

# RTTOV development status

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# Contents:

RTTOV v12.1 – new features

RTTOV v12.2 – planned developments

NWP SAF website

NWP SAF Radiance Simulator

RTTOV technical sub-group

# RTTOV v12.1 – released Feb 2017

Updated visible/IR optical depth coefficients  
including optional variable SO<sub>2</sub>.

# Visible/IR optical depth coefficients

LBLRTM v12.2, AER v3.2, MT\_CKD\_2.5.2

Updated ECMWF 83 profile set:

- More fixed gas species included.
- Modified CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O profiles.
- Reference profiles are valid for present-day.
- Profile ranges cover 1970-202x.

***Black:*** mean (reference) profile

***Blue:*** min/max envelopes

***Dashed:*** previous dataset (2008)

***Solid:*** new dataset (2016)

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Coefficients on 54 levels.

Also 101 levels for hi-res IR sounders.

Variable O<sub>3</sub>+CO<sub>2</sub> coefficients available for all IR-only and visible+IR sensors (v8 and v9 predictors).

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Sensors recently added/updated:

- *NOAA-20 VIIRS*
- *GEO-KOMPSAT-2 AMI*
- *GOES-16-19 ABI*
- *INSAT 3DR imager and sounder*
- *updated HIRS coefficients with shifted channels*
- ...

Future plans:

- Evaluate impact of LBLRTM v12.8 and CLBLM for training coefficients
- Improve accuracy of SO<sub>2</sub> optical depth prediction

# Microwave optical depth coefficients

Liebe-MPM 89/92 with O<sub>2</sub>, N<sub>2</sub>, WV, O<sub>3</sub>

- O<sub>2</sub> line parameters from Tretyakov et al. 2005
- H<sub>2</sub>O half-width of 183GHz line and its temperature dependency from Payne et al. 2008

ECMWF 83 profile set, coefficients on 54 levels.

Updated Zeeman SSMI/S coefficients on 84 levels:

- New LBL calculations for SSMI/S Zeeman channels using AMSUTRAN's new Zeeman capability.
- Smoother pressure grid.

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New files available on website with band-correction coefficients: these will become the default. Only affects radiances (not BTs).

Sensors recently added:

- *ORS COWVR*
- *SMOS MIRAS*
- *Nimbus-6 SCAMS*

Future plans:

- Improve spectroscopy above 200GHz (for MetopSG ICI).
- Test impact of non-uniform spectral response functions.
- Test impact of Planck-weighted coefficients.



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New visible/IR scattering solver.

New visible/IR ice cloud optical properties.

Optionally supply cloud/aerosol concentrations in kg/kg for visible/IR simulations.

# Visible/IR scattering solver

Discrete Ordinates solver for aerosol and cloud simulations.

Solvers can be selected independently for thermal emission and solar radiation.

