NASA GRIP 2010

Overview of research flights

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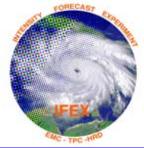
on behalf of the Science Team

What did we do during hurricane season 2010?

- NSF/NCAR PREDICT (PRE-Depression Investigation of Cloud Systems of the Tropics)
- NASA GRIP (Genesis and Rapid Intensification Processes)
- NOAA IFEX (Intensity Forecasting Experiment)

GOALS: Remarkably Similar.....Not a coincidence!





Mission and Science Overview: Summary of GRIP Science Objectives



- 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.



Scientific Accomplishments

- Tropical cyclone genesis
 - Tropical Storm Gaston—null case for development
 - Hurricane Karl—unprecedented multiday coverage from first detection through genesis
- Rapid Intensification
 - Hurricane Earl—documentation of rapid intensification as well as weakening stage of a previously large Category 4 storm
 - Hurricane Karl—observations of rapid intensification from storm stage to Category 3 and landfall

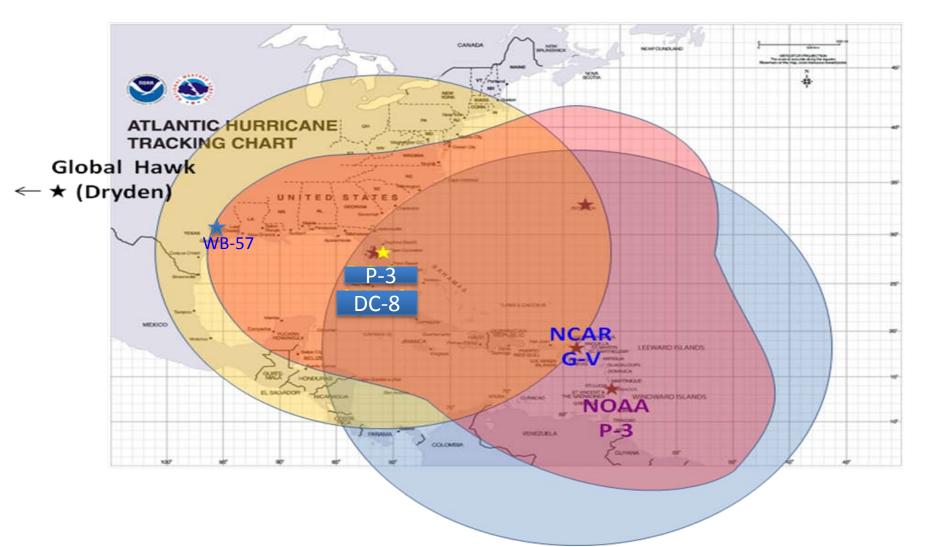
Aircraft Hours in GRIP



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

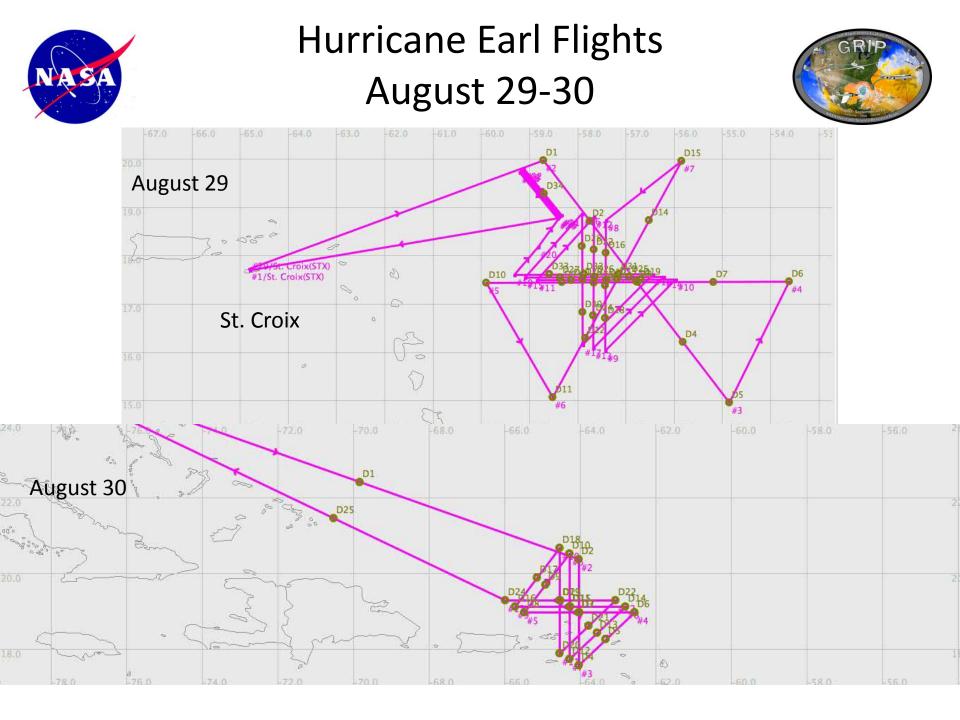


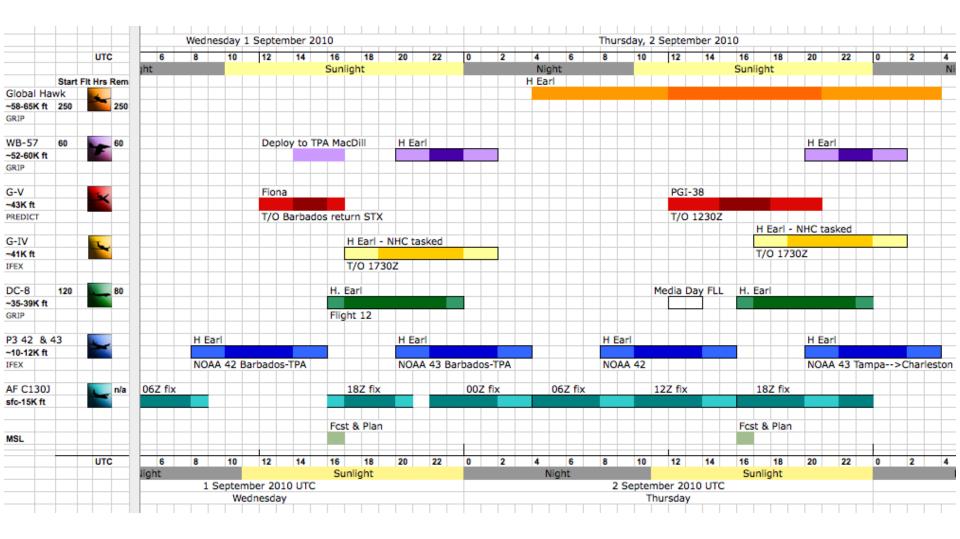
PREDICT/GRIP/IFEX Domains



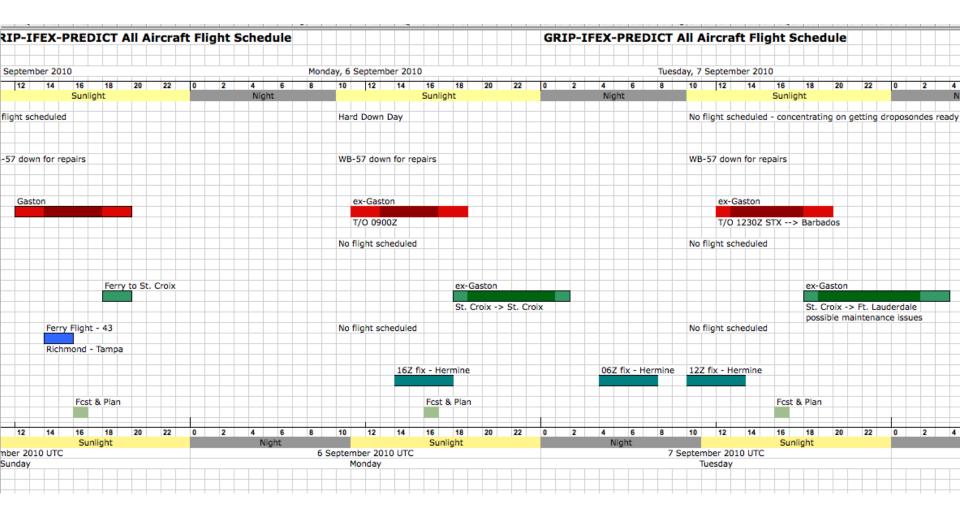
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GRIP																												
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All flights into Earl during rapid intensification, 29-31 August 2010

