ICE-T Planning: Lessons Learned from RICO

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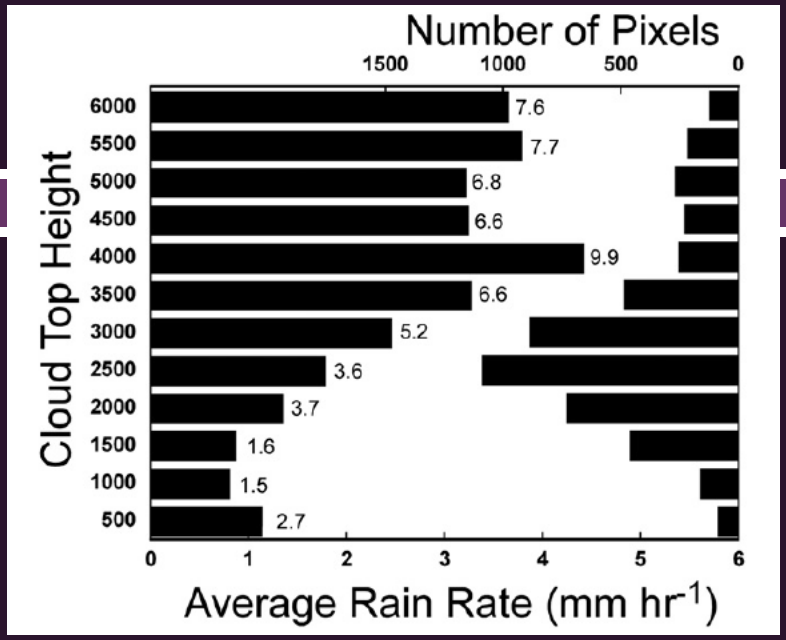
ICE-T steering committee meeting

01/05/11

RICO: Nov 2004- Jan 2005
ICE-T: July 2011

Cloud Depth & Mesoscale Cloud Organization



Snodgrass et al 2009

- Cloud depth consistently appeared to be the most important factor in warm rain formation (Nuijens et al. 2008, Snodgrass et al. 2009, Reiche and L-T 2010, Arthur et al. 2010, Rauber group).
- Snodgrass et al. (2009), from radar and satellite data comparison, state that the cloud depth was related to the mesoscale organization:
  - Less precip with shallower clouds arranged in streets
  - More precip in deeper clouds arranged in arcs (convergence lines from old outflows)
- Only a few clouds (if any) developed deeper than 3 km on a given day in Nov-Jan.

