# The CFMIP-GCSS Column Cloud Feedbacks Study: Overview and Preliminary Results


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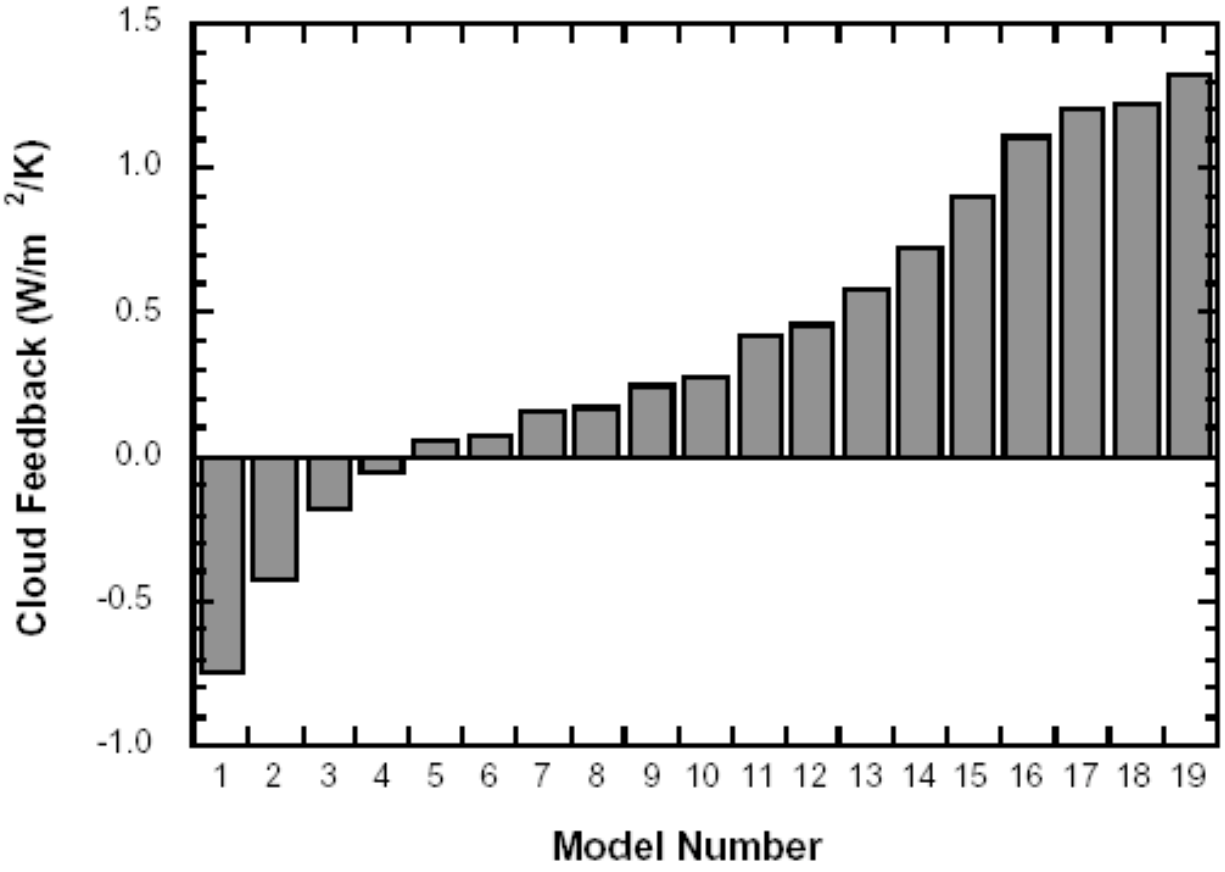
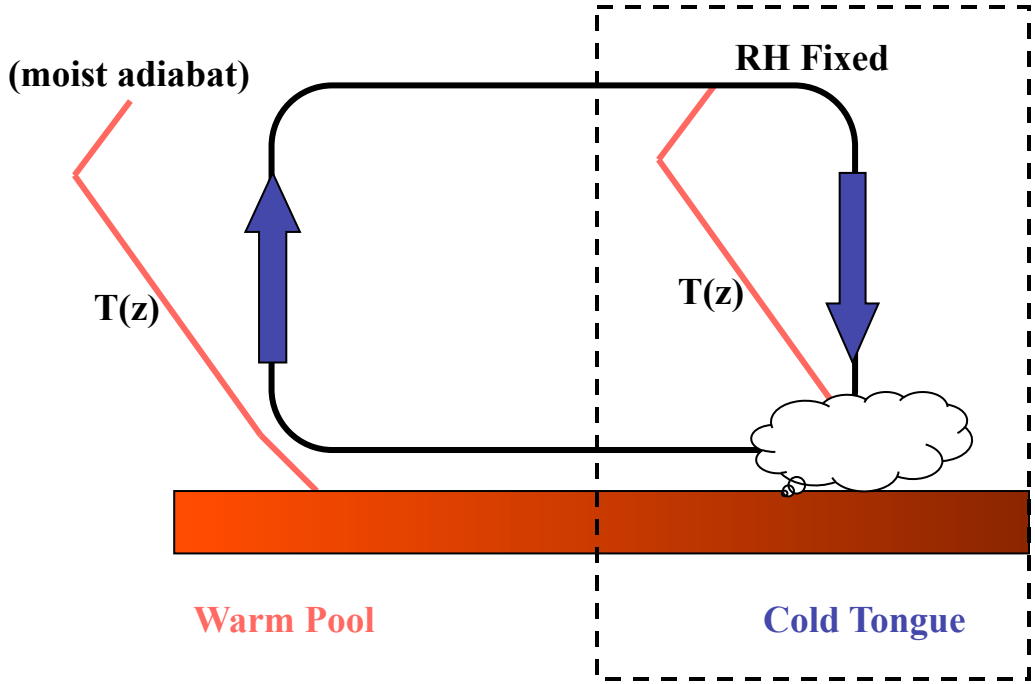
Based on Minghua Zhang's presentation to the GCSS-CFMIP meeting, Vancouver, Jun. 2009.

