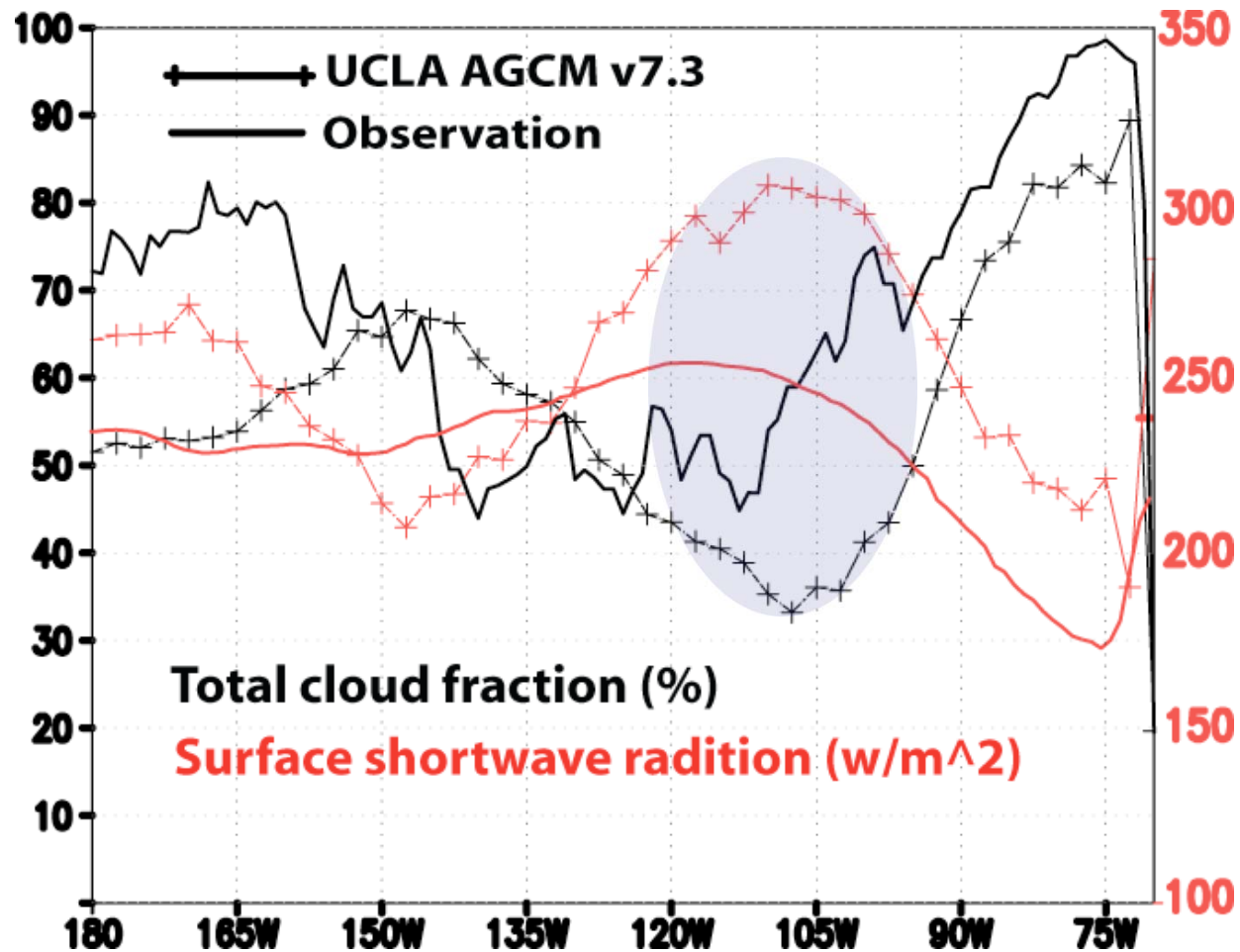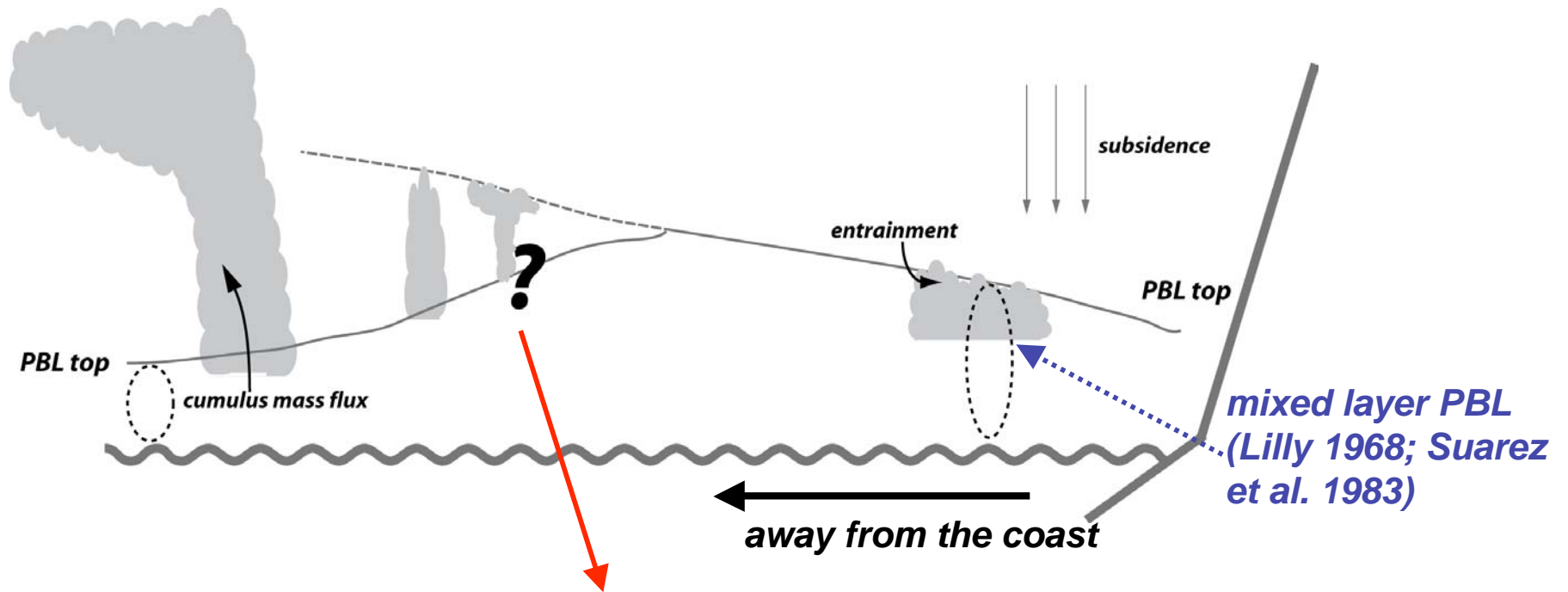# Transition from stratocumulus to shallow cumulus regimes in the UCLA AGCM

