A CPT (Climate Process Team) for Improving the Representation of Stratocumulus to Cumulus Transitions in the CAM

AMWG-CCSM Meeting

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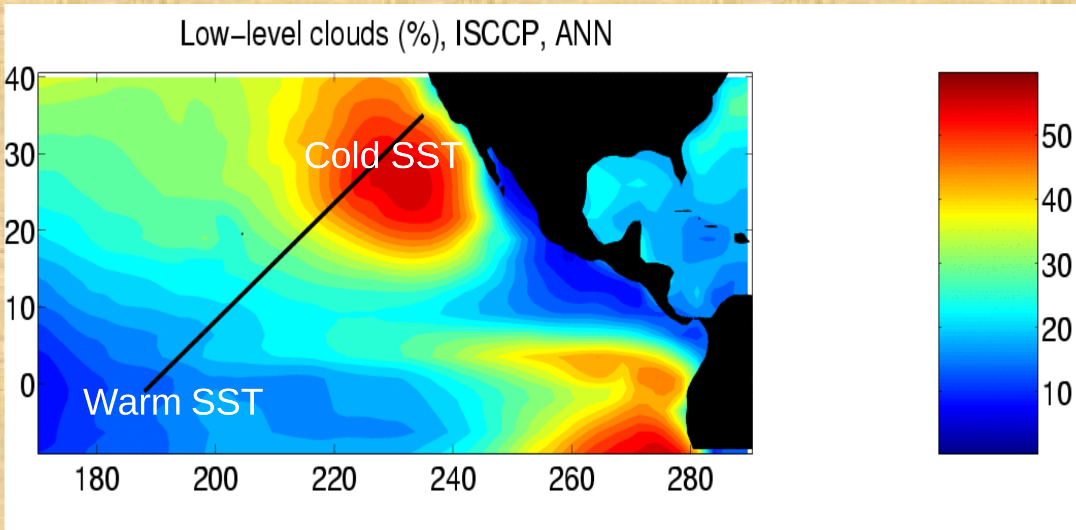
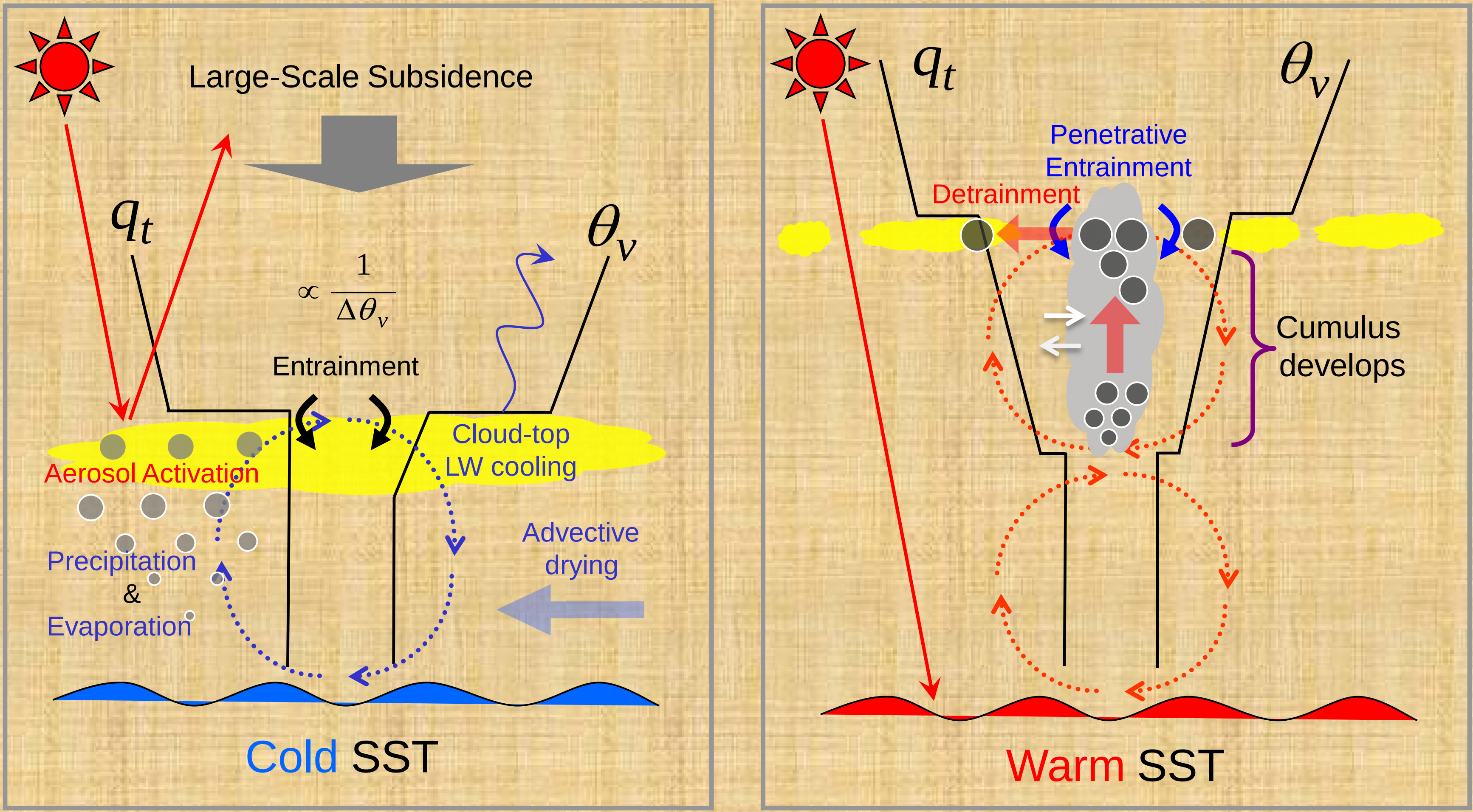
Stratocumulus-Cumulus Transition CPT

- GOAL: *Improve the representation of cloud processes in global weather/climate models with a focus on the subtropical stratocumulus to cumulus (Sc-Cu) transition*

- NOAA funded ($680K/yr), 1 July 2010 – 30 June 2013



Stratocumulus to Cumulus Transition



• Correct simulation of Sc-Cu transition is a really challenging issue since it requires to correctly simulate many (virtually *all*) physical and dynamic processes and interactions between them.

