Comparison of Cloud Fraction and Liquid Water Path between ECMWF Simulations and ARM Long-term Observations at the NSA Site

Ming Zhao (mzhao@uwyo.edu) and Zhien Wang (zwang@uwyo.edu)
Department of Atmospheric Science, University of Wyoming

Introduction

In this poster, seasonal and annual variations of cloudiness and liquid water path (LWP) from European Center for Medium-Range Weather Forecasts (ECMWF) model were compared with surface measurement from the ARM Climate Research Facility (ARCF) North Slope of Alaska (NSA) site between January 1999 and December 2004.

Comparison Strategy

	Observed	Modeled
Cloud Fraction	Lidar/Radar	Outputs of the ECMWF forecast model
Liquid Water Path	Microwave Radiometer	

Observed-Modeled Cloud Fraction

- Model simulated large scale features match well with observations.
- There are significant differences in cloud vertical and temporal distributions and in the magnitude.

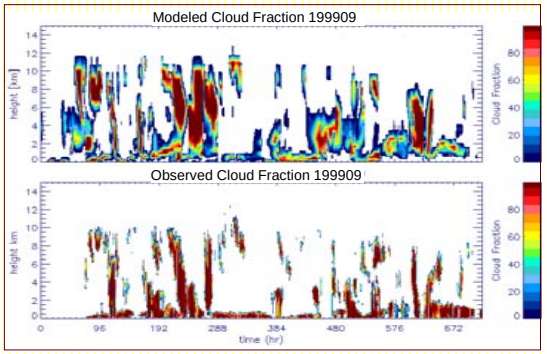

FIG. 1: Time-height display of cloud fraction from model simulations and observations in September 1999.

Comparison of Cloud Fraction--Vertical Distribution

- Model overestimates high clouds, especially in warm seasons.
- Model makes close estimation for middle clouds.
- Model underestimates low clouds in warm seasons, especially in October; while overestimates low clouds in cold seasons.

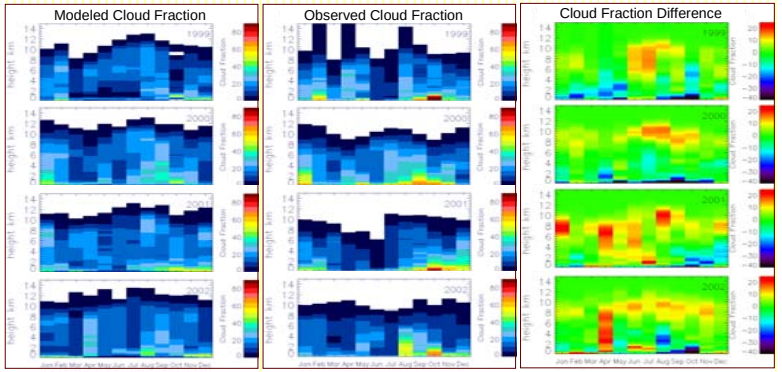

FIG. 2: Monthly mean modeled and observed cloud fraction vertical distribution and their differences (model minus observation) from the year of 1999 to 2002.

Comparison of Cloud Fraction-- Statistic Evaluation

- Model underestimates clouds below 0.5 km by ~21.1%.
- Model underestimates clouds between 2 and 4 km by ~14.1%.
- Model significantly overestimates clouds above 6 km by ~105%.

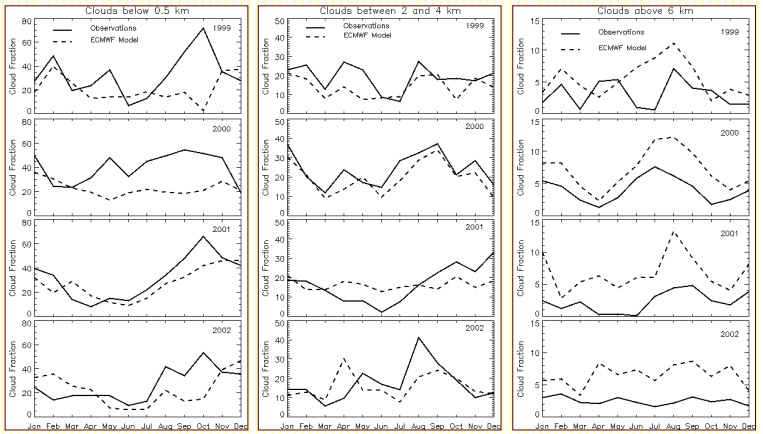

FIG 3: Monthly mean cloud fraction comparison between model simulations and observations from the year of 1999 to 2002 at three different levels.

Observed-Modeled Liquid Water Path

- Magnitude of model simulated LWP is significantly smaller than that of observations.

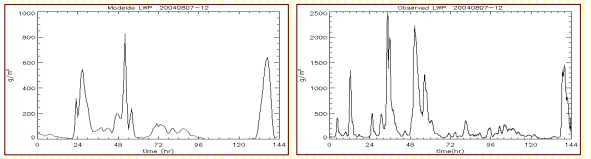

FIG. 4: LWP from observations and model simulations during 7 to 12 August 2004.

Comparison of Liquid Water Path

- Model can capture the major seasonal trends.
- The modeled value is significantly smaller than the observed, the annual relative difference is around 250%.

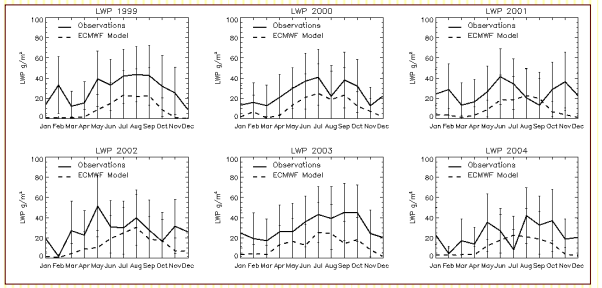

FIG. 5: Monthly mean LWP comparison between model simulations and observations from the year of 1999 to 2004.

Conclusions

1. Model underestimates low clouds and middle clouds, however the percentage error of middle clouds is smaller than that of low clouds. And model tends to overestimate clouds above 6 km.
2. Model simulated LWP values are significantly smaller than the observed, and the relative difference is as large as 250% in terms of annual mean, especially during cold season.

References:

Beesley, J. A., 2000: A comparison of cloud and boundary layer variables in the ECMWF forecast model with observations at Surface Heat Budget of the Arctic Ocean (SHEBA) ice camp. *J. Geophys. Res., 105*, 12,337-12,349.

Xie, S., 2006:, An assessment of ECMWF analyses and model forecasts over the North Slope of Alaska using observations from the ARM Mixed-Phase Arctic Cloud Experiment. *J. Geophys. Res., 111*, D0517.