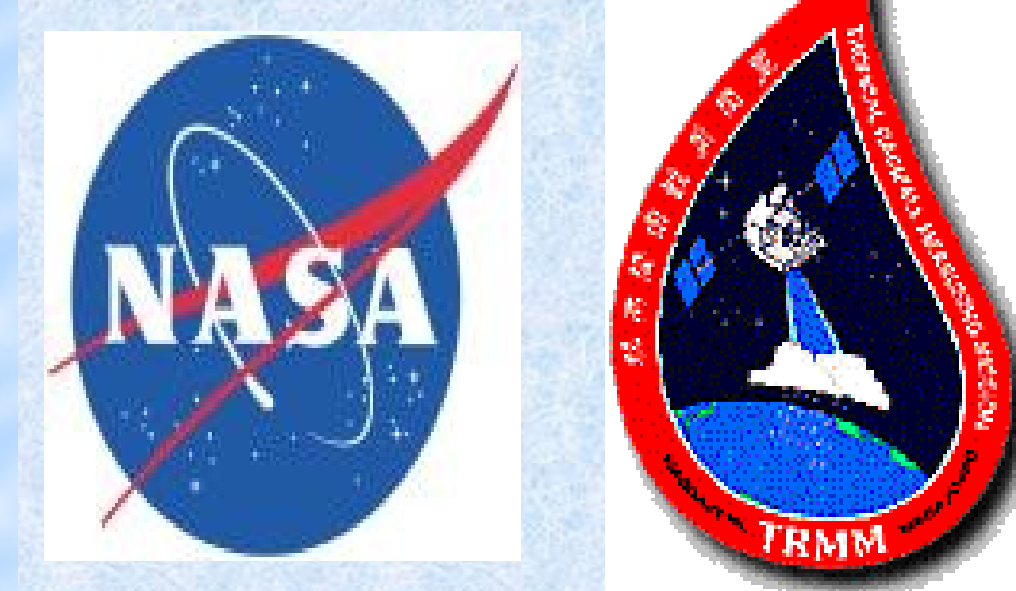


# The 13-Year TRMM-Based Tropical Cyclone Precipitation Feature (TCPF) Database

Haiyan Jiang<sup>1</sup>, Chuntao Liu<sup>2</sup>, and Edward J. Zipser<sup>2</sup>

<sup>1</sup> Department of Earth & Environment, Florida International University, Miami, Florida

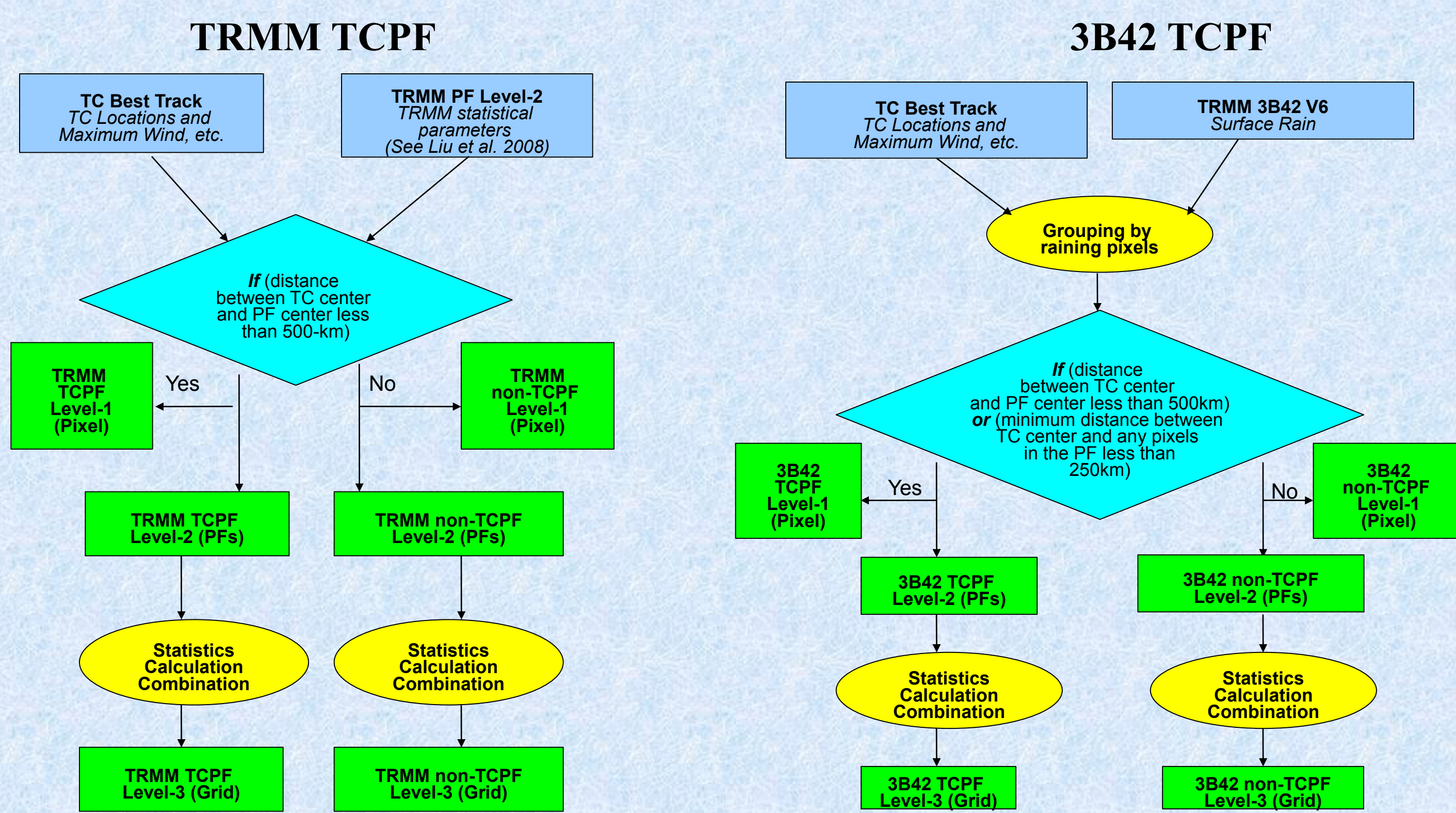
<sup>2</sup> Department of Atmospheric Sciences, University of Utah, Salt Lake City, Utah



