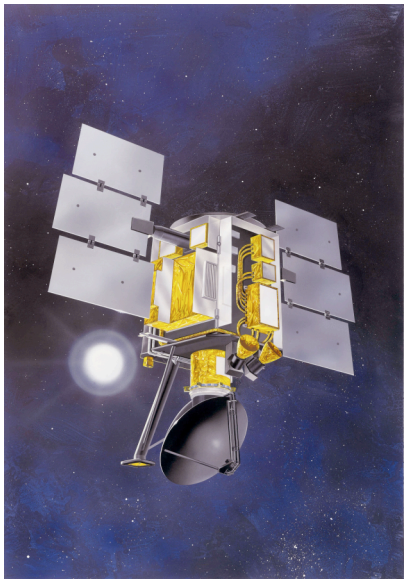
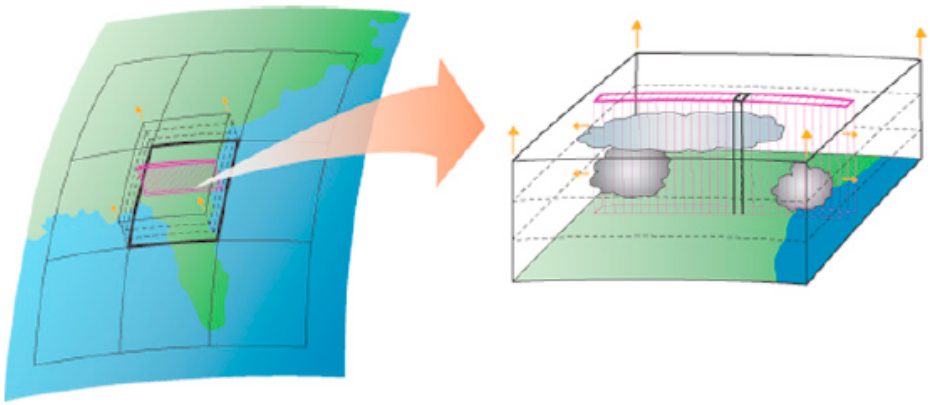
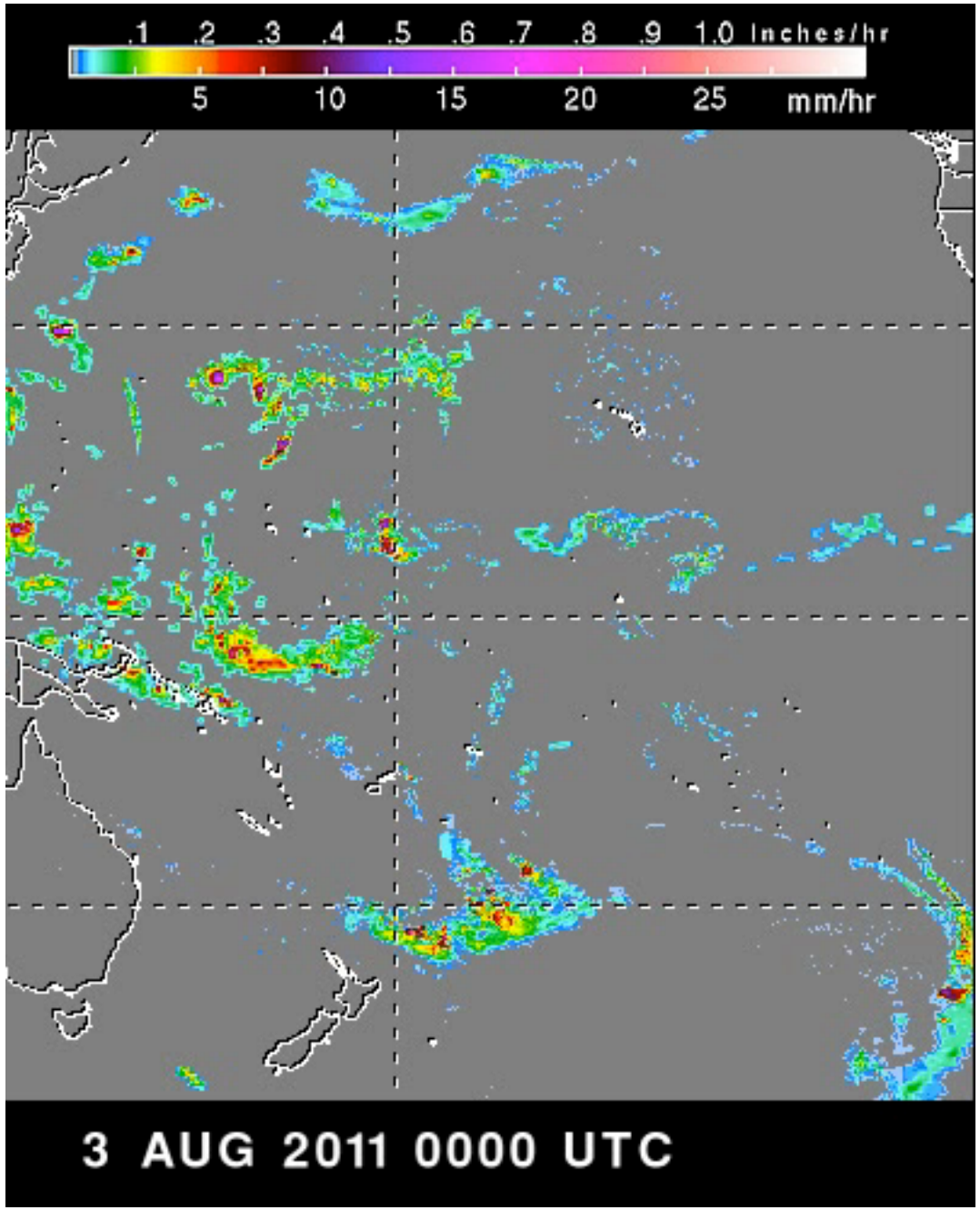




