Genesis and Rapid Intensification Processes (GRIP) Field Experiment

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NASA Field Experiments

We do field experiments to accomplish:

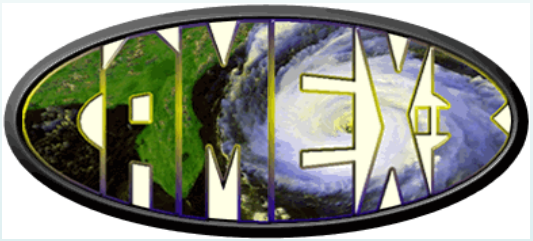
- - calibration/validation of satellite sensors
- - evaluation of new sensor concepts
- - process studies

- Since 1998 we have carried out five major field experiments in support of hurricane research in collaboration with other US agencies

NASA Hurricane Field Experiments

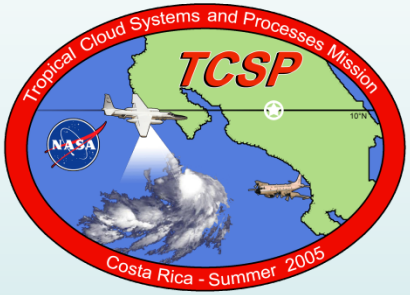
Field programs coordinated with other Federal Agencies

1998



2001

2005



2006

2010 GRIP

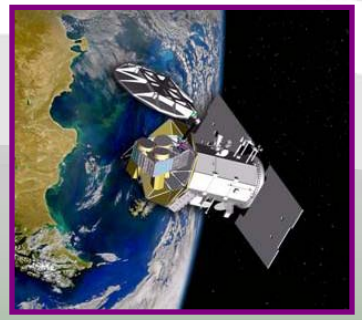
- NASA sponsored field campaigns have helped us develop a better understanding of many hurricane properties including inner core dynamics, rapid intensification and genesis

NASA Operating Missions

Mission	Program Sci	Launch	Phase	Extension to	Dec	Jan	Feb	Comments
TRMM	R. Kakar	11/27/1997	Extended	9/30/2011				Participates in Hurricane Related Research
QuikSCAT	E. Lindstrom	6/19/1999	Extended	9/30/2011				Participated in Hurricane Related Research
Terra	G. Gutman	12/18/1999	Extended	9/30/2011				Participates in Hurricane Related Research
ACRIMSat	R. Kakar	12/20/1999	Extended	9/30/2011				
NMP EO-1	G. Gutman	11/21/2000	Extended	9/30/2011				
Jason	E. Lindstrom	12/7/2001	Extended	9/30/2011				Participates in Hurricane Related Research
GRACE	J. Labrecque	3/17/2002	Extended	9/30/2011				
Aqua	R. Kakar	5/3/2002	Extended	9/30/2011				Participates in Hurricane Related Research
ICESat	T. Wagner	1/12/2003	Extended	9/30/2010				
SORCE	R. Kakar	1/25/2003	Extended	9/30/2011				
Aura	E. Hilsenrath	7/15/2004	Prime thru 9/10	9/30/2011				
Cloudsat	D. Considine	4/28/2006	Extended	9/30/2011				Participates in Hurricane Related Research
CALIPSO	D. Considine	4/28/2006	Extended	9/30/2011				Participates in Hurricane Related Research
OSTM	E. Lindstrom	6/20/2008	Prime thru 6/11	Ends 6/30/11				Participates in Hurricane Related Research

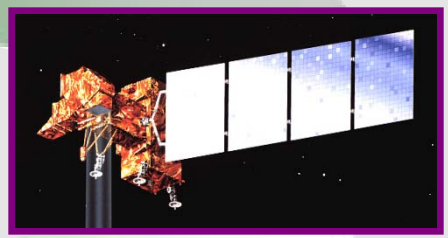
	On plan, adequate margin, no significant issues.
	Problems, working to resolve within planned margin
	Problems, not enough margin to recover

ESD Missions in Development & Formulation

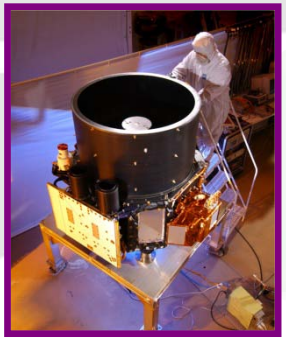


AQUARIUS
Late 2010

NPP
Sep 2011

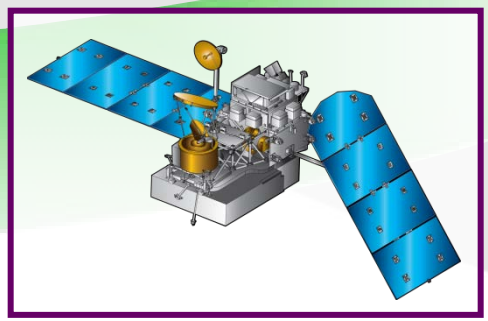


LDCM
Dec 2012



ICESat-2
Late 2015

SMAP
Nov 2014



GPM
Jul 2013
Nov 2014

NASA Hurricane Research Science Team (selected competitively)

