either or both.

Each "data" option ("ozone_data", "co2_data", "n2o_data", "co_data", "ch4_data" and "so2_data") is enabled only if the RTTOV coefficient file has been computed for the corresponding gas. (See in the RTTOV User Guide about the three flavours of predictors used for the coefficients files)

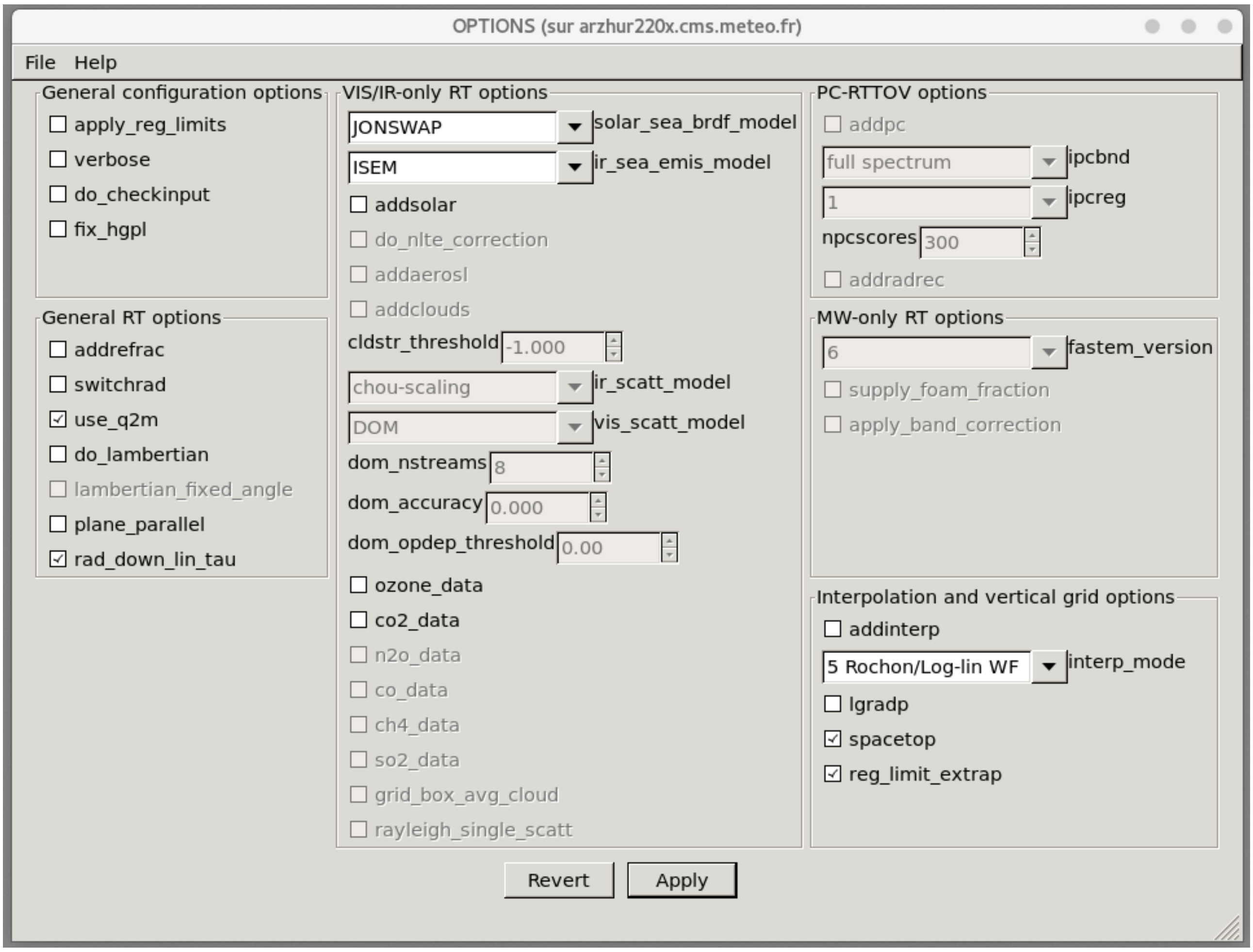
**PC-RTTOV options:**

These options can be enabled only if a PC-RTTOV coefficient file is loaded. If "addpc" is ticked, the options "ipcbnd", "ipcreg" and "addradrec" become available. And in this case, PC-RTTOV will be used. Choosing "addradrec" allows the computation of reconstruted radiances, and therefore this checkbox is linked to the "switchrad" option.

**MW-only RT options:**

These options can only be modified if a microwave instrument is used. These options are:
"fastem_version" which allows you to choose the version of the FASTEM model.
"supply_foam_fraction" which allows you to give the ocean foam fraction but the foam fraction has to be modified in the surface window.

Once you have made your choices for the options, you have to save them for the run by clicking the "Apply" button.



General configuration options
☐ apply_reg_limits
☐ verbose
☐ do_checkinput
☐ fix_hgpl

General RT options
☐ addrefrac
☐ switchrad
☑ use_q2m
☐ do_lambertian
☐ lambertian_fixed_angle
☐ plane_parallel
☑ rad_down_lin_tau

VIS/IR-only RT options
JONSWAP solar_sea_brdf_model
ISEM ir_sea_emis_model
☐ addsolar
☐ do_nlte_correction
☐ addaerosl
☐ addclouds
cldstr_threshold -1.000
chou-scaling ir_scatt_model
DOM vis_scatt_model
dom_nstreams 8
dom_accuracy 0.000
dom_opdep_threshold 0.00
☐ ozone_data
☐ co2_data
☐ n2o_data
☐ co_data
☐ ch4_data
☐ so2_data
☐ grid_box_avg_cloud
☐ rayleigh_single_scatt

PC-RTTOV options
☐ addpc
full spectrum ipcbnd
1 ipcreg
npcscores 300
☐ addradrec

MW-only RT options
6 fastem_version
☐ supply_foam_fraction
☐ apply_band_correction

Interpolation and vertical grid options
☐ addinterp
5 Rochon/Log-lin WF interp_mode
☐ lgradp
☑ spacetop
☑ reg_limit_extrap

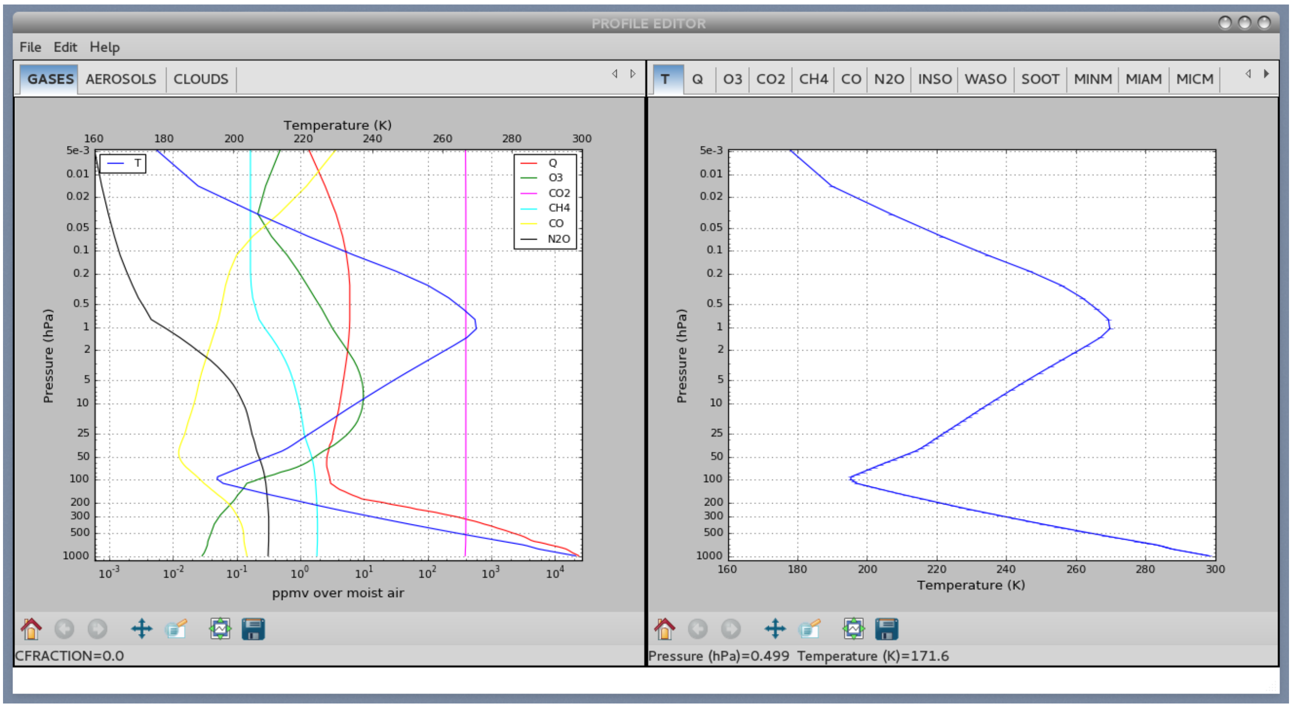
*Figure 2.6.1: Options Editor window*

## *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 window.

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

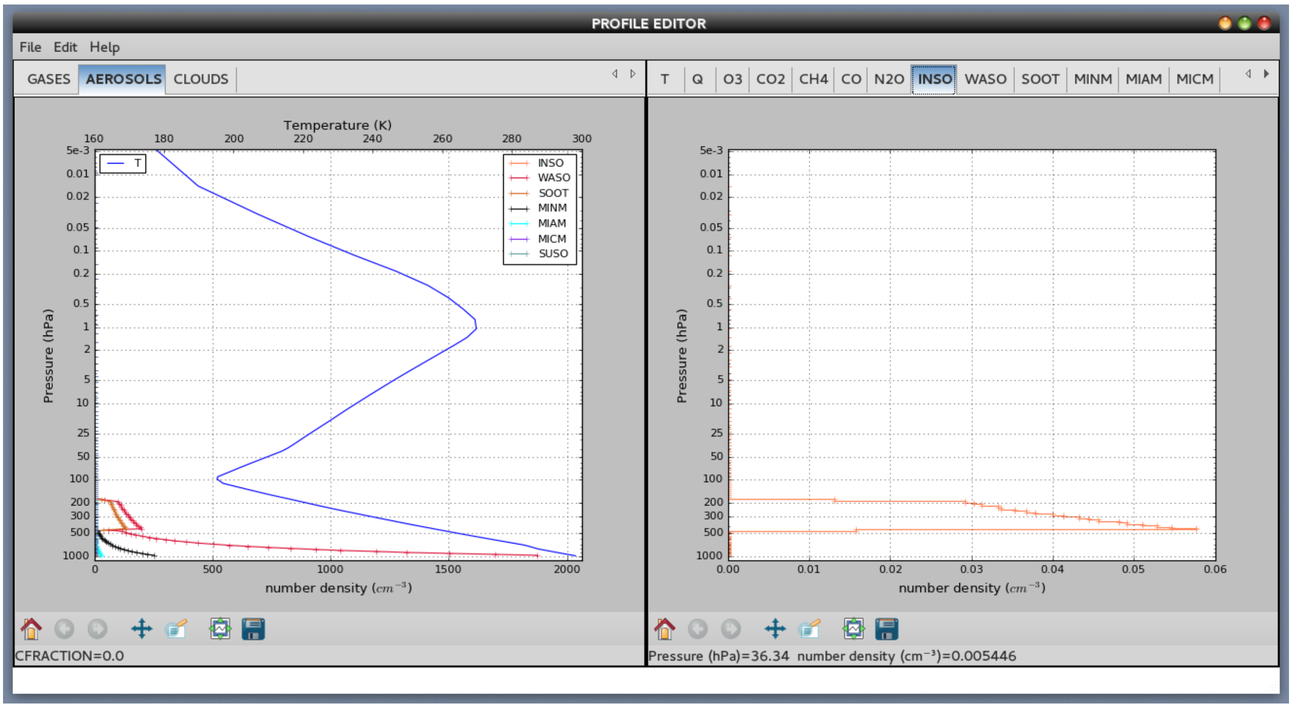
Figures 2.7.2 and 2.7.3 provide examples for aerosol and cloud profiles respectively. Aerosol components and cloud types are described in the RTTOV users guide.