• Due to positive 'Stratocumulus-SST' feedback, it can have substantial impact on the coupled atmosphere-ocean system (e.g., ENSO).

- **JPL**
  Joao Teixeira (Lead PI), Marcin Witek
  EDMF Implementation in GFS

- **U. Washington**
  Chris Bretherton (PI), Peter Blossey, Matt Wyant, Jennifer Fletcher
  NCEP and NCAR Parameterization Development Advise
  LES / NCEP SCM runs of GCSS Sc-Cu and other cases
  Evaluate GFS / CAM5 forecast runs for Azores, VOCALS

- **UCLA**
  Roberto Mechoso (PI), Heng Xiao
  Sc-Cu Impact on ENSO, Ocean Coupling

- **NCEP**
  Hua-Lu Pan (PI), Jongil Han, Ruiyu Sun
  Development and Evaluation of Moist Physics and Shallow Cu for GFS/CFS.

- **LLNL**
  Steve Klein (PI), Peter Caldwell
  PDF-based Stratus Scheme for CAM5

- **NCAR**
  Sungsu Park (PI), John Truesdale, Cecile Hannay
  Further Development of CAM5 Moist Turbulence / Convection / Macrophysics Schemes
  SCAM / CAM5 Forecast Runs and Diagnostics

CAM5+ Model Development Plan
(Moist Turbulence / Cloud Macrophysics / Convection)

❑ Extension of Moist Turbulence Scheme

• CAM5 shut-off turbulences if $Ri > Ri_c = 0.19$.
→ Relax Ri_c by using a more generalized stability function.

❑ Consistent Cloud Macrophysics

• CAM5 uses *diagnostic* stratus fraction and *prognostic* condensation with a *fixed* width of q_t-PDF (e.g., rhminl = 0.89).
→ Compute *diagnostic* stratus fraction and *diagnostic* condensation using a single PDF of q_t and θ_l with *internally-computed* PDF width.

• CAM5 uses *diverse* vertical cloud overlap structures.
→ Develop a *single* cloud overlap structure for all physics schemes.

❑ Convective Transport of Cloud Droplet Number (n_l):

• CAM5 uses *prescribed* effective droplet radius (r_e) for convective condensate.
→ Develop (1) *explicit* convective transport algorithm for n_l and (2) r_e-dependent cumulus microphysics.

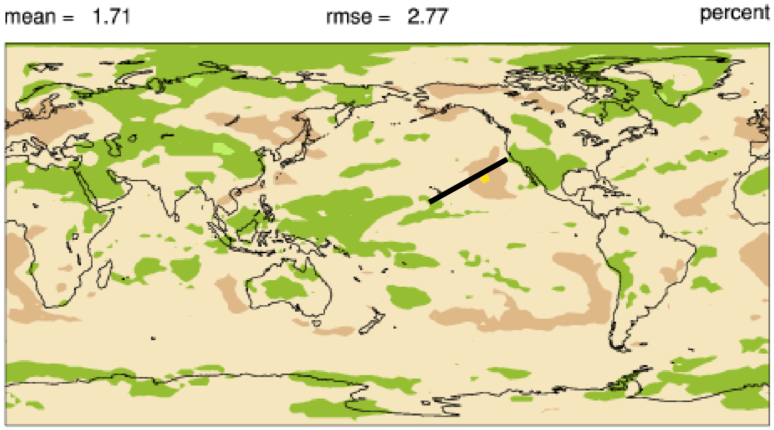
❑ Unified Convection Scheme

• CAM5 uses *separate* shallow and deep convection schemes.
→ Develop a *unified* convection scheme.

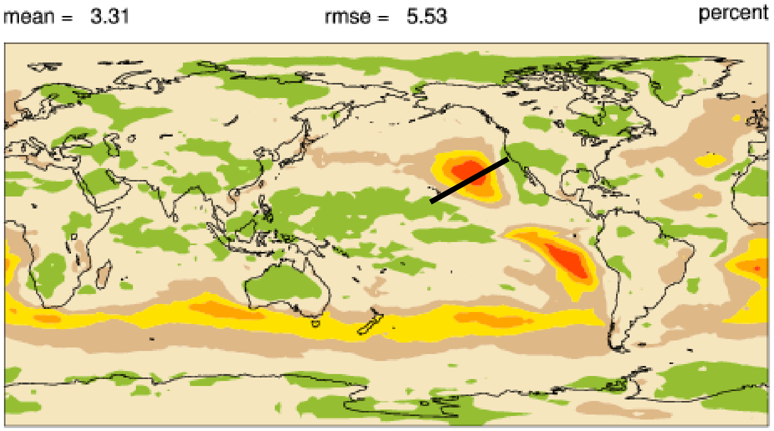
Δ CLDLOW

'Moist Turbulence', 'Shallow Convection', 'Cloud Macrophysics'

Reduce Entrainment at the Sc-Top



Reduce Convective Penetrative Entrainment



Δ ('*Targeted* Detrainment' – '*Random* Detrainment')