# Models disagree on cloud response to a global SST increase




(Cess et al. 1990)

Column framework for assessing subtropical low cloud response (Zhang and Bretherton, 2008)




(Zhang and Bretherton, 2008)

GCSS-CFMIP column cloud feedback intercomparison

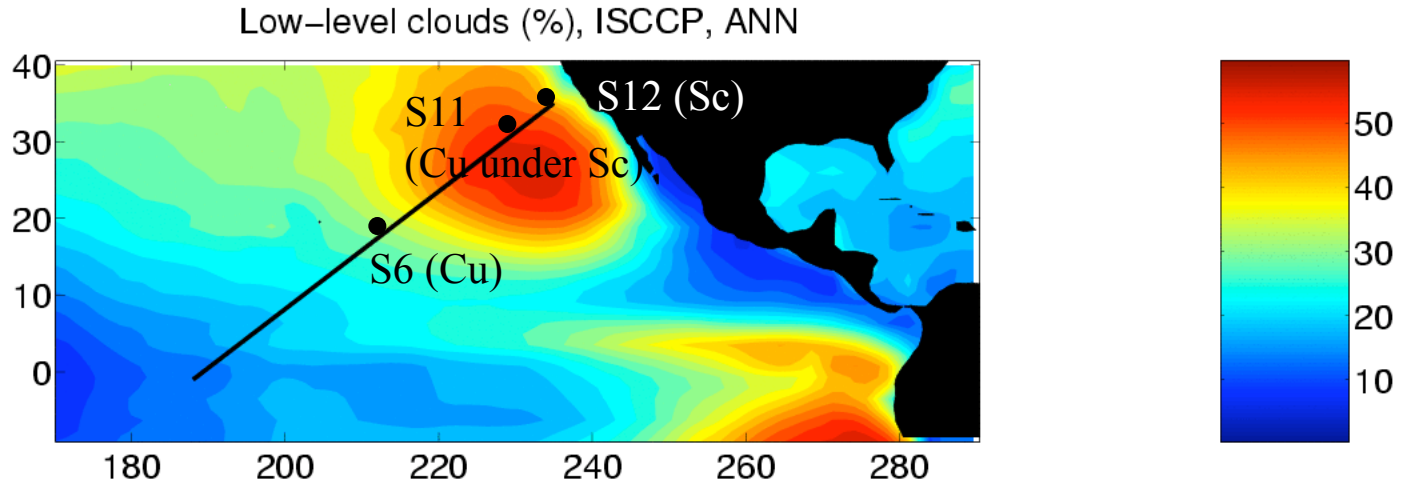
Objectives:

1. To test whether a column analogue to a climate change (+2K SST) reproduces the intermodel variability in AGCM subtropical cloud response.