CFRACTION=0.0

Pressure (hPa)=0.499 Temperature (K)=171.6

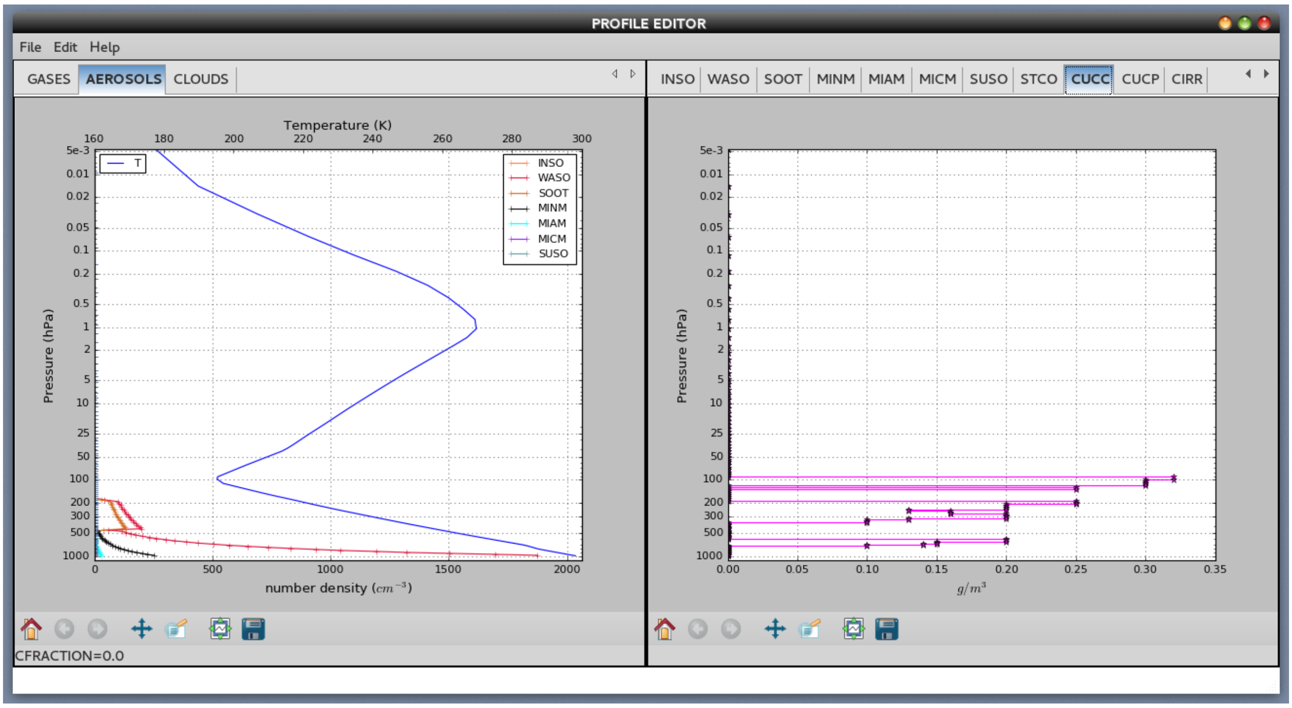
*Figure 2.7.1: Profile Editor window for gases*



CFRACTION=0.0

Pressure (hPa)=36.34 number density (cm⁻³)=0.005446

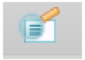
*Figure 2.7.2: Profile Editor window for aerosols*



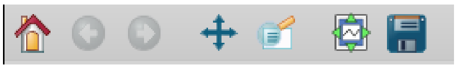
CFRACTION=0.0

*Figure 2.7.3: Profile Editor window for 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 button or the right button to modify the profile. The closer point on a profile pressure level or layer is moved to the new value. The left panel is also updated. Use the zoom widget of the matplotlib toolbar to zoom in or to zoom out.



*zoom widget*



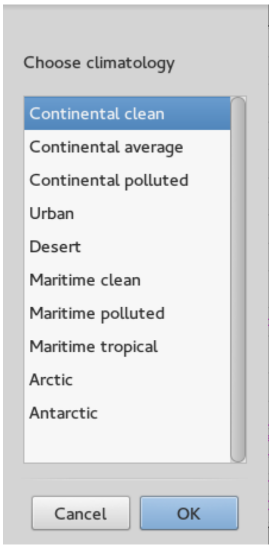
*matplotlib toolbar*

Finally, apply your changes or save the profile for the next run of RTTOV.

**Edit menu functionalities:**

Undo: undo the last modification of the curve.
Redo: redo the last modification of the curve.
Insert: For aerosols or clouds only, a click moves or creates a new point.
Remove: For aerosols or clouds only, a click removes the nearest point of a layer.
Change profile values: Apply scale*value + offset on the profile values between P min and P max.
Edit X axis: This menu item allows to modify the X axis bounds.
Add gas: With this menu item it is possible to add a gas.
Remove gas: With this menu item, it is possible to remove a gas.
Add aerosol: With this menu item, it is possible to add an aerosol model.

Remove aerosol: With this menu item, it is possible to remove an aerosol model.
Add cloud: With this menu item, it is possible to add a cloud.
Remove cloud: With this menu item, it is possible to remove a cloud.
Replace aerosol by clim: With this menu item, it is possible to replace all aerosols by an aerosol climatology. The user is allowed to choose between different types of climatology (see Figure 2.7.4)



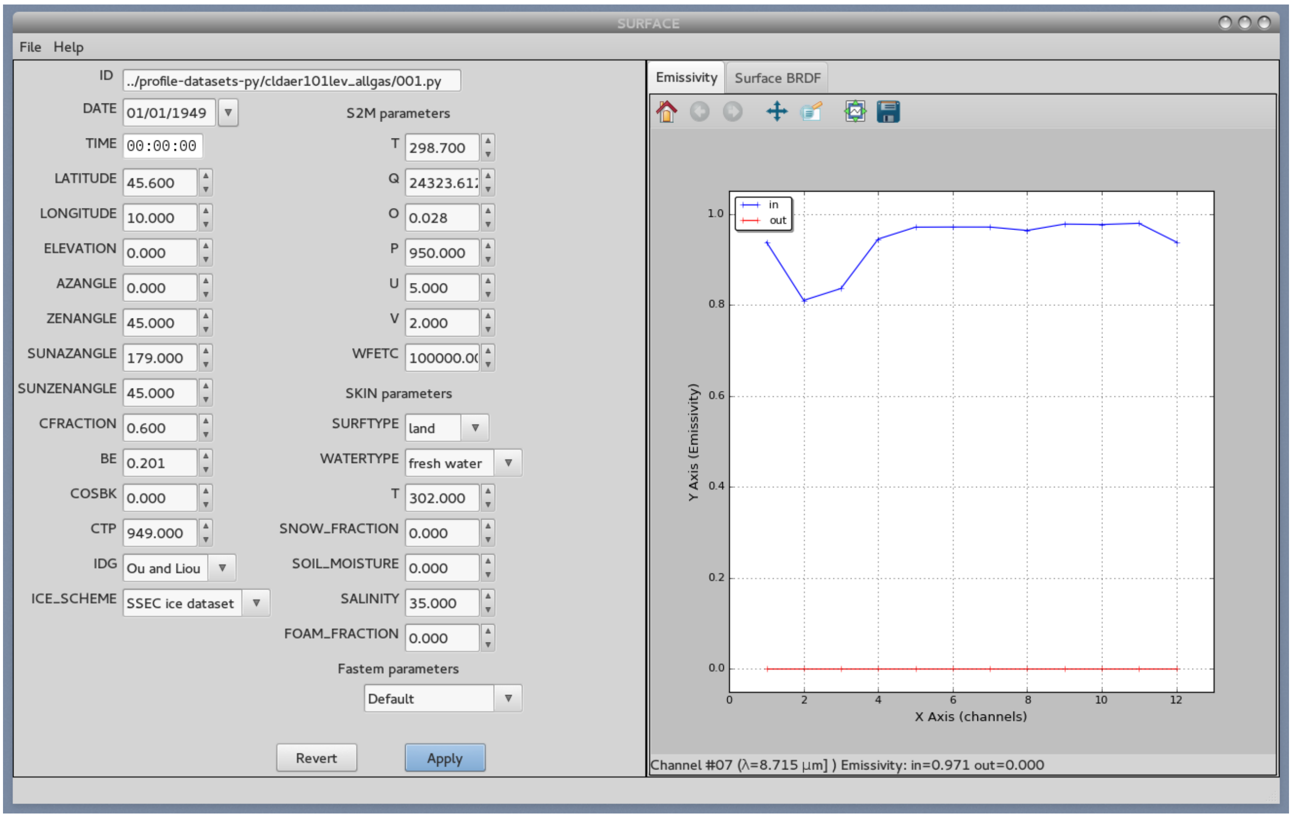
Choose climatology

- Continental clean
- Continental average
- Continental polluted
- Urban
- Desert
- Maritime clean
- Maritime polluted
- Maritime tropical
- Arctic
- Antarctic

*Figure 2.7.4: Climatology choices for aerosols (see RTTOV User Guide for full description)*

## *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 (Figure 2.8.1).



ID ../profile-datasets-py/cldaer101lev_allgas/001.py
DATE 01/01/1949
TIME 00:00:00
LATITUDE 45.600
LONGITUDE 10.000
ELEVATION 0.000
AZANGLE 0.000
ZENANGLE 45.000
SUNAZANGLE 179.000
SUNZENANGLE 45.000
CFRACTION 0.600
BE 0.201
COSBK 0.000
CTP 949.000
IDG Ou and Liou
ICE_SCHEME SSEC ice dataset

S2M parameters
T 298.700
Q 24323.61
O 0.028
P 950.000
U 5.000
V 2.000
WFETC 100000.0(

SKIN parameters
SURFTYPE land
WATERTYPE fresh water
T 302.000
SNOW_FRACTION 0.000
SOIL_MOISTURE 0.000
SALINITY 35.000
FOAM_FRACTION 0.000

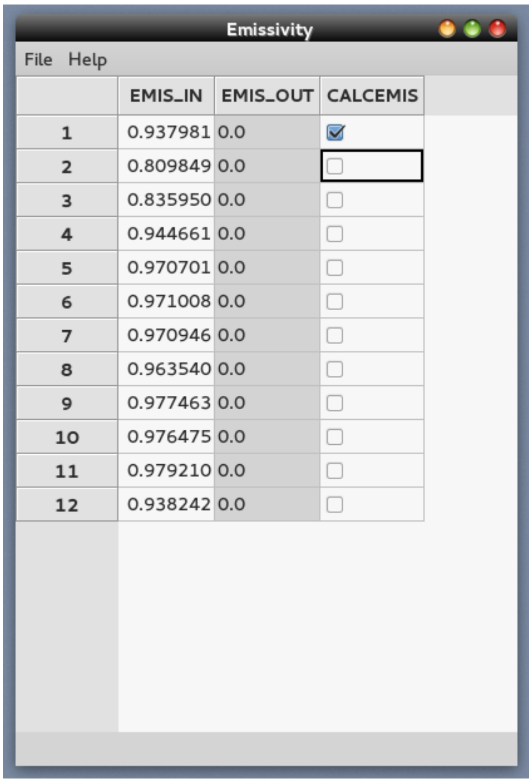
Fastem parameters
Default

Channel #07 (λ=8.715 µm] ) Emissivity: in=0.971 out=0.000

*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 (Figure 2.8.2). The emissivity/reflectance computed 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.