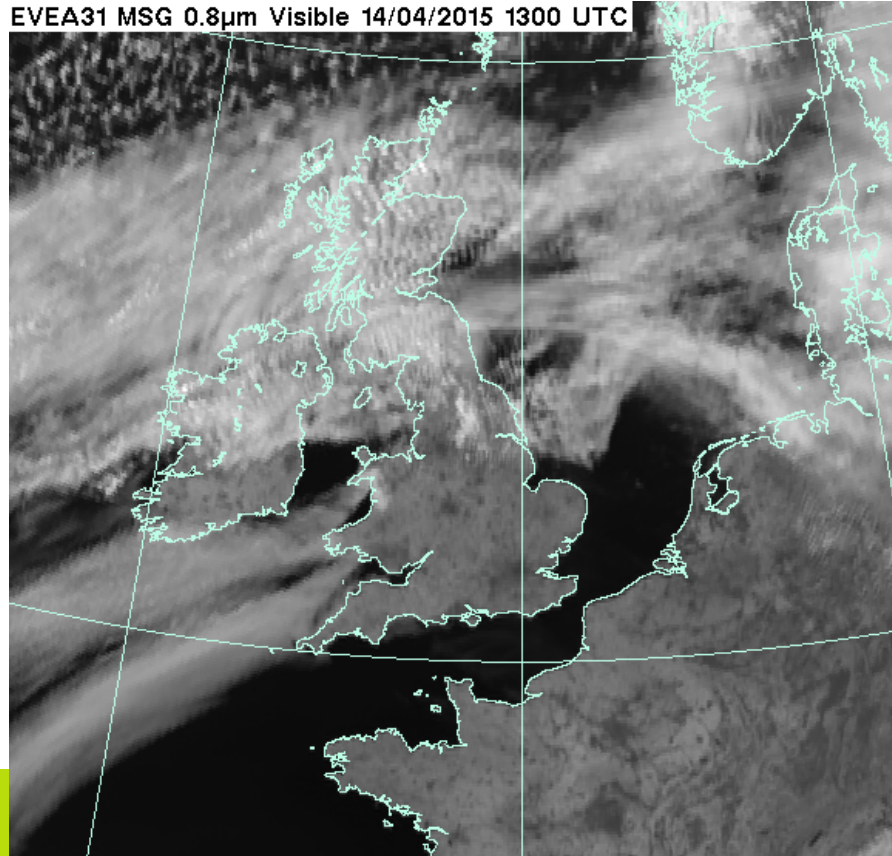
Essentially reproduces DISORT radiances for equivalent calls, but can be many times faster than DISORT, especially for clouds.

Direct, TL, AD and K models.

The SSEC (Baum *et al* 2011) ice optical properties replace the old Hex/Agg shapes.

The Baran ice parameterisation has been extended to the visible.

EVEA31 MSG 0.8 $\mu$ m Visible 14/04/2015 1300 UTC



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Emissivity/BRDF atlas updates:

- New CAMEL IR emissivity atlas (Eva Borbas, 10p.02).
- Updated TELSEM2 and CNRM MW atlases.
- New more flexible interface to atlases.

New IR sea surface emissivity model including Tskin dependency.

New MW sea surface emissivity model TESSEM2 intended for use with MetopSG ICI.

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Interface to the HT-FRTC PC-based fast RT model (Stephan Havemann, 2p.01).

Python/C++ wrapper supports all direct and K model clear-sky and scattering simulations.

RTTOV GUI updates (Pascale Roquet, 1p.03).

# RTTOV v12.2 – March 2018

MFASIS fast visible scattering  
parameterisation.

New cloud liquid water optical property  
parameterisation in terms of LWC and *Deff*.

MFASIS is a look-up-table-based parameterisation of libRadtran/DISORT cloud scattering simulations.

Input variables: *vertically integrated cloud liquid and ice water optical depths and effective radii, surface albedo, satellite and solar zenith angles, and the scattering angle.*

TOA reflectance represented by the first terms of a 2D Fourier series as a function of the zenith angles.

MFASIS is ~4 orders of magnitude faster than DISORT with 16 streams.

RTTOV v12.2 will also include alternative Mie optical properties for water cloud based on liquid water content and cloud droplet effective diameter.

Much of this work is being undertaken by DWD who recently joined the NWP SAF consortium.

*Scheck, L., P. Frèrebeau, R. Buras-Schnell, B. Mayer, 2016: A fast radiative transfer method for the simulation of visible satellite imagery. JSQRT, 175, 54-67.*

