Use of ARM/NSA Products to Evaluate IPCC-AR4 Arctic Cloud and Radiative Simulations

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Objectives:

-- use ARM/NSA measurements to assess model-derived surface radiation fluxes and cloud fraction at the Barrow site

-- produce ranked lists of cloud and radiation performance based on monthly mean RMSE

-- diagnose cloud/radiation performance based on model parameterization type

Methodology:

-- determine monthly RMSE biases of GCM and reanalysis-derived cloud fraction, downwelling solar and longwave flux from corresponding observations at the Barrow ARM site

-- create an "integrated model rank" from sums of ranks for cloud, solar and longwave flux

-- isolate cloud and radiative model formulations responsible for good vs. poor model performance
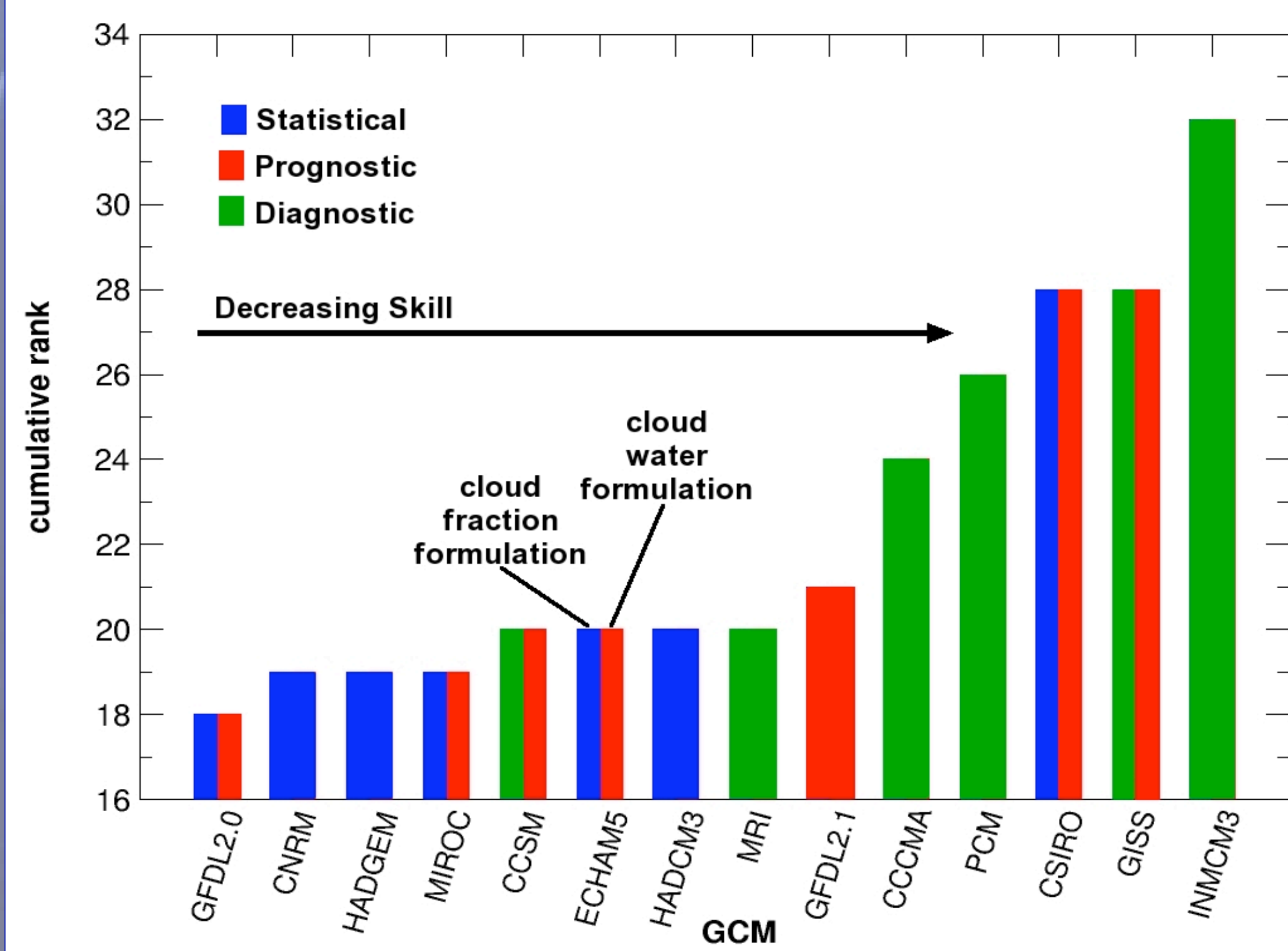
Conclusions