ICE-T SOD

PURDUE CLOUD MICROPHYSICS

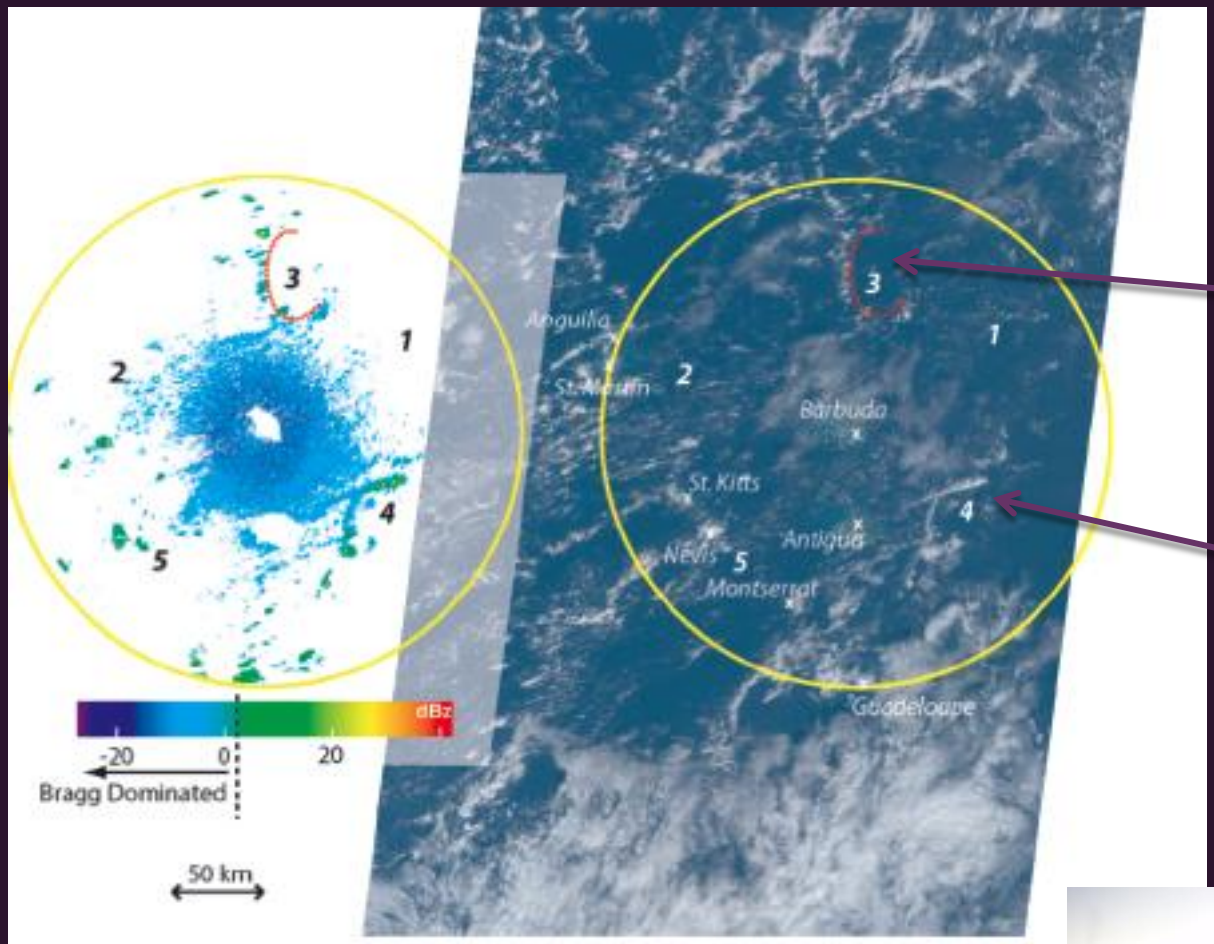


FIG. 6. Sample of cloud forms observed during RICO.

from Rauber et al. (BAMS, 2007)

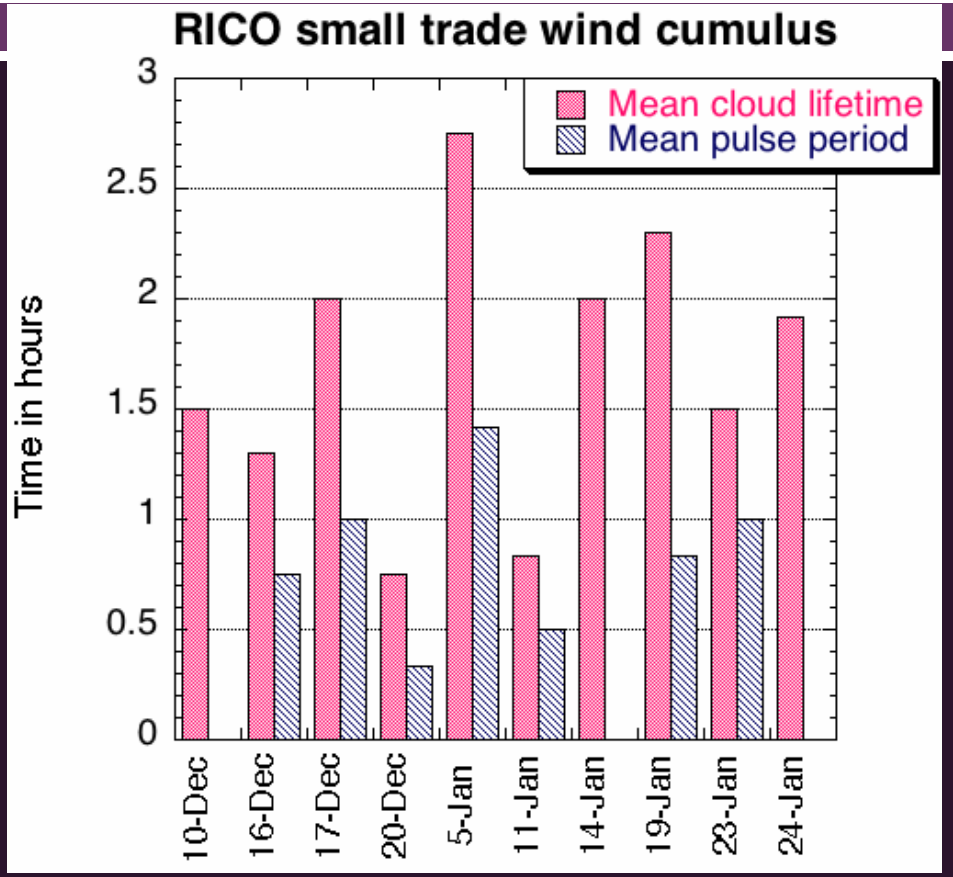
Arcs with deeper clouds;

may persist for several hours

Cloud forcing can be augmented by intersection with other arcs, or flow over islands

