Incorporating partial cloudness in the radiation scheme for a Super-CAM with a third-order turbulence closure used in the embedded CRM

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Introduction

- Radiation is calculated in each CRM grid.
- Partial cloudness, liquid water, and ice water content are passed to radiation package for consistent consideration of subgrid-scale processes.
- Global energy balance is still an unresolved issue, but representation of low-level cloud was improved in the 1-month testing run.
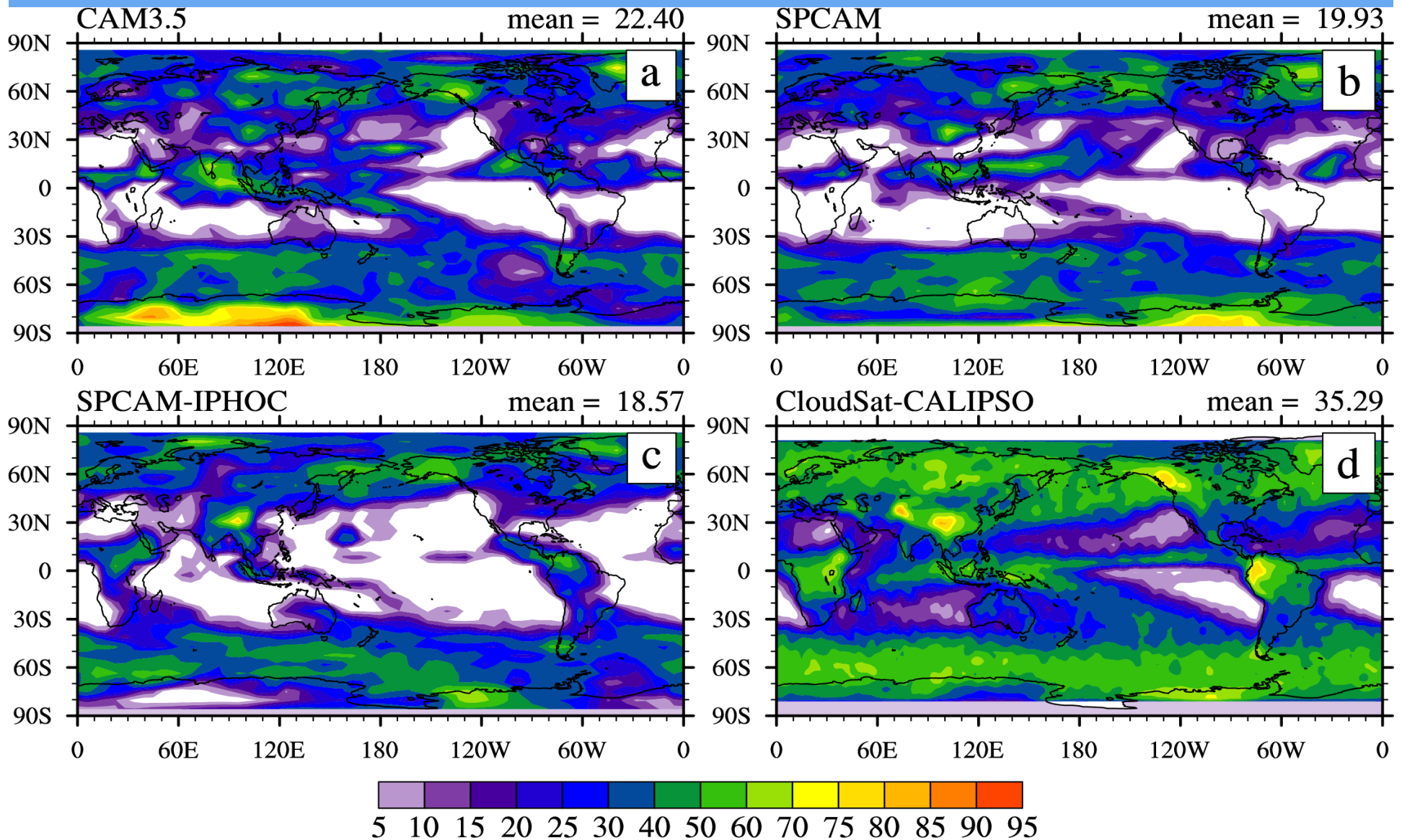
Experiment Design

- Standard initial condition and forcing for CAM3.5, beginning at September 1, 1990
- T21 with 26 levels in vertical direction