ROSES 08 (Science Team)

Scott Braun	NASA GSFC
Shu-Hua Chen	U. of California, Davis
William Cotton	Colorado State U.
Robert Hart	Florida State U.
Gerald Heymsfield	NASA GSFC
Robert Houze	U. of Washington
Haiyan Jiang	U. of Utah (to FIU)
Tiruvalam Krishnamurti	Florida State U.
Greg McFarquhar	U. of Illinois
John Molinari	U. of Albany
Michael Montgomery	Naval Postgrad School
Elizabeth Ritchie	U. of Arizona
Robert Rogers	NOAA/AOML
Nick Shay	U of Miami
Eric Smith	NASA GSFC
Christopher Thorncroft	U. of Albany
Edward Zipser	U. of Utah

ROSES 09 (Field/Instrument Team)

Richard Blakeslee	NASA MSFC
Paul Bui	NASA ARC
Stephen Durden	NASA JPL
Michael Goodman	NASA MSFC &
Svetla Hristova-Veleva	NASA JPL
Jeffrey Halverson	UMBC/JCET
Andrew Heymsfield	NCAR
Gerald Heymsfield	NASA GSFC
Syed Ismail	NASA LARC
Michael Kavaya	NASA LARC
Tiruvalam Krishnamurti	Florida State U.
Bjorn Lambrigtsen	NASA JPL

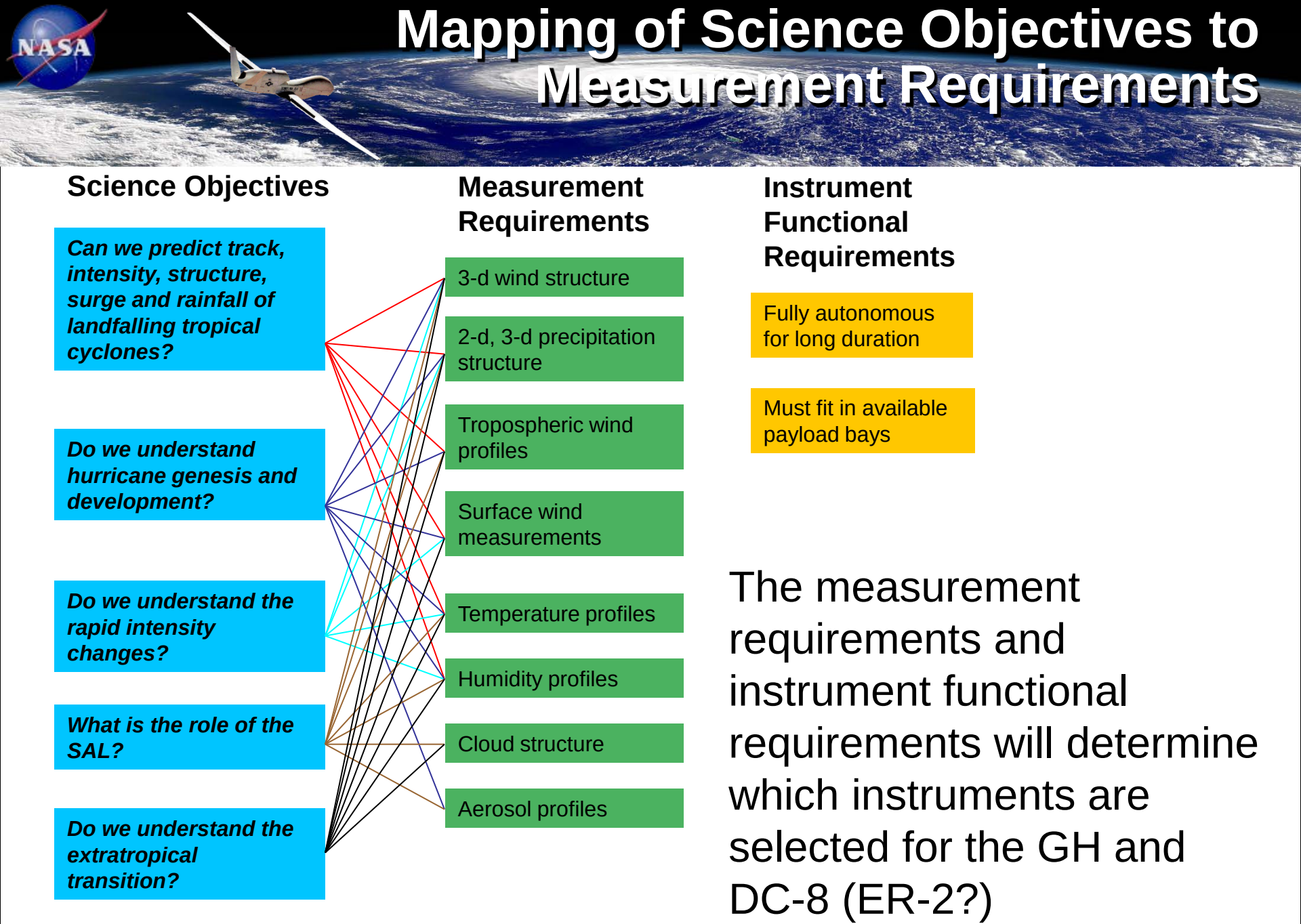
Mission and Science Overview: Summary of GRIP Science Objective