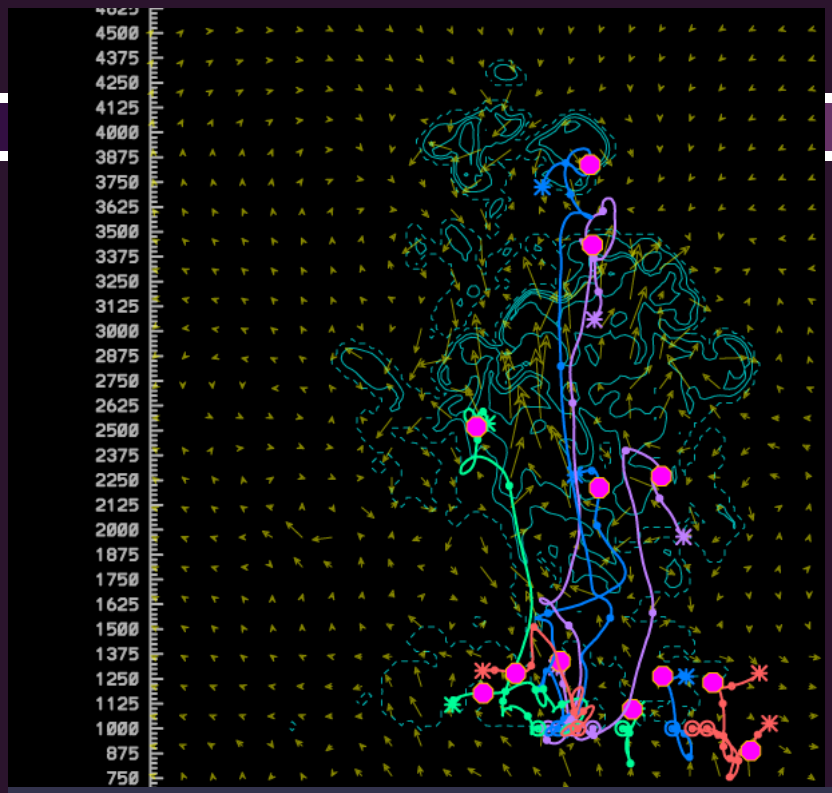
Pulsing Trade Wind Cumuli

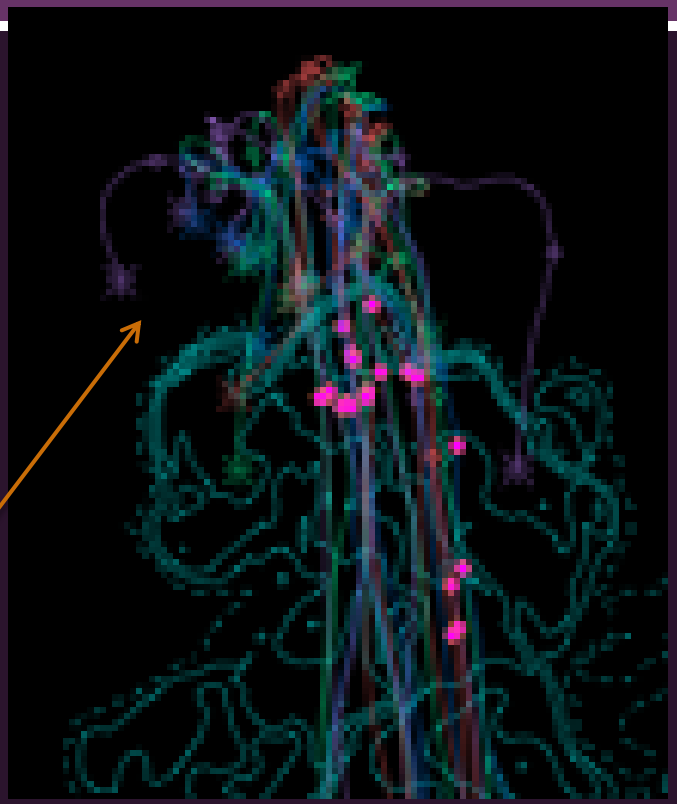
- Many clouds during RICO were observed to pulse --reported by Arthur et al. (2010) and Rauber group.
- Thus the cloud dynamics may sometimes be quite complicated.