## Abstract

The Tropical Rainfall Measuring Mission (TRMM) satellite has provided invaluable data for tropical cyclone (TC) research since December 1997. However, the challenge is how to analyze and efficiently utilize all the information from several instruments on TRMM that observe the same target. In this study, a Tropical Cyclone Precipitation, cloud, and convective cell Feature (TCPF) database has been developed by using observations of the TRMM precipitation radar (PR), Microwave Imager (TMI), Visible and Infrared Scanner (VIRS), Lightning Imaging System (LIS), and the TRMM 3B42 rainfall product. The database is based on an event-based method that analyzes the measurements from multiple sensors. This method condenses the original information of pixel-level measurements into the properties of events, which can significantly increase the efficiency of searching and sorting the observed historical TCs. With both convective and rainfall properties included, the database offers potential to aid the research aiming to improve both TC intensification and rainfall forecasts. Environmental parameters are also added into each TCPF from NCEP and ECMWF INTERIM reanalyses. Sea surface temperature (SST) is added from the daily Reynolds SST data. A Web application based on the TRMM TCPF database has been developed for users to easily find TRMM observations for each TC from December 1997 to December 2010 (13 full years).

## FIU/UU TCPF Database Construction Flow Chart



## Definitions of TRMM Precipitation, Cloud, and Convective Features

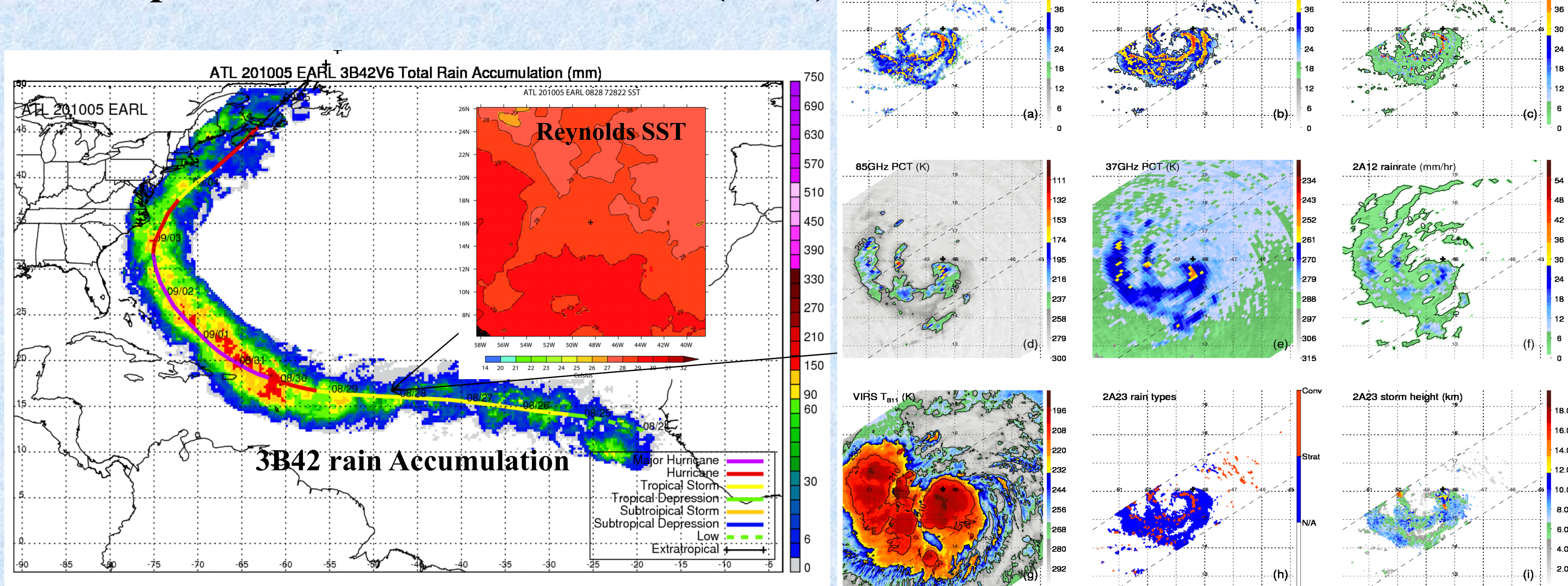
