

2. WORKING GROUP REPORTS

2.1 RADIATIVE TRANSFER AND SURFACE PROPERTY MODELLING

Web site: <https://groups.ssec.wisc.edu/groups/itwg/rtsp>

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2.1.1 Scattering RT Intercomparison

With the increasing use of cloudy radiances in NWP and other applications, an intercomparison and validation of scattering RT fast models was proposed. There was discussion over what form this comparison would take (e.g., validating satellite imagery, using flight campaigns, using case studies, Jacobian comparisons, etc.) and what datasets would actually be needed and useful (e.g., profile datasets, optical properties, ground-based measurements, etc.).

It was decided a list of needs would be drawn up and disseminated to the group to allow for a more comprehensive survey of requirements.

Action RTSP-1

Paul van Delst (IMSG@NCEP/EMC), Marco Matricardi (ECMWF), Jerome Vidot (MeteoFrance), and Pascal Brunel (MeteoFrance) to coordinate this task with the RTSP-WG to determine data requirements and define any standard approaches or data formats.

Some specific announcements and requests for data came up in the meeting as part of this effort:

Colocated Datasets

Action RTSP-2

Sergio Machado (UMBC) to provide a dataset of ~7000 AIRS spectra matched to ECMWF profiles that contain information on cloud liquid water and ice amount.

Aerosol Optical Properties

Requests were made regarding the public availability of aerosol optical property data, as well as a recognition that current laboratory data for aerosol refractive indices should be reviewed for use in any intercomparisons.

Action RTSP-3

RTSP WG co-chairs to contact Dave Turner (NOAA/NSSL) regarding aerosol refractive index data.

Action RTSP-4

Marco Matricardi to provide links to aerosol refractive index and optical property datasets, as well as electromagnetic theory code to compute aerosol optical properties.

Recommendation RTSP-1

The RTSP working group recommends that aerosol optical property data be made publicly available, including documentation of the particle size distributions.

Recommendation RTSP-2

The RTSP working group recommends encouraging research into laboratory measurements of aerosol refractive indices.

2.1.2 Line-by-line Modeling

Recommendation RTSP-3

The RTSP working group recommends the continued support of LBL model development and validation, both the forward model science/software and the measurements/calculations to improve the spectroscopy in all spectral regions covered by fast RTMs.

Characterising RTM Error Covariance

The group discussed the possible use of ensemble techniques for characterizing RTM error covariances, in particular for line-by-line (LBL) models. The group expressed the view that it is not an intractable problem but is still a very difficult one. It was felt the group should pursue the more classical approach of using colocated datasets for validation at this point.

Absorption Line Profile Characterisation

It was noted that there is recent research about a reformulation of the absorption line shape profile – other than a Voigt line shape – used in LBL models. The rationale being that the simplified assumptions on which the Voigt profile is based (e.g., the collisional parameters are independent from the velocity of the absorber) can negatively affect the accuracy of the simulated spectra. The use of a new line shape would have an impact on not just the current LBL model implementations but also on the spectroscopic databases. There are many suggested models for the new line profile. Recently, the IUPAC task group recommended the adoption of the Hartmann-Tran profile.

Implementation of a new line shape formulation is already being tested in 4A/STRANSAC at LMD. There are currently no plans to include this reformulation in the Community Line-by-Line (CLBL) model at NOAA/JCSDA.

Recommendation RTSP-4

Include the potential reformulation of the absorption line shape profile into other LBL model development plans (CLBL mentioned specifically, but applies to any LBL model).

2.1.3 Datasets for Validation

Use of GRUAN datasets for validating LBL RT models was discussed. Several datasets of colocated ground-based and IASI measurements are available.

This topic was raised with respect to LBL model validation, but these data would also be useful for cloudy RT model comparisons, but would require specification of the cloud state variables.

Action RTSP-5

Marco Matricardi (ECMWF) to provide information on how to obtain the GRUAN datasets available on the RTSP-WG website.

2.1.4 183GHz Workshop

The 183GHz Workshop was held 29-30 June 2015 in Paris to discuss biases observed between measurements at 183 GHz and calculations carried out using different radiative transfer models. The RTSP working group acknowledged that fact that there is still uncertainty regarding the full origin of the biases although it recognized that deficiencies in water vapour spectroscopy (line parameters and continuum) are probably making a significant contribution to the biases. Pascal Brunel mentioned tests he is performing to look at the impact of using Planck weighted transmittances to improve RT model results. It was also noted that the measured spectral response of microwave instruments are not generally available.

Recommendation RTSP-5

The RTSP working group recommends that radiative transfer modelers continue investigating the biases observed in the 183GHz channels using state of the art spectroscopic data. The RTSP working group also encourages accurate laboratory measurements of the spectroscopic line parameters and the use of alternative models for the water vapour continuum.

Action RTSP-6

Marco Matricardi to make the workshop final report available on the RTSP-WG website.

Action RTSP-7

Paul van Delst to make the measured spectral response functions for ATMS and GMI available via the RTSP-WG website.

2.1.5 Impact of HDO Absorption

The treatment of HDO, an isotopologue of water, in line-by-line modeling generally assumes a constant mixture with H₂O in the vertical. However, it is well known that the vertical distribution of HDO compared with H₂O can vary significantly both spatially and temporally. Assuming a constant mixture in LBL calculations introduces an error in the radiance spectra that could be as high as 1.5K. When the HDO/H₂O vertical profile mixture differences are accounted for, those errors can decrease to 0.3K.