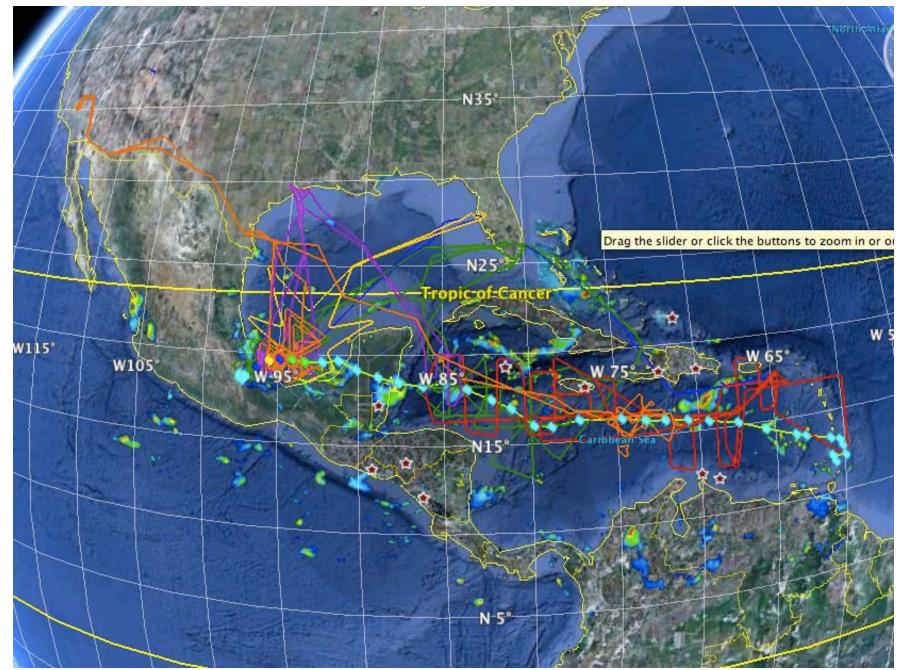




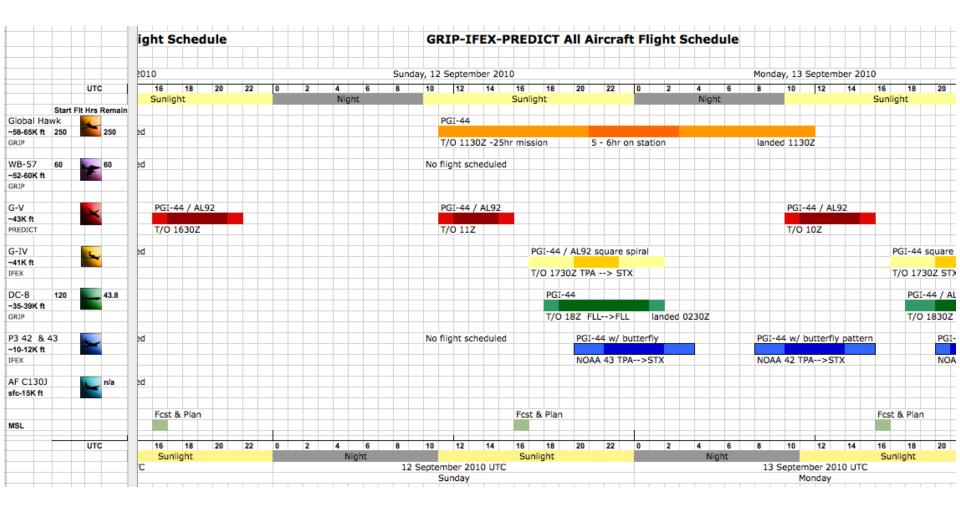
All flights into Hurricane Earl, 1-3 September 2010



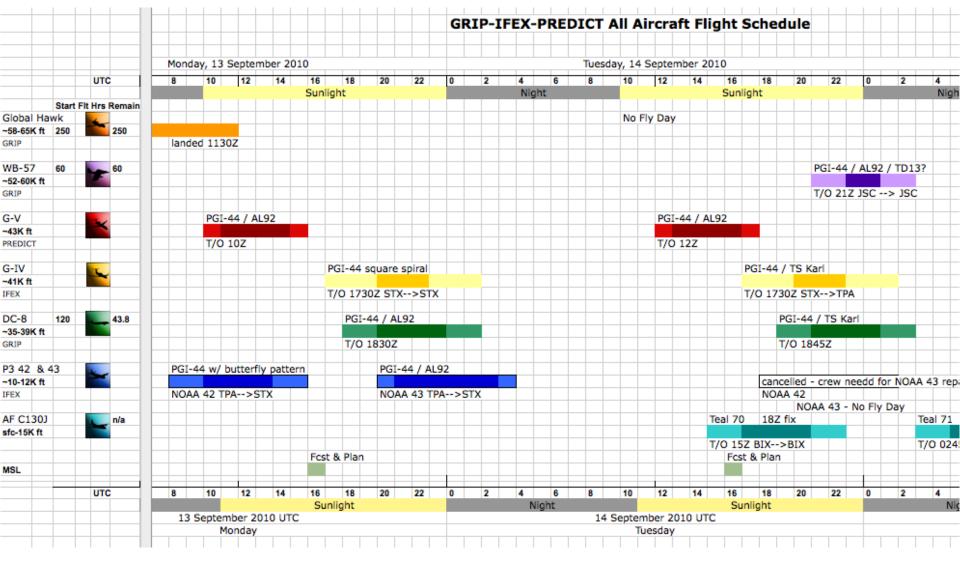
All flights into ex-Gaston, 5-7 September 2010



This made all the planning worthwhile! Karl 2010: All Flight tracks (almost) Sept 11-17 Courtesy Scott Braun



All flights into pre-Karl, 11 – 13 September 2010



All flights into pre-Karl and TS Karl, 13 – 14 September 2010

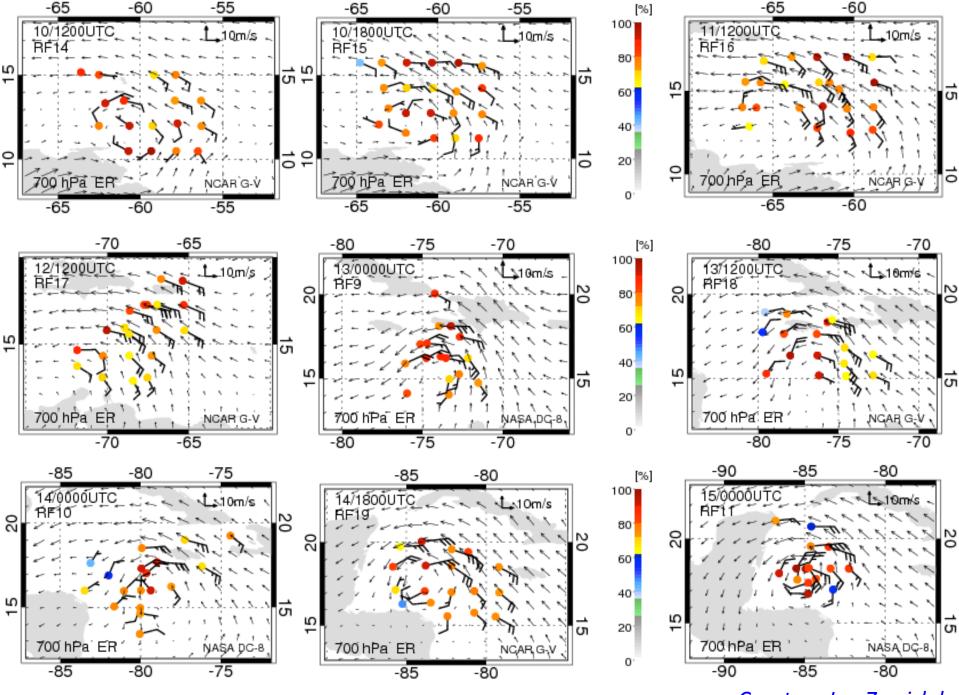
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All flights into Hurricane Karl, 16 – 17 September 2010

