On Improved Representation of MBL Clouds in ARW–WRF with a Modified Tiedtke Cumulus Parameterization Scheme

Yuqing Wang and Chunxi Zhang

International Pacific Research Center
University of Hawaii at Manoa, Honolulu, Hawaii

PreVOCA regional simulations using WRF

- UCLA and UCHILE both used ARW-WRF as the regional climate model. Their mean *geographic distributions of cloud fraction and boundary layer depth are biased* compared to the observations.
- iRAM (IPRC Regional Atmospheric Model) has shown its skill in simulating marine low-clouds over the eastern Pacific.
- Can improved WRF simulation of low-clouds be achieved using iRAM's modified Tiedtke Cu parameterization?

4. Implementation of a modified Tiedtke scheme into ARW– WRF

- Tiedtke (1989), moisture convergence closure
- Nordeng (1995), CAPE closure
- Roeckner et al. (1996), ECHAM4, cloud-top detrained hydrometeor partitioned into liquid and ice phases

$$f_{liq} = a + (1-a)e^{-b(T-T_0)^2}$$

- Wang et al. (2003), convective trigger $\overline{RH} \geq RH_c$
- Wang et al. (2004, 2007), adjusted entrainment rates for shallow/deep convection based on LES results.

5. Model Configuration and Experimental design

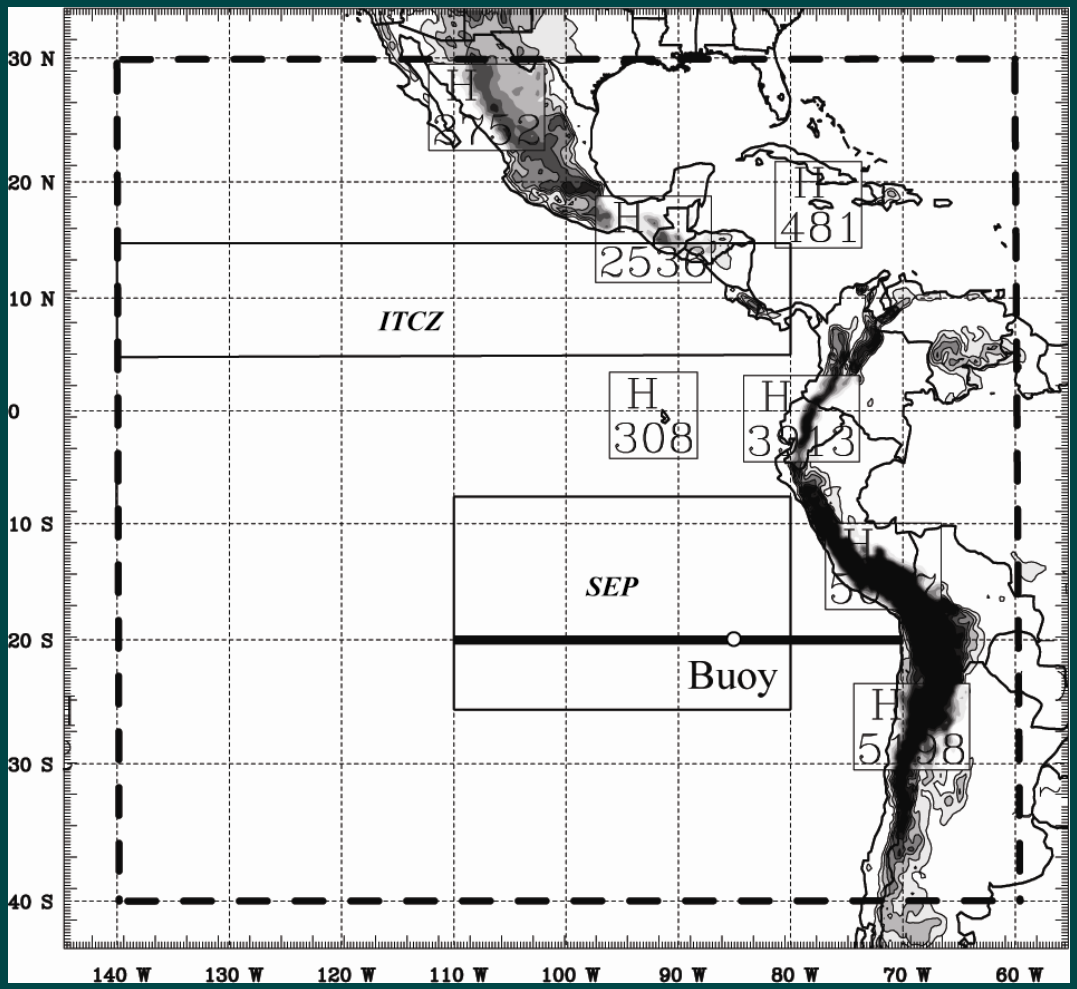
ARW– WRF version 3.2.1
October 2006

27 km horizontal resolution and
31 full σ-levels in the vertical
(14 levels below 700hPa and
model top at 50hPa)