To mitigate this effect in hyperspectral infrared radiances at the affected frequencies, HDO should be specified as a separate molecule in LBL calculations, to allow for a separate concentration profile to be specified. This is already implemented in 4A/STRANSAC.

Recommendation RTSP-6

The RTSP working group recommends having HDO be specified as a separate molecule in both the LBL models and the spectroscopic data to provide the flexibility to treat it separately in LBL calculations.

2.1.6 Surface Properties

The first item discussed by the group regarded reference data sets for validation. Thomas August (EUMETSAT) brought to the working group's attention a research team – Dr. Folke Olesen's group at Karlsruhe Institute of Technology (KIT) – preparing to take FTIR measurements of surface emissivity. Given the benefit of these measurements for RT validation, a recommendation from the RTSP-WG was requested.

Recommendation RTSP-7

The RTSP working group recommends that funding be made available to research groups making measurements of land surface emissivity in the infrared.

A call for similar surface emissivity and reflectivity measurements in the microwave was also made. In addition, to maximize the utility of these measurements, it was recommended that sufficient in situ data for physical model validation (surface and soil temperature, surface and soil moisture, etc) be taken alongside any spectral measurements.

Recommendation RTSP-8

The RTSP working group encourages the measurement of land surface emissivity and reflectivity in the microwave spectral regions of interest to the ITWG members.

Physical Models

A recommendation was requested to encourage modeling of bidirectional reflectances for use in fast models. While the discussion focused on the microwave, similar efforts were encouraged for infrared and visible sensors.

Recommendation RTSP-9

The RTSP working group recommends development of BRDF models for use in fast RT models.

Surface Emissivity Datasets

Eva Borbas (CIMSS/SSEC/University of Wisconsin-Madison) put out a call for beta-testers of the new emissivity dataset (reported here at ITSC-20). Contact information: eva.borbas@ssec.wisc.edu.

Additionally, Eva Borbas asked the RTSP group, and the ITWG in general, for feedback on the emissivity covariance dataset. In particular, she is seeking information on the utility of these data and their actual use.

Recommendation RTSP-10

The RTSP working group recommends that users of any of the UW IREMIS datasets provide feedback to Eva Borbas to allow for reporting at the next ITSC.

Ben Ruston (NRL Monterey) brought to the RTSP group's attention that he, Eva Borbas, and Glynn Hulley (NASA/JPL) are working on a better definition of snow emissivity spectra in the infrared.

Action RTSP-8

Ben Ruston to notify the RTSP-WG co-chairs when the improved snow emissivity dataset becomes available.

Louis Garand (Environment Canada) inquired about the availability of broadband emissivities for use with radiation models in the current databases.

Recommendation RTSP-11

The RTSP working group recommends the addition of broadband emissivities to the available databases where appropriate or possible.

2.1.7 Ongoing RT Intercomparisons

EUMETSAT Retrieval Algorithm Comparison

It was noted that EUMETSAT is embarking on an intercomparison of retrieval algorithms and that the first step will involve an intercomparison of the RTMs used in the retrievals.

Recommendation RTSP-12

The RTSP working group recommends the results of the RTM intercomparison, including Jacobian comparisons, be reported to the ITWG, via the RTSP-WG, when they are available.

CRTM/RTTOV Intercomparison

Emily Liu (SRG@NCEP/EMC) has been running both CRTM and RTTOV in the NCEP data assimilation system in preparation for the assimilation of all-sky microwave radiances. The RTSP-WG has found the initial comparison of CRTM and RTTOV Jacobians for cloudy atmospheres has highlighted some interesting differences between the two models.

Recommendation RTSP-13

The RTSP working group recommends that the CRTM/RTTOV intercomparison continues, including Jacobians. Particular emphasis should be put on understanding the origin of the differences.

2.1.8 Spectral Response Function (SRF) Database Repository

There was insufficient time to discuss this topic with the group but the co-chairs would like to get the need for the following actions in the record:

- Providing SRF definition software and I/O (netCDF4) modules,
- Including FTS responsivities in the SRF databases, and
- Establishing a central repository for SRF data. This should be coordinated with similar efforts being undertaken by both GSICS and GEWEX.

Recommendation RTSP-14

The RTSP working group recommends that agencies and/or manufacturers provide future microwave instrument channel characterization data. The GMI Spectral Requirements Verification Report¹ can be used as a model.

¹ GMI Spectral Requirements Verification, Systems Engineering Report, Doc. No.2346140 Rev.A, Ball Aerospace & Technologies Corp., Oct. 30, 2010.

Recommendation RTSP-15

The RTSP working group recommends that agencies provide responsibilities for Fourier Transform Spectrometers (FTS) that can be used in modeling those instruments in current RT models.

2.1.9 Other Issues

Action RTSP-9

RTSP WG co-chairs to contact AER Inc. and find out what portions of the OSS software package are public.

A continuation from the ITSC-19 RTSP-WG report, the group recognized that the use of the scalar form of the radiative transfer equation is not adequate for specific microwave simulations (reported on at ITSC-20). Depending on the application, the full or a reduced number of Stokes vectors is required.

Recommendation RTSP-16

The RTSP-WG encourages RT model developers to generalize the form of the RT equation introducing a vector formalism.

2.1.10 Carryover from ITSC-19

Action RTSP-10

Paul van Delst to followup on ITSC-19 RTSP-WG action items 1, 4, 12-14, 16-19, and 21.

Action RTSP-11

Stu Newman (MetOffice) to follow up on ITSC-19 RTSP-WG action items 3 and 7.