- Genesis: Distinguish the role of the larger-scale environment vs. meso-convective processes near the putative developing center.

- Rapid Intensification: Relative role of environmental vs. inner core processes? Is RI predictable?

- Test-bed: Evaluate candidate technologies for remote sensing from aircraft and from satellites. Wind lidar, high frequency passive microwave, dual-frequency radars, Global Hawk itself.

Mapping of Science Objectives to Measurement Requirements

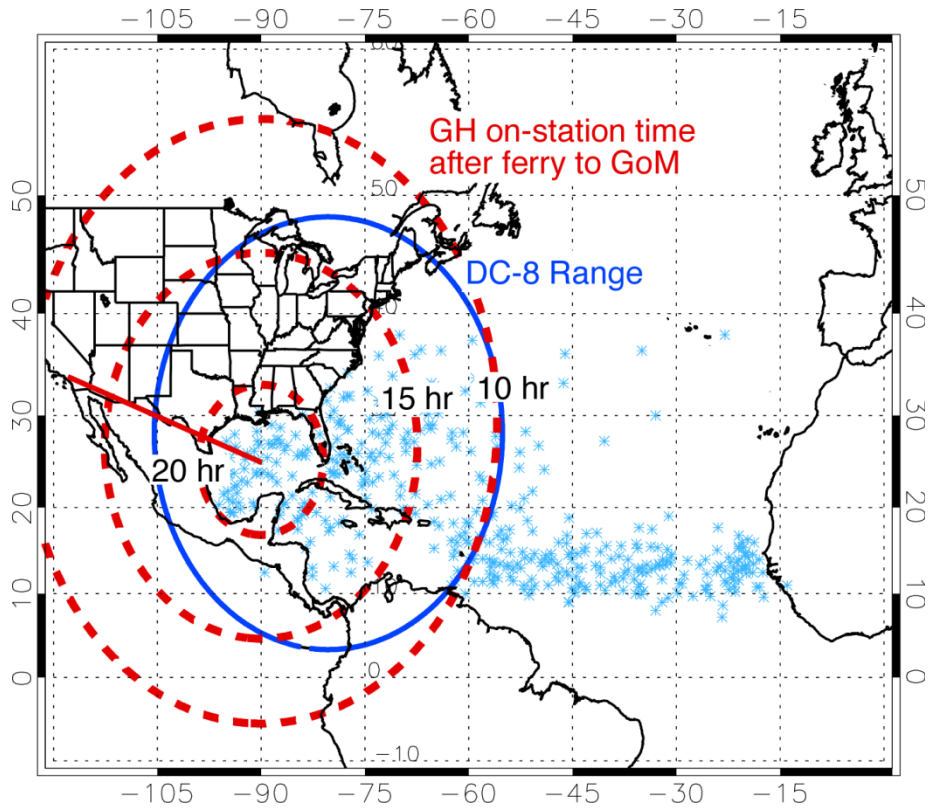


The measurement requirements and instrument functional requirements will determine which instruments are selected for the GH and DC-8 (ER-2?)