***Please note that the parameter CFRACTION (cloud fraction for simple cloud) may have a non-zero value for many of the profiles supplied with RTTOV. This parameter is used for the simple RTTOV cloud scheme (IR/VIS only): see RTTOV User Guide.***



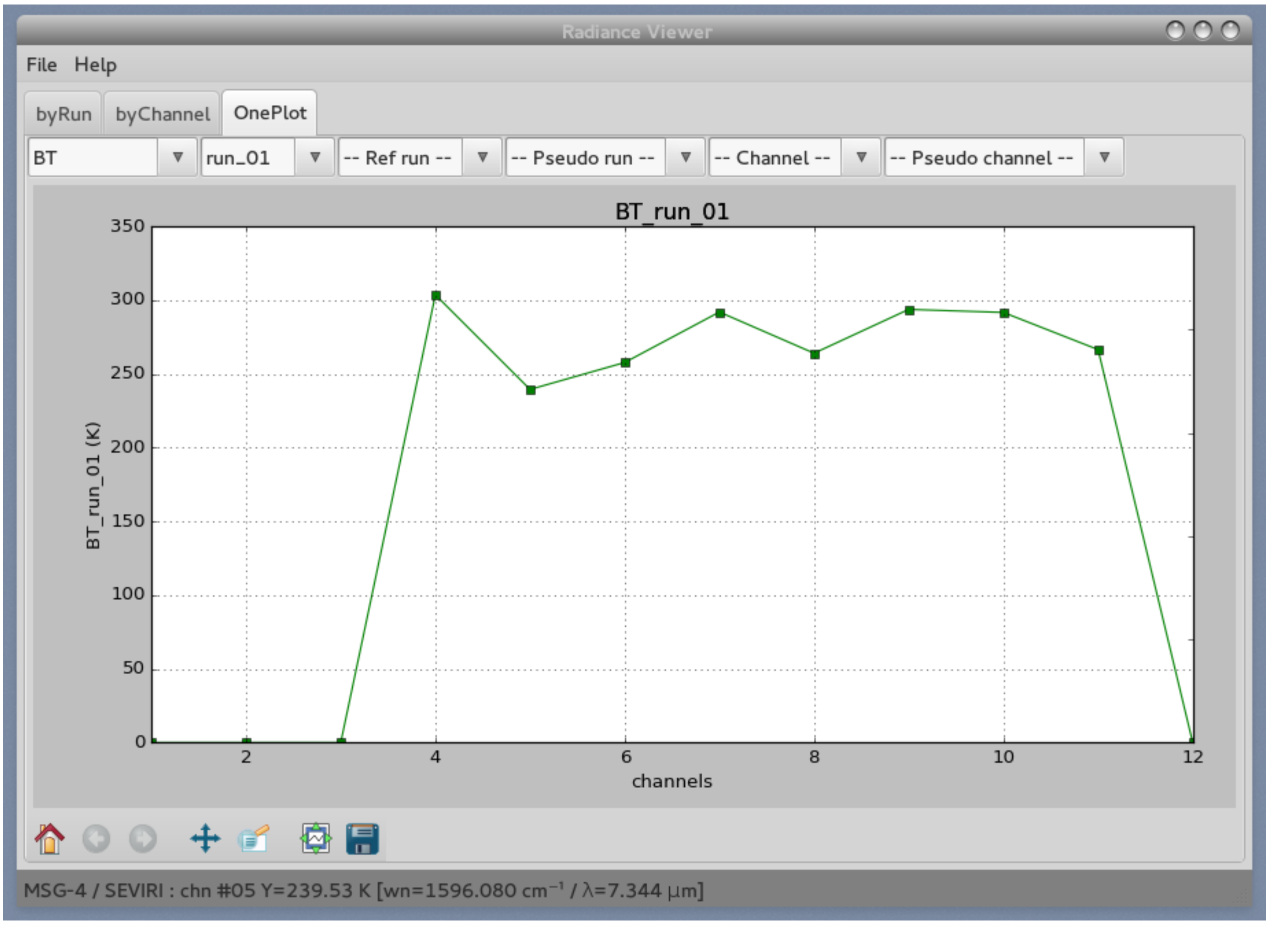
| | EMIS_IN | EMIS_OUT | CALCEMIS |
|---|---|---|---|
| 1 | 0.937981 | 0.0 | ☑ |
| 2 | 0.809849 | 0.0 | □ |
| 3 | 0.835950 | 0.0 | □ |
| 4 | 0.944661 | 0.0 | □ |
| 5 | 0.970701 | 0.0 | □ |
| 6 | 0.971008 | 0.0 | □ |
| 7 | 0.970946 | 0.0 | □ |
| 8 | 0.963540 | 0.0 | □ |
| 9 | 0.977463 | 0.0 | □ |
| 10 | 0.976475 | 0.0 | □ |
| 11 | 0.979210 | 0.0 | □ |
| 12 | 0.938242 | 0.0 | □ |

*Figure 2.8.2: Edit Input Emissivity Values. (Tip for check boxes: write 1 for check off , write 0 or nothing otherwise)*

## *2.9. Running RTTOV Direct Model and working with the Radiance Window.*

It is possible to run the RTTOV direct model. For this purpose, select the RTTOV menu from the main window. Then select « Run direct ». 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 (~/.rttov/prof.h5)).

If the run is successful, a new window appears: the radiance window which displays the result of the RTTOV direct model. This windows has three tabs: byRun, byChannel, OnePlot. By default the OnePlot tab is opened with the brightness temperatures curve (Figure 2.9.1)



MSG-4 / SEVIRI : chn #05 Y=239.53 K [wn=1596.080 cm$^{-1}$ / λ=7.344 µm]

*Figure 2.9.1: Radiance window OnePlot tab*

The plots which can be displayed in the radiance window are:

- TOTAL: Clear+cloudy top of atmosphere radiance for given cloud top pressure and fraction [-]
- CLEAR: Clear sky top of atmosphere radiance (channels) [mW . $(cm^{-1})^{-1}$. $sr^{-1}$. $m^{-2}$]
- BT: Brightness temperature equivalent to total radiance [K]
- BT_CLEAR: Brightness temperature equivalent to clear radiance [K]
- REFL: Reflectance calculated from total radiance [-]
- REFL_CLEAR: Reflectance calculated from clear radiance [-]

It is possible to choose different types of visualisation:
**OnePlot**: View of one plot (Figure 2.9.1)
In this view you can select:

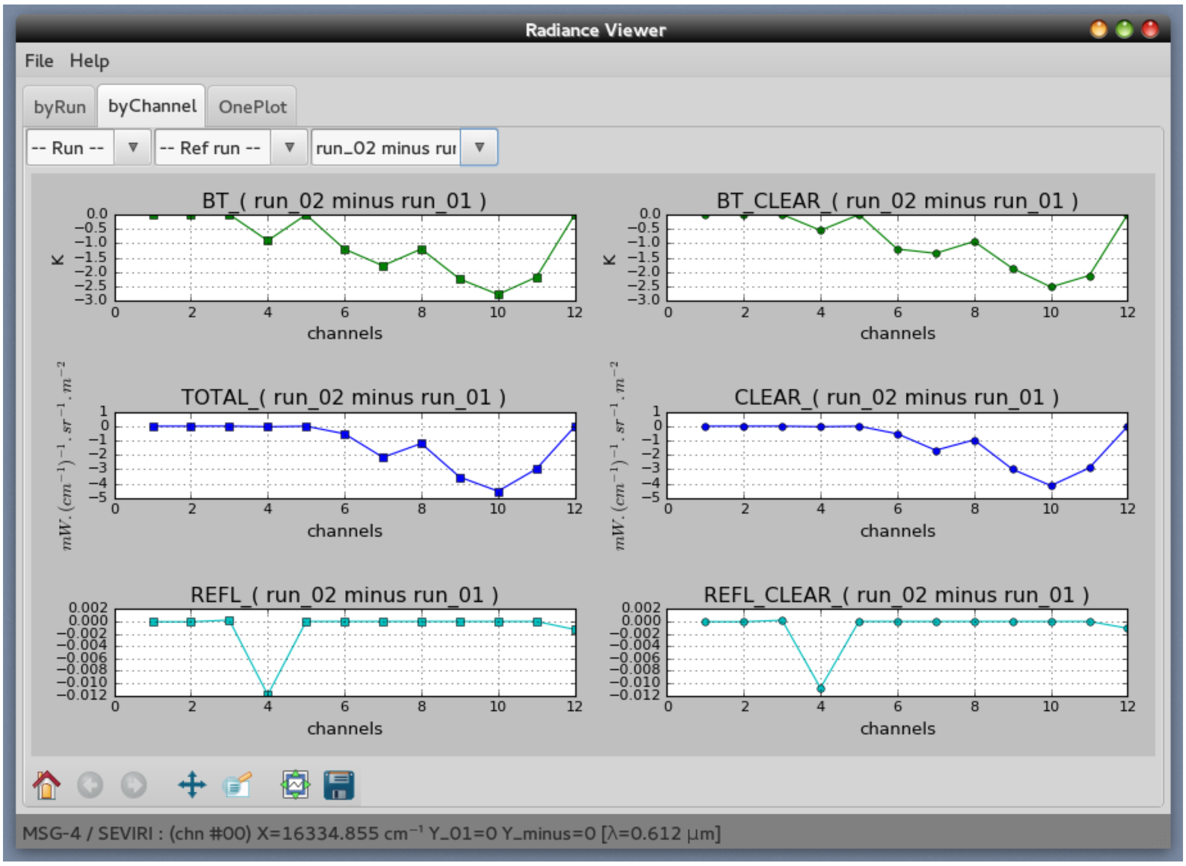
- **The parameter**: BT, BT_CLEAR, TOTAL, CLEAR, REFL, REFL_CLEAR: choose a plot type
- **-- Run --**: to choose a run
- **ref run:** to choose a reference run (for differences and comparaison)
- **-- Pseudo Run --**: difference (minus) or overlay (versus) with reference run
- **-- Channel --**: to choose and display only one channel
- **-- Pseudo Channel --:** to display user's made combinations of channels

**byRun :** For each channel, view of all plots with all runs values
In this view you can select:

- **-- Channel --**: to choose a channel
- **-- Pseudo Channel --:** for channels combination: in this text field, user can write a formula (see the example displayed in the text field), which will become a “pseudo channel”.