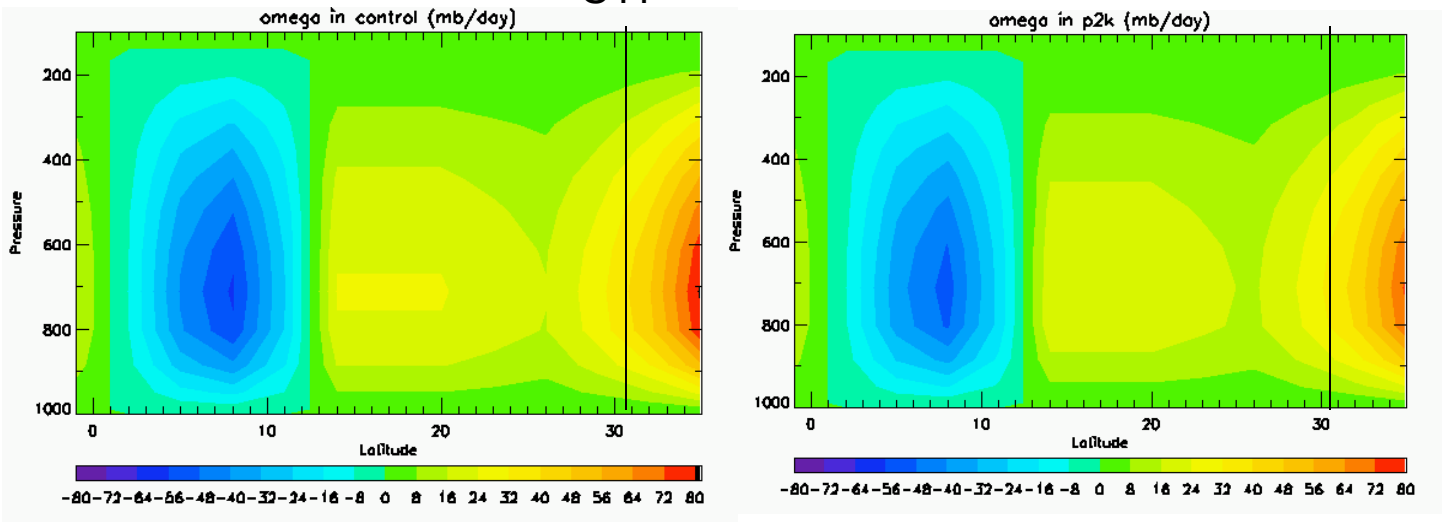
2. To understand the low cloud response mechanisms in the column models.