Based on data presented in Arthur et al. (JTECH, 2010)

Entrainment Near Ascending Cloud Top (AGU 2010)

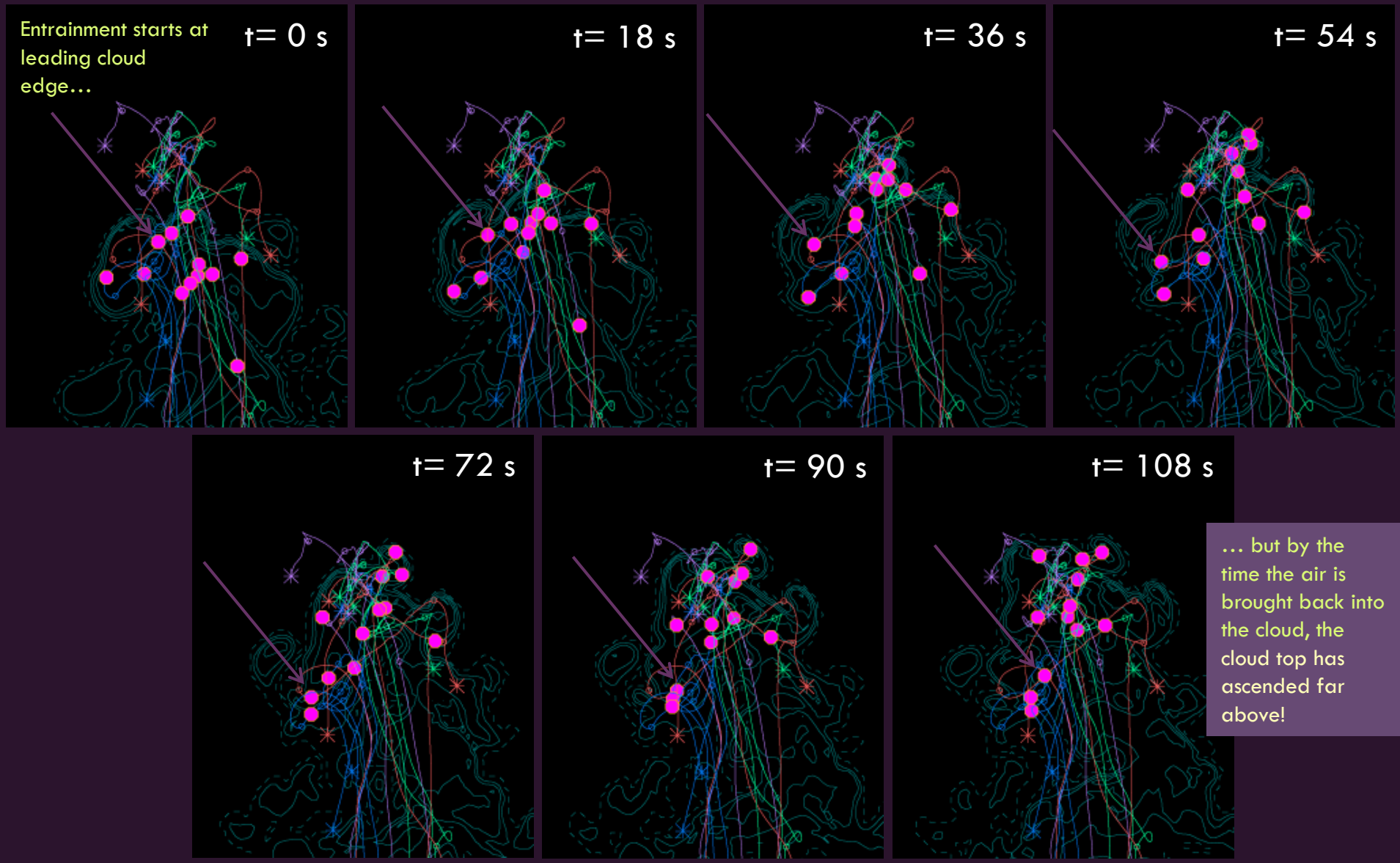




Over a span of 15 min, 219,032 trajectories were released from cloud base.

39% have one or more vertical loops meeting criteria:

- Traj must descend then ascend to that same altitude
- Loop must be > 10 m in depth
- Loop must be above any previous loops


Entrainment starts at leading cloud edge…
t= 0 s
t= 18 s
t= 36 s
t= 54 s
t= 72 s
t= 90 s
t= 108 s
… but by the time the air is brought back into the cloud, the cloud top has ascended far above!

CCN & Giant CCN effects

- The general consensus among multiple RICO studies (Colón-Robles et al. 2006, Knight et al. 2008, Reiche and Lasher-Trapp 2010, Arthur et al. 2010, Rauber group) is that giant CCN could explain large drops formed within a short (< 1km) distance above cloud base, but giant CCN were not the primary mechanism for the bulk of the warm rain produced.