Investigating the Short Timescale Transition from Light To Heavy Rainfall in the Tropics

Greg Elsaesser, CSU
Chris Kummerow
Physical Processes Breakout Session



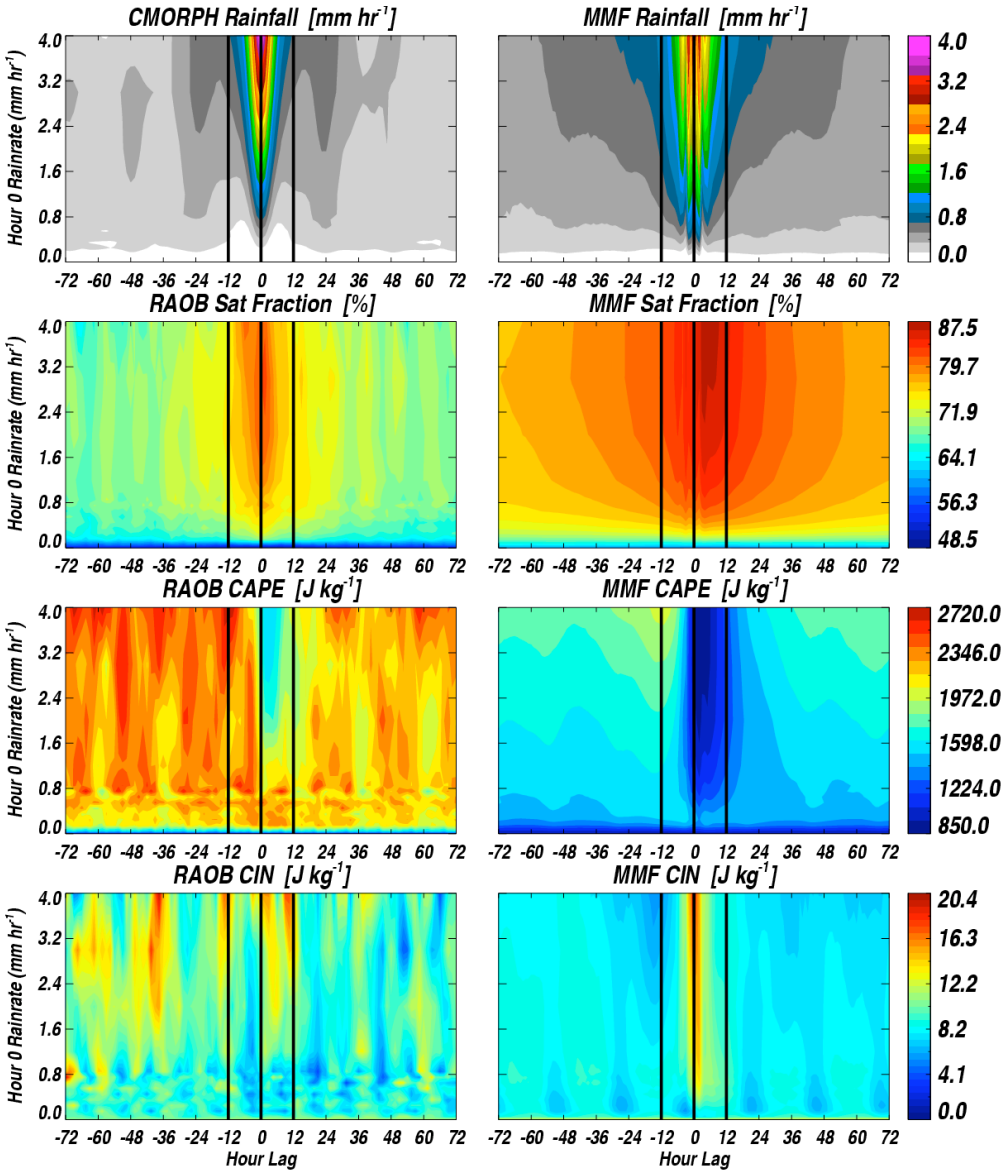
Different lifecycles of rainfall - many weak amplitude cycles (mostly diurnal); others exhibit much more variation (associated with traveling waves?)

