# Warm Rain Formation

## by Ultragiant Particles & Cumulus Entrainment

QuickTime™ and a
decompressor
are needed to see this picture.

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***In collaboration with***
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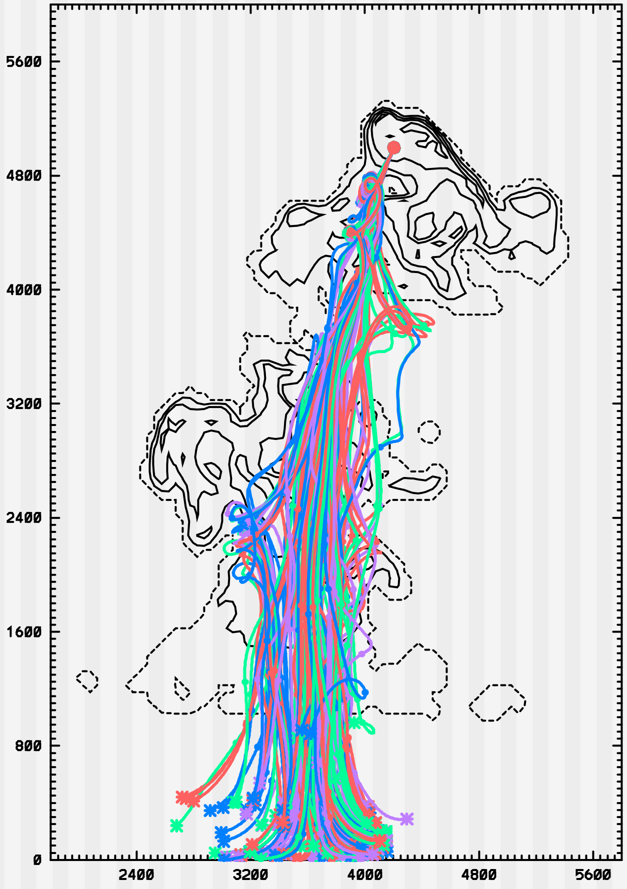
**Movie courtesy of D. Ebert's Visualization Group, Purdue University**

# RICO Interests: Determine Importance of These Mechanisms to Warm Rain Formation

- Ultragiant particles
  - build on past studies by acquiring better obs of UGP size distributions and spatial and temporal variability
- Large-drop formation by entrainment and mixing
  - extend our model calculations through coalescence
  - increase our understanding of cumulus entrainment

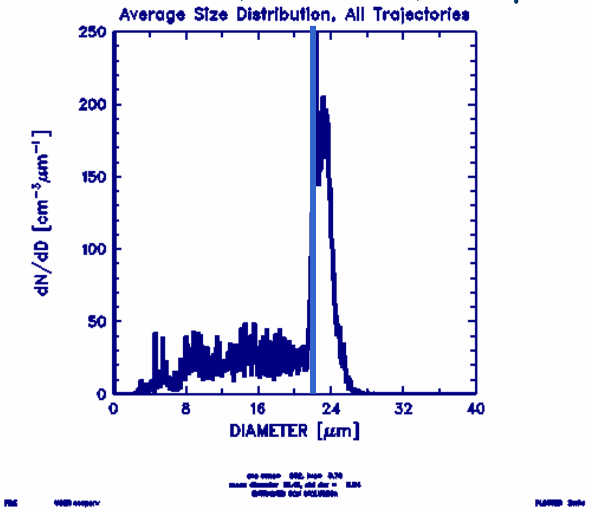
# Method and Ultimate Goal

- **Use high-resolution 3D cloud simulations, with detailed microphysics run along trajectories through modeled 3D fields (as in Lasher-Trapp et al. 2001, 2004)**
- **Use RICO observations to**
  - **(a) constrain model calculations**
  - **(b) evaluate realism of model results**
- **Evaluate importance of UGP versus large drop formation by entrain. & mixing**