GRIP: (Hurricane) Genesis and Rapid Intensification Processes Field Experiment

- Global Hawk (UAV) (240 hours)
  - Radar (Heymsfield/GSFC), Microwave Radiometers (Lambrigtsen/JPL), Dropsondes (NOAA), Electric Field (Blakeslee/MSFC)
  - Geosynchronous Orbit Simulation
- DC-8 four engine jet (120 hours)
  - Dual frequency precipitation radar (Durden/JPL)
  - Dropsondes (Halverson/UMBC), Variety of microphysics probes (Heymsfield/NCAR)
  - Lidars for 3-D Winds (Kavaya/LaRC) and for high vertical resolution measurements of aerosols and water vapor (Ismail/LaRC)
  - In-situ measurements of temperature, moisture and aerosols (Bui/ARC)
- ☐ WB-57 (60 hours, partially funded by NOAA)
  - Advanced Microwave Precipitation Radiometer
  - Hurricane Imaging Radiometer
- Six week deployment during the 2010 HS

RED= IIP, GREEN= IIP+AITT

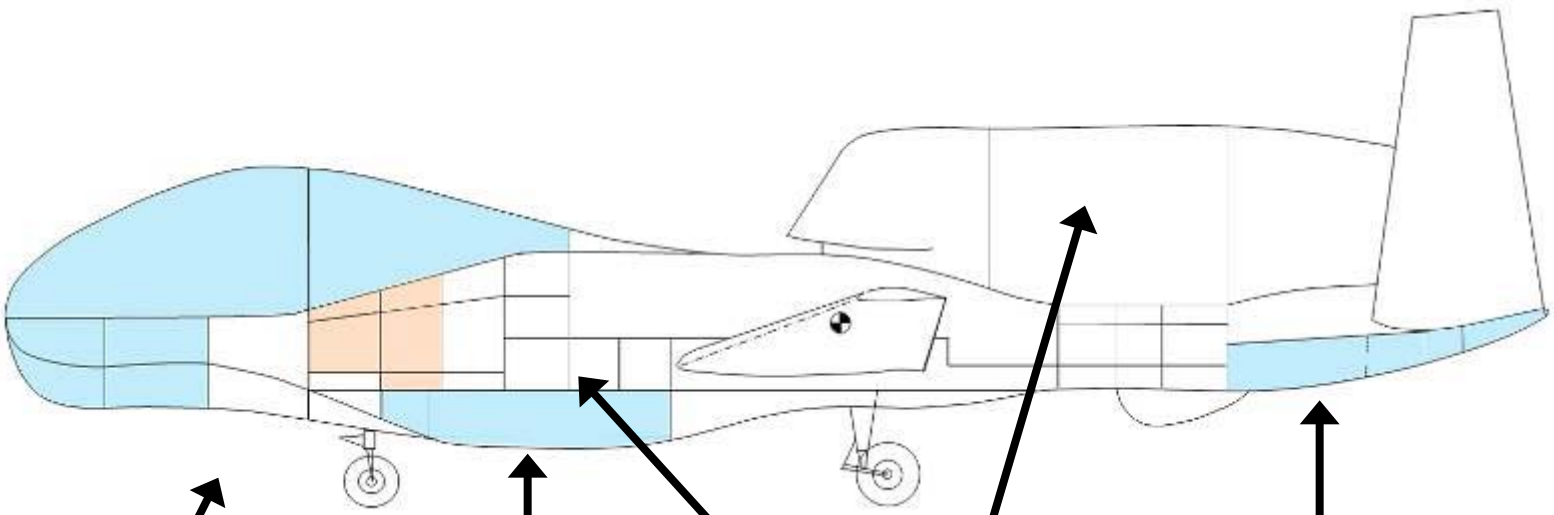


Blue line: DC-8 range for 12-h flight, 6 h on station

Red lines: GH range for 30-h flight with 10, 15 and 20 h on station

Light blue X: Genesis locations for 1940-2006

GRIP GH Payload



HAMSR
High Altitude MMIC Sounding Radiometer (Temp, H2Ov, Cloud liquid & ice distribution)

HIWRAP
High Altitude Imaging Wind and Rain Profiler (Horizontal wind vectors and ocean surface winds)

LIP
Lightning Instrument Package (Lightning and Electrical Storm observation)

Driftsondes
High Altitude Lightweight Dropsonde (Vertical profiles of temp, humidity, pressure & winds)

GRIP DC-8 Payload

Dropsondes
(Vertical Profiles of Temp, Press, Humidity and Winds)

CAPS, CVI, PIP
(Cloud Particle Size distributions, Precip Rate, Rain & Ice water content)

LASE
Lidar Atmospheric Sensing Experiment
(H2Ov, Aerosol profiles and Cloud distributions)

