

# CRTM Development 2011-2012

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# Outline

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- 2010-2011 accomplishments
- 2011-2012 development
  - Science updates
  - Software updates

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# 2010-2011 Accomplishments

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- Released v2.0.2
- In preparation for v2.1 release:
  - Implementation of new microwave sea surface emissivity model.
  - Implementation of non-local thermodynamic equilibrium (non-LTE) correction algorithm.
    - Yong Han will discuss in next presentation.
  - Implementation of Successive Order of Interaction (SOI) radiative transfer model (Tom Greenwald and David Groff).
    - Completed code not received in time for *initial* v2.1 cutoff.

# 2010-2011 Accomplishments

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- Infrared land surface emissivity databases were tested in the CRTM.
- Worked with JCSDA Land Data Assimilation group to modify CRTM to accept additional input for parameterisation of the microwave land surface emissivity. (Weizhong Zheng, EMC, did the work and subsequent testing.)
- Planck-weighted transmittances for broadband channels.
- Correction of solar reflection for broadband infrared satellite channels in clear sky over ocean.
- Continued investigation of the radiometric impact of the different forms of the ATMS NPP spectral response functions (SRFs).
- Assessment of GOES-14/15 sounder and NPP VIIRS SRFs.

# 2010-2011 Accomplishments

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- Added new sensors
  - Visible channels for GOES-11-15, MTSAT-2, and VIIRS imagers.
  - Kalpana (India) and COMS (Korea) imagers.
  - FY3B (China) IRAS, MWRI, MWHS, and MWTS.
- Updated the CRTM testing framework, adding new software for unit and component testing. The main CRTM tests were also updated for use by the growing number of CRTM developers.
- Transmittance production software updates (not all completed)
  - Extensively updated the SRF processing software to improve the throughput. Generated software templates for processing. Minimal changes required to begin processing the datafiles.

# Microwave Sea Surface Emissivity

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- FASTEM4 implementation issues.
  - Delivered code was for RTTOV. Refactored to make code modular, and to remove repeated forward model calculations in tangent-linear and adjoint procedures.
  - Offline tests showed large differences wrt current model (LFMWSSEM+FASTEM1)  
<https://svnemc.ncep.noaa.gov/trac/crtm/ticket/216#comment:9>
  - Tests of new model in GSI produced larger first guess departures than current operational model (LFMWSSEM+FASTEM1) for AMSU-A surface channels:  
<https://svnemc.ncep.noaa.gov/trac/crtm/ticket/216#comment:15>
  - **Result: No CRTM v2.1 upgrade in next GSI implementation.**

Science Updates

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# 2011-2012 Development

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## Science Updates

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- Investigate FASTEM4 performance.
  - Discussions with RTTOV users of FASTEM4 indicates similar results for European NWP centres.
  - Need to discover the causes of the differences, e.g.
    - Regression fits to data over a large frequency range is suboptimal.
    - Foam reflectivity.
    - Etc..
  - Quanhua and I have briefly discussed how to get around this via sensor-specific models, but still retain the flexibility of a general, frequency-based model.

# 2011-2012 Development

## Science Updates

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- Release of v2.1
  - Was scheduled for April-May, 2011. Investigation of FASTEM4 issues have put this on hold.
- Release of v2.2, 4Q 2011 (calendar).
  - Implementation of new microwave land surface emissivity model (from Weizhong Zheng)
  - Inclusion of SOI RT algorithm.
  - Addition of scattering switch to allow for cloud and aerosol absorption only.
  - Aircraft version of CRTM
  - Additional FASTEM4.X updates.

# 2011-2012 Development

## Science Updates

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- Surface emissivity model updates.
  - Continued improvement of microwave land surface emissivity (Weizhong Zheng)
  - Implementation of a dense medium radiative transfer model for microwave snow surface emissivity (Ding Liang)
  - Implementation of infrared land surface emissivity database(s) (Yong Chen)

Software Updates

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# 2011-2012 Development

# 2011-2012 Development

## Software Updates

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- Surface emissivity model update support.
  - Generation of “boilerplate” code for reading any required datasets (see below also).
  - Software design.
- Tool for Fortran95/2003 code generation.
  - The CRTM framework relies heavily on an OO design approach, encapsulating functionality via structures and specific application modules.
  - To encourage CRTM developers to write loosely coupled code, a ruby application is being developed to generate much of the boilerplate code from an XML definition of the data structures.

# 2011-2012 Development

## Software Updates

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- Update interface specification for v3.0
- This effort is in partial support of the surface emissivity updates mentioned above and has two aspects:
  - Currently the CRTM can only handle a combination of the gross surface types (land, water, snow, and ice). To make full use of the expected updates to the land surface emissivity models, combinations of the subtypes will be introduced. This will allow a CRTM user to specify as many surface subtypes as required.
  - The initialization interface needs to be updated to allow for files to be specified for a variety of models (e.g. IR land, IR snow, MW snow, MW land etc).

# 2011-2012 Development

## Software Updates

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- Transmittance production software updates to be completed.
  - XML specification files to generate Fortran95/2003 software to interface with the both LBLRTM (IR) and MonoRTM ( $\mu$ W).
  - Control scripts for the transmittance production software suite need to be upgraded to work with MonoRTM (currently only setup for LBLRTM).
  - Work towards packaging the first two steps of the “CRTM process”:
    - Process instrument SRFs and generate **SpCcoeff** and sensor channel resolution transmittance profiles (**TauProfile**) datafiles.
    - Perform regression fitting on the transmittance profile data resulting in the CRTM transmittance coefficient, **TauCoeff**, datafiles.

# Questions?