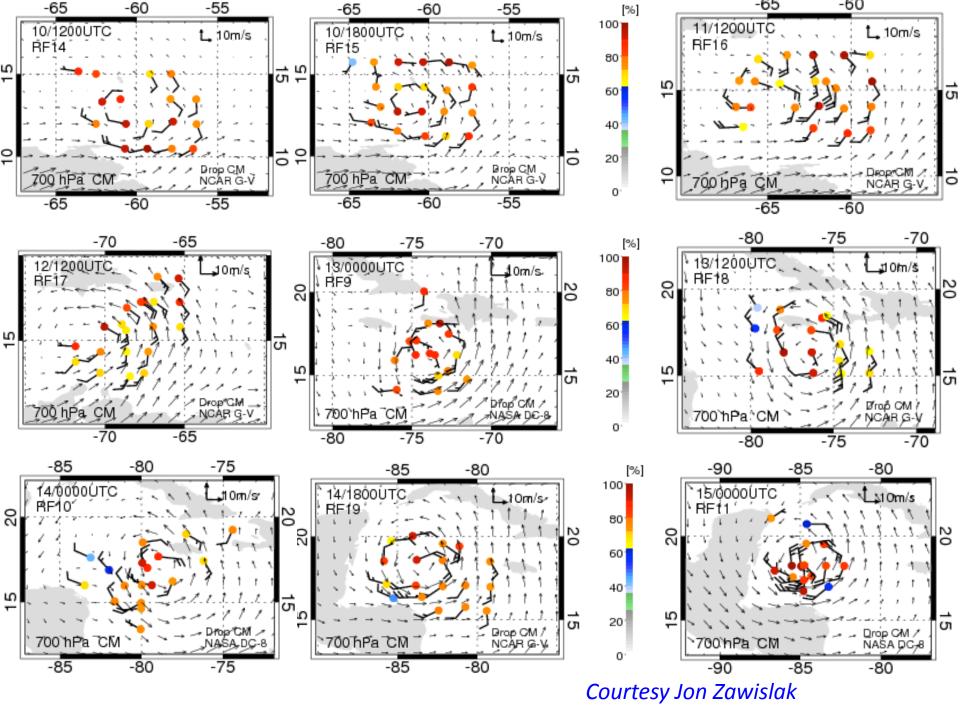
Major Science Questions: Why did Karl take so long to form?

What was the time evolution of inner core moistening? Did the convective bursts help?