3. To compare SCM with LES/CRM column simulations

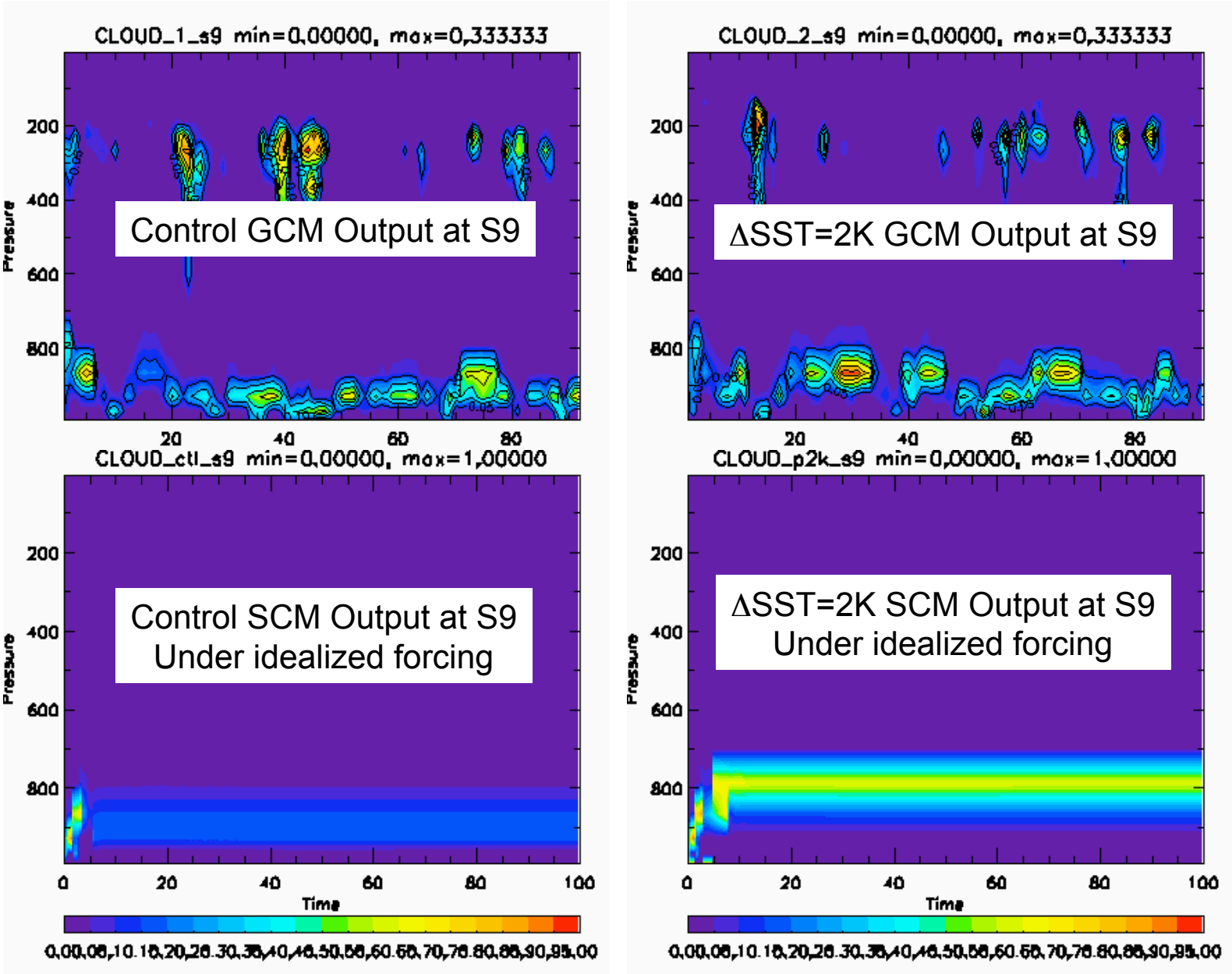
Control: Force column models with JJA climo from 3 GPCI points (mainly S11)
SST+2K: Start with warmer free-trop moist adiabat, same free-trop RH=30%.
Subsidence reduced ~10%, same horizontal T,q advection profiles.




S11



# Cloud Amount from CAM3.5 - GCM vs. steadily forced SCM



## Models WITH Results Submitted

| | |
|---|---|
| LES | LaRC/UCLA |
| | SAM |
| | UKMO |
| CRM | CAM3.1 (CAM3) |
| | CAM3.5 (CAM4) |
| | CSIRO |
| | ECHAM1 |
| | ECHAM2 |
| | ECMWF |
| | GFDL |
| | GSFC |
| | KNMI |
| | LMD |
| | SNU |
| | UKMO-L38 |
| | UKMO-L63 |

## Will Submit

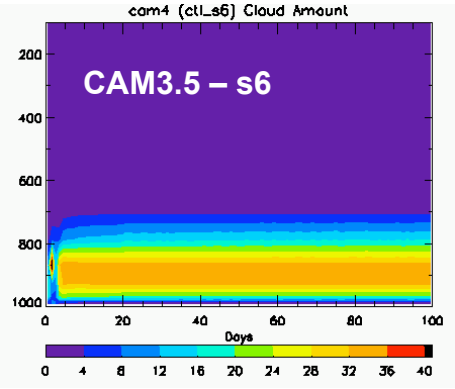
| | |
|---|---|
| LES | UUtah* |
| | UW* |
| CRM | CCC |
| | FranceMet |
| | GISS |
| | UWisconsin |

