

Review of the July 8th Entrainment workshop

Mike Jensen (BNL)

2011 ASR Working Group meetings

Sept. 14, 2011

Annapolis, MD

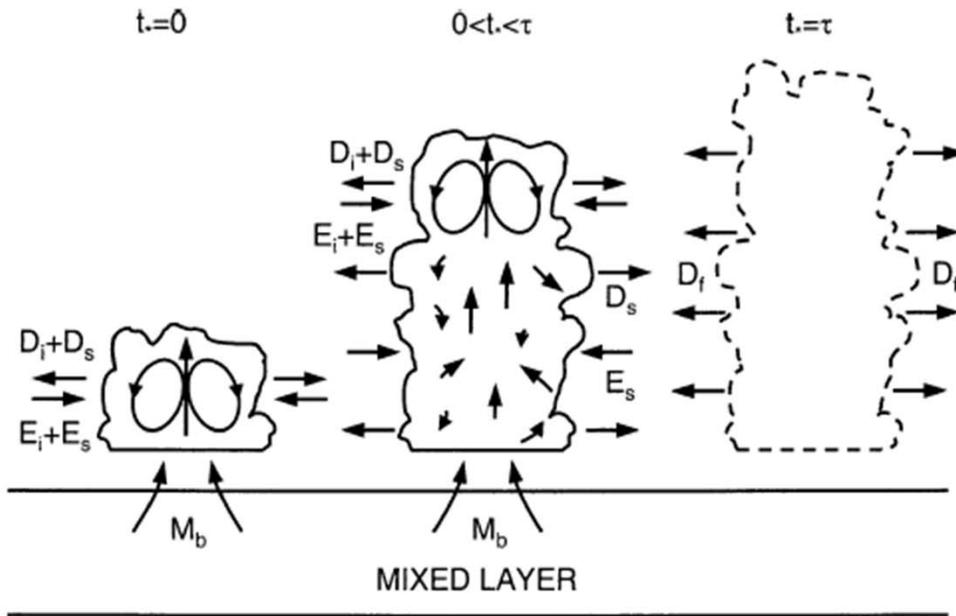


FIG. 1. Simplified life cycle of a shallow cumulus cloud. The cloud begins to form at time $t_* = 0$ and collapses at $t_* = \tau$. The air in the cloud is modified by entrainment and detrainment at the top of the cloud (E_i and D_i) and at the lateral boundaries (E_s and D_s). Final and complete detrainment (D_f) occurs at $t_* = \tau$.

Zhao and Austin

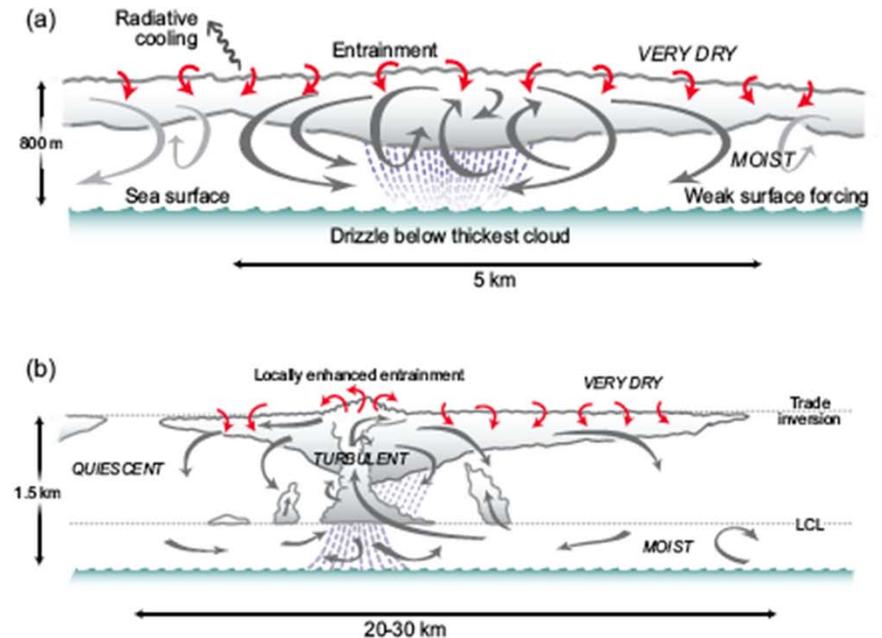


FIG. 11. Schematic showing structure of marine stratocumulus in (a) the shallow, well-mixed boundary layer; (b) deeper, cumulus-coupled boundary layers. Gray arrows indicate the primary motions on the scale of the boundary layer, while smaller red arrows indicate the small-scale entrainment mixing taking place at the inversion atop

Wood

Review of the July 8th Entrainment workshop

Conveners: Mike Jensen and Pavlos Kollias

Goals:

- 1) What is the state of the art in modeling and observation of entrainment processes?
- 2) Is there added value in setting up a focus group within ASR?

Entrainment Workshop Agenda

July 8, 2011 Brookhaven National Laboratory

Why Do We Need to Understand Entrainment? Why Don't We? (Del Genio)
Modeling of Entrainment Processes at Various Scales: State of the Art (Krueger)
Modeling (and observing) of entrainment processes (Romps)

Entrainment Processes – Aircraft Observations (Gerber)
Satellite Observations of Entrainment Processes in Convective Clouds (Luo)
Surface-based observations of the fractional entrainment rate (Wagner)
DISCUSSION: Where are the Gaps and Limitations in ARM? (Miller)

Thoughts about Measuring Entrainment (Turner)
Cloud-Environment Interface Studies (Kollias)
Coupling observations with models for entrainment studies (Fridlind)

Entrainment workshop soundbytes

- Entrainment has been a problem for more than half a century- we are not going to solve it. Can we take a couple of steps forward?
- What is the relative importance of Lateral Entrainment versus cloud-top entrainment?
- deterministic entrainment by pdf of cloud base properties (Neggers et al. 2002) vs. intermittent stochastic entrainment from uniform cloud base properties (Romps and Kuang 2010)
- Entrainment processes occur on scales that are smaller than most (if not all) of our observations
- The AMF dataset from Gracioso Island in the Azores may be the best dataset for the study of entrainment in boundary layer stratocumulus
- Marriage between observations and LES is the key to solve this problem.
- Need combination of high resolution aircraft measurements coincident with detailed surface-based observations (particularly scanning cloud radar, and Doppler spectra)...perhaps with release of chaff for explicit study of mixing at boundaries.

Outcomes and Action Items

- Further pursue the formation of an ASR focus group
- Follow-up with breakout session at ASR Fall WG mtgs
- “Focus” activities on boundary layer clouds
- Marriage of observations and LES is important component
- AMF-Azores dataset a good place to start
- Draft white paper proposal by ASR Fall WG meetings