- Hudson et al. (2009) found large negative correlation of CCN and large cloud drops & drizzle in RICO clouds, also noted by Arthur et al. (2010).

- Influence of giant CCN upon ice nucleation? TBD!
- Concentrations observed during RICO: ~ 20 to 200 L^{-1}

Raindrop shattering on probes

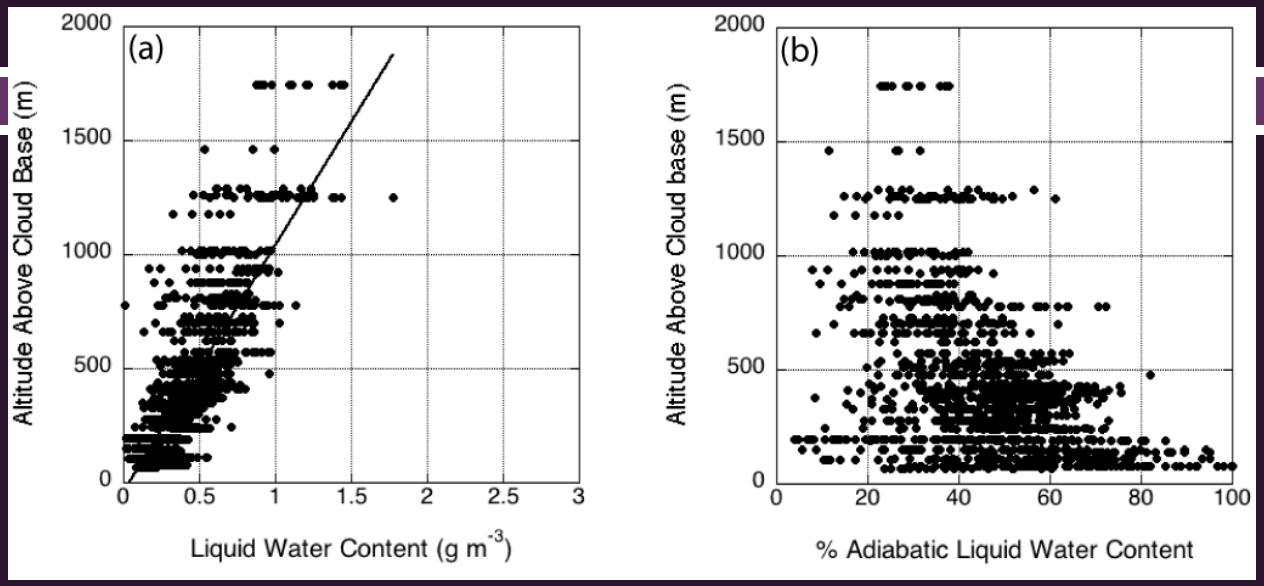
- Baker et al. (2008) used inter-arrival distances of images from the 2D-S to remove spurious drops from raindrop shattering in rain shafts.

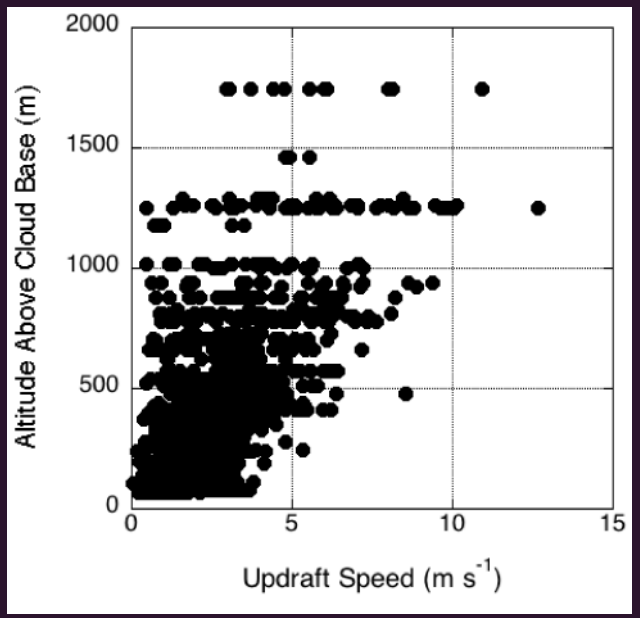
- Shattering of raindrops on the FSSP was also found– paper not out yet? (Paul, Dave??)

Question for ICE-T:
a more interactive ops center than RICO?

Analysis

- Forward-looking camera was crucial for filtering out "undesirable clouds"





PURDUE CLOUD MICROPHYSICS