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October total cloudiness and surface shortwave radiation along 20ºS

What to improve in the model?

The cloudiness in the region where transitioning from stratocumulus to shallow cumulus happens most frequently is not well simulated.

We need to better simulate the breakdown of stratocumulus regimes and its "aftermath" in the AGCM.

We can diagnose breakdown of the stratocumulus regime when

the cloud top (PBL top) becomes unstable to entrainment mixing
(Cloud top entrainment instability (CTEI), Deardorff 1980; Randall
1980 (CIFKUD));
- originally in the model
- large-scale parameter, does not consider response of cloud-
turbulence structure in PBL

or when
the cloud-topped mixed layer structure can not be maintained
(negative buoyancy flux at cloud base level (decoupling), Wyant et
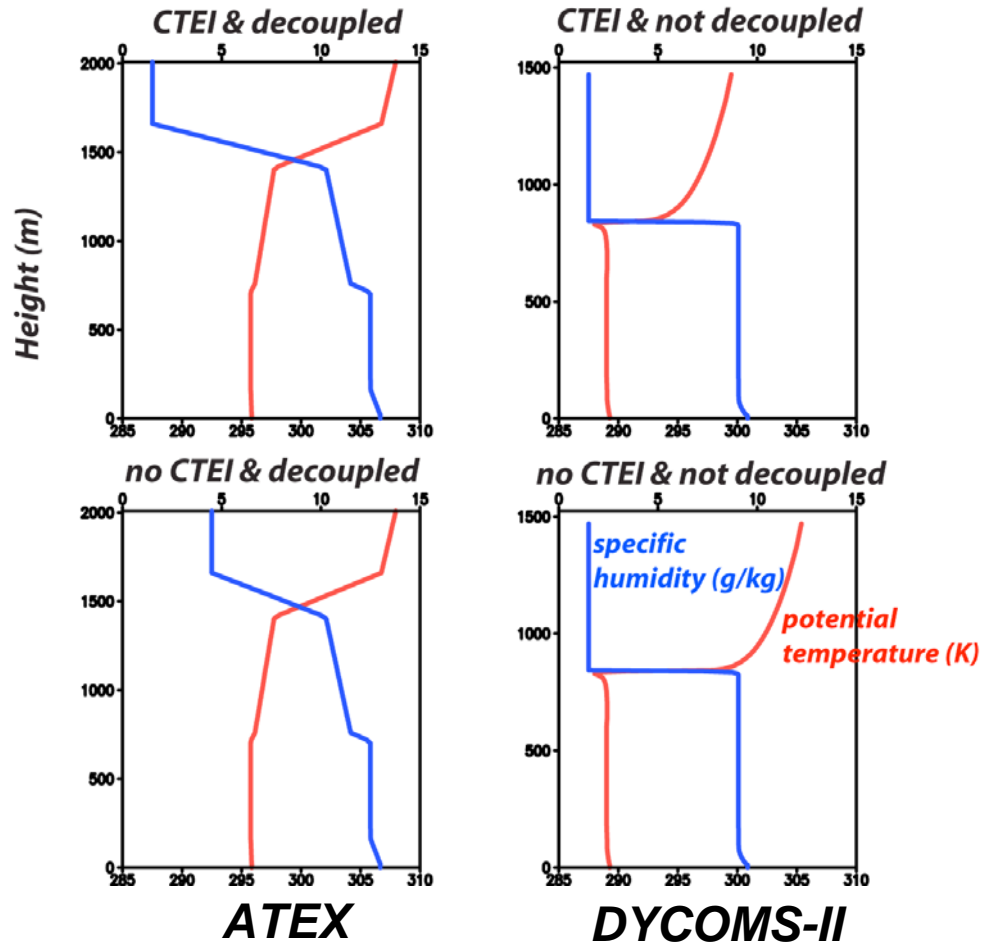**al. 1997; Bretherton and Wyant 1997).**
- experimental addition
- dependent on entrainment formulation
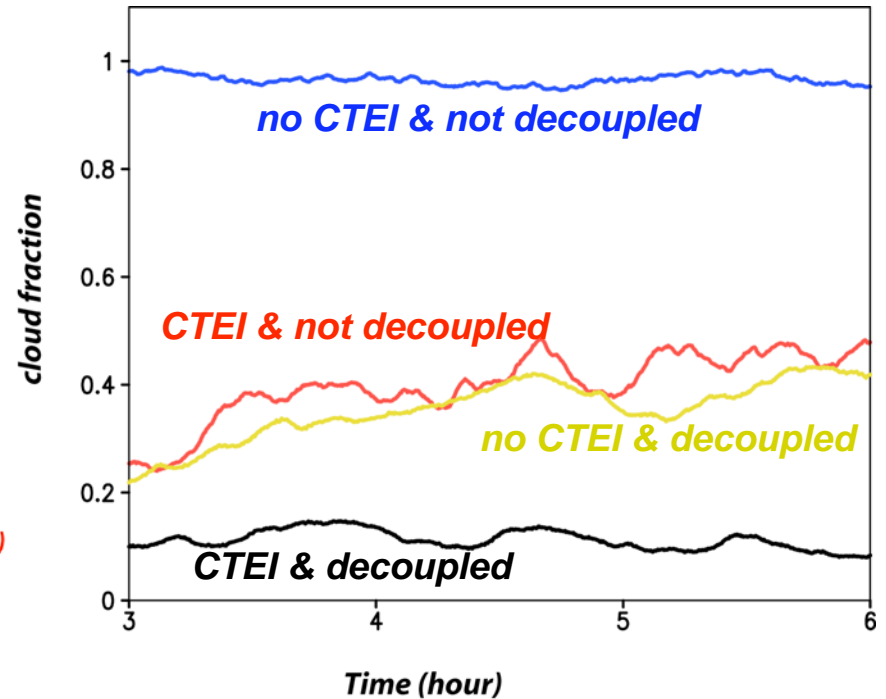
How do we deal with the "aftermath"?

