Community Radiative Transfer Model Working Group (CWG)
Meeting Summary

World Weather Building – Room 701
July 31, 2008

Attendees:

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
Emily Liu, NASA/GMAO
Dan Birkenheuer, OAR

CWG Collaborating Members:
Ping Yang, Texas A&M
Vivienne Payne, AER
Jean-Luc Moncet, AER
Weizhong Zheng, NCEP/EMC
Quanhua (Mark) Liu, Perot Systems
David Groff, SAIC
Yong Chen, CIRA
Banghua Yan, Perot Systems
Ron Vogel, IMSG

I. Review of Action Items from CWG Meeting 2008-Apr-28 (Paul van Delst)

- More information on the SSMIS SRFs have been obtained, and the version of the SRFs that are Fourier filtered will be used (DMSP 16, 17, 18)
- Paul van Delst is working on a new User Guide (web based).
- CRTM version plan:
  - v1.1: current version
  - v1.2 (mid August): MWSSE improvement (for AMSR-E), improved interpolation scheme for preserving derivatives (affects CRTM Adjoint)
  - 4th Quarter file update: new transmittance coefficients (new sensors; new spectroscopy: updated LBLRTM, using MonoRTM for MW)

    - v2.0 (2nd Quarter 2009): new transmittance algorithm framework, Zeeman algorithm for more sensors, ODCAPS transmittance algorithm (SARTA-like), ODPS transmittance algorithm (RTTOV-like), height-dependent zenith angle
- Discussion
  BY: new snow/sea-ice emissivity model for SSMIS will also be available before 2.0 release
  PVD: Other incremental releases are possible before the 2.0 release
  FW & PVD: Fengyun SRFs are available also. Transmittance coefficients for IR are done, MW still need to be calculated.
  QL & PVD: Transmittance calculations for high view angles (>70 deg) are not done because atmosphere is plane-parallel. Affects GOES users who want CRTM simulations at high view angles.

II. Updates to Spectroscopy for Radiative Transfer Models (Vivienne Payne)

- New MonoRTM release anticipated in September. The release will include an update of H2O continuum in MW and O2 absorption similar to Rosenkranz model.
- CO2 IR spectroscopy
    - Improvements in LBLRTM for CO2: v2 and v3 region improvements still needed (using new line strengths from Tashkun to improve)
- H2O IR spectroscopy
    - Improvements needed in 1200-2100 cm^{-1} and 2500-2600 cm^{-1} (using Coudert's line strengths to improve)
- Discussion of priorities
  EL & VP: Non-LTE effect will not have a big impact in 667 cm-1 band
  YH & VP: Non-LTE corrections will require vibrational temperatures.
  QL, VP, JLM: LBLRTM does not allow calculations for large spectral ranges (e.g. 2020 cm^{-1}). Better to do calculations over smaller ranges.
  PVD: CRTM group will think about priorities and respond to VP.

III. Updates on the Work at ESRL/GSD in Using the CRTM (Dan Birkenheuer)

- CRTM installed on 2 different platforms.
- CRTM tested with ECMWF profiles (91 levels) and truncated ECMWF profiles. Tests are successful.
- ECMWF data are now ingested at ESRL, and CRTM is working with WRF.

IV. Improvements of Land Skin Temperature in GFS and Simulation of Brightness Temperature with GSI/CRTM (Weizhong Zheng)

- GFS land skin temperature has large cold bias in daytime over dry land areas.
- This is improved with new aerodynamic conductance formulation (roughness length for heat now treated differently than roughness length for momentum) in Noah Land

Surface Model. Previously, roughness length for heat and momentum were treated the same.

- Tb simulation for HIRS and AMSU-A (CONUS region) in GSI/CRTM shows improved usage of land pixels in data assimilation
- For AMSU-A over North Africa (no vegetation), CRTM bare soil MW emissivity is preventing better Tb simulation. CRTM uses constant emissivity of 0.95 in this region.
- New LST improves CRTM Tb simulation for IR wavelengths.
- Discussion
  BY: MW emissivity for bare soil is currently being tested using empirical model.
  FW: Subsurface penetration will be used indirectly in new MW multi-layer soil emissivity model.