320*300 horizontal grid points
9 grid points in the buffer zone on
each side

Physics Schemes

Cloud microphysics: WSM6
Land Surface Model: Noah
Short and long wave radiation: CAM
Daily SST update,
Diurnal cycle in SST
Gravity wave drag

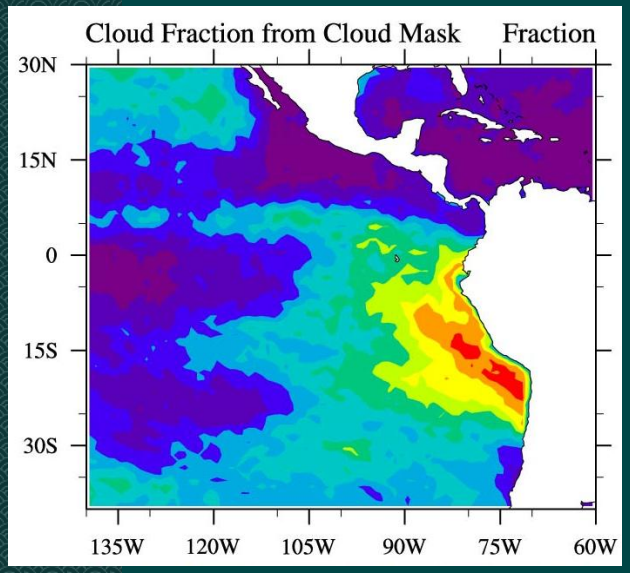


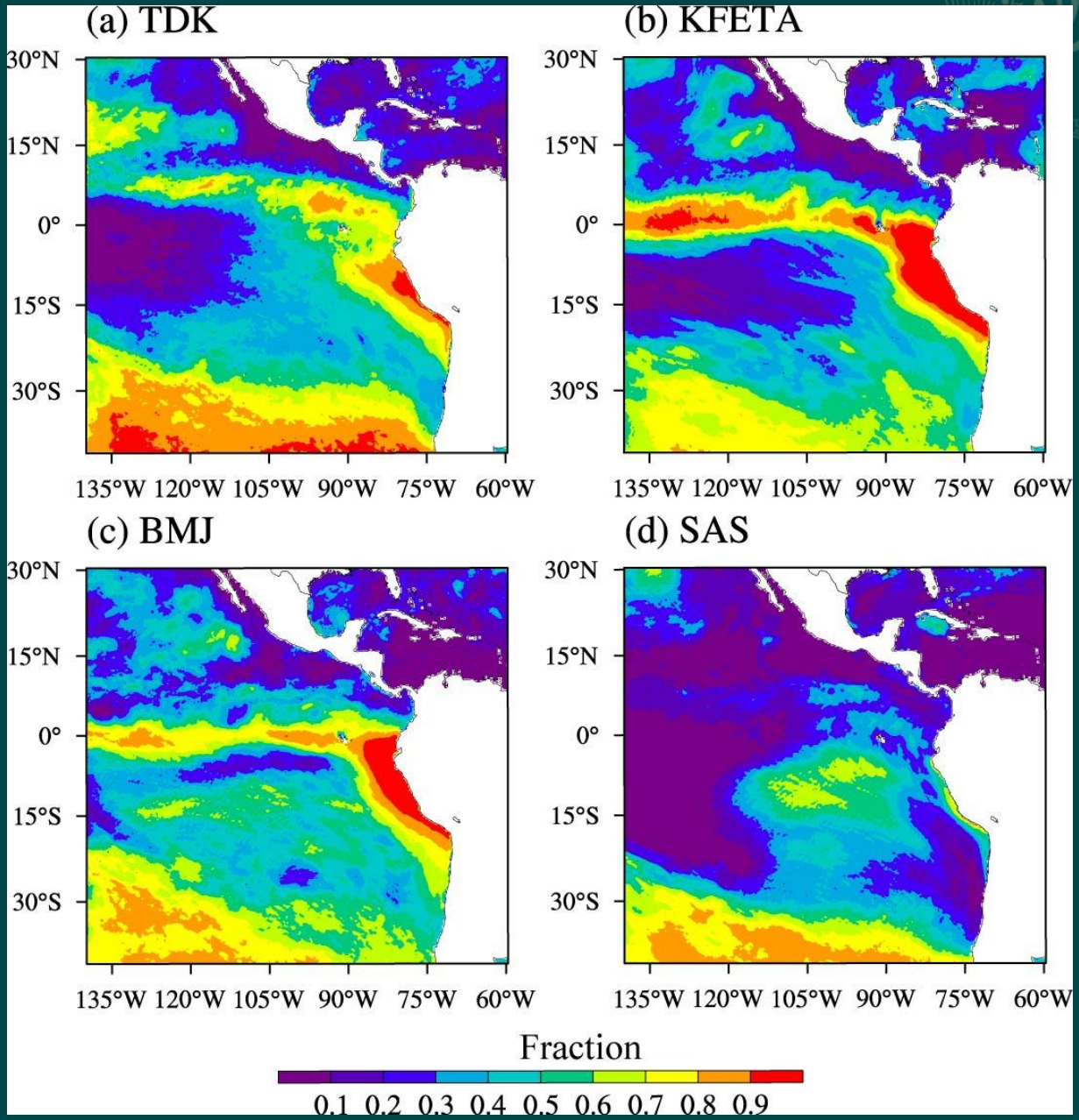
Cloud fraction below 3km height