• **relax the well-mixed assumption in the PBL**

• *decouple the cloud layer from the subcloud layer and then*
parameterize the cloud-turbulence structure in the cloud layer
separately (or shallow cumulus schemes?)

Hints from LES simulations

Initial profiles

CTEI & decoupled

CTEI & not decoupled

no CTEI & decoupled

no CTEI & not decoupled

Height (m)

specific humidity (g/kg)

potential temperature (K)

ATEX

DYCOMS-II

Cloud fraction after 3 hrs

no CTEI & not decoupled

CTEI & not decoupled

no CTEI & decoupled

CTEI & decoupled

cloud fraction

Time (hour)

Significant and persistent cloud cover can be maintained when only one criterion is met.

We start with the simplest revision for a test:

Diagnose the breakdown of stratocumulus PBLs only when both CTEI and decoupling conditions are satisfied.

If breakdown is diagnosed, relocate the PBL top to the cloud base level. Treat the separated cloud layer as "large-scale" clouds in the free atmosphere.
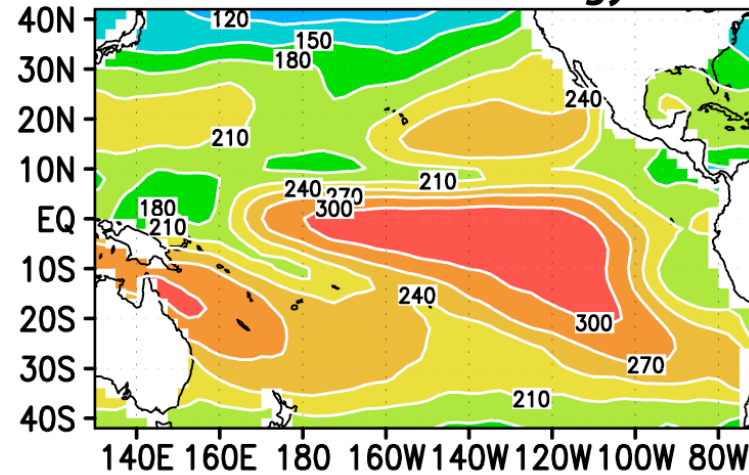
Preliminary results from UCLA AGCM