Investigate these varying amplitude rainfall cycles from combined observational and multiscale modeling framework.

- **Use 3-hourly CMORPH rainfall product, collocated with island-based radiosonde observations (RAOB). For each RAOB site, compute temporal (± 72 hrs) composite of rainfall and select environmental parameters centered on local maxima in 6-hr smoothed rainfall time-series.**

- **Perform same analysis on MMF output. MMF analyzed here is a version of CAM imbedded with SAM CRM (4 km resolution) coupled with slab ocean model (simulation output provided by Mark Branson and Jim Benedict)**

Results (OBS and MMF)

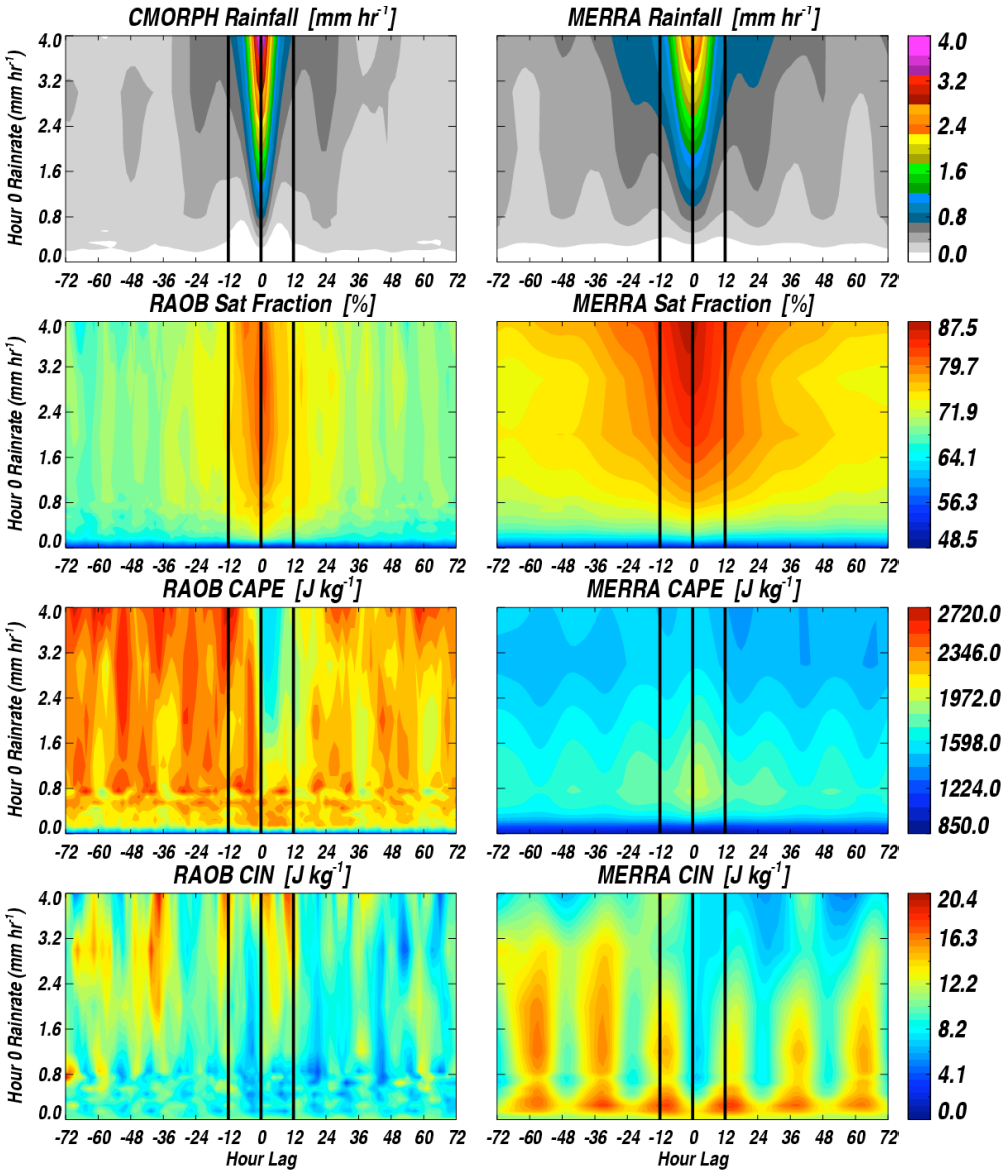


Rainfall lasts longer in the MMF.

Significant decreases in CAPE in presence of heavier rainfall; MMF reproduces this behavior well.

Substantial increase in CIN - in phase with rainfall in MMF; lagged in OBS.