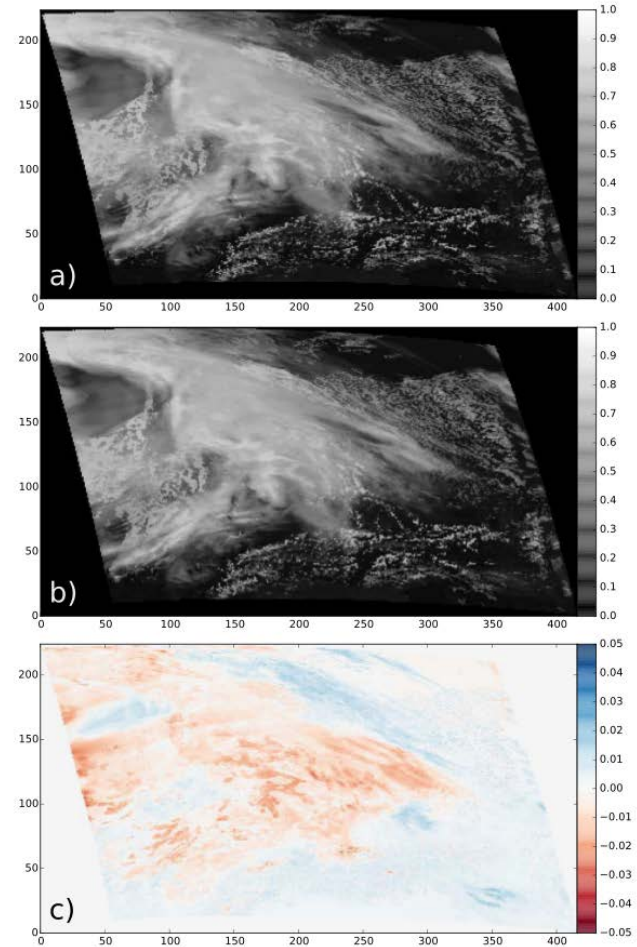


Figure 6: Synthetic  $0.6\mu\text{m}$  SEVIRI images of the COSMO-DE domain generated by a) DISORT and b) MFASIS, and c) the difference MFASIS-DISORT for 12 UTC on June 15th, 2012.



# RTTOV v12.2 – March 2018

MFASIS fast visible/near-IR scattering parameterisation.

New cloud liquid water optical property parameterisation in terms of LWC and *Deff*.

Explicit visible/IR cloud/aerosol optical properties active in TL/AD/K.

New option for sea surface solar BRDF model with reduced bias.

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RTTOV-SCATT updates to enable ICI simulations.

Updates to RTTOV-SCATT optical properties.

New OpenMP interfaces for RTTOV-SCATT.

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Updates to RTTOV-SCATT optical properties.

New OpenMP interfaces for RTTOV-SCATT.

Updates to HT-FRTC interface.

Support for MTG-IRS lightly-apodised radiances via PC-RTTOV and HT-FRTC.

# NWP SAF web site

Register once, download any NWP SAF product including archived versions.

<https://www.nwpsaf.eu/>

## Software Downloads

Hello, **James Hocking**! On this page you will find access to your NWP SAF software download links, and the option to change software download options.

### Instructions

- Click on the 'Change Software Preferences' link below.
- To confirm any new changes, read and accept the licence agreement before clicking Update Software Preferences at the bottom of the form.
- Downloads appear in the table at the bottom of the page.

## Change Software Preferences

### Latest software package download links:

[RTTOV v12.1, February 2017](#)

[HTFRFC v2.1, February 2017](#)

[1DVAR v1.1, February 2017](#)

[Radiance Simulator v2.0, May 2017](#)

**Archived versions of old software:** Note that support is not provided for many older versions of NWP SAF software.

[\\_rttov\\_v11.3](#)

[\\_rttov\\_v11.2](#)

[\\_rttov\\_v11.1](#)

[\\_rttov\\_v10.2](#)

[rttov\\_v10.1](#)