STAY TUNED: WORK IS JUST GETTING STARTED

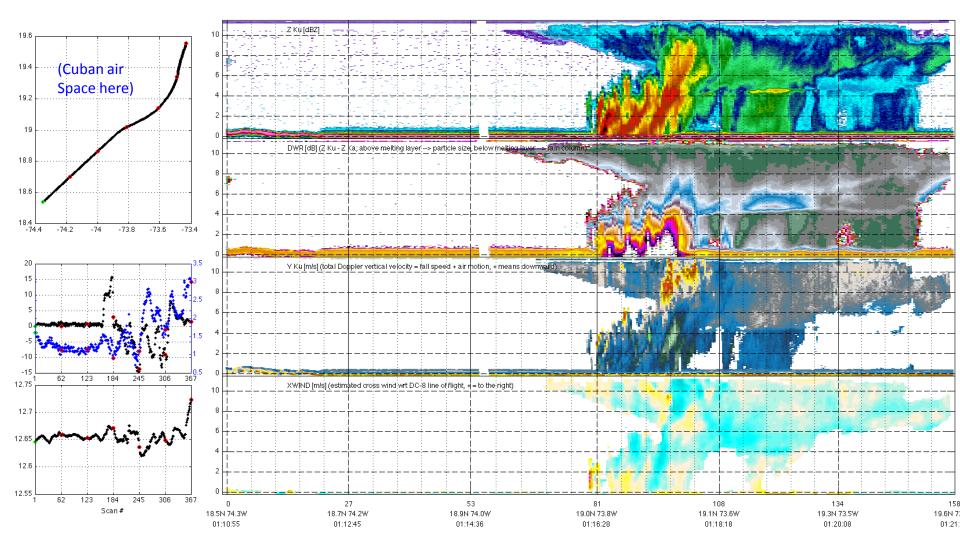


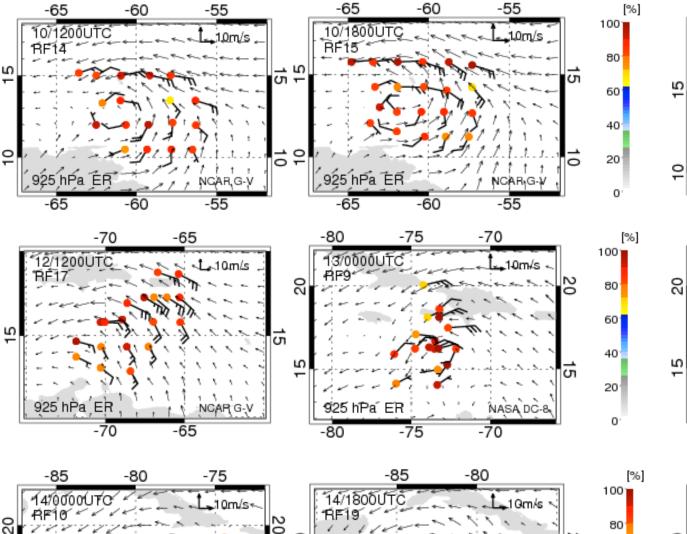
Courtesy Jon Zawislak

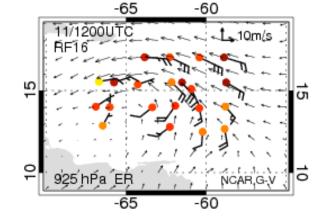


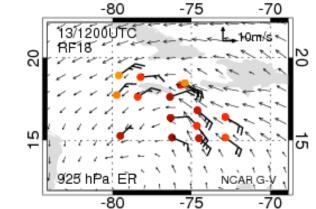
Example of great data obtained by APR-2 when the DC-8 pilot preferred penetration of an active thunderstorm/MCS complex over Haiti to entering Cuban air space

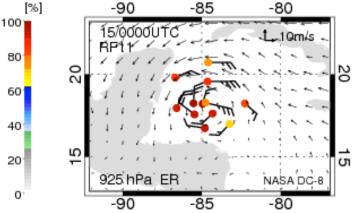
Courtesy Simone Tanelli and APR-2 team from JPL