Slight Tangent (OBS and MERRA Reanalysis)

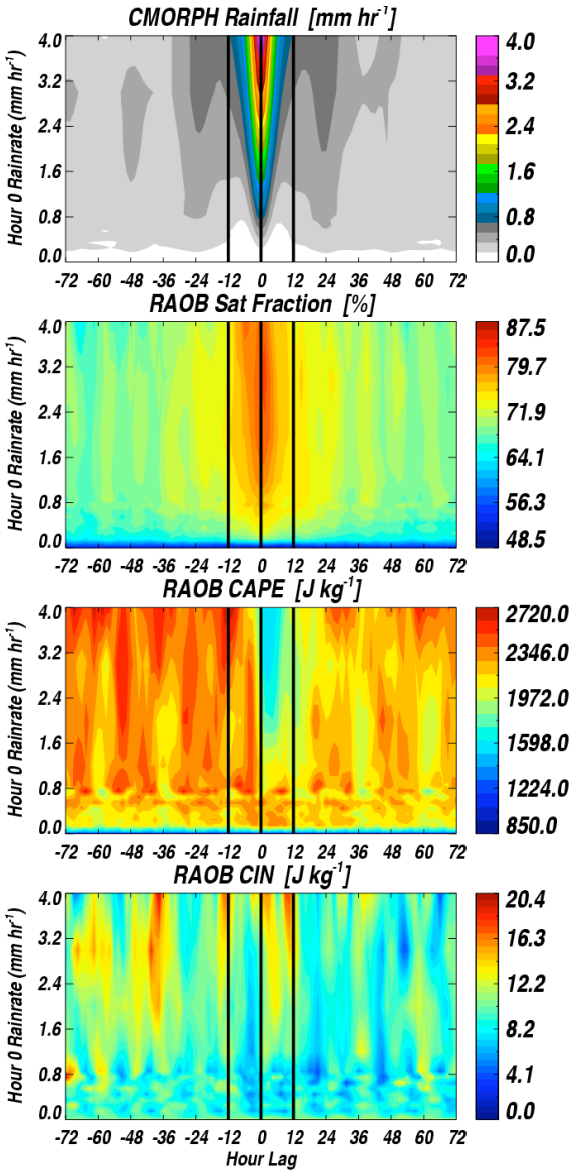


MERRA uses Relaxed-Arakawa Schubert for Convective Parameterization.

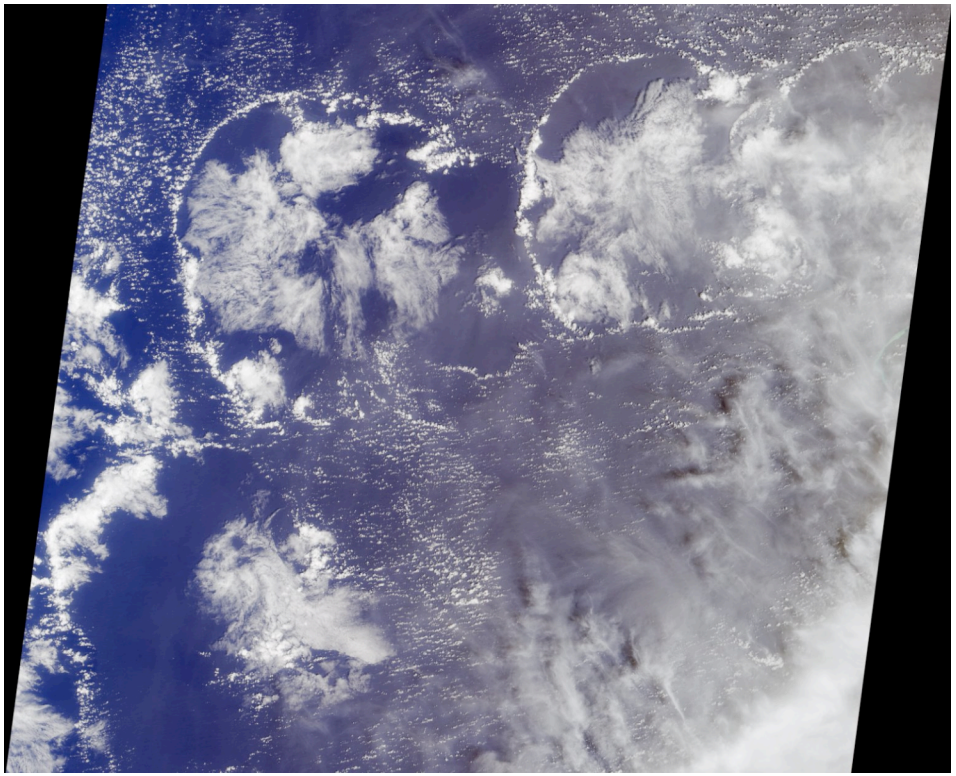
In contrast to OBS and MMF, MERRA shows little variation in CAPE (heavy rainfall likely occurs only in strong-forcing).

Minima in CIN during axis of heaviest rainfall, in contrast to OBS and MMF.

