NASA CRYSTAL-FACE Grant #NAG5-11532 (U of U Grant # 56000106)

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"Connecting the Properties of Anvil Cirrus to the Properties of the Convective Source"

Period of Performance: Dec. 15 2001 – June 30 2004

(NOTE: Research under this grant has been continued under NNG04GG45G with a one-year period of performance from July 1 2004 – June 30 2005)

Final Report

Preparation for CRYSTAL-FACE Field Program. Together with graduate student Yaping Li, we extracted all precipitation features (PF) in and around Florida from the 3-year University of Utah TRMM PF database. Initial findings were that thunderstorms over water as well as over land had greater convective intensities than those in the deep tropics, such as over the western Pacific warm pool. This finding was reported during the Maryland Science Team meeting, and affected field program planning at the Penn State meeting in May.

Participation in CRYSTAL-FACE Field Program. The PI spent 30 June – 19 July in Florida, mostly at the N-POL radar site near Everglades City. Together with David Starr, he was fully engaged in optimizing the flight tracks of all C-F aircraft for maximum effectiveness in achieving the observational requirements set forth by the Science Team. Yaping Li spent 30 June – 31 July at the PARSL site, mainly assisting with soundings and feeding mosquitoes. She also learned enough about the N-POL data to analyze it during Year 2.

Yaping Li's M.S, thesis results. Ms. Li successfully defended her thesis in July 2003, forming the basis for 3 papers, now in preparation, This work comprised 3 parts.

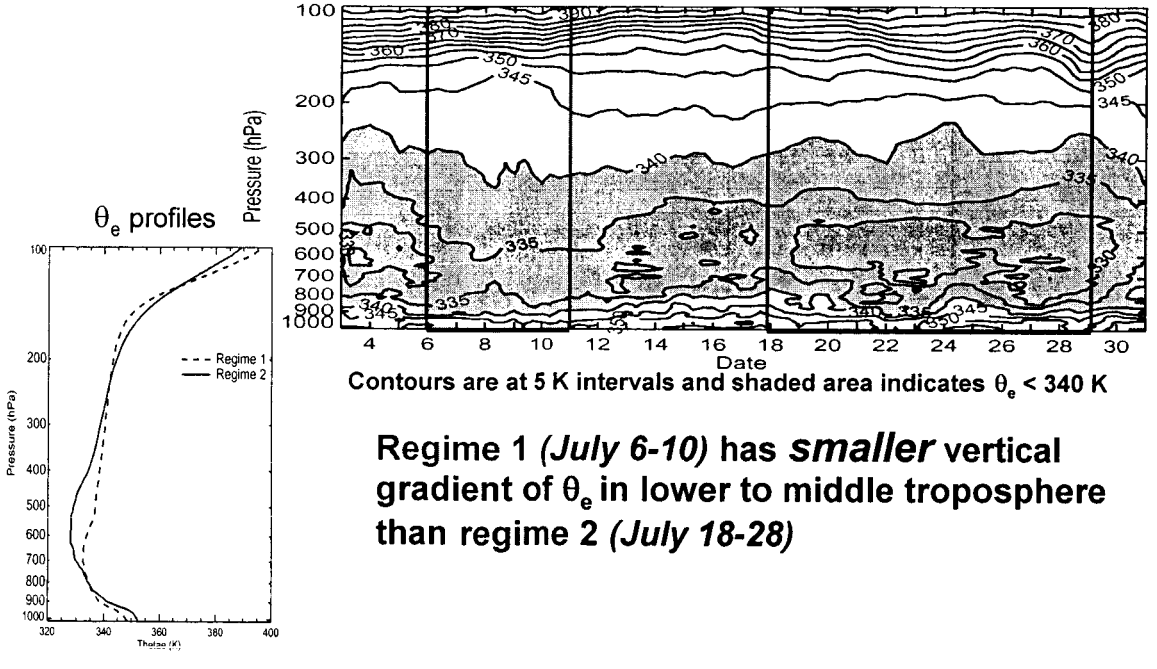
a. Using TRMM data to link the properties of Florida convection (over both land and ocean) with those from other tropical regions of the world. This work is also highly relevant to the planning of the TCSP and TWP-ICE programs anticipated for the tropical Pacific Ocean in 2005 and Darwin Australia in early 2006. Some of these results were presented in the TC4 meeting in Boulder CO in June 2003.