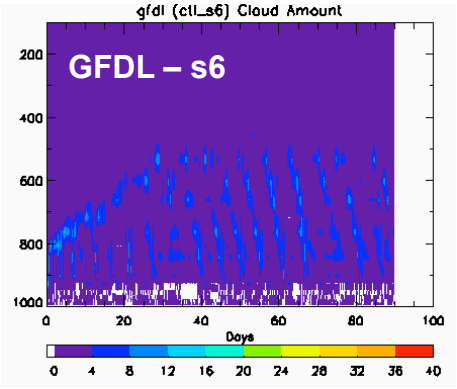
Sample of Simulated Cloud Amount from Control Case
at s6 (top row), s11 (middle row), and s12 (bottom row)

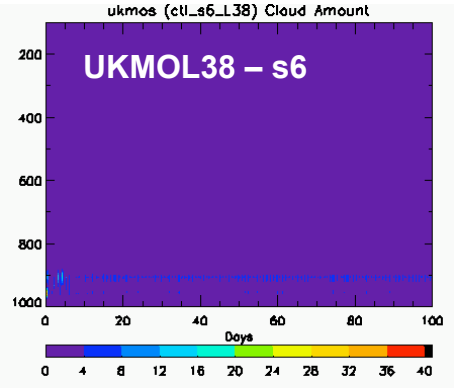
CAM3.5 (1st column), GFDL (2nd Column),UKMO L38 (3rd Column)
LaRC/UCLA LES (4th Column)

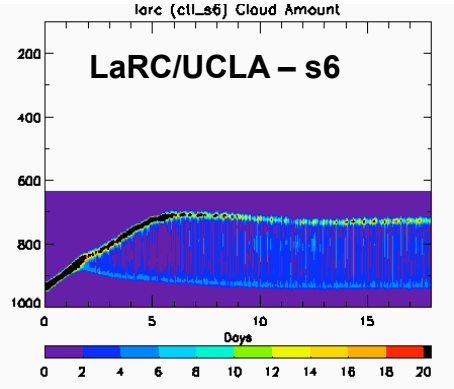
In all 2-D plots that follow,
the ordinate is pressure, the abscissa is time in days

