Community Radiative Transfer Model Working Group (CWG)
Meeting Summary

World Weather Building – Room 209
February 5, 2009

Attendees:

JCSDA Director
Lars Peter Riishojgaard

CWG Technical and Management Oversight:
Fuzhong Weng, NESDIS/STAR

CWG Co-chairs:
Yong Han, NESDIS/STAR
Paul van Delst, SAIC

CWG Core Members:
Ben Ruston, NRL
Zhiquan Liu, NCAR/AFWA

CWG Collaborating Members:
Ralf Bennartz, Univ. Wisconsin
Tom Greenwald, Univ. Wisconsin
Ping Yang, Texas A&M
Alan Lipton, AER
Vivienne Payne, AER
Jean-Luc Moncet, AER
Weizhong Zheng, NCEP/EMC
Quanhua (Mark) Liu, Perot Systems
Banghua Yan, Perot Systems
David Groff, SAIC
Yong Chen, CIRA
Tong Zhu, CIRA
Ron Vogel, IMSG

I. Review of Action Items from CWG Meeting #3, 2008-Jul-31 (Paul van Delst)

- Respond to AER on spectroscopy priorities (P. vanDelst and Y. Han).
  PVD: Will be discussed.
- Address land MW desert emissivity bias (B. Yan and W. Zheng); produce new empirical emissivity (B. Yan).

BY: New empirical dessert MW emissivity algorithm has been developed, and shows positive impact. Has been tested by W. Zheng (EMC). May be ready to be included in next CRTM release.
ZL: How do you decide if surface is desert?
BY: Check for bare soil condition & surface temperature.

- Investigate large CRTM Jacobians responsible for the large stratopause temperature increments at GMAO (Y. Chen and E. Liu).
  QL: Extra layering not included in version that E. Liu used?
  QL: Vertical layering of input profile can't be too thick.
  PVD: Include note on vertical layering in CRTM User Guide.
- Address large ocean surface MW emissivity error at high frequency and any other outstanding bias issues in GFS (Q. Liu and B. Yan).
  QL: This was worked on at UK Met Office using RTTOV. Algorithms are still under investigation. Bias could be result of emissivity model.
  FW: This was also an action from ITWG meeting.
- Complete generation of FengYun-3 CRTM transmittance coefficients. (F. Weng, Y. Han and P. van Delst).
  PVD: Completed, available on CRTM ftp site.
- Improve CRTM User Guide (P. vanDelst).
  PVD: Draft completed, available on CRTM ftp site.

II. CRTM Software Status (Paul van Delst)

- CRTM REL-1.2 made available on 2009-02-04. See slides for list of changes.
- New coefficients for IR cloud (from Texas A&M) and aerosol (from NASA) optical properties.
- New coefficients for sensors: CrIS, MT-2 imgr, NOAA-19, SSMIS F17-F20.

LPR: CrIS instrument line shape is spec or measured?
PVD: Currently, CRTM uses spec from CrIS ATBD, which was discussed with Karen St Germaine (IPO) and Gail Bingham (SDL/Utah State) in mid-2008.
FW: ATMS characterization has been updated.

III. Visible Radiative Transfer (Quanhua Liu)

- CRTM test version for visible channels is available (forward model). GOES-R group has tested molecular scattering and compared with 6S. CRTM is more accurate.
- Visible version includes: transmittance extended to visible (uses OPTRAN), cloud and aerosol optical properties extended to visible, Rayleigh scattering added, solar dependence on azimuth angle added to Advanced Doubling-Adding (ADA) RT solver.

IV. Multiple Transmittance Algorithm (Yong Han, Yong Chen, Tong Zhu)

- New transmittance model: Optical Depth in Pressure Space (ODPS)
    - Optical depth calculated at fixed pressure layers.
    - Training software completed. FWD, TL and AD models completed (testing continues). Variable absorber gases added: CO2, N2O, CO, CH4 (in addition to H2O and O3).
    - Still need to take Earth curvature into account in zenith angle profiles.
    - Still need to test and refine algorithm and implementation.
- Multiple transmittance algorithm framework in CRTM: Compact-OPTRAN, ODPS, SSMIS-Zeeman, or SARTA. Select algorithm dynamically using Algorithm ID in sensor-dependent TauCoeff files.

