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Comparison of Radiative Transfer Model Jacobians in the Presence of Hydrometeors Between JCSDA Model and NWP SAF Model

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Visiting Scientist Mission Report

Comparison of Radiative Transfer Model Jacobians in the Presence of Hydrometeors Between JCSDA Model and NWP SAF Model

Gary Wick
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May 10-13, 2005

Overview

Dr. Gary Wick of the NOAA Environmental Technology Laboratory visited the Met Office between May 10-13, 2005 to meet with Dr. Stephen English and his group to continue work towards comparing radiative transfer model Jacobians in the presence of hydrometeors. Dr. Wick continued interacting with the group in the following week while attending another workshop held at the Met Office. During the visit, significant progress was made towards directly comparing and evaluating the accuracy of the predictions of the NWP SAF and NOAA ETL models. Activities focused on porting the NOAA ETL model to the Met Office environment to facilitate side-by-side comparisons and compiling common input data for the models. A strategy for model comparisons was developed and intercomparisons will be conducted during a reciprocal visit of a NWP SAF scientist to NOAA ETL currently scheduled for October.

Mission Objectives

The primary objective of the visit was to begin work intercomparing the predictions of radiative transfer models in development and use at the NWP SAF and NOAA ETL. The focus of the comparison is the model Jacobians in the presence of hydrometeors. The models apply different solutions to the radiative transfer equation which could impact the accuracy of the computed Jacobians. Knowledge of the Jacobians is of critical importance for assimilation of microwave satellite data under all-weather conditions. The ultimate goal of the comparisons is to obtain a better understanding of the uncertainties in the existing models and their suitability for operational applications. These objectives were stated in the original visiting scientist proposal.

Initial plans for the intercomparison were developed during an earlier visit of Dr. Albin Gasiewski of NOAA ETL to the Met Office in the summer of 2004. The intercomparisons were to be conducted through this visit and a later visit of NWP SAF staff to NOAA ETL.

Activity Summary

Initial discussions during the visit focused on developing a strategy for the model intercomparisons. For direct comparisons between the NOAA ETL and NWP SAF models, it was agreed that the two quantities for comparison were to be the Jacobian components and model execution time. Performance of the comparison also requires common input data and

common microwave channel frequencies at which to compare output. Data included with the ETL model code consists of detailed simulations of Hurricane Bonnie off the eastern coast of the US in August 1998. The data has been used in other evaluations of the NOAA ETL model and was agreed to be suitable for initial model comparisons. A significant advantage of the data was available independent information on ice and snow as required by the ETL model. It was further decided to perform simulations at frequencies representative of the Advanced Microwave Sounding Unit (AMSU).

Following agreement on the nature of the comparisons, the bulk of the activities centered on readying the models and input data for the comparisons. The first task in this area was to install the NOAA ETL model on the computer system of the Met Office. While both groups work under the Linux operating system, use of different compilers and different associated run-time libraries required that the code be recompiled at the Met Office. Several different problems were identified that had to be solved. The most significant of these entailed redefining data structures in the model code to provide consistent record lengths. After completing the changes, the model was run on the Met Office system with the ETL forcing data and it was verified that the model gave results consistent with those obtained at ETL. Model outputs were visualized with the same software applied at ETL. The required configuration files were then edited to perform simulations at the new AMSU-B frequencies selected for comparison.

The next task was to convert the input data for the NOAA ETL model into a format compatible with RTTOVSSCAT. Existing file generation codes were modified to write the data in the required format. An initial test run was completed and results were available for conversion to a visualization compatible format at the end of the visit period.

To allow parallel intercomparisons at NOAA ETL, Dr. Wick was also supplied with a version of the NWP SAF RTTOVSCAT model code. Compilation and operation of the code was explained and minor changes to the code were made to enable the specific planned intercomparisons. Direct application and evaluation of the RTTOVSCAT code by Dr. Wick was somewhat hindered by security requirements at the Met Office. While the necessary security clearance paperwork was initiated over a month prior to the visit, the clearance was not obtained in time and Dr. Wick could not have access to the computer system. This lack of access also slowed the migration of the ETL model. The RTTOVSCAT code was successfully installed at NOAA ETL following the return of Dr. Wick.

The initial comparisons planned for the NOAA ETL and NWP SAF model were further extended and formalized to be a part of a broader comparison incorporating also the Atmospheric Radiative Transfer System (ARTS) from the University of Bremen and a model from the ECMWF. A meeting was held between Stephen English and his staff, Peter Bauer of ECMWF, a representative of Bremen University, and Gary Wick of NOAA ETL to plan a pure radiative transfer model forward comparison. The comparison is to be composed of multiple phases: the first a comparison of Jacobians computed with respect to commonly specified scattering coefficients and the second an extension of the comparison back to meteorological parameters. Initial profiles for testing were to be drawn from a set from Peter Bauer and a sampling of tropical profiles from the NOAA ETL Hurricane Bonnie simulation.

Continuing Actions

The intercomparison activities initiated during the visit are ongoing and a return visit of a Met Office NWP SAF staff member to NOAA ETL is planned. Una O'Keeffe of the Met Office is currently scheduled to visit NOAA ETL in early October to continue the intercomparisons. Following the preparation work completed during the visit of Gary Wick, comparisons should be able to proceed rapidly. Trial comparisons will be completed prior to the visit to make optimal use of the available time. A more formal scientific description of the comparisons and their implications should be available following this visit.