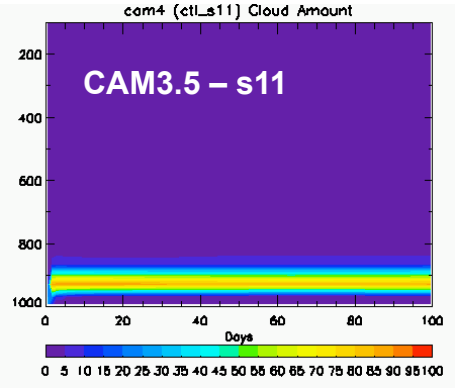
# Cloud Amount in Control Simulation

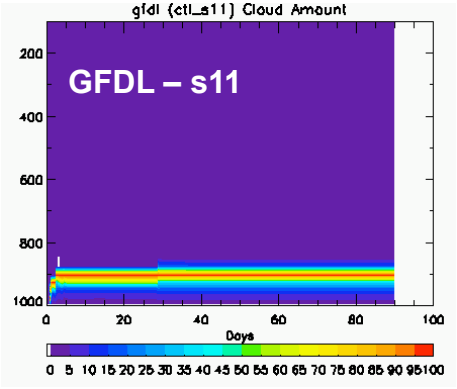


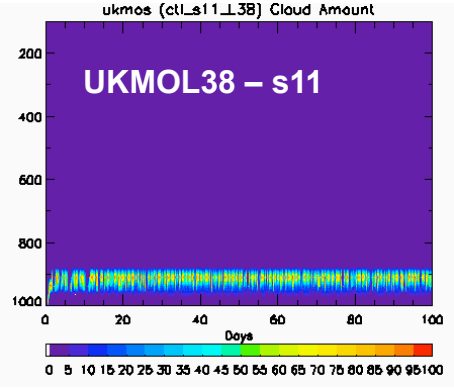



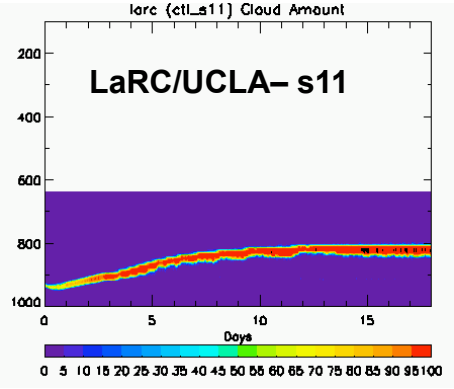



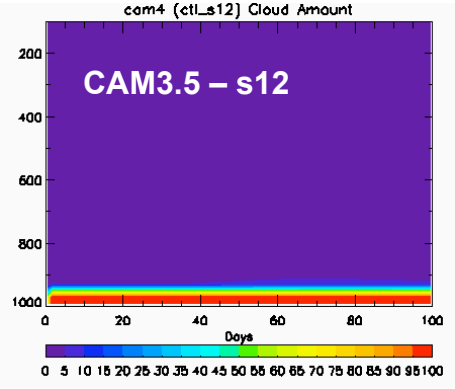



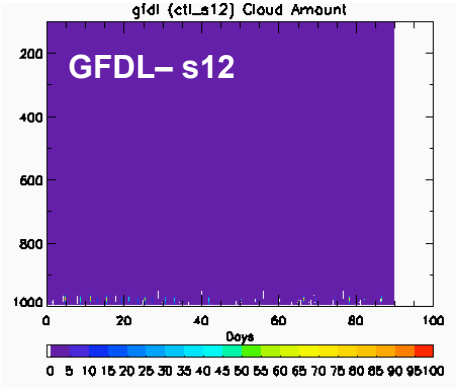



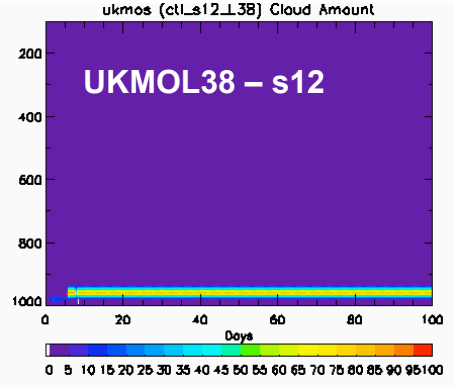



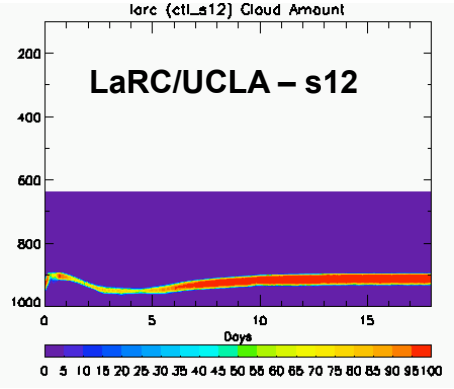



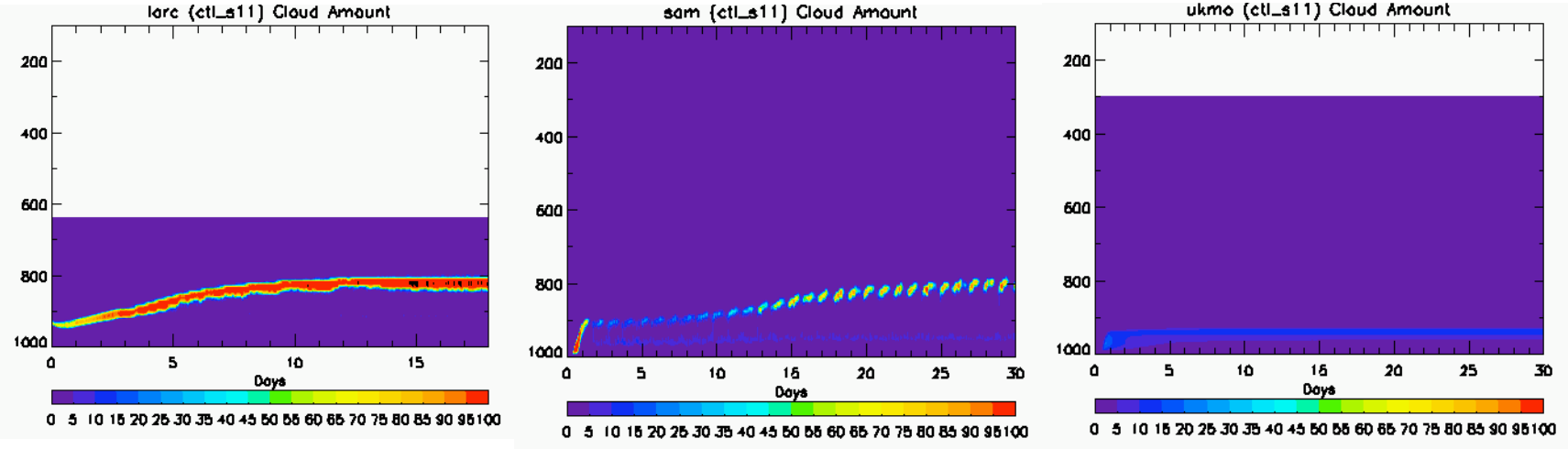



# Cloud Amount in Control Simulation at s11: LES results profoundly disagree

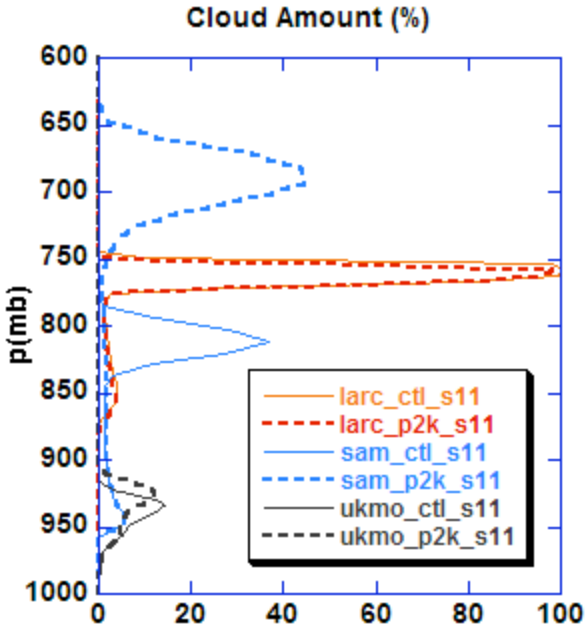


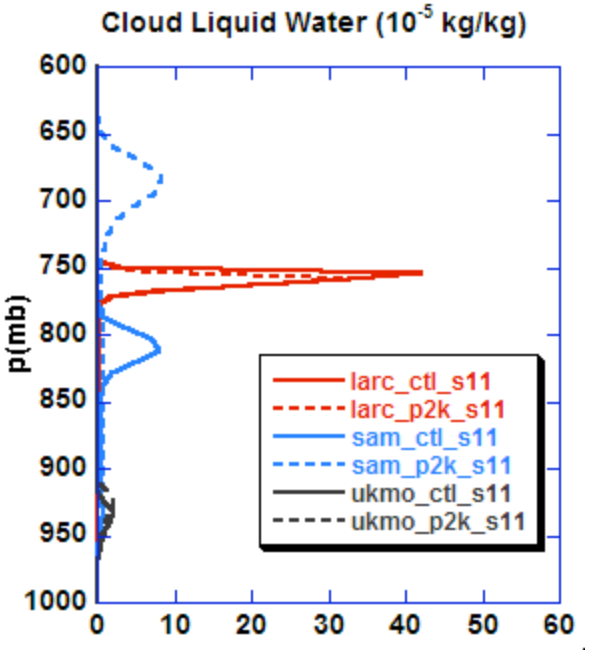

...we still don't really understand why

This is an issue for CMMAP, which is founded on the assumption that LES/CRM can lead to more reliable modeling of cloud/climate interactions.

# LES Vertical Profiles at S11

Control (ctl, solid) and Perturbed (p2k, dashed)




+2K response:

LaRC: No $z_{inv}$ change, thinner cloud, weak positive $\Delta$CRF

SAM: Large $z_{inv}$ rise, more cloud, negative $\Delta$CRF

UKMO: Small $z_{inv}$ rise, less cloud, positive $\Delta$CRF

Thus the LES do not even agree on the sign of the predicted low cloud response

# What's Next?

- New LES participants still welcome.

- Interpretation of the LES results
  - Control slow free-trop T drift ($\omega$ -feedback?)
  - All use same radiation (RRTM interface - Blossey)
  - Workshop planned at SUNY in November.

- Analyze LES cloud response mechanisms and their observational testability.

- Do SCM/GCM cloud responses reflect same mechanisms?