V. CRTM Public Repository Status and Implementation of the Improved Low-frequency MW Sea Surface Emissivity Model (Paul van Delst)

- Subversion server hardware was delivered this week (2 servers). Available end of August.
- Backups after each commit, nightly (incremental), and weekly (full). Backups kept for one month.
- Developers outside of NOAA can submit code via subversion (don't need to go through CRTM team).
- Current server will be useful for web services (forum, wiki).
- New MWSSE model for f < 20GHz (Fastem3 used elsewhere).
- Tangent linear model affected by interpolation across surface heights.
- Discussion
  FW & PVD: There may be a discontinuity at 20 GHz.

VI. Systematic Differences in LBLRTM-derived Optical Depths (David Groff)

- LBLDIS and CRTM share common RTsolver and gas absorption components. Testing these components shows that LBLRTM optical depth calculations are dependent on band width.
- Discussion
  JLM: Differences are expected due to line coupling within 15μm CO2 region. One should be careful about start and end frequencies in LBLRTM calculation.

VII. Microwave Emissivity Model Update (Banghua Yan)

- Applied AMSU snow and sea ice empirical algorithms to MHS and SSMIS. Shows improved data assimilation impact for both SSMIS and MHS.
- New two-layer MW snow emissivity physical model. AMSU snow validation shows accuracy within 0.007.

- New multi-layer MW canopy/bare soil emissivity physical model: canopy layer and multiple soil layers (good for lower frequencies).
- Validation and assimilation impact assessment of physical models still underway.
- Discussion
  FW & BY: Difference between one-layer model and two-layer model not large for snow at low frequency. Need to understand when to use one-layer or two-layer model.

VIII. RMS Differences Between Model and Measurements (Ben Ruston)

- RMS differences between model and measurements for AMSU, SSMIS, IASI, and AIRS show a number of good channels. Water vapor channel errors (AIRS) due to NOGAPS error (too moist).
- Sensors will be monitored on a daily basis. CRTM changes will be tested.

IX. Aerosol Look-up Tables in the CRTM (Quanhua Liu)

- GOCART model completed
- GOES-R aerosol model being worked on
- CMAQ aerosol model under consideration
- Non spherical aerosol work by Ping Yang was delivered to CRTM.
- UV+VIS transmittance model is being worked on. Needs testing for speed.
- Discussion
  QL: To take vertical distribution of aerosols into account, use aerosol property (dust, stratospheric, etc.) at different layers.

X. Update on the Implementation of the Multiple Transmittance Algorithm Framework (Yong Han)

- Tau coefficient file contains new algorithm ID.
- User program check algorithm ID for each channel to select transmittance model.
- Transmittance output is on user pressure grid (regardless of transmittance model)
- Currently implemented in the framework:
  - CompactOPTRAN
  - SARTA
- Next steps: completion of ODPS transmittance model (RTTOV-like), implementation of Zeeman models, implementation of SSU transmittance model

XI. Potential Issues in CRTM Jacobians in Stratosphere (Emily Liu)

- When validating temperature profiles, large stratopause temperature increments have been observed.

- IR instruments show bigger increment (AIRS, HIRS). SSU or MW instruments do not show increment.
- Verification of GEOS-5 with MLS shows temperature discrepancy at stratopause.
- Profiles of CRTM Jacobians will need investigation.

Action Item Summary:

1. Respond to AER on spectroscopy priorities (P. vanDelst and Han).
2. Address land MW desert emissivity bias (Yan and W. Zheng); produce new empirical emissivity (Yan)
3. Investigate large CRTM Jacobians responsible for the large stratopause temperature increments at GMAO (Chen and E. Liu).
4. Address large ocean surface MW emissivity error at high frequency and any other outstanding bias issues in GFS (M. Liu and Yan)
5. Complete generation of FengYun-3 CRTM transmittance coefficients. (Weng, Han and Paul)
6. Item from CWG-M2: CRTM team update and improve the User Guide for broader users (P. vanDelst)