  FW: Which instruments are included in multiple-algorithm? Is there improvement over Compact-OPTRAN?
  YH: All instruments. Tests show improvement over Compact-OPTRAN.

V. Transmittance Production (David Groff, Paul van Delst)

- Verification of all IR sensor SRFs. Conversion to new format.
- Creation of MW SRFs from frequency-only definitions.
- Started use of MonoRTM for MW transmittances. Will be recomputing transmittance database for all instruments (LBLRTM for IR, MonoRTM for MW).

  PVD: How to get optical depth profiles from MonoRTM?
  VP: Optical depth profile is stored in code but next release could have optical depth profile as output.

VI. NRL Update (Ben Ruston)

- Will use NOAA-19 coefficients with CRTM REL-1.1
- Will test surface emissivity.
- Raised model top to .04 mb (65km). IASI and AIRS improved. Forecast impacts are positive.
- Will compare CRTM with RTTOV 9.3 (using higher model top).

  PVD: What have you found when assimilating water vapor channels?
  BR: Water vapor channels are turned off, but will try ozone channels soon.
  QL: How many layers are used in new assimilation?
  BR: 42 layers

VII. STAR Update (Fuzhong Weng)

- New developments in land emissivity models and datasets
    - Working on multi-layer snow emissivity model, multi-layer land emissivity model

- AIRS & IASI derived land emissivity (pentad, monthly) to be extended from 39 hinge points to hyperspectral
- 15-year time series of SSM/I derived land emissivity (from DMSP F10 through F15)

BR: When compositing ascending/descending passes, is there bias? When using ascending/descending as a predictor, we found a decrease in bias.
JLM: What surface temperature source is used in SSMIS database?
FW: Training dataset is used in regression to determine SSMIS emissivity.

VIII. NCAR/AFWA Update (Zhiquan Liu)

- Studied impact of SSMIS radiance assimilation in WRF-Var (Aug – Sep 2007).
  - Slightly less RMSE for T,Q,U,V profiles compared to ECMWF analysis when using SSMIS.
  - Similar for T,Q,U,V 500-hPa time series (Aug – Sep 2007): RMSE smaller when using SSMIS, compared to ECMWF.
- Include T. Auligne's CRTM modifications for cloudy radiance and gamma correction?
  PVD: T. Auligne's changes were made to an unversioned release. T. Auligne should make changes to an official CRTM version. Once the CRTM repository is available to outside users, users can check out any version.
- Keep CRTM historical releases on FTP site?
  PVD: This can be done.
- Ability to select specific channels for CRTM processing and in Emissivty_Switch in Options structure.
  YH/PVD: This can be done.

IX. Univ. Wisconsin Update (Ralf Bennartz, Tom Greenwald)

- Completely revamping SOI integration. Takes advantage of internal CRTM routines for standard tasks (reduces overhead). FWD model ready by Feb 2009. TL and AD models ready by May 2009 (for JCSDA Science Workshop).
- Speed and accuracy comparison against ADA should be coordinated with JCSDA staff.
- Some integration and interfacing issues need to be discussed in detail.

PVD: We should coordinate a visit and make it hands-on.
LPR: In terms of the JCSDA Science Workshop, it is tentatively scheduled (90% sure) for 12-13 May at UMBC (Baltimore).

X. AER Update (Vivienne Payne)

- Improvement in LBLRTM consistency between spectral regions brought about by incorporating techniques for CO2 line parameter and coupling (Niro application of

Tashkun line parameters), ARM measurements for CO2 continuum, and Coudert et al. technique for H2O continuum.