**byChannel:** For each run, view of all charts with all channels values (Figure 2.9.2)
In this view you can select:

- **-- Run --**: to choose a run (needs at least 2 different runs)
- **-- Pseudo Run --**: to see the difference between with reference run (needs at least 2 different runs ) (Figure 2.9.3)


Radiance Viewer
File Help
byRun
byChannel
OnePlot
-- Run --
-- Ref run --
run_02 minus rui
BT_( run_02 minus run_01 )
K
0.0 −0.5 −1.0 −1.5 −2.0 −2.5 −3.0
channels
0 2 4 6 8 10 12
BT_CLEAR_( run_02 minus run_01 )
TOTAL_( run_02 minus run_01 )
CLEAR_( run_02 minus run_01 )
$mW.(cm^{-1})^{-1}.sr^{-1}.m^{-2}$
1 0 −1 −2 −3 −4 −5
REFL_( run_02 minus run_01 )
REFL_CLEAR_( run_02 minus run_01 )
0.002 0.000 −0.002 −0.004 −0.006 −0.008 −0.010 −0.012

MSG-4 / SEVIRI : (chn #00) X=16334.855 $\text{cm}^{-1}$ Y_01=0 Y_minus=0 [λ=0.612 µm]

*Figure 2.9.2: Radiance window showing differences between two runs of the direct model.*

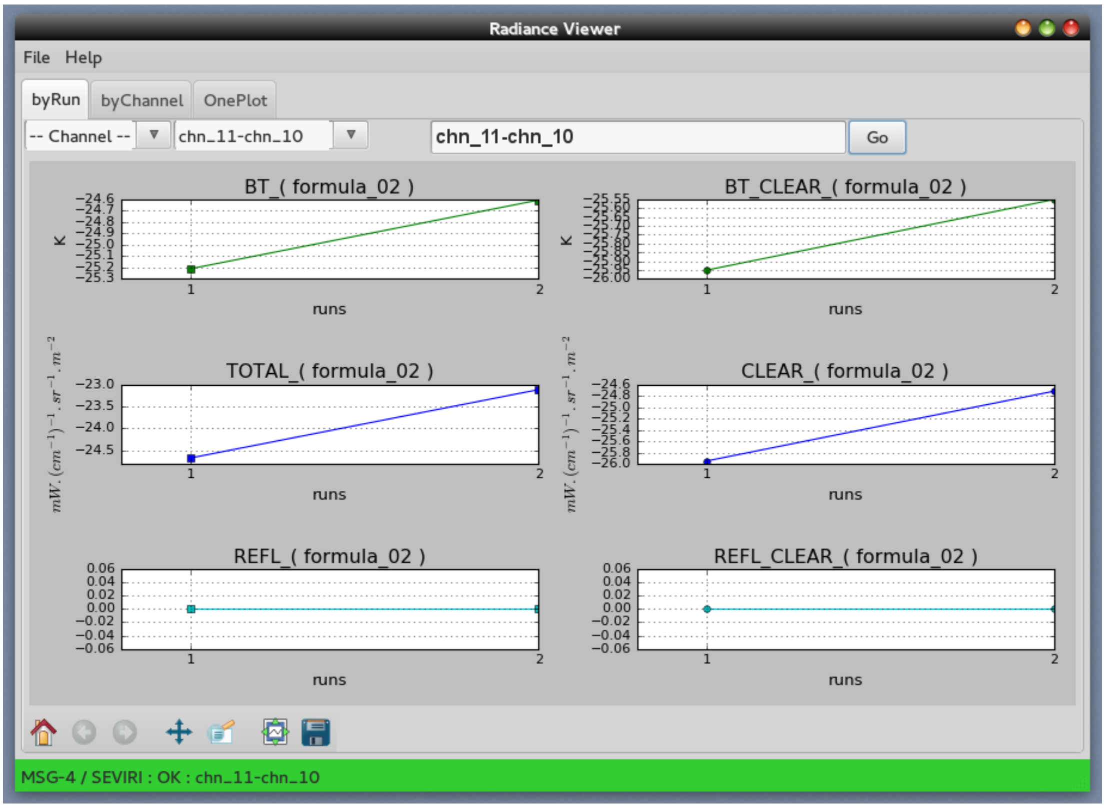
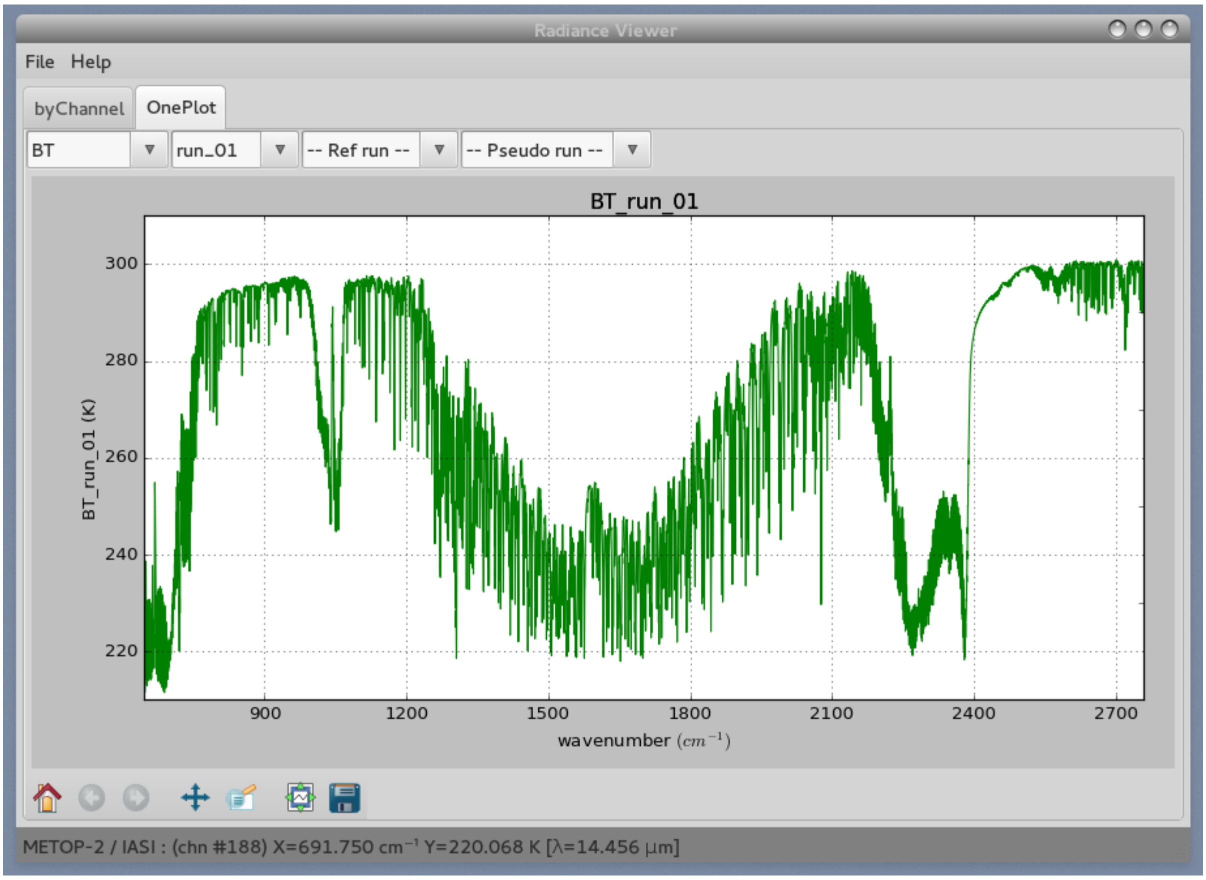


*Figure 2.9.3: Radiance window (byRun view with a computed pseudo channel)*

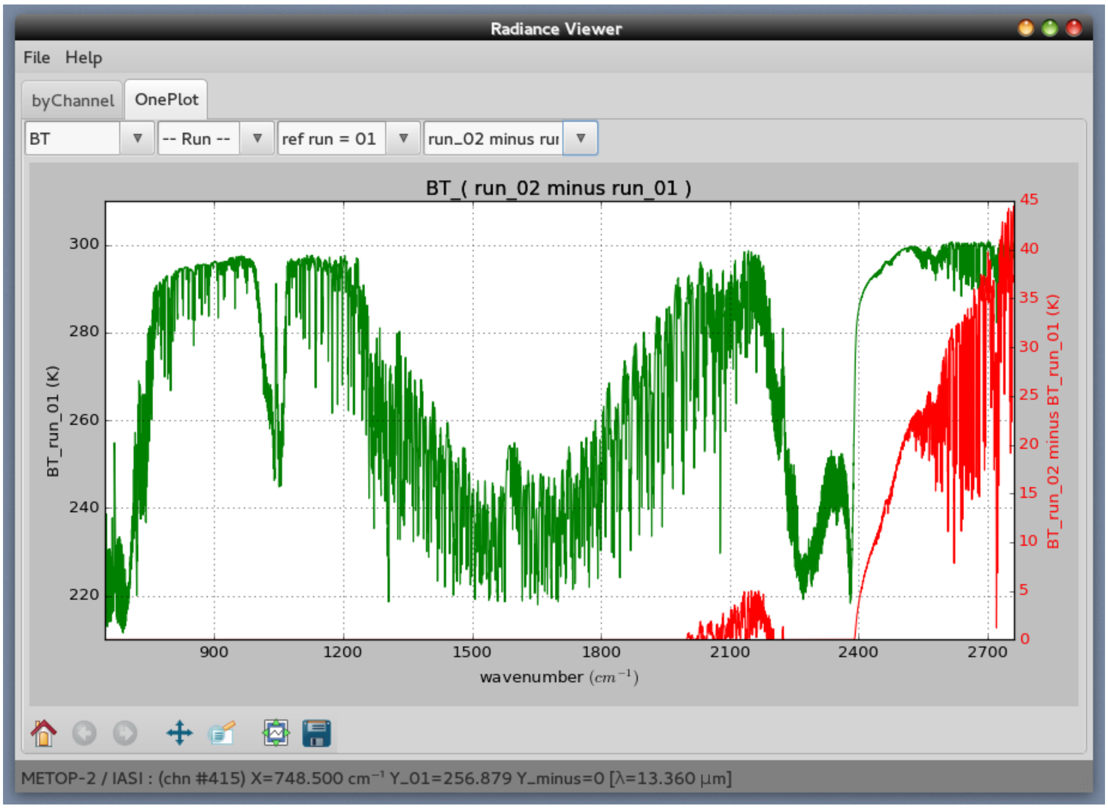
For high-resolution sounders such as IASI, AIRS or CrIS, a spectrum is displayed when the direct model is run (fig. 2.9.5).



METOP-2 / IASI : (chn #188) X=691.750 $cm^{-1}$ Y=220.068 K [λ=14.456 µm]

*Figure 2.9.5: Radiance window for hyperspectral instruments*

For any subsequent run you can select pseudo run such as “run_02 minus run _01” or “run_02 versus run_01” to see the spectrum differences (see fig. 2.9.6 spectrum difference between run 02 (with “addsolar”) and run 01(without “addsolar”) for IASI.



METOP-2 / IASI : (chn #415) X=748.500 cm$^{-1}$ Y_01=256.879 Y_minus=0 [λ=13.360 µm]

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

**Instrument change:**
If you want to run RTTOV with a new instrument, by loading different coefficient files, with an active radiance window displaying the results of a previous RTTOV run, the radiance window becomes obsolete and the GUI will close it.