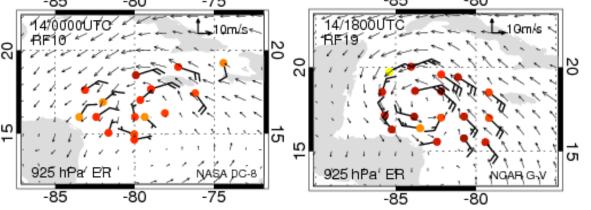


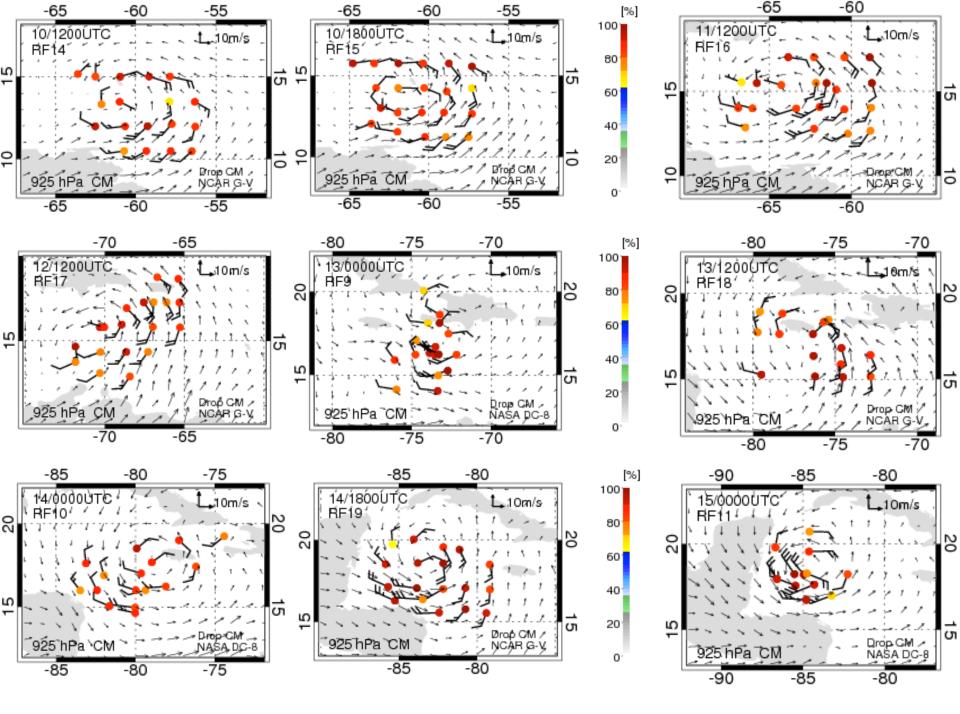










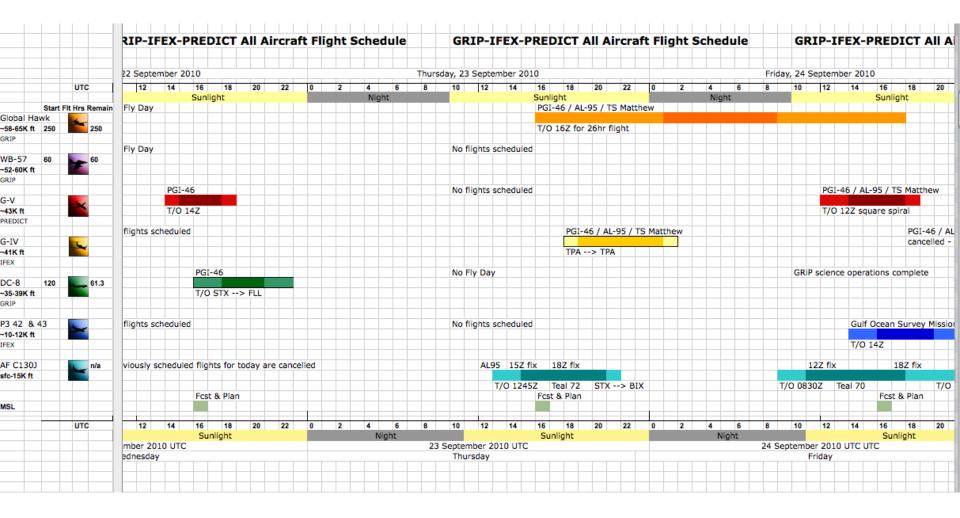


GRIP-IFEX-PREDICT All Aircraft Flight Schedule