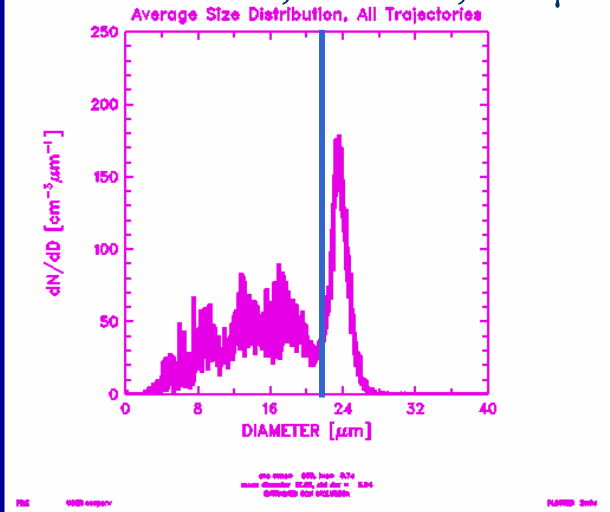


# Increasingly Inhomogeneous Mixing

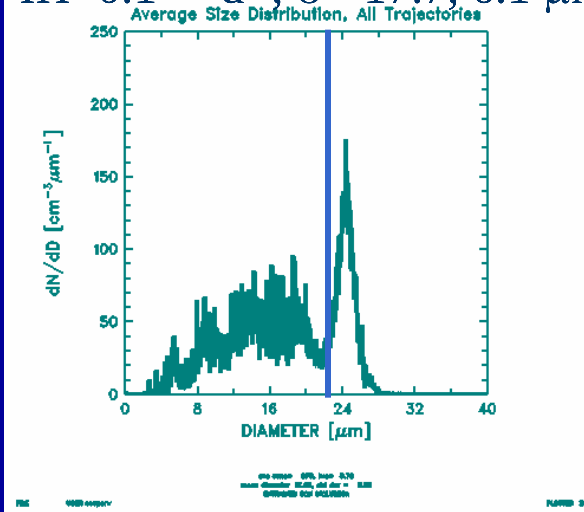
IH=0. <d>, σ= 18.4, 6.6 μm




IH=0.05 <d>, σ= 17.6, 5.9 μm

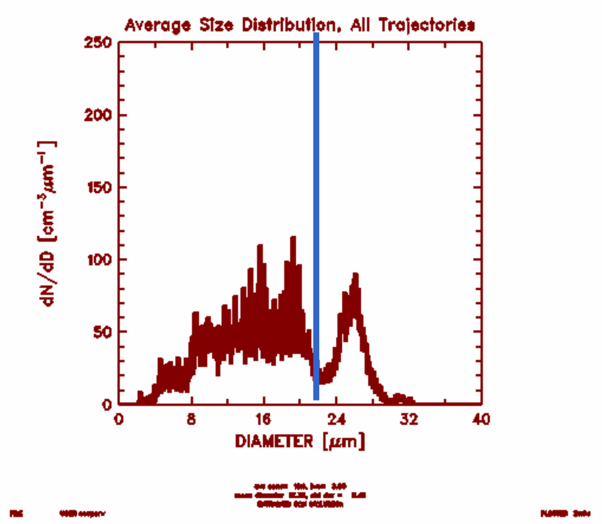



IH=0.1 <d>, σ= 17.7, 6.1 μm

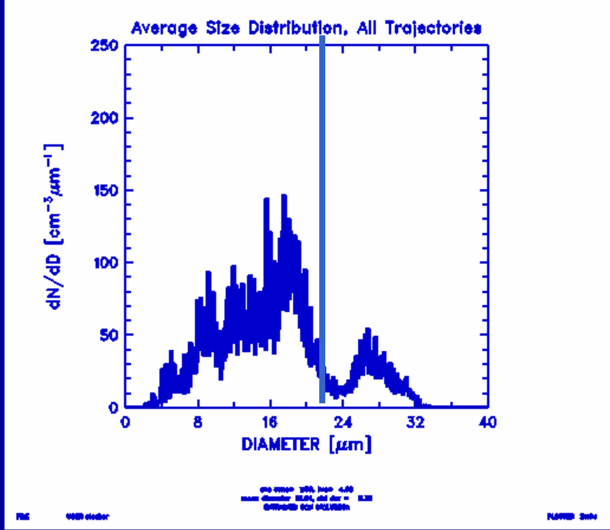



***Little difference in distrib. widths by changing character of mixing***

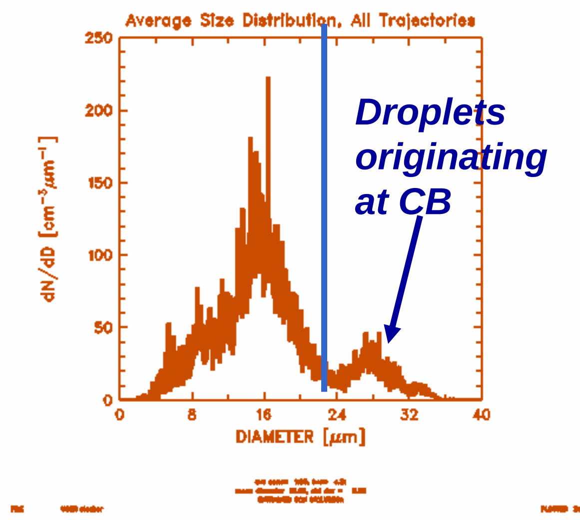
IH=0.2 <d>, σ= 17.3, 6.5 μm




IH=0.5 <d>, σ= 16.6, 6.4 μm




IH=1.0 <d>, σ= 16.7, 6.3 μm




***Big difference in location of modes and max droplet size by changing character of mixing***

# RICO Observations Needed

- UGA particle sizes and concentrations, including day-to-day variations
- CCN and variability with height
- Penetrations at same altitude through multiple clouds at multiple stages (statistical variab. on a given day)
  - Drop size distributions
  - Liquid water content
  - Cloud motions
- Radar data
- Atmospheric wind and thermodynamic profile, and changes during the day

# Desired Radar/AC Sampling Strategy

- **Daily Characterization of CCN and UGP**
- **Radar operating in PPI mode, over large sector**
- **Aircraft operating in same sector at different altitudes, penetrating same clouds but no necessarily trying to target only one cloud**