**Radiance window command line functionality:**

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

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

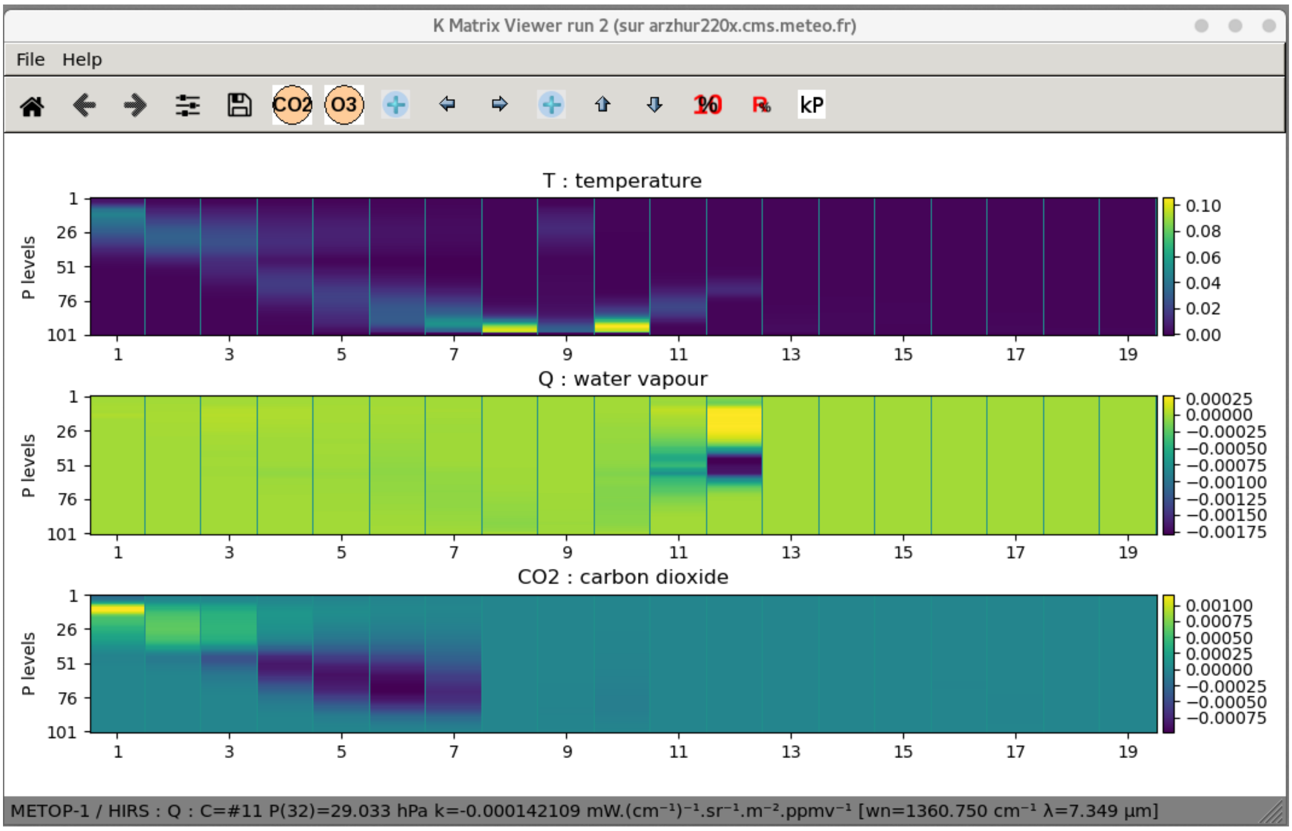
**Interactive navigation:**

The toolbar at the bottom of the radiance window is the matplotlib tool bar: it allows you to zoom and navigate in the Figure.

## 2.10. Running RTTOV K and working with the K-Matrix and the Kprofile windows.

It is possible to run the Jacobian 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 (Figure 2.10.1). With every RTTOV K run, a new window is displayed. Depending on the choice of the switchrad option, the Jacobians are expressed either in radiance unit or in temperature unit by the unit of the considered variable. Exemple: mW.(cm$^{-1}$)$^{-1}$.sr.m$^{-2}$.K$^{-1}$ for the Jacobien of temperature variable and mW.(cm$^{-1}$)$^{-1}$.sr.m$^{-2}$.ppmv$^{-1}$ for the Jacobien of gases with switchrad not checked in the option window.



```
METOP-1 / HIRS : Q : C=#11 P(32)=29.033 hPa k=-0.000142109 mW.(cm⁻¹)⁻¹.sr⁻¹.m⁻².ppmv⁻¹ [wn=1360.750 cm⁻¹ λ=7.349 µm]
```

*Figure 2.10.1: K-Matrix window*

Move the mouse on a channel and enter P on your keyboard to display the K profile (Figure 2.10.2)

Icon Toolbars:

kP

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

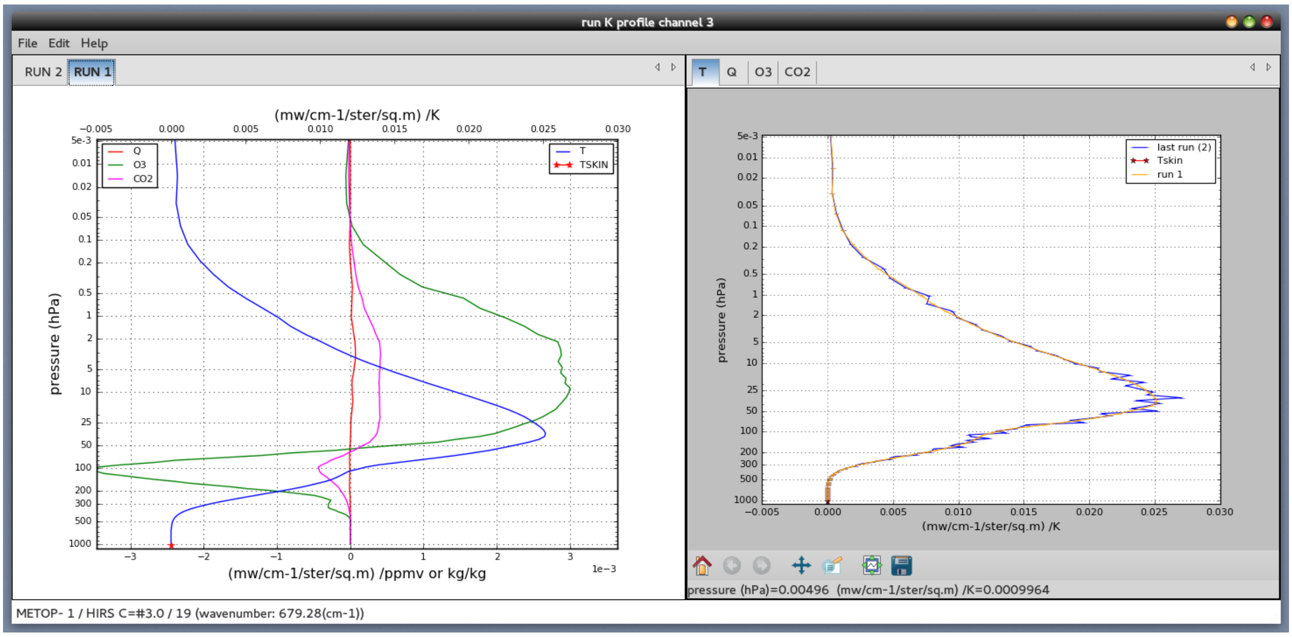
1/10

This icon allows you to multiply by 0.1 all values.

CO2 O3

These icons, if present, allow you to display the K matrix for the different gaz.

The K-profile windows allows you to overlay up to four K-profiles from four successives K-run. In the example below (Figure 2.10.2), one can see the impact of the vertical interpolation mode (run 1 with mode 5 (Rochon/Log-lin WF) and run 2 with mode 1 (Rochon/Rochon OD) on the computed K-profile for channel 3 of HIRS.



pressure (hPa)=0.00496 (mw/cm-1/ster/sq.m) /K=0.0009964

METOP- 1 / HIRS C=#3.0 / 19 (wavenumber: 679.28(cm-1))

*Figure 2.10.2: The K profile window*

## 2.11. Running RTTOV PC (Principal Components)

It is possible to run RTTOV PC. For this purpose you have to load a PC coefficient file, and to 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 (Figure 2.11.1).

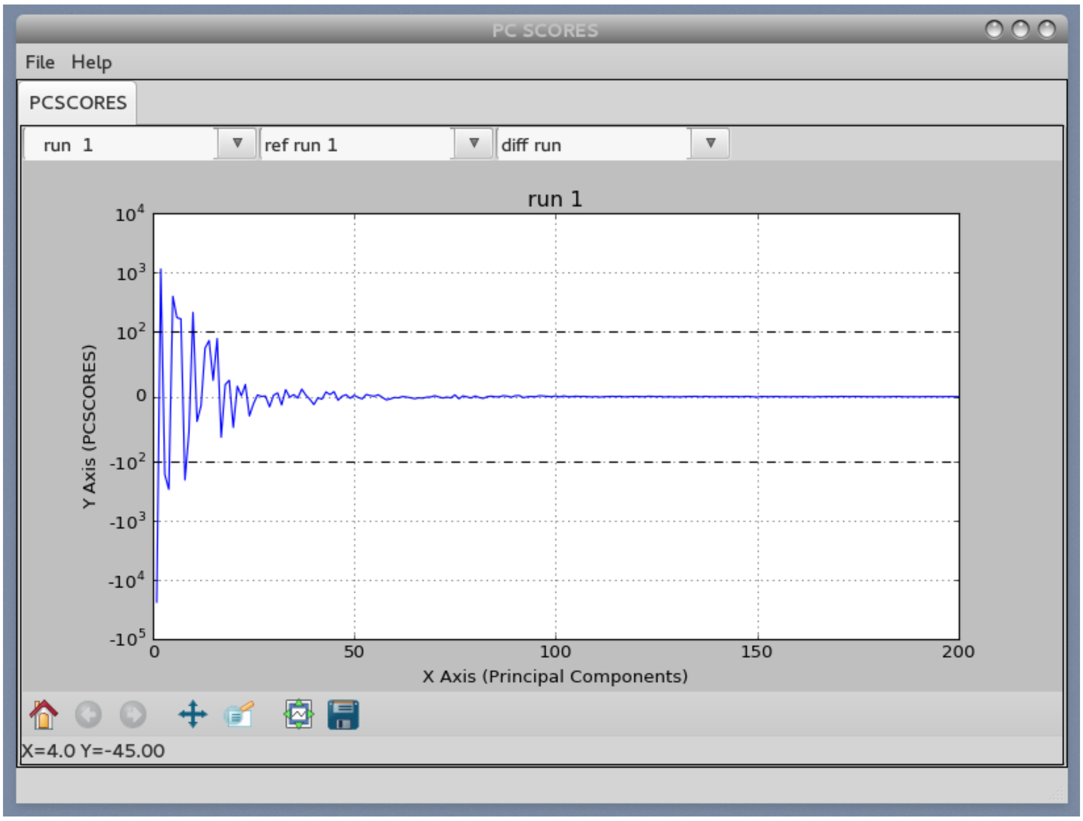


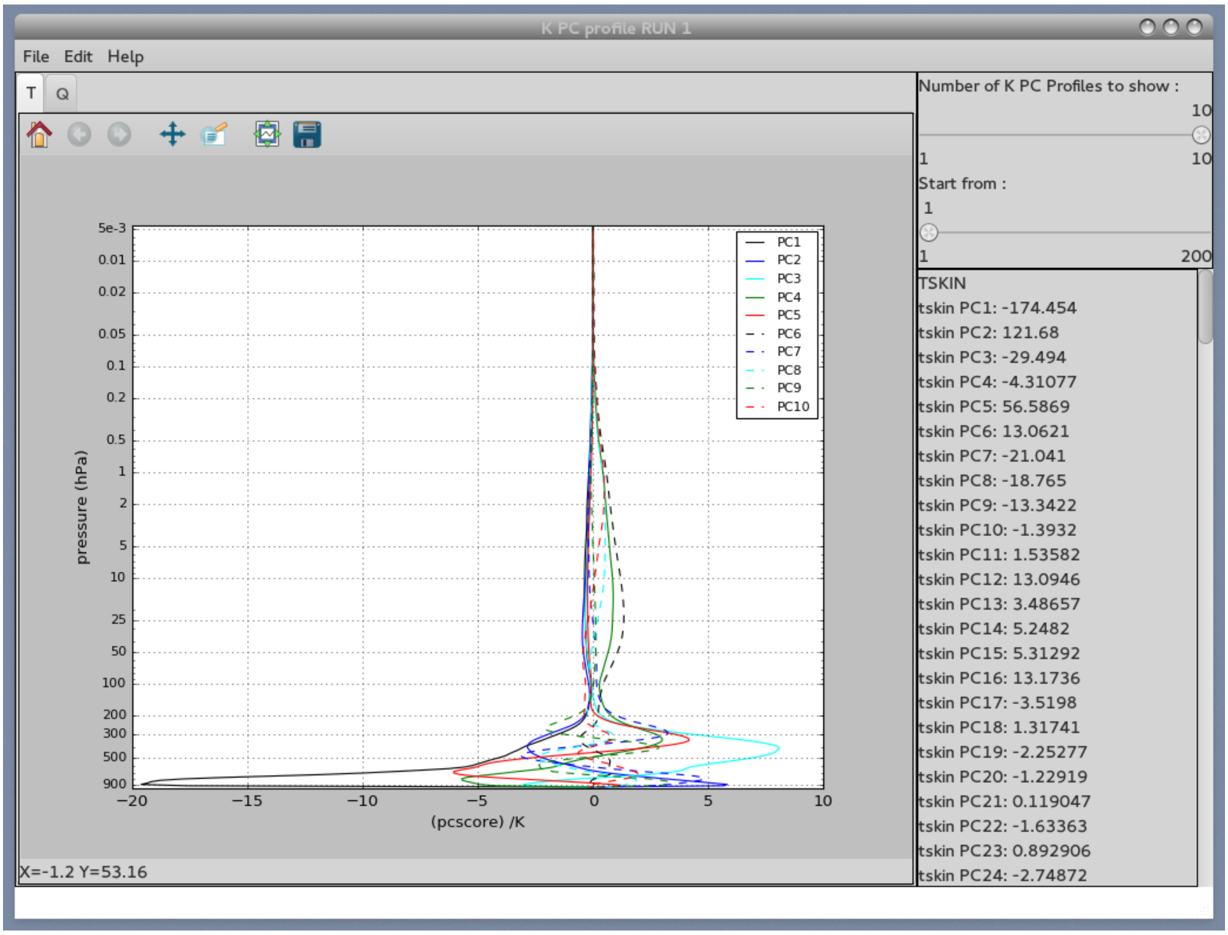
*Figure 2.11.1: The PC SCORES window. Note the symmetrical log axis for pcscores. (range [-100,100] is linear)*