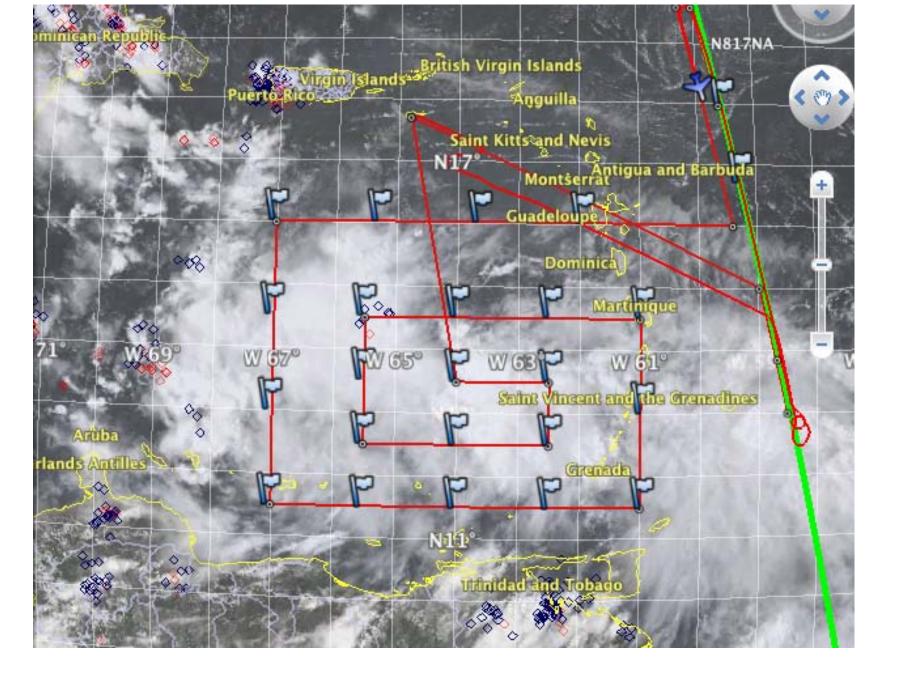
GRIP-IFEX-PREDICT All

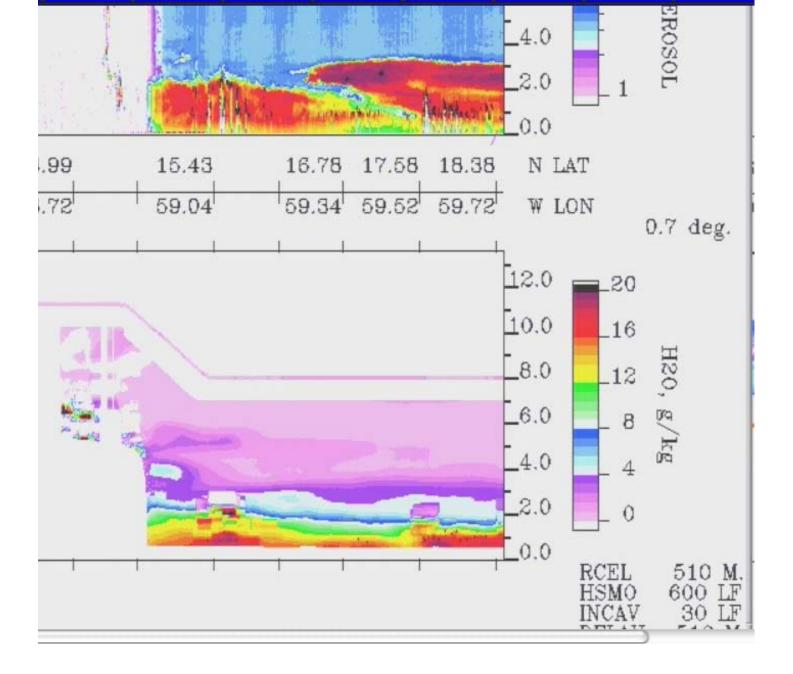


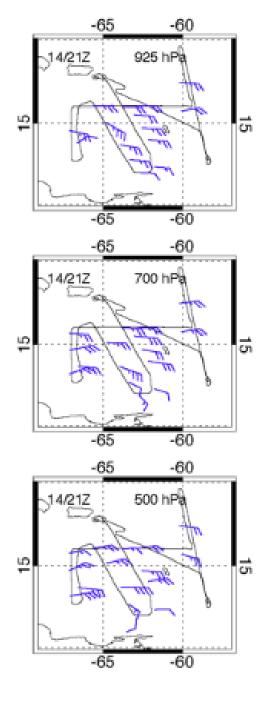
All flights into pre-Matthew, 20-22 September 2010