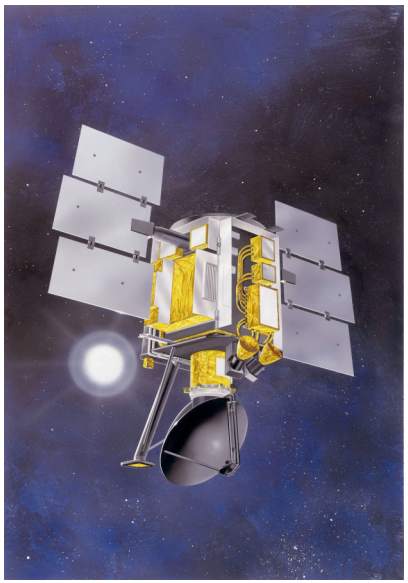
Why does rainfall increase when it does?

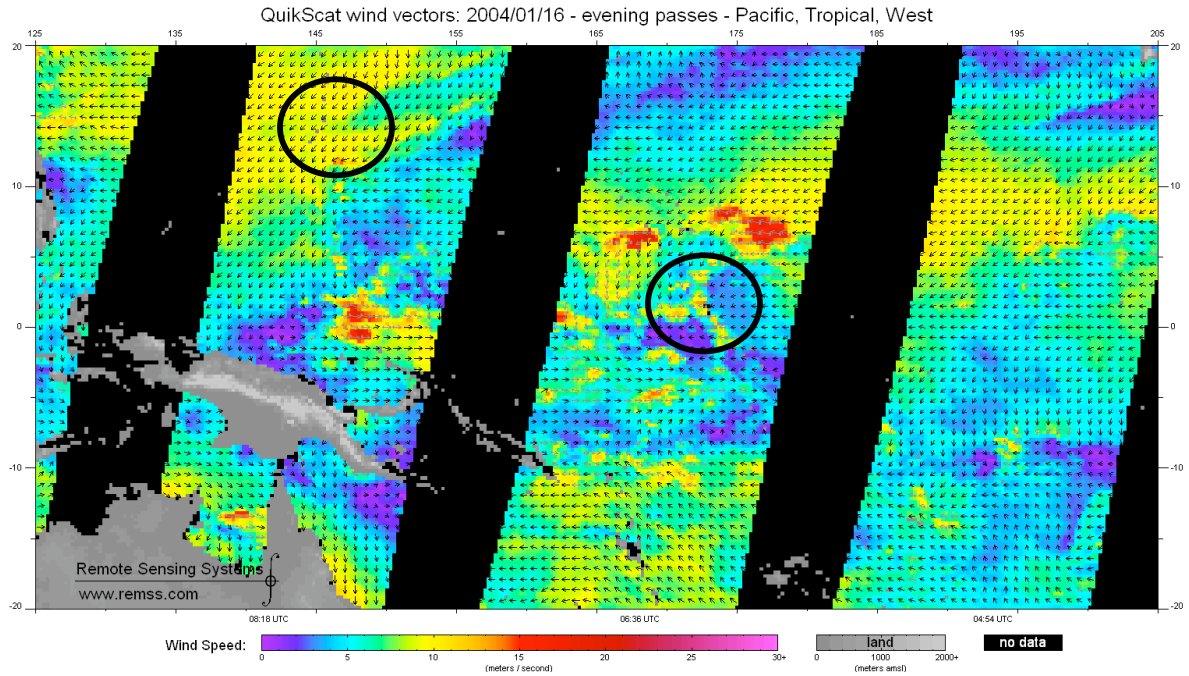


A number of possible reasons, but decided to investigate cold pools and the role they may play in rainfall increase…