- Integration time: 2 years for CAM3.5, SPCAM with a first-order closure, and 1 month testing run for SPCAM with IPHOC, respectively
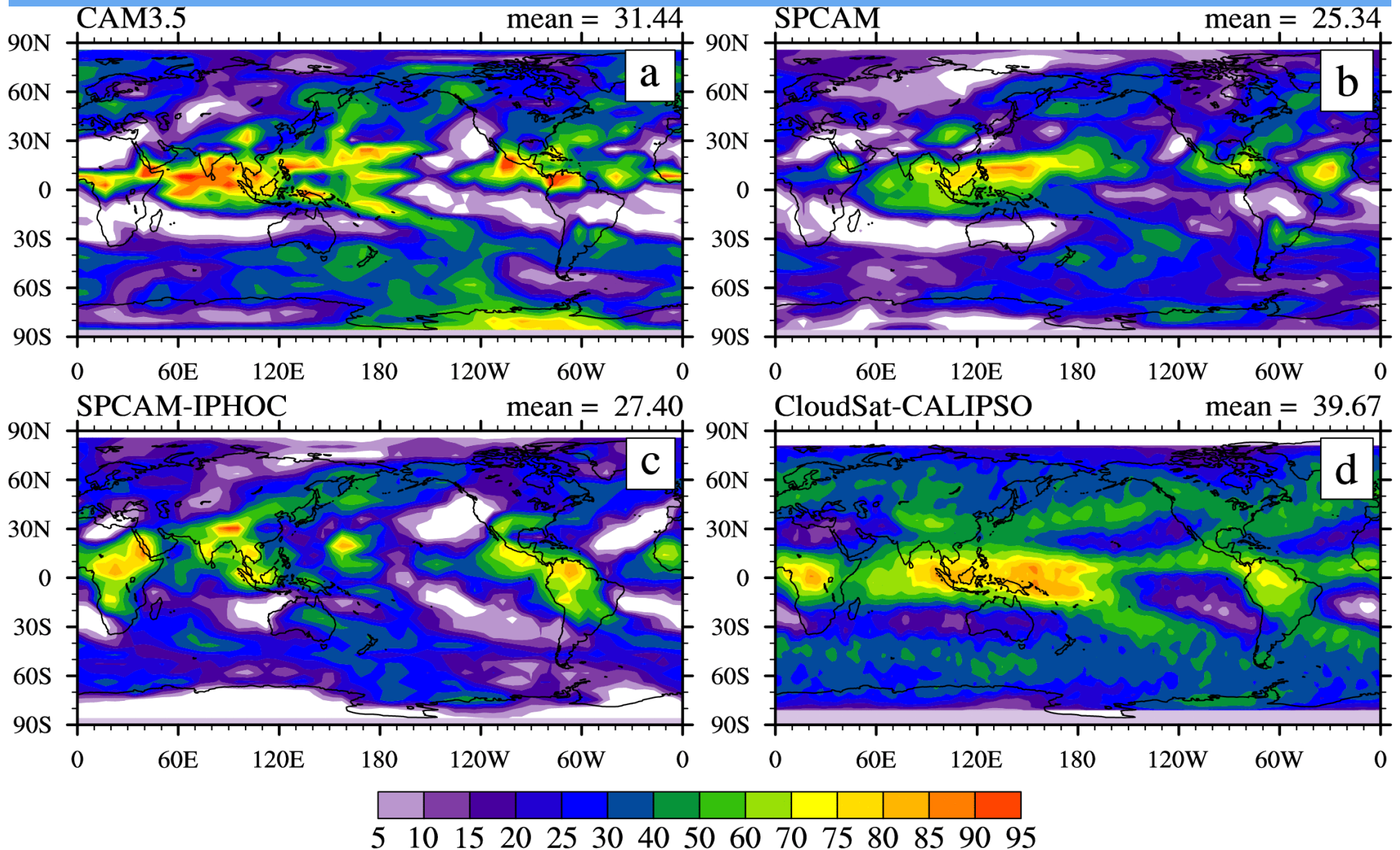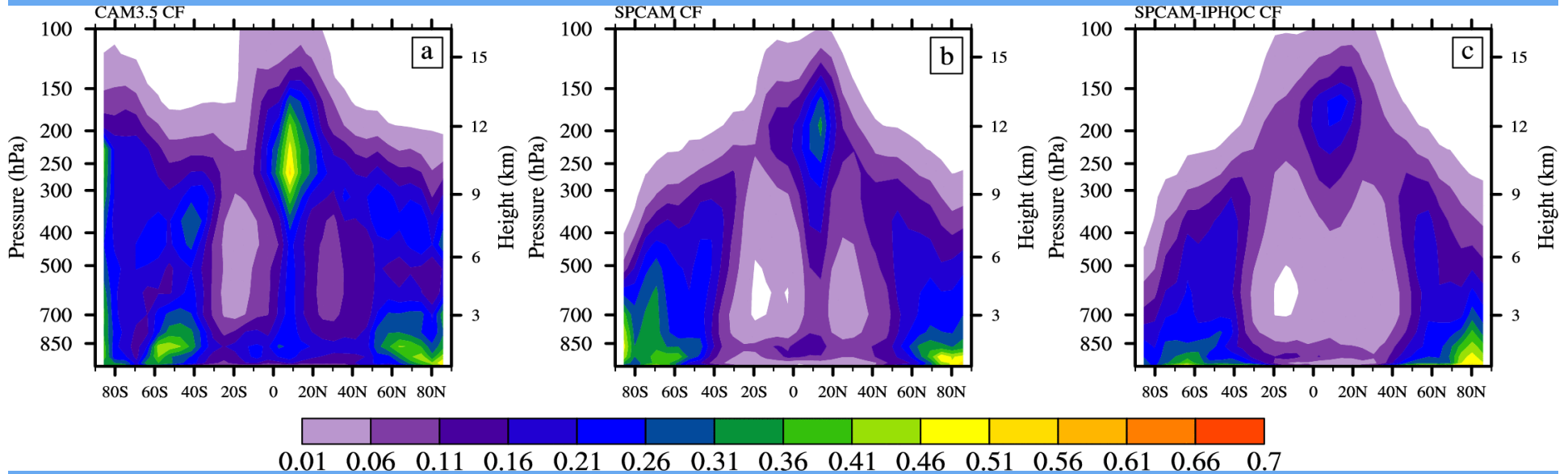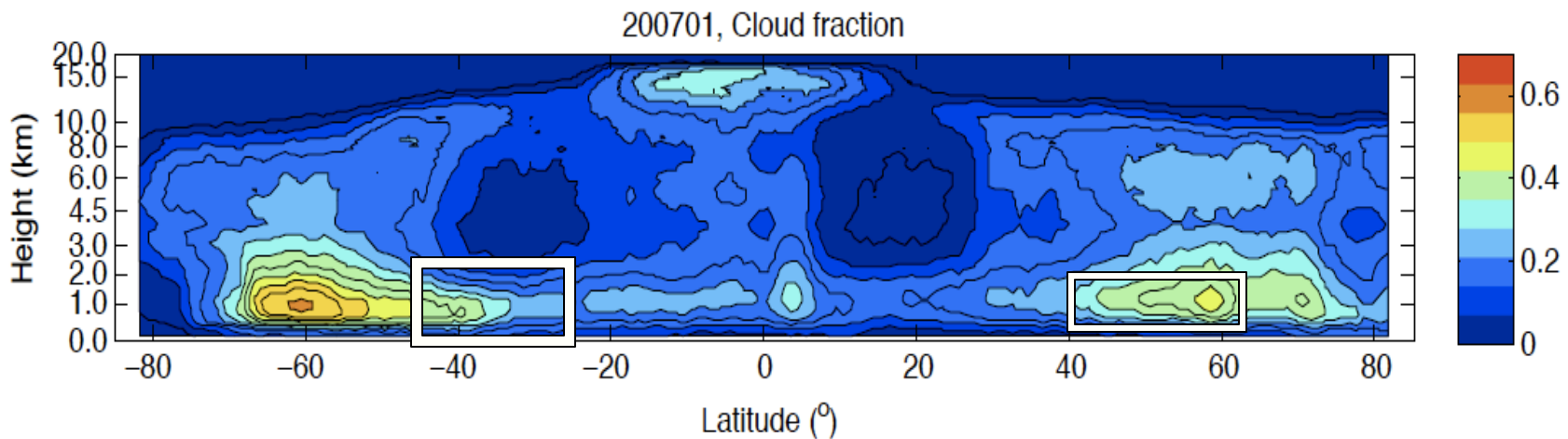