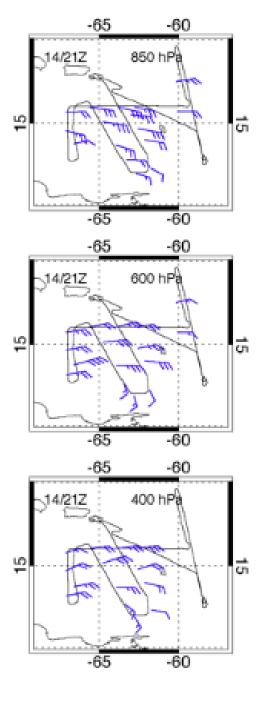


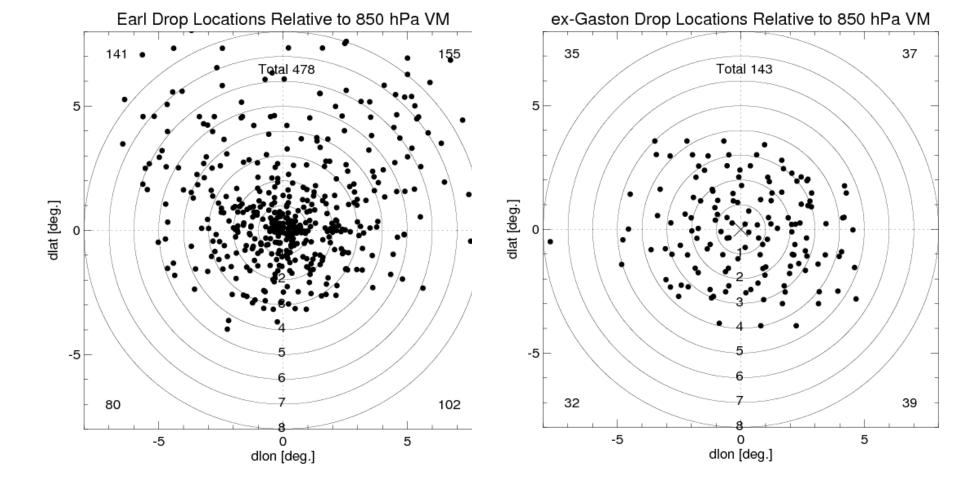
All flights into pre-Matthew and Matthew, 22-24 September 2010

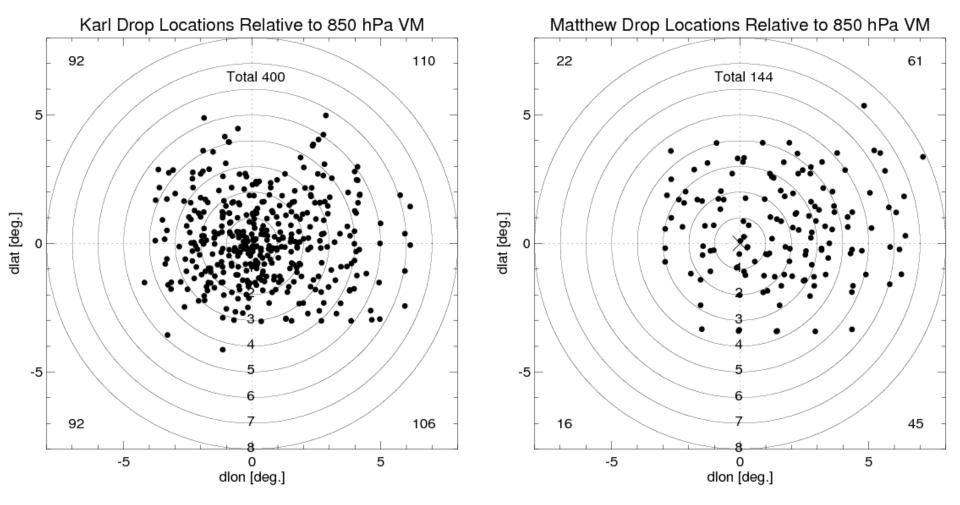








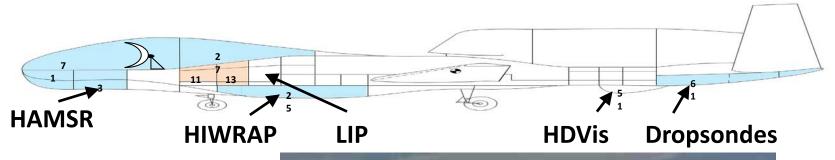




Now it's time to get to work!

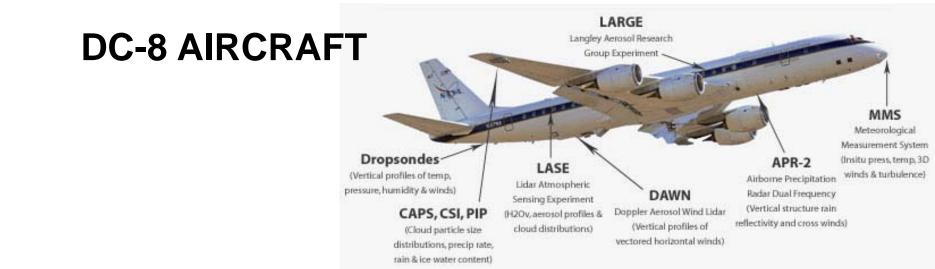


GLOBAL HAWK











WB-57 AIRCRAFT

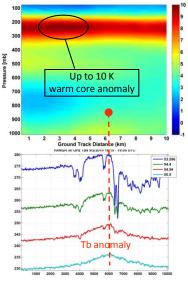


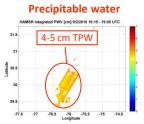
PREDICT planning meeting, Nov 2009 at HRD, together with IFEX and GRIP people