Make attempt to observe from satellite (QuikSCAT) perspective



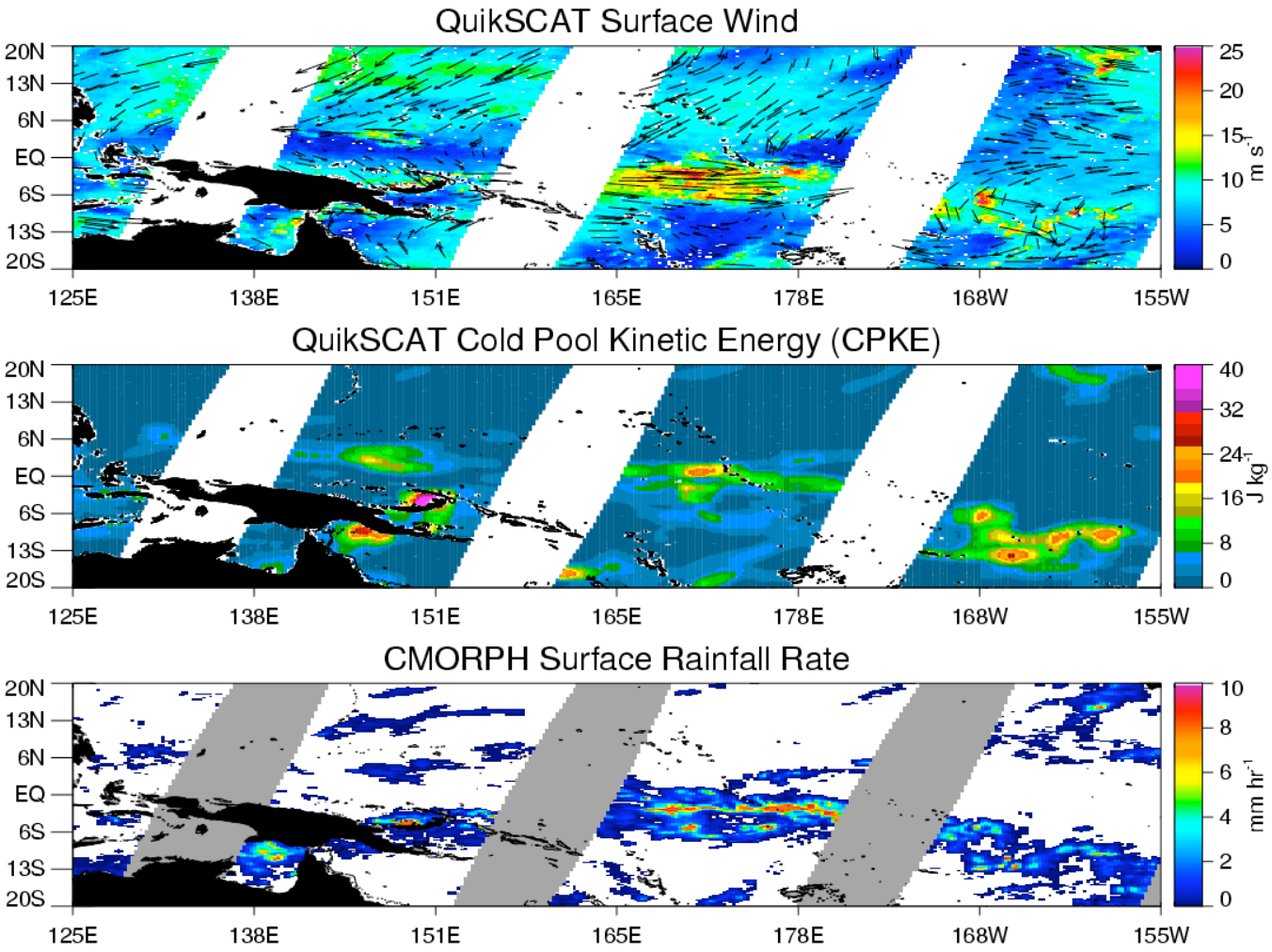


Look at mesoscale wind vector fluctuations; convert to an energy unit.

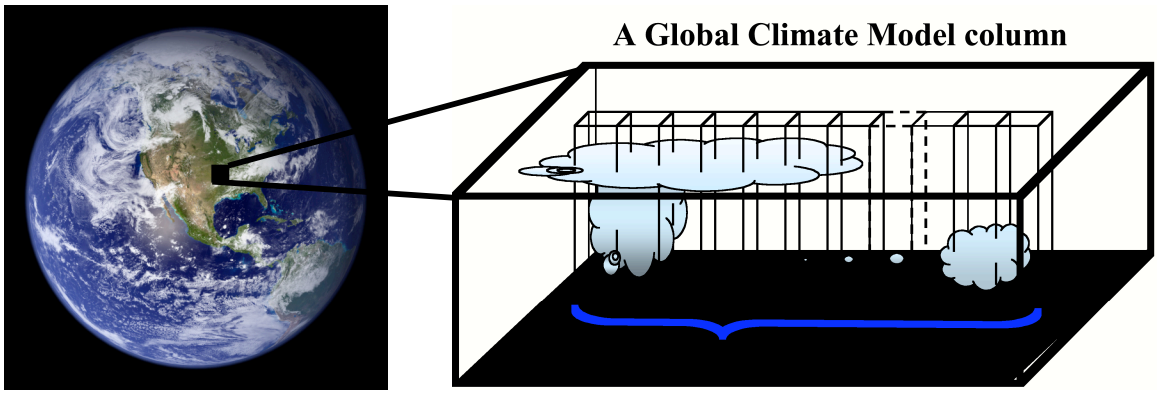
$$\frac{1}{2}\rho\left(\overline{u'^2} + \overline{v'^2}\right)$$

Call it cold pool kinetic energy (CPKE)