Low-level Clouds
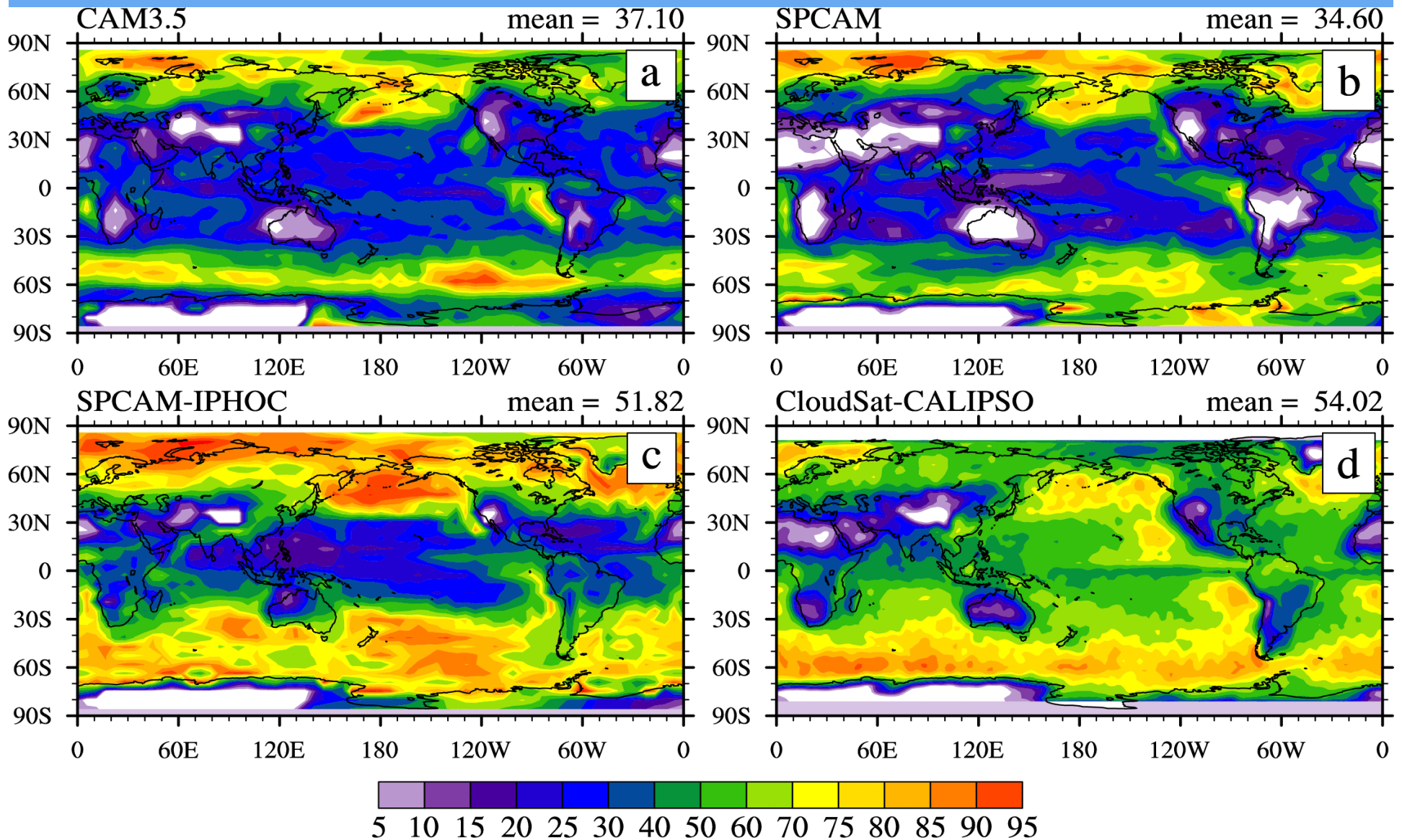
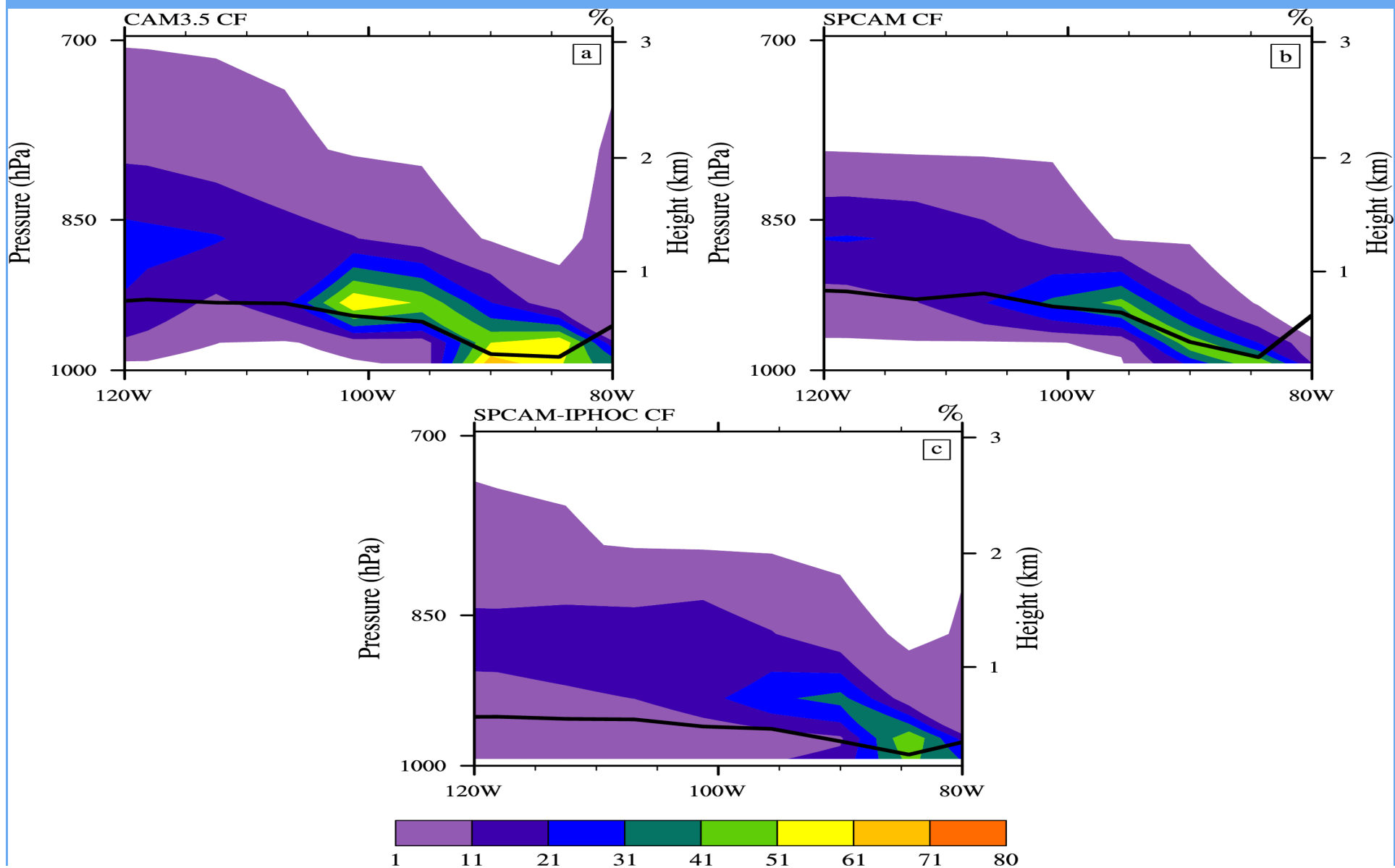# Middle-level Clouds

High-level Clouds
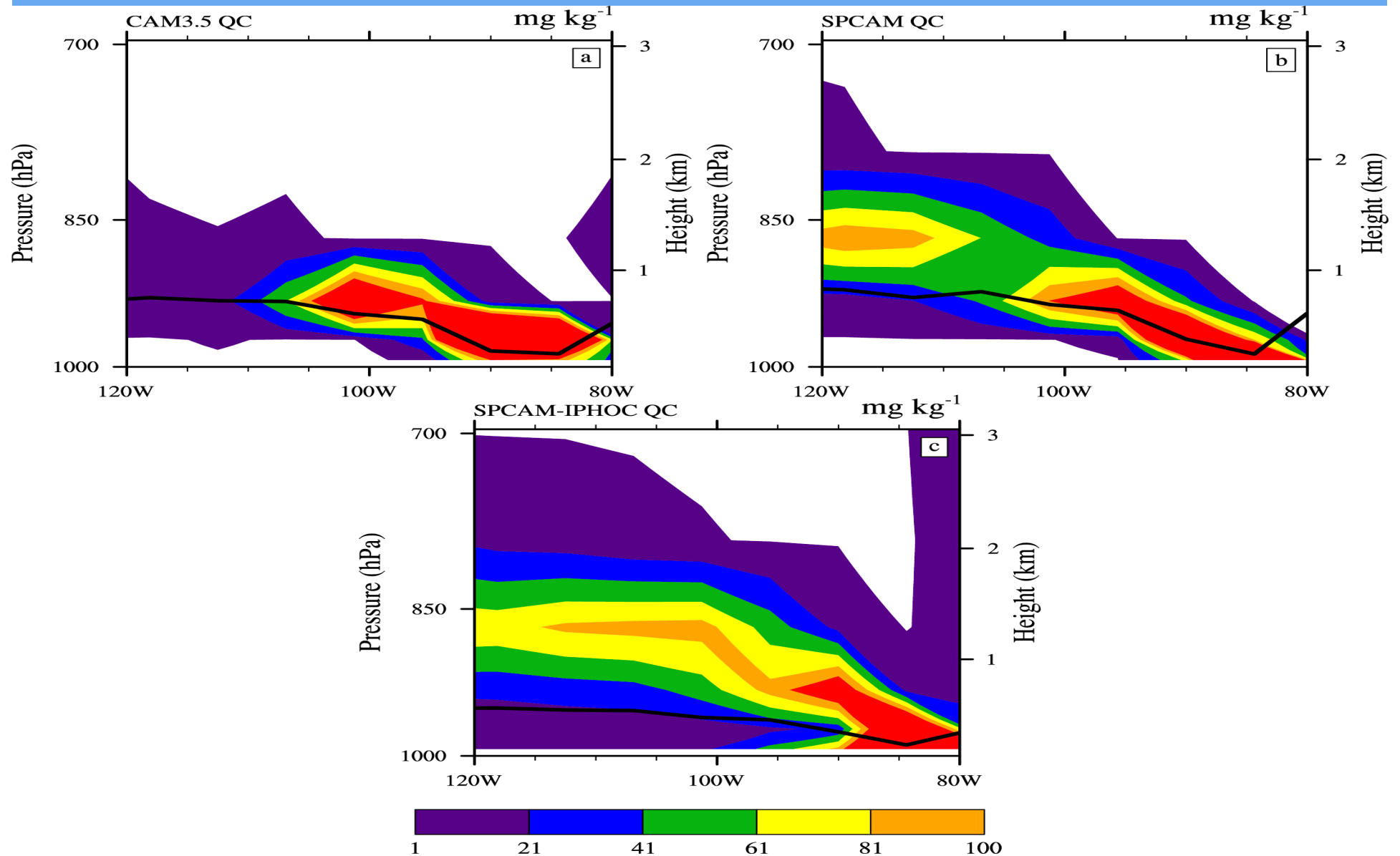
Zonal-Mean Cloud Fraction
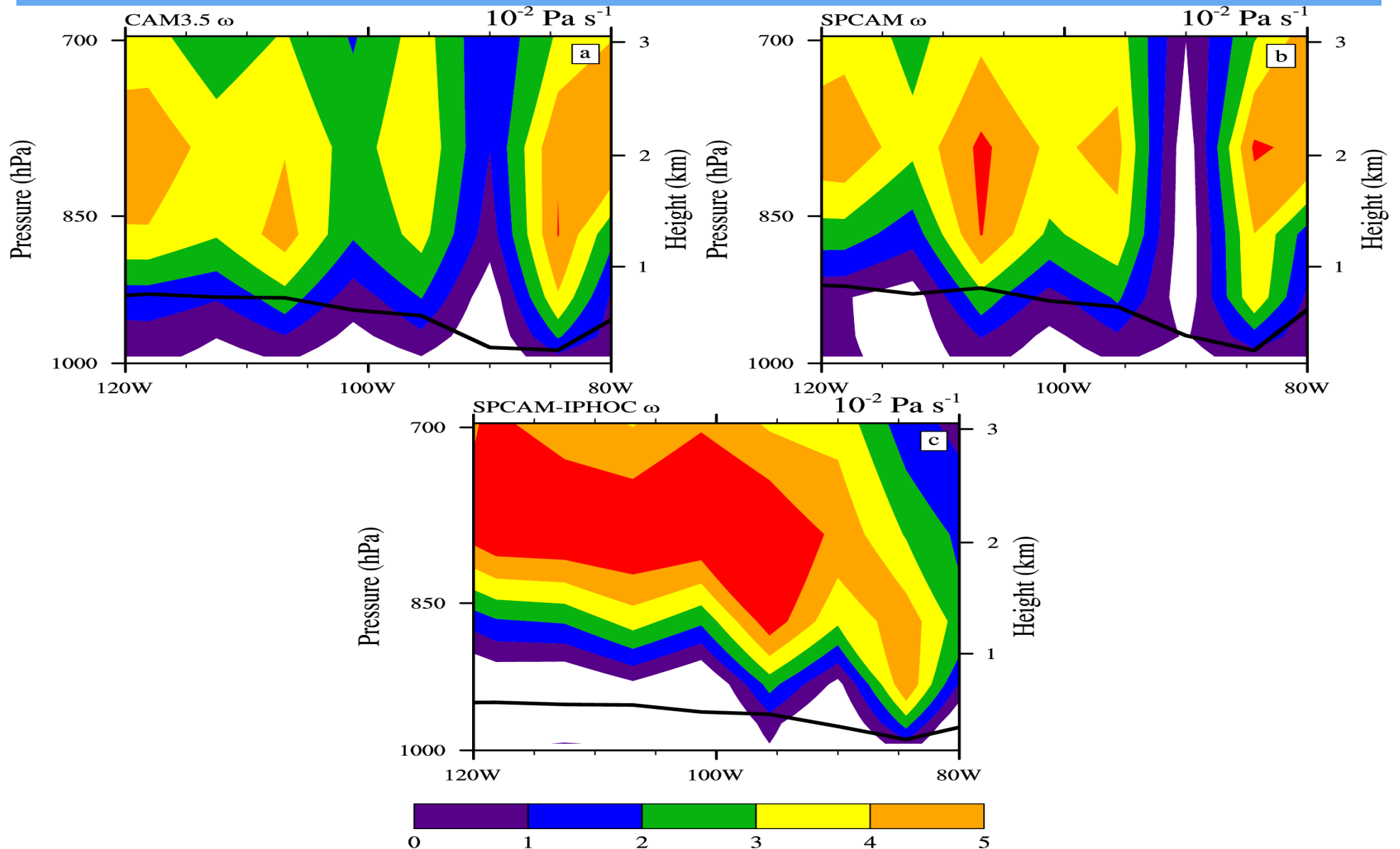

