ITSC-18 Radiative Transfer and Surface Properties Working Group

Name	Email
Paul van Delst	paul.vandelst@noaa.gov
Marco Matricardi	Marco.matricardi@ecmwf.int
Robert Knuteson	Robert.knuteson@ssec.wisc.edu
Eva Borbas	Eva.borbas@ssec.wisc.edu
Pascal Brunel	Pascal.brunel@meteo.fr
Jerome Vidot	Jerome.videot@meteo.fr
Benjamin Ruston	Ben.ruston@nrlmry.navy.mil
Gerrit Holl	Gerrit.holl@ltu.se
Stuart Newman	Stu.newman@metoffice.gov.uk
Peter K.H. Wang	Kunghwa.wang@noaa.gov
Enza Di Tomaso	Enza.ditomaso@ecmwf.int
Xavier Calbet	Xavier.calbet@eumetsat.int
Nicole Jacquinet-Husson	jacquinet@lmd.polytechnique.fr
Tom Kleespies	tkleespies@hotmail.com
Carmine Serio	Carmine.serio@unibas.it
Jose A. Aravequia	Jose.aravequia@cptec.inpe.br
James Hocking	James.hocking@metoffice.gov.uk
Olaf Stiller	Olaf.stiller@dwd.de
Virginie Capelle	Virginie.capelle@lmd.polytechnique.fr
Raymond Armante	Raymond.armante@lmd.polytechnique.fr
Guido Masiello	Guido.masiello@unibas.it

Table 1: ITSC-18 RTSP working group attendees

Clouds and aerosols

Profile and observation data

Collect existing profile and observation (in-situ and radiance) datasets for use in comparisons, and in validating the cloudy/scattering RT models. Current list:

- DARDAR (CALIOP, CALYPSO). Only for ice. (Jerome Vidot)
- C3VP (Paul van Delst)
- Ongoing work at UKMO for validation (Stuart Newman).
- Rydberg, Frank Evans. (Gerrit Holl)
- MACC for aerosols (Marco Matricardi)

Action RTSP-1: on indicated members to provide either the dataset or information about it (URLs, etc) to be hosted, or linked to, on the RTSP-WG website. **COMPLETED**

Optical properties datasets (IR and MW, spherical and non).

Collect existing cloud and aerosol optical properties datasets used by RT models for use in comparisons, and in validating the cloudy/scattering RT models. Current list:

- Baran (meas. + calcs) dataset (Jerome Vidot)

- Gang Hong (MW only calcs, includes polarisation) (Gerrit Holl)
- OPAC (meas. + calc) dataset. GADS as well. (Nicole Husson/Virginie Capelle)
- RTTOV calculated dataset (Marco Matricardi)
- CRTM calculated dataset (Paul van Delst)

Action RTSP-2: On indicated members to provide either the dataset or information about it (URLs, etc) to be hosted, or linked to, on the RTSP-WG website. **COMPLETED**

Reference RT model for scattering

List available models for generating cloud- and/or aerosol- affected radiances for use as a reference. For example,

- LBLRTM+optical properties+DISORT
- 4A+DISORT
- VLIDORT (similar to DISORT but with Jacobians)
- VDISORT

Action RTSP-3: Co-Chairs to compile list of available models and publish on RTSP-WG website (with associated links as appropriate.) **COMPLETED**

Cloudy radiance model intercomprison and validation

Intercomparison and validation of cloudy radiative transfer models is difficult to outline without first defining the input data sets, the particle optical properties, and a reference calculation.

Recommendation 1: Based upon the actions RTSP-1, RTSP-2, and RTSP-3, contemplate the possibility of Garand-type study for cloudy radiance model intercomparison/validation.

Fast model new features

Non-LTE

Several items regarding the implementation of non-LTE in fast models were discussed, specifically:

- What channels are affected (daytime/nightime)?
- Where to get the vibration temperature profiles? (Manuel Lopez-Puertas, IAA)
- Are all the isotopologues of affected molecules in the spectroscopic database?
- What are the accuracies of the current fast model parameterisations?

The following actions were introduced to facilitate the implementation of non-LTE effects in fast models:

Action RTSP-4: Marco Matricardi to provide line-by-line dataset of LTE vs non-LTE computations. Data, or links to data, to be placed on the RTSP-WG website. **COMPLETED**

Action RTSP-5: Marco Matricardi to contact Manuel Lopez-Puertas to investigate the wider distribution of vibrational temperature profile data. **COMPLETED**

Recommendation 2: Introduce non-LTE effects in fast models.

Unapodised radiance models for FTS sensors.

Radiative transfer models to compute unapodised radiances are not currently used operationally, but their development anticipates a future need. For example, the baseline for MTG-IRS is for unapodised radiances.

The currently available candidates to generate unapodised radiances are

- OSS (Jean-Luc Moncet)
- PCRTM (Xu Liu)
- RTTOV/PC_RTTOV (James Hocking)

Alternative methodologies were also discussed, e.g. deapodisation – all channels only.

Action RTSP-6: Jean-Luc Moncet, Xu Liu, and James Hocking to provide feedback and current+planned capabilities of their respective fast models regarding unapodised radiances. **COMPLETED**

Recommendation 3: Encourage development of fast unapodised RT models.

Instruments

Sensors

Sensors for which instrument characteristics are required are shown in Table 2.