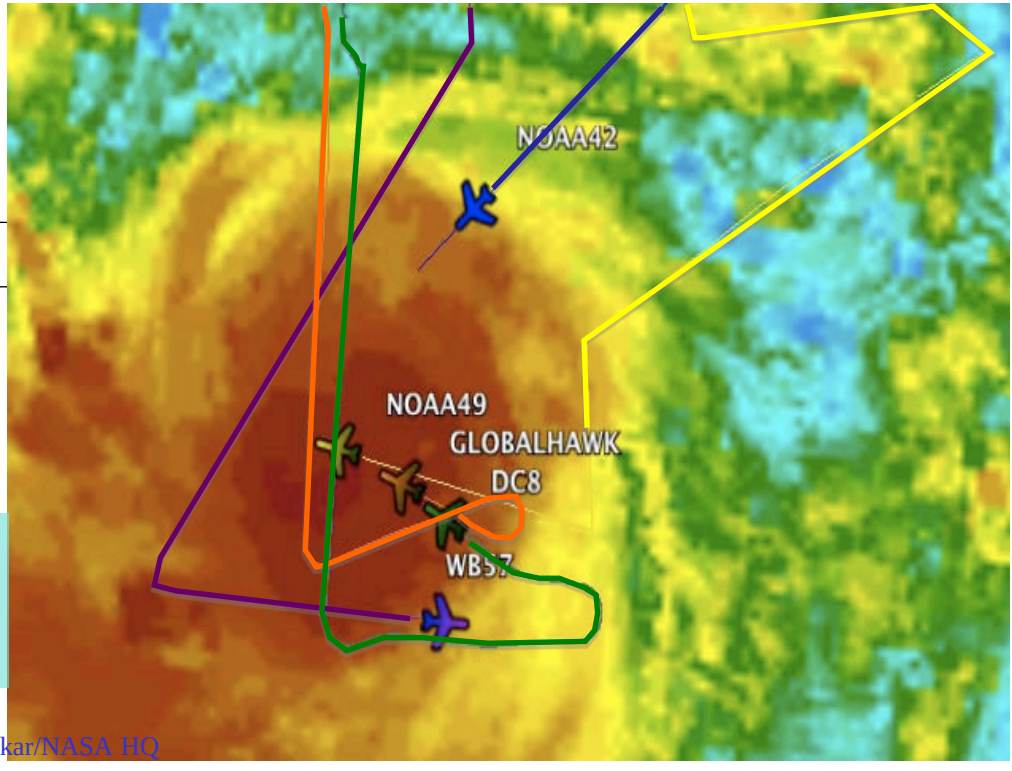
DAWN
Doppler Aerosol Wind Lidar
(Vertical Profiles of Vectored Horizontal Winds)

APR-2
Airborne Precipitation Radar Dual Frequency
(Vertical Structure Rain Reflectivity and Cross Winds)

MMS
Meteorological Measurement System
(Insitu Press, Temp, 3D Winds and Turbulence)

NASA Aircraft Hours and GRIP Coordination

Storm	GH	DC-8	WB-57	NOAA	NSF	AF
Frank	15.3	0	0	N	N	N
Earl	24.2	39.3	10.9	Y	Y	Y
Gaston	0	14.5	0	N	Y	N
Karl	48.5	40.2	17.5	Y	Y	Y
Matthew	25.1	17.8	0	Y	Y	Y
Other Sci	0	12.2	0			
Transit/test flights	8.6	14.9	0			
TOTAL	**121.7**	**138.9**	**28.4**			



Coordination of a combined 5 NASA and NOAA aircraft in Hurricane Karl on 16 September 2010 at ~1955 UTC

GRIP Planning and the Future

- The availability of long endurance UAV's like the Global Hawk prompted us to design an experiment for a sustained look at hurricanes with satellite quality instruments

- Jack Kaye strongly supported my GRIP planning but we could not talk to too many people outside NASA Headquarters. We quietly mentored several state of the art instruments via the IIP and the AITT programs

- HS3 (PI: Scott Braun) is the future of NASA hurricane research field experiments and has been called the GRIP experiment on steroids

- Many of my new innovative ideas are taking a backseat to NAS Decadal Survey planning

- I would like to keep the NASA hurricane research momentum alive to complement Scott Braun's team with a ROSES call

Summary

- NASA sponsored field campaigns have helped us develop a better understanding of many hurricane properties including inner core dynamics, rapid intensification and genesis

- NASA satellite and field experiment sensor data is being under utilized in hurricane research (assimilation of satellite and/or field experiment data, probably, has a much greater potential impact on the track and intensity forecasts)

- A ROSES call may be needed to keep the NASA hurricane research momentum alive if the present team is able to show significant progress in utilizing satellites and field experiment data for hurricane research