Cu param affects SE Pac cloud frac

Tiedtke scheme also reduces E Pac circulation biases

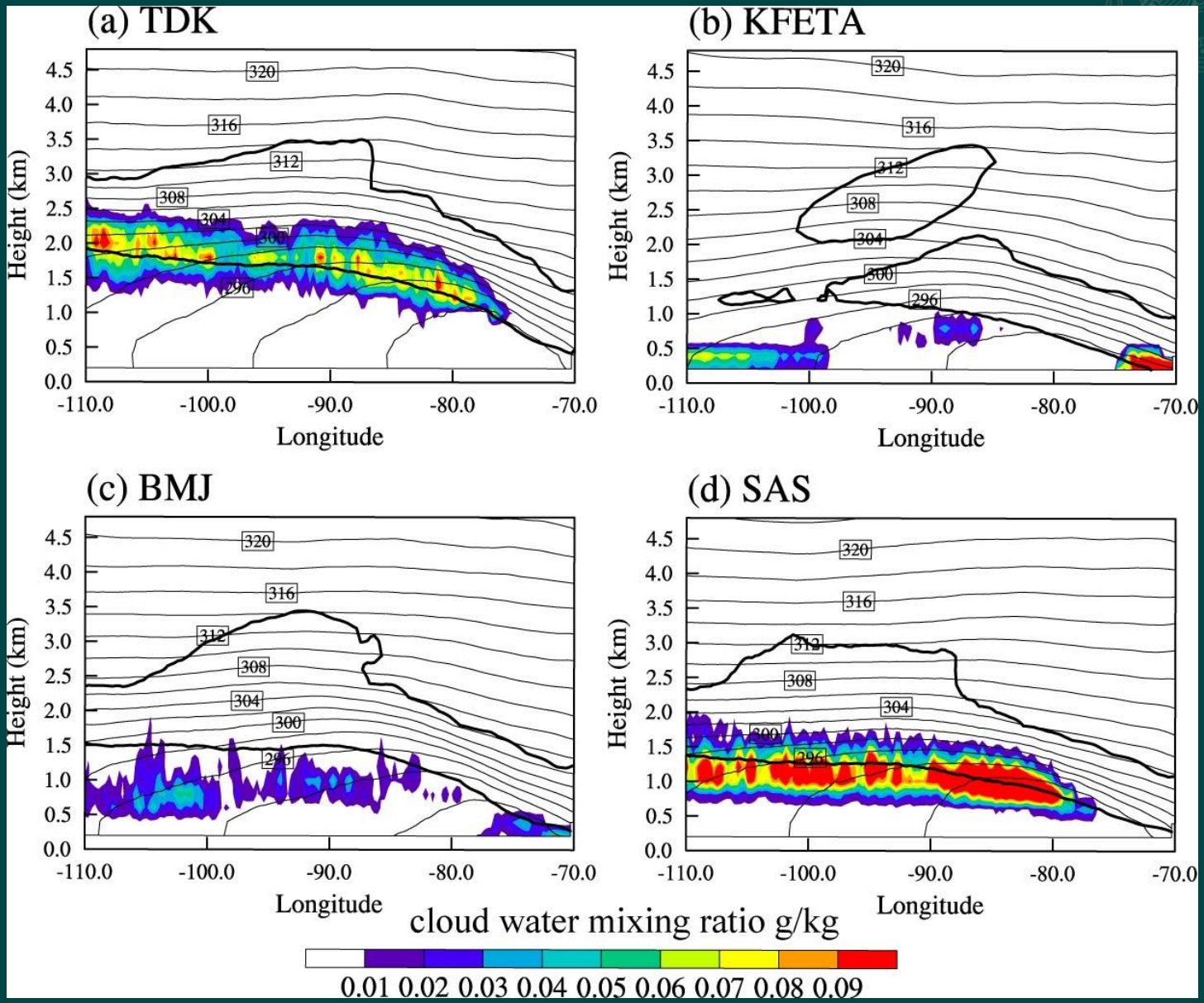
MODIS cloud fraction





Cu param strongly affects 20S vertical structure

5 days mean (Oct 16 - 20)



Cloud fraction below 3km height

PBL scheme has less impact on SE Pac cld frac, LWP

MODIS cloud fraction