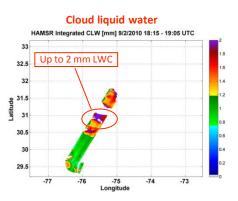
HAMSR @ Earl, 9/2/2010, 1815-1905 UTC

(All retrievals are preliminary)

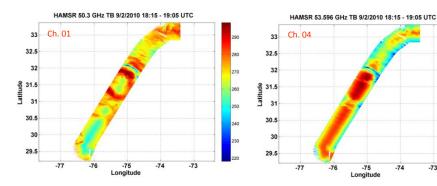
Temperature

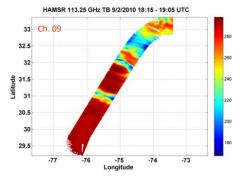


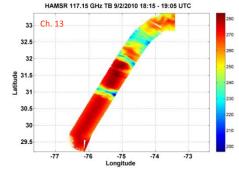




Brightness temperatures







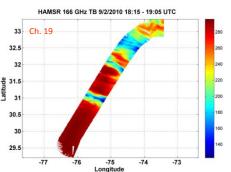
-75

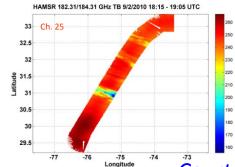
Longitude

-74

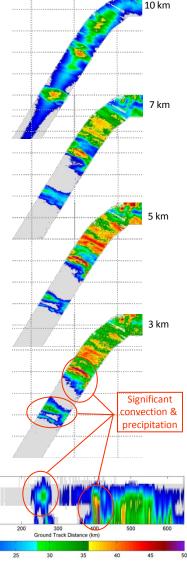
-73

-76





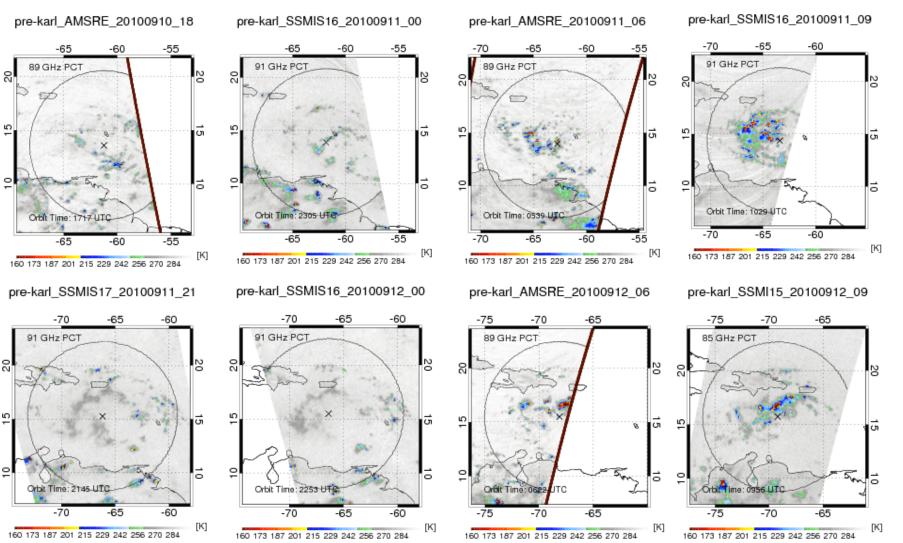
Reflectivity (experimental)



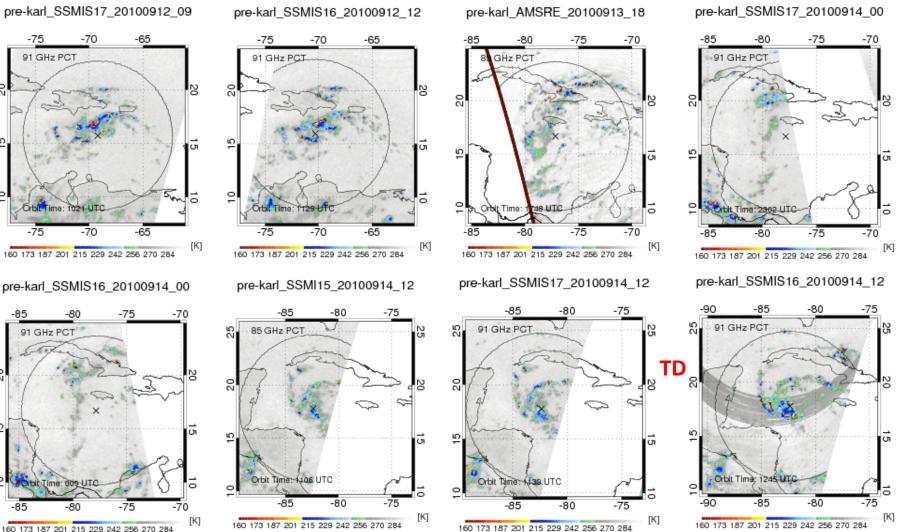
Courtesy Bjorn Lambrigtsen

Nadir (0-15 km altitude)

Major Science Questions: Why did Karl take so long to form? What was the time evolution of inner core moistening? Did the convective bursts help?

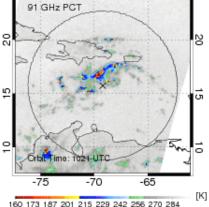


Courtesy Jon Zawislak



Courtesy Jon Zawislak

-75



-85

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-85