	Acronyms	Definitions	Criteria	Total population	TCPF population
Precipitation Features	<i>RPF</i>	Radar precipitation feature	Pixels with 2A25 rainfall rate > 0	26,523,461	239,375
	<i>RPPF</i>	Radar projection precipitation feature	Pixels with reflectivity ≥ 20 dBZ anywhere above ground	25,703,571	153,096
	<i>RTPF</i>	Radar/TMI precipitation feature	Pixels with 2A25 or 2A12 rainfall rate > 0	24,447,777	152,792
	<i>TPF</i>	TMI precipitation feature	Pixels with 2A12 rainfall rate > 0	13,286,077	97,246
	<i>TTPF</i>	TMI precipitation feature in TMI swath	Same as above, but in TMI swath	13,649,884	95,956
Cold PCT Features	<i>TPCTF</i>	TMI cold 85-GHz PCT feature with 250K in TMI swath	Pixels with 85 GHz PCT ≤ 250 K	5,475,411	70,703
	<i>T200F</i>	TMI cold 85-GHz PCT feature with 200K in TMI swath	Pixels with 85-GHz PCT ≤ 200 K	1,303,750	18,539
Cold Cloud Features	<i>C210F</i>	Cloud feature with 210 K	VIRS T <sub>B11</sub> ≤ 210 K	1,529,363	39,962
	<i>C235F</i>	Cloud feature with 235 K	VIRS T <sub>B11</sub> ≤ 235 K	9,071,722	87,442
Convective Cell Features	<i>CLCONV</i>	2A23 convective cell feature	2A23 convective pixels	15,010,443	211,214
	<i>CL40P</i>	Convective cell feature with radar projection reflectivity greater than 40 dBZ	Pixels with reflectivity ≥ 40 dBZ anywhere above ground	2,694,447	62,653
	<i>CL6KM30</i>	Convective cell feature with 6-km greater than 30 dBZ	Pixels with 6 km reflectivity ≥ 30 dBZ	1,354,985	33,188
	<i>CL12KM20</i>	Convective cell feature with 12-km greater than 20 dBZ	Pixels with 12 km reflectivity ≥ 20 dBZ	352,581	6,437