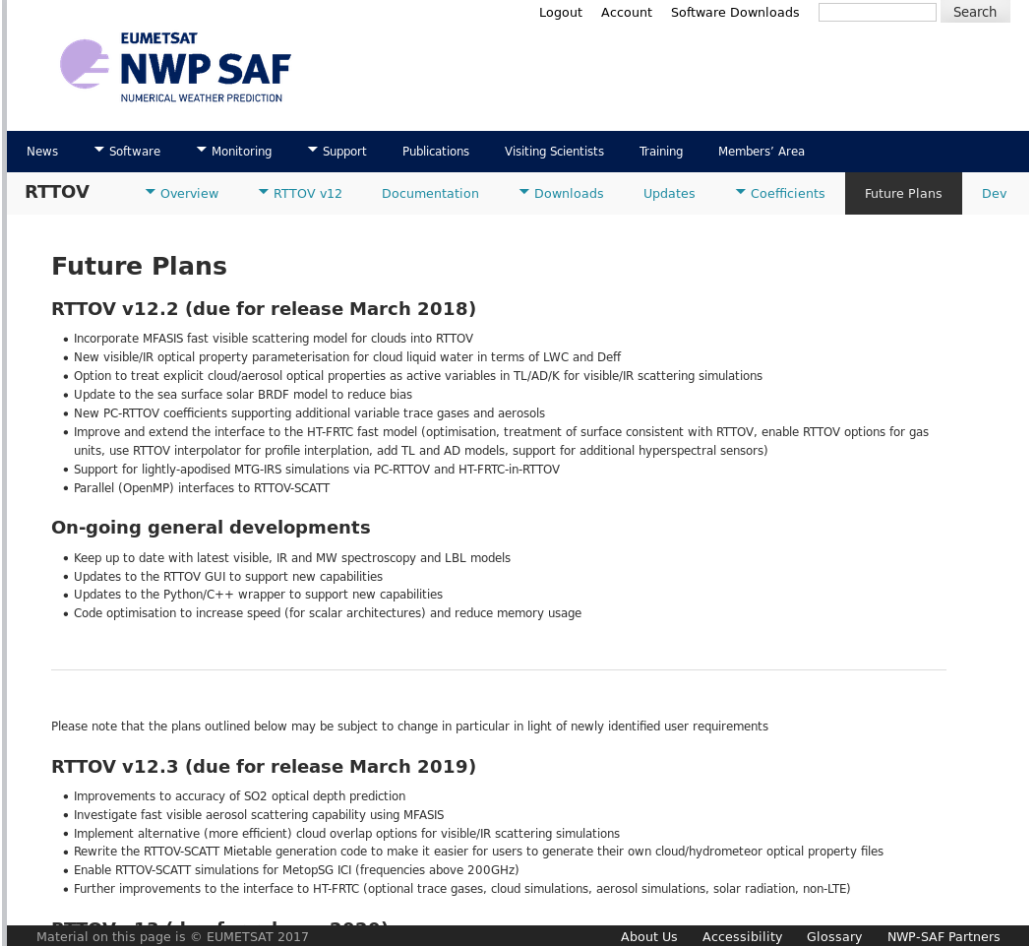
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Future plans and user survey.

<https://www.nwpsaf.eu/site/software/rttov/future-plans/>

<https://www.surveymonkey.co.uk/r/7BL2YPN>



The screenshot shows the NWP SAF website interface. At the top right, there are links for 'Logout', 'Account', 'Software Downloads', and a search box. The main navigation bar includes 'News', 'Software', 'Monitoring', 'Support', 'Publications', 'Visiting Scientists', 'Training', and 'Members' Area'. Below this, a secondary navigation bar for 'RTTOV' includes 'Overview', 'RTTOV v12', 'Documentation', 'Downloads', 'Updates', 'Coefficients', 'Future Plans', and 'Dev'. The 'Future Plans' section is highlighted. It contains two sub-sections: 'RTTOV v12.2 (due for release March 2018)' and 'RTTOV v12.3 (due for release March 2019)'. Each sub-section lists several development items. A note at the bottom of the page states that the plans may be subject to change. The footer contains copyright information for EUMETSAT 2017 and links for 'About Us', 'Accessibility', 'Glossary', and 'NWP-SAF Partners'.