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 RTTOV PC K , two windows are displayed: the KPCMatrix Window and the KPC profile window.

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



Number of K PC Profiles to show :
10
1 10
Start from :
1
1 200

```
TSKIN
tskin PC1: -174.454
tskin PC2: 121.68
tskin PC3: -29.494
tskin PC4: -4.31077
tskin PC5: 56.5869
tskin PC6: 13.0621
tskin PC7: -21.041
tskin PC8: -18.765
tskin PC9: -13.3422
tskin PC10: -1.3932
tskin PC11: 1.53582
tskin PC12: 13.0946
tskin PC13: 3.48657
tskin PC14: 5.2482
tskin PC15: 5.31292
tskin PC16: 13.1736
tskin PC17: -3.5198
tskin PC18: 1.31741
tskin PC19: -2.25277
tskin PC20: -1.22919
tskin PC21: 0.119047
tskin PC22: -1.63363
tskin PC23: 0.892906
tskin PC24: -2.74872
```

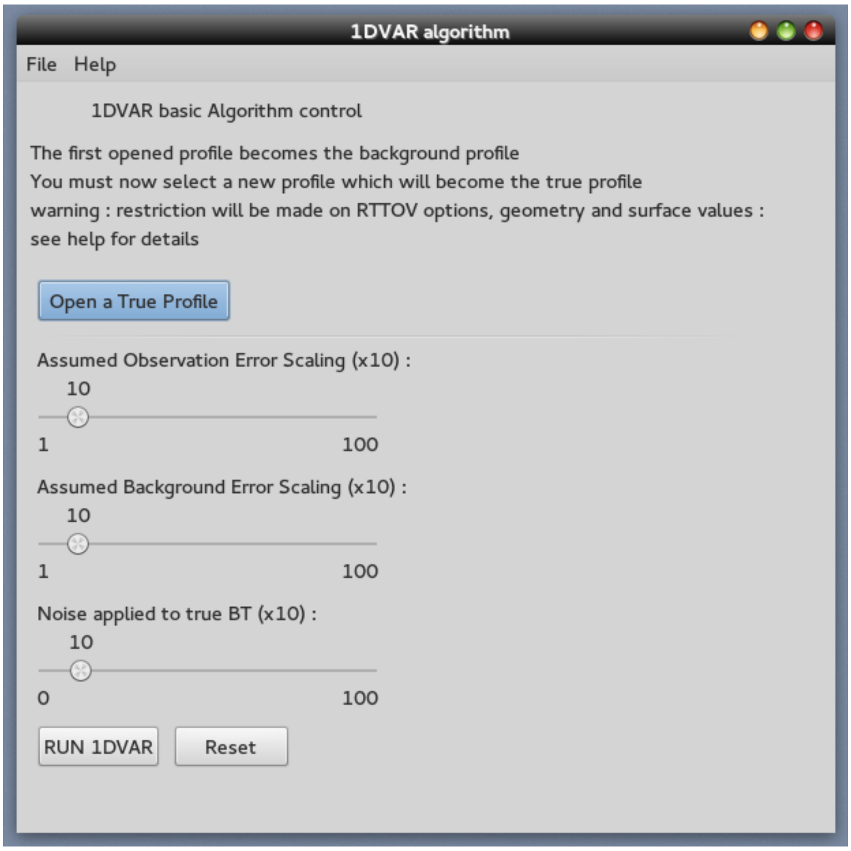
*Figure 2.12.1: The K PC profile window*

# 3. The 1D-VAR functionality

This new functionality was added to RTTOV GUI for the 2015 SAFNWP-ECMWF satellite data assimilation course. Its purpose is to demonstrate to a student how the 1D-VAR retrieval works.
The 1D-VAR functionality uses Background and Observation error covariances matrices. These matrices are inherited from the NWP-SAF 1D-VAR retrieval package and they can be customized if necessary: see the NWP-SAF 1D-VAR retrieval package documentation. (https://nwpsaf.eu/deliverables/nwpsaf_1dvar/index.html).

In order to use the 1DVAR functionality you must use RTTOV GUI with a 54 levels profile, which once opened from the file menu of the RTTOV GUI main window, will be considered as the background profile. It can be modified with the “profile editor” window.
The covariance observation error matrices come from the 1Dvar therefore the number of permitted instruments for the RTTOV GUI 1Dvar functionality is restricted: AMSUA, MHS, ATMS, HIRS, AIRS, CrIS, IASI, SSMIS. Choose a 54 levels coefficient file among these instruments.
With this 2 prerequisites, the “Configure 1Dvar” command of the “1Dvar” menu of the main window becomes available: select it .

Work now from the “1D-VAR” window (Figure 3.1):



1DVAR basic Algorithm control

The first opened profile becomes the background profile
You must now select a new profile which will become the true profile
warning : restriction will be made on RTTOV options, geometry and surface values :
see help for details

Assumed Observation Error Scaling (x10) : 10

Assumed Background Error Scaling (x10) : 10

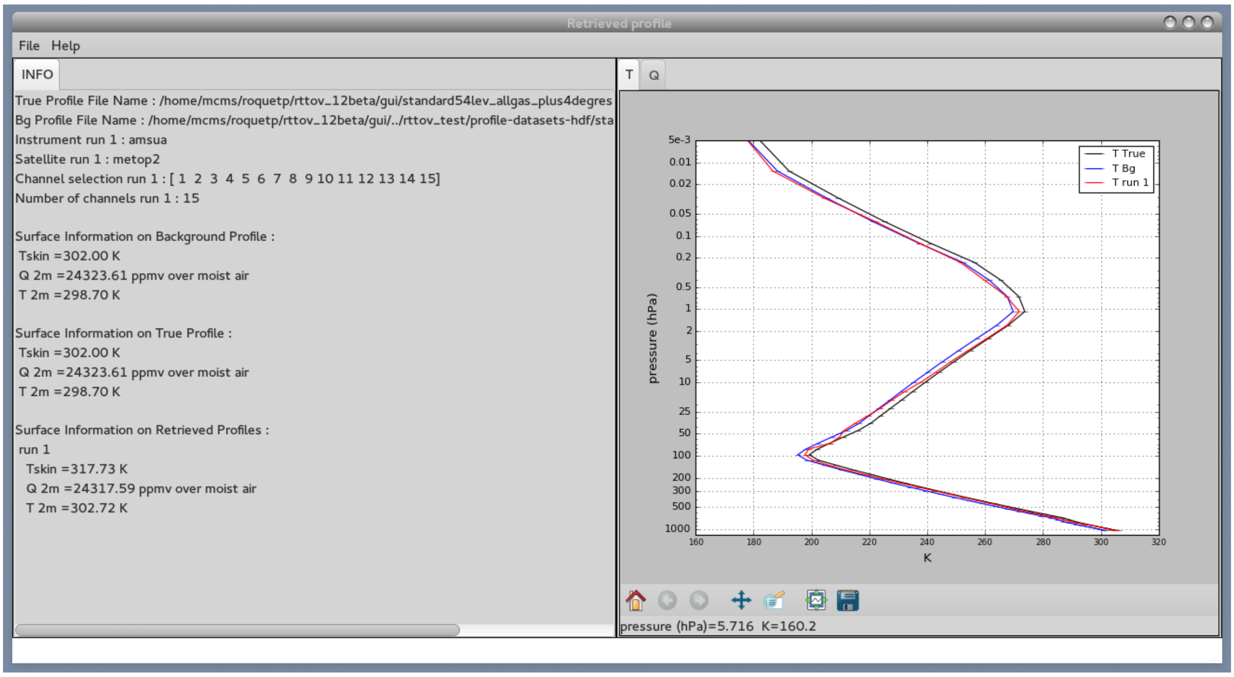
Noise applied to true BT (x10) : 10

*Figure 3.1: 1D-VAR window*

1. Click on the “Open a true profile” in order to load what will be considered as the True profile (Xt): This true profile will be used to compute the simulated observed radiances, and to compare with the retrieved profile.
2. Change the value of the scaling factor (fb) for the background errors if necessary
3. Change the value of the scaling factor (fr) for the observation errors if necessary
4. Change the value of the maximum random noise if necessary
5. Click on the RUN 1DVAR button

The results are displayed in two windows:

- the retrieved profile window (Figure 3.2), the true profile is in black, the background in blue and the retrieval in red.
- and the brightness temperatures window (Figure 3.3), which displays the brightness temperatures obtained with the RTTOV direct model for the true and the background profiles, and the difference (True - Bg).



```
True Profile File Name : /home/mcms/roquetp/rttov_12beta/gui/standard54lev_allgas_plus4degres
Bg Profile File Name : /home/mcms/roquetp/rttov_12beta/gui/../rttov_test/profile-datasets-hdf/sta
Instrument run 1 : amsua
Satellite run 1 : metop2
Channel selection run 1 : [ 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15]
Number of channels run 1 : 15

Surface Information on Background Profile :
 Tskin =302.00 K
 Q 2m =24323.61 ppmv over moist air
 T 2m =298.70 K

Surface Information on True Profile :
 Tskin =302.00 K
 Q 2m =24323.61 ppmv over moist air
 T 2m =298.70 K

Surface Information on Retrieved Profiles :
 run 1
   Tskin =317.73 K
   Q 2m =24317.59 ppmv over moist air
   T 2m =302.72 K
```

```
pressure (hPa)=5.716  K=160.2
```