• On balance, models using statistical formulations for cloud condensate and cloud fraction outperform those using diagnostic (RH threshold-based) formulations; Mixed results for prognostic cloud-radiative formulations.

• Some GCMs outperform reanalysis products - a positive result given that reanalyses are constrained by observations.

• Models that perform well with respect to cloud fraction do not necessarily rank high for radiation variables.

• GCMs show considerable variability in their ability to simulate correctly cloud and radiative parameters in the Arctic. Correct simulations of cloud fraction appear to be particularly difficult.

ARM vs. GCM cloud fraction
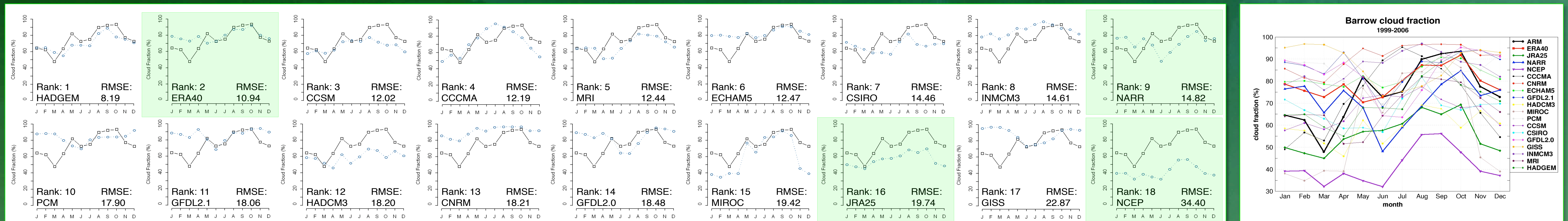
ARM vs. GCM downwelling longwave flux
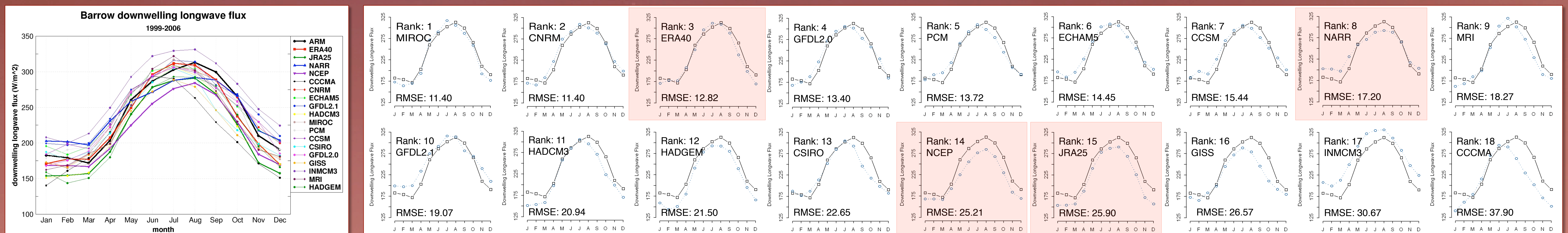
ARM vs. GCM downwelling shortwave flux