New Sensors		Old Sensors[1]	
Meteor-M	FY-3B	SSU	SCAMS (Nimbus-6)
EPS-NG	IASI-NG	PMR (Nimbus-6)	SSMR (Seasat)
MTG-IRS	GIFTS/STORM	HIRS (Nimbus-6)	SSM/T (DMSP)
Iridium		VTPR (NOAA 2-5)	SSM/T-2 (DMSP)

Table 2: List of sensors for which instrument characteristics are required.

Action RTSP-7: ITSC members to contact RTSP-WG co-chairs regarding information on available sensor data. **OPEN**

Action RTSP-8: Paul van Delst to create a sensor acronym glossary on RTSP-WG web site. **OPEN**

Recommendation 4: Pascal Brunel and Paul van Delst to specify a common convention for instrument characteristics data files to contain:

- Spectral response function data.
- Antenna pattern data.
- FTS instrument line shape.

Recommendation 5: Create a repository of sensor characteristics data for RT modeling community accessible via the RTSP-WP page.

Sensor characteristics

Generation of fast model coefficients for sensors requires timely delivery of sensor characteristics data to RT model developers. Satellite radiance data cannot be

[1] From Saunders, R. "RTTOV coefficients for old satellite sensors", MetOffice/ERA-CLIM report.

effectively used in either NWP or retrieval schemes if the RT model does not accurately reflect the sensor response.

The data typically required are:

- Spectral Response Functions (SRFs)
- Channel polarisations,
- Antenna temperature corrections
- FTS line shape or analytical model. Information on spectral sampling, and how to best handle the band edges should also be supplied.

Recommendation 6: Sensor vendors supply digitised channel system responses for BOTH microwave, infrared, and visible instruments.

Recommendation 7: Delivery of instrument characteristics as early as possible (even if not the final version – or especially so) to allow analysis of data in an RT modeling context.

Action RTSP-9: ITWG co-Chairs to identify contacts for various programs (MetOp, JPSS, etc.; similar for Chinese, Japanese, Indian, Russian, Korean, etc. programs) and inform RTSP-WG co-Chairs. **COMPLETED**

Peng Zhang

Kozo Okamoto

Ashim Mitra

Alexander Uspensky ?

Hong Sung Wook

Mitch Goldberg

Dieter Klaes

Surface Properties

Action RTSP-10: Ben Ruston to provide report from Surface Properties Technical Sub-Group. **COMPLETED.**

BRDF implementations for fast RT models are required for all land surface types. E.g. Jerome Vidot's BRDF model is for land, but need similar for snow and ice (water can use analytical model).

Recommendation 8: Develop BRDF models for snow and ice

Additionally, an interface can be provided for users to input their own model data into the fast RT models.

Surface property physical reference models should be identified for use in validating fast RT surface property modelling. The reference models should have the following characteristics:

- Be themselves validated.
- Include angular dependence.
- Be valid on both micro- and macroscopic scales.
- Be usable with dedicated surface property missions (e.g. SMOS, SMAP)

Some initial reference model candidates mentioned were

- MW: CMEM, QC/DMRT
- IR: Snyder's model.
- NWP-SAF RTTOV Emissivity data[2].

Action RTSP-11: RTSP-WG co-Chairs to list reference model candidates on RTSP-WG website. COMPLETED

To ease the implementation of emissivity atlases and databases in fast RT models, a convention for datafile formats should be investigated. The questions to be answered regarding content are:

- What quantities, units, spectral sampling, spectral resolution, spatial resolution, and temporal resolution are required?
- What ancillary information is required? E.g. surface type, quality control, error characteristics, etc.
- What naming conventions should be used?

Action RTSP-12: Eva Borbas, Fatima Karbou, Catherine Prigent, and Filipe Aires to provide information and guidance for determining a file convention. OPEN

Spectroscopy and forward models

Continuum updates from CAVIAR.

- MT-CKD-type of format for continuum coefficients allows for easy insertion into LBLRTM – which is the forward model employed by RTTOV and CRTM to generate the transmittance data used to train the regression models.
- There is a dependence of continua parameterisation on line spectroscopy so the MT-CKD-type of continua updates are not necessarily transferable to other LBL models.

Action RTSP-13: Stuart Newman to provide the CAVIAR MT-CKD-form of the updated IR water vapour continuum and associated documentation for use in generating transmittance training sets for RTTOV and CRTM. COMPLETED

Action RTSP-14: Carmine Serio to provide measured continua coefficients for the far-IR and associated documentation (see Serio, C. et al 2012, JQSRT). OPEN

Action RTSP-15: Nicole Jacquinet to provide documentation on the relationship between spectroscopic databases and other quantities such as line coupling coefficients and continua. OPEN

Spectroscopy is updated continously, in *both* the microwave and infrared.

Recommendation 9: Fast RT developers update their training datasets and coefficients when new spectroscopy becomes available.

Recommendation 10: Encourage validation and intercomparison of LBL models/spectroscopy to assess the impact of spectroscopic uncertainties and the differences between line-by-line models. The members of the RTSP working group recognise this is a project that will require a large effort.

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[2] http://research.metoffice.gov.uk/research/interproj/nwpsaf/rtm/emissivity

Recommendation 11: Support for line-by-line (LBL) reference model development is of paramount importance and should be continued to ensure that operational centres have access to the latest updates in LBL forward modelling.