

# Wind Shear Effects on Cloud-Radiation Feedback Simulated by the MMF

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## Motivation

- In the tropical west Pacific,
- Saxen and Rutledge (2003): vertical wind shear decreases cloud overlap and increases cloud cover in tropics.
- Lin and Mapes (GRL, 2004):
  - Vertical wind shear reduces outgoing longwave and increases upward solar flux by tens of  $W\ m^{-2}$ .
  - Cumulus schemes in current climate models neglect this effect and hence climate models fail to produce it.
- The MMF explicitly simulates the influence of wind shear on cloud dynamics and hence should produce a more realistic dependence of cloud overlap, cloud cover, OLR, and solar flux on wind shear.

A four year MMF simulation is available to test this hypothesis.

## Methodology

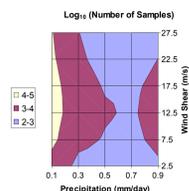
MMF is the CSU version in the NCAR CAM3, run at  $2^\circ \times 2.5^\circ$  resolution. Radiative fluxes are calculated for each CRM column and averaged over all columns in the grid cell. Wind shear between 200 and 850 hPa is for the grid-cell mean wind vector.

Stratification: OLR and solar fluxes are strongly influenced by the intensity of the convection. To separate this influence from the influence of shear, we stratify the data by the gridcell mean precipitation rate, which is a measure of convective intensity.

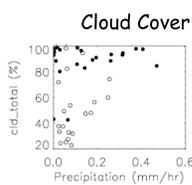
Sampling strategy: To increase the sample size, we select 3-hrly data from nine columns within the TOGA COARE region 2S-2N, 150E-160E from four years of simulations.

## Conclusions

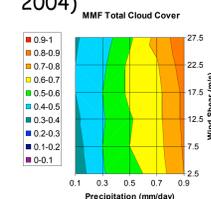
- We find only weak support for the hypothesis that the MMF simulates the influence of vertical wind shear on clouds and radiative fluxes more realistically than a conventional cloud and radiation parameterization.
- The cyclical boundary conditions in the CRMs may play a role in suppressing the influence.



The sample size ranges from 200 to 24,000.

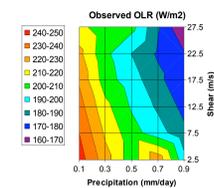


Cloud cover from ISCCP is much greater for strong shear (solid circles) than for weak shear (open circles). (Lin and Mapes, 2004)

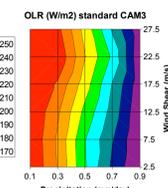


Total cloud cover simulated by the MMF is related much more to precipitation than to wind shear.

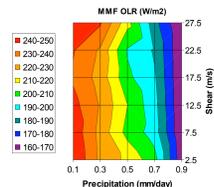
## Outgoing Longwave Radiation



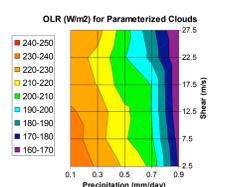
Observed OLR decreases with increasing wind shear and precipitation.



OLR simulated with standard CAM3 increases with increasing wind shear.



OLR simulated with MMF is weakly related to wind shear.



OLR determined from parameterized clouds in the MMF simulation has a shear-dependence more similar to the CRM clouds than to the standard CAM3.