*Figure 3.2: Retrieved profile window*

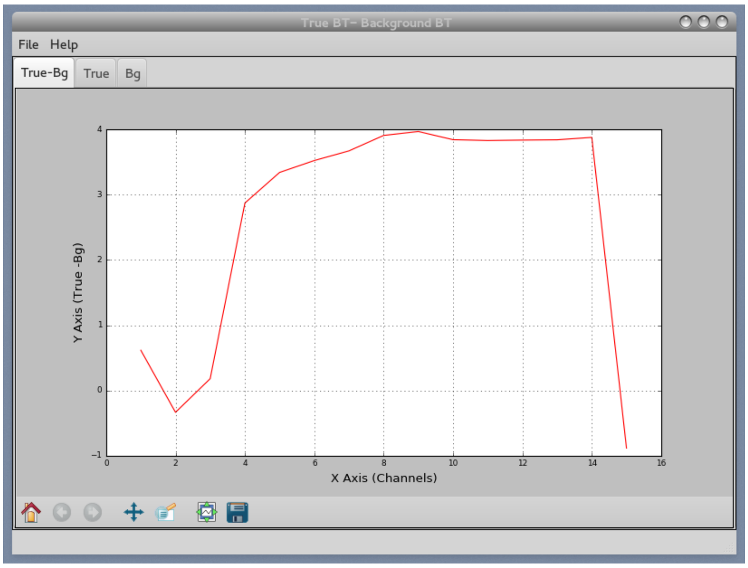
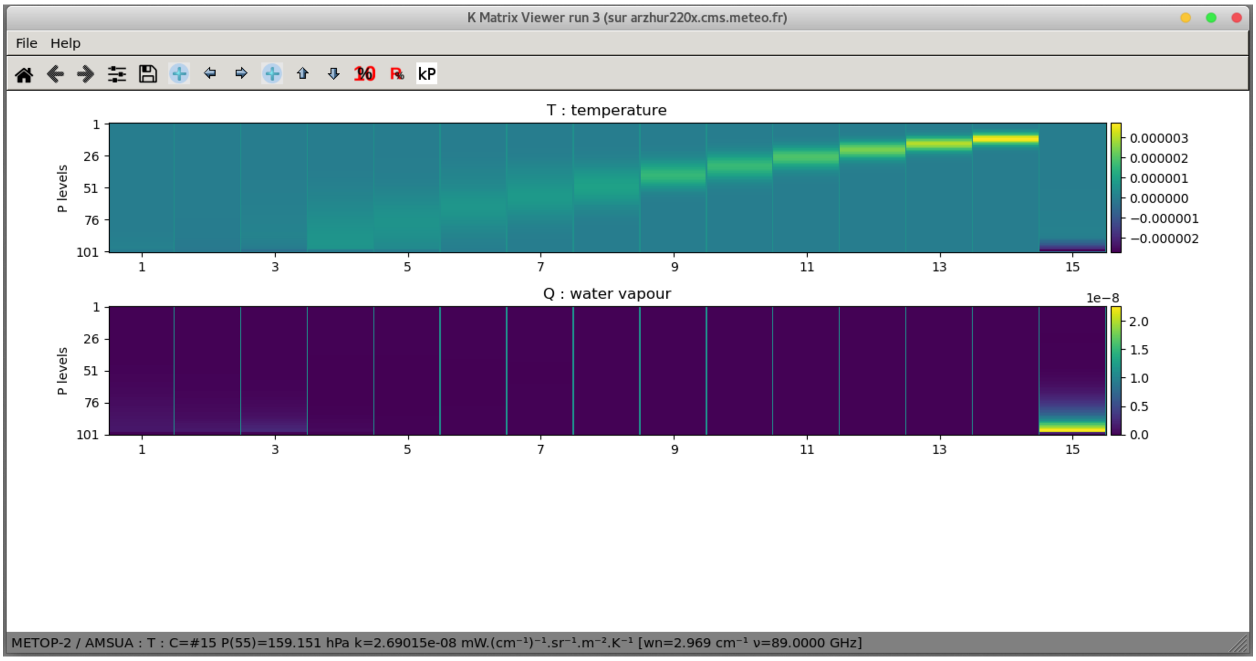


*Figure 3.3: Brightness temperatures window*

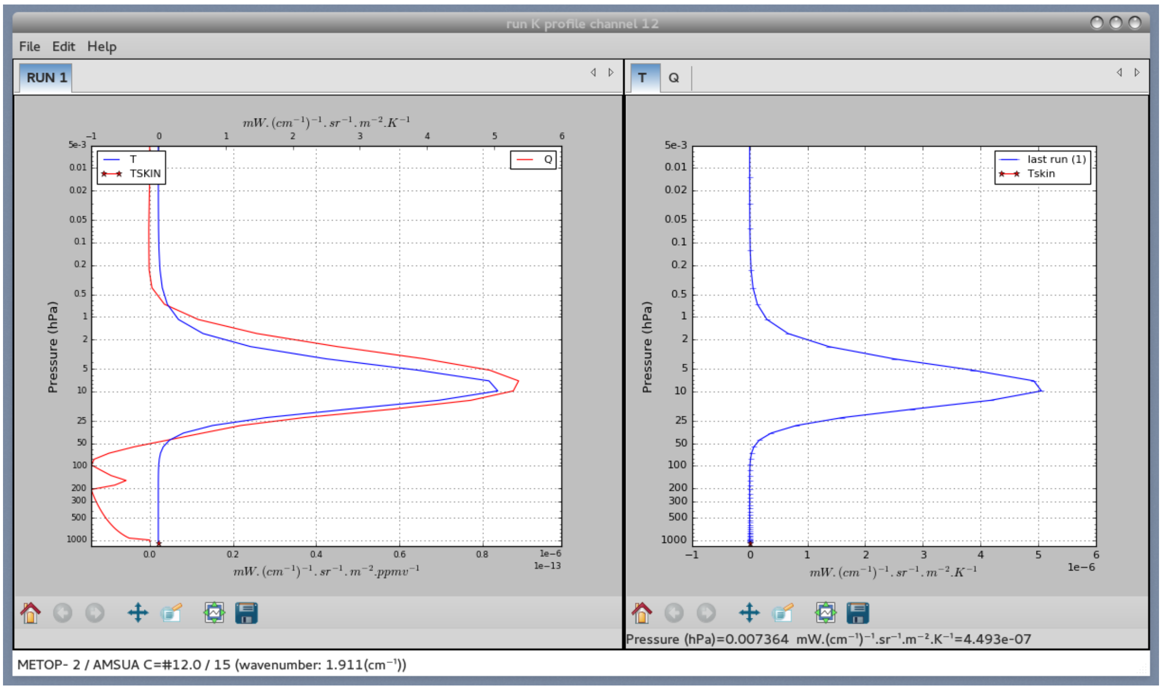
RTTOV GUI allows you to perform a channel selection on the instrument, this functionality can be very useful. Let us see a concrete case:
In order to visualize at which level a specific channel of a instrument may be useful for the retrieval process, you can run RTTOV-K for all channels of an instrument from the Rttov menu of the main window. RTTOV GUI displays the K Matrix Window. This window shows the results of the Jacobian model for the different channels, for the temperature and for the gases concentrations. In this example (Figure 3.4) of a K matrix window for the METOP 2/AMSUA instrument, one can easily see that the influence of a slight modification of the temperature may be of some importance at the level where the Jacobian is the largest.



METOP-2 / AMSUA : T : C=#15 P(55)=159.151 hPa k=2.69015e-08 $mW.(cm^{-1})^{-1}.sr^{-1}.m^{-2}.K^{-1}$ [wn=2.969 $cm^{-1}$ ν=89.0000 GHz]

*Figure 3.4: K Matrix window for the METOP 2/AMSUA instrument*

From the K matrix viewer, the user can, with the “kP button”, select a channel in order to display the K profile. In Figure 3.5, on the K profile window for channel 12 of METOP-2/AMSUA, the peak around 10hPa on the Jacobian of temperature curve is clearly visible: this channel will add some important information in the retrieval process at this level.

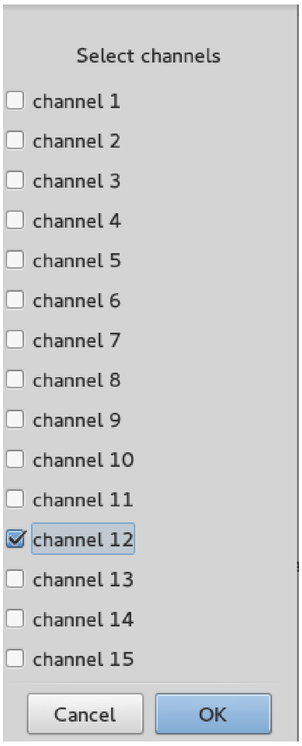


Pressure (hPa)=0.007364 $mW.(cm^{-1})^{-1}.sr^{-1}.m^{-2}.K^{-1}$=4.493e-07

METOP- 2 / AMSUA C=#12.0 / 15 (wavenumber: 1.911($cm^{-1}$))

*Figure 3.5: K profile window which displays a Jacobian for METOP-2/AMSUA channel 12*

From the “Rttov” menu of the main window, with the “Select Channels” command, the user can perform the channel selection and choose the 12th channel (Figure 3.6) .

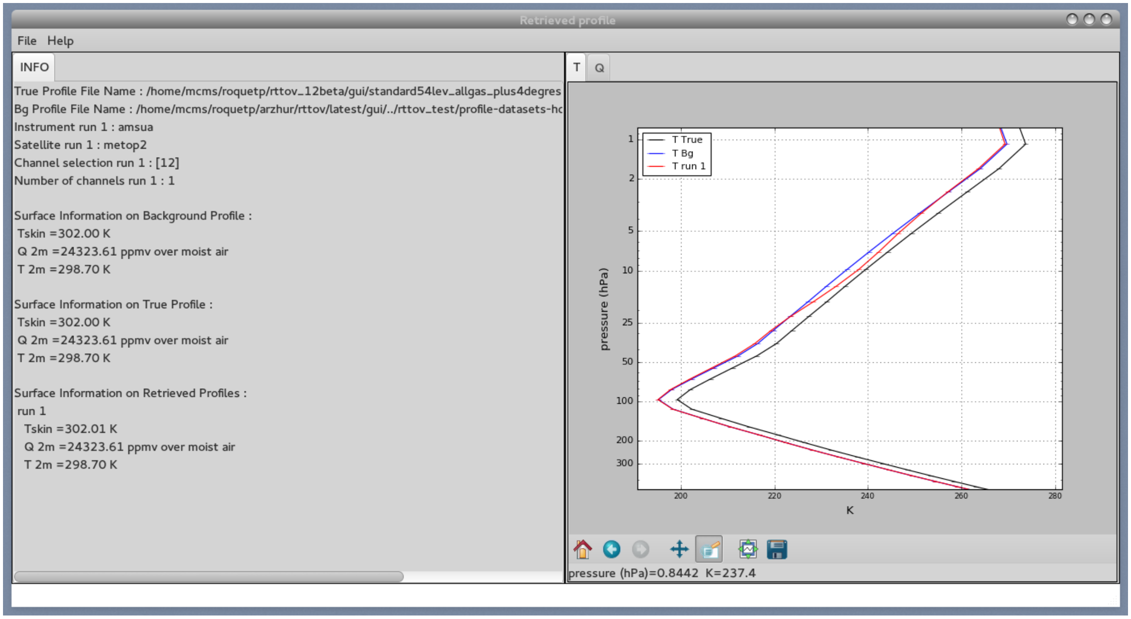


Select channels

□ channel 1
□ channel 2
□ channel 3
□ channel 4
□ channel 5
□ channel 6
□ channel 7
□ channel 8
□ channel 9
□ channel 10
□ channel 11
☑ channel 12
□ channel 13
□ channel 14
□ channel 15

*Figure 3.6: The select channels window.*

The user can now perform the retrieval with just the METOP-2/AMSUA 12th channel.
In the Figure 3.7, which is a retrieval for the METOP-2/AMSUA 12th channel, one can easily see that the retrieved curve for the temperature adjusts very nicely around 10 hPa.



```
True Profile File Name : /home/mcms/roquetp/rttov_12beta/gui/standard54lev_allgas_plus4degres
Bg Profile File Name : /home/mcms/roquetp/arzhur/rttov/latest/gui/../rttov_test/profile-datasets-hc
Instrument run 1 : amsua
Satellite run 1 : metop2
Channel selection run 1 : [12]
Number of channels run 1 : 1

Surface Information on Background Profile :
 Tskin =302.00 K
 Q 2m =24323.61 ppmv over moist air
 T 2m =298.70 K

Surface Information on True Profile :
 Tskin =302.00 K
 Q 2m =24323.61 ppmv over moist air
 T 2m =298.70 K

Surface Information on Retrieved Profiles :
 run 1
  Tskin =302.01 K
  Q 2m =24323.61 ppmv over moist air
  T 2m =298.70 K
```

```
pressure (hPa)=0.8442  K=237.4
```

