Breakout Session Report
ARM/ASR User and PI Meeting
March 16-20, 2015

Session Title: Radar Science—Simulators
Session Date: Thursday, March 19, 2015
Session Time: 1:30–3:30 p.m.
Summary Authors: Eugene Clothiaux and Scott Collis

Description

Models of various levels of sophistication and resolutions are being used to aid in understanding atmospheric processes, increasingly in the ARM Facility and ASR program. For various reasons (i.e., uncertainty quantification, model calibration, assimilation) simulated geophysical parameters need to be compared to ARM measurements. Traditionally, this is achieved by performing retrievals, but another approach is to use instrument simulators to calculate ARM measurements from model output. This session focused on current and future use cases for such tools and solicited discussion on needs from science and infrastructure for ARM radar simulator packages.

Main Discussion

The breakout session had two parts. During the first part, Alexander Ryzhkov and V. Chandrasekar presented on the value of ARM's polarimetric radar observables for identifying the fingerprints of cloud liquid- and ice-microphysical processes. Dr. Ryzhkov presented examples of radar forwarded model output and how they compared against radar observations. Emphasis was given on ice processes such as riming and dendritic growth. During the second part, there were two presentations on the current status of two radar simulators developed with support from ARM and ASR. Shaocheng Xie and Yuying Zhang presented the current status of the development of the ARM cloud radar simulator that is intended for the Cloud Feedback Model Intercomparison Project, (CFMIP) Observation Simulator Package (COSP) that is intended to connect climate model output to observations through forward model calculations. Pavlos Kollias and Aleksandra Tatarevic presented the current development status of the CRM Radar SIMulator (CR-SIM) that is suitable for Cloud Resolving Models (CRMs, e.g., Weather Research and Forecasting [WRF] Model) with both bulk and bin microphysics schemes.

Key Findings

Xie and Zhang have made significant progress on the development of the ARM cloud radar simulator for COSP. They have a working version of the ARM cloud radar simulator outside of COSP that currently produces contoured frequency by altitude diagrams (CFAD). They are currently focused on producing CFADs for a number of ARM sites for the year of 2009 and using them to assess the Department of Energy Accelerated Climate Model for Energy (ACME). Importantly, the ARM simulator at this stage in its development requires inputs that are now standard outputs of the climate models participating in the CFMIP. Therefore, it can be used in assessments of these climate models without formally being a part of the COSP. This alleviates needing to meet strict deadlines in order to participate in ongoing CFMIP activities.

After receiving feedback during the ASR working group 2014 Fall Meeting, Kollias and Tatarevic have built from scratch a scanning/profiling radar simulator capable of producing most radar observables from WRF model outputs at the resolution of the model output. The simulator does not include an instrument model nor does it include propagation effects, though it does not preclude these features from being added

at a future time. Kollias made a very good point that a simulator should not compensate for the microphysical deficiencies of a model, such as a model's inability to produce a melting layer. Rather, observational detection of microphysical fingerprints, such as those presented by Ryzhkov, should act as targets for the modeling community. They have interfaced this simulator to two cloud microphysical packages within WRF and will include others of value to the ARM/ASR community. Feedback from Jimy Dudhia and Hugh Morrison, two scientists intimately familiar with the WRF model cloud microphysical packages, emphasized the importance of interacting with developers of the cloud microphysical packages when incorporating their packages into a simulator in order to make sure the interface is physically consistent between the package and simulator physics. Another important point was that simulators that operate on bin microphysics models need to run real-time within WRF because outputting bin microphysics is prohibitively expensive while simulators operating on bulk microphysics models can run offline as these models routinely output their properties.

Decisions

There was general support for the continued development of both simulators. Consequently, both teams will continue development of their simulators. Xie and Zhang received support to continue their ARM simulator development for COSP as did Kollias and Tatarevic for their ARM simulator intended for WRF and similar models.

Issues

None were discussed nor identified during this breakout session.

Needs

None were discussed nor identified during this breakout session.

Future Plans

Xie and Zhang are committed to evaluation of the ACME for the year of 2009 using their simulator results; dissemination of the results of this comparison will be important going forward. Kollias and Tatarevic are committed to the public release of their code in the April/May 2015 timeframe in order to facilitate its adoption by members of the ARM/ASR communities.

Action Items

Hugh Morrison and Jimy Dudhia will assess interest amongst the developers of the cloud microphysical packages for WRF in collaborating with Kollias, Tatarevic, and other ARM/ASR investigators in interfacing their codes to the ARM simulator being developed by Kollias and Tatarevic. Moreover, Zhe Feng at PNNL expressed specific interest in the Thompson and WDM6 microphysical packages and indicated that he has a good working relationship with their developers; as a result, these are packages for which there is a high probability of success in getting developer support in terms of interfacing them to a simulator. Once this activity has been completed, the availability of this new ARM simulator will be broadly advertised across the ARM/ASR programs in order to assess interest in it from the community and to facilitate its application to scientific investigations that rely upon ARM radar data.