C3M Cloud fraction
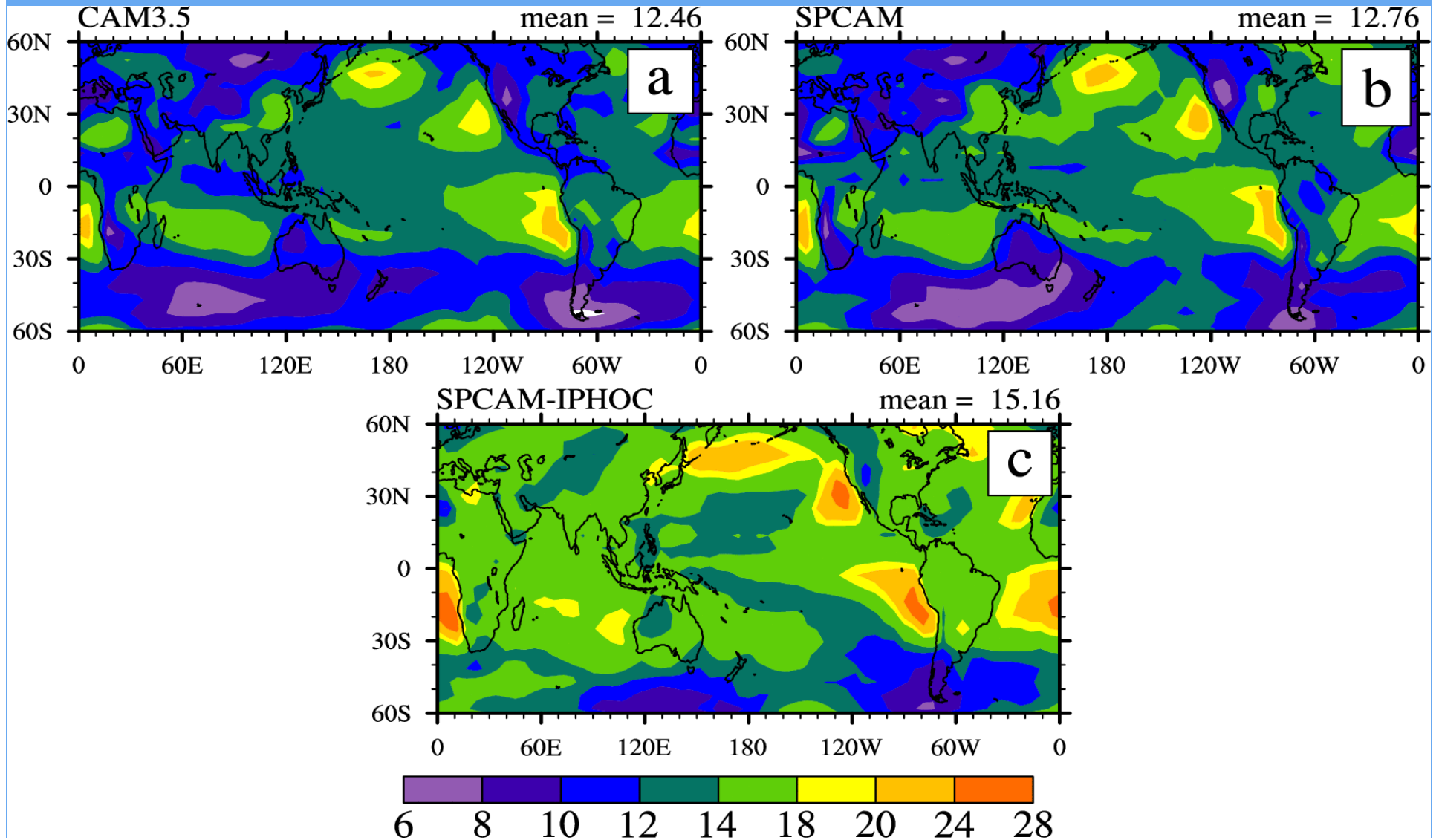
Cloud Fraction Cross Section along 10°S

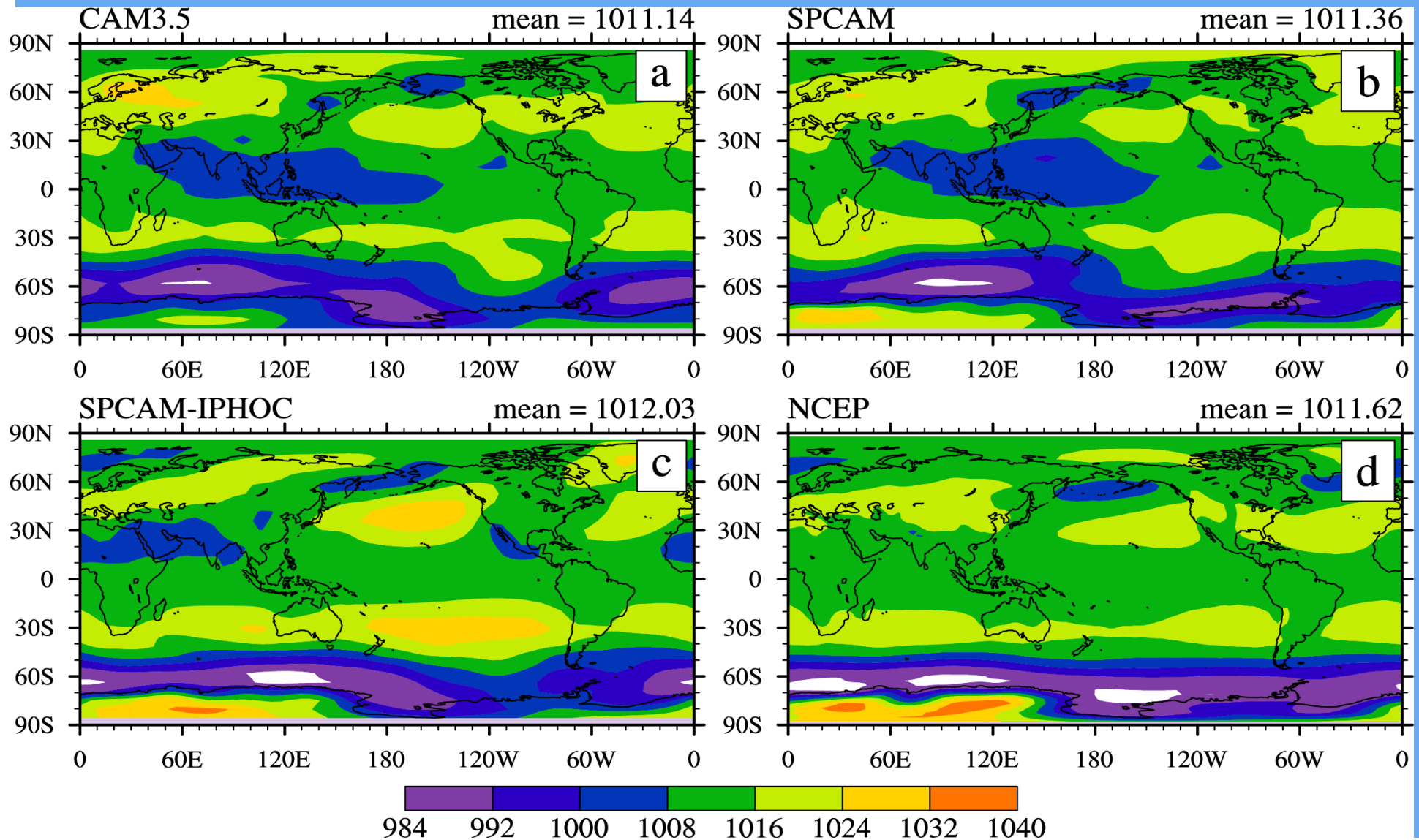# Cloud Liquid Water Cross Section along 10°S

Subsidence Cross Section along 10°S

Lower Tropospheric Stability

Sea-level pressure

Summary

- A one-month simulation was performed with the partial cloudness implemented in the radiation scheme of the MMF with an HOC in its CRM component.

- Representation of low-level clouds shows improvement over the CAM3.5 and SPCAM-IPHOC.

- The improved simulation of low clouds is due to:

  1. Subgrid-scale condensation
  2. Realistic cloud feedback cycle: low-level clouds -> subtropical highs-> subsidence and radiation cooling -> low level clouds