*Figure 3.7: Retrieval example (zoomed) with METOP-2/AMSUA 12th channel, and a background error scalling of 10.*

## Computations made by RTTOV GUI:

In the calcul below $X_t$ is the true vertical profile. This vertical profile is never known in the reality. But the purpose is to show with RTTOV GUI, how it is possible to retrieved it from satellite observations. In the reality what are known are the observed brightness temperatures: they can be simulated in this experiment with the direct model of RTTOV from $X_t$ :

The computation made by RTTOV GUI are:

1. Compute brightness temperatures $Y_t$ from $X_t$ (RTTOV direct model)

$$Y_t = RTTOV_{direct} (X_t) \quad [1]$$

2. Compute brightness temperatures $Y_b$ from $X_b$ (RTTOV direct model)

$$Y_b = RTTOV_{direct} (X_b) \quad [2]$$

3. Compute Jacobian matrix K and transpose $K^T$ (RTTOV-K model):

$$K = RTTOV\text{-}K (X_b) \quad [3]$$

4. Apply scaling factor to background errors:

$$B = f_b \; B \quad [4]$$

5. Apply scaling factor to observation errors:

$$R = f_r\ R \qquad [5]$$

6. Compute linear 1DVAR weights W:

$$W = B\ K^T\ [\ K\ B\ \ K^T + R\ ]^{-1} \qquad [6]$$

7. Compute linear 1DVAR retrieved profile $X_r$:

$$X_r = X_b + W\ \ [\ (\ Y_t + N\ )\ -\ Y_b\ ] \qquad \text{where } N = \text{random noise vector} \qquad [7]$$

# 4. 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 only necessary variables. The two formats are described below.

## 4.1. HD5 profile file format

The HDF5 profile format allows to store a single profile or a profile dataset such as ECMWF83. It also allows to store RTTOV options.

The HDF5 top level structure is like the following (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 rttov_type.F90 and RTTOV User's manual). 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), substructures skin and s2m are HDF5 subgroups which contains the relevant variables; see below table.

| Name | HDF5 type | Dimension | Comment |
|---|---|---|---|
| ID | Dataset | {SCALAR} | User may give text ID to each profile |

| | | | |
|---|---|---|---|
| DATE | Dataset | {3} | Year Month Day |
| TIME | Dataset | {3} | Hour Minute Second |
| NLAYERS | Dataset | {1} | Number of atmospheric layers |
| NLEVELS | Dataset | {1} | Number of atmospheric levels |
| CTP | Dataset | {1} | Black body cloud top pressure (hPa) |
| CFRACTION | Dataset | {1} | Black body cloud fraction (0 - 1) 1 for 100% cloud cover |
| | | | |
| CLOUD | Dataset | {nlayers,6} | optional |
| CFRAC | Dataset | {nlayers} | Cloud fraction (0 - 1) 1 for 100% cloud cover |
| ICEDE | Dataset | {nlayers} | Units for gas profiles :0 or less => ppmv over dry air, 1 => kg/kg over moist air, 2 => ppmv over moist air) |
| IDG | Dataset | {1} | Scheme for IWC to eff diameter,Dg 1=Ou and Liou; 2=Wyser et al.; 3=Boudala et al; 4=McFarquhar et al. |
| ICE_SCHEME | Dataset | {1} | ice cloud scheme (1-2) |
| CLW | Dataset | {nlevels} | optional, not used in GUI |
| CLW_SCHEME | Dataset | {1} | liquid cloud scheme (1-2) |
| CLWDE | Dataset | {nlayers} | liquid water diameter |
| AEROSOLS | Dataset | {nlayers,13} | optional |
| | | | |
| P | Dataset | {nlevels} | Pressure (hPa) |
| T | Dataset | {nlevels} | Temperature |
| Q | Dataset | {nlevels} | Water vapour |
| O3 | Dataset | {nlevels} | optional Ozone (O3) |
| CO2 | Dataset | {nlevels} | optional |
| N2O | Dataset | {nlevels} | optional |
| CO | Dataset | {nlevels} | optional |
| CH4 | Dataset | {nlevels} | optional |

| | | | |
|---|---|---|---|
| SO2 | Dataset | {nlevels} | optional |
| GAS_UNITS | Dataset | {1} | Units for gas profiles :0 or less => ppmv over dry air, 1 => kg/kg over moist air, 2 => ppmv over moist air) |
| | | | |
| BE | Dataset | {1} | COMMENT = Earth magnetic field strength<br>UNITS = Gauss |
| COSBK | Dataset | {1} | Cosine of the angle between the Earth magnetic field and wave propagation direction |
| | | | |
| LATITUDE | Dataset | {1} | Latitude (deg) |
| LONGITUDE | Dataset | {1} | Longitude (deg) |
| AZANGLE | Dataset | {1} | Satellite azimuth angle<br>UNITS = degree (0-360 deg; east=90) |
| ZENANGLE | Dataset | {1} | Satellite zenith angle |
| SUNAZANGLE | Dataset | {1} | Sun azimuth angle |
| SUNZENANGLE | Dataset | {1} | Sun zenith angle |
| ELEVATION | Dataset | {1} | Surface elevaton |
| MMR_CLDAER | Dataset | {1} | Units for cloud and aerosol profiles 0: g/m^3 (cld); cm^-3 (aer), 1: kg/kg |
| | | | |
| ***S2M*** | ***Group*** | | |
| S2M/O | Dataset | {1} | Ozone |
| S2M/P | Dataset | {1} | Surface pressure (hPa) |
| S2M/Q | Dataset | {1} | Water vapour |
| S2M/T | Dataset | {1} | Temperature (K) |
| S2M/U | Dataset | {1} | U 10m wind component (m/s) |
| S2M/V | Dataset | {1} | V 10m wind component (m/s) |
| S2M/WFETC | Dataset | {1} | Wind fetch (metres) |
| | | | |
| ***SKIN*** | ***Group*** | | |
| SKIN/FASTEM | Dataset | {5} | Land/sea-ice surface parameters for fastem |
| SKIN/FOAM_FRACTION | Dataset | {1} | Ocean foam coverage fraction passed to FASTEM |

| | | | |
|---|---|---|---|
| SKIN/SALINITY | Dataset | {1} | Practical salinity unit %o - FASTEM-4/5 only |
| SKIN/SNOW_FRACTION | Dataset | {1} | Surface snow coverage fraction (0-1). Used only by IR emissivity atlas |
| SKIN/SOIL_MOISTURE | Dataset | {1} | soil moisture (m^3/m^3) |
| SPECULARITY | Dataset | {1} | specifies linear combination of Lambertian and specular downwelling radiance<br>0 (purely Lambertian) to 1 (purely specular) |
| SKIN/SURFTYPE | Dataset | {1} | 0=land, 1=sea, 2=sea-ice |
| SKIN/T | Dataset | {1} | Radiative skin temperature (K) |
| SKIN/WATERTYPE | Dataset | {1} | 0=fresh water, 1=ocean water |

The  /OPTIONS group contains a copy of the RTTOV option structure (see rttov_type.F90 and RTTOV User's manual). There is only option structure in the HDF5 file even if several profiles are stored in. This /OPTIONS group is optional. All RTTOV option 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} |
| ADDREFRAC | Dataset | {1} |
| SWITCHERAD | Dataset | {1} |
| USE_Q2M | Dataset | {1} |
| DO_LAMBERTIAN | Dataset | {1} |
| LAMBERTIAN_FIXED_ANGLE | Dataset | {1} |
| PLANE_PARALLEL | Dataset | {1} |
| IR_SEA_EMIS_MODEL | Dataset | {1} |
| ADDSOLAR | Dataset | {1} |
| DO_NLTE_CORRECTION | Dataset | {1} |
| ADDAEROSL | Dataset | {1} |

| | | |
|---|---|---|
| ADDCLOUDS | Dataset | {1} |
| CLDSTR_THRESHOLD | Dataset | {1} |
| IR_SCATT_MODEL | Dataset | {1} |
| VIS_SCATT_MODEL | Dataset | {1} |
| DOM_NSTREAMS | Dataset | {1} |
| DOM_ACCURACY | Dataset | {1} |
| DOM_OPDEP_THRESHOLD | Dataset | {1} |
| USER_AER_OPT_PARAM | Dataset | {1} |
| USER_CLD_OPT_PARAM | Dataset | {1} |
| OZONE_DATA | Dataset | {1} |
| CO2_DATA | Dataset | {1} |
| N2O_DATA | Dataset | {1} |
| CO_DATA | Dataset | {1} |
| CH4_DATA | Dataset | {1} |
| SO2_DATA | Dataset | {1} |
| ADDPC | Dataset | {1} |
| IPCBND | Dataset | {1} |
| IPCREG | Dataset | {1} |
| ADDRADREC | Dataset | {1} |
| | | |
| FASTEM_VERSION | Dataset | {1} |
| CLW_DATA | Dataset | {1} |
| SUPPLY_FOAM_FRACTION | Dataset | {1} |
| | | |
| ADDINTERP | Dataset | {1} |
| INTERP_MODE | Dataset | {1} |
| LGRADP | Dataset | {1} |
| SPACETOP | Dataset | {1} |

| | | |
|---|---|---|
| REG_LIMIT_EXTRAP | Dataset | {1} |
| RAYLEIGH_SINGLE_SCATT | Dataset | {1} |

## 4.2. 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 only necessary variables. Thus the format should respect the Python syntax language. 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 16 of Users guide)
- aerosols where 2D aerosols array is replaced by 1D aerosol arrays, one for each aerosol short name (table 19 of Users guide)

Units should be the ones described in RTTOV Users Guide for profile structure (Annex O)

3 arrays are mandatory, pressure, temperature and water vapour; all other RTTOV profile variables are optional, they will be set to default values at reading time.

The list of profile variables that can be set by the user is given below; with the default values. Default values aims to a clear atmosphere. 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([...])
self["SO2"] = numpy.array([...])

#" Aerosols (1/cm3 on layers)"
self["INSO"] = numpy.array([...]) # Insoluble
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 # (%o)
self["SKIN"]["FOAM_FRACTION"] = 0.0
self["SKIN"]["SNOW_FRACTION"] = 0.0
```

```
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)
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)

#" Magnetic field "
self["BE"]    = 0.3 # (Gauss)
self["COSBK"] = 1.
# units
self["MMR_CLDAER"] = 1 #Cloud/aerosol units: 0: "g/m3", 1: "kg/kg",
                        #None:"kg/kg"
self["GAS_UNITS"] = 2 #-1: ppmv over dry air, 0: ppmv over dry air,
                      # 1: kg/kg over moist air, 2: ppmv over moist air,
                      #None: ppmv over moist air
#" 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
```

## 4.3. How to create an HDF5 profile file from Fortran

RTTOV user can create an HDF5 profile file for use in the RTTOV GUI using the associated RTTOV subroutine RTTOV_HDF_SAVE. That subroutine allows to store any RTTOV structure in 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 )
```

## 4.4. How to create an HDF5 profile file from ASCII text profile file

The ASCII text profile files are Python files. A Python command named rttov_gui_import_ascii_profile.py allows the user to convert an ASCII text profile in an HDF5 profile file. This command makes use of RTTOV GUI Python software (Profile class), so cannot be used outside this framework.

```
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
```

# 5. Reporting bugs

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. Then 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://nwpsaf.eu/site/forums/forum/rttov/