- MonoRTM improved using ARM ground-based radiometer measurements. New version available in March.
- Water vapor and CO2 regions will still be worked on.

YH: Comparison of MonoRTM with Rosenkrantz model? How different is MonoRTM?
VP: There are significant differences in some spectral regions. Rosenkrantz also has inconsistencies.
PVD: When will the new LBLRTM be available? We are interested in H2O improvements.
VP: Water vapor changes will be in LBLRTM v.11.5. CO2 changes will be available later.

XI. Texas A&M Update (Ping Yang)

- Three bulk scattering property datasets (dust aerosol, water cloud, ice cloud) developed for wavelengths 0.225 to 20 um.
- 16 and 32 terms of Legendre polynomials can be used to simulate BRDF for dust, water cloud and ice cloud (visible wavelength at 0.65 um).
- 4 terms of Legendre polynomials can be used to simulate brightness temperature at IR wavelengths using dust aerosol, water cloud and ice cloud scattering properties.

BY: What particle size distribution is used?
PY: For ice it is NCAR, for dust it is gamma.
QL: For new particle roughness, will we get an updated table?
PY: Yes, table will be in same format.
RB: CRTM depends on the number of Fourier terms and streams as well as Legendre terms? So include all 128 terms?
PY: All 128 terms have already been delivered to the JCSDA CRTM team.

XII. Open Discussion

- Spectroscopic priorities for AER

  PVD: Spectroscopy is still very important. Lots of good improvement in current work.
  YH: Plan to include non-LTE developments?
  JLM: AER contract will end soon. Shift priorities?
  PVD: Both spectroscopy and non-LTE effects are important. Spectroscopy is important for RT, and non-LTE affected channels can't be assimilated without modeling the non-LTE effects.
  FW: We should bring the AER contract continuation to the attention of JCSDA management.
  FW: Working on smaller bias for the 9.6um ozone region?

VP: Line parameters are available for ozone. This could be worked on.
YH: It is the input ozone profile that is problematic.
QL: Why always use the same 36 ARM profile dataset?
VP: It's a lot of work to put these best-estimate profiles together.

- Large upper level Jacobians at GMAO. Extra layering capability was used in GMAO's CRTM version?
  - No input from E. Liu yet.
- How to improve collaboration/communication among team?
  PVD: One person keep track of issues and touch base with each individual group.
  FW: This person could touch base every 2 weeks. Visits to JCSDA will help.
  PY: Group share JCSDA monthly highlight reports among team members.
  JLM: Monthly email from JCSDA on recent updates.
  PVD: Everyone subscribe to CRTM-Developers email list.
- Science: What do we want? What can we do?
  FW: IR emissivity needs to be worked on. Test newly available emissivity databases. Need interpolation methods to get information from databases.
  RV: We should discuss priorities in emissivity development.
  JLM: Need soil temperature profile to determine surface emissivity.
  PVD: Soil temperature profile can be added to Surface structure for CRTM input.
  ZL: Surface type is static. May need to be dynamic depending on surface conditions.
  FW/QL: We may need external emissivity model(s) to pass emissivity to CRTM.
  YH: Cloudy radiance issues need to be worked on.
  FW: Need to work on cloudy radiance speed/accuracy. Structure already available.
  ZL: Particle size range not large enough for precipitation radiance calculations.
  QL: Table can be updated for larger particle sizes.

Action Item Summary:

1) F. Weng provide IPO cal/val report that includes updated ATMS instrument characterization.
2) P. van Delst contact T. Auligne about adding cloudy radiance code to the appropriate CRTM version.
3) P. van Delst make CRTM historical releases available on CRTM FTP site.
4) P. van Delst add channel selection for CRTM processing and emissivity switch with regards to the Options structure.
5) P. van Delst organize visit with Univ. Wisconsin to discuss SOI integration issues.
6) F. Weng discuss precipitation particle sizes with Z. Liu.
7) Y. Han coordinate discussion for continuation of AER funding.