CRTM Working Group Report

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Outline

- Last formal meeting of CWG held on Feb. 5, 2009 (yes, 2009)
  - Focus in 2009 was on CRTM 2.0 release.
- CRTM 2.0 release
  - Where to get it.
  - Feature list.
- Next releases
  - CRTM 2.0.1
  - CRTM 2.1
  - Updated transmittance coefficients
- Collaborations
- Recommendations from ITSC-17 RTSP Working Group
- CRTM version control and Software Configuration Management

CRTM 2.0 Released (1)

- Version 2.0 of the CRTM released March 12, 2010. Available at

  ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/REL-2.0

- The 2.0 User Guide is also available there

  ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/CRTM_User_Guide.pdf

- Email address for CRTM Support:

  NCEP.List.EMC.JCSDA_CRTM.Support@noaa.gov

- Many people at the JCSDA (and EMC and STAR) have been involved in the update, but special mention must be made of
  - Yong Han (NESDIS/STAR)
  - Quanhua Liu (NESDIS/STAR/Dell Perot)
  - Yong Chen (NESDIS/STAR/CIRA)

  for their efforts in developing, implementing, and testing many of the new science features.

CRTM 2.0 Released (2)

Brief listing of CRTM 2.0 updates:

- New Science
  - Multiple transmittance models, including SSU-specific model.
  - Zeeman-splitting transmittance for SSMIS upper-level channels
  - Visible sensor capability
  - Matrix operator method (MOM) in radiative transfer
  - Additional IR sea surface emissivities developed by Nick Nalli (see poster)
  - Surface BRDF for solar affected shortwave IR channels
  - IR reflectivity over water changed from Lambertian to specular
- Interface changes
  - Initialisation function
  - User accessible structure definitions use Fortran2003 features to mitigate memory leakage problems. To delineate this change from previous versions of the CRTM the various structure procedures have been renamed.
  - **`Options`** structure specific changes to accommodate input for new features (e.g. SSU, Zeeman, etc)

CRTM 2.0.1 (!)

- To address various issues with the 2.0 release, we're targeting mid-May (was end of April) for a minor update, REL-2.0.1
- ***No changes will be made that alter results***. Only minor fixes made (e.g. makefiles, error messages, example code, address compiler bugs, etc).

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Milestone: REL-2.0.1 (9 matches)

Ticket	Summary	Status	Owner	Priority	Component	Resolution
#147	REL-2.0 Users reporting example code failures.	accepted	paul.vandelst@noaa.gov	critical	src	--
#111	Update CRTM makefiles to check for Fortran2003 compliance.	new		major	src	--
~~#112~~	Modification of `Type_Kinds.f90` to remove conditional LLong and Quad kind types.	closed	david.groff@noaa.gov	major	src	fixed
~~#114~~	Workaround in CRTM_Atmosphere_AddLayerCopy procedure to allow for PGI compilation	closed	paul.vandelst@noaa.gov	major	src	completed
~~#110~~	Test of SensorData % Tb	closed	paul.vandelst@noaa.gov	minor	src	fixed
~~#113~~	change n_Azi from MAX_N_AZI to a needed value	closed	paul.vandelst@noaa.gov	minor	src	completed
~~#141~~	Incorrect error message in CRTM_Atmosphere_IsValid() function.	closed		trivial	src	fixed
#143	Update use of the Quiet argument for message suppression in CRTM_LifeCycle.f90	accepted	paul.vandelst@noaa.gov	trivial	src	--
#144	Investigate potential allocation bug in CRTM_IRSSEM	accepted	david.groff@noaa.gov	unknown	src	--

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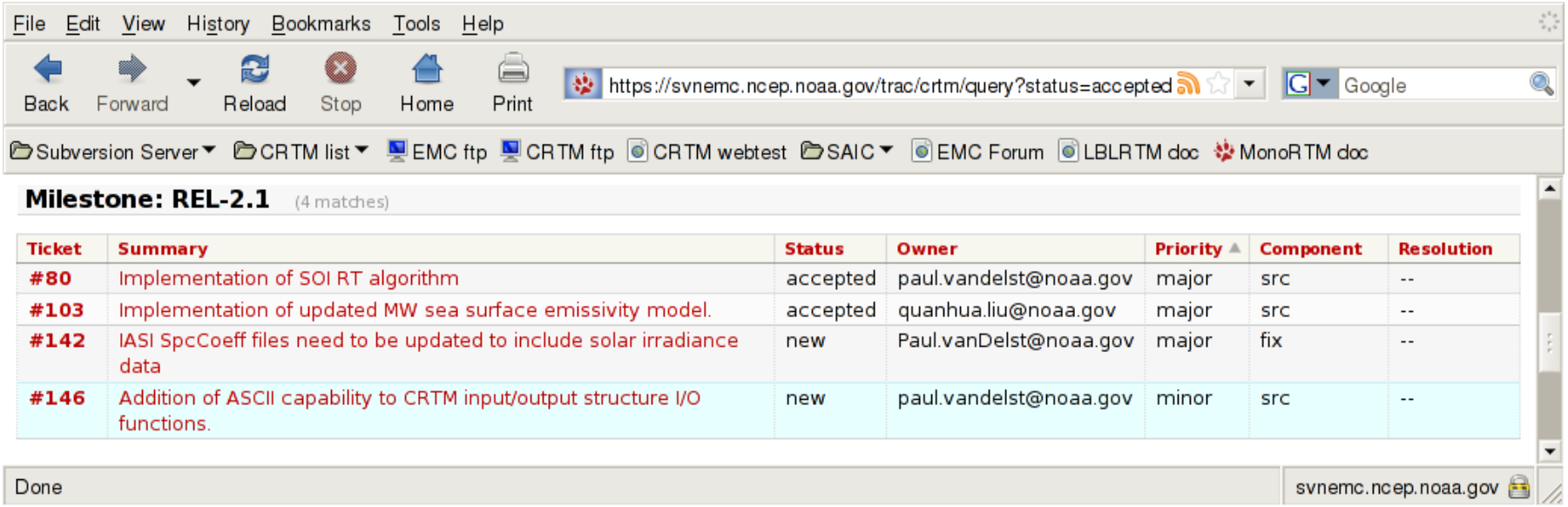
CRTM 2.1