## TRMM TCPF Database Webpage Storm Search Table (<http://tcpf.fiu.edu>)

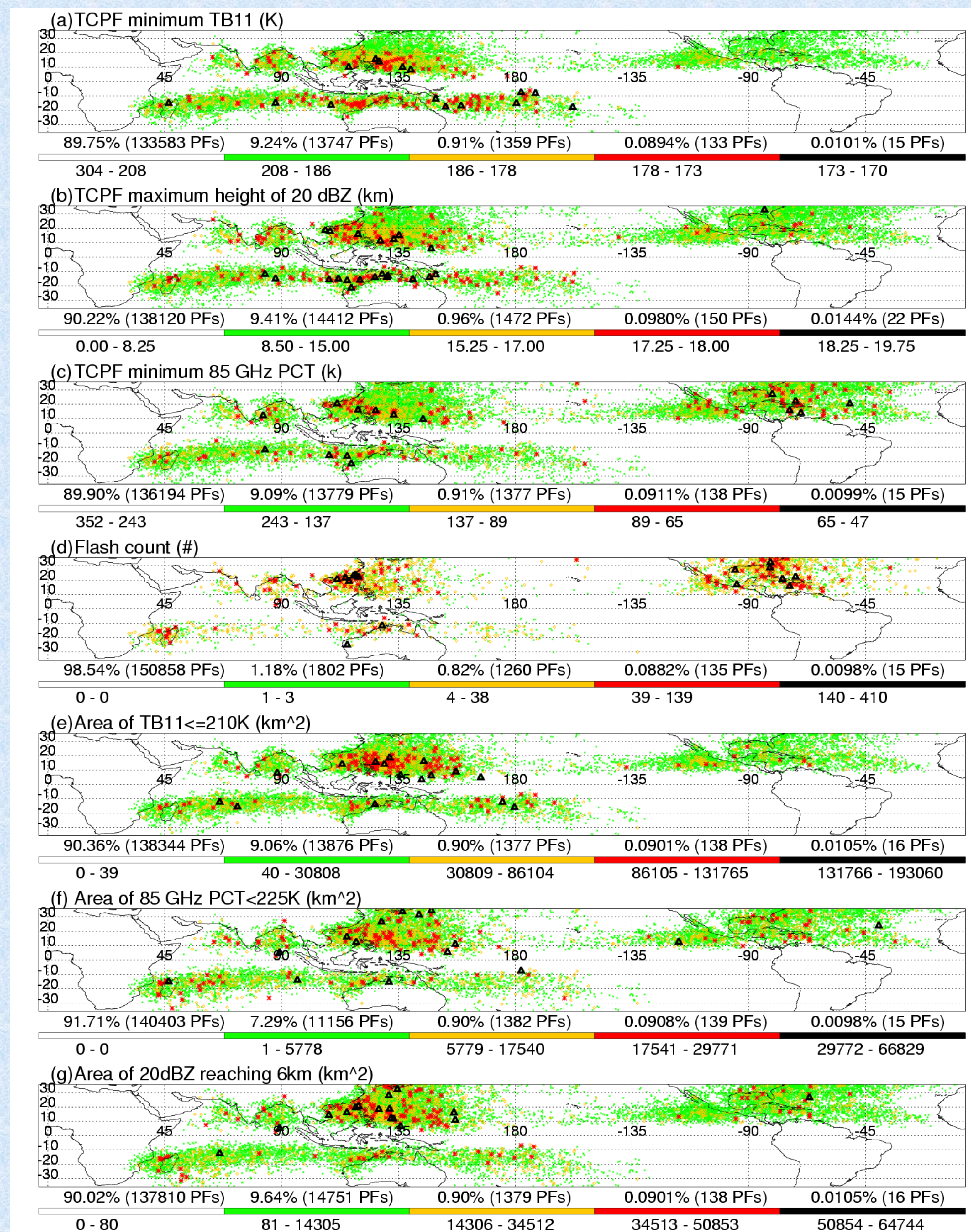
TRMM has overpassed 1077 storms in 1997–2010 :

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Atlantic	14	12	15	14	12	16	15	28	10	16	16	9	10	10
East & Central Pacific	13	9	18	15	15	12	12	15	19	11	17	18	8	5
Northwest Pacific	246	246	383	382	383	403	349	336	336	336	336	336	336	336
North Indian Ocean	3	3	3	3	3	3	3	3	3	3	3	3	3	3
South Indian Ocean	17	17	17	17	17	17	17	17	17	17	17	17	17	17
South Pacific	18	18	18	18	18	18	18	18	18	18	18	18	18	18