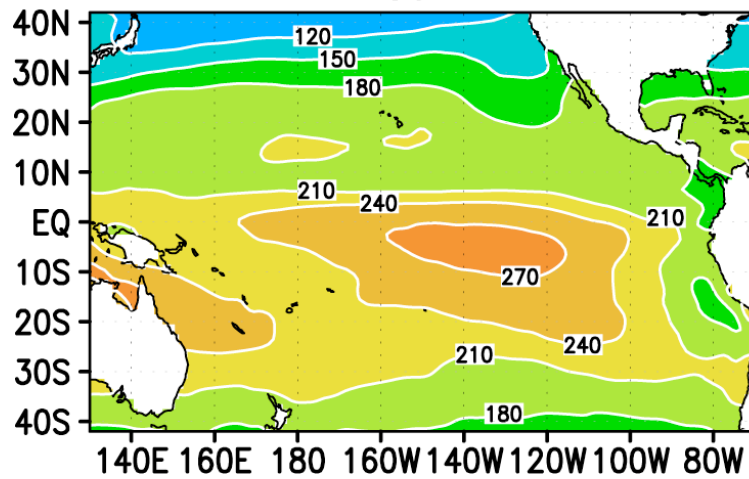## October mean surface shortwave radiation ($w{\cdot}m^{-2}$)
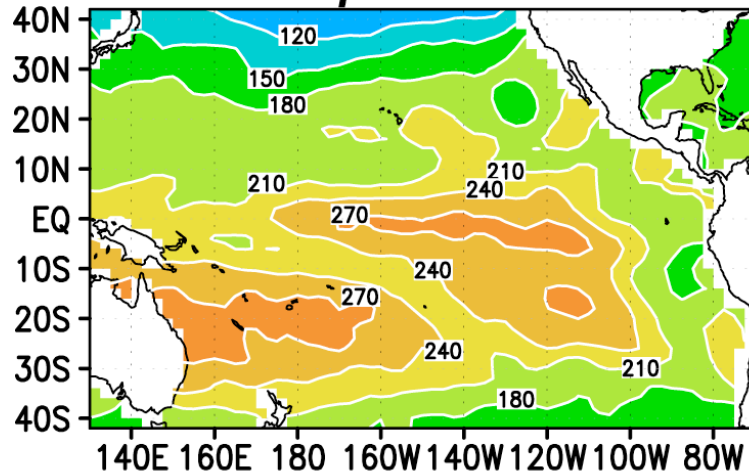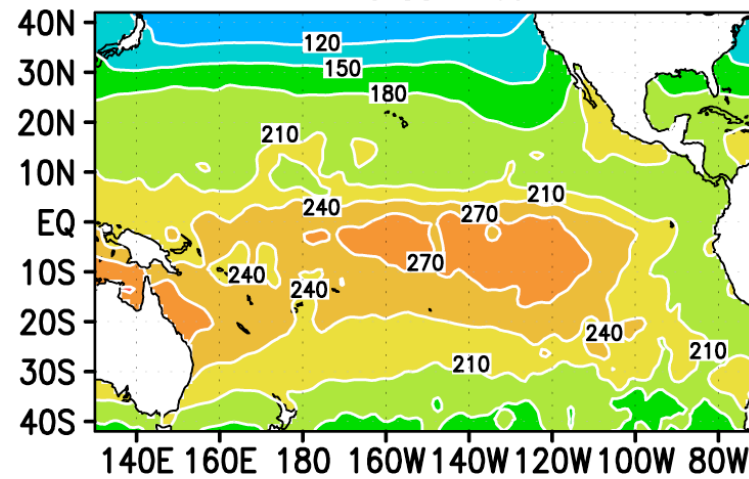
Things to do …

• *explore observational data to study the cloud structure and variability in the "transitional" region and analyze the LES simulations in more details to improve parameterization of the "aftermath", e.g., characterizing the cloud-turbulence structure in the decoupled cloud layer (TKE, cloud layer mixing length scale …);*

• *explore the impact on cumulus parameterization and the need to improve cumulus parameterization. Will shallow cumulus grow out of the "aftermath" of the breakdown?*

October surface fluxes along 20°S

(following Simon de Szoeke)