- The next update to CRTM science is targeted for a July 2010 release.
- Currently planned major updates:
  - FASTEM-4 (Q. Liu at JCSDA)
  - SOI radiative transfer algorithm (T. Greenwald at CIMSS/SSEC/UWisc)
- Possible updates:
  - Implementation of new IR land surface emissivity models (currently being tested).
    - GrELS
    - UW HSR (see poster)



Ticket	Summary	Status	Owner	Priority	Component	Resolution
#80	Implementation of SOI RT algorithm	accepted	paul.vandelst@noaa.gov	major	src	--
#103	Implementation of updated MW sea surface emissivity model.	accepted	quanhua.liu@noaa.gov	major	src	--
#142	IASI SpcCoeff files need to be updated to include solar irradiance data	new	Paul.vanDelst@noaa.gov	major	fix	--
#146	Addition of ASCII capability to CRTM input/output structure I/O functions.	new	paul.vandelst@noaa.gov	minor	src	--

Updated transmittance coefficients

- Over the summer we will be upgrading our:
  1. Transmittance production (TauProd) software,
  2. Transmittance modeling/fitting (TauRegress) software, and, thus,
  3. Transmittance coefficient data files.

- TauProd update will take advantage of:
  - Spectroscopy updates to LBLRTM for the infrared (IR) region.
  - Switch to MonoRTM software for the microwave (MW) spectral region.

- TauRegress update should be minor; it is mostly to remove redundancies in the code (e.g. repeated modules) and more cleanly join the processing to the TauProd output (e.g. generating viewable fit statistics datafiles)

- End result of these software upgrades are updated coefficient files.
  - No CRTM application code changes should be required.
  - However, if they are, there will be no impact to the CRTM User Interface.

- Speaking of LBL code updates…

Collaborations (1)

- AER Inc. (Jean-Luc Moncet and Vivienne Payne)
  - They supply us with the line-by-line (LBL) software as well as spectroscopy updates.
  - Their improvements to both IR and MW spectroscopy over the past several years has been significant (see Eli Mlawer's talk for details)
  - They have also delivered initial LBLRTM updates to allow us to start working on including non-LTE effects in the CRTM.

- CIMSS/SSEC/UWisconsin-Madison (Tom Greenwald)
  - Implementing the Successive Order of Interaction (SOI) radiative transfer algorithm in CRTM.
  - Has led to a needed restructuring of our RT framework.

- Texas A&M University (Ping Yang's group)
  - Delivered cloud and aerosol optical properties used in the CRTM scattering RT.
  - Validating CRTM (see their poster)

Collaborations (2)

- CIMSS/SSEC@JCSDA (Jim Jung)
  - GDAS runs to test impact of IR sea surface emissivity model updates (see poster)
  - Same to test impact of transmittance model subtleties for weak water vapour absorption lines (see his talk).

- A plethora of people for the ATMS-NPP Spectral Response Function investigations (see poster).
  - Bill Blackwell (MIT/LL), Giovanni De Amici (Northrop Grumman), Lynn Chidester (Utah State University/SDL), Gene Poe (NRL), and Steve Swadley (NRL)

- Feedback from various users
  - Ben Ruston and Song Yang (NRL)
  - Alexander Ignatov's group (NESDIS/STAR)
  - Dan Birkenheuer's group (OAR/ESRL)
  - Louis Garand at Environment Canada
  - Several other users have provided comments and suggestions regarding general usability of both the code (including our example codes) and documentation.

ITSC-17 RTSP Working Group Recommendations (1)

- **Line-by-line Modeling.**

Currently, the fast RT models RTTOV and CRTM are based on LBLRTM

> Recommendation RTSP-1 to NWP-SAF and JCSDA:
> Ensure the future development of LBLRTM is secure.

With emphasis on 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.

ITSC-17 RTSP Working Group Recommendations (2)

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

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

- What accuracy is required?
- What are the computational speed requirements?
- How to handle cloud overlap?
- How to handle footprint non-uniformity?

The first two requirements above are difficult to answer – their inclusion in the RTSP 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.

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CRTM
Community Radiative Transfer Model

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CRTM Trac Wiki

Current Release

The current CRTM release is REL-2.0. The v2.0 release code and coefficient tarballs can be obtained from the CRTM ftp site.

Current Work

What we're currently working on:

REL-2.0.1
- Bugfixes for REL-2.0.
- Ticket status

REL-2.1
- Successive Order of Interation update. Implementation of the SOI RT solver.
- Microwave Water Surface Optics update. Implementation of FASTEM4 in the CRTM.
- Ticket status

Infrared Land Surface Optics update
A new framework for surface emissivity models, starting with the IR land models.

NLTE
Adding a non-LTE capability to the CRTM.

TauProd transmittance production
- Setting up to use MonoRTM to compute our microwave transmittance profiles.
- Updating our TauProd support software.

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