This table demonstrates some surprising results. The convective systems over Florida are smaller but more convectively intense (by several measures) than those over the deep tropical oceans in the GATE and TOGA COARE areas, and even those over land in Rondonia Brazil (the LBA site). This is even true if the Florida data are restricted to storms over the eastern Gulf of Mexico. As shown at the TC4 workshop, these conclusions hold for the Guam, eastern Pacific, and offshore Darwin regions. The importance for CRYSTAL and TC4 is that the conditions over Florida are not directly transferrable to those in the deep tropical oceans. (Work by G. Mace at Univ. of Utah

shows that the properties of the cirrus also differ markedly between Florida and the ARM sites in the west Pacific.)

		Area (km^2)	Min PCT (K)	Max 20-dBZ height (km)	Max 6-km dBZ
Florida Land	w/ice	610.5	212.9	11.0	39.0
	w/mcs	7289.0	119.2	14.5	47.7
Florida Ocean	w/ice	462.5	223.7	10.0	33.9
	w/mcs	7714.5	135.1	14.0	45.4
GATE	w/ice	1369.0	231.0	8.8	28.0
	w/mcs	15410.5	170.0	12.3	35.1
TOGA COARE	w/ics	814.0	227.9	9.3	32.2
	w/mcs	16890.5	167.2	13.3	38.7
TRMM-LBA	w/ice	851.0	228.7	9.8	32.2
	w/mcs	14541.0	169.2	13.3	39.2

b. Characterizing the weather regimes over south Florida during CRYSTAL-FACE revealed some subtle but important distinctions. During 6-11 July "regime 1" was marked by lower CAPE but moister mid-troposphere, and longer-lasting cirrus. During 18-29 July, CAPE was larger, storms tended to be stronger, with a dry mid-troposphere.



Regime 1 *(July 6-10)* has *smaller* vertical gradient of θ_e in lower to middle troposphere than regime 2 *(July 18-28)*

c. Case studies began with the storms of 16 and 28 July. Each of these systems, although rather small, consisted of about 12-16 distinct "cells" (really multi-cell storms) on the N-POL radar which each had an identifiable life cycle, contributing to the lifetime of several hours for the cirrus-producing system that was sampled by many of the aircraft.

CRYSTAL-FACE Florida case studies. Doppler wind analysis programs) and to incorporate both NPOL and ELDORA as well as EDOP and CRS from the ER-2 (cooperating with G, Heymsfield and others). Only in this way will the original objectives of estimating updraft strength and mass flux for more than a few cells be possible, perhaps also incorporating estimates of detrained ice mass into the anvil as functions of height and time. This will be the core of the observational portion of Yaping's PhD work.

Using CRMs to relate convective intensity to cirrus properties. According to the hypothesis in the original proposal leading to this grant, the stronger convective storms should produce denser cirrus with large concentration of small ice particles near the tropopause. The sticking point in evaluating this hypothesis is not the cirrus observations, which are numerous and being completed by many C-F PIs. Rather, it is the small number of direct observations of convective updraft profiles in the parent cumulonimbus clouds. Therefore, we are working with Dr. Steven Krueger's cloud resolving model (CRM) to be able to link the updraft velocity in convective cores to the measurable properties of the convection and the derivative anvils and cirrus. One way to extend this work beyond CRYSTAL-FACE to Costa RIca and the Tropical West Pacific is through observables such as radar profiles and microwave brightness temperatures from TRMM as well as from the project-supported aircraft observations. This work is in progress and we expect to have reportable results in early 2005.