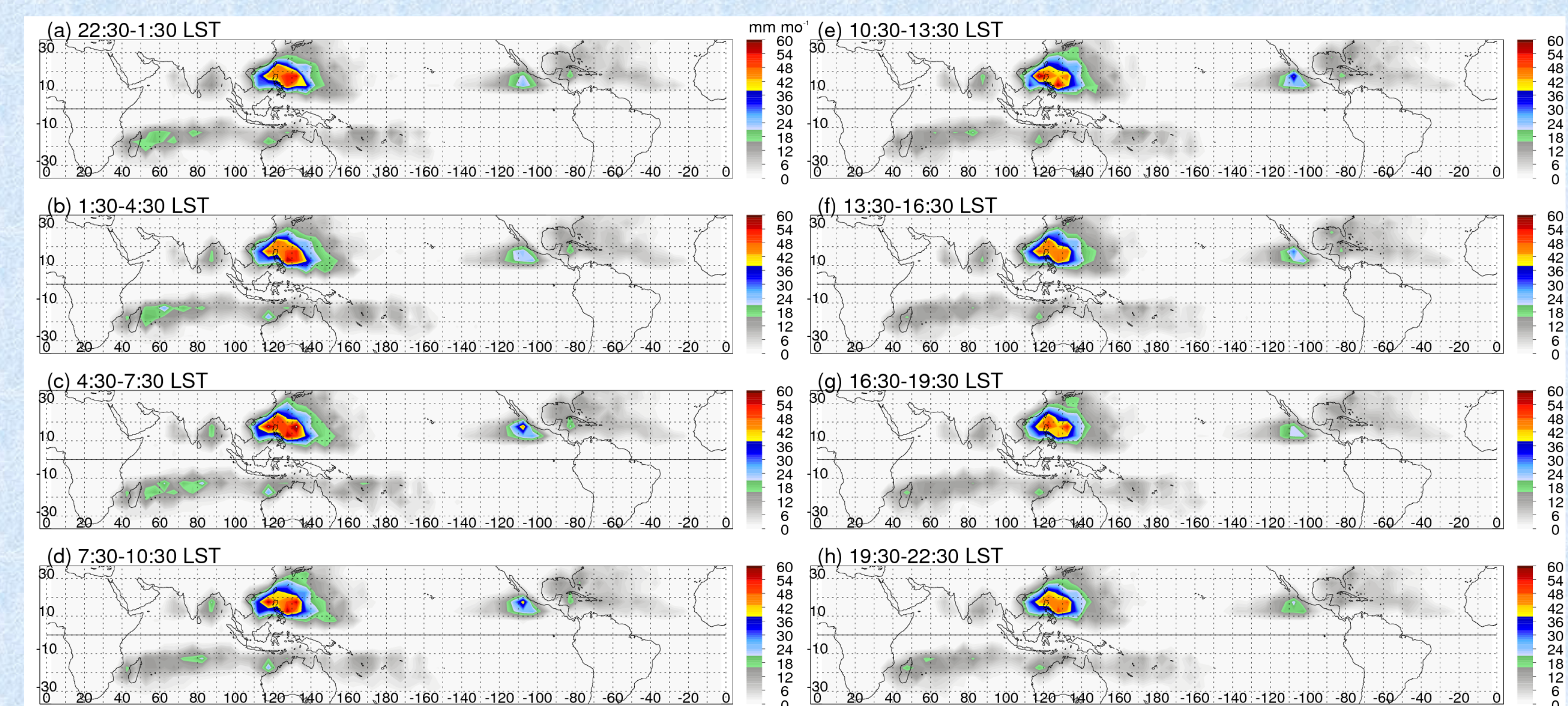
## Example: Atlantic Hurricane Earl (2010)



## Locations of Deep Convection Events in TCs



## Diurnal Variations of 3B42 TC Monthly Rain



## Summary

This study introduces the construction and applications of a TRMM-based TCPF database. This database is built upon the existing UU TRMM precipitation feature database. 1077 TCs are included for six global TC-prone basins from December 1997 to December 2010. TRMM measurements of radar, visible and infrared sensors, passive microwave radiometers, and lightning sensors for TCs are collocated and integrated with TC best track, Reynolds SST, and NCEP and ECMWF INTERIM re-analysis parameters. The TRMM 3B42 rainfall product is also used to build a parallel TCPF dataset. Three levels of TRMM TCPF product are constructed following the same construction concept as in UU TRMM PF database. New convective cell feature definitions are added as a result of the recent update of the parental TRMM database.

The web application of the database provides a search engine for users to easily find TC overpasses by TRMM, as well as download the level-1 data and best track data and corresponding images.

## Future Work

- Potential research applications: 1) comparison of 2A25, 2A12, and 3B42 rainfall retrievals for TCs; 2) regional, seasonal, and diurnal variations of TC size.
- Add NASA MERRA reanalysis parameters into the database.

Reference: Jiang, H., C. Liu, and E. J. Zipser, 2011: A TRMM-based Tropical Cyclone Cloud and Precipitation Feature Database. *J. Appl. Meteor. Climatol.*, in press.

Acknowledgements: This research is supported by the NASA HSRP program: Ramesh Kakar (NASA/HQ). Thanks to Tie Yuan for adding 2010 storms into the database. Ellen Ramirez helped on identifying landfalling TCs from 1998 to 2004. Michael Peterson has been very helpful on adapting the "Google Earth" web feature to the TCPF database. The authors also would like to thank Dan Cecil, John Molinari, and Deanne Hence for their comments and helps.