Snapshot of CPKE and Rainfall

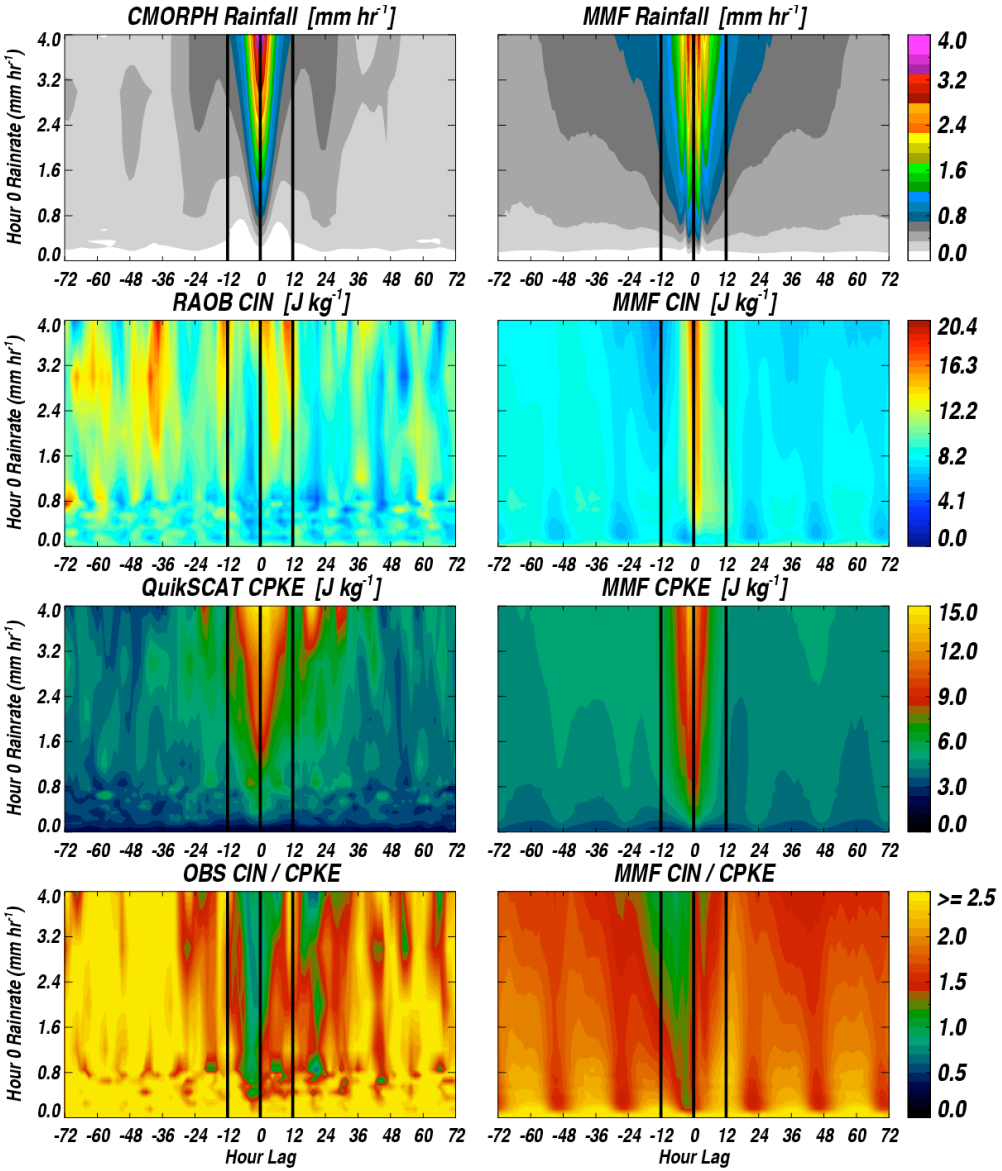


MMF Analog



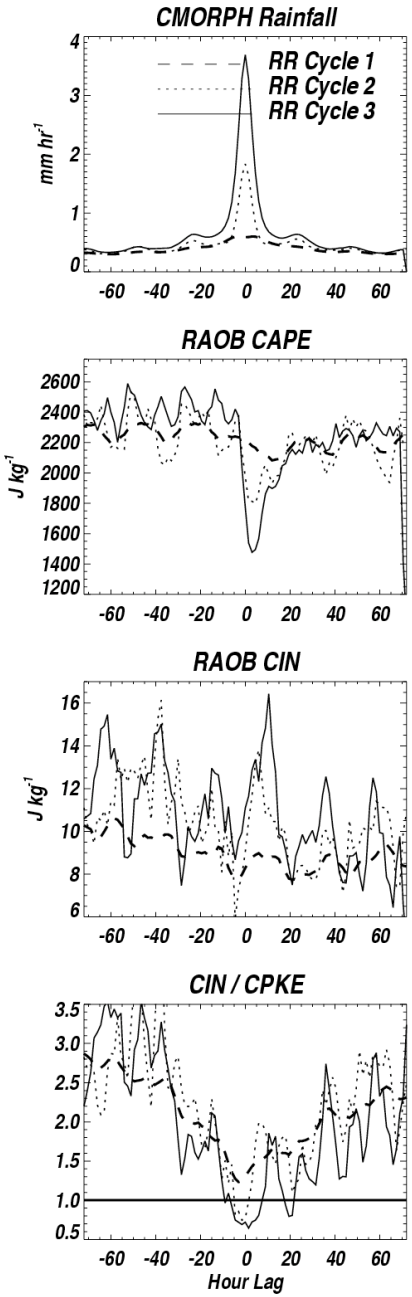
Derive CPKE through consideration of surface wind vector fluctuations over CRM domain in MMF.

Results (OBS and MMF)



Evaluate CIN in ratio to CPKE (cast within context of prior studies considering ratio of CIN / TKE).

Rainfall picks up when CPKE approaches magnitude of CIN.

