

## 2.1 RADIATIVE TRANSFER AND SURFACE PROPERTY MODELLING

Web site: <http://cimss.ssec.wisc.edu/itwg/groups/rtwg/rtwg.html>

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### 2.1.1 Introduction

Four areas were discussed in the RTSP-WG meeting at ITSC-17: issues relating to land surface emissivity modeling, line-by-line modeling, cloudy and aerosol-affected radiative transfer, and instrument characterization.

The new action items listed below are to be completed by May 2011.

Louis Garand is leaving as co-Chair of the RTSP-WG. Marco Matricardi was nominated and agreed to become an RTSP-WG co-Chair.

### 2.1.2 Land Surface Emissivity Modeling

The availability of many surface emissivity models was pointed out. It was suggested a catalogue of the available of the various emissivity models and/or data be created and made available to the community; not just the ITWG. Ralph Ferraro requested (prior to the WG meeting) that the IPWG be notified of what land surface emissivity models were available for use in RT modeling.

Ben Ruston has previously catalogued land surface emissivity model via the NWP-SAF.

#### Action RTSP-1

**Ben Ruston to update NWP-SAF page with the latest information of available land surface emissivity models and data for use in RT modeling.**

#### Action RTSP-2

**Following on from Action RTSP-1, Paul van Delst to notify IPWG members of the availability of the land surface emissivity model catalogue.**

It was also noted that RT/surface emissivity modelers need to assess the current assumptions about the surface reflectivity being specular or Lambertian. At microwave frequencies, Fatima Karbou and Stephanie Guedj have compared different assumptions about the surface reflectivity ranging from specular to Lambertian, with intermediate quasi-Lambertian assumption also, and have seen a large effect over desert and snow areas where scattering effects dominate. These differences are noticed near nadir, as expected. These data are available upon request from Fatima Karbou.

The assessment of the accuracy of land surface temperature retrievals and their comparison with analyses for certain surface types was discussed. The target areas of interest include such surface types as desert, forest, sea ice, etc. Roger Saunders pointed out that the surface types on which effort should be concentrated to increase satellite radiance data assimilation over land should be explicitly identified. Louis Garand suggested starting with geostationary

retrievals to get a time series, but direct comparisons of low earth orbit retrievals should also be done.

### **Action RTSP-3**

**Yong Han to coordinate with Weizhong Chen (NOAA LDAS contact) to start organizing this work.**

### **2.1.3 Line-by-line (LBL) modeling**

Currently, the fast RT models (RTTOV and CRTM) are all based on LBLRTM.

### **Recommendation RTSP-1 to NWP-SAF and JCSDA**

**Ensure the future development of LBLRTM is secure.**

As with the land surface emissivity models, the LBL models being actively developed and in use should be catalogued, as well as which group(s) are using what models.

With emphasis of the infrared region (where we have hyperspectral instruments in orbit), to assess the quality of LBL models we generally look at

- Accuracy of spectroscopy
- Assessment of spectroscopy differences

### **Recommendation RTSP-2 to LBL modelers and users**

**Exploit all possible methodologies to validate LBL models and spectroscopy. For example: validation of LBL calculations against observations using high quality in situ data; validate using retrieved profiles to compare instrument residuals to instrument noise.**

Regarding the use of field campaign data, the links to previous and current field experiment websites need to be updated or verified on the RTSP-WG website. Additionally,

- Catalogue available in situ data for validation (sondes, dropsondes, rain estimates, etc)
- Determine target periods where there is good independent data available,
- Which channels should be targeted for validation?

### **Action RTSP-4**

**RTSP-WG co-chairs to coordinate catalogue of datasets for validation:**

- **Target periods**
- **Field experiments with in situ data coincident with instrument overpasses.**

**Emphasis is placed on those datasets with high water vapour loading, and field campaign organizers are encouraged to pursue those conditions.**

**This action is in concert with recommendations made at the 2<sup>nd</sup> International IASI Conference.**

### **Action RTSP-5**

**Stuart Newman to notify RTSP-WG when water vapour continuum model updates due to CAVIAR work become available.**

Line mixing for trace gas molecules, such as CH<sub>4</sub>, should be included in LBL models as soon as possible.