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RTTOV Overview RTTOV v12 Documentation Downloads Updates Coefficients Future Plans Dev

## Future Plans

### RTTOV v12.2 (due for release March 2018)

- Incorporate MFASIS fast visible scattering model for clouds into RTTOV
- New visible/IR optical property parameterisation for cloud liquid water in terms of LWC and Deff
- Option to treat explicit cloud/aerosol properties as active variables in TL/AD/K for visible/IR scattering simulations
- Update to the sea surface solar BRDF model to reduce bias
- New PC-RTTOV coefficients supporting additional variable trace gases and aerosols
- Improve and extend the interface to the HT-FRTC fast model (optimisation, treatment of surface consistent with RTTOV, enable RTTOV options for gas units, use RTTOV interpolator for profile interpolation, add TL and AD models, support for additional hyperspectral sensors)
- Support for lightly-apodised MTG-IRS simulations via PC-RTTOV and HT-FRTC-in-RTTOV
- Parallel (OpenMP) interfaces to RTTOV-SCATT

### On-going general developments

- Keep up to date with latest visible, IR and MW spectroscopy and LBL models
- Updates to the RTTOV GUI to support new capabilities
- Updates to the Python/C++ wrapper to support new capabilities
- Code optimisation to increase speed (for scalar architectures) and reduce memory usage

Please note that the plans outlined below may be subject to change in particular in light of newly identified user requirements

### RTTOV v12.3 (due for release March 2019)

- Improvements to accuracy of SO<sub>2</sub> optical depth prediction
- Investigate fast visible aerosol scattering capability using MFASIS
- Implement alternative (more efficient) cloud overlap options for visible/IR scattering simulations
- Rewrite the RTTOV-SCATT Mitable generation code to make it easier for users to generate their own cloud/hydrumeteor optical property files
- Enable RTTOV-SCATT simulations for MetopSG ICI (frequencies above 200GHz)
- Further improvements to the interface to HT-FRTC (optional trace gases, cloud simulations, aerosol simulations, solar radiation, non-LTE)

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# NWP SAF Radiance Simulator

RadSim is essentially a wrapper for RTTOV.

Generates simulated observations. Currently supports atmospheric profile data from:

- *Met Office UM PP files*
- *ECMWF GRIB files*
- *NWP SAF profile datasets*  
(available on the NWP SAF website)

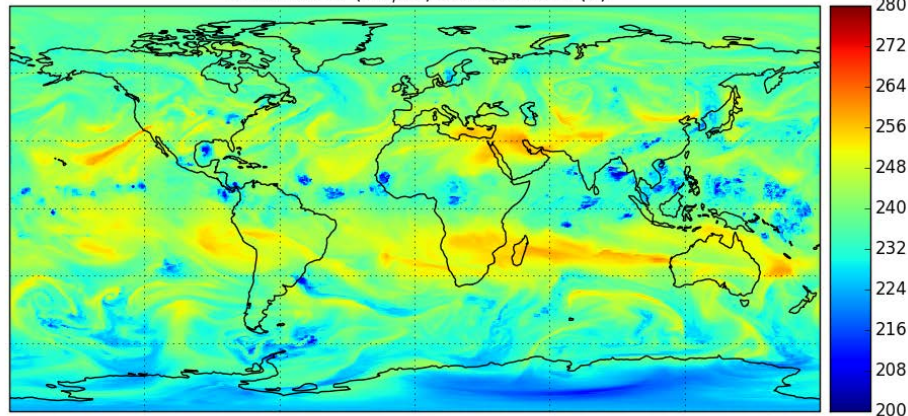
Supports IR and MW clear-sky and cloudy simulations and use of emissivity atlases.

Simulations run on given NWP model grid or for a user-specified list of latitudes/longitudes.

Next minor release due Q2 2018:

- Updated for RTTOV v12.2
- Variable ozone enabled for all data sources
- Enable use of RTTOV parallel interfaces
- More RTTOV options available

SEVIRI Ch05 (6.2 $\mu$ m) simulated BT (K)



# RTTOV technical sub-group 17:30 Thursday

Talk about some of the recent and planned developments in greater detail.

Come and ask questions about RTTOV (and the Radiance Simulator).

Feedback welcome including requests for new/updated capabilities.

## Thanks for your attention