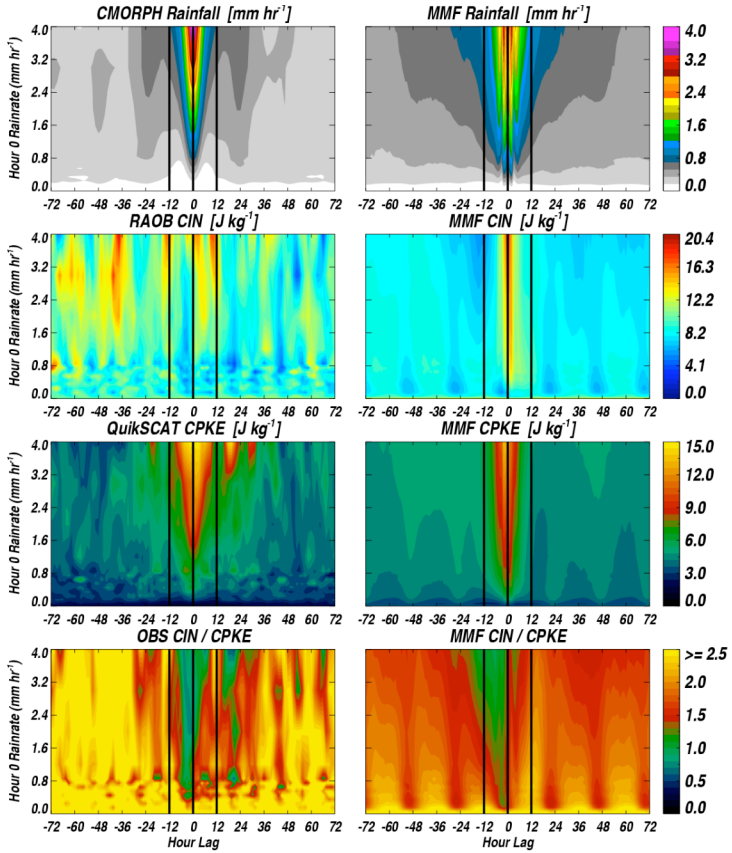


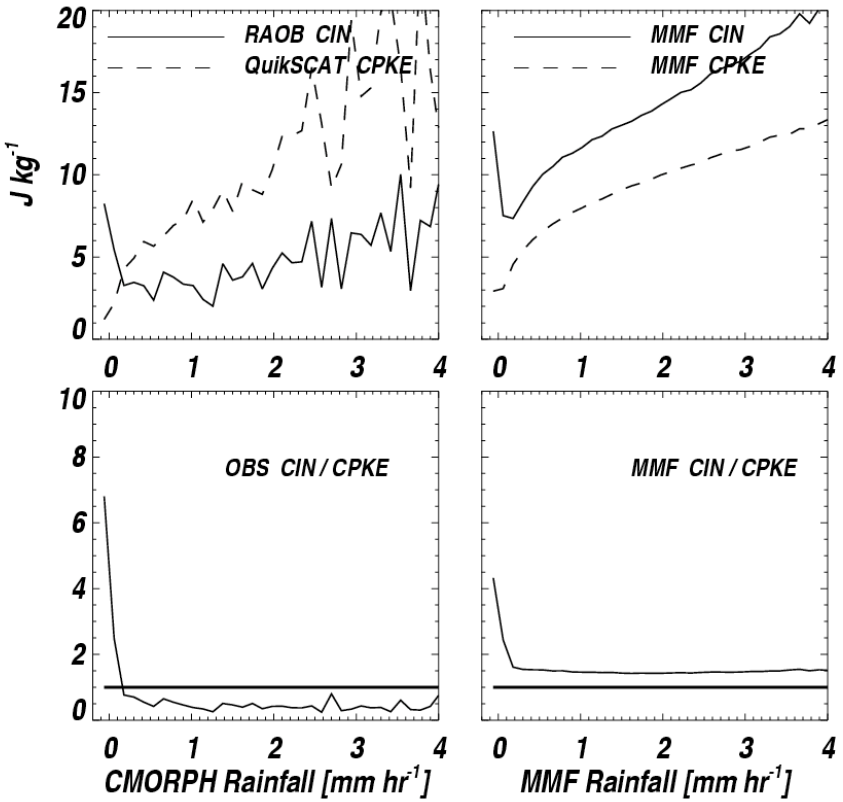
Time tendency for rainfall rapidly increases when CPKE approaches magnitude of CIN.

Also outlines the time during which CAPE decays.

Ratio approaches unity before minimum in CIN, which may be why rainfall begins drastically increasing before minimum in CIN is reached.

Conclusions





Framework of CPKE, CIN and rainfall time tendency applied to both OBS and MMF - MMF simulates OBS tendencies in many ways (CAPE, CIN, water vapor).

Rainfall lasts longer in MMF. Note the "redder" MMF CIN / CPKE panel (tighter coupling between rainfall, CPKE and CIN than in obs). Because the ratio is smaller overall, does this help to explain why rainfall lasts longer in MMF (quick to pick up, slow to end)?