#### **Action RTSP-6**

**Nicole Jacquinet to report to RTSP-WG on the upcoming HITRAN conference (June 2010) in particular on spectroscopy data and modeling updates applicable to the RTSP-WG.**

#### **2.1.4 Cloudy and aerosol-affected radiances.**

Regarding cloudy and aerosol-affected radiance assimilation, questions regarding requirements for RT models were raised:

- 1) What accuracy is required?
- 2) What are the computational speed requirements?
- 3) How to handle cloud overlap?
- 4) How to handle footprint non-uniformity?

The first two requirements above are difficult to answer – their inclusion in this report is to start people thinking about them. Regarding the last two questions, Marco Matricardi has addressed these issues in RTTOV-9 (ECMWF Tech. Memo 474, 2005).

#### **Recommendation RTSP-3 to NWP centres**

**Begin routine monitoring of cloudy and aerosol-affected radiances. This is a first step towards assimilation of the radiances anyway, and it will provide guidance to the RT modelers.**

It was noted that the required RT model inputs for clouds (e.g. particle effective radius) are not necessarily provided by the forecast models which typically supply quantities such as cloud water, or ice, content. Documentation of techniques, and software, to perform conversions between the supplied and required variables for RT models is needed.

#### **Action RTSP-7**

**RTSP-WG co-chairs to report on what cloud model outputs are available from various centres.**

#### **Action RTSP-8**

**RTSP-WG co-chairs to publish on the RTSP-WG website methods (and software if available) to convert forecast model outputs of cloud data to those quantities required by RT models.**

#### **2.1.5 Instrument Characterization**

There is quite good sharing of spectral response function (SRF) information between the various RT modeling groups involved in the ITWG. However, it would be preferable if the various instrument parameters required by RT modelers be made available as soon as possible (even if they are not finalized) by the instrument vendors and mission scientists and managers. The quicker RT modelers get this information, the earlier they can begin modeling the instrument and thus minimize any delay in monitoring and assimilating the radiance data after launch.

### **Action RTSP-9**

**Paul van Delst to notify the RTSP-WG when NPP VIIRS SRF data become publicly available (including non-US-based researchers). The NOAA IPO has already been contacted with the request.**

### **Recommendation RTSP-4 to ITWG co-Chairs**

**Contact the various space and research agencies to ask them to make instrument parameters required for fast RT modeling be made available to the RTSP-WG as soon as possible so as to allow dissemination to the interested parties.**

Paul van Delst brought up the relative differences seen in simulated brightness temperatures for NPP ATMS between using a boxcar response and high-frequency spectral responses digitized after measurement from scanned paper documents. It would be preferable for the high resolution measurements of microwave channel spectral response be retained in digital form and passed along to RT modelers.

### **Recommendation RTSP-5 to ITWG co-Chairs**

**Contact the various space and research agencies to ask them to retain the high spectral resolution scans of microwave instrument channel responses in digital form and make those data available to the RTSP-WG as soon as possible so as to allow dissemination to the interested parties.**

The topic of SRF data coordination was raised. Given that SRF data can be modified post-launch to address any issues or problems, it is difficult to determine whether the SRF data used in fast RT models is the current and/or best data available. Action RTSP-12 mentioned below addresses this in finalizing the action from ITSC-16.

### **2.1.6 Miscellaneous**

The RTSP-WG website hosted at SSEC is not easily accessible for modification by the RTSP-WG co-Chairs (or other group members). SSEC already offers an easier alternative to allow more interactive updates of the RTSP-WG page by the working group's members.

### **Action RTSP-10**

**Paul van Delst to contact SSEC webmasters responsible for the RTSP-WG webpage and coordinate transitioning the current RTSP-WG webpage to the Plone groups site at SSEC. The RTSP-WG will be notified when this is completed.**

Tom Kleespies indicated he would update his tangent-linear (TL) and adjoint (AD) coding class notes and examples on the RTSP-WG website.

### **Action RTSP-11**

**Tom Kleespies to update his TL and AD coding notes and examples on the RTSP-WG website.**

Regarding the outstanding action items for the RTSP-WG from ITSC-16, Paul van Delst will work towards resolving (i.e. completing or deleting with explanation) any incomplete items.

**Action RTSP-12**

**Paul van Delst to resolve any outstanding RTSP-WG action items from ITSC-16 by August 2010.**