Geophysical Research Abstracts, Vol. 9, 03069, 2007
SRef-ID:


# Evaluation of cloud representation in the Canadian GEM model using ARM data

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Clouds are one of the dominant sources of uncertainty in climate models. A large part of this uncertainty arises from the numerous scale interactions, both in space and time, controlling cloud formation and the interaction of clouds with radiation and dynamical processes. Microphysical processes play a key role in controlling the liquid and ice water content of simulated clouds and, as a result, are important controls on the interaction of clouds with both solar and terrestrial radiation. Due to their extreme complexity most microphysical processes are highly parameterised in present-day climate models.

In this presentation we will evaluate the microphysical parameterisations in the new Canadian Regional Climate Model, based on the limited area version of GEM (Global Environmental Multiscale Model, Côté et al. 1998). GEM employs a prognostic total cloud water variable, with a Sundqvist-type, bulk-microphysics scheme, along with a new radiation scheme based on the correlated-K approach (Li and Barker 2005). GEM-LAM was integrated for the period 1998-2004 over 2 domains, centred on the ARM Southern Great Plains site, and North Slope of Alaska site, respectively. Both integrations used ERA40 and ECMWF lateral boundary conditions, prescribed SSTs and employed a horizontal resolution of 42km. Time series of model results were extracted from grid-points closest to the relevant ARM sites and were used in model evaluation.

We compare simulated frequency distributions of Liquid Water Path (LWP) and precipitation rate, for different seasons and periods of the diurnal cycle, with observation distributions. Comparison across different seasons, the diurnal cycle and at both ARM sites allows an evaluation of the microphysical processes in GEM across a wide range

of meteorological conditions. It further allows us to identify in which regimes the microphysics is well simulated and in which regimes improvements are required. To better understand the interaction between cloud-microphysics and radiation we compare the simulated co-variability of solar and terrestrial radiation as a function of LWP, with the same co-variability from observations. The co-variability of clouds with solar radiation is also studied as a function of different solar zenith angles.